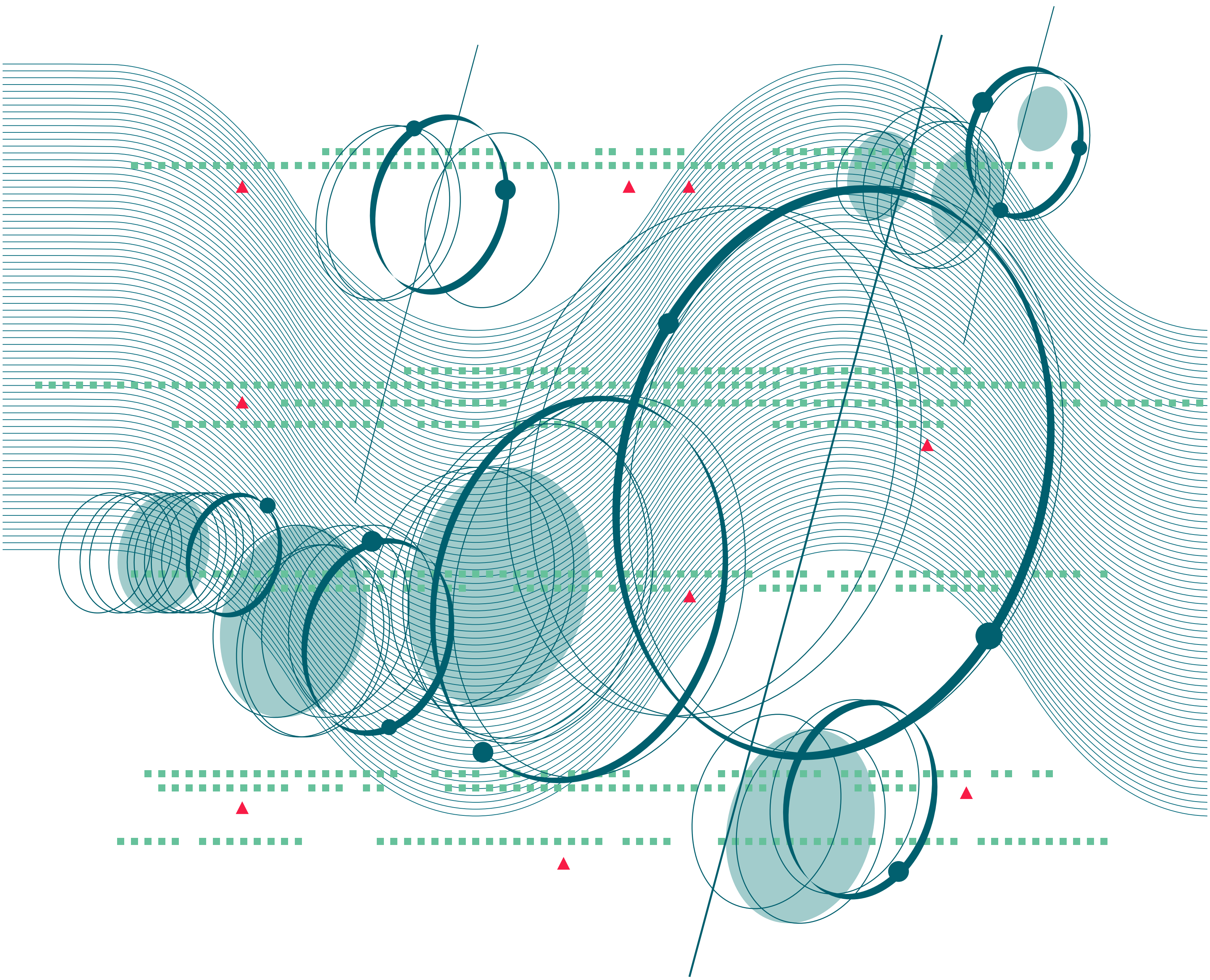
Discover What's Possible™ Anritsu

ELECTRONIC MEASURING INSTRUMENTS



2005

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Request for measuring instruments not appearing
in this catalog will also be accepted.

OUTLINE OF ANRITSU CORPORATION

Anritsu Corporation's predecessor, Anritsu Electric Co. Ltd., was created by the 1931 merger of Kyoritsu Denki, which grew out of Sekisansha Co., founded in 1895 as a manufacturer of wire communication equipment, and Annaka Denki Seisakusho, established in 1900 as a pioneer in wireless communication equipment. The company name was changed to Anritsu Corporation in 1985 to reflect the firm's status as an international enterprise.
With a history in wire and wireless communications equipment, Anritsu has contributed to the enhancement of society through its numerous products, which include equipment for "original and high-level" communication equipment, instrumentation and control equipment, information terminals, and manufacturing equipment. In particular, Anritsu has grown to be recognized as a world leader in measurement systems for wireless communications as well as optical and super high-speed digital communications. Customers in well over 100 countries use Anritsu products in a diverse range of industrial areas.
To ensure that Anritsu products are of the highest quality, the Anritsu Group is establishing a quality system conforming to international standards, and has become registered as an ISO9001 quality assurance corporation by JQA.
Meanwhile, Anritsu head office and Tohoku Anritsu Corporation have earned ISO14001 environmental management certification, demonstrating our dedication to preserving the natural environment.
It is now apparent that the focus of Anritsu's attention, the mobile and Internet areas, are about to evolve even further. And in addition to broadband and IP, the entrance of digital broadcasting and intelligent home appliances means the arrival of a ubiquitous network society where people are able to communicate anytime, anywhere, with everything as seamless connection between networks developed.
In order to be both the best partner for our customers and to continue to evolve, Anritsu is putting the "original and high-level" technology and intelligence coming from our 100-year history toward this ubiquitous network society. We have transformed ourselves into an "Intelligent Solution Creator." By providing electronic, information communication and measurement solutions that directly contribute to the success of our customers' businesses, Anritsu is supporting the evolution of a ubiquitous network society.

Established .... March 17, 1931
Paid-up capital ¥14,043,000,000
Employees .... 3,568 (worldwide)

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See page 4 for sales network.

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Index

Three easy ways to find the information you need.
- Use the Alphabetical Index on pages 8 to 11.
- Use the Model Number Index on pages 12 to 17 to locate a specific instrument by model number.

Standard products

All measuring instruments appearing in this catalog are standard products. For information on non-standard instruments please contact us.

New products

Identifies products developed and introduced in the period from July 2003 to June 2004.

CE

Measuring instruments whose outline views are marked with CE conform to EMC (EN61326, EN61000-3-2) and LVD (EN61010-1) standards.

Products conformed to environment-friendly criteria uniquely set by ourselves is called “Excellent Eco Product.”
For the details of the mark and environment-friendly criteria, please refer to Anritsu Corporation home page.
(URL: http://www.anritsu.co.jp/English)

Specification changes

We reserve the right to discontinue any item without notice and to change specifications at any time without incurring any obligation to incorporate new features in instruments or parts previously sold.

Accessories

Two types of accessories are available: Supplied and Optional. All instruments include the cost of supplied accessories, including fuses and one operation (or instruction) manual in English. The cost of optional accessories, however, is not included and, therefore, the optional accessories will be supplied only on request.

- **Measuring cords**

The measuring cord in the accessory column is indicated in the sequence of Connector · Cord · Connector.
A type S connector is compatible to a type N.

Numerical values used in this catalog

All numerical values are expressed according to the following units:

- **Output voltage of signal generator**

The output voltage expressed in a unit of dB or dBμ is calibrated in terms of e.m.f. (open circuit output voltage). 1 μV is equal to 0 dB or 0 dBμ.

- **Input power of level meter**

The input power is expressed in a unit of dBm which is terminated by nominal impedance. 0 dBm is equal to 1 mW.
Even if the input power is applied to the “high” impedance input terminal, the indicated value is calibrated as mentioned above.

- **Power supply voltage**

Any rated voltage between 100 V and 240 V is available. Normal operation can be obtained within ±10% of each rated voltage (however, maximum permissible operating voltage is 250 V).

- **Ambient temperature, rated range of use**

“Ambient temperature, rated range of use” in the specifications represents the range of ambient temperature, which guarantees values given in specifications.

- **External dimensions**

External dimensions are indicated in width, height, and depth in millimeters, and do not include controls, fittings, or stands.

Technical publications

In this catalog you will notice that an outline of usage, noteworthy points, and standards have been prepared. If further information is required please contact us directly. We will be happy to send you the technical publications of your choice.

Order by model number
When ordering, please specify the model number and name of the instrument desired, for example, “MP1570A SONET/SDH/PDH/ATM Analyzer.” To prevent misunderstandings, include all necessary specifications and specific instructions in your order. That is to say, include all special options or features such as special color, nonstandard power line voltage, etc. To expedite your order we suggest that you contact us directly.

Shipment
Generally, instruments will be shipped within two months of receipt of your order. In the case of “Custom-made products” mentioned in the footnotes, shipment may take from 4 to 7 months. Every endeavor will be made to maintain delivery dates, but no liability is accepted for loss, damage, or delay of instruments, for reasons which are out of our control.

Terms
Unless previous terms have been arranged, we will use one of the following:
- Full payment in advance of shipment
- Sight draft against an irrevocable confirmed letter of credit

Quotations and pro forma invoices
FOB, CIF, C&F, etc., quotations, and pro forma invoices are available on request. The instrument price includes a packing charge.

Inspection surcharge
An inspection surcharge is applied to all orders requiring inspection by government agencies or individually appointed inspectors at our factory.

Special products made-to-order
Requests for remodeling standard products for special use will be accepted, but only after detailed discussions.

Returning instrument for repairs
When returning the instrument to Anritsu for repairs, the following suggestions will help us return it to you in the shortest possible time:
- Send complete instructions about what you would like done to the instrument.
- If possible, include the “symptoms” or “defects.”
- Indicate the return address and, if different, the address to be used for billing purposes.
  All repairs and recalibrations are carried out at our factory.

Extension service
The normal warranty term is one year, but may be extended to three or five years as an option when purchasing equipment. For three or five years extension service, please ask your local Anritsu Field Office or Sales Representative for price and availability.

WARRANTY
All other expressed warranties are disclaimed and all implied warranties for this product, including the warranties of merchantability and fitness for a particular purpose, are limited in duration to a period of one year from the date of delivery. In no event shall all Anritsu group be liable to the customer for any damages, including lost profits, or other incidental or consequential damages arising out of the use or inability to use this product.

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• Zimbabwe

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All-New Field Measuring Instrument for FTTx

MT9080 Series ACCESS Master™

1.31/1.55/1.65 μm (SM)

The functions and performance required for field measuring instruments are changing according to network trends.
Access providers are now starting broadband optical access services such as FTTB, including Gigabit Ethernet for enterprises, FTTC, and FTTP for general homes.
The MT9080 Series ACCESS Master is a compact and high-cost-performance OTDR for installation and maintenance of FTTx optical fibers.

(For further information see page 59)

For Optical Fiber Monitor System, Compact and High Performance OTDR Module

MW9077A/A1 OTDR Module

1.31 μm (SM)/1.55 μm (SM)

The MW9077A/A1 OTDR module is a suitable OTDR module for an optical fiber monitor system. In recent years, monitoring of optical fibers is applicable to many fields, not only in maintenance of optical-communications network systems, but also security sensor, flood sensor, and prevention of disaster, etc. The MW9077A/A1 OTDR module offers a compact and high performance OTDR solution in such an optical fiber application system.

(For further information see page 72)

IP Testing Instruments Changing in Response to Applications for Core, Metropolitan-area, and Access Networks

MD1230 Family

MD1230B Data Quality Analyzer, MD1231A/A1 IP Network Analyzer, MT7407A Multislot Chassis

Anritsu's MD1230 Family can measure network quality. Evaluating the network quality of service (QoS) based on various indexes has importance in terms of assuring the accurate transmission of video, voice, and mission-critical data.
The MD1230 Family puts together all the functions required to measure network quality into one unit. The functions include the multi-flow counter useful to measure the performance of VLAN, packet jitter checking by the measurement of the intervals of arriving packets, and packet transmission at the wire rate.
With its integrated operation, the MD1230 Family provides highly efficient measurements and cost reduction.

(For further information see page 124)

Supports Next Generation Network Measurement from OTN to 10GbE

MP1590B Network Performance Tester

The MP1590B Network Performance Tester is a measuring instrument capable of measuring IP networks using the Ethernet plug-in modules of the Anritsu IP tester MD1230A, as well as traditional functions including testing of PDH, DSn, SDH/SONET, and OTN equipment and jitter measurement, with only one box. A new EoS unit supports EoS measurement, virtual concatenation, and LCAS measurement to enable testing of next-generation SDH/SONET equipment. The traditional MP1590A plug-in units can also be used without changes.
The MP1590B can perform some simultaneous applications - such as SDH/SONET, OTN, EoS, jitter and Ethernet measurement - using combination of plug-in units.

(For further information see page 173)

For Testing System Conforming to Clause 5, 6, 7 in 3GPP TS34.121 Standards

ME7873A W-CDMA TRX/Performance Test System

ME7873A is the auto testing system for the Tx/Rx/Performance characteristic of W-CDMA mobile terminals conforming to 3GPP standards. This system enables to perform measurement conforming to Clause5 (Transmitter test), 6 (Reception test), 7 (Performance test) in 3GPP TS 34.121 standards.
The dedicated software runs on Windows2000 and provides easy management of measurement parameters during tests and test result data.

(For further information see page 211)

Global Mobile Communications Network Realized on the Desks of Wireless Application Developers

MD8470A Signaling Tester

Simple operations of the MD8470A Signaling Tester implement the simulation environment required for application tests of mobile UE.
The MD8470A is compliant with GSM/GPRS and W-CDMA standards that are the world's major 2.5G and 3G mobile communication systems and supports the processes required for various application developments such as voice communications, packet communications including browser/contents download, video calling and end-to-end UE communications (requires two sets of MD8470A).
Also, the MD8470A supports basic call processing scenarios for W-CDMA (Voice Communications/Video call/Packet Communications), GSM (Voice Communications), and GPRS (Packet Communications).
Since a wide frequency band (400 to 2700 MHz) is covered seamlessly, the MD8470A can easily support the development of multiband mobile UE and the frequency expansion of systems in the future.

(For further information see page 236)

A Multi-Function Base Station Test Tool for Greater Flexibility and Technician Productivity

MT8212B Cell Master

25 MHz to 4.0 GHz

Cell Master MT8212B is a comprehensive, one-box base station test tool for deploying, maintaining and troubleshooting wireless base stations. Combining the functionality of a cable and antenna analyzer (25 MHz to 4.0 GHz), spectrum analyzer (100 kHz to 3.0 GHz), power meter, Interference analyzer, channel scanner, Transmission Measurement, Transmitter measurements (CDMA and GSM), GPS and T1/E1 analyzer into one lightweight, handheld test set - eliminates the need for the field engineer and field technician to carry, manage and learn multiple test sets. MT8212B measurement capability includes precision return loss, VSWR, cable loss, distance-to-fault, signal identification, interference analysis, channel power, adjacent channel power ratio, field strength, occupied bandwidth, burst power, code domain power, noise floor, voltage peak to peak, listen to DS0 or VF channel access. Patented RF interference rejection enables accurate, repeatable measurements in the presence of high RF activity. PC data analysis software enables assessment of system trends, problems, and performance in addition to professional report generation. Built-in GPS stores traces with location information.

(For further information see page 311)

High Performance Handheld Spectrum Analyzer

MS2721A Spectrum Master

100 kHz to 7.1 GHz

The MS2721A is the first handheld spectrum analyzer to deliver the ability to measure very low level signals with a displayed average noise level of ≤ -153 dBm typical @ 1 GHz in a 10 Hz RBW. Coupled with a wide range of resolution bandwidth choices, you can configure the Spectrum Master to meet your most challenging measurement needs. As the spectrum becomes more and more congested, the ability to measure low level, closely spaced signals becomes more and more important not only for interference detection but also for wireless system planning.

(For further information see pages 322, 385)

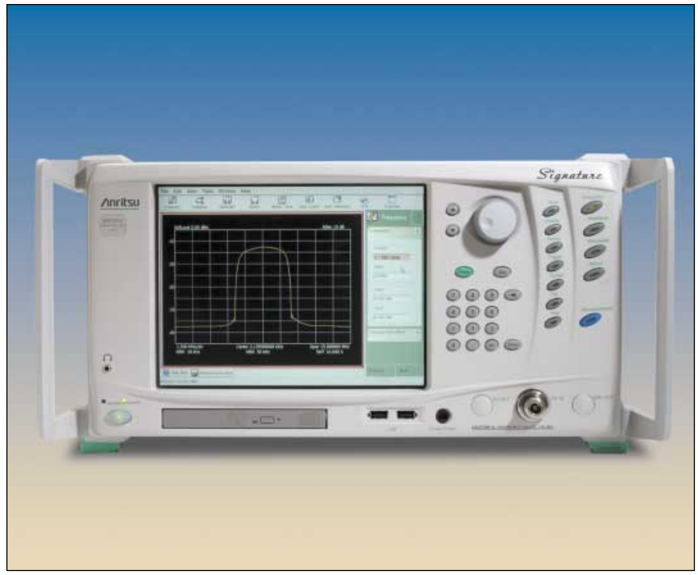
A new Plateau in Signal Analysis for providing exceptional Engineering Insight into wireless communication products

MS2781A Signature™

100 Hz to 8 GHz

The MS2781A, Signature High Performance Signal Analyzer, is a combined high performance spectrum analyzer and a high performance vector signal analyzer. Signature expands the ability to analyze digitally modulated RF signals by offering seamless connectivity with MATLAB® and Simulink® from The MathWorks. Engineers can view measurement results through custom MATLAB and Simulink analysis giving exceptional insight into the performance of new designs. Signature can help make tomorrows communications systems a reality today.

(For further information see pages 379, 390)



For Fast and Accurate S-Parameter Measurements

37000D Series Lightning VNAs

40 MHz to 65 GHz

The Lightning D-Series Vector Network Analyzers (VNAs) are high performance test tools designed to satisfy the growing needs of defense, satellite, radar, broadband communication, and high speed component markets. The new 37000D VNAs improve upon performance while providing a wider set of standard application features to better suit the need of R&D engineers working on next generation designs. These new features, when combined with the ease of programming through helpful software utilities and faster data transfer over Ethernet, make it an equally valuable tool for manufacturing as well.

(For further information see page 399)

For Single-Ended, Balanced-Differential and Mixed-Mode S-Parameter Measurements

37000D Series Microwave Multiport Balanced VNA

40 MHz to 65 GHz

The Microwave Multiport Balanced VNA consists of a Lightning 37000D VNA, a multiport test set, and the Navigator™ Multiport software (external PC is required and is not included). The multiport test set is a 2x4 switch matrix that allows either port on the VNA to connect with any of the 4 ports on the test set. The easy-to-use Navigator™ Multiport software provides full step-by-step direction, simplifying calibration, and speeding measurement throughput.

(For further information see page 403)

Broadband S-Parameter Measurements to 110 GHz and Beyond

ME7808B Broadband and Millimeter Wave VNA

40 MHz to 110 GHz (expandable to 325 GHz)

The ME7808B Broadband Vector Network Analyzer (VNA) is a high performance measurement solution that covers 40 MHz to 110 GHz in a single fast sweep. Built on the advanced technology of the Lightning 65 GHz VNA, the ME7808B is ideal for making accurate S-parameter measurements of components and devices to 110 GHz. The flexible system architecture of the ME7808B makes it easy to adapt to multiple measurement applications. An alternate configuration is the ME7808B Millimeter Wave VNA that covers discrete millimeter wave bands from 50 to 325 GHz.

(For further information see page 406)

Single Connection Differential Measurements for Signal Integrity and Multi-Port Applications

MS4624D Series RF Multi-Port VNA

10 MHz to 9 GHz

The RF Multi-Port System consists of the Scorpion® Vector Network Measurement System, the SM5992 RF Multi-Port Test Set and Navigator™ software (external personal computer is required, but not included). Simply enter your multi-port module topology and Navigator guides you quickly and intuitively through the setup so you can accurately perform multi-port measurements. Especially suited for next generation modules with balanced interfaces, Navigator also supports full N-port calibrations for the ultimate in accuracy.

(For further information see page 408)

Single Connection Swept Frequency PIM and S-Parameters

MS4622B Series PIM-S System (VNA and Passive Intermodulation System)

10 MHz to 3 GHz

The PIM-S System conducts passive intermodulation distortion (PIM) and S-parameter measurements with a single connection. This innovative system consists of the MS4622B Scorpion® Vector Network Measurement System (VNMS), SM612x PIM Power Amplifier Unit, SM612x PIM Filter Unit, and SM6130 PIM-S Software (external personal computer is required, but not included).

(For further information see page 410)

OPTICAL MEASURING INSTRUMENTS

Selection guide

Application / Model		Optical power		Light source wavelength		Loss			Optical identification		Optical return loss measurement	Fiber evaluation		Laser diode testing	Others	Remarks
		Low level	Medium/high level	Spectrum	Wavelength	High-loss	High accuracy	Loss-wavelength	Identification	Loss		Fault location	Splice loss			
Optical Power Meter	ML9001A	√	√			√	√				√		√			–100 to +10 dBm
	ML9002A		√				√				√		√			–70 to +20 dBm
Optical Test Set	MT9810B	√	√			√	√	√	√	√	√		√			0.75 to 1.7 µm
Multi Channel Box	MT9812B	√	√				√	√	√	√			√			0.75 to 1.7 µm
Optical Loss Test Set	MS9020D		√				√		√	√	√		√			0.85/1.3/1.55 µm
Optical Spectrum Analyzer	MS9710B	√	√	√	√	√		√			√			√		0.6 to 1.75 µm
	MS9710C	√	√	√	√	√		√			√			√		0.6 to 1.75 µm
	MS9780A	√	√	√	√	√		√			√			√		0.6 to 1.75 µm
WDM Tester	MS9715A	√	√	√	√			√								1.527 to 1.567 µm
Optical Time Domain Reflectometer	MW9076 series		√				√		√	√	√		√	√		1.31/1.45/1.55/1.625 µm (SM), 0.85/1.3 µm (GI)
OTDR Module	MW9077A/A1						√		√	√	√		√	√		1.31 µm (SM)/1.55 µm (SM)
ACCESS Master	MT9080 series		√				√		√	√	√		√	√		1.31/1.55/1.65 µm (SM)
Optical Attenuator	MN938A					√										0.85/1.3 µm
	MN9605C					√										1.31/1.55 µm
	MN95D					√										1.3 µm
Optical Channel Selector	MN9662A/9664A/9672A/9674A														√	1.2 to 1.65 µm
Optical Directional Coupler	MN9604C/D										√				√	1.25 to 1.60 µm
Bare Fiber Connector	MA9014A, MP922B														√	
Fiber Adapter	MA9013A														√	
Optical Accessories	Optical fiber cord, adapter, dummy fiber, optical fiber cutter, jacket stripper, mode scrambler														√	

Optical connector options for Anritsu optical measuring instruments

A variety of optical connectors are used with optical fibers worldwide. Specify the option number, model name, and number of the optical connector from the table below according to the type of optical connector you use. If no specification is made, an FC-type connector will be supplied.
For combinations marked with "√" symbols in the table, the required instrument can be supplied according to the order. For connectors without "√" symbols or which do not appear in the table, consult your sales representative. For measuring equipment with more than one control panel, specify only the connector connected to the measured fiber. Be sure to consult us before ordering, particularly for optical connectors for single-mode fibers, to avoid trouble with connectors not fitting.
Optical connectors may be designed for either flat-polished or PC-polished ends. Some measuring instruments use connectors only for PC-polished ends; consult the literature on the instrument before specifying the connector option.

Model		25 FC-APC*1	26 SC-APC*1	27 E-2000*2	31 EC*1	32 MU*2	33 LC*2	37 FC	38 ST	39 DIN 47256	40 SC	41 TOCP 172*3	42 HFS-13/A (GI)*3	43 HMS-10/A (SM)*2	47 HRL-10 (APC)*1
LED Source (for MS9020D)	MS0901A							√	√	√	√	√	√	√	
	MS0902A							√	√	√	√	√	√	√	
	MS0903A							√	√	√	√	√	√	√	
	MS0904A							√	√	√	√	√	√	√	
	MS0906A							√	√	√	√	√	√	√	
LD Source (for MS9020D)	MS0902D							√			√				
	MS0903D							√			√				
	MS0908A							√*4	√*4	√*4	√*4			√*4	
	MS0909A							√*4	√*4	√*4	√*4			√*4	
LD/SLD Source (for MT9810B and MT9812B)	MU95xxxxA							√*4	√*4	√*4	√*4			√*4	
Optical Power Sensor (for ML9001A)	MA9411A					√	√	√	√	√	√	√	√	√	
	MA9611A					√	√	√	√	√	√		√	√	
	MA9612A							√	√	√	√		√	√	
	MA9711A					√	√	√	√	√	√	√	√	√	
	MA9712A					√	√	√	√	√	√	√	√	√	
	MA9714B							√*4	√*4	√*4	√*4			√*4	
Optical Power Sensor (for ML9002A and MS9020D)	MA9421A					√	√	√	√	√	√	√	√	√	
	MA9422A					√	√	√	√	√	√	√	√	√	
	MA9423A					√	√	√	√	√	√	√	√	√	
	MA9621A					√	√	√	√	√	√	√	√	√	
Optical Power Sensor (for MS9020D)	MA9622A							√*4	√*4	√*4	√*4			√*4	
Optical Power Sensor (for MT9810B and MT9812B)	MU931311A							√*4	√*4	√*4	√*4			√*4	
	MU931421A							√*4	√*4	√*4	√*4			√*4	
	MU931422A					√	√	√	√	√	√			√	
	MU931431A					√	√	√	√	√	√			√	
	MA9331A					√	√	√	√	√	√			√	
	MA9332A					√	√	√	√	√	√			√	
Optical Power Sensor (for MT9810B)	MA9333A					√	√	√	√	√	√			√	
Optical Return Loss Measuring Unit	MS0907A (for MS9020D)							√*4	√*4	√*4	√*4			√*4	
Optical Test Set	MT9810B							√*4	√*4	√*4	√*4			√*4	
Multi Channel Box	MT9812B							√*4	√*4	√*4	√*4			√*4	
Adapter	MP92B					√	√	√	√	√	√	√	√	√	
	MA9001A							√	√	√	√	√	√	√	
	MA9001B					√	√	√	√	√	√	√	√	√	
	MA9004A							√	√	√	√	√	√	√	
	MA9005A					√	√	√	√	√	√	√	√	√	
	MA9005B					√	√	√	√	√	√			√	
	MA9008A					√	√	√	√	√	√			√	
	MA9013A							√*3	√*3	√*3	√*3		√*3	√*3	
Optical Spectrum Analyzer	MS9710B	√	√	√	√			√*4	√*4	√*4	√*4			√*4	√
	MS9710C	√	√	√	√			√*4	√*4	√*4	√*4			√*4	√
	MS9780A			√				√*4	√*4	√*4	√*4			√*4	
WDM Tester	MS9715A			√	√			√*4	√*4	√*4	√*4			√*4	
Optical Time Domain Reflectometer	MW9076B/B1/C	√	√					√*4	√*4	√*4	√*4			√*4	√
	MW9076D1/J/K							√*4	√*4	√*4	√*4			√*4	
OTDR Module	MW9077A/A1						√	√							
ACCESS Master	MT9080A/B/C/D/E/F							√*4	√*4	√*4	√*4			√*4	
Optical Attenuator	MN95D							√	√	√	√		√		
	MN9605C							√*4	√*4	√*4	√*4			√*4	
	MN938A							√	√	√	√		√		

Connector option number

Continued on next page

Model		Connector option number													
		25	26	27	31	32	33	37	38	39	40	41	42	43	47
		FC-APC*1	SC-APC*1	E-2000*2	EC*1	MU*2	LC*2	FC	ST	DIN 47256	SC	TOCP 172*3	HFS-13/A (GI)*3	HMS-10/A (SM)*2	HRL-10 (APC)*1
Optical Channel Selector	MN9662A/9664A/9672A/9674A							√*4	√*4	√*4	√*4			√*4	
Optical Directional Coupler	MN9604C							√*4	√*4	√*4	√*4			√*4	
	MN9604D	√*5	√*5												√*5
Optical fiber cord for baseband measurements								√*3							
Dummy fiber cord for optical loss measurements								√							
Mode Scrambler	MZ106C							√			√				

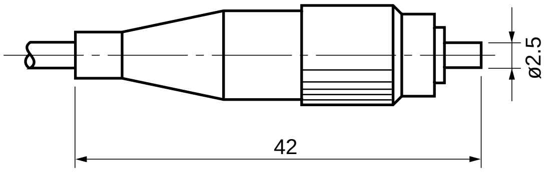
*1: Ferrule type; APC (angled PC)
*2: Ferrule type; PC
*3: Ferrule type; Flat
*4: Ferrule type; PC (user replaceable and cleanable)
*5: It can use for Port A, Port B & C are PC type.

No marking: Ferrule type; Flat and PC.

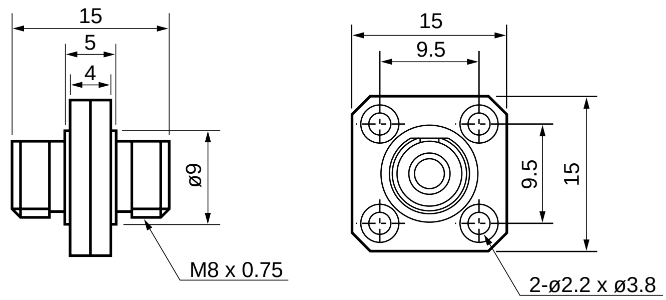
Unit in mm

Option 25: FC-APC (angled convex)
Option 37: FC (convex)

Plug

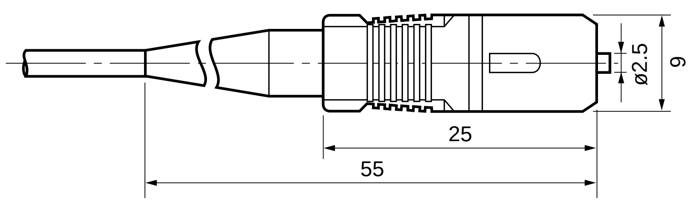


Adapter

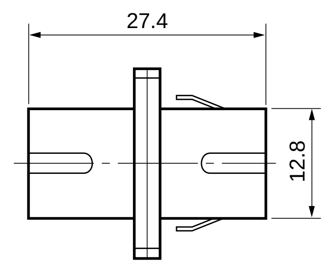


Option 26: SC-APC (angled convex)
Option 40: SC connector (flat, convex: PC)

Plug

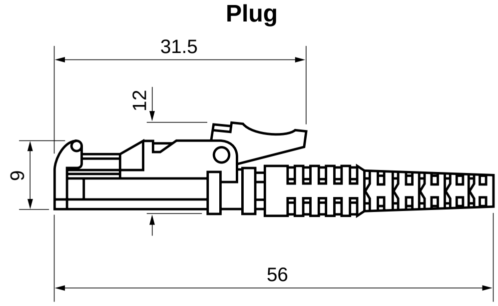


Adapter

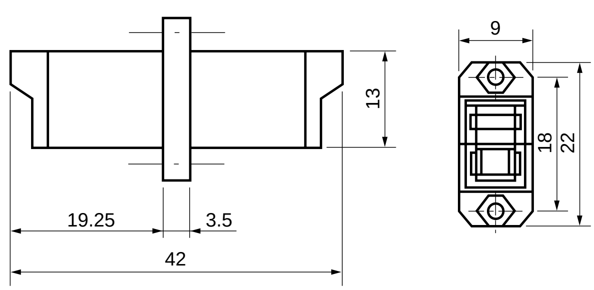


Option 27: E-2000 (convex: PC, angled convex: APC)

Plug

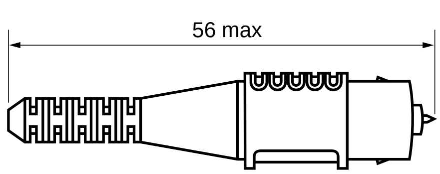


Adapter

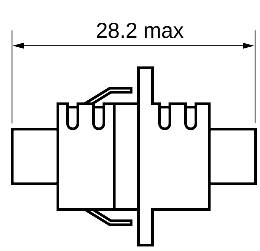


Option 31: EC (angled convex: APC)

Plug



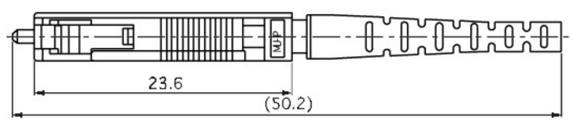
Adapter



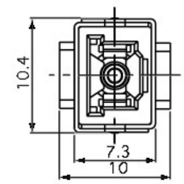
Unit in mm

Option 32: MU

Plug

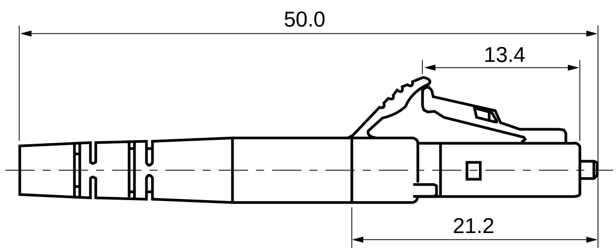


Adapter

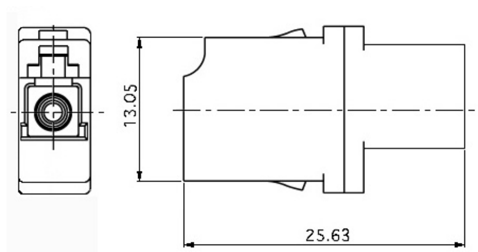


Option 33: LC

Plug

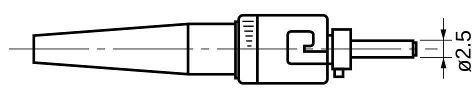


Adapter

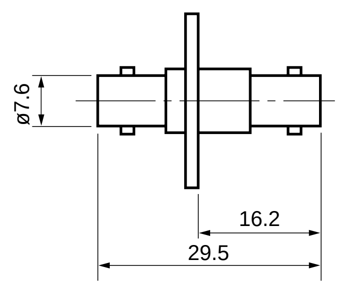


Option 38: ST connector (flat, convex: PC)

Plug

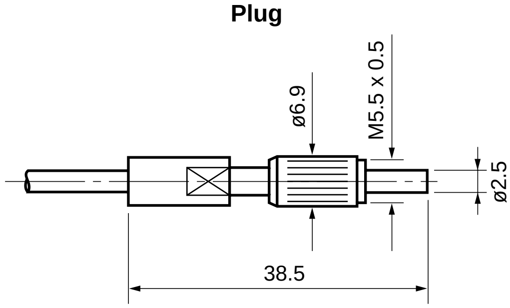


Adapter

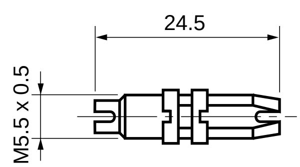


Option 39: DIN 47256 connector (flat, convex: PC)
Option 47: HRL-10 (angled convex)

Plug

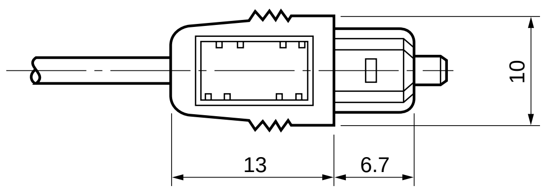


Adapter



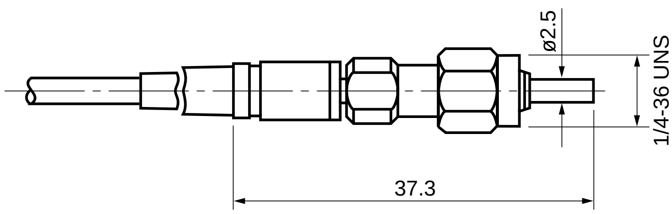
Option 41: TOCP 172 (flat)

Plug

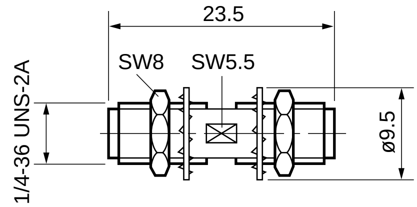


Option 42: HFS-13/A (GI, flat)

Plug

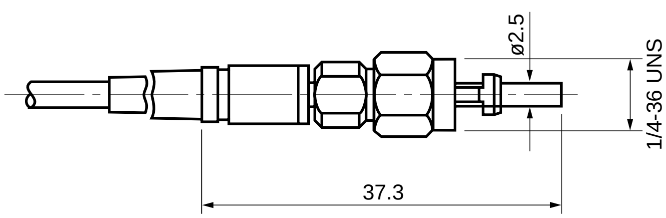


Adapter

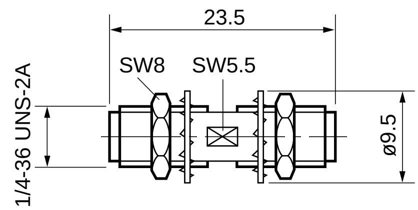


Option 43: HMS-10/A (SM, convex: PC)

Plug



Adapter



OPTICAL POWER METER
ML9001A
0.38 to 1.8 µm

CE GPIB

A Variety of Optical Sensors such as Si, Ge and InGaAs

The ML9001A is a single-channel digital-display optical power meter. It ensures accuracy and linearity over a wide wavelength range and greatly improves measurement reliability. It also has an improved basic performance. For example, measurements can be made over the wide level range from –100 to +20 dBm because internal reflection in the power sensors has been suppressed. The ML9001A also has many new functions that make it easier to use than other power meters. It can be used for all optical power measurements such as optical fiber loss measurement and optical device performance evaluation.

Features

• Enables high-accuracy measurement

The ML9001A accurately and automatically calibrates all the power sensors within the specified wavelength range and ensures a ±5% accuracy at –23 dBm. It also has a ±0.15 dB linearity (–23 dBm reference value). The ML9001A extends the guaranteed accuracy range of the measured values and enables high-accuracy measurement.

• One power sensor for repeater maintenance and long-distance fiber loss measurement

The MA9612A Optical Power Sensor has ultra-high sensitivity. Its measurement level range is –100 to ±3 dBm in the 1.3 µm band and it can sense either continuous light or modulated light. A single MA9612A can measure the near-end and far-end outputs of a repeater as well as measure long-distance fiber losses.

• Interchangeable optical connectors

The optical connectors of all the power sensors accept adapters. This system allows the optical connectors to be interchanged so the ML9001A can be quickly used with various optical connectors. Since the internal coating of the optical power sensors suppresses reflected light, measurement errors are reduced in beam measurement (with or without an optical fiber).

• Reduced measurement time

The ML9001A has a much better response speed and stability than conventional optical power meters. With GPIB, it can measure at 30 ms/point so the measurement time can be reduced to less than 50% of conventional automatic measurement.

Specifications

• ML9001A Optical Power Meter

Indicator

Display	4 digit, W, $W_{(REL)}$, dBm, $dB_{(REL)}$ selectable
Calibration coefficient	Adjustable
Recorder output	1 V/full-scale, linear output
Range select	Manual selection and automatic ranging
Measurement mode	Continuous and modulated light*1
Wavelength sensitivity correction	Automatic correction in 1 nm steps
Data memory	Max. 1000 data via GPIB
Dimensions and mass	213 (W) x 88 (H) x 250 (D) mm, ≤4 kg

Sensor

Model	MA9411A	MA9611A	MA9612A
Wavelength range	0.38 to 1.15 µm	0.75 to 1.7 µm	
Element	Si photodiode	InGaAs photodiode	
Active area diameter	9.5 mm	–	
Input type	Direct to photodiode	Connector[*2]	
Dimensions and mass	40 (W) x 32 (H) x 62/73 (D) mm, ≤400 g	40 (W) x 32 (H) x 65 (D) mm, ≤400 g	61 (W) x 42 (H) x 110 (D) mm, ≤800 g

Model	MA9711A/A1	MA9712A	MA9714B
Wavelength range	0.75 to 1.8 µm		
Element	Ge photodiode	Cooled-Ge photodiode	
Active area diameter	5 mm		–
Input type	Direct to photodiode		Connector[*3]
Dimensions and mass	40 (W) x 32 (H) x 62/73 (D) mm, ≤400 g	42 (W) x 47 (H) x 110 (D) mm, ≤500 g	47 (W) x 61 (H) x 128 (D) mm, ≤800 g

Overall

Model		MA9411A	MA9611A	MA9612A
Optical power measurement range	Continuous light	–70 to +10 dBm[*4] (0.1 nW to 10 mW)	–70 to +3 dBm[*5] (0.1 nW to 2 mW)	–100 to +3 dBm[*5] (0.1 pW to 2 mW)
	Modulated light	–70 to +7 dBm[*6] (0.1 nW to 5 mW)	–80 to 0 dBm[*7] (10 pW to 1 mW)	–90 to 0 dBm[*7] (1 pW to 1 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	±5%[*8] (0.5 to 0.95 µm)	±5%[*9] (1.0 to 1.6 µm)	
	Linearity continuous light: 23°C, –23 dBm as reference	±0.15 dB[*10] (±0.45 dB for –70 to –60 dBm)	±0.15 dB[*10] (±0.45 dB for –70 to –60 dBm)	±0.15 dB[*10] (±0.45 dB for –90 to –80 dBm)
Resolution		W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB		
Power		100/115/120/200/220 Vac $^{+10}_{-15}$ %, 240 Vac $^{+4}_{-15}$ %, 50/60/400 Hz, ≤40 VA		
Operating temperature		0° to 50°C		
EMC[*11]		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)		
LVD		EN61010-1: 2001 (Pollution Degree 2)		

Model		MA9711A/A1	MA9712A	MA9714B
Optical power measurement range	Continuous light	–40 to +10 dBm[*5] (0.1 µW to 10 mW)	–60 to +10 dBm[*5] (1 nW to 10 mW)	–47 to +23 dBm[*12] (20 nW to 200 mW)
	Modulated light	–60 to +7 dBm[*7] (1 nW to 5 mW)	–70 to +7 dBm[*7] (0.1 nW to 5 mW)	–57 to +20 dBm[*13] (2 nW to 100 mW)
Measurement accuracy	Absolute accuracy (–23 dBm)	±5%[*9] (0.95 to 1.5 µm)	±4.5% (1.3 µm) ±5%(0.95 to 1.6 µm)	±4.5% (1.55 µm)[*14] ±5%(0.95 to 1.6 µm)[*15]
	Linearity continuous light: 23°C, –23 dBm as reference	±0.15 dB[*10] (±0.45 dB for –40 to –30 dBm)	±0.15 dB[*10] (±0.45 dB for –60 to –50 dBm)	±0.15 dB[*16](–37 to +20 dBm, ±0.45 dBm for –47 to –37 dBm)
Resolution		W, W (REL) display: 0.1 to 1%, dBm display: 0.01 dB, dB (REL) display: 0.001 dB		
Power		100/115/120/200/220 Vac $^{+10}_{-15}$ %, 240 Vac $^{+4}_{-15}$ %, 50/60/400 Hz, ≤40 VA		
Operating temperature		0° to 50°C		
EMC[*11]		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)		
LVD		EN61010-1: 2001 (Pollution Degree 2)		

*1: Twelve modulation frequencies including 270 Hz and 1 kHz
*2: FC-type connector standard
*3: Only for PC type SM fiber (10/125 µm, NA 0.1)
*4: At 0.85 µm
*5: At 1.3 µm
*6: At 0.85 µm, 270 Hz
*7: At 1.3 µm, 270 Hz
*8: For wavelengths other than 0.85 µm, specified at 23° ±5°C
*9: For wavelengths other than 1.3 µm, specified at 23° ±5°C
*10: At 23° ±5°C
*11: Electromagnetic compatibility
*12: At 1.55 µm
*13: At 1.55 µm, 270 Hz
*14: At 1.55 µm, 0 dBm
*15: At 0 dBm
*16: Reference = 0 dBm

Note:
When an optical fiber is used, performance is guaranteed for a fiber core diameter of up to 62.5 µm and an NA of up to 0.29.
When any other fiber is used, a measurement error may occur.

• **Optical connector options**

Option No.	Optical connector
32	MU
33	LC
37	FC
38	ST
39	DIN
40	SC
41*1	TOCP172
42	HFS-13A
43	HMS-10/A

*1: For MA9411A

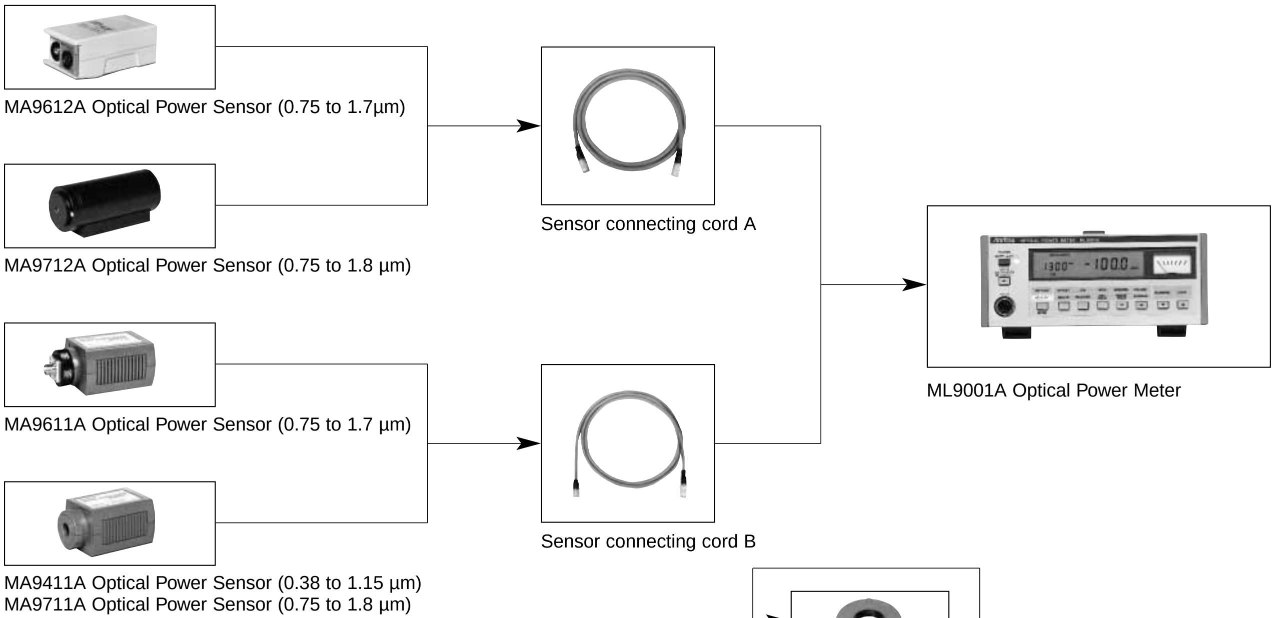
Ordering information

Please specify model/order number, name, and quantity when ordering.

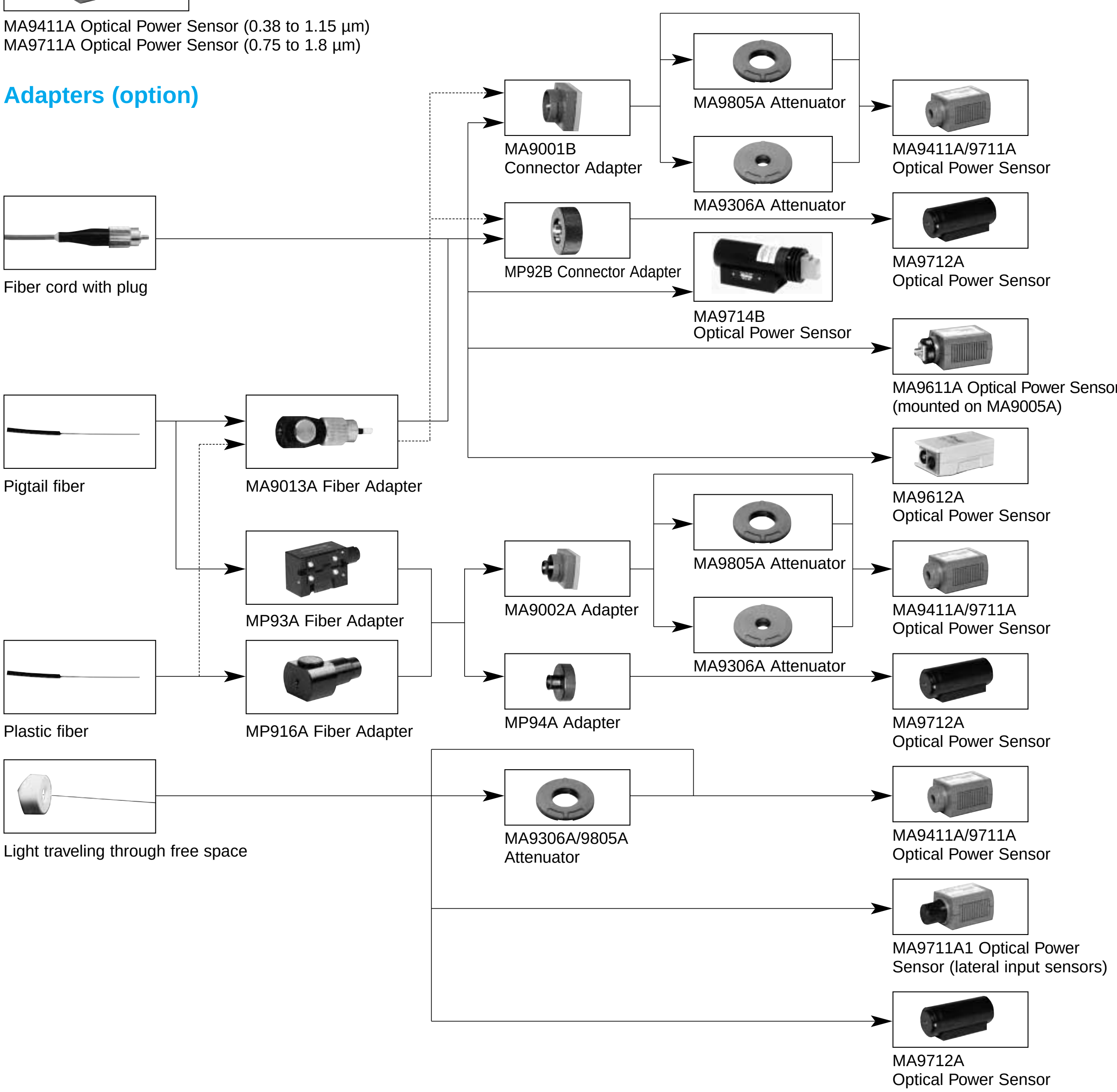
Model/order No.	Name	
	Main frame	
ML9001A	Optical Power Meter	
	Standard accessories (for ML9001A)	
J0313	Sensor connecting cord A, 2 m (for MA9612A/9712A/9714B):	1 pc
J0314	Sensor connecting cord B, 2 m (for MA9411A, MA9611A and MA9711A/A1):	1 pc
	Power cord, 2.5 m:	1 pc
F0004	Fuse, 0.4 A (T400MA250V):	2 pcs
F0007	Fuse, 0.8 A (T800MA250V):	2 pcs
W0420AE	ML9001A operation manual:	1 copy
	Optical power sensors	
MA9411A*1	Optical Power Sensor	
MA9611A	Optical Power Sensor (with MA9005A connector adapter)	
MA9612A	Optical Power Sensor (with J0480A connector adapter)	
MA9711A/A1*1	Optical Power Sensor	
MA9712A	Optical Power Sensor	
MA9714B*2	Optical Power Sensor	
	Optional accessories	
MA9001B*3	Connector Adapter (FC type, for MA9411A/MA9711A)	
J0480B*3	Connector adapter (FC type, for MA9612A)	
MA9005A*3	Connector Adapter (FC type, for MA9611A)	
MP92B*3	Connector Adapter (FC type, for MA9712A)	
MA9013A*3	Fiber Adapter (with FC type plug, for fibers with 125 µm clad dia., 0.25 to 1.0 mm jacket dia.)	
MP916A	Fiber Adapter (for MA9002A and MP94A, for plastic fiber with 1 mm dia.)	
MP93A	Fiber Adapter (≤150 µm clad dia., 0.8 to 1.0 mm jacket dia.)	
MP94A	Adapter (for MA9712A, used with MP93A)	
MA9002A	Adapter (for MA9411A/MA9711A, used with MP93A)	
MA9805A	Optical Attenuator (for MA9411A, 10 dB)	
MA9306A	Optical Attenuator (for MA9711A, 10 dB)	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
B0186	Front cover	
J0617B*4	Replaceable optical connector (FC)	
J0618D*4	Replaceable optical connector (ST)	
J0618E*4	Replaceable optical connector (DIN)	
J0618F*4	Replaceable optical connector (HMS-10/A)	
J0619B*4	Replaceable optical connector (SC)	
J0741A	Replaceable ferrule (for MA9714B)	
Z0282	Ferrule cleaner (Cletop A type, 1 pc)	
Z0283	Tape for ferrule cleaner (6 pcs/set, for Z0282)	
Z0284	Cleaner for optical adapter (stick-type, 200 pcs/set)	

*1: MA9711A1 is lateral input sensors.
*2: Specify one of FC, ST, DIN, SC or HMS-10A.
When the connector type is not specified, FC is supplied.
*3: The optical connector of the standard product is FC. Please specify the option numbers along with model names shown in the tables, if you need a different optical connector.
*4: For MA9714B

ML9001A with sensor

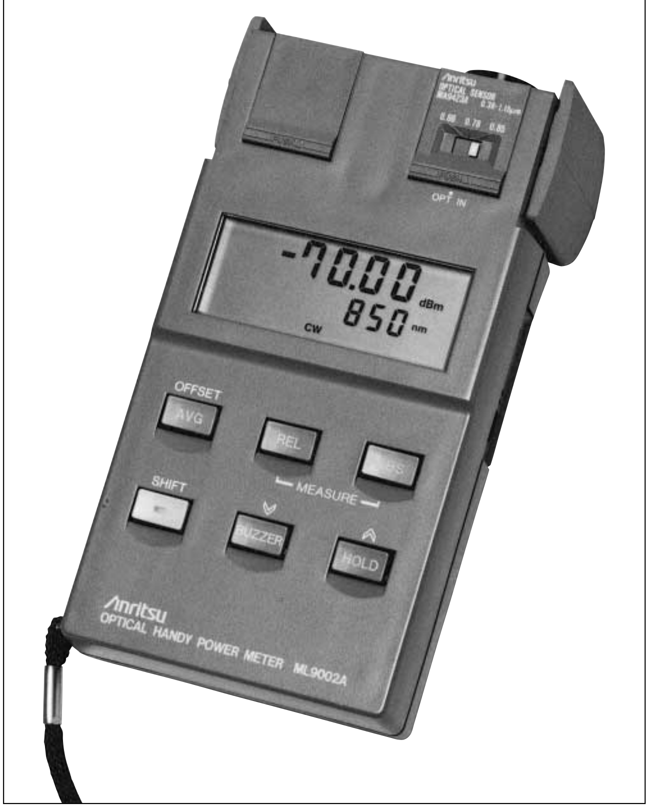


Adapters (option)



OPTICAL HANDY POWER METER
ML9002A
0.38 to 1.8 µm

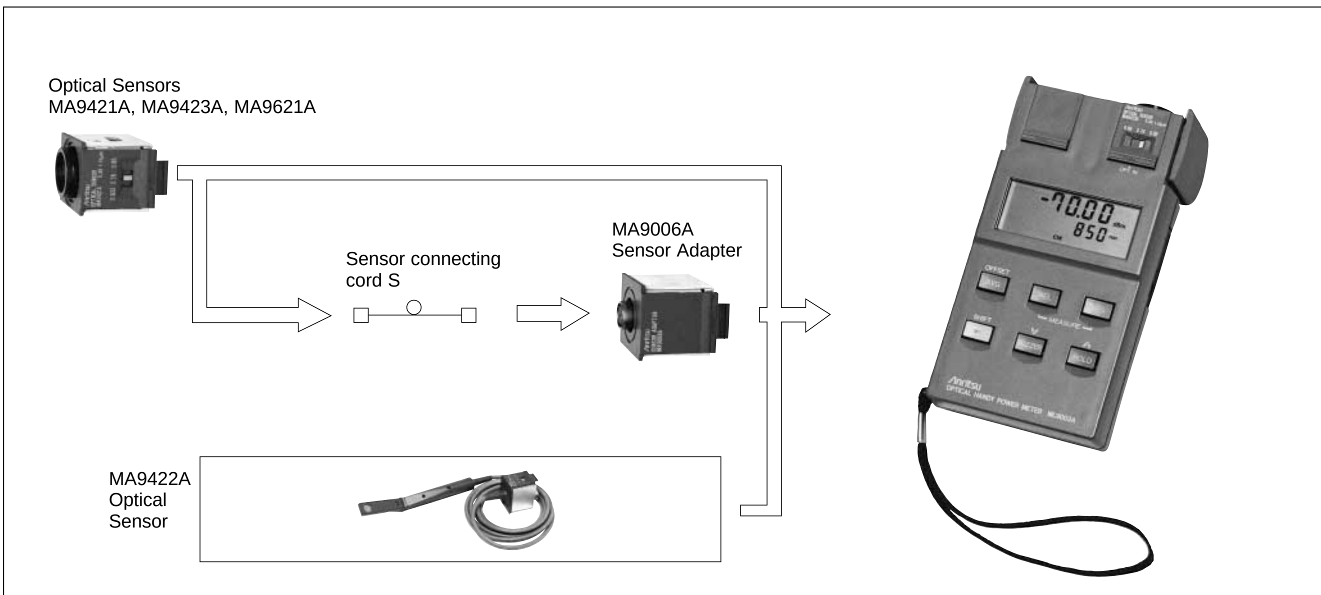
For Easy Optical Power Measurement

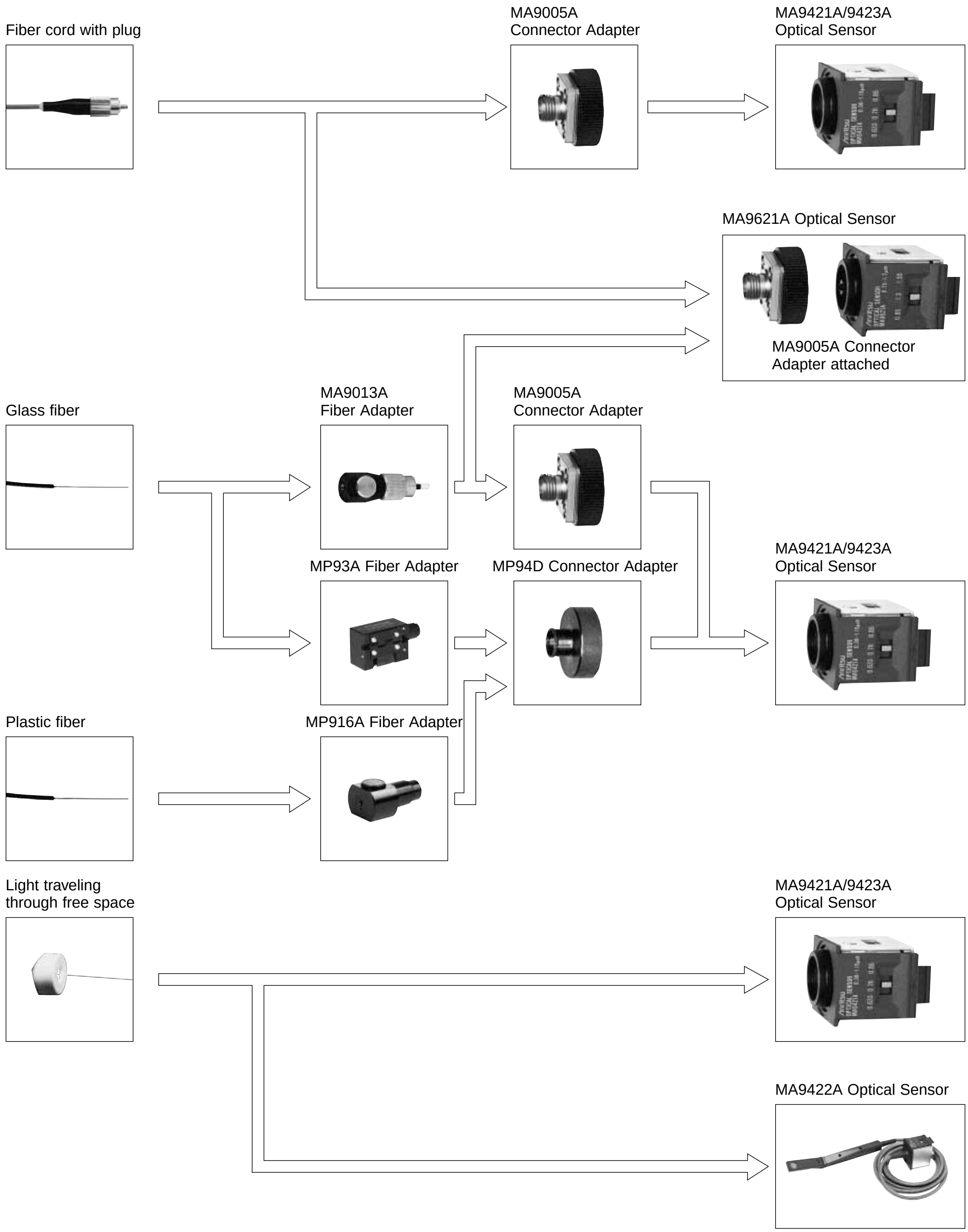


The ML9002A is a compact handy power meter with a measurement level as wide as other more expensive instruments. Optical sensors are available for different wavelengths, measurement levels, and optical input types. Each can be calibrated for three common wavelengths so absolute optical power can be read directly. Each optical sensor can either be incorporated directly in the main frame or connected using a connecting cord. The ML9002A can be used to check optical disks, optical printers and optical communications systems and can back-up on-side operations as a powerful multifunctional measuring instrument for maintenance.

Features

- **Accurate optical power measurement**
The power of a narrow beam can be accurately measured even when an adapter is changed because anti-reflection optical sensor is used.
- **Long-distance measurement with wide measurement level range**
An unprecedented wide measurement level has been achieved in this handy optical power meter. Optical power of –70 to +3 dBm (MA9621A Optical Power Sensor) in the 1.3 µm band and –70 to +10 dBm (MA9423A Optical Power Sensor) in the 0.85 µm band can be measured.
- **Direct absolute power readings for three wavelengths**
Each optical sensor is calibrated at three wavelengths (0.633/0.78/0.85 µm or 0.66/0.78/0.85 µm for short wavelengths, and 0.85/1.3/1.55 µm for long wavelengths). The absolute power is indicated automatically just by switching to the measured wavelength.
- **Flexible measurements**
Two types of connections, a plug-in system (sensor incorporated into main frame) or a cord system (sensor connected using connecting cord), are possible so that measurement capabilities are flexible.
- **Compatible with various connectors**
The ML9002A can be quickly connected to FC, ST, DIN, HMS-10/A, and SC connectors just by replacing the connector adapter.




Fiber cord with plug
MA9005A
Connector Adapter
MA9421A/9423A
Optical Sensor
MA9621A Optical Sensor
MA9005A Connector
Adapter attached
Glass fiber
MA9013A
Fiber Adapter
MA9005A
Connector Adapter
MP93A Fiber Adapter
MP94D Connector Adapter
MA9421A/9423A
Optical Sensor
Plastic fiber
MP916A Fiber Adapter
Light traveling
through free space
MA9421A/9423A
Optical Sensor
MA9422A Optical Sensor

Specifications

Main frame	Unit display	W, W(REL), dBm, and dB(REL), selectable, 4 digits			
	Recorder output	1 V/full-scale, 0.316 V/–5 dB			
	Averaging	ON/OFF settings			
	Range hold	Range settings			
	Buzzer	1 dB sound threshold level setting			
	Auto power off	After 5 minutes non-use (with internal Ni-Cd battery)			
	Dimensions and mass	90 (W) x 190 (H) x 38 (D) mm, ≤700 g			
Sensors	Model	MA9421A	MA9422A	MA9423A	MA9621A
	Wavelength (µm)	0.38 to 1.15			0.75 to 1.7
	Element	Si photodiode			InGaAs photodiode
	Active area diameter	9.5 mm	9 mm	9.5 mm	1 mm
	Input	Direct			FC connector adapter[*1]
	Measurement range (dBm)	–60 to +20 (at 0.85 µm)	–50 to +20 (at 0.85 µm)	–70 to +10 (at 0.85 µm)	–70 to +3 (at 1.3 µm)
	Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤100 g	15 (W) x 16 (H) x 140 (D) mm, ≤200 g	30 (W) x 30 (H) x 37 (D) mm, ≤100 g	
Overall	Measurement accuracy	±5% (–10 dBm, CW mode)			
	Calibration wavelength	0.633/0.78/0.85 µm		0.66/0.78/0.85 µm	0.85/1.3/1.55 µm
	Measurement resolution	W/W(REL): 0.1 to 1%, dBm/dB(REL): 0.01 dB			
	Operating hours	20 hr or more, floating operation possible (on internal Ni-Cd battery)			
	Temperature range	Operating: 0° to +50°C, Storage: –30° to +50°C, Recharging: +10° to +45°C			
	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)			
	LVD	EN61010-1: 2001 (Pollution Degree 2)			

*1: Used for NA ≤0.29 core diameter fiber ≤62.5 µm

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML9002A	Optical Handy Power Meter	
	Optical sensors	
MA9421A	Optical Sensor	
MA9422A	Optical Sensor (Thin sensor)	
MA9423A	Optical Sensor	
MA9621A	Optical Sensor (MA9005A Connector Adapter attached)	
	Standard accessories	
Z0178	AC adapter:	1 pc
	Power cord, 2.5 m:	1 pc
B0232	Blank panel:	1 pc
W0400CE	ML9002A instruction manual:	1 copy
J0477[*1]	Auto-power-off override plug:	1 pc
	Optional accessories	
MA9005A[*2]	Connector Adapter (for optical sensor)	
MA9006A	Sensor Adapter (for sensor connecting cord S/T)	
MP93A	Fiber Adapter (≤150 µm clad dia., 0.8 to 1.0 mm jacket dia.)	
MP94D	Connector Adapter (for MP93A and MP916A)	
MA9013A	Fiber Adapter	
J0056B	FC-FC-2M-SM (FC optical fiber cord, 2 m, SM)	
J0200B	FC-FC-2M-GI (FC optical fiber cord, 2 m, GI)	
J0436	Sensor connecting cord S (for ML9002A sensors)	
J0438	Recorder output cord	
Z0179	Carrying case (with shoulder strap)	
Z0182	Soft case	
B0234	Battery box	

*1: Auto power OFF function is not effective, using battery.
*2: Choose from the options listed in the following table when ordering non-FC optical connector.

Optical connector options table

Option No.	Optical connector
32	MU[*1]
33	LC[*1]
37	FC
38	ST
39	DIN47256
40	SC
41	TOCP172[*2]
42	HFS-13/A (GI)[*2]
43	HMS-10/A (SM)[*1]

*1: Ferrule type; PC
*2: Ferrule type; Flat

OPTICAL LOSS TEST SET

MS9020D

For Measuring Optical Loss and Checking Optical Parts

The MS9020D is a handy optical measuring instrument that incorporates an LD or an LED light source and an optical power meter. It can also be used for return loss measurement. Every unit of the LD light source, LED source, the sensors and the return loss measurement unit is a plug-in type, for easy exchange and highest suitability for field use.
The MS9020D covers 0.66 µm, 0.85 µm, 1.3 µm, and 1.55 µm bands for optical loss measurement. In addition to the CW mode, it provides a modulated light mode with 270 Hz, 1 kHz, and 2 kHz modulation signals. Therefore, it is possible to measure optical loss over a wide dynamic range without stray light effect. This is the most suitable for single mode fiber measurement. For return loss, 1.3 µm band single mode fibers can be measured in the 0 to 40 dB range. As a power meter, every sensor has a wavelength calibration function of 5 nm steps at 3 wavelengths, so absolute values can be read directly.

Features

- Measures optical loss up to 67 dB
- Measures CW and modulated light
- Provides calibration function of 5 nm steps at 3 wavelengths
- Also measures optical return loss (0 to 40 dB)
- Operates in 3 modes; AC, rechargeable battery, and dry cells
- Various connectors

Applications

- **Optical fiber loss measurement**

When measuring optical fibers, it is convenient to provide one MS9020D each at both the near and far ends. By using switchable light source units (MS0904A, MS0909A), one-touch measurement of 0.85/1.3 µm and 1.3/1.55 µm can be done.
More accurate loss measurement is possible by using the modulated light function. When an LD light source is used, it is possible to measure optical loss up to 67 dB.

- **Optical parts performance check**

A light source and optical power meter are provided, and an optical parts performance check is possible at low cost.

- **Optical return loss measurement**

Return loss of connectors or optical devices can be measured easily using return loss measuring units.

Specifications

- **MS9020D (mainframe)**

Unit display	W, W (REL), dBm, dB (REL) selectable, 4 digits
Measurement resolution	W/W (REL) display: 0.1 to 1%, dBm/dB (REL) display: 0.01/0.1 dB, Blanking is possible.
Auto power off	Power turns off automatically after 5 minutes of no adjustment
Recorder output	1 V (on full-scale display), 0.316 V (on –5 dB from full-scale)
Battery alarm	Down-side part flickers when battery voltage goes down.
Auto offset	Sensor zero point is adjusted automatically.
Back light	Display section back light can be set on and off.
Averaging	On and off selectable
Range hold	Range can be specified and set to be on and off.
Reference value input	Used to input the loss point reference value
Buzzer	Sound when input level is higher than set reference level in 1 dB steps
Wavelength sensitivity characteristics compensation	Deviation of optical power sensor is compensated automatically in 5 nm steps.

Continued on next page

Resume function	At power on, the state when the power is just turned off is restored.
Backup	Setting condition is backed up for 30 minutes, when the line voltage is zero at exchanging batteries for example.
Modulation	CW, 270 Hz, 1 kHz, 2 kHz (2 kHz is for MA9621A only)
Power	Operation is possible using AC adapter, Ni-Cd battery [Operation hour: 4-hour for outputting light, No operation hour: 9-hour for light is turned off (when fully charged after new battery fully discharged), Charge time: 6-hour], UM-3 Alkali/Manganese battery[*1] (Require 4 pcs. Operation hour is equivalent with Ni-Cd battery at 25˚C.)
Temperature range	0˚ to 50˚C (use), 10˚ to 45˚C (at charging), –30˚ to +50˚C (storage)
Dimensions and mass	90 (W) x 190 (H) x 38 (D) mm, ≤700 g
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Optional accessories

• **Light sources**

Model	MS0901A	MS0902A	MS0903A	MS0904A
Applicable fiber	GI	SM, GI		
Element	LED			
Wavelength (µm)[*1]	0.85 ±0.03	1.3 ±0.03	1.55 ±0.035	1.3 ±0.03 1.55 ±0.035
Spectral half-width (nm)[*1]	≤60	≤140	≤210	≤140 (1.3 µm) ≤210 (1.55 µm)
Optical output level: CW mode (dBm)[*2]	≥–20[*3]	≥–20[*3] ≥–40[*4]	≥–25[*3] ≥–45[*4]	≥–22 (1.3 µm)[*3] ≥–27 (1.55 µm)[*3] ≥–42 (1.3 µm)[*4] ≥–47 (1.55 µm)[*4]
Stability[*2,*5]	≤0.3 dB			
Short-term stability[*2,*6]	≤0.04 dB			
Internal modulation	Frequency: 270 Hz/1 kHz/2 kHz ±1.5%, Square wave (duty factor: 45 to 55%)			
Optical connector[*7]	FC, ST, DIN, HMS-10/A, SC type connector adapter			
Temperature range	0˚ to +50˚C (use), –40˚ to +70˚C (storage)			
Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤200 g			

Model	MS0906A	MS0902D[*8]	MS0903D[*8]	MS0908A[*9]	MS0909A[*8]
Applicable fiber	GI, SM	SM		SM (ITU-T G.652)	
Element	LED	FP-LD		FP-LD	
Wavelength (µm)	0.85 ±0.03 1.30 ±0.03	1.31 ±0.025[*1]	1.55 ±0.025[*1]	0.635 ±0.010[*1]	1.31 ±0.02[*1] 1.55 ±0.02[*1]
Spectral half-width (nm)	≤60 (0.85 µm) ≤140 (1.30 µm)	≤5[*1]	≤10[*1]	≤5[*1]	≤5 (1.31 µm)[*1] ≤10 (1.55 µm)[*1]
Optical output level: CW mode (dBm)[*2]	≥22 (0.85/1.3 µm)[*3] ≥–42 (1.3 µm)[*4]	–3 ±1[*1,*4]		–3 ±1[*1,*10]	≥–3[*1,*10]
Stability[*2,*5]	≤0.3 dB	±0.5 dB[*4]		±2 dB[*2,*10,*11]	±0.5 dB[*2,*5,*10]
Short-term stability[*2,*6]	≤0.04 dB	±0.05 dB[*4]		–	±0.05 dB[*2,*6,*10]
Internal modulation	Frequency: 270 Hz/1 kHz/2 kHz ±1.5%, Square wave (duty factor: 45 to 55%)			Flickering light function (3 steps)	Frequency: 270 Hz/ 1 kHz/2 kHz ±1.5% Duty: 45 to 55%
Optical connector[*7]	FC, ST, DIN, HMS-10/A, SC type connector adapter	FC or SC type integrated with connector[*12]		Replaceable connector, PC polish (FC, ST, DIN, HMS-10A, SC)	
Temperature range	0˚ to +50˚C (use), –40˚ to +70˚C (storage)			0˚ to +40˚C (use), –40˚ to +70˚C (storage)	0˚ to +50˚C (use), –40˚ to +70˚C (storage)
Dimensions and mass	30 (W) x 30 (H) x 37 (D) mm, ≤200 g			90 (W) x 133 (H) x 38 (D) mm, ≤300 g	90 (W) x 133 (H) x 38 (D) mm, ≤500 g

*1: CW, 25˚C
*2: Used with FC-type connectors
*3: When connected with Anritsu GI fiber (50/125 µm, NA 0.2, 2 m)
*4: When connected with Anritsu SM fiber (10/125 µm, NA 0.1, 2 m)
*5: CW, 0˚ to +50˚C (5 hour)
*6: CW, at ±1˚C (1 minute) within 0˚ to +50˚C
*7: Specify one connector among those shown in the specification table. When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 38.
*8: Laser Product Safety Standards: IEC 60825-1 Class-1, FDA 21CFR Class-1
*9: Laser Product Safety Standards: IEC 60825-1 Class-1M, FDA 21CFR Class-2
*10: Connected with SM fiber (ITU-T G.652), 2 m
*11: CW, at 0˚ to +40˚C ambient temperature, 5 hour
*12: Use the conversion cord (see ordering information) for other optical connectors

• **Optical sensors**

Model		MA9421A	MA9422A	MA9423A	MA9621A	MA9622A*1
Wavelength range		0.38 to 1.15 µm			0.75 to 1.7 µm	1.2 to 1.7 µm
Element		Si diode			InGaAs diode	
Active area diameter		ø9.5 mm	ø9 mm	ø9.5 mm	ø1 mm	–
Input		Direct			FC, ST, DIN, HMS-10/A, SC type connector adapter*2	FC, SC, ST, DIN, HMS-10/A, replaceable connector, PC polishing
Measurement range	CW (dBm)	–60 to +20 (0.85 µm)	–50 to +20 (0.85 µm)	–70 to +10 (0.85 µm)	–70 to +3 (1.3 µm)	–50 to +23 (1.3/1.55 µm)
	MOD (dBm)	–65 to +17 (0.85 µm)	–50 to +17 (0.85 µm)	–75 to +7 (0.85 µm)	–75 to 0 (1.3 µm)	–55 to +20 (1.3/1.55 µm)
Measurement accuracy*3		±5%*4		±5%*5	±5%*6	±5%*7
Temperature range		0˚ to +50˚C (use), –40˚ to +70˚C (storage)				
Dimensions and mass		30 (W) x 30 (H) x 37 (D) mm, ≤100 g	15 (W) x 16 (H) x 140 (D) mm, ≤200 g	30 (W) x 30 (H) x 37 (D) mm, ≤100 g		

*1: Applicable connector: SM fiber (ITU-T G.652)
Return loss: ≥40 dB (1.55 ±0.2 µm, only when return loss of optical connector: ≥45 dB)
Polarization dependency: ≤0.1 dB (1.55 ±0.02 µm)
*2: Specify one connector among those shown in the specification table.
When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 38.
*3: Used with FC-type connectors
*4: At –10 dBm, 0.633/0.78/0.85 µm CW light mode
*5: At –10 dBm, 0.66/0.78/0.85 µm CW light mode
*6: At –10 dBm, 0.85/1.3/1.55 µm CW light mode
*7: At –10 dBm, 1.3/1.55 µm CW light mode

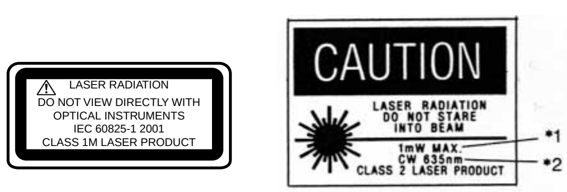
• **MS0907A Return Loss Measurement Unit*1**

Applicable fiber	SM (10/125 µm, NA 0.1)
Wavelength	1.31 ±0.03 µm (25˚C)
Measurement range	0 to 40 dB (relative to total internal reflection cord, including output connector reflection)
Measured data display range	0 to 60 dB (relative to total internal reflection cord, excluding output connector reflection)
Measurement accuracy	±1 dB (relative to the reflection, constant temperature)
Optical output connector*2	FC, ST, DIN, HMS-10/A, SC: PC-type
Temperature range	0˚ to +50˚C (use), –40˚ to +70˚C (storage)
Dimensions and mass	90 (W) x 93 (H) x 36 (D) mm, ≤300 g

*1: Laser Product Safety Standards: IEC 60825-1 Class-1, FDA 21CFR Class-1
*2: Specify one connector among those shown in the specification table.
When no connector and manufacturer's name are specified, FC-type will be mounted and supplied.
Other than the connectors indicated in the table are dealt in special connectors of custom-made. The ordering method of optical connectors are indicated in the table on page 38.

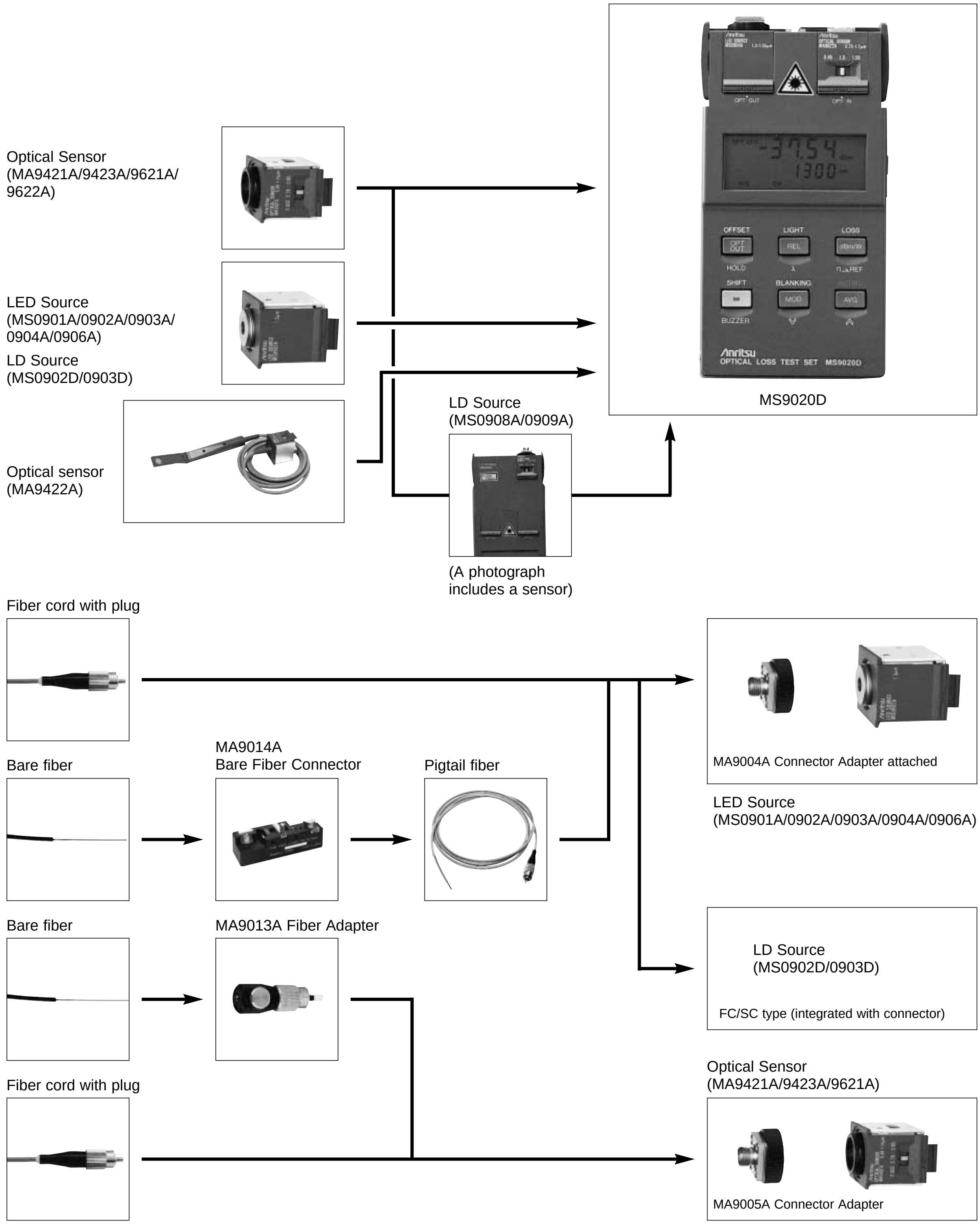
Safety measures for laser products

The MS0908A complies with the optical safety standards in Class 1M of the IEC 60825-1 and the FDA (21CFR 1040.10, USA); the following descriptive labels are affixed to the product (FDA label is only affixed to product for export to the USA).



IEC FDA (CFR)

The maximum output is indicated under *1, and the wavelength under *2.
Caution: Do not look directly into the laser beam.



Optical Sensor
(MA9421A/9423A/9621A/
9622A)
LED Source
(MS0901A/0902A/0903A/
0904A/0906A)
LD Source
(MS0902D/0903D)
Optical sensor
(MA9422A)
LD Source
(MS0908A/0909A)
(A photograph
includes a sensor)
OFFSET
LIGHT
LOSS
HOLD
SHIFT
BLANKING
BUZZER
Anritsu
OPTICAL LOSS TEST SET MS9020D
MS9020D
Fiber cord with plug
Bare fiber
MA9014A
Bare Fiber Connector
Pigtail fiber
MA9004A Connector Adapter attached
LED Source
(MS0901A/0902A/0903A/0904A/0906A)
Bare fiber
MA9013A Fiber Adapter
LD Source
(MS0902D/0903D)
FC/SC type (integrated with connector)
Fiber cord with plug
Optical Sensor
(MA9421A/9423A/9621A)
MA9005A Connector Adapter

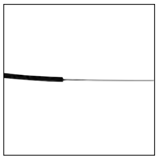
Fiber cord with plug

LD Source (MS0908A/0909A)

(Replaceable connector)

(A photograph includes a sensor)

Bare fiber

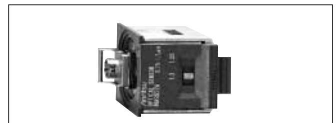


MA9014A
Bare Fiber Connector

Pigtail fiber

Fiber cord with plug

MA9622A Optical Sensor



(Replaceable connector)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MS9020D	Optical Loss Test Set (with Ni-Cd batteries)
	Standard accessories
Z0178	AC adapter: 1 pc
	Power cord, 2.5 m: 1 pc
J0599*1	AC operation adapter: 1 pc
J0477*2	Continuant adapter: 1 pc
J0597	Total internal reflection cord (for MS0907A only): 1 pc
W1306AE	MS9020D operation manual: 1 copy
	LED sources
MS0901A	LED Source (MA9004A Connector Adapter attached)
MS0902A	LED Source (MA9004A Connector Adapter attached)
MS0903A	LED Source (MA9004A Connector Adapter attached)
MS0904A	LED Source (MA9004A Connector Adapter attached)
MS0906A	LED Source (MA9004A Connector Adapter attached)
	LD sources
MS0902D	LD Source (integrated with connector)
MS0903D	LD Source (integrated with connector)
MS0908A	LD Source (replaceable connector attached)
MS0909A	LD Source (replaceable connector attached)
	Optical sensors
MA9421A	Optical Sensor
MA9422A	Optical Sensor (thin type)
MA9423A	Optical Sensor
MA9621A	Optical Sensor (MA9005A Connector Adapter attached)
MA9622A	Optical Sensor (for high power, replaceable optical connector attached)
	Optical return loss measuring unit
MS0907A	Optical Return Loss Measuring Unit

*1: It is the short connector, not using battery.
*2: Auto power OFF function is not effective, using battery.
*3: It is connected instead of an optical sensor.

Model/Order No.	Name
	Optional accessories
MA9004A	Connector Adapter (for MS0902A/0903A/0904A)
MA9005A	Connector Adapter (for MA9421A/9423A/9621A)
MA9006A	Sensor Adapter (for optical sensors)
MA9013A	Fiber Adapter (Clad diam. 125 µm; Jacket diam. 0.25 to 1 mm)
MA9014A	Bare Fiber Connector
MP93A	Fiber Adapter (Clad diam. ≤150 µm)
MP94D	Connector Adapter (used with MP93A)
J0436	Optical sensor cord S (for ML9002A, MS9020D)
J0438	Recorder output cord (mini-jack with clips)
J0598	Plastic fiber cord (ø1 mm, NA 0.5, 2 m)
J0200B	Optical fiber cord (GI fiber, 50/125 µm, NA 0.2, FC-type), 2 m
J0056B	Optical fiber cord (SM fiber, 10/125 µm, NA 0.1, FC-type), 2 m
Z0179	Carrying case
Z0180	Battery pack (for Alkali/Manganese cell, up to 4 pcs)
Z0181	Ni-Cd battery pack
Z0182	Soft case (MS0908A/0909A can not house)
Z0426	Carrying case (for MS9020D + MS0908A/0909A)
J0206A	FC-Diamond conversion cord, 1 m (for SM)
J0208A	FC-Biconical conversion cord, 1 m (for SM)
J0210A	FC-D4 conversion cord, 1 m (for SM)
J0517A	FC-DIN conversion cord, 1 m (for SM)
J0519A	FC-ST conversion cord, 1 m (for SM)
J0521A	FC-SC conversion cord, 1 m (for SM)
J0617B	Replaceable connector (FC) *For MA9622A, MS0908A/0909A
J0618D	Replaceable connector (ST) *For MA9622A, MS0908A/0909A
J0618E	Replaceable connector (DIN) *For MA9622A, MS0908A/0909A
J0618F	Replaceable connector (HMS-10/A) *For MA9622A, MS0908A/0909A
J0619B	Replaceable connector (SC) *For MA9622A, MS0908A/0909A
Z0333A*3	Wavelength selector *For MS0904A/0906A/0909A

OPTICAL TEST SET
MT9810B

GPIB

Multipurpose Optical Measuring Instruments Supporting Reference Light Sources

Today, as we turn to photonic communications, a variety of optical communication networks, from core to access, are about to be realized. For this reason, there are a wide variety of performance requirements demanded of optical components and optical communications systems making up these rapidly developing optical communication networks.

And the performance and specifications of the sought after evaluation systems vary depending on the field (development, manufacturing, inspection, maintenance) in which these are developed, supplied and implemented.

The MT9810B Optical Test Set is the most fundamental optical measurement instrument with a complete line-up of light sources (DFB-LD, FP-LD, SLD) and optical sensors (high-speed, general-purpose, high-power).

The evaluation system can be configured to fit the users needs. In addition, by combining the optical test set with peripheral devices such as the optical directional coupler and the optical channel selector, the user can construct even more diverse evaluation systems. The MT9810B is a highly accurate and reliable evaluation system that will respond with flexibility to future diverse measurement needs.

• Light source
The DFB-LD complies with ITU-T recommended wavelengths and highly stable 1.31 µm band, 1.55 µm band FP-LD's are also offered. In addition, an SLD light source with a center wavelength of 1.55 µm and an approximately 40 nm wavelength band is provided.

• Optical sensors
There are three optical sensors: high-sensitivity, general-purpose and high-power. Each has sensor head and plug-in models.

• Measurement conditions saving function
Up to 10 sets of measurement conditions can be saved for each channel, permitting the repetition of measurements.

• Clone function
When the same types of units are mounted in Channels 1 and 2, the measurement conditions for one side can be copied onto the other side.

• Measurement of max., min. and variation of optical power
By mounting an optical sensor, the maximum and minimum values of optical power and the variations in its value can be always displayed, eliminating the need for saving the measured optical power various in the memory. Light source stability and PDL (polarization dependent loss) characteristics can be evaluated in real time.

• Recording measured optical power values
By mounting an optical sensor, a maximum of 1000 power measurement values can be saved per channel. The saved measurement values can be read by remote control, permitting various analyses and processings.

• Variable optical power measurement interval
By mounting an optical sensor, the optimum measurement interval can be set according to the applications (1 ms to 99 h 59 min 59 s); for example, a long interval for a long-duration measurement, and a short interval for high-speed measurement.

• Variable optical power measurement bandwidth
By mounting an optical sensor, the bandwidth can be set according to the measured item; for example, the average pulse optical power can be measured by widening the bandwidth, and the variations in optical power at an optical switch can be measured by narrowing the bandwidth. The setting range is between 0.1 Hz to 100 kHz (MU931311A) or 10 kHz (MU931421A/931422A).

• Relative measurement
By mounting an optical sensor, 0 dB is displayed as the measured value on the display when the relative key (Rel) is pressed. It allows the difference from the reference value to be read directly in the loss measurement of an optical fiber or device.

• Reference measurement
By mounting an optical sensor, a relative value based on a reference value (reference) entered using the keys can be displayed. When the light is incident at a distant location in the loss measurement of an optical fiber, the fiber loss can be read directly by entering the reference value of incident light as a reference.

• Controlling optical channel selector
The MN96xxA Optical Channel Selector can be controlled from the MT9810B Optical Test Set by connecting the two via a dedicated cable. It facilitates the measurement if the optical test set and the optical channel selector are at a distance from each other due to the configuration of the measurement system. The cable lengths are available in the range from 1 to 10 m.

• GPIB and RS-232C I/F as standard
GPIB and RS-232C interfaces are provided as standard, permitting remote control of the measurements via a PC. In addition, the LabVIEW® software driver for remote control is provided as standard, enhancing the construction of a remote measurement system.

∗ LabVIEW® is registered trademark of National Instruments Corporation.

Light source units

• DFB-LD light source unit

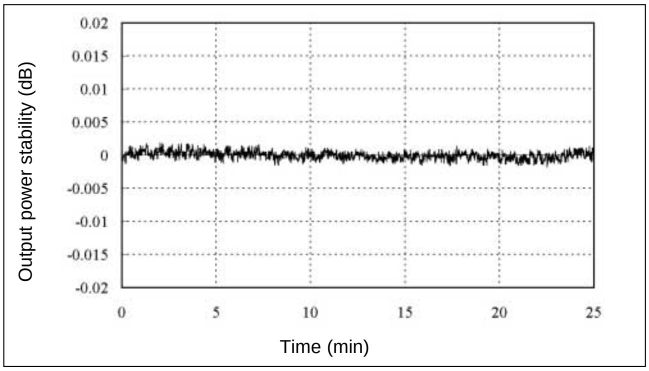
MU952500A/952600A series are 97 wavelengths supporting WDM. The unit is equipped with a high-output and high-stability DFB-LD light source.

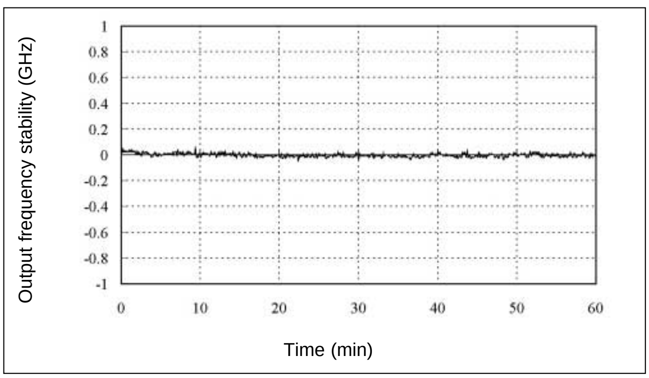
Conforms to wavelengths complying with ITU-T

The unit incorporates a DFB-LD light source that supports D-WDM and complies with ITU-T. Frequencies from 186.3 to 195.9 THz (1609.19 to 1530.33 nm) over a 100 GHz interval are available.

High-power, high-stability

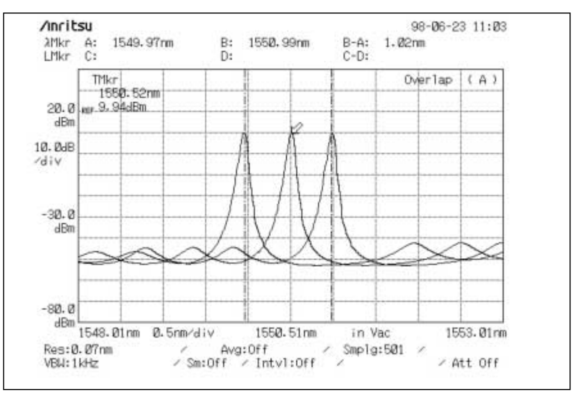
High Power of +10 dBm and high stability of better than or equal to ±0.005 dB are provided. In addition, high stability of better than or equal to ±2 GHz can be achieved for the center frequency (MU952501A/952502A/952503A/952504A/952505A).





Variable optical frequency

The center frequency of the light source can be varied in the maximum range of ±60 GHz (approx. ±0.5 nm). Moreover, the frequency can be displayed in either frequency or wavelength units. This function allows a required frequency to be set between reference grids.



• FP-LD light source units

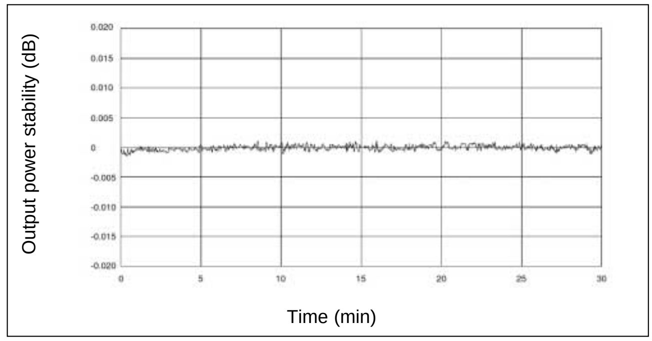
The MU951301A and MU951501A have a wavelength of 1.31 µm and 1.55 µm, respectively. The MU951001A allows the wavelength to be selected as either 1.31 or 1.55 µm.

High-power

The units are general-purpose light sources with a high output of +7 dBm, making them ideal for performing measurements over a high dynamic range.

High-stability

The units provide high output-power stability of better than or equal to ±0.002 dB. They are suitable as light sources for measurements in which high accuracy is required(MU951301A/951501A).



• SLD light source unit

This light source has a center wavelength of 1550 nm and an approximate wavelength band of 40 nm. Optical output power is –3 dBm. The output level is higher than LED light source. A measurement system of MS9710B/C Optical Spectrum Analyzer and SLD light source unit achieves more dynamic range.
On the other hand, when combined with the MN9604C/D Optical Directional Coupler, highly stable reflectance measurements can be performed because of low interference to use SLD light source.

Optical sensor units

High-sensitivity, general-purpose or high-power optical sensors are available. A remote sensor head model and a plug-in model are also provided. Furthermore, besides supporting all optical connectors, the optical input method (connection method) for optical sensors supports bare fiber connection and free-space optical input. The user can select the optical sensor that meets his use environment and purpose.

• General-purpose optical sensor (MU931421A/MU931422A/MA9332A)

MU931421A and MU931422A with measurement ranges of +10 to –80 dBm and MA9332A with a measurement range of +7 to –80 dBm, are highly accurate optical sensors that achieve a measurement accuracy of ±2% and linearity of ±0.01 dB.
MU931422A and MA9332A can be used in measuring fiber with an APC connector, GI fiber and bare fiber. MU931422A is a plug-in model and MA9332A, a sensor head model.
∗ When using MA9332A, MU931002A sensor adapter is necessary.

• High-power optical sensor (MA9331A/MU931431A)

High-power optical sensors MA9331A and MU931431A have maximum measurement optical inputs of +35 dBm and +33 dBm, respectively. These sensors have NPL (National Physical Laboratory) traceability in conducting calibration at +30 dBm, and are able to measure “high-power” with an even higher level of confidence than conventional high-power optical sensors. And of course all types of corresponding connectors also support fiber with an APC connector, GI fiber and bare fiber. MU931431A is a plug-in model and MA9331A, a sensor head model.
∗ When using MA9331A, MU931002A sensor adapter is necessary.

Optical input method of the sensor

Item	Model	Type	Various connector	Bare fiber	Space beam
General purpose	MU931421A	Unit	√*1		
	MU931422A	Unit	√	√	
	MA9332A	Sensor head	√	√	
High power	MU931431A	Unit	√	√	
	MA9331A	Sensor head	√	√	
High sensitivity	MU931311A	Unit	√*1		
Large diameter PD	MA9333A	Sensor head	√	√	√

*1: MU931421A/MU931311A does not correspond to MU connector, LC connector, and APC connector.

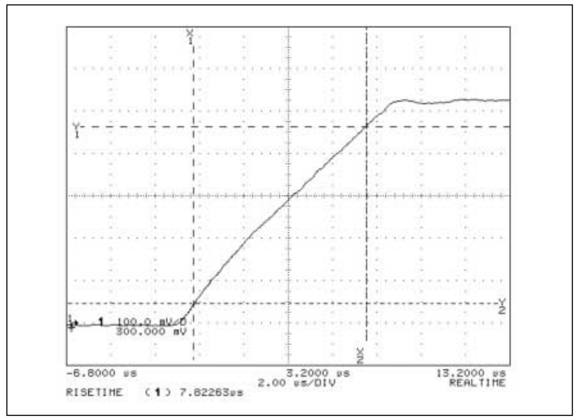
• High-sensitivity optical sensor (MU931311A)
The MU931311A has an optical power range of +10 to –110 dBm and measures high-level to extremely low-level light. It achieves measurement uncertainty of ±2% and linearity of ±0.01 dB. Optical power can be measured with a high degree of accuracy. And of course, this optical sensor is compatible with all connectors.

• Large diameter PD sensor (MA9333A)
This is a sensor head-model optical sensor that has low noise characteristics, and uses an internal photo acceptance unit with a ±5 mm-InGaAs-PD. In addition to SM, GI and POF (plastic fiber), a collimated spatial beam can also be measured directly. This optical sensor also supports bare fiber.
* When using MA9333A, MU931002A Sensor Adapter is necessary.

• MA9901A/B Fiber Adapter
Setting can be accomplished without touching the cut fiber edge by using the clamping method, which catches and then fixes the fiber at both ends. Fiber can also be easily attached and removed by pinching the clamp, making this adapter perfect for extended work.

High-resolution optical power measurement
The MT9810B has a panel of high resolution of 1/1000 dB. In addition, the optical power can be measured at a high resolution of 1/10000 dB via GPIB or RS-232C interface.

High-speed analog output
The MU931311A Optical Sensor can send a signal to an analog output terminal with a response speed of approx. 10 µs (The response speed of other optical sensors is approx. 100 µs).



Specifications

• MT9810B Optical Test Set

Display resolution	dBm: 0.001, 0.01, 0.1 dB: 0.001, 0.01, 0.1 W: 5 digits
Display range	–199.999 to +199.999 dBm, ±0.0001 pW to ±10000 W
Display	Fluorescent character display tube, 7 segments (5-1/2 digits), 2 screens, dot matrix (138 x 20 dots), dedicated segments (AUTO, AVG, MOD, CAL, SYS, PRMTR, APPL, REMOTE)
System settings	Remote (GPIB, RS-232C) GPIB: Address RS-232C Data length: 7/8 bits, Stop bit: 1/2 bits Parity bit: None, odd, even Speed: 1200, 2400, 4800, 9600, 14400, 19200 bps Buzzer volume: 4 levels, Contrast: 9 levels Time setting: Year, month, day, hour, minute, second (24 hour display)
Functions	General Settings save: 10 max. (each channel) Settings copy: Between channels (only for same type of unit) Selectable controlled channel Using optical sensor Bar graph display: 60 dots Record measurement: 1000 max. data (each channel) Calculations: Channel subtraction, max./min./(max. – min.) displays, relative value display (measured value reference, numeric value input), calibration value correction
Remote control	GPIB, RS-232C
Laser safety mechanism	Remote inter-lock, optical output control (key control)
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); Storage temperature: –25˚ to +71˚C
Plug-in units	2 max.
LabVIEW® driver	Bundled as standard
Dimensions and mass	213 (W) x 88 (H) x 351 (D) mm, ≤3.5 kg (without units)
Power	100 to 120/200 to 240 Vac (+10%/–15%), ≤70 VA, 47.5 to 63 Hz
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• **Light sources**

DFB-LD light source

Model	MU952501A/952502A/952503A/952504A/952505A	MU952601A/952602A/952603A/952604A/952605A/952606A
Optical element	DFB-LD	
Applicable optical fiber	SM (ITU-T G.652)	
Specified wavelength range (fp)[*1]	191.7 to 195.9 THz (1563.86 to 1530.33 nm)	186.3 to 191.6 THz (1609.19 to 1564.68 nm)
Center optical frequency[*2]	fp ±0.01 THz (approx. ±0.08 nm)	
Spectrum half width[*2]	≤30 MHz	
Optical output power[*2]	+10 ±1 dBm	+7 ±1 dBm
Optical power stability	Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB	Time stability (short term)[*2, *3, *4]: ≤±0.01 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.25 dB
Center frequency stability	Time stability (short term)[*2, *4]: ≤±2 GHz (approx. ±0.02 nm) Time stability (long term)[*2, *5]: ≤±4 GHz (approx. ±0.04 nm)	
Optical frequency tuning	Tuning range: fp ±60 GHz (approx. ±0.48 nm), Step: 1 GHz (approx. 0.01 nm), Accuracy[*2]: ≤±10 GHz (setting to fp +60 GHz, or fp –60 GHz, 25˚C)	
Internal modulation	Frequency[*2]: 270 Hz, 1 kHz, 2 kHz ±0.1% Duty: 50% ±5%, Extinction ratio: ≥13 dB	
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)	
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb	
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7] (all PC type)	
Warm-up time	1 h (after optical output on)	
Environmental conditions	Operating temperature/humidity: +15˚ to +35˚C/≤90% (no condensation), Storage temperature: –25˚ to +71˚C	
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	

Note: Wavelengths in vacuum
*1: Specify an optical frequency (wavelength) and model name from the ordering information.
*2: At CW, optical attenuation setting (0.00 dB), center optical frequency (fp) using SM fiber (ITU-T G.652) and FC-PC connector
*3: When return loss seen from light source side is 40 dB min.
*4: 5 min at constant temperature (at one point 20˚ to 30˚C)
*5: 1 h at constant temperature
*6: 8 h at +15˚ to +35˚C
*7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

FP-LD light source

Model	MU951301A	MU951501A	MU951001A[*1]
Optical element	FP-LD		
Fiber	SM (ITU-T G.652)		
Wavelength[*2]	1310 ±20 nm	1550 ±20 nm	1310/1550 ±20 nm
Spectral half-width[*2]	≤5 nm	≤10 nm	≤5 nm (1310 nm), ≤10 nm (1550 nm)
Optical output power[*2]	+7 ±1 dBm		
Optical output power stability	Time stability (short term)[*2, *3, *4]: ≤±0.002 dB Time stability (long term)[*2, *3, *5]: ≤±0.02 dB Temperature stability[*2, *3, *6]: ≤±0.1 dB		Time stability (short term)[*2, *3, *4]: ≤±0.005 dB Time stability (long term)[*2, *3, *5]: ≤±0.05 dB Temperature stability[*2, *3, *6]: ≤±0.15 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB		
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)		
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb		
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC[*7] (all PC type)		
Warm-up time	1 h (after optical output on)		
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); Storage temperature: –40˚ to +71˚C (no condensation)		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g		

Note: Wavelengths in vacuum
*1: Only one MU951001A can be installed into MT9812B.
*2: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
*3: When return loss seen from light source side is 40 dB min.
*4: 15 min at constant temperature (at one point from 20˚ to 30˚C)
*5: 6 h at constant temperature
*6: 8 h at 0˚ to 50˚C
*7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

SLD light source

Model	MU954501A
Optical element	SLD
Fiber	SM fiber (ITU-T G.652)
Wavelength[*1]	1550 ±20 nm
Spectral half-width[*1]	≥40 nm
Optical output power[*1]	–3 ±1 dBm

Continued on next page

Optical output power stability	Time stability (short term)*1, *2, *3: ±0.01 dB Time stability (long term)*1, *2, *4: ±0.1 dB Temperature stability*1, *2, *5: ±0.5 dB
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB
Warm-up time	1 h (after optical output on)
Optical connector*6	FC, ST, DIN, HMS-10/A, SC (all PC type)
Laser safety mechanism	IEC60825-1: Class 1, 21CFR1040.10: Class I
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation) Storage Temperature: –40˚ to +71˚C
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g

Note: Wavelengths in vacuum, please contact us for 1310 nm SLD light source.
*1: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
*2: When return loss seen from light source side is 40 dB min.
*3: 15 min at constant temperature
*4: 6 h at constant temperature
*5: 8 h at 0˚ to 50˚C
*6: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

Laser product safety protection

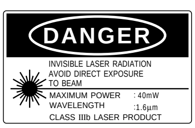
The MU952501A/952502A/952503A/952504A/952505A, MU952601A/952602A/952603A/952604A/952605A/952606A, MU951301A/951501A/951001A, and MU954501A are laser products and safety protection conforming to optical safety standards IEC 60825-1 and 21CFR1040.10 (USA) is incorporated; the following warning label is affixed to the product.

• 21CFR1040.10 warning label

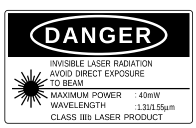
MU952501A/952502A/952503A/952504A/952505A

MU951501A

MU952601A/952602A/952603A/952604A/952605A/952606A



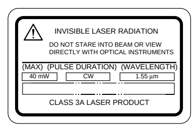
MU951001A



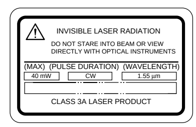
MU951301A

• IEC 60825-1 warning label

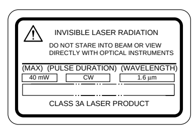
MU952501A/952502A/952503A/952504A/952505A



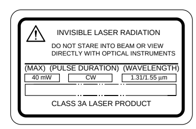
MU951501A



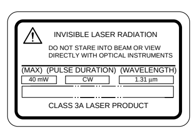
MU952601A/952602A/952603A/952604A/952605A/952606A



MU951001A



MU951301A



MU954501A

• Optical sensors (unit)

Model	MU931311A	MU931421A	MU931422A
Element	InGaAs-PD		
Input type	Fiber		
Applicable optical fiber	SM (ITU-T G.652)		9/125 to 62.5/125 µm (NA: ≤0.29) PC, APC polish conformity
Wavelength range	800 to 1600 nm	750 to 1700 nm	
Optical power measurement range*1	CW: +10 to –110 dBm MOD: +7 to –90 dBm	CW: +10 to –80 dBm MOD: +7 to –90 dBm	
Noise level*2	≤–93 dBm	≤–73 dBm	
Polarization dependency*3	≤±0.01 dB		≤±0.025 dB
Return loss*3	≥40 dB		—
Optical power measurement uncertainty	Reference conditions*4: ±2%, Operating conditions*5: ±3.5%		

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Model	MU931311A	MU931421A	MU931422A
Linearity*6	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±0.3 pW (0 to –90 dBm)	±0.05 dB (+10 to 0 dBm) ±0.01 dB ±30 pW (0 to –70 dBm)	
Calibration factor input	–99.999 to +99.999 dB		
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units		
Zero set operation	Automatic zero calibration		
Range select	Auto, manual		
Modulated light reception	CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz		
Measurement interval*7	1, 10, 20, 50, 100, 200, 500 ms, 1 s to 99 h 59 min 59 s		
Average setting	Off, 2, 5, 10, 20, 50, 100, 200, 500, 1000 times		
Analog output*8	Approx. +2 V		
Bandwidth select*9	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only)	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only)	
Optical connector*10	FC-PC, ST, DIN, HMS-10/A, SC (all PC type)		FC, ST, DIN, HMS-10/A, SC, MU, LC
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation), Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	41 (W) x 78 (H) x 335 (D) mm, ≤550 g	

*1 Wavelength: 1300 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1300 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1300 nm, ambient temperature: 23˚ ±2˚C, at day of calibration,
Warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, CW light, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), power level: 100 µW (–10 dBm), ambient
temperature: 23˚ ±5˚C, within 1 year after calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A), Uncertainty increase by 1% if either an APC connector or NA ≤0.29 fiber is used with the MU931422A.
*6 Measurement conditions: Constant temperature within 23˚ ±5˚C, bandwidth: auto/0.1/1/10 Hz, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), CW light, power level: 100 µW (–10 dBm) reference, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*7 Only record measurements for measurement interval of ≤100 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth. Response time at bandwidth setting of 100 kHz varies according to analog output amplitude
*10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• Optical sensor (sensor head)

Model	MU931002A + MA9332A/MA9333A
Element	InGaAs-PD
Input type	Fiber
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity
Wavelength range	750 to 1700 nm
Optical power measurement range*1	CW: +7 to –80 dBm
Noise level*2	≤–73 dBm
Polarization dependency*3	≤±0.017 dB (MA9332A), ≤±0.013 dB (MA9333A)
Optical power measurement accuracy	Reference conditions*4: ±2%, Operating conditions*5: ±3.5%
Linearity*6	±0.05 dB (+7 to 0 dBm), ±0.01 dB ±30 pW (0 to –70 dBm)
Zero set operation	Automatic zero calibration
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units
Measurement interval*7	1 ms to 99 h 59 min 59 s
Average setting	2 to 1000 times
Analog output*8	Approx. +2 V
Bandwidth select*9	Auto, manual Manual setting: 1, 10, 100 Hz, 1, 20 kHz (CW mode only)
Optical connector*10	FC, ST, DIN, HMS-10/A, SC, MU, LC
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)
Dimensions and mass	MU931002A: 41 (W) x 78 (H) x 335 (D) mm, ≤500 g MA9332A/MA9333A: 65 (W) x 80 (H) x 110 (D) mm, ≤750 g

*1 Wavelength: 1550 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
*3 SM fiber (ITU-T G.652), power level: 100 µW (–10 dBm), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1550 nm, ambient temperature: 23˚ ±2˚C
At day of calibration, warm-up: 30 min, 1 h (when using MA9333A)

*5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, power level: 100 µW (–10 dBm)
CW light, wavelength: 1000 to 1650 nm, ambient temperature: 23˚ ±5˚C, within 1 year after calibration
warm-up: 30 min, 1 h (when using MA9333A)
Uncertainty increase by 1% if either an APC connector or NA ≤0.29 fiber is used.
*6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 100 µW (–10 dBm) reference
Bandwidth: auto/1/10 Hz, warm-up: 30 min, 1 h (when using MA9333A)
*7 Only record measurements for measurement interval of ≤20 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth
*10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• Optical sensor (high-power)

Model	MU931002A + MA9331A	MU931431A
Element	InGaAs-PD	
Input type	Fiber	
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity	
Wavelength range	940 to 1640 nm	
Optical power measurement range*1	CW: +35 to –50 dBm	CW: +33 to –50 dBm
Noise level*2	≤–43 dBm	
Polarization dependency*3	PC connector: ≤±0.005 dB, APC connector: ≤±0.025 dB	PC connector: ≤±0.025 dB, APC connector: ≤±0.05 dB
Optical power measurement accuracy	Reference conditions*4: ±3%, Operating conditions*5: ±4%	Reference conditions*4: ±4%, Operating conditions*5: ±5%
Linearity*6	±0.05 dB ±30 nW (+35 to –40 dBm)	±0.05 dB ±30 nW (+33 to –40 dBm)
Zero set operation	Automatic zero calibration	
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units	
Measurement interval*7	1 ms to 99 h 59 min 59 s	
Average setting	2 to 1000 times	
Analog output*8	Approx. +2 V	
Bandwidth select*9	Auto, manual Manual setting: 1, 10, 100 Hz, 1, 20 kHz	
Optical connector*10	FC, ST, DIN, HMS-10/A, SC, MU, LC	
Environmental conditions	Operating temperature/humidity: 0˚ to +40˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)	
Dimensions and mass	MU931002A: 41 (W) x 78 (H) x 335 (D) mm, ≤500 g MA9331A: 65 (W) x 80 (H) x 110 (D) mm, ≤750 g	41 (W) x 78 (H) x 335 (D) mm, ≤880 g

*1 Wavelength: 1550 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions,
Connector adapter, SM fiber (ITU-T.G.652), APC connector
Power level 1 W (+30 dBm), CW light, and wavelength 1550 nm
Ambient temperature 23 ±2˚C, humidity 60 % ±10 %
Warm-up time 30 minutes, day of calibration.
*5 Operating conditions
Connector adapter, SM fiber (ITU-T G.652), APC connector, power level: 1 W (30 dBm)
CW light, wavelength: 980 ±1 nm, 1240 to 1340 nm, 1440 to 1640 nm
Ambient temperature: 23˚ ±5˚C, within 6 months after calibration
warm-up: 30 min
Uncertainty increase by 1% if either NA ≤0.29 fiber is used.
2 % added when wavelength besides above are used (However, humidity 60 % ±10 %)
*6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 1 W (+30 dBm) reference
Bandwidth: auto/1/10 Hz, warm-up: 30 min
*7 Only record measurements for measurement interval of ≤20 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth
*10 Specify connector for optical connector option supplied as standard accessory.
If connector not specified, FC (Option 37) supplied as standard.

• MA9901A Fiber Adapter

Fiber	ø250 µm strand (Clad diameter: ø125 mm)
Dimensions and mass	20 (W) x 22.5 (H) x 29.5 (D) mm, ≤30 g

Ordering information

Specify the model order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT9810B	Optical Test Set	
	Standard accessories	
W1886AE	MT9810B operation manual:	1 copy
W1887AE	MT9810B remote control operation manual:	1 copy
J0895	RCA short pin (for remote inter-lock):	1 pc
J0896	RCA plug (for remote inter-lock):	1 pc
Z0391	Key (for laser output control):	2 pcs
F0011	Fuse, 2 A (for 100 to 120 Vac):	2 pcs
F0008	Fuse, 1 A (for 200 to 240 Vac):	2 pcs
	Power cord, 2.6 m:	1 pc
B0425	Blank panel:	1 pc
	Application parts	
J0006	GPIB cable, 0.5 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0009	GPIB cable, 4 m	
J0655A	RS-232C cable (9P-25P, cross)	
J0654A	RS-232C cable (9P-9P, cross)	
J0897B	8P modular cable, 1 m	
J0897C	8P modular cable, 2 m	
J0897D	8P modular cable, 5 m	
J0897E	8P modular cable, 10 m	
B0438B	Rack mount Kit	
B0438	Rack mount Kit	
B0425	Blank panel	
B0427	Protect cover	
	[Light sources]	
	Main frame	
MU952501A	DFB-LD Light Source*1	
MU952502A	DFB-LD Light Source*1	
MU952503A	DFB-LD Light Source*1	
MU952504A	DFB-LD Light Source*1	
MU952505A	DFB-LD Light Source*1	
MU952601A	DFB-LD Light Source*1	
MU952602A	DFB-LD Light Source*1	
MU952603A	DFB-LD Light Source*1	
MU952604A	DFB-LD Light Source*1	
MU952605A	DFB-LD Light Source*1	
MU952606A	DFB-LD Light Source*1	
MU951301A	FP-LD Light Source	
MU951501A	FP-LD Light Source	
MU951001A	Switchable FP-LD Light Source	
	Standard accessory	
	Optical connector adapter*2	
	Options	
MU952501A-01	Light source (fp: 193.10 THz, 1552.52 nm)	
MU952501A-02	Light source (fp: 193.20 THz, 1551.72 nm)	
MU952501A-03	Light source (fp: 193.30 THz, 1550.92 nm)	
MU952501A-04	Light source (fp: 193.40 THz, 1550.12 nm)	
MU952501A-05	Light source (fp: 193.50 THz, 1549.32 nm)	
MU952501A-06	Light source (fp: 193.60 THz, 1548.51 nm)	
MU952501A-07	Light source (fp: 193.70 THz, 1547.72 nm)	
MU952501A-08	Light source (fp: 193.80 THz, 1546.92 nm)	
MU952501A-09	Light source (fp: 193.90 THz, 1546.12 nm)	
MU952501A-10	Light source (fp: 194.00 THz, 1545.32 nm)	
MU952502A-01	Light source (fp: 192.10 THz, 1560.61 nm)	
MU952502A-02	Light source (fp: 192.20 THz, 1559.79 nm)	
MU952502A-03	Light source (fp: 192.30 THz, 1558.98 nm)	
MU952502A-04	Light source (fp: 192.40 THz, 1558.17 nm)	
MU952502A-05	Light source (fp: 192.50 THz, 1557.36 nm)	
MU952502A-06	Light source (fp: 192.60 THz, 1556.55 nm)	
MU952502A-07	Light source (fp: 192.70 THz, 1555.75 nm)	
MU952502A-08	Light source (fp: 192.80 THz, 1554.94 nm)	
MU952502A-09	Light source (fp: 192.90 THz, 1554.13 nm)	
MU952502A-10	Light source (fp: 193.00 THz, 1553.33 nm)	
MU952503A-07	Light source (fp: 191.70 THz, 1563.86 nm)	
MU952503A-08	Light source (fp: 191.80 THz, 1563.05 nm)	
MU952503A-09	Light source (fp: 191.90 THz, 1562.23 nm)	
MU952503A-10	Light source (fp: 192.00 THz, 1561.42 nm)	
MU952504A-01	Light source (fp: 194.10 THz, 1544.53 nm)	
MU952504A-02	Light source (fp: 194.20 THz, 1543.73 nm)	
MU952504A-03	Light source (fp: 194.30 THz, 1542.94 nm)	
MU952504A-04	Light source (fp: 194.40 THz, 1542.14 nm)	
MU952504A-05	Light source (fp: 194.50 THz, 1541.35 nm)	
MU952504A-06	Light source (fp: 194.60 THz, 1540.56 nm)	
MU952504A-07	Light source (fp: 194.70 THz, 1539.77 nm)	
MU952504A-08	Light source (fp: 194.80 THz, 1538.98 nm)	
MU952504A-09	Light source (fp: 194.90 THz, 1538.19 nm)	

Model/Order No.	Name
MU952504A-10	Light source (fp: 195.00 THz, 1537.40 nm)
MU952505A-01	Light source (fp: 195.10 THz, 1536.61 nm)
MU952505A-02	Light source (fp: 195.20 THz, 1535.82 nm)
MU952505A-03	Light source (fp: 195.30 THz, 1535.04 nm)
MU952505A-04	Light source (fp: 195.40 THz, 1534.25 nm)
MU952505A-05	Light source (fp: 195.50 THz, 1533.47 nm)
MU952505A-06	Light source (fp: 195.60 THz, 1532.68 nm)
MU952505A-07	Light source (fp: 195.70 THz, 1531.90 nm)
MU952505A-08	Light source (fp: 195.80 THz, 1531.12 nm)
MU952505A-09	Light source (fp: 195.90 THz, 1530.33 nm)
MU952601A-01	Light source (fp: 191.10 THz, 1568.77 nm)
MU952601A-02	Light source (fp: 191.20 THz, 1567.95 nm)
MU952601A-03	Light source (fp: 191.30 THz, 1567.13 nm)
MU952601A-04	Light source (fp: 191.40 THz, 1566.31 nm)
MU952601A-05	Light source (fp: 191.50 THz, 1565.50 nm)
MU952601A-06	Light source (fp: 191.60 THz, 1564.68 nm)
MU952602A-01	Light source (fp: 190.10 THz, 1577.03 nm)
MU952602A-02	Light source (fp: 190.20 THz, 1576.20 nm)
MU952602A-03	Light source (fp: 190.30 THz, 1575.37 nm)
MU952602A-04	Light source (fp: 190.40 THz, 1574.54 nm)
MU952602A-05	Light source (fp: 190.50 THz, 1573.71 nm)
MU952602A-06	Light source (fp: 190.60 THz, 1572.89 nm)
MU952602A-07	Light source (fp: 190.70 THz, 1572.06 nm)
MU952602A-08	Light source (fp: 190.80 THz, 1571.24 nm)
MU952602A-09	Light source (fp: 190.90 THz, 1570.42 nm)
MU952602A-10	Light source (fp: 191.00 THz, 1569.59 nm)
MU952603A-01	Light source (fp: 189.10 THz, 1585.36 nm)
MU952603A-02	Light source (fp: 189.20 THz, 1584.53 nm)
MU952603A-03	Light source (fp: 189.30 THz, 1583.69 nm)
MU952603A-04	Light source (fp: 189.40 THz, 1582.85 nm)
MU952603A-05	Light source (fp: 189.50 THz, 1582.02 nm)
MU952603A-06	Light source (fp: 189.60 THz, 1581.18 nm)
MU952603A-07	Light source (fp: 189.70 THz, 1580.35 nm)
MU952603A-08	Light source (fp: 189.80 THz, 1579.52 nm)
MU952603A-09	Light source (fp: 189.90 THz, 1578.69 nm)
MU952603A-10	Light source (fp: 190.00 THz, 1577.86 nm)
MU952604A-01	Light source (fp: 188.10 THz, 1593.79 nm)
MU952604A-02	Light source (fp: 188.20 THz, 1592.95 nm)
MU952604A-03	Light source (fp: 188.30 THz, 1592.10 nm)
MU952604A-04	Light source (fp: 188.40 THz, 1591.26 nm)
MU952604A-05	Light source (fp: 188.50 THz, 1590.41 nm)
MU952604A-06	Light source (fp: 188.60 THz, 1589.57 nm)
MU952604A-07	Light source (fp: 188.70 THz, 1588.73 nm)
MU952604A-08	Light source (fp: 188.80 THz, 1587.88 nm)
MU952604A-09	Light source (fp: 188.90 THz, 1587.04 nm)
MU952604A-10	Light source (fp: 189.00 THz, 1586.20 nm)
MU952605A-01	Light source (fp: 187.10 THz, 1602.31 nm)
MU952605A-02	Light source (fp: 187.20 THz, 1601.46 nm)
MU952605A-03	Light source (fp: 187.30 THz, 1600.60 nm)
MU952605A-04	Light source (fp: 187.40 THz, 1599.75 nm)
MU952605A-05	Light source (fp: 187.50 THz, 1598.89 nm)
MU952605A-06	Light source (fp: 187.60 THz, 1598.04 nm)
MU952605A-07	Light source (fp: 187.70 THz, 1597.19 nm)
MU952605A-08	Light source (fp: 187.80 THz, 1596.34 nm)
MU952605A-09	Light source (fp: 187.90 THz, 1595.49 nm)
MU952605A-10	Light source (fp: 188.00 THz, 1594.64 nm)
MU952606A-03	Light source (fp: 186.30 THz, 1609.19 nm)
MU952606A-04	Light source (fp: 186.40 THz, 1608.33 nm)
MU952606A-05	Light source (fp: 186.50 THz, 1607.47 nm)
MU952606A-06	Light source (fp: 186.60 THz, 1606.60 nm)
MU952606A-07	Light source (fp: 186.70 THz, 1605.74 nm)
MU952606A-08	Light source (fp: 186.80 THz, 1604.88 nm)
MU952606A-09	Light source (fp: 186.90 THz, 1604.03 nm)
MU952606A-10	Light source (fp: 187.00 THz, 1603.17 nm)
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	Main frame
MU954501A	SLD Light Source
	Standard accessory
	Optical connector adapter*2
W2023AE	MU954501A instruction manual

Continued on next page

Model/Order No.	Name
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	[Optical sensor]
	Main frame
MU931311A	Optical Sensor
MU931421A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type with connector, RL >50 dB, SM), 2 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931422A	Optical Sensor (MA9005A Connector Adapter attached)
	Standard accessory
	Optical connector adapter (for MU931311A/931421A)*2
W1624AE	MU931422A operation manual
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901A	Fiber Adapter (for bare fiber)
MA9902A	Connector Adapter (for MA9901A)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type, with connector, RL >50 dB, SM), 2 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931431A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
W1896AE	MU931431A operation manual
	Applications parts
MA9005B-32	Connector adapter (MU, user replaceable)
MA9005B-33	Connector adapter (LC, user replaceable)
MA9005B-37	Connector adapter (FC, user replaceable)
MA9005B-38	Connector adapter (ST, user replaceable)
MA9005B-39	Connector adapter (DIN, user replaceable)
MA9005B-40	Connector adapter (SC, user replaceable)
MA9005B-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901B	Fiber Adapter (for bare fiber)
MA9902B	Connector Adapter (for MA9901B)
J0178A	AG adapter
J0952A	Conversion cord (FC · PC-FC · APC), 1 m
J0954A	Conversion cord (SC · PC-SC · APC), 1 m

Model/Order No.	Name
	Main frame
MA9331A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
MA9008A-32	Connector adapter (MU, user replaceable)
MA9008A-33	Connector adapter (LC, user replaceable)
MA9008A-37	Connector adapter (FC, user replaceable)
MA9008A-38	Connector adapter (ST, user replaceable)
MA9008A-39	Connector adapter (DIN, user replaceable)
MA9008A-40	Connector adapter (SC, user replaceable)
MA9008A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter
MA9901B	Fiber Adapter
MA9903A	Connector Adapter (for MA9901B)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	Main frame
MA9332A	Optical Sensor
MA9333A	Optical Sensor
	Standard accessory
	Optical connector adapter*2
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
MA9901A	Fiber Adapter (for bare fiber)
MA9902A	Connector Adapter (for MA9901A)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	[Sensor adapter]
	Main frame
MU931002A	Sensor Adapter
	Standard accessory
J1073A	Optical sensor connect cable, 1.5 m
	Applications parts
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Optical connector options
	(for light sources and optical sensors)
[Model]-32	MU connector (user replaceable)
[Model]-33	LC connector (user replaceable)
[Model]-37	FC connector (user replaceable)
[Model]-38	ST connector (user replaceable)
[Model]-39	DIN connector (user replaceable)
[Model]-40	SC connector (user replaceable)
[Model]-43	HMS-10/A connector (user replaceable)

*1: Specify an optical frequency (wavelength) and model name when ordering.
*2: When ordering, the option specified connector is supplied as standard. Specified the option number after the light source or optical sensor model number. If a connector is not specified, a FC (Option 37) connector is supplied as standard. These are applied to DFB-LD unit, FP-LD unit, SLD unit and optical sensor. However, MU and LC connecter option are only apply to MU931422A, MA9331A, MA9332A and MA9333A.

MULTI CHANNEL BOX
MT9812B

GPIB

For Adding Light Sources and Optical Sensors for Maximum of 9 Channels

The MT9812B is a mainframe supporting devices such as DFB-LD multiple light sources and multi-channel device evaluation systems. A maximum of 9 MT9810B compatible light sources (DFB-LD, FP-LD, SLD) and optical sensor units can be inserted. In addition to being able to set and verify setting conditions for each unit on the front panel, a remotely controlled measurement system can be supported as GPIB and RS-232C interfaces are standard equipment.

Comparison of the features of MT9810B and MT9812B

	Functions	MT9810B	MT9812B
Main frame	Number of channels	2	9
	Remote functions	√	√
	Date/time setting	√	
	Optical channel selector control	√	
	Laser safety protection mechanism	√	√
Optical sensor	Measuring power display	√	√
	Measuring range	√	Can be set remotely
	BW/interval	√	Can be set remotely
	Averaging	√	Can be set remotely
	Optical modulation mode	√	Can be set remotely
	Max/min value memory	√	
	Measurement condition/measuring value saving	√	
	Relative measurement	√	
	Reference measurement	√	
	Calibration measurement	√	
	Wavelength calibration	√	√
	Unit*	√	√
	Sensor head*	√	
DFB-LD	Attenuation	√	√
	Variable wavelength	√	√
	Modulation frequency	√	Can be set remotely
FP-LD	Attenuation	√	√
	Modulation frequency	√	Can be set remotely
	Changed wavelength (2 wavelength unit)	√	√
SLD	Modulation frequency	√	Can be set remotely

* Unit: MU931311A, MU931421A, MU931422A, MU931431A
Sensor head: MA9331A, MA9332A, MA9333A

Specifications

• MT9812B Multi Channel Box

Plug-in units*1	9 max.
Display	7 segments LED, 7 digits (sign: 1 digit, numerical value: 6 digits)
Remote control	GPIB, RS-232C
Laser safety mechanism	Remote inter-lock, optical output control (key control)
Environmental conditions	Operating temperature/humidity*2: 0˚ to 40˚C/≤90% (no condensation) Storage temperature: –30˚ to +71˚C
Power	85 to 132/170 to 250 Vac, 47.5 to 63 Hz, ≤250 VA
Dimensions and mass	426 (W) x 133 (H) x 451 (D) mm, ≤9 kg (without units)
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Only one MU951001A can be installed into MT9812B
*2: Narrowest temperature range of the plug-in units or MT9812B

• DFB-LD light sources

Model	MU952501A/952502A/952503A/952504A/952505A	MU952601A/952602A/952603A/952604A/952605A/952606A
Optical element	DFB-LD	
Applicable optical fiber	SM (ITU-T G.652)	
Specified wavelength range (fp)*1	191.7 to 195.9 THz (1563.86 to 1530.33 nm)	186.3 to 191.6 THz (1609.19 to 1564.68 nm)
Center optical frequency*2	fp ±0.01 THz (approx. ±0.08 nm)	
Spectrum half width*2	≤30 MHz	
Optical output power*2	+10 ±1 dBm	+7 ±1 dBm
Optical power stability	Time stability (short term)*2, *3, *4: ≤±0.005 dB Time stability (long term)*2, *3, *5: ≤±0.02 dB Temperature stability*2, *3, *6: ≤±0.25 dB	Time stability (short term)*2, *3, *4: ≤±0.01 dB Time stability (long term)*2, *3, *5: ≤±0.02 dB Temperature stability*2, *3, *6: ≤±0.25 dB
Center frequency stability	Time stability (short term)*2, *4: ≤±2 GHz (approx. ±0.02 nm) Time stability (long term)*2, *5: ≤±4 GHz (approx. ±0.04 nm)	
Optical frequency tuning	Tuning range: fp ±60 GHz (approx. ±0.48 nm), Step: 1 GHz (approx. 0.01 nm) Accuracy*2: ≤±10 GHz (setting to fp + 60 GHz or fp – 60 GHz, 25˚C)	
Internal modulation	Frequency*2: 270 Hz, 1 kHz, 2 kHz ±0.1% Duty: 50% ±5%, Extinction ratio: ≥13 dB	
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)	
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb	
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC*7	
Warm-up time	1 h (after optical output on)	
Environmental conditions	Operating temperature/humidity: +15˚ to +35˚C/≤90% (no condensation); Storage temperature: –25˚ to +71˚C	
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	

Note: Wavelengths in vacuum
*1: Specify an optical frequency (wavelength) and model name from the ordering information.
*2: At CW, optical attenuation setting (0.00 dB), center optical frequency (fp) using SM fiber (ITU-T G.652) and FC-PC connector
*3: When return loss seen from light source side is 40 dB min.
*4: 5 min at constant temperature (at one point from +20˚ to +30˚C)
*5: 1 h at constant temperature
*6: 8 h at +15˚ to +35˚C
*7: Specified connector for optical connector option supplied as standard accessory.
If connector not specified, FC (Option 37) supplied as standard.

• FP-LD light sources

Model	MU951301A	MU951501A	MU951001A*1
Optical element	FP-LD		
Fiber	SM fiber (ITU-T G.652)		
Wavelength*2	1310 ±20 nm	1550 ±20 nm	1310/1550 ±20 nm
Spectral half-width*2	≤5 nm	≤10 nm	≤5 nm (1310 nm), ≤10 nm (1550 nm)
Optical output power*2	+7 ±1 dBm		
Optical output power stability	Time stability (short term)*2, *3, *4: ≤±0.002 dB Time stability (long term)*2, *3, *5: ≤±0.02 dB Temperature stability*2, *3, *6: ≤±0.1 dB		Time stability (short term)*2, *3, *4: ≤±0.005 dB Time stability (long term)*2, *3, *5: ≤±0.05 dB Temperature stability*2, *3, *6: ≤±0.15 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB		
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)		
Laser safety mechanism	IEC60825-1: Class 3A, 21CFR1040.10: Class IIIb		
Optical connector	FC-PC, ST, DIN, HMS-10/A, SC*7		

Continued on next page

Model	MU951301A	MU951501A	MU951001A*1
Warm-up time	1 h (after optical output on)		
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); Storage Temperature: –25˚ to +71˚C		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g		

Note: Wavelengths in vacuum
∗1: Only one MU951001A can be installed into MT9812B.
∗2: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
∗3: When return loss seen from light source side is 40 dB min.
∗4: 15 min at constant temperature (at one point from +20˚ to +30˚C)
∗5: 6 h at constant temperature
∗6: 8 h at 0˚ to +50˚C
∗7: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• MU954501A Light Source (SLD)

Optical element	SLD
Fiber	SM fiber (ITU-T G.652)
Wavelength*1	1550 ±20 nm
Spectral half-width*1	≥40 nm
Optical output power*1	–3 ±1 dBm
Optical output power stability	Time stability (short term)*1, *2, *3: ≤±0.01 dB Time stability (long term)*1, *2, *4: ≤±0.1 dB Temperature stability*1, *2, *5: ≤±0.5 dB
Internal modulation	Frequency: 270 Hz, 1 kHz, 2 kHz ±0.1%, Duty: 50% ±5%, Extinction ratio: ≥13 dB
Optical output attenuation	0.00 to 6.00 dB (0.01 dB steps), Accuracy: ≤±0.5 dB (at 25˚C when set to 6.00 dB)
Laser safety mechanism	JIS, IEC60825-1: Class 1, 21CFR1040.10: Class I
Optical connector*6	FC, ST, DIN, HMS-10/A, SC (all PC type)
Warm-up time	1 h (after optical output on)
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation) Storage Temperature: –40˚ to +71˚C
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g

Note: Wavelengths in vacuum, please contact us for 1310 nm SLD light source.
∗1: At CW, optical attenuation setting (0.00 dB), using SM fiber (ITU-T G.652) and FC-PC connector
∗2: When return loss seen from light source side is 40 dB min.
∗3: 15 min at constant temperature
∗4: 6 h at constant temperature
∗5: 8 h at 0˚ to +50˚C
∗6: Specified connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• Optical sensors

Model	MU931311A	MU931421A	MU931422A
Element	InGaAs-PD		
Input type	Fiber		
Applicable optical fiber	SM (ITU-T G.652)		9/125 to 62.5/125 µm (NA: ≤0.29)
Wavelength range	800 to 1600 nm	750 to 1700 nm	
Optical power measurement range*1	CW: +10 to –110 dBm MOD: +7 to –90 dBm	CW: +10 to –80 dBm MOD: +7 to –90 dBm	
Noise level*2	≤–93 dBm	≤–73 dBm	
Polarization dependency*3	≤0.02 dB		≤0.05 dB
Return loss*3	≥40 dB		–
Optical power measurement uncertainty	Reference conditions*4: ±2%, Operating conditions*5: ±3.5%		
Linearity*6	±0.05 dB (+10 to 0 dBm), ±0.01 dB ±0.3 pW (–90 to 0 dBm)	±0.05 dB (+10 to 0 dBm), ±0.01 dB ±30 pW (–70 to 0 dBm)	
Calibration factor input	–99.999 to +99.999 dB		
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units		
Zero set operation	Automatic zero calibration		
Range select	Auto, manual		
Modulated light reception	CW/MOD selectable, MOD: 270 Hz, 1 kHz, 2 kHz		
Measurement interval*7	1, 10, 20, 50, 100, 200, 500 ms, 1 s to 99 h 59 min 59 s		
Average setting	Off, 2, 5, 10, 20, 50, 100, 200, 500, 1000 times		
Analog output*8	Approx. +2 V		
Bandwidth select*9	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10, 100 kHz (CW mode only)	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 10 kHz (CW mode only)	
Optical connector*10	FC-PC, ST, DIN, HMS-10/A, SC		
Environmental conditions	Operating temperature/humidity: 0˚ to +50˚C/≤90% (no condensation); storage: –40˚ to +71˚C		
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤700 g	41 (W) x 78 (H) x 335 (D) mm, ≤550 g	

*1 Wavelength: 1300 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1300 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions
SM fiber (ITU-T G.652), master FC connector
Power level: 100 µW (–10 dBm), CW light, wavelength: 1300 nm, ambient temperature: 23˚ ±2˚C
At day of calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*5 Operating conditions
SM Fiber (ITU-T G.652), master FC connector, CW light, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), power level: 100 µW (–10 dBm), ambient temperature: 23˚ ±5˚C, within 1 year after calibration, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A), Uncertainty increase by 1% if either a fiber other than a SM fiber (ITU-T G.652) or an APC connector is used with the MU931422A.
*6 Measurement conditions: Constant temperature within 23˚ ±5˚C, bandwidth: auto/0.1/1/10 Hz, any wavelength in 1000 to 1600 nm (MU931311A) and 1000 to 1650 nm (MU931421A/931422A), CW light, power level: 100 µW (–10 dBm) reference, warm-up: 1 h (MU931311A) and 30 min (MU931421A/931422A)
*7 Only record measurements for measurement interval of ≤100 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth. Response time at bandwidth setting of 100 kHz varies according to analog output amplitude
*10 Specify connector for optical connector option supplied as standard accessory. If connector not specified, FC (Option 37) supplied as standard.

• MU931431A Optical Sensor (high-power)

Element	InGaAs-PD
Input type	Fiber
Applicable optical fiber	9/125 to 62.5/125 µm (NA: ≤0.29), PC, APC polish conformity
Wavelength range	940 to 1640 nm
Optical power measurement range*1	CW: +33 to –50 dBm
Noise level*2	≤–43 dBm
Polarization dependency*3	PC connector: ≤±0.025 dB, APC connector: ≤±0.05 dB
Optical power measurement accuracy	Reference conditions*4: ±4% Operating conditions*5: ±5%
Linearity*6	±0.05 dB ±30 nW (+33 to –40 dBm)
Zero set operation	Automatic zero calibration
Wavelength sensitivity correction	Measurement wavelength input in 0.01 nm units
Measurement interval*7	1 ms to 99 h 59 min 59 s
Average setting	2 to 1000 times
Analog output*8	Approx. +2 V
Bandwidth select*9	Auto, manual Manual setting: 0.1, 1, 10, 100 Hz, 1, 20 kHz
Optical connector*10	FC, ST, DIN, HMS-10/A, SC, MU, LC
Environmental conditions	Operating temperature/humidity: 0˚ to +40˚C/≤90% (no condensation) Storage temperature/humidity: –40˚ to +71˚C/≤95% (no condensation)
Dimensions and mass	41 (W) x 78 (H) x 335 (D) mm, ≤880 g

*1 Wavelength: 1550 nm
*2 Measurement interval: 100 ms, average: 10 times, peak to peak noise, wavelength: 1550 nm
*3 SM fiber (ITU-T G.652), return loss: ≥45 dB, wavelength: 1550 nm
*4 Reference conditions,
Connector adapter, SM fiber (ITU-T.G.652), APC connector
Power level 1 W (+30 dBm), CW light, and wavelength 1550 nm
Ambient temperature 23˚ ±2˚C, humidity 60 % ±10 %
Warm-up time 30 minutes, day of calibration.
*5 Operating conditions
Connector adapter, SM fiber (ITU-T G.652), APC connector, power level: 1 W (30 dBm)
CW light, wavelength: 980 ±1 nm, 1240 to 1340 nm, 1440 to 1640 nm
Ambient temperature: 23˚ ±5˚C, within 6 months after calibration
warm-up: 30 min
Uncertainty increase by 1% if either NA ≤0.29 fiber is used.
2 % added when wavelength besides above are used (However, humidity 60 % ±10 %)
*6 Measurement conditions
Constant temperature within 23˚ ±5˚C, any wavelength in 1000 to 1650 nm, CW light, power level: 1 W (+30 dBm) reference
Bandwidth: auto/0.1/1/10 Hz, warm-up: 30 min
*7 Only record measurements for measurement interval of ≤20 ms
*8 Full-scale value for each measurement range
*9 Approx. 3 dB bandwidth
*10 Specify connector for optical connector option supplied as standard accessory.
If connector not specified, FC (Option 37) supplied as standard.

Ordering information

Please specify the model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT9812B	Multi Channel Box	
	Standard accessories	
J0895	RCA short pin (for remote inter-rock):	1 pc
J0896	RCA plug (for remote inter-rock):	1 pc
Z0391	Key (for laser output control):	2 pcs
F0013	Fuse, 5 A (for 100/200 Vac):	2 pcs
	Power cord, 2.6 m:	1 pc
B0425	Blank panel:	8 pcs
W1555AE	MT9812B operation manual:	1 copy
	Option	
MT9812B-01	High power sensor option (for MU931431A)	
	Application parts	
J0006	GPIB cable, 0.5 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0009	GPIB cable, 4 m	
J0655A	RS-232C cable (9P-25P, cross)	
J0654A	RS-232C cable (9P-9P, cross)	
	[Light sources]	
	Main frame	
MU952501A	DFB-LD Light Source*1	
MU952502A	DFB-LD Light Source*1	
MU952503A	DFB-LD Light Source*1	
MU952504A	DFB-LD Light Source*1	
MU952505A	DFB-LD Light Source*1	
MU952601A	DFB-LD Light Source*1	
MU952602A	DFB-LD Light Source*1	
MU952603A	DFB-LD Light Source*1	
MU952604A	DFB-LD Light Source*1	
MU952605A	DFB-LD Light Source*1	
MU952606A	DFB-LD Light Source*1	
MU951301A	FP-LD Light Source	
MU951501A	FP-LD Light Source	
MU951001A	Switchable FP-LD Light Source	
	Standard accessory	
	Optical connector adapter*2	
	Options	
MU952501A-01	Light source (fp: 193.10 THz, 1552.52 nm)	
MU952501A-02	Light source (fp: 193.20 THz, 1551.72 nm)	
MU952501A-03	Light source (fp: 193.30 THz, 1550.92 nm)	
MU952501A-04	Light source (fp: 193.40 THz, 1550.12 nm)	
MU952501A-05	Light source (fp: 193.50 THz, 1549.32 nm)	
MU952501A-06	Light source (fp: 193.60 THz, 1548.51 nm)	
MU952501A-07	Light source (fp: 193.70 THz, 1547.72 nm)	
MU952501A-08	Light source (fp: 193.80 THz, 1546.92 nm)	
MU952501A-09	Light source (fp: 193.90 THz, 1546.12 nm)	
MU952501A-10	Light source (fp: 194.00 THz, 1545.32 nm)	
MU952502A-01	Light source (fp: 192.10 THz, 1560.61 nm)	
MU952502A-02	Light source (fp: 192.20 THz, 1559.79 nm)	
MU952502A-03	Light source (fp: 192.30 THz, 1558.98 nm)	
MU952502A-04	Light source (fp: 192.40 THz, 1558.17 nm)	
MU952502A-05	Light source (fp: 192.50 THz, 1557.36 nm)	
MU952502A-06	Light source (fp: 192.60 THz, 1556.55 nm)	
MU952502A-07	Light source (fp: 192.70 THz, 1555.75 nm)	
MU952502A-08	Light source (fp: 192.80 THz, 1554.94 nm)	
MU952502A-09	Light source (fp: 192.90 THz, 1554.13 nm)	
MU952502A-10	Light source (fp: 193.00 THz, 1553.33 nm)	
MU952503A-07	Light source (fp: 191.70 THz, 1563.86 nm)	
MU952503A-08	Light source (fp: 191.80 THz, 1563.05 nm)	
MU952503A-09	Light source (fp: 191.90 THz, 1562.23 nm)	
MU952503A-10	Light source (fp: 192.00 THz, 1561.42 nm)	
MU952504A-01	Light source (fp: 194.10 THz, 1544.53 nm)	
MU952504A-02	Light source (fp: 194.20 THz, 1543.73 nm)	
MU952504A-03	Light source (fp: 194.30 THz, 1542.94 nm)	
MU952504A-04	Light source (fp: 194.40 THz, 1542.14 nm)	
MU952504A-05	Light source (fp: 194.50 THz, 1541.35 nm)	
MU952504A-06	Light source (fp: 194.60 THz, 1540.56 nm)	
MU952504A-07	Light source (fp: 194.70 THz, 1539.77 nm)	
MU952504A-08	Light source (fp: 194.80 THz, 1538.98 nm)	

Model/Order No.	Name
MU952504A-09	Light source (fp: 194.90 THz, 1538.19 nm)
MU952504A-10	Light source (fp: 195.00 THz, 1537.40 nm)
MU952505A-01	Light source (fp: 195.10 THz, 1536.61 nm)
MU952505A-02	Light source (fp: 195.20 THz, 1535.82 nm)
MU952505A-03	Light source (fp: 195.30 THz, 1535.04 nm)
MU952505A-04	Light source (fp: 195.40 THz, 1534.25 nm)
MU952505A-05	Light source (fp: 195.50 THz, 1533.47 nm)
MU952505A-06	Light source (fp: 195.60 THz, 1532.68 nm)
MU952505A-07	Light source (fp: 195.70 THz, 1531.90 nm)
MU952505A-08	Light source (fp: 195.80 THz, 1531.12 nm)
MU952505A-09	Light source (fp: 195.90 THz, 1530.33 nm)
MU952601A-01	Light source (fp: 191.10 THz, 1568.77 nm)
MU952601A-02	Light source (fp: 191.20 THz, 1567.95 nm)
MU952601A-03	Light source (fp: 191.30 THz, 1567.13 nm)
MU952601A-04	Light source (fp: 191.40 THz, 1566.31 nm)
MU952601A-05	Light source (fp: 191.50 THz, 1565.50 nm)
MU952601A-06	Light source (fp: 191.60 THz, 1564.68 nm)
MU952602A-01	Light source (fp: 190.10 THz, 1577.03 nm)
MU952602A-02	Light source (fp: 190.20 THz, 1576.20 nm)
MU952602A-03	Light source (fp: 190.30 THz, 1575.37 nm)
MU952602A-04	Light source (fp: 190.40 THz, 1574.54 nm)
MU952602A-05	Light source (fp: 190.50 THz, 1573.71 nm)
MU952602A-06	Light source (fp: 190.60 THz, 1572.89 nm)
MU952602A-07	Light source (fp: 190.70 THz, 1572.06 nm)
MU952602A-08	Light source (fp: 190.80 THz, 1571.24 nm)
MU952602A-09	Light source (fp: 190.90 THz, 1570.42 nm)
MU952602A-10	Light source (fp: 191.00 THz, 1569.59 nm)
MU952603A-01	Light source (fp: 189.10 THz, 1585.36 nm)
MU952603A-02	Light source (fp: 189.20 THz, 1584.53 nm)
MU952603A-03	Light source (fp: 189.30 THz, 1583.69 nm)
MU952603A-04	Light source (fp: 189.40 THz, 1582.85 nm)
MU952603A-05	Light source (fp: 189.50 THz, 1582.02 nm)
MU952603A-06	Light source (fp: 189.60 THz, 1581.18 nm)
MU952603A-07	Light source (fp: 189.70 THz, 1580.35 nm)
MU952603A-08	Light source (fp: 189.80 THz, 1579.52 nm)
MU952603A-09	Light source (fp: 189.90 THz, 1578.69 nm)
MU952603A-10	Light source (fp: 190.00 THz, 1577.86 nm)
MU952604A-01	Light source (fp: 188.10 THz, 1593.79 nm)
MU952604A-02	Light source (fp: 188.20 THz, 1592.95 nm)
MU952604A-03	Light source (fp: 188.30 THz, 1592.10 nm)
MU952604A-04	Light source (fp: 188.40 THz, 1591.26 nm)
MU952604A-05	Light source (fp: 188.50 THz, 1590.41 nm)
MU952604A-06	Light source (fp: 188.60 THz, 1589.57 nm)
MU952604A-07	Light source (fp: 188.70 THz, 1588.73 nm)
MU952604A-08	Light source (fp: 188.80 THz, 1587.88 nm)
MU952604A-09	Light source (fp: 188.90 THz, 1587.04 nm)
MU952604A-10	Light source (fp: 189.00 THz, 1586.20 nm)
MU952605A-01	Light source (fp: 187.10 THz, 1602.31 nm)
MU952605A-02	Light source (fp: 187.20 THz, 1601.46 nm)
MU952605A-03	Light source (fp: 187.30 THz, 1600.60 nm)
MU952605A-04	Light source (fp: 187.40 THz, 1599.75 nm)
MU952605A-05	Light source (fp: 187.50 THz, 1598.89 nm)
MU952605A-06	Light source (fp: 187.60 THz, 1598.04 nm)
MU952605A-07	Light source (fp: 187.70 THz, 1597.19 nm)
MU952605A-08	Light source (fp: 187.80 THz, 1596.34 nm)
MU952605A-09	Light source (fp: 187.90 THz, 1595.49 nm)
MU952605A-10	Light source (fp: 188.00 THz, 1594.64 nm)
MU952606A-03	Light source (fp: 186.30 THz, 1609.19 nm)
MU952606A-04	Light source (fp: 186.40 THz, 1608.33 nm)
MU952606A-05	Light source (fp: 186.50 THz, 1607.47 nm)
MU952606A-06	Light source (fp: 186.60 THz, 1606.60 nm)
MU952606A-07	Light source (fp: 186.70 THz, 1605.74 nm)
MU952606A-08	Light source (fp: 186.80 THz, 1604.88 nm)
MU952606A-09	Light source (fp: 186.90 THz, 1604.03 nm)
MU952606A-10	Light source (fp: 187.00 THz, 1603.17 nm)
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)

Continued on next page

Model/Order No.	Name
	[Light source]
	Main frame
MU954501A	Light Source (SLD)[*3]
	Standard accessories
J0617B	Optical connector adapter[*3]
W2023AE	MU954501A instruction manual: 1 copy
	Optical connector options
MU954501A-37	FC connector
MU954501A-38	ST connector
MU954501A-39	DIN connector
MU954501A-40	SC connector
MU954501A-43	HMS-10/A connector
	Application parts
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
	[Optical sensor]
	Main frame
MU931311A	Optical Sensor
MU931421A	Optical Sensor
	Standard accessory
	Optical connector adapter[*2]
	Applications parts
J0617B	Replaceable optical connector (FC, user replaceable)
J0618D	Replaceable optical connector (ST, user replaceable)
J0618E	Replaceable optical connector (DIN, user replaceable)
J0618F	Replaceable optical connector (HMS-10/A, user replaceable)
J0619B	Replaceable optical connector (SC, user replaceable)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type with connector, RL >50 dB, SM), 2 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)
	Main frame
MU931422A	Optical Sensor (MA9005A Connector Adapter attached)
	Standard accessory
	Optical connector adapter (for MU931311B/931421B)[*2]
W1624AE	MU931422B operation manual
	Applications parts
MA9005A-32	Connector adapter (MU, user replaceable)
MA9005A-33	Connector adapter (LC, user replaceable)
MA9005A-37	Connector adapter (FC, user replaceable)
MA9005A-38	Connector adapter (ST, user replaceable)
MA9005A-39	Connector adapter (DIN, user replaceable)
MA9005A-40	Connector adapter (SC, user replaceable)
MA9005A-43	Connector adapter (HMS-10/A, user replaceable)
MA9013A	Fiber Adapter (for bare fiber)
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J0635B	Optical fiber cord (both-end FC-PC type, with connector, RL >50 dB, SM), 2 m
B0444A	Cap R
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0003A	Coaxial cord (SMA-P · 3D-2W · SMA-P), 1 m
J0901A	HRM-517 (09) conversion connector (SMA-P · BNC-J)
J0902A	HRM-518 (09) conversion connector (SMA-J · BNC-P)

Model/Order No.	Name
	Main frame
MU931431A	Optical Sensor
	Standard accessory
	Optical connector adapter[*2]
W1896AE	MU931431A operation manual
	Applications parts
MA9005B-32	Connector adapter (MU, user replaceable)
MA9005B-33	Connector adapter (LC, user replaceable)
MA9005B-37	Connector adapter (FC, user replaceable)
MA9005B-38	Connector adapter (ST, user replaceable)
MA9005B-39	Connector adapter (DIN, user replaceable)
MA9005B-40	Connector adapter (SC, user replaceable)
MA9005B-43	Connector adapter (HMS-10/A, user replaceable)
J1078A	AG adapter
	Optical connector options (for light sources and optical sensors)
[Model]-32	MU connector (user replaceable)
[Model]-33	LC connector (user replaceable)
[Model]-37	FC connector (user replaceable)
[Model]-38	ST connector (user replaceable)
[Model]-39	DIN connector (user replaceable)
[Model]-40	SC connector (user replaceable)
[Model]-43	HMS-10/A connector (user replaceable)

*1: Specify an optical frequency (wavelength) and model name when ordering.

*2: When ordering, the option specified connector is supplied as standard. Specified the option number after the light source or optical sensor model number. If a connector is not specified, a FC (Option 37) connector is supplied as standard. These are applied to DFB-LD unit, FP-LD unit, SLD unit and optical sensor. However, MU and LC connecter option are only apply to MU931422B, MA9331A, MA9332A and MA9333A.

*3: Connector for specified options at ordering supplied as standard. Specify by appending number after model. If connector not specified, FC (Option 37) supplied as standard.

ACCESS MASTER™

MT9080 Series

1.31/1.55/1.65 µm (SM)

All-New Field Measuring Instrument Integrating Functions Required for FTTx Optical Fiber Installation and Maintenance in One Unit

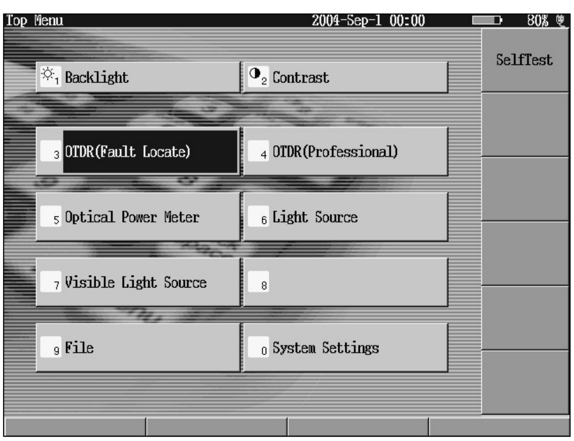
NEW

- SM 1310 nm/1550 nm/1650 nm OTDR for optical fiber installation and maintenance
- Functions and performance supporting FTTx (FTTB, FTTC, FTTH, PON)
- Short dead zone of 1 m (event)
- Light source and optical power meter function provided as standard
- Effective Performance and Functions for Installation and Maintenance of Optical Fibers

User-friendly operation & all-in-one

• Simple operation from the top menu

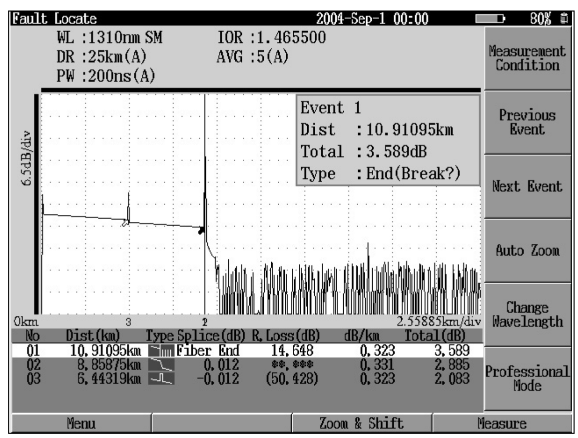
The top menu shown below appears when the MT9080 Series ACCESS Master is activated. You can return to this screen any time by pressing the top menu button (panel key) even if the measurement window is displayed in the selection area. Necessary test items for the user can therefore be executed smoothly.



• Easily identifies failure location with enhanced maintenance function

If a failure occurs, the failure location should be identified immediately and recovery should be made as soon as possible. The MT9080 Series ACCESS Master offers a fault failure locate mode for identifying the failure location easily.

A pulse test is automatically started by pressing the measurement button, and the failure location is displayed enlarged on the screen.



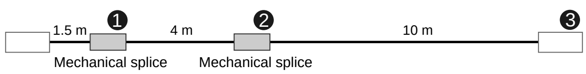
• Provides light source and optical power meter functions as standard, as well as optionally available visible light source

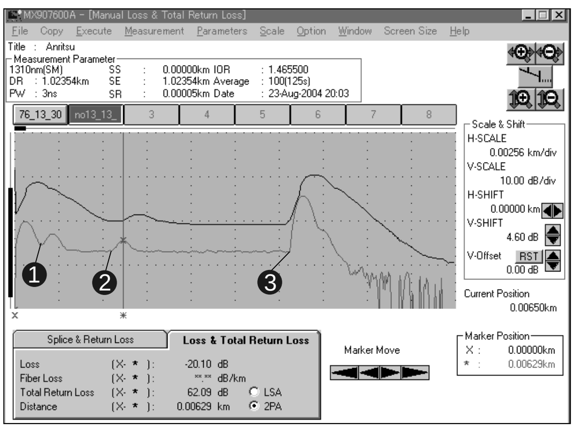
The concept of the MT9080 Series ACCESS Master is to support the functions required for optical fiber installation and maintenance as standard. The MT9080 Series ACCESS Master comes equipped with a light source for fiber identification and an optical power meter function as standard. Together with the optional visible light source, optical fiber installation and maintenance are supported with only one MT9080 Series unit.

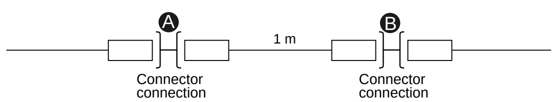
Short dead zone

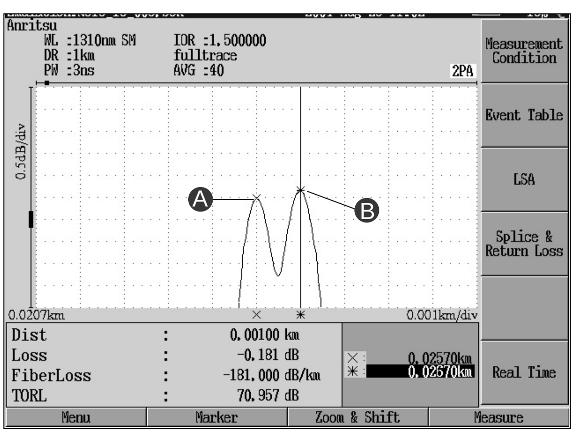
• Short dead zone of 1 m (event) Effective for FTTx

The MT9080 Series ACCESS Master has achieved an event dead zone of 1 m and a high sampling resolution of 5 cm, so the connection status in a building and the failure location, which were hard to analyze, can be analyzed and identified.
This OTDR is small but has a high performance.









Compact, lightweight, and convenient functions

• Compactness, lightweight (2.2 kg), and non-HDD

One of the requirements for field measuring instruments is that they can be carried into any field location such as the top of a telephone pole or in a manhole; in other words, they must be able to be used in any measurement location. The MT9080 Series ACCESS Master is smaller and lighter than the traditional MW9076 Series. The user can concentrate on measurement without worrying about the measurement location. Further, the MT9080 Series ACCESS Master is a non-hard-disk measuring instrument, so the system is not started from the hard disk. Stable operation is thus ensured regardless of shock and vibration. Since this compact unit can be brought into any field location, the MT9080 Series ACCESS Master can accommodate sudden problems and support installation and maintenance of optical fibers to the customer's satisfaction. The MT9080 Series ACCESS Master is handy and convenient in the field.

• Dynamic range supporting FTTx

The MT9080 Series ACCESS Master realizes a dynamic range performance for installation and maintenance of optical fibers up to approximately 50 km.

• High-speed starting for 15 or less seconds

The MT9080 Series ACCESS Master has realized high-speed starting. It is 15 or less seconds until a top menu is displayed from a power supply injection. Therefore, it puts into work, without waiting.

• Telcordia format (SR-4731) supported

The Telcordia format (SR-4731), the common format for OTDRs, is supported.

• More than 1,000 waveforms recordable in the internal memory; more than 30,000 waveforms recordable with an additional USB memory*1

The MT9080 Series ACCESS Master can record files of more than 1,000 waveforms in the internal memory. If a USB memory is inserted into the USB port, files of more than 30,000 waveforms*1 can be recorded.

*1: When a 512 MB USB memory is used.

• Communication light check

If the fiber being tested contains communication light, the OTDR cannot perform measurement successfully. Also, the pulse light from the OTDR may damage the receiver of a system such as WDM or PON that performs transmission and reception through one fiber.
The MT9080 Series ACCESS Master executes a communication light check before emitting a pulse, and displays the check result on the screen. This function is provided to ensure normal measurement and protect communication system.

• Waveform comparison function

Measurement data is compared with the saved data by reading it. If measurement data is compared with the data provided when the optical fiber was installed, this function can be used to check aging and identify the failure location in the event of a failure.

• Warning level setting function

Events of loss and reflection at or above the set level are highlighted in the event table. At a glance, whether the line is acceptable can be identified when connection loss at each point is evaluated in installation or maintenance of the optical fiber.

• Emulation software MX907600A

This PC software is used to analyze and edit the recorded data on a Windows-based PC in the office. A report can also be created.

Specifications

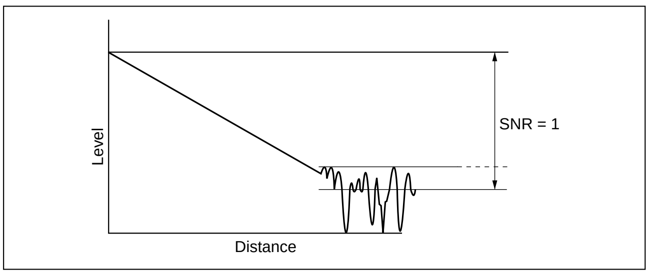
• ACCESS Master (main frame)

Model	MT9080A	MT9080B	MT9080C	MT9080D	MT9080E	MT9080F
Wavelength	1310 ±30 nm*1	1550 ±30 nm*1	1645 to 1655 nm*1,*2	1310/1550 ±30 nm*1	1550 ±30 nm/ 1645 to 1655 nm*1,*2	1310/1550 ±30 nm/ 1645 to 1655 nm*1,*2
Measurable optical fiber	10/125 µm single-mode optical fiber (ITU-T G.652)					
Optical connector	FC, SC, DIN, HMS-10/A, ST, LC (replaceable, PC type); FC, SC (APC type)					
Distance range	0.5, 1, 2.5, 5, 10, 25, 50 km					
Pulse width	3 ns, 20 ns, 50 ns, 100 ns, 200 ns, 500 ns, 1 µs, 2 µs					
Dynamic range*3,*4,*5 (S/N = 1)	26.5 dB (1.31 µm)	25 dB (1.55 µm)	22 dB (1.65 µm)	26 dB (1.31 µm) 24.5 dB (1.55 µm)	24.5 dB (1.55 µm) 22 dB (1.65 µm)	25.5 dB (1.31 µm) 24 dB (1.55 µm) 22 dB (1.65 µm)
Dead zone*6 (back-scattered light) (IOR = 1.500000)	≤7.5 m (1.31 µm)	≤8.5 m (1.55 µm)	≤11 m (1.65 µm)	≤7.5 m (1.31 µm) ≤8.5 m (1.55 µm)	≤8.5 m (1.55 µm) ≤11 m (1.65 µm)	≤7.5 m (1.31 µm) ≤8.5 m (1.55 µm) ≤11 m (1.65 µm)
Dead zone*7 (Fresnel reflection) (IOR = 1.500000)	≤1 m ≤0.8 m (Typ.)					
Marker resolution (IOR = 1.500000)	0.05 to 100 m					
Sampling resolution (IOR = 1.500000)	0.05 to 10 m					
Sampling points	Normal: 5001 High density: 20001 or 25001*8					
Y-axis scale	0.05, 0.125, 0.25, 0.5, 1.25, 2.5, 5, 6.5 dB/div					
IOR settings	1.000000 to 1.999999 (0.000001 steps)					
Distance measurement accuracy	±1 m ±3 x measurement distance x 10^{-5} ±marker resolution (excluding uncertainty caused by fiber IOR)					
Loss measurement accuracy (linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)					
Return loss measurement accuracy	±2 dB					
Automatic measurement*9	Fault locate: Events judged as a failure are displayed sequentially from the first possible event. The distance of the possible event point, Total loss or Splice loss, and event type are displayed at the upper right of the wavelength display screen. Measurement items: Total loss, Total return loss or Average loss Each event distance, Connection loss, Return loss or Reflection amount, Total return loss or Average loss (displays in table format) Threshold values Connection loss: 0.01 to 9.99 dB (0.01 dB steps), Return loss: 20.0 to 60.0 dB (0.1 dB steps), Fiber-end: 1 to 99 dB (1 dB steps) Number of detected events: Up to 99 Automatic setting: Distance range, Pulse width, Averaging count (time) Connection check: Automatic check of front panel connector connection quality Communication light check: Check for presence of communication light in optical fiber to be measured (≥–40 dBm)					
Manual measurement	Measurement items: Transmission loss and distance between 2 points, Loss per unit length between 2 points, Connection loss, Return loss or difference of levels Real-time sweep: 0.2 second or less (sampling mode: Normal)					
Light source for identification tester	Applicable fiber: SM fiber (ITU-T G.652), PC type Optical connector: Shared with OTDR (same port) Light emission element: FP-LD Central wavelength*10: 1310 ±30 nm (MT9080A/D/F), 1550 ±30 nm (MT9080B/D/E/F), 1650 ±5 nm (MT9080C/E/F) Optical output power*11: –8 dBm or more Optical output waveform: 270 Hz/1 kHz/2 kHz (Modulation light is square wave) Modulated frequency: 270 Hz/1 kHz/2 kHz ±1.5% Warm-up time: 10 minutes (after turning optical output On) Laser safety specification: 21CFR Class 1, IEC 60825-1 Class 1					
Optical power meter	Applicable fiber: SM fiber (ITU-T G.652) Wavelength setting: MT9080A/B/D (1310/1550 nm port): 1310/1550/1625/1650 nm, MT9080C/E/F (1310/1550 nm port): 1310/1550/1625 nm, MT9080C/E/F (1650 nm port): 1650 nm Optical connector: Shared with OTDR Optical power: –50 to –5 dBm (peak power) Absolute maximum rated input: +10 dBm Measurement accuracy: ±6.5% (–20 dBm, CW light, 23˚C ±2˚C, after executing zero offset, Wavelength 1550 nm)					
Other functions	Waveform storage: SR-4731 Horizontal offset setting (zero cursor setting) Internal memory Language display: English/Japanese switchable by system configuration Power-saving setting function Backlight off: Disable/1 to 99 min., Shutdown: Disable/1 to 99 min. Waveform comparing function Calendar clock Distance unit set: km, kf, mi, f, m Title input: Up to 32 characters Remaining battery power display, Auto dummy fiber setting function, Continuous light emitting function, Buzzer setting					

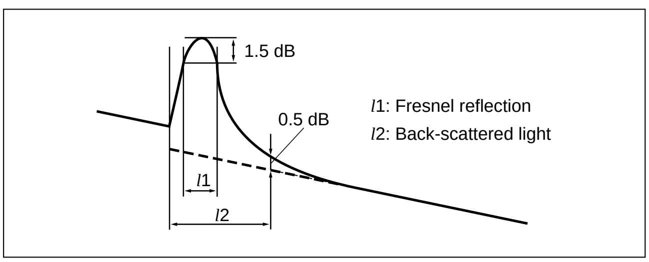
Continued on next page

Model	MT9080A	MT9080B	MT9080C	MT9080D	MT9080E	MT9080F
Display	6.2 inch monochrome LCD (Option 04, 640 x 480 dots, with backlight, semi-transparent)					
Interface	USB 1.1 Type A x 1 (memory), Type B x 1 (USB mass storage class): The internal memory of the MT9080 Series product can be read/written as a PC disk drive by connecting with the PC via a USB cable.)					
Laser safety specification	21CFR Class 1, IEC 60825-1 Class 1					
Power supply	12 Vdc, Allowable input voltage range: 10.8 to 15 Vdc 100 to 240 Vac, Allowable input voltage range: 90 to 264 V, 50/60 Hz (Specific AC adapter is used.) Battery pack: DR15SBA can be used.					
Power	≤20 W (when charged), Standard 5 W (With backlight Off, sweeping halted)					
Battery operating time[∗12]	Continuous operation time: 4 h (typical value)					
Battery charging time[∗13]	≤3 h					
Dimensions and mass	254 (W) x 162 (H) x 61 (D) mm (main body only), ≤2 kg (only main frame), ≤2.2 kg (DR15SBA battery pack included) 277 (W) x 199 (H) x 80 (D) mm [main body + protector + protective cover (without hand strap and shoulder strap)], ≤2.9 kg [main body + battery pack + VLD + protector (without protective cover)]					
Environmental condition	Operating temperature and humidity: 0˚ to +40˚C, ≤85% (no condensation), During battery charge: 0˚ to +30˚C (power OFF), Storage temperature and humidity: –20˚ to +60˚C, ≤85% Vibration: Conforming to MIL-T-28800E Class 3, Pulse shock: MIL-T-28800E, Move shock: MIL-T-28800E Style C (20.3 cm corner, surface total 14 times shocks, Power OFF), Vamp: IEC 63-2-29, JIS C 0042					
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)					
LVD	EN61010-1: 2001 (Pollution Degree 2)					

∗1 At 25˚C, pulse width: 1 µs
∗2 Wavelength range for 20 dB lower than the peak value. Peak value +15 dB or less.
∗3 At 25˚C, pulse width: 2 µs, Distance range: 50 km, Average: 180 sec.
∗4 Dynamic range (one-way back-scattered light), SNR = 1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



∗5 At 1.65 µm: With backlight, 1.55 µm –19 dBm CW light
∗6 At 25˚C, pulse width: 20 ns, Return loss: 40 dB, Deviation: ±0.5 dB (Refer to the figure below.)
∗7 At 25˚C, pulse width: 3 ns (Refer to the figure below.)



∗8 Either value is automatically selected in each mode, depending on the distance range.
∗9 The automatic measurement is an auxiliary function to facilitate measurement operations, and does not assure any detected results. As there may be a case of miss detection, be sure to check waveform data as well for final judgement of measured results.
∗10 +25˚C, 270 Hz
∗11 25˚C, SM fiber 2 m, Modulation light: 270 Hz, Averaged power with 50% duty. Operating temperature range for 1.65 µm: 0˚ to +35˚C
∗12 Backlight Off, Sweeping halted, at 25˚C
∗13 With power Off, Temperature range: 0˚ to +30˚C

• Battery pack: DR15SBA

Battery	Ni-MH secondary battery
Voltage, capacity	10.8 Vdc, 2100 mAh
Dimensions and mass	145 (W) x 52.8 (H) x 19.3 (D) mm, 305 g typ.
Operating temperature	Charging: 0˚ to +45˚C Discharging: –20˚ to +50˚C Storage: –20˚ to +35˚C

• AC adapter: SA165A-1250V-3

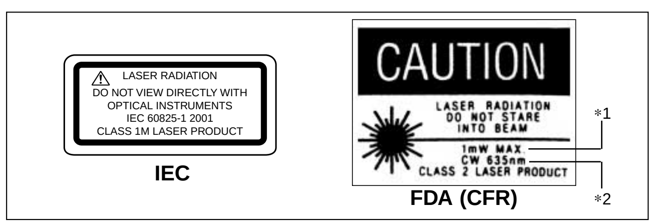
Rated AC input	100 to 240 Vac, 50/60 Hz
Rated DC output	12 Vdc, 3 A
Dimensions and mass	122 (W) x 60 (H) x 34 (D) mm, 305 ±5 g
Environmental conditions	Operating temperature: 0˚ to +40˚C, 20 to 80% R.H. Storage temperature: –20˚ to +80˚C, 10 to 95% R.H.

• Visible LD (Option 02)

Central wavelength	635 nm ±15 nm (at 25˚C)
Optical output	–3 ±1.5 dBm
Output optical fiber	10/125 µm, SM (ITU-T G.652)
Optical connector	FC, SC, ST, DIN, HMS-10/A, LC
Optical safety	IEC60825-1 Class 1M, 21CFR Class 2
Environmental conditions	Operating temperature and humidity: 0˚ to +35˚C, ≤85% (no condensation)

Safety measures for laser products

This option complies with optical safety standards in Class 1M of the IEC 60825-1 and the FDA (21CFR1040.10, USA) in Class 2; the following descriptive labels are affixed to the product (FDA label is only affixed to product for export to the USA).



The maximum output is indicated under ∗1, and the wavelength under ∗2.
Caution: Do not look directly into the laser beam.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	ACCESS Master (main frame)	
MT9080A	SMF 1.31 µm	
MT9080B	SMF 1.55 µm	
MT9080C	SMF 1.65 µm	
MT9080D	SMF 1.31/1.55 µm	
MT9080E	SMF 1.55/1.65 µm	
MT9080F	SMF 1.31/1.55/1.65 µm	
	Standard accessories	
W2487AE	MT9080 Series operation manual (CD):	1 copy
SA165A-1250V-3	AC adapter:	1 pc
DR15SBA	Battery pack:	1 pc
	Software	
MX907600A	OTDR Emulation Software	
	Options*1	
MT9080[ ]-02	Visible LD (Factory option)	
MT9080[ ]-04*2	Monochrome LCD	
MT9080[ ]-09*2	English language display	
MT9080[ ]-10	Protector (Factory option)	
MT9080[ ]-25*3	FC-APC connector (Factory option)	
MT9080[ ]-26*3	SC-APCconnector (Factory option)	
MT9080[ ]-33*3	LC connector	
MT9080[ ]-37*3	FC connector	
MT9080[ ]-38*3	ST connector	
MT9080[ ]-39*3	DIN connector	
MT9080[ ]-40*3	SC connector	
MT9080[ ]-43*3	HMS-10/A connector	
	Application parts	
Z0740	Battery charger (For DR15SBA)	
B0547*4	Soft carrying case	
B0548*5	Soft transit case	
B0549	Hard carrying case	
B0550*6	Front cover (For option 10)	
DR15SBA	Battery pack	
J1270	Replaceable optical LC connector	
J0617B	Replaceable optical FC connector	
J0618D	Replaceable optical ST connector	
J0618E	Replaceable optical DIN connector	
J0618F	Replaceable optical HMS-10/A connector	
J0619B	Replaceable optical SC connector	
J0057	Optical adapter FC type	
J0635[ ]*7	Optical fiber cord with FC-PC at both ends (SM, with FC-PC at both ends)	
W2462AE	MT9080 Series operation manual (print)	
Z0282	Ferrule cleaner	
Z0283	Ferrule cleaning tape (6 pcs/set)	
Z0284	Adapter cleaner (Stick type, 200 pcs/set)	

*1: Installed in MT9080A/B/C/D/E/F
*2: Please be sure to specify
*3: Specify the optical connector
*4: It can't be used when it equips with a projector (option 10)
*5: Attache case type [440 (W) x 310 (H) x 110 (D) mm]
*6: Only front cover for option 10
*7: Specify the optical fiber length as A, B or C (A: 1 m, B: 2 m, C: 3 m)

OPTICAL TIME DOMAIN REFLECTOMETER

MW9076 Series

1.31/1.45/1.55/1.625 µm (SM), 0.85/1.3 µm (GI)

CE

Simple Measurement of Chromatic Dispersion

Features

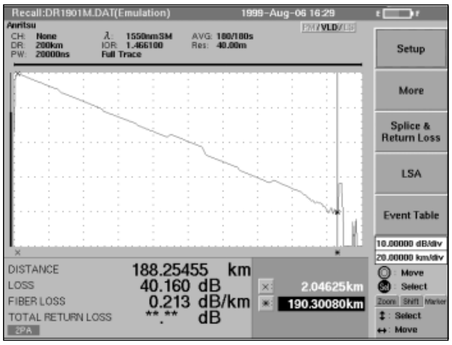
- 45 dB high dynamic range
- 8 m short dead zone
- Simple measurement of chromatic dispersion from one end of optical fiber
- Measurement in 10 s (Full-Auto mode), 0.15 s real-time sweep
- 5 cm high resolution, 50,000 sampling points
- 8.4 inch TFT-LCD color display

Model		MW9076B1	MW9076B	MW9076C	MW9076D1	MW9076J	MW9076K
Optical fiber		SM	SM	SM	SM	GI	GI
Wavelength		1.31/1.55 µm ± 25 nm	1.31/1.55 µm ± 25 nm	1.31/1.55/ 1.625 µm ± 25 nm	1.31/1.45/1.55/ 1.625 µm ± 3 nm	0.85 µm ± 30 nm	0.85/1.3 µm ± 30 nm
Dynamic range		40.5/38.5 dB (typical value)	45/43 dB (typical value)	41.5/39.5/37 dB	34.5/33.5/32.5/30.0 dB	21 dB	21/25 dB
Dead zone (Fresnel/ back-scattered)		1.6/8 m	1.6/8 m	1.6/8 m	3/25 m	2/7 m	2/7 m
Chromatic dispersion					√		
Light source function			√	√			
Options	Visible LD	√	√	√	√	√	√
	Optical power meter	√	√	√			
	High power optical power meter	√	√	√			
	Optical channel selector	√	√	√			
Features		• High cost performance • Short dead zone • Low cost	• Highest class model • Wide dynamic range • Short dead zone	• Three wavelengths • L-band measurement	• Chromatic dispersion measurement • Four wavelengths • Wavelength accuracy: ±3 nm	• For GI fiber • Short dead zone	• For GI fiber • Dual wavelengths • Short dead zone

Performance and functions

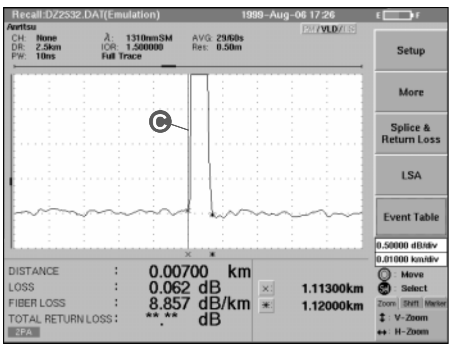
• High dynamic range

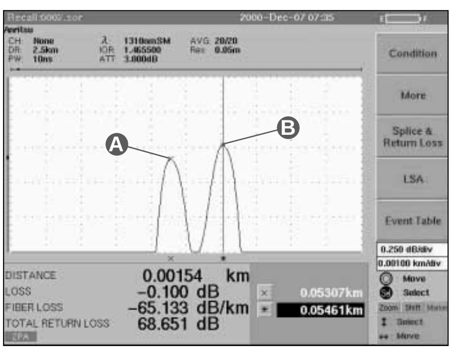
When using a wavelength of 1.55 µm, a point about 190 km distant can be measured.



• Short dead zone

Clearly measure up to near end by 8 m dead zone (back-scatter, SM unit)





• Chromatic dispersion measurement

The MW9076D1 has a built-in function for measuring chromatic dispersion even outdoors. The chromatic dispersion can be measured automatically over a wide range from 1300 to 1660 nm from one end of the fiber. The dispersion reproducibility is ±0.05 ps/(nm · km)* and the dynamic range is 30 dB. The MW9076D1 can be operated from an external PC using remote commands to measure the chromatic dispersion. For detail of the chromatic dispersion measurement, refer to the document of "product introduction MW9076 series Optical Time Domain Reflectometer".

*: Measured with 25 km of 1.3 µm zero-dispersion fiber (ITU-T G.652) at 1550 nm.

• Fresnel reflection

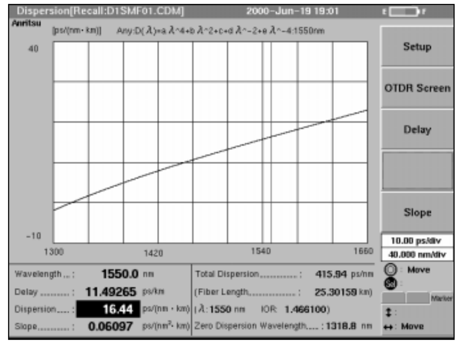
The far-end Fresnel reflection can be measured for four wavelengths (1310/1450/1550/1625 nm).

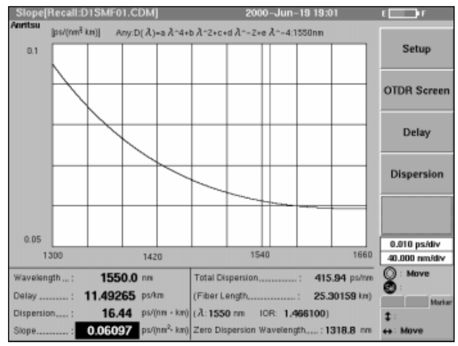
• Group delay characteristics

The fitting formula supports cubic or quintic Sellmeier, and polynomials can be applied to various types of fibers.

• Chromatic dispersion characteristics

The zero and total dispersion can be displayed along with the delay, dispersion and dispersion slope at 0.1 nm steps.





• High-speed measurement

It takes only 10 seconds to measure and display the waveform and connection loss on one screen. Just one press of the Start key is all that is needed to make measurement.

• Full automatic mode

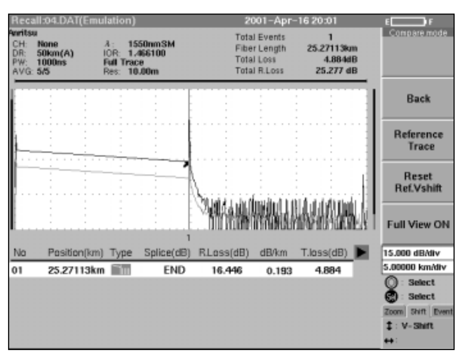
Measurement results are displayed by simply pressing the Start key. All complicated settings of distance range, pulse width, attenuator, and maker can be automatically executed. Measurement speed in this mode was significantly increased. When the wavelengths are set to ALL, wavelengths are automatically changed.

• Repeated measurement

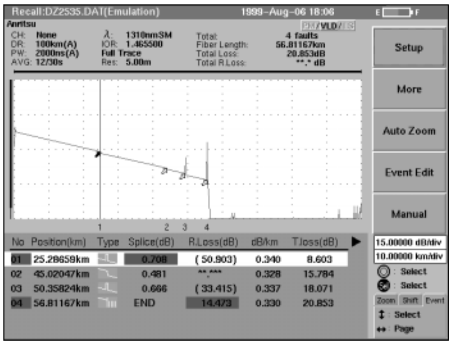
A series of operations, such as measurement, wavelength switching, data saving, optical channel switching, and next optical fiber measurement, can be executed automatically under preset measurement conditions. This mode is ideal for measuring a multi-core optical fiber.

• Waveform comparison function

Measured and saved data can be compared on the same screen. In addition, differences can be displayed as a waveform for simple observation of distance and level differences. This is useful for checking aging changes or comparing several fibers.



• Warning level setup function
In automatic measurement mode, an event warning value can also be set in addition to a detection threshold value. For example, the threshold value can be set to the acceptance level, and warning value to a pass/rejection decision level. In this case, all events will be detected, and those exceeding the warning value are displayed in another color, therefore, enabling the operator to easily identify possible “borderline” events.

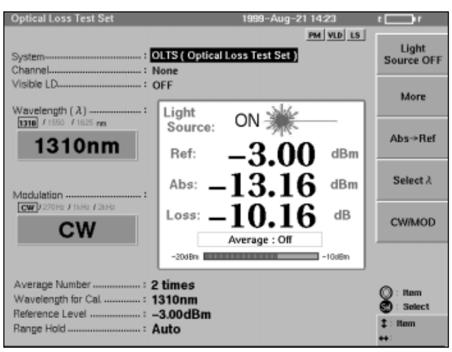


• Communication light check function
When measuring a fiber in service, there is a possibility of mis-measurement by an OTDR. To guard against the risk of mis-measurement, this check function checks for the presence of light other than the OTDR optical measurement pulse.

• Optical channel selector control function
In addition to using the built-in optical channel selector, external MN9662A/9664A Optical Channel Selector can be controlled via the RS-232C interface from an OTDR. By using these selectors, an optical fibercable consisting of up to 32 cores can be measured automatically.

• Visible LD
A 635 nm visible LD option is available for the detection of breaks and loss points along the fiber to be measured.

• Light source, power meter
Optical fiber loss can be measured using the optical power meter function and light source function. Two types of optical power meters are supported: One is measurement range of –70 to +3 dBm (MW9076B/B1/C-02 option), the other is measurement range of –50 to +23 dBm (MW9076B/B1/C-03 option).



∗ Light source function is mounted on MW9076B/C as standard. Power meter function is optional to MW9076B/B1/C.

• VGA output terminal
The VGA connector outputs the screen interface to a CRT monitor, which is very useful for production-line applications.

• Large internal memory
About 18 MB internal memory is provided as standard. The following table shows the number of waveforms which can be saved in each media.

Media	GR196	Analysis
FDD (1.4 MB)	123	67
PC-ATA card (32 MB)	2700	1520
PC-ATA card (256 MB)	16000	10600
Internal memory (18 MB)	1560	860
Hard disk (1 GB)∗	32700	32700

Number of data points: 5,000
∗: The hard disk is for the PC card slot (IBM Microdrive DSCM-11000 + PC card adapter)

MX907600A OTDR Emulation Software

• Emulation function
Measured waveform data can be analyzed using a PC.

• Data transmission function
Data files recorded by the MW9076 series can be transferred to a PC via the RS-232C port.

• Both-end measurement function
A new waveform can be composed by averaging data measured at both ends of an optical fiber.

Specifications

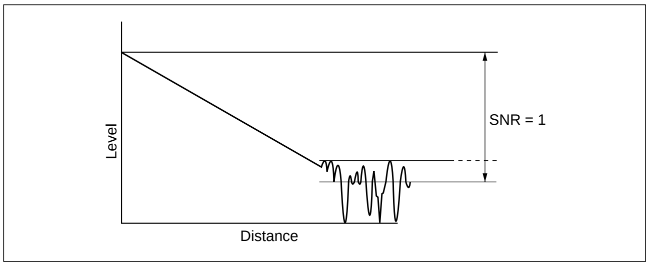
• Optical Time Domain Reflectometer (main frame)

Model	MW9076B	MW9076C	MW9076B1	MW9076J	MW9076K	MW9076D1
Wavelength	1310/1550 nm ±25 nm[*1]	1310/1550/1625 nm ±25 nm[*1]	1310/1550 nm ±25 nm[*1]	850 nm ±30 nm	850/1300 nm ±30 nm	1310/1450/1550/ 1625 nm ±3 nm[*1]
Measurable optical fiber	10/125 µm single-mode optical fiber (ITU-T G.652)			62.5/125 µm GI fiber[*2]		10/125 µm single-mode optical fiber (ITU-T G.652)
Optical connector	FC, SC, DIN, HMS-10/A, ST (replaceable, PC type)			FC, SC, DIN, ST (replaceable, PC type)		FC, SC, DIN, HMS-10/A, ST (replaceable, PC type)
Distance range	1, 2.5, 5, 10, 25, 50, 100, 200, 250, 400 km			1, 2.5, 5, 10, 25, 50, 100 km		1, 2.5, 5, 10, 25, 50, 100, 200, 250, 400 km
Pulse width	10, 20, 50, 100, 500, 1000, 2000, 4000, 10000, 20000 ns			10, 20, 50, 100 ns	10, 20, 50, 100 ns (0.85 µm) 10, 20, 50, 100, 500, 1000 ns (1.3 µm)	10, 20, 50, 100, 500, 1000, 2000, 4000, 10000, 20000 ns
Dynamic range[*3, *4] (S/N = 1)	42.5 dB (1.31 µm) 40.5 dB (1.55 µm) *Typical value: 45 dB (1.31 µm) 43 dB (1.55 µm)	41.5 dB (1.31 µm) 39.5 dB (1.55 µm) 37 dB (1.625 µm)	38 dB (1.31 µm) 36 dB (1.55 µm) *Typical value: 40.5 dB (1.31 µm) 38.5 dB (1.55 µm)	21 dB	21 dB (0.85 µm) 25 dB (1.3 µm)	34.5 dB (1.31 µm) 33.5 dB (1.45 µm) 32.5 dB (1.55 µm) 30.0 dB (1.625 µm)
Dead zone (back-scattered light)[*5]	≤8 m (1.31 µm) ≤9 m (1.55 µm)	≤8 m (1.31 µm) ≤9 m (1.55 µm) ≤12 m (1.625 µm)	≤8 m (1.31 µm) ≤9 m (1.55 µm)	≤7 m (deviation: ±0.5 dB) ≤50 m (deviation: ±0.1 dB)	≤7 m (0.85 µm, deviation: ±0.5 dB) ≤10 m (1.3 µm, deviation: ±0.5 dB) ≤50 m (deviation: ±0.1 dB)	≤25 m
Dead zone (Fresnel reflection)[*6]	≤1.6 m			≤2 m		≤3 m
Marker resolution	0.05 to 800 m			0.05 to 200 m		0.05 to 800 m
Sampling resolution	0.05 to 80 m			0.05 to 20 m		0.05 to 80 m
Sampling points[*7]	Quick mode: 5001, 6251 Normal mode: 20001, 25001 High mode: 40001, 50001					
Y-axis scale	0.25, 0.5, 1, 2.5, 5, 10, 15 dB/div (15 dB/div is indicated only at Auto and Full Auto measurement.)					
IOR settings	1.400000 to 1.699999 (0.000001 steps)					
Distance measurement accuracy	±1 m ±3 x measurement distance x 10^{-5} ±marker resolution (excluding uncertainty caused by fiber IOR)					0.1 m ±3 x measurement distance x 10^{-5} ±marker resolution (excluding uncertainty caused by fiber IOR)
Loss measurement accuracy (linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)					
Return loss measurement accuracy	±2 dB			±4 dB		±2 dB
Automatic measurement[*8]	Measurement items: Total loss, total return loss. Each event distance, connection loss, return loss, or reflection amount (displays in table format) Threshold values Connection loss: 0.01 to 9.99 dB (in 0.01 dB steps), Return loss: 20 to 60 dB (in 0.1 dB steps), Fiber-end: 1 to 99 dB (in 1 dB steps) Warning values Splice connection loss: 0.1 to 10 dB (in 0.01 dB steps), Connector connection loss: 0.1 to 10 dB (in 0.01 dB steps), Return loss: 10 to 50 dB (in 0.1 dB steps), Fiber loss: 0.01 to 10 dB (in 0.01 dB steps), Total loss: 0.1 to 60 dB (in 0.1 dB steps), Total return loss: 10 to 50 dB (in 0.1 dB steps), Average loss: 0.01 to 10 dB (in 0.01 dB steps) Number of detected events: Up to 99 Automatic setting: Distance range, pulse width, averaging count (time) Measurement time: ≤60 s (in full automatic measurement mode) Connection check: Automatic check of front panel connector connection quality Communication light check: Check for presence of communication light in optical fiber to be measured					
Manual measurement	Measurement items: Transmission loss and distance between 2 points, loss per unit length between 2 points, connection loss, return loss/reflection amount, total return loss, average loss Real-time sweep: 0.1 to 0.2 second or less[*9]					

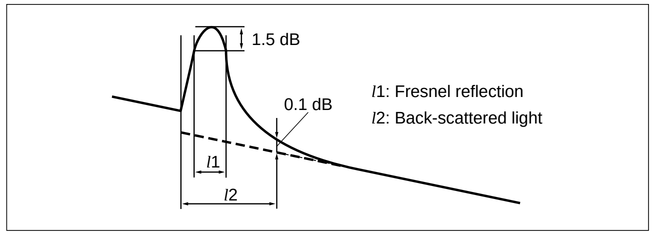
Continued on next page

Model	MW9076B	MW9076C	MW9076B1	MW9076J	MW9076K	MW9076D1
Optical loss measurement light source function	Applicable optical fibers: SM optical fiber (ITU-T G.652) Optical connectors: Shared with OTDR (same port) Light-emitting elements: FP-LD Center wavelength: 1310/1550 ±25 nm (MW9076B, CW, 25°C) 1310/1550/1625 ±25 nm (MW9076C, CW, 25°C) Spectrum width: ≤5/10 nm (MW9076B, CW, 25°C) ≤5/10/10 nm (MW9076C, CW, 25°C) Output level accuracy: –3 ±1.5 dBm (CW, 25°C, SM optical fiber: 2 m) Optical output short term stability: ≤0.1 dB [CW, at one point from –10° to +40°C (±1°C), Difference between maximum and minimum values in one min, SM optical fiber cable: 2 m] Output waveform CW, 270 Hz, 1 kHz, 2 kHz (Modulated waves are square waves.) Modulation frequency: 270 Hz/1 kHz/2 kHz ±1.5% Laser safety specification: 21CFR Class 1, IEC 60825-1 Class 1		—			
Chromatic dispersion measurement	—					Wavelength range: 1300 to 1660 nm, Wavelength accuracy: ±0.5 nm[*10] (typical), Zero-dispersion repeatability: ±0.6 nm (typical)[*11], Dispersion repeatability: ±0.05 ps/(nm·km)[*11] * Typical Dynamic range: 30 dB (4% Fresnel, typical)
Other functions	Waveform storage [Bellcore. SOR (GR-196-CORE, SR-4731) or Anritsu. Dat format, user selectable], waveform comparing function, print output (Centronics), repeated measurement function (A series of operations such as wavelength switching, waveform storage, and printing can be executed by pressing a single key.), relative distance set (zero cursor set), calendar clock, distance unit set (km, m, kf, f, mi), title input (up to 32 characters), remaining battery power display					
Laser safety specification	21CFR Class 1, IEC 60825-1 Class 1					
Power	≤35 W max. (at charging), 4 W (in standard state, MU250000A power consumption included.)					
Battery	Continuous operation: 6 h (typical value)[*12]					
Dimensions and mass	290 (W) × 194 (H) × 30 (D) mm (MW9076B/B1/C/J/K main frame) 290 (W) × 194 (H) × 75 (D) mm (MU250000A Display Unit included) ≤1.4 kg ≤4.0 kg (MU250000A display unit and battery pack included)					290 (W) × 194 (H) × 77 (D) mm (MW9076D1 main frame) 290 (W) × 194 (H) × 122 (D) mm (with MU250000A Display Unit) ≤3.1 kg (MW9076D1 main frame only), ≤5.7 kg (with MU250000A Display Unit and battery pack included)
Environmental condition	Operating temperature and humidity: –10° to 40°C, ≤ 85% (no condensation) Storage temperature and humidity: –20° to 60°C, ≤ 85% Vibration: Conforming to MIL-T-28800E Class 3 Shock: 76 cm height, 6 surfaces, 8 corners[*13] Dust-proofing: MIL-T-28800E Drip-proofing: MIL-T-28800E					
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)					
LVD	EN61010-1: 2001 (Pollution Degree 2)					

*1 At 25°C, pulse width: 1 µs
*2 For GI fiber (core diameter: 62.5 µm ±3.0 nm, NA: 0.275 ±0.015, transmission loss: ≤3.2/0.9 dB/km (wavelength: 0.85/1.3 µm). At measurement of 50/125 µm GI fiber, the dynamic range drops by about 3.0 dB.
*3 At 25°C, pulse width: SM 20 µs, Average 360 sec., GI 100 ns (0.85 µm), 1 µs (1.3 µm), Average 180 sec.
*4 Dynamic range (one-way back-scattered light)
SNR=1: The level difference between the RMS noise level and the level where near end back-scattering occurs.



*5 Pulse width: 10 ns, return loss: SM 40 dB, GI 30 dB, deviation: ±0.1 dB (Refer to the figure right.)
*6 Pulse width: 10 ns (Refer to the figure right.)
*7 Either value is automatically selected in each mode, depending on the distance range.
*8 Automatic measurement is a supporting function which enables to operate easier, it doesn't assure results. As there is a case of miss detection, please check a waveform data, either.
*9 At quick mode
*10 Compared value with internal wavelength data at chromatic dispersion measurement
*11 Measured with 25 km of 1.3 µm zero-dispersion fiber (ITU-T G.652) at 1550 nm.
Not an error from absolute value but repeatability of measured results. Contact Anritsu Corporation in case of measuring ITU-T G.655 fiber.
*12 At back light low brightness, measurement not executed.
*13 Dropped on the floor of plywood thickness 5 cm fixed by concrete. Not applicable to the MW9076D1.



Note: This product outputs the pulse light of a high peak power.
When this product is used in the state where it connected with transmission system, attach a wavelength filter or attenuator to Receiver of transmission system.
There is a possibility of damaging Receiver of transmission system because of high power pulse of OTDR.

• MU250000A/A4 Display Unit

Display	MU250000A Unit: 8.4 inch color, TFT-LCD (640 x 480 pixels, transparent type, with back light) MU250000A4 Unit: 7.8 inch color, STN-LCD (640 x 480 pixels, reflective type, with front light on/off)
Interface	Serial interface: RS-232C-1 (115.2 kbps max.), with D-sub 9-pin connector RS-232C-2 (57.6 kbps max.), with mini-DIN 8-pin connector Printer interface: 8-bit parallel interface (Centronics), with D-sub, 25-pin connector Keyboard interface: IBM US ENGLISH (101 keys) 106 keys compatible, with mini-DIN 6-pin connector VGA output connector: Mini-DIN 10-pin connector
FDD	Built-in 3.5 inch (1.44 MB/720 kB)
Power supply	10 to 26.4 Vdc 100 to 250 Vac (rated), 50/60 Hz, ≤50 VA max. (Specific AC adapter is used.) Battery: CGR-B/802 Lithium ion battery pack can be used. (mounted in main frame)
Power	≤35 W
Dimensions and mass	290 (W) x 194 (H) x 45 (D) mm, ≤2.2 kg
Environmental conditions	Restricted by memory card specifications when a memory card is mounted. AC adapter: Depend on the conditions of AC adapter Operation temperature and humidity: –10° to +40°C, ≤85% (no condensation), +5° to 40°C, ≤80% (FDD is used.) Storage temperature and humidity: –20° to 60°C, ≤85% Vibration: Conform to MIL-T-28800E Class 3 Shock: 76 cm height, 6 surfaces, 8 corners* Dust proofing: Conform to MIL-T-28800E Drip proofing: Conform to MIL-T-28800E
EMC	Same as MW9076 series
LVD	Same as MW9076 series

*: Dropped on the floor of plywood (thickness 5 cm) fixed by concrete

• Battery pack: CGR-B/802D

Battery	Lithium ion secondary battery
Voltage, capacity	14.4 V, 3440 mAh (49.53 Wh)
Continuous drive time	See the MW9076 series specifications
Charging time	≤3 h (charge at the circumference temperature of 0° to +40°C)
Dimensions and mass	134.5 (W) x 89.5 (H) x 20.5 (D) mm, ≤420 g

• AC adapter: Z0695 (SA165A-2425V-3)

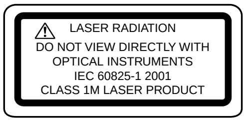
Rated AC input	100 to 240 Vac, 50/60 Hz
Rated DC output	24 Vdc, 2.5 A
Dimensions and mass	122 x 60 x 34 mm, ≤350 g
Safety specifications	UL, CSA, TÜVCB, CE, NORDIC, PSE
Environmental conditions	Operating temperature and humidity: 0° to +40°C, 80% Storage temperature and humidity: –20° to +80°C, 90%

• Visible light source: MW9076B/B1/C/D1/J/K-01

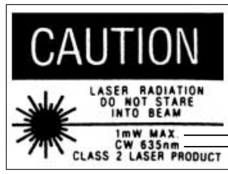
Central wavelength	635 ±15 nm (at 25°C)
Optical output	–3.0 ±1.5 dBm
Output optical fiber	10/125 µm, SM (ITU-T G.652)
Optical connector	FC, SC, ST, DIN, HMS-10/A *Replaceable
Optical safety	IEC 60825-1 Class 1M, 21CFR Class 2
Environmental conditions	Same as MW9076 series
EMC	Same as MW9076 series
LVD	Same as MW9076 series

Safety measures for laser products

This option complies with optical safety standards in Class 1M of the IEC 60825-1 and the FDA (21CFR1040.10, USA) in Class 2; the following descriptive labels are affixed to the product (FDA labels is only affixed to product for export to the USA).



IEC



∗1

FDA (CFR) ∗2

The maximum output is indicated under ∗1, and the wavelength under ∗2.
Caution: Do not look directly into the laser beam.

• Optical power meter: MW9076B/B1/C-02, MW0976B/B1/C-03

Applicable optical fiber	10/125 µm, SM (ITU-T G.652)
Optical connector	FC, SC, ST, DIN, HMS-10/A ∗Replaceable
Wavelength range	1.2 to 1.7 µm
Measurement range	Option 02: +3 to –70 dBm (continuous light) 0 to –73 dBm (modulated light) Option 03: +23 to –50 dBm (continuous light) +20 to –53 dBm (modulated light)
Measurement accuracy	Option 02: ±5% (–10 dBm, 1.31/1.55 µm, continuous light) Option 03: ±5% (–10 dBm, 1.31/1.55 µm, continuous light)
Environmental conditions	Same as MW9076 series
EMC	Same as MW9076 series
LVD	Same as MW9076 series

• MU960001A/960002A Optical Channel Selector Unit

Model	MU960001A	MU960002A
Configuration	1 x 4	1 x 8
Wavelength range	1.2 to 1.65 µm (The special wavelength are 1.31/1.55 µm.)	
Optical fiber	10/125 µm, SM (ITU-T G.652)	
Optical connector	FC, SC, ST, DIN, HMS-10/A ∗Replaceable	
Insertion loss	≤2.5 dB	≤4.5 dB
Environmental conditions	Same as MW9076 series (not applicable to the shock)	
Dimensions	290 (W) x 194 (H) x 47 (D) mm	
Mass	≤1.5 kg	≤2.0 kg
EMC	Same as MW9076 series	
LVD	Same as MW9076 series	

∗MU960001A/MU960002A can not be attached to MW9076D1.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Optical Time Domain Reflectometer (main frame, requires display unit)
MW9076B	SMF 1.31/1.55 µm OTDR
MW9076B1	SMF 1.31/1.55 µm OTDR
MW9076C	SMF 1.31/1.55/1.625 µm OTDR
MW9076D1	SMF 1.31/1.45/1.55/1.625 µm OTDR
MW9076J	GIF 0.85 µm OTDR
MW9076K	GIF 0.85/1.3 µm OTDR
	Standard accessories (main frame)
W1659AE	MW9076 series operation manual: 1 copy
W1660AE	MW9076 series serial interface manual: 1 copy
	Connector adapter*1: 1 pc
Z0619	Lithium ion battery pack: 1 pc
	Units
MU250000A	Display Unit (8.4 inch TFT-LCD)
MU250000A4	Display Unit (7.8 inch STN-LCD)
	Standard accessories (display unit)
Z0695	AC adapter (SA165A-2524V-3, SINO-AMERICAN ELECTRONIC products)
Z0402	Front cover
0979	A-2 power cord*2 (for Japan)
J0980	A-2 power cord*2 (for USA, Canada, Taiwan)
J0981	B4 power cord*2 (for UK, Malaysia, South Africa, Hong Kong)
J0982	C7 power cord*2 (for Europe)
J0983	S3 power cord*2 (for Oceania, China)
J1027	P4 power cord*2 (for India)
J1028	D1 power cord*2 (for Switzerland)
Z0403A	Belt with hook
	Optical Channel Selector
MU960001A	Optical Channel Selector Unit (1 x 4 channels, with connector adapter*1)
MU960002A	Optical Channel Selector Unit (1 x 8 channels, with connector adapter*1)
	Battery pack
Z0619	Lithium ion battery pack
	Software
MX907600A	OTDR Emulation Software
	Options
MW9076B/B1/C/D1/J/K-01	Visible LD (factory option)*1
MW9076B/B1/C-02	Optical power meter (factory option)*1, *3
MW9076B/B1/C-03	High power optical power meter (factory option)*1, *3
MW9076B/B1/C-25	FC · APC connector (angled PC type, factory option)
MW9076B/B1/C-26	SC · APC connector (angled PC type, factory option)
MW9076B/B1/C/D1/J/K-37	FC connector (user replaceable)
MW9076B/B1/C/D1/J/K-38	ST connector (user replaceable)
MW9076B/B1/C/D1/J/K-39	DIN connector (user replaceable)
MW9076B/B1/C/D1/J/K-40	SC connector (user replaceable)
MW9076B/B1/C/D1/J/K-43	HMS-10/A connector (user replaceable)
MW9076B/B1/C-47	HRL-10 connector (factory option)
MU960001A-37	FC connector
MU960002A-37	FC connector
MU960001A-38	ST connector
MU960002A-38	ST connector
MU960001A-39	DIN connector
MU960002A-39	DIN connector
MU960001A-40	SC connector
MU960002A-40	SC connector
MU960001A-43	HMS-10/A connector
MU960002A-43	HMS-10/A connector
	Application parts
Z0321A	Keyboard (PS/2)
JT8MA3-NT1	PC-ATA card (8 MB)
JT16MA3-NT1	PC-ATA card (16 MB)
JT32MA3-NT1	PC-ATA card (32 MB)
JT64MA3-NT1	PC-ATA card (64 MB)
JT128MA3-NT1	PC-ATA card (128 MB)

Continued on next page

Model/Order No.	Name
JT256MA3-NT1	PC-ATA card (256 MB)
JT512MA3-NT1	PC-ATA card (512 MB)
J0057	Optical adapter FC type
J0635□*4	Optical fiber cord [with FC-PC at both ends (SM)]
B0442	Soft carrying case [440 (W) x 310 (H) x 110 (D) mm]
Z0435	Soft carrying case [430 (W) x 300 (H) x 170 (D) mm]
Z0436	Hard carrying case (holds main frame and thermal printer)
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A, HFS-13/A)
J0619B	Replaceable optical connector (SC)
J0441	Total internal reflection cord (SM)
J1039	Total internal reflection cord (SC-PC)
J0654A	Serial interface cord (for remote control with IBM-PC/AT or J-310, 9 pin-9 pin)
J0655A	Serial interface cord (for PC-98 remote control, 9 pin-25 pin)
J0977	Serial interface cord (for connection with external optical channel selector)
J0978	VGA conversion cable (for external monitor)
J0952A	FC · PC-FC · APC(SG)-1M-SM (FC · APC closed width: 2 mm, conforms to seiko-giken)
J0953A	FC · PC-FC · APC(SI)-1M-SM (FC · APC closed width: 2.14 mm, conforms to SSI)
J0954A	SC · PC-SC · APC-1M-SM [return loss: >50 dB (SC · PC), >65 dB (SC · APC)]
Z0282	Ferrule cleaner
Z0283	Ferrule cleaning tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
J1041A	1.31/1.55 LWPF filter cord (SC · PC), 1 m
SDC60-3020	Car charger (adapter for car battery, DC 10 to 15 V)
	Peripherals
BL-80R2	High speed thermal printer*5
BL-100W	AC adapter (for BL-80R2, AC 100 to 240 V)
DPU-414-31B	Thermal printer*6
PW-4007-U1	AC adapter*6
DPU-414-31B	Thermal printer*7
PW-4007-E1	AC adapter*7
J0614	Printer connection cable (for DPU-414)
	Supplies
BL-80-30	Printer paper (for BL-80R2 thermal printer, 10 rolls/set)
TP411-28CL	Printer paper (for DPU-414 Thermal printer, 10 rolls/set)

*1: Specify one of FC, ST, DIN, SC or HMS-10/A. When the connector type is not specified, FC is supplied.
*2: Specify one of A-2, B4, C7, S3, P4 or D1.
*3: The optical power meter (Option 02) and high-level-input optical power meter (Option 03) cannot be mounted at the same time.
*4: Specify the optical fiber length as A, B or C (A: 1 m, B: 2 m, C: 3 m)
*5: Operates only with AC adapter, printing width: 72 mm, printing speed: approximately 13 s (manual measure-ment result with header), 0° to +40°C, dimensions: 119 (W) x 77 (H) x 174 (D) mm, Sanei products (AC adapter and printer cable are sold separately.)
*6: 120 VAC ±10 %, 60 Hz, 0° to +40°C, Seiko products (printer cable: sold separately)
*7: 230 VAC ±10 %, 50 Hz, 0° to +40°C, Seiko products (printer cable: sold separately)

OTDR MODULE

MW9077A/A1

1.31 µm (SM)/1.55 µm (SM)

CE

For Optical Fiber Monitor System, Compact and High Performance OTDR Module

NEW

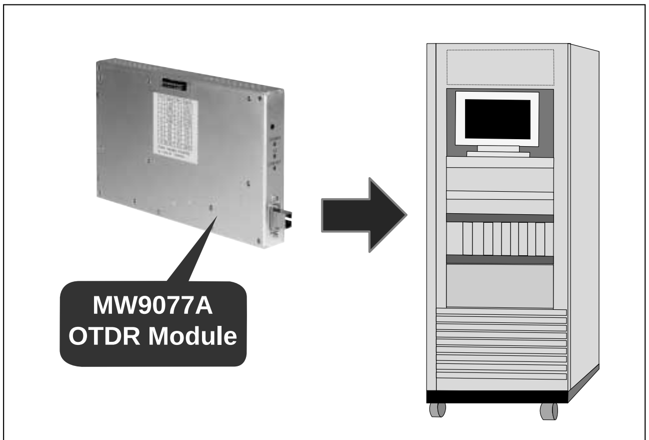
The MW9077A/A1 OTDR module is suitable OTDR module for optical fiber monitor system. In recent years, monitoring of optical fibers is applicable to many fields, not only in maintenance of optical-communications network systems, but also security sensor, flood sensor and prevention of disaster, etc. The MW9077A/A1 OTDR module offers a compact and highly performance OTDR solution in such an optical fiber application system.

Features

- A5 size compact for optical fiber monitor system
- Extensive operating temperature range of –5˚ to +55˚C
- High performance inherited from MW9076 Series
- OTDR quick data transmit by Ethernet interface and RS-232C

• A5 size compact for optical fiber monitor system

When designing a monitor system, the space factor is important. To satisfy the system requirement in the limited space, a system designer investigates a system configuration from various angles, such as functions, abilities, and module size. Therefore, it is effective to use a compact module for the achievement of a system requirements. Furthermore, using a compact module will miniaturize the whole monitor system, and it leads to a system-wide cost cut as a result. The MW9077A/A1 OTDR module is a compact module less than A5 size (200 x 130 x 25 mm). Even for strict system conditions, there will still be sufficient space to install the module.



• Extensive operating temperature range of –5˚ to +55˚C

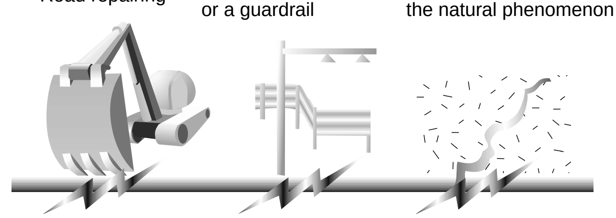
The operation temperature of system is influenced by various environmental conditions, such as the installation place, and the objects being monitored. Moreover, the heat which the system itself generates in fluents the operation temperature. Even such a operation temperature changes, it is necessary for each module that configured system be maintained the performance and the monitor system must be maintained the its reliability. The MW9077A/A1 OTDR module has a standardized dynamic range from –5˚ to +55˚C. The monitor system can be got a ability of wide range temperature. When the circumference temperature conditions are severe, The MW9077A/A1 OTDR module always works at stabilized performance.

• High performance inherited from MW9076 series OTDR

The MW9077A/A1 OTDR module inherits the technology of the MW9076 series Mini-OTDR. The event dead zone is 5 m and the back-scattered dead zone is 20 m. The dynamic ranges are 41 dB (1310 nm) and 40 dB (1550 nm). The sampling resolution is a minimum of 5 cm. The MW9077A/A1 is compact, it has a high performance to use the optical fiber monitor.

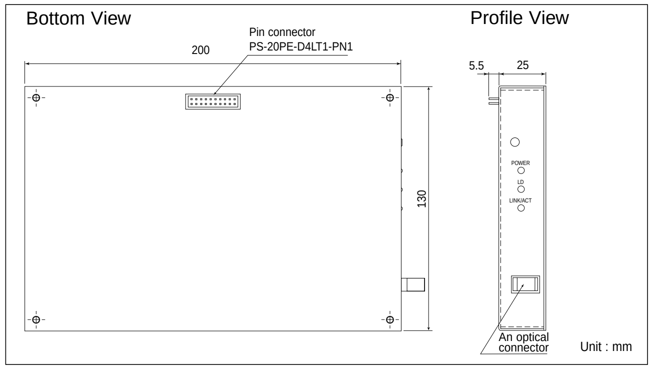
• Quick data transmit by Ethernet interface and RS-232C

The situation of the optical fiber monitoring is various. For example, in the case of measuring long-term change of optical fiber, the system checks optical fiber once in several hours by OTDR. In other cases of fiber monitoring, when the communication network happens to be troubled, the system check optical fiber immediately to find a fiber break point by OTDR. On the other hand, the monitoring of the optical fiber is always carried out to detect change of an optical fiber loss quickly. The MW9077A/A1 OTDR module can carry out trace sweep at intervals of about 1 second or less as well as getting smooth trace by averaging. The MW9077A/A1 OTDR module has 10 Base Ethernet interface. It can transmit the waveform data to a control device at high speed. The MW9077A/A1 can carry out the monitor of an optical fiber without stress.

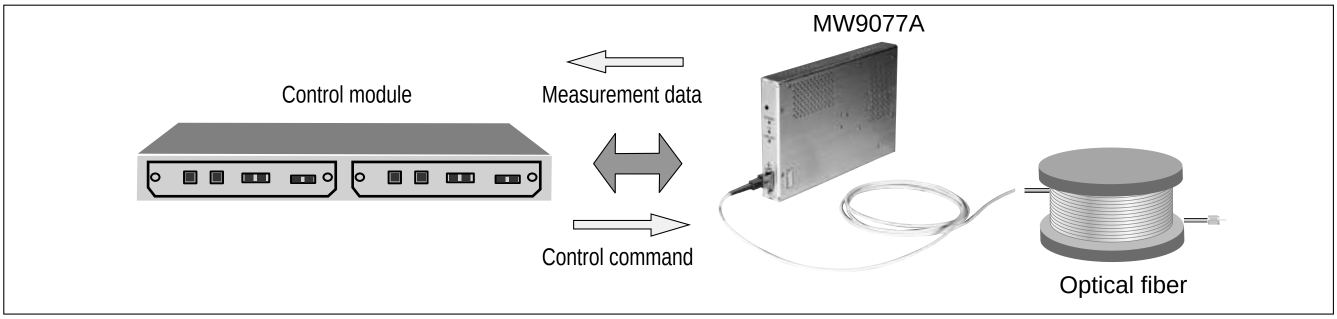


• Fine operation from a control device

The MW9077A/A1 OTDR module has two types of interfaces, 10 Base Ethernet interface and RS-232C. From the control device, The MW9077A/A1 OTDR module is controlled by some useful control commands, such as the measurement conditions setup commands and data transmission command to the control device. The fine set-up is possible for each system.



Appearance of MW9077A



Specifications

Model	MW9077A	MW9077A1
Wavelength*1	1310 ±25 nm	1550 ±25 nm
Fiber under test	10/125 µm single-mode optical fiber (ITU-T G.652)	
Distance range	5/10/25/50/100/200/250/400 km	
Pulse width	10 ns ±30%, 30 ns ±25%, 100 ns ±10%, 300 ns ±10%, 1 µs ±10%, 3 µs ±10%, 10 µs ±10%, 20 µs ±10%	
Dynamic range	41 dB (25˚C, Pulse width 20 µs) 39 dB at –5˚ to +55˚C (S/N = 1)	40 dB (25˚C, Pulse width 20 µs) 38 dB at –5˚ to +55˚C (S/N = 1)
Dead zone (back scattered light)*2	≤20 m	
Dead zone (Fresnel reflection)*3	≤5 m	
Sampling resolution*4	0.05 to 80 m	
Number of sampling points	Normal: 5001 or 6251, Fine: 20001 or 25001	
IOR	1.400000 to 1.699999 (in 0.000001 steps)	
Distance measurement accuracy	±1 m ±3 x measurement distance x 10^{-5} ± sampling resolution	
Loss measurement accuracy (linearity)	±0.05 dB/dB or ±0.1 dB (whichever is greater)	
Return loss measurement accuracy	±2 dB	
Automatic measurement*5	Measurement items: Total loss, Each event distance, Connection loss, Return loss or reflectance Threshold values: Connection loss : 0.01 to 9.99 dB (in 0.01 dB steps) Reflectance: –14 to –70 dB (in 0.1 dB steps), Fiber end : 1 to 99 dB (in 1 dB steps) Number of detected events: Up to 99 Automatic setting: Distance range, Pulse width, Averaging count (time)	
Manual measurement	Measurement items: Transmission loss and distance between 2 points, Connection loss, Reflectance	
Other functions	Relative distance setting (zero offset cursor), Calendar clock (without backup), Distance unit: m (Fixed)	
Laser safety specification	21CFR Class 1, IEC Pub60825-1 Class 1	
Power	+12 Vdc ±1 V, 1.5 A max	
Interface	Serial interface: RS-232C: 115.2 kbps Ethernet interface*6: 10 Base with 20pin connector	
Dimensions and mass	200 x 130 x 25 mm, ≤0.6 kg	
Environmental conditions	Operating temperature and humidity: –5˚ to +55˚C, ≤95% (no condensation) Storage temperature: –40˚ to +70˚C	
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)	
LVD	EN61010-1: 2001 (Pollution Degree 2)	

*1: At 25˚C, Pulse width: 1 µs
*2: At pulse width 10 ns
*3: At pulse width 10 ns, Reflectance: –35 dB
*4: IOR = 1.500000
*5: Automatic measurement is support function: Automatic measurement results are not guaranteed. There is a possibility to miss detection of event. Please check each result at on your own.
*6: Signal exchange with 10 Base-T

Note: This product outputs the pulse light of a high peak power. When this product is used in the state where it connected with transmission equipment, attaching a wavelength filter etc. should take care about the input of too much OTDR pulse light to Receiver. There is a possibility of damaging Receiver of transmission equipment.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MW9077A*1	OTDR module (wavelength 1.31 µm, SC connector, fixed)
MW9077A1*1	OTDR module (wavelength 1.55 µm, SC connector, fixed)
	Standard accessory
W2254AE	MW9077A/A1 operation manual
	Options
MW9077A-01	1550 nm filter (factory option, 1550 nm cut filter inside)
MW9077A-33	LC connector (OTDR main frame + LC connector, fixed)
MW9077A1-33	LC connector (OTDR main frame + LC connector, fixed)

*1: In the case of purchase, Please concluded a sales contract.

OPTICAL SPECTRUM ANALYZER

MS9710C

600 to 1750 nm

GPIB

High Performance for DWDM Optical Communications

The MS9710C is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as NF/Gain of optical fiber amplifier systems.
In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) offer the severe level and wavelength specifications particularly in the WDM band.
This analyzer has the dynamic range, reception sensitivity, and sweep speed requested by users, backed by Anritsu's high-level technology. The high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements (1520 to 1620 nm).
The MS9710C Optical Spectrum Analyzer is the successor to the popular MS9710B but with improved functions and higher performance. The specifications have been upgraded for the important 1.55 µm band for WDM communications and have also been optimised to include the new requirements for L-band (1570 to 1620 nm) use. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

Features

- Wavelength accuracy of ±20 pm (C-band) and ±50 pm (L-band)
- Dynamic range of 42 dB (0.2 nm from peak wavelength), 70 dB (1 nm from peak wavelength)
- WDM measurement of wavelength, level, and SNR for up to 128 channels

Performance and applications

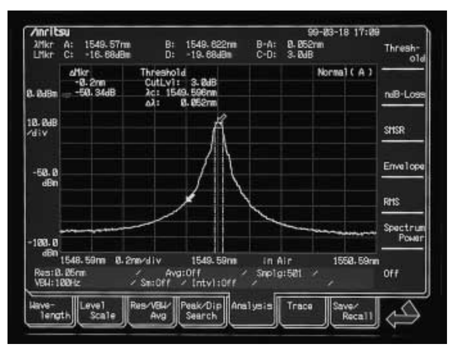
• 70 dB dynamic range

The dynamic range at 0.2 nm from the peak wavelength is better than 42 dB and is a high 58 dB min. at 0.4 nm from the peak, permitting high-accuracy measurement of DWDM systems with a 50 GHz (0.4 nm) channel spacing. The analyzer demonstrates its excellence in SNR measurement of WDM light sources, as well as in evaluation of narrow-band optical band pass filters.

Distance from peak wavelength	0.2 nm	0.4 nm	1 nm
Normal dynamic range mode	42 dB (45 dB typical)	58 dB	62 dB
High dynamic range mode	42 dB (45 dB typical)	60 dB	70 dB

High-dynamic range measurement example with DFB-LD spectrum passed via narrow-band Band-Pass Filter (BPF).

DFB-LD — Narrow-band BPF — MS9710C



• Relying on WDM transmission

As a result of the need for increased transmission capacity, R&D into large-capacity transmission techniques is becoming more active, and Wavelength Division Multiplexing (WDM) is now in use. This WDM transmission technology requires quantitative measurement of the signal quality and wavelength transmission characteristics of each channel.
Measuring instruments for this purpose require highly-accurate wavelength and level measurements. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarization dependant loss characteristics and level linearity specifications.
The MS9710C design achieves excellent wavelength and level specifications for this purpose in the 1520 to 1620 nm wavelength band and also in the extended band (L-band) to 1620 nm. In particular, the wavelength accuracy can be calibrated automatically using an optional internal reference wavelength light source; the post-calibration accuracy is better than ±20 pm.

Specifications for WDM application

Mainframe, option	MS9710C	With Option 15*2
Wavelength accuracy*1	±20 pm (1530 to 1570 nm) ±50 pm (1520 to 1600 nm)	±20 pm (1520 to 1620 nm)
Wavelength resolution	50 pm (FWHM of internal optical BPF)	
Resolution accuracy	≤±3% (1530 to 1570 nm, resolution: 0.2 nm)	≤±3% (1520 to 1620 nm, resolution: 0.2 nm)
Level flatness to wavelength	±0.1 dB (1530 to 1570 nm) ±0.3 dB (1520 to 1620 nm)	±0.1 dB (1520 to 1620 nm)
	Resolution: 0.5 nm, ATT: off	
Polarization dependency	±0.05 dB (1550/1600 nm)	
Level linearity	±0.05 dB (1550 nm)	±0.05 dB (1550/1600 nm)
	–50 to 0 dBm (ATT: off), –30 to +20 dBm (ATT: on)	

*1: After calibration with optical reference wavelength light source
*2: L-band enhancement

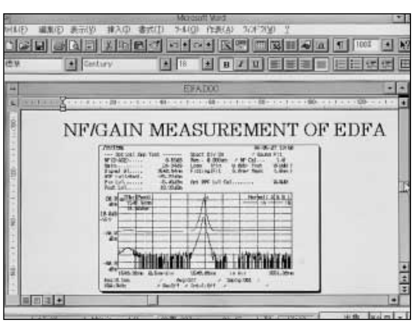
Full function lineup

In addition to its excellent basic functions, the MS9710C comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical devices (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, polarization mode dispersion measurement
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz
Markers	Multimarkers: Marker function for max. 300 points Zone markers: For waveform analysis within zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions an optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C, VGA monitor output

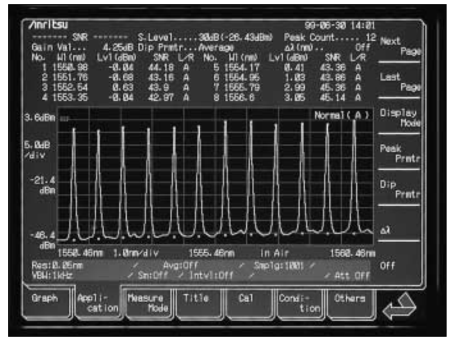
• 3.5 inch internal FDD

In addition to saving and recalling measurement data, etc., waveforms saved to floppy disk can be easily and directly read by a personal computer.
The PC screen shown on the right is displaying an image of the MS9710C screen saved to floppy disk. Screen images can be saved to FD media and output as Windows® bitmap-format files. In addition, since the data can be output in text-file format, it can be manipulated easily using spreadsheet software.

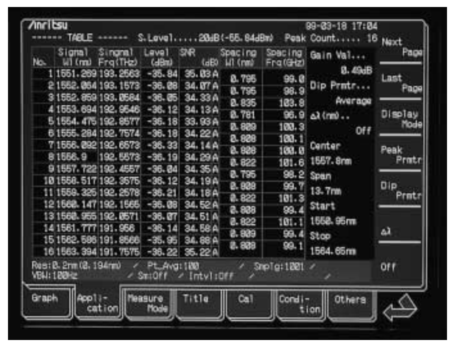


• Spectrum analysis for WDM communication systems

The wavelength, level, and SNR of up to 300 WDM channels can be analyzed.
A new noise level left/right average function (shown below) has been added to SNR measurement. In addition, the noise level is normalized to a per nm figure. Accurate SNR measurement can be achieved due to the high-resolution accuracy of the MS9710C.

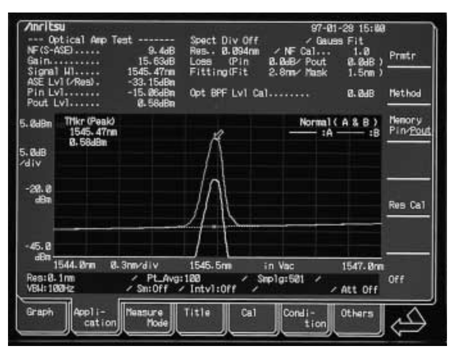


The measurement results described above can be switched to a table display that can be saved and recalled in text format. Both the wavelength and frequency are shown in the table.



• NF measurement of fiber amplifier (EDFA)

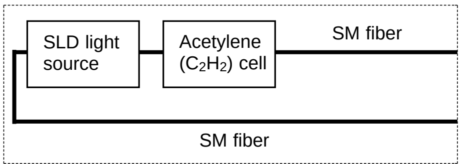
NF measurement by the optical method using an optical spectrum analyzer measures the light input to and output from the EDFA. NF is determined by the beat noise between the optical signal and the Amplified Spontaneous Emission (ASE) from the EDFA as well as by the beat noise between the ASE.
Since the MS9710C measures the ASE level with very high accuracy, three methods can be used to measure NF: 1. Pulse measurement (JIS: under discussion), 2. Level calibration using fitting, and 3. Polarization nulling. Moreover, measurement can be performed with the required dynamic range, level linearity, and polarization dependency.



• Convenient light source option, including reference wavelength light source for better accuracy

Any one of the Wavelength reference & SLD light source (Option 13), SLD light source (Option 14), Wavelength reference light source (Option 05), and White light source (Option 02) can be installed in the MS9710C.

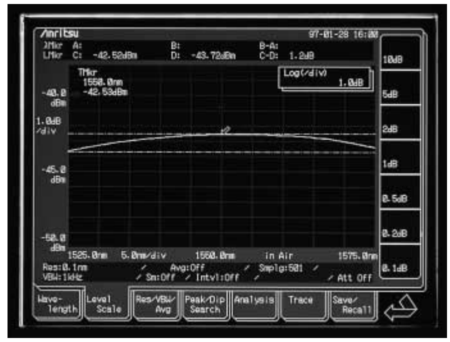
The block diagram of the SLD light source & Reference wavelength light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration, and the Port 2 for measuring transmission characteristics. When the MS9710C is calibrated automatically by inputting the reference wavelength light source, post-calibration wavelength accuracy in the 1520 to 1620 nm range is better than ±20 pm (Option 15). This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of SLD light source & Reference wavelength light

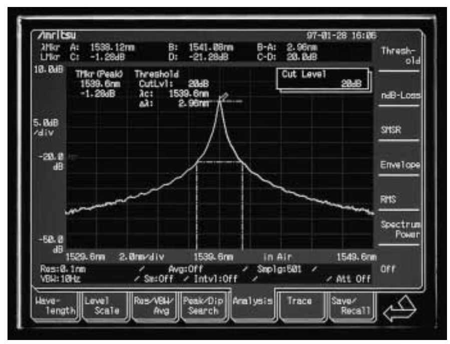
The following diagram shows the spectrum of the SLD light source output from Port 2.

When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.



Spectrum of SLD light

The following figure is a measurement example of the transmission characteristics of an optical band pass filter using the SLD light source.



Measurement of optical bandpass filter

If this dynamic range is not required, a lower-cost white light source can be installed instead.

Specifications

Main frame, option		MS9710C	With Option 15 (L-band enhancement)
Applicable optical fiber		10/125 µm SM fiber (ITU-T G.652)	
Optical connector*1		User replaceable (FC, SC, ST, DIN, HMS-10/A), factory option (E2000, FC-APC, SC-APC, HRL-10)	
Wavelength	Measurement range	600 to 1750 nm	
	Accuracy	±20 pm (1530 to 1570 nm)*2, ±50 pm (1520 to 1600 nm)*2	±20 pm (1520 to 1620 nm)*2
		±200 pm (1530 to 1570 nm)*3 , ±300 pm (600 to 1750 nm)*3	
	Stability	±5 pm	
	Linearity	±20 pm (1530 to 1570 nm)	
	Resolution	0.05, 0.07, 0.1, 0.2, 0.5, 1.0 nm (RBW: 3 dB optical filter; transmission bandwidth)	
	Read resolution	5 pm	
	Resolution*4	≤±2.2% (1530 to 1570 nm, resolution: 0.5 nm) ≤±3% (1530 to 1570 nm, resolution: 0.2 nm) ≤±7% (1530 to 1570 nm, resolution: 0.1 nm) ≤±4% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.5 nm) ≤±5% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.2 nm) ≤±10% (1520 to 1530 nm, 1570 to 1620 nm, resolution: 0.1 nm)	≤±2.2% (1520 to 1620 nm, resolution: 0.5 nm) ≤±3% (1520 to 1620 nm, resolution: 0.2 nm) ≤±7% (1520 to 1620 nm, resolution: 0.1 nm)
		≤±7% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.5 nm) ≤±15% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.2 nm) ≤±30% (1600 to 1520 nm, 1620 to 1750 nm, resolution: 0.1 nm)	

Continued on next page

Main frame, option		MS9710C	With Option 15 (L-band enhancement)
Level	Measurement range	–65 to +10 dBm (600 to 1000 nm, 0 to +30˚C, optical ATT: off) –85 to +10 dBm (1000 to 1250 nm, 0 to +30˚C, optical ATT: off) –90 to +10 dBm (1250 to 1600 nm, 0 to +30˚C, optical ATT: off) –75 to +10 dBm (1600 to 1700 nm, 0 to +30˚C, optical ATT: off) –55 to +10 dBm (1700 to 1750 nm, 0 to +30˚C, optical ATT: off) –60 to +10 dBm (600 to 1000 nm, +30 to +50˚C, optical ATT: off) –80 to +10 dBm (1000 to 1250 nm, +30 to +50˚C, optical ATT: off) –85 to +10 dBm (1250 to 1600 nm, +30 to +50˚C, optical ATT: off) –70 to +10 dBm (1600 to 1700 nm, +30 to +50˚C, optical ATT: off) –50 to +10 dBm (1700 to 1750 nm, +30 to +50˚C, optical ATT: off) –70 to +23 dBm (1100 to 1600 nm, 0 to +30˚C, optical ATT: on) –65 to +23 dBm (1100 to 1600 nm, +30 to +50˚C, optical ATT: on) [Resolution: ≥0.07 nm, VBW: 10 Hz, sweep average: 10 times]	
	Accuracy	±0.4 dB (1300/1550 nm, input: –23 dBm, resolution: ≥0.1 nm)	
	Stability	±0.02 dB (1 min, resolution: ≥0.1 nm, input: –23 dBm, no polarization fluctuation)	
	Flatness	±0.1 dB (1530 to 1570 nm, resolution: 0.5 nm, optical ATT: off) ±0.3 dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)	±0.1 dB (1520 to 1620 nm, resolution: 0.5 nm, optical ATT: off)
	Linearity	±0.05 dB (1550 nm, –50 to 0 dBm, optical ATT: off) ±0.05 dB (1550 nm, –30 to +20 dBm, optical ATT: on)	±0.05 dB (1550/1600 nm, –50 to 0 dBm, optical ATT: off) ±0.05 dB (1550/1600 nm, –30 to +20 dBm, optical ATT: on)
Polarization dependency		±0.05 dB (1550/1600 nm), ±0.1 dB (1300 nm) *Setting resolution: ≥0.5 nm	
Dynamic range*5		High-dynamic range mode (20˚ to 30˚C): 70 dB (1 nm from peak wavelength), 60 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength) Normal mode (20˚ to 30˚C): 62 dB (1 nm from peak wavelength), 58 dB (0.4 nm from peak wavelength), 42 dB (0.2 nm from peak wavelength)	
Optical return loss		≥35 dB (1300/1550 nm)	
Sweep		Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical)*6 : 0.5 s (normal dynamic mode, sweep width: 500 nm, VBW: 10 kHz, center wavelength: 1200 nm, sweep start to stop, no optical input, sampling point: 501)	
Display		6.4 inch, color TFT-LCD	
Memory		A/B (2 trace), 3.5 inch FDD (for MS-DOS® format)	
Printer		Internal (thermal type)	
Interface		GPIB, RS-232C, VGA output	
Operating conditions		Operating temperature: 0˚ to +50˚C (FDD: +5˚ to +50˚C), storage temperature: –20˚ to +60˚C, Relative humidity: ≤90% (no condensation, FDD: 20 to 80%) Shock: 30 G, 11 ms pulse, half sine	
Power		85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)	
Dimensions and mass		320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg	
EMC		EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)	
LVD		EN61010-1: 2001 (Pollution Degree 2)	

*1: One of these connector is attached. Please specify when ordering.
*2: After Wl cal (ref) at wavelength reference optical light source (Option 05/13), resolution: 0.05 to 0.2 nm
*3: After Wl cal (Ext) at DFB-LD and soon external optical light source
*4: Actual screen resolution, 0˚ to +30˚C
*5: Setting resolution: 0.05 nm, wavelength: 1550 nm, optical attenuator: off
*6: Typical value for reference; not guaranteed specification

VBW, sweep speed, minimum light reception sensitivity*1

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity*2	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

*1: Data for reference (501 points no averaging; not guaranteed specifications)
*2: RMS noise level (1250 to 1600 nm)

Note: Warm-up the MS9710C for about 5 min. to ensure stable operation. The above specifications were obtained 2 hours after power-on.

White light source (Option 02)

Optical output	≥–59 dBm/nm (multimode fiber input)*1
Wavelength range	900 to 1600 nm
Operating temperature	+18˚ to +28˚C

*1: –65 dBm (typ) measured with MS9710C (at 1 nm wavelength resolution) which has single-mode fiber at the input.

Wavelength reference light source (Option 05)

Wavelength reference	1530 nm band Acetylene

Wavelength reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C
Wavelength reference	1530 nm band Acetylene

*1: Measured after one hour warm-up

SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710C setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C

*1: Measured after one hour warm-up

Ordering information

Please specify model/order number, name, and quantity when ordering.

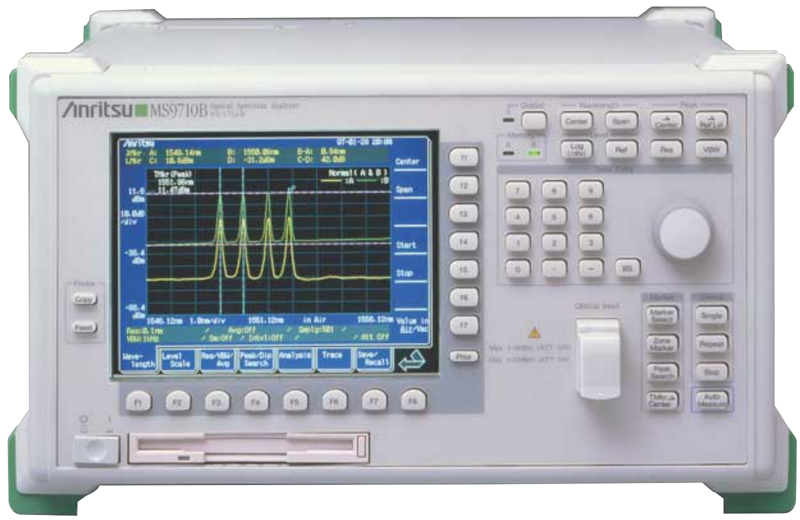
Model/Order No.	Name	
	Main frame	
MS9710C	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter*1:	1 pc
	Power cord, 2.5 m:	1 pc
Z0312	Printer paper:	2 rolls
W1579AE	MS9710C operation manual:	1 copy
W1580AE	Remote control operation manual:	1 copy
MX971003S	LabVIEW® driver (RS-232C):	1 pc
MX971003G	LabVIEW® driver (GPIB):	1 pc
B0329G	Front cover:	1 pc
	Options	
MS9710C-02	White light source*2	
MS9710C-05	Wavelength reference light source*2	
MS9710C-13	Wavelength reference & SLD light source*2	
MS9710C-14	SLD light source*2	
MS9710C-15	L-band enhancement	
MS9710C-25	FC-APC connector*3	
MS9710C-26	SC-APC connector*3	
MS9710C-27	E2000 connector*3	
MS9710C-31	EC (Radial) connector*3	
MS9710C-37	FC connector*4	
MS9710C-38	ST connector*4	
MS9710C-39	DIN connector*4	
MS9710C-40	SC connector*4	
MS9710C-43	HMS-10/A connector*4	
MS9710C-47	HRL-10 connector*3	
	Application parts	
J0654A	RS-232C cable (9P-9P)	
J0655A	RS-232C cable (9P-25P)	
J0007	GPIB cable, 1 m	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0635B	FC-PC · FC-PC 2M-SM (FC-PC optical fiber cord, 2 m, SM)	
Z0282	Ferrule cleaner	
Z0283	Replacement reel for ferrule cleaner (for Z0282)	
Z0284	Cleaner for optical adapter (stick type)	
G0084A	Polarization rotation module (for PMD measurement)	
B0330C	Tilt stand	

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9710C-37) is supplied as standard.
*2: Factory options; Two units cannot be installed simultaneously.
Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.
*3: Factory option
*4: User replaceable

OPTICAL SPECTRUM ANALYZER
MS9710B
600 to 1750 nm

GPIB

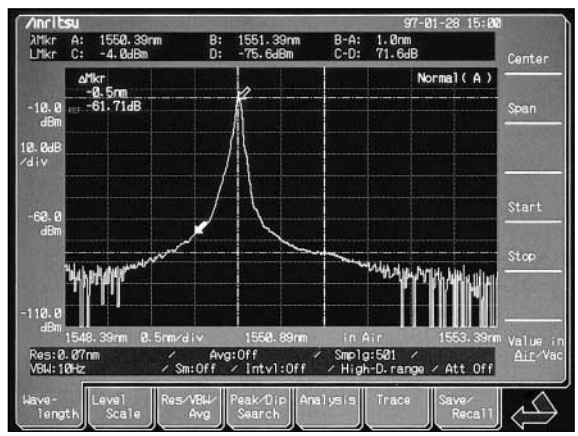
For Evaluating LED/LD Spectra and Transmission Characteristics of Passive Elements



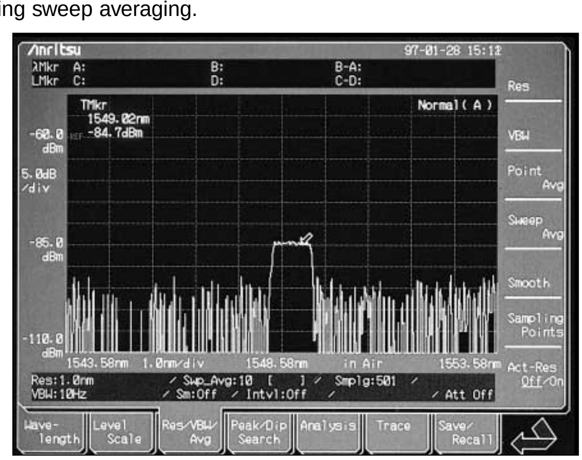
The MS9710B is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as the NF/Gain of optical fiber systems.
In addition to its basic features, the superior stability and reliability of the diffraction grating (patent pending) easily pass the severe specifications required for precise measurement of WDM communications methods, particularly in the 1.55 µm band. This analyzer has the dynamic range, reception sensitivity, and sweep speed requested by users, backed by Anritsu's high-level technology. The high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements in the 1.55 µm band.
In addition to having a much wider dynamic range, its compact portability (approx. 50% lighter) eliminates the large cumbersome image of earlier analyzers by perfectly combining portability with high performance. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

Features
- 70 dB dynamic range
- –90 dBm guaranteed optical reception sensitivity
- Internal 3.5 inch FDD (Windows®)
- Tracking with tunable laser source
- Optical pulse measurement
- Full range of WDM application functions

Performance and functions
• 70 dB dynamic range
The measurement dynamic range of the MS9710B in the normal measurement mode at a wavelength 1 nm from the peak wavelength is 62 dB. In the high dynamic range measurement mode, better than 70 dB can be achieved. The analyzer demonstrates its excellence in SMSR measurement of DFB-LDs, as well as in evaluation of narrow-band optical band pass filters. (See top screen in adjoining column.)



• –90 dBm guaranteed optical reception sensitivity
The MS9710B has achieved an improved S/N over a wide range by taking thorough countermeasures to noise and stray light. The RMS noise level at wavelengths from 1250 to 1600 nm is –90 dBm max. The screen display below is the waveform obtained when measuring a 1.55 µm DFB-LD optical source of –85 dBm; only 25 seconds are required for the measurement. In addition, the S/N can be improved using sweep averaging.



• Full function lineup

In addition to its excellent basic functions, the MS9710B comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, PMD measurement (See applications.)
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz
Markers	Multimarkers: Marker function for max. 128 points (See applications.) Zone markers: For waveform analysis in zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength display	Converts displayed wavelength to value in vacuum
External interfaces	GPIB, RS-232C

• Relying on 1.55 µm transmission band

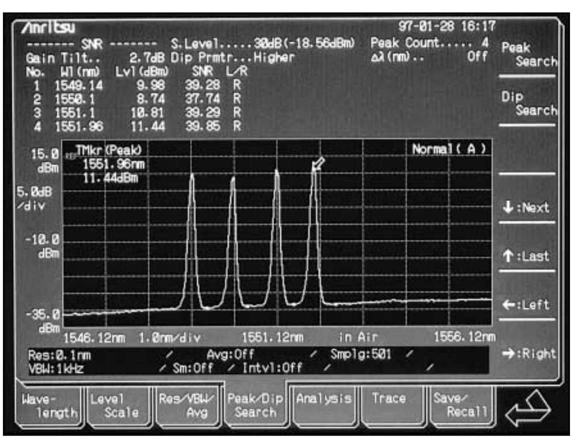
As a result of the need for increased transmission capacity, R&D into large-capacity transmission techniques is becoming more active and wavelength division multiplexing (WDM) is ready to use. This WDM transmission technology requires quantitative measurement of the wavelength transmission characteristics between each channel.

Measuring instruments for this purpose require more accurate wavelength and level measurement. Furthermore, accurate measurement of fiber-amplifier NF requires extremely good polarized light dependency and level linearity specifications. The MS9710B design has achieved excellent wavelength and level specifications for this purpose in the 1.53 to 1.57 µm wavelength band. In particular, the wavelength accuracy can be calibrated automatically using an optional internal reference wavelength light source — the post-calibration accuracy is better than ±0.05 nm. Evaluation of WDM systems requires measurement without repeated calibration at each measurement and the MS9710B achieves high-accuracy measurement with high repeatability.

Applications

• Spectrum analysis for WDM communication system

The wavelength characteristics for the gain, and signal to noise ratio (SNR) between each channel are difficult problems in WDM transmission technology. In evaluation, it is very important to measure this quantitatively. The MS9710B permits extremely quick and simple waveform analysis of up to 300 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain.

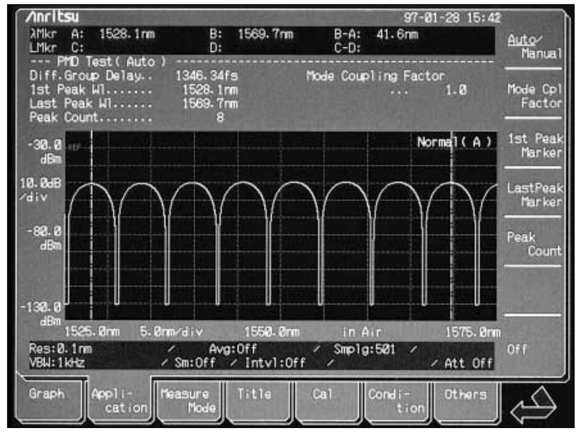


• Polarization mode dispersion

An important factor determining the upper limit of the transmission bit rate is the polarization mode dispersion (PMD). PMD is measured in the time and wavelength domains (see below). The MS9710B can be used as a fixed analyzer to perform simple and automated measurement in the wavelength domain and immediately computes the PMD by data processing from the measured waveform. The wavelength difference ($\lambda_2 - \lambda_1$) between the peak wavelength (λ_1) and the wavelength at the Nth peak (λ_2) are read directly, and the PMD is calculated from the following equation:

$$PMD = K \frac{N-1}{C} \times \frac{\lambda_1 \cdot \lambda_2}{\Delta\lambda}$$

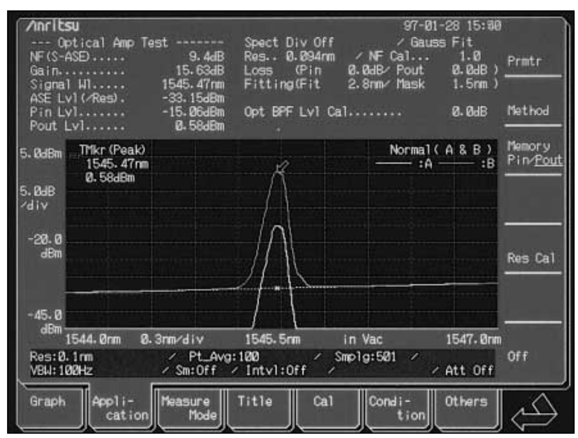
where: K is the mode coupling factor and C is the speed of light (m/s).



• NF measurement of fiber amplifier (EDFA)

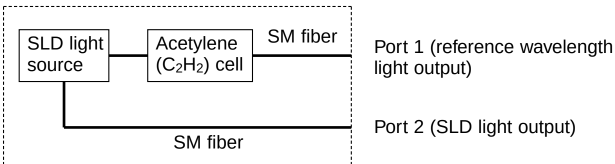
NF measurement by the optical method using an optical spectrum analyzer measures the light input and output to and from the EDFA. NF is determined by the beat noise between the optical signal and the amplified spontaneous emission (ASE) as well as by the beat noise between the ASE (see below).

Since the MS9710B measures the ASE level with very high accuracy, three methods can be used to measure NF: 1. Pulse measurement (JIS Method: under discussing), 2. Level calibration using fitting, and 3. Polarized light nulling. Moreover, measurement can be performed with the required dynamic range, level linearity, and polarization dependency.



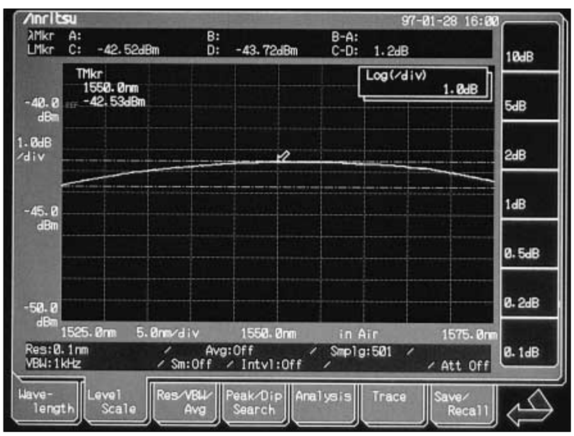
• Convenient light source option (reference wavelength or white light) for better accuracy

The Wavelength reference & SLD light source (Option 13), SLD light source (Option 14), Wavelength reference light source (Option 05), and White light source (Option 02) can each be installed in the MS9710B. The block diagram of the SLD light source and reference wavelength light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration and Port 2 for measuring transmission characteristics. When the MS9710B is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.52 to 1.57 µm range is better than ±0.05 nm. This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.



Block diagram of SLD light source & reference wavelength light

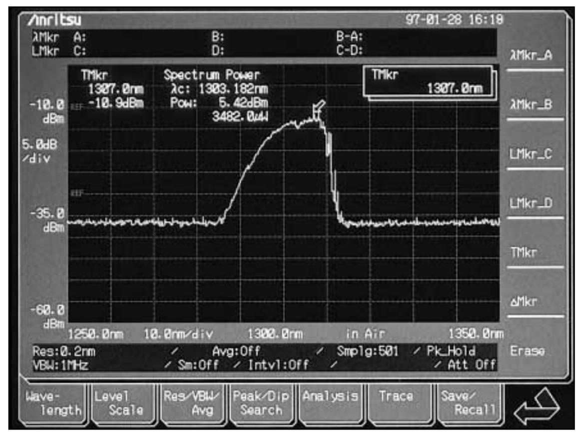
The following diagram shows the spectrum of the SLD light output from Port 2. When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.



Spectrum of SLD light source

• Measurement of modulated and pulsed light

The synchronization signal for the measured modulated/pulsed light is input to the external input trigger on the rear panel. With this analyzer, the data can be held by this sync signal. As a result, the spectrum of the modulated or pulsed light can be measured accurately without data loss. In addition, an optical source that does not have a sync signal can be measured in the same manner by setting an appropriate gate time. The waveform in the diagram on the right shows measurement of an optical pulse (OTDR's light source) with a pulse width of 1 µs and a duty cycle of 1%. However, for accurate spectrum measurement, the VBW must be set to a wider bandwidth than the modulation frequency of the measured light (see below). The maximum settable VBW in the MS9710B is 1 MHz. (Refer to the specifications page for the relationship between VBW, received light sensitivity and sweep time.)



Specifications

• MS9710B

Fiber	10/125 µm SM fiber (ITU-T G.652)
Optical connector*1	User replaceable: FC, SC, ST, DIN, HMS-10/A Factory option (not user replaceable): E-2000, EC (Radial), FC-APC, SC-APC, HRL-10
Wavelength	Range: 600 to 1750 nm Accuracy: ±0.2 nm (1530 to 1570 nm, after wavelength calibration) ±0.3 nm (600 to 1750 nm, after wavelength calibration) ±0.05 nm (1530 to 1570 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option) ±0.1 nm (1530 to 1570 nm, resolution: 0.5 to 1 nm, after calibration with wavelength reference light source option) Stability: ±5 pm (smoothing: 11 points, 1 minute, at half-width center wavelength) Linearity: ±20 pm (1530 to 1570 nm) Resolution: 0.07, 0.1, 0.2, 0.5, 1 nm Resolution accuracy*2: ±≤2.2% (resolution: 0.5 nm, 1550 ±20 nm), ±≤7% (resolution: 0.5 nm, at other wavelength), ±≤3% (resolution: 0.2 nm, 1550 ±20 nm), ±≤15% (resolution: 0.2 nm, at other wavelength), ±≤7% (resolution: 0.1 nm, 1550 ±20 nm), ±≤30% (resolution: 0.1 nm, at other wavelength)
Level	Measurement range: –65 to +10 dBm (600 to 1000 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –85 to +10 dBm (1000 to 1250 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –90 to +10 dBm (1250 to 1600 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –75 to +10 dBm (1600 to 1700 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –55 to +10 dBm (1700 to 1750 nm, +10˚ to +30˚C, VBW: 10 Hz, sweep averaging: 10 times) –65 to +20 dBm (1100 to 1600 nm, attenuator: on) Accuracy: ±0.4 dB (1300/1550 nm, –23 dBm, resolution: ≥0.1 nm) Stability: ±0.02 dB (1550 nm, –23 dBm, resolution: ≥0.1 nm, 1 minute, constant temperature, no polarization shift) Linearity: ±0.05 dB (1550 nm, 0 to –50 dBm) Flatness: ±0.1 dB (1530 to 1570 nm)

Continued on next page

Polarization dependency	±0.05 dB (1.55 µm band, resolution: ≥0.5 nm), ±0.1 dB (1.3 µm band, resolution: ≥0.5 nm)
Dynamic range	70 dB (±1 nm, resolution: 0.07 nm, 1.55 µm band, high-dynamic range mode measurement, 20˚ to 30˚C) 60 dB (±0.5 nm, resolution: 0.07 nm, 1.55 µm band, high-dynamic range mode measurement, 20˚ to 30˚C) 62 dB (±1 nm, resolution: 0.07 nm, 1.55 µm band, normal mode measurement) 58 dB (±0.5 nm, resolution: 0.07 nm, 1.55 µm band, normal mode measurement)
Optical return loss	≥35 dB (1.3/1.55 µm band)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed*3(typical): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4 inch color TFT-LCD
Memory	A, B (2 traces), 3.5 inch FDD (for Windows®)
Printer	Internal (thermal type)
Interface	GPIB, RS-232C
Main functions	Optical pulse measurement, power monitor, wavelength auto-calibration
Operating conditions	Operating temperature: 0˚ to +50˚C (FDD: 5˚ to 50˚C), storage temperature: –20˚ to +60˚C, Relative humidity: ≤90% (no condensation)
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: One of these connector is attached. Please specify when ordering.
*2: Actual screen resolution
*3: Typical value for reference; not guaranteed specification

• White light source (Option 02)

Optical output	≥–59 dBm/1 nm (multimode/fiber input)*1
Wavelength range	900 to 1600 nm
Operating temperature	18˚ to 28˚C

*1: –65 dBm (typ.) measured with MS9710B (at 1 nm wavelength resolution) which has single mode fiber at the input

• Wavelength reference light source (Option 05)

Wavelength reference	1.53 µm band Acetylene

• Wavelength reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C
Wavelength reference	1530 nm band Acetylene

*1: Measured after one hour warm-up

• SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C

*1: Measured after one hour warm-up

• VBW, sweep speed, minimum light reception sensitivity*1

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ.)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity*2	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

*1: Data for reference; not guaranteed specifications
*2: RMS noise level (1.25 to 1.6 µm)

Note: Warm-up to the MS9710B for about 5 minutes to ensure stable operation. The above specifications were obtained 2 hours after power-on.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS9710B	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter*1:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100/200 Vac system):	2 pcs
Z0312	Printer paper:	2 rolls
W1283AE	MS9710B operation manual:	1 copy
W1284AE	Remote control operation manual:	1 copy
MX971002S	LabVIEW® driver (RS-232C):	1
MX971002G	LabVIEW® driver (GPIB):	1
B0329G	Front cover:	1 pc
	Options	
MS9710B-02	White light source*2	
MS9710B-05	Wavelength reference light source*2	
MS9710B-06	Monitor output	
MS9710B-10	Functional addition (Frequency display, table display)	
MS9710B-13	Wavelength reference & SLD light source*2	
MS9710B-14	SLD light source*2	
MS9710B-25	FC-APC connector*3	
MS9710B-26	SC-APC connector*3	
MS9710B-27	E2000 connector*3	
MS9710B-31	EC (Radial) connector*3	
MS9710B-37	FC connector*4	
MS9710B-38	ST connector*4	
MS9710B-39	DIN connector*4	
MS9710B-40	SC connector*4	
MS9710B-43	HMS-10/A connector*4	
MS9710B-47	HRL-10 connector*3	
	Application parts	
J0654A	RS-232C cable, 9P-9P	
J0655A	RS-232C cable, 9P-25P	
J0007	GPIB cable, 1 m	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0635B	FC·PC-FC·PC-2M-SM (FC·PC optical fiber cord, 2 m, SM)	
Z0282	Ferrule cleaner	
Z0283	Replacement reel for ferrule cleaner (for Z0282)	
Z0284	Cleaner for optical adapter (stick type)	
G0084A	Polarization rotation module (for PMD measurement)	
B0330C	Tilt stand	

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9710B-37) is supplied as standard.
*2: Factory options; Two units cannot be installed simultaneously. Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.
*3: Factory option
*4: User replaceable

OPTICAL SPECTRUM ANALYZER

GPIB

MS9780A

600 to 1750 nm

For Fibers with Core Diameters of 10, 50, and 62.5 µm

The MS9780A is a diffraction-grating spectrum analyzer for analyzing optical spectra in the 600 to 1750 nm wavelength band. Its input section has been redesigned to support fibers with core diameters of 50/62.5 µm; the input section of the MS9780A can be used to measure the spectra of LDs and LEDs, etc. In addition to uses such as measurement of LD and LED spectra, it has functions for measuring the transmission characteristics of passive elements such as optical isolators, as well as the NF/Gain of optical fiber amplifier systems. In addition to its basic features, the superior stability and reliability of the diffraction-grating (patent pending) capability easily passes the severe specifications required for the precise measurement of WDM communications methods, particularly in the 1.55 µm band.
This analyzer, which is backed by Anritsu's high-level technology, has the dynamic range, reception sensitivity and sweep speed requested by users. Its high sensitivity meets the exacting demands placed on today's measuring instruments. In particular, the excellent wavelength and level specifications fully meet the dense WDM requirements in the 1.55 µm band. In addition to the high reliability and excellent basic performance, this analyzer has a full range of application functions to support accurate measurement in the fastest possible time.

Features

- **70 dB dynamic range**
- **–90 dBm guaranteed optical reception sensitivity**
- **Optical pulse measurement**
- **Full range of WDM application functions**
- **Tracking with tunable laser source**

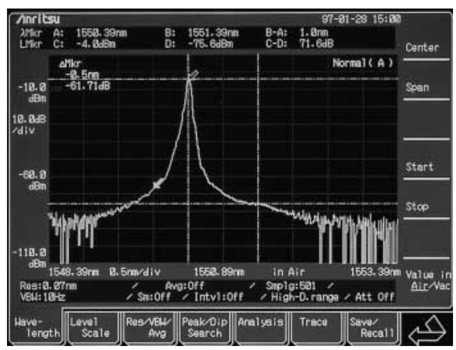
Applications

• 70 dB dynamic range
The measurement dynamic range of the MS9780A in the normal measurement mode at a wavelength 1 nm from the peak wavelength is 62 dB. In the high-dynamic range measurement mode, better than 70 dB can be achieved. The analyzer demonstrates its excellence in SMSR measurement of DFB-LDs, as well as in evaluation of narrow-band optical band pass filters.

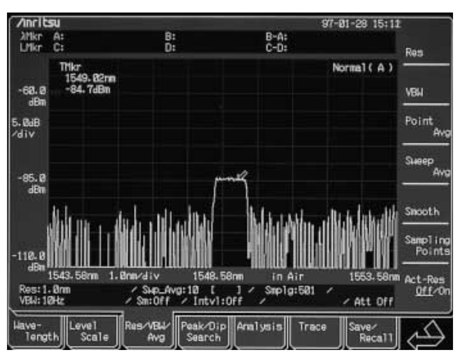
Measurement mode	Dynamic range (at SM fiber)	
	1 nm from peak	0.5 nm from peak
High dynamic range	70 dB	60 dB
Normal	62 dB	58 dB

Wide-dynamic range measurement example with DFB-LD spectrum passed via narrow-band BPF.

DFB-LD — Narrow-band BPF — MS9780A



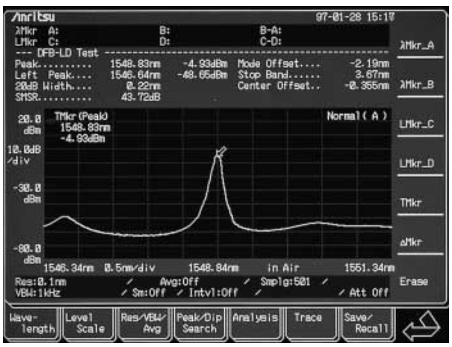
• –90 dBm guaranteed optical reception sensitivity
The MS9780A has achieved an improved S/N over a wide range by taking thorough countermeasures to noise and stray light. The RMS noise level at wavelengths from 1250 to 1600 nm is –90 dBm max. In addition, the S/N can be improved using sweep averaging. The screen display below shows the waveform after 10 averagings; the S/N is improved by more than 5 dB.



• Full function lineup

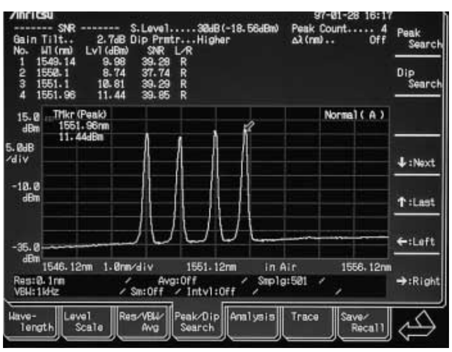
In addition to its excellent basic functions, the MS9780A comes with a full lineup of other useful functions summarized in the following table.

Device analysis	For analyzing and evaluating waveforms of optical elements (DFB-LDs, FP-LDs, LEDs)
Waveform analysis	For waveform analysis by RMS and threshold methods; SMSR, half-width evaluation, WDM waveform analysis
Application measurement	EDFA NF and gain measurement, PMD measurement (See applications.)
Modulation, pulsed light measurement	Max. frequency range (VBW) = 1 MHz (See applications.)
Markers	Multimarkers: Marker function for max. 128 points (See applications.) Zone markers: For waveform analysis in zone specified zone Peak/dip search: Searches for a peak or dip
Power monitor	Also functions as optical power meter
Vacuum wavelength	Converts displayed wavelength to value in display vacuum
External interfaces	GPIB, RS-232C



• Spectrum analysis for WDM communication systems

Difficult problems in WDM transmission technology are the wavelength characteristics for the gain, and signal to noise ratio (SNR) between each channel. In evaluation, it is very important to measure this quantitatively. The MS9780A permits extremely quick and simple waveform analysis of up to 128 spectra. The waveform and level (SNR) of each peak exceeding the set threshold is displayed. The screen display below shows an example of the tilt gain.

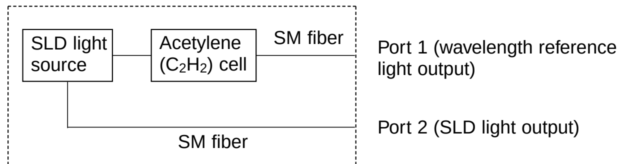


• Convenient light source option (refer wavelength light) for better accuracy

Any one of the wavelength reference & SLD light source (Option 13), SLD light source (Option 14), wavelength reference light source (Option 05), and white light source (Option 02) can be installed in the MS9780A.

The block diagram of the wavelength reference & SLD light source option is shown below. This option has two separate output ports: Port 1 for wavelength calibration, and Port 2 for measuring transmission characteristics. When the MS9780A is calibrated automatically by inputting the reference light for the wavelength, post-calibration wavelength accuracy in the 1.52 to 1.57 µm range is better than ±0.05 nm. This is very useful in precision absolute measurement of the wavelengths of light sources used in WDM systems.

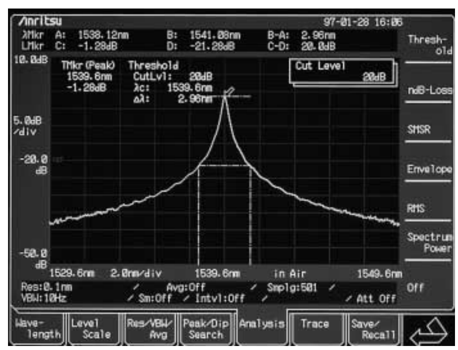
MS9780A



Block diagram of wavelength reference & SLD light

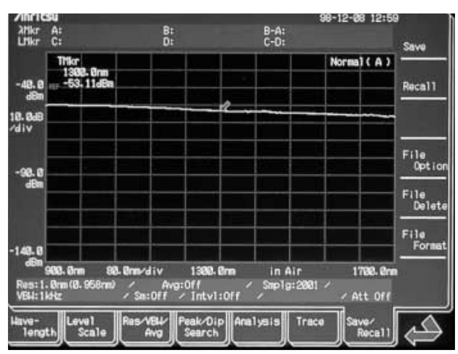
The following diagram shows the spectrum of the SLD light output from Port 2. When this light source is used instead of the earlier white light source for measurement of the wavelength transmission characteristics of optical receiver elements, it is possible to achieve a 20 dB wider dynamic range.

The following figure shows an example of measuring the transmission characteristics of optical band pass filter using the SLD light.



Measurement of optical band pass filter

If this dynamic range is not required, a lower-cost white light source can be installed instead. The following figure shows the spectrum of the white light source. When this light is used, transmission characteristics can be measured in wide range of 900 to 1750 nm.



Spectrum of white light source

Specifications

• MS9780A

Fiber	SM (9.5/125 µm), GI (50/125 µm)*1, GI (62.5/125 µm)*1
Wavelength	Range : 600 to 1750 nm Sweep width: 0, 0.2 to 1200 nm Accuracy: ±0.3 nm (600 to 1750 nm, after wavelength calibration with external light source) ±0.05 nm (1550 ±20 nm, resolution: 0.07 to 0.2 nm, after calibration with wavelength reference light source option)*2 ±0.1 nm (1550 ±20 nm, resolution: 0.5/1.0 nm, after calibration with wavelength reference light source option)*2 Stability: ±5 pm (1 minute)
Resolution	Setting: 0.07*2, 0.1, 0.2, 0.5, 1.0 nm Accuracy*2,*3: ±30% (1300/1550 nm, resolution: 0.1 nm), ±15% (1300/1550 nm, resolution: 0.2 nm), ±7% (1300/1550 nm, resolution: 0.5 nm)
Level	Measurement range (attenuator: off, 0° to +30°C)*4: –65 to +10 dBm (600 to 1000 nm), –85 to +10 dBm (1000 to 1250 nm), –90 to +10 dBm (1250 to 1600 nm), –75 to +10 dBm (1600 to 1700 nm), –55 to +10 dBm (1700 to 1750 nm, +10° to +30°C) Measurement range (attenuator: on, 0° to +30°C): –65 to +20 dBm (1100 to 1650 nm) Accuracy*2: ±0.6 dB (1300/1500 nm, –23 dBm, resolution: ≥0.2 nm) Stability*2: ±0.1 dB (1550 nm, –23 dBm, resolution: ≥0.2 nm, 1 minute) Linearity*2: ±0.1 dB (1550 nm, –50 to 0 dBm) Polarization dependency*2: ±0.15 dB (1300/1500 nm, resolution: ≥0.5 nm) Dynamic range*2 Normal mode: 62 dB (±1 nm), 58 dB (±0.5 nm) *1550 nm, resolution: 0.07 nm Wide dynamic range mode: 70 dB (±1 nm), 60 dB (±0.5 nm) *1550 nm, resolution: 0.07 nm, 25° ±5°C Return loss*2: 32 dB (1300/1550 nm)
Sweep	Sweep width: 0, 0.2 to 1200 nm Sweep speed (typical*5): 0.5 s (sweep width: 500 nm, normal mode measurement, VBW: 10 kHz)
Display	6.4 inch color TFT-LCD
Memory	A, B (2 trace), 3.5 inch FDD (for Windows®)
Printer	Internal (thermal type)
Interface	GPIB, RS-232C
Main functions	Optical pulse measurement, power monitor, wavelength auto-calibration
Operating conditions	Operating temperature: 0° to +50°C (FDD: 5° to 50°C), Storage temperature: –20° to +60°C Relative humidity: ≤90% (no condensation)
Power	85 to 132 Vac/170 to 250 Vac, 47.5 to 63 Hz, 150 VA (max.)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg

*1: The NA of GI fiber is 0.2 for a core diameter of 50/125 µm and 0.275 for 62.5/125 µm. However, the permissible NA is 0.1 due to the spectroscope limitations.
*2: Connects to SM fiber (10/125 µm)
*3: Effective resolution value
*4: VBW: 10 Hz, sweep average: 10 times
*5: Typical value for reference; not guaranteed specification

• White light source (Option 02)

Optical output	≥–59 dBm/1 nm (typical value: –55 dBm/1 nm)
Wavelength range	900 to 1600 nm
Operating temperature	+18° to +28°C

• Wavelength reference light source (Option 05)

Wavelength reference	1.53 µm band Acetylene

• Wavelength reference & SLD light source (Option 13)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C
Wavelength reference	1530 nm band Acetylene

*1: Measured after one hour warm-up

• SLD light source (Option 14)

Wavelength range	1450 to 1650 nm
Output level	>–40 dBm/nm (1550 nm ±10 nm) >–60 dBm/nm (1450 to 1650 nm)
Output level stability*1	±0.04 dB (MS9710B setting resolution: 1 nm, no polarization change, constant temperature, measured for 20 min at 1550 nm)
Spectrum half width	>70 nm (typical: 90 nm)
Optical connector	User replaceable type (FC, SC, ST, DIN, HMS-10/A)
Operating temperature	0˚ to 40˚C

*1: Measured after one hour warm-up

• VBW, sweep speed, minimum light reception sensitivity*1

VBW	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
Sweep speed (typ.)	30 s	5 s	0.5 s	0.5 s	0.5 s	0.5 s
Minimum light reception sensitivity*2	–90 dBm	–80 dBm	–70 dBm	–60 dBm	–50 dBm	–40 dBm

*1: Data for reference; not guaranteed specifications
*2: RMS noise level (1.25 to 1.6 µm)

Note: Warm-up to the MS9780A for about 5 minutes to ensure stable operation. The above specifications were obtained 2 hours after power-on.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS9780A	Optical Spectrum Analyzer	
	Standard accessories	
	Optical connector adapter*1:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100 Vac system):	2 pcs
Z0312	Printer paper:	2 rolls
W1477AE	MS9780A operation manual:	1 copy
W1478AE	Remote control operation manual:	1 copy
MX978001S	LabVIEW® driver (RS-232C):	1
MX978001G	LabVIEW® driver (GPIB):	1
B0239G	Front cover:	1 pc
	Options	
MS9780A-02	White light source*2	
MS9780A-05	Wavelength reference light source*2	
MS9780A-06	Monitor output (VGA output)*3	
MS9780A-13	Wavelength reference & SLD light source*2	
MS9780A-14	SLD light source*2	
MS9780A-27	E2000 connector*3	
MS9780A-37	FC connector*4	
MS9780A-38	ST connector*4	
MS9780A-39	DIN connector*4	
MS9780A-40	SC connector*4	
MS9780A-43	HMS-10/A connector*4	
	Application parts	
J0654A	RS-232C cable (9P-9P)	
J0655A	RS-232C cable (9P-25P)	
J0007	GPIB cable, 1m	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0893B	FC · PC-FC · PC-2M-GI (50/125 µm)	
J0894B	FC · PC-FC · PC-2M-GI (62.5/125 µm)	
J0203	Optical fiber cord with lens attached to end (50 µm core diameter), 2 m	
J0204	Optical fiber cord with lens attached to end (200 µm core diameter), 2 m	
Z0282	Ferrule cleaner (Cletop A type, 1 pc)	
Z0283	Tape for ferrule cleaner (6 pcs/set)	
Z0284	Cleaner for optical adapter (stick-type, 200 pcs/set)	
B0330C	Tilt stand	

*1: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified, the FC connector (MS9780A-37) is supplied as standard.
*2: Factory options; Two units cannot be installed simultaneously.
Exchangeable-type optical connectors (FC, SC, ST, DIN, HMS-10/A) are supplied when specified at ordering. One conversion cord is supplied for connecting other optical connectors to the FC connector.
*3: Factory option
*4: User replaceable

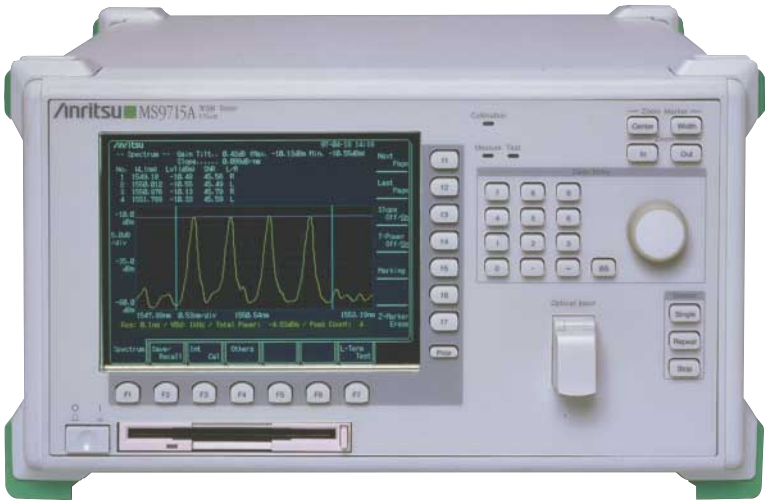
Note:
Windows is a registered trademark of Microsoft Corporation in the United States and other countries.
LabVIEW is a registered trademark of National Instruments.

1

WDM TESTER
MS9715A
1.527 to 1.567 µm

GPIB

For Maintaining and Monitoring WDM Optical Communication Systems



Custom-made product

Optical communications are getting into full swing. Great things are expected of WDM optical communications in answer to the recent social demand for dramatic increases in transmission volume. In WDM communications, multiple optical elements are used in an optical amplifier and various characteristics are precisely controlled to maintain system performance.
The MS9715A is a measuring instrument for use in system manufacture, construction, and maintenance. One instrument combines accurate measurement of necessary items over long periods and satisfies conditions of simplicity of use in construction and maintenance operations, lightness and compactness, and superior environmental performance with respect to vibration and shock. In addition, since the LabVIEW driver is fitted as standard, programming by remote control is simple. A windows compatible floppy disk drive is also fitted as standard.

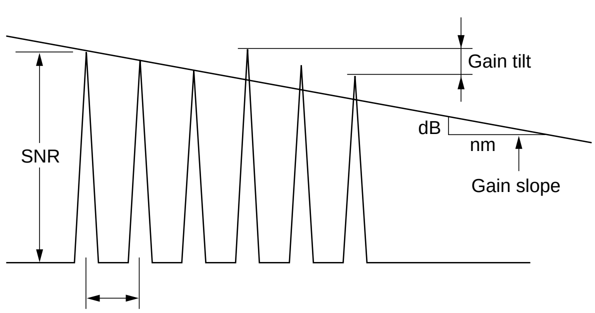
Feature
• For WDM optical communication

Performance and functions

• Measurement items

Maximum, minimum, and average values over a long period for wavelength, level, SNR*1, channel spacing*2, gain tilt*3, gain slope*4, total power, and spectrum measurement.

*1: Signal to Noise Ratio (dB). Noise resolution level of 0.1 nm. Of the signal's 2 extremes, that with the greater level (smaller SNR) is automatically selected.



Channel spacing

*2: Wavelength difference between spectra for individual signal (nm, GHz)

*3: Difference between maximum and minimum peak values for total signal spectrum

*4: Slope of least mean square regression line of total signal spectrum peaks (dB/nm)

• Superior basic functions

The MS9715A provides the high performance required for the performance testing and evaluation of WDM equipment. Wavelength measurement has ±50 pm accuracy, ±5 pm wavelength stability, and ±20 pm wavelength linearity. High performance level measurement has a dynamic range of 53 dB (0.5 nm from peak), ±0.4 dB level accuracy, ±0.02 dB level stability, and ±0.05 dB level linearity*5.

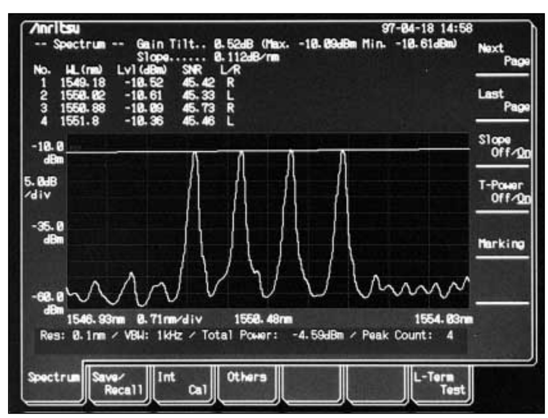
*5: 5 performances at 0.1 nm resolution

• Calculation functions

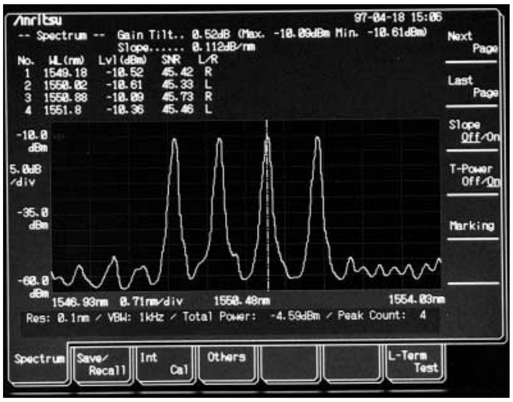
Measurement calculation functions for SNR, gain tilt, total power, gain slope, channel spacing, etc. are provided.

• 2 measurement modes

Spectrum measurement mode and long-time measurement mode are provided. As shown on the screen below, in spectrum measurement mode, the results calculated are displayed. (Spectrum is expanded or contracted using the zoom marker).

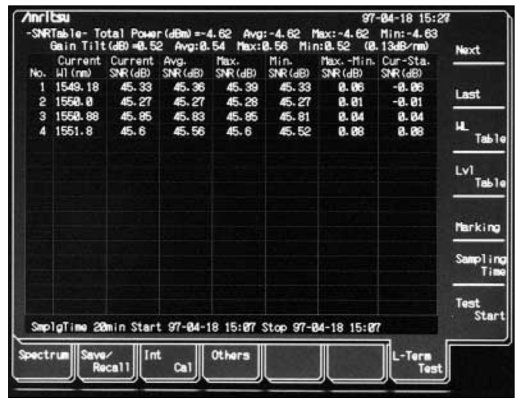


Example of gain tilt and gain slope display



Example of specific spectrum emphasis display

Wavelength table



Level table

• Ease of operation

Measured wavelength settings can be freely expanded or contracted using the zoom marker. The guide spectrum for a specific spectrum can be found at a glance while freely setting the marker. In addition, the level axis is automatically set by detection of maximum and minimum. Wavelength calibration is performed automatically using an internal standard light source.

• Long-time mode

The long-time mode displays measurement results for wavelength, level, and SNR in tables. Besides average value, maximum value, minimum value, and maximum – minimum value for the time interval set by the user (sampling period), the table displays the difference between the current value and that at start time (initial long-time measurement). The wavelength tables also display channel spacing. The complete table value display for each sampling period is treated as one set, and a maximum of 1000 sets are recorded on floppy disk. The behavior of the measured system can be analyzed over a long time period. During the long-time measurement, wavelength calibration is performed automatically using the internal wavelength standard; even if ambient conditions change during the measurement, high wavelength measurement accuracy is secured.

Specifications

Wavelength	Range: 1.527 to 1.567 µm (integrate power: 1.52 to 1.58 µm) Accuracy: ±0.05 nm Stability: ±5 pm (1 min), ±10 pm (constant temperature: 60 min) Linearity: ±20 pm Resolution: 0.1 nm Resolution accuracy: ±10% (actual display resolution)
Level	Range: –65 to +20 dBm Accuracy: ±0.4 dB Stability: ±0.02 dB (–23 dBm, 1 min, constant temperature) Linearity: ±0.05 dB (0 to –50 dBm) Flatness: ±0.15 dB
Polarization dependency	±0.25 dB
Dynamic range	58 dB (±1 nm), 53 dB (±0.5 nm)
Measurement signal	Max. 32 waves
Return loss	≥35 dB
Wavelength reference	Acetylene (1.52 µm)
Display	6.4", color TFT-LCD
Measurement item	Maximum, minimum and average values over a long period for wavelength, level, SNR, channel spacing, gain tilt, gain slope, total power, and spectrum
Memory	3.5" FD (for Windows)
Interface	RS-232C, GPIB
Environmental condition	Operating temperature: +5˚ to +50˚C Storage temperature: –20˚ to +60˚C Relative humidity: ≤90%
Power	AC 85 to 132/170 to 250 V, 47.5 to 63 Hz, ≤150 VA
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤16.5 kg

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Mainframe	
MS9715A	WDM Tester (custom-made product)	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (for 100/200 Vac system):	2 pcs
B0329G	Front cover (3/4MW4U):	1 pc
MX971501S	LabVIEW® driver (RS-232C):	1
MX971501G	LabVIEW® driver (GPIB):	1
W1234AE	MS9715A operation manual:	1 copy
W1235AE	MS9715A remote control operation manual:	1 copy
	Options	
MS9715A-27	E-2000 connector	
MS9715A-31	EC (Radial) connector	
MS9715A-37	FC connector	
MS9715A-38	ST connector	
MS9715A-39	DIN connector	
MS9715A-40	SC connector	
MS9715A-43	HMS-10/A connector	
	Optional accessories	
J0654A	Serial interface cable (IBM-PC/AT, for J-310)	
J0655A	Serial interface cable (9/25-pin, 9P-9P)	
J0007	GPIB cable, 1 m (2 pcs)	
J0617B	Replaceable optical connector (FC)	
J0618D	Replaceable optical connector (ST)	
J0618E	Replaceable optical connector (DIN)	
J0618F	Replaceable optical connector (HMS-10/A)	
J0619B	Replaceable optical connector (SC)	
J0635B	Optical fiber cord (FC-PC connector, for SM), 2 m	
Z0282	Ferrule cleaner (Cletop A type)	
Z0283	Tape for Ferrule cleaner (6 pcs/set, for Z0282)	
Z0284	Adapter cleaner (200 pcs/set)	

OPTICAL CHANNEL SELECTOR

MN9662A/9664A/9672A/9674A

1.2 to 1.65 µm

CE GPIB

For Automatic Switching of Optical Paths

The optical channel selector is a switching device used for outputting the light that is inputted to the common channels to any channel. The above devices are equipped with eight (for MN9662A/9672A) and sixteen (for MN9664A/9674A) channels, making them ideal for the evaluation of devices for WDM and various optical transmission devices*.
They possess excellent switching repeatability of 0.003 dB (typical value) and low polarization dependent loss of 0.03 dBp-p (MN9662A/9664A). Cleanable and replaceable optical adapters (FC, SC, ST, DIN and HMS-10/A) are also available as applications. Moreover, in addition to the control by the MT9810B Optical Test Set, GPIB and RS-232C interfaces are provided as standards, allowing the above devices to be used as components of an automatic measurement system.

*: Please contact us for 1 x 24, 2 x 24, 1 x 32 and 2 x 32 optical channel selectors

Features

- Low polarization-dependent Loss (0.03 dBp-p: MN9662A/9664A)
- Cleanable and replaceable optical adapters (FC, SC, ST, DIN, HMS-10/A)

Specifications

Typical values are given for reference only to assist in the use of these instruments, and are not guaranteed specifications.

Model		MN9662A	MN9664A	MN9672A	MN9674A
Number of channels		1 x 8	1 x 16	2 x 8	2 x 16
Wavelength		1.2 to 1.65 µm			
Applicable optical fiber		SM (ITU-T G.652)			
Insertion loss[*1, *2]		≤1.6 dB (1.1 dB typ.)		≤2.5 dB (2.0 dB typ.)	
Return loss[*3]		≥45 dB (PC connector)			
Polarization dependent loss[*1]		≤0.03 dBp-p (0.015 dBp-p typ.)[*4]		≤0.05 dBp-p (0.025 dBp-p typ.)[*5]	
Crosstalk		≤–80 dB			
Switching repeatability[*6]		≤0.02 dBp-p (0.003 dBp-p typ.)			
Switching time	Min.[*7]	≤600 ms			
	Max.	≤800 ms[*8]	≤1100 ms[*9]	≤800 ms[*8]	≤1100 ms[*9]
Switching life		≥1 x 10^7 times			
Max. input level		+23 dBm (200 mW)			
I/O optical connector		FC, SC, ST, DIN, HMS-10/A (all PC type)			
Temperature range		Operating: 0˚ to 50 ˚C, Storage: –30˚ to +71 ˚C			
Remote control		GPIB, RS-232C (D-sub 9-pin), control by MT9810B			
Power		85 to 132/170 to 250 Vac, ≤35 VA, 47.5 to 63 Hz			
Dimensions and mass		213 (W) x 88 (H) x 351 (D) mm, ≤4.5 kg			
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)			
LVD		EN61010-1: 2001 (Pollution Degree 2)			

*1: Specifications measured using master optical fiber cable
*2: Including connector loss at 2 points at 1.31 and 1.55 µm
*3: Loss depends on connected connector, using PC connector at ≥50 dB return loss at 1.31 and 1.55 µm
*4: At constant temperature in operating temperature range at 1.31 and 1.55 µm
*5: At constant temperature in operating temperature range at 1.55 µm
*6: At constant temperature in operating temperature range and constant polarization condition
*7: Between channel 1 and channel 2
*8: Between channel 7 and channel 8
*9: Between channel 15 and channel 16
Note: Please contact us for 1 x 24, 2 x 24, 1 x 32 and 2 x 32 optical channel selectors.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MN9662A	Optical Channel Selector (1 x 8 channels)	
MN9672A	Optical Channel Selector (2 x 8 channels)	
MN9664A	Optical Channel Selector (1 x 16 channels)	
MN9674A	Optical Channel Selector (2 x 16 channels)	
	Standard accessories	
	Power cord:	1 pc
F0008	Fuse, 1 A (for 100/200 V mains):	2 pcs
Z0397A	FC adapter caps*1	
B0329L	Front cover:	1 pc
W1489AE	MN9662A/9672A/9664A/9674A operation manual:	1 copy
	Options	
MN9662A/9664A-37	FC connector (with FC adapter cap)*2	
MN9672A/9674A-37	FC connector (with FC adapter cap)*2	
MN9662A/9664A-38	ST connector (with ST adapter cap)*2	
MN9672A/9674A-38	ST connector (with ST adapter cap)*2	
MN9662A/9664A-39	DIN connector (with DIN adapter cap)*2	
MN9672A/9674A-39	DIN connector (with DIN adapter cap)*2	
MN9662A/9664A-40	SC connector (with SC adapter cap)*2	
MN9672A/9674A-40	SC connector (with SC adapter cap)*2	
MN9662A/9664A-43	HMS-10/A connector (with HMS-10/A adapter cap)*2	
MN9672A/9674A-43	HMS-10/A connector (with HMS-10/A adapter cap)*2	
	Application parts	
J0617B	Replaceable optical adapter (FC-PC)	
J0618D	Replaceable optical adapter (ST)	
J0618E	Replaceable optical adapter (DIN)	
J0618F	Replaceable optical adapter (HMS-10/A)	
J0619B	Replaceable optical adapter (SC)	
Z0397A	FC adapter cap	
Z0411A	ST adapter cap	
Z0412A	DIN adapter cap	
Z0413A	SC adapter cap	
Z0414A	HMS-10/A adapter cap	
J0635B	Optical fiber cord (FC-PC connector), 2 m	
J0006	GPIB cable, 0.5 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0009	GPIB cable, 4 m	
J0654A	Serial interface cross cable (for IBM-PC/AT, J-310)	
J0655A	Serial interface cross cable (for PC-98)	
J0897B	MT9810B connection cable, 1 m	
J0897C	MT9810B connection cable, 2 m	
J0897D	MT9810B connection cable, 5 m	
J0897E	MT9810B connection cable, 10 m	
Z0282	Ferrule cleaner (Cletop A-type)	
Z0283	Ferrule cleaning tape (6 pcs/set)	
Z0284	Adapter cleaner (stick type, 200 pcs/set)	
B0390G	Rack mount for 1 set	
B0390H	Rack mount for 2 sets	

*1: Number differs according to model
MN9662A: 9 pcs; MN9672A: 10 pcs; MN9664A: 17 pcs; MN9674A: 18 pcs
*2: Standard connector for specified option. If not specified, FC connector (Option 37) supplied as standard.

OPTICAL DIRECTIONAL COUPLER

MN9604C/D

1.25 to 1.65 µm

For High-Accuracy Measurement of Optical Connector Return Loss

The MN9604C/D is used in combination with stabilized light source and optical power meter to measure optical return loss of optical connectors at approx. 50 dB.

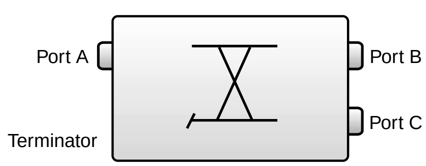
Specifications

Model	MN9604C	MN9604D
Compatible fiber	SM (10/125 µm, NA 0.1)	
Wavelength range	1.25 to 1.65 µm	
Insertion loss	<5.5 dB (1.31/1.55 µm: <5.0 dB, between ports A to B and ports A to C)	
Loss difference between ports	<2.2 dB (1.31/1.55 µm: <1.5 dB, between ports A to B and ports A to C)	
Insertion loss polarization dependency	<0.15 dB[*1]	
Crosstalk attenuation	>54 dB[*1,*2]	>70 dB[*1,*3]
Optical connector	FC, SC, ST, DIN, HMS-10/A	
Ambient temperature, rated range of use	0˚ to +50˚C	
Storage temperature	–40˚ to +71˚C	
Dimensions and mass	110 (W) x 52 (H) x 121 (D) mm, ≤500 g	

*1: Wavelength: 1.31/1.55 µm
*2: When using the connector with return loss of >53 dB
*3: Specified with the wavelength of 1.55 µm, except from the reflection of APC connector.

• MN9604D optical connector option

Model No.	Connector	
	Port A	Port B, C
MN9604D-25	FC-APC	FC-PC
MN9604D-26	SC-APC	SC-PC
MN9604D-47	HRL-10	DIN (47256)



Ordering information

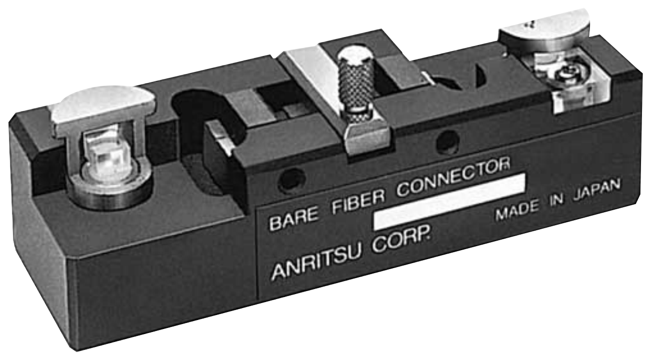
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MN9604C	Optical Directional Coupler (for SM fiber)
	Standard accessories
W1563AE	MN9604C operation manual: 1 copy
	Optical connectors
MN9604C-37	FC connector
MN9604C-38	ST connector
MN9604C-39	DIN connector
MN9604C-40	SC connector
MN9604C-43	HMS-10/A connector
	Optional accessories
J0441	Total internal reflection fiber cord, 1 m (with FC · PC connector)
J0617B	Replaceable optical connector (FC)
J0618D	Replaceable optical connector (ST)
J0618E	Replaceable optical connector (DIN)
J0618F	Replaceable optical connector (HMS-10/A)
J0619B	Replaceable optical connector (SC)
Z0282	Ferrule cleaner (Cletop A-type, 1 pc)
Z0283	Ferrule cleaner spare tape (6 pcs/set)
Z0284	Adapter cleaner (stick type, 200 pcs/set)
	Main frame
MN9604D	Optical Directional Coupler*1
	Standard accessory
W2025AE	MN9604D operation manual: 1 copy
	Optical connectors
MN9604D-25	FC-APC connector
MN9604D-26	SC-APC connector
MN9604D-47	HRL-10 connector
	Optional accessory
J1148A	Total internal reflection cord

*1: Connector for specified options at ordering supplied as standard. Specify by appending number after model. If connector not specified, FC-APC (Option 25) supplied as standard.

BARE FIBER CONNECTOR
MA9014A

Simple to Use



The MA9014A Bare Fiber Connector has a V-groove design to permit quick connections of optical fibers. During maintenance and installation, bare optical fibers with mirrored cut-end faces can be connected. And the use of optical fiber guide and glass tube ensures that the fibers are easily and reliably set.

Features
- Simple to use
- Accommodates single-mode fibers

Applications
- Measuring breakes in optical fiber cable with optical time domain reflectometer
- Two-way communication during optical-fiber cable installation

Specifications

Compatible optical fibers	10/125 µm	50/125, 62.5/125, 100/140 µm
Connection loss*	≤0.5 dB	≤0.2 dB
Dimensions and mass	74 (W) x 28 (H) x 24 (D) mm, <100 g	

*: When optical fibers with same core and clad diameters and matching oil used

Note: Usable optical fiber jacket diameter: Φ0.25 to Φ1 mm

Ordering information
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MA9014A	Bare Fiber Connector	
	Standard accessories	
Z0049	Matching oil (3 cc volume):	1 bottle
Z0051	Toothpick:	5 pcs
Z0157	Cleaning liquid (37 cc volume)	1 bottle
Z0158	Cleaning paper (50 sheets)	1 pack
Z0156	Insertion jig:	1 pc
B0282	Storage case:	1 pc
W0483AE	MA9014A operation manual:	1 copy
	Option	
MA9014A-01	Microscope	
	Application instruments	
MP924A	Jacket Stripper	
Z0052	Optical fiber cutter	

PROGRAMMABLE OPTICAL ATTENUATOR
MN938A
0.85/1.3 µm

For Two Wavelengths of 0.85/1.3 µm

GPIB

The MN938A can set attenuation in a range of 0 to 60 dB in 0.1 dB steps. Two wavelengths can be selected. As the MN938A is provided with GPIB as standard, it can be used in a variety of automatic measuring systems for development, production, and inspection. A rotary encoder permits attenuation to be set smoothly even when used manually.

Features
- Wide attenuation range: 0 to 60 dB
- Application for two wavelengths by switch selection
- Suitable for multi-mode fibers (50/125 µm)

OPTICAL VARIABLE ATTENUATOR
MN95D
1.3 µm

High-Stabile Attenuation

The MN95D optical variable attenuator passes an optical signal from a light emitting element through an optical fiber via a lens through an attenuating filter to reduce it to an appropriate light power output. It is a reflection type using metallic film and is used in the 1.3 µm band. The MN95D can be varied continuously and in steps.

Features
- Metallic film filters assure a wide range of usable wavelengths and stable accuracy.
- Prevention of multiple reflection
- Small and lightweight
- Suitable for multi-mode fibers (50/125 µm)

OPTICAL ATTENUATOR
MN9605C
1.3/1.55 µm

Easy-to-Change Optical Connector Adapters

The MN9605C is high-precision optical attenuators designed for use with single mode optical fibers. A combined step attenuator and continuous attenuator permit highly accurate attenuation adjustment. The MN9605C has PC-type optical connectors, so that internally-reflected light is thoroughly suppressed. It is precisely constructed for single-mode fiber use and can be used as a highly accurate 65 dB variable attenuator.

Features
- Suitable for 1.3 and 1.55 µm wavelengths
- Minimal light reflection at input/output connectors (return loss: ≥40 dB)
- Optical connector adapters easily attached and removed

BARE FIBER CONNECTOR
MP922B

For Low-Loss Connection of GI/SM Fibers

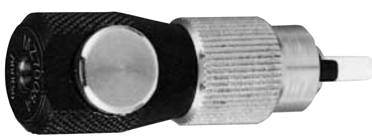
The MP922B is a bare-fiber connector using a V-shaped groove to temporarily and quickly connected optical fiber cores. The V-groove can be observed by microscope. This permits fine control of distance between optical fiber end-surfaces, and allows low-loss single mode fiber connection.

Features

- No special technical training required
- Low-loss connection even for single mode and multi-mode fibers
- Usable for optical fibers with jacket diameters from 0.25 to 1.2 mm

FIBER ADAPTER
MA9013A

Easy-to-Use Optical FIber Insertion



With the MA9013A Fiber Adapter, bare fiber connections can be made quickly and easily. The device, engineered to allow fiber core connections without need for polishing, is especially useful for simple temporary instrument connections during on-site operations. Moreover, the high-precision ferrule facilitates low-loss single-mode and multi-mode fiber connections.

Features

- Simple to use
- Suitable for single-mode and multi-mode fibers
- Accommodates optical fibers with external diameter error
- Compatible with various optical fibers
- Easy ferrule replacement (FC connector)

OPTICAL ACCESSORIES

Anritsu offers a full line of accessories for use with optical communications measuring equipment. Please specify model/order number, name, and quantity when ordering.

	Model/Order No.	Name	Remarks		Photo No.
Optical fiber cord	J0893[*]	FC · PC-FC · PC-<*>M-GI	FC · PC optical fiber cord (GI)	GI (50/125)	1
	J0635[*]	FC · PC-FC · PC-<*>M-SM	FC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J1053[*]	FC · APC-FC · APC-<*>M-SM	FC · APC optical fiber cord (SM)	RL: ≥65 dB	
	J0839[*]	SC · PC-SC · PC-<*>M-GI	SC · PC optical fiber cord (GI)	GI (50/125)	–
	J0660[*]	SC · PC-SC · PC-<*>M-SM	SC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J1054[*]	SC · APC-SC · APC-<*>M-SM	SC · APC optical fiber cord (SM)	RL: ≥65 dB	
Optical conversion cord	J0952[*]	FC · PC-FC · APC-<*>M-SM	FC · PC-FC · APC optical fiber cord (SM)	RL: ≥50 dB (PC side), ≥65 dB (APC side)	–
	J0954[*]	SC · PC-SC · APC-<*>M-SM	SC · PC-SC · APC optical fiber cord (SM)	RL: ≥50 dB (PC side), ≥65 dB (APC side)	
	J0692[*]	FC · PC-SC · PC-<*>M-SM	FC · PC-SC · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0757[*]	FC · PC-ST · PC-<*>M-SM	FC · PC-ST · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0760[*]	FC · PC-DIN · PC-<*>M-SM	FC · PC-DIN · PC optical fiber cord (SM)	RL: ≥50 dB	
	J0763[*]	FC · PC-HMS-10A-<*>M-SM	FC · PC-HMS-10/A optical fiber cord (SM)	RL: ≥50 dB	
Replaceable optical connector	J0617B	Replacement optical connector (FC)	–		6
	J0618D	Replacement optical connector (ST)			
	J0618E	Replacement optical connector (DIN)			
	J0618F	Replacement optical connector (HMS-10/A)			
	J0618B	Replacement optical connector (SC)			
Replacement optical connector	J0739A	Replacement optical connector (FC · APC)	–		
	J0739C	Replacement optical connector (SC · APC)			
	J0739D	Replacement optical connector (HRL-10)			
	J0739G	Replacement optical connector (FC-PANDA)			–
Other accessories	J0601	Dummy fiber for optical loss measurements	–		2
	Z0052	Optical fiber cutter	–		3
	MP924A	Fiber Jacket Stripper	–		4
	MZ106C	Mode Scrambler	–		5
	J0057	Optical adapter FC type	–		–
	J0596	Optical adapter SC type	–		–
	J0849B	Optical conversion adapter FC to SC type	–		–

Fiber length	Value	
	[*]	<*>
1 m	A	1
2 m	B	2
3 m	C	3

Optical fiber cord

Photo 1

Dummy fiber for optical loss measurements

This is a dummy fiber used in optical loss measurements to excite the normal propagation mode of the light.

Insertion loss	Applicable connector
<8 dB	FC-P

Photo 2

Optical fiber cutter

This device cuts optical fibers to produce a right-angle mirror-face break.

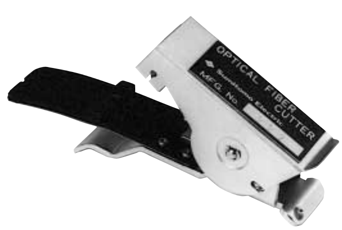


Photo 3

MP924A Fiber Jacket Stripper

This tool is used to remove the nylon jacket from around the core.

Photo 4

MZ106C Mode Scrambler

When measuring optical fiber loss or instrument insertion loss, this device is attached to LED light sources to ensure a uniform injection mode.

Insertion loss	1.5 dB*1
NA (numerical aperture)	0.195 ±0.01*2
Connector	FC
Optical fiber	GI (50/125 µm)*3
Dimensions	20 (W) x 20 (H) x 205 (D) mm

*1: Typical value (typical value is given for reference only and is not guaranteed specifications.)
Does not include connector loss.
*2: Test method depends on JIS C5961
*3: Does not include fiber

Photo 5

Replaceable and replacement optical connector

Replaceable

Replacement

Photo 6

PULSE PATTERN GENERATORS/ ERROR DETECTORS

Selection guide

Model \ Application		Module test for 1 GbE SFF Module test	Module test for 10 GbE XFP, XENPAK, XPAK Module test for 10G SDH/SONET	Multi-channel test of high speed module Multi-channel signal source for 10G WDM	Ultra High Speed Pulse Generator Network test for over 40G bit/s Transponder test for 40G bit/s High Speed device test		Remarks
						Remote	
Digital Data Analyzer	MP1632C	√					10 MHz to 3.2 GHz*1
Pulse Pattern Generators	MP1763C (1ch)		√				50 MHz to 12.5 GHz
	MP1775A (4ch)			√	√	√	100 MHz to 12.5 GHz
Error Detectors	MP1764C/1764D (1ch)		√				50 MHz to 12.5 GHz
	MP1776A (4ch)			√	√	√	100 MHz to 12.5 GHz
43.5G MUX	MP1801A				√		25 to 43.5 GHz
	MP1803A					√	25 to 43.5 GHz
2.6 V Data Output	MP1803A-01					♦*2	For MP1803A
43.5G DEMUX	MP1802A				√		25 to 43.5 GHz
	MP1804A					√	25 to 43.5 GHz
Text to MP1632A/C Pattern Conversion Software	MX163201A	♦					For MP1632C
MX165X to MP1632A/C Pattern Conversion Software	MX163202A						For MP1632C
Q and Eye Analysis Software	MX163205A	♦					For MP1632C
SDH/SONET Pattern Editor	MX163206A	♦					For MP1632C
Q and Eye Analysis Software	MX176400A		♦				For MP1762C
SDH/SONET Pattern Editor	MX176401A		♦				For MP1763C/1764C/1764D
SDH/SONET Pattern Editor	MX177601A			♦	♦	♦	For MP1775A/1776A
Q and Eye Analysis Software	MX180400A				♦	♦	For MP1804A
System Model Name*3					ME7760A*4	ME7760B*4	

√: Standard component
♦: Application

*1: Please use external synthesizers (10 MHz to 50 MHz)
*2: Amplitude range is from 1.0 to 2.6 V. Crosspoint range is from 30 to 70%. Offset range is from –2 to +2 V.
*3: Software is application for system, not a part of the system.
*4: It is necessary to prepare signal generator for 1/1 clock, ex. MG3695A.

43.5 Gbit/s BERT SYSTEM

ME7760A/B

25 to 43.5 Gbit/s

GPIB ME7760B

Measurement Solution for 40 Gbit/s SONET/SDH System and Modules

The ME7760A/B is bit error rate measurement equipments which measures a bit error rate of transmission signals 25 to 43.5 Gbit/s. This equipment is composed of pulse pattern generator, multiplexer, demultiplexer, error detector and synthesizer.
The ME7760A/B are applied for electrical or optical market which examines from components evaluations to communication equipments. MX177601A SDH/SONET Pattern Editor Software is provided and is used to edit a SDH/SONET frame.

Features

• High quality waveform
A re-timing circuit using D-type Flip-Flop realizes high quality waveform (small jitter and low wave distortion) and high output amplitude (2 Vp-p).

• Measurement with pure PRBS
The MP1775A Pulse Pattern Generator can generate PRBS on 43.5 Gbit/s (selectable pattern length = $2^n - 1$: n= 7, 9, 11, 15, 20, 23, 31). The phase of each channel is shifted by 1/4 cycle and multiplexed signal can be treated as pure PRBS.

• Wide operation frequency
ME7760A have capability to treat FEC signals on the 40 Gbit/s. 4 channels pulse pattern generator (MP1775A) and the 4 channels error detector (MP1776A) can support 100 Mbit/s to 12.5 Gbit/s signals.
The multiplexer (MP1801A/1803A) and the de-multiplexer (MP1802A/1804A) can support 25 to 43.5 Gbit/s signals.

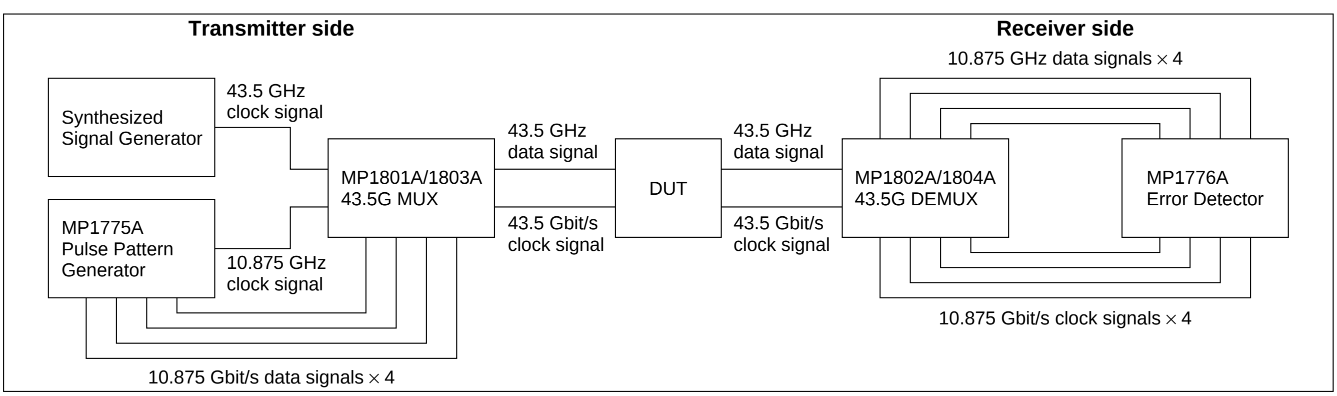
• 32 Mbits pattern memory for OC-768/STM-256
Both the MP1775A and the MP1776A have 32 Mbits pattern memory and it is suitable for 40 Gbit/s SDH/SONET frames (OC-768/STM-256). Its pattern can be edited using the MX177601A SDH/ SONET Pattern Editor via GPIB interface.

• High flexibility
The MP1775A Pulse Pattern Generator and the MP1776A Error Detector can be used as the single measurement equipment. It will bring you a high flexibility on the various combinations and scenes.

Selection guide

	ME7760A	ME7760B
MP1801A	√	
MP1802A	√	
MP1803A*		√
MP1804A*		√
MP1775A	√	√
MP1776A	√	√

*: Custom-made product



System configurations

Specifications

• MP1801A 43.5G MUX

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 DATA, $\overline{\text{DATA}}$, Output waveform: NRZ, Output amplitude: 2.0 Vp-p (AC coupling) fixed, Tr/Tf (10 to 90%): ≤18 ps, Pattern jitter: ≤10 ps (p-p), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Output amplitude: 1.0 Vp-p (AC coupling) fixed, Tr/Tf (10 to 90%): ≤18 ps, Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V, Phase adjust range: 120 ps
1/4 Data input	Number of inputs: 4 Input level: V_{OH}, V_{OL}: –1.0 Termination: 50 Ω/GND, Connector: K
1/4 Clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH}: 0 ±0.4 V, Output amplitude: 1.40 V ±0.4 V Tr/Tf (20 to 80%): 40 ps (typ.) Waveform distortion: ≤0.4 Vp-p Connector: K Phase adjust range: 120 ps
Dimensions and mass	213 (W) x 132.5 (H) x 350 (D) mm, ≤8 kg
Power	85 to 265 V, 47 to 63 Hz, ≤75 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• MP1802A 43.5G DEMUX

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: +0.25 to –0.75 V (variable), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty 50%), Input amplitude: 0.7 to 1.5 Vp-p, Termination: 50 Ω/GND, Connector: V, Phase adjust range: 120 ps
1/4 Data output	Number of outputs: 4 Output amplitude: V_{OH}: 0 ±0.3 V, V_{OL}: –1.0 ±0.3 V Tr/Tf (10 to 90%): ≤35 ps (typ.) Pattern jitter: ≤20 ps (peak to peak) Waveform distortion: ≤10% Termination: 50 Ω/GND Connector: K
1/4 Clock output	Number of outputs: 4 Output amplitude: V_{OH}: 0 ±0.3 V, V_{OL}: –1.0 ±0.3 V Tr/Tf (10 to 90%): ≤35 ps Waveform distortion: ≤10% Termination: 50 Ω/GND Connector: K Phase adjust range: 120 ps
DEMUX reset input	Input level: V_{OH}: 0 ±0.1 V, V_{OL}: –1.0 ±0.1 V Termination: 50 Ω/GND Connector: K
Dimensions and mass	213 (W) x 132.5 (H) x 350 (D) mm, ≤8 kg
Power	85 to 265 V, 47 to 63 Hz, ≤75 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• MP1803A 43.5G MUX

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty: 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 (DATA, $\overline{\text{DATA}}$), Output waveform: NRZ, Output amplitude: 2.0 ±0.2 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 10 ps (typ.), Pattern jitter: Less than 10 ps (P-P), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Number of outputs: 1 (CLOCK), Output amplitude: 0.7 to 1.6 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 5 ps (typ.), Waveform distortion: ≤10%, Phase adjust range: –70.0 to +70.0 ps (0.1 ps step), Termination: 50 Ω/GND (with back termination), Connector: V,
1/4 data input	Number of inputs: 4 (D1, D2, D3, D4), Input amplitude: V_{IH} = 0 V ±0.07 V, V_{IL} = –1 V ±0.07 V, Termination: 50 Ω/GND, Connector: SMA
1/4 clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH} = 0 V ±0.40 V, V_{amp} = 1.40 V ±0.40 V, Phase adjust range: –70 to 70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA

Continued on next page

Sync. output	Number of outputs: 1 (1/64 clock output), Output voltage: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 450 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• MP1804A 43.5G DEMUX

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: –0.75 to +0.25 V (0.001 V step), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty: 50%), Output amplitude: 0.7 to 1.5 Vp-p (AC coupled), Phase adjust range: –70 to +70 ps (0.1 ps step), Termination: 50 Ω/GND, Connector: V
1/4 data output	Number of outputs: 4, Output voltage: V_{OH} = 0 V ±0.2 V, V_{OL} = –1 V ±0.2 V, Termination: 50 Ω/GND, Connector: SMA
1/4 Clock output	Number of outputs: 4, Output voltage: V_{OH} = 0 ±0.25 V, V_{OL} = –1 ±0.25 V Phase adjust range: –70 to +70 ps (1 ps step), Impedance: 50 Ω/GND, Connector: SMA
DEMUX reset input	Number of inputs: 1 (1/64 clock output), Input voltage: V_{1H} = 0 ±0.1 V, V_{IL} = –1 ±0.1 V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• MX177601A SDH/SONET Pattern Editor

Required system	Computer: IBM-PC/AT or full compatible CPU: Pentium 200 MHz or higher OS: Windows 95/98/2000/NT4.0 Memory: 128 MB or more Display resolution and color: 800 x 600 or more and 256 colors or more FDD: 3.5-inch (1.44 MB), Hard drive: require 100 MB or more GPIB: National Instruments-made GPIB Interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping for SDH: [MP1775A/1776A] STM-n (n = 1, 4c, 12c, 16c, 32c, 64c, 256c) Mapping for SONET: [MP1775A/1776A] STS-n (n = 3c, 12c, 48c, 192c, 768c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS 2^n – 1 (n = 7, 9, 11, 15, 20, 20z, 23, 31) [Pattern repetition up to the length of all frames] Measurement condition: ALL, payload, SOH ALL, POH ALL, OH (D1-D3), OH (D4-D12), OH (1 byte) [Pattern repetition up to the length of all frames] CID pattern: Available (Conforming to ITU-T G.958) Frame repetition: Maximum 6 frames Alarm addition: Alarm addition conforming to SDH/SONET standard SDH: [items: OOF/LOF, MS-AIS, MS-RDI, MS-REI, MS-AIS, HP-RDI, HP-REI] SONET: [items: OOF/LOF, AIS-L, RDI-L, REI-L, AIS-P, RDI-P, REI-P] BIP error addition: B1, B2 and B3 B1, B2 and B3 calculation: Automatic calculation Scramble: ON/OFF OH editor: All bytes edit are possible except B1, B2, B3, H1, H2, H3. Pointer (H1, H2, H3) is fixed value.

2

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1801A	43.5G MUX	
	Standard accessories	
J1090	Cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	SMA cable (AA-165-1500), 1.5 m:	5 pcs
	Power cord, 2.5 m:	1 pc
F0012	Fuse (T3.15 A 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
B0329M	Front cover:	
J1108	Cable (V120MM-50CM), 50 cm:	1 pc
J1138	SMA cable (SF1041/SMA-451/11SMA/451/1.5M), 1.5 m:	1 pc
J1137	Terminator (HRM-601):	6 pcs
J1145	Terminator (V210):	4 pcs
W1961AE	MP1801A operation manual:	1 copy
	Main frame	
MP1802A	43.5G DEMUX	
	Standard accessories	
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J1090	Cable (V120MM-30CM), 30 cm:	2 pcs
J0696E	SMA cable (AA-165-1500), 1.5 m:	8 pcs
	Power cord, 2.5 m:	1 pc
J1144	Fixed coaxial attenuator (41V-6):	1 pc
F0012	Fuse (T3.15 A 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
B0329M	Front cover:	1 pc
J1137	Terminator (HRM-601):	9 pcs
J1145	Terminator (V210):	2 pcs
W1960AE	MP1802A operation manual:	1 copy
	Main frame	
MP1803A	43.5G MUX (Custom-made product)	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	5 pcs
J1108	Coaxial cable (V120MM-50CM), 50 cm:	1 pc
J1138	Coaxial cable, 1.5 m:	1 pc
J1145	Terminator (V210):	4 pcs
J1137	Terminator (HRM-601):	6 pcs
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2031AE	MP1803A operation manual:	1 copy
W2032AE	MP1803A GPIB remote control operation manual:	1 copy
	Options	
MP1803A-01	2.6 V data output	
MP1803A-11	Extended up to 48 Gbit/s	
W2156AE	MP1803A-01 operation manual	
W2157AE	MP1803A-01 GPIB remote control operation manual	
	Optional accessory	
B0523E	F 3U 1/2MW*2 Rack mount kit	
	Main frame	
MP1804A	43.5G DEMUX (Custom-made product)	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	2 pcs
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	8 pcs
J1145	Terminator (V210):	2 pcs
J1137	Terminator (HRM-601):	9 pcs
J1144	Fixed coaxial attenuator (41V-6, for MUX-DEMUX connection):	1 pc
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2033AE	MP1804A operation manual:	1 copy
W2034AE	MP1804A GPIB remote control operation manual:	1 copy
	Option	
MP1804A-11	Extended up to 48 Gbit/s	

For the details of MP1775A Pulse Pattern Generator, MP1776A Error Detector and MG3695A, please refer to page 108, 110 and 458 respectively.

43.5G MUX/43.5G DEMUX
MP1803A/MP1804A
25 to 43.5 Gbit/s

For R&D and Manufacturing of 40 Gbit/s Devices and Transmission systems

MP1803A

MP1804A

Custom-made product

The MP1803A 43.5G MUX can multiplex a maximum of four data signal inputs (each transmission speed is maximum 10.875 Gbit/s) and generate a 43.5 Gbit/s multiplexed signal. It can also generate a 1/4 clock signal.
The MP1804A 43.5G DEMUX can de-multiplex the 43.5 Gbit/s data input into four signals. Its four output signal lines are brought to the four channels error detector (MP1776A) and it enables to evaluate 43.5 Gbit/s high-speed data signal.

Features
- Adopting high resolution variable delay unit (Resolution: 0.1 ps)
- High resolution threshold voltage setting suitable for the Q factor analysis (Resolution: 0.001V)
- Digital display
- For various applications with the remote control

Specifications
- **MP1803A 43.5G MUX**

Operation frequency	25 to 43.5 GHz (external)
Clock input	Input waveform: Sine or rectangular wave (duty: 50%), Input amplitude: 0.7 to 1.5 Vp-p, Connector: V
Data output	Number of outputs: 2 (DATA, $\overline{\text{DATA}}$), Output waveform: NRZ, Output amplitude: 2.0 ±0.2 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 10 ps (typ.), Pattern jitter: Less than 10 ps (P-P), Waveform distortion: ≤10%, Termination: 50 Ω/GND (with back termination), Connector: V
Clock output	Number of outputs: 1 (CLOCK), Output amplitude: 0.7 to 1.6 Vp-p (AC coupled), Tr/Tf (20 to 80%, ≥38 Gbit/s): 5 ps (typ.), Waveform distortion: ≤10%, Phase adjust range: –70.0 to +70.0 ps (0.1 ps step), Termination: 50 Ω/GND (with back termination), Connector: V
1/4 data input	Number of inputs: 4 (D1, D2, D3, D4), Input amplitude: V_{IH} = 0V ±0.07V, V_{IL} = –1V ±0.07V, Termination: 50 Ω/GND, Connector: SMA
1/4 clock output	Number of outputs: 1 (CLOCK), Output amplitude: V_{OH} = 0V ±0.40V, V_{amp} = 1.40V ±0.40V, Phase adjust range: –70 to 70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA
Sync. output	Number of outputs: 1 (1/64 clock output), Output amplitude: V_{OH} = 0V ±0.2V, V_{OL} = –1V ±0.2V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• **MP1804A 43.5G DEMUX**

Operation frequency	25 to 43.5 GHz
Data input	Number of inputs: 1 (DATA), Input waveform: NRZ, Input amplitude: 0.1 to 1.0 Vp-p, Threshold voltage: –0.75 to +0.25V (0.001V step), Termination: 50 Ω/GND, Connector: V
Clock input	Number of inputs: 1 (CLOCK), Input waveform: Sine or rectangular wave (duty: 50%), Output amplitude: 0.7 to 1.5 Vp-p (AC coupled), Phase adjust range: –70 to +70 ps (0.1 ps step), Termination: 50 Ω/GND, Connector: V
1/4 data output	Number of outputs: 4, Output voltage: V_{OH} = 0V ±0.2V, V_{OL} = –1V ±0.2V, Termination: 50 Ω/GND, Connector: SMA
1/4 Clock output	Number of outputs: 4, Output voltage: V_{OH} = 0 ±0.25V, V_{OL} = –1 ±0.25V Phase adjust range: –70 to +70 ps (1 ps step), Termination: 50 Ω/GND, Connector: SMA
DEMUX Reset input	Number of inputs: 1 (1/64 clock output), Input voltage: V_{1H} = 0 ±0.1V, V_{IL} = –1 ±0.1V Termination: 50 Ω/GND, Connector: SMA
Control interface	GPIB
Dimensions and mass	213 (W) x 132.5 (H) x 364 (D) mm, ≤10 kg
Power	AC 100 to 240 V, Frequency: 47 to 63 Hz, ≤100 VA
Operation temperature	+20˚ to +30˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1803A	43.5G MUX	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	3 pcs
J0696E	Coaxial cable (AA-165-1500), 1.5m:	5 pcs
J1108	Coaxial cable (V120MM-50CM), 50 cm:	1 pc
J1138	Coaxial cable, 1.5 m:	1 pc
J1145	Terminator (V210):	4 pcs
J1137	Terminator (HRM-601):	6 pcs
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2031AE	MP1803A operation manual:	1 copy
W2032AE	MP1803A GPIB remote control operation manual:	1 copy
	Options	
MP1803A-01	2.6 V data output	
MP1803A-11	Extended up to 48 Gbit/s	
W2156AE	MP1803A-01 operation manual	
W2157AE	MP1803A-01 GPIB remote control operation manual	
	Optional accessory	
B0523E	F 3U 1/2MW*2 Rack mount kit	
	Main frame	
MP1804A	43.5G DEMUX	
	Standard accessories	
J1090	Coaxial cable (V120MM-30CM), 30 cm:	2 pcs
J0696D	Semi-flexible cable (AA-165-2000), 2 m:	1 pc
J0696E	Coaxial cable (AA-165-1500), 1.5 m:	8 pcs
J1145	Terminator (V210):	2 pcs
J1137	Terminator (HRM-601):	9 pcs
J1144	Fixed coaxial attenuator (41V-6, for MUX-DEMUX connection):	1 pc
J0008	GPIB cable, 2.0 m:	1 pc
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A (T3.15 250 V):	1 pc
Z0306A	Wrist strap:	1 pc
W2033AE	MP1804A operation manual:	1 copy
W2034AE	MP1804A GPIB remote control operation manual:	1 copy
	Option	
MP1804A-11	Extended up to 48 Gbit/s	

PULSE PATTERN GENERATOR
MP1775A
100 MHz to 12.5 GHz (4 channels)

GPIB

Supports Measurement for up to 50 Gbit/s System (Installed with 4 Channels)

The MP1775A Pulse Pattern Generator has four channels of data output lines and each channel has capability to generate a maximum 12.5 Gbit/s signal. It is available to create PRBS (maximum pattern length is $2^n - 1$, n = 7, 9, 11, 15, 20, 23, 31) and 32 Mbits programmable pattern (user defined pattern). Combining with the MP1801A/MP1803A 43.5G Multiplexer makes it possible to generate 43.5 Gbit/s pure PRBS or programmable pattern suitable for OC-768/STM-256.

Features
- Error measurement of OC-768c/STM-256c SDH/SONET frame using 8 Mbits/channel PRGM pattern and application software (MX177601A)
- Parallel output of 12.5 Gbit/s x 4-channels
- Independent level adjustment for each of the 4-channels
- Reduce waveform distortion using back-termination
- Cross-Point adjustment capability on the front panel

Specifications

Operation frequency	From 0.1 to 12.5 GHz (internal/external selectable)
External clock	Input level from: 0.8 to 2.0 Vp-p, Input waveform: sign wave (over 500 MHz) or Pulse, Connector: APC-3.5
Internal clock (option 03)	Resolution: 1 kHz, 1 MHz, Reference signal of PLL: 10 MHz (internal/external selectable)
Pattern	Pseudo random pattern: $2^n - 1$ (n = 7, 9, 11, 15, 20, 23, 31), PRGM pattern: 8 Mbits/channel total 32 Mbits Logic: POS/NEG Error insertion: 10^{-n} (n = 4, 5, 6, 7, 8, 9 and single) insertion root selectable from 32 channels by switch on front panel
Data output	Waveform: NRZ, Number of output: 4 (CH1, CH2, CH3, CH4), Amplitude : from 0.5 to 2.0 Vp-p/10 mV step*1 Offset: from –2.0 to 2.0 V_{OH}/5 mV step*1, termination: GND/–2V (ECL) selectable Load impedance: 50Ω, Connector: APC-3.5
Clock output	Number of output : 2 (CLOCK1, CLOCK2), Amplitude: from 0.5 to 2.0 Vp-p/10 mV step*1 Offset: from –2.0 to 2.0 V_{OH}/5 mV step*1, termination: GND/–2V (ECL) selectable Variable delay: from –500 to 500 ps/1 ps step, Load impedance: 50Ω, Connector: APC-3.5
Sync. output	Number of output: 1 (1/32 clock or pattern sync.) Amplitude: 1 Vp-p fixed, termination: to GND with 50Ω, Connector: SMA
Control interface	GPIB/Parallel port, Parameter memory: 3.5 inch FDD (MS-DOS compatible)*2
Dimensions and mass	426 (W) x 221 (H) x 450 (D) mm (16.8W x 8.7H x 17.7D inches), less than 35 kg (77.2 pounds), from 85 to132 Vac or from 170 to 250 Vac, power: less than 1000 Watts
Operation temperature	From +15˚ to +35˚C (59 to 95˚F)
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Independently settable in each channel
*2: MS-DOS is registered trademark of Microsoft Corporation in the United States and other countries.

Ordering Information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MP1775A	Pulse Pattern Generator
	Standard accessories
J0491	Shield power cord (13 A): 1 pc
J0008	GPIB cable, 2 m: 1 pc
J0496	APC3.5J-J connector: 7 pcs
J0696A	SMA cable (AA-165-500), 0.5 m: 6 pcs
J0696B	SMA cable (AA-165-800), 0.8 m: 1 pc
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m: 1 pc
J1141	50 Ω terminator (BL02-6113-02): 7 pcs
F0100A	Fuse, 6.3 A: 2 pcs
W1937AE	MP1775A panel operation manual: 1 copy
W1938AE	MP1775A GPIB operation manual: 1 copy
Z0168	3.5 inch mini floppy disk (2HD, MF-2HD-3.5MF): 2 pcs
Z0306A	Wrist strap: 1 pc
	Option
MP1775A-01	Clock, $\overline{\text{Clock}}$ output (custom-made product)
MP1775A-03	Internal synthesizer
	Optional accessories
J0500A	Semi-rigid cable (SMA-P UT-141 SMA-P), 0.5 m
MB24B	Portable Test Rack (with 20 A power cord)
J0007	GPIB cable, 1 m
B0523C	F 5U Rack mount kit

ERROR DETECTOR
MP1776A
100 MHz to 12.5 GHz

CE

Supports Measurement for up to 50 Gbit/s System (Installed with 4 Channels)

MP1776A is an error detector housing four error detectors that can measure error up to 12.5 Gbit/s. It has four-channels independent measurement mode, two-channels or four-channels combined measurement mode and be used for development, manufacturing and maintenance of transmission systems and modules from 12.5 Gbit/s to maximum 50 Gbit/s.

Features
- Max. 4-channels in one box
- Independent measurement of 4-channels
- PRBS patterns from $2^7 – 1$ to $2^{31} – 1$
- Max. 32 Mbit programmable pattern at 4-channels combined mode (corresponding six frames of STM-256/ STS-768)
- Burst data BER measurement for optical circulating loop test
- Good operability by GUI
- Display 4-channels measurement results on screen

Specifications
- **MP1776A (main frame), MU177601B (12.5 Gbit/s Error Detector)**

Operating frequency	100 MHz to 12.5 GHz
Measurement pattern	PRBS pattern: $2^n – 1$ (n: 7, 9, 11, 15, 20, 23, 31) Zero substitution pattern: 2^n (n: 7, 9, 11, 15), consecutive zero-pattern can be inserted up to pattern length – 1 Programmable data Independent: 2 to 8,388,608 bits 2-channels combined: 4 to 16,777,216 bits 4-channels combined: 8 to 33,554,432 bits Logic inversion: Positive/negative switching possible
Measurement mode	Independent*1, 2-channels combined*2, 4-channels combined*3
Synchronization method	Normal, frame
Error detection mode	Insertion, omission, total
Measurement items	Error ratio: 0.0000×10^{-16} to 1.0000×10^0 Error count: 0 to 9,999,999, 1.0000×10^7 to 9.9999×10^{16} Clock frequency: 0.1 to 12.5 GHz (independent), 0.2 to 25 GHz (2-channels combined), 0.4 to 50 GHz (4-channels combined) *Resolution: 1 kHz, accuracy: 10 ppm ±1 kHz
Sync threshold value	Internal, 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Auto search function	Supported
Data input	Input waveform: NRZ Input amplitude: 0.5 to 2.0 Vp-p Threshold voltage: –3.000 to +1.750 V (1 mV step) Termination condition: GND/–2.0 V Input impedance: 50 Ω Connector: APC-3.5 Number of input: 1 (MU177601B 12.5 Gbit/s Error Detector Unit)
Clock input	Input level: 0.5 to 2.0 Vp-p Input waveform: Square wave only (<0.5 GHz, Duty: 50%), Sine or square wave (≥0.5 GHz, duty: 50%) Clock delay: ±500 ps (1 ps step) Polarity inversion: POS/NEG inversion selectable Input impedance: 50 Ω Connector: APC-3.5 Number of input: 1 (MU177601B 12.5 Gbit/s Error Detector Unit, up to 4 channel can be added.)

Continued on next page

Resync input	Input level: 0/–1 V ±0.1 V, Connector: SMA
System environment	Display: 10.4-inch, color LCD, touch screen, 640 x 480 dots, 256 colors (16 M colors in VGA when external display is connected.) Printer: Parallel port for external printer (D-sub 25-pin) Keyboard: 101-type (English), PS/2 (mini DIN 6-pin) Mouse: Serial, PS/2 (mini DIN 6pin) FDD: 3.5-inch, 2 models (740 KB, 1.44 MB) HDD C drive: ≥474 MB (Used for system: measurement data, pattern) D drive: ≥30 MB (Not accessible to users, interface: IDE)
Remote control	RS-232C (standard, D-sub 9-pin), GPIB (IEEE488.2)
Power	90 to 120 Vac/180 to 250 Vac, 47.5 to 63 Hz, ≤1000 VA
Operating temperature	+15˚ to +35 ˚C
Dimensions and mass	426 (W) x 266 (H) x 584 (D) mm, ≤50 kg (with 4 units of MU177601B)
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Different measurement pattern and frequency can be set for each channel.
*2: Evaluates 1:2 DEMUX to check that the signal before demultiplexing is PRBS.
*3: Evaluates 1:4 DEMUX to check that the signal before demultiplexing is PRBS.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/order No.	Name	
	Main frame	
MP1776A	Error Detector	
	Standard accessories	
J0491	Power cord (with shield, 13 A):	1 pc
J0670A	Power cord (L-type, C7, for 200 V main), 2.5 m:	1 pc
F0074	Fuse, 10 A:	1 pc
Z0319A	PS/2 mouse:	1 pc
Z0320	Input pen:	1 pc
J0008	GPIB cable, 2 m	
W1410AE	MP1776A operation manual:	1 copy
W1411AE	MP1776A remote control operation manual:	1 copy
Z0306A	Wrist strap:	1 pc
Z0352	MP1776A recovery tool:	2 pcs
Z0396A	Pen holder:	1 pc
	Unit	
MU177601B	12.5 Gb/s Error Detector Unit	
	Standard accessories	
J0696B	SMA cable (AA-165-800), 0.8 m:	2 pcs
J0693A	Coaxial cable (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
	Optional accessories	
Z0321A	Keyboard (PS/2)	
J0007	GPIB cable, 1 m	
B0496	Portable test rack	
B0374G	Carrying case	
B0497A	Dummy unit (for Slot 5)	
B0497B	Dummy unit (for Slot 1 to Slot 4)	
Z0416	Head cleaning disk (for 3.5-inch FDD)	
B0523D	F 6U Rack mount kit	

PULSE PATTERN GENERATOR
MP1763C
50 Mbit/s to 12.5 Gbit/s

CE GPIB

For R&D of High-Speed Logic, ICs, Optical Modules and Devices

The MP1763C is used in combination with the MP1764C/1764D Error Detector. The amplitude of the clock and data signals can be varied from 0.25 to 2 Vp-p while the offset can be adjusted to within ±2 V so that the amplitude and the offset margin can be measured. The clock has a variable delay function so that time-dependent characteristics or phase margins of the input clock and data can be measured. An M series pseudorandom pattern representative of actual conditions or a programmable pattern can be selected as cell data. In addition, a 3.5 inch floppy disk drive is built in for storing preset data, enabling rapid measurements to be performed by simply pressing a key. A GPIB function is provided, enabling automatic or remote measurement via an external controller.
The MP1763C is a pulse pattern generator ideal for research and development of high-speed logic, ICs, and digital systems.

MX176400A Q and Eye Analysis Software controls MP1763C and MP1764C from the PC to measure Q factor, eye margin, and eye diagram. MX176401A SDH/SONET Pattern Editor controls the MP1763C and MP1764C/1764D to generate frame pattern conforming to SDH/SONET standards.

Features
- High quality waveform
- Low FM/PM-noise clock generator
- 8 Mbit programmable pattern corresponding to six frames of STM-64/STS-192
- Generates PRBS patterns with bit length from $2^7 - 1$ to $2^{31} - 1$ bits
- Complementary outputs of both data and clock
- The amplitudes and offsets of all 8 data outputs that have 1/8 speed of fundamental clock signal can be set

Specifications
- **MP1763C (main frame)**

Operation frequency		0.05 to 12.5 GHz
Internal clock (option 01)	Frequency range	0.05 to 12.5 GHz
	SSB phase noise (at 10 kHz offset, 1 Hz bandwidth)	≤–85 dBc/Hz (0.05 to 4 GHz), ≤–80 dBc/Hz (4 to 8 GHz), ≤–75 dBc/Hz (8 to 10 GHz), ≤–70 dBc/Hz (10 to 12.5 GHz)
External clock input level		0.4 to 2.5 Vp-p
Pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 (1/2, 3/4, 7/8, 8/8 are possible with logic inversion) Bit shifts number for mark ratio varied: 1, 3 bits selectable
	Data pattern	Data length: 2 to 8388608 bits
	Alternate pattern	A/B pattern data length: 128 to 4194304 bits (128 bit steps); Loop time: A, B pattern (1 to 127, 1 steps)
	Zero substitution pattern	Zero bit length: 1 to (pattern length – 1) bits; Pattern: 2^n (n: 7, 9, 11, 15)
	Error addition	Error rate: 10^{-n} (n: 4, 5, 6, 7, 8, 9), and single error External error injection: Provided

Continued on next page

Data output	Number of outputs	2 (DATA/$\overline{\text{DATA}}$ independently)
	Amplitude	0.25 to 2 Vp-p, 2 mV steps
	Offset voltage	V_{OH}: –2 to +2 V, 1 mV steps Display: V_{OH}, V_{TH} or V_{OL} selectable
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Pattern jitter	≤20 psp-p, typical 10 psp-p
	Waveform distortion (0-peak)	≤15% or ≤150 mV whichever is greater
	Gating input	Provided
	Load impedance	50 Ω (with back termination)
	Connector	APC-3.5
	DATA/$\overline{\text{DATA}}$ tracking	$\overline{\text{DATA}}$ amplitude and offset voltage can be set to the same values as for DATA.
	Cross point adjustment function	The cross point of DATA and $\overline{\text{DATA}}$ outputs can be adjusted at semifixed resistor of side.
Clock output	Number of outputs	3 (CLOCK 1/$\overline{\text{CLOCK 1}}$, CLOCK 2)
	Amplitude	CLOCK 1/$\overline{\text{CLOCK 1}}$: 0.25 to 2 Vp-p (2 mV steps) CLOCK 2: 1 Vp-p
	Offset voltage	CLOCK 1/$\overline{\text{CLOCK 1}}$: V_{OH} –2 to +2 V (1 mV steps) CLOCK 2: V_{OH} 0 V fixed
	Rise/fall time	Typical 30 ps (10% to 90% of amplitude)
	Load impedance	50 Ω (CLOCK 1/$\overline{\text{CLOCK 1}}$: with back termination)
	Connector	CLOCK 1/$\overline{\text{CLOCK 1}}$: APC-3.5, CLOCK 2: SMA
	Delay	±500 ps (1 ps steps)
1/8 data and clock output	Number of outputs	DATA 8, CLOCK 1
	Output level	ECL
	Connector	SMA
1/4 data and clock output (option 03)*1	Number of outputs	DATA: 4, CLOCK: 1
	Amplitude	0.5 to 2 Vp-p (2 mV steps)
	Offset voltage	V_{OH}: –1.5 to +1.5 V (1 mV steps)
	Connector	SMA
1/4 differential data, clock output (option 08)*1	Operation bit rate	1/4 DATA/$\overline{\text{DATA}}$: 100 Mbit/s to 3.125 Gbit/s
	Number of outputs	1/4 DATA/$\overline{\text{DATA}}$ differential 4 system. 1/4 CLOCK/$\overline{\text{CLOCK}}$ differential 1 system
	Amplitude	0.5 to 2.0 Vp-p (2 mV steps), 1/4 DATA/$\overline{\text{DATA}}$: All channels same settings
	Offset voltage	1/4 DATA/$\overline{\text{DATA}}$: –1.0 to +2.5 V (V_{OH}) (1 mV steps, PRBS 50 Ω/GND termination) All channels same settings 1/4 CLOCK/CLOCK: –1.5 to +1.5 V (V_{OH}) (1 mV steps, PRBS 50 Ω/GND termination)
	Connector	SMA
Sync. signal output	Number of outputs	1 (1/64 clock, fixed position pattern, or variable position pattern selectable)
	Output level	0/–1 V
	Connector	SMA
Parameter memory		Media: 3.5 inch FD (2HD, 2DD), Format: MS-DOS (Rev. 3.1)*2, Content: Pattern or other parameters
Operating temperature range		0˚ to +50˚C
Dimensions and mass		426 (W) x 221 (H) x 450 (D) mm, ≤33 kg
Power		≤400 VA
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

*1: Select one type from three items
- 1/8 data and 1/8 clock output
- 1/4 data and 1/4 clock output (option 03)
- 1/4 differential data and 1/4 differential clock output (option 08)

*2: MS-DOS is a registered trademark of Microsoft Corporation.

• MX176400A Q and Eye Analysis Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 95/98/NT, CPU: Pentium 166 MHz or higher, Memory: 64 MB or more, Hard disk space: 100 MB or more GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.) Display Resolution: 800 x 600 or more, Display colors: 256 or more *If two or more applications are running simultaneously, operation cannot be guaranteed.

Continued on next page

Functions	Measurement frequency: 2 to 12.5 GHz (eye diagram/eye margin measurement), 1 to 12.5 GHz (Q factor measurement) Measurement patterns: PRGM, PRBS 7, 9, 11, 15, 20, 23, 31 Pattern format: Continuous/burst (To be synchronized within 1 s) Eye margin measurement Measurement resolution (threshold): 1 to 10 mV (1 mV steps), Measurement resolution (phase): 1 to 10 ps (1 ps steps), Measurement rate: E-2 to E-15 Eye diagram measurement Measurement resolution (phase): 1 to 10 ps (1 ps steps) Measurement rate: E-2 to E-15 (actual measurement), E-3 to E-12 (estimate measurement) Display rate: E-2 to E-15 (actual measurement), E-2 to E-4915 (estimate measurement) Mask test judgment rate: E-2 to E-15 Q factor measurement Measurement style: Multiple measurements at fixed phase/phase vs. Q factor measurements Bit error rate range: Upper limit at E-3 to E-5, lower limit at E-7 to E-12 Minimum error count (measurement accuracy): 1, 10, 100, 1000 Vth shift width: Automatic, fixed (1 to 10 mV/1 mV/steps)

• MX176401A SDH/SONET Pattern Editor

Required system	Computer: IBM-PC/AT or full compatible, CPU: Pentium 200 MHz or higher, OS: Windows 95/98/NT, Memory: 64 MB or more Display Resolution: 800 x 600 or more; Display colors: 256 or more FDD: 3.5-inch (1.44 MB), Hard disk space: 100 MB or more GPIB: National Instruments-made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping: STM-N (N = 1, 4c, 12c, 16c, 32c, 64c), STS-N SPE (N = 1, 3c, 12c, 48c, 192c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS $2^n - 1$ (n = 7, 9, 11, 15, 20, 20z, 23, 31) *Pattern repetition up to the length of all frames Measurement condition: ALL, payload, SOH ALL, POH ALL, OH (D1-D3), OH (D4-D12), OH (1 byte) *Pattern repetition up to the length of all frames CID pattern: Available Frame repetition: Maximum 6 frames Alarm addition: Alarm addition conforming to SDH/SONET Standard; [items: OOF/LOF, MS-AIS (L-AIS), MS-RDI (L-RDI), MS-REI (L-REI), HP-AIS (P-AIS), HP-REI (P-REI), HP-RDI (P-RDI)] BIP error addition: Generates parity errors of B1, B2, and B3 B1, B2, and B3 calculation: Available Scramble: Available BIP correction: Available Bit window: Active for patterns without frame Block window: Active for patterns without frame with a pattern length of multiples of 32 OH editor: Available

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Pentium is a registered trademark of Intel Corporation.
PCMCIA-GPIB and AT-GPIB/TNT are registered trademarks of National Instruments.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1763C	Pulse Pattern Generator	
	Standard accessories	
J0500A	Semi-rigid cable (SMA-P · UT-141 · SMA-P), 0.5 m:	2 pcs
J0672F	Semi-rigid cable (SMA-P · UT-85 · SMA-P), 10 cm:	1 pc
J0693A	SMA cable (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
J0496	APC-3.5 J-J connector:	4 pcs
J0008	GPIB cable, 2 m:	1 pc
J0491	Power cord (13 A):	1 pc
Z0168	3.5 inch floppy disk (MF2HD-3.5MF):	2 pcs
Z0306A	Wrist strap:	1 pc
F0014	Fuse, 6.3 A (T6.3A250V):	1 pc
W1848AE	MP1763C operation manual:	1 copy
W1849AE	MP1763C GPIB operation manual:	1 copy
Z0481	12.5G/3.2G BERTS application software demo:	1 pc
B0021	Protective cover (for 1MW · 5U):	1 pc
	Options	
MP1763C-01	12.5 GHz synthesizer (50 MHz to 12.5 GHz)	
J0672D	Semi-rigid cable (SMA-P · UT-85 · SMA-P), 7 cm	
MP1763C-03	1/4 speed output	
MP1763C-08	1/4 differential data output function (100 Mbit/s to 3.125 Gbit/s)	
W2339AE	MP1763C-08 operation manual	
W2340AE	MP1763C-08 GPIB operation manual	

Model/Order No.	Name
	Application equipment
68347C	Synthesized Sweep Generator (10 MHz to 20 GHz)
	Application software
MX176400A	Q and Eye Analysis Software
MX176401A	SDH/SONET Pattern Editor
MX176403A	GbE/10GbE Pattern Editor
	Optional accessories
J0500B	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 1 m
J0322A	Coaxial cable (SUCOFLEX104, 11SMA-11SMA), 0.5 m
J0322B	Coaxial cable (SUCOFLEX104, 11SMA-11SMA), 1 m
J0007	408JE-104 GPIB cable, 1 m
Z0054	3.5 inch floppy disk (MF2DD-3.5MF)
MB24B	Portable Test Rack (rating current of power cord and plug: 20 A)
B0413A	Carrying case
B0163	Portable Quilting
B0044	Rack mount kit (for 1MW · 5U panel)
Z0416	3.5 inch head cleaning disk
J0498	Coaxial code, 0.5 m
J0499	Coaxial code, 1 m
J1141	50 Ω Terminator

ERROR DETECTOR
MP1764C/MP1764D
50 Mbit/s to 12.5 Gbit/s

GPIB

For R&D of High-Speed Logic, ICs, Optical Modules and Devices

The MP1764C/1764D are used in combination with the MP1763C Pulse Pattern Generator to detect errors used to evaluate conformity with ITU-T standards. In addition, complicated searching for input thresholds or phase adjustments is simplified with the touch of a single key. These functions are ideally suited for the research and development of ultrahigh-speed logic ICs and digital communication systems. MX176400A Q and Eye Analysis Software controls MP1764C/1764D and MP1763C from the PC to measure Q factor, eye margin, and eye diagram. MX176401A SDH/SONET Pattern Editor controls the MP1763C and MP1764C/1764D to generate frame pattern conforming to SDH/SONET standards.

Features
- Auto-search function for setting optimum values of input threshold and phase setting by a "one-touch" operation
- Synchronization of 8 Mbits pattern is easily made within a short period of time (when in frame mode)
- Errors are detected in intervals as short as 0.1 sec.
- Zero wait time counter gate

Specifications

Operation frequency		0.05 to 12.5 GHz
DATA/$\overline{\text{DATA}}$ input (MP1764C Option 02)	Input waveform	NRZ
	Input amplitude	0.25 to 2.0 Vp-p
	Threshold voltage variable range	–3.000 to +1.875 Vp-p (1 mV steps)
	Phase margin	≥70 ps (typical value at 10 Gbit/s, PRBS 2^{23} – 1, and an input amplitude of 1 Vp-p)
	Input sensitivity	50 mVp-p (typical value at 10 Gbit/s and PRBS 2^{23} – 1
	Termination	Connected to GND or –2 V via a 50 Ω termination
	Connector	APC-3.5
Clock input	Input waveform	Rectangular wave (<0.5 GHz), rectangular or sine wave (≥0.5 GHz), duty factor: 50%
	Input voltage	0.25 to 2.0 Vp-p
	Input delay variable range	±500 ps (1 ps steps)
	Polarity inversion	CLOCK/$\overline{\text{CLOCK}}$ inversion possible
	Termination	Connected to GND or –2 V via a 50 Ω termination
	Connector	APC-3.5
Clock recovery function (MP1764C Option 03)	Operation bit rate	62.5 to 100 Mbit/s, 125 to 200 Mbit/s, 250 to 400 Mbit/s, 500 to 800 Mbit/s, 1,000 to 1,600 Mbit/s, 2,000 to 3,200 Mbit/s, 4,250 Mbit/s ±50 ppm, 9,900 to 11,100 Mbit/s
	CLOCK selection	Internal/External
	Continuous 0 s tolerance (withstand)	72 bit min.
	Regenerated CLOCK output	Output level: 1.0 ±0.25V (AC coupling)
Auto search function		Provided

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Receive pattern	Pseudorandom binary sequence pattern (PRBS)	Pattern: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8 (1/2, 3/4, 7/8, 8/8 are possible with logic inversion.) Number of AND bit shift at mark ratio setting: 1, 3 bits (selectable by using DIP switch on rear panel)
	Data pattern	Data length: 2 to 8388608 bits
	Alternate pattern	A/B pattern word length: 128 to 4194304 bits (128 bits steps), Number of loops: Controlled using external signal
	Zero substitution pattern	Zero bit length: 1 to (pattern length –1) bits, Pattern length: 2^n (n: 7, 9, 11, 15)
Synchronous mode		Normal, frame, quick
Synchronous threshold		Preset value or 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Error detection mode		Omission insertion, total (selectable with DIP switch on rear panel)
Measurement item	Error rate	0.0000×10^{-16} to 1.0000×10^{-0}
	Number of errors	0 to 9.9999×10^{16}
	Error interval (asynchronous)	0 to 9999999 (interval: 1 ms, 10 ms, 100 ms, 1 s)
	Error free interval (EFI)	0.0000% to 100.0000%
	Clock frequency	0.05 to 12.5 GHz, (resolution: 1 kHz, accuracy: 10 ppm ±1 kHz)
Eye margin measurement function		Provided
Error performance data calculation function		Provided
Measurement CH mask		1 to 32 ch (settable independently)
Block window		Error for any block of 32-bit segments can be measured.
Error analysis (option 01)		Pattern (256 bits in total) before and after bit in which error occurred is stored.
Auxiliary output	Error output (direct)	1/128 OR error, Output level: 0/–1 V, Connector: SMA
	Error output (stretched)	Pulse width: 350 ns (typical), Output level: TTL, Connector: BNC
	Alarm output (clock loss, sync. loss)	Output level: TTL Connector: BNC
	Sync. gain output	Output level: 0/–1 V; Connector: SMA
Auxiliary input	External mask input	Input level: 0/–1 V; Connector: SMA
	Resync. input	Input level: 0/–1 V; Connector: SMA
	Alternate A/B switching input	Input level: ECL; Connector: SMA
Sync. signal output	Number of outputs	1 (1/32 clock, fixed position pattern, or variable position pattern selectable)
	Output level	0/–1 V
	Connector	SMA
Parameter memory		Media: 3.5 inch FD (2HD, 2DD), Format: MS-DOS (Rev. 3.1)*1, Content: Pattern or other parameters
Operating temperature range		0˚ to +50˚C
Dimensions and mass		426 (W) x 221.5 (H) x 450 (D) mm, ≤30 kg (except Option 02, 03) 426 (W) x 266 (H) x 450 (D) mm, ≤35 kg (Option 02, 03)
Power		≤300 VA
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

*1: MS-DOS is a registered trade mark of Microsoft Corporation.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1764C	Error Detector	
MP1764D*1	Error Detector	
	Standard accessories	
J0500A	Semi-rigid cable (SMA-P · UT-141 · SMA-P), 0.5 m:	2 pcs (MP1764C) 4 pcs (MP1764D)
J0693A	SMA cable (HRM202B-3D2W-HRM202B), 1 m:	3 pcs
J0496	APC-3.5 J-J connector:	2 pcs (MP1764C) 3 pcs (MP1764D)
J0008	GPIB cable, 2 m:	2 pcs
J0776D	BNC cable (BNC-P · 3W · 3D · 2W · BNC-P · 3W), 2 m:	2 pcs
J0491	Power cord (13 A):	1 pc
Z0168	3.5-inch floppy disk (MF2HD-3.5MF):	2 pcs
F0014	Fuse, 6.3 A:	1 pc
Z0306A	Wrist strap:	1 pc
B0021*2	Protective cover (for 1MW · 5U):	1 pc
B0022*3	Front cover:	1 pc
W1850AE	MP1764C operation manual:	1 copy
W1851AE	MP1764C GPIB operation manual:	1 copy
W2341AE	MP1764D operation manual:	1 copy
W2342AE	MP1764D GPIB operation manual:	1 copy

*1: MP1764C + Option 02, 03
*2: For MP1764C
*3: For MP1764C-02,03 and MP1764D

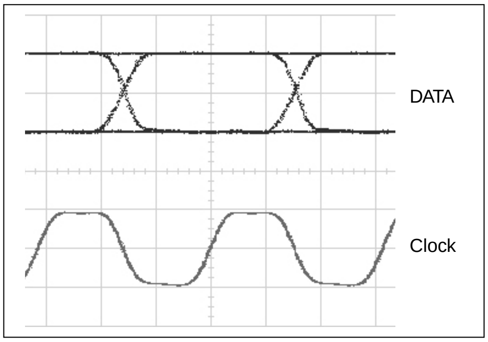
Model/Order No.	Name
	Options
MP1764C-01	Error analysis
MP1764C-02	Differential data input function
MP1764C-03	Clock recovery function
MP1764D-01	Error analysis
W2373AE	MP1764C-02, 03 operation manual
W2374AE	MP1764C-02, 03 GPIB Programming operation manual
	Application software
MX176400A	Q/Eye Analysis Software
MX176401A	SDH/SONET Pattern Editor
MX176403A	GbE/10GbE Pattern Editor
	Optional accessories
J0500B	Semi-rigid cable (SMA-P · SX-36 · SMA-P), 1 m
J0322A	Coaxial cable (SUCOFLEX104,11SMA-11SMA), 0.5 m
J0322B	Coaxial cable (SUCOFLEX104,11SMA-11SMA), 1 m
J0007	408JE-104 GPIB cable, 1 m
Z0054	3.5 inch floppy disk (MF2DD-3.5MF)
MB24B	Portable Test Rack (rating current of power cord and plug: 20A)
B0413A	Carrying case
B0163	Portable Quilting
B0044	Rack mount kit (for 1MW · 5U panel)
Z0416	3.5 inch head cleaning disk
J0498	Coaxial cord, 0.5 m
J0499	Coaxial cord, 1 m
J1141	50 Ω terminator

DIGITAL DATA ANALYZER
MP1632C
50 MHz to 3.2 GHz

GPIB OPTION

For Development, Manufacturing and Inspection of Transmission Systems, Optical Modules and Logic Devices

Core networks and computer networks are increasing rapidly as the volume of data transmitted in this multimedia data is growing. In addition to the STM-16/OC-48 (2.488 Gbit/s), Fibre channel, Giga-bit Ethernet, etc. are being commercialized. Compact and high performance digital data analyzer are required for inspecting products like digital transmission systems, optical modules, and logic devices.
The MP1632C realizes a compact solution that incorporates former measuring equipment (Pulse Pattern Generator and Error Detector) into a case.
MX163201A TEXT to MP1632A/C Pattern Conversion Software, MX163202A MP165X to MP1632A/C Pattern Conversion Software, MX163205A Q and Eye Analysis Software, and MX163206A SDH/SONET Pattern Editor are available as application software.



H: 100 ps/div, V: 1 V/div
MU163220C output waveform (3.2 GHz)

Features
- 3.2 Gbit/s PPG and ED in a case
- Eye diagram measurement and burst signal measurement supported

Performance and functions
• Easy operation
The MP1632C has a large, color LCD with touch screen. Customized screens enable one-key and one-parameter operation.

• High-quality pulse pattern generator
Programmable patterns of 8 Mbit max, PRBS patterns [(2^7 – 1) to (2^{31} – 1) with variable mark ratio], and zero substitution patterns can be generated. Variable cross-point of data output waveform is also supported.

• Error detector with many functions
High input sensitivity (25 mVp-p*) and wide phase margin (250 ps*) performance is provided. The autosearch function enables PRBS pattern search with usual phase and threshold search. Insertion error and omission error can be measured simultaneously.
*Typical values at 3 Gbit/s, PRBS 2^{23} – 1

• Internal synthesizer with high signal purity (Option)
Highly pure signals, SSB phase noise characteristics of –85 dBc/Hz or less (10 kHz offset), is generated.

• Support of various applications
The MP1632C supports testing of SDH/SONET (STM-0, 1, 4, 16/OC-1, 3, 12, 48) devices and modules, research and development on WDM components, Fibre channels, Giga-bit Ethernet, evaluation of E/O and O/E module, GaAs IC, and high-speed ASIC/FPGAs.

Specifications

• MU163220C 3.2G Pulse Pattern Generator

Operating frequency	10 MHz to 3.2 GHz (50 MHz to 3.2 GHz when using MP1632C-03 3.2G Internal Synthesizer)
External clock input	0.5 to 2 Vp-p (<0.5 GHz: square wave, ≥0.5 GHz: square wave or sine wave, 50% duty cycle)
Generation pattern	Pseudo random pattern (PRBS) Pattern length: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Mark ratio: 1/2, 1/4, 1/8, 0/8, $\overline{1/2}$, 3/4, 7/8, 8/8 AND bit shift upon mark ratio setting: 1, 3 bits Data pattern Data length: 2 to 8,338,608 bits Zero substitution pattern Continuous 0 bit length: 1 to (pattern length – 1) bits Pattern length: 2^n (n: 7, 9, 11, 15) Error insertion Error ratio: 10^{-n} (n: 3, 4, 5, 6, 7, 8, 9), single error External error input: Provided
Data output	Number of outputs: 2 (DATA/$\overline{\text{DATA}}$, independent) Amplitude: 0.5 to 2 Vp-p (10 mV steps, setting error: ±15% or ±0.1 V, whichever is greater) Offset voltage V_{OH}: –2 to +2 V (at 2 Vp-p amplitude), –3.5 to +2 V (at 0.5 Vp-p amplitude) (5 mV steps, setting error: ±15% of offset voltage, ±0.1 V or ±15% of amplitude, whichever is the greatest) Display: V_{OH}, V_{TH}, and V_{OL} selectable Rise/fall time: ≤80 ps (10% to 90% of amplitude) Pattern jitter: ≤30 psp-p Waveform distortion: 10% or 0.1 V of amplitude, whichever is greater Load impedance: 50 Ω (with back termination) Connector: SMA DATA/$\overline{\text{DATA}}$ tracking: $\overline{\text{DATA}}$ amplitude and offset voltage can be set to same value as DATA. Crosspoint adjustment function: Provided
Clock output	Number of output: 2 (CLOCK/$\overline{\text{CLOCK}}$, independent) Amplitude: 0.5 to 2 Vp-p (10 mV steps, setting error: ±15% or ±0.1 V, whichever is greater) Offset voltage V_{OH} : –2 to +2 V (at 2 Vp-p amplitude), –3.5 to +2 V (at 0.5 Vp-p amplitude) (5 mV steps, setting error: ±15% of offset voltage, ±0.1 V or ±15% of amplitude, whichever is the greatest) Display: V_{OH}, V_{TH}, and V_{OL} selectable Rise/fall time: ≤80 ps (10% to 90% of amplitude) Load impedance: 50 Ω (with back termination) Connector: SMA Clock delay: –1 to +1 ns (2 ps steps)
External burst trigger input	Input level: 0/–1 V, connector: SMA
Internal burst signal	Burst cycle: 2 µs to 50 ms (1 µs steps), Enable length: 1 µs to 49.999 ms (1 µs steps)
Burst trigger output	Output level: 0/–1 V, connector: SMA
Sync signal output	Number of outputs: 1 (1/8 clock, variable pattern synchronization output selectable), Output level: 0/–1 V, Connector: SMA
Operating temperature	+5 to +45˚C
Power	≤200 VA
Dimensions and mass	232 (W) x 49 (H) x 449 (D) mm, ≤4.5 kg

• MU163240C 3.2G Error Detector

Operating frequency	10 MHz to 3.2 GHz (50 MHz to 3.2 GHz when using MP1632C-03 3.2G Internal Synthesizer)
Data input	Input waveform: NRZ Input voltage: 0.5 to 4 Vp-p Variable threshold voltage: –4 to +4 V (1 mV steps) Termination: Connected to GND, –2 V or +3 V via 50 Ω Connector: SMA
Clock input	Input waveform: Square wave (<0.5 GHz), square wave or sine wave (≥0.5 GHz), duty: 50% Input amplitude: 0.5 to 4 Vp-p Variable input delay: –1 to +1 ns (2 ps steps) Polarity inversion: POS/NEG inversion selectable Termination: Connected to GND, –2 V or +3 V via 50 Ω Connector: SMA
Auto search function	Phase, threshold, phase & threshold, PRBS pattern (allowed if the mark ratio is between 1/8 and 7/8)
Receive pattern	Pseudo random pattern (PRBS) Pattern length: $2^n - 1$ (n: 7, 9, 11, 15, 20, 23, 31) Marker ratio: 1/2, 1/4, 1/8, 0/8, $\overline{1/2}$, 3/4, 7/8, 8/8 AND bit shift upon mark ratio setting: 1, 3 bits Data pattern Data length: 2 to 8,338,608 bits Zero substitution pattern Continuous 0 bit length: 1 to (pattern length – 1) bits Pattern length: 2^n (n: 7, 9, 11, 15)
Sync mode	Normal, frame
Sync threshold	AUTO or 10^{-n} (n: 2, 3, 4, 5, 6, 7, 8)
Error detection mode	Omission, insertion, total

Continued on next page

Measurement items	Error rate: 0.0000 x 10^{-16} to 1.0000 x 10^{0} Number of errors: 0 to 9.9999 x 10^{16} Error interval (async): 0 to 9999999 (Interval: 100 ms, 1 s) Error free interval (EFI): 0.0000 to 100.0000% Clock frequency: 0.01 to 3.2 GHz (resolution: 1 Hz, accuracy: 10 ppm ±1 kHz)
Eye margin measurement function	Provided
Error performance calculation function	Provided
Measurement channel mask	1 to 8 channels, each channel settable independently
Error output	Number of output: 1 (1/32 bit rate OR error), Output level: 0/–1, Connector: SMA
Sync signal output	Number of outputs: 1 (switchable among 1/8 clock, fixed pattern sync, sync gain output) Output level: 0/–1 V, Connector: SMA
Burst trigger input	Input level: 0/–1 V, connector: SMA
Operating temperature	+5˚ to +45˚C
Power	≤250 VA
Dimensions and mass	232 (W) x 54 (H) x 449 (D) mm, ≤5 kg

• MP1632C (Main frame)

System environment	OS: Microsoft Windows® operating system Version 3.1 Display: 10.4 inch, color LCD (touch screen), 640 x 480 dots, 256 colors Printer: Parallel port for external printer (D-sub, 25-pins) Keyboard: 101 type (English), PS/2 (mini DIN 6-pin connector) Mouse: Serial, PS/2 (mini DIN, 6-pin connector) FDD: 2 modes (1.44 MB, 740 KB) HDD C drive: ≥474 MB (used for system: measurement data, pattern), D drive: ≥30 MB (not accessible to users, interface: IDE)
Remote control	RS-232C (standard), GPIB (option): IEEE488.2, Ethernet (option): 10 Base-T
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)
Power supply	100 to 120 Vac/200 to 240 Vac, 47.5 to 63 Hz, ≤150 VA
Operating temperature	+5˚ to +45˚C
Dimensions and mass	426 (W) x 221.5 (H) x 451(D) mm, ≤20 kg

• 3.2G internal synthesizer (Option 03)

Frequency range	50 MHz to 3.2 GHz (1 kHz steps)
Frequency accuracy	±2 ppm
SSB phase noise	≤–85 dBc/Hz (10 kHz offset, 1 kHz bandwidth)
Non-harmonic spurious	≤–60 dBc (limited to spurious 10 kHz or more distant from carrier frequency)
Reference lock range	10 MHz ±10 ppm
Power	≤50 VA
Mass	≤5 kg

• MX163201A TEXT to MP1632A/C Pattern Conversion Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 3.1/95/98, CPU: Pentium 133 MHz or higher, Memory: 32 MB or more, Hard disk space: 25 MB or more Display Resolution: 640 x 480 or more, Display colors: 256 or more FDD: 3.5-inch (1.44 MB)
Text file	A text file describing the program pattern in hex format (maximum number of characters in a line: 32696 bits including spaces and return characters)
MP1632A/C pattern data file (PTN)	All the MP1632A/C set data and patterns (file format for reading/writing on the MP1632A/C main screen)
MP1632A/C pattern clip file (PCP)	Only patterns (a file format that can be read or written in the MP1632A/C Pattern Editor)

• MX163205A Q and Eye Analysis Software

Required system	Computer: IBM-PC/AT or full compatible, OS: Windows 95/98/NT, CPU: Pentium 166 MHz or higher, Memory: 64 MB or more, Hard disk space: 100 MB or more, GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT- GPIB/TNT series boards are recommended.) Display Resolution: 800 x 600 or more, Display colors: 256 or more *If two or more applications are running simultaneously, operation cannot be guaranteed.
Function	Measurement frequency: 1 to 3.2 GHz Measurement patterns: PRGM, PRBS 7, 9, 11, 15, 20, 23, 31 Pattern format: Continuous/burst (To be synchronized within 1 s) Eye margin measurement Measurement resolution (threshold): 1 to 10 mV (1 mV steps), Measurement resolution (phase): 2 to 10 ps (2 ps steps), Measurement rate: E-2 to E-15 Eye diagram measurement Measurement resolution (phase): 2 to 10 ps (2 ps steps) Measurement rate: E-2 to E-15 (actual measurement), E-3 to E-12 (estimate measurement) Display rate: E-2 to E-15 (actual measurement), E-2 to E-4915 (estimate measurement) Mask test judgment rate: E-2 to E-15 Q factor measurement Measurement style: Multiple measurements at fixed phase/phase vs. Q factor measurements Bit error rate range: Upper limit at E-3 to E-5, lower limit at E-7 to E-12 Minimum error count (measurement accuracy): 1, 10, 100, 1000 Vth shift width: Automatic, fixed (1 to 10 mV/1 mV steps)

• MX163206A SDH/SONET Pattern Editor

Required system	Computer: IBM-PC/AT or full compatible, CPU: Pentium 200 MHz or higher, OS: Windows 95/98/NT, Memory: 64 MB or more Display Resolution: 800 x 600 or more; Display colors: 256 or more FDD: 3.5-inch (1.44 MB), Hard disk space: 100 MB or more, GPIB: National Instruments made GPIB interface (PCMCIA-GPIB or AT-GPIB/TNT series boards are recommended.)
Functions	SDH/SONET pattern editor Mapping: STM-N (N = 1, 4c, 12c, 16c), STS-N SPE (N = 1, 3c, 12c, 48c) Pattern edit: Arbitrary editing of program patterns (PRBS pattern can be inserted in the payload.), time indication, table indication/edit Payload: Free format, ALL 0, ALL 1, PRBS $2^n - 1$ (n = 7, 9, 11, 15, 20, 20z, 23, 31) *Pattern repetition up to the length of all frames CID pattern: Available Frame repetition : Maximum 26 frames Alarm addition: Alarm addition conforming to SDH/SONET Standard *items: OOF/LOF, MS-AIS (L-AIS), MS-RDI (L-RDI), MS-REI (L-REI), HP-AIS (P-AIS), HP-REI (P-REI), HP-RDI (P-RDI) BIP error addition: Generates parity errors of B1, B2, and B3 B1, B2, and B3 calculation: Available Scramble: Available BIP correction: Available OH editor: Available

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IBM and AT are registered trademarks of International Business Machines.
Pentium is a registered trademark of Intel Corporation.
PCMCIA-GPIB and AT-GPIB/TNT are registered trademarks of National Instruments.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1632C	Digital Data Analyzer	
	Standard accessories	
	Power cord (shielded):	1 pc
F0090	Fuse, 8 A:	2 pcs
Z0319A	PS/2 mouse:	1 pc
Z0320	Input pen:	1 pc
Z0527	Recovery disk*1:	1 set
Z0528	Application disk*1:	1 set
Z0529	Remote sample disk*1:	1 set
Z0396A	Pen holder:	1 pc
W1859AE	MP1632C operation manual:	1 copy
W1860AE	MP1632C remote control operation manual:	1 copy
B0447B	Dummy unit for EXTENSION:	1 pc
B0329D	Front cover:	1 pc
	Options	
MP1632C-01	GPIB	
MP1632C-02	Ethernet	
MP1632C-03	3.2G internal synthesizer	
	Application software	
MX163201A	TEXT to MP1632A/C Pattern Conversion Software	
MX163205A	Q and Eye Analysis Software	
MX163206A	SDH/SONET Pattern Editor	

*1: Only for MP1632C customer
*2: Units are factory options (not user replaceable)
*3: Not supplied when 3.2G pulse pattern generator purchased as same time

Model/Order No.	Name	
	Peripherals	
Z0321A	Keyboard (PS/2)	
J0008	GPIB cable, 2 m	
B0447A	Dummy unit for CG	
B0447C	Dummy unit for PPG	
B0447D	Dummy unit for ED	
Z0416	3.5 inch head cleaning disk	
MB24B	Portable Test Rack (specified current: 20 A)	
B0348	Soft case	
B0329D	Front cover	
B0333D	Rack mount kit	
J0905A	Semi-rigid cable (for Option 03)	
Z0398	Ethernet installation disk (for Option 02)	
W1529AE	Ethernet operation manual (for Option 02)	
MU163220C	3.2G Pulse Pattern Generator*2	
	Standard accessories	
J0693A	Coaxial cord (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
J0696A	Coaxial cord (AA-165-500), 0.5 m:	2 pcs
W1857AE	MU163220C/163240C operation manual:	1 copy
Z0306A	Wrist strap:	1 pc
MU163240C	3.2G Error Detector*2	
	Standard accessories	
J0693A	Coaxial cord (HRM202B · 3D2W · HRM202B), 1 m:	1 pc
J0696A	Coaxial cord (AA-165-500), 0.5 m:	2 pcs
W1857AE	MU163220C/163240C operation manual*3:	1 copy

IP/NETWORK MEASURING INSTRUMENTS

Selection guide

• Bit rate/Interface

Model / Bit rate/Interface	MP1220A	MP1570A/A1	MP1580A	MP1590B	MD1231A	MD1231A1	MD1230B	MT7407A	MD6420A	MD6430A
50 bit/s to 200 kbit/s: V.24/V.28 (RS-232C)									√	√
50 bit/s to 10 Mbit/s: V.35									√	√
50 bit/s to 10 Mbit/s: V.36 (RS-449)									√	√
50 bit/s to 10 Mbit/s: X.20 (RS-423)/X.21 (RS-422)									√	√
50 bit/s to 10 Mbit/s: TTL									√	√
64 kbit/s									√	√
192 kbit/s: ISDN									√	√
1.544 Mbit/s: DS1	√	√		√					√	√
2.048 Mbit/s: E1	√	√		√						√
6.312 Mbit/s: DS2	√								√	√
8.448 Mbit/s: E2		√		√						
32.00 Mbit/s: ATM25M	√									
34.368 Mbit/s: E3	√	√		√						
44.736 Mbit/s: DS3	√	√		√						
139.264 Mbit/s: E4	√	√		√						
51.84 Mbit/s: STM-0/OC-1	√	√		√						
155.52 Mbit/s: STM-1/OC-3	√	√		√	√	√	√	√		
622.08 Mbit/s: STM-4/OC-12	√	√		√	√	√	√	√		
2488.32 Mbit/s: STM-16/OC-48		√	√	√		√	√	√		
9953.28 Mbit/s: STM-64/OC-192		√	√	√		√	√	√		
2666.057 Mbit/s: OTU-1				√						
10709.225 Mbit/s: OTU-2				√						
10M/100M Ethernet				√	√	√	√	√		
Gigabit Ethernet				√	√	√	√	√		
10 Gigabit Ethernet				√		√	√	√		

• **Measurement functions**

Measurement functions		MP1220A	MP1570A/A1	MP1580A	MP1590B	MD1231A	MD1231A1	MD1230B	MT7407A	MD6420A	MD6430A
ISDN, PDH/ DSn	Analog measurements									√	
	Digital level measurements A-law, μ-law										√
	Frequency measurements		√		√					√	√
	Pattern trace									√	√
	Error measurement (G.821, etc.)	√	√		√	√	√	√	√	√	√
	ISDN origination/termination									√	√
	Frame relay										√
OTN/ SDH/ SONET/ EOS	OTN frame				√						
	SDH/SONET frame	√	√		√	√	√	√	√		
	GFP frame				√	√	√	√	√		
	O.191 test cells	√	√								
	1 point CDV, 2 point CDV	√	√								
	ATM cell capture	√	√								
	CID pattern G.958		√								
	Tandem connection pattern G.707		√		√						
	Automatic Protection Switch		√		√	√	√	√	√		
	Frame memory/Capture		√								
	PDH/DSn mapping		√		√						
	POS		√		√	√	√	√	√		
	Through mode		√		√	√	√	√	√		
	Optical power measurements		√		√	√	√	√	√		
	Jitter/wander measurements		√	√	√						
	Frequency offset		√		√	√	√	√	√		
Ethernet	Packet capture				√	√	√	√	√		
	Protocol decoding				√	√	√	√	√		
	Protocol emulation				√	√	√	√	√		
	XENPAK measurements				√		√	√	√		
	RFC2544 Automatic test				√	√	√	√	√		
	RFC2889 Automatic test				√	√	√	√	√		
	Through mode				√	√	√	√	√		
	Traffic map				√	√	√	√	√		
	Traffic monitor				√	√	√	√	√		
	Full wire rate transmission				√	√	√	√	√		
	Packet BER measurement				√	√	√	√	√		
	Latency				√	√	√	√	√		
Remote Control		√	√	√	√	√	√	√	√	√	√

MD1230 FAMILY

MD1230B DATA QUALITY ANALYZER
MD1231A/A1 IP NETWORK ANALYZER
MT7407A MULTISLOT CHASSIS

GPIB OPTION

IP testing instruments changing in response to applications for core, metropolitan-area, and access networks

NEW

Anritsu's MD1230 Family can measure network quality.
Evaluating the network quality of service (QoS) based on various indexes has importance in terms of assuring the accurate transmission of video, voice, and mission-critical data.
The MD1230 Family puts together all the functions required to measure network quality into one unit. The functions include the multiflow counter useful to measure the performance of VLAN, packet jitter checking by the measurement of the intervals of arriving packets, and packet transmission at the wire rate.
With its integrated operation, the MD1230 Family provides highly efficient measurements and cost reduction.

• Simple automatic measurement of network performance
The MD1230 Family provides testing that conforms to the RFC 2544 standard test. After setting up test conditions in advance, five performance parameters, (throughput, latency, frame loss rate, back-to-back frames, and system recovery) can be measured automatically with a single start button.

Throughput test
The MD1230 Family has a standard function to conduct a throughput test in conformity with RFC 2544. It can also conduct the throughput test for many-to-one, one-to-many, and many-to-many connections.

Latency measurement
The MD1230 Family has a standard function to perform latency measurement in conformity with RFC 2544. It can also conduct the latency measurement on broadcast frames in conformity with RFC 2889.

Option 10: RFC 2889 Benchmarking Test
RFC 2889 benchmark test is a specialty benchmark test for LAN Switches. It describes 10 types test such a meshed throughput test, forwarding rates test, address catching capacity test and errored frames filtering test. The MD1230 Family can conduct those tests in conformity with RFC 2889.

• Real-time detection of frame loss

Option 11: Packet BER Test
The MD1230 Family provides a test frame that allows the user to detect frame loss in real time. In addition, the BER Test in packet level allows the user to detect single-bit errors.

• Protocol emulation
The MD1230 Family supports emulation of various protocols. The emulation function can create pseudo routers and hosts, which can be useful for router testing.

IPv6
Option 12: IPv6 Expansion

Multicast Protocol
Option 14: IGAP Protocol
Option 21: PIM-SMv2 Protocol
Option 22: MLDA Protocol

Routing protocol
Option 07: OSPF Protocol
Option 18: OSPFv3 Protocol
Option 19: BGP4+ Protocol

MPLS
Option 08: LDP/CR-LDP Protocol
Option 09: RSVP-TE Protocol

• Traffic counting functions

Multi-layer VLAN
The MU120121A and MU120122A support a multi-layer VLAN. Since the user can set the TPID (tag protocol identifer), the traffic count function can be tailored to support the vendor's original specification conforming to the VLAN specification*1.

Single-layer VLAN

Ether DA	Ether SA	VLAN TPID=0x8100 Tag ID=✻	Type TPID=0x0800	IP	Ether FCS

Triple-layer VLAN

Ether DA	Ether SA	X Tag TPID=0xXXXX Tag ID=✻	Y Tag TPID=0xYYYY Tag ID=✻	VLAN Tag TPID=0x8100 Tag ID=✻	Type TPID=0x0800	IP	Ether FCS
		1st layer	2nd layer	3rd layer			

*1: A 4-byte tag can be identified only when it contains 2 bytes of TPID.

Multi-flow counter

The MU120121A and MU120122A can count frames in each flow separately by using the value in a specific field.
For example, frames can be counted separately according to the VLAN ID or Flow ID given to transmission test frames.
There are a total of 4,096 kinds of VLAN IDs. The multi-flow counter can count frames classified in up to 65,536 kinds by VLAN ID. The multi-flow counter can also perform real-time measurement of 32 kinds of selected frames.

1 ms traffic counter (Option 20: Application traffic monitor)

The volume of traffic can be measured at a high resolution of 1 ms. Even when the total traffic measured every second results in 10 Mbit/s, the total traffic measured every millisecond (ms) may exceed 20 Mbit/s, beyond relaying equipment, due to the momentary convergence of frames. Such traffic characterized by bursts can cause missing frames in video delivery services and sound deterioration in voice communications.

• Frame capturing

The capture function can analyze a protocol sequence to understand frames of a stream or to find an abnormal sequence in a stream. The trigger function by the sequence error*1 can evaluate a switching time because MD1230 Family can capture frames which is existing before and after the lost frame or the overlapping frame.

• Protocol analysis

The MD1230 Family has standard functions to analyze Ethernet, IP, and TCP/UDP.

Ethereal converter

Ethereal® is Open Source Software to analyze various protocols. The MD1230 family can convert it to decode captured frames*1.

Option 04: Decoding function

MX123002A expert analysis function

The use of optional Sniffer® Technologies allows the user to analyze about 400 types of protocols, including HTTP, FTP, SNMP, SIP, and RTP. The MX123002A Expert Analysis Module can detect the parts where faults or other problems may occur, and display guidance messages.

*1: Ethereal must be installed by the customer.

• Highly flexible frame transmission function

It is important to customize frames easily because a network device evaluation requires many frames to test the various situations. Using a model of protocols, the MD1230 Family provides easily working. The MD1230 Family can also use captured frame and text file, it includes protocols which do not exist in the models.

Step 1

First, select a model. The following models are available for selection:

Standard:

None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPv6 Extension Header, IPX, IS-IS, MAC Control Frame (Pause Frame)

To use EoMPLS or a protocol excluded from selectable models, load a commented text or CSV file.

```
; Ether Header
00 00 91 00 32 01     ; SA
00 00 91 00 32 02     ; DA
08 00        ; Type
; IP Heaser
45 00 00 2E 00 00 40 00
40           ; TTL
00           ; Protocol
26 CE        ; Header Checksum
0A 00 00 01           ; SA
0A 00 00 02           ; DA
.....
```

Step 2

Set up each protocol based on the model selected in Step 1. For example, when TCP/IP is selected, IP and TCP tabs appear in addition to the Ethernet tab on the setup screen, allowing values in the setting fields to be changed for the respective protocols.

Step 3

After setting the header, create the data part. Selectable values are All 0, All 1, Increment, and Random. When Test Frame is selected, latency, bit error*2 and sequence error measurement*2 can be done.
A flow IDs can be set when Test Frame is selected. With this setting, frames can be counted separately in each of up to 65,536 flows by the multi-flow counter function of the MU120121A/120122A.

*2: It requires Option 11 Packet BER Test in the MD1230 Family of receiver side.

Step 4

The frame format was specified by the setting operation in Step 3 and before. Next, specify how to send frames. A burst means a set of frames; a stream means a set of bursts.
For example, when “3 Frame per Burst” and “2 Burst per Steam” are specified, a set of three frames will be sent twice in one stream.
The gaps between frames, between bursts, and between streams can be specified as IFG, IBG, and ISG, respectively.

Step 5

After setting the number of frames in the stream and gaps, specify the relationship of the stream to other streams. Simple sequences of streams can be created by using Next Stream and Jump to Stream commands.

Module Table

Model	Name	MD1230B	MD1230A	MD1231A	MD1231A1	MT7407A*1	Power consumption
MU120101A	10M/100M Ethernet Module	√	√	√	√	√	4.5
MU120102A	Gigabit Ethernet Module	√	√	√	√	√	3.5
MU120103A	2.5G (1.31) Module	√	√		√	√	5.0
MU120103B	2.5G (1.31) Module	√	√		√	√	8.0
MU120104A	2.5G (1.55) Module	√	√		√	√	5.0
MU120104B	2.5G (1.55) Module	√	√		√	√	8.0
MU120105A	10G (1.31) Module	√	√		√	√	10.0
MU120106A	10G (1.55) Module	√	√		√	√	10.0
MU120111A	10/100M Ethernet Module	√	√	√	√	√	5.5
MU120112A	Gigabit Ethernet Module	√	√	√	√	√	5.5
MU120118A	10 Gigabit Ethernet Module	√	√		√	√	17.0
MU120118B	10 Gigabit Ethernet Module	√	√		√	√	19.0
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)	√	√	√	√	√	3.5
MU120120A	OC-3/STM-1 Module (1310 nm)	√	√	√	√	√	3.5
MU120121A	10/100/1000M Ethernet Module	√	√*2				19.0
MU120122A	Gigabit Ethernet Module	√	√*2				19.0
MU740701A	IP Tester Control Module					√	2.0

*1: The total current consumption by the modules mounted in one MU740702A must be 65 A or less.
*2: The MD1230A-47 can accommodate on slot 1, 3, 5. The total current consumption by the modules mounted in one MD1230A must be 60 A or less.

Selection guide

• Ethernet modules

Model	MU120101A	MU120111A	MU120121A	MU120102A	MU120112A	MU120122A	MU120118B
Interface	10/100M		10/100/1000M	GbE			10GbE
Ports (Connector)	8 (RJ-45)	8 (RJ-45)	4 (RJ-45)	2 (GBIC*1)	2 (GBIC)	2 (RJ-45) 2 (SFP)	2 (XENPAK)
Clock Variation			√			√	√*2
Auto MDI/MDI-X Detection			√			√	
Frame Generation							
Stream Generation (TxStream)	√	√	√	√	√	√	√
Multi Layer VLAN			√			√	
MAC Address Increment	√	√	√	√	√	√	√
IP Address Increment	√	√	√	√	√	√	√
TCP/UDP Port Number Increment		√	√	√	√	√	√
Spanning Tree / Link Aggregation Frame (opt23)		√	√		√	√	√
Test Frame Addition	√*3	√	√	√	√	√	√
Hardware Random Pattern			√			√	
Measurement							
Counter	√	√	√	√	√	√	√
Multi Flow Counter			√		√		
Capture	√	√	√	√	√	√	√
Decode	√	√	√	√	√	√	√
Latency	√	√	√	√	√	√	√
Ping	√	√	√	√	√	√	√
Ping6 (opt12)		√	√		√	√	√
Arrival Time Variation	√	√	√	√	√	√	√
Through Mode	√	√	√	√	√	√	√
Monitor Mode	√	√	√	√	√	√	√
Address Swap Mode		√	√		√	√	√
Unframe BER Test		√	√	√	√	√	√*4
Packet BER Test (opt11)		√	√	√	√	√	√
Autonegotiation Analysis (opt15)*5					√	√	
Application Traffic Monitor (opt20)*6					√		
Link Fault Signaling (opt16)*7							√
XENPAK Test (opt13)*7							√
Optical Power Meter							
Automatic Test							
RFC2544	√	√	√	√	√	√	√
RFC2889 (opt10)		√	√	√	√	√	
Protocol Emulation							
ARP	√	√	√	√	√	√	√
ICMP	√	√	√	√	√	√	√
OSPF (opt07)		√	√		√	√	√
BGP-4	√*8	√	√	√*8	√	√	√
ICMPv6 (opt12)		√	√		√	√	√
OSPFv3 (opt18)*9		√	√		√	√	√
BGP4+ (opt19)*9		√	√		√	√	√
IGMP	√	√	√	√	√	√	√
IGAP (opt14)		√	√		√	√	√
MLD (opt12)		√	√		√	√	√
MLDA (opt22)*9		√	√		√	√	√
PIM-SMv2 (opt21)*10		√	√		√	√	√
MPLS (LDP/CR-LDP) (opt08)		√	√		√	√	√
MPLS (RSVP-TE) (opt09)		√	√		√	√	√

*1: 1000BASE-T GBIC is not supported.
*2: Option 13 provides its clock only to XAUI interface of the XENPAK module.
*3: Packet BER Test is disabled when a test frame is sent to another module.
*4: Option 13 XENPAK Test is required.
*5: This function is implemented by using GBIC on the SX/LX/LH/ZX and SFP on the SX/LX/LE/LR.
*6: This function cannot be used on the MT7407A. (Use the MD1230A/B or MD1231A/A1.)
*7: This function cannot be used on the MD1231A. (Use the MD1231A1, MD1230A/B, or MT7407A.).
*8: Only up to eight virtual routers can be emulated.
*9: Option 12 IPv6 Expansion is required.
*10: Option 12 IPv6 Expansion is required when IPv6 addresses are to be used. This option supports only IPv4 addresses.

• **POS/EoS modules**

Model	MU120120A	MU120119A	MU120103A	MU120104A	MU120105A	MU120106A	MU120103B	MU120104B
Interface	STM-1 OC-3	STM-1/4 OC-3/12	STM-16 OC-48	STM-16 OC-48	STM-64 OC-192	STM-64 OC-192	STM-16 OC-48	STM-16 OC-48
Bit Rate	155.52 M	155.52 M 622.08 M	2,488.32 M	2,488.32 M	9,953.28 M	9,953.28 M	2,488.32 M	2,488.32 M
Wavelength	1,310 nm	1,310 nm	1,310 nm	1,550 nm	1,310 nm	1,550 nm	1,310 nm	1,550 nm
Input Sensitivity (dBm)	–28 to –8	–28 to –8	–18 to 0	–28 to –9	–12 to 0	–14 to –3	–18 to 0	–18 to 0
Output Level (dBm)	–15 to –8	–15 to –8	–5 to 0	–2 to +3	–4 to 0	–1 to +2	–5 to 0	–5 to 0
Ports (Connector)	2 (SC)	2 (SC)	1 (SC)	1 (SC)	1 (SC)	1 (SC)	1 (SC)	1 (SC)
Mapping								
POS	√	√	√	√	√	√	√	√
EoS							√*1	√*2
VCAT							√*3	√*4
Frame Generation								
Stream Generation (TxStream)	√	√	√	√	√	√	√	√
Multi Layer VLAN								
MAC Address Increment							√	√
IP Address Increment	√	√	√	√	√	√	√	√
TCP/UDP Port Number Increment	√	√	√	√	√	√	√	√
Spanning Tree/Link Aggregation Frame (opt23)								
Test Frame Addition	√	√	√	√	√	√	√	√
Hardware Random Pattern								
Measurement								
Counter	√	√	√	√	√	√	√	√
Multi Flow Counter								
Capture	√	√	√	√	√	√	√	√
Decode	√	√	√	√	√	√	√	√
Latency	√	√	√	√	√	√	√	√
Ping	√	√	√	√	√	√	√	√
Ping6 (opt12)								
Arrival Time Variation	√	√	√	√	√	√	√	√
Through Mode	√	√	√	√	√	√	√	√
Monitor Mode	√	√	√	√	√	√	√	√
Address Swap Mode								
Unframe BER Test	√	√	√	√	√	√	√	√
Packet BER Test (opt11)	√	√	√	√	√	√	√	√
Autonegotiation Analysis (opt15)								
Application Traffic Monitor (opt20)								
Link Fault Signaling (opt16)								
XENPAK Test (opt13)								
Optical Power Meter	√*5	√*6	√	√	√	√	√	√
Automatic Test								
RFC2544	√	√	√	√	√	√	√	√
RFC2889 (opt10)								
Protocol Emulation								
ARP							√	√
ICMP	√	√	√	√	√	√	√	√
OSPF (opt07)								
BGP-4	√*7	√*7	√*7	√*7	√*7	√*7	√*7	√*7
ICMPv6 (opt12)								
OSPFv3 (opt18)								
BGP4+(opt19)								
IGMP	√	√	√	√	√	√	√	√
IGAP (opt14)								
MLD (opt12)								
MLDA (opt22)								
PIM-SMv2 (opt21)								
MPLS (LDP/CR-LDP) (opt08)								
MPLS (RSVP-TE) (opt09)								

*1: The module option (MU120103B-01 EOS Mapping) is required.
*2: The module option (MU120104B-01 EOS Mapping) is required.
*3: The module option (MU120103B-02 Virtual Concatenation) is required.
*4: The module option (MU120104B-02 Virtual Concatenation) is required.
*5: The module option (MU120120A-01 Optical Power Meter) is required.
*6: The module option (MU120119A-01 Optical Power Meter) is required.
*7: Only up to eight virtual routers can be emulated.

Specifications

• MD1230B Data Quality Analyzer

Indicator	LCD	8.4in. Color TFT, SVGA (800 x 600)
	LED	Power, HDD, Remote, Panel Lock, Power Fail, Error, Alarm, History
OS		Windows® XP Professional
Storage Unit		HDD and 3.5in. FDD
Interface		RS-232C, GPIB, Ethernet (RJ-45), USB1.1 x 3 ports, Keyboard (PS/2), GPS antenna, CRT (15-pin mini D-sub)
	Trigger	Trigger Input: for APS test and Frame Capture Trigger Output: Capture Trigger Level: TTL (active HIGH) Connector: BNC (75 Ω)
	Unit Sync. Input/Output	Time Synchronization for MD1230 Family Level: TTL Connector: BNC (75 Ω)
	DCS Input	Frequency Clock: 1.544 MHz, 2.048 MHz, 64 kHz + 8 kHz Data: 1.544 Mbit/s, 2.048 Mbit/s Input Range: ±50 ppm Level/Code 1.544 M: ANSI T1.403 (B8ZS) 2.048 M: ITU-T G.703 Table 10 (HDB3) 64 kHz + 8 kHz: 0.63 to 1.1 Vo-p (AMI, 8 kHz violation) Connector BNC (75 Ω): 2.048 MHz, 2.048 Mbit/s Siemens (120 Ω balanced): 2.048 MHz, 2.048 Mbit/s, 64 kHz + 8 kHz Bantam (100 Ω balanced): 1.544 MHz, 1.544 Mbit/s
Remote Control		Remote control using LAN (10BASE-T/100BASE-TX) with MX123001A Remote command control with RS-232C (Opt01) or GPIB (Opt02) or LAN (10BASE-T/100BASE-TX, Opt03/Opt06)
Input Device		Pointing Device, Front Panel Keys
Power		AC 100 to 120 V/200 to 240 V (100/200 V system automatic change), 50 to 60 Hz
Power Consumption		≤650 VA
Operational Temperature		+5 to +40˚C
Dimensions and Mass		320 (W) x 177 (H) x 350 (D) mm, ≤15 kg (excluding option and plug-in modules)
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)
Number of Slots		5
Corresponding Modules		MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120103A: 2.5G (1.31) Module, MU120103B: 2.5G (1.31) Module, MU120104A: 2.5G (1.55) Module, MU120104B: 2.5G (1.55) Module, MU120105A: 10G (1.31) Module, MU120106A: 10G (1.55) Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120118A: 10 Gigabit Ethernet Module, MU120118B: 10 Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm), MU120121A: 10/100/1000M Ethernet Module, MU120122A: Gigabit Ethernet Module
Corresponding Options*1		MD1230B-01: RS-232C Control*2, MD1230B-02: GPIB Control*2, MD1230B-03: Ethernet Control*2, MD1230B-04: MD1230B Decode Module*3, MD1230B-05: GPS Module*4, MD1230B-06: Tcl Interface*5, MD1230B-07: OSPF Protocol, MD1230B-08: MPLS (LDP/CR-LDP) Protocol, MD1230B-09: MPLS (RSVP) Protocol, MD1230B-10: RFC2889 Benchmarking Test, MD1230B-11: Packet BER Test, MD1230B-12: IPv6 Expansion, MD1230B-13: XENPAK Test, MD1230B-14: IGAP Protocol, MD1230B-15: Auto Negotiation Analysis, MD1230B-16: Link Fault Signaling, MD1230B-18: OSPFv3 Protocol*6, MD1230B-19: BGP4+ Protocol*6, MD1230B-20: Application Traffic Monitor, MD1230B-21: PIM-SMv2 Protocol*7, MD1230B-22: MLDA Protocol*6, MD1230B-23: Spanning Tree/Link Aggregation, MX123002A: MD1230A Expert Analysis Module*8

*1: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide.
*2: The MD1230B-01/02/03 options are required only for remote control using GPIB commands.
Note that these options may be installed together, although only one of them can be used at a time.
*3: Purchase MD1230B-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*4: An accessory GPS antenna (with a 5 m cable) is bundled together with the module.
*5: MD1230B-06 is the option to operate the Tcl server. MD1230B-06 can be mounted together with MD1230B-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*6: MD1230B-12 IPv6 Expansion is required.
*7: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1230B-12 IPv6 Expansion is required.
*8: MD1230B-04 MD1230B Decode Module is required.

• MD1231A/A1 IP Network Analyzer

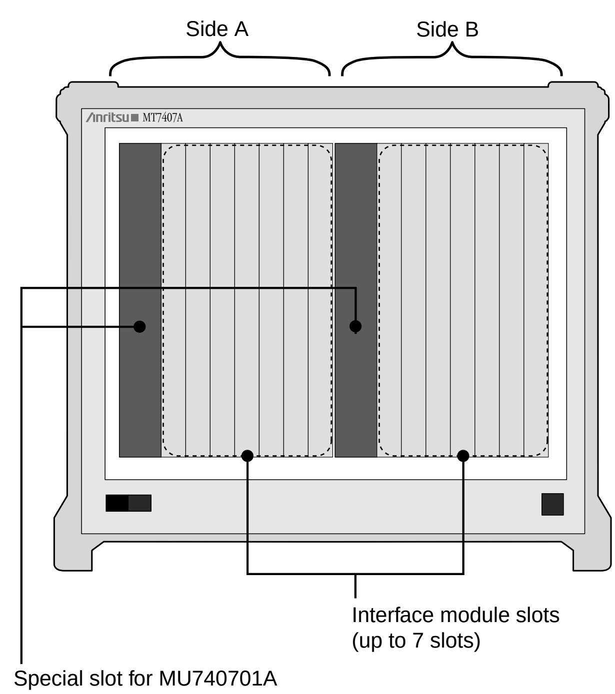
Model		MD1231A	MD1231A1
Indicator	LCD	8.4in. Color TFT, SVGA (800 x 600)	
	LED	Power, HDD, Remote, Panel Lock	
OS		Windows® 98 Second Edition Embedded	
Storage Unit		HDD and 3.5in. FDD	
Interface		GPIB, Ethernet (RJ-45), USB1.1 x 2 ports, Keyboard (PS/2), GPS antenna	
	Trigger	Trigger Input: for APS test and Frame Capture Trigger Output: Capture Trigger Level: TTL (active HIGH) Connector: SMB (75 Ω)	
	Unit Sync. Input/Output	Time Synchronization for MD1230 Family Level: TTL Connector: SMB (75 Ω)	
	DCS Input	—	
Remote Control		Remote control using LAN (10BASE-T/100BASE-TX) with MX123001A Remote command control with GPIB (Opt02) or LAN (10BASE-T/100BASE-TX, Opt03/Opt06)	
Input Device		Pointing Device	
Power		AC 85 to 132 V/170 to 250 V (100/200 V system automatic change), 47.5 to 63 Hz	
Power Consumption		≤150 VA	≤330 VA
Operational Temperature		+5 to +40°C	
Dimensions and Mass		320 (W) x 100 (H) x 300 (D) mm, ≤5 kg (excluding option and plug-in modules)	320 (W) x 100 (H) x 300 (D) mm, ≤6 kg (excluding option and plug-in modules)
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)	
LVD		EN61010-1: 2001 (Pollution Degree 2)	
Number of Slots		2	
Corresponding Modules		MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm)	MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120103A: 2.5G (1.31) Module, MU120103B: 2.5G (1.31) Module, MU120104A: 2.5G (1.55) Module, MU120104B: 2.5G (1.55) Module, MU120105A: 10G (1.31) Module, MU120106A: 10G (1.55) Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120118A: 10 Gigabit Ethernet Module, MU120118B: 10 Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm)
Corresponding Options*1		MD1231A-02: GPIB Control*2, MD1231A-03: Ethernet Control*2, MD1231A-04: MD1231A Decode Module*3, MD1231A-05: GPS Module*4, MD1231A-06: Tcl Interface*5, MD1231A-07: OSPF Protocol, MD1231A-08: MPLS (LDP/CR-LDP) Protocol, MD1231A-09: MPLS (RSVP) Protocol, MD1231A-10: RFC2889 Benchmarking Test, MD1231A-11: Packet BER Test, MD1231A-12: IPv6 Expansion, MD1231A-14: IGAP Protocol, MD1231A-15: Auto Negotiation Analysis, MD1231A-18: OSPFv3 Protocol*6, MD1231A-19: BGP4 + Protocol*6, MD1231A-20: Application Traffic Monitor, MD1231A-21: PIM-SMv2 Protocol*7, MD1231A-22: MLDA Protocol*6, MD1231A-23: Spanning Tree/Ling Aggregation, MX123002A: MD1230A Expert Analysis Module*8	MD1231A1-02: GPIB Control*9, MD1231A1-03: Ethernet Control*9, MD1231A1-04: MD1231A1 Decode Module*10, MD1231A1-05: GPS Module*4, MD1231A1-06: Tcl Interface*11, MD1231A1-07: OSPF Protocol, MD1231A1-08: MPLS (LDP/CR-LDP) Protocol, MD1231A1-09: MPLS (RSVP) Protocol, MD1231A1-10: RFC2889 Benchmarking Test, MD1231A1-11: Packet BER Test, MD1231A1-12: IPv6 Expansion, MD1231A1-13: XENPAK Test, MD1231A1-14: IGAP Protocol, MD1231A1-15: Auto Negotiation Analysis, MD1231A1-16: Link Fault Signaling, MD1231A1-18: OSPFv3 Protocol*12, MD1231A1-19: BGP4 + Protocol*12, MD1231A1-20: Application Traffic Monitor, MD1231A1-21: PIM-SMv2 Protocol*13, MD1231A1-22: MLDA Protocol*12, MD1231A1-23: Spanning Tree/Ling Aggregation, MX123002A: MD1230A Expert Analysis Module*14

*1: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide.
*2: The MD1231A-02/03 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*3: Purchase MD1231A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*4: An accessory GPS antenna (with a 5 m cable) is bundled together with the module.
*5: MD1231A-06 is the option to operate the Tcl server. MD1231A-06 can be mounted together with MD1231A-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*6: MD1231A-12 IPv6 Expansion is required.
*7: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1231A-12 IPv6 Expansion is required.
*8: MD1231A-04 MD1231A Decode Module is required.
*9: The MD1231A1-02/03 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*10: Purchase MD1231A1-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*11: MD1231A1-06 is the option to operate the Tcl server. MD1231A-06 can be mounted together with MD1231A1-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*12: MD1231A1-12 IPv6 Expansion is required.
*13: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1231A1-12 IPv6 Expansion is required.
*14: MD1231A1-04 MD1231A1 Decode Module is required.

• MT7407A Multislot Chassis[*1]

Indicator	LCD	—
	LED	Power
OS		Use an external PC
Storage Unit		
Interface		Ethernet (RJ-45)
	Trigger	Trigger Input: for APS test and Frame Capture Trigger Output: Capture Trigger Level: TTL (active HIGH) Connector: BNC (75 Ω)
	Unit Sync. Input/Output	Provided by MT7407A-01 Interface Board for IP Tester
	DCS Input	
Remote Control		Remote Control using LAN (10BASE-T/100BASE-TX) with MX123001A Remote Command control using RS-232C (MX123001A-06) or GPIB (MX123001A-07) or LAN (10BASE-T/100BASE-TX, MX123001A-09)
Input Device		—
Power		Provided by MU740702A Power Unit for IP Tester (2 power units can install on MT7407A. Right side and left side are independently.) When MU740702A Power Unit for IP Tester is installed, AC 85 to 132 V/170 to 250 V (100/200 V system automatic change), 47.5 to 63 Hz
Power Consumption		When one Power Unit (MU740702A) is installed, ≤550 VA When two Power Unit (MU740702A) is installed, ≤1100 VA
Operational Temperature		+5 to +40˚C
Dimensions and Mass		426 (W) x 355 (H) x 501 (D) mm, ≤20 kg (excluding option and plug-in modules)
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)
Number of Slots		14
	Slot for only MT7407A	MU740701A IP Tester Control Module: 2 MT7407A-01 Interface Board for IP Tester: 1
Corresponding Modules		MU120101A: 10M/100M Ethernet Module, MU120102A: Gigabit Ethernet Module, MU120103A: 2.5G (1.31) Module, MU120103B: 2.5G (1.31) Module, MU120104A: 2.5G (1.55) Module, MU120104B: 2.5G (1.55) Module, MU120105A: 10G (1.31) Module, MU120106A: 10G (1.55) Module, MU120111A: 10/100M Ethernet Module, MU120112A: Gigabit Ethernet Module, MU120118A: 10 Gigabit Ethernet Module, MU120118B: 10 Gigabit Ethernet Module, MU120119A: OC-3/12 STM-1/4 Module (1310 nm), MU120120A: OC-3/STM-1 Module (1310 nm)
Corresponding Option		MT7407A-01 Interface Board for IP Tester

*1: MT7407A can mount up to 7 interface modules on each side (A or B).
Sides A and B are independent from each other.
MU740701A IP Tester Control Module and MU740702A Power Unit for IP Tester must be mounted on each side.
The MU740701A IP Tester Control Module must be inserted into the designated slot indicated by red color.



• MU740701A IP Tester Control Module

Indicator	LED	Ready
Interface		RS-232C
Number of Support Modules		7 modules
Corresponding Options[*1]		MU740701A-04: MU740701A Decode Module[*2], MU740701A-05: GPS Module[*3], MU740701A-07: OSPF Protocol, MU740701A-08: MPLS (LDP/CR-LDP) Protocol, MU740701A-09: MPLS (RSVP) Protocol, MU740701A-10: RFC2889 Benchmarking Test, MU740701A-11: Packet BER Test, MU740701A-12: IPv6 Expansion, MU740701A-13: XENPAK Test, MU740701A-14: IGAP Protocol, MU740701A-15: Auto Negotiation Analysis, MU740701A-16: Link Fault Signaling, MU740701A-18: OSPFv3 Protocol[*4], MU740701A-19: BGP4 + Protocol[*4], MU740701A-21: PIM-SMv2 Protocol[*5], MU740701A-22: MLDA Protocol[*4], MU740701A-23: Spanning Tree/Link Aggregation, MU740701A-30: MU740701A Expert Analysis Module[*6]

*1: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide.
*2: A separate MX123001A-01 is required to use the decode module function. The operation manual (W2107AE) is included in MX123001A-01. A printed version is sold separately.
*3: MT7407A-01 is required. An accessory GPS antenna (with a 5 m cable) is bundled together with the module.
*4: MU740701A-12 IPv6 Expansion is required.
*5: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MU740701A-12 IPv6 Expansion is required.
*6: Using the expert analysis module function requires a separate MU740701A-04 MU740701A Decode Module, MX123001A Data Quality Analyzer Control Software, MX123001A-01, MD1230A-04 Remote Control Software, and MX123003A MX123002A Remote Control Software.

• MT7407A-01 Interface Board for IP Tester

Interface		GPS antenna
	Unit Sync. Input/Output	Time Synchronization for MD1230 Family Level: TTL Connector: BNC (75 Ω)
	DCS Input	Frequency Clock: 1.544 MHz, 2.048 MHz, 64 kHz + 8 kHz Data: 1.544 Mbit/s, 2.048 Mbit/s Input Range: ±50 ppm Level/Code 1.544 M: ANSI T1.403 (B8ZS) 2.048 M: ITU-T G.703 Table 10 (HDB3) 64 kHz + 8 kHz: 0.63 to 1.1 Vo-p (AMI, 8 kHz violation) Connector BNC (75 Ω): 2.048 MHz, 2.048 Mbit/s Siemens (120 Ω balanced): 2.048 MHz, 2.048 Mbit/s, 64 kHz + 8 kHz Bantam (100 Ω balanced): 1.544 MHz, 1.544 Mbit/s

• **Standard Module**

Model		MU120101A	MU120102A
Name		10M/100M Ethernet Module	Gigabit Ethernet Module
Corresponding Specification		10BASE-T, 100BASE-TX	1000BASE-SX/LX/LH/ZX (depend on GBIC Module)
Connector		RJ-45	GBIC (SC)
Number of Ports		8	2
Bit Rate		10M, 100 Mbit/s	1000 Mbit/s
Duplex Mode		Full/Half	Full
Auto Negotiation		On/Off	On/Off
Flow Control		On/Off	On/Off
LED		Link, Tx/Collision, Rx/Error	Link, Tx, Rx, Error
Mode		Normal, Monitor, Through[*1]	Normal, Monitor, Through
Frame Generation (TxStream)			
Number of Streams		256 Streams/Port	
Stream Setting		Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)	
	Frame per Burst	1 to 16,777,215	
	Burst per Stream	1 to 16,777,215	
Gap Setting	Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed or Random.	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random.
	Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed
	Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed
Frame Setting		Preamble Size: 4 to 255 byte	Preamble Size: 2 to 255 byte,
		MAC Address: Fixed, Increment, Decrement, Random(Changeable portion specified in 4 bits units) VLAN tag[*2]: 1 layer VLAN tag can be appended. VLAN ID can be set Increment, Decrement, Random. MPLS label[*2]: Up to 10 MPLS labels can be appended. Fixed setting. Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame) IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently[*3]. TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random. Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2bits, Each 4bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random. Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp[*4], Sequence Number[*4], Test Frame[*5]. Programmable Header Pattern:1 user defined pattern can be set.	
Frame Size		18 to 10,000 byte (Settable as Auto, Fixed, Increment[*6], or Random[*6])	48 to 65,280 byte (Settable as Auto, Fixed, Increment[*6], or Random[*6])
Error Insertion	Ethernet	FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error	
		Dribble Bit Error, Alignment Error, Collision	—
	IP	IPv4 Header Checksum Error	
	TCP/UDP	TCP/UDP Checksum Error	
	Data	—	Supported by Option 11 Packet BER Test: PRBS Error
Unframed BER Setting		—	Test Pattern: All0, All1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)

Continued on next page

Model		MU120101A	MU120102A
Measurement Function			
Counter	Ethernet	Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error	
		Dribble Bit, Alignment Error, Line Error, Collision, Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply	Byte Alignment Error, Line Error, Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply
	IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error	
	TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*7, UDP Checksum Error*7	
	Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).	
	Packet BER Test (Opt11)	—	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate
	Unframed BER Test	—	Bit Error Count/Rate, Pattern Sync. Loss Count/Second
Latency		When Test Frame receives, the latency result appears. The result includes 1 s sampling value, max, min, avg. and number of samples.	
Frame Arrival Time (Packet Jitter)		32 counters make the result. Resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.	
Capture	Capture Buffer	8 MByte/Port	32 MByte/Port
	Capture Filter/ Trigger	At following conditions for each port, Capture Filter/Trigger condition settings: Condition: Destination MAC Address, Source MAC Address, 32-bit pattern 1, 32-bit pattern 2, Error Only capture trigger can be set following: Traffic Over, Latency Over, External Trigger, Manual Trigger	
	Decode Protocol	Ethernet (Type Ⅱ, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP(RSVP-TE), BGP4+, PIM-SMv2, PPP(include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame	
	Extended Decode Protocol	By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400. MD1230 Family includes Ethereal® Convert Function.	
Protocol Emulation		ARP, ICMP, IGMP, BGP-4	
Traffic Monitor		Traffic Monitor can measure up to 64 streams on real-time. Target : MAC Address, IPv4 Address, Protocol Number (include Ether Type and IP Protocol Number)	
Traffic Map		Traffic Monitor can measure up to 64 streams on real-time. Target : MAC Address, IPv4 Address	
Service Disruption Time		Time of frame disruption.	
RFC2544 Automatic Test		Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [5].) [1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames, [5] System recovery, [6] Reset	
RFC2889 Automatic Test (Opt10)		—	Following 10 types test can be supported. [1] Fully meshed throughput, frame loss, and forwarding rate, [2] Partially meshed one-to-many/many-to-one, [3] Partially meshed multiple devices, [4] Partially meshed unidirectional traffic, [5] Congestion control, [6] Forward pressure and maximum forwarding rate, [7] Address caching capacity, [8] Address learning rate, [9] Error-frame filtering, [10] Broadcast frame forwarding and latency

*1: On MU120101A, the Through mode can use with a pair of port 1 and port 2, or port 5 and port 6.
*2: VLAN tag and MPLS labels cannot both be used simultaneously.
*3: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32.
*4: When a sequence number or time stamp is used, the check sum field of the TCP/UDP packet contains an error code.
*5: When a test frame is sent from the MU120101A to another module, Packet BER Test is disabled.
*6: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*7: On MU120101A, the packets fragmented in the IP layer are counted as error packets. On MU120102A, they are not counted as error packets.

• **Advanced Protocol Module**

Model		MU120111A	MU120112A	MU120118B
Name		10M/100M Ethernet Module	Gigabit Ethernet Module	10 Gigabit Ethernet Module
Corresponding Specification		10BASE-T, 100BASE-TX	1000BASE-SX/LX/LH/ZX/T (depend on GBIC Module)	10GBASE-SR/LR/ER (depend on XENPAK Module)
Connector		RJ-45	GBIC (SC, RJ-45)	XENPAK (SC)
Number of Ports		8	2	2
Bit Rate		10 M, 100 Mbit/s	1000 Mbit/s	10 Gbit/s
Duplex Mode		Full/Half	Full	Full
Auto Negotiation		On/Off	On/Off	—
Flow Control		On/Off	On/Off	On/Off
LED		Link, Tx/Collision, Rx/Error	Link, Tx, Rx, Error	Link, Tx, Rx, Error
Mode		Normal, Monitor, Through[*1], Address Swap[*2]		Normal, Monitor, Through
Frame Generation (TxStream)				
Number of Streams		256 Streams/Port		
Stream Setting		Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)		
	Frame per Burst	1 to 16,777,215		1 to 1,099,511,627,775
	Burst per Stream	1 to 16,777,215		1 to 1,099,511,627,775
Gap Setting	Inter Frame Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed or Random. 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed or Random.	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random.	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed or Random.
	Inter Burst Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed	Resolution of 0.8 ns, 7.2 ns to 120 s Settable as Fixed.
	Inter Stream Gap	10BASE-T: Resolution of 800 ns, 8 µs to 1700 s Settable as Fixed 100BASE-TX: Resolution of 80 ns, 800 ns to 170 s Settable as Fixed	Resolution of 8 ns, 64 ns to 120 s Settable as Fixed	Resolution of 0.8 ns, 64 ns to 120 s Settable as Fixed.
Frame Setting		Preamble Size: 4 to 255 byte	Preamble Size: 2 to 255 byte	
		MAC Address: Fixed, Increment, Decrement, Random (Changeable portion specified in 4 bits units) VLAN tag[*3]: 1 layer VLAN tag can be appended. VLAN ID can be set Increment, Decrement, Random. MPLS label[*3]: Up to 10 MPLS labels can be appended. Fixed setting. Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame) Supported by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4 Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message Supported by Spanning Tree/Link Aggregation (Opt23): STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU IPv4/IPv6: IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently. TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random. Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random. Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp[*4], Sequence Number[*4], Test Frame. Programmable Header Pattern: 1 user defined pattern can be set.		
Frame Size		18 to 10,000 byte (Settable as Auto, Fixed, Increment[*5], or Random[*5])	48 to 65,280 byte (Settable as Auto, Fixed, Increment[*5], or Random[*5])	
Error Insertion	Ethernet	FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error		
		Dribble Bit Error, Alignment Error, Collision	—	
	IP	IPv4 Header Checksum Error		
	TCP/UDP	TCP/UDP Checksum Error		
	Data	Supported by Option 11 Packet BER Test: PRBS Error		
Unframed BER Setting[*6]		Test Pattern: All0, All1, User 16, PRBS23, PRBS31 Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)	Test Pattern: All0, All1, User 16, PRBS23, PRBS31, CJPAT, CRPAT Error Insertion: Bit All, Bit All0 to 3 Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)	

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Model		MU120111A	MU120112A	MU120118B
Measurement Function				
Counter	Ethernet	Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error		
		Dribble Bit, Alignment Error, Line Error, Collision, Flow Control, Transmitted/ Received ARP Request, Transmitted/ Received ARP Reply	Byte Alignment Error, Line Error, Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply	Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply
	IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error		
	IPv6 (Opt12)	Transmitted/Received IPv6 Packet Count, Transmitted/ Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count		
	TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*7, UDP Checksum Error*7		
	Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).		
	Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate		
	Unframed BER Test*6	Bit Error Count/Rate, Pattern Sync. Loss Count/Second		When XENPAK Test (Opt13) is installed: Bit Error Count/Rate, Pattern Sync. Loss Count/Second, Lane 0 to 3 Bit Error Count/Rate, Lane 0 to 3 Pattern Sync. Loss Count/Second
	LFS (Opt16)	—		Transmitted/Received RF Signal Transmitted/Received LF Signal
Latency		When Test Frame receives, the latency result appears. The result includes 1s sampling value, max, min, avg. and number of samples.		
Frame Arrival Time (Packet Jitter)		32 counters make the result. Resolution : 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.		
Capture	Capture Buffer	8 MByte/Port	32 MByte/Port	256 MByte/Port
	Capture Filter/ Trigger	At following conditions for each port, Capture Filter/Trigger condition settings: Condition: Destination MAC Address, Source MAC Address, 128-bit pattern 1, 128-bit pattern 2, Error Only capture trigger can be set following: Traffic Over, Latency Over, External Trigger, Manual Trigger		
	Decode Protocol	Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame		
	Extended Decode Protocol	By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400. MD1230 Family includes Ethereal® Convert Function.		
Protocol Emulation		ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*8, BGP4+ (Opt19)*8, IGMP, IGAP (Opt14), MLD (Opt12), MLDA (Opt22)*8, PIM-SMv2 (Opt21)*9, MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)		
Traffic Monitor		Traffic Monitor can measure up to 64 streams on real-time. Target : MAC Address, IPv4 Address, IPv6 Address, Protocol Number (include Ether Type and IP Protocol Number)		
Traffic Map		Traffic Monitor can measure up to 64 streams on real-time. Target : MAC Address, IPv4 Address, IPv6 Address		
Service Disruption Time		Time of frame disruption.		
Auto Negotiation Analysis (Opt15)		—	10B Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function	—
Application Traffic Monitor (Opt20)		—	Support 1ms traffic monitoring within 2 ports.	—
RFC2544 Automatic Test		Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [5].) [1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames, [5] System recovery, [6] Reset		
RFC2889 Automatic Test (Opt10)		Following 10 types test can be supported. [1] Fully meshed throughput, frame loss, and forwarding rate, [2] Partially meshed one-to-many/many-to-one, [3] Partially meshed multiple devices, [4] Partially meshed unidirectional traffic, [5] Congestion control, [6] Forward pressure and maximum forwarding rate, [7] Address caching capacity, [8] Address learning rate, [9] Error-frame filtering, [10] Broadcast frame forwarding and latency		—

*1: On MU120111A, the Through mode can use with a pair of port 1 and port 2, or port 5 and port 6.
*2: On MU120111A, the Address Swap mode can use with a port 1 and port 5.
*3: VLAN tag and MPLS labels cannot both be used simultaneously.
*4: When a sequence number or time stamp is used, the check sum field of the TCP/UDP packet contains an error code.
*5: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*6: Only port 1 or 5 can be used for the unframed BER test on the MU120111A.
*7: On MU120111A, the packets fragmented in the IP layer are counted as error packets. On MU120102A and MU120118A, they are not counted as error packets.
*8: Option 12 IPv6 Expansion is required.
*9: Option 12 IPv6 Expansion is required when IPv6 addresses are used.
Option 21 supports only IPv4 addresses.

• **Power Protocol Module**

<table>
<tr><td colspan="2">Model</td><td>MU120121A</td><td>MU120122A</td></tr>
<tr><td colspan="2">Name</td><td>10/100/1000M Ethernet Module</td><td>Gigabit Ethernet Module</td></tr>
<tr><td colspan="2">Corresponding Specification</td><td>Electrical: 10BASE-T, 100BASE-TX, 1000BASE-T</td><td>Electrical: 10BASE-T, 100BASE-TX, 1000BASE-T
Optical: 1000BASE-SX/LX/LE/LR (depend on SFP Module)</td></tr>
<tr><td colspan="2">Connector</td><td>RJ-45</td><td>SFP (LC), RJ-45</td></tr>
<tr><td colspan="2">Number of Ports</td><td>4</td><td>SFP: 2, RJ-45: 2</td></tr>
<tr><td colspan="2">Bit Rate</td><td>10, 100, 1000 Mbit/s</td><td>10, 100, 1000 Mbit/s</td></tr>
<tr><td colspan="2">Duplex Mode</td><td>Full/Half</td><td>Electrical: Full/Half, Optical: Full</td></tr>
<tr><td colspan="2">Auto Negotiation</td><td>On/Off</td><td>On/Off</td></tr>
<tr><td colspan="2">Flow Control</td><td>On/Off</td><td>On/Off</td></tr>
<tr><td colspan="2">LED</td><td>Tx/Collision, Rx/Error, 10 M, 100 M, 1000 M, Duplex</td><td>Electrical:
Tx/Collision, Rx/Error, 10 M, 100 M, 1000 M, Duplex
Optical: Link, Tx, Rx, Error</td></tr>
<tr><td colspan="2">Mode</td><td colspan="2">Normal, Monitor, Through[*1], Address Swap</td></tr>
<tr><td colspan="4">Frame Generation (TxStream)</td></tr>
<tr><td colspan="2">Number of Streams</td><td colspan="2">256 Streams/Port</td></tr>
<tr><td rowspan="3">Stream Setting</td><td></td><td colspan="2">Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)</td></tr>
<tr><td>Frame per Burst</td><td colspan="2">1 to 16,777,215</td></tr>
<tr><td>Burst per Stream</td><td colspan="2">1 to 1,099,511,627,775</td></tr>
<tr><td rowspan="3">Gap Setting</td><td>Inter Frame Gap</td><td colspan="2">Electrical: 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed or Random, 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed or Random, 10BASE-T: Resolution of 800 ns, 8 µs to 12000 s Settable as Fixed or Random.
Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed or Random.</td></tr>
<tr><td>Inter Burst Gap</td><td colspan="2">Electrical: 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed, 100BASE-TX: Resolution of 80 ns, 800 ns to 1200 s Settable as Fixed, 10BASE-T: Resolution of 800 ns, 8 µs to 12000 s Settable as Fixed.
Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed.</td></tr>
<tr><td>Inter Stream Gap</td><td colspan="2">Electrical: 1000BASE-T: Resolution of 8 ns, 80 ns to 120 s Settable as Fixed, 100BASE-TX: Resolution of 80 ns, 800 ns to 120 s Settable as Fixed, 10BASE-T: Resolution of 800 ns, 8 µs to 12000 s Settable as Fixed.
Optical: Resolution of 8 ns, 64 ns to 120 s Settable as Fixed.</td></tr>
<tr><td colspan="2" rowspan="2">Frame Setting</td><td colspan="2">Electrical: Preamble Size: 2 to 255 byte, Optical: Preamble Size: 4 to 255 byte</td></tr>
<tr><td colspan="2">MAC Address: Fixed, Increment, Decrement, Random (Changeable portion specified in 4 bits units)
VLAN tag[*2]: Up to 10 layer VLAN tags can be appended. VLAN ID can be set Increment, Decrement, Random.
MPLS label[*2]: Up to 10 MPLS labels can be appended. Fixed setting.
Protocol Editing: None, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame (Pause Frame)
Support by IPv6 Expansion (Opt12): ICMPv6/IPv6, TCP/IPv6, UDP/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4
Supported by PIM-SMv2 Protocol (Opt21): PIM Register Message
Supported by MLDA Protocol (Opt22): ICMPv6 MLDA Type Message
Supported by Spanning Tree/Link Aggregation (Opt23):
STP Configuration BPDU, STP TCN BPDU, RST BPDU, MST BPDU, LACPDU, Marker PDU, Marker Response PDU
IPv4/IPv6 : IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently.
TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.
Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2bits, Each 4bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random.
Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp[*3], Sequence Number[*3], Hardware Random Pattern[*3], Test Frame. Settable Flow ID number when Test Frame is used.
Programmable Header Pattern: 1 user defined pattern can be set.</td></tr>
<tr><td colspan="2">Frame Size</td><td colspan="2">48 to 10,000 byte, Settable as Auto, Fixed, Increment[*4], or Random[*4]</td></tr>
<tr><td rowspan="5">Error Insertion</td><td rowspan="2">Ethernet</td><td colspan="2">FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error</td></tr>
<tr><td>Dribble Bit Error, Alignment Error, Collision</td><td>—</td></tr>
<tr><td>IP</td><td colspan="2">IPv4 Header Checksum Error</td></tr>
<tr><td>TCP/UDP</td><td colspan="2">TCP/UDP Checksum Error</td></tr>
<tr><td>Data</td><td colspan="2">Supported by Option 11 Packet BER Test: PRBS Error</td></tr>
<tr><td colspan="2">Unframed BER Setting</td><td colspan="2">Test Pattern (Electrical): All0, All1, User 16, PRBS23, PRBS31
Test Pattern (Optical): All0, All1, User 16, PRBS23, PRBS31, CJPAT, CRPAT
Error Insertion: Bit All
Insertion Timing:
Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)</td></tr>
</table>

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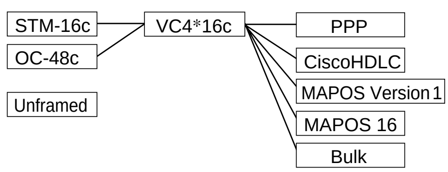
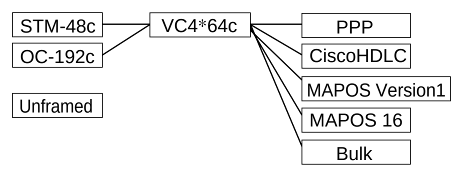
<table>
<tr><td colspan="2">Model</td><td>MU120121A</td><td>MU120122A</td></tr>
<tr><td colspan="4">Measurement Function</td></tr>
<tr><td rowspan="10">Counter</td><td rowspan="2">Ethernet</td><td colspan="2">Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate,FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error</td></tr>
<tr><td>Dribble Bit, Alignment Error, Line Error, Collision
Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply</td><td>Line Error, Flow Control, Transmitted/Received ARP Request, Transmitted/Received ARP Reply
Electrical: Dribble Bit, Alignment Error, Collision
Optical: Byte Alignment Error</td></tr>
<tr><td>IPv4</td><td colspan="2">Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error</td></tr>
<tr><td>IPv6 (Opt12)</td><td colspan="2">Transmitted/Received IPv6 Packet Count, Transmitted/ Received IPv6 Packet Rate, Transmitted/Received ICMPv6 (NS) Count, Transmitted/Received ICMPv6 (NA) Count, Transmitted/Received ICMPv6 (Echo Request) Count, Transmitted/Received ICMPv6 (Echo Reply) Count</td></tr>
<tr><td>TCP/UDP</td><td colspan="2">Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*5, UDP Checksum Error*5</td></tr>
<tr><td>Data</td><td colspan="2">Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate
QoS Counter Setting: The target of QoS is IPv4 (ToS) or VLAN tag (Priority).</td></tr>
<tr><td>Packet BER Test (Opt11)</td><td colspan="2">Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate</td></tr>
<tr><td>Unframed BER Test</td><td colspan="2">Bit Error Count/Rate, Pattern Sync. Loss Count/Second</td></tr>
<tr><td>Multi Flow Counter</td><td colspan="2">(Port 1,2 only) Settable as up to 16 bits filter to count each value at a special bit in frames. (Max 65,536 values)
ex) VLAN ID, Flow ID at test frame and so on.
32 of 65,536 counters are supported real time count.</td></tr>
<tr><td colspan="2">Latency</td><td colspan="2">When Test Frame receives, the latency result appears. The result includes 1s sampling value, max, min, avg. and number of samples.</td></tr>
<tr><td colspan="2">Frame Arrival Time (Packet Jitter)</td><td colspan="2">32 counters make the result.
Resolution : 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.</td></tr>
<tr><td rowspan="4">Capture</td><td>Capture Buffer</td><td colspan="2">32 MByte/Port</td></tr>
<tr><td>Capture Filter/ Trigger</td><td colspan="2">At following conditions for each port, Capture Filter/Trigger condition settings:
Condition: Destination MAC Address, Source MAC Address, 128-bit pattern 1, 128-bit pattern 2, Error
Only capture trigger can be set following:
Traffic Over, Latency Over, External Trigger, Manual Trigger</td></tr>
<tr><td>Decode Protocol</td><td colspan="2">Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame</td></tr>
<tr><td>Extended Decode Protocol</td><td colspan="2">By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400.
MD1230 Family includes Ethereal® Convert Function.</td></tr>
<tr><td colspan="2">Protocol Emulation</td><td colspan="2">ARP, ICMP, OSPF (Opt07), BGP-4, ICMPv6 (Opt12), OSPFv3 (Opt18)*6, BGP4+ (Opt19)*6, IGMP, IGAP (Opt14), MLD (Opt12), MLDA (Opt22)*6, PIM-SMv2 (Opt21)*7, MPLS (LDP/CR-LDP) (Opt08), MPLS (RSVP-TE) (Opt09)</td></tr>
<tr><td colspan="2">Traffic Monitor</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.
Target : MAC Address, IPv4 Address, IPv6 Address, Protocol Number(include Ether Type and IP Protocol Number)</td></tr>
<tr><td colspan="2">Traffic Map</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.
Target : MAC Address, IPv4 Address, IPv6 Address</td></tr>
<tr><td colspan="2">Service Disruption Time</td><td colspan="2">Time of frame disruption.</td></tr>
<tr><td colspan="2">Auto Negotiation Analysis (Opt15)</td><td>—</td><td>10B Code data transmitted function, Auto negotiation sequence capture function, Link timer value variable function</td></tr>
<tr><td colspan="2">RFC2544 Automatic Test</td><td colspan="2">Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [5].)
[1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames, [5] System recovery, [6] Reset</td></tr>
<tr><td colspan="2">RFC2889 Automatic Test (Opt10)</td><td colspan="2">Following 10 types test can be supported.
[1] Fully meshed throughput, frame loss, and forwarding rate, [2] Partially meshed one-to-many/many-to-one,
[3] Partially meshed multiple devices, [4] Partially meshed unidirectional traffic, [5] Congestion control, [6] Forward pressure and maximum forwarding rate, [7] Address caching capacity, [8] Address learning rate, [9] Error-frame filtering,
[10] Broadcast frame forwarding and latency</td></tr>
</table>

*1: On MU120121A, the Through mode can use with a pair of port 1 and port 2, or port 3 and port 4.
*2: VLAN tag and MPLS labels cannot both be used simultaneously.
*3: When a sequence number or time stamp or hardware random pattern is used, the check sum field of the TCP/UDP packet contains an error code.
*4: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*5: The packets fragmented in the IP layer are not counted as error packets.
*6: Option 12 IPv6 Expansion is required.
*7: Option 12 IPv6 Expansion is required when IPv6 addresses are used. Option 21 supports only IPv4 addresses.

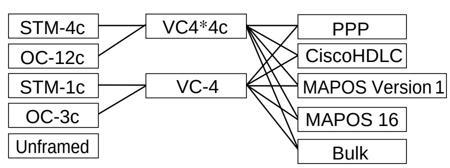
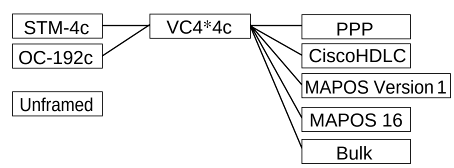
• **POS Module**

Model		MU120103A	MU120104A	MU120105A	MU120106A
Name		2.5G (1.31) Module	2.5G (1.55) Module	10G (1.31) Module	10G (1.55) Module
Corresponding Specification		OC-48/STM-16		OC-192/STM-64	
Wavelength		1,260 to 1,360 nm	1,500 to 1,580 nm	1,290 to 1,330 nm	1,530 to 1,565 nm
Connector		SC			
Number of Ports		1 Port			
Bit Rate		2,488.320 Mbit/s (NRZ)		9,953.280 Mbit/s (NRZ)	
Output Level		–5 to 0 dBm	–2 to +3 dBm	–4 to 0 dBm	–1 to +2 dBm
Input Sensitivity		–18 to 0 dBm	–28 to –9 dBm	–12 to 0 dBm	–14 to –3 dBm
Clock		Internal (±50 ppm Variable), Receive, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)		Internal (±100 ppm Variable), Receive, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)	
LED		Link, Tx, Rx, Error, Optical Send			
SONET/SDH Setting					
Frame		SONET/SDH			
PPP Scramble		On/Off			
Alarm Addition		LOS, LOF, AIS-L/MS-AIS, RDI-L/MS-RDI, TIM-L/MS-TIM, AIS-P/AU-AIS, LOP-P/AU-LOP, RDI-P/HP-RDI, PLM-P/HP-SLM, TIM-P/HP-TIM, UNEQ-P/HP-UNEQ			
Alarm Addition Timing		Single, Single Burst Frame (Burst Size: 1 to 64,000), Alternative (Alarm Frame: 0 to 8,000, Normal Frame: 1 to 8,000), All			
Error Insertion		FAS, B1, B2, B3, REI-P/MS-REI, REI-P/HP-REI, HP-IEC, Bit All, Bit Info.			
Error Insertion Timing		Single, Single Burst Bit (Burst Size: 1 to 64,000), Rate (1.0E-9, 1.0E-8, 1.0E-7,1.0E-6,1.0E-5, 1.0E-4, 1.0E-3), Programmed Rate (A*E-B I A: 1.0 to 9.9, B: 3 to 10), All			
APS Sequence Generation		K1/K2: 2 to 64 Words, Repeat 1 to 8000 Frame/Word, Single or Repeat generation.			
Mapping					
Frame Generation (TxStream)					
Number of Streams		256 Streams/Port			
Stream Setting		Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)			
	Frame per Burst	1 to 1,099,511,627,775			
	Burst per Stream	1 to 1,099,511,627,775			
Gap Setting	Inter Frame Gap	Resolution of 3.3 ns, 3.3 ns to 120 s Settable as Fixed or Random*1.		Resolution of 0.8 ns, 0.8 ns to 120 s Settable as Fixed or Random*1.	
	Inter Burst Gap	Resolution of 3.3 ns, 3.3 ns to 120 s Settable as Fixed.		Resolution of 0.8 ns, 0.8 ns to 120 s Settable as Fixed.	
	Inter Stream Gap	Resolution of 3.3 ns, 427.4 ns to 120 s Settable as Fixed.		Resolution of 0.8 ns, 106.8 ns to 120 s Settable as Fixed.	
Frame Setting		FCS: CRC32 MPLS label: Up to 10 MPLS labels can be appended. Fixed setting. Protocol Editing: None, IPv4, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IS-IS IPv4/IPv6 : IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently*2. TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random. Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2bits, Each 4bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random. Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp*3, Sequence Number*3, Test Frame. Programmable Header Pattern: 1 user defined pattern can be set.			
Frame Size		8 to 65,535 byte. Settable as Auto, Fixed, Increment*4, or Random*4			
Error Insertion	PPP	FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error			
		Aborted Frame			
	IP	IPv4 Header Checksum Error			
	TCP/UDP	TCP/UDP Checksum Error			
	Data	Supported by Option 11 Packet BER Test: PRBS Error			
Unframed BER Setting		Test Pattern: PRBS23, PRBS31 Error Insertion: Bit All Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)			

Continued on next page

Model		MU120103A	MU120104A	MU120105A	MU120106A
Measurement Function					
SONET/SDH Test		OH Monitor, Path Trace Monitor, K1/K2 Monitor, Pointer Monitor, APS Sequence Capture (Max 64 words), APS Switch Time Test, Performance Monitoring (ITU-T G.826)			
Counter	SONET/SDH	NDF Count/Rate, +PJC Count/Rate, –PJC Count/Rate, Consecutive Count/Rate, PPM, HP-IEC Count/Rate, REI-P/HP-REI Count/Rate, B3 Count/Rate, UNEQ-P/HP-UNEQ Count/Second, PLM-P/HP-SLM Count/Second, RDI-P/HP-RDI Count/Second, LOP-P/AU-LOP Count/Second, AIS-P/AU-AIS Count/Second, REI-L/MS-REI Count/Second, B2 Count/Rate, B1 Count/Rate, RDI-L/MS-RDI Count/Second, AIS-L/MS-AIS Count/Second, OOF Count/Second, LOF Count/Second, Bit Info. Count/Rate*5, Pattern Sync. Loss Count/Second*5			
	PPP	Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error			
		Transmitted Bytes After Stuffing, Received Bytes Before Destuffing, Aborted Frame			
	IPv4	Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error			
	TCP/UDP	Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*6, UDP Checksum Error*6			
	Data	Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate QoS Counter Setting: The target of QoS is IPv4 (ToS).			
	Packet BER Test (Opt11)	Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate			
	Unframed BER Test	Bit Error Count/Rate, Pattern Sync. Loss Count/Second			
Latency		When Test Frame receives, the latency result appears. The result includes 1s sampling value, max, min, avg. and number of samples.			
Frame Arrival Time (Packet Jitter)		32 counters make the result. Resolution : 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.			
Capture	Capture Buffer	256 MByte/Port			
	Capture Filter/ Trigger	At following conditions for each port, Capture Filter/Trigger condition settings: Condition: Destination IP Address, Source IP Address, 32-bit pattern 1, 32-bit pattern 2, Error Only capture trigger can be set following: Traffic Over, Latency Over, External Trigger, Manual Trigger			
	Decode Protocol	Ethernet (Type Ⅱ, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame			
	Extended Decode Protocol	By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400. MD1230 Family includes Ethereal® Convert Function.			
Protocol Emulation		PPP (LCP, IPCP), ICMP, BGP-4, IGMP			
Traffic Monitor		Traffic Monitor can measure up to 64 streams on real-time. Target: IPv4 Address, Protocol Number (include Ether Type and IP Protocol Number)			
Traffic Map		Traffic Monitor can measure up to 64 streams on real-time.Target : IPv4 Address			
Service Disruption Time		Time of frame disruption.			
Power Meter		Range: –25 to +1 dBm Accuracy: ±2 dB	Range: –35 to –9 dBm Accuracy: ±2 dB	Range: –14 to 0 dBm Accuracy: ±2 dB	Range: –14 to 0 dBm Accuracy: ±2 dB
RFC2544 Automatic Test		Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [5].) [1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames, [5] System recovery, [6] Reset			

*1: To select the Random setting for the inter-frame gap, the frame length must be 64 bytes or more.
*2: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32. Also, only either the destination or sender address can be selected.
*3: When a sequence number or time stamp is used, the check sum field of the TCP/UDP packet contains an error code.
*4: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*5: Measurement is enabled only when the Bulk setting is specified for mapping.
*6: The packets fragmented in the IP layer are counted as error packets.

<table>
<tr><td colspan="2">Model</td><td>MU120119A</td><td>MU120120A</td></tr>
<tr><td colspan="2">Name</td><td>OC-3/12 STM-1/4 Module (1310 nm)</td><td>OC-3/STM-1 Module (1310 nm)</td></tr>
<tr><td colspan="2">Corresponding Specification</td><td>OC-3/STM-1 OC-12/STM-4</td><td>OC-3/STM-1</td></tr>
<tr><td colspan="2">Wavelength</td><td colspan="2">1,274 to 1,356 nm</td></tr>
<tr><td colspan="2">Connector</td><td colspan="2">SC</td></tr>
<tr><td colspan="2">Number of Ports</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Bit Rate</td><td>155.52 Mbit/s (NRZ) / 622.08 Mbit/s (NRZ)</td><td>155.52 Mbit/s (NRZ)</td></tr>
<tr><td colspan="2">Output Level</td><td colspan="2">–15 to –8 dBm</td></tr>
<tr><td colspan="2">Input Sensitivity</td><td colspan="2">–28 to –8 dBm</td></tr>
<tr><td colspan="2">Clock</td><td colspan="2">Internal (±50 ppm Variable), Receive,
Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)</td></tr>
<tr><td colspan="2">LED</td><td colspan="2">Link, Tx, Rx, Error</td></tr>
<tr><td colspan="4">SONET/SDH Setting</td></tr>
<tr><td colspan="2">Frame</td><td colspan="2">SONET/SDH</td></tr>
<tr><td colspan="2">PPP Scramble</td><td colspan="2">On/Off</td></tr>
<tr><td colspan="2">Alarm Addition</td><td colspan="2">LOS, LOF, AIS-L/MS-AIS, RDI-L/MS-RDI, TIM-L/MS-TIM, AIS-P/AU-AIS, LOP-P/AU-LOP, RDI-P/HP-RDI, PLM-P/HP-SLM, TIM-P/HP-TIM, UNEQ-P/HP-UNEQ</td></tr>
<tr><td colspan="2">Alarm Addition Timing</td><td colspan="2">Single, Single Burst Frame (Burst Size: 1 to 64,000), Alternative (Alarm Frame: 0 to 8,000, Normal Frame: 1 to 8,000), All</td></tr>
<tr><td colspan="2">Error Insertion</td><td colspan="2">FAS, B1, B2, B3, REI-P/MS-REI, REI-P/HP-REI, HP-IEC, Bit All, Bit Info</td></tr>
<tr><td colspan="2">Error Insertion Timing</td><td colspan="2">Single, Single Burst Bit (Burst Size: 1 to 64,000), Rate (1.0E-9, 1.0E-8, 1.0E-7,1.0E-6,1.0E-5, 1.0E-4, 1.0E-3),
Programmed Rate (A*E-B I A: 1.0 to 9.9, B: 3 to 10), All</td></tr>
<tr><td colspan="2">APS Sequence Generation</td><td colspan="2">K1/K2: 2 to 64 Words, Repeat 1 to 8000 Frame/Word, Single or Repeat generation.</td></tr>
<tr><td colspan="2">Mapping</td><td></td><td></td></tr>
<tr><td colspan="2">Frame Generation (TxStream)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Number of Streams</td><td colspan="2">256 Streams/Port</td></tr>
<tr><td rowspan="3">Stream Setting</td><td></td><td colspan="2">Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)</td></tr>
<tr><td>Frame per Burst</td><td colspan="2">1 to 1,099,511,627,775</td></tr>
<tr><td>Burst per Stream</td><td colspan="2">1 to 1,099,511,627,775</td></tr>
<tr><td rowspan="3">Gap Setting</td><td>Inter Frame Gap</td><td colspan="2">155 M: Resolution of 53.4 ns, 53.4 ns to 120 s Settable as Fixed or Random*1.
622 M: Resolution of 13.4 ns, 13.4 ns to 120 s Settable as Fixed or Random*1.</td></tr>
<tr><td>Inter Burst Gap</td><td colspan="2">155 M: Resolution of 53.4 ns, 53.4 ns to 120 s Settable as Fixed.
622 M: Resolution of 13.4 ns, 13.4 ns to 120 s Settable as Fixed.</td></tr>
<tr><td>Inter Stream Gap</td><td colspan="2">155 M: Resolution of 53.4 ns, 427.4 ns to 120 s Settable as Fixed.
622 M: Resolution of 13.4 ns, 106.8 ns to 120 s Settable as Fixed.</td></tr>
<tr><td colspan="2">Frame Setting</td><td colspan="2">FCS: CRC32
MPLS label: Up to 10 MPLS labels can be appended. Fixed setting.
Protocol Editing: None, IPv4, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IS-IS
IPv4/IPv6 : IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently*2.
TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random.
Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2bits, Each 4bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random.
Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp*3, Sequence Number*3 Test Frame.
Programmable Header Pattern: 1 user defined pattern can be set.</td></tr>
<tr><td colspan="2">Frame Size</td><td colspan="2">8 to 65,535 byte. Settable as Auto, Fixed, Increment*4 or Random*4</td></tr>
<tr><td rowspan="4">Error Insertion</td><td>PPP</td><td colspan="2">FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error
Aborted Frame</td></tr>
<tr><td>IP</td><td colspan="2">IPv4 Header Checksum Error</td></tr>
<tr><td>TCP/UDP</td><td colspan="2">TCP/UDP Checksum Error</td></tr>
<tr><td>Data</td><td colspan="2">Supported by Option 11 Packet BER Test: PRBS Error</td></tr>
<tr><td colspan="2">Unframed BER Setting</td><td colspan="2">Test Pattern: PRBS11, PRBS15, PRBS20, PRBS23, PRBS31
Error Insertion: Bit All
Insertion Timing: Single, Rate (1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)</td></tr>
</table>

Continued on next page

<table>
<tr><td colspan="2">Model</td><td>MU120119A</td><td>MU120120A</td></tr>
<tr><td colspan="4">Measurement Function</td></tr>
<tr><td colspan="2">SONET/SDH Test</td><td colspan="2">OH Monitor, Path Trace Monitor, K1/K2 Monitor, Pointer Monitor, APS Sequence Capture (Max 64 words), APS Switch Time Test, Performance Monitoring (ITU-T G.826)</td></tr>
<tr><td rowspan="9">Counter</td><td>SONET/SDH</td><td colspan="2">NDF Count/Rate, +PJC Count/Rate, –PJC Count/Rate, Consecutive Count/Rate, PPM, HP-IEC Count/Rate, REI-P/HP-REI Count/Rate, B3 Count/Rate, UNEQ-P/HP-UNEQ Count/Second, PLM-P/HP-SLM Count/Second, RDI-P/HP-RDI Count/Second, LOP-P/AU-LOP Count/Second, AIS-P/AU-AIS Count/Second, REI-L/MS-REI Count/Second, B2 Count/Rate, B1Count/Rate, RDI-L/MS-RDI Count/Second, AIS-L/MS-AIS Count/Second, OOF Count/Second, LOF Count/Second, Bit Info. Count/Rate*5, Pattern Sync. Loss Count/Second*5</td></tr>
<tr><td rowspan="2">PPP</td><td colspan="2">Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate, FCS Error, Undersize, Fragment, Oversize, Oversize & FCS Error</td></tr>
<tr><td colspan="2">Transmitted Bytes After Stuffing, Received Bytes Before Destuffing, Aborted Frame</td></tr>
<tr><td>IPv4</td><td colspan="2">Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error</td></tr>
<tr><td>TCP/UDP</td><td colspan="2">Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*6, UDP Checksum Error*6</td></tr>
<tr><td>Data</td><td colspan="2">Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate
QoS Counter Setting: The target of QoS is IPv4 (ToS).</td></tr>
<tr><td>Packet BER Test (Opt11)</td><td colspan="2">Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate</td></tr>
<tr><td>Unframed BER Test</td><td colspan="2">Bit Error Count/Rate, Pattern Sync. Loss Count/Second</td></tr>
<tr><td colspan="2">Latency</td><td colspan="2">When Test Frame receives, the latency result appears. The result includes 1s sampling value, max, min, avg. and number of samples.</td></tr>
<tr><td colspan="2">Frame Arrival Time (Packet Jitter)</td><td colspan="2">32 counters make the result.
Resolution : 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.</td></tr>
<tr><td rowspan="4">Capture</td><td>Capture Buffer</td><td colspan="2">256 MByte/Port</td></tr>
<tr><td>Capture Filter/ Trigger</td><td colspan="2">At following conditions for each port, Capture Filter/Trigger condition settings:
Condition: Destination IP Address, Source IP Address, 32-bit pattern 1, 32-bit pattern 2, Error
Only capture trigger can be set following: Traffic Over, Latency Over, External Trigger, Manual Trigger</td></tr>
<tr><td>Decode Protocol</td><td colspan="2">Ethernet (Type II, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame</td></tr>
<tr><td>Extended Decode Protocol</td><td colspan="2">By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400.
MD1230 Family includes Ethereal® Convert Function.</td></tr>
<tr><td colspan="2">Protocol Emulation</td><td colspan="2">PPP (LCP, IPCP), ICMP, BGP-4, IGMP</td></tr>
<tr><td colspan="2">Traffic Monitor</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.
Target : IPv4 Address, Protocol Number(include Ether Type and IP Protocol Number)</td></tr>
<tr><td colspan="2">Traffic Map</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.Target: IPv4 Address</td></tr>
<tr><td colspan="2">Service Disruption Time</td><td colspan="2">Time of frame disruption.</td></tr>
<tr><td colspan="2">Power Meter</td><td>Supported by MU120119A-01 Optical Power Meter
Maximum Input Range: +10 dBm
Range: –40 to +5 dBm
Accuracy: ±0.5 dB</td><td>Supported by MU120120A-01 Optical Power Meter
Maximum Input Range: + 10 dBm
Range: –40 to +5 dBm
Accuracy: ±0.5 dB</td></tr>
<tr><td colspan="2">RFC2544 Automatic Test</td><td colspan="2">Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [5].)
[1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames, [5] System recovery, [6] Reset</td></tr>
</table>

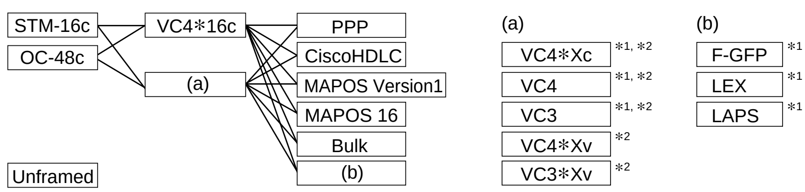
*1: To select the Random setting for the inter-frame gap, the frame length must be 64 bytes or more.
*2: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32. Also, only either the destination or sender address can be selected.
*3: When a sequence number or time stamp is used, the check sum field of the TCP/UDP packet contains an error code.
*4: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*5: Measurement is enabled only when the Bulk setting is specified for mapping.
*6: The packets fragmented in the IP layer are counted as error packets.

3

• **EoS Module**

Model		MU120103B	MU120104B
Name		2.5G (1.31) Module	2.5G (1.55) Module
Corresponding Specification		OC-48/STM-16	
Wavelength		1,260 to 1,360 nm	1,500 to 1,580 nm
Connector		SC	
Number of Ports		1	
Bit Rate		2,488.320 Mbit/s (NRZ)	
Output Level		–5 to 0 dBm	–2 to +3 dBm
Input Sensitivity		–18 to 0 dBm	–28 to –9 dBm
Clock		Internal (±50 ppm Variable), Receive, Lock (64 kHz + 8 kHz, 1.5 MHz, 2 MHz, 1.5 Mbit/s, 2 Mbit/s)	
LED		Link, Tx, Rx, Error, Optical Send	
SONET/SDH Setting			
Frame		SONET/SDH	
PPP Scramble		On/Off	
Alarm Addition		LOS, LOF, AIS-L/MS-AIS, RDI-L/MS-RDI, TIM-L/MS-TIM, AIS-P/AU-AIS, LOP-P/AU-LOP, RDI-P/HP-RDI, PLM-P/HP-SLM, TIM-P/HP-TIM, UNEQ-P/HP-UNEQ	
Alarm Addition Timing		Single, Single Burst Frame (Burst Size: 1 to 64,000), Alternative (Alarm Frame: 0 to 8,000, Normal Frame: 1 to 8,000), All	
Error Insertion		FAS, B1, B2, B3, REI-P/MS-REI, REI-P/HP-REI, HP-IEC, Bit All, Bit Info.	
Error Insertion Timing		Single, Single Burst Bit (Burst Size: 1 to 64,000), Rate (1.0E-9, 1.0E-8, 1.0E-7,1.0E-6,1.0E-5, 1.0E-4, 1.0E-3), Programmed Rate (A*E-B I A: 1.0 to 9.9, B: 3 to 10), All	
APS Sequence Generation		K1/K2: 2 to 64 Words, Repeat 1 to 8000 Frame/Word, Single or Repeat generation.	

Mapping



Frame Generation (TxStream)			
Number of Stream		256 Streams/Port	
Stream Setting		Stream Transport Mode: Continuous, Continuous Burst, Stop after this Stream, Next Stream, Jump to Stream, Jump to Stream for Count (Loop Count: 1 to 16,000,000)	
	Frame per Burst	1 to 1,099,511,627,775	
	Burst per Stream	1 to 1,099,511,627,775	
Gap Setting	Inter Frame Gap*3	PPP/LEX/LAPS: Resolution of 3.3 ns, 3.3 ns to 120 s Settable as Fixed or Random*4. GFP: Resolution of 13.4 ns, 0 ns to 120 s Settable as Fixed or Random.	
	Inter Burst Gap*3	PPP/LEX/LAPS: Resolution of 3.3 ns, 3.3 ns to 120 s Settable as Fixed. GFP: Resolution of 13.4 ns, 53.5 ns to 120 s Settable as Fixed or Random.	
	Inter Stream Gap*3	PPP/LEX/LAPS: Resolution of 3.3 ns, 267.1 ns to 120 s Settable as Fixed. GFP: Resolution of 13.4 ns, 267.1 ns to 120 s Settable as Fixed or Random.	
Frame Setting		FCS: CRC32, CRC16 MAC Address: Fixed, Increment, Decrement, Random (Changeable portion specified in 4 bits units) VLAN tag*5: Up to 1 layer VLAN tags can be appended. VLAN ID can be set Increment, Decrement, Random. MPLS label*5: Up to 10 MPLS labels can be appended. Fixed setting. Protocol Editing: None, IPv4, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, ARP, MAC Control, IS-IS, LEX Control Packet*6, GFP, PPP, Ethernet IPv4/IPv6 : IP Destination/Source Address can be set Fixed, Increment, Decrement, Random independently*7. TCP/UDP: Either Destination Port Number or Source Port Number can be set Increment, Random. Data Field: Can set any portions of data field as All0, All1, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each 1 Byte, Each 2 Bytes), Increment, Decrement, Random. Only Data Field 1 can set Programmable, Single PRBS9, Time Stamp*8, Sequence Number*8, Test Frame. Programmable Header Pattern: 1 user defined pattern can be set.	
Frame Size		8 to 65,535 Byte. Settable as Auto, Fixed, Increment*9, or Random*9	
Error Insertion	PPP	FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error, Aborted Frame	
	GFP*1	Correctable cHEC Error, Uncorrected cHEC Error, Correctable tHEC Error, Uncorrected tHEC Error, Correctable eHEC Error, Uncorrected eHEC Error, FCS Error, Ethernet: FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error	
	LAPS*1	FCS Error, Aborted Frame ,Ethernet: FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error	
	LEX*1	FCS Error, Undersize, Oversize, Fragment, Oversize & FCS Error, Aborted Frame, Ethernet: Undersize	
	IP	IPv4 Header Checksum Error	
	TCP/UDP	TCP/UDP Checksum Error	
	Data	Supported by Option 11 Packet BER Test: PRBS Error	
Unframed BER Setting		Test Pattern: PRBS23, PRBS31 Error Insertion: Bit All Insertion Timing: Single, Rate(1.0E-9, 1.0E-8, 1.0E-7, 1.0E-6, 1.0E-5, 1.0E-4, 1.0E-3), Programmable Rate (1.0E-10 to 9.9E-3)	

Continued on next page

<table>
<tr><td colspan="3">Model</td><td>MU120103B</td><td>MU120104B</td></tr>
<tr><td colspan="5">Measurement Function</td></tr>
<tr><td colspan="3">SONET/SDH Test</td><td colspan="2">OH Monitor, Path Trace Monitor, K1/K2 Monitor, Pointer Monitor, APS Sequence Capture (Max 64 words), APS Switch Time Test, Performance Monitoring (ITU-T G.826)</td></tr>
<tr><td rowspan="11">Counter</td><td colspan="2">SONET/SDH</td><td colspan="2">NDF Count/Rate, +PJC Count/Rate, –PJC Count/Rate, Consecutive Count/Rate, PPM, HP-IEC Count/Rate, REI-P/HP-REI Count/Rate, B3 Count/Rate, UNEQ-P/HP-UNEQ Count/Second, PLM-P/HP-SLM Count/Second, RDI-P/HP-RDI Count/Second, LOP-P/AU-LOP Count/Second, AIS-P/AU-AIS Count/Second, REI-L/MS-REI Count/Second, B2 Count/Rate, B1 Count/Rate, RDI-L/MS-RDI Count/Second, AIS-L/MS-AIS Count/Second, OOF Count/Second, LOF Count/Second, Bit Info. Count/Rate*10, Pattern Sync. Loss Count/Second*10, SQ Error Count/Second*11, Out of Alignment Count/Second*11</td></tr>
<tr><td rowspan="5">PPP, GFP, LEX, LAPS</td><td></td><td colspan="2">Transmitted/Received Frame Count, Transmitted/Received Frame Rate, Transmitted/Received Bit Count, Transmitted/Received Bit Rate, Transmitted/Received Byte Count, Transmitted/Received Rate, Oversize, Oversize & FCS Error, Undersize, Fragments, FCS Error</td></tr>
<tr><td>PPP</td><td colspan="2">Aborted Frame, Transmitted Bytes After Stuffing, Received Bytes Before Destuffing</td></tr>
<tr><td>GFP*1</td><td colspan="2">Transmitted/Received Ethernet Frame, Transmitted/Received Ethernet Bit Rate, Transmitted/Received Ethernet Byte, Ethernet Oversize, Ethernet Oversize & FCS Error, Ethernet Undersize, Ethernet Fragments, Ethernet FCS Error, Server Signal Fail Interval, Client Loss of Sync Frame, Client Loss of Sync Interval, Client Loss of Signal Frame, Client Loss of Signal Interval, Correctable cHEC Error, Uncorrected cHEC Error, Correctable tHEC Error, Uncorrected tHEC Error, eHEC Error</td></tr>
<tr><td>LAPS*1</td><td colspan="2">Transmitted Bytes After Stuffing, Received Bytes Before Destuffing, Transmitted Byte After Adaptation, Received Byte Before Adaptation, Aborted Frame, Transmitted/Received Ethernet Frame, Transmitted/Received Ethernet Bit Rate, Transmitted/ Received Ethernet Byte, Ethernet Oversize, Ethernet Oversize & FCS Error, Ethernet Undersize, Ethernet Fragments, Ethernet FCS Error</td></tr>
<tr><td>LEX*1</td><td colspan="2">Transmitted Bytes After Stuffing, Received Bytes Before Destuffing, Aborted Frame, Transmitted/Received Ethernet Frame, Transmitted/Received Ethernet Bit Rate,Transmitted/Received Ethernet Byte, Ethernet Undersize</td></tr>
<tr><td colspan="2">IPv4</td><td colspan="2">Transmitted/Received IPv4 Packet Count, Transmitted/Received IPv4 Packet Rate, Transmitted/Received Ping Request, Transmitted/Received Ping Reply, IP Header Checksum Error</td></tr>
<tr><td colspan="2">TCP/UDP</td><td colspan="2">Received TCP Packet Count, Received TCP Packet Rate, Received UDP Packet Count, Received UDP Packet Rate, TCP Checksum Error*12, UDP Checksum Error*12</td></tr>
<tr><td colspan="2">Data</td><td colspan="2">Capture Trigger, Capture Filter, User Defined 1 Count/Rate, User Defined 2 Count/Rate, QoS 0 to 7 Frame Count/Rate
QoS Counter Setting: The target of QoS is IPv4 (ToS).</td></tr>
<tr><td colspan="2">Packet BER Test (Opt11)</td><td colspan="2">Transmitted/Received Test Frame Count, Sequence Error, Received PRBS Error Frame Count/Rate, Received PRBS Error Bit Count/Rate</td></tr>
<tr><td colspan="2">Unframed BER Test</td><td colspan="2">Bit Error Count/Rate, Pattern Sync. Loss Count/Second</td></tr>
<tr><td colspan="3">Latency</td><td colspan="2">When Test Frame receives, the latency result appears. The result includes 1s sampling value, max, min, avg. and number of samples.</td></tr>
<tr><td colspan="3">Frame Arrival Time (Packet Jitter)</td><td colspan="2">32 counters make the result.
Resolution : 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s.</td></tr>
<tr><td rowspan="4">Capture</td><td colspan="2">Capture Buffer</td><td colspan="2">256 MByte/Port</td></tr>
<tr><td colspan="2">Capture Filter/ Trigger</td><td colspan="2">At following conditions for each port, Capture Filter/Trigger condition settings:
Condition: Destination MAC Address*13, Source MAC Address*13, Destination IP Address, Source IP Address, 32-bit pattern 1, 32-bit pattern 2, Error
Only capture trigger can be set following: Traffic Over, Latency Over, External Trigger, Manual Trigger</td></tr>
<tr><td colspan="2">Decode Protocol</td><td colspan="2">Ethernet (Type Ⅱ, IEEE802.3, Mac Control), VLAN, MPLS, LLC, LACP, BPDU (STP, RST, MST), ARP, IP, IPv6 (include Extended Header), IPX, OSINL, IS-IS, IGMP (include IGAP), ICMP, ICMPv6 (include NDP, MLD, MLDA) TCP, UDP, OSPF, OSPFv3, DVMRP, LDP (CR-LDP), BGP4, RIP, DHCP, RSVP (RSVP-TE), BGP4+, PIM-SMv2, PPP (include LCP, IPCP, IPV6CP, OSINLCP, MPLSCP), CiscoHDLC, MAPOS, NSP, SSP, Test Frame</td></tr>
<tr><td colspan="2">Extended Decode Protocol</td><td colspan="2">By Sniffer® Technologies (Opt04) or MX123002A Expert Analysis Module, a decode protocol can be increased up to 400.
MD1230 Family includes Ethereal® Convert Function.</td></tr>
<tr><td colspan="3">Protocol Emulation</td><td colspan="2">PPP (LCP, IPCP), ICMP, BGP-4, IGMP, ARP</td></tr>
<tr><td colspan="3">Traffic Monitor</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.
Target : MAC Address*13, IPv4 Address, Protocol Number (include Ether Type and IP Protocol Number)</td></tr>
<tr><td colspan="3">Traffic Map</td><td colspan="2">Traffic Monitor can measure up to 64 streams on real-time.Target: MAC Address*13, IPv4 Address</td></tr>
<tr><td colspan="3">Service Disruption Time</td><td colspan="2">Time of frame disruption.</td></tr>
<tr><td colspan="3">Power Meter</td><td>Range: –25 to +1 dBm, Accuracy: ±2 dB</td><td>Range: –35 to –9 dBm, Accuracy: ±2 dB</td></tr>
<tr><td colspan="3">Module Options</td><td colspan="2">MU120103B-01/MU120104B-01: EoS Mapping
Mapping: F-GFP, LAPS, LEX
Concatenation: [SDH] VC-4-Xc (X = 16, 8, 4, 3, 2), VC-4, VC-3, [SONET] STS-Xc (X = 48, 24, 12, 9, 6, 3), STS-1
MU120103B-02/MU120104B-02: Virtual Concatenation
[SDH] VC-4-Xv (X = 8, 7, 6, 5, 4, 3, 2), VC-3-Xv (X = 24, 21, 18, 15, 12, 9, 6, 3)
[SONET] STS3c-Xv (X = 8, 7, 6, 5, 4, 3, 2), STS1-Xv (X = 24, 21, 18, 15, 12, 9, 6, 3)</td></tr>
<tr><td colspan="3">RFC2544 Automatic Test</td><td colspan="2">Following 6 types test can be supported. (MD1230 Family supports continuous test [1] to [4].)
[1] Throughput, [2] Latency, [3] Frame loss rate, [4] Back-to-back frames</td></tr>
</table>

*1: MU120103B-01/MU120104B-01: Selectable only when EoS mapping is used.
*2: MU120103B-02/MU120104B-02: Selectable only when virtual concatenation mapping is used.
*3: This value indicates the gap measured with OC-48 or STM16 mapping. When contiguous or virtual concatenation mapping is used, the value is inversely proportional to the set bit rate.
*4: To select the Random setting for the inter-frame gap, the frame length must be 64 bytes or more.
*5: VLAN tag and MPLS labels cannot be used simultaneously.
*6: LEX Control Packet can be chosen only when choosing LEX mapping.
*7: For IPv6, any Increment, Decrement, or Random setting can be specified for bit widths 1 to 32. Also, only either the destination or sender address can be selected.
*8: When a sequence number or time stamp is used, the check sum field of the TCP/UDP packet contains an error code.
*9: Increment and Random settings can be specified for the frame size only when None is selected for the protocol.
*10: Measurement is enabled only when bulk mapping is used.
*11: Settable as only Virtual Concatenation.
*12: The packets fragmented in the IP layer are counted as error packets.
*13: Settable as only GFP/LAPS/LEX mapping.

Ordering information

Please specify model/order number, name and quantity when ordering.

• MD1230B

Model/Order No.	Name
	Main frame
MD1230B	Data Quality Analyzer
	Standard accessories
	Power cord, 2.5 m: 1 pc
F0113	Fuse, 15 A: 1 pc
B0329G	Front cover (for 3/4MW4U): 1 pc
B0500A	Side cover: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Main frame options[*2]
MD1230B-01	RS-232C Control[*3]
MD1230B-02	GPIB Control[*3]
MD1230B-03	Ethernet Control[*3]
MD1230B-04	MD1230B Decode Module[*4]
MD1230B-05	GPS Module[*5]
MD1230B-06	Tcl Interface[*6]
MD1230B-07	OSPF Protocol
MD1230B-08	MPLS (LDP/CR-LDP) Protocol
MD1230B-09	MPLS (RSVP) Protocol
MD1230B-10	RFC2889 Benchmarking Test
MD1230B-11	Packet BER Test
MD1230B-12	IPv6 Expansion
MD1230B-13	XENPAK Test
MD1230B-14	IGAP Protocol
MD1230B-15	Auto Negotiation Analysis
MD1230B-16	Link Fault Signaling
MD1230B-18	OSPFv3 Protocol[*7]
MD1230B-19	BGP4+ Protocol[*7]
MD1230B-20	Application Traffic Monitor
MD1230B-21	PIM-SMv2 Protocol[*8]
MD1230B-22	MLDA Protocol[*7]
MD1230B-23	Spanning Tree/Ling Aggregation
MX123002A	MD1230A Expert Analysis Module[*9]

• MD1231A1

Model/Order No.	Name
	Main frame
MD1231A1	IP Network Analyzer
	Standard accessories
	Power cord, 2.5 m: 1 pc
F0100	Fuse, 6.3 A: 1 pc
B0489	Front cover: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Main frame options[*2]
MD1231A1-02	GPIB Control[*10]
MD1231A1-03	Ethernet Control[*10]
MD1231A1-04	MD1231A1 Decode Module[*11]
MD1231A1-05	GPS Module[*5]
MD1231A1-06	Tcl Interface[*12]
MD1231A1-07	OSPF Protocol
MD1231A1-08	MPLS (LDP/CR-LDP) Protocol
MD1231A1-09	MPLS (RSVP) Protocol
MD1231A1-10	RFC2889 Benchmarking Test
MD1231A1-11	Packet BER Test
MD1231A1-12	IPv6 Expansion
MD1231A1-13	XENPAK Test
MD1231A1-14	IGAP Protocol
MD1231A1-15	Auto Negotiation Analysis
MD1231A1-16	Link Fault Signaling
MD1231A1-18	OSPFv3 Protocol[*13]
MD1231A1-19	BGP4+ Protocol[*13]
MD1231A1-20	Application Traffic Monitor
MD1231A1-21	PIM-SMv2 Protocol[*14]
MD1231A1-22	MLDA Protocol[*13]
MD1231A1-23	Spanning Tree/Ling Aggregation
MX123002A	MD1230A Expert Analysis Module[*15]

• MT7407A

Model/Order No.	Name
	Main frame
MT7407A	Multislot Chassis[*16]
	Standard accessories
	Power Cord, 3 m: 1 pc
F0108	Fuse, 20 A: 1 pc
J1109B	LAN cable (CAT5, cross), 5 m: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Option for MT7407A
MT7407A-01	Interface Board for IP Tester[*17]
	Plug-in modules for MT7407A
MU740701A	IP Tester Control Module[*18]
MU740702A	Power Unit for IP Tester[*19]
	Standard accessories for MT7407A-01
J0775I	Coaxial cable, 0.1 m (75) 1 pc
	Standard accessories for MU740701A
J1221B	RS-232C cross cable 1 pc
	Control module options for MU740701A[*2]
MU740701A-04	MU740701A Decode Module[*20]
MU740701A-05	GPS Module[*21]
MU740701A-07	OSPF Protocol
MU740701A-08	MPLS (LDP/CR-LDP) Protocol
MU740701A-09	MPLS (RSVP) Protocol
MU740701A-10	RFC2889 Benchmarking Test
MU740701A-11	Packet BER Test
MU740701A-12	Ipv6 Expansion
MU740701A-13	XENPAK Test
MU740701A-14	IGAP Protocol
MU740701A-15	Auto Negotiation Analysis
MU740701A-16	Link Fault Signaling
MU740701A-18	OSPFv3 Protocol[*22]
MU740701A-19	BGP4+ Protocol[*22]
MU740701A-21	PIM-SMv2 Protocol[*23]
MU740701A-22	MLDA Protocol[*22]
MU740701A-23	Spanning Tree/Ling Aggregation
MU740701A-30	MU740701A Expert Analysis Module[*24]

• MD1231A

Model/Order No.	Name
	Main frame
MD1231A	IP Network Analyzer
	Standard accessories
	Power cord, 2.5 m: 1 pc
F0101	Fuse, 2 A: 1 pc
B0489	Front cover: 1 pc
W2306AE	MD1230A Family operation manual CD-ROM[*1]: 1 pc
	Main frame options[*2]
MD1231A-02	GPIB Control[*25]
MD1231A-03	Ethernet Control[*25]
MD1231A-04	MD1231A Decode Module[*26]
MD1231A-05	GPS Module[*5]
MD1231A-06	Tcl Interface[*27]
MD1231A-07	OSPF Protocol
MD1231A-08	MPLS (LDP/CR-LDP) Protocol
MD1231A-09	MPLS (RSVP) Protocol
MD1231A-10	RFC2889 Benchmarking Test
MD1231A-11	Packet BER Test
MD1231A-12	IPv6 Expansion
MD1231A-14	IGAP Protocol
MD1231A-15	Auto Negotiation Analysis
MD1231A-18	OSPFv3 Protocol[*28]
MD1231A-19	BGP4+ Protocol[*28]
MD1231A-20	Application Traffic Monitor
MD1231A-21	PIM-SMv2 Protocol[*29]
MD1231A-22	MLDA Protocol[*28]
MD1231A-23	Spanning Tree/Ling Aggregation
MX123002A	MD1230A Expert Analysis Module[*30]

• **Common to the MD1230 Family**

Model/Order No.	Name
	Softwares
MX123001A	Data Quality Analyzer control Software*31
MX123001A-05	Data Quality Analyzer Control Software (5 licenses)*31
MX123001A-08	Data Quality Analyzer Control Software (8 licenses)*31
MX123001A-01	Remote Control Software for MD1230A-04*32
MX123001A-15	Remote Control Software for MD1230A-04 (5 licences)*32
MX123001A-18	Remote Control Software for MD1230A-04 (8 licences)*32
MX123001A-20	Application Traffic Monitor Option*33
MX123003A	Remote Control Software for MX123002A*34
MX123003A-05	Remote Control Software for MX123002A (5 licences)*34
MX123003A-08	Remote Control Software for MX123002A (8 licences)*34
	Software options
MX123001A-06	Tcl Interface*35
MX123001A-07	RS-232C Control*36
MX123001A-09	GPIB Control*36
MX123001A-10	Ethernet Control*36
	Software upgrade service
MD1230B-40	Annual Software Upgrade Service for MD1230B*37
MD1230B-41	Annual Software Maintenance for MD1230B-04*38
MD1230B-42	Annual Software Maintenance for MX123002A*39
MD1231A-40	Annual Software Upgrade Service for MD1231A*37
MD1231A-41	Annual Software Maintenance for MD1231A-04*40
MD1231A-42	Annual Software Maintenance for MX123002A*39
MD1231A1-40	Annual Software Upgrade Service for MD1231A1*37
MD1231A1-41	Annual Software Maintenance for MD1231A1-04*41
MD1231A1-42	Annual Software Maintenance for MX123002A*39
MT7407A-40	Annual Software Upgrade Service for MT7407A*42
MU740701A-41	Annual Software Maintenance for MU740701A-04*43
MU740701A-42	Annual Software Maintenance for MU740701A-30*44
	Plug-in modules
MU120101A	10M/100M Ethernet Module
MU120102A	Gigabit Ethernet Module*45
MU120103A	2.5G (1.31) Module
MU120103B	2.5G (1.31) Module
MU120104A	2.5G (1.55) Module
MU120104B	2.5G (1.55) Module
MU120105A	10G (1.31) Module
MU120106A	10G (1.55) Module
MU120111A	10/100M Ethernet Module
MU120112A	Gigabit Ethernet Module*45
MU120118B	10 Gigabit Ethernet Module*46
MU120119A	OC-3/12 STM-1/4 Module (1310 nm)
MU120120A	OC-3/STM-1 Module (1310 nm)
MU120121A	10/100/1000M Ethernet Module
MU120122A	Gigabit Ethernet Module*47
	Plug-in module options
MU120103B-01	EOS Mapping
MU120103B-02	Virtual Concatenation
MU120104B-01	EOS Mapping
MU120104B-02	Virtual Concatenation
MU120119A-01	Optical Power Meter
MU120120A-01	Optical Power Meter
	Maintenance service
MD1230B-90	Extended Three Year Warranty Service
MD1231A-90	Extended Three Year Warranty Service
MD1231A1-90	Extended Three Year Warranty Service
MT7407A-90	Extended Three Year Warranty Service*48
MU740701A-90	Extended Three Year Warranty Service*48
MU740702A-90	Extended Three Year Warranty Service*48
MU120101A-90	Extended Three Year Warranty Service
MU120102A-90	Extended Three Year Warranty Service
MU120103A-90	Extended Three Year Warranty Service
MU120103B-90	Extended Three Year Warranty Service
MU120104A-90	Extended Three Year Warranty Service
MU120104B-90	Extended Three Year Warranty Service
MU120105A-90	Extended Three Year Warranty Service
MU120106A-90	Extended Three Year Warranty Service
MU120111A-90	Extended Three Year Warranty Service
MU120112A-90	Extended Three Year Warranty Service
MU120118B-90	Extended Three Year Warranty Service
MU120119A-90	Extended Three Year Warranty Service
MU120120A-90	Extended Three Year Warranty Service
MU120121A-90	Extended Three Year Warranty Service
MU120122A-90	Extended Three Year Warranty Service

Model/Order No.	Name
	Hardware upgrade service
MD1230A-47	MD1230A Retrofit for Fan
MD1231A-48	MD1231A1 Upgrade
	Optional accessories
G0105A	GBIC SX 850 nm*49
G0106A	GBIC LX 1310 nm*49
G0107A	GBIC LH 1310 nm*49
G0108A	GBIC ZX 1550 nm*49
G0124A	GBIC T (1000BASE-T)*49
G0136	SFP SX 850 nm*50
G0137	SFP LX 1310 nm*50
G0138	SFP LE 1310 nm*50
G0139	SFP LR 1550 nm*50
G0132	XENPAK (10GBASE-SR)*51
G0126A	XENPAK (10GBASE-LR)*51
G0131	XENPAK (10GBASE-ER)*51
J1049A	Fixed Optical Attenuator (SC, 5 dB)*52
J1049B	Fixed Optical Attenuator (SC, 10 dB)*52
J1049C	Fixed Optical Attenuator (SC, 15 dB)*52
MZ1221A	XAUI Extender*53
MZ1222A	XENPAK Interface
J1163A	XAUI cable, 0.5 m
J1164A	MDIO cable, 0.5 m
J0660B	Optical fiber cord (SM, SC-SC connector both ends), 2 m
J0773B	Optical fiber cord (GI, SC-SC connector), 2 m
J1119B	Optical fiber cord (Duplex, MM), 2 m
J1271	Optical fiber cord (Duplex, SM, LC-LC connector), 2 m
J1272	Optical fiber cord (Duplex, SM, LC-SC connector), 2 m
J1273	Optical fiber cord (Duplex, GI, LC-LC connector), 2 m
J1274	Optical fiber cord (Duplex, GI, LC-SC connector), 2 m
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m*54
J1165A	Coaxial cable (27CP-P-1.5-BNC-P-1.5C-CR10), 0.5 m*54
J1166A	Coaxial cable (both ends, 27CP-P-1.5), 0.5 m*54
J0845A	Balanced cable (BANTAM 3P · BANTAM 3P), 6 ft
J0162B	Balanced cable (SIEMENS 3P-SIEMENS 3P), 2 m
J0008	GPIB cable, 2 m
J1110B	LAN cable (CAT5, straight), 5 m
J1109B	LAN cable (CAT5, cross), 5 m
J1275	LAN cable (CAT5E, straight), 1 m
J1275B	LAN cable (CAT5E, straight), 5 m
J1275C	LAN cable (CAT5E, cross), 1 m
J1275D	LAN cable (CAT5E, cross), 5 m
Z0321A	Keyboard (PS/2)
Z0541A	USB mouse
B0448	Soft case*55
B0336C	Carrying case (3/4MW4U, 350D)*56
B0530	Carrying case caster for B0336C
B0533	Carrying case (3/4MW4U, 350D)*57
B0510	Soft case*58
B0501B	Blank panel*59
B0531	Blank panel*60
B0532	Rack flange*61
W1927AE	MD1230A/B operation manual
W2096AE	MD1231A/A1 operation manual
W2238AE	MT7407A operation manual
W1928AE	MX123001A Data Quality Analyzer Control Software operation manual
W1929AE	MD1230A-01/02/03 Remote Control operation manual
W2107AE	MD1230A-04 MD1230A Decode Module, MX123001A-01 Remote Control Software for MD1230A-04 operation manual
W2122AE	MD1230A-06 Tcl Interface operation manual
W2134AE	MD1230A-20/MD1231A-20/MX123001A-20 Application Traffic Monitor operation manual
W2108AE	MX123002A MD1230A Expert Analysis Module, MX123003A Remote Control Software for MX123002A operation manual
W1931AE	MU120101A/11A 10M/100M ethernet Module, MU120102A/12A Gigabit Ethernet Module, MU120118A 10 Gigabit Ethernet Module operation manual
W1932AE	MU120103A/B 2.5G (1.31) Module, MU120104A/B 2.5G (1.55) Module, MU120105A 10G (1.31) Module, MU120106A 10G (1.55) Module operation manual
W2121AE	MU120119A OC-3/12 STM-1/4 Module (1310 nm), MU120120A OC-3/STM-1 Module (1310 nm) operation manual

*1: Includes W1927AE, W1928AE, W1929AE, W2122AE operation manuals. Printed versions sold separately.
*2: Some of these interface modules may not work in certain combinations depending on the modules and software versions. Please see the selection guide.
*3: The MD1230B-01/02/03 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*4: Purchase MD1230B-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*5: An accessory GPS antenna (with a 5 m cable) is bundled together with the module.
*6: MD1230B-06 is the option to operate the Tcl server. MD1230B-06 can be mounted together with MD1230B-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*7: MD1230B-12 IPv6 Expansion is required.
*8: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1230B-12 IPv6 Expansion is required.
*9: MD1230B-04 MD1230B Decode Module is required.
*10: The MD1231A1-02/03 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*11: Purchase MD1231A1-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*12: MD1231A1-06 is the option to operate the Tcl server. MD1231A1-06 can be mounted together with MD1231A1-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*13: MD1231A1-12 IPv6 Expansion is required.
*14: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1231A1-12 IPv6 Expansion is required.
*15: MD1231A1-04 MD1231A1 Decode Module is required.
*16: One MT7407A can accommodate two MU740701A IP Tester Control Modules, one MT7407A-01 Interface Board for IP Tester, and two MU740702A Power Unit for IP Tester.
*17: This board is required for time synchronization with another MD1230 Family equipments cabinet or synchronization with an external clock on SONET/SDH.
*18: Each MU740701A supports 7 slots.
*19: One MU740702A Power Unit for IP Tester can power one MU740701A. To mount an additional MU740702A, the cabinet must be modified at the factory.
*20: A separate MX123001A-01 is required to use the decode module function. The operation manual (W2107AE) is included in MX123001A-01. A printed version is sold separately.
*21: MT7407A-01 is required. An accessory GPS antenna (with a 5 m cable) is bundled together with the module.
*22: MU740701A-12 IPv6 Expansion is required.
*23: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MU740701A-12 IPv6 Expansion is required.
*24: Using the expert analysis module function requires a separate MU740701A-04 MU740701A Decode Module, MX123001A Data Quality Analyzer Control Software, MX123001A-01 MD1230A-04 Remote Control Software, and MX123003A MX123002A Remote Control Software.
*25: The MD1231A-02/03 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*26: Purchase MD1231A-04 and the operation manuals (W2107AE) on CD-ROM. Printed versions sold separately.
*27: MD1231A-06 is the option to operate the Tcl server. MD1231A-06 can be mounted together with MD1231A-03, but both options cannot be operated at the same time because they are controlled via Ethernet.
*28: MD1231A-12 IPv6 Expansion is required.
*29: This module can operate independently when used for an IPv4 network. When this module is used for an IPv6 network, MD1231A-12 IPv6 Expansion is required.
*30: MD1231A-04 MD1231A Decode Module is required.
*31: Ethernet control options (Option 03) are not required.
*32: One of the decode module options (Option 04) is required for MX123001A Data Quality Analyzer Control Software and for cabinet control.
*33: Software for external control of MD1230B-20, MD1231A-20 and MD1231A1-20. It can be used even if there is no MX123001A.
*34: One of the decode module options (Option 04) and MX123002A MD1230A Expert Analysis Module are required for cabinet control. Also, MX123001A Data Quality Analyzer Control Software and MX123001A-01 MD1230A-04 Remote Control Software must be installed on the PC where this software is installed.
*35: MX123001A-06 is the option to operate the Tcl server on the PC. MX123001A-06 can be mounted together with MX123001A-10, but both options cannot be operated at the same time because they are controlled via Ethernet.
*36: The MX123001A-07/09/10 options are required only for remote control using GPIB commands. Note that these options may be installed together, although only one of them can be used at a time.
*37: Option 40 are provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase.
*38: Annual Maintenance Service for MD1230B-04 and MX123001A-01. You have to purchase this software maintenance simultaneously with MD1230B-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.
*39: Annual Maintenance Service for MX123002A and MX123003A. You have to purchase this software maintenance simultaneously with and MX123002A and MX123003A. Moreover, when continuing this software maintenance, annual renewal is required each year.
*40: Annual Maintenance Service for MD1231A-04 and MX123001A-01. You have to purchase this software maintenance simultaneously with MD1231A-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.
*41: Annual Maintenance Service for MD1231A1-04 and MX123001A-01. You have to purchase this software maintenance simultaneously with MD1231A1-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.
*42: MT7407A-40 is provided free for the first year after purchase. It is required to receive software upgrade service starting with the second year after purchase. One license supports two MU740701A.
*43: Annual Maintenance Service for MU740701A-04 and MX123001A-01. You have to purchase software maintenance simultaneously with MU740701A-04 and MX123001A-01. Moreover, when continuing this software maintenance, annual renewal is required each year.
*44: Annual Maintenance Service for MU740701A-30 and MX123003A. You have to purchase software maintenance simultaneously with MU740701A-30 and MX123003A. Moreover, when continuing this software maintenance, annual renewal is required each year.
*45: The GBIC module is sold separately. 1000BASE-T GBIC is not supported. Note that Anritsu supports GBIC modules only which are purchased from Anritsu.
*46: The XENPAK module is sold separately. Note that Anritsu supports XENPAK modules only which are purchased from Anritsu.
*47: The SFP module is sold separately. Note that Anritsu supports SFP modules only which are purchased from Anritsu.
*48: Extended Three Year Warranty Service is divided into three orders for main frame, CPU module and Power Unit. Please choose your need order among them.
*49: The GBIC module is sold on a per-unit basis. MU120102A/12A has two GBIC interface slots. MU120102A does not support 1000BASE-T.
*50: The SFP module is sold on a per-unit basis. MU120122A has two SFP interface slots.
*51: The XENPAK module is sold on a per-unit basis. MU120118B has two XENPAK interfaces slots.
*52: Check the optical input power level carefully before use. Incorrect level of optical input may damage the instrument.
*53: Using the XAUI extender requires the MZ1222A XENPAK interface, J1163A XAUI cable, J1164A MDIO cable, and a separate external power supply (5 V, 4 A)
*54: This cable is required for time synchronization between MD1230 Family cabinets. MD1230A/B and MT7407A use BNC connectors, and MD1231A/A1 uses an SMB connector. J0775D is required to connect BNC connectors to each other. J1166A is required to connect SMB connectors to each other. J1165A is required to connect a BNC connector to an SMB connector.
*55: Soft case for MD1230A/B
*56: Carrying case for MD1230A/B
*57: Carrying case for MD1230A/B
*58: Soft case for MD1231A/A1
*59: Blank panel for module slot
*60: Blank panel for MT7407A CPU Module slot
*61: Flange to fix MT7407A to the rack. Fixing MT7407A to the rack requires separate screws.

SONET/SDH/PDH/ATM ANALYZER

MP1570A

1.5 Mbit/s to 10 Gbit/s

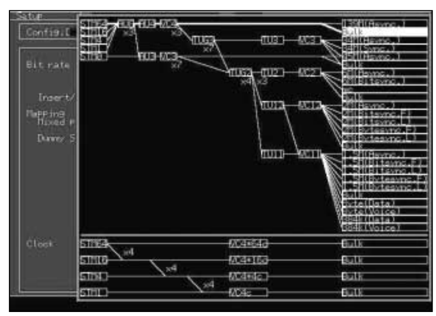
CE GPIB OPTION

Comprehensive Testing of Core Networks from One Compact Portable Analyzer

The MP1570A analyzer is designed for the development, manufacturing, construction, maintenance, and inspection of SDH, SONET, PDH, and ATM equipment and networks.
A variety of plug-in units and options are available that offer the flexibility to the users to configure various analysis systems for different applications.
The MP1570A is scalable from 1.5 Mbit/s to 10 Gbit/s, and has six slots to install the plug-in units required for SDH, SONET and PDH tests at bit different rates. Installing the appropriate combinations of plug-in units can also perform ATM, jitter and wander tests conform to ITU-T O.171/O.172.
The MP1570A conforms to the ITU-T recommendations and Bellcore standards, and supports concatenation mapping, tandem connection, APS measurement, CID measurement and POS measurement. The user can measure 1.5 Mbit/s to 10 Gbit/s signals using a single MP1570A; previously, this required several measuring instruments.
The MP1570A has a built-in printer and a 3.5-inch floppy disk drive as standard output devices to print measurement results, and to save and read measurement data to and from the floppy disk (FD), which can also be read on an external PC. The user can also save screen data to the FD. The MP1570A has a "HELP" key function that explains operations, functions and connections.

SDH, SONET and PDH measurement

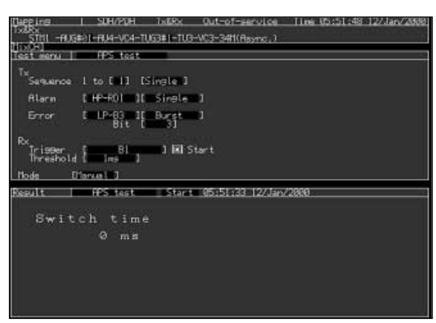
• Measurement at bit rates from 1.5 Mbit/s to 10 Gbit/s
A mapping route to a bit rate of up to 10 Gbit/s can be set.
The MP1570A mainly supports SDH, SONET, and Japanese mapping, European PDH and North American DSn for digital communications. For concatenation mapping, a route can be set from STM-1c/STS-3c up to STM-64c/STS-192c. Furthermore, the MP1570A supports a combination of channels. For example, 64 channels of VC4c/STS3c, 16 channels of VC4-4c/STS-12c, and four channels of VC4-16c/STS-48c (See Figure 1 or Figure 2 in page 151 and 152).



Mapping

• Overhead setting and testing
The user can modify and capture the overhead, and test the overhead portion with overhead change, pointer 64 frames, overhead add/drop and overhead bit errors.

• APS function
The user can test the automatic protection switch (APS) by measuring the equipment switching time accurately in milliseconds. The MP1570A also conforms to ITU-T Rec. G.783 and G.841.



APS test sub-screen

• Mixed payload
At mapping measurement in TUG-3 and AU3, the user can set different mapping for three additional channels other than the target measurement channel.

• **Tandem connection**
The N1/Z5 and N2/Z6 bytes can be set and measured.

• **Various analysis functions**
The internal optical power meter and frequency counter allows the user to measure optical power and frequency during error and alarm measurement without changing the connections of the signal cables. The MP1570A can capture any SOH/TOH or POH (1 byte), K1/ K2 byte, or H1/H2 byte in 1023 frames to analyze errors and alarms, and check APS operation.
Measured errors and alarms can be displayed as a graph with a time scale in 1 second, 1 minute, 15 minutes, or 60 minutes.

• **Pointer value monitoring**
Changes in pointer value can be displayed as a graph with values updated in real time.

• **MUX/DEMUX function (option)**
When the MUX/DEMUX option is added, the multiplexing structure including the frame alignment signal can be generated, and multiplexer/demultiplexer measurement can be performed.

• **Non frame pattern/CID pattern**
Frames can be set on/off at all bit rates. CID pattern can generate or analysis at SONET/SDH measurements.

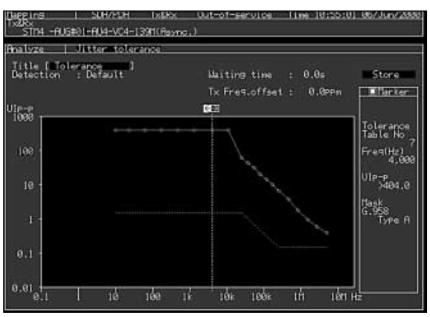
• **Through modes**
One of the three through modes can be selected: (1) Transparent, (2) Overhead/Overwrite, and (3) Payload/Overwrite. The external DS1/DS3/PDH signal can be added/dropped to/from payload by payload overwrite.

• **Enhanced error/alarm simulation**
The MP1570A can generate normal and abnormal frames alternately to test the frame synchronization function of terminal equipment. (This is an SDH/SONET FAS error addition function.)

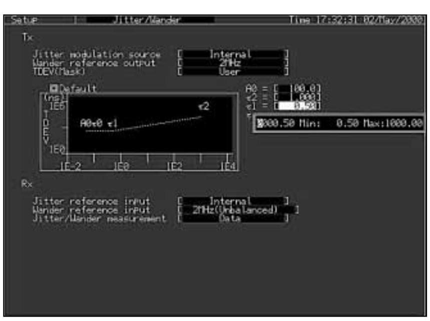
• **Easily operated pointer sequence test (combined jitter measurement)**
Able to generate the justification pattern conforming to ITU-T G.783 from the transmission equipment side, and simultaneously make the tributary signal offset variable. This makes the combined jitter test possible.

Jitter, wander measurements

The jitter/wander measurement conforming to ITU-T O.171/O.172 exceeds these standards in performance evaluation. Automatic measurements, such as jitter tolerance, jitter transfer, and jitter vs. frequency offset are performed in a short time. Various automatic measurements can be achieved with just one unit.



• **Various wander generation functions (option)**
Various wander generations for evaluation are available: such as TDEV wander tolerance measurement and TDEV wander transfer characteristics measurement that were regulated by ITU-T, ANSI, Bellcore, and ETSI.

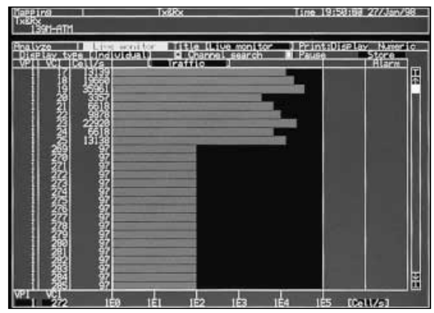


• **Wander measurement (option)**
Subdivides the bandwidth of the wander measurement into three ranges, and can analyze the wander factor caused by temperature change, pointer, etc. It can also perform measurements conforming to ITU-T O.172.

• **Through jitter function (only SONET/SDH)**
Able to generate the jitter by through, while monitoring the input jitter quality.

ATM

• **Supports ATM from 1.5M to 622M rates**
TC layer mappings of 622M, 156M, 52M, 139M, 45M, 34M, 2M and 1.5M are supported along with ATM mappings of O.191, AAL1, AAL2, AAL3/4, and AAL5, which makes the MP1570A ideal for various combinations of layers. The VPI/VCI for 1023 channels can be detected automatically, and the presence/absence of alarms, cell count, and non-conforming cell count can be displayed graphically, for easy comparison of line channel traffic.



• **1- and 2-point CDV in conformance with I.356**
When measuring delay in cell traffic, either 1-point CDV or 2-point CDV conforming to ITU-T Rec. I.356 can be selected according to the conditions.

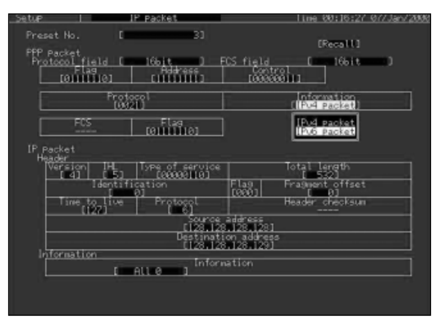
• **Simultaneous display of error cells, inserted error cells and lost cells**
The error/alarm generation conditions can be displayed both numerically and graphically to give a visual impression of the traffic conditions.

• **Traffic monitoring**
The constantly changing traffic can be displayed as a graph for the selected-one-channel VPI/VCI.

IP-over-SONET/SDH, IP-over-ATM (option)

Programs IP/PPP at will transmits it, picks PPP packet from capture memory (option), displays it and supports high-speed POS router evaluation. Programs IP in the AAL5 payload at will transmits it, picks the IP packet from the cell capture memory, and displays it. And evaluate router ATM function.

• **IP/PPP header setting**
Able to set the value of each header optionally when selecting IPv4 or IPv6. Calculates FCS or header checksum automatically.



• **PPP packet transmission and real time count**
Transmits the three types of packets (can be set separately) by optional sequence (the idle length between each packet can be set simultaneously.). Displays the number of Tx packets and Rx PPP packets at real time.

• **PPP packet capture and display**
Samples PPP packet from the capture memory, and displays IP header. Detects FCS error and displays it in red.

Specifications

• MP0121A 2/8/34/139/156M*1 Unit

Bit rate	2.048, 8.448, 34.368, 139.264 Mbit/s
Level/waveform	Conforms to ITU-T G.703 (with 20 dB monitoring point)
Connectors	BNC (75 Ω, unbalanced), 3-pin Siemens (120 Ω, balanced) 2.048 Mbit/s: HDB3 (balanced/unbalanced) 8.448, 34.368 Mbit/s: HDB3 (unbalanced) 139.264 Mbit/s: CMI (unbalanced)
Clock	Internal (accuracy: ±7 ppm, jitter unit not installed), external (ECL [AC] 50 Ω), received signal
Frame format	Unframed: 2, 8, 34, 139 Mbit/s Framed: 2 Mbit/s (with/without CRC-4 at channels 30/31, G.704), 8 Mbit/s (G.742), 34 Mbit/s (G.751), 139 Mbit/s (G.751), MUX/DEMUX (Option 06)
Test patterns	PRBS: 2^{11} – 1, 2^{15} – 1, 2^{20} – 1, 2^{23} – 1 (O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit (all, test pattern), code, E-bit Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS: n in 16 (n: 1 to 4), all
Alarm addition	LOS, LOF, AIS, RDI, RDI (MF) Timing: All
Measurements	Mode: Single, repeat, manual In-service Errors: Frame, code, CRC-4, E-bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF) Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: Frame, code, CRC-4, E-bit, bit Alarms: Power-fail, LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
Delay	Measurement cycle: 0.5, 1 s Measurement range: 0 to 1.00 s, timeout Display accuracy: Within ±5 µs, 0 to 999 µs, 1.0 to 999.9 ms, 1.0 s, timeout
LEDs	LOS, AIS, LOF, MF loss, RDI, RDI (MF), sync loss, errors
Monitor	Frame word
Trouble search	Auto search for errors/alarms in all measured channels
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 156M CMI (electrical) interface

• MP0122A 1.5/45/52M*1 Unit, MP0122B 1.5/45/52/52M*2 (1.31) Unit

Bit rate	1.544, 44.736 Mbit/s
Level/waveform	1.544 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/655 ft 44.736 Mbit/s: ANSI T1.102 (with 20 dB monitoring point), 0/450/900 ft
Connectors	BNC (75 Ω, unbalanced), BANTAM (100 Ω, balanced) 1.544 Mbit/s: AMI/B8ZS (balanced), 44.736 Mbit/s: B3ZS (unbalanced)
Clock	Internal (accuracy: ±7 ppm, jitter unit not installed), external (ECL [AC] 50 Ω) received signal
Frame format	Unframed: 1.5, 45 Mbit/s Framed: 1.5 Mbit/s (D4, ESF, Japan ESF*3), 45 Mbit/s (M13, C-bit), MUX/DEMUX (Option 07)
Test patterns	PRBS: 2^{11} – 1, 2^{15} – 1, 2^{20} – 1 (zero suppress), 2^{20} – 1, 2^{23} – 1 (O.151) Invert: On/off Word: 16-bit program, all 0, all 1, 3 in 24 (1.5 Mbit/s)
Error addition	Bit (all, test pattern), code, parity, CRC-6, C-bit, REI Timing: Single, rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7) FAS (45 Mbit/s): n in 16 (n: 1 to 4), all
X-bit setting	00, 01, 10, 11
Alarm addition	LOS, LOF, AIS, RDI Timing: All
Measurements	Mode: Single, repeat, manual In-service Errors: FAS, code, parity, CRC-6, C-bit, REI Alarms: Power-fail, LOS, AIS, LOF, RDI Error performance: G.821 (inc. Annex D), M.2100, G.826 Out-of-service Errors: FAS, code, parity, CRC-6, C-bit, REI, bit Alarms: Power-fail, LOS, AIS, LOF, RDI, sync loss Error performance: G.821 (inc. Annex D), M.2100, G.826
Delay	Measurement cycle: 0.5, 1 s Measurement range: 0 to 1.00 s, timeout Display accuracy: Within ±5 µs, 0 to 999 µs, 1.0 to 999.9 ms, 1.0 s, timeout
LEDs	LOS, LOF, AIS, RDI, sync loss, errors
Trouble search	Auto search for errors/alarms in all measured channels
Auxiliary interface	Clock sync output, frame sync output, error output

*1: Built-in 52M B3ZS (electrical) interface
*2: Built-in 52M B3ZS (electrical) and optical interfaces
*3: Mounted Option 09 (Japan mapping)

• **52/156/622/2488/9953M (SDH)**

Bit rate	51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s
Level/waveform	52M (electrical: B3ZS)*1: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)*2: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), external (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET, CID pattern, non-frame
Mapping	See Fig. 1
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: 2^{11} – 1, 2^{15} – 1, 2^{20} – 1 (zero suppress, MP0122A/B installed), 2^{20} – 1, 2^{23} – 1, 2^{31} – 1 (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Timing: Single, single (burst) frame Alternative: Alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI Alarms: Power-fail, LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-SLM, HP-TIM, HP-RDI, HP-UNEQ, TU-AIS, TU-LOP, TU-LOM, LP-SLM, LP-TIM, LP-RDI, LP-UNEQ, LP-RFI Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-SLM, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, LP-SLM, Tandem, sync. loss, errors
Tandem connection	N1 byte (Type 1, Type 2), N2 byte Errors: N2 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI
Justification	AU pointer, TU pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2
Monitor	SOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Pointer sequence	Signal of opposites polarity, regular with double, regular with missing, double of opposites polarity, 87-3/26-1 (normal, add, cancel), continuous pattern (normal, add, cancel), single pointer adjustment, maximum rate pointer burst, phase transient pointer burst, initialize period polarity, cooldown period
Over head capture	SOH/POH (any 1 byte), H1/H2, K1/K2
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VC2, VC12, VC11
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, MS-REI, HP-REI, LP-REI, MS-AIS, AU-AIS, AU-LOP, HP-RDI, TU-AIS, TU-LOM, TU-LOP, LP-RDI, LP-RFI, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm (jitter unit not installed)
Over head test	OH change: SOH/POH 1 byte, K1/K2, RSOH, MSOH, SOH, POH (except B1, B2, B3, BIP-2) PTR 64 frame: AU pointer, TU pointer Timing: Single, repeat (2 to 64) Setting: PTR, NDF, +PJC, –PJC OH BERT: SOH/POH 1 byte (exclude B1, B2, B3, BIP-2), D1-D3, D4-D12 Test pattern: 2^{11} – 1, 2^{15} – 1 OH add/drop: SOH/POH 1 byte, D1-D3, D4-D12 (exclude B1, B2, B3, BIP-2 additional type)
Japan mapping (option 09)	VC11 Signaling (8-multiframe, 64-multiframe setting)
Frame memory/capture	Memory size: 64 frame (156M, 622M, Option 13), 64 frame (MU150008A-01/150009A-01/150010A-01, 2.5G), 26 frame (MU150000A-01, 2.5G/10G)
Insert/extract	Bit rate: 10G (52M, 156M), 2.5G (52M, 156M)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted MP0122A/B *2: Mounted MP0121A

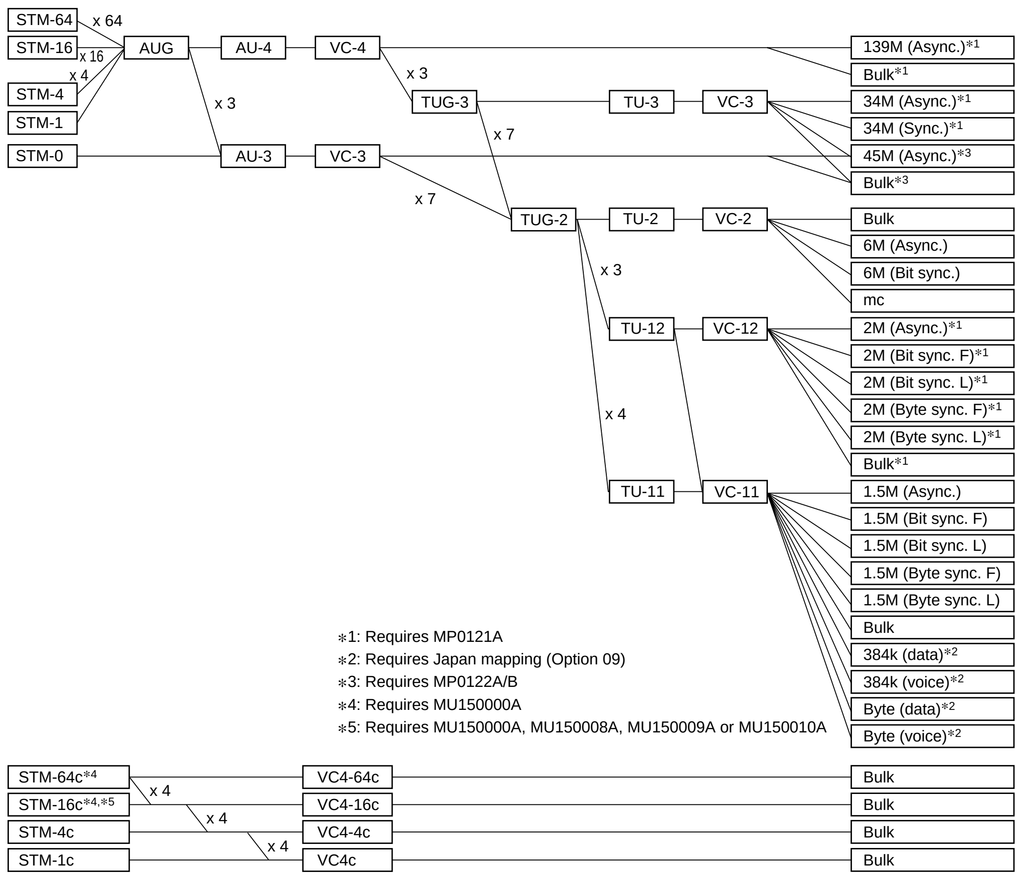


Fig. 1 Mapping structure (SDH)

• **52/156/622/2488/9953M (SONET)**

Bit rate	51.84, 155.52, 622.08, 2488.32, 9953.28 Mbit/s
Level/waveform	52M (electrical: B3ZS)*1: ANSI T1.102, 0/450 ft 52M (optical): As per MP0122B unit optical interface specifications 156M (electrical: CMI)*2: ITU-T G.703 156M (optical): As per optical 156M/622M unit specifications 622M (electrical/optical): As per optical 156M/622M unit and NRZ unit specifications 2488M (electrical/optical): As per 2.5G unit and 2.5G/10G unit specifications 9953M (electrical/optical): As per 2.5G/10G unit specifications
Clock	Internal (accuracy: ±3.5 ppm, jitter unit not installed), Lock (2 MHz, 1.5 MHz, 64 kHz + 8 kHz, 2 Mbit/s, 1.5 Mbit/s), External (ECL [AC] 50 Ω, 9953M: 1.02 to 0.58 Vp-p, 50 Ω), received signal
Frame	SDH/SONET, CID pattern, non-frame
Mapping	See Fig. 2
Through	Trance parent, over head overwrite, payload overwrite
Test patterns	PRBS: 2^{11} – 1, 2^{15} – 1, 2^{20} – 1 (zero suppress, MP0122A/B installed), 2^{20} – 1, 2^{23} – 1, 2^{31} – 1 (only concatenation mapping 16c/64c, conform to O.151) Invert: On/off Word: 16-bit programmable, all 0, all 1
Error addition	Bit all (all, test pattern), FAS, B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Timing: Single, single (burst) bit (1 to 64000), rate (1E–3, 1E–4, 1E–5, 1E–6, 1E–7, 1E–8, 1E–9) User program AE-B [A: 1.0 to 9.9 (step: 0.1), B: 2 to 10] Alternative: Error frame (0 to 8000), normal frame (1 to 8000)
Alarm addition	LOS, LOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Timing: Single, single (burst) frame Alternative: alarm frame (0 to 8000), normal frame (1 to 8000), all
Measurements	Mode: Single, repeat, manual In-service/Out-of-service Errors: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V Alarms: Power-fail, LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, PLM-P, HP-TIM, RDI-P, UNEQ-P, AIS-V, LOP-V, LOM-V, PLM-V, LP-TIM, RDI-V, UNEQ-V, RFI-V Error performance: G.826, M2101, M2110, M2120 Preset: Alarm measurement condition
LEDs	LOS, LOF, OOF, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, PLM-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, PLM-V, Tandem, sync. loss, errors
Tandem connection	Z5 byte (Type 1, Type 2), Z6 byte Errors: Z6 BIP-2, TC-REI, OEI, IEC Alarms: VC-AIS, ISF, FAS, HP-Incoming-AIS, HP-TC-RDI, HP-ODI, LP-Incoming-AIS, LP-TC-RDI, LP-ODI

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Justification	STS pointer, VT pointer, C, C1/C2 Measurement: NDF, +PJC, –PJC, Cons, C, C1/C2
Monitor	TOH, POH, K1/K2, pointer, path trace (TIM alarms detectable), Tandem, payload
Pointer sequence	Signal of opposites polarity, regular with double, regular with missing, double of opposites polarity, 87-3/26-1 (normal, add, cancel), continuous pattern (normal, add, cancel), single pointer adjustment, maximum rate pointer burst, phase transient pointer burst, initialize period polarity, cooldown period
Over head capture	TOH/POH (any 1 byte), H1/H2, K1/K2
Dummy channel setting	Payload: Dummy, copy, mixed payload Setting: POH, pathtrace, SS bit, Tandem
Simultaneous measurement	VT6SPE, VT2SPE, VT1.5SPE
Trouble search	Auto search for errors/alarms in all measured channels
Delay	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, time out Display accuracy: ±5 µs (0.5, 1 s), ±50 µs (2, 5, 10 s)
APS (K1/K2)	Switching time measurement Measurement range: 1 to 2000 ms, >2000 ms Trigger Internal: B1, B2, B3, BIP-2, REI-L, REI-P, REI-V, AIS-L, AIS-P, LOP-P, RDI-P, AIS-V, LOM-V, LOP-V, RDI-V, RFI-V, Bit External: Measures trigger input signal (active high) Threshold: Specify non-error alarm between 1 ms, 10 ms, 100 ms Sequence generation: 2 to 64 word, repeat (8000 frame) Sequence capture: 2 to 64 word, repeat (8000 frame)
Frequency measurement	Range: ±100 ppm, Accuracy: ±3.5 ppm (jitter unit not installed)
Over head test	OH change: TOH/POH 1 byte, K1/K2, LOH, SOH, TOH, POH (except B1, B2, B3, BIP-2) PTR 64 frame: STS pointer, VT pointer Timing: Single, repeat (2 to 64) Setting: PTR, NDF, +PJC, –PJC OH BERT: TOH/POH 1 byte (exclude B1, B2, B3, BIP-2), D1-D3, D4-D12 Test pattern: 2^{11} – 1, 2^{15} – 1 OH add/drop: TOH/POH 1 byte, D1-D3, D4-D12 (exclude B1, B2, B3, BIP-2 additional type)
Japan mapping (option 09)	VT1.5SPE Signaling (8-multiframe, 64-multiframe setting)
Frame memory/capture	Memory size: 64 frame (156M, 622M, Option 13), 64 frame (MU150008A-01/150009A-01/150010A-01, 2.5G), 26 frame (MU150000A-01, 2.5G/10G)
Insert/extract	Bit rate: 10G (52M, 156M), 2.5G (52M, 156M)
Payload offset	±100 ppm/0.1 ppm step
Auxiliary interface	Clock sync output, trigger input, trigger output, DCC interface (V.11), orderwire, receive clock output

*1: Mounted MP0122A/B *2: Mounted MP0121A

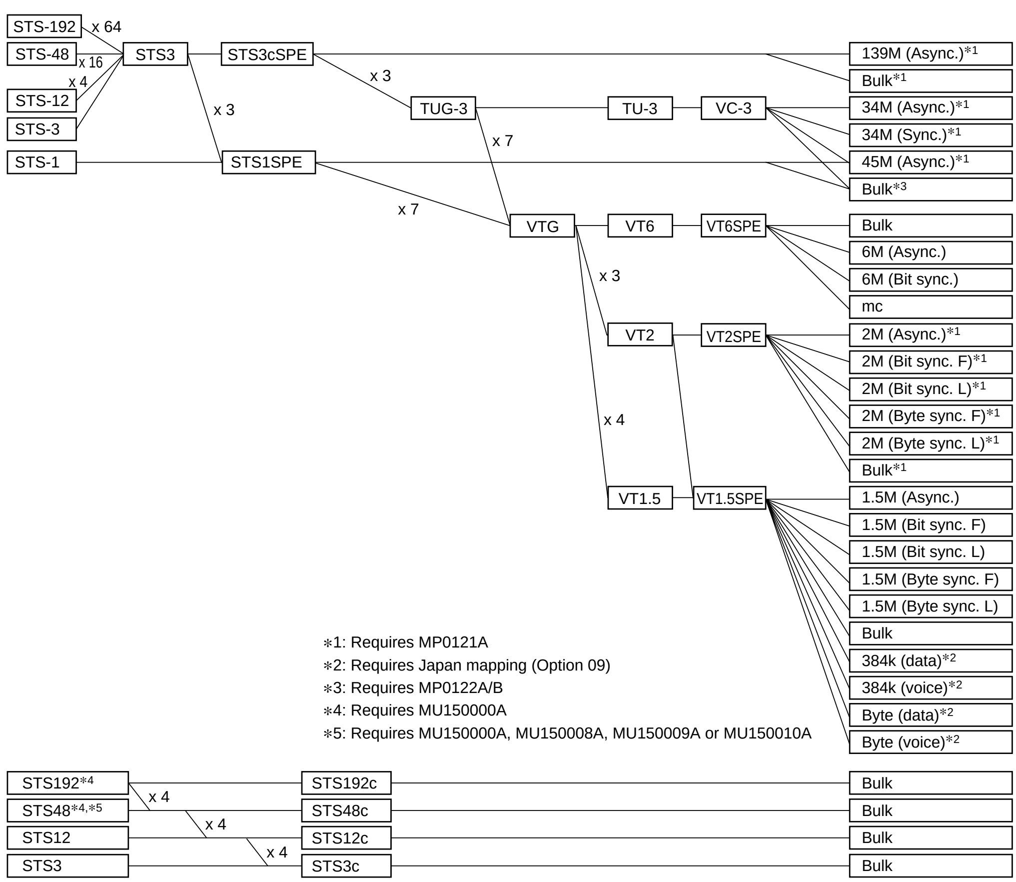


Fig. 2 Mapping structure (SONET)

• IP-over-SONET/SDH (Option)*1

Bit rate	155.52, 622.08, 2488.32, 9953.28 Mbit/s
PPP setting (RFC1662)	Flag, address, control: Any settable Protocol: 8/16 bit selectable and any settable FCS: 16/32 bit selectable and auto calculate Information: IPv4/IPv6 selectable and any settable
IPv4 setting (RFC791)	Any setting: Version, IHL, TOS, total length, ID, flags, flagment offset, TTL, protocol, address (source, destination) Header checksum: Auto calculate Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 byte)
IPv6 setting (RFC1883)	Any setting: Version, priority, flow label, payload length, next header, hop limit, address (source, destination) Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 byte)
Packet transmission setting	1 to 3 in IP/PPP (independently), IP/PPP sending pattern, packet sending interval (max. 100000 bytes), single/repeat, sending on/off, scramble (X^{43} + 1) on/off, control escape auto insertion, FCS error insertion (single), number of packet count display
Packet receiving/analysis	PPP frame calculation (count), scramble (X^{43} + 1) on/off setting, automatic analysis of control escape. Frame/capture memory (option) required data captured into the capture memory (max. 64 frames*2), IPv4/IPv6 select, IP address filter set

*1: The frame/capture memory (option) is required.
*2: Maximum 26 frames at 2488/9953 Mbits when MU150000A is inserted.

• IP-over-ATM (Option)*1

Bit rate	155.52, 622.08 Mbit/s
AAL5 edit pattern	IPv4/IPv6 selectable
IPv4 setting (RFC791)	Any setting: Version, IHL, TOS, total length, ID, flags, flagment offset, TTL, protocol, address (source, destination) Header checksum: Auto calculate Data byte: All 0, all 1, 8 bit program, single PRBS 7, user program (max. 65535 bytes)
IPv6 setting (RFC1883)	Any setting: Version, priority, flow label, payload length, next header, hop limit, address (source, destination) Data byte: All 0, all 1, 8 bits program, single PRBS 7, user program (max. 65535 bytes)
Packet sending	Follow with AAL5 distribution setting
Packet receiving/analysis	Displays the IP packet from the data captured into cell capture memory (maximum 2016 cells), IPv4/IPv6 selectable

*1: MP0123A ATM Unit is required.

• General

Printer	Internal, external
Internal memory	Measurement settings memory: 10, Graphics memory: 15
Others	FDD, RS-232C (Option 01)*1, GPIB (Option 02)*1, Ethernet (Option 03)*1, video output (Option 04)*1, buzzer, clock, help, screen copy
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, 10 kg approx. (excluding plug-in units and options)
Power	100 to 240 Vac, 47.5 to 63 Hz, ≤500 VA
Temperature	0˚ to +40˚C

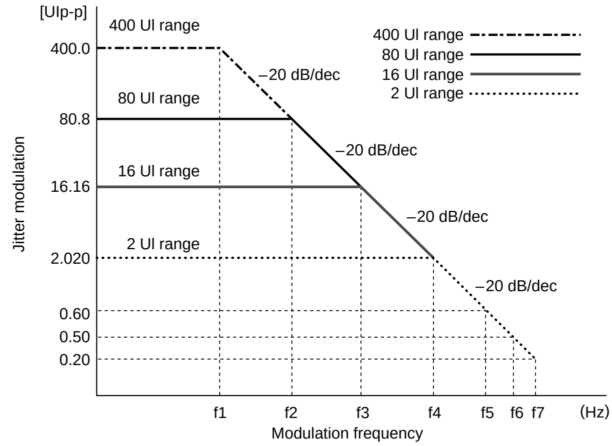
*1: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously.
Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

• **MU150005A/150006A/150007A Jitter Units**

Bit rate	MU150005A: 2.048, 8.448, 34.368, 139.264, 155.52, 622.08 Mbit/s MU150006A: 1.544, 44.736, 51.84, 155.52, 622.08 Mbit/s MU150007A: 1.544, 2.048, 8.448, 34.368, 44.736, 139.264, 51.84, 155.52, 622.08 Mbit/s

Jitter generation

Conform to ITU-T O.171/O.172
Modulation frequency: 0.1 Hz to 6 MHz
Amplitude: 0 to 404.0 UIp-p
Resolution:0.001 UIp-p (2 UI range), 0.01 UIp-p (16 UI range), 0.1 UIp-p (80 UI range), 0.2 UIp-p (400 UI range)



Bit rate (Mbit/s)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (kHz)	f6 (kHz)	f7 (kHz)
1.544	130	630	3.2	25	—	100	—
2.048	300	1.5k	7.5	60	—	240	—
8.448	1.1k	5.5k	28	220	—	880	—
34.368	2.5k	13k	63	500	—	—	5000
44.736	2.5k	13k	63	500	—	—	5000
139.264	9k	45k	230	1800	6000	—	—
51.84	2.5k	13k	63	500	—	—	5000
155.52	7.5k	38k	190	1500	—	6000	—
622.08	3k	15k	75	600	—	—	6000

Accuracy
2 UI range: (±Q% of setting) ±0.02 UIp-p, 16 UI range: (±Q% of setting) ±0.2 UIp-p, 80 UI range: (±Q% of setting) ±1.2 UIp-p, 400 UI range: (±Q% of setting) ±6 UIp-p

Bit rate (Mbit/s)	Error Q	Frequency range
1.544	±12%	0.1 to 2 Hz
	±8%	2 Hz to 100 kHz
2.048	±12%	0.1 to 10 Hz
	±8%	10 Hz to 240 kHz
8.448	±12%	0.1 to 20 Hz
	±8%	20 Hz to 880 kHz
34.368	±12%	0.1 to 100 Hz
	±8%	0.1 to 500 kHz
	±12%	500 kHz to 5 MHz
44.736	±12%	0.1 to 2 Hz
	±8%	2 Hz to 5 MHz
139.264	±12%	0.1 to 100 Hz
	±8%	0.1 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 6 MHz
51.84	±12%	0.1 to 300 Hz
	±8%	300 Hz to 5 MHz
155.52	±12%	0.1 to 500 Hz
	±8%	0.5 to 500 kHz
	±12%	0.5 to 6 MHz
622.08	±12%	0.1 Hz to 1 kHz
	±8%	1 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 6 MHz

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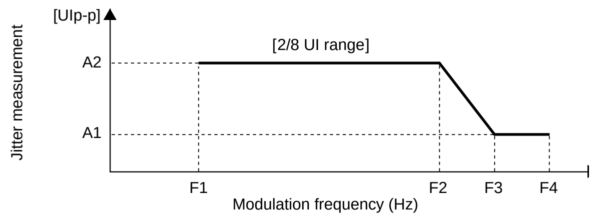
Frequency offset	Range: ±999.9 ppm/0.1 ppm steps (jitter off), ±100 ppm/0.1 ppm steps (jitter on/off) Accuracy: ±0.1 ppm after power-on, calibrates after 60 min warm-up, 23˚ ±5˚C
Auxiliary interface	External modulation input, External 5/10 MHz reference input, Jitter clock/Jitter reference output, Wander reference output

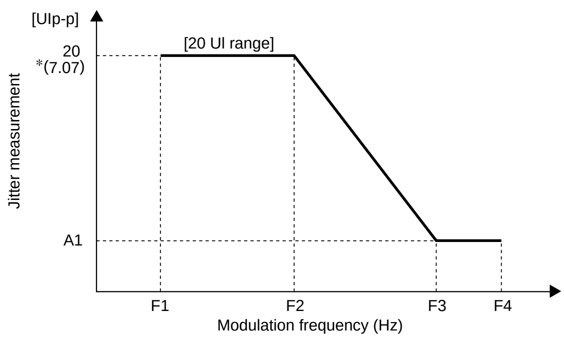
Jitter measurement

Conform to ITU-T O.171/O.172
Modulation frequency: 0.1 Hz to 5 MHz
Amplitude: 0.0 to 400 UI (800 UI: at 622M)
Resolution:
0.001 UIp-p/0.001 UIrms (2 UI range), 0.01 UIp-p/0.01 UIrms (8 UI/20 UI range), 0.2 UIp-p (400 UI range), 0.5 UIp-p (800 UI range)



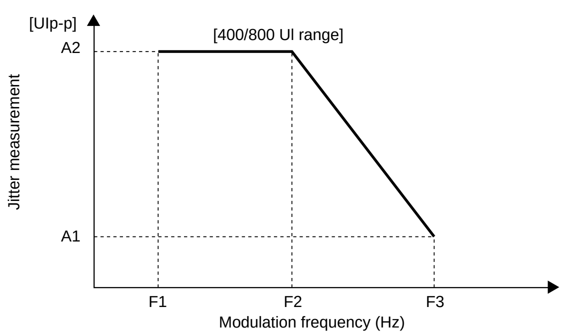
Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)		F1* (Hz)		F2 (Hz)		F3 (Hz)	F4 (Hz)
	—	Full	Wide	Full	Wide	Full	Wide	—	—
1.544	0.5	8	2	0.1	10	1.25k	5k	20k	40k
2.048	0.5	8	2	0.1	10	3.75k	15k	60k	100k
8.448	0.5	—	2	—	10	—	50k	200k	400k
34.368	0.5	8	2	0.1	10	18.75k	75k	300k	800k
44.736	0.5	8	2	0.1	10	25k	100k	400k	400k
139.264	0.5	8	2	0.1	10	50k	200k	800k	3.5M
51.84	0.5	8	2	1	10	25k	100k	400k	400k
155.52	0.4	8	2	1	10	25k	100k	500k	1.3M
622.08	0.3	8	2	1	10	75k	300k	2M	5M

*F1 = 100 Hz at RMS



Bit rate (Mbit/s)	A1 (UIp-p)	F1* (Hz)		F2 (Hz)	F3 (Hz)	F4 (Hz)
	—	Full	Wide	—	—	—
1.544	0.67	0.1	1	600	15k	15k
2.048	1.67	0.1	1	1.5k	18k	18k
8.448	1.43	0.1	1	5k	70k	70k
34.368	0.5	0.1	1	8k	300k	300k
44.736	0.5	0.1	1	10k	400k	400k
139.264	0.5	0.1	1	20k	800k	1.2M
51.84	0.5	1	1	10k	400k	400k
155.52	0.4	1	1	10k	500k	1.3M
622.08	0.3	1	1	30k	2M	5M

*F1 = 100 Hz at RMS



Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)	F1** (Hz)	F2 (Hz)	F3 (Hz)
1.544	20	400	0.1	10	200
2.048	20	400	0.1	10	200
8.448	20	400	0.1	10	200
34.368	20	400	0.1	10	200
44.736	20	400	0.1	10	200
139.264	20	400	0.1	10	200
51.84	20	400	0.1	10	200
155.52	4	400	0.1	10	1k
622.08	4	800	0.1	10	2k

**: Full band only

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Jitter measurement

Filter:
Conform to O.171/O.172, LP, HP0 + LP, HP1 + LP, HP2 + LP, HP + LP, user

Bit rate (Mbit/s)	HP0 (Hz)	HP1 (Hz)	HP2 (Hz)	HP2' (Hz)	HP (Hz)	LP (Hz)
1.544	10	10	8k	—	12k	40k
2.048	10	20	18k	700	12k	100k
8.448	10	20	3k	80k	12k	400k
34.368	10	100	10k	—	12k	800k
44.736	10	10	30k	—	12k	400k
139.264	10	200	10k	—	12k	3.5M
51.84	10	100	20k	—	12k	400k
155.52	10	500	65k	—	12k	1.3M
622.08	10	1k	250k	—	12k	5M

Accuracy (UIp-p, UI+p, UI-p)
2 UI range: ±R% of reading ±W UIp-p, 20 UI range: ±R% of reading ±W UIp-p, 400 UI range: ±R% of reading ±W UIp-p, 800 UI range: ±R% of reading ±W UIp-p

Fixed error [W]
UIp-p

Bit rate (Mbit/s)	Pseudo-random signal							
	HP1 + LP				HP2 + LP			Bit length
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI	
1.544	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{20} - 1$
2.048	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{15} - 1$
8.448	0.040	—	0.22	3.5	0.025	—	0.15	$2^{15} - 1$
34.368	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{23} - 1$
44.736	0.040	0.08	0.22	3.5	0.025	0.05	0.15	$2^{15} - 1$
139.264	0.040	0.08	0.30	5.0	0.025	0.05	0.15	$2^{23} - 1$

Bit rate (Mbit/s)	Clock signal						
	HP1 + LP				HP2 + LP		
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI
1.544	0.015	0.03	0.10	1.6	0.010	0.02	0.08
2.048	0.015	0.03	0.10	1.6	0.010	0.02	0.08
8.448	0.015	—	0.10	1.6	0.010	—	0.08
34.368	0.030	0.06	0.18	2.8	0.020	0.04	0.15
44.736	0.030	0.06	0.18	2.8	0.020	0.04	0.15
139.264	0.030	0.06	0.22	3.8	0.020	0.04	0.20

Bit rate (Mbit/s)	SONET/SDH signal							
	HP1 + LP				HP2 + LP			Container
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI	
51.84e	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC3
51.84o	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC3
155.52e	0.070	0.14	0.30	5.0	0.025	0.05	0.20	VC4
155.52o	0.070	0.14	0.30	5.0	0.050	0.10	0.20	VC4
622.08	0.100	0.20	0.30	10.0	0.050	0.10	0.20	VC4-4c

At PRBS $2^{23} - 1$

Bit rate (Mbit/s)	Clock signal						
	HP1 + LP				HP2 + LP		
	2 UI	8 UI	20 UI	400/800 UI	2 UI	8 UI	20 UI
51.84e	0.050	0.10	0.22	3.8	0.030	0.06	0.20
155.52e	0.050	0.10	0.22	3.8	0.030	0.06	0.20
622.08	0.050	0.10	0.22	5.0	0.030	0.06	0.20

Frequency error [R]

Frequency error	Frequency range
±10%	0.1 to 20 Hz
±7%	20 Hz to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 5 MHz

Continued on next page

Jitter measurement

UIrms
2 UI range: ±R% ±Y UIrms, 20 UI range: ±R% ±Y UIrms

Fixed error [Y]
UIrms

Bit rate (Mbit/s)	Pseudo-random signal			
	HP + LP			Bit length
	2 UI	8 UI	20 UI	
1.544	0.006	0.02	0.04	$2^{20} – 1$
2.048	0.006	0.02	0.04	$2^{15} – 1$
8.448	0.006	—	0.04	$2^{15} – 1$
34.368	0.008	0.02	0.05	$2^{23} – 1$
44.736	0.008	0.02	0.05	$2^{15} – 1$
139.264	0.008	0.02	0.05	$2^{23} – 1$

Bit rate (Mbit/s)	Clock signal		
	HP + LP		
	2 UI	8 UI	20 UI
1.544	0.004	0.02	0.03
2.048	0.004	0.02	0.03
8.448	0.004	—	0.03
34.368	0.006	0.02	0.04
44.736	0.006	0.02	0.04
139.264	0.006	0.02	0.04

Bit rate (Mbit/s)	SONET/SDH signal			
	HP + LP			Container
	2 UI	8 UI	20 UI	
51.84e	0.010	0.02	0.06	VC3
51.84o	0.010	0.02	0.06	VC3
155.52e	0.010	0.02	0.06	VC4
155.52o	0.010	0.02	0.06	VC4
622.08	0.012	0.03	0.08	VC4-4c

At PRBS $2^{23} – 1$

Bit rate (Mbit/s)	Clock signal		
	HP + LP		
	2 UI	8 UI	20 UI
51.84e	0.008	0.02	0.05
155.52e	0.008	0.02	0.05
622.08	0.010	0.02	0.06

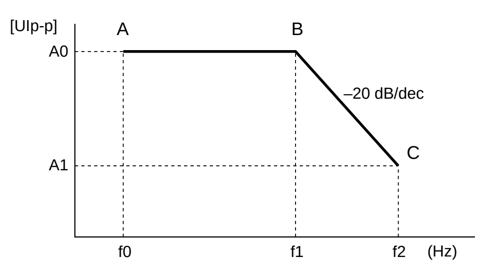
Frequency error [R]

Frequency error	Frequency range
±10%	0.1 to 20 Hz
±7%	20 Hz to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 5 MHz

Hit measurement	Count, seconds, % free Seconds
Frequency measurement	Resolution: 0.1 ppm, Display: Hz or ppm (After power-on, calibrates after 60 min warm-up, 23˚ ±5˚C)
Auxiliary interface	Demodulation output, Clock/Reference input
Jitter auto measurement	Jitter tolerance measurement: Evaluates jitter tolerance point automatically Jitter sweep measurement: Conforms to high-speed jitter tolerance evaluation for mass production, etc. Jitter transfer measurement: High dynamic range measurement by selective level method (variable) Jitter frequency measurement: Measures the mapping jitter automatically Frequency sweep measurement: Measures the jitter tolerance automatically while changing the offset

Line wander generation

Modulation frequency: 10 µHz to 10 Hz (sine wave)
Amplitude: 0 to 400,000 UI (10 UIp-p steps)



Bit rate (Mbit/s)	f0 (µHz)	f1 (mHz)	f2 (Hz)	A0 (UIp-p)	A1 (UIp-p)
1.544	10	20	10	400,000	800
2.048	10	20	10	400,000	800
8.448	10	200	10	400,000	8,000
34.368	10	400	10	400,000	16,000
44.736	10	400	10	400,000	16,000
139.264	10	2,000	10	400,000	80,000
51.84	10	400	10	400,000	16,000
155.52	10	2,000	10	400,000	80,000
622.08	10	400	10	400,000	16,000

Accuracy: ±Q% of setting ±100 UIp-p

Error Q	Frequency range
±8%	10 µHz to 0.125 Hz
±12%	0.125 Hz to 1 Hz
±15%	1 to 10 Hz

Wander auto measurement	Automatically evaluates the wander of the sine wave by the wander sweep measurement

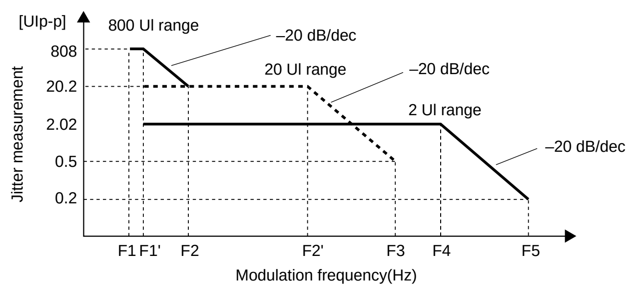
Continued on next page

Reference wander generation (Option 03)	Off: Able to set non-modulated status TDEV mask: The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default. It is possible to add the wander modulation on the user specified TDEV mask. Transient: It is possible to change the A $(1 - e^{-63.7t})$ phase by the timing of the start. Signal off: It is possible to disconnect the standard signal.
Wander measurement (Option 02)	Conform to ITU-T O.172 Reference input: 2.048M (HDB3, Clock), 1.544M (AMI/B8ZS, Clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 40 Hz, 1 Hz, 0.1 Hz, 5 mHz (select by MX150001B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Accuracy: Conform to ITU-T O.172 Measurement time: 10 to 1 x 10^8 s (max. 120, 000 s; MP1570A only) Wander application (requires MX150001B Wander Application Software) TIE: Max. 1 x 10^8 s, MTIE: Max. 1 x 10^8 s, TDEV: Max. 1 x 10^6 s Frequency offset: Measurement conforms to ANSI TI.105.09 Frequency drift rate: Measurement conforms to ANSI TI.105.09 MRTIE: The evaluation separated from the wander by a frequency offset Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations Wander transfer (TDEV) measurement: Calibration method by simulation,outputting results by the one measurement

• MU150011A 2.5G Jitter Unit

Jitter generation

Conforms to ITU-T O.172
Frequency: 2488.32 MHz
Modulation frequency: 0.1 Hz to 20 MHz
Amplitude: 0 to 808.0 UIp-p
Resolution: 0.001 UIp-p (2 UI range), 0.01 UIp-p (20 UI range), 0.4 UIp-p (800 UI range)



Bit rate (Mbit/s)	F1 (Hz)	F1' (Hz)	F2* (kHz)	F2'* (kHz)	F3* (MHz)	F4* (MHz)	F5* (MHz)
2488.32	0.1	60	2.5	30	1.2	2	20

*Typical value

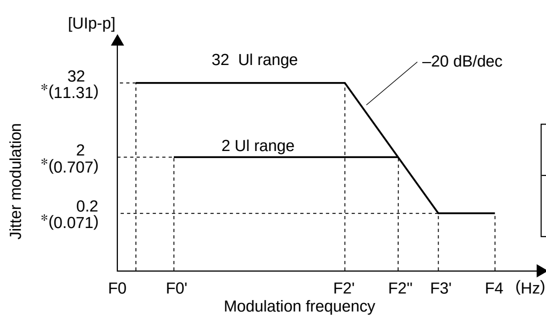
Accuracy
2 UI range: (±Q% of setting) ±0.02 UIp-p, 20 UI range: (±Q% of setting) ±0.3 UIp-p, 800 UI range: (±Q% of setting) ±12.5 UIp-p

Bit rate (Mbit/s)	Error Q	Frequency range
2488.32	±12%	0.1 Hz to 5 kHz
	±8%	5 to 500 kHz
	±12%	0.5 to 2 MHz
	±15%	2 to 20 MHz

Frequency offset	Range: ±100 ppm/0.1 ppm steps (jitter on/off) Accuracy: ±0.1 ppm (after power-on, calibrate after 60 min warm-up, 23˚±5 ˚C)
Auxiliary interface	External clock input, Jitter reference output

Jitter measurement

Conforms to ITU-T O.172
Frequency: 2488.32 MHz ±100 ppm
Modulation frequency: 10 Hz to 20 MHz
Amplitude: 0.0 to 32 UI
Resolution: 0.001 UIp-p/0.001 UIrms (2 UI range), 0.01 UIp-p/0.01 UIrms (32 UI range)



Bit rate (Mbit/s)		F0 (Hz)	F0' (Hz)	F2' (kHz)	F2" (kHz)	F3' (MHz)	F4 (MHz)
2488.32	2 UI	–	100	–	100	1	20
	32 UI	10	–	6.25	–	1	20

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Jitter measurement

Conforms to ITU-T O.172
LP, HP0 + LP, HP1 + LP, HP2 + LP, HP + LP

Bit rate (Mbit/s)	HP0 (Hz)	HP1 (Hz)	HP2 (Hz)	HP (Hz)	LP (Hz)
2488.32	10	5k	1M	12k	20M

Accuracy (UIp-p, UI+p, UI–p)
2 UI range: Measurement value ±R% ±W UIp-p, 32 UI range: Measurement value ±R% ±W UIp-p
[MU150008A/150009A/150010A are simultaneously installed, conform to ITU-T O.172]

Fixed error [W]
Input level: –12 to –10 dBm (adds to 0.01 UIp-p/dB at <–12 dBm)

Bit rate (Mbit/s)	SONET/SDH signal				
	HP1 + LP		HP2 + LP		Container
	2 UI	32 UI	2 UI	32 UI	
2488.32	0.100	2.2	0.050	1.40	VC4-16c

At PRBS $2^{23} - 1$

Bit rate (Mbit/s)	Clock signal			
	HP1 + LP		HP2 + LP	
	2 UI	32 UI	2 UI	32 UI
2488.32	0.050	0.60	0.030	0.50

Accuracy (UIrms)
2 UI range: ±R% ±Y UIrms, 32 UI range: ±R% ±Y UIrms

Fixed error [Y]
Input level: –12 to –10 dBm (adds to 0.002 UIrms/dB at <–12 dBm)

Bit rate (Mbit/s)	SONET/SDH signal			Clock signal	
	HP + LP		Container	HP + LP	
	2 UI	32 UI		2 UI	32 UI
2488.32	0.012	0.08	VC4-16c	0.010	0.16

At PRBS $2^{23} - 1$

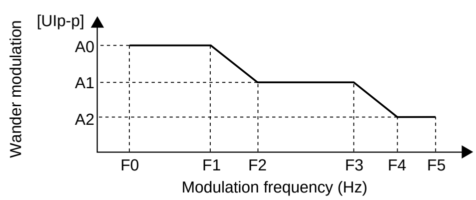
Frequency error [R]

Frequency error	Frequency range
±7%	5 to 300 kHz
±8%	300 kHz to 1 MHz
±10%	1 to 3 MHz
±15%	3 to 10 MHz
±20%	10 to 20 MHz

Hit measurement	Count, Seconds, % free seconds
Frequency measurement	Resolution: 0.1 ppm, Display: Hz or ppm (after power-on, calibrates after 60 min warm-up, 23˚ ±5˚C)
Auxiliary interface	Reference clock input
Auto jitter measurement	Jitter tolerance measurement: Evaluates jitter tolerance point automatically Jitter sweep measurement: Conforms to high-speed jitter tolerance evaluation for mass production, etc. Jitter transfer measurement: High dynamic range measurement by selective level method Frequency sweep measurement: Measures the jitter tolerance automatically while changing the offset

Line wander generation

Modulation frequency: 10 µHz to 0.2 Hz (sine wave)
Amplitude: 0 to 57,600 UIp-p (30 UIp-p steps)



Bit rate (Mbit/s)	Amplitude (UIp-p)			Frequency (Hz)					
	A0	A1	A2	f0	f1	f2	f3	f4	f5
2488.32	57600	6480	810	10µ	180µ	1.6m	16m	0.13	0.2

Accuracy: ±Q% ±160 UIp-p

Frequency error	Frequency range
±8%	10 µHz to 0.1 Hz
±12%	0.1 to 0.2 Hz

Auto wander measurement	Wander sweep measurement
Reference wander generation	Reference wander generation is valid when MU150005A/150006A/150007A Option 03 is mounted. Off: Able to set non-modulated status TDEV mask: The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default. It is possible to add the wander modulation to the user specified TDEV mask. Transient: It is possible to change the A $(1 - e^{-63.7t})$ phase by the timing of the start. Signal off: It is possible to disconnect the standard signal.

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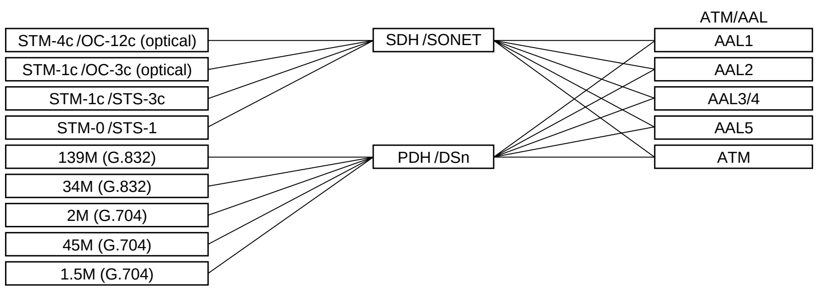
Wander measurement	Wander measurement is valid when MU150005A/150006A/150007A Option 02 is mounted. Conforms to ITU-T O.172 Reference input: 2.048M (HDB3, clock), 1.544M (AMI/B8ZS, clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 320 Hz, 40 Hz, 1 Hz, 0.1 Hz, 5 mHz (select from MX150001B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Accuracy: Conform to ITU-T O.172 Measurement time: 10 to 1 x 10^8 s (Max. 120,000 s: MP1570A only) Wander application (requires MX150001B Wander Application Software) TIE: Max. 1 x 10^8 s MTIE: Max. 1 x 10^8 s TDEV: Max. 1 x 10^6 s Frequency offset: Measurement with conform to ANSI TI.105.09 Frequency drift rate: Measurement with conform to ANSI TI.105.09 MRTIE: Evaluation separated from the wander by the frequency variation Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations Wander transfer (TDEV) measurement: Calibration method by simulation, outputting results by the one measurement

• MP0123A ATM Unit

Bit rate	1.544, 2.048, 34.368, 44.736, 139.264, 51.84, 155.52, 622.08 Mbit/s
Mapping	
Traffic pattern	CBR, burst, sawtooth, CBR/PCR with CDV, Poisson
Test patterns	Cell: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern, time stamp O.191: Edit pattern AAL1: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern, time stamp AAL2 (CPS-PDU): Time stamp AAL2 (CPS-PACKET): Single cell PRBS 7, 8-bit word pattern, edit pattern AAL3/4 (SAR-PDU): Time stamp AAL3/4 (CPCS-PDU): Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern AAL5: Single cell PRBS 9, cross cell PRBS 9/15/23, 16-bit word pattern, edit pattern
Error addition	Cell: HEC, programmable pattern O.191: Lost cell, misinserted cell, errored cell, SECB AAL1: Lost cell, SNP, PRBS, word AAL2 (CPS-PDU): P, SN, OSF AAL2 (CPS-PACKET): HEC, PRBS, word AAL3/4 (SAR-PDU): SN, CRC10, segment type, LI, abort AAL3/4 (CPCS-PDU): CPI, B/E tag mismatch, BA size, AL, length, PRBS, word AAL5: Frame size, length, CRC32, abort, PRBS, word
Alarm addition	LCD, VP/VC AIS, VP/VC RDI, VP/VC CC, VP/VC loopback cell
PM cell	Error insertion: Lost cell, misinserted cell, BIPV, SECB
Cell editing	O.191, AAL1, AAL2, AAL3/4, AAL5, AIS, RDI, CC, loopback, FM, BR, background (10 ch)
Memorized cell	Possible to send after editing receiver's capture data
Measurement	Mode: Single, repeat, manual Error Cell: Cell count, correctable HEC, uncorrectable HEC, non-conforming cell O.191: Errored cell, lost cell, misinserted cell, SECB AAL1: SAR-PDU count, lost cell, SNP, uncorrectable SNP, PRBS, word AAL2: CPS-PDU count, P, OSF, SN, CPS packet count, CID count, HEC, PRBS, word AAL3/4*: SAR-PDU count, CRC10, MID count (SAR-PDU with selected MID value), SN, ST (segment type), LI, abort, discarded PDU (one of SN error, LI error, abort, COM with ST error, or EOM with ST error), CPCS-PDU count, CPI, B/E tag mismatch, BA size, AL, length, undeliverded PDU (one of CPI error, B/E tag mismatch, BA size error, AL error, or length error), PRBS, word *CRC10 is calculated for all SAR-PDU. The others are calculated for SAR-PDU with specified MID. AAL5: CPCS-PDU count, frame size, length, CRC32, abort, discarded PDU (one of frame size error, length error, CRC32 error, or abort), PRBS, word FM: Lost cell, misinserted cell, BIPV, SECB BR: Lost cell, misinserted cell, BIPV, SECB Alarm: LCD, VP/VC segment AIS, VP/VC end-to-end AIS, VP/VC segment RDI, VP/VC end-to-end RDI, VP/VC segment LOC, VP/VC end-to-end LOC
LED	LCD, VP-AIS, VP-RDI, VP-LOC, VC-AIS, VC-RDI, VC-LOC, errors
Monitor	Live monitor (1023 channel monitor), traffic monitor, cell monitor
Delay measurement	1-point CDV, 2-point CDV
Capture	1 to 2016 cells

• MP0131A Add/Drop Unit

Bit rate	1.544, 2.048, 34.368, 44.736, 139.264 Mbit/s
Level/waveform	1.544 Mbit/s: ANSI T1.102, 0/655 ft 44.736 Mbit/s: ANSI T1.102, 0/450/900 ft (0 ft: Drop only) 2.048/34.368/139 Mbit/s: ITU-T G.703
Connector	BANTAM (100 Ω, balanced): 1.544 Mbit/s (AMI/B8ZS) 3-pin Siemens (120 Ω, balanced): 2.048 Mbit/s (HDB3) BNC (75 Ω, unbalanced): 2.048 Mbit/s, 34.368 Mbit/s (HDB3), 139.264 Mbit/s (CMI)
Mapping	See Fig. 3 and 4

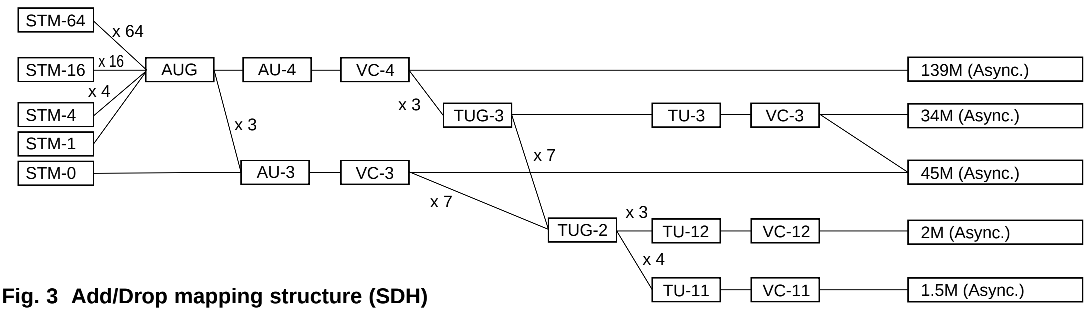


Fig. 3 Add/Drop mapping structure (SDH)

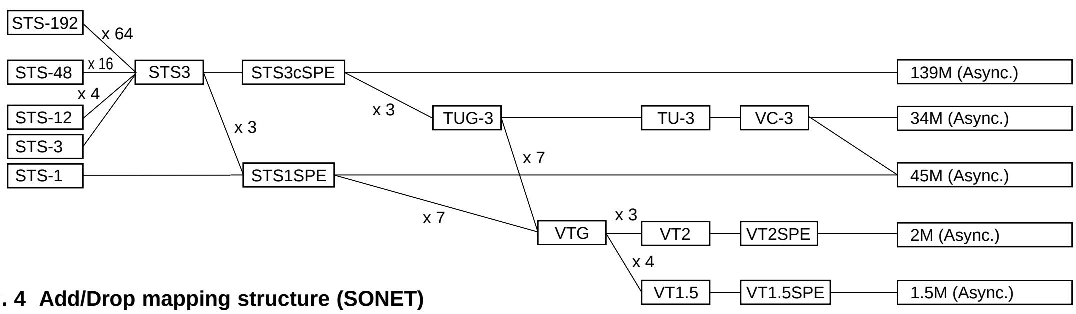


Fig. 4 Add/Drop mapping structure (SONET)

• MP0111A Optical 156M/622M (1.31) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1310 nm Output level: –11.5 dBm ±3.5 dB Optical safety: IEC 825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0112A Optical 156M/622M (1.55) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1550 nm Output level: –5 dBm ±2 dB Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0113A Optical 156M/622M (1.31/1.55) Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Wavelength: 1310/1550 nm Output level 1.31 µm: –11.5 dBm ±3.5 dB, 1.55 µm: –5 dBm ±2 dB Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 155.52, 622.08 Mbit/s (NRZ) Sensitivity 156M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) 622M: –28 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm)

• MP0105A CMI Unit

Transmit	Bit rate: 155.52 Mbit/s, Level: 1 ±0.1 V, Connector: BNC (75 Ω)
Receive	Bit rate: 155.52 Mbit/s Level: 1 ±0.1 V (0 to 12 dB, with $\sqrt{f}$ auto correction and monitor function) Connector: BNC (75 Ω)

• MP0108A NRZ Unit

Transmit	Bit rate: 155.52, 622.08 Mbit/s Level: ECL Connector (data, clock): SMA (50 Ω)
Receive	Bit rate: 155.52, 622.08 Mbit/s Level: ECL (–2 V) Connector (data, clock): SMA (50 Ω)

• MP0122B 1.5/45/52/52 (1.31) Unit

Optical interface

Transmit	Bit rate: 51.84 Mbit/s (NRZ) Wavelength: 1310 nm Output level: –11.5 dBm ±3.5 dB Optical safety: IEC 825-1 Class 1, 21CFR1040.10 Class I Connector: FC-PC (SMF)
Receive	Bit rate: 51.84 Mbit/s (NRZ) Sensitivity 52M: –33 to –8 dBm (test pattern: PRBS 2^{23} – 1, BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Measurement range: –30 to 0 dBm (peak power) Accuracy: ≤±1 dB (–20 dBm) Linearity: ≤±1 dB (–30 to 0 dBm) Monitor input Level: 0.1 to 1.0 Vp-p (AC), Connector: SMA (50 Ω)

• MU150008A/150009A/150010A 2.5G Unit

Bit rate	2488.32 Mbit/s (NRZ)
Optical output	Wavelength: 1310 nm (MU150008A), 1550 nm (MU150009A), 1310/1550 nm (MU150010A) Output level: –4 dBm ±3 dB Optical safety: IEC825-1 Class 3A, 21CFR1040.10 Class IIIb Connector: FC-PC (SMF)
Optical input	Sensitivity Narrow: –28 to –9 dBm (BER 10^{-10}, +10˚ to +30˚C), –27 to –9 dBm (BER 10^{-10}, 0˚ to +30˚C) Wide: –20 to –9 dBm (BER 10^{-10}, +10˚ to +40˚C) Connector: FC-PC (SMF) Power measurement Range: –30 to –9 dBm (peak power) Accuracy: ≤±2 dB (–20 dBm) Linearity: ≤±2 dB (–30 to –9 dBm)
Electrical I/O	Transmit (NRZ) Level: ECL (–2 V), Connector (data, clock): SMA (50 Ω) Receive (NRZ) Level: ECL (–2 V), Connector (data, clock): SMA (50 Ω) Monitor input Level: 0.1 to 1.0 Vp-p (AC), Connector (data): SMA (50 Ω)
Auxiliary interface	External clock input, receive clock output, sync. output

• MU150000A 2.5G/10G Unit

Bit rate	9953.28, 2488.32 Mbit/s (NRZ)
Electrical I/O	Transmit (NRZ) Level Data H: 0 to –0.2 V, Data L: –0.85 to –1.4 V Clock H: 0 to –0.2 V, Clock L: –0.85 to –1.3 V Connector (data, clock): SMA (50 Ω) Receive (NRZ) Level Data: 0.65 to 1.4 Vp-p, Clock: 0.65 to 1.3 Vp-p Connector (data, clock): SMA (50 Ω)
Auxiliary interface	External clock input, internal clock output, receive clock output,156M sync. output

• MU150001A/B Optical 10G Tx (1.55) Unit

Bit rate	9953.28, 2488.32 Mbit/s (Option)
Optical output	Wavelength: 10G: 1550 nm band 2.5G: 1310 nm band (Option 01), 1550 nm band (Option 02), 1310/1550 nm band (Option 03) Output level: –4 dBm ±3 dB Optical safety: IEC825-1 Class 3A, 21CFR1040.10 Class IIIb Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA 50 Ω

• MU150002A Optical 10G Rx (Narrow) Unit

Bit rate	9953.28, 2488.32 Mbit/s (Option 01)
Optical input	Sensitivity 10G: –13 to –3 dBm (BER 10^{-12}, NRZ, mark ratio: 1/2, PRBS: 2^{31} – 1) 2.5G: –29 to –10 dBm (BER 10^{-11}, NRZ, mark ratio: 1/2, PRBS: 2^{23} – 1) (Option 01) Connector: FC-PC (SMF) Power measurement Range:–16 to 0 dBm (10G, average power), –30 to –10 dBm (2.5G, average power) Accuracy: ≤±2 dB (10G, –10 dBm), ≤±2 dB (2.5G, –20 dBm) Linearity: ≤±2 dB (10G, –16 to 0 dBm), ≤±2 dB (2.5G, –30 to –10 dBm)
Electrical output	Data output: 0.65 to 1.4 Vp-p Clock output: 0.65 to 1.3 Vp-p Connector: SMA 50 Ω

• MU150031A/C Optical 10G Tx (1.55) High Power Unit

Bit rate	MU150031A: 9953.28 Mbit/s MU150031C: 9953.28 Mbit/s, 2488.32 Mbit/s
Optical output	Wavelength: 1525 to 1565 nm Output level: +2 dBm ±2 dB Optical Safety: IEC825-1 (Class 3A), 21CFR1040.10 (Class IIIb) Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA (50 Ω)

• MU150061A/B Optical 10G Tx (1.31) Unit

Bit rate	MU150061A: 9953.28 Mbit/s MU150061B: 9953.28 Mbit/s, 2488.32 Mbit/s
Optical output	Wavelength: 1290 to 1330 nm Output level: +3 dBm ±2 dB Optical Safety: IEC825-1 (Class 3A), 21CFR1040.10 (Class IIIb) Connector: FC-PC (SMF)
Electrical input	Data input H: 0 to –0.2 V, L: –0.85 to –1.4 V Clock input H: 0 to –0.2 V, L: –0.85 to –1.3 V Connector: SMA (50 Ω)

• MU150017A/B Optical 10G Rx (Wide) Unit

Bit rate	MU150017A: 9953.28 Mbit/s ±100 ppm MU150017B: 9953.28 Mbit/s ±100 ppm, 2488.32 Mbit/s ±100 ppm
Optical output	Wavelength 10G: 1550 nm band, 2.5G: 1310/1550 nm band (MU150017B) Sensitivity: –11 to –3 dBm (10G BER10^{-12}, NRZ, VC4-64c, scramble: on, mark ratio: 1/2, PRBS 2^{23} – 1 –15 to –3 dBm (2.5G BER10^{-12}, NRZ, VC4-16c, scramble: on, mark ratio: 1/2, PRBS 2^{23} – 1 Connector: FC-SPC (SMF) Power measurement Range: –16 to –2 dBm (10G, average power), –36 to –2 dBm (2.5G average power) Accuracy: ≤±2 dB
Electrical input	Data output: 0.7 to 1.3 Vp-p Clock output: 0.65 to 1.3 Vp-p Connector: SMA (50 Ω) Output phase: Variable output clock phase according to output data (10G only)

Unit	Slot 1	Slot 2	Slot 3	Slot 4/5	Front
MP0121A 2/8/34/139/156M Unit	√				
MP0122A 1.5/45/52M Unit	√*	√			
MP0122B 1.5/45/52/52M (1.31) Unit	√*	√			
MP0123A ATM Unit			√		
MU150005A 2/8/34/139M, 156/622M Jitter Unit				√	
MU150006A 1.5/45/52M, 156/622M Jitter Unit				√	
MU150007A 2/8/34/139M, 1.5/45/52M, 156M/622M Jitter Unit				√	
MP0111A Optical 156/622M (1.31) Unit					√
MP0112A Optical 156/622M (1.55) Unit					√
MP0113A Optical 156/622M (1.31/1.55) Unit					√
MU150008A 2.5G (1.31) Unit		√			
MU150009A 2.5G (1.55) Unit		√			
MU150010A 2.5G (1.31/1.55) Unit		√			
MU150011A 2.5G Jitter Unit			√		
MP0131A Add/Drop Unit	√	√			
MU150000A 2.5G/10G Unit				√	
MU150001A/B Optical 10G Tx (1.55) Unit			√		
MU150002A Optical 10G Rx (Narrow) Unit		√			
MP0105A CMI Unit					√
MP0108A NRZ Unit					√
MU150031A/C Optical 10G Tx (1.55) High Power Unit			√		
MU150061A/B Optical 10G Tx (1.31) Unit			√		
MU150017A/B Optical 10G Rx (Wide) Unit		√			

Note: The same model name units can not be used simultaneously with inserted them in to the plural slots. Only one unit is usable at a time.

*: MP0122A/B can not insert in to slot 1 when MP0123A is inserted in to Slot 3

Ordering information

Please specify model/order number name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1570A*1	SONET/SDH/PDH/ATM Analyzer	
	Standard accessories	
	AC power cord:	1 pc
Z0169	Printer paper (5 rolls/pack):	1 pack
F0079	Fuse, 10 A:	2 pcs
B0329G	Front cover:	1 pc
Z0486	Side cover:	1 pc
J0907Q	Remote interlock cord (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
J0908	Remote interlock terminator (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
E0008A	Optical output control key (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	2 pcs
J0747A	Fixed optical attenuator (5 dB, for MU150017A/B):	1 pc
J0747B	Fixed optical attenuator (10 dB, for MU150002A):	1 pc
J0900A	Coaxial cable (AA-165-200), 20 cm (for MU150011A):	2 pcs
J0635A	Optical fiber cable (FC · PC-FC · PC), 1 m (for MU150002A, MU150008A, MU150009A, MU150010A, MU150017A/B):	1 pc
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02, MU150006A-02, MU150007A-02):	1 pc
W1719AE	MP1570A operation manual (Vol. 1 Basic operation for SDH):	1 copy
W1720AE	MP1570A operation manual (Vol. 1 Basic operation for SONET):	1 copy
W1721AE	MP1570A operation manual (Vol. 2 Remote control):	1 copy
W1722AE	MP1570A operation manual (Vol. 3 ATM measurement):	1 copy
W1723AE	MP1570A operation manual (Vol. 4 2.5G/10G measurement):	1 copy
W1724AE	MP1570A operation manual (Vol. 5 Add/Drop function):	1 copy
W1725AE	MP1570A operation manual (Vol. 6 Jitter/wander measurement, for MU150005A/150006A/150007A):	1 copy
W1726AE	MP1570A operation manual (Vol. 7 2.5G jitter/wander measurement, for MU150011A):	1 copy
W1763AE	Wander (MTIE, TDEV) APPLI SOFT manual (supplied with MX150001B):	1 copy
J1002A	Semi-rigid cable (for MU150001A/B, MU150031A/C, MU150061A/B):	2 pcs
J1002B	Semi-rigid cable (for MU150002A, MU150017A/B):	2 pcs
J1002C	Semi-rigid cable (for MU150000A):	3 pcs
	Plug-in units	
MP0121A	2/8/34/139/156M Unit	
MP0122A	1.5/45/52M Unit	
MP0122B*2	1.5/45/52/52M (1.31) Unit	
MP0123A	ATM Unit	
MU150008A*2	2.5G (1.31) Unit (with optical power meter)	
MU150009A*2	2.5G (1.55) Unit (with optical power meter)	
MU150010A*2	2.5G (1.31/1.55) Unit (with optical power meter)	
MP0131A	Add/Drop Unit	
MU150000A	2.5G/10G Unit	
MU150001A*2	Optical 10G Tx (1.55) Unit (2 km transmission)	
MU150001B*2	Optical 10G Tx (1.55) Unit (40 km transmission)	
MU150002A*2	Optical 10G Rx (Narrow) Unit (with optical power meter)	
MP0111A*2	Optical 156M/622M (1.31) Unit (with optical power meter)	
MP0112A*2	Optical 156M/622M (1.55) Unit (with optical power meter)	
MP0113A*2	Optical 156M/622M (1.31/1.55) Unit (with optical power meter, 1.31/1.55 switchable)	
MU150017A	Optical 10G Rx (Wide) Unit	
MU150017B	Optical 2.5G/10G Rx (Wide) Unit	
MU150031A	Optical 10G Tx (1.55) High Power Unit	
MU150031C	Optical 2.5G/10G Tx (1.55) High Power Unit	
MU150061A	Optical 10G Tx (1.31) Unit	

Continued on next page

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Model/Order No.	Name
MU150061B	Optical 2.5G/10G Tx (1.31) Unit
MU150005A	2/8/34/139M, 156/622M Jitter Unit [jitter generation/measurement only (requires MP0121A)]
MU150006A	1.5/45/52M, 156/622M Jitter Unit [jitter generation/measurement only (requires MP0122A/B)]
MU150007A	2/8/34/139M, 1.5/45/52M, 156/622M Jitter Unit [jitter generation/measurement only (requires MP0121A or MP0122A/B)]
MU150011A	2.5G Jitter Unit [jitter generation/measurement only (requires MU150008A/150009A or MU150010A)]
MP0105A	CMI Unit
MP0108A	NRZ Unit
	Options
MP1570A-01*3	RS-232C
MP1570A-02*3	GPIB
MP1570A-03*3	Ethernet
MP1570A-04*3	VGA output
MP1570A-06	MUX/DEMUX (2/8/34/139 Mbit/s, for MP0121A)
MP1570A-07	MUX/DEMUX (1.5/45 Mbit/s, for MP0122A/B)
MP1570A-08	45M-2M MUX/DEMUX (requires MP0121A and MP0122A/B)
MP1570A-09	Japan mapping (requires MP0122A or MP0122B)
MP1570A-10*1	SDH
MP1570A-11*1	SONET
MP1570A-13	Frame memory capture (156M/622M, 64 frame)
MP1570A-14	IP-over-SONET/SDH (requires MP1570A-13)
MP1570A-15	IP-over-ATM (requires MP0123A)
MP1570A-22	K1/K2 overwrite through
MU150005A-02	Wander measurement
MU150006A-02	Wander measurement
MU150007A-02	Wander measurement
MU150005A-03	Wander reference output
MU150006A-03	Wander reference output
MU150007A-03	Wander reference output
MU150008A-01	Frame memory capture (2.5G, 64 frame)
MU150009A-01	Frame memory capture (2.5G, 64 frame)
MU150010A-01	Frame memory capture (2.5G, 64 frame)
MU150000A-01	Frame memory capture (2.5G/10G, 26 frame)
MU150001A/B-01	2.5G (1.31)
MU150001A/B-02	2.5G (1.55)
MU150001A/B-03	2.5G (1.31/1.55)
MU150002A-01	2.5G
MU150002A-04	Available for 10G (1.31)
MP0111A/0112A-37	FC connector (replaceable, 2 sets)
MP0111A/0112A-38	ST connector (replaceable, 2 sets
MP0111A/0112A-39	DIN connector (replaceable, 2 sets)
MP0111A/0112A-40	SC connector (replaceable, 2 sets)
MP0111A/0112A-43	HMS-10/A connector (replaceable, 2 sets)
MP0113A-37	FC connector (replaceable, 3 sets)
MP0113A-38	ST connector (replaceable, 3 sets)
MP0113A-39	DIN connector (replaceable, 3 sets)
MP0113A-40	SC connector (replaceable, 3 sets)
MP0113A-43	HMS-10/A connector (replaceable, 3 sets)
MP0122B-37	FC connector (replaceable, 2 sets)
MP0122B-38	ST connector (replaceable, 2 sets)
MP0122B-39	DIN connector (replaceable, 2 sets)
MP0122B-40	SC connector (replaceable, 2 sets)
MP0122B-43	HMS-10/A connector (replaceable, 2 sets)
MU150008A-37	FC connector (replaceable, 2 sets)
MU150008A-38	ST connector (replaceable, 2 sets)
MU150008A-39	DIN connector (replaceable, 2 sets)
MU150008A-40	SC connector (replaceable, 2 sets)

Model/Order No.	Name
MU150008A-43	HMS-10/A connector (replaceable, 2 sets)
MU150009A-37	FC connector (replaceable, 2 sets)
MU150009A-38	ST connector (replaceable, 2 sets)
MU150009A-39	DIN connector (replaceable, 2 sets)
MU150009A-40	SC connector (replaceable, 2 sets)
MU150009A-43	HMS-10/A connector (replaceable, 3 sets)
MU150010A-37	FC connector (replaceable, 3 sets)
MU150010A-38	ST connector (replaceable, 3 sets)
MU150010A-39	DIN connector (replaceable, 3 sets)
MU150010A-40	SC connector (replaceable, 3 sets)
MU150010A-43	HMS-10/A connector (replaceable, 3 sets)
MU150001A/B-37	FC connector (replaceable, 1 set)
MU150001A/B-38	ST connector (replaceable, 1 set)
MU150001A/B-39	DIN connector (replaceable, 1 set)
MU150001A/B-40	SC connector (replaceable, 1 set)
MU150001A/B-43	HMS-10/A connector (replaceable, 1 set)
MU150002A-37	FC connector (replaceable, 1 set)*4
MU150002A-38	ST connector (replaceable, 1 set)*4
MU150002A-39	DIN connector (replaceable, 1 set)*4
MU150002A-40	SC connector (replaceable, 1 set)*4
MU150002A-43	HMS-10/A connector (replaceable, 1 set)*4
MU150017A/B-37	FC connector (user replaceable, 1 set)
MU150017A/B-38	ST connector (user replaceable, 1 set)
MU150017A/B-39	DIN connector (user replaceable, 1 set)
MU150017A/B-40	SC connector (user replaceable, 1 set)
MU150017A/B-43	HMS-10/A connector (user replaceable, 1 set)
MU150031A/C-37	FC connector (user replaceable, 1 set)
MU150031A/C-38	ST connector (user replaceable, 1 set)
MU150031A/C-39	DIN connector (user replaceable, 1 set)
MU150031A/C-40	SC connector (user replaceable, 1 set)
MU150031A/C-43	HMS-10/A connector (user replaceable, 1 set)
MU150061A/B-37	FC connector (user replaceable, 1 set)
MU150061A/B-38	ST connector (user replaceable, 1 set)
MU150061A/B-39	DIN connector (user replaceable, 1 set)
MU150061A/B-40	SC connector (user replaceable, 1 set)
MU150061A/B-43	HMS-10/A connector (user replaceable, 1 set)
	Maintenance service*5
MP1570A-90	Extended three year warranty service
MP0121A-90	Extended three year warranty service
MP0122A-90	Extended three year warranty service
MP0122B-90	Extended three year warranty service
MP0123A-90	Extended three year warranty service
MU150005A-90	Extended three year warranty service
MU150006A-90	Extended three year warranty service
MU150007A-90	Extended three year warranty service
MU150008A-90	Extended three year warranty service
MU150009A-90	Extended three year warranty service
MU150010A-90	Extended three year warranty service
MU150011A-90	Extended three year warranty service
MU150000A-90	Extended three year warranty service
MU150001A-90	Extended three year warranty service
MU150001B-90	Extended three year warranty service
MU150002A-90	Extended three year warranty service
MP0111A-90	Extended three year warranty service
MP0112A-90	Extended three year warranty service
MP0113A-90	Extended three year warranty service
MP0105A-90	Extended three year warranty service
MP0108A-90	Extended three year warranty service
MU150017A/B-90	Extended three year warranty service
MU150031A/C-90	Extended three year warranty service
MU150061A/B-90	Extended three year warranty service

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Model/Order No.	Name
	Application equipment
MP1580A	Portable 2.5G/10G Analyzer
MU150018A	2.5G/10G Jitter Unit (for MP1580A)
	Optional accessories
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02/150006A-02/ 150007A-02)
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0162A	Balanced cable, 1 m (Siemens 3p-Siemens 3p)
J0162B	Balanced cable, 2 m (Siemens 3p-Siemens 3p)
J0845A	Balanced cable, 6 ft (BANTAM 3P/BANTAM 3P)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0898A	Conversion cable (M-1PS · BANTAM 3P), 1 m
J0898B	Conversion cable (M-1PS · BANTAM 3P), 2 m
J0635A	Optical fiber cable, 1 m (SM, FC-SPC connector both ends)
J0635B	Optical fiber cable, 2 m (SM, FC-SPC connector both ends)
J0635C	Optical fiber cable, 3 m (SM, FC-SPC connector both ends)
J0660A	Optical fiber cable, 1 m (SM, SC connector, both-ends)
J0660B	Optical fiber cable, 2 m (SM, SC connector, both-ends)
J0660C	Optical fiber cable, 3 m (SM, SC connector, both-ends)
J0756A	Optical fiber cable, 1 m (SM, ST connector, both-ends)
J0756B	Optical fiber cable, 2 m (SM, ST connector, both-ends)
J0756C	Optical fiber cable, 3 m (SM, ST connector, both-ends)
J0747A	Fixed optical attenuator (5 dB)
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J1049A	Fixed optical attenuator, SC (5 dB)
J1049B	Fixed optical attenuator, SC (10 dB)
J1049C	Fixed optical attenuator, SC (15 dB)
J1049D	Fixed optical attenuator, SC (20 dB)
J1050A	Fixed optical attenuator, ST (5 dB)
J1050B	Fixed optical attenuator, ST (10 dB)
J1050C	Fixed optical attenuator, ST (15 dB)
J1050D	Fixed optical attenuator, ST (20 dB)
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0008	GPIB cable, 2 m
A0006	Head set
B0453B	Blank panel (for front slot)
B0454C	Blank panel (for slot 1 to 3)
B0454D	Blank panel (for slot 4/5)
B0448	Soft case
B0336C	Carrying case

*1: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your system. The option price is included in the MP1570A. These two options can be installed simultaneously. But in this case, one option price is charged.
*2: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified the FC connector (MP0111A/0112A/0113A/0122B-37, MU150008A/150009A/150010A/150001A/150001B/150002A-37) is supplied as standard.
*3: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.
*4: With Option 01, 2 sets
*5: Please ask your local Anritsu Field Office or Sales. Representative for price and availability.

SONET/SDH/PDH/ATM ANALYZER

MP1570A1

1.5 Mbit/s to 10 Gbit/s

GPIB OPTION

Supports North American and European Mapping in One Box

MP1570A1 is a SONET/SDH/PDH/ATM Analyzer that has one more slot than the MP1570A. It can measure a bit rate of 2488M (OC-48) or more in North American and European mapping without the DSn and PDH plug-in units exchange.

Specifications

• General

(Other specifications are the same as the MP1570A. For the specifications, refer to page 149.)

Printer	Internal, external
Internal memory	Measurement settings memory: 10 Graphics memory: 15
Others	FDD, RS-232C (Option 01)^{*1}, GPIB (Option 02)^{*1} Ethernet (Option 03)^{*1}, Video output (Option 04)^{*1} buzzer, clock, help, screen copy
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)
Dimensions and mass	320 (W) x 222 (H) x 350 (D) mm, 12 kg approx. (excluding plug-in units and options)
Power	100 to 240 Vac, 47.5 to 63 Hz, ≤500 VA
Temperature	0° to +40°C

*1: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1570A1^{*1}	SONET/SDH/PDH/ATM Analyzer	
	Standard accessories	
	AC power cord:	1 pc
Z0169	Printer paper (5 rolls/pack):	1 pack
F0079	Fuse, 10 A:	2 pcs
B0482	Front cover:	1 pc
J0907Q	Remote interlock cord (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
J0908	Remote interlock terminator (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	1 pc
E0008A	Optical output control key (for MU150001A/B, MU150008A, MU150009A, MU150010A, MU150031A/C, MU150061A/B):	2 pc
J0747A	Fixed optical attenuator (5 dB, for MU150017A/B):	1 pc
J0747B	Fixed optical attenuator (10 dB, for MU150002A):	1 pc
J0900A	Coaxial cable (AA-165-200, 20 cm, for MU150011A):	2 pcs
J0635A	Optical fiber cable (FC · PC-FC · PC, 1 m, for MU150002A/150008A/150009A/150010A, MU150017A/B):	1 pc
MX150001B	Wander (MTIE, TDEV) Measurement Application Software (supplied with MU150005A-02/150006A-02/150007A-02):	1 pc
W1882AE	MP1570A1 operation manual:	1 copy
W1719AE	MP1570A operation manual (Vol. 1 Basic operation for SDH):	1 copy
W1720AE	MP1570A operation manual (Vol. 1 Basic operation for SONET):	1 copy
W1721AE	MP1570A operation manual (Vol. 2 Remote control):	1 copy
W1722AE	MP1570A operation manual (Vol. 3 ATM measurement):	1 copy
W1723AE	MP1570A operation manual (Vol. 4 2.5G/10G measurement):	1 copy

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Model/Order No.	Name
W1724AE	MP1570A operation manual (Vol. 5 Add/Drop function): 1 copy
W1725AE	MP1570A operation manual (Vol. 6 Jitter/wander measurement, for MU150005A/150006A/150007A): 1 copy
W1726AE	MP1570A operation manual (Vol. 7 2.5G jitter/wander measurement, for MU150011A): 1 copy
W1763AE	Wander (MTIE, TDEV) Measurement Application Software (supplied with MX150001B): 1 copy
J1002A	Semi-rigid cable (for MU150001A/B, MU150031A/C, MU150061A/B): 2 pcs
J1002B	Semi-rigid cable (for MU150002A, MU150017A/B): 2 pcs
J1002C	Semi-rigid cable (for MU150000A): 3 pcs
	Plug-in units
MP0121A	2/8/34/139/156M Unit
MP0122A	1.5/45/52M Unit
MP0122B*2	1.5/45/52/52M (1.31) Unit
MP0123A	ATM Unit
MU150005A	2/8/34/139M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0121A)
MU150006A	1.5/45/52M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0122A/B)
MU150007A	2/8/34/139M, 1.5/45/52M, 156/622M Jitter Unit (only jitter generation/measurement, requires MP0121A or MP0122A/B)
MU150008A*2	2.5G (1.31) Unit (with optical power meter)
MU150009A*2	2.5G (1.55) Unit (with optical power meter)
MU150010A*2	2.5G (1.31/1.55) Unit (with optical power meter)
MU150011A	2.5G Jitter Unit (only jitter generation/measurement, requires MU150008A, MU150009A, or MU150010A)
MP0131A	Add/Drop Unit
MU150000A	2.5G/10G Unit
MU150001A*2	Optical 10G Tx (1.55) Unit (2 km transmission)
MU150001B*2	Optical 10G Tx (1.55) Unit (40 km transmission)
MU150002A*2	Optical 10G Rx (Narrow) Unit (with optical power meter)
MP0111A*2	Optical 156M/622M (1.31) Unit (with optical power meter)
MP0112A*2	Optical 156M/622M (1.55) Unit (with optical power meter)
MP0113A*2	Optical 156M/622M (1.33/1.55) Unit (with optical power meter, 1.31/1.55 switchable)
MU150017A	Optical 10G Rx (Wide) Unit
MU150017B	Optical 2.5G/10G Rx (Wide) Unit
MU150031A	Optical 10G Tx (1.55) High Power Unit
MU150031C	Optical 2.5G/10G Tx (1.55) High Power Unit
MU150061A	Optical 10G Tx (1.31) Unit
MU150061B	Optical 2.5G/10G Tx (1.31) Unit
MP0105A	CMI Unit
MP0108A	NRZ Unit
	Options
MP1570A1-01*3	RS-232C
MP1570A1-02*3	GPIB
MP1570A1-03*3	Ethernet
MP1570A1-04*3	VGA output
MP1570A1-06	MUX/DEMUX (2/8/34/139 Mbit/s, for MP0121A)
MP1570A1-07	MUX/DEMUX (1.5/45 Mbit/s, for MP0122A/B)
MP1570A1-08	45M-2M MUX/DEMUX (requires MP0121A and MP0122A/B)
MP1570A1-09	Japan mapping (requires MP0122A or MP0122B)
MP1570A1-10*1	SDH
MP1570A1-11*1	SONET
MP1570A1-13	Frame memory capture (156M/622M, 64 frame)
MP1570A1-14	IP-over-SONET/SDH (requires option of frame memory/capture)
MP1570A1-15	IP-over-ATM (requires MP0123A)
MP1570A1-22	K1/K2 overwrite through
MU150005A-02	Wander measurement
MU150006A-02	Wander measurement
MU150007A-02	Wander measurement
MU150005A-03	Wander reference output
MU150006A-03	Wander reference output
MU150007A-03	Wander reference output
MU150008A-01	Frame memory capture (2.5G, 64 frame)
MU150009A-01	Frame memory capture (2.5G, 64 frame)
MU150010A-01	Frame memory capture (2.5G, 64 frame)
MU150000A-01	Frame memory capture (2.5G/10G, 26 frame)
MU150001A/B-01	2.5G (1.31)
MU150001A/B-02	2.5G (1.55)
MU150001A/B-03	2.5G (1.31/1.55)
MU150002A-01	2.5G
MU150002A-04	Available for 10G (1.31)
MP0111A/0112A-37	FC connector (replaceable, 2 sets)
MP0111A/0112A-38	ST connector (replaceable, 2 sets)
MP0111A/0112A-39	DIN connector (replaceable, 2 sets)

Model/Order No.	Name
MP0111A/0112A-40	SC connector (replaceable, 2 sets)
MP0111A/0112A-43	HMS-10/A connector (replaceable, 2 sets)
MP0113A-37	FC connector (replaceable, 3 sets)
MP0113A-38	ST connector (replaceable, 3 sets)
MP0113A-39	DIN connector (replaceable, 3 sets)
MP0113A-40	SC connector (replaceable, 3 sets)
MP0113A-43	HMS-10/A connector (replaceable, 3 sets)
MP0122B-37	FC connector (replaceable, 2 sets)
MP0122B-38	ST connector (replaceable, 2 sets)
MP0122B-39	DIN connector (replaceable, 2 sets)
MP0122B-40	SC connector (replaceable, 2 sets)
MP0122B-43	HMS-10/A connector (replaceable, 2 sets)
MU150008A-37	FC connector (replaceable, 2 sets)
MU150008A-38	ST connector (replaceable, 2 sets)
MU150008A-39	DIN connector (replaceable, 2 sets)
MU150008A-40	SC connector (replaceable, 2 sets)
MU150008A-43	HMS-10/A connector (replaceable, 2 sets)
MU150009A-37	FC connector (replaceable, 2 sets)
MU150009A-38	ST connector (replaceable, 2 sets)
MU150009A-39	DIN connector (replaceable, 2 sets)
MU150009A-40	SC connector (replaceable, 2 sets)
MU150009A-43	HMS-10/A connector (replaceable, 2 sets)
MU150010A-37	FC connector (replaceable, 3 sets)
MU150010A-38	ST connector (replaceable, 3 sets)
MU150010A-39	DIN connector (replaceable, 3 sets)
MU150010A-40	SC connector (replaceable, 3 sets)
MU150010A-43	HMS-10/A connector (replaceable, 3 sets)
MU150001A/B-37	FC connector (replaceable, 1 set)
MU150001A/B-38	ST connector (replaceable, 1 set)
MU150001A/B-39	DIN connector (replaceable, 1 set)
MU150001A/B-40	SC connector (replaceable, 1 set)
MU150001A/B-43	HMS-10/A connector (replaceable, 1 set)
MU150002A-37	FC connector (replaceable, 1 set*4)
MU150002A-38	ST connector (replaceable, 1 set*4)
MU150002A-39	DIN connector (replaceable, 1 set*4)
MU150002A-40	SC connector (replaceable, 1 set*4)
MU150002A-43	HMS-10/A connector (replaceable, 1 set*4)
MU150017A/B-37	FC connector (user replaceable, 1 set)
MU150017A/B-38	ST connector (user replaceable, 1 set)
MU150017A/B-39	DIN connector (user replaceable, 1 set)
MU150017A/B-40	SC connector (user replaceable, 1 set)
MU150017A/B-43	HMS-10/A connector (user replaceable, 1 set)
MU150031A/C-37	FC connector (user replaceable, 1 set)
MU150031A/C-38	ST connector (user replaceable, 1 set)
MU150031A/C-39	DIN connector (user replaceable, 1 set)
MU150031A/C-40	SC connector (user replaceable, 1 set)
MU150031A/C-43	HMS-10/A connector (user replaceable, 1 set)
MU150061A/B-37	FC connector (user replaceable, 1 set)
MU150061A/B-38	ST connector (user replaceable, 1 set)
MU150061A/B-39	DIN connector (user replaceable, 1 set)
MU150061A/B-40	SC connector (user replaceable, 1 set)
MU150061A/B-43	HMS-10/A connector (user replaceable, 1 set)
	Maintenance service*5
MP0121A-90	Extended three year warranty service
MP0122A-90	Extended three year warranty service
MP0122B-90	Extended three year warranty service
MP0123A-90	Extended three year warranty service
MU150005A-90	Extended three year warranty service
MU150006A-90	Extended three year warranty service
MU150007A-90	Extended three year warranty service
MU150008A-90	Extended three year warranty service
MU150009A-90	Extended three year warranty service
MU150010A-90	Extended three year warranty service
MU150011A-90	Extended three year warranty service
MU150000A-90	Extended three year warranty service
MU150001A-90	Extended three year warranty service
MU150001B-90	Extended three year warranty service
MU150002A-90	Extended three year warranty service
MP0111A-90	Extended three year warranty service
MP0112A-90	Extended three year warranty service
MP0113A-90	Extended three year warranty service
MP0105A-90	Extended three year warranty service
MP0108A-90	Extended three year warranty service
MU150017A/B-90	Extended three year warranty service
MU150031A/C-90	Extended three year warranty service
MU150061A/B-90	Extended three year warranty service
	Application equipment
MP1580A	Portable 2.5G/10G Analyzer
MU150018A	2.5G/10G Jitter Unit (for MP1580A)

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Model/Order No.	Name
	Optional accessories
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0162A	Balanced cable (Siemens 3P-Siemens 3P), 1 m
J0162B	Balanced cable (Siemens 3P-Siemens 3P), 2 m
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0898A	Conversion cable (M-1PS · BANTAM 3P), 1 m
J0898B	Conversion cable (M-1PS · BANTAM 3P), 2 m
J0635A	Optical fiber cable (SM, FC-SPC connector both ends), 1 m
J0635B	Optical fiber cable (SM, FC-SPC connector both ends), 2 m
J0635C	Optical fiber cable (SM, FC-SPC connector both ends), 3 m
J0660A	Optical fiber cable, 1 m (SM, SC connector, both-ends)
J0660B	Optical fiber cable, 2 m (SM, SC connector, both-ends)
J0660C	Optical fiber cable, 3 m (SM, SC connector, both-ends)
J0756A	Optical fiber cable, 1 m (SM, ST connector, both-ends)
J0756B	Optical fiber cable, 2 m (SM, ST connector, both-ends)
J0756C	Optical fiber cable, 3 m (SM, ST connector, both-ends)
J0747A	Fixed optical attenuator (5 dB)
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J1049A	Fixed optical attenuator, SC (5 dB)
J1049B	Fixed optical attenuator, SC (10 dB)
J1049C	Fixed optical attenuator, SC (15 dB)
J1049D	Fixed optical attenuator, SC (20 dB)
J1050A	Fixed optical attenuator, ST (5 dB)
J1050B	Fixed optical attenuator, ST (10 dB)
J1050C	Fixed optical attenuator, ST (15 dB)
J1050D	Fixed optical attenuator, ST (20 dB)
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0008	GPIB cable, 2 m
A0006	Head set
B0453B	Blank panel (for front panel)
B0454C	Blank panel (for Slot 1 to 3)
B0454D	Blank panel (for Slot 4/5)

*1: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your system. The option price is included in the MP1570A1. These two options can be installed simultaneously. But in this case, one option price is charged.

*2: Specify the connector to be supplied as the standard connector when ordering the above options. If the connector is not specified the FC connector (MP0111A/0112A/0113A/0122B-37, MU150008A/150009A/150010A/150001A/150001B/150002A-37) is supplied as standard.

*3: The video output, RS-232C, GPIB and Ethernet options cannot all be used simultaneously. Only the video output + RS-232C, or video output + GPIB, or RS-232C + GPIB board, or Ethernet board combinations support simultaneous use, so change the board combinations according to the purpose.

*4: With Option 01, 2 sets

*5: Please ask your local Anritsu Field Office or Sales. Representative for price and availability.

PORTABLE 2.5G/10G ANALYZER

MP1580A

For 2.5G/10G Jitter/Wander Measurements

The MP1580A is a unique and powerful solution for analyzing jitter at the standard OC-48/192 or STM-16/64 bit rates. It can measure jitter of 2.5G/10G electrical interfaces (clock signal) with a simple operation. In addition, when used in combination with the MP1570A SONET/SDH/PDH/ATM Analyzer, evaluation of jitter characteristics in digital transmission lines, systems and devices, such as jitter tolerance, jitter transfer, jitter generation, etc., can be performed easily.

Functions

- **Complies with the latest ITU-T O.172 and Bellcore GR-1377 standards**

The MP1580A conforms to both the OC-192/STM-64 jitter measurement standards and supports required jitter modulation amplitude of 4000 UIp-p and 80 MHz jitter bandwidth.

- **Supports 10 GHz wander measurement according to the latest ITU-T G.813 standard (option)**

The MP1580A can generate and measure various types of wander. It can generate wander in the frequency range of 10 µHz to 10 Hz at 400,000 UIp-p max. In addition, MTIE/TDEV can be measured in real-time using an external PC and optional application software (MX150002B).

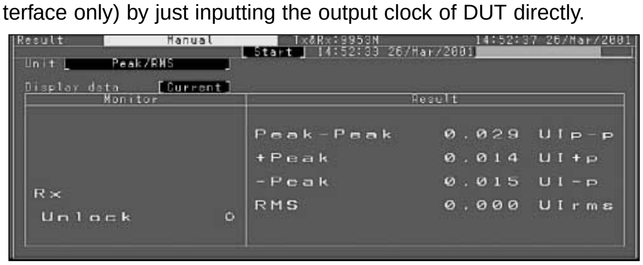
- **Single cabinet support for both 2.5G and 10G jitter/wander measurements**

Just one MP1580A is required for 2.5G and 10G jitter generation and analysis. When combined with the MP1570A and MU150000A, jitter can be added to SONET/SDH signals and measured.

Application

- **Output jitter measurement**

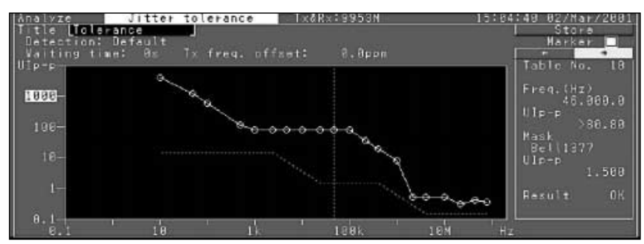
The MP1580A can easily measure the jitter clock signal (electrical interface only) by just inputting the output clock of DUT directly.



Optical signals can be measured easily by combining the MP1580A with the MP1570A, MU150000A, MU150001A and MU150017A/B.

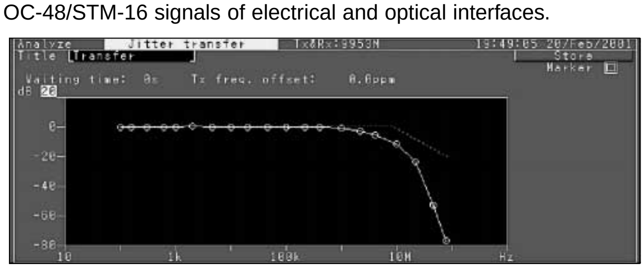
- **Jitter tolerance measurement**

When the MP1580A is used with the MP1570A (send/receive jittered clock), jitter tolerance tests can be performed on OC-192/STM-64 and OC-48/STM-16 signals of electrical and optical interfaces.



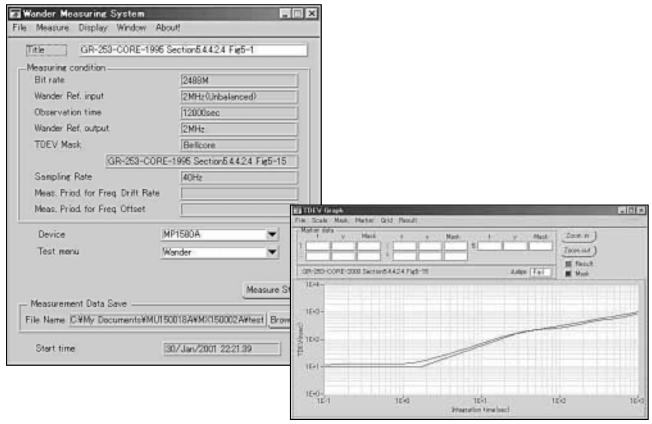
- **Jitter transfer measurement**

When the MP1580A is used with the MP1570A (send/receive jittered clock), jitter transfer tests can be performed on OC-192/STM-64 and OC-48/STM-16 signals of electrical and optical interfaces.



• Wander generation and measurement

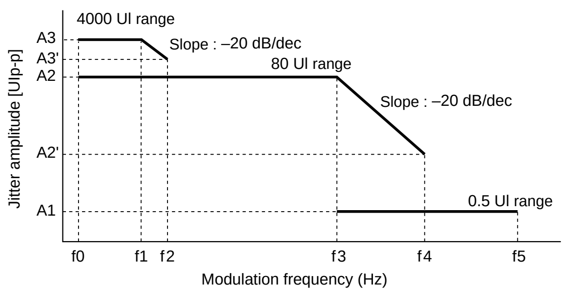
The MP1580A can generate and measure wander conforming to ITU-T O.172 and also generation of TDEV conforming to ITU-T G.813. It also can measure TIE (Time Interval Error) by itself and measure MTIE and TDEV by connection of an external PC in which MX150002B is installed.



Specifications

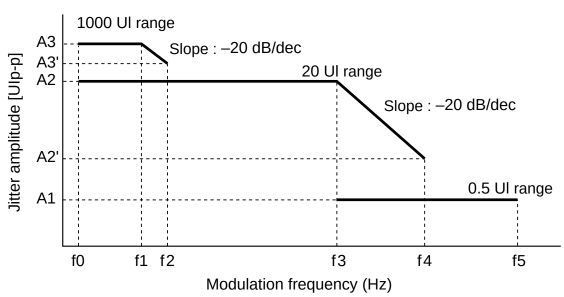
Jitter generation

Frequency
  Range: 9953.28, 2488.32 MHz
  Offset range: ±100 ppm
  Resolution: 0.1 ppm
  Accuracy: ±0.1 ppm (calibrate after 60 min warm-up, 23 ±5˚C)
Generation function: Clock signal output, data signal output (with MP1570A), jitter on, wander on/off
Modulation source: Internal (sine wave), external (for jitter generation function only)
Modulation frequency accuracy: fm ±100 ppm (0.1 Hz to 80 MHz)
Jitter generation: Conform to ITU-T O.172



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (MHz)	f5 (MHz)	A1 (UIp-p)	A2' (UIp-p)	A2 (UIp-p)	A3' (UIp-p)	A3 (UIp-p)
9953.28M	0.1	15	600	100	2	80	0.5	4	80	100	4000

0.5 UI range: 0.000 to 0.505 UIp-p (0.001 UIp-p steps)
80 UI range: 0.00 to 80.80 UIp-p (0.05 UIp-p steps)
4000 UI range: 0 to 4040 UIp-p (2 UIp-p steps)



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (MHz)	f5 (MHz)	A1 (UIp-p)	A2' (UIp-p)	A2 (UIp-p)	A3' (UIp-p)	A3 (UIp-p)
2488.32M	0.1	15	600	100	2	20	0.5	1	20	25	1000

0.5 UI range: 0.000 to 0.505 UIp-p (0.001 UIp-p steps)
20 UI range: 0.00 to 20.20 UIp-p (0.01 UIp-p steps)
1000 UI range: 0 to 1010 UIp-p (1 UIp-p steps)

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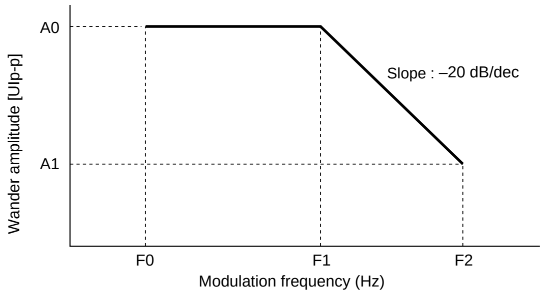
Wander generation

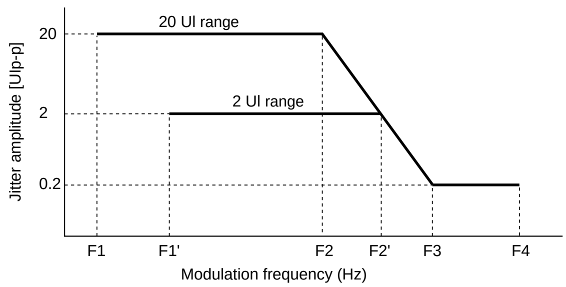
Wander generation: 10 µHz to 10 Hz, 0 to 400,000 UIp-p (1 UIp-p steps), conform to ITU-T O.172



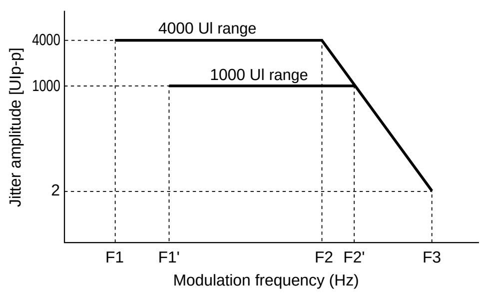
Bit rate (bit/s)	F0 (µHz)	F1 (mHz)	F2 (Hz)	A0 (UIp-p)	A1 (UIp-p)	Steps (UIp-p)
2488.32M	10	400	10	400,000	16,000	1
9953.28M	10	400	10	400,000	16,000	1

Jitter measurement

Measurement functions: UIp-p, UI + peak, UI – peak, UIrms, hit count, hit second, %F second, peak jitter
Measurement mode: Repeat, single, manual
Display: Current, last
Measurement interval: 1 to 99 s, 1 to 99 min, 1 to 99 h, 1 to 99 day
Jitter measurement: Conform to ITU-T O.172



Bit rate (bit/s)	Range (UI)	F1 (Hz)	F1' (Hz)	F2 (kHz)	F2' (kHz)	F3 (MHz)	F4 (MHz)
2488.32M	2	—	100	—	100	1	20
	20	10	—	10	—	1	20
9953.28M	2	—	100	—	400	4	80
	20	10	—	40	—	4	80



Bit rate (bit/s)	Range (UI)	F1 (Hz)	F1' (Hz)	F2 (Hz)	F2' (Hz)	F3 (kHz)
2488.32M	1000	—	1	—	12.1	5
9953.28M	4000	1	—	12.1	—	20

UIp-p measurement
2 UI range: 0.000 to 2.020 UIp-p (0.001 UIp-p steps)
20 UI range: 0.00 to 20.20 UIp-p (0.01 UIp-p steps)
1000 UI range: 0 to 1010 UIp-p (1 UIp-p steps, 2488.32 Mbit/s only)
4000 UI range: 0 to 4040 UIp-p (2 UIp-p steps, 9953.28 Mbit/s only)
UI rms measurement
2 UI range: 0.000 to 0.714 UIrms (0.001 UIrms steps)
20 UI range: 0.00 to 7.17 UIrms (0.01 UIrms steps)
Filters:
Confirming to ITU-T O.172 and Bellcore GR1377
LP, HP0 + LP, HP1 + LP, HP1' + LP, HP2 + LP, HP + LP, HP' + LP, LP' (1000/4000 UI range only), HP0 + LP' (1000/4000 UI range only)

Bit rate (bit/s)	HP0 (Hz)	HP1 (kHz)	HP1' (kHz)	HP2 (MHz)	HP' (kHz)	HP (kHz)	LP (MHz)	LP' (kHz)
2488.32M	10	5	—	1	—	12	20	5
9953.28M	10	10	20	4	50	12	80	20

Reference wander generation (Option 03)	Off: Able to set non-modulated status* TDEV mask: The 37 types of TDEV masks that are regulated by ITU-T, ETSI, ANSI, and Bellcore standards are available as default. It is possible to add the wander modulation on the user specified TDEV mask. Transient: It is possible to change the A $(1 – e^{–63.7t})$ phase by the timing of the start. Signal off: It is possible to disconnect the standard signal. Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations
Wander measurement (Option 02)	Conform to ITU-T O.172 Reference input: 2.048M (HDB3, clock), 1.544M (AMI/B8ZS, clock), 64k + 8 kHz, 5 MHz, 10 MHz Sampling frequency: 40 Hz, 1 Hz, 0.1 Hz (select by MX150002B) Measurement range P-P: 0.0 to 2E10 ns, +P/–P: 0.0 to 1E10 ns, TIE: 0.0 to ±1E10 ns Measurement time: 10 to 1 x 10^8 s (max. 120,000 s; MP1570A only) Wander application (requires MX150002B Wander Application Software) TIE: Max. 1 x 10^8 s, MTIE: Max. 1 x 10^8 s, TDEV: Max. 1 x 10^6 s Frequency offset: Measurement conforms to ANSI TI.105.09 Frequency drift rate: Measurement conforms to ANSI TI.105.09 Wander tolerance (TDEV) measurement: Evaluation by the various TDEV mask generations
Other measurement	Jitter transfer, frequency measurement, jitter tolerance, jitter sweep, frequency sweep, wander sweep (with MP1570A)
Dimensions and mass	320 (W) x 100 (H) x 350 (D) mm, ≤10 kg (with MU150018A)
Power	≤250 VA
Temperature range	0˚ to +40˚C (operating), –20˚ to +60˚C (storage)

*: Only non-modulated status can be set without this option.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MP1580A	Portable 2.5G/10G Analyzer
	Standard accessories
	AC power cord: 1 pc
F0093A	Fuse, 6.3 A: 1 pc
B0489	Front cover: 1 pc
W1889AE	MP1580A operation manual (Vol 1 Jitter/wander): 1 copy
W1890AE	MP1580A operation manual (Vol 2 Remote control): 1 copy
MX150002B	Wander Measurement Application Software (MTIE/TDEV) *Supplied with MU150018A-02: 1 pc
W1892AE	MX150002B operation manual (wander application) *Supplied with MX150002B: 1 copy
J1074	Semirigid cable Tx (for connection to MP1570A): 1 pc
J1075	Semirigid cable Rx (for connection to MP1570A): 1 pc
	Plug-in unit
MU150018A	2.5G/10G Jitter Unit
MU150018A-02	Wander measurement
MU150018A-03	Wander reference output phase modulation
	Options
MP1580A-01	RS-232C
MP1580A-02	GPIB
MP1580A-03	ETHERNET
MP1580A-04	VGA
	Maintenance service
MP1580A-90	Extended three year warranty service
MU150018A-90	Extended three year warranty service
	Peripherals
MP1570A	SONET/SDH/PDH/ATM Analyzer
MP1570A-02	GPIB (requires to combine with MP1580A)
MP1570A-10*	SDH
MP1570A-11*	SONET
MU150000A	2.5G/10G Unit (electrical for MP1570A)
MU150001A	Optical 10G Tx (1.55) Unit *2 km, for MP1570A
MU150001B	Optical 10G Tx (1.55) Unit *40 km, for MP1570A
MU150001A/B-01	2.5G (1.31, option for MP1570A)
MU150001A/B-02	2.5G (1.55, option for MP1570A)
MU150001A/B-03	2.5G (1.31/1.55, option for MP1570A)
MU150017A	Optical 10G Rx (Wide) Unit *For MP1570A
MU150017B	Optical 2.5G/10G Rx (Wide) Unit *For MP1570A
MP35A	Matching Transformer (BNC-J/Siemence, C42334-A282, 75/120 Ω)

Model/Order No.	Name
	Optical accessories
J0661A	RS232C cable (cross cable with D-sub 9 pin connector at both ends), 2 m
J0006	GPIB cable, 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0322B	Coaxial cord, 1 m
J0696A	Coaxial cord (AA-165-500), 0.5 m
J0696C	Coaxial cord (AA-165-1000), 1 m
J0900E	Coaxial cord (AA-165-1500), 1.5 m
J0162A	Balanced cord (Siemence 3P · Siemence 3P) 1 m
J0162C	Balanced cord (Siemence 3P · Siemence 3P), 2 m
J0845A	Balanced cord, (Bantam 3P · Bantam 3P), 6 ft
J0775D	Coaxial cord (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cord (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
B0490	Joint plate (to mount MP1580A and MP1570A in a stack)
B0491	Soft case
B0492	Hard carrying case
B0495	Side cover
B0330F	Tilt stand

*: Must specify SDH (Option 10) or SONET (Option 11) when ordering depends on your systems. The option price is included in the MP1570A. These two options can be installed simultaneously. But in this case, one option is charged.

NETWORK PERFORMANCE TESTER
MP1590B

Supports Next Generation Network Measurement from OTN to 10 GbE

NEW

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The MP1590B Network Performance Tester is a measuring instrument capable of measuring IP networks using the Ethernet plug-in modules of the Anritsu IP tester MD1230A, as well as traditional functions including testing of PDH, DSn, SDH/SONET, and OTN equipment and jitter measurement, with only one box. A new EoS unit supports EoS measurement, virtual concatenation, and LCAS measurement to enable testing of next-generation SDH/SONET equipment. The traditional MP1590A plug-in units can also be used without changes.
The MP1590B can perform some simultaneous applications - such as SDH/SONET, OTN, EoS, jitter and Ethernet measurement - using combination of plug-in units.

• Encapsulation test
The EoS unit MU150101A supports the GFP-F, LEX, LAPS (X.86), PPP, CiscoHDLC, and MAPOS encapsulation methods. With more than 120 types of real-time counter functions and a 256 MB frame capture analysis function, it is possible to verify detailed information of EoS frames like GFP-F frames.
Since both this unit and Ethernet modules can work at the same time, the EoS Layer and Ethernet Layer can be measured simultaneously to evaluate the EoS encapsulation function with one box.

• Virtual concatenation
In addition to traditional concatenation mapping, the MP1590B supports virtual concatenation and arbitrary concatenation.

Virtual concatenation member size

SONET	STS3cSPE-Xv (X = 1 to 16) STS1SPE-Xv (X = 1 to 48): High order VT2SPE-Xv (X = 1 to 63) VT1.5-Xv (X = 1 to 64)
SDH	VC-4-Xv (X = 1 to 16) VC-3-Xv (X = 1 to 48): High order VC-12-Xv (X = 1 to 63) VC-11-Xv (X = 1 to 64)

*: Don't support the member setting over AU/STS3.

• LCAS measurement
The EoS unit also supports LCAS measurement.
The LCAS monitoring function can monitor all members and all MSTs (Member Statuses) in a VCAT group simultaneously.
The LCAS capture function can capture up to 64 LCAS sequences for easy analysis of the LCAS protocol. The LCAS generation function can generate up to 64 LCAS sequences to test the LCAS function using several sequence patterns.

• Ethernet/IP measurement
Since the 10M/100M, Gigabit, and 10 Gigabit Ethernet modules for the Anritsu IP tester MD1230A can be used without changes, the MP1590B can be used as a full-scale IP tester with these Ethernet modules.
Also, because the MP1590B unit and Ethernet modules can be used simultaneously, comprehensive measurements for several layers including SDH/SONET, OTN, Ethernet, IP, and TCP/UDP can be performed.

• Supports PDH/DSn/SDH/SONET/OTN (1.5 Mbit/s to 10.7 Gbit/s) interfaces with only one unit
The MP1590B supports the following electrical interfaces and optical interfaces.

Electrical interfaces:
PDH (2.048, 8.448, 34.368, 139.264 Mbit/s), DSn (1.544, 44.736 Mbit/s), STM-0/1/64, STS-1/3/192
Optical interfaces:
STM-0/1/4/16/64, STS-1/3/12/48/192 OTU-1, OTU-2

Because a plug-in system is employed, units can be used in various combinations as needed.

• ITU-T G.709 OTN measurement
The MP1590B supports setting/monitoring of all overheads for OTU-1 (2.66 Gbit/s) and OTU-2 (10.71 Gbit/s) conforming to ITU-T G.709. It also supports multi-frame OH. Functions of OTN equipment can be tested by using error/alarm generation/ detection functions. In particular, the random error insertion function on the MP1590B enables evaluation of the FEC function on OTN equipment. The built-in optical output power adjustable function allows one MP1590B to test the error correction ratio of OTN equipment based on its input power specification.

• SDH/SONET functions

Switchover between SDH and SONET can be controlled on the screen. Transmission/reception with a Tandem Connection pattern (ITU-T Rec. G.707) is possible, and functions for setting and monitoring the section overhead (SOH/TOH) and path overhead (POH) have been implemented. Moreover, various error/alarm generation functions enable stress testing of SDH/SONET equipment.

• Jitter generation/measurement

Installing a jitter unit enables SDH/SONET (52 to 9953 Mbit/s), OTU-1 (2.66 Gbit/s), OTU-2 (10.71 Gbit/s) generation/measurement. Jitter tolerance and jitter transfer characteristic measurements conforming to ITU-T Rec. G.783, G.825, G.8251 and Telcordia GR-253 can be performed. The measured results are displayed in numeric values and graphs, allowing user evaluation and simplifying pass/fail judgment. It also supports 10.3 GHz clock jitter generation/measurement.

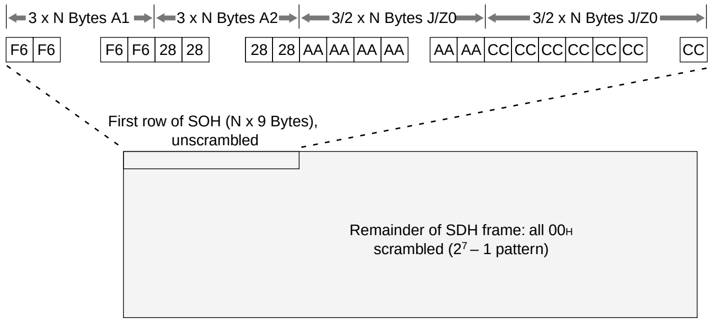
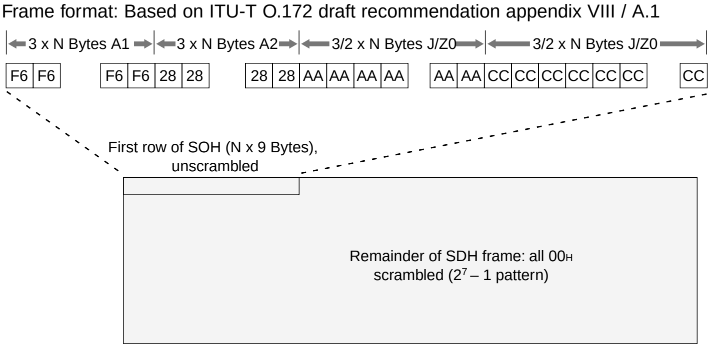
Specifications

• MP1590B (main frame)

Mode	SDH/SONET/OTN/PDH/DSn mode	EoS/Ethernet mode
Reference Clock input	Frequency Clock: 1.544 MHz[*1], 2.048 MHz, 64 kHz + 8 kHz, 5 MHz[*1], 10 MHz[*1] Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Input range: ±50 ppm Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz[*1], 2.048 MHz, 5 MHz[*1], 10 MHz[*1]: TTL (Rectangle, Sine Wave) 64 kHz + 8 kHz: 0.63 to 1.1 Vo-p (AMI, 8 kHz violation) Connector 1.544 MHz[*1], 2.048 MHz, 2.048 Mbit/s, 5 MHz[*1], 10 MHz[*1]: BNC 75 Ω 2.048 MHz, 2.048 Mbit/s, 64 kHz + 8 kHz: SIEMENS 120 Ω 1.544 Mbit/s: BANTAM 100 Ω Effective SDH/SONET/OTN bit rate.	
Reference Clock output	Frequency Clock: 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz Data: 1.544 Mbit/s (BITS), 2.048 Mbit/s Level/Code 1.544 Mbit/s: ANSI T1.403 (B8ZS) 2.048 Mbit/s: ITU-T G.703 Table10 (HDB3) 1.544 MHz, 2.048 MHz, 5 MHz, 10 MHz: TTL (Rectangle) Connector 1.544 MHz, 2.048 MHz, 2.048 Mbit/s, 5 MHz, 10 MHz: BNC 75 Ω 1.544 Mbit/s: BANTAM 100 Ω Effective SDH/SONET/OTN bit rate.	—
Trigger	Trigger input: For capture/APS measurement Trigger output: Transmit Error/Alarm, Receive Error/Alarm, Capture trigger Level: TTL (active High) Connector: BNC 75 Ω	Trigger input: For capture Trigger output: Capture trigger Level: TTL (active High) Connector: BNC 75 Ω
DCC/GCC	Data input/output: D1-D3 (192 kbit/s), D4-D12 (576 kbit/s), GCC0-2 (13124 kbit/s, 326.7 kbit/s) Clock output: 192 kHz , 576 kHz, 13124 kHz, 326.7 kHz Level: V.11 Connector: D-sub 9 pin	—
Remote interface	RS-232C (installed MP1590B-01), GPIB (installed MP1590B-02), LAN (10BASE-T/100BASE-TX, installed MP1590B-03)	
Peripheral connection	VGA output (SVGA), USB (2 port, Rev. 1.1), keyboard (PS/2)	
External memory	Compact flash (2 to 512 MB, recommended by CFA)	
Pointing device	By standard pointing device for a main frame, cursor movement in a screen is possible.	
Display size	8.4 inch, color TFT (800 x 600)	
LED	OTN: Frame, OTU, ODU, OPU SDH/SONET: Frame, MS/Line, AU/Path, TU/VT Standby, HDD, Clock Loss, Power Fail, History, Signal Loss, Errors, Test Pattern, Jitter, PDH/DSn, Event, All Errors, All Alarms	
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)	
LVD	EN61010-1: 2001 (Pollution degree 2)	
Power	85 to 132/170 to 250 Vac (100/200 V system automatic change), 47.5 to 63 Hz	
Power consumption	≤500 VA	
Operational temperature	+5˚ to +40˚C	
Dimensions and mass	320 (W) x 177 (H) x 350 (D) mm, ≤13 kg (excluding plug-in units)	

*1: Only support on SDH/SONET/OTN/PDH/DSn mode.

• MP1590B Option 30 (High Precision Jitter Analysis)

Bit rate	2488.32 Mbit/s, 9953.28 Mbit/s
The Jitter generation measurement accuracy	±20 mUIp-p (toward the amount of transmitter Jitter (≤100 mUIp-p) made a standard by the Phase Analysis Calibration Method) Measurement condition Measurement period: 60 sec/1 time Measurement method: The Phase Analysis Calibration Method (O.172 May. 2004 Appendix VIII) Average value: Five measurements Filters: 10G, 20 kHz to 80 MHz, 50 kHz to 80 MHz 2.5G, 5 kHz to 20 MHz, 12 kHz to 20 MHz Optical unit for Tx: MU150121A or Transmitter specified by Anritsu Frame format: Based on ITU-T O.172 draft recommendation appendix VIII / A.1  Optical input power: –10 to –12 dBm
Repeatability of Jitter generation measurement	±5 mUIp-p (Average value at five measurements under constant measurement condition) Measurement condition Measurement period: 60 sec/1 time Measurement method: Loop Back Filters: 10G, 20 kHz to 80 MHz, 50 kHz to 80 MHz, 4 to 80 MHz 2.5G, 5 kHz to 20 MHz, 12 kHz to 20 MHz Optical unit for Tx: 10G, MU150121A, MU150134A 2.5G, MU150100A Mapping: STS192c/VC4-64c-Bulk, STS48c/VC4-16c-Bulk Payload pattern: 2^{23} – 1 (Inv.) Optical input power: –10 to –12 dBm
Intrinsic Jitter (at Loop back mode)	<50 mUIp-p Measurement condition Measurement period: 60 sec/1 time Measurement method: Loop Back Filters: 10G, 20 kHz to 80 MHz, 50 kHz to 80 MHz Optical unit for Tx: 10G, MU150134A Mapping: STS192c/VC4-64c-Bulk Payload pattern: 2^{23} – 1 (Inv.) Optical input power: –10 to –12 dBm
Output Jitter of Transmitter	MU150121A, <60 mUIp-p MU150134A, <50 mUIp-p Measurement condition Measurement method: The Phase Analysis Calibration Method (O.172 May.2004 Appendix VIII) Filters: 10G, 20 kHz to 80 MHz, 50 kHz to 80 MHz 2.5G, 5 kHz to 20 MHz, 12 kHz to 20 MHz Frame format: Based on ITU-T O.172 draft recommendation appendix VIII / A.1  Sampling oscilloscope: >20 GHz bandwidth
General specification	Operating temperature: +20˚ to +30˚C Recommending calibration period: One year after the shipping or after the calibration

Notes for MP1590B Option 30:

This option is only appropriate for instruments configured as follows:
MP1590B: Network Performance Tester
MU150100A: 10/10.7G Unit
MU150121A/134A: 10/10.7G Optical Unit (Tx)
MU150123A: 10/10.7G Optical Unit (Rx Wide)
MU150125A: 10/10.7G Jitter Unit

This option doesn't support the MU150101A.
This option cannot be installed in other combinations.

This option does not guarantee the amount of Jitter contained in transmitting data.
A certificate about the amount of Jitter normally contained in transmitting data is attached.

This option guarantees the performance for instruments configured when option 30 is installed.
When units from other instruments are exchanged after installing option 30 (including the situation where a module is exchanged for another of the same type with a different serial number), the performance of option 30 is not guaranteed.
Other MP1590B functions can still be operated normally, however.

The guarantee period of MP1590B-30 performance is one year after the shipping or after the calibration.
Therefore MP1590B-90 (Extended three years warranty service) is not applied to the specifications or calibration cycle of the MP1590B-30.

• MU150100A 10G/10.7G Unit, MU150101A 2.5/2.6G EoS Unit

<table>
<tr><td>Model</td><td>MU150100A</td><td>MU150101A*1</td></tr>
<tr><td>Electrical interface
(1.544 to 155.52 Mbit/s)</td><td colspan="2">Bit rate
PDH/DSn: 1.544 Mbit/s, 2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s, 44.736 Mbit/s, 139.264 Mbit/s
SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s
Code
1.544 Mbit/s: AMI/B8ZS
2.048 Mbit/s, 8.448 Mbit/s, 34.368 Mbit/s: HDB3
44.736 Mbit/s, 51.84 Mbit/s: B3ZS
139.264 Mbit/s, 155.52 Mbit/s: CMI
Connector
1.5M: BANTAM 100 Ω Balanced
2M: 3 pin Siemens 120 Ω Balanced
2/8/34/139/45/52/156M: BNC 75 Ω
Level
ANSI T1.102 (1.5/45M)
ITU-T G.703 (2/8/34/139/156M)
DSX output (1.5M): 0/655 feet
DSX output (45M, 52M): 0/450/900 feet
Monitor gain
20 dB, 26 dB: 1.5M/2M/8M/34M/45M/52M
20 dB: 139M/156M</td></tr>
<tr><td>Electrical interface
(9953.28 M,
10709.225 Mbit/s)</td><td>Bit rate
SDH/SONET: 9953.28 Mbit/s
OTN: 10709.225 Mbit/s (Installed Option 05)
Code: NRZ
Connector: SMA 50 Ω
Level
Clock Output: 1.3 to 0.6 Vp-p
Data Output: 0 to –0.2 V (High), –0.85 to –1.5 V (Low)
Data Input: 1.5 to 0.3 Vp-p</td><td>—</td></tr>
<tr><td>Optical interface</td><td colspan="2">Bit rate
SDH/SONET: 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2488.32 Mbit/s
OTN: 2666.057 Mbit/s (Installed Option 05)
Code: NRZ
Connector: FC-PC (SMF), replaceable</td></tr>
<tr><td>Optical output</td><td colspan="2">Level: –1 to +3 dBm (ATT = 0 dB, Option 04)
Extinction ratio: ≥10 dB
SMSR: ≥30 dB
Peak wavelength: 1550 nm ±20 nm (Option 02,03), 1310 nm ±20 nm (Option 01,03)
–20 dB width: ≤1 nm
Safety classification: IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS III b</td></tr>
<tr><td>Optical input</td><td colspan="2">Optical input level: –8 to –33 dBm (52/156M), –8 to –29 dBm (622M/2.5G/2.6G)
Wavelength: 1260 to 1610 nm
Overload: +3 dBm (Average)</td></tr>
<tr><td>Clock</td><td colspan="2">Internal, External (Reference input, 1/1 input), Receive
Internal
Accuracy: ±0.1 ppm [After power on, calibrate after 24 hours, warm-up 23 ±5˚C, aging rate (Max.): ±0.05 ppm/day, ±0.5 ppm/year]
Offset range: ±100 ppm/0.1 ppm step</td></tr>
</table>

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Model	MU150100A	MU150101A[*1]
Frame	1.544 Mbit/s: D4/ESF/Japan ESF 2.048 Mbit/s: 30, 31ch with or without CRC4 8.448 Mbit/s: G.742 34.368 Mbit/s: G.751 44.736 Mbit/s: M13/C-bit 139.264 Mbit/s: G.751 51.84 Mbit/s: SDH/SONET 155.52 Mbit/s: SDH/SONET 622.08 Mbit/s: SDH/SONET 2488.32 Mbit/s: SDH/SONET 9953.28 Mbit/s: SDH/SONET[*2]	
No frame	1.544, 2.048, 8.448, 34.368, 44.736, 139.264 Mbit/s 51.84, 155.52, 622.08, 2488.32, 9953.28[*2] Mbit/s	
Test pattern	PRBS, Word, all0, all1, 3 in 24 (only 1.5M) PRBS (SDH/SONET) No Frame: $2^{15} – 1$ (only 52/156M), $2^{23} – 1$, $2^{31} – 1$ Concatenation mapping: $2^{15} – 1$ (1c/4c), $2^{23} – 1$, $2^{31} – 1$ Another mapping: $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$, $2^{20} – 1$z (only 1.5M/45M), $2^{23} – 1$ Invert ON/OFF PRBS (PDH/DSn) $2^{11} – 1$, $2^{15} – 1$, $2^{20} – 1$, $2^{20} – 1$z (only 1.5M/45M), $2^{23} – 1$ Invert ON/OFF Word: 16-bit programmable (mark ratio 1/2 at no frame) Transmit/Receive: An independent setup is possible	
OH preset	SOH/TOH/POH: All bytes (except parity byte, K1/K2 byte, H1, H2 and H3) Dummy channel POH: All bytes (except parity byte)	
Error addition/ measurement	PDH/DSn: Bit all (only addition), Code, Bit info, Bit 1.5M, Bit 2M, Bit 8M, Bit 34M, Bit 45M, Bit 139M, FAS 1.5M, FAS 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, EXZ, CRC6, Ebit, Parity, Cbit, REI SDH: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, MS-REI (M0/M1), HP-REI, LP-REI, Bit all (only addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI SONET: FAS, Frame (only measurement), B1, B2, HP-B3, LP-B3, BIP-2, REI-L (M0/M1), REI-P, REI-V, Bit all (only addition), Bit info, OH bit, HP-IEC, LP-IEC, N2 BIP-2, HP-TC-REI, LP-TC-REI, HP-OEI, LP-OEI	
Error addition timing	Rate, Alternative, Single, Burst, All, Frame Rate Fix rate: 1*10^{-n} (n: 3 to 9), User program: A*10^{-B} (A: 1.0 to 9.9 step 0.1, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Frame (only PDH/DSn) : n in 16 frame (n: 1 to 4) B1, B2, B3, BIP-2 can be set Error bit.	
Alarm addition/ measurement	PDH/DSn: LOS, LOF, AIS, RDI, RDI (MF) SDH: LOS, LOF, OOF (only measurement), RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-RDI, HP-ERDIP, HP-ERDIS, HP-ERDIC, HP-TIM, HP-UNEQ, HP-SLM, TU-AIS, TU-LOP, TU-LOM, LP-RDI, LP-ERDIP, LP-ERDIS, LP-ERDIC, ISF, LP-RFI, LP-TIM, LP-UNEQ, LP-SLM, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC SONET: LOS, LOF, OOF (only measurement), RS-TIM, AIS-L, RDI-L, AIS-P, LOP-P, RDI-P, ERDIP-P, ERDIS-P, ERDIC-P, TIM-P, UNEQ-P, PLM-P, AIS-V, LOP-V, LOM-V, RDI-V, ERDIP-V, ERDIS-V, ERDIC-V, ISF, RFI-V, TIM-V, UNEQ-V, PLM-V, Sync. loss, OH Sync., HP-VC-AIS, LP-VC-AIS, HP-FAS, LP-FAS, HP-Incoming AIS, LP-Incoming AIS, HP-TC-RDI, LP-TC-RDI, HP-ODI, LP-ODI, HP-TC-TIM, LP-TC-TIM, HP-LTC, LP-LTC	
Alarm addition timing	Single, Burst, Alternative, All Alternative Error frame = 0 to 64000, Normal frame = 1 to 64000	
Monitor	PDH/DSn: FAS 1.5M, FW 2M, NFW 2M, MFW 2M, FAS 8M, FAS 34M, FAS 45M, FAS 139M, Info byte (only 2M) SDH/SONET: SOH/TOH/POH, Path Trace, Tandem byte, K1/K2 byte, AU/STS, TU/VT pointer	
Through	Transparent, Overhead overwrite (only SDH/SONET/OTN)	
MUX/DEMUX	MUX/DEMUX is possible to 64 k units in PDH and DSn	
Add/Drop	PDH/DSn signal can be added to or dropped from the SDH/SONET mapping. Bit rate: 1.5 Mbit/s, 2 Mbit/s, 34 Mbit/s, 45 Mbit/s, 139 Mbit/s STM-0/1/4/16 or OC-1/3/12/48 signal can be added to or dropped from STM-64 or OC-192 signal (required MU150100A-09)[*2]	
Delay measurement	Measurement period: 0.5, 1, 2, 5, 10 s Measurement range: 0.1 to 999 µs, 1.0 to 999.9 ms, 1.0 to 10.0 s, >Time out	
Dummy channel	Mode: Copy/Dummy Dummy pattern: all 0, all 1, $2^{11} – 1$, $2^{15} – 1$ (Invert)	
Path Trace	J0, J1, J2 byte can be set arbitrarily. 16 byte (CRC On), 32 byte (CRC Off)	
Tandem connection	N1/Z5, N2 byte can be set arbitrarily. It can set ON/OFF	
Pointer generation	AU/STS, TU/VT pointer Action: NDF, ±PJ (Pointer Justification) PJC Timing: Manual, Burst (2 to 64)	
Pointer measurement	AU/STS, TU/VT pointer, C bit Measurement item: NDF, + PJC, –PJC, Cons, C, C1/C2	
Payload offset	Offset range: ±100 ppm/0.1 ppm step can set at the Async. mapping.	

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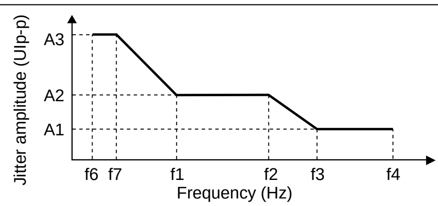
Model	MU150100A	MU150101A*1
APS test	Switching time measurement Measurement time: 0.1 to 2000.0 ms, Timeout (not include time for pointer/frame synchronization) APS Sequence Generator Generator timing: 2 to 64 word, Max. 8000 frame/word It can be set for each K1/K2, K3, K4.	
Overhead sequence capture	Capture byte: K1/K2, K3, K4, AU/STS-Pointer, TU/VT-Pointer Size: 64 sequence Repeat: Max. 8000 frame/sequence	
Overhead test	SOH/TOH/POH 1byte, A1/A2, K1/K2, RSOH, MSOH, SOH, POH (except parity byte, K1/K2 byte, H1, H2 and H3) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.	
OH BERT test	Test byte: SOH/TOH/POH 1 byte, D1-D3, D4-D12 (except parity byte, K1/K2 byte, H1, H2 and H3) Pattern: $2^{11} – 1$, $2^{15} – 1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync loss	
OH Add/Drop	Test byte: D1-D3, D4-D12	
Performance	G.821, G.826, G.828, G.829, M.2100, M.2101, M.2110, M.2120, GR.820	
Optical power meter	Wavelength: 1310 nm/1550 nm, Measurement range: –7 to –40 dBm Measurement accuracy: ±1 dB (–10 to –30 dBm), ±2 dB (–7 to –9.9 dBm, –30.1 to –40 dBm)	
Frequency counter	Measurement frequency (f0): 1.544, 2.048, 8.448, 34.368, 44.736, 139.264 MHz 51.84, 155.52, 622.08, 2488.320, 2666.057 MHz 9953.28*2, 10709.225*2 MHz Measurement range: f0 ±100 ppm Accuracy: ±0.1 ppm	

Jitter tolerance (52M to 2.5G/2.6G)



Bit rate (Mbit/s)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	f6 (Hz)	f7 (Hz)	f1 (Hz)	f2 (Hz)	f3 (Hz)	f4 (Hz)
51.84	20	2	0.2	10	30	300	2k	20k	400k
155.52	50	2	0.2	10	19.3	500	6.5k	65k	1.3M
622.08	200	2	0.2	10	10	1k	25k	250k	5M
2488.32	800	2	0.2	10	12.1	5k	100k	1M	20M
2666.05*3	800	2	0.2	10	12.1	5k	100k	1M	20M

Measurement condition: MU150100A/MU150101A loop-back measurement
- Temperature condition: +10˚ to +40˚C
- Optical input level: –10 to –12 dBm (2488M, 2666M), –10 to –20 dBm (52M, 156M, 622M)
- Error threshold: $10^{–8}$ (52M), $10^{–9}$ (156M, 622M), $10^{–10}$ (2488M, 2666M)
- Optical input wavelength: 1310 nm/1550 nm
- Mapping
  - SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)
  - SONET: STSnc (n = 1, 3, 12, 48)
  - OTU-1: ODU1-OPU1-PRBS
- Test pattern: $2^{23} – 1$ (Inv.) (SDH/SONET), $2^{23} – 1$ (OTU-1), Mark ratio 1/2, Scramble “On”
- Clock: internal

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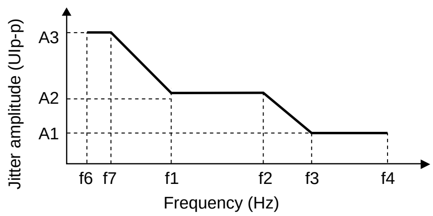
<table>
<tr><td>Model</td><td>MU150100A</td><td>MU150101A*1</td></tr>
<tr><td>Jitter tolerance*2
(9.9G/10.7G)</td><td>


<table>
<tr><td>Bit rate (Mbit/s)</td><td>A1 (UIp-p)</td><td>A2 (UIp-p)</td><td>A3 (UIp-p)</td></tr>
<tr><td>9953</td><td>0.2</td><td>2</td><td>3200</td></tr>
<tr><td>10709*3</td><td>0.2</td><td>2</td><td>3200</td></tr>
</table>
<table>
<tr><td>Bit rate (Mbit/s)</td><td>f6 (Hz)</td><td>f7 (Hz)</td><td>f1 (Hz)</td><td>f2 (Hz)</td><td>f3 (Hz)</td><td>f4 (Hz)</td></tr>
<tr><td>9953</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>80M</td></tr>
<tr><td>10709*3</td><td>10</td><td>12.1</td><td>20k</td><td>400k</td><td>4M</td><td>80M</td></tr>
</table>
Measurement condition:
MU150100A, MU150121A, MU150123A loop-back measurement
Temperature condition: +10˚ to +40˚C
Optical input level: –10 to –12 dBm
Optical input wavelength: 1310 nm/1550 nm
Mapping
SDH: VC4-64c (9953M)
SONET: STS192c (9953M)
OTU-2: ODU2-OPU2-PRBS
Test pattern: 2^{23} – 1 (Inv.) (SDH/SONET), 2^{31} – 1 (OTU-2),
Mark ratio 1/2, Scramble “On”
Clock: internal
</td><td>—</td></tr>
<tr><td>Auxiliary interface</td><td colspan="2">External clock input, Receive clock output, Cock/Frame sync. output</td></tr>
<tr><td>Optical output power adjustable (Option 04)</td><td colspan="2">Variable range: 0 to 30 dB, Accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 30 dB), Setting resolution: 0.1 dB</td></tr>
<tr><td>Supported main frame option</td><td>MP1590B-30</td><td>MP1590B-11</td></tr>
</table>

*1: Please refer to the section of MU150101A-06/-07 about specification of EoS mode.
*2: Don't support in MU150101A.
*3: When it is installed MU150125A-05.

• MU150100A Option 05 (OTU-1/OTU-2), MU150101A Option 05 (OTU-1)

<table>
<tr><td>Option</td><td>MU150100A-05</td><td>MU150101A-05*1</td></tr>
<tr><td>Bite rate</td><td>10709.225 Mbit/s, 2666.057 Mbit/s</td><td>2666.057 Mbit/s</td></tr>
<tr><td>Frame</td><td>10709.225 Mbit/s: OTU-2, 2666.057 Mbit/s: OTU-1</td><td>2666.057 Mbit/s: OTU-1</td></tr>
<tr><td>No frame</td><td>10709.225 Mbit/s, 2666.057 Mbit/s</td><td>2666.057 Mbit/s</td></tr>
<tr><td>Test pattern</td><td colspan="2">PRBS, Word, all 0, all 1
PRBS
No frame: 2^{15} – 1, 2^{23} – 1, 2^{31} – 1
PRBS mapping: 2^{15} – 1, 2^{23} – 1, 2^{31} – 1
SDH/SONET mapping: According to SDH/SONET mapping
Invert ON/OFF
Word: 16-bit programmable (mark ratio 1/2 at no frame)
Transmit/Receive: An independent setup is possible</td></tr>
<tr><td>OH preset</td><td colspan="2">OTU, ODU, OPU, FAS (except parity byte, MFAS and JC byte)
TTI (SPAI [1] - [15], DAPI [1] - [15]) can be set character.
PT is set automatically according to mapping (can be edit).</td></tr>
<tr><td>FEC</td><td colspan="2">G.709, RS (255, 239)
It can set ON/OFF.</td></tr>
<tr><td>Justification</td><td colspan="2">Generation
Action: ±Justification
Timing: Single, Burst (2 to 64)
Measurement item: + JC, –JC</td></tr>
<tr><td>Payload offset</td><td colspan="2">Offset range: ±65.9 ppm/0.1 ppm step can set at the Async. mapping.</td></tr>
<tr><td>Error addition/ measurement</td><td colspan="2">FAS, BIP-8 (SM, PM, TCM1-6), BEI (SM, PM, TCM1-6), Bit all (only addition for OTN frame), Bit, Corrected error bit (only measurement), Uncorrectable FEC block (only measurement)</td></tr>
</table>

Continued on next page

Option	MU150100A-05	MU150101A-05[*1]
Error addition timing	Single, Rate, All, Alternate, Random (only Bit all) Rate Fix rate: $1 * 10^{-n}$ (n: 3 to 9), User program: $A * 10^{-B}$ (A: 1.0 to 9.9, B: 2 to 10) Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000 Random: Only Bit all When the Parity error is set, it can be select Error position	
Alarm addition/ measurement	LOF, OOF (only measurement), LOM, OOM (only measurement), BDI (SM, PM, TCM1-6), AIS (OTU, ODU), ODU-OCI, ODU-LCK, ODU-PLM (only measurement), IAE (SM,TCM1-6), TIM (SM, PM, TCM1-6), LTC (TCM1-6), BIAE (SM, TCM1-6)	
Alarm addition timing	Alternative, All, Burst, Single Alternative Error frame: 0 to 64000, Normal frame: 1 to 64000	
Monitor	All OH (OTU, ODU, OPU), TTI, FTFL, Payload Multi-frame indicate is possible at the TTI and FTFL.	
Overhead sequence capture	Capture byte: APS/PCC Size: 64 sequence Repeat: Max. 8000 frame/sequence	
Overhead test	OTU/ODU/OPU 1byte, FAS, APS/PCC, TCM1-6, SM, PM, GCC0-2, EXP (except parity byte, MFAS and JC byte) Timing: Alternative (A: 1 to 8000 times, B: 1 to 8000 times), A and B can be set up to 256 frames.	
OH BERT test	GCC0-2, OH 1byte (except Parity byte) Pattern: $2^{11} - 1$, $2^{15} - 1$ (Invert) Error addition: Bit (only Single) Measurement: Bit error, Sync.loss	
OH Add/Drop	Test byte: GCC0-2	

*1: MU150101A doesn't support OTN measurement on EoS mode.

• MU150100A Option 07 (10/10.7G Minus option)

Function	This Option removes the 10/10.7G electrical capability from the MU150100A. This Option must be installed in the factory.

*1: This option cannot be installed together with MU150100A-09.

• MU150101A Option 06 (GFP-F/LEX/LAPS), MU150101A Option 07 (POS)

Option	MU150101A-06	MU150101A-07
Bit rate	155.52 Mbit/s, 622.08 Mbit/s, 2488.32 Mbit/s	
Encapsulation	GFP-F, LEX, LAPS (X.86)	PPP, CiscoHDLC, MAPOS version1, MAPOS 16
Frame setting	FCS(LEX): 16 bit MAC address: fixed, increment, decrement, random (Changeable portions specified in 4 bits units) IP address: fixed, increment, decrement, random VLAN tag[*1]: fixed, increment, decrement, random Protocol editing: GFP, LEX, LAPS, Ethernet, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IPX, IS-IS, MAC Control Frame, LEX Control Packet	FCS: CRC32, CRC16 IP address: fixed, increment, decrement, random Protocol editing: PPP, CiscoHDLC, MAPOS v1, MAPOS16, ARP, IPv4, IGMP/IPv4, ICMP/IPv4, TCP/IPv4, UDP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPv6, IS-IS
	MPLS label[*1]: Up to 10 MPLS labels can be appended. Fixed setting Data field Can set any 4 parts in data field: All 1, All 0, Alternate 1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment[*2], Decrement[*2], Random[*2], Single PRBS9[*2] Data field 1 only: Time stamp[*2], Sequence number[*2], User defined, Test frame	
Frame length	8 to 65536 byte (Settable as auto, Fixed, Increment[*3], or Random[*3])	
Stream Gap Setting	Stream transport mode: Continuous, continuous burst, stop after this stream, next stream, jump to stream, jump to stream for count (loop count: 1 to 16,000,000, frame count per burst: 1 to 16,000,000, burst count per stream: 1 to 16,000,000) Inter frame gap GFP: 0 ns to 120 s, Resolution of 13.4 ns, Settable as fixed, Random[*4] Other: 3.3 ns to 120 s, Resolution of 3.2 ns, Settable as fixed, Random[*4] Inter burst gap: 51.4 ns to 120 s, Resolution of 3.2 ns, Settable as fixed (IFG <51.4 ns or frame length <63 bytes) IFG + 51.4 ns to 120 s Inter stream gap: 427.4 ns to 120 s, Resolution of 3.2 ns, Settable as fixed (IFG <51.4 ns or frame length <63 bytes) IFG + 427.4 ns to 120 s	
Number of streams	256 streams	

Continued on next page

<table>
<tr><td>Option</td><td>MU150101A-06</td><td>MU150101A-07</td></tr>
<tr><td rowspan="2">Error insertion</td><td>GFP:
cHEC error, Correctable cHEC error, tHEC error, Correctable tHEC error, eHEC error, Correctable eHEC error, FC
LAPS: FCS error, abort frame
LEX: FCS error, fragment error, undersize, oversize, oversize & FCS error</td><td>—</td></tr>
<tr><td colspan="2">Frame error: FCS error, abort frame, flagment, undersize, oversize, oversize & FCS error
Packet error: IPv4 header checksum error, TCP/UDP checksum error
PRBS: PRBS bit error (required MP1590B-11)</td></tr>
<tr><td rowspan="2">Counter</td><td>GFP/LEX/LAPS:
Transmitted bytes (after stuffing), Transmitted bytes (after adaptation), cHEC error, Correctable cHEC error, tHEC error, Correctable tHEC error, eHEC error, GFP FCS error, Server signal fail interval, Client loss of sync frame, Client loss of sync interval, Client loss of signal frame, Client loss of signal interval, Fragment, Undersize, Oversize, Oversize & FCS error, Abort frame
Ethernet:
Transmitted Ethernet frame/rate, Received Ethernet frame/rate, Transmitted Ethernet byte, Received Ethernet byte, Ethernet FCS error, Flow control, Ethernet fragment error, Ethernet undersize error, Ethernet oversize error, Ethernet oversize & FCS error</td><td>—</td></tr>
<tr><td colspan="2">SDH/SONET/Bulk:
B1 count/rate, B2 count/rate, B3 count/rate, HP-IEC count/rate, MS-REI count/rate, HP-REI count/rate, LOS count/second, LOF count/second, OOF count/second, MS-AIS count/second, MS-RDI count/second, AU-AIS count/second, AU-LOP count/second, HP-SLM count/second, HP-RDI count/second, HP-UNEQ count/second, Bit Info count/rate, Pattern Sync Loss second, MFI alignment Error count/second, sequence error count
Justification: NDF count/rate, +PJC count/rate, –PJC count/rate, Consecutive count/rate, PPM
Common:
Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate, Transmitted test frame, Received test frame
ARP: Transmitted ARP request, Received ARP request, Transmitted ARP reply, Received ARP reply
PPP/IP/TCP/UDP:
Transmitted bytes (after stuffing), Received bytes (before destufing), Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error
Unframe: Bit Info count/rate, Pattern Sync Loss second
Packet BER (MP1590B-11): Sequence error, Received PRBS frame error count/rate, Received PRBS bit error count/rate</td></tr>
<tr><td>Frame Arrival Time Variation Measurement</td><td colspan="2">Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s</td></tr>
<tr><td>QoS Counter Settings</td><td colspan="2">Using QoS described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field</td></tr>
<tr><td>Unframed BER Test</td><td colspan="2">Test pattern: $2^{23}-1$ (Inv), $2^{31}-1$
Error insertion: Bit unit
Error insertion timing: Single error, Fix rate: 1 $*10^{-n}$ (n: 3 to 9), User program: A $*10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10)</td></tr>
<tr><td>Capture Buffer</td><td colspan="2">256 Mbyte</td></tr>
<tr><td>Capture Filter</td><td colspan="2">At following conditions, capture filter condition settings:
Destination MAC address[*5], Source MAC address[*5], Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions</td></tr>
<tr><td>Capture Trigger</td><td colspan="2">At following conditions, capture trigger condition settings:
Destination MAC address[*5], Source MAC address[*5], Destination IP address, Source IP address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input</td></tr>
<tr><td>Protocol Decode</td><td colspan="2">ARP, Cisco HDLC, DHCP, DVMRP, Ethernet, GFP, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LAPS (X.86), LCP, LDP, LEX, LLC, MAC Control Frame, MAPOS, MPLS, MPLSCP, OSPFv2, PPP, PPP-LEX, RIP, RSVP, SNAP, TCP, UDP, VLAN, Test Frame</td></tr>
<tr><td>Protocol Emulation</td><td colspan="2">ARP, PPP, ICMPv4 (PING), IGMP,</td></tr>
<tr><td>Traffic Monitor</td><td colspan="2">IP packet count for up to 64 flows, Frame count for up to 64 protocols</td></tr>
<tr><td>Traffic Map</td><td colspan="2">IP data flow for up to 256 flows</td></tr>
<tr><td>Service Disruption Time</td><td colspan="2">Measure a total time of receiving no frame as service disruption time. A resolution of this measurement depends on the transmitted frame size and IFG.</td></tr>
</table>

*1: VLAN tag and MPLS labels cannot be used simultaneously.
*2: This function causes TCP/UDP checksum error when it uses TCP/UDP frame.
*3: Increment and random of frame length can be used only when choosing None as a protocol.
*4: Random setting is effective only when frame length is more than 64 bytes.
*5: Available only on GFP/LAPS/LEX mapping.

• **MU150101A Option 11 (HO Virtual Concatenation), MU150101A Option 12 (LO Virtual Concatenation)**

Option	MU150101A-11	MU150101A-12
Mapping	VC-4-Xv (X = 1 to 16)/STS3cSPE-Xv (X = 1 to 16) VC-3-Xv (X = 1 to 48)/STS1SPE-Xv (X = 1 to 48)	VC-12-Xv (X = 1 to 63)/VT2SPE-Xv (X = 1 to 63) VC-11-Xv (X = 1 to 64)/VT1.5 SPE-Xv (X = 1 to 64)
Group	A setup is arbitrarily possible in a member's position and SQ.	
Dummy channel	Payload data: $2^{15}-1$ (Inv.), $2^{23}-1$ (Inv.), $2^{31}-1$, all 0, all 1, Idle	
Error addition	1st MFI (HOVCAT), 2nd MFI (LOVCAT), SQM, MFI (LOVCAT)	
Error addition timing	Single, all (About a VCAT group all channel)	
Alarm addition	VCAT-LOM	
Alarm addition timing	Single, Single burst, Alternative, all (About a VCAT group all channel)	
Error measurement	1st MFI count/rate, 2nd MFI count/rate, SQM count/rate	
Alarm measurement	VCAT-LOM count/rate, LOA count/rate, OOM1 count/rate, OOM2 count/rate	

• **MU150101A Option 13 (LCAS)**

LCAS ON/OFF	ON/OFF is settable
Command generation	ADD, REMOVE, TEMP REMOVE, User defined command
Sequence generation	It is possible to set LCAS sequences gap and transmitting time of each command. Generating up to 64 sequences.
Monitor	About a VCAT group all channel, a monitor is possible in SQ, CTRL, RS-Ack, MST of SQ0 and GID.
Capture	A capture is possible in a maximum of 64 LCAS sequences. Trigger condition: Change point of CTRL, SQ, MST and RS-Ack. And external trigger input. It is possible to set trigger channel. It is possible to set capture channel. Display items: SQ, CTRL, Rs-Ack, MST and number of multi-frames
Error addition	GID, CRC8 (HOVCAT), CRC3 (LOVCAT)
Error addition timing	Single, All (About a VCAT group all channel)

• **MU150121A 10/10.7G Optical Unit (Tx)**

Bit rate	9953.28 Mbit/s, 10709.225 Mbit/s Depends on frequency accuracy and external input frequency of the MU150100A.
Peak wavelength	1310 ±20 nm (Option 01, 03), 1550 ±20 nm (Option 02, 03)
–20 dB width	≤0.5 nm (@–20 dB)
SMSR	≥30 dB
Extinction ratio	≥10 dB
Optical output power	0 to +3 dBm
Signal code	NRZ
Connector	FC-PC (SMF), replaceable
Electrical input	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm Input level H: 0 to –0.2 V, L: –0.85 to –1.5 V Impedance: 50 Ω Connector: SMA
Safety classification	IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS Ⅲ b
Optical output power adjustable (MU150121A-04)	Variable range: 0 to 20 dB, Accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 20 dB), Setting resolution: 0.1 dB
Supported main frame option	MP1590B-30

• **MU150134A 10/10.7G Optical Unit (Tx external modulation)**

Bit rate	9953.28 Mbit/s 10709.225 Mbit/s Depends on frequency accuracy of the MU150100A and external input frequency.
Optical output modulation	Output power: +3 dBm (C band) However, typical value when using built-in CW light source, and modulating by data signal of mark ratio 1/2. Extinction ratio: ≥10 dB Signal code: NRZ Connector: FC-PC (SMF) replaceable
External optical input	Light source: CW light source, polarization preservation fiber is used Peak wavelength: C band, L band Maximum input power: +15 dBm Minimum input power: +6 dBm Insertion loss: ≤7 dB (C band), ≤8 dB (L band) Connector: FC-PC (PMF), replaceable
Clock input	Frequency: 9953.28 MHz ±100 ppm, 10709.225 MHz ±100 ppm Input voltage: 1.3 to 0.6 Vp-p Connector: SMA (50 Ω GND)
Data input	Bit rate: 9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm Input voltage Hi: 0.0074 to –0.2074 V, Lo: –0.8426 to –1.3074 V Connector: SMA (50 Ω GND)
Optical reference output	Optical source: CW light source Peak wavelength: 1550 ±20 nm (C band) –20 dB width: ≤1 nm Side mode suppression ratio: ≥30 dB Output power: +10 to +13 dBm Polarization Extinction ratio: ≥20 dB Connector: FC-PC (PMF), replaceable
Safety classification	IEC 60825-1: CLASS 1M, 21CFR 1040.10: CLASS Ⅲ b
Optical output power adjustable (MU150134A-04)	Variable range: 0 to 20 dB, Accuracy: ≤±0.5 dB (0 to 10 dB), ≤±1.0 dB (10.1 to 20 dB), Setting resolution: 0.1 dB
Supported main frame option	MP1590B-30

• **MU150122A 10/10.7G Optical Unit (Rx narrow), MU150123A 10/10.7G Optical Unit (Rx wide)**

Model	MU150122A	MU150123A
Bit rate	9953.28 Mbit/s ±100 ppm, 10709.225 Mbit/s ±100 ppm	
Optical input wavelength	1260 to 1610 nm	
Optical input sensitivity	–14 to 0 dBm	
Absolute maximum optical input	+3 dBm (average)	
Optical input signal code	NRZ	
Optical input return loss	≥27 dB	
Optical connector	FC-PC (SMF), replaceable	
Electrical output signal	9953.28 Mbit/s, 10709.225 Mbit/s Output level: 0.2 to 1.0 Vp-p Signal code: NRZ Impedance: 50 Ω Connector: SMA	Data output: 9953.28 Mbit/s, 10709.225 Mbit/s*1 Output level: 1.0 ±0.25 Vp-p Signal code: NRZ Clock output 9953.28 MHz, 10709.225 MHz*1 Output level: 0.8 ±0.25 Vp-p Impedance: 50 Ω Connector: SMA
Optical input power measurement	Measurement range: –20 to +2 dBm Measurement accuracy: ≤±0.5 dB (+2 to –10 dBm), ≤±1.0 dB (–10.1 to –20 dBm)	
Supported main frame option	—	MP1590B-30

*1: MU150123A-05 is required.

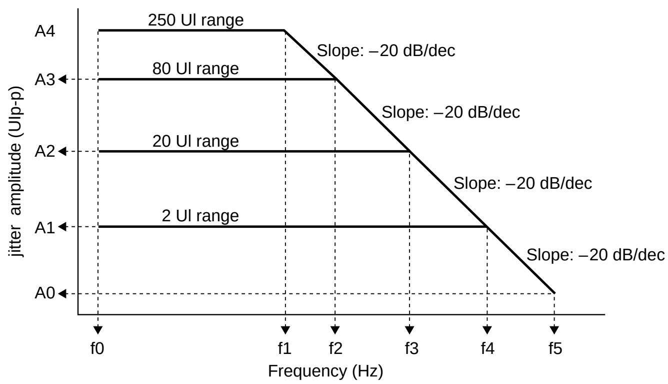
• **MU150125A 10/10.7G jitter Unit**

Jitter generation/ measurement frequency	51.84 MHz, 155.52 MHz, 622.08 MHz, 2488.32 MHz, 9953.28 MHz 2666.06 MHz (MU150125A-05), 10709.225 MHz (MU150125A-05) 10312.5 MHz (MU150125A-06)
10/10.3/10.7G Clock output 52M to 2.66 GHz Clock output	Frequency: 51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm Accuracy: ±0.1 ppm [After power on, calibrate after 24 hours, warm-up 23 ±5˚C, aging rate (Max.): ±0.05 ppm/day, ±0.5 ppm/year] Level: 0.8 Vp-p ±0.25 V Connector: SMA, 50 Ω (AC)

Jitter generation

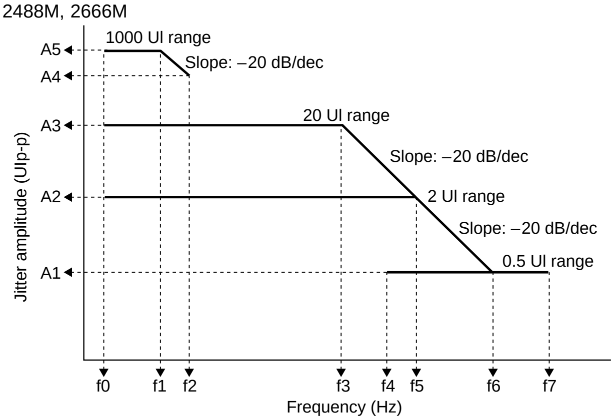
Modulation frequency: 0.1 to 80 MHz
Amplitude: 0 to 4040 UIp-p

Modulation value:
52M, 156M, 622M



Bit rate (bit/s)	f0 (Hz)	f1 (kHz)	f2 (kHz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	A0 (UIp-p)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)
52M	0.1	—	—	50	500	1.3	0.776	2.02	20.20	—	—
155M	0.1	—	38	150	1500	3.8	0.797	2.02	20.20	80.8	—
622M	0.1	4.8	15	60	600	5	0.242	2.02	20.20	80.8	253.0

2488M, 2666M

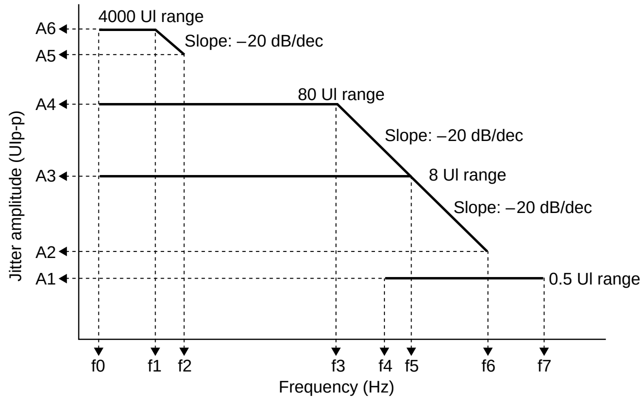


Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (MHz)	f6 (MHz)	f7 (MHz)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)	A5 (UIp-p)
2488M 2666M	0.1	15	600	100	500	1	4	20	0.505	2.02	20.2	25	1010

Continued on next page

Jitter generation

9953M, 10.3G, 10.7G



Bit rate (bit/s)	f0 (Hz)	f1 (Hz)	f2 (Hz)	f3 (kHz)	f4 (kHz)	f5 (kHz)	f6 (MHz)	f7 (MHz)	A1 (UIp-p)	A2 (UIp-p)	A3 (UIp-p)	A4 (UIp-p)	A5 (UIp-p)	A6 (UIp-p)
9953M 10.3G 10.7G	0.1	15	600	100	500	1	4	80	0.505	2.02	8.08	80.8	110	4040

Accuracy:
- 0.5 UI range: ±Q % of setting ±0.02 UIp-p
- 2 UI range: ±Q % of setting ±0.02 UIp-p
- 8 UI range: ±Q % of setting ±0.8 UIp-p
- 20 UI range: ±Q % of setting ±0.2 UIp-p
- 20 UI range: ±Q % of setting ±1.2 UIp-p (2488M, 2666M)
- 80 UI range: ±Q % of setting ±1.2 UIp-p
- 80 UI range: ±Q % of setting ±4.8 UIp-p (9953M, 10.3G, 10.7G)
- 250 UI range: ±Q % of setting ±6 UIp-p
- 1000 UI range: ±Q % of setting ±6 UIp-p
- 4000 UI range: ±Q % of setting ±24 UIp-p

Frequency	Variable error Q	Frequency range
52 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 1.3 MHz
156 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 1.5 MHz
	±15 %	1.5 MHz to 3.8 MHz
622 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 5 MHz
2488 MHz 2666 MHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 20 MHz
9953MHz 10.3 GHz 10.7 GHz	±8 %	0.1 to 500 kHz
	±12 %	500 kHz to 2 MHz
	±15 %	2M to 80 MHz

10/10.3/10.7G Clock input
52M to 2.66 GHz Clock input

Frequency:
51.84 MHz ±100 ppm, 155.52 MHz ±100 ppm, 622.08 MHz ±100 ppm, 2488.32 MHz ±100 ppm, 2666.057 MHz ±100 ppm, 9953.28 MHz ±100 ppm, 10312.5 MHz ±100 ppm, 10709.225 MHz ±100 ppm
Level: 0.8 Vp-p ±0.3 V (52 MHz to 2.6 GHz), 0.8 Vp-p ±0.25 V (10/10.3/10.7 GHz)
Connector: SMA, 50 Ω (AC)

Jitter measurement

Manual jitter measurement: UIp-p, UI+p, UI-p/UIrms
UIp-p measurement:
- 2 UI range (–1.010 to 1.010 UIp-p/Step 0.001 UIp-p)
- 20 UI range (–10.10 to 10.10 UIp-p/Step 0.01 UIp-p)
- 80 UI range (–40.4 to 40.4 UIp-p/Step 0.25 UIp-p)
- 250 UI range (–123.0 to 123.0 UIp-p/Step 0.5 UIp-p)
- 1000 UI range (–510.0 to 510.0 UIp-p/Step 1 UIp-p)
- 4000 UI range (–2020 to 2020 UIp-p/Step 2 UIp-p)

UIrms measurement:
- 2 UI range (0.000 to 0.714 UIrms/Step 0.001 UIrms)
- 20 UI range (0.00 to 7.14 UIrms/Step 0.01 UIrms)

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Jitter measurement

Filter

Frequency (Hz)	HP0 (Hz)	HP1 (Hz)	HP1' (Hz)	HP2 (Hz)	HP' (Hz)	HP (Hz)	LP (Hz)	LP' (Hz)
52M	10	100	—	20k	—	12k	400k	—
156M	10	500	—	65k	—	12k	1.3M	500
622M	10	1k	—	250k	—	12k	5M	1k
2488M 2666M	10	5k	—	1M	—	12k	20M	5k
9953M 10.3G 10.7G	10	20k	10k	4M	50k	12k	80M	20k

Accuracy (UIp-p, UI+p, UI-p):
- 2 UI range: ±R% ±W UIp-p
- 20 UI range: ±R% ±W UIp-p
- 80 UI range: ±R% ±W UIp-p
- 250 UI range: ±R% ±W UIp-p
- 1000 UI range: ±R% ±W UIp-p
- 4000 UI range: ±R% ±W UIp-p

Accuracy (UIrms)
- 2 UI range: ±R% ±Y UI rms
- 20 UI range: ±R% ±Y UI rms

Frequency (Hz)	W Clock signal						
	HP1+LP		HP2+LP		HP+LP*		HP0+LP'
	2 UI	20 UI	2 UI	20 UI	2 UI	20 UI	80/250/1000/4000 UI
52M	0.05	0.5	0.03	0.3	0.03	0.3	—
156M	0.05	0.5	0.02	0.2	0.03	0.3	2
622M	0.05	0.5	0.03	0.3	0.03	0.3	8
2488M 2.6G	0.05	0.5	0.03	0.3	0.03	0.3	20
9953M 10.3G 10.7G	0.05	0.5	0.03	0.3	0.03	0.3	80

Frequency (Hz)	Y Clock signal	
	HP+LP*	
	2 UI	20 UI
52M	0.008	0.04
156M	0.008	0.04
622M	0.008	0.04
2488M 2666M	0.008	0.04
9953M 10.3G 10.7G	0.008	0.05

*: Apply HP'+LP at 9953M, 10.3G, 10.7G

MU150100A loop back measurement

Bit rate (Mbit/s)	W data signal			Y data signal
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.070	0.070	0.035	0.010
51.84 (Electrical)	0.070	0.070	0.035	0.010
155.52 (Optical)	0.070	0.070	0.035	0.010
155.52 (Electrical)	0.070	0.070	0.035	0.010
622.08 (Optical)	0.070	0.070	0.035	0.010
2488.32 (Optical)	0.080	0.080	0.060	0.010
2666.05* (Optical)	0.080	0.080	0.060	0.010

*: Built-in MU150125A-05

Measurement condition
- Temperature condition: +10˚ to +40˚C
- Optical input level: –10 to –12 dBm
- Measurement time: 1 min
- Optical input wavelength: 1310 nm/1550 nm
- Mapping
  - SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)
  - SONET: STSnc (n = 1, 3, 12, 48)
  - OTU-1: ODU1-OPU1-PRBS

Test pattern: 2^{23} – 1 (Inv.) (SDH/SONET), 2^{31} – 1 (OTU-1), Mark ratio 1/2, Scramble “On”
Clock: internal

Continued on next page

Jitter measurement

MU150100A with MU150125A Receiver only

Bit rate (Mbit/s)	W data signal (Typical)			Y data signal
	UIp-p			UIrms
	HP1+LP	HP+LP	HP2+LP	HP+LP
	2 UI	2 UI	2 UI	2 UI
51.84 (Optical)	0.035	0.035	0.035	0.009
51.84 (Electrical)	0.035	0.035	0.035	0.009
155.52 (Optical)	0.035	0.035	0.035	0.009
155.52 (Electrical)	0.035	0.035	0.025	0.009
622.08	0.035	0.035	0.035	0.009
2488.32	0.035	0.035	0.035	0.009
2666.05*	0.035	0.035	0.035	0.009

*: Built-in MU150125A-05

Measurement condition
Temperature condition: +10˚ to +40˚C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1310 nm/1550 nm
Mapping
SDH: VC3-Bulk (52M), VC4-nc (n = 1, 4, 16) (156M/622M/2488M)
SONET: STSnc (n = 1, 3, 12, 48)
OTU-1: ODU1-OPU1-PRBS
Test pattern: 2^{23} – 1 (Inv.) (SDH/SONET), 2^{31} – 1 (OTU-1), Mark ratio 1/2, Scramble “On”

MU150100A, MU150121A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			Y data signal
	UIp-p			UIrms
	HP1+LP	HP'+LP	HP2+LP	HP'+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.080	0.080	0.060	0.010
10709.225*	0.080	0.080	0.060	0.010

*: Built-in MU150125A-05

Measurement condition
Temperature condition: +10° to +40°C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1310 nm/1550 nm
Mapping
SDH: VC4-64c (9953M)
SONET: STS192c (9953M)
OTU-2: ODU2-OPU2-PRBS
Test pattern: 2^{23} – 1 (Inv.) (SDH/SONET), 2^{31} – 1 (OTU-2), Mark ratio 1/2, Scramble “On”
Clock: internal

MU150100A, MU150134A, MU150123A loop back measurement

Bit rate (Mbit/s)	W data signal			Y data signal
	UIp-p			UIrms
	HP1+LP	HP'+LP	HP2+LP	HP'+LP
	2 UI	2 UI	2 UI	2 UI
9953.280	0.065	0.065	0.060	0.010
10709.225*	0.065	0.065	0.060	0.010

*: Built-in MU150125A-05

Measurement condition
Temperature condition: +10° to +40°C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1550 nm
Mapping
SDH: VC4-64c (9953M)
SONET: STS192c (9953M)
OTU-2: ODU2-OPU2-PRBS
Test pattern: 2^{23} – 1 (Inv.) (SDH/SONET), 2^{31} – 1 (OTU-2), Mark ratio 1/2, Scramble “On”
Clock: internal

Continued on next page

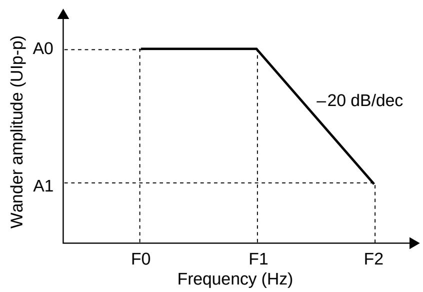
<table>
<tr><td>Jitter measurement</td><td>
MU150123A with MU150125A Receiver only
<table>
<tr><td rowspan="4">Bit rate
(Mbit/s)</td><td colspan="3">W data signal</td><td>Y data signal</td></tr>
<tr><td colspan="3">UIp-p</td><td>UIrms</td></tr>
<tr><td>HP1+LP</td><td>HP'+LP</td><td>HP2+LP</td><td>HP'+LP</td></tr>
<tr><td>2 UI</td><td>2 UI</td><td>2 UI</td><td>2 UI</td></tr>
<tr><td>9953.280</td><td>0.035</td><td>0.035</td><td>0.035</td><td>0.009</td></tr>
<tr><td>10709.225*</td><td>0.035</td><td>0.035</td><td>0.035</td><td>0.009</td></tr>
</table>
*: Built-in MU150125A-05

Measurement condition
Temperature condition: +10° to +40°C
Optical input level: –10 to –12 dBm
Measurement time: 1 min
Optical input wavelength: 1310 nm/1550 nm
Mapping
SDH: VC4-64c (9953M)
SONET: STS192c (9953M)
OTU-2: ODU2-OPU2-PRBS
Test pattern: $2^{23} – 1$ (Inv.) (SDH/SONET), $2^{31} – 1$ (OTU-2), Mark ratio 1/2, Scramble “On”

Additional error [R]
<table>
<tr><td>Additional error</td><td>Frequency range</td></tr>
<tr><td>±15 %</td><td><100 Hz (52M)
<500 Hz (156M)
<1 kHz (622M)
<5 kHz (2488M, 2666M)
<20 kHz (9953M/10.3G/10.7G)</td></tr>
<tr><td>±7 %</td><td>100 Hz to 300 kHz (52M)
500 Hz to 300 kHz (156M)
1 kHz to 300 kHz (622M)
5 kHz to 300 kHz (2488M, 2666M)
20 kHz to 300 kHz (9953M/10.3G/10.7G)</td></tr>
<tr><td>±8 %</td><td>300 kHz to 400 kHz (52M)
300 kHz to 1 MHz (≥156M)</td></tr>
<tr><td>±10 %</td><td>1 MHz to 1.3 MHz (156M)
1 MHz to 3 MHz (≥622M)</td></tr>
<tr><td>±15 %</td><td>3 MHz to 5 MHz (622M)
3 MHz to 10 MHz (≥2448M)</td></tr>
<tr><td>±20 %</td><td>10 MHz to 20 MHz (2488M, 2666M)
10 MHz to 80 MHz (9953M/10.3G/10.7G)</td></tr>
</table>
</td></tr>
<tr><td>Hit measurement</td><td>Count, Hit seconds, % free seconds</td></tr>
<tr><td>Jitter tolerance</td><td>Evaluate jitter tolerance by selected Mask
Mask selection:
Telcordia GR-253, ANSI T1.105.03
ITU-T G.783, G.825, G.813, G.8251
ETSI EN 302 084
User</td></tr>
<tr><td>Jitter transfer</td><td>Evaluate jitter transfer by selected Mask
Accuracy:±0.05 dB ±0.12*g
Applicable frequency range
0.01*fc to 100*fc, or maximum frequency setting value
The maximum frequency setting value is applied in the case of 100*fc
g: Transfer gain (dB) for every frequency point
fc: Cut-off frequency of transfer mask
Measurement condition
Average level: Fine
Waiting time: 20 s
Input jitter value: ≥0.15 UIp-p
Jitter modulation frequency: ≥300 Hz
Dynamic range: ≤–40 dB (at the above measurement condition)
Mask selection [Maximum value of a mask is 100 times as much modulation frequency as a break point (fc)]:
Telcordia GR-253
ANSI T1.105.03
ITU-T G.783, G.8251
ETSI 300 417-1-1
User</td></tr>
<tr><td>Reference clock output</td><td>Frequency: 52M: 51.84 MHz ±100 ppm
156M: 155.52 MHz ±100 ppm
622M: 622.08 MHz ±100 ppm
2448M/9953M: 155.52 MHz ±100 ppm or 622.08 MHz ±100 ppm
2666M: 166.629 MHz ±100 ppm or 666.514 MHz ±100 ppm
10.3G: 161.133 MHz ±100 ppm or 644.531 MHz ±100 ppm
10.7G: 167.332 MHz ±100 ppm or 669.327 MHz ±100 ppm
Output Voltage: 0.8 Vp-p ±0.25 V
Connector: SMA (50 Ω AC)</td></tr>
</table>

Continued on next page

<table>
<tr><td>External jitter modulation signal input</td><td>Frequency: 0.1 to 80 MHz
Accuracy: 0.5 UI range : 2488M/2666M 0.5 UIp-p / 1Vp-p, 9953M/10.3G/10.7G 0.5 UIp-p / 0.25Vp-p
2 UI range : 2 UIp-p / 1 Vp-p
20 UI range : 20 UIp-p / 1 Vp-p
80 UI range : 80 UIp-p / 1 Vp-p
250 UI range : 250 UIp-p / 1 Vp-p
1000 UI range : 1000 UIp-p / 1 Vp-p
4000 UI range : 4000 UIp-p / 1 Vp-p
Connector: BNC (50 Ω GND)</td></tr>
<tr><td>Jitter recovery signal output</td><td>Frequency: 0.1 to 80 MHz
2 UI range : 2 UIp-p / 1 Vp-p
20 UI range : 20 UIp-p / 1 Vp-p
80 UI range : 80 UIp-p / 1 Vp-p
250 UI range : 250 UIp-p / 1 Vp-p
1000 UI range : 1000 UIp-p / 1 Vp-p
4000 UI range : 4000 UIp-p / 1 Vp-p
Connector: BNC (50 Ω GND)</td></tr>
<tr><td>Wander generation</td><td>Modulation frequency: 10 µHz to 10 Hz
Amplitude: 0 to 400,000 UI/Step 1 UIp-p



<table>
<tr><th>Bit rate (bit/s)</th><th>F0 (Hz)</th><th>F1 (Hz)</th><th>F2 (Hz)</th><th>A0 (UIp-p)</th><th>A1 (UIp-p)</th><th>Step (UIp-p)</th></tr>
<tr><td>52M
156M
622M
2488M
9953M</td><td>10 µ</td><td>400m</td><td>10</td><td>400,000</td><td>16,000</td><td>1</td></tr>
</table>

Accuracy
±Q% of setting ±100 UIp-p

<table>
<tr><th>Error Q</th><th>Frequency range</th></tr>
<tr><td>±8 %</td><td>10 µHz to 0.125 Hz</td></tr>
<tr><td>±12 %</td><td>0.125 to 1 Hz</td></tr>
<tr><td>±15 %</td><td>1 to 10 Hz</td></tr>
</table>
</td></tr>
<tr><td>Wander measurement (MU150125A-01)</td><td>Bit rate (bit/s): 52M, 156M, 622M, 2488M, 9953M
Evaluation mode: TIE (P-P, +P, –P)
Range
p-p: 0.0 to 2E10 ns
+p, –p: 0.0 to 1E10 ns
Resolution: 0.1 ns
Accuracy: TIE
±0.5% ±Z0 (τ)
Filter selection: DC to 10 Hz, DC to 0.01 Hz, 0.01 to 10 Hz

<table>
<tr><th>Z0 (τ)(ns)</th><th>Observation time τ (s)</th></tr>
<tr><td>2.5 + 0.0275 τ</td><td>0.05 ≤ τ ≤1000</td></tr>
<tr><td>29 + 0.001 τ</td><td>τ >1000</td></tr>
</table>
</td></tr>
<tr><td>Supported main frame option</td><td>MP1590B-30</td></tr>
</table>

• **MU120101A 10M/100M Ethernet Module, MU120102A Gigabit Ethernet Module, MU120118A 10 Gigabit Ethernet Module**

<table>
<tr><td colspan="2">Model</td><td>MU120101A</td><td>MU120102A</td><td>MU120118A</td></tr>
<tr><td colspan="2">Ports</td><td>10BASE-T/100BASE-TX
Number of ports: 8
Connector: RJ-45
Link speed: 10 Mbit/s, 100 Mbit/s
Duplex mode: Full, Half
Auto negotiation: On/Off
Flow control: On/Off</td><td>1000BASE-SX/LX/LH/ZX*1
Number of ports: 2
Connector: GBIC interface (SC connector)
Link speed: 1 Gbit/s
Duplex mode: Full
Auto negotiation: On/Off
Flow control: On/Off</td><td>10GBASE-SR/LR/ER*2
Number of ports: 2
Connector: XENPAK interface (SC connector)
Link speed: 10 Gbit/s
Duplex mode: Full
Flow control: On/Off</td></tr>
<tr><td colspan="2">LEDs</td><td>Link, Tx/Collision, Rx/Error</td><td colspan="2">Link, Tx, Rx, Error</td></tr>
<tr><td colspan="2">Frame Settings</td><td colspan="3">MAC address: Fixed, Increment, Decrement, Random (changeable portions specified in 4 bits units)
VLAN tag*3: Fixed, Increment, Decrement, Random
MPLS label*3: Up to 10 MPLS labels can be appended. Fixed setting
Protocol editing:
IPv4, IPv6, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPX, ARP, MAC control, IS-IS
Data field
Can set any 4 portions of data field: All 1, All 0, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment*4, Decrement*4, Random*4, Single PRBS9*4
Data field 1 only: Time stamp*4, Sequence number*4, User defined, Test frame</td></tr>
<tr><td colspan="2">Frame Length</td><td>12 to 10000 byte (Settable as auto, Fixed, Increment*5, or Random*5)</td><td colspan="2">48 to 65280 byte (Settable as auto, Fixed, Increment*5, or Random*5)</td></tr>
<tr><td colspan="2">Stream Transport Mode</td><td colspan="2">Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count
Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,777,215,
Burst count per stream: 1 to 16,777,215</td><td>Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count
Loop count: 1 to 16,000,000, Frame count per burst: 1 to 1,099,511,627,775, Burst count per stream: 1 to 1,099,511,627,775</td></tr>
<tr><td rowspan="3">Stream Gap Setting</td><td>Inter Frame Gap</td><td>10BASE-T: Resolution of 800 ns
8 µs to 1700 s, Settable as fixed, Random
100BASE-TX: Resolution of 80 ns
800 ns to 170 s, Settable as fixed, Random</td><td>Resolution of 8 ns
64 ns to 120 s, Settable as fixed, Random</td><td>Resolution of 0.8 ns
7.2 ns to 120 s, Settable as fixed, Random</td></tr>
<tr><td>Inter Burst Gap</td><td>10BASE-T: Resolution of 800 ns
8 µs to 1700 s, Settable as fixed
100BASE-TX: Resolution of 80 ns
800 ns to 170 s, Settable as fixed</td><td>Resolution of 8 ns
64 ns to 120 s, Settable as fixed</td><td>Resolution of 0.8 ns
7.2 ns to 120 s, Settable as fixed</td></tr>
<tr><td>Inter Stream Gap</td><td>10BASE-T: Resolution of 800 ns
8 µs to 1700 s, Settable as fixed
100BASE-TX: Resolution 80 ns
800 ns to 170 s, Settable as fixed</td><td>Resolution of 8 ns
64 ns to 120 s, Settable as fixed</td><td>Resolution of 0.8 ns
64 ns to 120 s, Settable as fixed</td></tr>
<tr><td colspan="2">Number of Streams</td><td colspan="3">256 Streams/Port</td></tr>
<tr><td rowspan="3">Error Insertion</td><td>Frame Error</td><td>FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error, Alignment error, Dribble bit error, Collision</td><td colspan="2">FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error</td></tr>
<tr><td>Packet Error</td><td colspan="3">IPv4 header checksum error, TCP/UDP checksum error</td></tr>
<tr><td>Packet BER Test (MP1590B-11)*6</td><td>—</td><td colspan="2">PRBS bit error</td></tr>
<tr><td rowspan="8">Counter</td><td>Common</td><td colspan="3">Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate</td></tr>
<tr><td>Ethernet</td><td>Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Dribble bit error, Line error, Fragment, Undersize, Oversize, Oversize & FCS error, FCS error, Alignment error, Collision</td><td>Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Line error,Fragment, Undersize, Oversize, Oversize & FCS error, FCS error, Byte alignment error</td><td>Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Fragment, Undersize, Oversize, Oversize & FCS error, FCS error</td></tr>
<tr><td>IP/TCP/UDP</td><td colspan="3">Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, IPv4 header checksum error, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, Fragments, Received TCP packet count/rate, TCP checksum error, Received UDP packet count/rate, UDP checksum error, QoS 0 to 7 frame count/rate</td></tr>
<tr><td>Unframed</td><td>—</td><td>Bit error count/rate, Pattern Sync Loss count/second</td><td>MP1590B-13*7</td></tr>
<tr><td>Packet BER Test (MP1590B-11)*6</td><td>—</td><td colspan="2">Transmitted test frame, Received test frame, Sequence error, Received PRBS bit error count/rate, Received PRBS error frame count/rate</td></tr>
<tr><td>XENPAK Test (MP1590B-13)*7</td><td colspan="2">—</td><td>Bit error count/rate, Pattern sync loss count/rate, Bit error count lane 0 to 3, Bit error rate lane 0 to 3, Pattern sync loss lane 0 to 3, Pattern sync loss second lane 0 to 3</td></tr>
<tr><td>Link Fault Signaling (MP1590B-16)*6</td><td colspan="2">—</td><td>Transmitted LFS, Received LFS</td></tr>
</table>

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Model	MU120101A	MU120102A	MU120118A
Latency	Maximum, Minimum, Average		
Frame Arrival Time Variation Measurement	Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s		
QoS Counter Setting	Using Qos described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field		
Unframed BER Test*7	–	Test pattern: All 0, All 1, User-defined 16-bit pattern, 2^{23} – 1 (Inv.), 2^{31} – 1, CJ PAT, CRPAT Error insertion: Bit error Error insertion timing: Single error, Fix rate: $1*10^{-n}$ (n: 3 to 9), User program: $A*10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10)	
Capture Buffer	8 Mbyte/port	32 Mbyte/port	256 Mbyte/port
Capture Filter	At following conditions for each port, capture filter condition settings: Destination MAC address, Source MAC address, 32-bit pattern (settable bit length and offset) x 2, Error conditions		
Capture Trigger	At following conditions for each port, capture trigger condition settings: Destination MAC address, Source MAC address, 32-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input		
Protocol Decode	ARP, BGP-4, DHCP, DVMRP, Ethernet, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAC Control Frame, MPLS, MPLSCP, OSPFv2, RIP, RSVP, SNAP, TCP, UDP, VLAN, Test Frame		
Protocol Emulation	ARP, PING, IGMP, BGP-4		
Traffic Monitor	Ethernet frame count for up to 64 flows, IP packet count for up to 64 flows, Frame count for up to 64 protocols		
Traffic Map	Ethernet data flow for up to 256 flows, IP data flow for up to 256 flows		
Service Disruption Time	Measure a total time of receiving no frame as service disruption time. A resolution of this measurement depends on the transmitted frame size and IFG.		
RFC2544 Automatic Test	Throughput, Latency, Frame Loss Rate, Back to Back Frame, System Recovery, Reset		
RFC2889 Automatic Test (MP1590B-10)*6	–	[1] Fully Meshed Throughput, Frame Loss and Forwarding Rates, [2] Partially Meshed one-to-Many/Many-to-One, [3] Partially Meshed Multiple Devices, [4] Partially Meshed Unidirectional Traffic, [5] Congestion Control, [6] Forward Pressure and Maximum Forwarding Rate, [7] Address Caching Capacity, [8] Address Learning Rate, [9] Error Frames Filtering, [10] Broadcast Frame Forwarding and Latency	–
Link Fault Signaling (MP1590B-16)*6	–		LFS pattern transmit function, LFS transmitted counter function, Received counter function, LFS data capture, LFS emulation function
Supported main frame option	–	MP1590B-10, MP1590B-11	MP1590B-11, MP1590B-13, MP1590B-16

*1: 1000BASE-SX/LX/LH/ZX can be selected by changing the GBIC module.
*2: 10GBASE-LR/SR/ER can be selected by changing the XENPAK module.
*3: VLAN tag and MPLS labels cannot both be used simultaneously.
*4: This function causes TCP/UDP checksum error when it uses TCP/UDP frame.
*5: Increment and random of frame length can be used only when choosing “None” as a protocol.
*6: Main frame option is required.
*7: Unframed BER Test (MU120118A) requires main frame option (MP1590B-13)

• MU120111A 10/100M Ethernet Module, MU120112A Gigabit Ethernet Module

Model		MU120111A	MU120112A
Ports		10BASE-T/100BASE-TX Number of ports: 8 Connector: RJ-45 Link speed: 10 Mbit/s, 100 Mbit/s Duplex mode: Full, Half Auto negotiation: On/Off Flow control: On/Off	1000BASE-SX/LX/LH/ZX[*1], Electrical: 1000BASE-T[*1] Number of ports: 2 Connector: GBIC interface (GBIC: SC, RJ-45) Link speed: 1 Gbit/s Duplex mode: Full Auto negotiation: On/Off Flow control: On/Off
LEDs		Link (10/100M), Tx/Collision, Rx/Error	Link, Tx, Rx, Error
Frame settings		MAC address: Fixed, Increment, Decrement, Random (changeable portions specified in 4 bits units) VLAN tag[*2]: Fixed, Increment, Decrement, Random MPLS label[*2]: Up to 10 MPLS labels can be appended (fixed setting) Protocol editing: Ethernet, IPv4, IPv6, TCP/IPv4, UDP/IPv4, IGMP/IPv4, ICMP/IPv4, RIP/UDP/IPv4, DHCP/UDP/IPv4, IPX, ARP, MAC control, IS-IS MP1590B-12[*3]: TCP/IPv6, UDP/IPv6, ICMPv6/IPv6, IPv6 over IPv4, ICMPv6/IPv6 over IPv4, TCP/IPv6 over IPv4, UDP/IPv6 over IPv4 Data field Can set any 4 portions of data field: All 1, All 0, Alternate1/0 (Each bit, Each 2 bits, Each 4 bits, Each byte, Each 2 bytes), Increment[*4], Decrement[*4], Random[*4], Single PRBS9[*4] Data Field 1 only: Time stamp[*4], Sequence number[*4], User defined, Test frame	
Frame length		12 to 10000 byte (Settable as auto, Fixed, Increment[*5], or Random[*5])	48 to 65280 byte (Settable as auto, Fixed, Increment[*5], or Random[*5])
Stream Transport Mode		Continuous, Continuous burst, Stop after this stream, Next stream, Jump to stream, Jump to stream for count (Loop count: 1 to 16,000,000, Frame count per burst: 1 to 16,777,215, Burst count per stream: 1 to 16,777,215)	
Stream Gap Setting	Inter Frame Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed, Random 100BASE-TX: Resolution of 80 ns 800 ns to 170 s, Settable as fixed, Random	Resolution of 8 ns 64 ns to 120 s, Settable as fixed, Random
	Inter Burst Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-T: Resolution of 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed
	Inter Stream Gap	10BASE-T: Resolution of 800 ns 8 µs to 1700 s, Settable as fixed 100BASE-TX: Resolution 80 ns 800 ns to 170 s, Settable as fixed	Resolution of 8 ns 64 ns to 120 s, Settable as fixed
Number of Streams		256 Streams/Port	
Error Insertion	Frame Error	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error, Alignment error, Dribble bit error, Collision	FCS error, Undersize error, Oversize error, Fragments error, Oversize & FCS error
	Packet Error	IPv4 header checksum error, TCP/UDP checksum error	
	Packet BER Test (MP1590B-11)[*3]	PRBS error	
Counter	Common	Transmitted frame count/rate, Received frame count/rate, Transmitted bit count/rate, Received bit count/rate, Transmitted byte/rate, Received byte/rate, Capture trigger, Capture filter, User defined 1 count/rate, User defined 2 count/rate	
	Ethernet	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Dribble bit error, Line error, Fragments, Undersize, Oversize, Oversize & FCS error, FCS error, Alignment error, Collision	Transmitted ARP reply, Received ARP reply, Transmitted ARP request, Received ARP request, Flow control, Line error, Fragments, Undersize, Oversize, Oversize & FCS error, FCS error, Byte alignment error
	IP/TCP/UDP	Transmitted IPv4 packet count/rate, Received IPv4 packet count/rate, Transmitted PING reply, Received PING reply, Transmitted PING request, Received PING request, QoS 0 to 7 frame count/rate, Received TCP packet count/rate, Received UDP packet count/rate, IPv4 header checksum error, TCP checksum error, UDP checksum error	
	Unframed[*6]	Bit error count/rate, Pattern sync loss count/second	
	Packet BER Test (MP1590B-11)[*3]	Transmitted test frame, Received test frame, Sequence error, PRBS bit error count/rate, PRBS frame error count/rate	
	IPv6 Expansion (MP1590B-12)[*3]	Transmitted IPv6 packet count/rate, Received IPv6 packet count/rate, Transmitted ICMPv6 echo request, Received ICMPv6 echo request, Transmitted ICMPv6 echo reply, Received ICMPv6 echo reply, Transmitted ICMPv6 (NA), Received ICMPv6 (NA), Transmitted ICMPv6 (NS), Received ICMPv6 (NS)	
Latency		Maximum, Minimum, Average	
Frame Arrival Time Variation Measurement		Time resolution: 1 µs, 10 µs, 100 µs, 1 ms, 10 ms, 100 ms, 1 s	
QoS Counter Setting		Using QoS described below, 8-level priority frame count: IEEE802.1D VLAN tag user priority field, 3 LSB of RFC2474 DSCP field	
Unframe BER Test[*6]		Test pattern: All 0, All 1, User-defined 16-bit pattern, $2^{23}-1$ (Inv.), $2^{31}-1$ Error insertion: Bit unit Error insertion timing: Single error, Fix rate: 1 $*10^{-n}$ (n: 3 to 9), User program: A $*10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10)	Test pattern: All 0, All 1, User-defined 16-bit pattern, $2^{23}-1$ (Inv.), $2^{31}-1$, CJPAT, CRPAT Error insertion: Bit unit Error insertion timing: Single error, Fix rate: 1 $*10^{-n}$ (n: 3 to 9), User program: A $*10^{-B}$ (A: 1.0 to 9.9 step 0.1, B: 2 to 10)
Capture Buffer		8 Mbyte/port	32 Mbyte/port

Continued on next page

Model	MU120111A	MU120112A
Capture Filter	At following conditions for each port, capture filter condition settings: Destination MAC address, Source MAC address, 128-bit pattern (settable bit length and offset) x 2, Error conditions	
Capture Trigger	At following conditions for each port, capture trigger condition settings: Destination MAC address, Source MAC address, 128-bit pattern (settable bit length and offset) x 2, Error conditions, Traffic over, Latency over, External trigger input	
Protocol Decode	ARP, BGP-4, DHCP, DVMRP, Ethernet, ICMP, ICMPv6, IGAP, IGMP, IPCP, IPv4, IPv6, IPv6CP, IPX, IS-IS, LCP, LDP, MAC Control Frame, MPLS, MPLSCP, OSPFv2, RIP, RSVP, SNAP, TCP, UDP, VLAN, MD1230A Test Frame	
Protocol Emulation	ARP, ICMP for IPv4, IGMP, BGP-4, OSPF (MP1590B-07), MPLS LDP/CR-LDP (MP1590B-08), MPLS RSVP (MP1590B-09), ICMP for IPv6 (MP1590B-12), IGAP (MP1590B-14)	
Traffic Monitor	Ethernet frame count for up to 64 flows, IP packet count for up to 64 flows, Frame count for up to 64 protocols	
Traffic Map	Ethernet data flow for up to 256 flows, IP data flow for up to 256 flows	
Service Disruption Time	Time of frame disruption	
RFC2544 Automatic Test	Throughput, Latency, Frame Loss Rate, Back-to-Back Frame, System Recovery, Reset	
RFC2889 Automatic Test (MP1590B-10)[*3]	[1] Fully Meshed Throughput and Frame Loss, Forwarding Rate, [2] Partially Meshed one-to-Many/Many-to-One, [3] Partially Meshed Multiple Devices, [4] Partially Meshed Unidirectional Traffic, [5] Congestion Control, [6] Forward Pressure and Maximum Forwarding Rate, [7] Address Caching Capacity, [8] Address Learning Rate, [9] Error Frames Filtering, [10] Broadcast Frame Forwarding and Latency	
Supported main frame option	MP1590B-07, MP1590B-08, MP1590B-09, MP1590B-10, MP1590B-11, MP1590B-12, MP1590B-14	

*1: 1000BASE-SX/LX/LH/ZX/T can be selected by changing the GBIC module.
*2: VLAN tag and MPLS labels cannot both be used simultaneously.
*3: Main frame option is required.
*4: This function causes TCP/UDP checksum error when it uses TCP/UDP frame.
*5: Increment and random of frame length can be used only when choosing "None" as a protocol.
*6: Unframe BER Test (MU120111A) works only on port 1 or port 5.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MP1590B	Network Performance Tester	
	Standard accessories	
	Shield power cord, 2.6 m:	1 pc[*1]
	Power cord L type (C7), 2.5 m:	1 pc[*1]
F0105	Fuse, 10 A:	2 pcs
E0008A	Optical output control key:	1 pc
E0010	Side cover:	1 pc
J0907Q	Remote inter lock cord:	1 pc
J0908	Remote inter lock terminator:	1 pc
B0329G	Front cover (3/4MW4U):	1 pc
W2428AE	MP1590B operation manual CD-ROM:	1 copy
J0617B[*2, *3]	Replaceable optical connector (FC-PC):	1 pc/2 pcs
J0739G[*4]	Optical adapter FC PANDA:	2 pcs
J0635A[*5]	Optical fiber cable (FC · PC-FC · PC-1M-SM), 1 m:	1 pc
J1200[*6]	Pmoptical fiber cord, 0.5 m:	1 pc
J0747B[*7]	Fixed optical attenuator (10 dB):	1 pc
J0747C[*8]	Fixed optical attenuator (15 dB):	1 pc
J1003N[*9]	Semi-rigid cable (136.6 mm):	2 pcs
J1003P[*9]	Semi-rigid cable (96 mm):	1 pc
J1003Q[*10, *11]	Semi-rigid cable (75.6 mm):	1 pc/2 pcs
J1003R[*9]	Semi-rigid cable (55.3 mm):	1 pc
J1003S[*8]	Semi-rigid cable (56.5 mm):	1 pc
	Units/Modules	
MU150100A[*12]	10/10.7G Unit	
MU150101A[*12]	2.5/2.6G EoS Unit	
MU150121A[*12]	10/10.7G Optical Unit (Tx)	
MU150122A	10/10.7G Optical Unit (Rx Narrow)	
MU150123A	10/10.7G Optical Unit (Rx Wide)	
MU150125A	10/10.7G Jitter Unit	
MU150134A	10/10.7G Optical Unit (Tx. Ex. mod)	
MU120101A	10M/100M Ethernet Module	
MU120102A[*13]	Gigabit Ethernet Module	
MU120111A	10/100M Ethernet Module	
MU120112A[*13]	Gigabit Ethernet Module	
MU120118A[*14]	10 Gigabit Ethernet Module	

Model/Order No.	Name
	Options
MP1590B-01	RS-232C
MP1590B-02	GPIB
MP1590B-03	LAN
MP1590B-07	OSPF Protocol
MP1590B-08	MPLS (LDP/CR-LDP) Protocol
MP1590B-09	MPLS (RSVP) Protocol
MP1590B-10	RFC2889 Benchmarking Test
MP1590B-11	Packet BER Test
MP1590B-12	IPv6 Expansion
MP1590B-13	XENPAK Test
MP1590B-14	IGAP Protocol
MP1590B-16	Link Fault Signaling
MP1590B-30[*15]	High precision Jitter analysis
MU150100A-01	Wavelength 1.31 µm
MU150100A-02	Wavelength 1.55 µm
MU150100A-03	Wavelength 1.31/1.55 µm
MU150100A-04	Optical output power adjustable
MU150100A-05	OTU1/OTU2
MU150100A-07[*16]	10/10.7G Minus Option
MU150100A-09[*16]	Insert/Extract
MU150100A-38[*17]	ST connector
MU150100A-39[*17]	DIN connector
MU150100A-40[*17]	SC connector
MU150100A-43[*17]	HMS-10/A connector
MU150101A-01	Wavelength 1.31 µm
MU150101A-02	Wavelength 1.55 µm
MU150101A-03	Wavelength 1.31/1.55 µm
MU150101A-04	Optical output power adjustable
MU150101A-05	OTU1
MU150101A-06	GFP-F/LEX/LAPS
MU150101A-07	POS
MU150101A-11	HO Virtual Concatenation
MU150101A-12	LO Virtual Concatenation
MU150101A-13[*18]	LCAS
MU150101A-38[*17]	ST connector
MU150101A-39[*17]	DIN connector
MU150101A-40[*17]	SC connector
MU150101A-43[*17]	HMS-10/A connector

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Model/Order No.	Name
MU150121A-01	Wavelength 1.31 µm
MU150121A-02	Wavelength 1.55 µm
MU150121A-03	Wavelength 1.31/1.55 µm
MU150121A-04	Optical output power adjustable
MU150121A-38*17	ST connector
MU150121A-39*17	DIN connector
MU150121A-40*17	SC connector
MU150121A-43*17	HMS-10/A connector
MU150122A-38*17	ST connector
MU150122A-39*17	DIN connector
MU150122A-40*17	SC connector
MU150122A-43*17	HMS-10/A connector
MU150123A-05	OTU2
MU150123A-38*17	ST connector
MU150123A-39*17	DIN connector
MU150123A-40*17	SC connector
MU150123A-43*17	HMS-10/A connector
MU150125A-01	Wander measurement
MU150125A-05	OTU1/OTU2
MU150125A-06	10.3G
MU150134A-04	Optical output power adjustable
MU150134A-38*17	ST connector
MU150134A-39*17	DIN connector
MU150134A-40*17	SC connector
MU150134A-43*17	HMS-10/A connector
	Maintenance service
MP1590B-90	Extended three year warranty service
MU150100A-90	Extended three year warranty service
MU150101A-90	Extended three year warranty service
MU150121A-90	Extended three year warranty service
MU150122A-90	Extended three year warranty service
MU150123A-90	Extended three year warranty service
MU150125A-90	Extended three year warranty service
MU150134A-90	Extended three year warranty service
MU120101A-90	Extended three year warranty service
MU120102A-90	Extended three year warranty service
MU120111A-90	Extended three year warranty service
MU120112A-90	Extended three year warranty service
MU120118A-90	Extended three year warranty service
	Optional accessories
J0796A	ST connector (replaceable, with protective caps, 1 set)
J0796B	DIN connector (replaceable, with protective caps, 1 set)
J0796C	SC connector (replaceable, with protective caps, 1 set)
J0796D	HMS-10/A connector (replaceable, with protective caps, 1 set)
J0796E	FC connector (replaceable, with protective caps, 1 set)
J0617B	Replaceable optical connector (FC-PC)
J1003N	Semi-rigid cable (136.6 mm)
J1003P	Semi-rigid cable (96 mm)
J1003Q	Semi-rigid cable (75.6 mm)
J1003R	Semi-rigid cable (55.3 mm)
J1003S	Semi-rigid cable (56.5 mm)
J1200	Pmoptical fiber cord (both-end SFC-SP connector), 0.5 m
J0747B	Fixed optical attenuator (10 dB)
J0747C	Fixed optical attenuator (15 dB)
J0747D	Fixed optical attenuator (20 dB)
J0775D	Coaxial cable (BNC-P620 · 3C-2WS · BNC-P620, 75 Ω), 2 m
J0776D	Coaxial cable (BNC-P-3W · 3D-2W · BNC-P-3W, 50 Ω), 2 m
J0322B	Coaxial cable (11SMA · SUCOFLEX104 · 11SMA), 1 m
J0162A	Balanced cable (Siemens 3P- Siemens 3P), 1 m
J0162B	Balanced cable (Siemens 3P- Siemens 3P), 2 m
J0845A	Balanced cable (BANTAM 3P/BANTAM 3P), 6 ft
J0635A	Optical fiber cable (SM, FC-SPC connector both ends), 1 m
J0635B	Optical fiber cable (SM, FC-SPC connector both ends), 2 m
J0635C	Optical fiber cable (SM, FC-SPC connector both ends), 3 m
J0008	GPIB cable, 2 m
Z0478	Polarization rotating module (for MU150134A)
G0105A*19	GBIC SX 850 nm
G0106A*19	GBIC LX 1310 nm
G0107A*19	GBIC LH 1310 nm
G0108A*19	GBIC ZX 1550 nm
G0124A*20	GBIC T (1000BASE-T)
G0126A*21	XENPAK (10GBASE-LR)
G0131*21	XENPAK (10GBASE-ER)
G0132*21	XENPAK (10GBASE-SR)

Model/Order No.	Name
MZ1221A	XAUI Extender
MZ1222A	XENPAK Interface
J1163A	XAUI cable, 0.5 m
J1164A	MDIO cable, 0.5 m
J1109B	LAN cable (Cross), 5 m
J1110B	LAN cable (Straight), 5 m
B0336C	Carrying case
B0448	Soft case
Z0321A	Keyboard (PS/2)
Z0541A	USB mouse
W2420AE	MP1590B operation manual
W2421AE	MX159001B operation SDH edition manual
W2422AE	MX159001B operation SONET edition manual
W2423AE	MP1590B remote control operation manual
W2424AE	MU150100A specifications operation manual
W2425AE	MU150101A specifications operation manual
W2426AE	MU150125A specifications operation manual
W2427AE	MU150121/2/3/34A specifications operation manual
W1931AE	MU120101A/11A 10M/100M Ethernet Module MU120102A/12A Gigabit Ethernet Module MU120118A 10 Gigabit Ethernet Module operation manual

*1: J0491 or J0670A is attached.
*2: Supplied with MU150100A, MU150121A, MU150122A, MU150123A, MU150134A.
*3: In MU150100A, 2 pcs are supplied.
*4: Supplied with MU150134A.
*5: Supplied with MU150100A, MU150122A, MU150123A. SM, FC-SPC connector both ends.
*6: Supplied with MU150134A, FC · PANDA cord.
*7: Supplied with MU150122A, MU150123A.
*8: Supplied with MU150100A.
*9: Supplied with MU150125A.
*10: Supplied with MU150121A, MU150122A, MU150123A, MU150134A.
*11: MU150122A/MU150123A: 1 pc, MU150121A/MU150134A: 2 pcs are supplied.
*12: Requires Option 01, 02 or 03.
*13: MU120102A/12A require GBIC modules (sold separately).
*14: MU120118A requires XENPAK modules (sold separately).
*15: Unit composition has restriction. For details, please refer to a specifications.
*16: This Option must be installed in the factory. MU150100A-07 and MU150101A-09 cannot be installed simultaneously.
*17: Replaceable.
*18: This option requires the MU150101A-11 and/or MU150101A-12.
*19: The GBIC module is sold per one piece on a per-unit basis. MU120102A/12A has two GBIC interface slots.
*20: The GBIC-T module is sold on a per-unit basis. MU120112A has two GBIC interface slots.
*21: The XENPAK module is sold on a per-unit basis. MU120118A has two XENPAK interface slots.

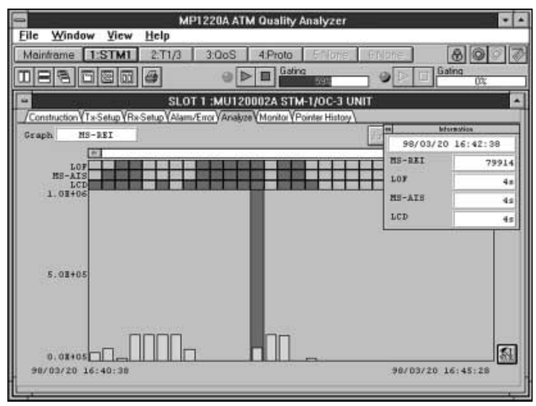
ATM QUALITY ANALYZER
MP1220A
1.5 Mbps (T1) to 622 Mbps (STM-4c/OC-12c)

For Construction and Maintenance of ATM Networks

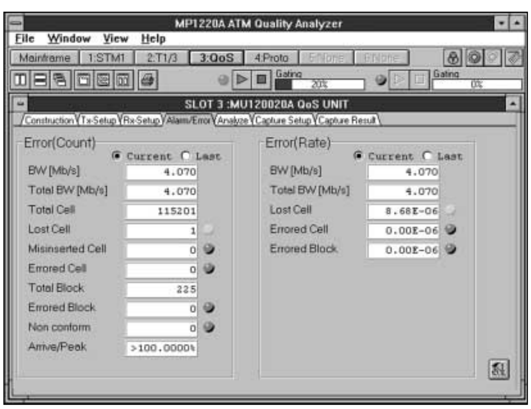
The MP1220A is a portable measuring instrument for ATM networks; it can measure the PDH/SDH physical layer, the ATM layer, and the AAL. It is the perfect instrument for troubleshooting ATM networks during construction and maintenance and has a wide range of convenient applications in manufacturing inspection of ATM devices.

Features

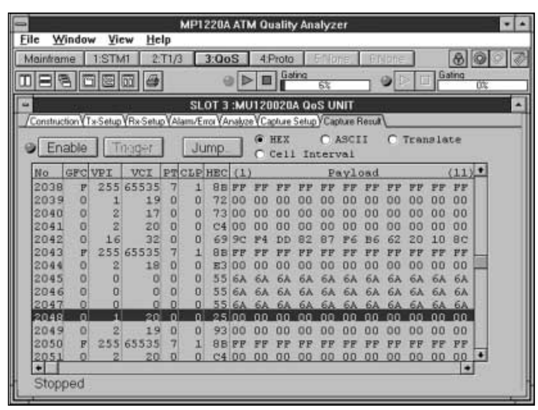
- Supports various interfaces from 1.5 Mbps (T1) to 622 Mbps (STM-4c/OC-12c) SONET and SDH
- Simultaneous measurement and real-time analysis up to the ATM-CPCS layer of two channels(up/down stream)
- Automated traffic monitoring of 1,023 network channels for bandwidth utilization
- Uses formatted payload data conforming to ITU-O.191 recommendations for cell delay performance measurements
- Small, lightweight, rack mount or portable
- Supports a variety of remote control testing configurations
- Online manuals and online help



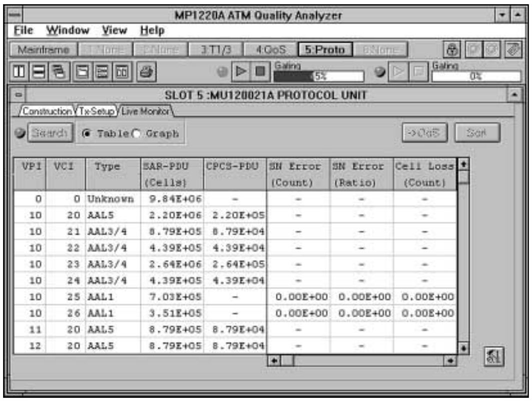
Graphical display of alarm/error history



Measurement items for test cells



Cell capture display (hexadecimal)



Automatic evaluation and measurement of AAL type for 1023 channels

Specifications

• MP1220A ATM Quality Analyzer

Display	10.4 inch TFT color LCD with touch panel (analog resistive membrane)
Memory storage	3.5 inch floppy disk drive (1.44 MB/720 KB) and hard disk drive (≥500 MB)
Buzzer	Alarm, error
External interface	RS-232C (D-sub 9-pin), printer (Centronics, D-sub, 25-pin), keyboard (PS/2, mini-DIN, 6-pin), mouse (PS/2, mini-DIN, 6-pin), VGA (analog RGB, D-sub, 15-pin)
Slots	6 (two channels max.)
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)
Dimensions and mass	284 (W) x 221.5 (H) x 365 (D) mm, ≤12 kg (excluding units)
Power supply	100 to 120/200 to 240 Vac (autoswitching), 50 to 60 Hz, ≤300 VA
Operating range	Operating: +5˚ to +50˚C (excluding FDD), Storage: –20˚ to +60˚C

• MU120001A STM-4/OC-12 Unit

Bit rate	51.84, 155.52, 622.08 Mbps
Frames	SDH/SONET
Output signal	Connector: FC (replaceable), 1.31 µm band (SM) Clock: Internal (±10 ppm), external, receive Level: –15 to –8 dBm Code: NRZ Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I
Input signal	Connector: FC (replaceable), 1.31 µm band (SM) Frequency range: ±100 ppm Level: –34 to –8 dBm (51.84 Mbps, 155.52 Mbps), –28 to –8 dBm (622.08 Mbps) Code: NRZ
Functions	SOH/POH setting, SOH/POH monitoring, path trace, empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, B1, B2, B3, FEBE-L, FEBE-P, cell Alarm addition: LOS, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LCD Error measurement: B1, B2, B3, MS-REI (FEBE-L), HP-REI (FEBE-P), HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, LOF, MS-AIS (AIS-L), MS-RDI (RDI-L), AU-AIS (AIS-P), HP-RDI (RDI-P), AU-LOP (LOP-P), LCD Pointers: Monitor, ±justification, NDF Auxiliary output: Receive clock output, trigger output

• MU120002A STM-1/OC-3 Unit

Bit rate	155.52 Mbps
Frames	SDH/SONET
Output signal	Connector Optical: SC 1.31 µm (SM); Electrical: BNC 75 Ω Clock: Internal (±10 ppm), external, receive Optical level: –15 to –8 dBm Electrical level: 1 ±0.1 Vp-p (CMI) Code Optical: NRZ, Electrical: CMI Optical safety: IEC825-1 Class 1, 21CFR1040.10 Class I

Continued on next page

Input signal	Connector Optical: SC 1.31 µm (SM/MM); Electrical: BNC 75 Ω Frequency range: ±100 ppm Optical level: –28 to –8 dBm (SM) Electrical level: 1 ±0.1 Vp-p (CMI) *Cable loss: 0 to 12 dB, Monitor: 20 dB attenuated level of above level can be applied. Code Optical: NRZ; Electrical: CMI
Functions	SOH/POH setting, SOH/POH monitoring, path trace, empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, B1, B2, B3, FEBE-L, FEBE-P, cell Alarm addition: LOS, LOF, AIS-L, RDI-L, AIS-P, RDI-P, LOP-P, LCD Error measurement: B1, B2, B3, MS-REI (FEBE-L), HP-REI (FEBE-P), HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, LOF, MS-AIS (AIS-L), MS-RDI (RDI-L), AU-AIS (AIS-P), HP-RDI (RDI-P), AU-LOP (LOP-P), LCD Pointers: Monitor, ±justification, NDF, history record Auxiliary output: Receive clock output, trigger output

3

• MU120010A T1/T3 Unit

Bit rate	1.544 Mbps (T1), 44.736 Mbps (T3)
Frames	1.5M ESF (PLCP: on/off), 45M C-bit parity (PLCP: on/off), 45M M23 (PLCP: on/off)
Output signal	Connector BNC: 75 Ω unbalanced (T3); 8-pin modular: 100 Ω balanced (ISO/IEC 10173, T1) Clock: Internal (±10 ppm), external, receive Level: 2.4 to 3.6 Vo-p (T1), 0.36 to 0.85 Vo-p (T3) Code T1: B8ZS, T3: B3ZS
Input signal	Connector BNC: 75 Ω unbalanced (T3); 8-pin modular: 100 Ω balanced (ISO/IEC 10173, T1) Frequency range: ±130 ppm (T1), ±20 ppm (T3) Level: 2.4 to 3.6 Vo-p (T1), 0.36 to 0.85 Vo-p (T3) *Monitor: 20 dB attenuated level of above level can be applied. Code T1: B8ZS, T3: B3ZS
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, FEBE, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, yellow, idle, PLCP-LOF, PLCP-yellow, LCD Error measurement: Code, CP, FEBE, CRC6, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, yellow, idle, PLCP-OOF, PLCP-yellow, LCD Auxiliary output: Receive clock output, trigger output

• MU120011A E1/E3/E4 Unit

Bit rate	2.048 Mbps (E1), 34.368 Mbps (E3), 139.264 Mbps (E4)
Frames	2M-CRC-4 off (PLCP: on/off), 2M CRC4 on (PLCP: on/off), 34M G.751 (PLCP: on), 34M GH.832 (PLCP: off), 139M G.832 (PLCP: off)
Output signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3/E4) Clock: Internal (±10 ppm), external, receive Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3), 1 ±0.1 Vp-p (E4) Code E1/E3: HDB3, E4: CMI
Input signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3/E4) Frequency range: ±100 ppm (E1/E4), ±20 ppm (E3) Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3), 1 ±0.1 Vp-p (E4) *Cable loss: 0 to 6 dB (E1), 0 to 12 dB (E3, E4), Monitor: 20 dB attenuated level of above level can be applied. Code E1/E3: HDB3, E4: CMI
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off (E1, E3) Error addition: Bit, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, RA, RA (MF), RDI, PLCP-LOF, PLCP-yellow, LCD Error measurement: CRC4, code, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, MF loss (CRC), MF loss (sig), RA, RA (MF), RDI, PLCP-OOF, PLCP-yellow, LCD Trail trace: Monitor, setting Auxiliary output: Receive clock output, trigger output

• MU120012A E1/E3 Unit

Bit rate	2.048 Mbps (E1), 34.368 Mbps (E3)
Frames	2M-CRC-4 off (PLCP: on/off), 2M CRC4 on (PLCP: on/off), 34M G.751 (PLCP: on), 34M G.832 (PLCP: off)
Output signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3) Clock: Internal (±10 ppm), external, receive Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3) Code: HDB3

Continued on next page

Input signal	Connector D-sub (9-pin): 120 Ω balanced (E1); BNC: 75 Ω unbalanced (E1/E3) Frequency range: ±100 ppm (E1), ±20 ppm (E3) Level: 3 ±0.3 Vo-p (E1 balanced), 2.37 ±0.237 Vo-p (E1 unbalanced), 1 ±0.1 Vo-p (E3) ∗Cable loss: 0 to 6 dB (E1), 0 to 12 dB (E3), Monitor: 20 dB attenuated level of above level can be applied. Code: HDB3
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, cell Alarm addition: LOF, LOS, AIS, RA, RA (MF), RDI, PLCP-LOF, PLCP-yellow, LCD Error measurement: CRC4, code, BIP-8, REI, PLCP-BIP-8, PLCP-FEBE, HEC corrected cells, HEC uncorrected cells Alarm measurement: LOS, OOF, AIS, MF Loss (CRC), MF Loss (Sig), RA, RA (MF), RDI, PLCP-OOF, PLCP-yellow, LCD Trail trace: Monitor, setting Auxiliary output: Receive clock output, trigger output

• MU120015A ATM25M Unit

Bit rate	32.00 Mbps (25M)
Output signal	Connector: 8-pin modular jack, 100 Ω (RJ45) Clock: Internal (±10 ppm), external, receive Level: 2.7 to 3.4 Vp-p (1 symbol) Code: NRZI (4B/5B)
Input signal	Connector: 8-pin modular jack, 100 Ω (RJ45); Frequency: ±100 ppm; Level: 2.7 to 3.4 Vp-p (1 symbol); Code: NRZI (4B/5B)
Functions	Empty cell setting, coset on/off Error addition: Code, cell Alarm addition: LOS Error measurement: Code, HEC uncorrected cell, illegal cell Alarm measurement: LOS Sync event: Send, measure Auxiliary output: Receive clock output, trigger output

• MU120016A 6.3M Unit

Bit rate	6.312 Mbps (6.3M)
Output signal	Connector: BNC, 75 Ω Clock: Internal (±10 ppm), external, receive Level: 2 ±0.3 Vo-p Code: B8ZS
Input signal	Connector: BNC, 75 Ω Frequency: ±30 ppm Level: 2 ±0.3 Vo-p ∗Cable loss: 0 to 6 dB, Monitor: 20 dB attenuated level of above level can be applied. Code: B8ZS
Functions	Empty cell setting, cell scramble (de-scramble) on/off, coset on/off, HEC error correction on/off Error addition: Bit, CRC5, cell Alarm addition: LOS, AIS, RAI, LOF, LCD Error measurement: CRC5, HEC corrected cell, HEC uncorrected cell Alarm measurement: LOS, AIS, RAI, LOF, LCD Auxiliary output: Receive clock output, trigger output

• MU120017A 6.3/25M Unit

Bit rate	6.312 Mbps (6.3M), 32.00 Mbps (25M)
Output signal	Connector BNC: 75 Ω (6.3M); 8-pin modular jack, 100 Ω (RJ45, 25M) Clock: Internal (±10 ppm), external, receive Level: 2 ±0.3 Vo-p (6.3M), 2.7 to 3.4 Vp-p (25M, 1 symbol) Code 6.3M: B8ZS, 25M: NRZI (4B/5B)
Input signal	Connector BNC: 75 Ω (6.3M); 8-pin modular jack, 100 Ω (RJ45, 25M) Frequency range: ±30 ppm (6.3M), ±100 ppm (25M) Level: 2 ±0.3 Vo-p (6.3M), 2.7 to 3.4 Vp-p (25M, 1 symbol) ∗Cable loss: 0 to 6 dB (6.3M), Monitor: 20 dB attenuated level of above level can be applied (6.3M). Code 6.3M: B8ZS, 25M: NRZI (4B/5B)
Functions	Empty cell setting, cell scramble (de-scramble) on/off (6.3M only), coset on/off, HEC error correction on/off (6.3M only), sync event send (25M only) Error addition 6.3M: Bit, CRC5, cell 25M: Code, cell Alarm addition 6.3M: LOS, AIS, RAI, LOF, LCD 25M: LOS Error measurement 6.3M: CRC5, HEC corrected cell, HEC uncorrected cell 25M: Code, HEC uncorrected cell, illegal cell Alarm measurement 6.3M: LOS, AIS, RAI, LOF, LCD 25M: LOS Sync event (25M only): Send, measure Auxiliary output: Receive clock output, trigger output

• MU120020A QoS Unit

Foreground cells (test cells)	O.191, extended O.191, OAM test cell (PRBS 15), null, AAL1, AAL3/4, (For null, AAL1, AAL3/4, next pattern settable to payload. PRBS 9, PRBS 15, PRBS 15 (non-inverted), PRBS 23, time stamp, programmable)
Cell generation timing	CBR, burst, sawtooth waveform, CBR with CDV, VBR, Poisson distribution, manual, external edge, external level, detailed CBR, burst for UPC measurement, programmable
Background cell	CBR (10 types)
OAM cell	AIS, RDI, continuity check, loopback, programmable, forward monitoring, backward reporting, PM activation/deactivation, CC activation/deactivation
Capture	Capacity: 4095 cells Filter: All cells, specified cells, header +first byte of payload match/mismatch cells Trigger: Manual, OAM cell receive, cell error detect, cell loss detect, cell misinsertion detect, cell tagging, external input signal, etc. Display: Hexadecimal, ASCII, cell interval, translate
Single-channel	Error addition: Cell loss, cell error Error detection: Bit error, error cell, cell loss, cell misinsertion, non-conforming cell, etc. (measurement items differ according to test cell) Alarm detection: VP-AIS, VP-RDI, VP-LOC, VC-AIS, VC-RDI, VC-LOC Others: Bandwidth, total cells, cell delay measurement, 1 point CDV measurement, 2 point CDV measurement, cell interval measurement
1023 channel measurement (live monitor)	Detect and measure 1023 channels on line Measurement items: Total cell count, CLP = 0 cell count, CLP = 1 cell count, OAM cell count
Auxiliary input	Trigger input

• MU120021A Protocol Unit

Send/receive memory	8 MB (≥130,000 cells, send: 8 MB, receive: 8 MB, send + receive: 4 + 4 MB selectable)
Cell send	Transmit from memory according to time stamp. Able to transmit in every 1 cell. Able to edit AAL1, AAL3/4, AAL5 frame
Capture	Capacity: ≥130,000 cells (at 8 MB receive setting) Filter: All cells, all cells (excluding idle cells), up to 16 specified channels Trigger: Specified event, specified event occurrence times, sequential event (second event after first event) Event: Specified channel, SN abnormality, ST abnormality, CRC abnormality, specified pattern, external input signal, etc. Display: Cell, SAR, CPCS, time stamp
Single-channel measurement	AAL type automatic evaluation and measurement Error addition: Cell loss, cell error Measurement items: Cell count, CPCS-PDU count, assembled timer timeout PDU count, frame size error count, CPI error count, SN error count, ST error count, LI error count, about count, BE tag error count, BA size error count, AL error count, length error count, CRC error count, etc. (measurement items differ according to AAL type)
1023 channel measurement (live monitor)	Detect and measure 1023 channels on line. AAL type automatically detected and measured Measurement items: Cell count, CPCS count, etc. (measurement items differ according to AAL type)
External interface	Trigger input (capture event)

• MX122020A Protocol Decoding Software

Supported protocols	ATM (ITU-T I.361), OAM (ITU-T I.610), AAL5-CPCS (ITU-T I.363), SSCOP (ITU-T Q.2110), UNI 3.1/4.0 (ATM forum), LLC (RFC2225), SNAP (RFC2225), ATMARP/InATMARP (RFC2225), IP (RFC791), ICMP (RFC792), UDP (RFC768), TCP (RFC793)
Decoded file type	Data captured by MU120021A Protocol Unit and saved in binary format
Operating environment	MP1220A or a PC running with Windows 3.1/95/98

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Mainframe	
MP1220A	ATM Quality Analyzer	
	Standard accessories	
	AC power cord:	1 pc
F0012	Fuse, 3.15 A:	2 pcs
W1304AE	MP1220A operation manual:	1 copy
W1305AE	MP1220A remote control operation manual:	1 copy
Z0339	Software recovery floppy disk*1:	1 pc
Z0340B	Protective cover (without keyboard):	1 pc
Z0343A	Input pen:	1 pc
Z0345A	Accessory bag:	1 pc
	Options	
MP1220A-01	RS-232C control	
MP1220A-02	GPIB control	
MP1220A-03	Ethernet control	
MU120001A-38	ST connector	
MU120001A-39	DIN connector	
MU120001A-40	SC connector	
MU120001A-43	HMS-10/A connector	
	Units	
MU120001A	STM-4/OC-12 Unit	
W1308AE	MU120001A operation manual	
W1314AE	MU120001A remote control operation manual	
MU120002A	STM-1/OC-3 Unit	
W1309AE	MU120002A operation manual	
W1315AE	MU120002A remote control operation manual	
MU120010A	T1/T3 Unit	
W1310AE	MU120010A operation manual	
W1316AE	MU120010A remote control operation manual	
MU120011A	E1/E3/E4 Unit	
W1311AE	MU120011A/120012A operation manual	
W1317AE	MU120011A/120012A remote control operation manual	
MU120012A	E1/E3 Unit	
W1311AE	MU120011A/120012A operation manual	
W1317AE	MU120011A/120012A remote control operation manual	

*1: Sold only to MP1220A users

Note:
Please consult our sales department about adding the VBR functions to your MP1220A.
Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

Model/Order No.	Name
MU120015A	ATM25M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120016A	6.3M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120017A	6.3/25M Unit
W1312AE	MU120015A/120016A/120017A operation manual
W1318AE	MU120015A/120016A/120017A remote control operation manual
MU120020A	QoS Unit
W1313AE	MU120020A operation manual
W1319AE	MU120020A remote control operation manual
MU120021A	Protocol Unit
W1371AE	MU120021A operation manual
W1372AE	MU120021A remote control operation manual
	Application software
MX122020A	Protocol Decoding Software
W1648AE	MX122020A operation manual
	Optional accessories
J0008	GPIB cable, 2 m
J0775D	Coaxial cord, 2 m (75 Ω)
J0776D	BNC cord, 2 m (twin shield)
J0635B	Optical fiber cord (FC/PC-FC/PC-2m-SM), 2 m
J0660B	Optical fiber cord (SC/PC-SC/PC-2m-SM), 2 m
J0796A	Replaceable optical connector (ST)
J0796B	Replaceable optical connector (DIN)
J0796C	Replaceable optical connector (SC)
J0796D	Replaceable optical connector (HMS-10/A)
J0796E	Replaceable optical connector (FC)
J0844A	ISO 10173 cable (T1), 2 m
J0838A	UTP category 3 cable (25M), 2 m
Z0319A	PS/2 mouse
Z0340A	Protective cover (with keyboard)
Z0340B	Protective cover (without keyboard)
B0414A	Hard case
B0163	Soft case

NETWORK DATA ANALYZER
MD6430A
50 bit/s to 10 Mbit/s

GPIB OPTION

One Instrument for Installation and Maintenance

The MD6430A Network Data Analyzer can measure errors on 13 different interfaces for leased lines (64 kbit/s to 6.3 Mbit/s), ISDN (BRI, PRI), and V/X series interfaces, making it suitable for installation and maintenance of a variety of networks.
Measurements include bit errors, alarms, delay time, frequency, digital level measurements, user pattern send/trace, etc., all of which can be displayed on the large color LCD.
Error performance (ITU-T G.821, G.826, M.2100) is available with various pseudorandom patterns and user patterns up to 1024 characters. Frame Relay measurement function, ISDN signaling function (optional), and a simultaneous two-channel monitoring function are also provided. Single button “quick” function and touch-screen ensure easy operation. This unit offers the user sophisticated functions required for installation and maintenance in a small compact unit.

Features

- One unit supports installation and maintenance of leased lines, ISDN, and frame relay
- Single button quick test operation
- Lightweight, with a battery-operated function

Applications

- **Many applications ranging from low-speed modems to high-speed digital lines**

The MD6430A can evaluate the quality of lines ranging from low-speed modems to high-speed digital lines spanning 50 bit/s to 10 Mbit/s.

- **Support for various interfaces**

The MD6430A supports G.703 64k, I.430/I-430a 192k, G.703/G.704/I.431 1.5M, 2M, 2M CMI, 6.3M, V.24/V.28, V.35, V.36, RS-449, X.20, X.21, TTL/CMOS interfaces in a number of optional units designed to meet customer needs.

Units	Interfaces	Uses
MU643000A	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M, G.703/G.704/I.431 2.0M, 2M CMI, G.703/G.704 6M	Europe and Japan
MU643000B	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M, 2M CMI, G.703/G.704 6M	Japan
MU643000C	G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 2.0M	Europe

Note: All interface units support V.24/V.28, V.35, V.36, RS-449, X.20, X.21, and TTL/CMOS.

- **Wide variety of measurement functions**

Various measurements, such as error, alarm, clock slip, delay, frequency, and digital level can be performed. Also, can send user patterns with tracing functions.

- **Frame relay measurements**

Frame relay network connections (conforming to PVC and ITU-T Q.933 Annex A) can be tested by the MD6430A. The user can also monitor the congestion status such as FECN, BECN, and CLLM.

- **Optional ISDN signaling functions (BRI, PRI)**

The unit can be connected to ISDN networks so that both voice communication and error measurement can be performed.

- **Error data analysis and storage functions**

Error data can be collected in log or histogram format. This data can also be stored in internal memory or on a floppy disk for later analysis.

- **Touch-screen**

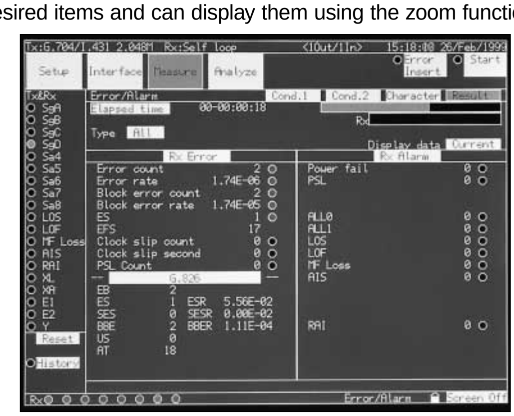
The touch-screen, large color LCD, and pop-up menus provide a much better GUI operating environment.

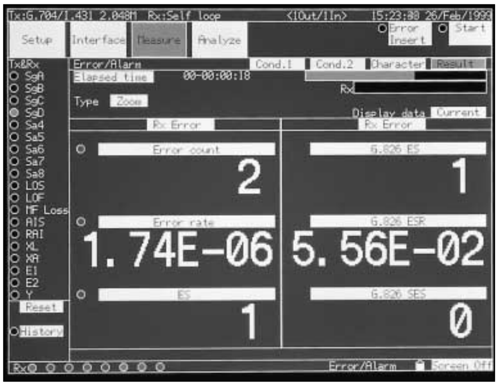
- **Battery operation**

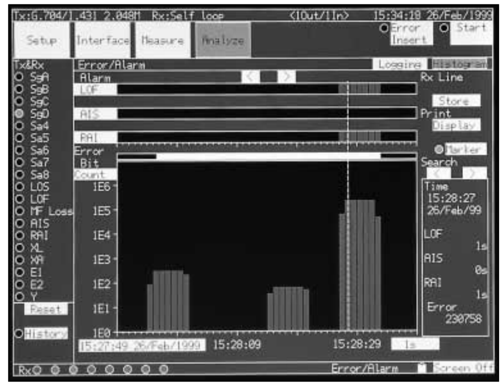
When a commercial power supply is not available, the optional battery pack provides operation for up to 3 hours, and 5 hours in power save operation.

- **Full range of error measurement screens**

Various measurement items can be displayed simultaneously for error count, error rate, block error count, clock slip count, character error count, error performance (G.821, G.826, M.2100), HDLC error (bad frame, abort frame), and various types of alarm. The user can select the desired items and can display them using the zoom function.

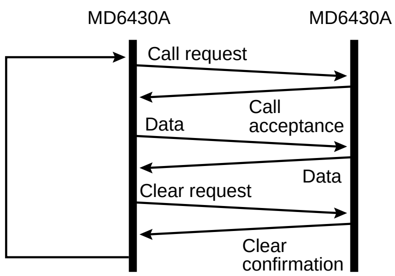




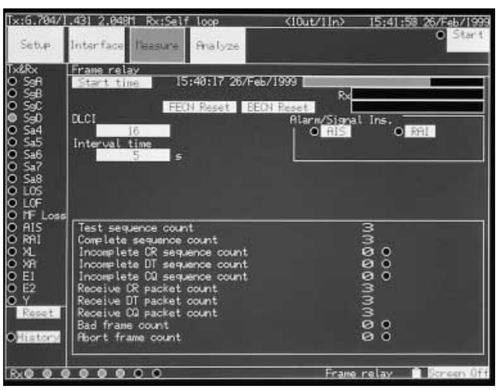


• Supports frame relay measurements

Specific DLCI connections can be checked. PVC status checking procedures are supported.

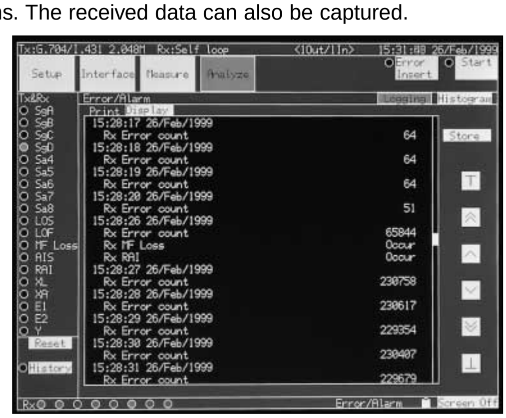


Frame relay measurement sequence



• Substantial analysis functions

Error status and alarm condition can be logged and displayed as histograms. The received data can also be captured.

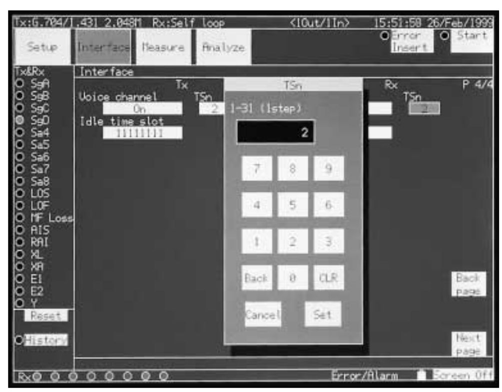


• Supports ISDN networks (BRI, PRI)

The unit can be connected to the ISDN public telephone network. Return testing using one unit can be done by using the call loop function as below.

• Voice channel function

The CODEC function permits voice communications over a specified channel. Simultaneous voice communications and measurements are possible.



• Easy operation

The touch-screen and pop-up menus are quick and user-friendly, making operation easy for all levels of expertise.

Specifications

Interface	High speed: G.703 64k, I.430/I430-a 192k, G.703/G.704/I.431 1.5M[*1, *2], G.703/G.704/I.431 2.0M[*1, *3], 2M CMI[*1, *2], G.703/G.704 6M[*1, *2] (2-wire simultaneous monitoring) Low speed: V.24/V.28, V.35, V.36, RS-449, X.20, X.21, TTL/CMOS (Send/receive simultaneous monitoring)
Clock (high-speed interface)	Internal clock: 64 kbit/s, 1.544 Mbit/s[*1, *2], 2.048 Mbit/s, 6.312 Mbit/s[*1, *2] (accuracy ≤±5 ppm) External clock: 64k + 8k or slave sync to received data (slave oscillation range: ≤±100 ppm)
G.703 64k clock mode	Centralized clock, codirectional clock
Code law (high-speed interface)	G.703 64k: AMI I.430/I430-a 192k: AMI G.703/G.704/I.431 1.5M: AMI/B8ZS[*1, *2] G.703/G.704/I.431 2.0M: AMI/HDB3[*1, *3] 2M CMI: CMI G.703/G.704 6M:B8ZS[*1, *2]
Impedance	64k: 110 Ω/HIGH, 192k: 50/100 Ω/HIGH, 1.5M:100 Ω/HIGH, 2 M:75/120 Ω/HIGH, 2M CMI: 110 Ω/HIGH, 6M: 75 Ω/HIGH
Frames (high-speed interface)	G.703/G.704/I.431 1.5M[*1, *2]: 12MFP (G.704), 24MFP (G.704), 24MFP (NTT), unframe G.703/G.704/I.431 2.0M[*1, *3]: 16MFP (30B + D), 16MFP (31B), 2MFP (30B + D), 2MFP (31B), Unframe 2M CMI[*1, *2]: PBX (TTC), CRV, ST (send only), unframe G.703/G.704 6M[*1, *2]: 4MFP (G.704), unframe
Data bit rate (high-speed interface)	64k x n: 64 to 6272 kbit/s (n =1 to 98[*4] , sequential or mixed configuration may be selected.) 56k (1-7) x n: 56 to 5488 kbit/s (n =1 to 98[*4]) 56k (2-8) x n: 56 to 5488 kbit/s (n =1 to 98[*4]) 8k x n: 8, 16, 32 kbit/s 2.4k x n: 2.4 to 48 kbit/s (n = 1 to 20, sequential or mixed configuration may be selected for X.50 20 multiframe.) 0.6k x n: 0.6 to 48 kbit/s (n = 1 to 80, sequential or mixed configuration may be selected for X.50 80 multiframe.) Others: Signaling, 1.544 Mbit/s
Send clock (low-speed interface)	Internal clock Sync (ST1): 50 bit/s to 10 Mbit/s (5 bit/s steps. However, V.24/V.28 and X.20 up to 200 kbit/s) Async: 50, 75, 100, 110, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1k, 1.2k, 1.6k, 1.8k, 2k, 2.4k, 2.56k, 3k, 3.2k, 3.6k, 4.8k, 7.2k, 8k, 9.6k, 12k, 12.8k, 14.4k, 16k, 16.8k, 19.2k, 28.8k, 32k, 38.4k, 46k, 48k, 50k, 56k, 56.6k, 64k, 72k, 76.8k, 115.2k (bit/s) Self oscillation accuracy: ≤±5 ppm External clock (ST2, RTS): Frequency for each interface of 50 to10 Mbit/s (may be inverted.)
Receive clock (low-speed interface)	External clock (ST, RTS): Frequency for each interface of 50 to 10 Mbit/s (May be inverted) Internal clock (Async): 50, 75, 100, 110, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1k, 1.2k, 1.6k, 1.8k, 2k, 2.4k, 2.56k, 3k, 3.2k, 3.6k, 4.8k, 7.2k, 8k, 9.6k, 12k, 12.8k, 14.4k, 16k, 16.8k, 19.2k, 28.8k, 32k, 38.4k, 46k, 48k, 50k, 56k, 56.6k, 64k, 72k, 76.8k, 115.2k (bit/s)
Error measurement pattern	Pseudorandom pattern: PRBS 6, 7, 9, 11, 15, 19, 20, 23, RPRBS 20 (reversed PRBS20), QRSS, positive/negative logic Programmable pattern: 8 bit repetitive (start-stop sync: 5 to 8 bits) Code pattern: 1:1, ALL 1, ALL 0 User pattern: 1 to 1024 characters (1 character steps), for character error measurement
Send pattern	User pattern: 1 to 128 kbyte
Error insertion	Error type: bit, bit + code, code Insertion types Single: 1 bit error inserted each time insert button pressed Repeat: 1 bit error inserted each second Cyclic: 2.5E-1 to 1.7E-7
Start-stop synchronization	Start bit length: 1 bit Stop bit length: 1, 1.5, 2 bits Data length: 5, 6, 7, 8 bits Parity: None, odd, even
Error/alarm measurement	Detected errors: Bit, code, parity, CRC, frame, character Measurements: Error count, error rate, block error count, block error rate, ES, EFS, clock slip, clock slip seconds, pattern sync loss count/time, frame sync loss time, alarm time, signal loss time, AC power loss time Error performance: G.821, G.826, M.2100 Measurement modes Single: 1 s to 99 d 23 h 59 min 59 s Repeat: 1 s to 99 d 23 h 59 min 59 s Manual: 1 y max. Measurement range Error rate: 1.00E-15 to 1.00E00, Error count: 0 to 9.99E15
Pattern trace	Trace byte count: 1 Mbit max. Trace start trigger: Manual, code detect Trace stop trigger: Manual, code detect, code mismatch detect, trace byte count Trigger detect delay: 0 to 8,000 bytes
Frequency measurement	Measurement range: DC to 10 MHz, Accuracy: ≤ (±5 ppm ±1 digit)
Delay time measurement (Sync. mode only)	Measurement range: 0 to 16 s (0.001 ms steps)
Frame relay measurement	Measurement items: Correct test packet count, lost test packet count, HDLC bad frame count, HDLC abort frame count PVC connect confirmation test: To MD6430A or circuit loopback test (Conforms to ITU-T Q.933 Annex A) DLCI: 16 to 991 (1 steps) Test packet send interval time: 5 to 30 s (1 s steps) Traffic congestion status monitoring: BECN, FECN, CLLM message detection (Conforms to ITU-T Q.922 Annex A)
Digital level measurement	Code law: A-law, µ-law Measurement range: –60 to +3 dBm (0.1 dBm steps) Send pattern: 0 dBm, 1 kHz pattern (Conforms to ITU-T G.711)

Continued on next page

ISDN calling/called function	INS64, INS1500 (Option: MU643000A/B-01), ETS1 ISDN (Option: MU643000A/C-02)
MUX/DEMUX	Able to drop/insert specified channels in high-speed interface through X.21 interface at 64k x n (n = 1 to 98)
Voice communication	Voice communication possible in any TS in high-speed interfaces (except G.703 64 kbit/s)
Error analysis	Displays sequential error/alarm measurement data and graphs
Signal monitor lamp	Indicates status of each signal line
External printer	Interface Centronics, D-sub 25-pin connector
External printer output	Enables printout of error measurement data Measurement start time: Prints time and measurement conditions During measurement: Prints specified error and alarm occurrence at each detected instance or at predefined time interval Measurement stop time: Prints measured total results Prints on screen contents
Display	Color TFT-LCD (8.4 inch)
Remote interface	RS-232C, D-sub 9-pin connector, GPIB (option)
Memory	3.5 inch FDD
Built-in timer	Year, month, day, hour, minute, second
Power supply	AC: 85 to 250 V, DC: Lithium ion battery (rechargeable, optional accessory), 50 VA
Battery operation time	3 h (max.) ∗5 h when using power save function
Operating temperature	0˚ to +50˚C, (FDD and at battery usage: +5˚ to +40˚C)
Dimensions and mass	290 (W) x 194 (H) x 94 (D) mm, ≤4.2 kg (excluding battery)
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

∗1: Specification when using MU643000A Datacom Interface
∗2: Specification when using MU643000B Datacom Interface
∗3: Specification when using MU643000C Datacom Interface
∗4: Max. n value depends on interfaces

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MD6430A	Network Data Analyzer	
	Standard accessories	
Z0695	AC adapter:	1 pc
	Power cord:	1 pc
Z0406A	Touch pen (for touch panel):	1 pc
Z0402A	Protective cover (protects display):	1 pc
W1542AE	MD6430A operation manual (includes MU643000A/B/C):	1 copy
W1543AE	MD6430A remote control operation manual (includes MU643000A/B/C):	1 copy
Z0417	MD6430A sample program (remote sample program):	1 pc
Z0403A	Belt with hook (MD6430A carrying belt):	1 pc
	Option	
MD6430A-01	GPIB	
	Units	
MU643000A	Datacom Interface Unit (for Europe and Japan)	
MU643000B	Datacom Interface Unit (for Japan)	
MU643000C	Datacom Interface Unit (for Europe)	
	Options	
MU643000A-01	JT-Q921/Q931 ISDN signaling	
MU643000A-02	ETSI ISDN signaling	
MU643000B-01	JT-Q921/Q931 ISDN signaling	
MU643000C-02	ETSI ISDN signaling	
MU643000A-22	CAS/FAS option (for Europe and Japan)	
MU643000B-22	CAS/FAS option (for Japan)	
MU643000C-22	CAS/FAS option (for Europe)	
	Optional accessories	
Z0619	Lithium ion battery pack (battery pack for main frame)	
B0441	Hard carrying case	
B0442	Soft carrying case	
B0443	Rack mount kit	
A0006	Headset	
J1026A	GPIB cable (for MD6430A-01's accessory), 2 m	
J0654A	Serial interface cross cable [D-Sub 9-pin (female) · D-Sub 9-pin (male)], 2 m (for remote control of main frame)	
J0661A	RS-232C straight cable [D-Sub 9-pin (female) · D-Sub 25-pin (male)], 2 m (for remote control of main frame)	
J0920B	Cross cable [D-Sub 9-pin (female) · D-Sub 25-pin (male)], 3 m (for remote control of main frame)	
J0913A	Measurement cable [D-Sub 25-pin (male) · half pitch 36-pin], 2 m (for V.24/V.28)	
J0914A	Measurement cable [V.35 connector (male) · half pitch 36-pin), 2 m (for V.35)	

Model/Order No.	Name
J0915A	Measurement cable [D-Sub 37-pin (male) · half pitch 36-pin], 2 m (for V.36/RS-449)
J0916A	Measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21, using B terminal as ST1 output type)
J0945	Measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21, using B terminal as ST2 input type)
J0929	Cross measurement cable [D-Sub 15-pin (male) · half pitch 36-pin], 2 m (for X.20/X.21 MUX/DEMUX)
J0388B	DCE/DTE conversion adapter (D-Sub 25-pin, for V.24/V.28)
J0390	DCE/DTE conversion adapter (D-Sub 34-pin, for V.35)
J0392B	DCE/DTE conversion adapter (D-Sub 37-pin, for V.36/RS-449)
J0917A	TTL/CMOS connection box∗1 (I/O connector: BNC type)
J0923	Measurement cable (both-end Amphenol half pitch 36-pin), 1 m (for connection between MD6430A to TTL/CMOS)
J0463C	Measurement cable [both-end 8-pin modular (RJ45) with shield], 2 m (for 192k)
J0959B	Measurement cable (RJ45 8-pin modular · clip), 2 m (for 192K)
J0844A	ISO1073 cable [both-end 8-pin modular (ISO10173)], 2 m (for 1.5M, 2M)
J0127B	Coaxial cord (BNC-P · RG58A/U · BNC-P), 2 m (for 2M, 6M)
J0939	Coaxial cord (C-H3T type plug · BNC), 2 m (for 6M)
J0921B	Measurement cable [8-pin modular (ISO10173) · M-1PS], 2 m (for 1.5M, 2M)
J0922B	Measurement cable (mini-BANTAM · M-1PS), 2 m (for 64k, 2M CMI)
J0924B	Measurement cable (mini-BANTAM · I-214APS), 2 m (for external input clock, 64k + 8k)
J0930	Measurement cable (mini-BANTAM · M-3912), 2 m (for 64k, Siemens type)
J0960B	Measurement cable (mini-BANTAM · clip), 2 m (for 64k, 2M, CMI)
J0946A	Measurement cable [8-pin modular (ISO10173) · M-3912], 1 m (for 1.5M/2M)
J0946B	Measurement cable [8-pin modular (ISO10173) · M-3912], 2 m (for 1.5M/2M)
J0950	Measurement cable [8-pin modular (ISO10173) · clip], 2 m (for 1.5M/2M)
J0968	Balance cable (RJ45 · ISO10173), 2 m (for 192k)
J0969C	Unbalance cable [SP3CP/3CV-P (BNC)], 2 m (for 6M)
J0925B	Y cable (D-sub 25-pin · half pitch 36-pin/D-sub 25-pin), 2 m (for V.24/V.28 monitor)
J0926B	Y cable (D-sub 25-pin · half pitch 36-pin/D-sub 25-pin), 2 m (for V.35 monitor)
J0927B	Y cable (V.37 · half pitch 36-pin/D-sub 37), 2 m (for V.36/RS-449 monitor)
J0928B	Y cable (D-sub 15-pin · half pitch 36-pin/D-sub 15-pin), 2 m (for X.20/X.21 monitor)

∗1: Cable (J0923) required when using with TTL/CMOS interface
Note: For details of the measurement cable, refer to the Measurement Cable Selection Guide in the MD6430A Application Note.

DATA TRANSMISSION ANALYZER

MD6420A

50 bit/s to 10 Mbit/s

GPIB OPTION

For Evaluating the Quality of Digital Data Networks

Bit error rate measurement is the most critical parameter in evaluating the quality of digital transmission modes. However, conventional methods, which measure only average bit error rates, are inadequate. In the MD6420A, various types of extension and remote control units are provided as options, as well as units which allow the use of various types of interfaces.
The measuring conditions can be stored in memory and recalled prior to measurement with the touch of a single key. In addition, the analyzer is portable so that it can be used on site for maintenance operations.

Features

- **Can measure a variety of devices from low-speed modems to high-speed digital lines**

Can be configured to a variety of communications protocols via ITU-T V, X, G, and I series by using plug-in units. Can perform high-quality evaluations of data communications systems that have bit rates from 50 bit/s to 10 Mbit/s.

- **Simultaneous error measurement of various error parameters**

The error count (bit error, parity error, and CRC error, etc.) error rate, block error count, block error rate, US, %US, SES, %SES, DM, %DM, ES, %ES, EFS, %EFS, AT, %AT, BBER, clock slip, and synchronization loss can be measured, Alarm states such as AIS can be continuously monitored*.

*: Conforms to ITU-T G.821

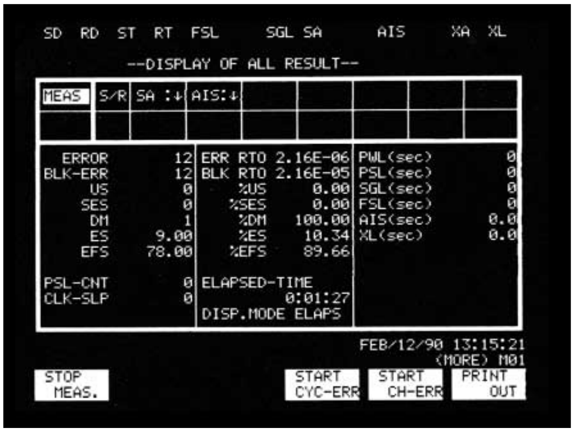
- **Data will not be lost if a power failure occurs during measurement**

If an AC power failure occurs during error rate measurements, all data obtained prior to the failure is recalled from memory and the measurement is automatically continued when the power is resupplied. When the power returns, the time at which power failure occurred is displayed on the EL display.

Example of display screen

- **Overall display of error measurements**

Up to 22 measurement items can be monitored simultaneously. If a power failure occurs during measurements then measurements will be continued from the time at which the power is resupplied. The failure time (PWL) will be displayed when power is resupplied.



Combinations of interface and extension units

The MD6420A can be combined with many plug-in units to perform a variety of measurement.

Interface units \ Extension units	MD0627A Analog
MD0621A V.24/V.28 (RS232C)	√
MD0621B V.35	√
MD0621C V.36 (RS-449)	√
MD0621D X.20 (RS-423)/X.21 (RS-422)	√
MD0622B G.703/G.704 1.544 Mb/s Bipolar	√*
MD0622D G.703/G.704 6.312 Mb/s Bipolar	√*
MD0622E G.703 64 kb/s	√*
MD0625B I.431 1.544 Mb/s	√*
MD0626A TTL	√*

*: Except DC voltage measurement

Interface units

• V/X series

MD0621A	V.24/V.28 (RS-232C)
MD0621B	V.35
MD0621C	V.36 (RS-449)
MD0621D	X.20 (RS-423)/X.21 (RS-422)

• G.703

MD0622B	G.703/G.704 1.544 Mb/s Bipolar
MD0622D	G.703/G.704 6.312 Mb/s Bipolar
MD0622E	G.703 64 kb/s

• I.431

MD0625B	I.431 1.544Mb/s

• TTL

MD0626A	TTL

Extension units

• Analog

MD0627A	Analog

Remote control units

MD0620A	GPIB
MD0620B	RS-232C

Specifications

Sending clock signal	Internal clock signal (ST1, ASYNC, ST/SP)*1	Clock: 50 to 20 kbit/s in 5 bit/s steps, 20 k to 400 kbit/s in 100 bit/s steps 512 k, 576 k, 672 k, 768 k, 1024 k, 1152 k, 1344 k, 1536 k, 1920 k, 2048 k, 4096 k, 8192 kbit/s Accuracy Self oscillation: ±5 ppm Slave oscillation: Subject to 8 kbit/s or 8 kbit/s of (64 k + 8 k) external input or receiving data Slave oscillation range: ≥ ±100 ppm
	External input	Operated by the external input clock signal (TTL level or sine waves)
	External clock signal (ST2, RT)	Clock (inversion can be used.) by each 50 bit/s to 10 Mbit/s interface
Receiving clock signal	External clock signal (RT)	Clock (inversion can be used.) by each 50 bit/s to 10 Mbit/s interface
	Internal clock signal (ASYNC, ST/SP)	50, 70, 100, 150, 200, 256, 300, 400, 500, 512, 600, 768, 800, 1 k, 1.2 k, 1.6 k, 1.8 k, 2 k, 2.4 k, 2.56 k, 3 k, 3.6 k, 4.8 k, 7.2 k, 9.6 k, 14.4 k, 19.2 kbit/s
Pattern	Code	A, Z, 1:1, 3:1, 1:3, 7:1, 1:7
	Programmable pattern	8 bit repetition (5 to 8 bits for ST/SP, 5 bits for 2.0 M G.704 spare bit)
	Pseudorandom pattern	$2^n - 1$ bits repetition (n: 6, 7, 9, 11, 15, 19, 20, 23), positive/negative logic
	Word pattern	8 bits x 8 k words (manual input, setting, user's pattern)
	FOX pattern	Conforms to ITU-T (EBCDIC, ASCII, EBCD, BAUDOT)
Error insertion	Manual error	Single-bit error whenever the key is pressed or single-bit error every second
	Cyclic error	2.5×10^{-1} to 1.7×10^{-7}($N \times 10^{-n}$, N: 1.0, 1.1, 1.3, 1.5, 1.7, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0)
Start-stop synchro-nization	Start-stop bit length	Start bit: 1 bit, Stop bit: 1, 1.5, and 2 bits
	Data length	5, 6, 7 and 8 bits
	Parity	None, odd, even
Error measure-ment	Detection error	Bit error, code error, parity error, CRC error and frame mismatch are selected.
	Measurement items	Error count, error rate, block error count, block error rate, ES, %ES, DM, %DM, SES, %SES, US, %US, EFS, %EFS, AT, %AT, BBER clock slip, sync count/time, frame sync loss time, signal loss, AC power failure time
	Block length	2^5 to 2^{16} bits or 10^1 to 10^{16} bits
	Measurement time	10^2 to 10^9 bits measurement and repetition of 1 s to 999 hr 59 min. 59 s
	Display of measurement results	Among the measurement results, five or all optional items can be displayed simultaneously. The buzzer sounds if an error is detected (the volume can be adjusted). The lapse time after the measurement starts is displayed in units of seconds.
Pattern trace	No. of trace bytes	32 KB max.
	Traces stop trigger	Manual code detection, not code detection, signal lines ON/OFF, No. of trace bytes, external input signal ON/OFF
	Delay trace after trigger detection	10 to 8000 bytes
	Trace data display	Displays together with trace stop time in HEX, JIS8, ASCII, EBCDIC, EBCDIK, EBCD, Baudot bit (shift: +4 to –3 bits)
Voltage measurement		Measuring range: –30 to +30 V Accuracy: ±5% ±1 digit
Frequency measurement and count		Measuring range: DC to 10 MHz Accuracy:±5 ppm ±1 digit Display: Decimal 7 digits
Time measurement*3		Measuring range: 0 to 10 sec.(10 µs steps) except for ASYNC and ST/SP Accuracy: ±5 ppm ±1 digit Display: Decimal 7 digits
Signal monitor lamp		Displays the status of each signal line ("1"/"ON" : green or red*2, "0"/"OFF": lamp off)

Continued on next page

External output		Error: Negative logic, TTL level (half clock with of receiving clock) Pattern sync loss: Negative logic, TTL level Clock: Receiving gate clock, TTL level Receiving clock: TTL level (64 k + 8 k) bit/s clock: 64 kbit/s clock with 8 kbit/s violation, AMI, RZ, 1.0 V±10%, Impedance: 120 Ω Video output: Composite video signal (vertical: 16.666 ms ±100 ppm, horizontal: 63.61 µs ±100 ppm, 1 Vp-p ±10%
External input		Clock: 50 bit/s to 9 Mbit/s, TTL (64 k +8 k) bit/s clock: 64 kbit/s clock with 8 kbit/s violation, AMI/RZ, Input level: 0.6 to 1.1 Vp-p, Impedance: 110 Ω Trigger: TTL level
Print output	Printing in error measurement	At measurement start: Prints measurement conditions and time During measurement Print time, error count and alarm generation/recovery information at specified intervals Prints time and measurement result after start of measurement Prints time and error count at termination of each measurement cycle At measurement end: Prints time and measurement result
	Other printing	Prints measurement conditions, measurement results, and time in manual measurement
Internal timer		Year, month, day, hour, minute, second
Power		85 to 132 Vac/170 to 250 Vac (changeable), 47 to 64 Hz, ≤180 VA (with full units)
Operating temperature range		0° to +40°C
Connectable unit		5 units max.
Dimensions and mass		319 (W) x 177 (H) x 450 (D) mm, ≤10.5 kg

∗1: Up to 20 kbit/s for ASYNC and STSP
∗2: Denotes red LED alarm
∗3: Can not measure delay time for async system and start-stop system

Ordering information

Please specify model/order number, name, and quantity when ordering.

MD6420A (main frame)

Model/Order No.	Name	
	Main frame	
MD6420A	Data Transmission Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013*	Fuse, 5 A:	2 pcs
F0012*	Fuse, 3.15 A:	2 pcs
B0301	Protection cover:	1 pc
Z0031A	Printer paper:	2 rolls
B0254C	Blank panel (for interface units):	5 pcs
B0254D	Blank panel (for remote control units):	1 pc
W0618AE	MD6420A operation manual:	1 copy
	Options	
MD6420A-01	Sending pattern synchronized signal output (video output cannot be used with this option.)	
MD6420A-02	Sending pattern for word memory, 32 KB	
	Optional accessories	
B0291B	Carrying case (with casters)	
B0251F	Shoulder bag (for MD6420A)	
B0302	Rack mount kit	
B0251E	Unit housing case (accommodates 10 units)	
A0006	Headset	
J0386	Probe for external input (BNC-P · IC clip), 1 m	
J0135	Balanced cord (I-214APS · – · M-1PS), 2 m	
J0162B	Balanced cord (M-3912 · – · M-3912), 2 m	
J0050B	Balanced cord [M-214S · – · M-214S (shielded)], 2 m	
J0127B	Coaxial cable (BNC-P · RG-58A/U · BNC-P)	
J0106	Coaxial cable (3CV-P2 · M-1P), 2 m	
Z0174	Service kit for MD6420A	
J0673A	Double-ended 25 pin cross cable, 3 m	

∗: Supplied one kind of fuse depending on the power supply voltage specified when ordering.

Interface units

Model/Order No.	Name	
MD0621A	V.24/V.28 (RS-232C) Interface Unit	
	Standard accessory	
W0595AE	MD0621A operation manual:	1 copy
	Optional accessories	
J0387	Double-ended 25-pin connector cable, 2 m	
J0388	25-pin DCE-DTE conversion adapter (used for DTE mode)	
MD0621B	V.35 Interface Unit	
	Standard accessory	
W0596AE	MD0621B operation manual:	1 copy
	Optional accessories	
J0864B	Double-ended 34-pin connector cable, 2 m	
J0390	34-pin DCE-DTE conversion adapter (used for DTE mode)	
MD0621C	V.36 (RS-449) Interface Unit	
	Standard accessory	
W0597AE	MD0621C operation manual:	1 copy
	Optional accessory	
J0391	Double-ended 37-pin connector cable, 2 m	
J0392	37-pin DCE-DTE conversion adapter (used for DTE mode)	
MD0621D	X.20 (RS-423)/X.21 (RS-422) Interface Unit	
	Standard accessory	
W0598AE	MD0621D operation manual:	1 copy
	Optional accessory	
J0393	Double-ended 15-pin connector cable, 2 m	
MD0622B	G.703/G.704 1.544 Mb/s Bipolar Interface Unit	
	Standard accessory	
W0599AE	MD0622B operation manual:	1 copy
	Optional accessories	
J0393	Double-ended 15-pin connector cable, 2 m	
J0440	Balanced cord (CS1-MM2), 2 m	
J0990	Measurement cable (D-SUB15/SBMD06FBS), 2 m	
J0991	Measurement cable (D-SUB15/CLIP), 2 m	
MD0622D	G.703/G.704 6.312 Mb/s Bipolar Interface Unit	
	Standard accessory	
W0600AE	MD0622D operation manual:	1 copy
	Optional accessories	
J0393	Double-ended 15-pin connector cable, 2 m	
J0127B	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m	

Continued on next page

Model/Order No.	Name
MD0622E	G.703 64 kb/s Interface Unit
	Standard accessory
W0601AE	MD0622E/E1 operation manual: 1 copy
	Optional accessories
J0162A	Balanced cord (M-3912 · – · M-3912), 1 m
J0162B	Balanced cord (M-3912 · – · M-3912), 2 m
J0162C	Balanced cord (M-3912 · – · M-3912), 2.5 m
J0162D	Balanced cord (M-3912 · – · M-3912), 5 m
J0537	Balanced cord (M-3912 · – · M-1PS), 2 m
J0164	Balanced cord (M-3912 · – · M-214-SP), 2 m
J0440	Balanced cord (CS1-MM2), 2 m
MD0625B	I.431 1.544 Mb/s Interface Unit
	Standard accessory
W0606AE	MD0625B operation manual: 1 copy
	Optional accessories
J0393	Double-ended 15-pin connector cable (GMP-AS12-001), 2 m
J0440	Balanced cord, CS1-MM2, 2 m
J0539	Cable with 15-pin and modular connectors, (ISO4903 · 15P-IS8877 · 8P), 3 m
J0540	Cable with 15-pin connector and screw terminals, [ISO4903 · 15P-4 screw terminals (3 mm)], 3 m
J0594	Cable with 8-pin modular connector, and alligator clip, ISO8877-8P alligator, 2 m
MD0626A	TTL Interface Unit
	Standard accessory
W0608AE	MD0626A operation manual: 1 copy
	Optional accessory
J0127B	Coaxial cable (BNC-P · RG-58A/U · BNC-P), 2 m
J0386	Probe for external input (BNC-P · IC clip), 1 m

Extension units

Model/Order No.	Name
MD0627A	Analog Unit
	Standard accessory
W0609AE	MD0627A operation manual: 1 copy
	Optional accessory
A0006	Head set
J0135	Balanced cord (I-214APS · – · M-1PS), 2 m

Remote control units

Model/Order No.	Name
MD0620A	GPIB Remote Control Unit (The operation is described in the MD6420A operation manual.)
	Optional accessory
J0008	GPIB cable, 2 m
MD0620B	RS-232C Remote Control Unit (The operation is described in the MD6420A operation manual.)
	Optional accessories
J0387	Double-ended 25-pin connector cable, 2 m
J0673A	Double-ended 25-pin cross cable, 3 m

MOBILE COMMUNICATIONS MEASURING INSTRUMENTS

Mobile communication measurement equipment

(example of an application; various other types of measurement equipment are also available)

Type of measurement equipment	Digital communication system													Anritsu model	Equipment to be measured										
															Mobile equipment				Base station						
	EDGE	GPRS	GSM	PCN (DCS1800)	NADC (IS-136)	CDMA2000 1X	CDMA2000 1xEV-DO	HSDPA	W-CDMA	PDC	PHS	WLAN	Bluetooth		Transmitter	Receiver	Signaling	Maintenance, troubleshooting	Transmitter	Receiver	Signaling	Construction, maintenance	Service areas	Entrance circuruty	Parts
Radio communication analyzer			√	√	√					√	√			MT8801C	√	√	√	√	√*1	√*1					√
	√	√	√	√		√	√		√	√	√			MT8820A	√	√	√	√	√*1	√*1					√
Digital mobile radio transmitter tester	√		√		√	√	√	√	√	√	√	√		MS8608A/MS8609A	√				√			√			√
Time-domain-capable spectrum analyzer			√		√					√				MS2651B, MS2661B/C, MS2663C, MS2665C, MS2667C, MS2668C	√				√			√			√
	√		√		√	√	√		√	√	√	√		MS2681A/MS2683A/ MS2687B	√				√			√			√
	√		√		√	√	√		√	√	√	√		MS2781A	√				√			√			√
			√		√					√				MS2711D	√				√			√			√
			√		√					√				MS2721A	√				√			√			√
Digital modulation signal generator			√		√	√	√	√	√	√	√			MG3681A		√		√		√		√			√
Signaling tester		√	√						√					MD8480B			√	√							
		√	√						√					MD8470A			√	√							
Conformance Test									√					ME7873A	√	√	√	√							
								√	√					MX785201A			√	√							
Radio communication test system								√	√		√			ME7812 series	√	√	√	√							
Error rate tester			√	√	√					√	√			MD6420A		√				√		√		√	
			√	√	√					√	√			MP8931A		√				√		√		√	
Area tester									√					ML8720B								√	√		
Signal generator			√		√									MG3641A		√				√		√	√		√
			√	√	√		√	√	√	√	√			MG3642A		√				√		√	√		√
			√	√	√		√	√		√	√			MG3633A		√				√		√			√
			√	√	√		√	√	√	√	√			MG3690A series		√				√		√		√	√
Power meter			√	√	√		√	√	√	√	√			ML2487A/ML2488A	√				√			√			√
			√	√	√		√	√	√	√	√			ML2437A/ML2438A	√				√			√			√
			√	√	√		√	√	√	√	√			ML2407A/ML2408A	√				√			√			√
Frequency counter			√	√	√		√	√	√	√	√			MF2400B series	√				√			√			√
Measuring receiver										√				ML5655C								√	√		
			√											ML524B*2								√	√		
Site Master			√	√	√		√	√	√	√	√			S331D/S332D								√			
Cell Master			√	√	√	√	√							MT8212B	√			√	√			√	√		
Scalar Network Analyzer			√	√	√		√	√	√	√	√			54100A series								√			√
Vector Network Analyzers			√	√	√		√	√	√	√	√			MS4630B	√	√			√	√					√
			√	√	√		√	√	√	√	√			MS462X series	√	√			√	√					√
			√	√	√		√	√	√	√	√			37200D series	√	√			√	√					√
One Box Tester												√		MT8860A	√	√			√	√					
													√	MT8852A	√	√			√	√					
Protocol Testing								√	√					MX785201A			√	√							
								√	√					MX785101A			√	√							
								√	√					MX786201A			√	√							
								√	√					MX848086A			√	√							

*1: Only PHS
*2: Custom-made product

W-CDMA TRX/PERFORMANCE TEST SYSTEM
ME7873A

CE

For Testing System Conformance to Clause 5, 6, 7 in 3GPP TS34.121 Standards

NEW

ME7873A is the auto testing system for the Tx/Rx/Performance characteristic of W-CDMA mobile terminals conforming to 3GPP standards. This system enables to perform measurement conforming to Clause 5 (Transmitter test), 6 (Reception test), 7 (Performance test) in 3GPP TS 34.121 standards.
The dedicated software runs on Windows 2000 and provides easy management of measurement parameters during tests and test result data.
PC with installed Windows® 2000 is used as system controller.
Furthermore, various tests are achieved while communicating (loop-back mode) with W-CDMA mobile terminals to be tested. Also, power consumption tests and temperature tests of W-CDMA mobile terminals are realized using DC power supply and temperature*1 chamber.
In summary, ME7873A is used for RF test use in the process ranging from the development to the final performance evaluation test of W-CDMA mobile terminals.

*1: DC power supply and temperature chamber are needed for power consumption tests and temperature tests separately.
For detailed information on DC power supply and temperature chamber, please contact your Anritsu sales representative.

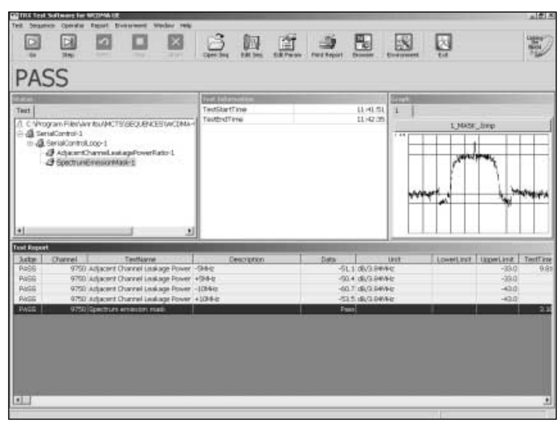
• Extension of measured units
Maximum 4 mobile terminals can be measured continuously with ME7417B-02 4 Antenna Connection Option*2.
*2: Only one unit in standard configuration.

• Auto measurement of correction value
The test system that is configured various equipments requires the frequency characteristic compensation of input/output level. Restoration with the substitution for configuration unit and periodical maintenance such as the update of correction value can be performed in user's site with the dedicated Correction Kit Option.

Windows® 2000 is a registered trademark of Microsoft corporation in the U.S. and other countries.

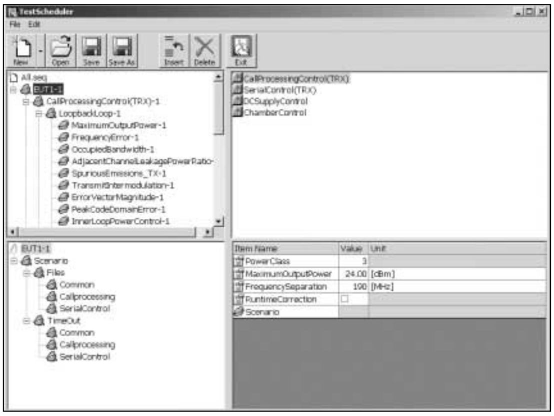
Understandable operation screen with Windows and help guide

• Main screen considering visual confirmability and operability
Operation on main screen is done with tool bar on upper part of the screen. The tool bar is composed of icons considering understandable operation detail. Test sequence items are displayed in the middle and on the left half of the screen, varied detailed information on the right half, and test results at the bottom, all in real time during the test. Thus all necessary information in testing can be confirmed on main screen.



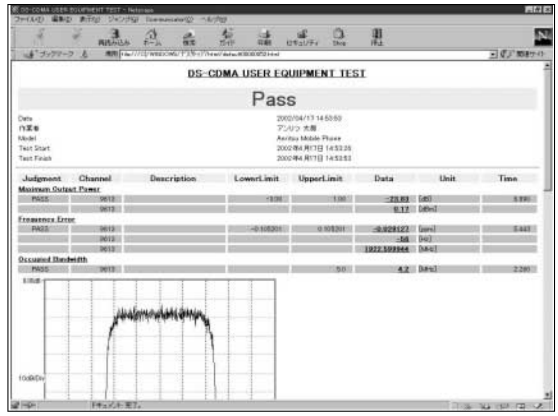
Main screen

• Abundant parameter setup
Parameter such as Spec. and Average can be specified for each test item. Testing can be performed under optimized conditions according to the model of device under test and test purpose.



Parameter setup example

• Measured data administrative function
Measured results acquired from this test unit can be displayed on browser screen and printed out. Various sorts of information such as test starting time, inputted to Header part of this measurement report, can all be administrated as a file.



Test result example

• Help guide
Software operation is supported by help guide. Also Japanese or English Help can be selected in installation.

Test items

• Loop-back mode (signaling control)

Measuring Instruments / 3GPP TS34.121 Standard Test Items	MD8480B W-CDMA Signaling Tester	MS8609A TX Tester 9 kHz to 13.2 GHz	MP8931A Error Rate Tester	MG3681A Interference SG2 250 kHz to 3 GHz	MG3692A CW SG3 10 kHz to 20 GHz
Clause 5 Transmitter Characteristics					
5.2 Maximum Output Power	√	√			√
5.3 Frequency Error	√	√			√
5.4.1 Open Loop Power Control in the Uplink	√	√			√
5.4.2 Inner Loop Power Control in the Uplink	√	√		√	√
5.4.3 Minimum Output Power	√	√			√
5.4.4 Out-of-synchronization handling of output power	√	√		+AWGN	√
5.5.1 Transmit OFF Power	√	√		√	√
5.5.2 Transmit ON/OFF Time mask	√	√		√	√
5.6 Change of TFC	√	√			√
5.7 Power setting in uplink compressed mode	√	√			√
5.8 Occupied Bandwidth (OBW)	√	√			√
5.9 Spectrum emission mask	√	√			√
5.10 Adjacent Channel Leakage Power Ratio (ACLR)	√	√			√
5.11 Spurious Emissions	√	√			√
5.12 Transmit Intermodulation	√	√			√
5.13.1 Error Vector Magnitude (EVM)	√	√			√
5.13.2 Peak code domain error	√	√			√
Clause 6 Receiver Characteristics					
6.2 Reference Sensitivity Level	√	√	√		√
6.3 Maximum Input Level	√	√	√		√
6.4 Adjacent Channel Selectivity (ACS)	√	√	√	√	√
6.5 Blocking Characteristics	√	√	√	√	√
6.6 Spurious Response	√	√	√		√
6.7 Intermodulation Characteristics	√	√	√	√	√
6.8 Spurious Emissions	√	√			√

+AWGN: Noise Generation Option needs to be installed.

3GPP TS34.121 Standard Test Items / Measuring Instruments	MD8480B W-CDMA Signaling Tester	MS8609A TX Tester 9 kHz to 13.2 GHz	MG3681A AWGN SG2 250 kHz to 3 GHz	PROPSim C2 Muitipath Fading Simulator*1
Clause 7 Performance Requirements				
7.2 Demodulation in Static Propagation conditions	√	√	√	√
7.3 Demodulation of DCH in Multi-path Fading Propagation conditions	√	√	√	√
7.4 Demodulation of DCH in Moving Propagation conditions	√	√	√	√
7.5 Demodulation of DCH in Birth-Death Propagation conditions	√	√	√	√
7.6.1 Demodulation of DCH in open-loop transmit diversity mode	√	√	√	√
7.6.2 Demodulation of DCH in closed loop transmit diversity mode	√	√	√	√
7.6.3 Demodulation of DCH in Site Selection Diversity Transmission Power Control mode	√	√	√	√
7.7.1 Demodulation of DCH in Inter-Cell Soft Handover	√	√	√	√
7.7.2 Combining of TPC Commands from radio links of different ratio link sets	√	√	√	√
7.8.1 Power control in the downlink, constant BLER target	√	√	√	√
7.8.2 Power control in the downlink, initial convergence	√	√	√	√
7.8.3 Power control in the downlink, wind up effects	√	√	√	√
7.9 Downlink compressed mode	√	√	√	√
7.10 Blind transport format detection	√	√	√	√

*1: PROPSim C2 Multipath Fading Simulator is a product of ELEKTROBIT.

Specifications

General*1	Max. input level	+34 dBm (2.5 W)
	Input/Output connector	Type N, 50 Ω VSWR ≤1.2 (9 kHz to 2.4 GHz: for measuring Maximum Output Power) VSWR ≤1.3 (1 to 3100 MHz: for measuring Blocking characteristics; Frequency range 3) VSWR ≤1.5 (3.1 to 8 GHz: for measuring Blocking characteristics; Frequency range 3) VSWR ≤1.7 (8 to 13 GHz: for measuring Blocking characteristics; Frequency range 3)
	Reference oscillator	Uses the MS8609A (Option 01 High stable reference recommendation oscillator provided) External reference input enabled (Frequency: 10/13 MHz selectable, BNC connector)
Power supply		AC 100 to 120 or 200 to 240 Vac, 50/60 Hz, ≤2710 VA, 1400 VA (typ.)
Dimensions and mass		1710 (W) x 1597 (H) x 797 (D) mm (excluding projections), ≤550 kg
Operating temperature		+15˚ to +35˚C (operation), 0˚ to +50˚C (storage)
EMC		EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

*1: The general specifications are applied to use of the ME7417B RF Interface Unit (with 3 dB Attenuator connector).

4

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
ME7873A	W-CDMA TRX/Performance Test System
	Components
MD8480B	W-CDMA Signaling Tester
MU848051A	CPU (include MD8480B)
MU848052A	Frame Decoder (include MD8480B)
MU848053A	RX Baseband (include MD8480B)
MU848056A	Voice Codec (include MD8480B)
MU848057A	Frame Coder (include MD8480B)
MU848058A	TX Baseband (include MD8480B)
MU848059B	Timing Generator 2 (include MD8480B)
MD8480A-01	Additional RF unit
MU848053A	RX Baseband
MU848057A	Frame Coder
MU848058A	TX Baseband
MU848061B	2nd OCNS
MX848010A	TS34.121 Support Control Software
MX848011A	TS34.121 Support Firmware
MX848012A	TS34.121 Support FPGA
MX848011A-01	W-CDMA signaling tester TX diversity
MX848011A-02	W-CDMA signaling tester compress mode
B0333F	Rack mount kit
MS8609A	Digital Mobile Radio Transmitter Tester
MS8609A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)
MS8609A-04	Digital resolution bandwidth
MS8609A-08	Pre-amplifier
MS8609A-31	Low noise floor
MS8609A-47	Rack mount without handle (IEC)
MX860901B	W-CDMA Measurement Software
MP8931A	Bit Error Rate Tester
B0333A	Rack mount kit
MG3681A	Digital Modulation Signal Generator
MU368040A	CDMA Modulation Unit
MX368041B	W-CDMA Software
MU368060A	AWGN Unit
B0333C	Rack mount kit
MG3692A	Synthesized Signal Generator
MG3690A/1B	Rack mount
MG3690A/2A	110 dB mechanical step attenuator
MG3690A/4	Digital down converter (RF coverage 0.01 to 2 GHz)
MG3690A/22	Audio frequency coverage, 0.1 Hz to 10 MHz
34RKNF50	Coaxial adapter (strengthened K-M, N-F)
MG3633A	Synthesized Signal Generator
B0048	Rack flange kit (for 1MW · 4U)
ME7416B	RF Switch Driver Unit
B0333A	Rack mount kit
ME7417B	RF Interface Unit
ME7417B-01	Three-signal junction
ME7417B-03	BRF for GSM band measurement
ME7417B-04	BRF for blocking characteristics measurement
ME7417B-10	Fading and AWGN addition
B0333B	Rack mount kit
ME7418A	Attenuator Unit
B0390G	Rack mount kit (1/2MW2U350D)
Z0622	Low noise amplifier (LNA1822-3212-R)
Z0621	Accessory kit
B0512	System rack (for Japan[*1])
B0519	System rack (for Europe[*1])
B0520	System rack (for North America[*1])
B0521	System rack (for China[*1])
MX787103A	W-CDMA TRX/Performance Test Software
MX787133A	TRX/Performance Test Self Test Software
	Standard accessory
W2289AE	ME7873A operation manual (CD-ROM): 1 copy
	Option
ME7417B-02	Four-antenna connection
	Application parts
Z0616[*2]	Accessory for basic correction
MX787113A[*2]	TRX/Performance Test Correction Software

*1: Customers can select one system rack from B0512, B0519, B0520 and B0521 depending on the area where it is used.
*2: For system correction, in addition to the Z0616 Accessory for Basic Correction and MX787113A TRX/Performance Test Correction Software, customers need to prepare measurement equipments for correction. For detailed information on additional equipments for correction, please contact your Anritsu sales representative

In addition to the components listed above, customers need to prepare the following components.

1. Fading Simulator
   Fading Simulator is used for performance test.
   Multipath Fading simulator PROPSim C2 (Product of Elektrobit)
2. Personal computer and peripherals
   Personal computer and peripherals are needed for controlling ME7873A.
   The following instruments with recommended spec need to be prepared by Customers.
   <Recommended Spec.>
   CPU: Pentium4 over 1.6 GHz
   OS: Microsoft Windows® 2000 Professional SP4
   Main Memory: over 512 MB
   Resolution: 1024 x 768 dots
   Hard Disk: over 10 GB
   Input/Output bus: USB,Ethernet (100BASE-TX), PCMCIA (PC Card)
   Others: CD-ROM, IE5.5
   <Peripherals>
   (1) GPIB Card
   Recommended Product: 778034-0212 PCMCIA-GPIB (for Windows® 2000) product of National Instruments
   (2) Ethernet Cable
3. DC power supply, Temperature chamber
   DC power supply and temperature chamber need to be prepared by customer for power consumption tests and temperature tests of W-CDMA mobile terminals. For detailed information on DC power supply and temperature chamber, please contact your Anritsu sales representative.

DIGITAL MODULATION SIGNAL GENERATOR
MG3681A
250 kHz to 3 GHz

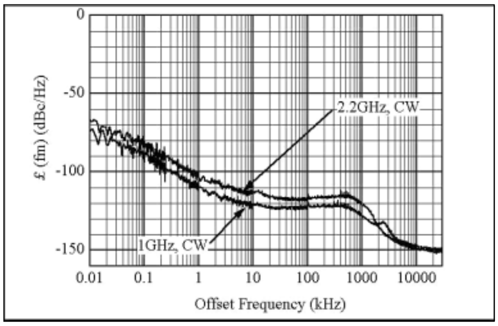
GPIB

For Evaluating Next Generation Digital Mobile Communications Systems

The MG3681A uses a wideband vector modulator to output the high-accuracy, high-speed vector modulation signals that are required for R&D and manufacturing of digital mobile communications equipment and related devices. It covers the frequency band of leading mobile communications systems for the frequency range of 250 kHz to 3 GHz. It uses vector modulator to provide excellent frequency response, distortion and S/N ratio. It can perform accurate receiver sensitivity test and transmitter adjacent channel leakage power test for high-speed modulation communications systems. Expansion units such as MU368040A CDMA Modulation Unit for modulation signals generation of W-CDMA communication system can be installed on the seven expansion slots in the MG3681A. Various modulation signals can be generated with the expansion units and associated software. The MG3681A also has analog modulation functions such as AM and FM for testing of analog communications systems. In addition, its excellent signal purity and various functions such as memory and frequency sweep are useful as a general-purpose signal generator.

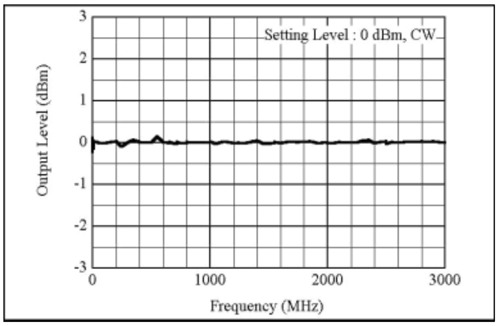
Features
- High-resolution setting of frequency 0.01 Hz and output level 0.01 dB
- 30 MHz wideband and high-accuracy vector modulation
- Excellent adjacent channel leakage power ratio
- Various expansion units

Performance and functions
• Excellent signal purity
Digital mobile communications evolve into wideband RF frequency bandwidth, and signal generator requires low-noise signal to faraway frequency offset. A unique synthesizer technology achieves low noise floor characteristics of –145 dBc/Hz (typ. at above 5 MHz offset).

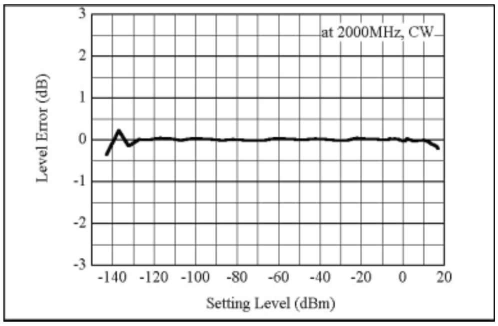


SSB phase noise characteristics

• Excellent level accuracy signal
The frequency response is excellent by calibrating output level across the entire output RF frequency range. Even low level can be output with high-accuracy due to use of a high-precision, high-reliability step attenuator calibrated.

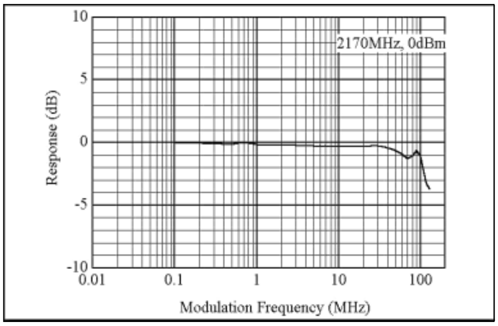


Output level frequency response

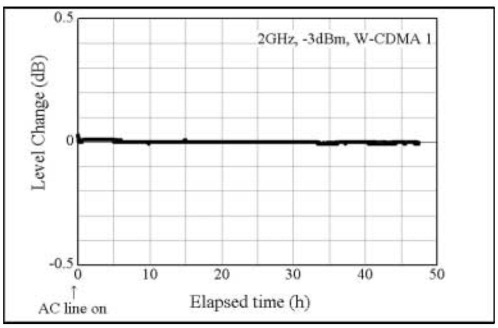


Output level accuracy

• Wideband vector modulation
The modulation frequency response of ±3 dB at the modulation frequency from DC to 30 MHz is achievable by the high-speed baseband signal processor and wideband vector modulator, permitting wideband vector modulation supporting high-speed data communications including W-CDMA system. Accurate wideband vector modulation is also available by using the external I/Q signals as well as internal modulation using the optional modulation units installed. In addition, a unique Automatic Level Control (ALC) technology assures stable output level at vector modulation.



Vector modulation frequency response

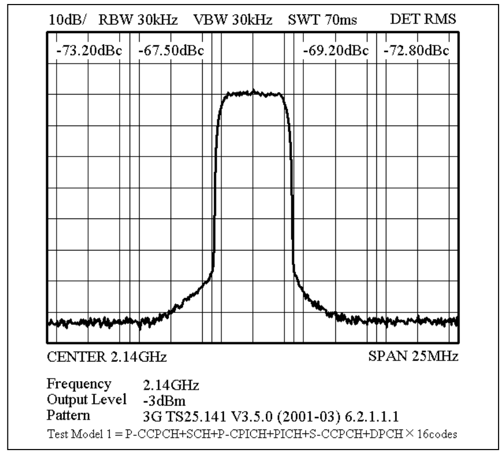


Output level stability at W-CDMA system modulation

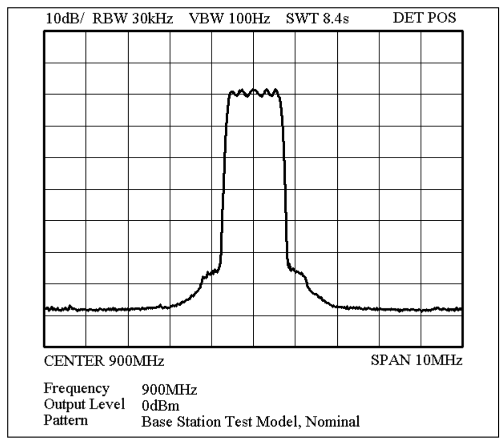
• Expansion units for up to seven slots
Seven slots for expansion units have 14 bits high-speed waveform data bus each In-phase and Quadrature signals. The excellent expansible platform covers future communication systems by addition of expansion units.

Note: When using the MU368010A, MU368030A and MU368040A, software for each communication system must be installed.
When the MU368060A AWGN Unit is installed in the MG3681A Digital Modulation Signal Generator, AWGN (Additive White Gaussian Noise) can be generated.

• Excellent adjacent channel leakage power ratio
The adjacent channel leakage power ratio of the digital modulation signal generator is an important factor in distortion testing of device and interference testing of receiver.
The MG3681A achieves an excellent adjacent channel leakage power ratio by an optimized circuit design. The typical adjacent channel leakage power ratio for W-CDMA system is –68 dBc/3.84 MHz and the secondary adjacent channel leakage power ratio is –75 dBc/3.84 MHz.



W-CDMA system adjacent channel leakage power ratio at 16 code multiplex



IS-95 system adjacent channel power ratio at 9 code multiplex

Configuration of communication system software and expansion units

Communication system	Applicable software	Expansion units
PDC	MX368011A PDC Software	MU368010A TDMA Modulation Unit
GSM	MX368012A GSM Device Test Software	
W-CDMA/3GPP (FDD)	MX368041B W-CDMA Software	MU368040A CDMA Modulation Unit
cdmaOne	MX368042A IS-95 Device Test Software	
HSDPA	MX368041B-11 HSDPA Signal Pattern	
cdma2000® 1X*1 cdma2000® 1xEV-DO*2 GSM/EDGE*3 PDC*3, NADC*3, PHS*3	MX368031A Device Test Signal Generation Software	MU368030A Universal Modulation Unit
cdma2000® 1xEV-DO	MX368033A cdma2000® 1xEV-DO Signal Generation Software	
PDC packet	MX368034A PDC Packet Software	
PHS	MX368035A PHS Signal Generation Software	
W-CDMA/3GPP cdma2000®	–	MU368060A AWGN Unit

*1: Since coding format of the Reverse is performed, it is utilizable for receiver sensitivity test (RC1 & 3) in base station production.
Since coding format of the Forward is not performed, it is not utilizable for receiver sensitivity test.
*2: For the Forward, only 16QAM modulation is available, 8PSK and QPSK modulation is not available. Since coding format of the Forward and the Reverse is not performed, it is not utilizable for receiver tests.
*3: It is a continuous modulation signal based on the communication system.

4

Specifications

• MG3681A main frame

<table>
<tr><td rowspan="6">Frequency</td><td>Range</td><td>250 kHz to 3000 MHz, Resolution: 0.01 Hz</td></tr>
<tr><td>Accuracy</td><td>Depends on installed reference oscillator, Reference frequency accuracy: ± (5% of FM setting deviation + 5 Hz) for frequency modulation</td></tr>
<tr><td>Internal reference oscillator</td><td>Aging rate: ±1 x 10^{-6}/year, Temperature stability: ±1 x 10^{-6} (0˚ to 50˚C)*1</td></tr>
<tr><td>External reference input</td><td>10 MHz/13 MHz auto-switching, ±10 ppm, ≥0.7 V(p-p)/50 Ω (AC coupled), BNC connector (rear panel)</td></tr>
<tr><td>Buffer output</td><td>10 MHz, TTL level (DC coupled), BNC connector (rear panel)</td></tr>
<tr><td>Switching time</td><td>≤20 ms (response time from final command to ±500 Hz of set frequency on GPIB at CW, ALC on, except when setting frequency is crossing over 600 MHz and 1010 MHz)</td></tr>
<tr><td rowspan="9">Output level</td><td>Range</td><td>–143 to +13 dBm (settable range: –143 to +17 dBm)</td></tr>
<tr><td>Unit</td><td>dBm, W, dBµV, V (dBµV, V selected terminate/open voltage display)</td></tr>
<tr><td>Resolution</td><td>0.01 dB (dBm, dBµV units), 3 digit (W, V units)</td></tr>
<tr><td>Frequency response</td><td>±1 dB (CW, ALC on, 0 dBm)</td></tr>
<tr><td>Accuracy</td><td>CW, ALC on
<table>
<tr><th>Level \ Frequency</th><th>≤1 GHz</th><th>>1 GHz</th></tr>
<tr><td>≤+13 dBm, ≥–127 dBm</td><td>±1 dB</td><td>±2 dB</td></tr>
<tr><td><–127 dBm</td><td>±2 dB</td><td>±3 dB</td></tr>
</table></td></tr>
<tr><td>Output connector</td><td>50 Ω, N-type connector (front panel)</td></tr>
<tr><td>Switching time</td><td>≤50 ms (normal mode), ≤100 ms (safety mode), ≤10 ms (continuous mode)
*Response time from final command to ±0.5 dB of final level on GPIB at CW, ALC on</td></tr>
<tr><td>Special setting mode</td><td>Continuous mode:
Level continuously adjustable in set value range of ±10 dB (dBm, dBµV units only)
For vector modulation by optional digital modulation unit, continuous mode variance depends on modulation setting
Safety mode: Mechanical attenuator decreases level to prevent generation of high-level signal spikes</td></tr>
<tr><td>ALC mode</td><td>ALC on
Usage: Continuous wave or pulse modulation wave (burst wave) with RF On time of 10 µs or more
ALC time constant: Auto, 500 ns, 2.4 µs, 5 µs, 24 µs, 50 µs, 240 µs, 500 µs selectable
At Auto, automatically selected depending on frequency, AM and vector modulation [when digital modulation unit (option) is used]
The ALC time constant is automatically selected, depending on the set frequency, regardless of the time constant selected on the front panel
ALC off
Usage: Pulse modulation wave (burst wave) whose RF on time is less than 10 µs
Restrict item: Without AM
ALC calibration: Automatic during ALC Calibration operation and at frequency/level setting change</td></tr>
<tr><td rowspan="2">Signal purity</td><td>Spurious</td><td>Harmonics: <–30 dBc
Non harmonic:
<table>
<tr><th>Frequency</th><th>15 kHz to 300 MHz offset</th><th>>300 MHz offset</th><th>Fixed frequency spurious</th></tr>
<tr><td>≤2500 MHz</td><td><–60 dBc</td><td><–30 dBc</td><td>–50 dBc (660, 1320 MHz)</td></tr>
<tr><td>>2500 MHz</td><td colspan="2"><–30 dBc</td><td>–</td></tr>
</table>
Those related power: <–40 dBc *CW, ≤0 dBm</td></tr>
<tr><td>SSB phase noise</td><td><–118 dBc/Hz (≥10 MHz, ≤1010 MHz), <–112 dBc/Hz (>1010 MHz) *At CW, 20 kHz offset</td></tr>
<tr><td rowspan="5">AM</td><td>Range</td><td>0 to 100% (cannot set internal/external modulation independently), Resolution: 0.1%</td></tr>
<tr><td>Modulation frequency response</td><td>≤0 dBm, ALC on, in band of ±1.5 dB based on modulation frequency of 1 kHz
<table>
<tr><th rowspan="3">Frequency</th><th rowspan="3">Lower limit frequency</th><th colspan="3">Upper limit frequency</th></tr>
<tr><th colspan="2">Vector modulation and wideband AM off</th><th>Vector modulation or wideband AM on</th></tr>
<tr><th>AM: 30%</th><th>AM: 80%</th><th>AM: 30%</th></tr>
<tr><td>≥0.4 MHz, <2 MHz</td><td rowspan="3">DC (Internal modulation, External modulation DC coupled), 20 Hz (External modulation AC coupled)</td><td>3 kHz</td><td>1 kHz</td><td rowspan="3">1 kHz</td></tr>
<tr><td>≥2 MHz, <10 MHz</td><td>10 kHz</td><td>10 kHz</td></tr>
<tr><td>≥10 MHz</td><td>10 kHz</td><td>10 kHz</td></tr>
</table></td></tr>
<tr><td>Internal modulation</td><td>Depends on AF synthesizer (Option 21)</td></tr>
<tr><td>External modulation</td><td>2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)</td></tr>
<tr><td>Modulation signal polarity</td><td>Positive/negative switchable</td></tr>
<tr><td rowspan="6">FM</td><td>Range</td><td>0 to 1000 kHz (≥10 MHz, ≤1010 MHz), 0 to 2000 kHz (>1010 MHz)
*Cannot set internal/external modulation independently.</td></tr>
<tr><td>Resolution</td><td>10 Hz (0 to 10 kHz deviation), 100 Hz (10.1 to 100 kHz deviation), 1 kHz (101 to 1000 kHz deviation), 10 kHz (1010 to 2000 kHz deviation)</td></tr>
<tr><td>Modulation frequency response</td><td>DC to 20 kHz (internal modulation, external modulation DC coupled), 20 Hz to 20 kHz (external modulation AC coupled)
*In band of ±1 dB based on modulation frequency of 1 kHz</td></tr>
<tr><td>Internal modulation</td><td>Depends on AF synthesizer (Option 21)</td></tr>
<tr><td>External modulation</td><td>2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)</td></tr>
<tr><td>Modulation signal polarity</td><td>Positive/negative switchable</td></tr>
</table>

Continued on next page

øM	Range	0 to 6.28 rad (≥10 MHz, ≤1010 MHz), 0 to 12.56 rad (>1010 MHz) ∗Cannot set internal/external modulation independently.
	Unit	rad, deg
	Resolution	rad unit: 0.01 rad, deg unit: 1 deg
	Modulation frequency response	DC to 20 kHz (internal modulation, external modulation DC coupled), 20 Hz to 20 kHz (external modulation AC coupled) ∗In band of ±1 dB based on modulation frequency of 1 kHz
	Internal modulation	Depends on AF synthesizer (Option 21)
	External modulation	2 V(p-p) approx., 600 Ω, AC/DC coupled switchable, BNC connector (front panel)
	Modulation signal polarity	Positive/negative switchable
Wideband AM	Modulation frequency response	DC to 15 MHz (±2 dB bandwidth), DC to 30 MHz (±3 dB bandwidth) ∗External modulation, input level: 0.9 V(p-p), ≥100 MHz, ≤0 dBm, modulation frequency of 1 kHz
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	≤1 V(p-p), 50 Ω, BNC connector (front panel), sensitivity: 1 V(p-p) = 100%
Pulse modulation	On/off ratio	>60 dB
	Rise/fall time	<100 ns (external modulation)
	Minimum pulse width	<500 ns (external modulation)
	Pulse repetition frequency	DC to 1 MHz (external modulation, ALC off)
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	TTL level, positive logic, 50 Ω, BNC connector (front panel)
Vector modulation	Modulation frequency response	DC to 15 MHz (±2 dB bandwidth), DC to 30 MHz (±3 dB bandwidth) ∗External modulation, input level: 0.5 V(rms), ≥100 MHz, ≤0 dBm, modulation frequency of 1 kHz
	Vector error	≤2.5%(rms) ∗External modulation, input level: 0.5 V(rms), ≥100 MHz, ≤0 dBm, 3.84 Msps QPSK modulation
	Internal modulation	Depends on installed digital modulation unit (option)
	External modulation	$\sqrt{(I^2+Q^2)}$ = 0.5 V(rms), I/Q = ±1.5V(peak), 50 Ω, BNC connector (front panel)
	Quadrature degree adjustment function	Adjustment range: ≥±1 deg
	I/Q change	I, Q signal changeable (RF spectrum invert)
Simultaneous modulation		Modulation depth and deviation same for combinations below: AM (internal/external), FM (internal/external), øM (internal/external) Frequency and waveform of modulation signal source same for combinations below: AM (internal)/FM (internal), AM (internal)/øM (internal) Simultaneous modulation impossible as below: FM/øM, wideband AM/vector modulation, vector (internal)/Vector (external) modulation
AF signal output		Depends on AF synthesizer (Option 21)
I/Q signal output∗2	Output level	Depends on installed digital modulation unit (option)
	Signal source	Depends on installed digital modulation unit (option)
	Output connector	50 Ω, BNC connector (front panel)
Memory function	Basic parameter memory	512 sets of frequency and level
	All parameter memory	All parameters including 100 sets maximum of analog modulation and digital modulation units (option)
Sweep function	Sweep parameter	Basic parameter memory address
	Sweep pattern	Start address → stop address
	Sweep time	1 ms to 600 s (per memory; memory recall time restricts lower limit, resolution: 1 ms)
	Sweep mode	Auto (repetition sweep), single (single sweep)
Special display	Relative display	Frequency, output level (dBm, dBµV units only)
	Offset display	Frequency (offset range: –3 to +3 GHz), output level (offset range: –55 to +55 dB, dBm, dBµV units only)
Display	Size	7.2 inch, 480 x 640 dots, color D-STN
	On/off setting	Panel display on/off
Backup function		All items reset at power-on except following: Input data contents, remote condition, contents of GPIB data being transferred, RPP operation condition, screen condition, main function selections
Panel lock function	Panel lock	Disable operation of all keys except front panel power key, panel lock key, local key and contrast key
	Knob hold	Disable rotary knob on front panel operation
External interface	GPIB	Remote control: All functions except power switch, local key, and contrast key Interfaces: SH1, AH1, T5, L4, TE0, SR1, RL1, DP0, PP0, DC1, DT1, C1, E2 Connector: Rear panel
	RS-232C	Remote control: All functions except power switch, local key, and contrast key Communications method: Async (start-stop), half-duplex Communications control method: X on/off by command Baud rate: 1200, 2400, 4800, 9600, 19200, 38400 bps Data bits; 7 or 8 Parity: Odd, even, none Start bit: 1 Stop bit: 1 or 2 Connector: D-sub 9 pins, rear panel

Continued on next page

External interface	PC card	Memory card (memory backup, screen hard copy) Connector: JEIDA Ver 4/4.1 PCMCIA Rel 2.0, 1 slot (rear panel)
	Trigger	Executes item specified by command-input signals (3 bits) from following items: Frequency step-up/step-down, output level step-up/step-down, basic parameter recall address up/down, output level on/off Interface: TTL level Connector: D-sub 9-pin, female (rear panel)
Reverse power protection		≤50 W (≤1 GHz), ≤25 W (>1 GHz), ±50 V (DC)
Power		AC 100 to 120/200 to 240 V (–15/+10%, 250 V max, automatic selection), 47.5 to 63 Hz, ≤300 VA
Temperature		Operating: 0˚ to 50˚C, Storage: –20˚ to 60˚C
Dimensions and mass		426 (W) x 177 (H) x 451 (D) mm, ≤25 kg (excluding option)
EMC		EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

∗1: Aging rates down to 5 x 10^{-10}/day are available as reference crystal oscillator (MG3681A Option 01/02).
∗2: Possible to expand the function with MG3681A Option 11

• Options

Option 01 (Reference crystal oscillator)	Frequency: 10 MHz Aging rate: ±5 x 10^{-9}/day Start-up characteristics: 1 x 10^{-7} (After 10 min, compared to frequency after 24 h warm-up) Temperature stability: ±3 x 10^{-8} (0˚ to 50˚C)
Option 02 (Reference crystal oscillator)	Frequency: 10 MHz Aging rate: ±5 x 10^{-10}/day Start-up characteristics: 1 x 10^{-7} (After 10 min, compared to frequency after 24 h warm-up) Temperature stability: ±5 x 10^{-9} (0 to 50˚C)
Option 11 (Additional function of I/Q output)	Functions: Adds level, offset setting, and differential output functions to I/Q output Level Range: 80 to 120% of nominal level, Resolution: 0.1% ∗2 sets of I/$\overline{I}$ and Q/$\overline{Q}$ set independently, 50 Ω termination Offset Range: –0.5 to +1.5 V, Resolution: 0.5 mV ∗4 sets of I, $\overline{I}$, Q, $\overline{Q}$ set independently, 50 Ω termination Quadrature degree variable function Range: ±5 deg, Resolution: 0.5 deg Differential output: I, Q signals (Using front I/Q input connector) Signal source: Depends on installed digital modulation unit (option) Output connector: 50 Ω, BNC connector (front panel)
Option 21 (AF synthesizer)	Frequency: 0.01 Hz to 400 kHz, Resolution: 0.01 Hz, Accuracy : same as reference oscillator Waveform: Sine, triangular, square, sawtooth Frequency response: ±1 dB [sine wave, level: 2 V(p-p), offset: 0 V, 600 Ω termination, reference to 1 kHz, 10 Hz to 100 kHz] Harmonics: ≤–50 dB [sine wave, level: 2 V(p-p), offset: 0 V, 600 Ω termination, 1 kHz] Level Range: 0 to 4 V(p-p), Resolution: 1 mV(p-p), Accuracy: ± [8% of set level + 2 mV(p-p)] ∗600 Ω termination Offset Range: –2 to +2 V, Resolution: 1 mV, Accuracy: ± (8% of set level + 2 mV) ∗600 Ω termination Output connector: 600 Ω, BNC connector (front panel)
Option 42 (RF high level output)	Functions: 8 dB gain of maximum output level in W-CDMA band Frequency: 1900 to 2200 MHz Gain: 8 ±1 dB (from –3 dBm, RF high level output off, 2.1 GHz) Gain frequency response: ±1 dB (at +5 dBm, referenced to 2.1 GHz)

• Expansion units and software

Refer to the individual catalogs for the expansion units and software.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MG3681A	Digital Modulation Signal Generator	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
B0325	GPIB connector shield cap:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
W1708AE	MG3681A operation manual:	1 copy
	Options	
MG3681A-01	Reference oscillator (aging rate: 5 x 10^{-9}/day)	
MG3681A-02	Reference oscillator (aging rate: 5 x 10^{-10}/day)	
MG3681A-11	Additional function of I/Q output (level and offset setting, differential output)	
MG3681A-21	AF synthesizer (0.01 Hz to 400 kHz, resolution: 0.01 Hz)	
MG3681A-42	RF high level output (for W-CDMA, 8 dB gain)	
	Maintenance service	
MG3681A-90	Extended three years warranty service	
MG3681A-91	Extended five years warranty service	
	Expansion units	
MU368010A	TDMA Modulation Unit*1,*2	
MU368030A	Universal Modulation Unit*1,*2	
MU368040A	CDMA Modulation Unit*1,*2	
MU368060A	AWGN Unit*1	
	Standard accessories	
W1835AE	MU368010A operation manual:	1 copy
W1973AE	MU368030A operation manual:	1 copy
W1758AE	MU368040A operation manual:	1 copy
W1955AE	MU368060A operation manual:	1 copy
	Maintenance service	
MU368010A-90	Extended three years warranty service	
MU368010A-91	Extended five years warranty service	
MU368030A-90	Extended three years warranty service	
MU368030A-91	Extended five years warranty service	
MU368040A-90	Extended three years warranty service	
MU368040A-91	Extended five years warranty service	
MU368060A-90	Extended three years warranty service	
MU368060A-91	Extended five years warranty service	

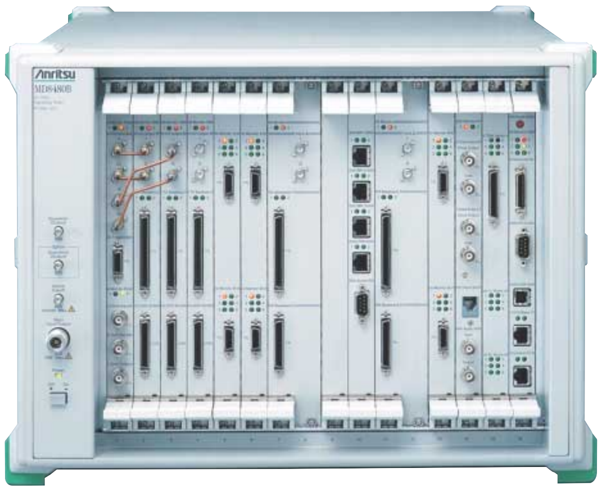
*1: Refer to the individual catalogs for the expansion units, software and band pass filter.
*2: When using the MU368010A, MU368030A and MU368040A, dedicated software must be installed.

Model/Order No.	Name	
	Softwares*1	
MX368011A	PDC Software (for MU368010A)	
MX368012A	GSM Device Test Software (for MU368010A)	
MX368031A	Device Test Signal Generation Software (for MU368030A)	
MX368033A	cdma2000® 1xEV-DO Signal Generation Software (for MU368030A)	
MX368034A	PDC Packet Software (for MU368030A)	
MX368035A	PHS Signal Generation Software (for MU368030A)	
MX368041B	W-CDMA Software (for MU368040A)	
MX368041B-11	HSDPA signal pattern (for MX368041B)	
MX368042A	IS-95 Device Test Software (for MU368040A)	
	Standard accessories	
W1836AE	MX368011A operation manual:	1 copy
W1837AE	MX368012A operation manual:	1 copy
W1974AE	MX368031A operation manual:	1 copy
W2072AE	MX368033A operation manual:	1 copy
W2073AE	MX368034A operation manual:	1 copy
W2167AE	MX368035A operation manual:	1 copy
W2089AE	MX368041B operation manual:	1 copy
W1838AE	MX368042A operation manual:	1 copy
	Optional accessories	
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m	
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m	
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m	
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
B0329C	Front cover (1MW4U)	
B0331C	Front handle (2 pcs/set)	
B0332	Joint plate (4 pcs/set)	
B0333C	Rack mount kit	
B0334C	Carrying case (Hard type, with front cover and casters)	
MA2512A	Band Pass Filter*1 (for W-CDMA, pass band: 1.92 to 2.17 GHz)	

W-CDMA SIGNALING TESTER
MD8480B

CE

One Unit Supports Development of 3G W-CDMA Mobile Stations



The MD8480B has a full lineup of advanced functions for testing third-generation W-CDMA mobile stations. Its air interface meets the 3GPP specifications and it can be used as a base station simulator. The test functions include mobile station modulation and demodulation processing, protocol sequence tests such as location registration, origination, termination, handover (option), disconnection from mobile station/network, various applications such as voice and packet communications as well as communications between two mobile stations (two sets of MD8480B are required).
Moreover, the addition of the function (option) of GSM/GPRS can perform the handover test between W-CDMA to GSM/GPRS.
In summary, the MD8480B is the ideal instrument for developing 3G W-CDMA mobile stations and application software.

Features

- Modulation/demodulation function tests for W-CDMA, GSM/GPRS mobile station
- Protocol sequence tests for W-CDMA, GSM/GPRS mobile station
- Flexible settings of test parameters and sequences for protocol sequences
- Voice and packet communications test, and communications testing between two mobile stations

Functions

Demodulation test channels

Channel	Logical	Transport	Physical	Symbol rate
Common	BCCH	BCH	P-CCPCH	15 ksps
			P-SCH	
			S-SCH	
			(P-) CPICH	15 ksps
			(S-) CPICH	15 ksps
			PICH	15 ksps
			AICH	15 ksps
	PCCH	PCH	S-CCPCH	60, 120 ksps
	CCCH/DCCH/DTCH	FACH		
Dedicated			DPCCH	15, 30, 60, 120, 240, 480, 960 ksps
	DCCH + DTCH	DCH	DPDCH	15, 30, 60, 120, 240, 480, 960 ksps
	DCCH + DTCH		DPDCH	
	DCCH + DTCH		DPDCH	

Modulated test channels

Channel	Logical	Transport	Physical	Symbol rate
Common			PRACH (preamble)	
			PRACH (control)	
	CCCH/DCCH/DTCH	RACH	PRACH (message)	15, 30, 60, 120 ksps
Dedicated			DPCCH	15 ksps
	DCCH/DTCH	DCH	DPDCH	15, 30, 60, 120, 240, 480, 960 ksps

Supported service

Service		Data rate	Physical channel downlink (1 symbol = 2 bits)	Physical channel uplink (1 symbol = 1 bit)
(Protocol)	(Standalone DCCH)		1 x DPCH (15 ksps)	1 x DPDCH (15 ksps)
Voice (GSM-AMR)		12.2 kbps (VAD Option 01)	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
ISDN 1B		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
Packet		32 kbps	1 x DPCH (60 ksps)	1 x DPDCH (120 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		128 kbps	1 x DPCH (240 ksps)	Not currently supported
		384 kbps	3 x DPCH (240 ksps)	1 x DPDCH (960 ksps)
Audio and video		32 kbps	1 x DPCH (60 ksps)	1 x DPDCH (120 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
Reference measurement channel		DCCH	1 x DPCH (15 ksps)	1 x DPDCH (15 ksps)
		12.2 kbps	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
		64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		144 kbps	1 x DPCH (240 ksps)	1 x DPDCH (480 ksps)
		384 kbps	1 x DPCH (480 ksps)	1 x DPDCH (960 ksps)
		BTFD	1 x DPCH (30 ksps)	1 x DPDCH (60 ksps)
Multicall	Voice + Packet	12.2 kbps + 32 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)
		12.2 kbps + 64 kbps	1 x DPCH (120 ksps)	Not currently supported
		12.2 kbps + 384 kbps	3 x DPCH (240 ksps)	1 x DPDCH (960 ksps)
	Voice + ISDN 1B	12.2 kbps + 64 kbps	1 x DPCH (120 ksps)	1 x DPDCH (240 ksps)

Specifications

General	Frequency range	W-CDMA Tx: 800 to 900 MHz (only after calibration[*1]), 2110 to 2170 MHz Rx: 800 to 900 MHz (only after calibration[*1]), 1920 to 1980 MHz Tx: 300 to 3000 MHz (only after calibration[*2]) Rx: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz (only after calibration[*2]) GSM Tx: 300 to 3000 MHz, Rx: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz
	I/O connector	Main N-type, Impedance: 50 Ω, VSWR: ≤1.3 Downlink 1 SMA-type, Impedance: 50 Ω, VSWR: ≤2.0 Downlink 2 SMA-type, Impedance: 50 Ω, VSWR: ≤2.0 Uplink SMA type, Impedance: 50 Ω, VSWR: ≤2.0
	Reference oscillator	Frequency: 10 MHz Startup characteristics: ≤5 x 10^{-8}/day (10 minutes after power-on, reference to 24 hours after power-on) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (reference to 24 hours after power-on) Temperature characteristics: ≤5 x 10^{-8} (0˚ to 50˚C, reference to 25˚C) External reference input: 10 MHz, 2 to 5 Vp-p
Transmitter (W-CDMA)	Frequency	Range: 800 to 900 MHz (only after calibration[*1]), 2110 to 2170 MHz, Step: 100 kHz Range: 300 to 3000 MHz (only after calibration[*2]), Step: 100 kHz
	Output level	Maximum output level Main: –25 dBm (each channel), –16 dBm (overall) Downlink: –10 dBm (each channel), –1 dBm (overall) Setting resolution: 0.1 dB Accuracy: ±1.5 dB (+18˚ to +28˚C)
	Spreading	Codes: Scrambling, channelization, synchronization Chip rate: 3.84 MHz
	Modulation	Method: QPSK Modulation band limit: Root Nyquist filter (α = 0.22) EVM: ≤10% rms
	AWGN	Setting resolution: 0.1 dB
Receiver (W-CDMA)	Frequency	Range: 800 to 900 MHz (only after calibration[*1]), 1920 to 1980 MHz, Step: 100 kHz Range: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz (only after calibration[*2]), Step: 100 kHz
	Input level	Range: –30 to +40 dBm (main), –50 to +20 dBm (uplink)
	Sync.	Rake receive: None, Capture range: ±200 chip (DPCCH), ±100 chip (PRACH preamble)
Transmitter (GSM)	Frequency	Range: 300 to 3000 MHz (200 kHz steps)
	Output level	Maximum output level Main: –15 dBm, Downlink: 0 dBm Setting resolution: 0.1 dB Accuracy: ±1.5 dB (+18˚ to +28˚C)
	Symbol rate	270.833 kHz
	Modulation	Method: GMSK, Phase error: ≤5.0˚ RMS

Continued on next page

Receiver (GSM)	Frequency	Range: 350 to 550 MHz, 700 to 1100 MHz, 1400 to 2200 MHz (200 kHz steps)
	Input level	Range: –30 to +35 dBm (main), –50 to +15 dBm (uplink)
Power		100 to 120/200 to 240 Vac (250 V max.), automatic switching, 47.5 to 63 Hz, ≤430 VA
Ambient temperature		0˚ to +50˚C (operating), –40˚ to +70˚C (storage)
Dimensions and mass		426 (W) x 310 (H) x 500 (D) mm, ≤35 kg
EMC		EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

∗1: Only when the sticker of “W-CDMA 800 MHz Calibrated” is attached to the MD8480B main frame.
∗2: Only when the sticker of “W-CDMA 350-550 MHz 700-1100 MHz 1400-2200 MHz Calibrated” is attached to the MD8480B main frame.

Options

• **Hardware**

ISDN (MU848055A)
It is the option which makes the ISDN interface usable, and can respond to the data rate of a maximum of 6 B (384 kbps). Moreover, RS-232C interface with which this option is equipped is used, and a PPP packet test can be performed.

Additional base station (MU848057A, MU848058A, MU848053A)
The standard composition of MD8480B has one transmission/reception function. By adding these options, it is possible to have the transmission function (an equivalent for three base stations) of a maximum of 3 base stations and two reception functions by one-set of MD8480B. The examination of soft handover is possible by this option (see the table of “Option functions” for details).

Additional RF unit (MD8480A/B-02)
It is an option corresponding to two different frequency (transmission and reception). The hard handover (handover between two base stations of different frequencies) is attained combining the above-mentioned additional base station option.

TDMA (MU848060B)
It is the option which makes the function of GSM/GPRS usable. As the GSM/GPRS functions, location registration, mobile station origination/termination, disconnection from mobile station/network and handover (intra-system) are possible. And various applications such as voice and data communications are supported. It combines with additional RF unit (MD8480A-01) and compressed mode (MX848001A-02, after-mentioned), and the examination of the handover between W-CDMA and GSM/GPRS is enabled.

• **Software**

Tx diversity (MX848001A-01)
As the option for corresponding to the function of Tx diversity, it corresponds to TSTD, STTD, the closed loop model 1, and the closed loop model 2. The MU848057A and MU848058A (two sets) become indispensable as an additional base station option.

Compressed mode (MX848001A-02)
As the option corresponding to a compressed mode function, it corresponds to SF/2, Puncturing, and Higher Layer Scheduling.

Router connection (MX848001A-03)
This option achieves data communications with a PC that has different subnet (segment) IP address. It is usable for data communications both W-CDMA and GPRS. Also, it is available for both IP and PPP packet tests.

GSM CSD (MX848001A-04)
This option brings the CSD function of GSM. It supports PPP packet and the data rate is 9.6 kbps and 14.4 kbps. Also, it supports ‘asynchronous’ mode data transmission in the non-transparent mode.

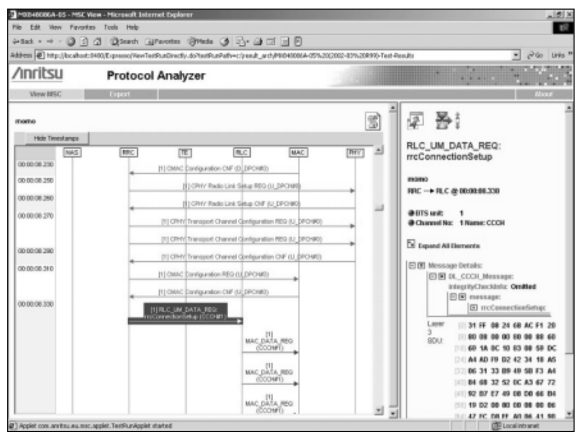
GSM frequency hopping (MX848001A-05)
As the option corresponding to GSM frequency hopping function, frequency hopping is realized in the GSM communication channel in 4.62 ms frame cycles. Also, an additional RF unit must be GSM frequency hopping compliant for the use of this option (see the table of “Option functions” for details).

Ciphering (MX848041A)
As the option which adds the function of authentication and ciphering, it corresponds to KASUMI (authentication and ciphering algorithm of the standard in 3GPP).

• **Software maintenance contract (MD8480A-20, MD8480A-21, MD8480B-20, MD8480B-21)**
This contract covers minute modification of software functions associated with 3GPP revisions. Also, it gives supports for the help of troubles caused in user side. The MD8480A-20 is a software maintenance contract for MD8480A, the MD8480A-21 is for ciphering authentication (MX848041A) of MD8480A, the MD8480B-20 is for MD8480B and the MD8480B-21 is for ciphering authentication (MX848041A) of MD8480B (Refer to the corresponding materials for details of the contract.).

Application software

• **Protocol analyzer (MX848086A)**
The execution result containing RRC and a NAS message obtained by MD8480B is decoded automatically. And it is displayed as a message sequence chart.
It is possible for other PCs to check the execution result by exporting it to the data of HTML format.



Option functions

Additional functions	MU848057A	MU848058A	MU848055A	MU848053A	MU848060B	MD8480A/B-02	MX848001A-01	MX848001A-02	MX848001A-03	MX848001A-04	MX848001A-05	MX848041A	MD8480A/B-20/21
2SB soft handover	√	√											
3SB soft handover	√	√*1											
ISDN			√										
Tx diversity (1RF output)	√	√*1					√						
Tx diversity (2RF output)	√	√*1				√	√						
Hard handover	√	√		√		√		√					
Inter-system (GSM/GPRS) handover					√	√		√					
Router connection (W-CDMA)									√				√
Router connection (GPRS)					√	√			√				√
GSM CSD			√		√	√				√			√
GSM frequency hopping					√	√*2					√		√
Ciphering												√*3	

*1: Requires two equipment sets
*2: MD8480A/B-02 is an additional RF unit that supports GSM frequency hopping. Also, when MD8480A-01 Additional RF Unit have been already mounted in main frame, “Z0730 Additional RF Unit for frequency hopping” offers upgrade to an additional RF unit that supports GSM frequency hopping.
*3: When using with the MX848001A-01, MX848001A-02, MX848001A-03 or MX848001A-04 requires the MX848041A-01, MX848041A-02, MX848041A-03 or MX848041A-04.

The options are all shared functions.
• Requires MD8480B + MU848057A + MU848058A + MU848058A for 3BS soft handover function.
This configuration also supports 2BS soft handover function.
• Requires MD8480B + MU848057A + MU848058A + MU848058A + MD8480A-01 + MX848001A-01 for Tx diversity (2RF output).
This configuration also supports the 2BS soft handover function, 3BS soft handover function and Tx diversity (1RF output) function.

Ordering information

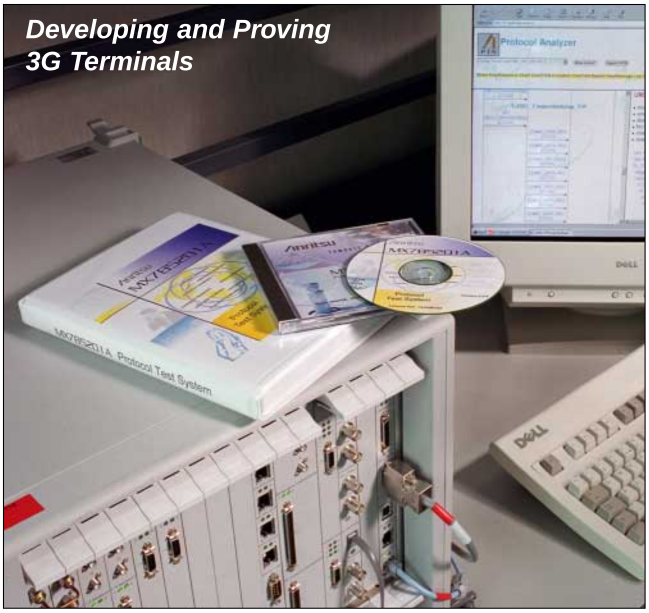
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MD8480B	W-CDMA Signaling Tester	
	Units (incorporated in the main frame)	
MU848051A	CPU:	1 pc
MU848052A	Frame Decoder:	1 pc
MU848053A	Rx Baseband:	1 pc
MU848056A	Voice Codec:	1 pc
MU848057A	Frame Coder:	1 pc
MU848058A	Tx Baseband:	1 pc
MU848059B	Timing Generator 2:	1 pc
	Standard accessories	
MX848000A	W-CDMA Signaling Tester Control Software (CD-ROM):	1 pc
MX848001A	W-CDMA Signaling Tester Firmware (CD-ROM):	1 pc
MX848002A	W-CDMA Signaling Tester FPGA (CD-ROM):	1 pc
MX848003A	W-CDMA Signaling Tester ISDN/PPP (CD-ROM):	1 pc
MX848005B	GSM/GPRS:	1 pc
J0892	Twisted pair cable, 5 m:	1 pc
G0091	Monitor board:	2 pcs
J1005	Monitor cable, 80-pin:	1 pc
J1006	Monitor cable, 20/50-pin:	1 pc
	Power cord, 2.6 m:	1 pc
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m:	1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m:	1 pc
J1010	U-link (50 mm):	2 pcs
J0654A	RS-232C cable (cross), 2 m:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
W1964AE	MD8480B operation manual (CD-ROM):	1 copy
A0010	Blank board (at option uninstalled):	1 to 6 pcs
A0011	Bridge board (at option uninstalled):	1 to 2 pcs
	Option units	
MU848053A	Rx Baseband (Hardware)	
MU848055A	ISDN (Hardware)	
MU848057A	Frame Coder (Hardware)	

MD8480B requires PC*1 and Microsoft Visual C++ Version 6.0*2 or .NET.
*1 PC is for controlling the MD8480B. The following is the required spec;
OS: Windows 95/98/2000, Windows NT4.0 Workstation
CPU: 400 MHz or better with minimum of 64 MB of memory, 10Base-T and RS-232C interfaces (D-Sub 9-pin), and CD-ROM drive
*2 Microsoft Visual C++ Version 6.0 or .NET is a registered trademark of Microsoft Corporation in USA and other countries.
Microsoft Visual C++ Version 6.0 or .NET is standard edition available.

Model/Order No.	Name
MU848058A	Tx Baseband (Hardware)
MU848060B	TDMA (Hardware)
MD8480A-02	Additional RF unit (Hardware, for MD8480A)
MD8480B-02	Additional RF unit (Hardware, for MD8480B)
MX848001A-01	W-CDMA signaling tester Tx diversity (software, license document)
MX848001A-02	W-CDMA signaling tester compressed mode (software, license document)
MX848001A-03	W-CDMA signaling tester router connection (software, license document)
MX848001A-04	W-CDMA signaling tester GSM CSD (software, license document)
MX848001A-05	W-CDMA signaling tester GSM frequency hopping (software, license document)
MX848041A	W-CDMA Signaling Tester Ciphering (software, CD-ROM, license document)
MX848041A-01	Tx diversity for ciphering (software, license document)
MX848041A-02	Compressed mode for ciphering (software, license document)
MX848041A-03	Router Connection for ciphering (software, license document)
MX848041A-04	GSM CSD for ciphering (software, license document)
MX848041A-05	GSM frequency hopping for ciphering (software, license document)
MD8480A-20	MD8480A support service (software maintenance contract, license document)
MD8480A-21	Support service for ciphering (software maintenance contract, license document)
MD8480B-20	MD8480B support service (software maintenance contract, license document)
MD8480B-21	Support service for ciphering (software maintenance contract, license document)
MD8480B-90	Extended three year warranty service
MD8480B-91	Extended five year warranty service
Z0730	Additional RF unit for frequency hopping (GSM frequency hopping compliant of MD8480A-01)
	Application softwares
MX848086A	3GPP Protocol Analyzer
MX848086A-09	3GPP R99 March 03 support

W-CDMA PROTOCOL TEST SYSTEM (PTS) MX785201A
W-CDMA VIRTUAL SIGNALING TESTER (VST) MX785101A



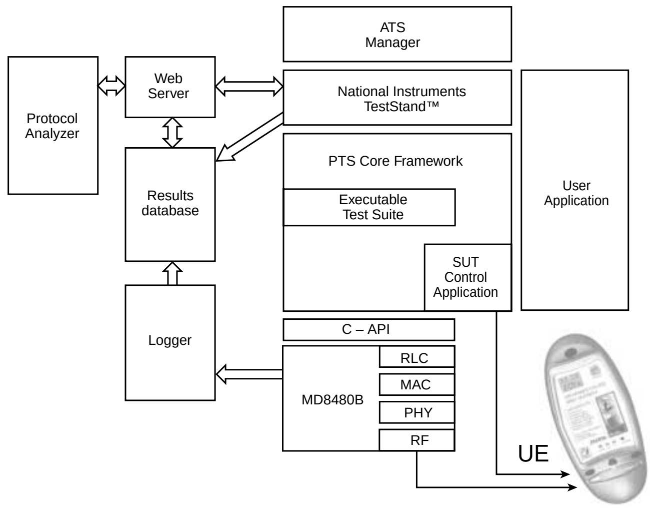
The MX785201A PTS (Protocol Test System) and MX785101A VST (Virtual Signaling Tester) are a family of test and verification tools for 3G wireless products. They have been developed to provide the test support today's research and development engineers need to successfully meet demanding performance and time to market targets. They provide a common user interface, thus reducing operator learning time as development progresses and migrates over the range of Anritsu's 3G development tools. In addition, test procedures generated for the PTS can be run on the VST and vice versa. This enables test procedures to be developed very early in the development cycle and to evolve as the user equipment evolves. A substantial saving in the investment in development of test procedures can be realized.

Features
- W-CDMA protocol test capability
- 3GPP Standard compliant development tool
- Common user interface across Anritsu development tools
- InterRAT capability for 2G/3G testing
- Environment supporting TTCN test case execution
- TTCN test libraries for development, integration and conformance testing
- Re-use of test cases on VST (Virtual Signaling Tester) and PTS (Protocol Test System)

PTS
The MX785201A PTS software is combined with the MD8480 W-CDMA Signaling Tester to make a system providing an environment to exercise Layer 3 and Layer 2 signaling protocols defined within the Third Generation Partnership Project (3GPP).
The PTS and VST software component runs on a Windows 2000/XP™ PC. They execute TTCN test cases through which can be defined:
- Sequences of Layer 3 messages and expected responses
- Layer 3 to Layer 2 service primitives to trigger specific Layer 2 procedures, or to configure Layer 2 operation
- Layer 3 to Layer 1 service primitives to configure and initiate Layer 1 operation
- Service primitives to and from user provided code modules for User Equipment (UE) control

The Layer 2 protocol stack and Layer 3 test tools are functionally equivalent to those used in the Anritsu VST (Virtual Signaling Tester). An application-programming interface (API) to enable user generated "C" language test scenarios to be executed is available for the PTS.
Supports multiple 3G cells, enabling Soft and Hard handover. In addition, supports inter-system handover between GSM to W-CDMA, GPRS to W-CDMA, and vice versa.

System overview



PTS Core Software

VST
The MX785101A VST software provides an environment to exercise Layer 3 and Layer 2 signaling protocols defined within the Third Generation Partnership Project (3GPP). When linked to the customer's signaling protocol software development environment, Layer 3 and Layer 2 Test Procedures running on the VST platform enable verification and subsequent validation of the signaling protocol Software Under Test (SUT) prior to integration with UE RF and baseband hardware.
The VST runs on a standard Windows PC. The SUT may reside on any machine that can be connected via a TCP/IP port to the Windows PC running the VST. In order to interface to the VST, the UE Abstract Layer 1 and UE Adapter software components are required for the Software Under Test. The VST Network Abstract Layer 1 and adapter components can be used as a starting point to develop these components. The Abstract Layer 1 has also been developed in such a way that users can easily customize it in order to simulate specific features of the air interface.

Evolution with 3GPP
The capabilities of the VST & PTS continue to evolve and additional capabilities are added in-line with the changing 3GPP specifications. The PTS runs the 3GPP Conformance Test Suite as defined in TS34.123. In addition, the Protocol Test System supports the Layer 1 and Layer 2 parameter sets defined in the 3GPP specification TS34.108.

ATS Manager

The ATS Manager provides a user interface that allows configuration of the MX785201A PTS, launch of the test sequencer tool to select and execute pre-prepared Layer 3 and Layer 2 Test Procedures and browse the results of the Test Procedures using the Protocol Analyzer.

Protocol Analyzer

All Layer 3, Layer 2 and Layer 1 message exchanges between the MX785201A PTS and the System Under Test are logged. These messages are decoded to show the name and content of each field and displayed using the Protocol Analyzer. Raw captured data is displayed in hexadecimal format.

National Instruments TestStand™

The MX785201A PTS uses the National Instruments TestStand™ run-time engine as a high level sequencing tool. The TestStand™ development system is used to create test sequences.

C-API

As an alternative language to develop Layer 3 and Layer 2 Test Procedures, a 'C' based Application Programmer's Interface (C-API) is included in the form of a DLL.

Executable Test Suite

Layer 3 and Layer 2 test cases are implemented using TTCN (Tree and Tabular Combined Notation). Created TTCN tests are compiled to an Executable Test Suite (ETS) which interfaces to the MX785201A PTS via the GCI Management Interface and the GCI Operational Interface. These provide an open, standardized interface to TTCN based executable test suites. The MX785201A PTS has been developed to work with the Telelogic Test Suite TTCN Browser tool.
The GCI framework provided by the MX785201A PTS provides support for a number of Test Suite Operations (TSOs) and also Protocol Implementation Conformance Statement (PICS/PIXIT).

Codec

The ETS is supported by a codec capable of encoding and decoding Radio Resource Control (RRC), Non Access Stratum (NAS) and lower layer configuration data.

Thin RRC

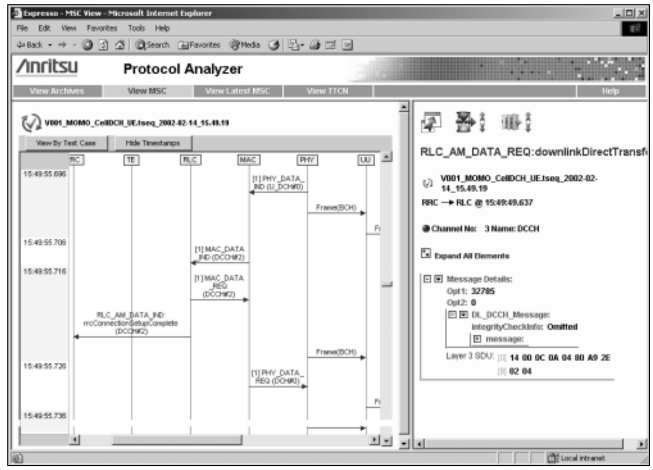
A thin RRC is provided to load NAS messages into RRC direct transfer messages and unload NAS messages from RRC direct transfer messages transparently.

SUT Control Application

The MX785201A PTS frame-work provides an API to support automatically communicating with the UE to replace keyboard or internal (to UE) signals.

Logger and Results Database

The logger captures data from the majority of components in the system and stores it in the results database. This data is used by the protocol analyzer to create message sequence charts and display decoded messages.



RLC and MAC

RLC and MAC layers conforming to the 3GPP specifications TS25.322 Radio Link Control Protocol Specification and TS25.321 Medium Access Control Specification are supplied as part of MD8480.

Terminal Equipment (TE)

The TE is an optional software component available as part of the MD8480 in the MX785201A PTS. It supports a number of features including voice AMR 12.2K Codec, ISDN, IP and PPP.

Layer 1

The MX785201A PTS provides a physical Layer 1 through the MD8480 that can communicate with a terminal.

Test Libraries

Integration Library

The Integration Library provides a proven set of TTCN test scripts that have been tested on real terminals. These test cases take the user through specific milestones (e.g., RRC connection, location update, voice call, etc.) and provide a straightforward method for testing of terminals during the integration process. They provide a step by step test approach to prove functionality in a UE.
The Test Procedures are 3GPP compliant and are designed to be customized to the particular needs of an Integration Environment. The PTS Integration Library provides TestStand™ Sequences in an executable form of the TTCN test cases. National Instruments TestStand is required to implement these cases.
The Integration Library is available in source code form allowing the more experienced user to make changes to the parameters in order to test more specific details of the terminal design.

Developer Library

The Developer Library provides a proven set of TTCN test scripts that have been tested on real terminals and complements the Integration Library. These test cases provide a more flexible test capability and allow experienced designers to exercise their terminals beyond the requirements of 3GPP. This library is supplied in source code form.

Conformance Testing

Anritsu offers a range of solutions designed to meet specific customer requirements for UE protocol conformance testing based on the 3GPP standards.

Standard PTS/VST Product

The 3GPP Adapter Option of the PTS/VST enables users to run 3GPP protocol conformance tests. PTS/VST includes 3GPP T1 approved test cases from 3GPP TS34.123 in ETS form as standard. New test cases are introduced every 3 months with the update of the PTS software. These are appropriate for pre-conformance and verification testing in an R&D Lab.

Subscription Service

For applications where conformance testing is on a critical development path, PTS users can gain earliest access to 3GPP conformance test cases through a subscription service. This provides monthly conformance test case updates and includes all working conformance test cases in ETS form ie those that are

– 3GPP T1 approved or
– 3GPP T1 submitted

GCF Conformance Test Toolkit

This package is designed for formal UE validation and pre-conformance testing. The toolkit includes:

- Specific PTS & MD8480 software required for validation
- Certificate of validation
- Product release notes
- Operating manuals
- GCF current exceptions/issues
- Test time estimates

The annual support contract provides an update following each quarterly GCF (Global Certification Forum) UAG approval meeting.

Options Available

MX785X01A-42 IP Driver

The IP Driver Option allows data and application testing to be performed in virtually any signaling environment or scenario using automated tests controlled via TTCN running on the MX785201A PTS or MX785101A VST. The IP Driver provides access to User-Plane packet data and routes that data through a PC onto a conventional data network.

Key features include multiple primary and secondary PDP contexts with single UE support. Traffic Flow Templates routing for secondary context is also supported. All protocols run over IPv4 and fully flexible IP address allocation is supported.

MX785201A-43 Rapid Test Designer

The Rapid Test Designer (RTD) Option provides a quick and easy method of developing test cases to run on the PTS. It provides a graphical, point and click interface to a broad library of procedural building blocks that can be placed on the screen to assemble more complex tests. The library contains composite functions that move the UE into a desired state to start the test, and elemental functions that allow the testing of detailed behaviour. This allows the test creator to focus on specific problem areas using his knowledge of 3GPP networks rather than test concepts.

The RTD's procedural building blocks are integrated with an expert system that guides the user through the complexity of the 3GPP protocols when setting the parameters for a particular test. Anritsu provides comprehensive catalogues of common network settings that can be used to quickly produce working test scenarios. The tool also provides interactive error checking on the procedures and parameters and will pick up many potential problems and mistakes made during test design. Finally, the RTD provides one click, instant execution with no test case build or compilation phase necessary to enable very effective and efficient development of test case libraries for a wide variety of purposes.

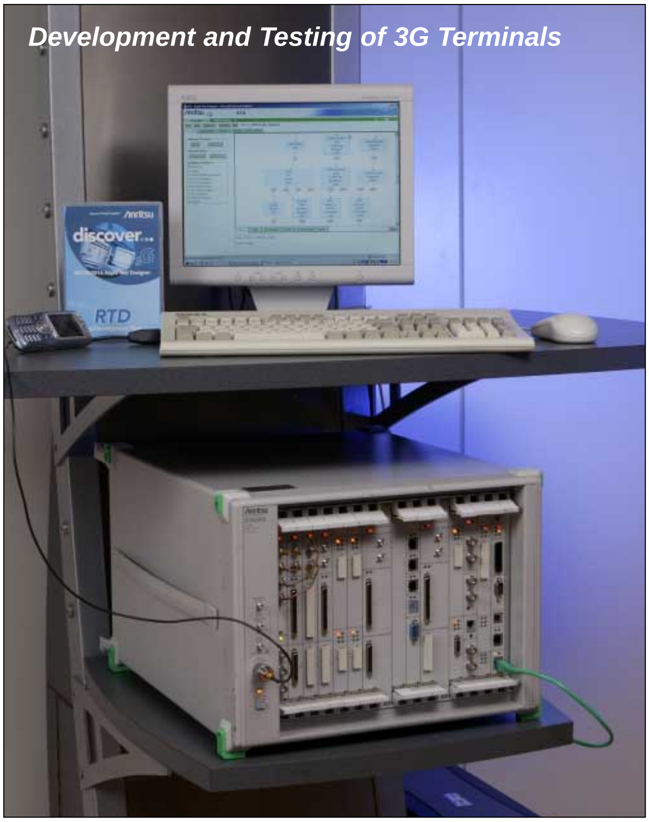
Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MX785201A	PTS Core Software Single Cell ETS Framework
	Options
MX785201A-10	Multi-Cell Capability (SHO)
MX785201A-11	Multi-Cell (Inter-frequency) Capability (HHO)
MX785201A-12	Multi-RAT (FDD/GSM) Capability
MX785201A-14	Multiple MD8480 Support
MX785201A-15	3GPP Compliant TTCN Adapter
MX785201A-40	Security Mode
MX785201A-41	OCNS
MX785201A-42	IP Driver
MX785201A-43	Rapid Test Designer
MX785201A-44	Monthly Conformance Test Subscription Service
	Libraries
MX785201A-31	TTCN Integration Library Source Code
MX785201A-33	TTCN Developer Library Source code
MX785220A	GCF 34.123 Protocol Test Toolkit for Rel-99 (Work Item 010)
	Support
MX785201A-01	National Instruments TestStand™
MX785201A-20	PTS Annual Software Update and Maintenance Contract
MX785220A-20	GCF Toolkit Annual Software Update and Maintenance Contract
MX785201A-21	Training Course (2 days)
MX785201A-23	Installation & Commissioning (1 day)
	Main frame
MX785101A	VST Core Software Single Cell ETS Framework
	Options
MX785101A-10	Multi-Cell Capability (SHO)
MX785101A-11	Multi-Cell (Inter-frequency) Capability (HHO)
MX785101A-15	3GPP Compliant TTCN Adapter
MX785101A-40	Security Mode
MX785101A-42	IP Driver
	Libraries
MX785101A-31	TTCN Integration Library Source Code
MX785101A-33	TTCN R&D Library Source code
	Support
MX785101A-01	National Instruments TestStand™
MX785101A-20	Software Update and Maintenance Contract
MX785101A-21	Training Course (2 days)
MX785101A-23	Installation & Commissioning (1 day)

Note that libraries and options require the underlying core functionality to be present to function fully.

W-CDMA RAPID TEST DESIGNER (RTD)
MX786201A



The Rapid Test Designer (RTD) is a revolutionary new tool which aims to speed up the testing of W-CDMA devices significantly by greatly simplifying the way in which tests are created, executed and analyzed.
The RTD presents an intuitive and interactive graphical environment for designing test cases, coupled with an expert system that guides the user through the complexity of the 3GPP protocols. It provides a graphical interface to a broad library of procedural building blocks that can be placed on the screen to assemble the tests. The building blocks can be configured through the setting of parameters.
The procedure library contains many standard procedures that can be used as they are or with minor changes to parameters to guide the UE into the desired test state. This allows the test creator to focus on specific problem areas using knowledge of 3GPP networks rather than test concepts.
Anritsu provides catalogues of common network settings that can be used to produce test scenarios that work "out of the box," or as a starting point for customer specific configurations.
The tool also provides interactive error checking on procedures and parameters that will pick up many potential problems and mistakes as early as possible during test design.
Finally, the RTD provides one click, instant execution with no test case build or compilation phase necessary to enable very effective and efficient development of test case libraries for a wide variety of purposes:

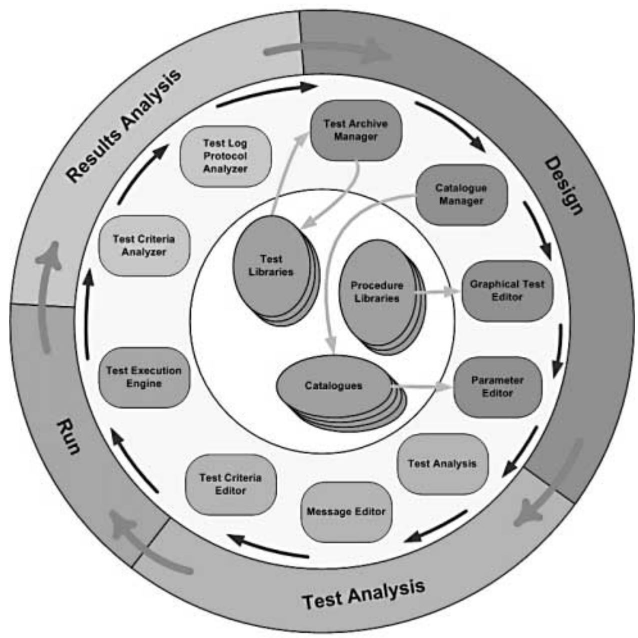
- Acceptance Testing
- Integration Testing
- Interoperability Testing
- Generating variants
- Application Testing
- Regression Testing

The RTD has an integrated Protocol Analyzer to show the decoded results of the message exchanges between the RTD and the System Under Test during the execution of a test.

This revolutionary test tool hides much of the complexity of testing 3GPP protocols and allows the user to concentrate on testing specific functions and protocols within the UE without having to be an expert on all the protocol layers. Because of the intuitive graphical interface, users do not need to learn a specialist test language, or have a detailed knowledge of how to drive the system simulator. It is built upon Anritsu's many years of experience in testing 3GPP protocols with the leading UE vendors.
The RTD system consists of a Personal Computer running a Windows operating system, connected to the Anritsu MD8480 W-CDMA Signaling Tester (system simulator). The RTD is also available as an upgrade for existing users of Anritsu's MD8480 and MX785201 (PTS) products.

Tool Overview

The RTD has been designed to support the iterative test process, which cycles between Design, Test Analysis, Test Execution and Results Analysis. The RTD consists of a set of core tools designed to support this process, together with a number of optional components that allow the RTD to easily support specialized testing activities.



RTD – An Integrated Development Environment for Testing

In addition to test and system simulator control procedures, the RTD provides support for a set of procedures similar to those defined in 3GPP standards, giving broad coverage of the various Layer 3 signaling protocols. Each procedure includes associated system simulator configuration, timers, and appropriate parameters.
Support is provided for soft & hard handovers, compressed mode, RRC state transitions, radio bearer reconfigurations, Inter RAT selections and reselections and Inter RAT handovers, including to and from GSM (circuit switched) and GPRS (packet switched). A wide selection of 34.108 RABs are supported with CS AMR rates from 4.75 to 12.2 kbps and PS data rates from 8 to 128 kbps for uplinks and 8 to 384 kbps for downlinks. For GSM voice calls both EFR and AMR traffic channels are supported.
Customers can create their own set of user -defined procedures and watch points for key variables, such as power, to speed up the development and debugging of test cases. Customers can also create interactive tests that use the content of messages or the behavior of the equipment under test, to determine the flow of the test. This provides a new way of testing equipment, that combines the best features of script based and network emulator based testing methodologies.

Procedures
In addition to test control and system simulator control procedures, the RTD provides support for a set of procedures similar to those defined in 3GPP standards.

RRC Procedures
Each procedure includes associated system simulator configuration, timers, and appropriate parameters.

General Functionality
- Broadcast of system information
- Create and release a signaling connection to the NAS Layer, with support for both Network and UE originated types
- Setup of a wide variety of TS 34.108 derived Radio Bearers into CELL_DCH or CELL_FACH.
- Enable/Disable application of security mode to a connection
- Perform a UE capability enquiry

RRC State Transitions
All standard RRC State Transitions are supported.

RRC Connection Mobility
Procedures support a number of cell/URA updating scenarios, including:
- Periodic Cell and URA Updating
- Change of Cell or URA
- Re-entry of service area
- Radio Link failure

Procedures support the following handover scenarios:
- Soft Handover: Radio Link addition and removal
- Hard Handover (CELL_FACH -> CELL_ FACH in FDD mode)

Measurement
Procedures support the following measurement controls:
- Measurement Control with periodic Measurement Reporting
- Measurement Control with selected event driven Measurement Reporting

NAS Procedures
The RTD includes support for the following types of NAS procedures. Each procedure includes associated system simulator configuration, timers and parameters.

Mobility Management (Packet and Circuit)
The RTD is able to create a MM or GMM connection suitable for the transport of CC/SM signaling to/from the UE. In addition, support is provided for the following types of procedures:

Abort	Authentication and ciphering
Attach & detach	Combined GPRS attach (PS & CS)
Authentication	IMSI attach & detach
CM service	Location updating (normal & periodic)
Identification	MM & GMM identity
Paging	MM & GMM information
Service	MM & GMM status
Status	TMSI & P-TMSI reallocation
Routing area update	

Call Control

Call Establishment and Clearing
The RTD can establish the following types of call:
- Speech Call
  - Mobile originated establishment, mobile and network originated clearing
  - Network originated establishment, mobile and network originated clearing
- Circuit Switched Data Call
  - Mobile originated establishment, mobile originated clearing
  - Network originated establishment, network originated clearing
- Packet Data Connection (refer to the Session Management paragraph below)

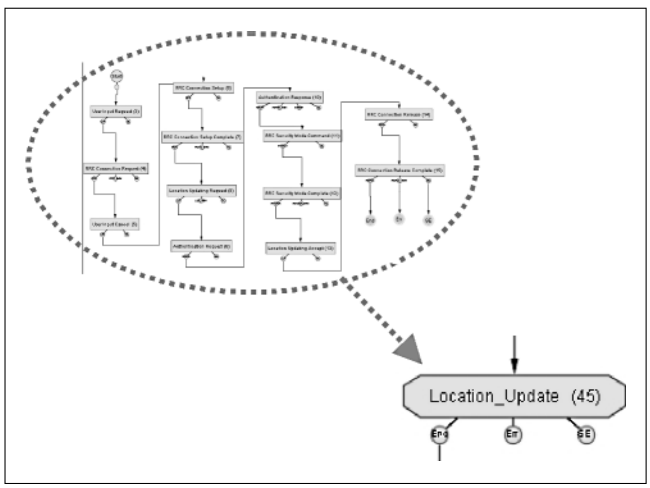
Other Call Control Procedures
- Call re-establishment, UE and Network side
- Progress
- DTMF protocol control

Session Management
The RTD supports PDP contexts and the handling of IP traffic as follows:
- Activation/Deactivation of multiple primary PDP contexts (Network or UE initiated)
- Activation/Deactivation of multiple secondary PDP contexts (Network or UE initiated)
- PDP Context Modification (Network initiated)

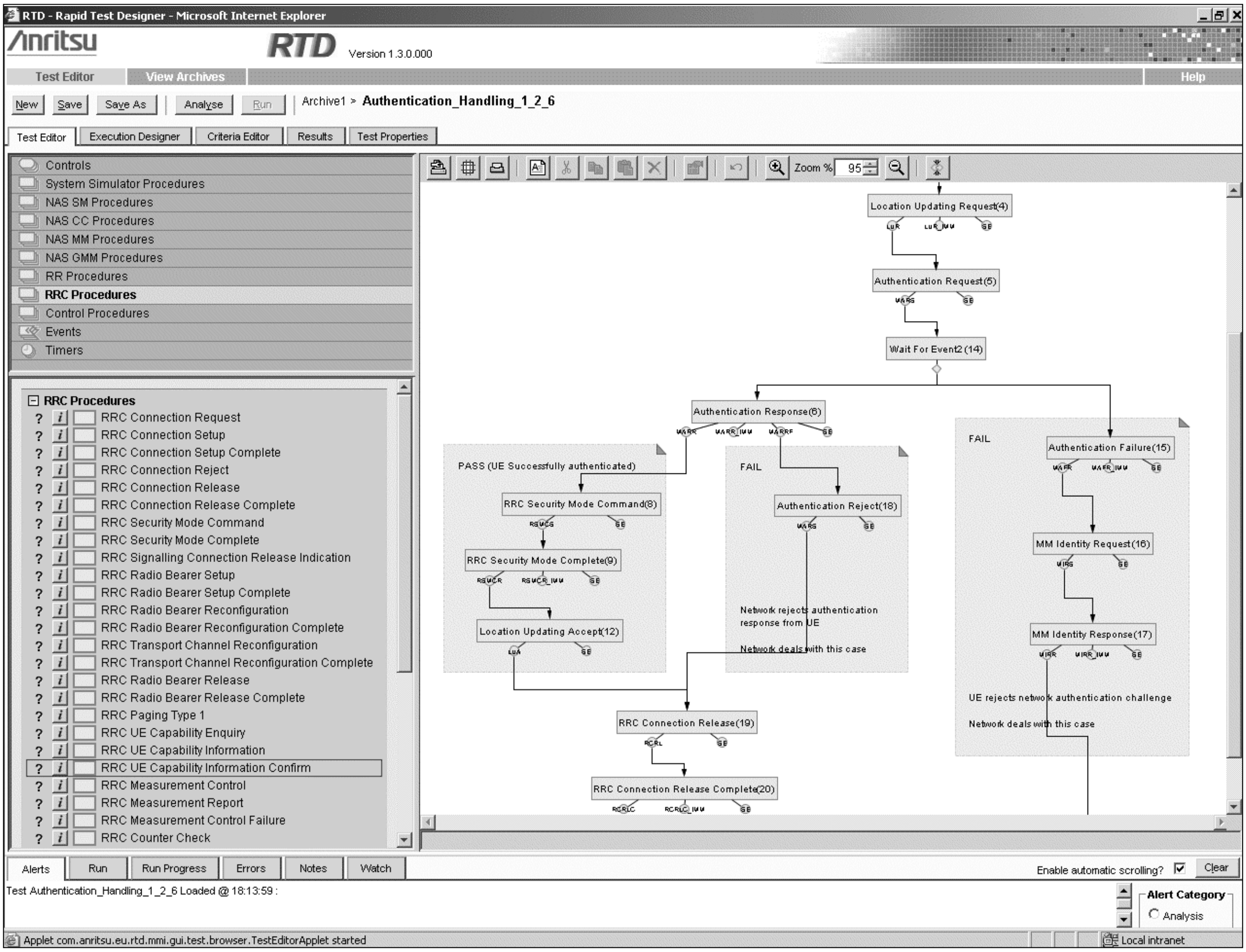
Other NAS Signaling Entities
The RTD supports the sending and receiving of SMS and Supplementary Services signaling messages.

GSM/GPRS Inter-working
Support for inter-working with GSM and GPRS is available as an option, which provides the following capabilities:
- GSM & GPRS Neighbor Cell (for InterRAT measurements)
- Reselection from UMTS to GSM and GSM to UMTS
- Handover of speech call from UMTS AMR to GSM FR & from GSM FR to UMTS AMR
- Reselection during packet data connection from UMTS to GPRS & from GPRS to UMTS

Lower Layer Capability
RTD conforms to Release 99 of the 3GPP specifications and follows industry agreement on which version of the specifications to support. The functionality mappings include:
- RTD Physical Layer functionality maps to TS25.211, TS25.212 & TS25.213.
- RTD MAC Layer functionality maps to TS25.321
- RTD RLC Layer functionality maps to TS25.322



User Defined Procedures simplify and speed-up testing process



Creating and annotating a complex multi-path test in the Graphical Test Case Editor

Graphical Test Case Editor

The RTD test is constructed and edited using a graphical environment, which supports the following features:

- Procedures, including user defined compound procedures
- Loops
- Delays, including waiting for events
- Interactive dialogs
- Free form notes

To construct a test the RTD provides:

- Drag and drop selection of procedures
- Guidance on available procedures suitable at any point in the test
- Addition/deletion of graphical test constructs
- Group selection
- Online help for the procedures and links to the relevant standards

RTD procedures are configured using parameters, which can be changed at three levels within the RTD:

- The user can make selections from configurations held in a catalogue, where frequently used configurations can be stored. The editor will search the catalogue and show all suitable sets of parameters for the procedure. The editor will also show suitable parameter sets for procedures used earlier in the test case. This allows the user to easily return to a previous state or configuration, at a later point in the test.
- The user can edit the parameters after they have been selected from catalogue components, overriding values if they wish to. These parameters are used to populate the actual protocol messages sent by the procedure, control the behavior of the procedure and control the configuration of the System Simulator in a consistent way.
- The user can edit the messages sent by the procedure, overriding any parameters previously selected or changed.

Parameter Editor

The Parameter Editor allows the user to parameterize procedures and provides the following features:

- Guidance on suitable catalogue entries for a procedure
- Modification of the catalogue entries to be used
- Ability to override values selected from catalogue entries
- Ability to revert parameter values back to original catalogue based configuration
- Type and range validation of parameters
- Matching of incoming messages, which enables procedures that handle responses or events from the UE to make decisions based upon the content of the messages received. The user can branch on specific content of individual information elements within the message. Omitted values and "don't cares" are also supported.

Test Analysis

Checks the test for simple errors and provides the following features:

- Correct procedure connectivity checking
- Parameterization completeness checking
- Parameter validation
- Warnings and error reports linked to the test

Message Editor

The Message Editor allows editing of air interface messages and System Simulator configuration messages that are to be sent by a procedure and provides the following features:

- Editing of message values
- Reverting messages back to their default values
- Collapsible tree presentation of the test
- Element name and type display
- Node highlighting
- Structure, type and range validation of a message

Easy to understand and change ASN.1 values in the tree structure based Parameter Editor

Test Criteria Editor & Analyzer

RTD defines the success or failure of a test execution at a high level by the means of test criteria. Test criteria are defined as the route taken through the procedures making up an RTD test, the content of incoming messages and the time between significant events.

After running a test, the RTD uses the logs generated to match the criteria specified against the actual test performance and report on the success or failure of each criterion. This also allows new criteria to be defined and quickly checked against old test results.

Test Execution Engine

RTD tests can be run immediately after they have been checked for simple errors (Analyzed). No compilation is necessary, and the test is run directly from within the integrated environment.

During execution a progress log from the test being run is displayed in a status window, and progress through the test is shown graphically by highlighting the blocks as they execute in a different colour. At any time during execution the user can edit parameters (these changes are picked up by the test case dynamically) or cancel execution.

Test Log (Protocol) Analyzer

For any test execution, the RTD has an integrated protocol analyzer, which logs all Layer 3, Layer 2 and Layer 1 message exchanges between the RTD and the System Under Test. These messages are decoded to show the name and content of each field, and displayed using the RTD Protocol Analyzer.

The RTD Protocol Analyzer also provides:

- Direct launch to test results from within the RTD
- Message Sequence Charts of test runs
- Full and collapsible sequence views at procedure level, with pre and post filtering of log files
- Display of test message contents sent or received by the RTD
- Naming and displaying of protocol layer information elements at Layer 1, 2, and 3
- Textual display of enumerated field values
- Decoding and displaying of MIB/SIB embedded bit strings
- Collapsible tree presentation of message contents
- Open Protocol Data Units in separate windows for ease of comparison
- Timestamps against individual messages
- Management of test log archives

Test Archive Manager

RTD stores tests in test archives. The Archive Manager is provided to allow the user to manipulate tests within the archives.

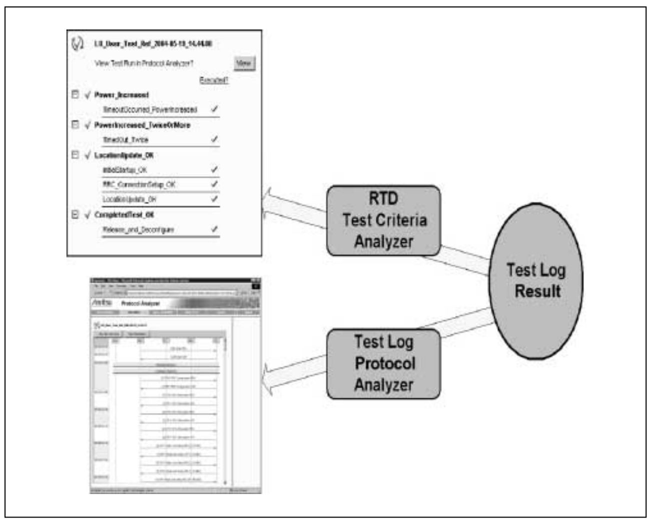
Catalogue Manager

The catalogues provide a convenient way of managing sets of parameters that are used frequently. The Catalogue Manager is used to manipulate and maintain entries. Entries can also be stored into the catalogue when editing a test.

Getting The Latest RTD Information

As the RTD is continuously tracking the 3GPP standards and is being updated regularly, the exact functionality in the product at any specific moment of time is subject to change. For full details of the exact functionality currently available and planned, please contact your local Anritsu Sales office to request the RTD (MX786201A) data sheet, specification and roadmap documents.

For the latest information about the RTD, please visit the Anritsu website (www.anritsu.com).



Test Criteria Analyzer for fast, high level analysis and Protocol Analyzer for detailed analysis of test logs

4

Ordering information

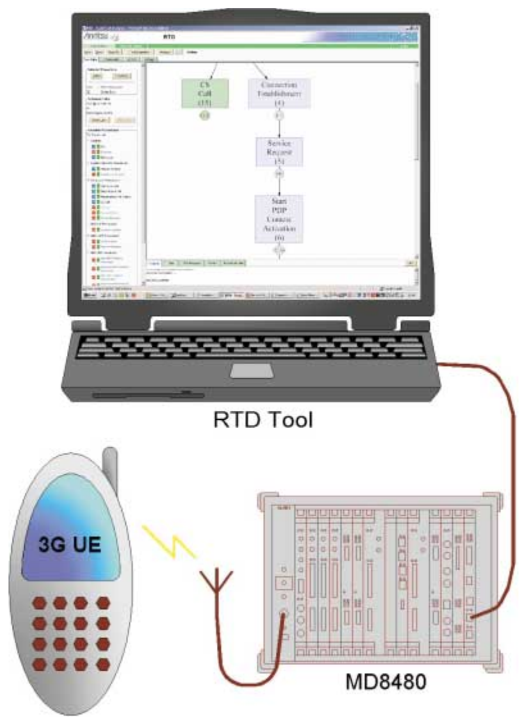
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MX786201A	RTD Core Software (Multi Cell Multi Frequency)
	Options
MX786201A-12	Multi-RAT (FDD/GSM) Capability
MX786201A-14	Multi-MD8480 Capability
MX786201A-40	Ciphering
MX786201A-45	RTD Test Creation and Editing Tools
MX786201A-46	RTD Run Time Engine
	Support
MX786201A-20	Software Update and Maintenance Contract
MX786201A-21	Training Course
MX786201A-22	Premium Support
MX786201A-23	Installation & Commissioning

Please note that the RTD is also available as Option 43 on the Protocol Test System (MX785201A-43).

3GPP PROTOCOL ANALYZER
MX848086A

Decode complex L2 / L3 messages with ease NEW



Introduction

Users of MD8480 W-CDMA Signaling Tester can now analyze their trace logs instantly and decode them fully. The MX848086A 3GPP Protocol Analyzer is an additional tool for the MD8480, providing fast and accurate analysis of the messages between a UE and the MD8480 system simulator. This tool provides a real advantage for development teams involved in 3GPP UE advancement where the number of scenarios needed is growing rapidly.
The tool is intuitive to use and provides the ideal graphical environment to allow study of the complex protocol messages that pass to and from the UE under test; particularly the RRC and NAS messages.

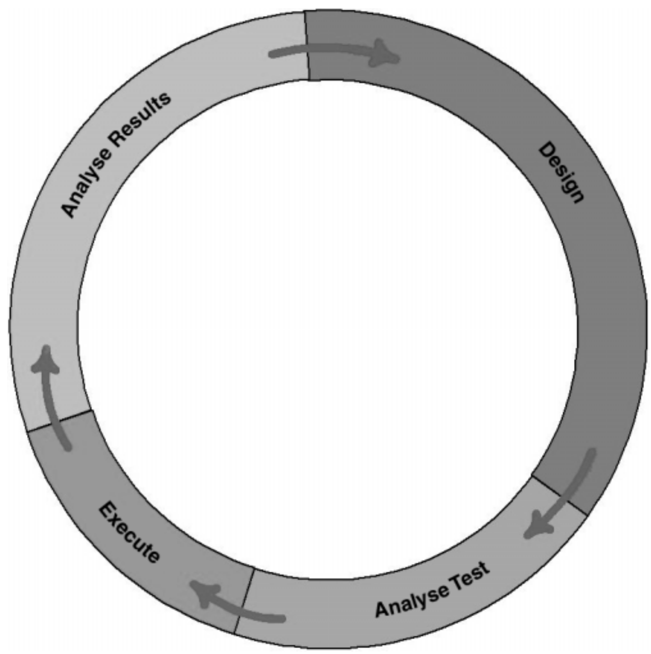
Tool Overview

The MX848086A has been designed to support the iterative process that cycles between Design, Test Analysis, Test Execution and Results Analysis. It is one tool in the family of Anritsu products that has shaped the way 3rd Generation UEs have been developed.
A test log from the MD8480 can be examined completely without the need to cut and paste elements into a separate tool.

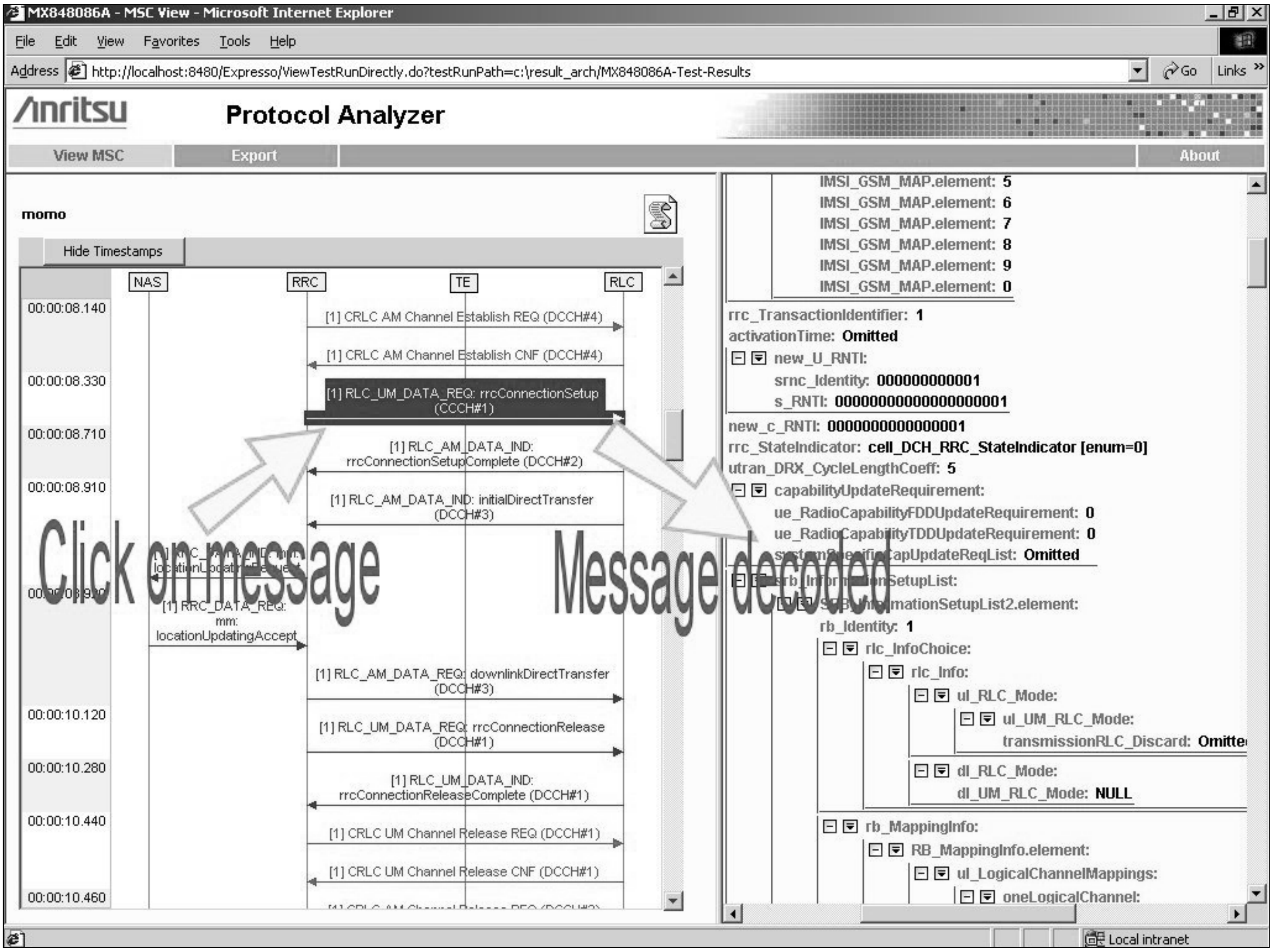
Decodes complex NAS and RRC messages.

A new challenge for W-CDMA protocol development is decoding RRC messages as these use ASN.1 Packed Encoding Rules (PER). PER adds a level of complexity over the TLV encoding used by GSM as information elements are not aligned to byte or nibble boundaries so even a hexadecimal display of the message is difficult to interpret. Further complexity is added by the extensive use of "optional" and "choice" elements throughout the RRC message specification. The result is that decoding the RRC messages manually is impractical.

The tool provides:
- Analysis to Information Element level of protocol exchanges between MD8480 and UE
- Decodes RRC & NAS messages to format recognised by 3GPP
- Support for GSM / GPRS / W-CDMA UEs
- Based on Globally recognised PTS and VST protocol development system
- 3GPP Standard compliant development tool

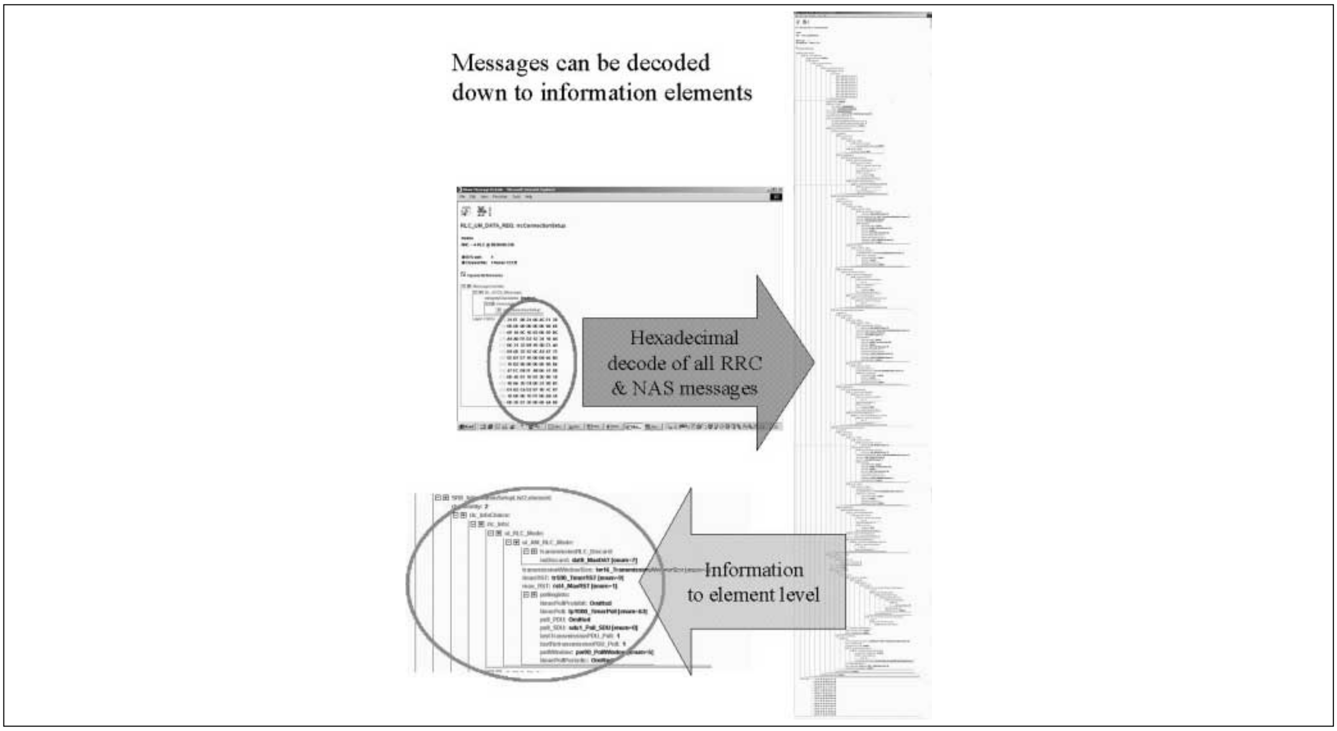


Typical cycle for scenario development and analysis

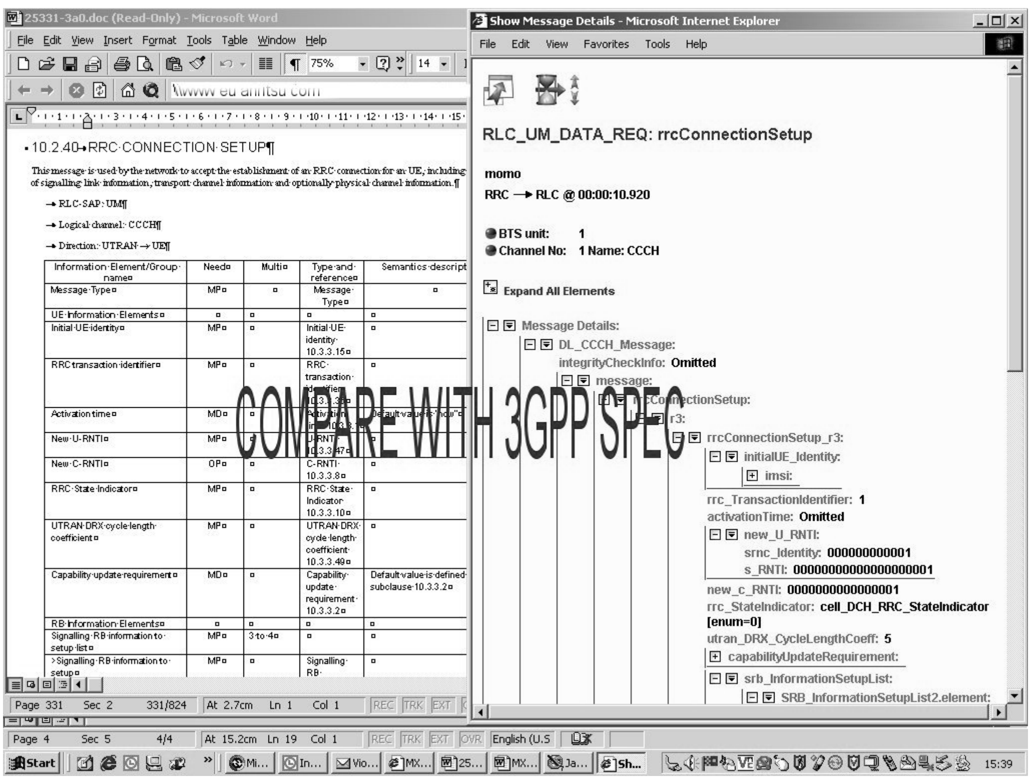


MD8480 customers that utilize the MX848000A to create "C" based test scenarios currently can only view "hex-dump" format data. It is not really practical to manually decode RRC/NAS messages, and cut/paste of hex strings into available automated tools is very laborious.
It is desirable to have a tool that automatically displays logs as MSCs with RRC and NAS messages fully decoded.
The MX848086A 3GPP Protocol Analyzer provides analysis of the data logged during execution of MX848000 scenarios to a detail that makes it easy to debug and understand the messages between the MD8480A and the UE under test. The user is provided with a HTML based display that provides "Links" from all the message interchanges and decodes each message in an easily read format. This means that finding mismatches in the configurations or signaling is relatively straightforward.

RRC & NAS messages can be decoded to information element level and can be correlated with the 3GPP specifications (see diagram on the next page).
The MX848086A runs on the same PC as the MX848000A Test scenarios, allowing immediate analysis of the scenario. It can also be run on a separate PC if required. This allows more efficient use of the MD8480 hardware.
Complex messages including broadcast information, establishment, reconfiguration and release of bearers and RRC connection mobility functions can be decoded in a format that is easily compared with the relevant 3GPP specification.



This diagram shows how any RRC or NAS message from a trace log can be decoded to information element detail



The decoded messages are easily compared with 3GPP documents as shown in the image above.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
MX848086A	3GPP Protocol Analyzer
MX848086A-05	3GPP R99 March 02 Support
MX848086A-08	3GPP R99 December 02 Support
MX848086A-09	3GPP R99 March 03 Support

Model/Order No.	Name
MX848086A-14	3GPP R5 June 04 Support
Z0682	Software update to latest version

For support of any other 3GPP Releases please contact Anritsu.
The recommended minimum specification is a 300MHz Pentium 2 PC with 128MBytes of RAM.

W-CDMA NETWORK SIMULATION LIBRARY
MX785281A

For Test and Final Evaluation in the Development of a 3G UE

NEW

MX785281A W-CDMA Network Simulation Library is an application software package comprising a comprehensive Graphical User Interface together with over 100 test cases which operate on a PC. In combination with MD8480A/B W-CDMA Signaling Tester it performs comprehensive operational and protocol test of a W-CDMA UE. The software enables testing of voice, packet data and SMS including U PLANE to be performed easily.
The test cases are supplied in a ready to run executable form enabling anyone to perform tests immediately after installing the software without needing to create test cases. Test results are displayed in a message sequence chart using the protocol analyzer.

Features

- Created on the basis of NTT DoCoMo, Inc.'s experience in 3G networks*1.
- Operation verified on an actual 3G UE*2.
- Conforms to 3GPP standard, March '03.
- Easily executable test cases for all.
- Comprehensive display of test results and log information.

*1: The connection with actual base stations is not assured.
*2: The UE was developed for NTT DoCoMo Inc..

Supporting test

Attach	Combined Attach
AMR	Origination and MS Release
	Termination and NW Release
	Soft Handover
	Origination (Secondary Scrambling Code)
	Read ID
Packet	Origination and MS Release
	Termination and NW Release
	Soft Handover
	Rate Switching
	RRC State Transration
	Read ID
SMS	MS Origination
	MS Termination
UDI	Origination and MS Release
Supplementary Service	Call Waiting
	Call Forwarding
	Line Identification
Multi Call	AMR/Packet Origination and MS Release
	AMR/Packet Termination and NW Release
	Soft Handover
	RRC State Transration

Required system

Refer to individual catalogs for details of configuration.

MD8480A/B	MD8480A/B W-CDMA Signaling Tester (V3.10)
	MU848053A RX Baseband
	MU848055A ISDN
	MU848057A Frame Coder
	MU848058A Tx Baseband x 2
	MD8480A-01 Additional RF Unit
	MX848041A W-CDMA Signaling Tester Ciphering (V3.10)
Control PC	Windows 2000 Professional*1 (English ver./Japanese ver.)
	PentiumIII 800 MHz or more*2
	Memory 256 Mbyte or more
	Hard disk space 2 Gbyte or more
	Display 1280 x 1024 pixel (SXGA) or more
	Microsoft Internet Explorer 5.5 or later*3
USIM	P0019 Test USIM (Anritsu)*4

*1: Windows2000 Professional is a registered trademark of the Microsoft Corporation.
*2: PentiumIII is a registered trademark of the Intel Corporation.
*3: Internet Explorer is a registered trademark of the Microsoft Corporation.
*4: The operation of this software has been verified by above USIM.

SIGNALING TESTER
MD8470A

Mobile Communications Network on the Desk

NEW

In today's wireless communication market, packet data services and third generation systems are growing globally. Factors for succeeding in the wireless communication business are shifting from basic communication technology to the ability to plan and develop attractive mobile devices and services. The MD8470A supports wireless application engineers in accelerating the development and reducing the test cycle of these ever-increasing product and service requirements.

Features

- A single platform implements functional testing of UE applications such as voice communications, video calling and contents download.
- Call processing is performed by simple operations (W-CDMA: Voice/Video call/Packet; GSM: Voice; GPRS: Packet)
- Supports multiple communication systems (W-CDMA, GSM/GPRS). Wide frequency coverage (400 MHz to 2.7 GHz).

• Single platform implements functional testing of UE applications such as voice communications, video calling and contents download.

The MD8470A Signaling Tester offers the optimum solution for mobile UE application development. It supports the processes required for various application developments such as voice communications, packet communications including browser/contents download, video calling and end-to-end UE communications (requires two sets of MD8470A). Also, the PPP server function is incorporated. The MD8470A serves as an effective tool for establishing an integrated simulation environment in application development.
In addition, Ethernet, ISDN, handset and serial I/O interfaces are provided for various data communication services.

• Call processing realized by simple operations
· W-CDMA: Voice/Video call/Packet
· GSM: Voice, GPRS: Packet

The MD8470A Signaling Tester supports basic call processing scenarios for W-CDMA (Voice Communications/Video call/Packet Communications), GSM (Voice Communications), and GPRS (Packet Communications). Simple operations implement the simulation environment required for application tests.

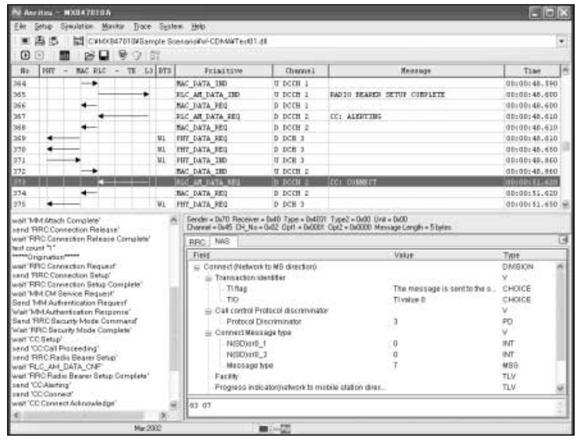
• Multiple communication system support
· W-CDMA, GSM/GPRS

The MD8470A Signaling Tester is compliant with GSM/GPRS and W-CDMA standards that are the world's major 2.5G and 3G mobile communication systems. Also, since a wide frequency band (400 to 2700 MHz) is covered seamlessly, it can easily support the development of multiband mobile UE and the frequency expansion of systems in the future. Since the baseband processing is configured by DSPs and other programmable devices, MD8470A will be able to provide flexible support for additional functions in the future.

• Platform Architecture

· The base station simulator function is accomplished by installing the communication system hardware and the control software.
· The Windows® operating system provides the user interface, so simulations can be controlled without using a remote PC.
(A 10.4-inch display and Windows® XP Professional operating system* are installed.)
*: Windows is a registered trademark of Microsoft Corporation in the United States and other countries.
· The chassis is designed with a small footprint so developers can use it in their personal simulation environments. (Width: 426 mm, Height: 221.5 mm, Depth: 281 mm)

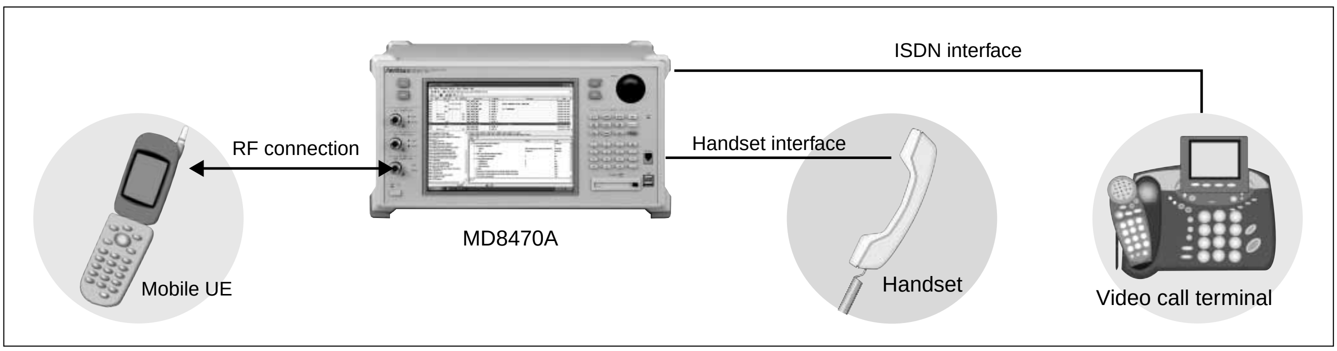
• W-CDMA, GSM/GPRS execution and analysis of simulations
The MD8470A Signaling Tester runs simulations by loading edited and compiled scenarios into the dedicated control software and executing them. The information being controlled during simulations, protocol messages, and user data exchanged between a mobile UE under test and a MD8470A are logged in real time. After the test, simulation results can be analyzed with the protocol message decode function (RRC, NAS [CC, MM, GMM, SM, SMS], Config) and the filtering function.



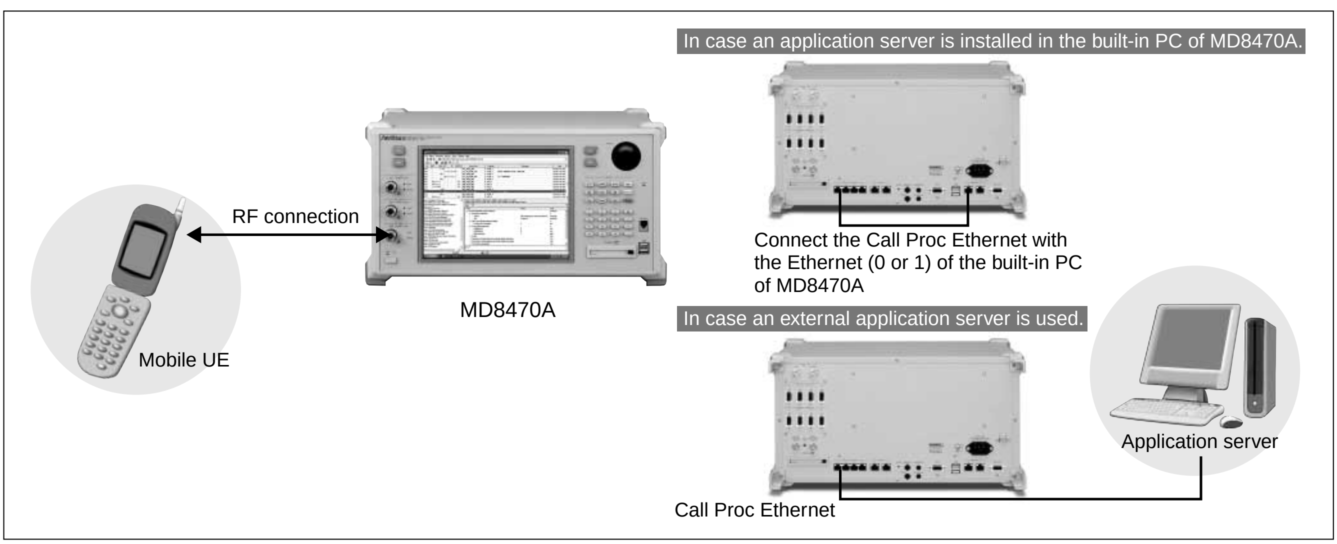
Application test examples

• Voice test
Voice communication testing can be performed between a mobile UE and a handset by connecting a handset (standard accessory) to the MD8470A. Voice communication testing by loopback can also be performed by voice data loopback in the MD8470A.

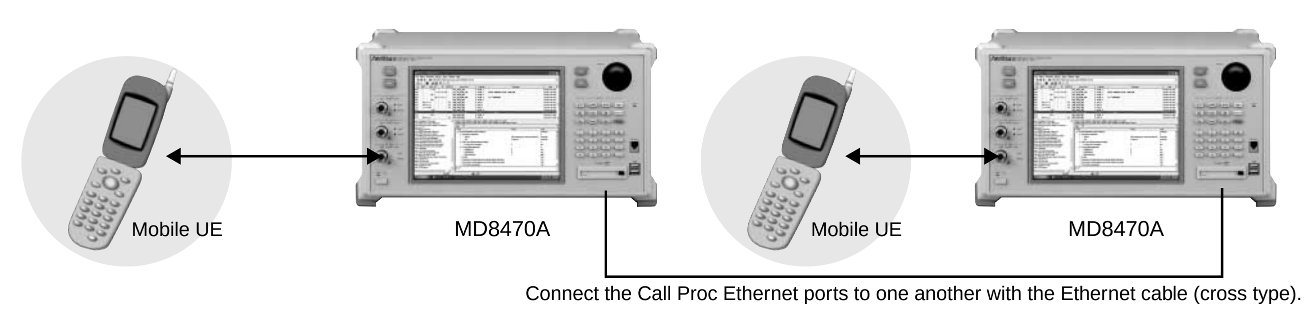
• Video call test
Communication testing of video and voice is performed between a mobile UE and a video call terminal by connecting a video call terminal to the MD8470A.
[Video call testing separately requires the MU847090A ISDN Interface Unit.]



• Packet communication test
A single platform is able to perform application function testing utilizing packet communications by installing the application server function in the MD8470A's built-in PC. (Application servers can be connected externally.)



• End-to-end UE test
End-to-end UE testing including video calls can be performed between two sets of mobile UE by connecting them to two sets of MD8470A interconnected with cross-wired Ethernet cables.



Units/Options/Software

• Hardware

W-CDMA Signaling Unit (MU847010A)
This hardware unit simulates the operation of W-CDMA base stations.

GSM Signaling Unit (MU847020A)
This hardware unit simulates the operation of GSM/GPRS base stations.

ISDN Interface Unit (MU847090A)
This unit enables the ISDN interface. A video call communication test is performed with a mobile UE under test by connecting a video call terminal UE to the ISDN interface.

• Software

W-CDMA/GSM Simulation Kit (MX847010A)
This software is required for use with W-CDMA and GSM/GPRS. The kit includes libraries for scenario programming, control software for scenario execution and tracing/analysis, sample scenarios for basic call processing, and user manuals.
(Microsoft® Visual C++®.NET Standard 2003*1 is separately required for scenario compiling. Also, in case Visual C++®.NET Standard 2003 is installed in the MD8470A's built-in PC, a CD or DVD drive with a USB interface is separately required.)
*1: Microsoft Visual C++ is a registered trademark of Microsoft Corporation in the United States and other countries.

W-CDMA Ciphering Software (MX847011A)
This software is required to test the W-CDMA ciphering function. It supports the standard ciphering algorithm in 3GPP.

• Software maintenance contract

MX847010A Support Service (One year) (MX847010A-20)
This contract covers response to inquiries from users, maintenance releases (including trouble support), and commercial UE support by standard scenarios.
MX847010A-20 is the software maintenance contract for MX847010A. (Refer to separate materials for contract detail.)

Configurations

Configurations \ Units/Options/Software	MU847010A W-CDMA Signaling Unit	MU847020A GSM Signaling Unit	MU847090A ISDN Interface Unit	MX847010A W-CDMA/GSM Simulation Kit	MX847011A W-CDMA Ciphering Software
W-CDMA test configuration	1		0/1*2	1	0/1*2
GSM/GPRS test configuration		1		1	
W-CDMA/GSM/GPRS test configuration	1	1	0/1*2	1	0/1*2

W-CDMA test configuration: Ability to run a simulation corresponding to W-CDMA 1BTS.
GSM/GPRS test configuration: Ability to run a simulation corresponding to GSM/GPRS 1BTS.
W-CDMA/GSM/GPRS test configuration: Includes the functions of test configurations for both W-CDMA and GSM/GPRS.

*2: "0/1" means either 0 or 1 can be selected.

List of supported functions

W-CDMA test functions (○: Sample scenarios are provided for connection test. △: Can be supported by creating scenarios)

Function	Description	
Location registration		○
MS (Mobile Station) originated voice call	Performs loopback or handset communication test.	○
MS terminated voice call	Performs loopback or handset communication test.	○
Voice call released from MS		○
Voice call released from NW (Network)		○
MS originated video call	Performs communication test with video call UE.*1	○
MS terminated video call	Performs communication test with video call UE.*1	○
MS originated video call (the end-to-end MS test)	Performs the end-to-end video call test between two sets of MS.*2	○
MS terminated video call (the end-to-end MS test)	Performs the end-to-end video call test between two sets of MS.*2	○
Video call released from MS		○
Video call released from NW		○
MS originated packet call	Performs application tests utilizing packet data communications by connecting to a server.	○
MS terminated packet call	Performs application tests utilizing packet data communications by connecting to a server.	△
Packet call released from MS		○
Packet call released from NW		△
MS originated unrestricted digital information (UDI)	*1	△
MS terminated unrestricted digital information	*1	△
Unrestricted digital information released from MS		△
Unrestricted digital information released from NW		△
Multi call		△
SMS		△
Supplementary service	Performs the testing of supplementary services such as call restriction, number identification and call waiting.	△
Ciphering function test	Performs call processing test with W-CDMA ciphering function.*3	△

*1: ISDN interface (option) is used.
*2: Two sets of MD8470A are used.
*3: W-CDMA Ciphering Software (option) is required.

GSM/GPRS test functions (○: Sample scenarios are offered for connection test. △: Can be supported by creating scenarios)

Function	Description	
Location registration		○
MS originated voice call	Performs loopback or handset communication test.	○
MS terminated voice call	Performs loopback or handset communication test.	○
Voice call released from MS		○
Voice call released from NW		○
MS originated packet call	Performs application tests utilizing packet data communications by connecting to a server.	○
MS terminated packet call	Performs application tests utilizing packet data communications by connecting to a server.	△
Packet call released from MS		○
Packet call released from NW		△
SMS		△
Supplementary service	Performs the testing of supplementary services such as call restriction, number identification and call waiting.	△

Control software support functions

Function	Description	
Scenario execution	Reads and executes the compiled DLL scenarios.	○
Real-time trace	Displays signaling messages and user data during the simulation in real time.	○
Trace log save/load	Saves (binary/text) and recalls (binary only) the traced log data.	○
Trace display filtering	Displays the trace filtered by channel and primitive classification.	○
Message decode and analysis	Translates and displays the traced messages (RRC, NAS*4, Config).	○
Scenario library function	Provides the C language library function for scenario creation.	○

*4: supports CC, MM, GMM, SM and SMS.

Specifications

Transmitter characteristic	Frequency range: 400 to 2700 MHz Frequency setting resolution: 100 Hz Output level range: –120 to –18 dBm (RF Main), –106 to –4 dBm (RF Aux1 when Tx mode) Level setting resolution: 0.1 dB Output level accuracy: ±3.0 dB (Output level: ≥–50 dBm, +18˚ to +28˚C) Modulation accuracy: ≤7%rms (when MU847010A is mounted) Phase error: ≤4˚rms (when MU847020A is mounted)
Receiver characteristic	Frequency range: 400 to 2700 MHz Frequency setting resolution: 100 Hz Maximum input level: +34 dBm (Average) Reference setting range: –30 to +20 dBm (RF Main)
External interface	RF Main/RF Aux1/RF Aux2: N type connector, Impedance: 50 Ω Trigger I/O: BNC connector, TTL, Event trigger input/output Call Proc Timing I/O A to D: 15-pin Mini D-Sub connector, TTL, Timing signal for call processing Call Proc Serial I/O A to D: 9-pin D-Sub connector, RS-232C, Serial interface for data communications Call Proc Ethernet A to D: RJ-45 connector, 10Base-T, Ethernet interface for data communications ISDN 0/1: RJ-45 connector (Option), ISDN interface for data communications (I.430), ISDN1 is reserved Handset: Modular jack, Handset interface (incl. the dedicated handset)
Reference oscillator	10 MHz Buff Output Frequency: 10 MHz Level: TTL level Connector: BNC type Startup characteristics: ≤±5 x 10^{-8} (5 minutes after power-on, reference to 24 hours after power-on) Aging rate: ≤±1 x 10^{-8}/day, ±1 x 10^{-7}/year (reference to 24 hours after power-on) Temperature characteristics: ≤±2 x 10^{-8}
External reference input	10 MHz Ref Input Frequency: 10 MHz (±0.5 ppm) Level: ≥0 dBm Impedance: 50 Ω Connector: BNC Type
Built-in personal computer	OS: Windows® XP Professional operating system*1 CPU: Mobile Intel® Pentium® 4 processor 1.7 GHz*2 HDD: 40 GByte Memory: 512 MByte
User interface	Display: Color TFT LCD monitor, 10.4 inch, XGA Headphone: 3.5 mm headphone jack Microphone: 3.5 mm microphone jack USB: USB1.1 (Front panel), USB2.0/1.1 (Rear panel) RS-232C: 9-pin D-Sub connector PCMCIA: Type I, II compliant (Front/Rear panel) Keyboard: PS/2 Mouse: PS/2 VGA: 15-pin Mini D-Sub connector Ethernet 0/1: RJ-45 connector (10/100Base-T)
Dimensions	426 (W) x 221.5 (H) x 281 (D) mm *Without protuberances
Mass	≤17 kg (when all options are installed)
Power supply	AC 100 to 120 V/200 to 240 V (–15%/+10%, Max: 250 V), 47.5 to 63 Hz, ≤300 VA
Operating temperature	+5˚ to +40˚C, Humidity ≤95% (no condensation)
Storage temperature	–20˚ to +65˚C, Humidity ≤95% (no condensation)
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Windows is a registered trademark of Microsoft Corporation in the United States and other countries.
*2: Intel and Pentium are registered trademarks of Intel Corporation.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MD8470A	Signaling Tester
	Standard accessories
	Power cord, 2.6 m
	MD8470A operation manual (CD-ROM)
	Keyboard (Japanese or English)*1
G0134	Mouse
A0013	Handset
MX847000A	Platform Software
	Units/options
MU847010A	W-CDMA Signaling Unit
MU847020A	GSM Signaling Unit
MU847090A	ISDN Interface Unit
Z0714	English OS option
Z0715	Japanese OS option
Z0716	Retrofit option
MD8470A-90	Extended three year warranty service
MD8470A-91	Extended five year warranty service
	Software
MX847010A	W-CDMA/GSM Simulation Kit*2
MX847011A	W-CDMA Ciphering Software
Z0728	Software installation kit
MX847010A-20	MX847010A support service (one year)
	Application parts
MN8110B	I/O Adapter (for call processing I/O)
Z0726	DVD drive
J1261A	Ethernet cable (shield type, straight), 1 m
J1261B	Ethernet cable (shield type, straight), 3 m
J1261C	Ethernet cable (shield type, cross), 1 m
J1261D	Ethernet cable (shield type, cross), 3 m
J1262A	RS-232C cable (straight), 2 m
J1262B	RS-232C cable (cross), 2 m
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m
J0127B	Coaxial cord (BNC-P · RG58A/U · BNC-P), 2 m
J1263	W-CDMA interface cable
J1264	N-SMA adapter
J1265	Adapter (serial connector)
J0658	Adapter (SMA, L Type)
B0543	Carrying case

*1: Selected by OS option.
*2: P0019: TEST USIM 001 is attached by this option.

DIGITAL MOBILE RADIO TRANSMITTER TESTER

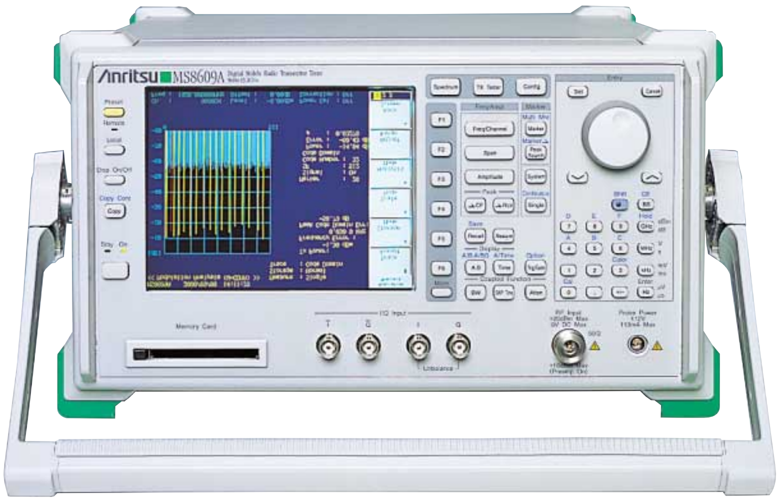
MS8609A

9 kHz to 13.2 GHz

CE GPIB

Measures Wide-Band Signals up to 2 Mbit/s

Excellent Eco Product
Lightweight
Power saving
Small size
(Conventional product ratio)



The MS8609A is a transmitter tester equipped with an internal spectrum analyzer, a modulation analyzer and a power meter. One tester covers the development, manufacturing of base stations, mobile stations to construction, maintenance of base stations.
The spectrum analyzer has resolution bandwidths up to 20 MHz, meaning that it can readily support measurement of wide-band signal.
The modulation analyzer realizes all Vector Signal Analysis (VSA) functions through high-speed DSP. The power sensor can perform highly accurate power measurements of ±0.4 dB by using an amorphous power sensor.
Up to three dedicated measurement software options (such as W-CDMA and GSM/EDGE) can be installed simultaneously. Input signals can be selected from either RF or I/Q inputs. For I/Q signals, balanced or unbalanced input can also be selected.
It is equipped with GPIB, RS-232C and 10 Base-T (optional) interfaces for remote measurement. High-speed GPIB data transmission of 120 kbyte/s enables high-speed measurement on the manufacturing line. The monitor uses an easy-to-see 6.5 type TFT color LCD.

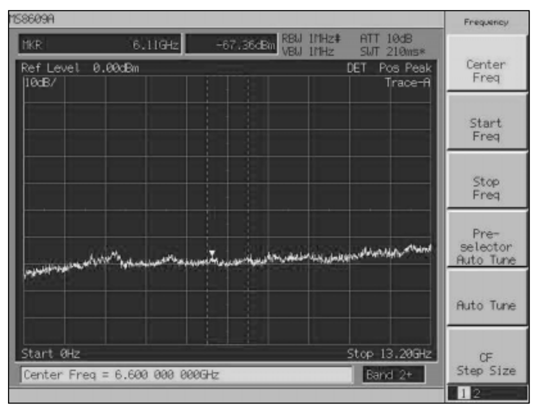
Spectrum analyzer functions

• Frequency
Frequency range: 9 kHz to 13.2 GHz
Resolution bandwidth:
300 Hz to 3 MHz, 5 MHz, 10 MHz, 20 MHz (to 3 GHz)
Frequency span: Zero, 1 kHz to 13.2 GHz
Span accuracy: ±1%
Reference frequency accuracy:
±2 x 10^{-8}/day, ±5 x 10^{-10}/day (option), ±1 x 10^{-10}/year (option)

• Level
Maximum input level: +20 dBm
Input attenuator: 0 to 62 dB (2 dB steps)
1 dB gain compression: +3 dBm (≥500 MHz)
Two tone 3rd order distortion: ≤–85 dBc (0.1 to 3.2 GHz)

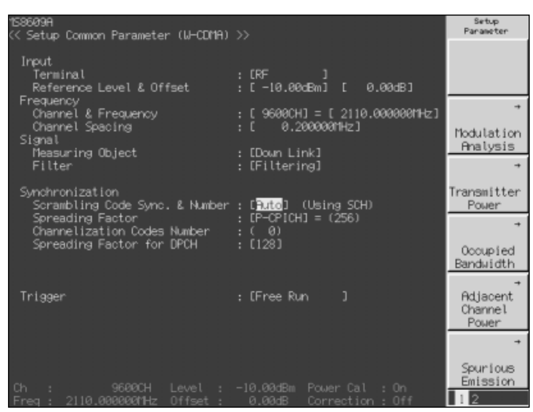
• Sweep
Frequency span: 10 ms to 1000 s
Time span: 1 µs to 1000 s
Refresh rate: >20 times/s

• Others
Detection mode:
Normal, positive, negative, sample, average, RMS (option)
Measurement functions:
Frequency counter, noise power, C/N, ACP, OBW, etc.
GPIB transmission speed: 120 kbyte/s



MX860901B W-CDMA Measurement Software

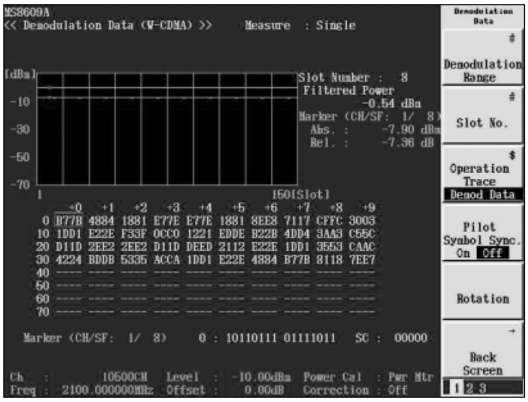
• Parameter setup
The measurement parameters such as modulation accuracy and code domain power, etc. are set on the screen shown below.
Measurement are simply performed via a soft-key menu after setting the measurement parameters.



• Code domain power
Only 1.5 seconds are required for measurement. Either automatic detection of scrambling code from SCH, or specification of scrambling code can be selected.

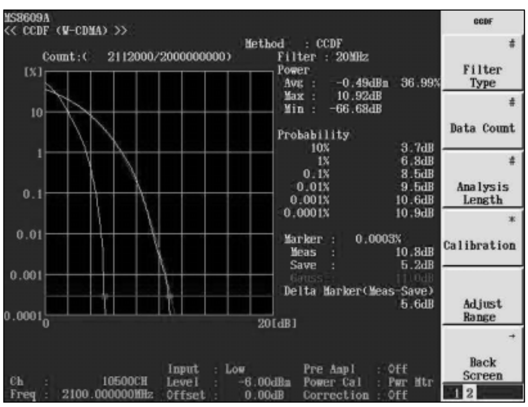
• Modulation accuracy measurement
The modulation accuracy of base station and mobile equipment can be measured and modulation analysis of multiple waveforms can be performed. The residual vector error (rms) accuracy is high (1%, typical).

• Demodulation data monitoring
After de-spreading, up to 10 frames of demodulation data can be evaluated.

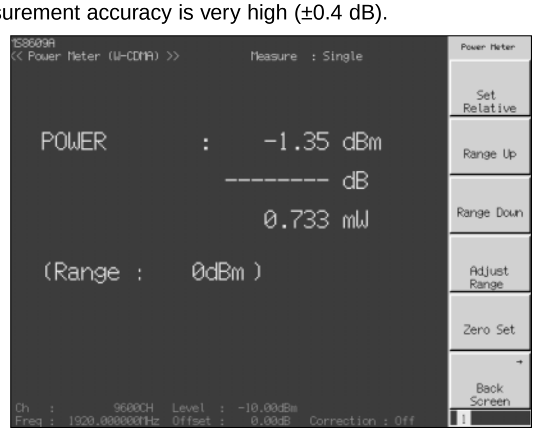


• I/Q level measurement
Measures and displays each I and Q input voltage (rms, p-p value). dBmV or mV units are selectable.

• CCDF measurement
It enables distribution display or cumulative distribution display of the power difference between instantaneous power and average power. Max. 20 MHz of filter bandwidth is able to perform multi-carrier measurement.



• Power meter function
The built-in power meter uses the amorphous power sensor and the measurement accuracy is very high (±0.4 dB).



MX860902A GSM Measurement Software

• Parameter setup
The measurement parameters such as GMSK modulation of GSM and 8PSK modulation of EDGE are set on the screen. Measurement are simply performed via a soft-key menu after setting the measurement parameters.

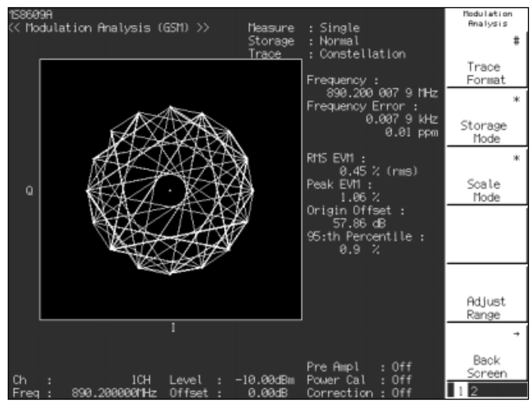
• Modulation accuracy measurement
The modulation accuracy is high. (The residual phase error of GMSK modulation: rms, < 0.5° and residual EVM of 8PSK modulation: rms, < 1.0%)

• Transmitter power measurement
The screen displays the amplitude waveforms with horizontal axis a symbol, vertical axis a level and the template simultaneously.

• Output RF spectrum measurement
The output RF spectrum measurement can be performed at high speed and simply.

• Spurious measurement
Spurious measurement has three kinds of method: Sweep, Search, and Spot. These can be selected depending on the usage.

• EDGE constellation display
The following screen represents constellation display through the filter of the EDGE constellation display of the GSM standard. And the screen represents constellation display of the 8PSK modulation through Nyquist filter and Gaussian inverse correction filter.



4

MX860903A cdma Measurement Software

• Parameter setup
A setup screen is provided for the entry of required parameters for modulation accuracy and code domain power measurements in cdmaOne or cdma2000® 1xRTT analysis.
Measurement can be performed after parameter setup.

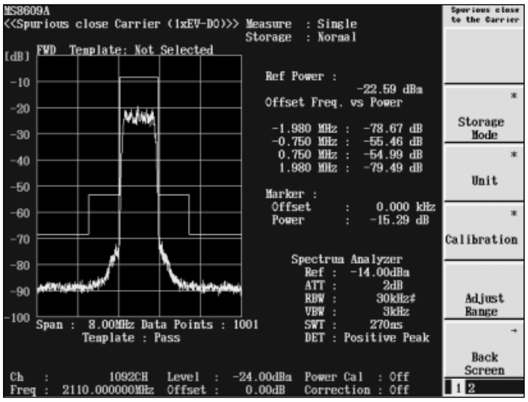
• Modulation accuracy measurement
Frequency error, modulation accuracy and code domain analysis are performed and then results are displayed on the screen. The measurement accuracy is 1% (typical value) of residual vector error (rms).

• BTS code domain analysis
Only 2 seconds are required for code domain analysis of 1xRTT signals, RC* 1 through RC5 can be measured.
Spreading factor of each code is automatically detected and displayed on the screen.
*: Radio Configuration

• MS code domain analysis
Perform code domain analysis of 1xRTT signals in RC3 and RC4 in only 2 seconds. Code domains of I/Q phase are displayed on the screen.

• Transmission power measurement
When transmission power is measured both the value and signal waveform are displayed on the screen. High accuracy power measurements are achieved using the built-in power meter function.

• Spurious close to the carrier measurement
Spurious close to the carrier is measured using the spectrum analyzer function. The PASS/FAIL result of a template judgement is displayed on the screen.

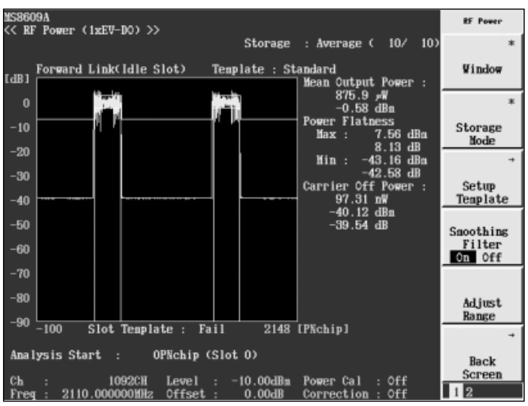


• **Spurious measurement**
A frequency table can be set up in spurious measurement to provide a PASS/FAIL measurement result. Fifteen different frequencies and their limit values can be entered.

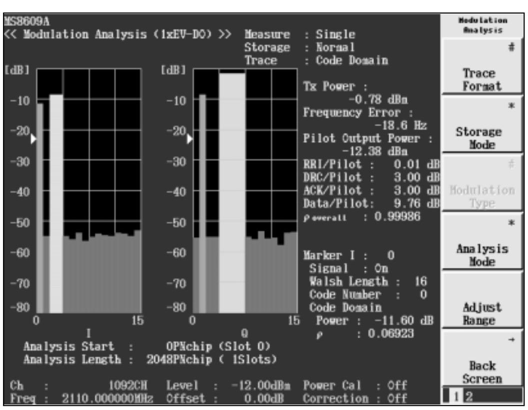
MX860904A cdma2000® 1xEV-DO Measurement Software

• **BTS code domain analysis**
Perform code domain analysis of forward link signals in approx. 2 seconds. Code domains of I/Q phase are displayed on the screen.

• **Transmission power measurement**
When transmission power is measured both the value and signal waveform are displayed on the screen. High accuracy power measurements are achieved using the built-in power meter function.



• **MS code domain analysis**
Perform code domain analysis of reverse link signals in approx. 2 seconds. Code domains of I/Q phase are displayed on the screen.



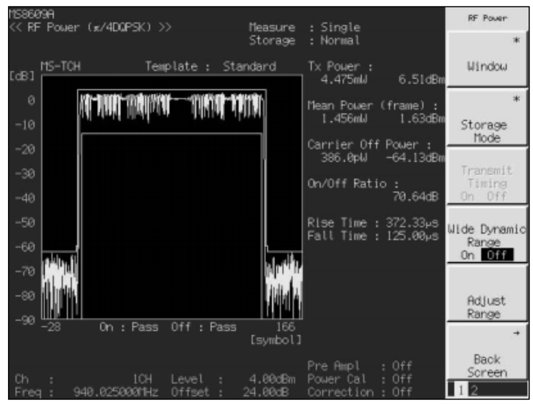
• **Spurious close to the carrier measurement**
Spurious close to the carrier is measured using the spectrum analyzer function. The PASS/FAIL result of a template judgement is displayed on the screen.

MX860905A π/4DQPSK Measurement Software

• **Parameter setting**
Analysis of PDC, PHS and NADC (IS-136) systems requires setting of parameters for important measurement such as modulation accuracy at this screen. Changing the symbol rate also permits analysis of systems other than PDC, PHS and NADC.

• **Modulation accuracy measurement**
The constellation display is combined with the modulation accuracy measurement results to monitor the residual vector error (rms) with a high accuracy of 0.5 % (PDC).

• **Transmitter power measurement**
This screen displays the transmitter power and waveform.
The power value is calibrated by the built-in power meter to achieve even higher accuracy power measurement.



• **Transmission timing measurement**
This screen displays the PHS send timing. In addition, when average measurement is selected, the send jitter is also displayed.

• **Occupied bandwidth measurement**
The occupied bandwidth is measured with a spectrum analyzer or by FFT using DSP, and displayed.

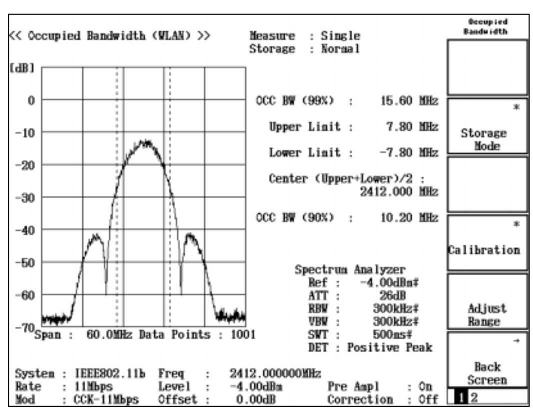
MX860930A Wireless LAN Measurement Software

• **Setup common parameter**
This screen is used to set common parameters such as signaling system, input level, frequency, data rate, and target system before starting analysis. Setting these parameters simplifies measurement operations.

• **Modulation analysis**
Displays numeric results, including the frequency, execution value and maximum value of the modulation accuracy (EVM) and the execution value of the phase error.

• **Power: Slot display**
Displays a burst waveform of one slot. Numeric results such as the average power and maximum instantaneous power are also displayed.

• **Occupied bandwidth**
Displays the occupied bandwidth, which includes 99% of the total emission power, in graph and numeric data forms. Also, the IEEE802.11b/11g displays the numeric data of spreading bandwidth, which includes 90% of the total emission power.



• Adjacent channel power
Displays the power to second adjacent channel in wide-range graph and numeric data forms. It is also possible to display the power for each channel separately.

• Spectrum mask
Executes pass/fail judgement using the standard line corresponding to each wireless LAN system. The level difference of the measured value or the measured level value is also displayed with its frequency.

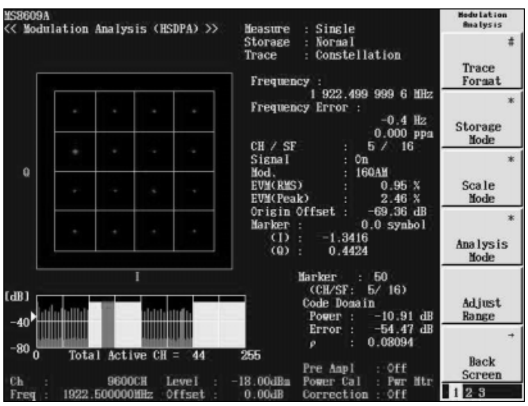
• Spurious
Displays the measured results for the spurious, including frequency, level, judgement result (PASS/FAIL), specifications, RBW and VBW in three sweep modes, on three separate screens.
Measured results are automatically judged and the PASS/FAIL is displayed by presetting the Limit.

• Macro function (Batch Processing)
By presetting the judgement values, each item listed below is batch measured and judged automatically.

For detail and specification, refer to the data sheet.

MX860950A HSDPA Measurement Software

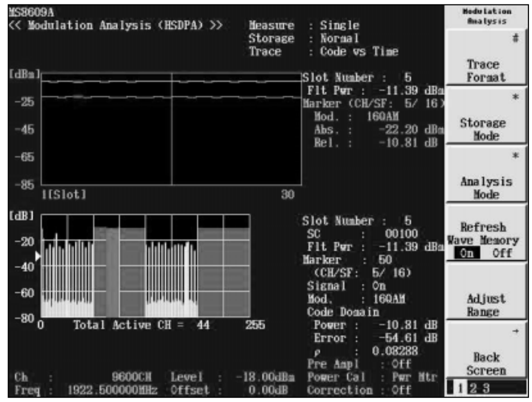
• Modulation analysis (constellation)
Display pattern is selective from either constellation only or constellation and code domain. Constellation of the code channel selected on code domain screen is displayed.



• Parameter setup
This setup screen is for conditions necessary for HSDPA analysis, such as modulation accuracy and code domain power measurement. Measurement is performed with simple operations after parameter setup.

• Modulation analysis (vector error)
Display pattern is selective from either vector error only or vector error and code domain. Residual vector error (rms) is 1% (typ.), enabling high-accuracy measurement.

• Code domain analysis
Code vs Slot can be displayed as well as normal code domain analysis display.



• IQ level measurement
Input voltage (rms value, p-p value) for IQ can be measured.

• Demodulation data display
Demodulation data display of multiple signals including 16QAM (10 frames max.) is available per code channel. Max. 10 frames of demodulation data can be outputted to a PC card.

• CCDF measurement
Display pattern is selective from either CCDF for instantaneous power and average power difference or APD. CCDF for 4 multi carriers can be measured.

• Adjacent channel power measurement
When measurement is performed using a spectrum analyzer, the adjacent channel power is measured after passage through a built-in filter (root Nyquist). A high-speed measurement method can also be selected.

• Spurious measurement
There are three methods: spot, sweep and search.
Frequency and limit value can be set maximum 15 in the tables. The measurement results are displayed with a limit evaluation.

Specifications

• MS8609A

Frequency range	9 kHz to 13.2 GHz
Max. input level	+20 dBm (100 mW), continuous average power, DC input: 0 Vdc
Input impedance	Power meter 50 Ω, VSWR: ≤1.3 (30 MHz to 3 GHz) Except power meter 50 Ω, VSWR: ≤1.5 (input attenuator: ≥4 dB, ≤3 GHz)/≤2.3 (input attenuator: ≥10 dB, >3 GHz)
Input connector	N-type
Reference oscillator	Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8}/day (after 10 minute warm-up, compared to frequency after 24 hour warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (compared to frequency after 24 hour warm-up) Temperature characteristics: ±5 x 10^{-8} (0˚ to 50˚C, compared to frequency at 25˚C)
Power meter	Frequency range: 30 MHz to 3 GHz Level range: –20 to +20 dBm Measurement accuracy (after zero calibration): ±10%

Continued on next page

Spectrum analyzer	Frequency	Frequency setting Setting range: 9 kHz to 13.2 GHz, Pre-selector range: 3.15 to 13.2 GHz (Band 1 and 2) Frequency accuracy Accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 x N Hz) ∗N: Mixer harmonic order Normal marker: Same as display frequency accuracy Delta marker: Same as span accuracy Frequency span setting range: 0 Hz, 5 kHz to 13.2 GHz Span accuracy: ±1.0% (at single band sweep, number of data points: 1001) RBW (resolution bandwidth) Setting range: 300 Hz to 3 MHz (1-3 sequence), 5 MHz, 10 MHz, 20 MHz (Band 0) Accuracy: ±20% (300 Hz to 10 MHz), ±40% (20 MHz) Selectivity (60 dB: 3 dB): ≤15:1 VBW (video bandwidth): 1 Hz to 3 MHz (1-3 sequence), off Sideband noise: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)
	Amplitude	Maximum input level Continuous average power: +20 dBm, DC voltage: 0 V Average noise level (RBW: 300 Hz, VBW: 1 Hz): [Without Option 08] ≤–124 dBm + 1.5 x f [GHz] dB (1 MHz to 2.5 GHz, Band 0) ≤–120 dBm + 1.5 x f [GHz] dB (2.5 to 3.2 GHz, Band 0) ≤–116 dBm (3.15 to 7.8 GHz, Band 1) ≤–107 dBm (7.7 to 13.2 GHz, Band 2) [With Option 08] ≤–122 dBm + 1.8 x f [GHz] dB (1 MHz to 2.5 GHz, Band 0) ≤–120 dBm + 1.8 x f [GHz] dB (2.5 to 3.2 GHz, Band 0) ≤–116 dBm (3.15 to 7.8 GHz, Band 1) ≤–107 dBm (7.7 to 13.2 GHz, Band 2) Residual response: ≤–100 dBm (1 MHz to 3.2 GHz, Band 0), ≤–90 dBm (3.15 to 7.8 GHz, Band 1) Reference level Setting range: –100 to +30 dBm Accuracy: ±0.75 dB (+0.1 to 20 dBm), ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, frequency: 50 MHz, span: 1 MHz (Input attenuator, RBW, VBW and sweep time are set to AUTO.) RBW switching uncertainty: ±0.3 dB (300 Hz to 5 MHz), ±0.5 dB (10, 20 MHz) ∗After calibration, with RBW 3 kHz referenced Input attenuator: 0 to 62 dB (2 dB steps) Switching uncertainty: ±0.3 dB (10 to 50 dB), ±0.5 dB (52 to 62 dB) ∗After calibration, with 50 MHz, RF ATT 10 dB referenced Frequency response: ±0.6 dB (9 kHz to 3.2 GHz, Band 0), ±1.5 dB (3.15 to 7.8 GHz, Band 1[*1]), ±2.0 dB (7.7 to 13.2 GHz, Band 2[*1]) Log linearity: ±0.4 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –90 dB, RBW: ≤1 kHz) 2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz), ≤–75 dBc (200 to 850 MHz, Band 0), ≤–70 dBc (0.85 to 1.6 GHz, Band 0), ≤–90 dBc (1.6 to 6.6 GHz, Band 1 and 2) Two-tone 3rd order distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.2 GHz), ≤–80 dBc (3.15 to 7.8 GHz), ≤–75 dBc (7.7 to 13.2 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm 1 dB gain compression: ≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, Band 0), ≥–3 dBm (≥3150 MHz, Band 1 and 2)
	Sweep	Setting range: 10 ms to 1000 s (frequency axis sweep), 1 µs to 1000 s (time axis sweep) Trigger switch: Free-run, triggered Trigger source: Wide IF video, Line, External (TTL level), External (±10 V) Trigger delay Pre-trigger range: –time span to 0 s Resolution: time span/500 or 100 ns whichever is larger. Post trigger: 0 µs to 65.5 ms Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms) Gate sweep mode Gate delay range: 0 to 65.5 ms (resolution: 1 µs), Gate length range: 2 µs to 65.5 ms (resolution: 1 µs)
	Functions	Number of data points: 501, 1001 Detection modes: Normal, Positive peak, Negative peak, Sample, Average, RMS (Option 04) Display functions: Trace A, Trace B, Trace A/B, Trace A/BG, Trace A/Time Storage functions: Normal, View, Max hold, Min hold, Average, Linear average, Cumulative, Overwrite Markers Signal search: Auto tune, Peak → CF, Peak → Ref, Scroll Zone markers: Normal, Delta Marker function: Marker → CF, Marker → Ref, Marker → CF step size, Δ marker → Span, Zone → Span Peak search: Peak, Next peak, Min dip, Next dip Multi-marker: 10 max. Measurements Noise power: dBm/Hz, dBm/ch, dBμ$\sqrt{Hz}$ C/N: dBc/Hz, dBc/ch Frequency counter Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Measurement accuracy: ± (display frequency x reference frequency accuracy + 2 x N Hz + 1 LSB) ∗At S/N 20 dB or more and RBW 3 MHz or less, N: Mixer harmonic order Occupied bandwidth: Power N% method, X-dB down method Adjacent channel power Reference measurement: Total power, reference level, in-band method Display methods: Channel specified display (3 channels x 2), graphic display Average power of burst signal: Average power within specified time range of time domain waveform Template comparison measurement (time sweep): Upper limit x 2, lower limit x 2 Mask measurement (frequency sweep): Upper limit x 2, lower limit x 2

Continued on next page

Others	Display: Color TFT-LCD, VGA 6.5 type Hard copy: Hard copy of screen via parallel interface (ESC/P compatible printer) Memory card interface: ATA flash card (3.3/5V) GPIB: Can be controlled from external controller (except power switch) when specified as device Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Parallel interface: Centronics printer I/F, D-sub 25-pin connector (female) Video output: Analog RGB output, D-sub 15-pin connector (female)
Dimensions and mass	320 (W) x 177 (H) x 411 (D) mm (except handle, feet, front cover and fan cover), ≤16 kg (nominal)
Power	100 to 120/200 to 240 Vac (–15/+10%, max. voltage: 250 V, automatic voltage selection), 47.5 to 63 Hz, ≤400 VA
Operating temperature and humidity	0˚ to +50˚C, ≤85% (no condensation)
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

∗1: Reference frequency: 50 MHz, input attenuator: 10 dB, +18˚ to +28˚C

4

• MX860901B W-CDMA Measurement Software

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on∗1) Carrier frequency accuracy: ±(reference oscillator accuracy + 10 Hz) ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on∗1),1 code channel Modulation accuracy (residual vector error): <2% (rms) ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on∗1), 1 code channel Origin offset accuracy: ±0.5 dB ∗Input level: ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on∗1), 1 code channel, relative to signal with origin offset of –30 dBc Waveform display (for one-channel to multi-channel) Constellation, eye pattern, vector error vs. chip, phase error vs. chip, amplitude error vs. chip, code vs. slot
Code domain analysis	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on∗1) Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) ∗Input level: ≥–10 dBm (pre-amplifier: off), ≥–20 dBm (pre-amplifier: on∗1) Code domain error Residual error: <–50 dB Accuracy: ±0.5 dB (error: relative to signal with origin offset of –30 dBc) ∗Input level: ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on∗1), spread factor: 512 (down-link)/256 (up-link) Display Function: Code domain power, code domain error Spread factor: 4 to 256 (up-link)/4 to 512 (down-link), spread factor auto detection function, SCH level measurement function, I/Q separately at up-link Code vs. slot measurement: Measures code domain power per slot of specified code channel for Max.150 slots. (Supporting compressed mode in downlink)
Amplitude measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08) Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on∗1) Transmitter power measurement Measurement range: –20 to +20 dBm (average power, pre-amplifier: off), –20 to +10 dBm (average power, pre-amplifier: on∗1) ∗Auto calibrated at internal power meter Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –40 dB) ∗Input level: ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on∗1), after the range adjusted, with the reference level setting unchanged Filter selection function: Power measurement through RRC (α = 0.22) filter Transmitter power control measurement function: Relative power display per slot for Max. 150 slots, NO/GO evaluation RACH measurement function: Measures the time difference between preamble RACH signal and message RACH signal.
Occupied bandwidth measurement	Frequency range: 50 MHz to 3 GHz Input level: –60 to +20 dBm (average power, pre-amplifier: off), –80 to +10 dBm (average power, pre-amplifier: on∗1) Measurement method Sweep method: Displays result after signal measured with sweep spectrum analyzer FFT method: Displays result after FFT
Adjacent channel power measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08, 30) Input level: –10 to +20 dBm (average power, pre-amplifier: off) Measurement method Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays power after each adjacent channel measured with sweep spectrum analyzer Filter method: Measures and displays power of adjacent channels after passing via built-in receiving filters (RRC: α = 0.22) Measurement range Input level: ≥0 dBm (filter method, wide dynamic range mode) Code channel (1 code): ≥55 dBc (5 MHz offset), ≥62 dBc (10 MHz offset) Code channel (16 multi-code): ≥50 dBc (5 MHz offset), ≥60 dBc (10 MHz offset, without Option 08) Input level: ≥–10 dBm (filter method, wide dynamic range mode) Code channel (1 code): 55 dBc (5 MHz offset, typical), 62 dBc (10 MHz offset, typical) Code channel (16 multi-code): 50 dBc (5 MHz offset, typical), 60 dBc (10 MHz offset, typical)

Continued on next page

Spurious measurement	Measurement frequency: 9 kHz to 12.75 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): 0 to +20 dBm (average power, pre-amplifier: off) Measurement method Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range*2: ≥79 dB (RBW: 1 kHz, 9 to 150 kHz, Band 0) ≥79 dB (RBW: 10 kHz, 150 kHz to 30 MHz, Band 0) ≥79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) ≥76 –f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0) ≥76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1) *Carrier frequency: 1.8 to 2.2 GHz
Spectrum emission mask measurement	Measures the signal under measurement with sweep spectrum analyzer and displays template evaluation result.
Demodulation display	Outputs Max. 10 frames of despread data for specified code channel.
CCDF measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (Option 08, 30) Measurement level range: –60 to +20 dBm (average power, pre-amplifier: off), +30 dBm (peak power, pre-amplifier: off) –80 to +10 dBm (average power, pre-amplifier: on), +20 dBm (peak power, pre-amplifier: on) Measurement method CCDF: Cumulative distribution display of the power difference between instantaneous power and average power. APD: Distribution display of the power difference between instantaneous power and average power. Filter selection function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, RRC: α = 0.22, RC: α = 0.22
I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Residual vector error: <2% (rms) *Input level: ≥0.1 V (rms), DC coupling I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main unit.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860902A GSM Measurement Software

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –40 to +20 dBm (burst average power, pre-amplifier: off), –60 to +10 dBm (burst average power, pre-amplifier: on*1) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level (burst average power): ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on*1) Residual phase error (GMSK modulation): <0.5 deg (rms), <2.0 deg (peak) *Input level (burst average power): ≥–30 dBm (pre-amplifier: off), ≥–40 dBm (pre-amplifier: on*1) Residual EVM (8PSK modulation): <1% (rms) Waveform display: Trellis (GMSK modulation), eye pattern, EVM vs. bit (8PSK modulation), phase vs. bit, amplitude vs. bit, I/Q diagram
Amplitude measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –40 to +20 dBm (burst average power, pre-amplifier: off), –60 to +10 dBm (burst average power, pre-amplifier: on*1) Transmitter power measurement (auto calibrated at internal power meter) Measurement range: –10 to +20 dBm (burst average power), –10 to +10 dBm (burst average power, pre-amplifier: on*1) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –30 dBm) *Input level (burst average power): ≥–10 dBm (pre-amplifier: off); ≥–20 dBm (pre-amplifier: on*1), without changing the reference level setting after range optimization Carrier-off power measurement range Input level (burst average power): ≥–10 dBm (pre-amplifier: off), ≥–20 dBm (pre-amplifier: on*1) Normal mode: ≥60 dB (compared with burst average power) Wide dynamic range mode: ≥80 dB (compared with 10 mW of burst average power) *Measurement limit is decided by average nose level (≤–70 dBm, 50 MHz to 2.7 GHz). Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display possible (measured by 1 MHz bandwidth). NO/GO judgment function
Output RF spectrum measurement	Frequency range: 100 MHz to 2.7 GHz Input level: –10 to +20 dBm (burst average power, pre-amplifier: off), –20 to +10 dBm (burst average power, pre-amplifier: on*1) Modulation portion measurement range: ≥60 dB (≥200 kHz offset), ≥68 dB (≥250 kHz offset) *CW signal, RBW: 30 kHz (<1.8 MHz offset), RBW: 100 kHz (≤1.8 MHz offset) Transient portion measurement range: ≥63 dB (CW, ≥400 kHz offset)

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Spurious measurement	Measurement frequency: 100 kHz to 12.75 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): 0 to +20 dBm (burst average power, pre-amplifier: off) Measurement method Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range: ≥72 dB (RBW: 10 kHz, 100 kHz to 50 MHz, Band 0) ≥72 dB (RBW: 100 kHz, 50 to 500 MHz, Band 0) ≥66 –f [GHz] dB (RBW: 3 MHz, 0.5 to 3.15 GHz, Band 0, except harmonic frequency) ≥66 dB (RBW: 3 MHz, 3.15 to 7.8 GHz, Band 1) *Carrier frequency: 0.8 to 1 GHz, 1.8 to 2 GHz
I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, I/Q level Modulation accuracy Residual phase error: <0.5 deg (rms), DC coupling Residual EVM: <1.0% (rms), DC coupling *Input level: ≥0.1 V (rms), 18˚ to 28˚C I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main unit.

• MX860903A cdma Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on*1) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on*1), at 1 code channel Modulation accuracy (residual vector error): <2.0% (rms) *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on*1), at 1 code channel Origin offset accuracy: ±0.50 dB *Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on*1), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform display: Displays the following items for 1 CH to multi CH input signals; constellation, eye pattern, vector error vs. chip number, phase error vs. chip number, amplitude error vs. chip number
Code domain analysis	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on*1) Analysis signal: Forward link (radio configuration 1 to 5), Reverse link (radio configuration 1 to 4), Reverse link (radio configuration 3, 4) at long code mask: 0 Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Display function: Code domain power, code domain timing offset, code domain phase offset
Amplitude measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on*1) Tx power measurement: (after level calibration using built-in power meter, automatic operation by pushing key) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off), –20 to +10 dBm (average power within burst, pre-amp on*1) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –40 dB) *Input level: ≥+10 dBm (pre-amp off), ≥–20 dBm (pre-amp on*1) , unchanged reference level setup after range adjustment Burst analysis: Rising/falling characteristics and on/off ratio analysis function
Occupied bandwidth measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off), –60 to +10 dBm (average power within burst, pre-amp on*1) Measurement method Sweep method: Sweeps signal using spectrum analyzer and calculates result FFT Method: Analyzes signal with FFT and calculates result

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Spurious close carrier to the measurement	Frequency range: 50 MHz to 2.3 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off) Measurement method: Calculates and displays the ratio of Tx power to the power measured by spectrum analyzer with sweep method Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range: ± 50 dBc (900 kHz offset), ±60 dBc (1.98 MHz offset) ∗Input level (average power within burst): ≥0 dBm (pre-amp off), RBW: 30 kHz, VBW: 300 kHz, detection mode: positive
Spurious measurement	Measurement frequency range: 10 MHz to 12.75 GHz (except within ±50 MHz of carrier frequency) Input level range (Tx power): +20 to +40 dBm (average power within burst) Measurement method Sweep method: Sweeps specified frequency range using spectrum analyzer and calculates ratio of carrier power and peak value detected during the sweep. Detection mode is average. Spot method: Measures average power of specified frequencies in time domain using spectrum Analyzer and calculates ratio of carrier power and measured power of the frequencies. Detection mode is average. Search method: Sweeps specified frequency range using spectrum analyzer and detects frequency of peak spurious. Measures average power of the detected frequencies in time domain using spectrum analyzer and calculates ratio of carrier power and the measured power for the frequencies. Detection mode is Average. Tx power measurement Tx power method: Carrier power measured in 1.23 bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range (typical) 79 dB (RBW: 10 kHz, 10 to 30 MHz, Band 0), 79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) ∗Carrier frequency: 800 to 1000 MHz/1.8 to 2.2 GHz, referential value of power ratio in Tx power∗2 Normal mode: 76 – f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0), 76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1)
Electric performance (I/Q input)	Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Balance input Differential voltage: 0.1 to 1 Vp-p, In-phase voltage: ±2.5 V Unbalance Input: 0.1 to 1 Vp-p DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement (residual vector error): <2% (rms) ∗DC coupling, input level: ≥0.1 V (rms) I/Q level measurement: Measures input level of I and Q (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

∗1: Can be set when MS8609A-08 option is installed in the main frame.
∗2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860904A cdma2000® 1xEV-DO Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on∗1) Carrier frequency accuracy: ±(reference oscillator accuracy +10 Hz) ∗Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on∗1), at 1 code channel Modulation accuracy (residual vector error): <2.0% (rms) ∗Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on∗1), at 1 code channel Origin offset accuracy: ±0.50 dB ∗Input level: ≥–30 dBm (pre-amp off), ≥–40 dBm (pre-amp on∗1), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform Display Forward link Displays the following items for each or entire domain of DATA, MAC and Pilot: Constellation, Eye Pattern, Vector Error vs. Chip Number, Phase Error vs. Chip Number, Amplitude Error vs. Chip Number Displays the symbol constellation of DATA domain Reverse link Displays the following items for 1CH to multi CH input signals: Constellation, Eye pattern, Vector Error vs. Chip Number, Phase Error vs. Chip Number, Amplitude Error vs. Chip Number
Code domain analysis	Measurement frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on∗1) Code domain power accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Input level: ≥–10 dBm (pre-amp off), ≥–20 dBm (pre-amp on∗1) Analysis signal: Forward link, Reverse link Display function Forward link: Displays the code domain power for each DATA and MAC domain Code domain power for DATA domain, Spread factor: IQ separate display for fixed 16 codes Code domain power for MAC domain, Spread factor: IQ separate display for fixed 64 codes Reverse link: Displays the code domain power for IQ separately, Detects the following channels

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Amplitude measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on*1) Tx power measurement: (after level calibration using built-in power meter, automatic operation by pushing key) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off) –20 to +10 dBm (average power within burst, pre-amp on*1) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –40 dB) *Input level: ≥0 dBm (pre-amp off), ≥–20 dBm (pre-amp on*1) , unchanged reference level setup after range adjustment Idle slot analysis: Rise/Fall characteristics and On/Off ratio analysis function are equipped.
Occupied bandwidth measurement	Frequency range: 50 MHz to 2.3 GHz Measurement level range: –40 to +20 dBm (average power within burst, pre-amp off) –60 to +10 dBm (average power within burst, pre-amp on*1) Measurement method Sweep method: Sweeps signal using spectrum analyzer and calculates result FFT method: Analyzes signal with FFT and calculates result
Spurious close to the carrier measurement	Frequency range: 50 MHz to 2.3 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off) Measurement method: Calculates and displays the ratio of Tx power to the power measured by spectrum analyzer with sweep method Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range: ≥50 dBc (900 kHz offset), ≥60 dBc (1.98 MHz offset) *Input level (average power within burst): ≥0 dBm (pre-amp off), RBW: 30 kHz, VBW: 3 kHz, detection mode: positive
Spurious measurement	Measurement frequency range: 10 MHz to 12.75 GHz (except within ±50 MHz of carrier frequency) Input level range (Tx power): 0 to +20 dBm (average power within burst, pre-amp off) Measurement method Sweep method: Sweeps specified frequency range using spectrum analyzer and calculates ratio of carrier power and peak value detected during the sweep. Detection mode is average. Spot method: Measures average power of specified frequencies in time domain using spectrum Analyzer and calculates ratio of carrier power and measured power of the frequencies Detection mode is average. Search method: Sweeps specified frequency range using spectrum analyzer and detects frequency of peak spurious. Measures average power of the detected frequencies in time domain using spectrum analyzer and calculates ratio of carrier power and the measured power for the frequencies. Detection mode is Average. Tx power measurement Tx power method: Carrier power measured in 1.23 MHz bandwidth SPA method: Carrier power measured in RBW: 3 MHz, VBW: 3 kHz, detection mode: sample, frequency span: 0 Hz Measurement range (typical): 79 dB (RBW: 10 kHz, 10 to 30 MHz, Band 0) 79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) *Carrier frequency: 800 to 1000 MHz/1.8 to 2.2 GHz, reference value of power ratio in Tx power*2 Normal mode: 76 – f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0) 76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1)
CCDF measurement	Frequency range: 50MHz to 3GHz, 50MHz to 2.3GHz (when Option MS8609A-08 or MS8609A-30 is installed) Measurement level range –60 to +20 dBm (average power), +30 dBm (peak power): Pre-amp off –80 to +10 dBm (average power), +20 dBm (peak power): Pre-amp on*1 Measurement method CCDF: Displays the cumulative distribution of the power difference between instantaneous power and average power APD: Displays the distribution of the power difference between instantaneous power and average power Filter selection function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, 1.23 MHz
Electric performance (I/Q input)	Input impedance:1 MΩ (parallel capacitance: <100 pF), 50 Ω Balance input Differential voltage: 0.1 to 1 Vp-p, In-phase voltage: ±2.5 V Unbalance input: 0.1 to 1 Vp-p DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement: (residual vector error): <2% (rms) *DC coupling, input level: ≥0.1 V (rms) I/Q level measurement: Measures input level of I and Q (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I-phase and Q-phase signals.

*1: Can be set when MS8609A-08 option is installed in the main frame.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

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• MX860905A π/4DQPSK Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measured frequency range: 50 MHz to 2.1 GHz Measured level ranges: –40 to +20 dBm (average power within burst, pre-amp off*1), –60 to +10 dBm (average power within burst, pre-amp on*1) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level (average power within burst): ≥–30 dBm (pre-amp off*1), ≥–40 dBm (pre-amp on*1) Modulation accuracy (residual vector error) PDC/NADC: <0.5% (rms), PHS: <0.7% (rms) *Input level: ≥–30 dBm (pre-amp off*1), ≥–40 dBm (pre-amp on*1), averaging: 10 times Origin offset accuracy: ±0.50 dB *Input level (average power within burst): ≥–30 dBm (pre-amp off*1), ≥–40 dBm (pre-amp on*1), relative to signal with origin offset of –30 dBc Transmission rate accuracy: ±1 ppm *Input level (average power within burst): ≥–30 dBm (pre-amp off*1), ≥–40 dBm (pre-amp on*1) Symbol rate: 2 to 300 k symbol/s Roll off ratio: 0.2 to 1.0 Analysis symbol: 48 to 1000 symbol Waveform displays: Constellation, eye diagram, EVM vs. symbol No., phase error vs. symbol No., amplitude error vs. symbol No.
Amplitude measurement	Frequency range: 50 MHz to 2.1 GHz Measurement level ranges: –40 to +20 dBm (average power within burst, pre-amp off*1), –60 to +10 dBm (average power within burst, pre-amp on*1) Transmitter power measurement*1 Measurement ranges: –10 to +20 dBm (average power within burst, pre-amp off*1), –10 to +10 dBm (average power within burst, pre-amp on*1) Accuracy: ±0.40 dB Power measurement linearity: ±0.20 dB (0 to –30 dB) *Input level (average power within burst): ≥–10 dBm (pre-amp off*1), ≥–20 dBm (pre-amp on*1), without changing the reference level setting after range optimization Carrier-off power measurement*3 Normal mode measurement range PDC/NADC: ≥65 dB, PHS: ≥60 dB *Relative to average power within burst Wide dynamic range mode measurement range PDC/PHS: ≥90 dB (measurement limits of average noise level: ≤–80 dBm, 50 Hz to 2.1 GHz) PHS: ≥80 dB (measurement limits of average noise level: ≤–70 dBm, 50 Hz to 2.1 GHz) *Average power within burst: 10 mW Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display, NO/GO judgement function
Occupied bandwidth measurement	Measured frequency range: 50 MHz to 2.1 GHz Measured level ranges: –40 to +20 dBm (average power within burst, pre-amp off*1), –60 to +10 dBm (average power within burst, pre-amp on*1) Measurement methods Sweep method: Calculates and displays result after signal measured with sweep spectrum analyzer FFT method: Calculates and displays result after FFT
Adjacent channel power measurement	Frequency range: 100 MHz to 2.1 GHz Input level range: –10 to +20 dBm (average power within burst, pre-amp off*1), –20 to +10 dBm (average power within burst, pre-amp on*1) Measurement methods Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays after measuring adjacent channel and next adjacent channel signal with sweep spectrum analyzer High-speed method: Calculates and displays after measuring adjacent channel and next adjacent channel power (rms) through internal receive filter Measurement range (CW signal input, at high-speed method) PDC: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset) PHS: ≥60 dB (600 kHz offset), ≥60 dB (900 kHz offset) NADC: ≥30 dB (30 kHz offset), ≥60 dB (60 kHz offset), ≥65 dB (90 kHz offset) *Adjacent channel power averaging ratio found from average power within burst and during burst on interval
Spurious measurement	Measured frequency range: 100 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level range (transmitter power): –10 to +20 dBm (average power within burst, pre-amp off*1), –20 to +10 dBm (average power within burst, pre-amp on*1) Measurement methods Sweep method: Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Spot method: Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Search method: Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average

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Electrical performance (I/Q input)	Input method: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Input level range Balanced input Differential voltage range: 0.1 to 1 Vp-p, In-phase voltage range: ±2.5 V (at input terminal) Unbalanced input: 0.1 to 1 Vp-p (at input terminal, switchable DC/AC coupling) Measurement items: modulation accuracy, amplitude, occupied bandwidth (FFT method), I/Q level Modulation accuracy measurement Input level: ≥0.1 V (rms) ∗Temperature range: 10° to 28°C Residual vector error PDC/NADC: <0.5% (rms) ∗Typical, DC coupling PHS: <0.7% (rms) ∗Typical, DC coupling I/Q level measurement Level measurement: Measurement and display each I, Q input voltage (rms, p-p) I/Q phase difference measurement: Phase difference between I and Q phase signals when CW signal input to I and Q input terminals

∗1: Can be set when MS8609A-08 option is installed in the main frame.
∗2: After level calibration using internal power meter
∗3: Input level (average power within burst): ≥–10 dBm (pre-amp off∗1), ≥–20 dBm (pre-amp on∗1)

• MX860950A HSDPA Measurement Software

Following specifications are guaranteed after optimized internal level (Range of internal receiver is automatically adjusted by pushing Adjust Range key).

Modulation/frequency measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off∗1) –80 to +10 dBm (average power within burst, pre-amp on∗1) Carrier frequency accuracy: ± (reference oscillator accuracy ±10 Hz), at 1 code channel (Modulation methods: QPSK) ∗Input level: ≥–30 dBm (pre-amp off∗1), ≥–40 dBm (pre-amp on∗1) Modulation accuracy Residual vector error: <2.0%(rms), at 1 code channel (Modulation methods: QPSK) ∗Input level: ≥–30 dBm (pre-amp off∗1), ≥–40 dBm (pre-amp on∗1) Origin offset accuracy: ±0.5 dB, at 1 code channel (Modulation methods: QPSK) ∗Input level: ≥–30 dBm (pre-amp off∗1), ≥–40 dBm (pre-amp on∗1) For the signals with Origin Offset = –30 dBc Waveform display Displays the following items for 1CH to multi CH input signals: Constellation, Vector error, Phase error, Amplitude error
Code domain analysis	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (When MS8609A-08 option is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off∗1) –80 to +10 dBm (average power within burst, pre-amp on∗1) Code domain power Input level: ≥–10 dBm (pre-amp off∗1), ≥–20 dBm (pre-amp on∗1) Modulation methods: QPSK Accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) Code domain error Input level: ≥–10 dBm (pre-amp off∗1), ≥–20 dBm (pre-amp on∗1) Modulation methods: QPSK Spread factor: 512 Residual error: <–50 dB Accuracy: ±0.5 dB (Error: –30 dBc) Display function Code domain power, code domain error display Supporting SF: 4 to 512 SF auto-detect function is equipped. SCH level measurement function is equipped. Code vs. Slot measurement: Code domain power is measured per slot (Max.150 slots) for the specified code channel. (supporting compressed mode)
Amplitude measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off∗1) –80 to +10 dBm (average power within burst, pre-amp on∗1) Tx power measurement: After level calibration with built-in power meter (executed automatically by a key push) Measurement range: –20 to +20 dBm (average power within burst, pre-amp off∗1) –20 to +10 dBm (average power within burst, pre-amp on∗1) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –40dB) unchanged reference level setup after range adjustment ∗Input level: ≥–30 dBm (pre-amp off∗1), ≥–40 dBm (pre-amp on∗1) Filter select function: Power value after passing RRC (α = 0.22) filter can be measured
CCDF measurement	Measurement frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (when MS8609A-08 is installed) Measurement level range: –60 to +20 dBm (average power within burst, pre-amp off∗1) –80 to +10 dBm (average power within burst, pre-amp on∗1) Measurement methods CCDF: Displays an accumulation distribution of a ratio between instantaneous power and average power APD: Displays a distribution of a ratio between instantaneous power and average power Filter select function: 20 MHz, 10 MHz, 5 MHz, 3 MHz, RRC: α = 0.22, RC: α = 0.22

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Electric performance (IQ input)	Input methods: Balance, Unbalance Input impedance: 1 MΩ (parallel capacitance: <100 pF), 50 Ω Input level range Balance input Differential voltage: 0.1 to 1.0 Vp-p, In-phase voltage: ≤±2.5 V (at input terminal) Unbalance input: 0.1 to 1.0 Vp-p (at input terminal), DC/AC coupling: Changeable Measurement items: Modulation accuracy, code domain power, amplitude, IQ level Modulation accuracy measurement Residual vector error: <2.0%(rms), typical 1.0%(rms) Input level: ≥0.1 V(rms), DC coupling IQ level measurement Level measurement: Measures input level of I and Q (rms, p-p) IQ phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q- phase signals.

∗1: Can be set when MS8609A-08 option is installed in the main frame.

• Option 01: Precision frequency reference

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8}/7 min. (with the frequency at 24 hours after the power is turned on referenced)
Aging rate	≤±5 x 10^{-10}/day (with the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10} (with the frequency at 0 to 50˚C and 25˚C referenced)

• Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	Without Option 08, when RBW is 1 Hz, RF ATT is 0 dB, sample detection mode ≤–148.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–144.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–138.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–129.5 dBm Typical (7.7 to 13.2 GHz, band 2) With Option 08, pre-amp off, when RBW is 1 Hz, RF ATT is 0 dB, sample detection mode ≤–146.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–144.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–138.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–129.5 dBm Typical (7.7 to 13.2 GHz, band 2)

• Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW ≥100 Hz), ±10% Typical (RBW ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz), ≤5:1 Typical (RBW ≤30 Hz) RBW switching uncertainty: ±0.5 dB
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level display	Without Option 08, when RBW is 10 Hz, RF ATT is 0 dB, sample detection mode ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–128.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–119.5 dBm Typical (7.7 to 13.2 GHz, band 2) With Option 08, pre-amp off, when RBW is 10 Hz, RF ATT is 0 dB, sample detection mode ≤–134.5 dBm + 1.8 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + 1.8 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–128.5 dBm Typical (3.15 to 7.8 GHz, band 1) ≤–119.5 dBm Typical (7.7 to 13.2 GHz, band 2)

• Option 05: Rubidium reference oscillator

Frequency	10 MHz
Start-up characteristics	±1 x 10^{-9}/7 min. (with frequency one hour after the power is turned on referenced)
Aging rate	±1 x 10^{-10}/month (with frequency one hour after the power is turned on referenced)
Temperature characteristics	±1 x 10^{-9} (with frequency at 0 to 45˚C and 25˚C referenced)
Accessories	J1066 coaxial code 0.15 m (BNC211-LP4)

• **Option 08: Pre-amplifier**

Gain	20 dB typical
Noise figure	6.5 dB typical (input frequency: ≤2 GHz) ,12 dB (input frequency: >2 GHz)
Frequency	Frequency range: 100 kHz to 3 GHz Band 0: 100 kHz to 3.0 GHz, 1–: 3.15 to 6.3 GHz, 1+: 6.2 to 7.8 GHz, 2+: 7.7 kHz to 13.2 GHz ∗The band, which can use with a pre-amplifier, is only band 0.
Amplitude	Level measurement: Average noise level to +10 dBm Max. input level: +10 dBm Average noise level: –137 dBm + 2.0 x f [GHz] dB (1 MHz to 2.5 GHz, band 0) ∗At RBW 300 Hz, VBW 1 Hz, RF ATT 0 dB, and detection mode of SAMPLE Reference level Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.90 dB (–69.9 to +10 dBm), ±1.50 dB (–90 to –70 dBm) ∗After calibration, with 50 MHz referenced, 1 MHz span (RF ATT, RBW, VBW, and sweep time are set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) ∗After calibration, with RBW 3 kHz referenced RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±1.0 dB (52 to 62 dB) Frequency response: ±2.0 dB (100 kHz to 3 GHz) ∗With 100 MHz referenced, when RF ATT is 10 to 50 dB, and temperature is 18˚ to 28˚C Linearity of waveform display Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level) Spurious response: Two-tone 3rd order distortion: ≤–70 dBc (10 MHz to 3 GHz) ∗Frequency difference of two signals ≥50 kHz, at pre-amplifier input level∗1 of –55 dBm 1 dB gain compression: ≥–35 dBm (input frequency ≥100 MHz) ∗At pre-amplifier input level∗1 Input impedance: VSWR ≤2.5 typical

∗1: Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

• **Option 09: Ethernet interface**

Function	Control with external controller (except for power switch)
Connector	10BASE-T

• **Option 30: LPF for 2 GHz band carrier cut**

Function	This is for suppression the distortion inside spectrum analyzer by the carrier wave (1.8 to 2 GHz) in W-CDMA low frequency band spurious measurement. ∗Option 08 cannot be installed simultaneously.
Frequency range	9 kHz to 3.2 GHz (LPF: OFF), 9 kHz to 1.0 GHz (LPF: ON)
LPF attenuation characteristics	≤–20 dB, –30 dB typical, at 1.8 to 2.2 GHz
Average noise level display	[LPF: ON] ≤–122 dBm + 2.0 x f [GHz] dB (1 MHz to 1.0 GHz, band 0) ∗RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB
Frequency response	[LPF: ON] ±1.0 dB (9 kHz to 1.0 GHz, band 0) ∗With 50 MHz referenced, when RF ATT is 10 dB, and temperature is 18˚ to 28˚C

• **Option 31: Low noise floor**

Function	This is used to decrease the floor noise in frequency band 2+.
Average noise level display	≤–112 dBm (7.7 to 13.2 GHz, band 2) ∗RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB

• **Option 32: Maximum Input Level Extension**

Function	The measurement level range is extended changed to +26 dBm
Max. input level	+30 dBm (1 W), continuous wave average power
Power meter function	Level range: –14 to +26 dBm
Spectrum analyzer amplitude	Setting range Log scale: –100 to +40 dBm or Equivalent level Linear scale: 22.4 µV to 22.4 V Reference level accuracy: ±0.75 dB (+0.1 to +30 dBm), ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, with frequency 50 MHz when span 1 MHz (RF ATT, RBW, VBW, and sweep time set to AUTO)

4

• **Option 33: High accuracy power measurement**

Function	Power measurement accuracy is improved without using the internal power meter when MX860901A W-CDMA Measurement Software is used.
Frequency range	1848 to 2171 MHz (Except 1995 to 2105 MHz)
Transmission power measurement range	–50 dBm to +20 dBm (average power)
Reference level	–10 dBm to +20 dBm
Transmission power accuracy	±0.4 dB ∗At reference input level, 25˚ ±3˚C, input ATT: AUTO, after calibration and except mismatch error
Power measurement linearity	±0.2 dB (0 to –40 dB) ∗Input level: ≥–10 dBm, at range optimization and no change of reference level setting.
Temperature coefficient	0.015 dB/˚C
Accessories	ATA flash memory card
Calibration interval	Six months

• **Option 46: Auto power recovery**

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. ∗Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

• **Option 47: Rack mount (IEC)**

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• **Option 48: Rack mount (JIS)**

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS8609A	Digital Mobile Radio Transmitter Tester	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
J0996	RS-232C cable:	1 pc
JT32MA3-NT1	PC-ATA card (32 MB):	1 pc
F0014	Fuse, 6.3 A:	1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m:	1 pc
MX268001A	File Transfer Utility:	1 pc
W1709AE	MS8608A/MS8609A operation manual (Vol. 1):	1 copy
W1744AE	MS8608A/MS8609A operation manual (Vol. 2):	1 copy
W1745AE	MS8608A/MS8609A operation manual (Vol. 3):	1 copy
	Options	
MS8609A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)	
MS8609A-02	Narrow resolution bandwidth (FFT)	
MS8609A-04	Digital resolution bandwidth	
MS8609A-05	Rubidium reference oscillator	
MS8609A-08	Pre-amplifier	
MS8609A-09	Ethernet interface	
MS8609A-30	LPF for 2 GHz band carrier cut	
MS8609A-31	Low noise floor	
MS8609A-32	Maximum input level extension	
MS8609A-33	High accuracy power measurement	
MS8609A-46	Auto-power recovery	
MS8609A-47	Rack mount without handle (JIS)	
MS8609A-48	Rack mount without handle (IEC)	
MU860920A	Demodulation unit	
	Measurement software	
MX860901B	W-CDMA Measurement Software	
MX860902A	GSM Measurement Software	
MX860903A	cdma Measurement Software	
MX860904A	cdma2000® 1xEV-DO Measurement Software	
MX860905A	π/4DQPSK Measurement Software	
MX860920A	BER/BLER Measurement Software (requires MU860920A)	
MX860930A	Wireless LAN Measurement Software	
MX860950A	HSDPA Measurement Software	
W1746AE	MX860801A/B, MX860901A/B operation manual	
W1795AE	MX860802A/MX860902A operation manual	
W1865AE	MX860803A/MX860903A operation manual	
W1866AE	MX860805A/MX860905A operation manual	
W2090AE	MX860x04A/MX268x04A operation manual	
W2154AE	MX860820A/MX860920A operation manual	
W2080AE	MX268x30A/MX860x30A operation manual	
W2131AE	MX860x50A operation manual	

Model/Order No.	Name
	Optional accessories
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
MA1612A	Four-Point Junction Pad (5 to 3000 MHz)
J0395	High-power fixed attenuator (30 dB, 30 W, DC to 9 GHz)
B0472	High-power fixed attenuator (30 dB, 100 W, DC to 18 GHz)
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0329G	Front cover (3/4 MW4U)
B0488	Rear panel protective pad
B0480	Tilt handle soft type
A3933	Circulator (1760 to 2115 MHz)
H3930	Isolator (1760 to 2115 MHz)
	Maintenance service
MS8609A-90	Extended three year warranty service
MS8609A-91	Extended five year warranty service

DIGITAL MOBILE RADIO TRANSMITTER TESTER
MS8608A
9 kHz to 7.8 GHz

CE GPIB

Measures Wide-Band Signals up to 20 MHz

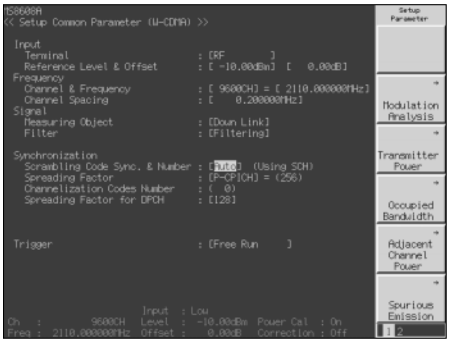
The MS8608A is a transmitter tester equipped with an internal spectrum analyzer, a modulation analyzer and a power meter. One tester covers the development to manufacturing of base stations, mobile stations and devices.
The spectrum analyzer has resolution bandwidths up to 20 MHz, meaning that it can readily support measurement of a wide-band signal.
The modulation analyzer realizes all Vector Signal Analysis (VSA) functions through high-speed DSP processing.
The power sensor can perform highly accurate power measurements of ±0.4 dB by using an amorphous power sensor.
Up to three dedicated measurement software options (such as W-CDMA and GSM/EDGE) can be installed simultaneously.
Input signals can be selected from either RF or I/Q inputs. For I/Q signals, balanced or unbalanced input can also be selected.
It is equipped with GPIB, RS-232C and 10 Base-T (optional) interfaces for remote measurement. High-speed GPIB data transmission of 120 kbyte/s enables high-speed measurement on the manufacturing line. The monitor uses an easy-to-see 6.5 type TFT color LCD.

Feature

• Broadband signal support (up to IMT-2000 2 Mbit/s)

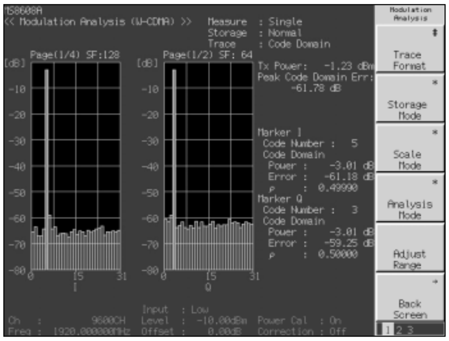
MX860801B W-CDMA Measurement Software

• Parameter setup
The measurement parameters such as modulation accuracy and code domain power, etc. are set on the screen shown below.
Measurement are simply performed via a soft-key menu after setting the measurement parameters.



• Base station code domain power
Only 3 seconds are required for measurement. Either automatic detection of scrambling code from SCH, or specification of scrambling code can be selected.
• Modulation accuracy measurement
The modulation accuracy of base station and mobile equipment can be measured and modulation analysis of multiple waveforms can be performed. The residual EVM (rms) accuracy is high (1%, typical).

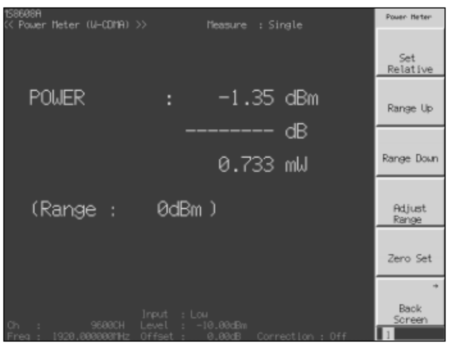
• Mobile terminal code domain power
Displays the code domain power measurement results of phase I and phase Q, separately. Either synchronization with DPCCH or specification of spreading factor and code can be selected.



• I/Q level measurement
Measures and displays each I and Q input voltage (rms, p-p value). dBmV or mV units are selectable.

• Spectrum analyzer function
This analyzer has a wide dynamic range and various useful measurement functions.

• Power meter function
The built-in power meter uses the amorphous power sensor and the measurement accuracy is very high (±0.4 dB).



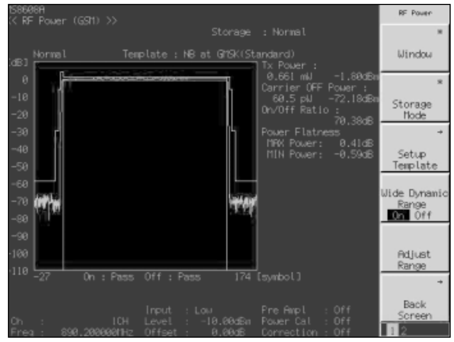
• Demodulation data monitoring
After de-spreading, up to 10 frames of I/Q data can be evaluated with external application software.

MX860802A GSM Measurement Software

• Parameter setup
The measurement parameters such as GMSK modulation of GSM and 8PSK modulation of EDGE are set on the screen.
Measurement are simply performed via a soft-key menu after setting the measurement parameters.

• Modulation accuracy measurement
The modulation accuracy is high. (The residual phase error of GMSK modulation: rms, <0.5° and residual EVM of 8PSK modulation: rms, <1.0%)

• Transmitter power measurement
The screen displays the amplitude waveforms with horizontal axis a symbol, vertical axis a level and the template simultaneously.

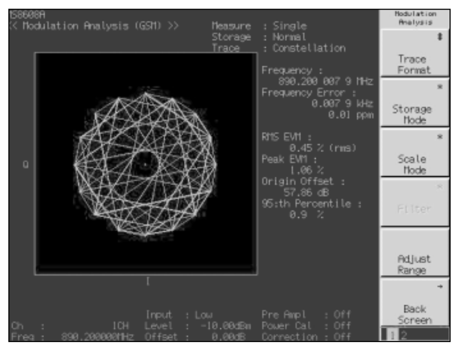


• Trellis display function
The screen displays the trellis and the modulation accuracy result simultaneously.

• Output RF spectrum measurement
The output RF spectrum measurement can be performed at high speed and simply.

• Spurious measurement
Spurious measurement has three kinds of method: Sweep, Search, and Spot. These can be selected depending on the usage.

• EDGE constellation display
The following screen represents constellation display of the 8PSK modulation through Nyquist filter and Gaussian inverse correction filter.



Specifications

• MS8608A

Frequency range	9 kHz to 7.8 GHz, 9 kHz to 7.9 GHz (with option 35)
Max. input level	High-power input: +40 dBm (10 W), Low-power input: +20 dBm (100 mW)
Input impedance	High-power input 50 Ω, VSWR: ≤1.2 (≤3 GHz)/≤1.3 (>3 GHz) Low-power input Power meter: 50 Ω, VSWR: ≤1.3 (≤3 GHz) Except power meter: 50 Ω, VSWR: ≤1.5 (≤3 GHz)/≤2.0 (>3 GHz) *Input attenuator: ≥4 dB
Input connector	N-type (high-power input), SMA-type (low-power input), BNC-type (I/Q input)
I/Q input	Input: Balanced, unbalanced Input impedance: 1MΩ (parallel capacitance: <100 pF), 50 Ω Balanced input Differential Voltage: 0.1 to 1V(p-p), In-phase voltage ±2.5 V Unbalanced input: 0.1 to 1V(p-p), AC/DC switchable

Continued on next page

Reference oscillator		Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8} (compared to frequency after 24 hour warm-up characteristics after 10 minute warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (compared to frequency after 24 hour warm-up) Temperature characteristics: ≤5 x 10^{-8} (0˚ to 50˚C, compared to frequency at 25˚C)
Power meter		Frequency range: 30 MHz to 3 GHz Level range: 0 to +40 dBm (high-power input), –20 to +20 dBm (low-power input) Measurement accuracy (after zero calibration): ±10%
Spectrum analyzer	Frequency	Frequency setting Setting range: 9 kHz to 3.2 GHz (Band: 0), 3.15 to 7.8 GHz (Band: 1) ∗Setting resolution: 1 Hz Pre-selector range: 3.15 to 7.8 GHz (Band: 1) Frequency accuracy Display accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz) Normal marker: Same as display frequency accuracy Delta marker: Same as span accuracy Frequency span setting range: 0 Hz, 5 kHz to 7.8 GHz Span accuracy: ±1.0% (at single band sweep) RBW (resolution bandwidth) Setting range: 300 Hz to 3 MHz (1-3 sequence), 5 MHz, 10 MHz, 20 MHz (Band 0) Accuracy: ±20% (300 Hz to 10 MHz) Selectivity (60 dB: 3 dB): ≤15:1 VBW (video bandwidth): 1 Hz to 3 MHz (1-3 sequence), off Sideband noise: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)
	Amplitude	Maximum input level Continuous average power: +40 dBm (high-power input), +20 dBm (low-power input) DC voltage: 0 V Average noise level (at RBW: 300 Hz, VBW: 10 Hz): [Without Option 08] ≤–104 dBm + 1.5 f [GHz] dB (high-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 1.5 f [GHz] dB (high-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 0.8 f [GHz] dB (high-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 20 dB) [With Option 08] ≤–102 dBm + 1.8 f [GHz] dB (high-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 1.8 f [GHz] dB (high-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 20 dB) ≤–100 dBm + 0.8 f [GHz] dB (high-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 20 dB) [Without Option 08] ≤–124 dBm + 1.5 f [GHz] dB (low-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 1.5 f [GHz] dB (low-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 0.8 f [GHz] dB (low-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 0 dB) [With Option 08] ≤–122 dBm + 1.8 [GHz] dB (low-power input, 1 MHz to 2.5 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 1.8 f [GHz] dB (low-power input, 2.5 to 3.2 GHz, Band 0, input attenuator: 0 dB) ≤–120 dBm + 0.8 f [GHz] dB (low-power input, 3.15 to 7.8 GHz, Band 1, input attenuator: 0 dB) Residual response: ≤–80 dBm (high-power input, 1 MHz to 3.2 GHz, input attenuator: 20 dB) ≤–70 dBm (high-power input, 3.15 to 7.8 GHz, input attenuator: 20 dB) ≤–100 dBm (low-power input, 1 MHz to 3.2 GHz, input attenuator: 0 dB) ≤–90 dBm (low-power input, 3.15 to 7.8 GHz, input attenuator: 0 dB) Reference level Setting range: –80 to +50 dBm (high-power input), –100 to +30 dBm (low-power input) Accuracy (high-power input, after calibration): ±0.5 dB (–29.9 to +20 dBm), ±0.75 dB (–49.9 to –30 dBm, +20.1 to +40 dBm), ±1.5 dB (–60 to –50 dBm) Accuracy (low-power input, after calibration): ±0.5 dB (–49.9 to +0 dBm), ±0.75 dB (–69.9 to –50 dBm, +0.1 to +20 dBm), ±1.5 dB (–80 to –70 dBm) ∗Frequency: 50 MHz, span: 1 MHz (Input attenuator, RBW, VBW and sweep time are set to AUTO.) RBW switching uncertainty: ±0.3 dB (300 Hz to 5 MHz, referenced to RBW: 3 kHz) Input attenuator: 20 to 82 dB (high-power input), 0 to 62 dB (low-power input), 2 dB steps Frequency response: ±0.6 dB (9 kHz to 3.2 GHz, Band 0), ±1.0 dB (3.15 to 7.8 GHz, Band 1) ∗Referenced to 50 MHz, input attenuator: 30 dB (high power input)/10 dB (low power input), 18˚ to 28˚C Log linearity: ±0.5 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –90 dB, RBW: ≤1 kHz) 2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, Band 0, mixer input: –30 dBm) ≤–75 dBc (200 to 850 MHz, Band 0, mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.6 GHz, Band 0, mixer input: –30 dBm) ≤–90 dBc (1.6 to 3.9 GHz, Band 1, mixer input: –10 dBm) Two tone 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 7.8 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm 1 dB gain compression: ≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz)

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Spectrum analyzer	Sweep	Setting range: 10 ms to 1000 s (frequency axis sweep), 1 µs to 1000 s (time axis sweep) Trigger switch: Free-run, triggered Trigger source: Wide IF video, video, external (TTL level), external (±10 V), line Trigger delay Pre-trigger range: –time span to 0 s Resolution: time span/500 or 100 ns whichever is lager. Post trigger: 0 µs to 65.5 ms, Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms) Gate sweep mode Gate delay range: 0 to 65.5 ms (resolution: 1 µs) Gate length range: 2 µs to 65.5 ms (resolution: 1 µs)
	Functions	Number of data points: 501 Detection modes: Normal, Positive peak, Negative peak, Sample, Average, rms (option 04) Display functions: Trace A, Trace B, Trace A/B, Trace A/BG, Trace A/Time Storage functions: Normal, View, Max hold, Min hold, Average, Cumulative, Overwrite Markers Signal search: Auto tune, Peak → CF, Peak → Ref, Scroll Zone markers: Normal, Delta Marker function: Marker → CF, Marker → Ref, Marker → CF step size, ∆ marker → Span, Zone → Span Peak search: Peak, Next peak, Min dip, Next dip Multi-marker: 10 max. Measurements Noise power: dBm/Hz, dBm/ch, dBµV/$\sqrt{Hz}$ C/N: dBc/Hz, dBc/CH Occupied bandwidth: Power N% method, X-dB down method Adjacent channel power Reference measurement: Total power, reference level, in-band method Display methods: Channel specified display (3 channels x 2), graphic display Average power of burst signal: Average power within specified time range of time domain waveform Template comparison measurement (time sweep): Upper limit x 2, lower limit x 2 Mask measurement (frequency sweep): Upper limit x 2, lower limit x 2
Others		Display: Color TFT-LCD, VGA 6.5 type Hard copy: Hard copy of screen via parallel interface (ESC/P compatible printer) Memory card interface: ATA Flash card (3.3/5 V) GPIB: Can be controlled from external controller (except power switch) when specified as device Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2 Parallel interface: Centronics printer I/F, D-sub 25-pin connector (female) Video output: Analog RGB output, D-sub 15-pin connector (female)
Dimensions and mass		320 (W) x 177 (H) x 411 (D) mm (except handle, feet, front cover and fan cover), ≤16 kg (nominal)
Power		100 to 120/200 to 240 Vac (–15%/+10%, max. voltage: 250 V, automatic voltage selection), 47.5 to 63 Hz, ≤400 VA
Operating temperature and humidity		0˚ to 50˚C, ≤85% (no condensating)
EMC		EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD		EN61010-1: 2001 (Pollution Degree 2)

• MX860801B W-CDMA measurement software

Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on[*1]) Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on[*1]), at 1 code channel Modulation accuracy (residual EVM): <2% (rms) *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on[*1]), at 1 code channel Origin offset accuracy: ±0.5 dB *Input level: ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), at 1 code channel, relative to signal with origin offset of –30 dBc Waveform display (for 1 CH to multi-channel) Constellation display, EVM vs. chip, amplitude error vs. chip, phase error vs. chip
Code domain analysis	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on[*1]) Code domain power measurement accuracy: ±0.1 dB (code power: ≥–10 dBc), ±0.3 dB (code power: ≥–25 dBc) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on[*1]) Code domain error measurement Residual error: <–50 dB, Measurement accuracy: ±0.5 dB (at error of –30 dBc) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on[*1]), spread factor: 512 (down-link)/256 (up-link) Display function: Code domain power, code domain error Spread factor: 4 to 256 (up-link)/4 to 512 (down-link), I/Q separately displayed at up-link

Continued on next page

Amplitude measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on[*1]) Transmitter power measurement Measurement range: 0 to +40 dBm (average power, high-power input), –20 to +20 dBm (average power, low-power input), –20 to + 10 dBm (average power, low-power input, pre-amplifier: on[*1]) Accuracy: ±0.4 dB (calibrated at internal power meter) Power measurement linearity: ±0.2 dB (0 to –40 dB) *Input level: ≥+10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (pre-amplifier: on[*1]) , after the range adjusted, with the reference level setting unchanged Filter selection function: Power measurement through RRC (α = 0.22) filter Transmitter power control measurement function: Relative power per slot, NO/GO evaluation
Occupied bandwidth measurement	Frequency range: 50 MHz to 3 GHz Input level: –40 to +40 dBm (average power, high-power input), –60 to +20 dBm (average power, low-power input), –80 to +10 dBm (average power, low-power input, pre-amplifier: on[*1]) Sweep mode: Displays result after signal measured with sweep spectrum analyzer FFT mode: Displays result after FFT
Adjacent channel power measurement	Frequency range: 50 MHz to 3 GHz, 50 MHz to 2.3 GHz (with option 08) Input level: +10 to +40 dBm (average power, high-power input), –10 to +20 dBm (average power, low-power input) Sweep method (all): Calculates and displays result after signal measured with sweep spectrum analyzer Sweep method (separate): Calculates and displays power after each adjacent channel measured with sweep spectrum analyzer Filter method: Measures and displays power of adjacent channels after passing via built-in receiving filters (RRC: α = 0.22) Measurement range Input level: +20 to +40 dBm (high-power input), 0 to +20 dBm (low-power input) ≥55 dBc (5 MHz offset), ≥62 dBc (10 MHz offset) *Filter method, wide dynamic range mode, 1 code channel ≥50 dBc (5 MHz offset), ≥60 dBc (10 MHz offset) *At 16 multi-code channel Input level: +10 to +40 dBm (high-power input), –10 to +20 dBm (low-power input) 55 dBc (5 MHz offset), 62 dBc (10 MHz offset) *Filter method, wide dynamic range mode, 1 code channel (typical) 50 dBc (5 MHz offset), 60 dBc (10 MHz offset) *At 16 multi-code channel (typical)
Spurious measurement	Measurement frequency: 9 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): +20 to +40 dBm (average power, high-power input), 0 to +20 dBm (average power, low-power input) Measurement method [Sweep method] Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Spot method] Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Search method] Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range[*2] [Carrier frequency: 1.8 to 2.2 GHz] ≥79 dB (RBW: 1 kHz, 9 to 150 kHz, Band 0), ≥79 dB (RBW: 10 kHz, 150 kHz to 30 MHz, Band 0), ≥79 dB (RBW: 100 kHz, 30 to 1000 MHz, Band 0) [Normal mode] ≥76 –f [GHz] dB (RBW: 1 MHz, 1 to 3.15 GHz, Band 0), ≥76 dB (RBW: 1 MHz, 3.15 to 7.8 GHz, Band 1) [Spurious mode (with option 03)] ≥76 dB (RBW: 1 MHz, 1.6 to 7.8 GHz, Band 1)
I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, code domain power, amplitude, occupied bandwidth (FFT method), I/Q level Residual vector error: <2% (rms) *Input level: ≥0.1 V (rms), DC coupling I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

*1: Can be set when MS8608A-08 option is installed in the main frame.
*2: When carrier frequency is in a 2030.354 to 2200 MHz range, spurious will be generated at the frequency below.
f (spurious) = f (input) – 2030.345 MHz

• MX860802A GSM measurement software
Guaranteed specifications after Adjust Range and Power Calibration keys pressed

Modulation/frequency measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –20 to +40 dBm (average power within burst, high-power input) –40 to +20 dBm (average power within burst, low-power input) –60 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Carrier frequency accuracy: ±(reference oscillator accuracy + 10 Hz) *Input level (average power within burst: ≥–10 dBm (high-power input): ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on*1) Residual phase error (GMSK modulation): <0.5˚ (rms), <2.0˚ (peak) *Input level (average power within burst): ≥–10 dBm (high-power input), ≥–30 dBm (low-power input), ≥–40 dBm (low-power input, pre-amplifier: on*1) Residual EVM (8PSK modulation): <1% (rms) Waveform display: Trellis (GMSK modulation), eye pattern, EVM vs. bit (8PSK modulation), phase vs. bit, amplitude vs. symbol, I/Q diagram
Amplitude measurement	Frequency range: 50 MHz to 2.7 GHz Input level: –20 to +40 dBm (average power within burst, high-power input) –40 to +20 dBm (average power within burst, low-power input) –60 to +10 dBm (average power within burst, , low-power input, pre-amplifier: on*1) Transmitter power measurement (auto calibrated at internal power meter) Measurement range: +10 to +40 dBm (average power within burst, high-power input) –10 to +20 dBm (average power within burst, low-power input) –10 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Accuracy: ±0.4 dB Power measurement linearity: ±0.2 dB (0 to –30 dBm) *Input level (average power within burst): +10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (low-power input, pre-amplifier: on*1), without changing the reference level setting after range optimization Carrier-off power measurement range [Input level (average power within burst)] +10 dBm (high-power input), ≥–10 dBm (low-power input), ≥–20 dBm (low-power input, pre-amplifier: on*1) [Normal mode] ≥60 dB (compared with average power within burst) [Wide dynamic range mode] ≥80 dB (high-power input: 1 W, compared with 10 mW of average power within burst, low-power input) *Measurement limit is decided by average nose level (≤50 dBm, 50 MHz to 2.7 GHz). Rise/fall characteristics: Display rising/falling edges while synchronizing to modulation data of signal data to be measured. Standard line display possible (measured by 1 MHz bandwidth). NO/GO judgement function
Output RF spectrum measurement	Frequency range: 100 MHz to 2.7 GHz Input level: +10 to +40 dBm (average power within burst, high-power input) –10 to +20 dBm (average power within burst, low-power input) –20 to +10 dBm (average power within burst, low-power input, pre-amplifier: on*1) Modulation portion measurement range: ≥60 dB (≥200 kHz offset), ≥68 dB (≥250 kHz offset) *CW signal, RBW: 30 kHz (<1.8 MHz offset), RBW: 100 kHz (≥1.8 MHz offset) Transient portion measurement range: ≥63 dB (CW, ≥400 kHz offset)
Spurious measurement	Measurement frequency: 100 kHz to 7.8 GHz (except within carrier frequency ±50 MHz) Input level (transmitter power): +20 to +40 dBm (average power within burst, high-power input) 0 to +20 dBm (average power within burst, low-power input) Measurement method [Sweep method] Sweeps the specified range of frequency using the spectrum analyzer, and then detects and displays the peak value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Spot method] Measures the specified frequency with time domain from the spectrum analyzer and then displays the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average [Search method] Sweeps the specified frequency range using the spectrum analyzer to detect the peak value, then measures the frequency using the time domain to display the average value. Calculates the rate for transmission power value and displays it as power rate. Waveform detection mode: average Measurement range [Carrier frequency: 0.8 to 1 GHz, 1.8 to 2 GHz] ≥72 dB (RBW: 10 kHz, 100 kHz to 50 MHz, Band 0), ≥72 dB (RBW: 100 kHz, 50 to 500 MHz, Band 0) [Normal mode] ≥66 –f [GHz] dB (RBW: 3 MHz, 0.5 to 3.15 GHz, Band 0, except harmonic frequency) ≥66 dB (RBW: 3 MHz, 3.15 to 7.8 GHz, Band 1) [Spurious mode (with option 03)] ≥66 dB (RBW: 3 MHz, 1.6 to 7.8 GHz, Band 1)

Continued on next page

I/Q signal	Input: Balanced, unbalanced Input impedance: 1 MΩ (parallel capacity: <100 pF), 50 Ω Balanced input Differential voltage: 0.1 to 1 V (p-p), In-phase voltage: ±2.5 V Unbalanced input: 0.1 to 1 V (p-p), AC/DC switchable Measurement items: Modulation accuracy, I/Q level Modulation accuracy Residual phase error: <0.5˚ (rms), DC coupling Residual EVM: <1.0% (rms), DC coupling ∗Input level: ≥0.1 V (rms), 18˚ to 28˚C I/Q level measurement: Measures and displays each I, Q input voltage (rms, p-p) I/Q phase difference measurement: When the CW signal is inputted to I and Q input terminals, measures and displays the phase difference between I- and Q-phase signals.

∗1: Can be set when MS8608A-08 option is installed in the main frame.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS8608A	Digital Mobile Radio Transmitter Tester	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
J0996B	RS-232C cable:	1 pc
JT32MA3-NT1	PC-ATA card (32 MB):	1 pc
F0014	Fuse, 6.3 A:	1 pc
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m:	1 pc
MX268001A	File transfer utility:	1 pc
W1709AE	MS8608A/8609A operation manual (Vol. 1):	1 copy
W1744AE	MS8608A/8609A operation manual (Vol. 2):	1 copy
W1745AE	MS8608A/8609A operation manual (Vol. 3):	1 copy
	Options	
MS8608A-01	Precision frequency reference (aging rate: 5 x 10^{-10}/day)	
MS8608A-02	Narrow resolution bandwidth (FFT)	
MS8608A-03	Extension of pre-selector lower limit (to 1.6 GHz)	
MS8608A-04	Digital resolution bandwidth	
MS8608A-05	Rubidium reference oscillator	
MS8608A-08	Pre-amplifier (100 kHz to 3 GHz)	
MS8608A-09	Ethernet interface	
MS8608A-35	7.9 GHz frequency extension	
MS8608A-46	Auto-power recovery	
MS8608A-47	Rack mount without handle (IEC)	
MS8608A-48	Rack mount without handle (JIS)	
MU860820A	RER/BLER Measurement Software	
	Measurement software	
MX860801B	W-CDMA Measurement Software	
MX860802A	GSM Measurement Software	
MX860803A	cdma Measurement Software	
MX860804A	cdma2000® 1xEV-DO Measurement Software	
MX860805A	π/4DQPSK Measurement Software	
MX860820A	BER/BLER Measurement Software (requires MU860820A)	
MX860830A	Wireless LAN Measurement Software	
MX860850A	HSDPA Measurement Software	
W1746AE	MX860801B/860901B operation manual	
W1795AE	MX860802A/860902A operation manual	
W1865AE	MX860x03A/MX268x03A operation manual	
W2090AE	MX860x04A/MX268x04A operation manual	
W1866AE	MX860x05A/MX268x05A operation manual	
W2154AE	MX860820A/MX860920A operation manual	
W2080AE	MX268x30A/MX860x30A operation manual	
W2131AE	MX860x50A operation manual	

Model/Order No.	Name
	Optional accessories
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127C	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
MA1612A	Four-Way Junction Pad (5 to 3000 MHz)
J0395	High-power fixed attenuator (30 dB, 30 W, DC to 9 GHz)
B0472	High-power fixed attenuator (30 dB, 100 W, DC to 18 GHz)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0329G	Front cover (3/4MW4U)
B0488	Rear panel protective pad
B0480	Tilt handle soft type
A3933	Circulator (1760 to 2115 MHz)
H3930	Isolator (1760 to 2115 MHz)
	Maintenance service
MS8608A-90	Extended three year warranty service
MS8608A-91	Extended five year warranty service

WLAN TEST SET

MT8860A

2.4 to 2.5 GHz and 4.8 to 6 GHz

GPIB

For High Speed Testing of 802.11 Wireless LAN Devices

The MT8860A WLAN Test Set from Anritsu is an integrated test set dedicated to testing WLAN devices in the 2.4 GHz (4.8 to 6 GHz future option) Industrial Scientific and Medical (ISM) frequency bands. MT8860A provides a high-speed measurement solution that is suitable for both production testing and design proving. The user interface is implemented through the supplied *LANLook* software package. *LANLook* runs on a standard PC and uses a conventional Windows™ interface for both instrument configuration and results displays. *LANLook* communicates with the MT8860A through a GPIB interface.

Benefits

- Single test instrument for both 802.11b transmitter and receiver measurements
- Reduced production test times through high speed spectral processing
- Graphical display of power burst profile and spectral mask
- Automated receiver PER measurements
- *LANLook* Windows™ style user interface runs on a standard PC
- Built in Reference Radio
- Advanced triggering and gating features for ease of measurement set-up
- Inputs for external Golden radio and interfering signal sources
- Upgradeable to 802.11a and 802.11g standards

802.11b Measurements

The IEEE 802.11 WLAN standards have become established as the preferred interface for wireless connectivity between a PC and a network. A PC can connect to a WLAN network either through the use of a PC card accessory or, more recently, using integrated WLAN technology.
To ensure a high quality link between the PC and the LAN access point, manufacturers need to validate that the performance of each product meets the 802.11 standard.
MT8860A supports the following 802.11b measurements. Each measurement can be performed on the 14 frequency channels and at all specified power levels.

Transmitter measurements

- Carrier frequency
- Carrier frequency error
- Transmitter power (average)
- Transmitter power (peak)
- Transmitter power control
- Spectrum mask compliance
- Carrier suppression
- Power burst profile
- Transmit power-on and power-down ramp

Receiver measurements

- Sensitivity (PER)
- Receiver saturation (max input power)
- Adjacent channel rejection*
- Non-Adjacent channel rejection*

* requires separate interfering signal source

Measurement Modes

DUT transmitter measurements

The DUT transmitter is tested using 802.11b test mode software supplied by the chipset supplier.

Measurements using Test Modes

When testing the DUT using test modes, the DUT is controlled through the host interface using software supplied by the chip set developer. This may require proprietary control software from the chip set developer.802.11b test mode commands can be used to configure the DUT to transmit continuously, or in a bursted manner, on any defined channel. The MT8860A receiver is tuned to that channel and triggers continuously or from the power burst rising edge.

Power vs. Time measurements

The burst profile can also be viewed. This provides a simple display of the DUT transmitter rising and falling edge, as well the full packet power v 's time graph. Two gates are used to define the parts of the profile over which peak and average power are measured.

Spectral measurements

The spectral content of the DUT transmitter can be measured and tested against the IEEE 802.11b spectral mask. All spectrum measurements are time gated, with two user-defined gates set in the time domain. Specific parts of a power burst can be isolated in the time domain and measured in the frequency domain. The highest power level in each spectral mask segment is also measured. In addition to the standard spectral mask measurement, MT8860A also measures the carrier suppression and occupied bandwidth of the transmitter.

Parallel measurements

MT8860A performs the power, frequency and spectral mask measurements of DUT in parallel. A high speed spectral processor performs the measurements in a much shorter time than swept tuned spectrum analysers giving reduced total test time.

DUT receiver sensitivity measurements
All DUT receiver measurements are based on the measurement of Packet Error Rate (PER).The definition of a packet error is (1-(Number of frames correctly received/Number of frames sent))x100%.The 802.11b specification does not define a common method for the measurement of PER. As a result, chip set developers have developed proprietary software to facilitate this measurement. The MT8860A allows for a variety of test methods to measure PER.

PER measurements in an ad-hoc connection with the MT8860A Reference Radio
The MT8860A can establish an ad-hoc connection with the DUT and transmit a user definable number of packets to the DUT. Under ideal link conditions, the DUT sends an Acknowledge packet in return for each received packet. The packet error rate can be calculated from the ratio of transmitted packets to received Acknowledge packets. When linked to the DUT the receiver sensitivity measurement can be run at either a fixed input level, or using a swept input level for a true sensitivity search.

PER measurements without forming a link to the DUT
The MT8860A can transmit a user definable number of packets on a fixed channel without first establishing a link with the DUT. These packets have standard 802.11b packet structure. To measure PER the DUT must be able to enter a "Permissive" receive mode. In this mode, the DUT receives and counts all incoming packets. It is necessary to be able to read the DUT received packet counter register to calculate the PER.

Receiver sensitivity and saturation measurements
The MT8860A signal source has a calibrated output power range of –100 dBm to 0 dBm. The 802.11b specification requires a DUT PER of <10% at a receiver input level of –76 dBm. MT8860A can measure the PER at a fixed level, or perform a power sweep and so plot PER vs. receiver input level. To ensure that the DUT receiver does not saturate when receiving a high signal level, the PER must also be measured with a receiver input of –10 dBm. This simulates the operation of the DUT in close proximity to, for example an access point.

Receiver adjacent and non-adjacent channel rejection measurements
Two inputs are provided on the front panel of the MT8860A so that an external signal source can be coupled onto the output of the MT8860A signal source. This facilitates the measurement of PER in the presence of interfering signals. The path loss of the coupled input is calibrated so that a precise signal level can be set for the interferer. Two inputs are offered so that both adjacent channel and intermodulation rejection measurements can be performed.

Planned future enhancements
The MT8860A hardware has been designed such that it can be upgraded to support measurements of the 802.11g and 802.11a standards.

4

Specification 802.11b measurement suite

Connectivity	MT8860A mode	Ad-hoc connections	
	Linking to the DUT	Active scanning	
Reference Radio transmitter	Frequency range	802.11b channels 1 to 14	
	Output power	0 dBm to –100 dBm	
	Accuracy	± 1 dB	
	Resolution	0.5 dB setting resolution	
	Output VSWR	1.5:1 (typically 1.3)	
	Output impedance	50 Ω (nominal)	
	Modulation	Quadrature Phase Shift Keying (QPSK)	
	Modulation accuracy	<10% EVM	
Reference Radio receiver	Frequency range	802.11b channels 1 to 14	
	Frequency accuracy	± 20 ppm	
	Maximum input	+30 dBm	
	Damage level	+35 dBm (peak or continuous power)	
	Sensitivity	–40 dBm (for <0.1% FER)	
Measurement Controls	Triggers	Free run	Continuous triggering
		RF edge	On rising or falling edge detected at RF input
		Video	Power detected at spectral processor
		External	BNC on rear panel
	Gates	Two gates for power, frequency and spectrum measurements	

Continued on next page

Measurements	Power	Definition	DUT channel Average and Peak power
		Range	+26 dBm to –55 dBm average power (+30 dBm peak)
		Accuracy	± 0.6 dB (+26 dBm to –30 dBm), ± 1.0 dB (–30 dBm to –50 dBm)
		Resolution	0.1 dB
		Bandwidth	Selectable, 15 to 22 MHz (default 18 MHz)
	Frequency	Definition	DUT channel frequency and frequency error
		Accuracy	± 1kHz ± reference frequency error (ppm) for gate >1ms
		Resolution	100 Hz
	Spectral mask	Definition	Compliance to IEEE 802.11b spectral mask, and occupied bandwidth
		Range	+20 dBm to –40 dBm modulated carrier power
		Dynamic range	>50 dB (802.11b, usable dynamic range)
		Flatness	± 1 dB
		Linearity	± 0.8 dB (50 dB dynamic range)
		Resolution	0.1 dB
		Resolution bandwidth	Equivalent to 100 kHz Gaussian
		Frequency span	70 MHz (fc ± 35 MHz)
		Noise floor	Minimum –110 dBm
	Carrier suppression	Definition	Relative level of the carrier to highest sideband, for a 10101010 test pattern
		Range	+20 dBm to –40 dBm modulated carrier power
		Dynamic range	>50 dB (802.11b, usable dynamic range)
		Flatness	± 1 dB
		Linearity	± 0.8 dB (50 dB dynamic range)
		Resolution	0.1 dB
	Receiver sensitivity	Definition	Packet Error Rate (PER) at defined input level
		Number of frames	1 to 50,000 user defined
		Payload length	1024 bytes (or user defined payload length)
		Preamble	Long, short
		Payload	All zeros, all ones, 1010, 0101, PN9
		Data rate	11, 5.5, 2, 1 Mbps
	Power burst profile	Definition	Display of the power in each bit of the measured frame verses time.
		Range	Average frame power +26 dBm to –40 dBm (+30 dBm peak)
		Dynamic range	>50 dB
		Power accuracy	Average frame power ± 0.6 dB; ≥30 dBm, ± 1.0 dB; ≥60 dBm
		Resolution	0.1 dB
		Time window	10 µs to 5.95 ms
		Time resolution	0.1 µs
Reference frequency oscillator	Frequency	10 MHz	
	Aging	<± 1ppm/year, <± 2.5ppm/10 years	
	Drift	<± 0.5ppm, 0 to 45°C	
Power supply	Volts	85 to 264 volts AC	
	Frequency	47 to 63 Hz	
	Power	100 VA max	
Size and weight	Dimensions	180 mm x 320 mm x 350 mm	
	Weight	<10 kg	
Environmental	Operating temperature	+5 to +40°C	
	Operating humidity	<75% non-condensing	
	Safety	Complies with IEC 1010-1	
	EMC	Conforms to the protection requirements of EEC Council Directive 89/336/EEC	
Front panel inputs and outputs	Test port – connection to DUT or transmitter analyser input, N type (f) 50 Ω nominal External Reference Radio - Input from external Reference Radio, N type (f), 50 Ω nominal, >+10 dBm required for levelling External interferer 1 - Input for external source, N type (f), 50 Ω nominal, typical path loss to Test Port 15 dB External interferer 2 - Input for external source, N type (f), 50 Ω nominal, typical path loss to Test Port 15 dB Signal Generator output - N type (f), 50 Ω nominal		
Rear panel connectors	GPIB Ethernet RJ45 (for future application) USB (for future application) RS 232 (for future application) Definable digital input 1, BNC (f) Definable digital input 2, BNC (f) Definable digital output 1, BNC (f) Definable digital output 2, BNC (f) 10 MHz reference input		

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
MT8860A	WLAN test set
	Included accessories
	LANLook User interface software
	Power cord for destination country
	Operation manual
	Certificate of calibration

Model/Order No.	Name
	Options
B0395A	Rack mount kit
B0331C	Front panel handles
MT8860A-10	2.4 GHz antenna and adapter

RADIO COMMUNICATION ANALYZER
MT8820A
30 MHz to 2.7 GHz

CE GPIB

The One Box Type Tester Supporting W-CDMA, GSM/GPRS/EGPRS, cdma2000® 1X, cdma2000® 1xEV-DO, PDC, PHS

The MT8820A hardware platform covers a frequency range of 30 MHz to 2.7 GHz. When dedicated measurement software and hardware (options) are installed, this single platform supports evaluation of all the main transmission/reception test items for W-CDMA, GSM/GPRS/EGPRS, cdma2000® 1X (IS-2000), cdma2000® 1xEV-DO, PDC and PHS terminals.
Advanced DSP (Digital Signal Processing) and parallel-measurement technology greatly reduce the time required for the production and testing of mobile terminals.
Combinations of parameters for batch measurements are freely selectable, and the number of repeat measurements for each measurement can be set independently. The selected items for measurement can be batch-processed through one-touch operation, enabling easy, high-speed Pass/Fail evaluation on major test items including transmission frequency, modulation accuracy, transmission power, adjacent channel power, occupied bandwidth and BER.
The standard GPIB interface enables for the MT8820A to be configured in existing automated production lines or to configure automatic test systems in maintenance site.

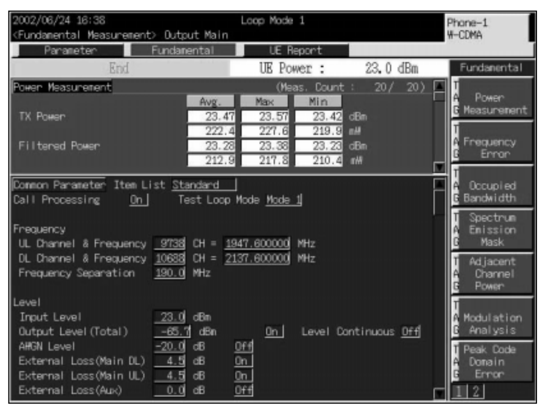
Measurement software	System	Description
MX882000B	W-CDMA	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-01 and MX882051A)
MX882001A	GSM/GPRS	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)
MX882001A-11	EGPRS	Tx and Rx measurements of mobile stations including call processing (requires MX882001A)
MX882002A	cdma2000® 1X	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-03)
MX882003A	cdma2000® 1xEV-DO	Tx and Rx measurements of access terminals including call processing (requires MT8820A-03, MT8820A-04 and MX882002A)
MX882004A	PDC	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)
MX882005A	PHS	Tx and Rx measurements of mobile stations including call processing (requires MT8820A-02)

∗: For W-CDMA terminal connectivity, contact Anritsu sales representative. Please refer to an individual catalogue for details.

Transmitter measurements

• Output power

The MT8820A enables measuring output power of mobile stations. When the number of measurements is set to two or more, the max., mean, and min. values of the result are displayed, providing evaluation of the terminal randomness. This repeat measurement function is also available for other measurements.



Example of transmission power measurement (W-CDMA)

• Modulation analysis

The MT8820A enables modulation analysis of mobile equipment. For example in GSM, simultaneous measurement and display of frequency, frequency error (in kHz and ppm), phase error and peak phase error is performable. Amplitude error at the burst-on section can be also measured.

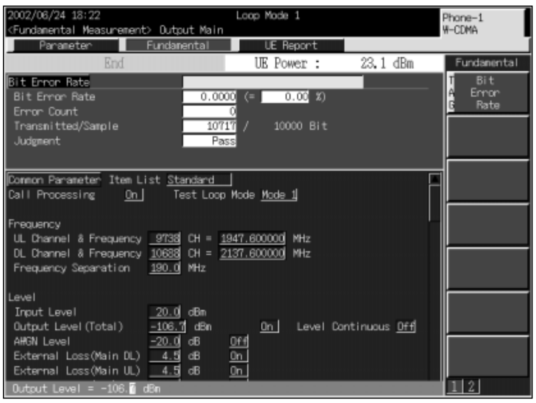
• Occupied frequency bandwidth
This test measures the occupied frequency bandwidth of the W-CDMA terminal. The ratio of the frequency bandwidth to the total power can be changed in the range of 80.0% to 99.9%.

• Adjacent channel power
Adjacent channel power is measured according to each communication system.
In W-CDMA, the power can be measured in ±5 MHz, ±10 MHz from center frequency. In GSM, the power of 25 points can be measured in ±2 MHz from center frequency.

• Spectrum waveform display
MT8820A has the spectrum waveform display function by W-CDMA. This function monitors the existence of the frequency ingredient with the spectrum exceeding the standard line defined by 3GPP standards.

Receiver measurement

Measurement of the error rate conforming to the standard of each communication system is performable. For example, in W-CDMA, the bit error rate can be measured by the loopback test mode specified in the 3GPP standards.



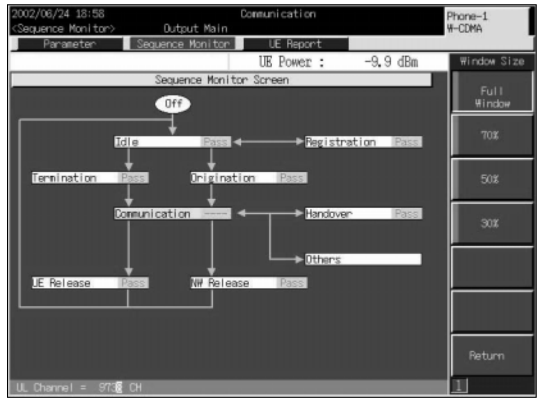
Example of error rate measurement (W-CDMA)

External packet data

• Test function for packet communication data transfer
External Packet Data software option enables to perform data transfer to/from external equipment via an Ethernet port in the rear of MT8820A. Installing the Measurement Software option 02 series (MX882051A-02/ MX882001A-02/ MX882002A-02/ MX882003A-02) realizes end-to-end data transfer between an application server connected to the MT8820A and a W-CDMA (GPRS, CDMA2000 1X, CDMA2000 1xEV-DO) terminals or a client PC connected to a W-CDMA (GPRS, CDMA2000 1X, CDMA2000 1xEV-DO) terminals, enabling various application tests to be performed.

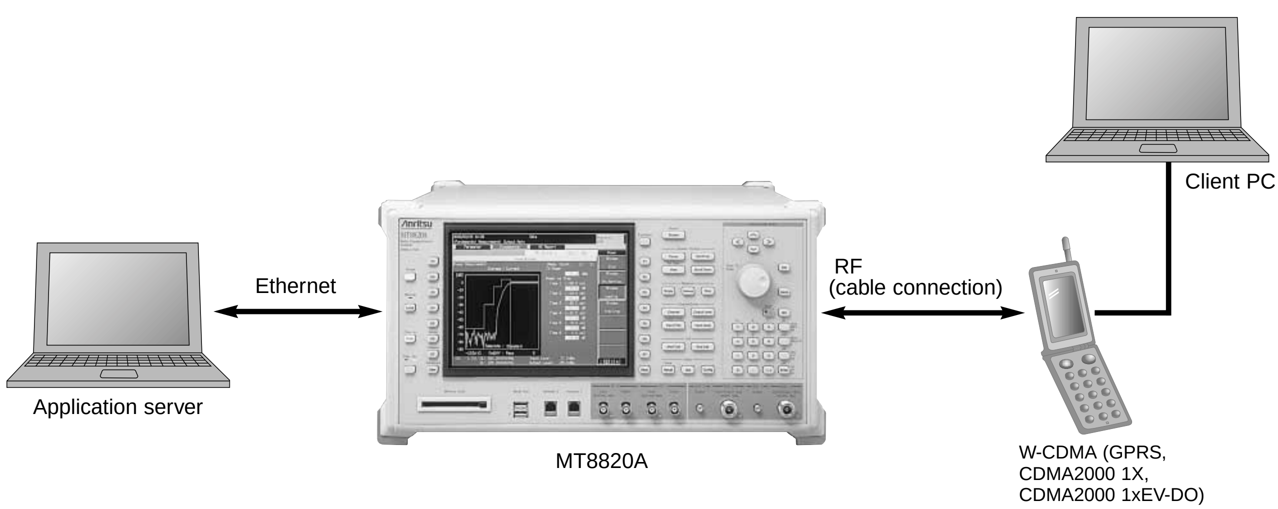
Call processing function

• Connection tests
The call processing function enables performance of various connection tests including location registration, terminal call origination, network call origination, terminal disconnect and network disconnect. During a call, the user's speech can be echoed back from the terminal to provide a simple voice communication test.



Example of sequence monitor (W-CDMA)

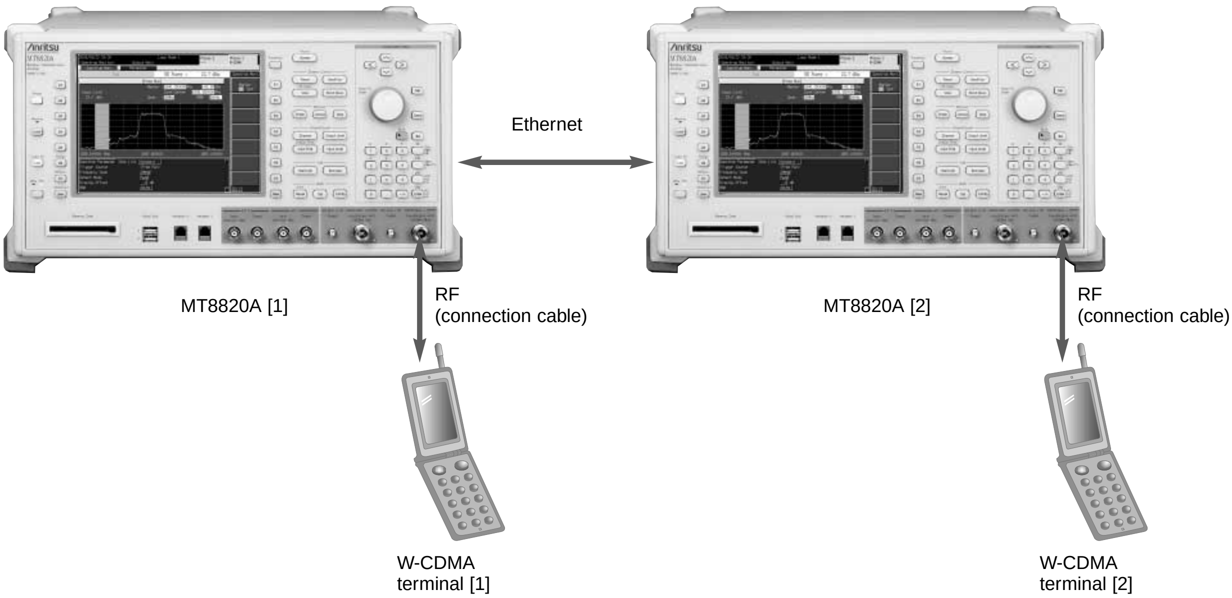
• Mobile terminal report monitor
Mobile terminal status can be displayed based on the measurement report that the terminal sends back to the tester. "RX Level" monitoring shows the down-link RF signal level received by the terminal.



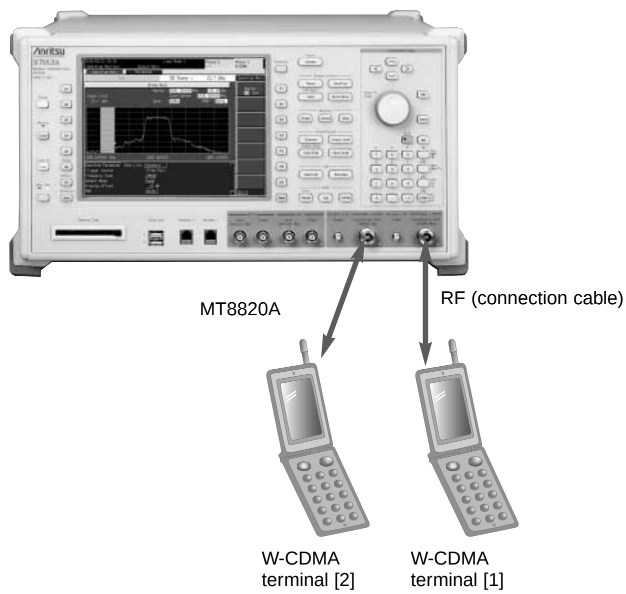
Sample MT8820A connection (W-CDMA)

• W-CDMA video phone test

W-CDMA video phone test realizes data transfer between two MT8820As via an Ethernet port in the rear of MT8820A. When the MX88205xA-03 W-CDMA Video Phone Test option is installed in the mainframe, end-to-end testing can be performed between two W-CDMA video phone terminals connected to two MT8820As respectively.



Sample MT8820A connection: when MT8820A is two sets



Sample MT8820A connection:
when MT8820A is one set (Parallelphone measurement correspondence)

GPIB control

• Batch readout command for measured results

All results obtained by batch measurement can be read out with the single command: "ALLMEAS?". If required, only desired measurement results can be read out using a command such as "ALL MEAS? MOD" (modulation analysis).

A decrease in the number of GPIB commands reduces the GPIB traffic on both the MT8820A and control PC, contributing to the increase in measurement throughput. Since the step size of the control program is also reduced, this provides a real benefit to the user for the creation of a control program that is easy to read and maintain.

Options

• W-CDMA measurement hardware (MT8820A-01)

The MT8820A-01 W-CDMA measurement hardware can measure the main test items of transmission and reception characteristics for 3G W-CDMA conforming to 3GPP in combination with MX882000B W-CDMA Measurement Software and MX88205xA W-CDMA call Process Software.

• TDMA measurement hardware (MT8820A-02)

The MT8820A-02 TDMA measurement hardware can measure the main test items of transmission and reception characteristics for GSM/GPRS that is most spread in the world in combination with MX882001A GSM Measurement Software.

The combined use of MX882001A-11 EGPRS Measurement Software enables the measurement of main Tx and Rx characteristics on EGPRS, which is the high-speed version of GPRS.

And this option can measure the major transmission/reception characteristics on the second-generation PDC (PHS) system, the most common terminal in Japan, in combination with the MX882004A (MX882005A) PDC (PHS) Measurement Software.

• CDMA measurement hardware (MT8820A-03)

This option can measure the major transmission/reception characteristics on the third-generation cdma2000® 1X terminals conforming to 3GPP2, in combination with the MX882002A cdma2000® Measurement Software.

• Audio board (MT8820A-11)

The MX882000B-01 W-CDMA (MX882001A-01 GSM) Voice Codec is optional software that brings real-time voice encoding and decoding to the W-CDMA (GSM) Measurement Software. Installation of this and the MT8820A Option 11 (audio board) achieves end-to-end communication testing with handsets. In addition, the audio measuring function enables transmission/reception audio measurements to be performed while a call is connected.

4

Specifications

• MT8820A (main frame)

General	Frequency range: 30 to 2700 MHz Max. input level: +35 dBm (MAIN 1) MAIN 1 I/O Impedance: 50 Ω VSWR: ≤1.2 (<1.6 GHz), ≤1.25 (1.6 to 2.2 GHz), ≤1.3 (>2.2 GHz) Connector: N type AUX 1 output Impedance: 50 Ω VSWR: ≤1.3 (at SG Output level: ≤–10 dBm) Connector: SMA type Reference oscillator Frequency: 10 MHz Level: TTL Startup characteristics: ≤±5 x 10^{-8} (at 10 min after startup referenced to frequency 24 h after startup) Aging rate: ≤±2 x 10^{-8}/day, ≤±1 x 10^{-7}/year (referenced to frequency 24 h after startup) Temperature characteristics: ≤±5 x 10^{-8} Connector: BNC type External reference input Frequency: 10 MHz or 13 MHz (±1 ppm) Level: ≥0 dBm Impedance: 50 Ω Connector: BNC type
RF signal generator	Frequency Frequency range: 30 to 2700 MHz (setting range: 0.4 to 2700 MHz) Setting resolution: 1 Hz Accuracy: Due to reference oscillator accuracy Output level Level range: –140 to –10 dBm (MAIN 1), –130 to 0 dBm (AUX 1) Resolution: 0.1 dB Accuracy: ±1.0 dB (–120 to –10 dBm, MAIN 1, after calibration), ±1.0 dB (–110 to 0 dBm, AUX 1, after calibration) Signal purity Non-harmonic spurious: ≤–50 dBc (offset frequency: ≥100 kHz, except Uplink frequency – Downlink frequency + 4.1825 GHz), ≤–40 dBc [spurious of (4.8 – Fout) GHz at ≥2.1 GHz] Harmonics: ≤–25 dBc Uninterrupted level variation Variable range: 0 to –30 dB Setting resolution: 1 dB
Others	Display: Color 8.4" TFT LCD, 640 x 480 dots External control GPIB: Control from external host with main unit as device (excluding some functions such as power-on), no external device control Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Power supply	100 to 120/200 to 240 Vac (–15/+15%, 250 V max.), 47.5 to 63 Hz, ≤300 VA (with Option 01), ≤650 VA (with all Options)
Dimensions and mass	426 (W) x 221.5 (H) x 498 (D) mm (excluding projections), ≤27 kg (with Option 01), ≤34 kg (with all Options)
Environmental conditions	Operating temperature and humidity: 0˚ to +50˚C, ≤95% (no condensation) Storage temperature and humidity: –20˚ to +60˚C, ≤95% (no condensation) EMC EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A) LVD EN61010-1: 2001 (Pollution Degree 2)

• **MT8820A-01 W-CDMA measurement hardware, MX882000B W-CDMA Measurement Software, MX88205xA W-CDMA Call Processing Software**

Modulation analysis	Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm (MAIN) Carrier frequency accuracy: Reference oscillator accuracy + 10 Hz Modulation accuracy (residual vector error): ≤2.5% (at input of 1-DPCCH and 1-DPDCH)
RF power	Frequency: 300 to 2200 MHz Input level: –65 to +35 dBm (MAIN) Measurement accuracy: ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration Linearity: ±0.2 dB (–40 to 0 dB, ≥–55 dBm), ±0.4 dB (–40 to 0 dB, ≥–65 dBm) Measurement object: DPCH, PRACH
Occupied bandwidth	Frequency: 300 to 2200 MHz Input level: –10 to +35 dBm (MAIN)
Adjacent channel leakage power	Frequency: 300 to 2200 MHz Input level: –10 to +35 dBm (MAIN) Measurement points: ±5 MHz, ±10 MHz Measurement range: ≥50 dB (at ±5 MHz), ≥55 dB (at ±10 MHz)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz step) Channel level (CPICH, P-CCPCH, SCH, PICH, DPCH, S-CCPCH, AICH): Off, –30.0 to 0.0 dB [0.1dB step, relative level for Ior (total level)] Channel level (OCNS): Off, Auto-setting Channel level accuracy: ±0.2 dB (relative level accuracy for Ior) AWGN level: Off, –20 to +5 dB (0.1 dB step) AWGN level accuracy: ±0.2 dB (relative level accuracy for Ior)
Bit error rate measurement	Functions: Insert PN9 or PN15 pattern in DTCH Measurement items: BER, BLER Measurement objective: Loop-back data imposed on uplink DTCH (BER, BLER), serial data inputted from rear-panel call processing I/O port (BER)
Call processing	Origination control: Registration, origination, termination, handover, disconnection from network, disconnection from mobile station (executes each processing conforming to 3GPP standards and performs pass/fail evaluation) Mobile station control: Output level, loop-back (executes each mobile function control conforming to 3GPP standards)

• **MT8820A-02 TDMA measurement hardware and MX882001A GSM Measurement Software**

Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Carrier frequency accuracy: Reference oscillator accuracy + 10 Hz at normal burst measurement Reference oscillator accuracy + 20 Hz at RACH measurement Residual phase error: ≤0.5° rms, ≤2° peak
Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –30 to +40 dBm (average power of burst signal, MAIN connector) Measurement items: Normal burst, RACH Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) (After calibration) Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Carrier-off power: ≥65 dB (≥–10 dBm), ≥45 dB (≥–30 dBm) Burst waveform display: Rise, fall, time slot, burst-on
Output RF spectrum measurement	Frequency: 300 to 2200 MHz Input level: –10 to +40 dBm (average power of burst signal, MAIN connector) Measurement item: Normal burst Measurement points: ±100 kHz, ±200 kHz, ±250 kHz, ±400 kHz, ±600 kHz, ±800 kHz, ±1000 kHz, ±1200 kHz, ±1400 kHz, ±1600 kHz, ±1800 kHz, ±2000 kHz Measurement range due to modulation: ≤–55 dB (≤250 kHz offset), ≤–66 dB (≥400 kHz offset) *10 times average Measurement range due to switching: ≤–57 dB (≥400 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz steps) Phase error: ≤1° rms, ≤4° peak Output patterns: CCH, TCH, CCH + TCH Channel coding: FS, EFS, HS0, HS1 TCH data: PN9, PN15, ALL 0, ALL 1, Fixed pattern (PAT0 - PAT9)
Error rate measurement	Function: Error rate measurement of frame, bit and CRC Measurement items GSM: Loop-back data inserted in up-link TCH Serial data inputted through the call processing I/O port on the rear panel GPRS: The number of blocks received from the terminal and inserted in up-link TCH The number of USF reception blocks of a terminal
Call processing	Call controlling GSM: Location registration, terminal call origination, network call origination, network disconnect, terminal disconnect GPRS: Connection, disconnection, data transfer Terminal controlling GSM: Output level, time slot, timing advance, loop-back on/off GPRS: Test Mode A, Test Mode B, BLER
Channel coding	FS, EFS, HS0, HS1, AFS, AHS0, AHS1, CS-1, CS-2, CS-3, CS-4
Frequency bands	GSM450, GSM480, GSM850, P-GSM, E-GSM, R-GSM, DCS1800, PCS1900

• MT8820A-02 TDMA Measurement Hardware, MX882004A PDC Measurement Software

Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level range: –30 to +40 dBm (measurement object: TCH), –30 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Carrier frequency accuracy: ± (reference oscillator accuracy + 1 Hz) Modulation accuracy: ± (2 % of indicated value + 0.7 %) rms Origin offset accuracy: ±0.5 dB (relative to signal of –30 dBc) Transmission rate: ±1 ppm (measurement range: 42 kbps ±100 ppm)
Amplitude measurement	Frequency range: 300 to 2200 MHz Input level range: –30 to +40 dBm (measurement object: TCH), –30 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Measurement accuracy: ±0.5 dB (–20 to +40 dBm), ±0.7 dB (–30 to –20 dBm) *After calibration Linearity: ±0.2 dB (0 to –40 dB, ≥–30 dBm) Power measurement range at carrier off: ≥65 dB (input level: ≥–10 dBm), ≥ (Amplitude measurement value [dBm] + 80) dB (wide dynamic range power measurement)
Occupied bandwidth measurement	Frequency range: 300 to 2200 MHz Input level range: –10 to +40 dBm (measurement object: TCH), –10 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave
Adjacent channel power measurement	Frequency range: 300 to 2200 MHz Input level range: –10 to +40 dBm (measurement object: TCH), –10 to +35 dBm (measurement object: UPCH continuous wave) Measurement items: TCH, UPCH, continuous wave Measurement range: ≤–60 dB (50 kHz offset), ≤–65 dB (100 kHz offset)
RF signal generator	Output frequency: 300 to 2200 MHz, 1 Hz step Modulation accuracy: ≤3% rms Modulation data Continuous wave output: PN9, PN15 and repetition of arbitrary 4-bit data Burst wave output: PN9, PN15
Error rate measurement	Function: Bit error rate measurement Measurement items: Serial data inputted from the Call Proc. I/O terminal of a back panel
Call processing	Call control: Location registration, call origination, call termination, communication, network-side termination, phone-side termination Phone control: Output level, time slot, time alignment
Channel coding	Full rate, Half rate
Frequency band	800 MHz-1, 800 MHz-2, 800 MHz-3, 1.5 GHz

• MT8820A-03 cdma2000® Measurement Hardware, MX882002A cdma2000® Measurement Software

Amplitude measurement	Frequency: 300 to 2200 MHz Input level: –65 to +35 dBm (Main connector) Measurement accuracy: ±0.5 dB (–25 to +35 dBm), ±0.7 dB (–55 to –25 dBm), ±0.9 dB (–65 to –55 dBm) *After calibration, at filtered power measurement Linearity: ±0.2 dB (0 to –40 dB, ≥–55 dBm), ±0.4 dB (0 to –40 dB, ≥–65 dBm)
Frequency/modulation measurement	Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm Carrier frequency accuracy: ± (reference oscillator accuracy + 10 Hz) Residual waveform quality: >0.999 Residual EVM: <2 % rm
Occupied bandwidth	Input level: –10 to +35 dBm
Code domain power	Can be measured at Reverse RC3/RC4. Frequency: 300 to 2200 MHz Input level: –30 to +35 dBm Measurement accuracy: ±0.2 dB (code power: ≥–15 dBc), ±0.4 dB (code power: ≥–23 dBc)
RF signal generator	Output frequency: 300 to 2200 MHz (1 Hz step) Channel level [Relative level to Ior (total level)] Pilot Ch: –30 to 0 dB, 0.25 dB step or off FCH, SCH: –30 to 0 dB, 0.1 dB step or off SYNC, PCH: –30 to 0 dB, 0.25 dB step or off OCNS: Auto, 0.01 dB step or off QPCH channel level (relative level to pilot channel): –5 to +2 dB (1 dB step) or off Channel level accuracy: <±0.2 dB typ. (≥–20 dB) PN offset: 0 to 511 settable Waveform quality: >0.99 (pilot only, AWGN off) AWGN AWGN level: –20 to +12 dB (relative level to CDMA signal) or off Maximum CDMA signal output level at AWGN On: –28 dBm (at MAIN output), –18 dBm (at AUX output)
Error rate measurement	FER (Frame Error Rate) measurement: FER measurement with service Option 2, 9, 55 and 32 (TDSO) Display items: FER, confidence level, sample frame count, error frame count
Call processing	Band class: Conforms to BC 0 to 10 Call control: Location registration, origination, termination, network disconnect, terminal disconnect Paging channel data rate: Full Radio configuration: F-RC1 + R-RC1, F-RC2 + R-RC2, F-RC3 + R-RC3, F-RC4 + R-RC3, F-RC5 + R-RC4 Service option: Conforms to SO 1, 2, 3, 9, 32, 33, 55, 32768. Fwd. FCH data rate: Full, half, quarter, eighth settable Fwd. SCH: Max. 1 channel Fwd. SCH data rate RC3: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC4: 9.6, 19.2, 38.4, 76.8, 153.6 kbps RC5: 14.4, 28.8, 57.6, 115.2, 230.4 kbps Access channel: Conforms to access Ch. Rev. closed loop power control mode: closed loop, alternate, All 0 (all up), All 1 (all down) Conformed protocol: IS-95B, J-STD-008C, ARIB T-53, Korean PCS, IS-2000 (SR1)

4

• MT8820A-11 Audio Board, MX882000B-01 W-CDMA Voice Codec

Voice codec	AMR 12.2 kbps
Codec level adjustment	Encoder input gain: –3.00 to 3.00 dB, in increments of 0.01 dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Setting range: 0 Vpeak to 5 Vpeak (AF Output connector) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: ≤30 kHz band ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1 Ω Max. output current: 100 mA
AF input	Frequency range: 50 Hz to 10 kHz Input voltage range: 1 mVpeak to 5 Vpeak (AF Input connector) Max. allowable input voltage: 30 Vrms Input impedance: 100 kΩ
Frequency measurement	Accuracy: Reference oscillator accuracy + 0.5 Hz
Level measurement	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
SINAD measurement	Frequency: 1 kHz in ≤30 kHz band ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
Distortion rate measurement	Frequency: 1 kHz in ≤30 kHz band ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

• MT8820A-11 Audio Board, MX882001A-01 GSM Voice Codec

Voice codec	GSM_EFR, GSM_AMR
Codec level adjustment	Encoder input gain: –3.00 to 3.00 dB, in increments of 0.01 dB Handset microphone volume: 0, 1, 2, 3, 4, 5 Handset speaker volume: 0, 1, 2, 3, 4, 5
AF output	Frequency range: 30 Hz to 10 kHz, 1 Hz resolution Setting range: 0 to 5 Vpeak (AF Output connector) Setting resolution: 1 mV (≤5 V peak), 100 µV (≤500 mVpeak), 10 µV (≤50 mVpeak) Accuracy: ±0.2 dB (≥10 mVpeak, ≥50 Hz), ±0.3 dB (≥10 mVpeak, <50 Hz) Waveform distortion: In ≤30 kHz band, ≤–60 dB (≥500 mV peak, ≤5 kHz), ≤–54 dB (≥70 mVpeak) Output impedance: ≤1 Ω Max. output current: 100 mA
AF input	Frequency range: 50 Hz to 10 kHz Input voltage range: 1 mVpeak to 5 Vpeak (AF Input connector) Max. allowable input voltage: 30 Vrms Input impedance: 100 kΩ
Frequency measurement	Accuracy: Reference oscillator accuracy + 0.5 Hz
Level adjustment	Accuracy: ±0.2 dB (≥10 mVpeak), ±0.4 dB (≥1 mVpeak, ≥1 kHz)
SINAD measurement	At frequency 1 kHz in ≤30 kHz band, ≥60 dB (≥1000 mVpeak), ≥54 dB (>50 mVpeak), ≥46 dB (≥10 mVpeak)
Distortion rate measurement	At frequency 1 kHz in ≤30 kHz band, ≤–60 dB (≥1000 mVpeak), ≤–54 dB (>50 mVpeak), ≤–46 dB (≥10 mVpeak)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT8820A	Radio Communication Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
HB28B064C8H	CF card (64 MB):	1 pc
CA68ADP	PC card adapter:	1 pc
W1940AE	MT8820A operation manual (CD-ROM):	1 copy
	Options	
MT8820A-01	W-CDMA Measurement Hardware	
MT8820A-02	TDMA Measurement Hardware	
MT8820A-03	CDMA2000 Measurement Hardware	
MT8820A-04	1xEV-DO Measurement Hardware	
MT8820A-11	Audio Board	
MT8820A-12	Parallel Phone Measurement Hardware	
MT8820A-21	W-CDMA Measurement Hardware retrofit	
MT8820A-22	TDMA Measurement Hardware retrofit	
MT8820A-23	CDMA2000 Measurement Hardware retrofit	
MT8820A-24	1xEV-DO Measurement Hardware retrofit	
MT8820A-31	Audio Board retrofit	
MT8820A-32	Parallel Phone Measurement Hardware retrofit	
	Softwares	
MX882000B	W-CDMA Measurement Software (requires MT8820A-01 and MX88205xA)	
MX882000B-01	W-CDMA Voice Codec (requires MT8820A-11 and MX882000B)	
MX882001A	GSM Measurement Software (requires MT8820A-02)	
MX882001A-01	GSM Voice Codec (requires MT8820A-11 and MX882001A)	
MX882001A-02	GSM External Packet Data (requires MX882001A)	
MX882001A-11	EGPRS Measurement Software (requires MX882001A)	
MX882002A	CDMA2000 Measurement Software (requires MT8820A-03)	
MX882002A-02	CDMA2000 External Packet Data (requires MX882002A)	
MX882003A	1xEV-DO Measurement Software (requires MT8820A-03, MT8820A-04 and MX882002A)	
MX882003A-02	1xEV-DO External Packet Data (requires MX882003A)	
MX882004A	PDC Measurement Software (requires MT8820A-02)	
MX882005A	PHS Measurement Software (requires MT8820A-02)	
MX882010A	Parallel Phone Measurement Software*1 [requires MT8820A-12, the two same measurement hardware (2 board/set) and one measurement software]	
MX882022A	CDMA2000 Wireless Application Test Software (requires MT8820A-03)	
MX882050A	W-CDMA Call Processing Software*2 (requires MX882000B)	
MX882050A-02	W-CDMA External Packet Data*2, *3 (requires MX882050A)	
MX882050A-03	W-CDMA Video Phone Test*2 (requires MX882050A)	
MX882051A	W-CDMA Call Processing Software*2 (requires MX882000B)	
MX882051A-02	W-CDMA External Packet Data*2 (requires MX882051A)	
MX882051A-03	W-CDMA Video Phone Test*2 (requires MX882051A)	
MX882071A	W-CDMA Ciphering Software*2 (requires MX882051A)	
W2161AE	MX882000B operation manual*4 (attached to MX882000B)	
W2026AE	MX882001A operation manual*4 (attached to MX882001A)	
W2104AE	MX882002A operation manual*4 (attached to MX882002A)	
W2201AE	MX882003A operation manual*4 (attached to MX882003A)	
W2159AE	MX882004A operation manual*4 (attached to MX882004A)	
W2228AE	MX882005A operation manual*4 (attached to MX882005A)	
W2247AE	MX882022A operation manual*4 (attached to MX882022A)	
W2220AE	MX88205xA operation manual*4 (attached to MX88205xA)	
W2230AE	MX88207xA operation manual*4 (attached to MX88207xA)	

*1: Maximum 2 types of measurement hardware can be used for the Parallelphone measurement option.
*2: For W-CDMA terminal connectivity, contact your Anritsu sales representative.
*3: MX882050A preinstalls the integrity protection function.
*4: Supplied by CD-ROM

Parallelphone™ is a registered trademark of Anritsu Corporation.

Model/Order No.	Name
	Warranty
MT8820A-90	Extended three year warranty service
MT8820A-91	Extended five year warranty service
	Application parts
P0019	TEST USIM001
A0012	Handset
J1249	CDMA2000 cable
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m
J0576D	Coaxial cord (N-P · 5D-2W · N-P), 2 m
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m
J0127C	Coaxial cord (BNC-P · RG58A/U · BNC-P), 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
MN8110B	I/O Adapter (for call processing I/O)
B0332	Joint plate (4 pcs/set)
B0333G	Rack mount kit
B0499	Carrying case (hard type, with protective cover and casters)
B0499B	Carrying case (hard type, with protective cover, without casters)
W1943AE	MT8820A operation manual (booklet)
W2162AE	MX882000B operation manual (booklet)
W2027AE	MX882001A operation manual (booklet)
W2100AE	MX882002A operation manual panel operation (booklet)
W2101AE	MX882002A operation manual remote control (booklet)
W2202AE	MX882003A operation manual panel operation (booklet)
W2203AE	MX882003A operation manual remote control (booklet)
W2160AE	MX882004A operation manual (booklet)
W2229AE	MX882005A operation manual (booklet)
W2245AE	MX882022A operation manual panel operation (booklet)
W2246AE	MX882022A operation manual remote control (booklet)
W2221AE	MX88205xA operation manual (booklet)
W2231AE	MX88207xA operation manual (booklet)

RADIO COMMUNICATION ANALYZER
MT8801C
300 kHz to 3 GHz

GPIB

Support for CDMA, GSM, DECT, IS-136A, PDC and PHS

Every major radio communication system in the world including AMPS/PCS1900, GSM400/900/1800/1900, GPRS, HSCSD, DECT, IS-136A, PDC, and PHS can be evaluated using just one MT8801C Radio Communication Analyzer, covering the 300 kHz to 3 GHz frequency band in one hardware platform, and the dedicated measurement software options. The call processing test and sensitivity test using the loopback method are possible for GSM/DCS1800/PCS1900, CDMA, IS-136A and DECT. In addition, connection testing as well as send testing while communicating, are also possible for PDC and PHS measurement by using the call processing function, and the PDC uplink RCH can be monitored (RSSI, estimated error rate) too. FM radio transmission/reception tests are simplified by using the optional analog measurement function, and the optional spectrum analyzer function covering 10 MHz to 3 GHz is very useful for maintaining as well as measuring spurious near carrier on production lines. GPIB and RS-232C interfaces are standard, so MT8801C can be incorporated easily into automated production lines or on-site automated testing systems.
The time required for testing equipment on production lines is greatly reduced using the high-speed adjacent channel power and occupied bandwidth measurement functions based on Anritsu's proprietary measurement algorithm and DSP (Digital Signal Processing). Furthermore, major transmission test items such as transmission frequency, modulation accuracy (phase error), transmission power, rise/fall characteristics of burst wave, adjacent channel power, etc. can be measured and judged pass/fail for the limit value of each item.

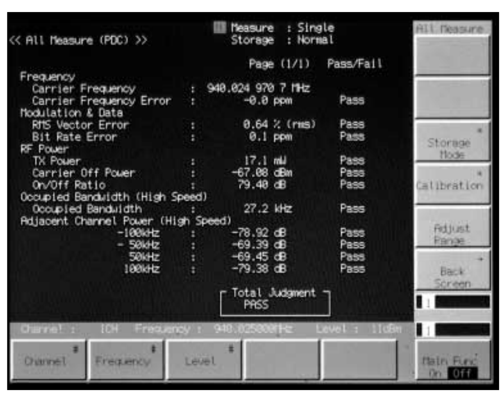
Features

- 1 unit for GSM, DECT, IS-136A, PDC and PHS systems
- All basic transmission and reception measurements performed by 1 unit

System type	Measurement software option	Description
IS-136A	MX880113A	Tx and Rx measurements of IS-136A mobile stations including call processing (requires option 01)
AMPS PCS1900	MX880114A	Tx and Rx measurements of AMPS analog mobile stations and PCS1900 digital mobile telephones including call processing (requires option 01)
GSM400/ 900/1800/ 1900	MX880115A	Tx and Rx measurements of GSM and advanced GSM mobile stations including call processing and multiple timeslot measurements
PDC	MX880116A	Tx and Rx measurements of PDC mobile stations including call processing
	MX880131A	Tx and Rx measurements of PDC mobile stations
PHS	MX880117A	Tx and Rx measurements of PHS mobile stations including call processing
	MX880132A	Tx and Rx measurements of PHS base stations and mobile stations
DECT	MX880118A	Tx and Rx measurements both portable part and fixed part for DECT including call processing (requires option 07)
GSM	Option 11	Audio test of GSM mobile stations including call processing (requires MX880115A and option 01)
CDMA	Option 12	Tx and Rx measurements of mobile stations including call processing (requires option 01)

Transmission test

• Batch measurements of transmission test items
Only about 1 second is required to measure all major transmission test items, including frequency, modulation accuracy, origin offset, transmission rate, transmission power, leakage power during carrier-off, rise/fall edge characteristics, occupied bandwidth, and adjacent channel power. Pass/fail decisions for limit value of each test item can also be displayed.



Example of linked send measurement items (PDC)

• Calibration functions
A built-in thermocouple power sensor is used for calibration, providing accurate measurement of absolute values such as average power within burst signal and leakage power during carrier-off. There is no need for other instruments; just one press of the CAL key during measurement performs calibration.

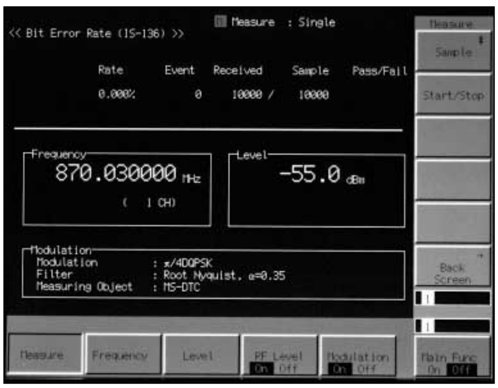
• Wide-band power meter
The power meter with built-in thermocouple power sensor can accurately measure power between 0 and +40 dBm.

• Modulation analysis
The user can display the waveform as either frequency deviation, eye diagram or constellation diagram to easily show any irregularities in the modulation.

• Measurement of antenna power rise/fall edge characteristics
Antenna power rise/fall edge characteristics can be measured simultaneously with antenna power measurements. In addition, the marker points can be moved and the power can be read directly with 1/10 symbol resolution.

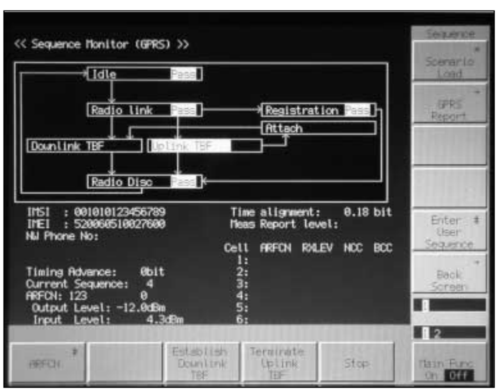
• Adjacent channel power measurement
The MT8801C can measure adjacent channel power for each communication system at high speed.

• Receiver sensitivity measurement
This function displays the error count and error rate in the RF input or DATA/CLOCK input measured signal.



Bit error rate measurement (IS-136A)

• Call processing function
The MT8801C acts as a pseudo base station permitting to judge pass/fail for registration, origination, termination, communication, handover (PHS: TCH switching type only), disconnection from network, and disconnection from mobile station at the sequence monitor screen.



Sequence monitor display (GSMGPRS)

Analog measurement

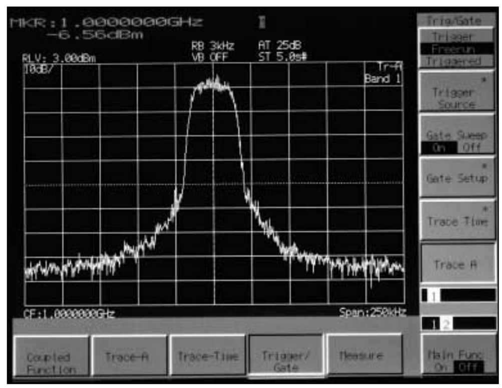
• Analog measurement function (Option 01)
The MT8801C has general analog measurement functions too. Efficient FM TX/RX testing is made easy by built-in signal generator, AF oscillator, RF analyzer (power meter, frequency counter, FM measurement) and audio analyzer functions. This function is especially useful for the IS-136A analog test.

• Transmission measurement
Characteristics such as frequency, power, and frequency deviation can be measured easily.

• Reception measurement
An FM modulated signal is output to permit measurement of the frequency and level of the AF signal from a receiver, as well as SINAD and distortion.

Spectrum analysis

• Spectrum analyzer function (Option 07)
The spectrum analyzer with synthesized local oscillator covers a frequency range of 10 MHz to 3 GHz with a resolution of 1 Hz. In addition to a C/N of –115 dBc (100 kHz offset), the RBW can be set to 300 Hz to 1 MHz, the VBW to 3 to 100 kHz, and the sweep time in the frequency domain to 100 ms to 1000 s (1 ms to 1000 s in time domain). The total level accuracy is an astonishing ±1.5 dB due to the analyzer's excellent linearity and the level calibration function. Moreover, the average noise level is just –85 dBm max (at 10 MHz to 1 GHz), and the secondary harmonic distortion is –60 dB max (100 MHz to 1.5 GHz).



IS-136A modulated wave measurement

Options

• Option 04: AF low impedance output
This option converts the output impedance of the AF oscillator of the Option 01 analog measurement to low impedance. It permits direct driving of an external speaker connected to the AF output connector.

• Option 11: GSM audio test
When using with the MX880115A GSM Measurement Software, speech Tx/Rx characteristics can be measured in accordance with GSM Rec. RPE LTP (Full Rate Speech CODEC).
The audio signal generated by the MT8801C is digitally processed and ideal audio signal is sent. In addition, this option can also be used to digitally process an audio signal sent from a GSM terminal for high-reliability and high-accuracy measurement.

• Option 12: CDMA measurement
The Option 12 can measure the following systems; USA 800-MHz cellular band (TIA/EIA/IS-95A standard), USA 1.9 GHz PCS band (ANSI J-STD-008 standard), Japan 800-MHz cellular band (ARIB STD-T53 standard).
The CDMA and analog dual mode standardized in the IS-95A standard are supported.

4

Specifications

• MT8801C

Frequency range	300 kHz to 3 GHz
Maximum input level	+40 dBm (10 W, MAIN connector), +20 dBm (100 mW, AUX connector)
Input/output connector	MAIN I/O connector Impedance: 50 Ω, N-type VSWR: ≤1.2 (≤2.2 GHz), ≤1.3 (>2.2 GHz) AUX input/output connector: TNC-type
Reference oscillator	Frequency: 10 MHz Starting characteristics: ≤5 x 10^{-8}/day (after 10 minutes of warm-up, referred to frequency after 24 hours warm-up) Aging rate: ≤2 x 10^{-8}/day, ≤1 x 10^{-7}/year (referred to frequency after 24 hours warm-up) Temperature characteristics: ≤5 x 10^{-8} (0˚ to 50˚C, referred to frequency at 25˚C) External standard input: 10 MHz or 13 MHz (±1 ppm), input level: 2 to 5 Vp-p
Power meter	Frequency range: 300 kHz to 3 GHz Level range: 0 to +40 dBm, –10 to +40 dBm (CDMA measurement) Level accuracy: ±10% (0 to +40 dBm, after zero point calibration), ±10% (–10 to +40 dBm, 18˚ to 28˚C, at average value, after zero point calibration)
Signal generator	Frequency Range: 300 kHz to 3 GHz Resolution: 1 Hz Accuracy: Reference frequency accuracy ±100 mHz Output level Level range (no modulation or analog modulation): –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Level accuracy: ±1 dB (10 MHz to 2.2 GHz, ≥–123 dBm, 18˚ to 28˚C), ±3 dB (10 MHz to 2.2 GHz, ≥–133 dBm), ±2 dB (>2.2 GHz, ≥–123 dBm, 18˚ to 28˚C), ±4 dB (>2.2 GHz, ≥–133 dBm) Radiated interference: 1 µV/50 Ω (carrier frequency measured, 25 mm from front panel with two-turn 25 mm diameter loop antenna) Signal purity Spurious: ≤–50 dBc (at CW, offset frequency 100 kHz to ≤50 MHz; where carrier frequency: other than 1300 MHz to 1400 MHz and 2000 MHz to 2100 MHz), ≤–40 dBc (for all band) Harmonics: ≤–25 dBc (at CW)
Others	Display: Color TFT-LCD, 7.8 inch, 640 x 480 dots Hard copy: Enables data hard copy of the display through a parallel interface (applicable only for EPSON VP series or equivalent) GPIB: This equipment is specified as a device, can be controlled from external controller (excluding power switch and FD ejection key). No controller function Interface: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2) Parallel Conform to the Centronics. Outputs printing data to printer. Data line exclusive for output: 8 Control line: 4 (BUSY, $\overline{\text{DTSB}}$, $\overline{\text{ERROR}}$, PE) Connectors: D-sub 25 pins, female (equivalent to the connector of IBM-PC/AT built-in printer) RS-232C: All functions except power switch controlled by external controller (baud rate: 1200, 2400, 4800, 9600 bps)
Dimensions and mass	426 (W) x 221.5 (H) x 451 (D) mm, ≤22 kg
Power	100 to 120/200 to 240 Vac (automatic voltage switch system), 47.5 to 63 Hz, ≤300 VA
Operating temperature	0˚ to +50˚C
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

• Option 01: Analog measurement

RF signal generator	Frequency range: 10 MHz to 3 GHz Output level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) FM deviation: 0 to 40 kHz (resolution: 10 Hz) Accuracy: Set value ±5% ±1 digit (internal modulation frequency: 1 kHz, excluding residual FM) Internal modulation: 20 Hz to 20 kHz External modulation: 20 Hz to 20 kHz (limited to 1Vpeak into 600 Ω) Flatness: ±0.5 dB (referenced to 1 kHz between 0.3 to 3 kHz with 4 kHz deviation) ±1 dB (referenced to 1 kHz between 20 Hz to 20 kHz with 4 kHz deviation) Distortion: ≤–50 dB (internal modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, frequency deviation: 5 kHz)
AF Generator	Frequency range: 20 Hz to 20 kHz, Setting resolution: 0.1 Hz, Accuracy: Same as reference oscillator Output Level range: 0.1 mVrms to 3.0 Vrms (EMF, MAIN output impedance: 600 Ω) 0.1 mVrms to 0.3 Vrms (EMF, MAIN output impedance: 50 Ω) Setting resolution: 1 µV (output level: <4 mV), 10 µV (output level: <40 mV) 100 µV (output level: <0.4 V), 1 mV (output level: ≤3 V) Accuracy (bandwidth: <30 kHz) Unbalanced output: ±0.5 dB (frequency: 1 kHz, output level: ≥1 mV), ±1 dB (frequency: 20 Hz to 20 kHz, output level: ≥1 mV) Floating output: ±2 dB (frequency: 1 kHz, output level: ≥1 mV) Output impedance MAIN output: 600 Ω, 50 Ω selectable (unbalanced, BNC connector) DUT interface microphone output: 600 Ω, floating Distortion: <–50 dBc (bandwidth: <30 kHz, frequency: 1 kHz, output level: 1 V) <–45 dBc (bandwidth: <30 kHz, frequency: 20 Hz to 20 kHz, output level: 1 V) Noise generator: White noise passed through a weighting filter (conforming to ITU-T Rec. G.227)

Continued on next page

Transmission measurement	RF power meter	Frequency range: 300 kHz to 3 GHz Input range: 0 to +40 dBm (MAIN connector) Accuracy: ±10% (after zero calibration)
	IF level meter	Frequency range: 10 MHz to 3 GHz Input range: 0 to +40 dBm (MAIN connector) Accuracy: ≤10% (after calibration with internal RF power meter) Linearity: ±0.3 dB (0 to –30 dB)
	Frequency counter	Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Resolution: 1 Hz Accuracy: ±(reference oscillator accuracy + 10 Hz) Method: IF frequency counting (bandwidth: ±30 kHz)
	Modulation	FM Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Filters (3 dB cut-off frequency): HPF (300 Hz, 50 kHz), LPF (3 kHz, 15 kHz) Deviation: 0 to 20 kHz Demodulation frequency: 20 Hz to 20 kHz Accuracy: 1% + residual FM (demodulation frequency: 1 kHz) Frequency response: ±0.5 dB (referenced to 1 kHz) Residual FM: 8 Hz-rms (demodulation frequency: 0.3 to 3 kHz) Distortion: 0.3% (modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz) øM Frequency range: 10 MHz to 3 GHz Input level range: –15 to +40 dBm (MAIN connector), –40 to +20 dBm (AUX connector) Filters (3 dB cut-off frequency): HPF (300 Hz, 50 kHz), LPF (3 kHz, 15 kHz) Deviation: 0 to 10 rad Demodulation frequency: 300 Hz to 3 kHz Accuracy: 1% + residual øM (modulation frequency: 1 kHz) Frequency response: ±0.5 dB (referenced to 1 kHz) Residual øM: 0.01 rad-rms (demodulation bandwidth: 0.3 to 3 kHz) Distortion: 0.5% (modulation frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, deviation: 5 rad) FM demodulation output Deviation: 0 to 40 kHz (4/40 kHz range selectable) Demodulation frequency range: 50 Hz to 10 kHz Output level: 4 Vpeak (EMF, at full-scale range) Output impedance: 600 Ω Frequency response: ±1 dB Distortion: 1% (FM frequency: 1 kHz, demodulation bandwidth: 0.3 to 3 kHz, frequency deviation: 4 kHz) Filters (3 dB cut-off frequency): HPF (300 Hz), LPF (3 kHz) De-emphasis: 750 µs
Audio analyzer		Input impedance: 600 Ω/100 kΩ selectable (unbalanced, BNC connector) Bandpass filter HPF: 400 Hz (for tone rejection) De-emphasis: 750 µs Weighting filter: ITU-T P.53, C-MESSAGE AF Level meter Frequency range: 30 Hz to 20 kHz Level range: 1 mVrms to 30 Vrms Accuracy: ±0.5 dB AF frequency counter Frequency range: 30 Hz to 20 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±0.1 Hz Distortion meter Frequency range: 100 Hz to 5 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±1 dB (frequency: 1 kHz, distortion factor: 1%)
Mass		≤500 g

• Option 04: AF low impedance output

AF oscillator	Output impedance[*1]: ≤1 Ω (MAIN connector, unbalanced, BNC connector) Maximum output current: ≥100 mApeak (MAIN connector) Waveform distortion: –50 dBc (band: <30 kHz, 1 kHz, output level: 0.3 V), –45 dBc (band: <30 kHz, 20 Hz to 20 kHz, output level: 0.3 V)

*1: <1 Ω fixed (can not exchange to 50/600 Ω)

• Option 07: Spectrum analyzer

Frequency	Band Band 0: 0 Hz to 3 GHz, Band 1: 10 MHz to 3 GHz; HPF: On/off switchable (Band 1, 1.6 to 3 GHz) Setting range 0 to 3 GHz (Band: 0), 10 MHz to 3 GHz (Band: 1); Resolution: 1 Hz Display accuracy: ± (display frequency x reference frequency accuracy + span x span accuracy) Marker frequency accuracy Normal marker: Same as display frequency accuracy; Delta marker: Same as span accuracy Span setting range: 0 Hz or 10 kHz to 3 GHz (Band: 0), 0 Hz or 10 kHz to 2.99 GHz (Band: 1) Span accuracy: ±2.5% Resolution bandwidth Setting range: 300 Hz to 1 MHz (3 dB BW, 1-3 sequence) Accuracy: ±2% (300 Hz to 300 kHz), ±10% (1 MHz) Selectivity (60 dB:3 dB): ≤5:1 Video bandwidth: 3 Hz to 100 kHz (1-3 sequence) or through ∗Setting range is limited by resolution bandwidth. Sideband noise: ≤–95 dBc/Hz (1 GHz, 10 kHz offset), ≤–115 dBc/Hz (1 GHz, 100 kHz offset)
Amplitude (band 1)	Maximum input level Continuous average power: +40 dBm (MAIN connector), +20 dBm (AUX connector) DC voltage: 0 V Average noise level (resolution bandwidth: 1 kHz, video bandwidth: 10 Hz) ≤–90 dBm (10 MHz to 2.2 GHz), ≤–85 dBm (>2.2 GHz) ∗MAIN connector input, input attenuator: 20 dB ≤–110 dBm (10 MHz to 2.2 GHz), ≤–105 dBm (>2.2 GHz) ∗AUX connector input, input attenuator: 0 dB Residual response: ≤–70 dBm (MAIN connector, input attenuator: 20 dB), ≤–90 dBm (AUX connector, input attenuator: 0 dB) Level accuracy ±1.5 dB (MAIN connector, reference level: +10.1 to +40 dBm, at 0 to –50 dB of reference level) ±1.5 dB (AUX connector, reference level: –9.9 to +20 dBm, at 0 to –50 dB of reference level) Reference Level Setting range: ≤–60 to +50 dBm (MAIN connector), ≤–80 to +30 dBm (AUX connector) Setting resolution: 0.1 dB Accuracy: ±0.5 dB (MAIN connector, +10.1 to +40 dBm), ±1.0 dB (MAIN connector, –60 to +10 dBm), ±0.5 dB (AUX connector, –9.9 to +20 dBm), ±1.0 dB (AUX connector, –80 to –10 dBm) ∗After calibration, frequency: 100 MHz, span: 2 MHz; Input attenuator, resolution bandwidth, video bandwidth, sweep time are AUTO.) Resolution bandwidth switching deviation: ±0.1 dB (resolution bandwidth reference: 3 kHz) Frequency characteristics: ±0.5 dB [100 MHz reference, input attenuation: 30 dB (10 dB for AUX input), 18˚ to 28˚C] Log linearity: ±0.5 dB (0 to –50 dB, resolution bandwidth: ≤1 MHz), ±1.0 dB (0 to –70 dB, resolution bandwidth: ≤30 kHz), ±1.0 dB (0 to –80 dB, resolution bandwidth: ≤1 kHz) ∗10 MHz to 2.2 GHz, reference level: ≥0 dBm (MAIN connector)/≥–20 dBm (AUX connector) Spurious (2nd harmonic distortion): ≤–55 dBc (10 to 100 MHz), ≤–60 dBc (100 to 1500 MHz) ∗Mixer input: –30 dBm
Sweep	Sweep time: 100 ms to 1000 s (frequency domain sweep), 100 ms to 1000 s (time domain sweep, resolution bandwidth: ≤1 kHz) 10 ms to 1000 s (time domain sweep, resolution bandwidth: 3 to 10 kHz), 1 ms to 1000 s (time domain sweep, resolution bandwidth: ≥30 kHz) Trigger switch: FREERUN, TRIGGERED Trigger source: WIDE IF VIDEO (3 dB bandwidth: ≥20 MHz, trigger slope: RISE/FALL), EXT (trigger: TTL level, trigger slope: RISE/FALL) Trigger delay Range: 0 µs to 100 ms, Resolution: 2 µs Gate sweep Displays spectrum of input signal at specified gate on frequency domain display Gate delay: 2 µs to 100 ms from trigger start point (resolution: 2 µs) Gate width: 2 µs to 100 ms from gate delay point (resolution: 2 µs)
Functions	Marker functions Signal search: PEAK → CF, PEAK → REF Zero marker: NORMAL, DELTA Marker function: MARKER → CF, MARKER → REF, ZONE → SPAN Peak search: PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK Measurement function Noise power: dBm/Hz, dBm/ch C/N: dBc/Hz, dBc/ch Occupied bandwidth: N% of power method, X-dB down method Adjacent channel power: Reference total power method, reference level method, channel designate display (2 channels x 2), graphic display Average power within a burst: Average power of time domain waveform within specified time
Others	Number of data point: 501 points Detector mode POS PEAK: Displays max. point between sample points, NEGATIVE PEAK: Displays min. point between sample points, SAMPLE: Displays momentary value at sample points Display memory TRACE A: Displays frequency spectrum, TRACE B: Displays frequency spectrum, Trace time: Displays time domain waveform at center frequency Storage function: NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE

• Option 11: GSM audio test

Tx measurement	Decoding characteristics	Frequency range: 50 Hz to 4 kHz Level range: 0 to 3.2768 V Accuracy: ±1 Hz (500 Hz to 2 kHz)
	AF oscillator	Frequency range: 50 Hz to 20 kHz (setting resolution: 50 Hz) Accuracy: Same as reference oscillator Output level range: 50 mVrms to 3 Vrms (EMF) *Setting resolution: 0.1 mV Accuracy (bandwidth: <30 kHz) Unbalanced output: ±0.5 dB (1 kHz, ≥1 mV), ±1 dB (20 Hz to 20 kHz, ≥1 mV) Floating output: ±2 dB (1 kHz, ≥1 mV) Output impedance Main output: 600 Ω, 50 Ω (unbalanced, BNC connector) Microphone input: 600 Ω (floating, DUT interface) Waveform distortion (bandwidth: <30 kHz): <–50 dBc (1 kHz, 1 Vrms), <–45 dBc (20 Hz to 20 kHz, 1 Vrms)
Rx measurement	Coded signal	Frequency range: 50 Hz to 4 kHz (setting resolution: 50 Hz) Level range: 0 to 2.2 V (setting resolution: 0.1 mV)
	AF level measurement	Frequency range: 30 Hz to 20 kHz Level range: 1 mVrms to 30 Vrms Accuracy: ±0.5 dB
	AF frequency measurement	Frequency range: 30 Hz to 20 kHz Level range: 30 mVrms to 30 Vrms Accuracy: ±0.1 Hz

• Option 12: CDMA measurement

Signal generator	Frequency range IS-95A: 869.01 to 893.97 MHz (30 kHz step) J-STD-008: 1930.00 to 1989.95 MHz (50 kHz step) ARIB STD-T53: 832.0125 to 833.9875 MHz, 843.0125 to 845.9875 MHz, 860.0125 to 869.9875 MHz (12.5 kHz step) KORER-PCS: 1805.05 to 1870.00 MHz (50 kHz step) Level setting range: –133 to –18 dBm (Main connector, AWGN off), –133 to +2 dBm (AUX connector, AWGN off) –133 to –24 dBm (Main connector, AWGN on), –133 to –4 dBm (AUX connector, AWGN on) Relative level accuracy: ±0.2/20 dB (Relative level accuracy at level change in time response of open-loop power control 18˚ to 28˚C) Waveform quality: >0.99 (pilot channel: 0 dB) Channel level accuracy: ±0.2 dB (relative level accuracy between any 2 channels) AWGN level accuracy: ±0.2 dB (relative level for forward traffic channel)
Reception measurement	FER measurement: FER measurement value, error frame number, test frame number, reliability limit (pass/fail)
Transmission measurement	Frequency range IS-95A: 824.01 to 848.97 MHz (30 kHz step) J-STD-008: 1850.00 to 1909.95 MHz (50 kHz step) ARIB STD-T53: 887.0125 to 888.9875 MHz, 898.0125 to 900.9875 MHz, 915.0125 to 924.9875 MHz (12.5 kHz step) KORER-PCS: 1715.05 to 1780.00 MHz (50 kHz step) Modulation analysis Level range: –20 to +40 dBm (average power within a burst, main connector only) Waveform quality measurement range: 0.9 to 1.0 Measurement error: ±0.003 (after executing adjust range) Residual vector error: <5% (after executing adjust range) Power measurement (IF level meter) Measurement range: –50 to +40 dBm Measurement accuracy: ±0.4 dB (0 to +40 dBm, after executing power meter calibration) ±0.4 dB (–10 to +40 dBm, after executing power meter calibration, 18˚ to 28˚C) ±0.7 dB (–10 to +40 dBm, after executing internal oscillator calibration, 18˚ to 28˚C) Linearity: ±0.1 dB (0 to –10 dB), ±0.2 dB (–10 to –20 dB), ±0.5 dB (–20 to –40 dB) *Referred to reference level: ≥–10 dBm Input connector: Main connector only Occupied bandwidth measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Spurious close to the carrier measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Measurement range: ≥50 dB (900 kHz offset), ≥60 dB (1.98 MHz offset) Spurious measurement Level range: 0 to +40 dBm (average power within a burst, MAIN connector), –20 to +20 dBm (average power within a burst, AUX connector) Measurement range: ≥60 dB
Call processing	Functions: Registration, origination, termination, conversation, loopback, hard handoff, disconnection from network, disconnection from mobile station, CDMA → analog handoff (IS-95A), soft handoff (MX880201A-01), softer handoff (MX880201A-01) Protocol: IS-95A (CDMA, analog), J-STD-008, ARIB STD-T53

• MX880113A IS-136A Measurement Software (extracts)

Transmission measurement	Digital	Frequency/modulation measurement Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.5%) Amplitude measurement Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration) Adjacent channel power measurement Measurement range: ≥30 dB (30 kHz offset), ≥60 dB (60 kHz offset), ≥65 dB (90 kHz offset) Batch measurement functions Measurement time: ≤1.5 s (amplitude measurement in normal mode)
	Analog	Same as Option 01
Reception measurement	Digital	Signal generator Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms Error rate measurement Measurement pattern: PN9 (measures TCH data of up communication burst at RF input) Number of measurement bits: 1 to 99999999
	Analog	Same as Option 01
Call processing		Pass/fail judgement of registration, origination, termination communication, handoff, disconnection from network, disconnection from mobile station

• MX880114A AMPS/PCS1900 Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Residual phase error accuracy: ≤0.5˚ rms, ≤2˚ peak
	Amplitude measurement	Input level range: –5 to +40 dBm (average power within burst, MAIN connector) Calibration input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmission power accuracy: ±0.4 dB (+10 to +40 dBm), ±0.7 dBm (–5 to +40 dBm) ∗MAIN connector, after calibration by using built-in power meter with same Tx reference level as calibration
	Output RF spectrum measurement	Modulation portion measurement range: ≥50 dB (200 kHz offset), ≥66 dB (250 kHz offset) Transition portion measurement range: ≥57 dB (400 kHz offset)
	All measurement items	Measurement time: ≤2.0 s (amplitude measurement: normal mode, except MS report measurement)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Phase error: ≤1˚ rms, ≤4˚ peak
	Error rate measurement	Measurement pattern: 10 test patterns selectable Number of measurement samples: 1 to 99999999 (FER, CIb, CII)
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station
Analog measurement		Same as Option 01 for AMPS

• MX880115A GSM Measurement Software (extracts)

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Residual phase error accuracy: ≤0.5˚ rms, ≤2˚ peak
	Amplitude measurement	Input level range: –5 to +40 dBm (average power within burst, MAIN connector) Calibration input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmission power accuracy: ±0.4 dB (+10 to +40 dBm), ±0.7 dBm (–5 to +40 dBm) ∗MAIN connector, after calibration by using built-in power meter with same Tx reference level as calibration
	Output RF spectrum measurement	Modulation portion measurement range: ≥50 dB (200 kHz offset), ≥66 dB (250 kHz offset) Transition portion measurement range: ≥57 dB (400 kHz offset)
	All measurement items	Measurement time: ≤2.0 s (amplitude measurement: normal mode, except MS report measurement)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Phase error: ≤1˚ rms, ≤4˚ peak
	Error rate measurement	Measurement pattern: 10 test patterns selectable Number of measurement samples: 1 to 99999999 (FER/CRC, CIb, CII, FAST)
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station
Analog measurement		Same as Option 01 for AMPS

• **MX880116A PDC Measurement Software with Call Processing (extracts)**

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ±(2% of indicated value + 0.5%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3% rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station

• **MX880117A PHS Measurement Software with Call Processing (extracts)**

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ±(2% of indicated value + 0.7%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter, at +10 to +40 dBm)
	Adjacent channel power measurement	Measurement range: ≥60 dB (600 kHz offset), ≥65 dB (900 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3% rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞
Call processing		Pass/fail judgement of registration, origination, termination, communication, hand-over, disconnection from network, disconnection from mobile station

• **MX880118A DECT Measurement Software (extracts)**

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz, RF carrier accuracy: ±250 Hz + reference oscillator accuracy, Frequency drift measurement accuracy: ±250 Hz, Modulation measurement accuracy: ±10 kHz
	Amplitude measurement	Input level range: –5 to +40 dBm (MAIN connector) Calibration input level range: +15 to +40 dBm (MAIN connector) Transmitter power accuracy: ±0.4 dB (+15 to +40 dBm), ±0.7 dB (–5 to +15 dBm) *MAIN connector, after calibration by using built-in power meter
	Adjacent channel power measurement	Emission due to modulation: –8 dBm/160 µW at M ±1, –30 dBm/1 µW at M ±2, –44 dBm/40 nW at M ±3, –47 dBm/20 nW at M ±4 and M ±5 Emission due to transmitter transient: –6 dBm/250 µW at M ±1, –13 dBm/40 µW at M ±2, –23 dBm/4 µW at M ±3, –30 dBm/1 µW at M ±4 and M ±5
	All measurement items	Frequency, deviation, frequency drift, Tx power, carrier-off power, template pass/fail, timing, adjacent channel emission
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation error: ≤±8% (at 288 kHz deviation, frequency 10 MHz to 2.2 GHz)
	Error rate measurement	Modes: FER, BER (Quick Mode), BER (Full Mode) Measurement pattern: 0000111100001111, 0011001100110011, 0101010101010101, 1010 64 x 1 64 x 0 1010, pseudo-random (D-M2), ETSI patterns Number of measurement bits: 1 to 99000 k
Call processing		Bearer setup, bearer release, hand-over, loopback

• **MX880131A PDC Measurement Software (extracts)**

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.5%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (50 kHz offset), ≥65 dB (100 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞

• **MX880132A PHS Measurement Software (extracts)**

Transmission measurement	Frequency/modulation measurement	Frequency range: 10 MHz to 2.2 GHz Modulation accuracy: ± (2% of indicated value + 0.7%)
	Amplitude measurement	Input level range: +10 to +40 dBm (average power within burst, MAIN connector) Transmitter power accuracy: ±10% (MAIN connector, after calibration by using built-in power meter)
	Adjacent channel power measurement	Measurement range: ≥60 dB (600 kHz offset), ≥65 dB (900 kHz offset)
	Batch measurement functions	Measurement time: ≤1.5 s (amplitude measurement in normal mode; occupied bandwidth and adjacent channel power measurement on high-speed mode)
Reception measurement	Signal generator	Frequency range: 10 MHz to 3 GHz Level range: –133 to –13 dBm (MAIN connector), –133 to +7 dBm (AUX connector) Modulation accuracy: ≤3%rms
	Error rate measurement	Measurement pattern: PN9, PN15 Number of measurement bits: 10^2, 10^3, 2556, 10^4, 10^5, 10^6, ∞

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MT8801C	Radio Communication Analyzer	
	Standard accessories	
J0576B	Coaxial cord (N-P · 5D-2W · P), 1 m:	1 pc
J0768	Coaxial adaptor (N-J · NC-P):	2 pcs
	Power cord:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
	Options*1	
MT8801C-01	Analog Measurement	
MT8801C-04	AF Low Impedance Output (requires Option 01)	
MT8801C-07	Spectrum Analyzer	
MT8801C-11	GSM Audio Test (requires MX880115A and Option 01)	
MT8801C-12	CDMA Measurement (requires Option 01)	
MX880113A	IS-136A Measurement Software (requires Option 01)	
MX880114A	AMPS/PCS1900 Measurement Software (requires Option 01)	
MX880115A	GSM Measurement Software	
MX880116A	PDC Measurement Software with Call Processing	
MX880117A	PHS Measurement Software with Call Processing	
MX880118A	DECT Measurement Software (requires Option 07)	
MX880131A	PDC Measurement Software	
MX880132A	PHS Measurement Software	
MX880201A-01	Soft Handoff (for CDMA, requires Option 12)	
	Peripherals	
MD6420A	Data Transmission Analyzer	
MS2683A	Spectrum Analyzer	
MG3681A	Digital Modulation Signal Generator	
	Optional accessories	
J0127C	Coaxial cord (BNC-P · G-58A/U · NC-P), 0.5 m	
J0769	Coaxial adapter (BNC-J · NC-P)	
J0040	Coaxial adapter (N-P · NC-J)	
MA1612A	Four-Point Junction Pad	
J0395	Fixed attenuator for high power (30 dB, 30 W, dc to 9 GHz)	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
B0329D	Front cover (1MW 5U)	
B0331D	Front handle kit (2 pcs/set)	
B0332	Joint plate (4 pcs/set)	
B0333D	Rack mount kit	
B0334D	Carrying case (hard type, with protective cover and casters)	
J0742A	RS-232C cable (for PC-98 PC, D-sub 25-pin), 1 m	
J0743A	RS-232C cable (for DOS/V PC, D-sub 9-pin), 1 m	

*1: Installed in Anritsu. It can be retrofitted to an already purchased MT8801C. For details, contact your Anritsu sales representative.

RADIO COMMUNICATION TEST SYSTEM

ME7812 Series

GPIB

Low-Cost Automatic Test System for cdmaOne/PDC/PHS Mobile Stations

The ME7812 series test system is for automatic testing of cdmaOne mobile station for both the Japanese ARIB system and the North-American IS-95 system and PDC/PHS mobile stations. It can also be used for testing dual mode stations of the North-American AMPS (analog) and cdmaOne.
The test method can be selected from the IS-95A, J-STD-008, ARIB STD-T53 KOREA-PCS (cdmaOne), RCR STD-27 (PDC) and RCR STD-28 (PHS) standards, the TELEC Technical Standard Conformity Certification, and a high-speed method.
A full range of options permits the test system to be configured for both production lines and specific applications. A personal computer running Windows 98 can be used as a system controller.

Models	Application systems
ME7812A	cdmaOne
ME7812B	cdmaOne, PDC
ME7812C	cdmaOne, PHS
ME7812D	cdmaOne, PDC, PHS
ME7812E	PDC
ME7812F	PHS
ME7812G	PDC, PHS

Features

- Standards-based measurement
- Easy-to-understand GUI operations and help guide

Functions and performance

• LAN connection, data collection and system management
A network of plural test systems can be constructed easily using the Windows 98 Network Drive Assignment function. The test conditions and data can be saved into a server*1. In addition, network construction services are supported.
*1: Requires LAN card in PC

• Automatic correction of frequency characteristics
The I/O frequency characteristics of the test system with the options must be corrected. The MX781250A Level Correction Software measures the correction data automatically. Maintenance and periodical updates are made easily using these corrected frequency characteristic values. I/O level errors can be detected by comparing the current and previous corrected values.

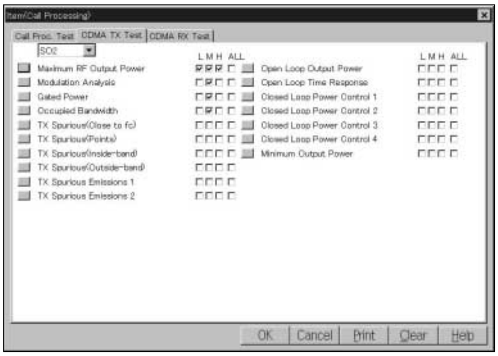
• Switching unit for continuous tests
The ME7411A Switching Unit for Transceiver Continuous Test is used for testing two mobile stations alternately. It eliminates the time required to change mobile stations, allowing continuous testing*2.
*2: The ME7410A or ME7413A switches the RF signals.

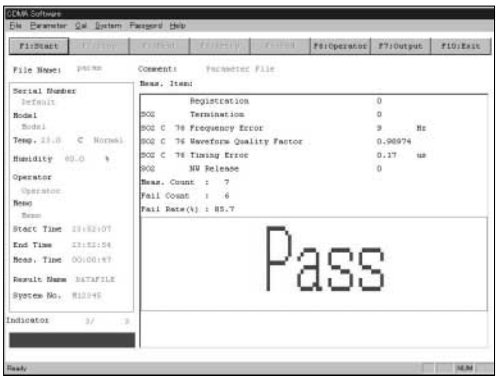
• Compact high-performance coaxial switch
The ME7413A Coaxial Switch can be connected directly to the RF I/O connector of the MT8801B/C and MT8802A. It is especially suitable for maintenance of mobile stations. The power is supplied and controlled from the controller.

• For maintenance of mobile stations
Call processing allows PDC, PHS, and cdmaOne mobile stations to be tested in the actual operation conditions (communication mode). Communication test is also possible.

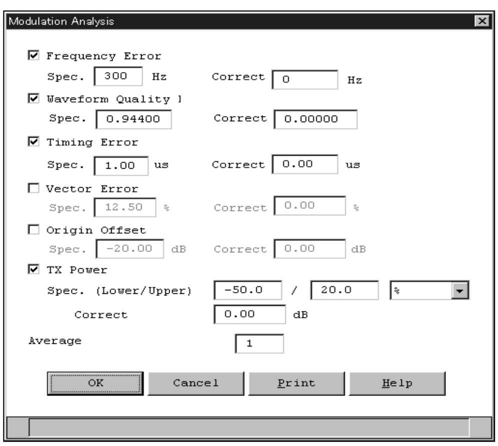
• High-speed measurement
TELEC Technical Standard Conformity Test items, such as frequency, transmission rates, antenna power, carrier-off leakage power, occupied bandwidth, adjacent channel power, spurious emissions and radiated spurious emissions can be measured for PDC/PHS in less than 30 seconds.

• Test by call processing or test mode control
Any frequency channel (L, M, H, ALL) can be selected for each test item of call processing or test mode control. The selected items can be tested continuously.

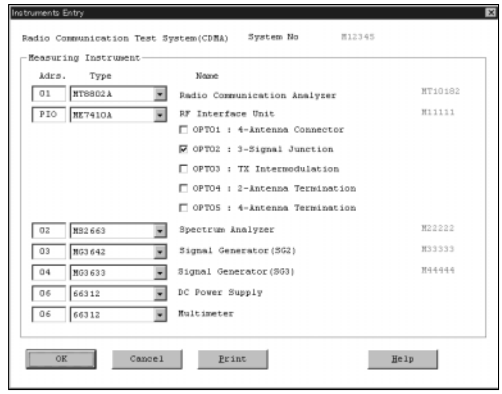




• Flexible tests with various parameters
Specifications and average, etc., parameters can be set for each test item, providing optimum test conditions suitable for the mobile station model or test purpose.

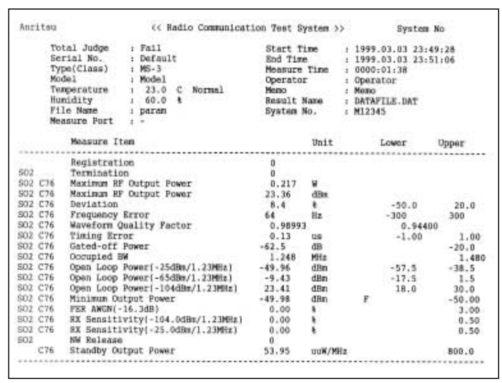


• Free choice of system components
System components can be chosen to match the required functions. For example, a signal generator can be chosen for 3-signal application.

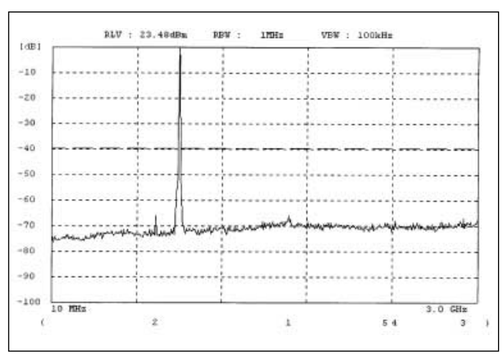


• Help guide
A help guide supports the software products. Either Japanese help guide or the English help guide (only for cdmaOne) can be selected at installation.

• Example of test data output



Data printout



Graphical data printout

Only cdmaOne graphical data can be saved on disk.

Test items (For system construction, please refer to the individual data sheet.)

• **ME7812A/B/C/D**

Measurement items	System	cdmaOne		
	Options	Standard	Option 03/13	Option 04
CDMA TX tests	Maximum RF output power	●		
	Frequency error	●		
	Waveform quality factor	●		
	Transmit time error	●		
	Gated output power	◆		
	Occupied bandwidth	●		
	TX spurious (close to fc) at maximum RF output power	●		
	TX spurious (points) at maximum RF output power	●		
	TX spurious (inside-band) at maximum RF output power		●	
	TX spurious (outside-band) at maximum RF output power		●	
	TX spurious emissions		●	
	Open loop output power	■		
	Time response of open loop power control	■		
	Range of closed loop power control	■		
	Minimum controlled output power	●		
	Stand-by output power	■		
	Access probe output power	■		
CDMA RX tests	Demodulation of forward traffic channel in AWGN	■		
	Receiver sensitivity and dynamic range	■		
	Single tone desensitization			■
	Intermodulation spurious response attenuation			■
	RX spurious emissions		●	
Analog TX tests	RF frequency error	◆		
	RF output power	◆		
	Compressor	◆		
	Transmit electrical audio response	◆		
	Modulation deviation limiting	◆		
	SAT	◆		
	SA	◆		
	FM hum and noise	◆		
	Modulation distortion	◆		
Analog RX tests	RF sensitivity	◆		
	RSSI	◆		
	Electrical audio frequency response	◆		
	Audio muting	◆		
	Expander	◆		
	Hum and noise	◆		
	Audio harmonic distortion	◆		
Call processing test	CDMA origination and termination	■		
	Voice test	■		
	CDMA-to-analog hand-off	■		
	Analog origination/release	■		
DC test*1	Current consumption	●		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control
*1: A DC power supply and a multimeter are required.

• **ME7812B/D/E/G**

Measurement items	System	PDC					
	Software	MX781217A (with processing)			MX781232A		
	Options	Standard	Option 03/13	Option 04	Standard	Option 03/13	Option 04
TX tests	Frequency error	●			◆		
	Modulation accuracy	●			◆		
	Transmission rate	●			◆		
	Antenna power deviation	●			◆		
	Leakage power during carrier-off	●			◆		
	Burst transmission transient response characteristics	●			◆		
	Occupied bandwidth	●	●		◆	◆	
	Adjacent channel power	●	●		◆	◆	
	Transmission timing	■			◆		
	Spurious emission strength		●			◆	
	Transmission intermodulation			◆*2			◆*2
	Transmission output control characteristics	●			◆		
	Time alignment	■					
RX tests	Receiver sensitivity	◆			◆		
	Bit error rate floor characteristics	◆			◆		
	Interference level			◆			◆
	Adjacent channel selectivity			◆			◆
	Intermodulation characteristics			◆			◆
	Spurious sensitivity			◆			◆
	Receiver level detection	●			◆		
	Network quality detection	●			◆		
	Secondary emission strength		◆			◆	
Call processing test	Origination/termination disconnection	■					
	Voice test	■					
DC test*1	Current consumption	●			◆		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control
*1: A DC power supply and a multimeter are required.
*2: ME7410A-03 and ME7812B/C/D-03 are required.

• **ME7812C/D/F/G**

Measurement items	System	PHS					
	Software	MX781217A (with processing)			MX781232A		
	Options	Standard	Option 03/13	Option 04	Standard	Option 03/13	Option 04
TX tests	Frequency error	●			◆		
	Modulation accuracy	●			◆		
	Transmission rate	●			◆		
	Antenna power deviation	●			◆		
	Leakage power during carrier-off	●*2			◆*2	◆	
	Burst transmission transient response characteristics	●			◆		
	Occupied bandwidth	●	●		◆	◆	
	Adjacent channel power	●	●		◆	◆	
	Transmission timing	■			◆*4		
	Spurious emission strength		●			◆	
	Transmission intermodulation			◆*3			◆*3
	Transmission output control characteristics	◆			◆		
	2 signal 3rd order distortion					◆*4	
RX tests	Receiver sensitivity	◆			◆		
	Bit error rate floor characteristics	◆			◆		
	Interference level			◆			◆
	Adjacent channel selectivity			◆			◆
	Intermodulation characteristics			◆			◆
	Spurious sensitivity			◆			◆
	Receiver level detection	◆			◆		
	Network quality detection						
	Secondary emission strength		◆			◆	
Call processing test	Origination/termination disconnection	■					
	Voice test	■					
DC test*1	Current consumption	●			◆		

● : Tests with call processing and test mode control
■ : Test with call processing
◆ : Test with test mode control
*1: A DC power supply and a multimeter are required.
*2: High-speed method only
*3: ME7410A-03 and ME7812B/C/D-03 are required.
*4: PHS base station (CS) test only

SHIELD BOX
MA8120A

CE

Suitable Shield Box for the Test of Mobile Phones

- The internal wide-band antenna (800 to 2500 MHz) enables the testing of W-CDMA, cdma2000®, GSM, PDC, PHS mobile terminals and Wireless LAN terminals etc. using air connection.
- Both air and coaxial connections between mobile phones and the MA8120A are available.

Specifications

Frequency	800 to 2500 MHz
Shield characteristic	≤–60 dB
Interface	RF connector: N type Control connector: DX50
Dimensions and mass	320 (W) x 132.5 (H) x 370 (D) mm, ≤3.5 kg
Environment conditions	Temperature: +10˚ to +50 ˚C (operating), –20˚ to +60 ˚C (storage)
LVD	EN61010-1: 2001 (Pollution Degree 2)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MA8120A	Shield Box	
	Standard accessories	
B0509	UE holder:	1 pc
W2115AE	MA8120A operation manual:	1 copy
	Application parts	
J1150D	Coaxial cable (N-P · N-P, 170 mm)	
J1150G	Coaxial cable (N-P · N-P, 3 m)	
J1152E	Control I/F cable [DX50 · DX50, 3 m, for external measurement equipment connection cable (control signal line)]	
J1151A	Control I/F cable for PC (DX50 · USB, for PC connection)	
J1152B	Control I/F cable [DX50 · DX50, 170 mm, for external measurement equipment connection cable (control signal line)]	
J1153A	UE I/F cable (for W-CDMA mobile phone connection inside MA8120A, control signal)	
J1155A	UE I/F cable with RF (for W-CDMA mobile phone connection inside MA8120A, control signal and RF)	
J1157A	Control cable for PC (DX50 · D-sub 9 pin, for PC connection)	
J1215A	UE I/F cable (DX36 · USB A TYPE FEMALE, for USB connection inside MA8120A)	

***Bluetooth*™ TEST SET**

MT8850A

2.4 GHz Reference *Bluetooth* Transceiver

Bluetooth™ CE

Test Bluetooth Modules and Products with a Bluetooth Interface

MT8850A makes RF measurements on Bluetooth modules and Bluetooth products, quickly and at low cost. All measurements are made in accordance with the Bluetooth RF Test Specification.
MT8850A establishes a Bluetooth link with the EUT (Equipment Under Test) using standard signaling. MT8850A is the Master, establishing the link by Paging the EUT. The EUT BT address can be entered manually or through the GPIB port. If the EUT BT address is not known, you can use Inquiry or read the address directly through the EUT HCI interface (RS 232).
Test Mode is then activated in the EUT and RF measurements performed. When the EUT is in Test Mode, the MT8850A has complete control over its operation. The EUT can be put into loopback or TX test mode, frequency hopping can be disabled or the EUT sent to defined TX and RX frequencies as required by the test specification.
The MT8850A runs a selected test script. A test script comprises of all (or a user selected subset) of the available RF measurements. The user can modify the measurements by editing test frequencies, number of bits/packets tested, hopping On or Off, whitening On or Off, and Pass/Fail limits. Pre programmed "qualification" and "quick test" scripts plus user-defined scripts. Script results can be viewed on the screen and accessed over the GPIB. In addition any individual measurement can be run continuously.

Features

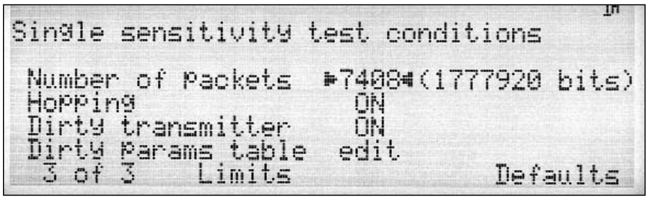
• Fast - 5 second test time
The rapid "Quick Test" measurement script is pre-configured for ease of operation. Production test scripts can run in as little as 5 seconds, measuring power, frequency, modulation and receiver sensitivity (BER).

• One touch testing
Once the MT8850A has been configured, each device is tested with a single keystroke. Press RUN to initiate a link, activate Test Mode, perform the measurements and report the results.

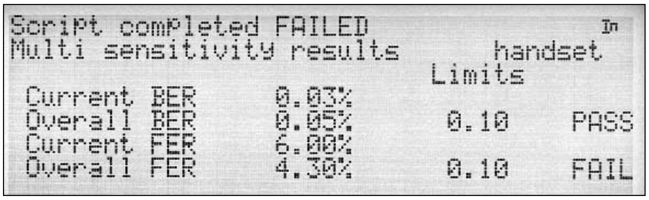
• Authoritative
Tests are made exactly as defined in the Bluetooth RF Test Specification. All measurements are traceable to International Standards so that you can be totally confident in both your production testing and design proving.

• Reference Bluetooth transceiver
A custom design transceiver offers <1 kHz frequency accuracy at the start of any packet and full compliance with the requirements for the "Dirty Transmitter" for true receiver sensitivity measurements. In addition to the standard dirty transmitter table, you can define customised stress conditions with user settable values of Carrier Frequency Offset, Modulation Index, Symbol Timing Error and simulated carrier frequency drift.

• Editing tests
Define your own test scripts to customise the test measurements to your specific requirements. Each test can be enabled or disabled and within any test, parameters such as hopping can be enabled or disabled, the number of measured packets defined and the specific frequencies of testing set up.



• Single test mode
A single test can be run continuously so that, for example, the BER of a link can be monitored as additional interfering Bluetooth devices are activated or the distance between the EUT and the MT8850A increased.



• Remote control
Both GPIB and RS 232 interfaces are offered as standard. Creating test programs has been simplified by the MT8850A's capability for initiating a test using a single command and then having results returned in a single string.

• Small size and weight
MT8850A takes up minimal space in your test system, thanks to its half-rack size and light weight. Where Bluetooth interfaces are being introduced into existing products, the disturbance to the test system is minimised.

- **Field upgradeable**

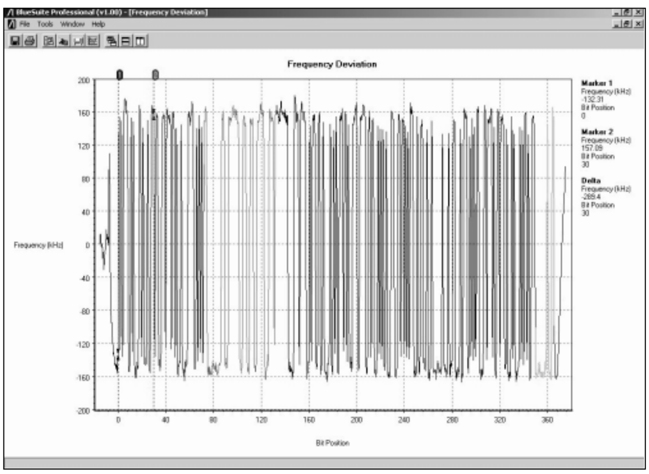
The Bluetooth protocol stack is held in FPGA so that future releases of the core Bluetooth specification can be installed locally. The instruments main program is held in flash memory; consequently, product enhancements can be downloaded in the field.

BlueSuite support software

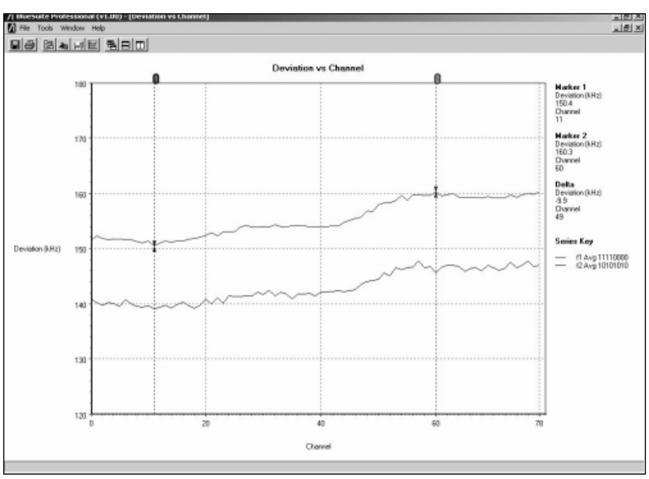
The standard BlueSuite software package, supplied at no charge with every MT8850A, gives PC control of the MT8850A/MT8852A for advanced design proving measurements on Bluetooth radios. Use BlueSuite to view packet modulation, power burst profiles and modulation eye diagrams. The standard BlueSuite software also offers a PC user interface for defining custom test scripts and reading script results into the PC. For interoperability testing during protocol development, BlueSuite offers a LMP message log capture facility. This can be used to view LMP messages between the MT8850A and the EUT during the initialisation of the link and while tests are running.

Upgrade to BlueSuite Pro to display graphs of the output power, deviation, carrier drift and sensitivity on each of the 79 channels. BlueSuite Pro also includes automated sensitivity search software for automatic measurements of BER and FER against receiver input level.

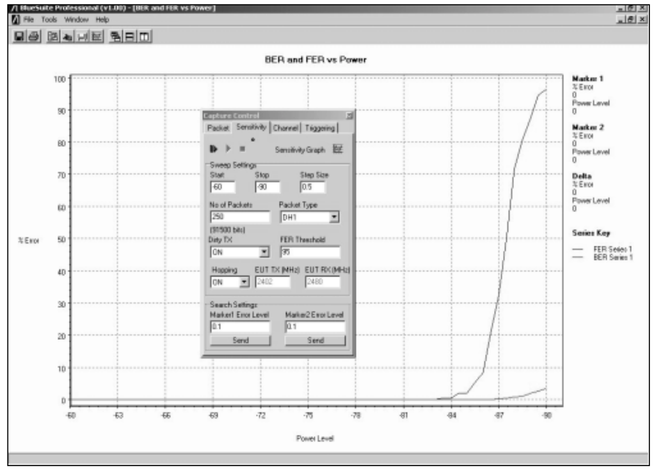
To help track down the cause of occasional rogue packets, BlueSuite Pro can be configured to only capture a packet trace when the packet fails any specific measurement.



Bluetooth DH1 packet deviation viewed with BlueSuite. Trace is colour coded such that; red is pre-amble, light blue is access code, brown is header, dark blue is payload and green is CRC.



BlueSuite Pro measures deviation for 10101010 and 11110000 payloads on each channel.

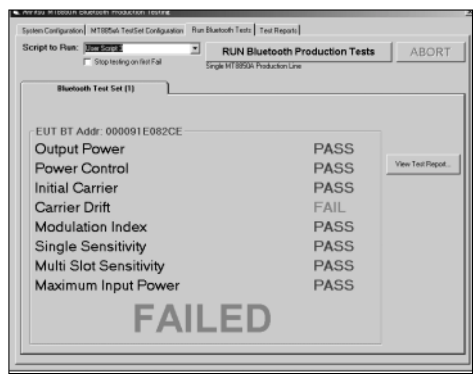


Automatic sensitivity search measured with BlueSuite Pro. Blue trace shows FER and red trace BER.

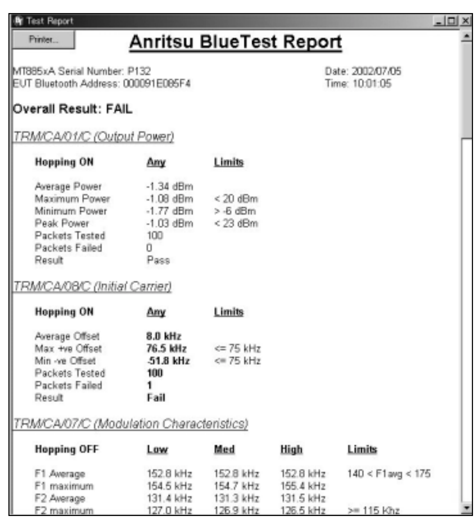
BlueTest production test software

The BlueTest PC software package controls up to 16 MT8850A/MT8852A Bluetooth Test Sets. It is designed for users requiring rapid testing of multiple devices such as modules. BlueTest software offers a simple interface for configuring scripts, triggering multiple instruments to start testing and reading script results back into the PC. The results are stored into a database from which they can be printed or archived for future analysis.

BlueTest software is supplied as standard with all MT8850A/MT8852As.



Results screen for BlueTest software.



Typical BlueTest test report.

Note: For MT8850A specifications and ordering information, see pages 294 – 298.

Bluetooth™ TEST SET
MT8852A
2.4 GHz Reference *Bluetooth* Transceiver

For RF and Audio Measurements on Bluetooth Radios

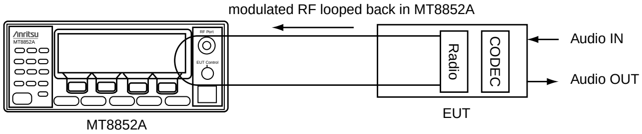
The new MT8852A Bluetooth test set offers all the functionality of the MT8850A plus the ability to make measurements on audio Bluetooth channels. Consumer products such as headsets, audio gateways and in-car consoles that offer voice over Bluetooth will require audio measurements as well as radio layer measurements. The MT8852A offers full audio test capability. It is fully compliant with all the functionality defined in the Bluetooth audio specification. MT8852A supports all three codec air interfaces (µ-law, A-law and CVSD) on up to three SCO audio channels. Rear-panel jack-plug connectors provide analog inputs and outputs for all three audio channels to give a convenient interface to audio signal sources and analyzers.
The MT8852A Bluetooth Test Set performs audio measurements by establishing a Synchronous Connection Oriented (SCO) link between the MT8852A and the EUT. A SCO link is a full duplex link between a Bluetooth master and slave.

Note: It should be noted that SCO is an optional feature within the Bluetooth specification. The MT8852A can be used to establish a SCO link and transmit HV packets to, or from, the EUT. To perform audio measurements, an audio signal source and audio analyzer are also required.

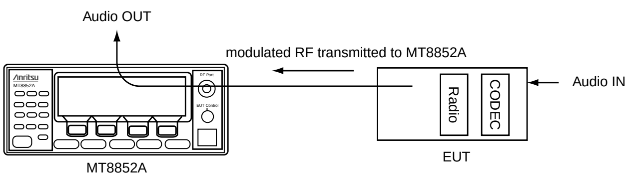
There are four basic scenarios in which audio measurements may be made. The four test scenarios are:

- Testing the EUT's audio performance using remote loopback on the MT8852A.
- Testing the audio performance of the EUT transmit path.
- Testing the audio performance of the EUT receive path.
- Putting the EUT into remote loopback.

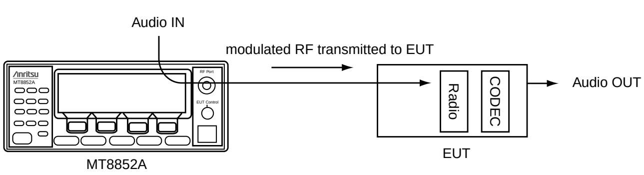
Testing the EUT's Audio Performance Using Remote Loopback on the MT8852A
The EUTs audio performance can be tested using the set-up below. The MT8852A is put into remote loopback and the audio path tested without passing the signal through the MT8852A CODEC. The audio is looped back in the MT8852A baseband and so there is no audio distortion introduced by the tester.



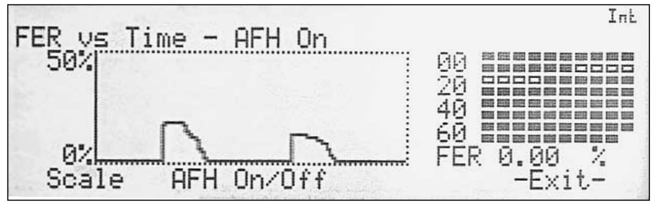
Testing the Audio Performance of the EUT Transmit Path
The performance of the EUT transmitter can be tested in isolation with the set-up shown below.



Testing the Audio Performance of the EUT Receive Path
The performance of the EUT receiver can be tested in isolation with the set-up shown below.
As a replacement for the external audio IN, it is also possible to use an internally generated tone. Use of this tone is ideal for quick tests and as it is generated internally, it does not pass through the MT8852A CODEC. The tone is fixed at 1kHz. For measurement at other frequencies use of external audio is required.



Adaptive Frequency Hopping option (MT8852A only)
Option 15 adds the ability to test the Bluetooth specification 1.2 Adaptive Frequency Hopping (AFH) capabilities of an EUT. This option provides the following measurement capability; real time display of frame error rate vs time and excluded channels vs time with AFH on, audio measurements with AFH on, display of EUT local assessment channel map. These measurements offer a standardised method to assess the performance of AFH capable devices in the presence of interfering signals such as 802.11bg WLAN and DECT.



Specifications

Output power	General	MT8850A/MT8852A measures average and peak power according to the Bluetooth RF Test Specification. Measurement of output power is made with the EUT in test mode, loopback enabled and hopping on. MT8850A/MT8852A transmits the longest supported packets and longest supported payload length, with a PRBS 9 payload. Power is measured at three defined frequencies. MT8850A/MT8852A identifies the position of p0 and measures the power of every bit in the packet.	
	Link conditions	Hopping	OFF or ON – measure at Defined, All or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Average power, peak power
		Number of measurement frequencies	User selectable, Defined (3), All, or Any
		Measurement range	+22 dBm to -35 dBm average power (+23 dBm peak power)
		Resolution	0.1 dB
		Accuracy	+20 dBm to -35 dBm, ±1 dB +22 dBm to +20 dBm, ±1.5 dB
		Speed	Greater than 300 DH1 packets/sec. with hopping mode set to "Any".
Modulation characteristics	General	MT8850A/MT8852A measures modulation characteristics according to the Bluetooth RF Test Specification. Measurement of modulation characteristics is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits longest supported packets, with the defined payload to the EUT. Modulation characteristics are measured at three defined frequencies.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	11110000 and 10101010
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Supported measurements: Frequency deviation. Δf1max, Δf2max, Δf1avg, Δf2avg and Δf2avg/Δf1avg plus % of Δf2max < 115 kHz
		Number of measurement frequencies	Three, default to qualification specification or user defined
		RF input measurement range	+20 dBm to -35 dBm
		Deviation measurement range	0 Hz to 350 kHz peak
		Deviation resolution	1 kHz
		Accuracy	1 kHz
Power control	General	MT8850A/MT8852A measures power control according to the Bluetooth RF Test Specification. Measurement of power control is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload. Power control is measured at three defined frequencies. MT8850A/MT8852A uses standard LMP commands to set the EUT power. MT8850A/MT8852A identifies the position of p0 and measures the power of every bit in the packet.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Maximum power, minimum power, maximum step size, minimum step size, and power at each power step.
		Number of measurement frequencies	Three, default to qualification specification or user defined
		Measurement range	+22 dBm to -35 dBm average power (+23 dBm peak power)
		Resolution	0.1 dB
		Accuracy	+20 dBm to -35 dBm, ±1 dB +22 dBm to +20 dBm, ±1.5 dB

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Initial carrier frequency tolerance	General	MT8850A/MT8852A measures initial carrier frequency tolerance according to the Bluetooth RF Test specification. Measurement of initial carrier frequency is made with the EUT in test mode, TX mode and hopping on and/or off. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload. Initial carrier frequency is measured at three defined frequencies. MT8850A/MT8852A identifies the position of p0 and measures the average frequency of the 4 preamble bits.	
	Link conditions	Hopping	OFF or ON – measure at Defined, All, or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	PRBS 9
		Packet type	DH1
	Measurement	Supported measurements	Initial carrier frequency error
		Number of measurement channels	User selectable, Defined (3), All, or Any
		RF input measurement range	+20 dBm to -35 dBm
		Initial frequency error measurement range	0 Hz to ±150 kHz
		Frequency resolution	1 kHz
		Accuracy	1 kHz
		Speed	Greater than 300 DH1 packets/sec. with hopping mode set to "Any".
Carrier frequency drift	General	MT8850A/MT8852A measures carrier frequency drift according to the Bluetooth RF Test Specification. Measurement of frequency drift is made with the EUT in test mode, with either loopback or transmitter test mode enabled. EUT transmits longest supported packets, with a 10101010 payload to the EUT. Measurements are made with hopping off and then with hopping on. Frequency drift is measured at three defined frequencies with hopping off and every frequency with hopping on.	
	Link conditions	Hopping	OFF or ON – measure at Defined, All, or Any frequencies
		Test mode	ON
		Loopback	Loopback or TX mode
		Payload	10101010
		Packet type	DH1, DH3, DH5
	Measurement	Supported measurements	Carrier frequency drift
		Number of measurement frequencies	User selectable, Defined (3), All, or Any
		RF input measurement range	+20 dBm to -35 dBm
		Frequency drift measurement range	0 Hz to 200 kHz, and > 2000/50 µs
		Frequency resolution	1 kHz
		Accuracy	Accuracy
Sensitivity - single slot packets	General	MT8850A/MT8852A measures single slot sensitivity according to the Bluetooth RF Test Specification. BER and FER are measured with the EUT in test mode and loopback on. MT8850A/MT8852A transmits DH1 packets, with a PRBS 9 payload to the EUT. The user can select to run the measurement with hopping on or off. Dirty transmitter conditions as defined in the *Bluetooth* test specifications can be enabled.	
	Link conditions	Hopping	OFF or ON, user selectable
		Test mode	ON
		Loopback	ON
		Payload	PRBS 9
		Packet type	DH1
		Dirty transmitter (as defined in RF test spec)	ON or OFF, user selectable

Continued on next page

<table>
<tr><td rowspan="20">Sensitivity - single slot packets</td><td rowspan="20">Measurement</td><td>Supported measurements</td><td colspan="4">BER, total number of bit errors and FER</td></tr>
<tr><td>Number of measurement frequencies</td><td colspan="4">Three with hopping off, or hopping on</td></tr>
<tr><td>Number of measured bits</td><td colspan="4">1 to 32,768 packets (216 to 7,077,888 bits)</td></tr>
<tr><td>MT8850A/MT8852A transmitter output range</td><td colspan="4">0 to –90 dBm, resolution 0.1 dB</td></tr>
<tr><td>BER/FER measurement range</td><td colspan="4">0.00% to 100%</td></tr>
<tr><td>BER/FER resolution</td><td colspan="4">0.01%</td></tr>
<tr><td rowspan="14">Dirty transmitter specification</td><td colspan="4">MT8850A/MT8852A transmits for the first 20 ms with the first set of measurement conditions, the second 20 ms with the second set of measurement conditions up to the tenth set of conditions. The cycle is then repeated until the test is complete.</td></tr>
<tr><td>Measurement conditions</td><td>Carrier frequency offset</td><td>Modulation index</td><td>Symbol</td></tr>
<tr><td>1</td><td>75 kHz</td><td>0.28</td><td>–20 ppm</td></tr>
<tr><td>2</td><td>14 kHz</td><td>0.30</td><td>–20 ppm</td></tr>
<tr><td>3</td><td>–2 kHz</td><td>0.29</td><td>+20 ppm</td></tr>
<tr><td>4</td><td>1 kHz</td><td>0.32</td><td>+20 ppm</td></tr>
<tr><td>5</td><td>39 kHz</td><td>0.33</td><td>20 ppm</td></tr>
<tr><td>6</td><td>0 kHz</td><td>0.34</td><td>–20 ppm</td></tr>
<tr><td>7</td><td>–42 kHz</td><td>0.29</td><td>–20 ppm</td></tr>
<tr><td>8</td><td>74 kHz</td><td>0.31</td><td>–20 ppm</td></tr>
<tr><td>9</td><td>–19 kHz</td><td>0.28</td><td>–20 ppm</td></tr>
<tr><td>10</td><td>–75 kHz</td><td>0.35</td><td>+20 ppm</td></tr>
<tr><td colspan="4">In addition to the above measurement conditions, MT8850A/MT8852A transmits with a sine wave, frequency modulation, with a deviation of ±25 kHz, rate 1.6 kHz, synchronized to zero phase at the packet start.</td></tr>
<tr><td>Dirty transmitter user control</td><td colspan="3">Any entry in the dirty transmitter table can be edited within the following ranges:
• Carrier frequency offset: 0 Hz to 100 kHz, 1 kHz resolution
• Modulation index 0.25 to 0.38, 0.01 resolution
• Symbol timing error: 0 ppm, +20 ppm or 20 ppm</td></tr>
<tr><td rowspan="14">Sensitivity - multi-slot packets</td><td>General</td><td colspan="5">MT8850A/MT8852A measures multi-slot sensitivity according to the Bluetooth RF Test Specification. BER and FER are measured with the EUT in test mode and loopback on. MT8850A/MT8852A transmits DH5 packets (or DH3 packets if DH5 not supported by EUT), with a PRBS 9 payload to the EUT. The user can select to run the measurement with hopping on or off. Dirty transmitter conditions as defined in the Bluetooth test specifications can be enabled.</td></tr>
<tr><td rowspan="6">Link conditions</td><td>Hopping</td><td colspan="4">OFF or ON, user selectable</td></tr>
<tr><td>Test mode</td><td colspan="4">ON</td></tr>
<tr><td>Loopback</td><td colspan="4">ON</td></tr>
<tr><td>Payload</td><td colspan="4">PRBS 9</td></tr>
<tr><td>Packet type</td><td colspan="4">DH3, DH5</td></tr>
<tr><td>Dirty transmitter
(as defined in RF test spec)</td><td colspan="4">ON or OFF, user selectable</td></tr>
<tr><td rowspan="7">Measurement</td><td>Supported measurements</td><td colspan="4">BER, total number of bit errors and FER</td></tr>
<tr><td>Number of measurement frequencies</td><td colspan="4">Three with hopping off, or hopping on</td></tr>
<tr><td>Number of measured bits</td><td colspan="4">1 to 32,768 packets (for DH3, 1,464 to 47,972,352 bits), (for DH5, 2,712 to 88,866,816 bits)</td></tr>
<tr><td>MT8850A/MT8852A transmitter output range</td><td colspan="4">0 to –90 dBm, 0.1 dB resolution</td></tr>
<tr><td>BER/FER measurement range</td><td colspan="4">0.00% to 100%</td></tr>
<tr><td>BER/FER resolution</td><td colspan="4">0.01%</td></tr>
<tr><td>Dirty transmitter specification</td><td colspan="4">As for single-slot sensitivity section except; in addition to the measurement condition table, MT8850A/MT8852A transmits with a sine wave, frequency modulation, with a deviation of ±40 kHz, rate 500 Hz (3 slots) or 300 Hz (5 slots), synchronized to zero phase at the packet start.</td></tr>
</table>

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Maximum input level	General	MT8850A/MT8852A measures BER and FER at the EUT maximum input level according to the *Bluetooth* RF Test Specification. Measurement is made with the EUT in test mode, loopback enabled and hopping off. MT8850A/MT8852A transmits the DH1 packets with a PRBS 9 payload. The MT8850A/MT8852A transmitter level is set so that the EUT receiver input level is -20 dBm. BER and FER are measured at three defined frequencies.	
	Link conditions	Hopping	OFF
		Test mode	ON
		Loopback	ON
		Payload	PRBS 9
		Packet type	DH1
	Measurement	Supported measurements	BER and FER for -20 dBm at receiver input
		Number of measurement frequencies	Three, default to qualification specification or user defined
		Number of measured bits	1 to 32,768 packets (216 – 7,077,888 bits)
		Transmitter power settable range	0 to –90 dBm
		Resolution	0.1 dB
EUT control interface		The EUT control interface provides HCI commands to EUT through a standard RS232 interface. Interface meets requirements of *Bluetooth* V1.1 specification for HCI UART transport layer. Cable supplied. The EUT control interface provides USB HCI commands to EUT through a standard USB interface. The interface meets the requirements of Bluetooth V1.1 specification section H:2. A USB cable is supplied (MT8852A only).	
Audio Specifications (MT8852A only)		Number of SCO channels supported	3
		Codec air interfaces supported	CVSD, A-Law, µ-Law
		Frequency response	(-3dB) measured CODEC in to CODEC out: 160Hz -3.5kHz. Measured with 50Ω source impedance and 10MΩ load impedance.
		Maximum input / output signal level	3.4 Vpk-pk = 1.2 V RMS.
		Distortion/noise	Greater than –40 dB relative to 1 kHz, 1 V RMS input/output.
		Input/Output connectors	3.5 mm audio jack plugs (one for each SCO channel)
		Input impedance	20 kΩ
		Minimum output load	600 Ω
		Internal audio source	1kHz fixed frequency
Adaptive Frequency Hopping (Option, MT8852A only)		Connections supported	ACL and SCO
		Displays	Active channels vs time, FER vs time, EUT local channel assessment map.
Frequency standard		Frequency	10 MHz
		Accuracy	±0.5 ppm at +25˚C
		Temperature Stability	±0.5 ppm, –10˚ to +85˚C
		Aging (1st year)	±1.0 ppm
		Aging (over 10 years)	±2.5 ppm, including year 1
Rear panel connectors		External frequency standard input	Rear panel BNC socket, 50 Ω 1 volt
		Output 1	TTL high when MT8850A TX on
		Output 2	TTL high when MT8850A RX active
		Input 1	For service use only
GPIB		IEEE 488.2. Offers full instrument control as standard. User can also read the 4 x over-sampled magnitude and frequency values of each data bit in the last measured packet.	
RS 232		RS 232 interface offering full instrument control as standard	
Power requirements		Supply	85 to 264 Volts AC 47 to 63 Hz 150 VA MAX
Environmental		Operating temperature	5 to +40ºC
		Operating humidity	20% to 75%
		Safety	Complies with IEC 1010-1
		EMC	Conforms to the protection requirements of EEC Council Directive 89/336/EEC.
Size and weight		Dimensions	216.5 x 88 x 380 mm
		Weight	<3.45 kg

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MT8850A/MT8852A signal generator		
Frequency	Frequency range	2.40 to 2.5 GHz
	Frequency resolution	1 kHz
	Frequency accuracy	As frequency standard ± 25 Hz
	Settling time (when hopping)	<160µs to ± 75 kHz during the establishing of a link. When a link has been established and the EUT been placed into test mode, the MT8850A/MT8852A transmitter is pre-tuned to ±1 kHz of the nominal channel frequency at the beginning of its data burst for both fixed frequency or hopping measurements.
Level	Amplitude range	0 to –90 dBm
	Amplitude accuracy	±1 dB to –80 dBm
	Amplitude resolution	±0.1 dB
	Output impedance	50 Ω (nominal)
	Output VSWR	1.5:1 (typically 1.3) Adjacent channels 3 or higher –40 dBc
	Spurious	30 MHz to 1 GHz: –36 dBc 1 to 12 GHz: –30 dBc 1.8 to 1.9 GHz: –47 dBc 5.15 to 5.3 GHz: –47 dBc or –80 dBm, whichever is greater
Modulation	Modulation	GFSK
	Modulation index	Variable, 0.25 to 0.38 (125 kHz to 190 kHz)
	Mod index resolution	0.01
	Mod index accuracy	1 kHz
	Baseband filter	BT=0.5
MT8850A/MT8852A measuring receiver		
Frequency	Range	2.40 to 2.5 GHz
	Resolution	1 kHz
	Settling time	<160 µs to 75 kHz during the establishment of a link. When a link has been established and the EUT has been placed into test mode, the MT8850A/8852A receiver is pre-tuned to ±1 kHz of the nominal channel frequency.
	Accuracy	As frequency standard ±25 Hz
	Measurement channel bandwidth	2 MHz 3dB bandwidth, flat response Fc ± 550 kHz, or 1.3 MHz 3dB bandwidth, flat response Fc ± 550 kHz.
Level	Range	+22 dBm to –35 dBm average power
	Power measurement accuracy	±1 dB (+20 dBm to –35 dBm)
	Input VSWR	1.5:1
	Damage level	+25 dBm
	Resolution	0.1 dB
Modulation	Modulation	GFSK
	Deviation measurement range	0 to 350 kHz peak
	Accuracy	1 kHz

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MT8850A	Bluetooth Test Set
MT8852A	Bluetooth Test Set with Audio
	Standard accessories
	MT885xA Operation Manual
	MT885xA Remote Programming Manual
	BlueSuite software (standard version)
	RS232 HCI control interface lead
	RS232 cable for firmware updates
	Power cord for destination country
	Certificate of calibration
	USB HCI control interface lead (MT8852A only)
	3.5 mm jack plug (MT8852A only)
	BlueTest software
	LabVIEW™ driver

Model/Order No.	Name
	Options and accessories
MT885xA-01	Rack Mount, single instrument
MT885xA-03	Rack Mount, side-by-side
MT885xA 10	Bluetooth antenna and adapter
MT8852A-12P/U	Headset Profile Emulator Software
MT8852A-15	Adaptive Frequency Hopping
MT8850A-20	Spare EUT/RS232 cable
MT8850A-21	Spare EUT/USB cable
MT8850A-30	Extra Operation and Programming Manual
D41310	Soft carry case with shoulder strap
2300-259	BlueSuite Pro software
MT885xA-98	Z540, SO25 calibration certificate + test data
MT885xA-99	PREMIUM Z540, ISO25 calibration certificate + test data

Bluetooth™ PREQUALIFICATION TEST SET SYSTEM (PQTS)
ME7865A
9 kHz to 3 GHz (20 GHz with option)

Bluetooth™ CE

For Prequalification Testing of all 16 RF Bluetooth Test Cases

The Anritsu ME7865A *Bluetooth* Prequalification Test System (PQTS) addresses the 16 test cases defined in the *Bluetooth* RF test specification.
Developed in partnership with CETECOM, (Centro de Tecnologia de las Comunicaciones S.A.) the ME7865A offers an integrated solution including all the necessary test instruments and test case software to rapidly characterise *Bluetooth* radios.

Applications

• Prequalification testing of chip sets
For *Bluetooth* chip set developers the ME7865A provides a test system that enables comprehensive testing of the radio performance before submission to a *Bluetooth* Qualification Test Facility (BQTF). This gives the developer a high degree of confidence that the chip set will achieve qualification first time.
All measurements are made in accordance with the *Bluetooth* RF test specification. The ME7865A generates test reports that are ideal for documenting the results from an EUT. Reports can include both numeric results as well as graphical traces of the measured packets.

• Module testing
After integrating a *Bluetooth* chip set onto a module, it is necessary to revalidate the RF performance. Module manufacturers will typically design a module that is based on a reference design from the chip set supplier.
When the module design is complete, the implementation must be tested and characterised. The ME7865A is the ideal test system for proving the performance of new module designs.

• Module selection
Selecting the appropriate module for integration into an end user product requires a complete understanding of the characteristics of each *Bluetooth* module.
The ME7865A provides a test system for comparative testing of chip sets and modules. This facilitates the selection of a *Bluetooth* module that is best suited to the specific product being developed.

• Selective test in volume production
The MT8850A Bluetooth Test Set has been developed for high speed testing of all products manufactured with a *Bluetooth* interface. MT8850A measures key radio parameters such as power, frequency, modulation and sensitivity in a test time of typically under 5 seconds. Volume manufacturers who wish to continuously monitor the quality of output often chose to selectively test a sample of the output more rigorously.
ME7865A is designed to be integrated into a high volume production test facility and used alongside the MT8850A for sample testing. The PC is supplied with a network interface so that results can be archived onto a company network.

• *Bluetooth* Qualification Test Facilities
Full qualification of a *Bluetooth* radio requires submission to a *Bluetooth* Qualification Test Facility (BQTF). The qualification process can be costly and time consuming. The ME7865A provides a solution for companies who wish to have a faster and lower cost analysis of their device before proceeding to full qualification.
The ME7865A reports generated will give the developer a full understanding of the performance of their device.
BQTFs can use ME7865A to offer a Prequalification test service.

Test management software

ME7865A software runs on an integrated rack mounted PC. The PC is supplied with a CD drive to facilitate software upgrades. A networking interface is also standard so that the ME7865A can easily be integrated into a company network. Free standing flat panel 15 inch TFT display, keyboard, and mouse are also supplied.
The ME7865A software consists of the following modules:

• Executable test cases
The RF test case software will control all of the instruments to perform the measurements automatically.

• ICS/IXIT modules
These modules contain the characteristics of the Equipment Under Test (EUT) for the selection of the applicable test cases. The data can be manually entered or read from the EUT supported features register.

• Configuration manager
The configuration manager is used to develop the test cases dependant on the contents entered into the IXIT module.

• Test case manager
The test case manager starts and finishes the test cases.
It also performs the verdict handling. The test case manager is also responsible for test case selection and the management of system files.

• Database and report generator
This module displays the results of test cases and generates reports in Microsoft Word format.

Transmitter measurements

• Output power

Output power measurements are made within the MT8850A *Bluetooth* Test Set. MT8850A identifies the position of P0 and measures the power in each of the bits within the packet. The average power across all the bits and the peak power are recorded.

• Power density

The power density measurement provides the peak power density in a 100 kHz bandwidth.
The measurement is made using the spectrum analyser. In the frequency domain a sweep over the ISM band is performed. The channel with the highest power is identified and this is set as the analyser's new centre frequency. A new one-minute single sweep is performed in the time domain. The power density is defined as the peak value of this trace.

• Power control

Power control tests allow for testing or calibration to be performed on the level control circuitry of the EUT.
This test is only performed on devices that support power control. The measure is performed in the same way as the average power measurement. The test verifies if power control step sizes are within the specified range.

• Transmit output spectrum tests

The transmit output spectrum measurements analyse the power levels in the frequency domain to ensure that out-of–channel emissions are minimised. The spectrum analyser performs these measurements. The *Bluetooth* specifications split the test into three parts; frequency range, –20 dB bandwidth, and adjacent channel power.
The frequency range measurement uses peak detection and validates that there is no spectral content outside the ISM band.
The –20 dB bandwidth test verifies the individual channel occupancy.
The adjacent channel power measurement uses average detection to validate the power spectral density over of all channels in the ISM band with a given wanted channel.

• Modulation tests

Modulation measurements reflect the performance of the modulator circuitry as well as local oscillator stability, and consist of modulation characteristics, initial carrier frequency tolerance and carrier frequency drift. Verification of modulation characteristics requires the ability to demodulate the *Bluetooth* signal so that the frequency of each bit can be determined.
For modulation characteristics, two sets of a repeating 8-bit sequence are used in the payload to check both the modulator performance and the pre-modulation filtering. Initial frequency error is measured by measuring the average frequency of the four preamble bits. Frequency drift is measured by comparing preamble bits with payload data. The maximum drift rate is also calculated in the payload.

Receiver measurements

BER is the parameter used to determine receiver performance. These tests perform BER analysis under various different conditions.

• Sensitivity tests

Sensitivity is tested by transmitting impaired signals (using a defined dirty transmitter) to the receiver. The transmitted power is fixed, with impairments defined in the test procedure, which include carrier frequency offset, modulation index variation and symbol timing error.

• Carrier-to-interference performance

C/I performance is measured by sending co-channel or adjacent channel *Bluetooth* modulated signals in parallel with the wanted signal and measuring the receiver's BER. One MT8850A delivers the wanted signal and a second MT8850A provides the PRBS15 interferer.

• Blocking performance

Blocking performance is measured by sending an out of band CW interfering carrier with the wanted signals in parallel and measuring the receiver's BER. One MT8850A delivers the wanted signal and a second source provides the CW interferer.

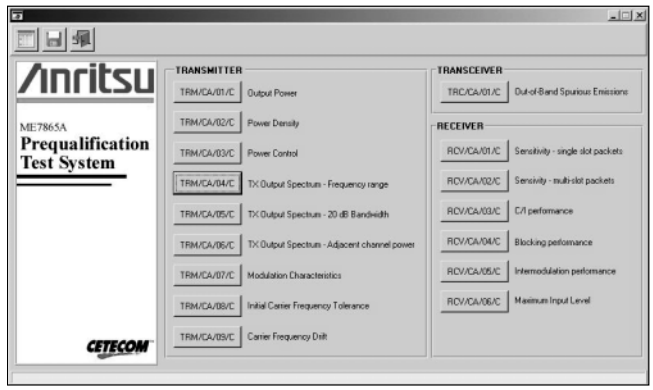
• Intermodulation performance

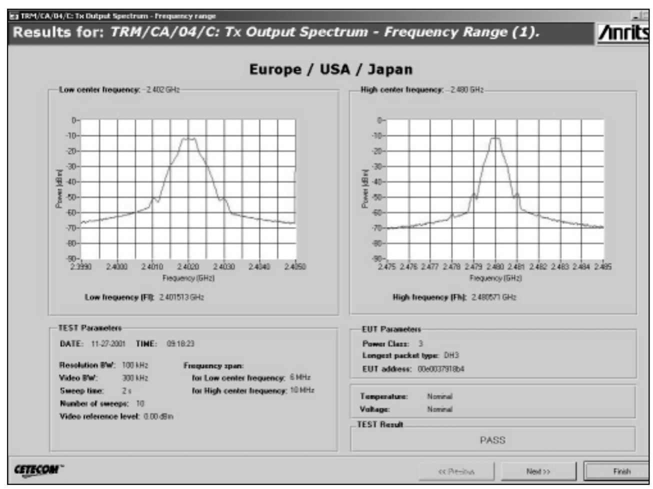
Intermodulation performance measures the effect of unwanted frequency components resulting from interaction between two interfering signals passing through receiver non-linear circuits. The test is performed by measuring receiver BER in the presence of an interfering modulated signal and a CW signal that generate an intermodulation product on the receiver operating frequency.

• Maximum input level

This test measures the BER performance when EUT input signal is at maximum input power level specified of –20 dBm.

Support services





• Software support and maintenance

The system support package provides customer technical support by email, fax, and telephone. Support staff are based in a European time zone and support response is guaranteed within one working day.
Following the release of the base line software, software upgrades will automatically be issued to customers on a maintenance contract. The ME7865A will be continually developed to follow changes to the RF Test Specification and to follow errata in the *Bluetooth* core specification.

System calibration

The ME7865A is supplied with an integrated power meter. Automated software routines calibrate the path losses from each measuring instrument port to the common EUT test port.
This path loss data is held in system files and corrected for during all measurements.

Supported measurements

Test case	Description
TRM/CA/01/C	Output Power
TRM/CA/02/C	Power Density
TRM/CA/03/C	Power Control
TRM/CA/04/C	TX Output Spectrum frequency range
TRM/CA/05/C	TX Output Spectrum 20 dB Bandwidth
TRM/CA/06/C	TX Output Spectrum Adjacent channel power
TRM/CA/07/C	Modulation Characteristics
TRM/CA/08/C	Initial Carrier Frequency Tolerance
TRM/CA/09/C	Carrier Frequency Drift
TRC/CA/01/C	Out-of-Band Spurious Emissions (conducted measurements to 3 GHz, manual measurement)
RCV/CA/01/C	Sensitivity – single slot packets
RCV/CA/02/C	Sensitivity – multi-slot packets
RCV/CA/03/C	C/I performance
RCV/CA/04/C	Blocking performance (3 GHz standard, 12.75 GHz with option 12 or 14)
RCV/CA/05/C	Intermodulation Performance
RCV/CA/06/C	Maximum Input Level

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
ME7865A	Bluetooth Prequalification Test System (comprises the following items integrated in a 12U rack).
	Test management software MT8850A *Bluetooth* Test Set (System *Bluetooth* controller version) MT8850A *Bluetooth* Test Set (System *Bluetooth* interferer version) MS2661C Spectrum Analyser with following options; Option 01 – reference crystal oscillator Option 02 –narrow resolution bandwidth filters Option 12 – quasi peak detector Option 20 – tracking generator ML2437A Power Meter MA2472A Power Sensor Combiner Network Unit Rack mount PC Microsoft Windows 2000 Operating System Microsoft Word 15 inch TFT PC display PC keyboard and mouse
	Options and accessories
Option 10	Replaces the 12U rack with a 34U rack on casters. This option adds a pull out EUT support shelf and space to integrate option 14.
Option 12	Free standing MG3692A CW signal generator, 10 MHz to 20 GHz RF test cable. For automated blocking measurements to 12.75 GHz
Option 14	(Only available with option 10) Rack mounted MG3692A CW signal generator, 10 MHz to 20 GHz. RF test cable. For automated blocking measurements to 12.75 GHz
Option 22	Software support and maintenance

W-CDMA AREA TESTER
ML8720B
2110 to 2200 MHz

For W-CDMA Base Station Area Investigation and Maintenance

The ML8720B is used for investigation and maintenance to evaluate the radio wave propagation characteristics in the area of a W-CDMA base station. When it is connected to a GPS receiver, the measured data can be correlated with positioning information (latitude and longitude).
The measurement items include functions for measuring the RSCP*1, Ec/No*2 and SIR*3, which is used to evaluate the strength of the radio wave received from each base station, and the delay profile, which is used to evaluate the delay characteristics of the radio wave caused by multipath propagation.
There are two measurement modes: the unspecified base station measurement mode, and the specified base station measurement mode. The CPICH*4 and SCH from the base station are measured in both cases. The unspecified base station measurement mode is used when the base station scrambling code is unknown. Search methods of scrambling code include SCH search method with SCH*5 and P-CPICH search method to directly search P-CPICH*6 without depending on SCH. The specified base station measurement mode is used when the base station scrambling code is known.

*1: RSCP (Received Signal Code Power)
*2: Ec/No (Ratio of desired receive power per chip to receive power density in the band.)
*3: SIR (Signal Interference Ratio)
*4: CPICH (Common Pilot Channel)
*5: SCH (Synchronization Channel)
*6: P-CPICH (Primary CPICH)

• High-speed and high-accuracy area analysis
RSCP, Ec/No and SIR can be measured at 30 cm intervals (at specified base station and single-channel measurement) while travelling at 100 km/h in a monitoring vehicle to provide fast and accurate area analysis.

• High-speed search with SCH
When SCH search is selected in unspecified base station mode, CPICH can be searched at high speed using the same SCH search method as user equipment. As one measurement example, 10 channels are searched for 4 sec on average and then the measurement is started.

• Correlation with GPS positioning data
The measured data can be correlated with GPS positioning data (latitude and longitude) and saved to a memory card. In addition, the measured data and positioning information can be downloaded at real time to an external PC via the RS-232C interface.

• High-accuracy measurement using diversity function
When used in combination with the optional diversity function, even higher-accuracy measurements, such as CPICH transmit diversity format and receive antenna diversity can be performed.

• Simultaneous measurement of two carrier frequencies
The optional Two Carrier Measurement function enables simultaneous measurement of two carrier frequencies in the specified base station measurement or the unspecified base station measurement.

• Indoor measurement support
Useful functions are offered for indoor measurement use; the fixed-point measurement for saving the data of specific measured points, the addition of comments to measured data and the automatic naming of data files before saving them.

• Handy type
At only 4 kg, the ML8720B is easily portable for both outside and inside work. 8.4-inch transparent color TFT-LCD display has been adopted (Standard).
For the use under direct sunlight, 7.8-inch reflective color STN-LCD display model is also available (Option 02)* .
*: Factory option (Display units can not be exchanged by customers)

• 3-hour battery operation
In the case of standard composition, the lithium-ion battery pack provides more than 3 hours of operation and a spare battery pack solves even long-term measurement problems.

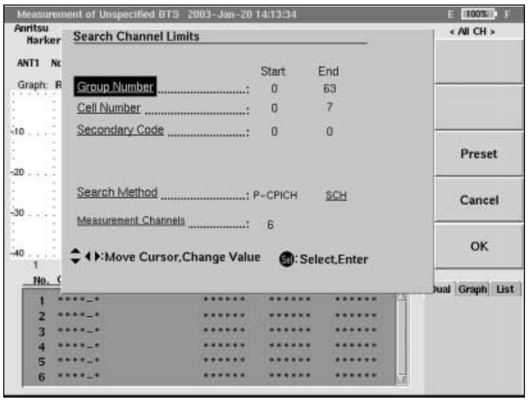
• Large-capacity memory cards
Large amounts of measured data can be saved to large-capacity flash-memory cards.

• Standalone operation
The control PC is not required externally. Basic measurements and data collection can be performed only by the ML8720B mainframe. Of course, the system can be extended in combination with area analysis software.

Measurement examples

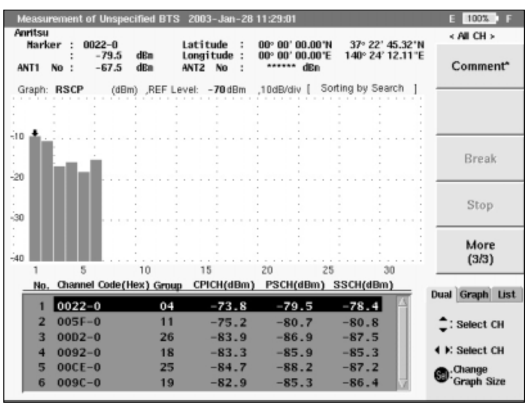
• Unspecified base station measurement

This screen is used to search for a receivable common pilot channel (CPICH) and to measure received signal code power (RSCP), ratio of desired receive power per chip to receive power density in band (Ec/No), and signal interference ratio (SIR) for up to 32 channels. Search method can be selected from either [SCH search] method to search in the same way as user equipment using SCH or [P-CPICH search] method to in order search 512 types of P-CPICH (Primary CPICH). Furthermore, hybrid measurement function, simultaneous measurement of searched CPICH and specified scrambling code's CPICH, is also available. With this function, the other receivable channels can be searched and measured with measuring known channels.



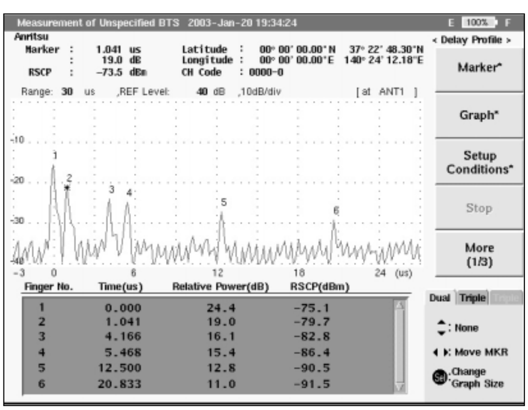
• Channel display

The measured results for all receive channels (32 max.) can be simultaneously displayed with a graph and data. Additionally, measurement interval setting and the cumulative processing (max., min., median, average) for the internally accumulated data within the span can be selected. However, in SCH, only average value can be chosen.



• Delay profile display

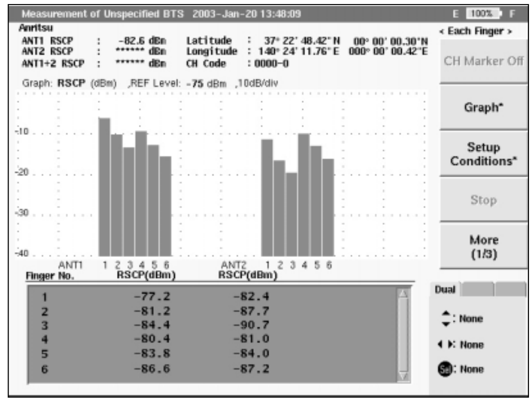
This displays the delay profile for one selected channel and the multipath can be visually confirmed. Furthermore, time, distance or the number of chip is selected for the horizontal axis.



• Finger display

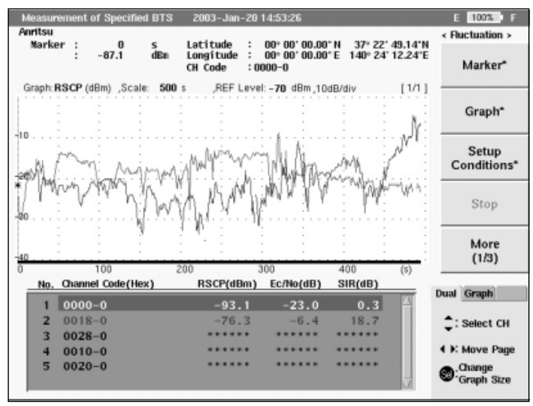
This displays the measured data for one selected channel path (finger). The RSCP for up to 12 paths can be simultaneously evaluated when the diversity option is installed.

RSCP per Finger can be outputted to a file for all channels under measurement when the measurement is performed in activated Each Finger data output. It is effective for multi-path environment analysis and indoor simulation based on acquired data.



• Time/Distance variation display

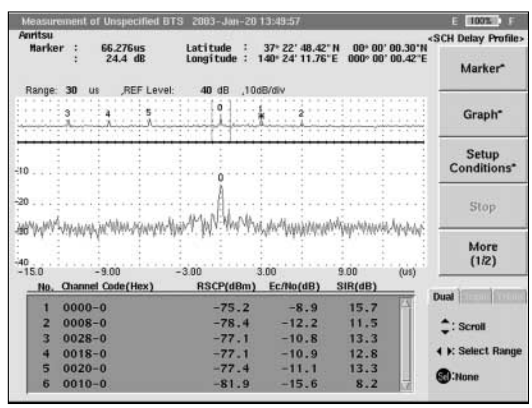
A time/distance variation of the RSCP, Ec/No and SIR are displayed for the selected channel (6 max). The time variation can be measured in 10 ms intervals for 10 ms to 500 s and the max., min., median or average value of the cumulative totals can be displayed. The distance variation can be measured using the vehicle wheel pulse (external trigger) for 1 to 500 pulses and the max., min., median or average value of cumulative totals can be displayed.



• SCH delay profile display

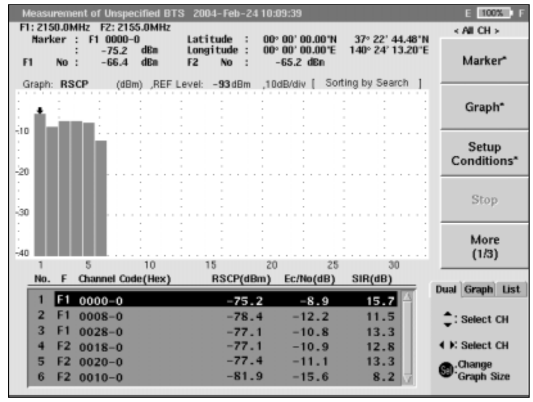
This displays the relative delay status between each base station with correlative value of P-SCH. This screen is used to confirm frame transmission timing gap or overlap between base stations.

Group No. is displayed on the graph to recognize base stations. Time or the number of chip can be selected for the horizontal axis.



• Screen display of two carrier frequency measurement (all channel display)

The number of channels to be measured is 32 at max. for two carrier frequencies.
Simultaneous measurement of multiple carrier frequencies enhances the measurement efficiency. Also, carrier frequencies of others can be simultaneously measured for comparison.



Specifications

Frequency range	2110 to 2200 MHz
Input impedance	50 Ω (SMA-type connector)
Frequency setting resolution	200 kHz (W-CDMA measurement mode), 1 kHz (spectrum monitor mode)
Reference oscillator	Aging rate: ±1 x 10^{-6}/year
Receive signals	P-CPICH, S-CPICH, P-SCH, S-SCH
Power measurement	Measurement range W-CDMA measurement mode: –117* to –33 dBm, Power at the end of RF input connector 1 and RF input connector 2 (when any of the Option 03/23/43 is equipped). Spectrum monitor mode: –123* to –33 dBm, Power at the end of RF input connector. *: When the built-in divider of option 03/23/43 is used, the level of minimum reception sensitivity is raised due to the divider's loss (Typ. 4.0 dB). Resolution: 0.1 dB Display units: dBm, dBµV, dBµV/m (spectrum monitor mode) Accuracy: CPICH-RSCP ±2 dB (at dynamic range: –117 to –33 dBm, –9 dB ≤ Ec/No) (at dynamic range: –110 to –33 dBm, –19 dB ≤ Ec/No) CPICH-SIR ±3 dB (at dynamic range: –100 to –40 dBm, SIR: 5 dB to 20 dB) SCH-RSCP ±3 dB (at dynamic range: –117 to –33 dBm, –9 dB ≤ Ec/No) (at dynamic range: –110 to –33 dBm, –19 dB ≤ Ec/No) Spectrum monitor ±2 dB (–118 dBm ≤ CW input ≤ –33 dBm), ±3 dB (–123 dBm ≤ CW input ≤ –118 dBm) Noise level: –127 dBm (typ., RBW: 4 kHz, spectrum monitor mode) Dynamic characteristics: RSCP, SIR measurement at 0 to 100 km/h (averaged distance: 50 m)
Measurement items	Specified base station, unspecified base station, spectrum monitor
Base station measurement	Measurement items: Received signal code power (RSCP), ratio of desired receive power per chip to receive power density (Ec/No), signal interference ratio (SIR) Measurement modes: Time variation (internal trigger) distance variation (external trigger) Sampling interval: 10 ms min. (at 1 channel measurement) Measurement channels: 32 max. Sync acquisition time: 600 ms x the number of search channel (CPICH mode), 4 sec on average for TOP 10 display (SCH mode) Search method of BTS: CPICH mode, SCH mode (Only measurement of unspecified BTS) Data processing method: Average, median, max., min., 10%, 20%, 30%, 40%, 60%, 70%, 80%, 90% Measurement displays: All channel, delay profile, each finger, fluctuation (fluctuation is only for specification base station measurement), SCH delay profile (unspecified base station measurement)
Spectrum monitor function	Frequency span: 4 MHz, 10 MHz, 90 MHz Resolution bandwidth: 4 kHz
Other functions	Master/slave function: Daisy chain of multiple ML8720B, parallel measurement GPS connection: Supports NMEA-0183 format Remote control: Via RS-232C File I/O: Read measurement conditions, output measured results file Diversity function: Transmit diversity, receive antenna diversity (Option 03/23/43) RAKE diversity: Six fingers Two carrier measurement function: Two carrier frequencies can be measured simultaneously in the specified base station measurement and the unspecified base station measurement (Option 03/23/43)
Interface	IF output: ≥10 dBµV (190 MHz), BNC connector External reference input: 2 to 5 Vp-p (10 MHz), BNC connector External trigger input: 1.5 Vdc ±(2 to 13 Vp-p), BNC connector Sync output: TTL level, BNC connector RS-232C-1: For external computer (max. 115.2 kbps), D-sub 9-pin connector RS-232C-2: For GPS (supports NMEA-0183 format), mini-DIN 8-pin connector Printer: 8-bit parallel I/F (conform to Centronics), D-sub 25-pin connector Keyboard: IBM US ENGLISH (101 keys) 106 supported, Mini-DIN 6-pin connector External monitor: VGA, mini-DIN 10-pin connector
Storage media	FDD (3.5", 2HD), ATA flash card
Display	640 x 480 dots, 8.4" color LCD, 7.8" color LCD (Option 02)

Continued on next page

Environment conditions	Temperature and humidity: 0˚ to +40˚C/≤85% (operating), –25˚ to +60˚C/≤85% (storage) Vibration: MIL-T-28800E Class 3 Drop test: 76 cm drop (Bellcore standard) EMC EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A) LVD EN61010-1: 2001 (Pollution Degree 2)
Power	10 to 26.4 Vdc 100 to 240 Vac, 50/60 Hz (with AC adapter) Battery: Z0404A Lithium Ion Battery Pack Power consumption: 35 W max., 20 W (typical), 30 W (typical with Option 01) Battery continuous operation time: 3 h (typical), 2 h (typical with Option 01)
Dimensions and mass	290 (W) x 194 (H) x 78 (D) mm, ≤4.5 kg (with battery pack) 290 (W) x 194 (H) x 123 (D) mm, ≤6.5 kg (with Option 03/23/43 and battery pack)

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML8720B*1	W-CDMA Area Tester	
	Standard accessories	
W1893AE	ML8720B operation manual:	1 copy
Z0619	Lithium Ion Battery Pack:	1 pc
J1069	AC adapter:	1 pc
	Power cord:	1 pc
Z0402A	Protective cover:	1 pc
Z0403A	Belt with hook:	1 pc
Z0516	Antenna:	1 pc (2 pcs)*2
Z0703	Antenna mount (with 5 m cable):	1 pc (2 pcs)*2
J1161	BL82-5133-02 (SMA Plug-SMA Jack):	1 pc (2 pcs)*2
J1248	SMA connecting cable (Type L):	(2 pcs)*3
J0977	Serial interface cable (for connecting GPS), 2 m:	1 pc
	Options	
ML8720B-02*1	Display unit (STN-LCD, 7.8 inch)	
ML8720B-03	Two Carrier Measurement (selected when ordering a mainframe)	
ML8720B-23	Two Carrier Measurement Retrofit (retrofitted to the already-shipped mainframe, mainframes need to be taken back.)	
ML8720B-43	ML8720B-03 Upgrade for ML8720B-01 (upgrade of ML8720B-01 to ML8720B-03, mainframes need to be taken back.)	
	Application software	
MX872022B	Data Conversion Software (date conversion output for MapInfo)	
	Maintenance service	
ML8720B-90	Extended three year warranty service	
ML8720B-91	Extended five year warranty service	
	Application parts	
P0020	Compact Flash 64 MB (requires J1254)	
P0021	Compact Flash 128 MB (requires J1254)	
P0022	Compact Flash 256 MB (requires J1254)	
P0023	Compact Flash 512 MB (requires J1254)	
J1254	Compact Flash adapter	
Z0436	Hard carrying case	
Z0435	Soft carrying case [430 (W) x 300 (H) x 170 (D) mm, use with an option]	
B0442	Soft carrying case [440 (W) x 310 (H) x 110 (D) mm]	
Z0526	Case for installation (for main frame)	
J0127D	BNC cable (for external trigger connection)	
J0654A	Serial interface cable (for connecting IBM-PC/AT)	
J0978	VGA conversion cable (for connecting external monitor)	
J1117	DC Power Cord (for cigarette lighter, minus grounding vehicle), 3 m	
J1118	DC Power Cord (with spade lugs), 3 m	
Z0697	Battery Charger (two Z0619 batteries can be charged simultaneously.)	
Z0705	Antenna mount (with 3.5 m cable)	
B0329D	Front cover for 1MW5U	

*1: There are two type displays, transparent color TFT-LCD type for indoor use and reflective color STN-LCD type for outdoor use. Specify display type when ordering. Display units can not be exchanged by customers.
*2: Antenna, Antenna mount and SMA Plug-SMA Jack are provided 2 packs each when any of the Option 03/23/43 (ML8720B-03/ML8720B-23/ ML8720B-43) is equipped.
*3: Attached only when any of the Option 03/23/43 (ML8720B-03/ML8720B-23/ML8720B-43) is equipped.

MEASURING RECEIVER
ML524B
25 to 1000 MHz

GPIB OPTION

For Measuring Service Area

Custom-made product

The ML524B has a full range of features and functions plus demodulation functions for various signals. The compact, lightweight construction makes it suitable for a variety of measurement applications. The GPIB interface option allows easy configuration of an automatic test system controlled by a personal computer.

Features
- Very compact and lightweight
- High frequency stability (A synthesizer local is used. Its reference oscillator has a high frequency stability of ±1 x 10^{-6}.)
- Wide dynamic range (80 dB without switching)
- Automatic gain calibration
- Direct readout of field strength
- High precision level display (indication in 0.1 dB steps)

Applications
For field strength measurement
- Investigation to determine service areas
- Radio wave propagation test
- Measurement of spurious radiation from transmitter

For other than field strength measurement
- Radio monitoring
- Measuring receiver
- High-sensitivity signal demodulation

Specifications

RF input		Nominal impedance 50 Ω, N-type connector
Frequency	Range	25.0000 to 999.9999 MHz
	Display	Liquid crystal display, 6 digits Minimum digit: 1 kHz (0.5 kHz is displayed using a symbol of ■.)
	Resolution	12.5 kHz (120 kHz bandwidth), 1 kHz (15 kHz bandwidth)
	Setting	Keyboard and FINE dial
	Memory	Up to 100 frequencies can be stored and recalled.
	Reference frequency stability	±1 x 10^{-6}
Voltage measurement (E.M.F.)	Minimum value	5 dBμV (25 to 300 MHz), 5 dBμV (300 to 999.999 MHz)
	Maximum value	100 dBμV (25 to 999.999 MHz)
	Setting	C/N: ≥6 dB (at minimum value), Bandwidth: 15 kHz
	Accuracy (digital display)	±2 dB (≥minimum value +6 dB)
	Comparison oscillator	Pulse generator
Field strength measurement	Minimum value	–5 to 19 dBμV/m (25 to 300 MHz), 19 to 32 dBμV/m (300 to 999.999 MHz)
	Maximum value	0 to 114 dBμV/m (25 to 300 MHz), 114 to 120 dBμV/m (300 to 999.999 MHz)
	Setting	C/N: ≥6 dB (at minimum value), Bandwidth: 15 kHz
	Type of antenna	Half-wave dipole
Selectivity	6 dB bandwidth	15 ±2 kHz (15 kHz bandwidth), 120 ±20 kHz (120 kHz bandwidth)
	Detuning characteristics	15 kHz bandwidth ≥50 dB (±20 kHz off center)
Image ratio		≥60 dB (at 25.000 to 299.999 MHz), ≥45 dB (at 300 to 999.999 MHz)
Residual spurious		≤10 dBμV (typical near 50, 130, 600, 1000 MHz)
Detection system		Average value

Continued on next page

Measured level indication	Display: Liquid crystal display, 4 digits, Minimum digit 0.1 dB (on digital display), Up to 80 dB (on analog display) Unit: dBµV, dBµV/m (on digital display)
Monitor output	AM and FM can be heard from a loudspeaker, and earphone output terminal is also provided.
IF output	Level: ≥85 dBµV at 80 dBµV input, Impedance: 50 Ω (nominal), Connector: BNC-type
Discriminator output	Level: 1 V ±20% (modulation frequency: 2 kHz, frequency deviation: 3.5 kHz, into 100 kHz load) Impedance: ≤150 Ω Connector: BNC-type
Output for recorder	Level: 1 V ±10% (at 80 dB on digital display, into 100 kΩ load), Impedance: ≤150 Ω, Connector: 3.5ø jack
Ambient temperature	0˚ to 50˚C (operate), –20˚ to 60˚C (storage)
Power	12 Vdc: <1 A 100 Vac, 50/60 Hz, ≤35 VA (using MZ114A AC Power Pack supplied) Ni-Cd battery (optional MZ110B Battery Pack)
Dimensions and mass	210 (W) x 60 (H) x 175 (D) mm, ≤4 kg

Power supply selection guide

Type of power supply	Model	When used with ML524B	Remarks
Dry cell	MZ137A Battery Pack 	• Operates continuously for about 2.5 to 5 hours[*1] • Sold separately	• Twelve alkaline dry cells (LR20) • Does not permit GPIB operation
Ni-Cd battery	MZ110B Battery Pack 	• Operates continuously for about 30 to 60 minutes[*1] • Sold separately	• Six Ni-Cd batteries with the same dimensions as R14 battery, chargeable 200 to 300 times • Fits inside the receiver • Does not permit GPIB operation
AC supply	MZ114A AC Power Pack 	• Permits operation at 100/220 Vac • One of accessories supplied	• DC power is fed to the EXT +12 V terminal of the receiver. • Permits GPIB operation • EMC, safety
External DC supply	–	• The receiver can be operated directly from an external 12 Vdc supply.	• One DC power cord is supplied. • Permits GPIB operation
Battery charger	MZ115B Battery Charger	• Sold separately	• Two MZ110B can be charged simultaneously. • EMC, safety

*1: For continuous reception after power on, with calibration performed once only (more calibrations reduce the operating time). Operating is also affected by how the battery has been stored, and operating temperature.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML524B	Measuring Receiver	
	Standard accessories	
J0231	Connecting cord for recorder (3.5ø plug · – · alligator clips), 1.5 m:	1 pc
J0144	DC power cord (RM12BPG-5S · 2CC7 · arrow tips), 1.5 m:	1 pc
A0002	Earphone:	1 pc
MZ114A	AC Power Pack:	1 pc
B0259	Carrying case:	1 pc
W0285AE	ML524A/B/C operation manual:	1 copy
	Options	
ML524B-01	GPIB	
ML524B-05	Terminated voltage indication	

Model/Order No.	Name
	Optional accessories
MP612A	RF Fuse Holder
MP613A	RF Fuse Element (5 pcs/set)
A0004	Headphone
MZ110B	Battery Pack (with six Ni-Cd batteries)
MZ115B	Battery Charger
MZ114A	AC Power Pack
MP635A	Log-periodic Antenna
MZ137A	Battery Pack
MB19A	Tripod (for MP635A)
J0006	GPIB cable, 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0009	GPIB cable, 4 m
MP663A	Dipole Antenna (with pole and tripod)
MP651B	Dipole Antenna
MP18A	Pole (for MP651B)
MB9A	Tripod (for MP651B)
MP520B	CM Directional Coupler (25 to 1000 MHz, 75 Ω, NC-type connector)
MP520D	CM Directional Coupler (100 to 1700 MHz, 50 Ω, N-type connector)

MEASURING RECEIVER
ML5655C
1.4 to 1.55 GHz

For Measuring Field Strength of Digital Cellular Phones and MCA Systems

GPIB OPTION

Recent radio communication systems such as the Personal Digital Cellular and MCA require high-speed and multichannel field strength measurements. The ML5655C Measuring Receivers meet these requirements and can be used as part of a mobile system for measuring radio wave propagation characteristics.

Applications
- Automatic radio wave propagation measurement system
- Radio wave propagation characteristics measurement system

Features
- 1 ms sampling rate
- 10%, 50%, 90% values calculation
- Measuring transmitter spurious, and measuring low-level signals in R&D and production
- Portable design

FREQUENCY CONVERTER
MH669B
1 to 3 GHz

Expandable to 3 GHz using ML524B

The measurable frequency range can be expanded to 3 GHz by using the MH669B in conjunction with the ML524B Measuring Receiver.

Applications
- Quasi-microwave propagation test
- Investigation to determine service areas

RADIO COMMUNICATION ANALYZER
MS555B
25 to 1000 MHz

For 400/800/900-MHz Narrow Band FM

GPIB

The MS555B is a versatile, compact, and portable test instrument with a frequency range of 25 to 1000 MHz. It includes all the necessary instruments for both transmitter and receiver testing, and can measure such fundamental characteristics as output power, frequency, FM deviation, sensitivity, signal-to-noise ratio, distortion, etc. The MS555B has a host of features that make many discrete instruments obsolete. For example, with its excellent frequency stability and low residual noise, the built-in signal generator is ideally suited to the production and maintenance of narrow-band 400 MHz transceivers and 800/900 MHz band radiotelephone systems. Moreover, thanks to an internal microprocessor, the MS555B can make automatic measurements via the GPIB when connected to an external computer controller. The built-in printer also provides convenient hard copies.

Features
- This instrument includes a power meter, frequency counter, FM deviation meter, AF level meter, SINAD meter, AF oscillator, synthesized signal generator, and DC voltmeter, all in a single cabinet. Additional options include a tone generator, signaling unit for personal radio, and weighting filter*.

  *: ITU-T, C-MESSAGE

BIT ERROR RATE TESTER

MP8931A

GPIB

NEW

MP8931A is the general-purpose BIT ERROR RATE TESTER which can be used in various fields dealing with digital data, such as digital broadcasting, mobile communications and digital circuits.

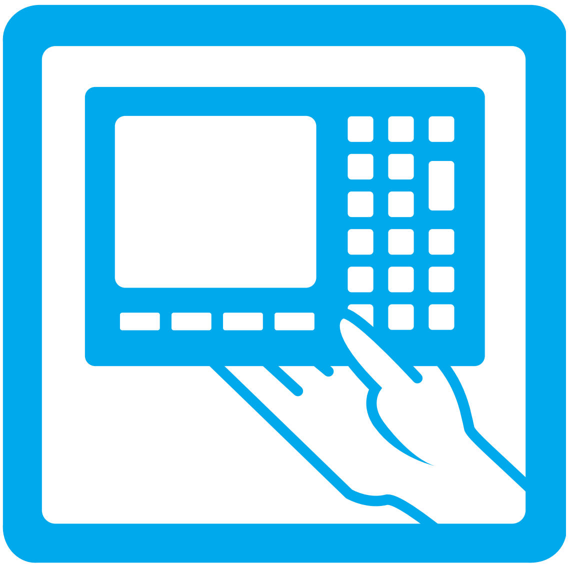
Features

- Clock frequency: 1 kHz to 155 MHz
- Pseudo-random (PN9/15/23) and ALL0/1, 1010 fixed pattern measurement
- NRZ (TTL-Clock/Data/Enable) I/F and DVB-ASI*, DVB-SPI*
- Selectable error rate measurement part in an DVB I/F data packet is possible
- Error insertion
- GPIB/RS232C I/F
- Small design (thin case)

* DVB-ASI: Digital Video Broadcasting - Asynchronous Serial Interface
* DVB-SPI: Digital Video Broadcasting - Synchronous Parallel Interface

Specifications

Interface	NRZ, DVB-SPI, DVB-ASI
Remote interface	GPIB, RS-232C
Internal clock frequency	1 kHz to 155 MHz
External clock input	1 kHz to 155 MHz, TTL/ECL, 75 Ω/1 MΩ (NRZ, DVB-SPI)
Test patterns	PN9, PN9_INV, PN15, PN15_INV, PN23, PN23_INV, ALL “0”, ALL “1”, “1010”
Error insertion	Nothing, Manual, Rate (10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7})
Measurement time/Bit setting	Measurement time (0 to 59 seconds, 0 to 59 minutes, 0 to 999 hours), Bit setting (10^{-3} to 10^{-15}), Manual
Auto sync	On/Off
DVB interface packet	204: (1) + 187 + (16) packets 188: (1) + 187 packets 204: (1 + 3) + 184 + (16) packets 188: (1 + 3) + 184 packets 204: (1) + 203 packets 204: (1 + 3) + 200 packets *DVB-ASI, DVB-SPI
Through-put setting	1 to 27 MHz (DVB-ASI)
LEDs	Counting, Syncloss, Signalloss, Errors
Display indication	“Error rate”, “Error/All data” switchable indication, “Over flow” indication
Display control	Display-Off, Bright control
Setting data auto-saving	Auto-saving the latest parameters which are set before power-off and Auto-setting on the next power-on.
Output monitorable/disable	Output terminal, setting the able/disable of output
Dimension and mass	426 (W) x 88 (H) x 451 (D) mm, ≤15 kg
Power	85 to 250 Vac, 47.5 to 63 Hz, ≤50 VA
Operating temperature	0˚ to +50˚C
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

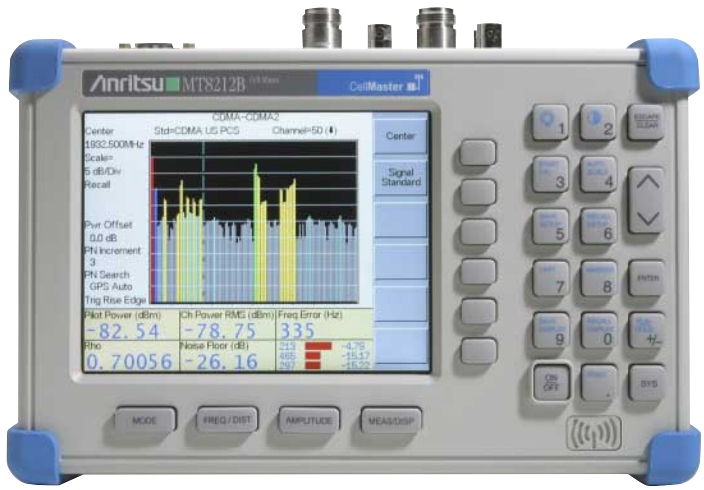


HANDHELD MEASURING INSTRUMENTS

CELL MASTER
MT8212B
25 MHz to 4.0 GHz

A Multi-Function Base Station Test Tool for Greater Flexibility and Technician Productivity

NEW



Cell Master MT8212B is a comprehensive, one-box base station test tool for deploying, maintaining and troubleshooting wireless base stations. Combining the functionality of a cable and antenna analyzer (25 MHz to 4.0 GHz), spectrum analyzer (100 kHz to 3.0 GHz), power meter (4.5 MHz to 3.0 GHz), interference analyzer, channel scanner, transmission analyzer for 2-port devices, transmitter analyzer (CDMA and GSM), GPS receiver and T1/E1 analyzer into one lightweight, handheld test set - eliminates the need for field engineer and field technician to carry, manage and learn multiple test sets. MT8212B measurement capability includes precision return loss, VSWR, cable loss, distance-to-fault, signal identification, interference analysis, channel power, adjacent channel power ratio, field strength, occupied bandwidth, burst power, code domain power, noise floor, voltage peak to peak, listen to DS0 or VF channel access. Patented RF interference rejection enables accurate, repeatable measurements in the presence of high RF activity. PC data analysis software enables assessment of system trends, problems, and performance in addition to professional report generation. Built-in GPS to store traces with location information (latitude, longitude and altitude).

The MT8212B includes PC data analysis software, soft carrying case, rechargeable battery, AC/DC power supply, 12V automotive cigarette lighter adapter, RS232 null modem serial cable and user's guide.

Features

- Handheld, battery-operated, under 5 lbs (2.28 kg), including battery
- Rechargeable, snap-in field replaceable battery
- Withstands repeated drops and rough handling
- Built-in worldwide signal standards and frequency channels
- Multilingual user interface: English, French, Chinese, Japanese, Spanish, German
- Intuitive and easy to use with on-screen test set-ups and single key functions
- No external power sensor required for power meter measurements
- Store/Recall 25 setup configurations and up to 200 traces
- Alphanumeric labeling and automatic time/date stamp of saved measurements
- 6 markers, limit line, and segmented limit lines
- Trace overlay, trace math
- Superior immunity to RF interference
- 130, 259 and 517 data points for optimal resolution and long range fault locations
- FlexCal™ allows troubleshooting cable and antenna systems without multiple calibrations and calibration setups
- < 500 msec per sweep to identify real time intermittent cable problems
- ± 0.5 dB typical amplitude accuracy power measurements
- –135 dBm typical DANL
- Interference analysis
- T1 and E1 histograms
- Using built-in GPS store traces with location information.
- Using Over The Air measurement demodulate CDMA signals sitting in the truck or car.

Handheld PC Software Analysis Tools Features

- Transfer traces with a single menu selection
- Stores an unlimited number of data traces for comparison to historical performances
- Cable editor supports downloading and uploading cable list and saving as a file
- Distance-to-fault and Smith Chart analysis

Specifications*1

Cable and Antenna Analyzer

Frequency	Range	25 MHz to 4.0 GHz
	Accuracy	≤± 75 ppm @ +25°C
	Resolution	100 kHz
Output Power	< 0 dBm (–10 dBm nominal)	
Immunity to Interfering Signals	on-channel*2	+17 dBm
	on-frequency*3	–5 dBm
Measurement speed	≤3.5 msec / data point (CW ON)	
Number of data points	130, 259, 517	
Return Loss	Range	0.00 to 60.00 dB
	Resolution	0.01 dB
VSWR	Range	1.00 to 65.00
	Resolution	0.01
Cable Loss	Range	0.00 to 30.00 dB
	Resolution	0.01 dB
Measurement Accuracy	> 42 dB corrected directivity after calibration	
Distance-To-Fault	Vertical Range	Return Loss: 0.00 to 60.00 dB VSWR: 1.00 to 65.00
	Horizontal Range	Range: 0 to (# of data pts –1) x Resolution to a maximum of 1197m (3929 ft), # of data pts = 130, 259, 517
	Horizontal Resolution (Rectangular windowing)	Resolution (meter) = (1.5 x 10^8) x (Vp)/DF Where Vp is the cable's relative propagation velocity and where DF is the stop frequency minus the start frequency (in Hz)

Spectrum Analyzer

Frequency	Range	100 kHz to 3.0 GHz
	Reference (Internal Timebase)	Aging: ± 1 ppm/yr Accuracy: ± 2 ppm
	Span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
	Sweep Time	≤1.1 sec full span; ≤50 µsec to 20 sec zero span
	Resolution Bandwidth (–3 dB)	100 Hz to 1 MHz in 1-3 sequence ± 5% Accuracy
	Video Bandwidth (–3 dB)	3 Hz to 1 MHz in 1-3 sequence ± 5% Accuracy
	SSB Phase Noise (1 GHz) @ 30 kHz Offset	≤–75 dBc/Hz
	Spurious Responses Input Related	≤–45 dBc
	Spurious Residual Responses	≤–90dBm, ≥10 MHz (10 kHz RBW, pre-amp on)
Amplitude	Total Level Accuracy	±1 dB typical (±1.5 dB max), >10 MHz to 3 GHz ±2 dB typical <10 MHz for input signal levels ≥–60 dBm, excluding input VSWR mismatch
	Measurement Range	+20 dBm to –135 dBm
	Input Attenuator Range	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
	Displayed Average Noise Level	≤–135 dBm, >10 MHz (preamp on) ≤–115 dBm (preamp off) for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
	Dynamic Range	>65 dB typical
	Display Range	1 to 15 dB/division, in 1 dB steps, 10 divisions displayed
	Scale Units	dBm, dBV, dBmV, dBµV, V, W
	RF Input VSWR	(with 20 dB atten.) 1.5:1 typical, (10 MHz to 2.4 GHz)

Power Meter

Frequency Range	4.5 MHz to 3.0 GHz
Display Range	–80 dBm to +80 dBm
Measurement Range	–80 dBm to +20 dBm (+80 dBm with external attenuator)
Offset Range	0 to +60 dB
Accuracy	±1 dB typical (±1.5 dB max), ≥10 MHz to 3 GHz (excludes input VSWR)
VSWR	1.5:1 typical (P_{in} > –30 dBm, >10 MHz to 2.4 GHz)
Maximum Power	20 dBm (0.1W) without external attenuator

T1 Analyzer (Option 50)

Line Coding	AMI, B8ZS
Framing Modes	D4 (Superframe), ESF (Extended Superframe)
Connection Configurations	Terminate (100 Ω) Bridge (≥1000 Ω) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity	0 to –36 dBdsx
Transmit Level	0 dB, –7.5 dB, and –15 dB
Clock Sources	External Internal: 1.544 MHz ± 30 ppm
Pulse Shapes	Conform to ANSI T1.403
Pattern Generation and Detection	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined (≤32 bits)
Circuit Status Reports	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection	AIS (Blue Alarm), RAI (Yellow Alarm)
Error Detection	Frame Bits, Bit, BER, BPV, CRC, Error Sec
Error Insertion	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes	Self loop, CSU, NIU, User defined, In-band or Data Link
Level Measurements	Vp-p (± 5%)
Data Log	Continuous, up to 48 hrs
DS0 Channel Access	Tone Generator: Frequency: 100 Hz to 3000 Hz Level: –30 to 0 dBm, 1 dB steps Audio Monitor: Manually select channel 1-24
VF Measurement	Frequency: 100 Hz to 3000 Hz ±2 Hz Level: –40.0 to +3.0 dBm ±0.2 dBml

E1 Analyzer (Option 50)

Line Coding	AMI, HDB3
Framing Modes	PCM30, PCM30CRC, PCM31, PCM31CRC
Connection Configurations	Terminate (75, 120 Ω) Bridge (≥1000 Ω) Monitor (Connect via 20 dB pad in DSX)
Receiver Sensitivity	0 to –43 dB
Clock Sources	External Internal 2.048 MHz ± 30 ppm
Pulse Shapes	Conform to ITU G.703
Pattern Generation and Detection	PRBS: 2-9, 2-11, 2-15, 2-20, 2-23 Inverted and non-inverted, QRSS, 1-in-8 (1-in-7), 2-in-8, 3-in-24, All ones, All zeros, T1-Daly, User defined (≥32 bits)
Circuit Status Reports	Carrier present, Frame ID and Sync., Pattern ID and Sync.
Alarm Detection	AIS, RAI, MMF
Error Detection	Frame Bits, Bit, BER, BPV, CRC, E-Bits, Error Sec
Error Insertion	Bit, BPV, Framing Bits, RAI, AIS
Loopback Modes	Self loopback
Level Measurements	Vp-p (± 5%), can also display in dBdsx
Data Log	Continuous, up to 48 hrs
E1 Frequency	±10 ppm
VF Channel Access	Tone Generator: Frequency: 100 Hz to 3000 Hz Level: –30 to 0 dBm Audio Monitor: Manually select channel 1-31
VF Measurement	Frequency: 100 Hz to 3000 Hz ±2 Hz Level: –40.0 to +3.0 dBm ±0.2 dBml

Channel Scanner (Option 27)

Frequency Range	100 kHz to 3.0 GHz
Frequency Accuracy	±10 Hz + Time base error, 99% Confidence level

AM/FM/SSB Demodulator

Standard speaker and headphone jack

Transmission Measurement (Option 21)

RF Source	Frequency Range	25 MHz to 3 GHz
	Frequency Resolution	10 Hz
	Output Power Level	–10 dBm typical (up to –90 dBm with external attenuator)
	Dynamic Range	80 dB, 25 MHz to 1 GHz 60 dB, >1 GHz to 3 GHz
	Output Impedance	50 Ω

RF Measurements - GSM (Option 40)

Occupied Bandwidth	Bandwidth within which 0-99% of the power transmitted on a single channel lies or 0 to –120 dBc to the down the skirts of the signal.
Channel power	±1 dB typical (±1.5 dB max)
Burst power	±1 dB typical for –20 dBm to +20 dBm (±1.5 dB max) ±1.75 dB typical for –80 dBm to –20 dBm (±2 dB max)
Carrier frequency	99% confidence level
Frequency error	±10 Hz + Time base error

RF Measurements - CDMA (Option 42)

Occupied Bandwidth	Bandwidth within which 0-99% of the power transmitted on a single channel lies
Channel power	±1 dB typical (±1.5 dB max)
Carrier frequency	99% confidence level
Frequency error	±50 Hz + Time base error

Demodulator - cdmaOne and cdma2000 1xRTT (Option 43)

Residual rho	≥0.98 for RF input from +20dBm to –48 dBm
Rho accuracy	±0.01 for ρ ≥0.9
Code domain power (CDP)	Accurate to within ±1.5 dB above –20dB for RF input from +20dBm to –48 dBm CDP can be displayed for RF input from +20 dBm to –90 dBm
Carrier Frequency Error	±100 Hz 99% confidence level
Power accuracy	±1 dB typical (±1.5 dB absolute)
PN Offset	Within 1 x 64 chips
Pilot power	±1.5 dB typical

OTA - cdmaone and cdma2000 1xRTT (Option 33) Requires option 31 and 43

Three strongest pilots with Ec/Io
Two multipaths relative to strongest pilot

GPS (Option 31)

GPS Location Indicator
Latitude, Longitude and Altitude on Display
Latitude, Longitude, Altitude with Trace Storage

Interference Analyzer (Option 25)

Audible tone
Strength of the Interferer
RSSI
Spectrogram

General

Language Support	English, Spanish, French, German, Chinese, Japanese	
Internal Trace Memory	Up to 200 traces	
Setup Configuration*4	25	
Display	TFT Color display, viewable in sunlight	
Input and Output Ports	RF Out Maximum Input without Damage	Type N, female, 50 Ω +20 dBm, ± 50 VDC
	RF In Maximum Input without Damage	Type N, female, 50 Ω +43 dBm (Peak), ± 50 VDC
	Ext. Trig In	BNC, female (5V TTL)
	Ext. Freq Ref In (2 to 20 MHz)	Shared BNC, female, 50 Ω, (–15 dBm to +10 dBm)
	T1/E1 (Receive & Transmit)	Bantam Jacks
	Serial Interface	RS-232 9 pin D-sub, three wire serial
	GPS antenna connector	Reverse BNC female
	CDMA Timing Input	BNC female (5V TTL)
Electromagnetic Compatibility	Meets European Community requirements for CE marking	
Safety	Conforms to EN 61010-1 for Class 1 portable equipment	
Temperature	Operating	–10°C to 50°C, humidity 85% or less
	Non-operating	–51°C to +71°C (recommend battery be stored separately between 0°C to +40°C for any prolonged non-operating storage period)
Power Supply	External DC Input	+12 to +15 VDC, 1500 mA
	Internal	NiMH battery: 10.8 volts, 1800 mA maximum
Dimensions	Size	25.4 cm x 17.8 cm x 6.1 cm (10.0 in x 7.0 in x 2.4 in)
	Weight	<2.28 kg (<5 lbs) includes battery

*1: All specifications apply when calibrated at ambient temperature after a five minute warm up.
*2: On-Channel interference immunity is specified to within 1 MHz of the carrier frequency.
*3: On-Frequency interference immunity is specified to within +10 kHz of the carrier frequency.
*4: Calibration stored with instrument configuration.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MT8212B	Cable & Antenna Analyzer (25 MHz to 4.0 GHz), with Built-in DTF, Spectrum Analyzer (10 MHz to 3.0 GHz), Power Meter, T1/E1 Analyzer, AM/FM/SSB Demodulator
	Options
Option 21	Transmission Measurement
Option 25	Interference Analyzer (requires directional antenna)
Option 27	Channel Scanner
Option 31	GPS
Option 33	cdmaOne and cdma2000 1xRTT Over The Air (OTA) (requires options 31 and 43)
Option 40	RF Measurements-GSM
Option 42	RF Measurements-CDMA
Option 43	cdmaOne and cdma2000 1xRTT demodulator
Option 50	T1/E1 Analyzer
	Standard Accessories Include
	User's Guide
	Soft Carrying Case
	AC-DC Adapter with Power Cord
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	Handheld Software Tools
	Serial Interface Cable
	Rechargeable Battery, NiMH
	Optional Accessories
1N50C	Limiter, N(m) to N(f), 50Ω, 10 MHz to 18 GHz
42N50-20	Attenuator, 20 dB, 5 watt, DC to 18 GHz, N(m)-N(f)
42N50A-30	Attenuator, 30 dB, 50 watt, DC to 18 GHz, N(m)-N(f)
SC7179	Variable Attenuator, DC to 2 GHz, 0~90 dB, N(m)-N(f)
ICN50	InstaCal™ Calibration Module, 2 MHz to 4.0 GHz, N(m), 50Ω
22N50	Open/Short, DC to 18 GHz, N(m), 50Ω
22NF50	Open/Short, DC to 18 GHz, N(f), 50Ω
SM/PL	Precision Load, DC to 4 GHz, 42 dB, N(m), 50Ω
SM/PLNF	Precision Load, DC to 4 GHz, 42 dB, N(f), 50Ω
OSLN50LF	Precision Open/Short/Load, DC to 4 GHz, 42 dB, 50Ω, N(m)
OSLNF50LF	Precision Open/Short/Load, DC to 4 GHz, 42 dB, 50Ω, N(f)
2000-767	Precision Open/Short/Load, DC to 4 GHz, 7/16 DIN(m), 50Ω
2000-768	Precision Open/Short/Load, DC to 4 GHz, 7/16 DIN(f), 50Ω
15NN50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-N(m), 6 GHz, 50Ω
15NN50-3.0C	Test Port Cable Armored, 3.0 meters, N(m)-N(m), 6 GHz, 50Ω
15NN50-5.0C	Test Port Cable Armored, 5.0 meters, N(m)-N(m), 6 GHz, 50Ω
15NNF50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-N(f), 6 GHz, 50Ω
15NNF50-3.0C	Test Port Cable Armored, 3.0 meters, N(m)-N(f), 6 GHz, 50Ω
15NNF50-5.0C	Test Port Cable Armored, 5.0 meters, N(m)-N(f), 6 GHz, 50Ω
15ND50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-7/16 DIN(m), 6 GHz, 50Ω
15NDF50-1.5C	Test Port Cable Armored, 1.5 meters, N(m)-7/16 DIN(f), 6 GHz, 50Ω

Model/Order No.	Name
34NN50A	Precision Adapter, N(m)-N(m), DC to 18 GHz, 50Ω
34NFNF50	Precision Adapter, N(f)-N(f), DC to 18 GHz, 50Ω
1091-26	Adapter, N(m)-SMA(m), DC to 18 GHz, 50Ω
1091-27	Adapter, N(m)-SMA(f), DC to 18 GHz, 50Ω
1091-80	Adapter, N(f)-SMA(m), DC to 18 GHz, 50Ω
1091-81	Adapter, N(f)-SMA(f), DC to 18 GHz, 50Ω
1091-172	Adapter, N(m)-BNC(f), DC to 1.3 GHz, 50Ω
510-90	Adapter, 7/16 DIN(f)-N(m), DC to 7.5 GHz, 50Ω
510-91	Adapter, 7/16 DIN(f)-N(f), DC to 7.5 GHz, 50Ω
510-92	Adapter, 7/16 DIN(m)-N(m), DC to 7.5 GHz, 50Ω
510-93	Adapter, 7/16 DIN(m)-N(f), DC to 7.5 GHz, 50Ω
510-96	Adapter, 7/16 DIN(m)-7/16 DIN(m), DC to 7.5 GHz, 50Ω
510-97	Adapter, 7/16 DIN(f)-7/16 DIN(f), DC to 7.5 GHz, 50Ω
510-102	Adapter, N(m)-N(m) 90° right angle, DC to 11 GHz, 50Ω
2000-1030	Portable Antenna, SMA (m), 1.71 to 1.88 GHz, 50Ω
2000-1031	Portable Antenna, SMA (m), 1.85 to 1.99 GHz, 50Ω
2000-1032	Portable Antenna, SMA (m), 2.4 to 2.5 GHz, 50Ω
2000-1200	Portable Antenna, SMA (m), 806-866 MHz, 50Ω
2000-1035	Portable Antenna, SMA (m), 896-941 MHz, 50Ω
2000-1410	Magnet Mount GPS Antenna with 15 ft. cable
2000-1411	Portable YAGI Antenna, N(f), 822-900 MHz, 10 dBd
2000-1412	Portable YAGI Antenna, N(f), 885-975 MHz, 10 dBd
2000-1413	Portable YAGI Antenna, N(f), 1.71-1.88 GHz, 10 dBd
2000-1414	Portable YAGI Antenna, N(f), 1.85-1.99 GHz, 9.3 dBd
2000-1415	Portable YAGI Antenna, N(f), 2.4-2.5 GHz, 12 dBd
2000-1416	Portable YAGI Antenna, N(f), 1.92-2.23 GHz, 12 dBd
806-16	Bantam Plug to Bantam Plug
806-116	Bantam Plug to BNC
806-117	Bantam "Y" Plug to RJ48
551-1691	USB to RS-232 adapter cable
48258	Soft Carrying Case
760-229	Transit Case
633-27	Rechargeable Battery, NiMH
2000-1029	Battery Charger, NiMH, w/ Universal Power Supply
40-115	AC/DC Adapter
806-62	Automotive Cigarette Lighter/12 Volts DC Adapter
800-441	Serial Interface Cable
2300-347	Software Tools
10580-00089	Cell Master User's Guide (for Model MT8212B)
10580-000106	Cell Master Programming Manual (for Model MT8212B)
10580-000107	Cell Master Maintenance Manual (for Model MT8212B)
	Printers
2000-1214	HP DeskJet Printer, Model 450: Includes printer cable, 2000-1216 black print cartridge and U.S. power cord. Also includes 2000-753 serial-to-parallel Centronics converter cable and 1091-310 Centronics-to DB25 adapter. Rechargeable battery is optional and is not included.
2000-753	Null Modem Serial-to-Parallel Centronics Converter Cable
1091-310	Adapter 36-pin Centronics female-to-DB25 female
2000-1216	Black Print Cartridge
2000-663	Power Cable (Europe) for DeskJet Printer
2000-664	Power Cable (Australia) for DeskJet Printer
2000-667	Power Cable (S. Africa) for DeskJet Printer
2000-1217	Rechargeable Battery for DeskJet Printer, Model 450
2000-1218	Power Cable (U.K.) for DeskJet Print

5

Anritsu

SITE MASTER

S100C/S200C/S300D/S800C Series

2 MHz to 20 GHz

CE GPIB

For Analyzing Cable and Antenna Problems

S331D

S332D

S251C

S113C

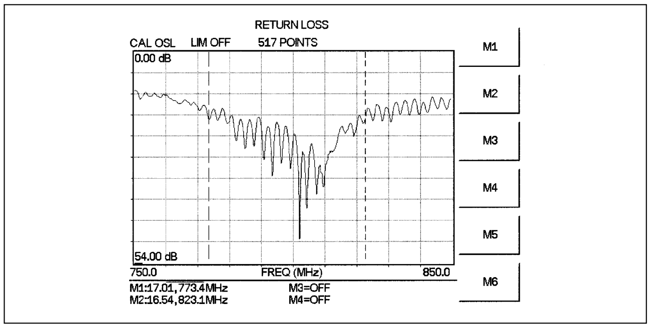
S114C

S820C

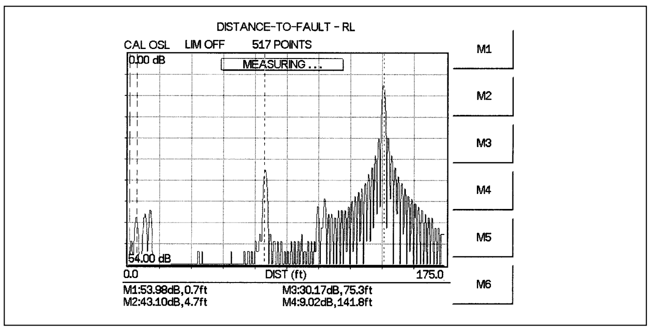
Site Master is the instrument of choice for transmission line/antenna installation and maintenance. It is the best way to reduce maintenance expenses and improve quality. It replaces stacks of heavy, expensive, and complex test equipment. Site Master's frequency domain reflectometry technique allows it to locate faults before they become catastrophic faults, thereby creating huge cost savings.
The Site Master is a precision, hand-held return loss/SWR and fault location measurement instrument. The Site Master series offers wide frequency coverage, from 2 MHz to 20 GHz. Built-in fault location, RF power monitor, bias tee, and spectrum analysis capabilities are available. Light weight, rugged design, and wide temperature range make them ideal for field applications. Site Master's proprietary design provides superior immunity to on-channel RF interference, which is important for live site testing.
Handheld Software Tools is a Windows® compatible software program provided with every Site Master unit. This software program provides many useful features, including a database for Site Master measurements, Smith Chart display of S11, zoom capability, a "drag-n-drop" overlay for measurement comparison, the capability to download data to a PC, the capability to upload data such as custom cable list or traces to selected Site Master models, and distance-to-fault calculation from return loss or SWR plots. Advanced printing capabilities are provided by Handheld Software Tools including user definable plot scaling and a multiple plots per page option.
Site Master is the first test tool to provide the required accuracy, interference immunity, and repeatability for transmission line/antenna commissioning, and maintenance of today's wireless systems infrastructures.

Features

- Accurate return loss/SWR and fault location measurements
- Accurately tests RF transmission lines and antennas
- Superior immunity to on-channel interference for testing at co-located antenna sites
- Multilingual user interface: English, German, Spanish, French, Chinese, Japanese
- Optional color display (S331D and S332D only)
- Insertion Loss/Gain (S251C only)
- Optional built-in bias tee (S251C only)
- Spectrum analysis (S114C and S332D only)
- T1/E1 Analyzer (S331D only)
- Optional RF power monitor and optional RF power meter
- Synthesizer accurate to 75 ppm
- Internal memory saves up to 200 traces
- Instrument configuration up to 20 configurations
- Alphanumeric trace naming
- Time, Date stamp
- Field replaceable battery
- Segmented limit lines
- Six markers
- Graticule lines
- Trace overlay
- Direct printing via RS-232 serial port
- Remote operation via RS-232 serial port



Return loss



Distance-to-fault

Applications

Cellular, ISM, PCS/PCN, paging service, safety service, avionics, two-way radio, military, and microwave point-to-point radio.
Site Master allows implementation of preventative maintenance procedures. Unlike TDRs and spectrum analyzers/tracking generators,

Site Master can spot RF degradation before failures occur. Problems can be fixed before expensive cables or waveguides are ruined. Site Master is designed for field requirements. Its rugged construction survives rough field treatment. Battery power, light weight, small size, wide temperature range, and simple user interface are exactly what field technicians want today. Technicians can test antennas from ground level because Site Master's distance-to-fault measurement compensates for cable insertion loss. Furthermore, spectrum analysis, available in certain Site Master models, allows technicians and field engineers to quickly identify and solve common RF system problems, such as coverage, interference, and other path related signal problems. Site Master offers a new and better method to install and maintain transmission lines and antennas.

Specifications[*1]

<table>
<tr><th>Model</th><th>S251C</th><th colspan="2">S113C/S331D</th><th colspan="2">S114C/S332D</th></tr>
<tr><td>Frequency range</td><td>625 to 2500 MHz</td><td colspan="2">2 to 1600 MHz (S113C)
25 to 4000 MHz (S331D)</td><td colspan="2">2 to 1600 MHz (114C)
25 to 4000 MHz (S332D)</td></tr>
<tr><td>Frequency resolution</td><td>10 kHz</td><td colspan="2">10 kHz (S113C)
100 KHz (S331D)</td><td colspan="2">10 kHz (S114C)
100 KHz (S332D)</td></tr>
<tr><td>Frequency accuracy (CW mode)</td><td colspan="5">± 75 ppm</td></tr>
<tr><td>Display data points</td><td colspan="5">Selectable: 130, 259, 517</td></tr>
<tr><td>Immunity to interfering RF signals[*2]</td><td>S251C</td><td>S113C</td><td>S331D</td><td>S114C</td><td>S332D</td></tr>
<tr><td>On-frequency[*3]</td><td>+10 dBm (RF out), +30 dBc transmission</td><td>+10 dBm</td><td>–5 dBm</td><td>+10 dBm</td><td>–5 dBm</td></tr>
<tr><td>On-channel[*4]</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td><td>+17 dBm</td></tr>
<tr><td>Return loss</td><td colspan="5">Range: 0 to 54 dB; Resolution: 0.01 dB (S331D and S332D have return loss range of 0 to 60 dB)</td></tr>
<tr><td>SWR</td><td colspan="5">Range: 1 to 65; Resolution:0.01</td></tr>
<tr><td>Cable loss</td><td colspan="5">Range: 0 to 30 dB; Resolution: 0.01 dB (S331D and S332D)
Range: 0 to 54 dB; Resolution: 0.01 dB (S251C, S113C and S114C)</td></tr>
<tr><td>Distance-to-fault</td><td colspan="5">Vertical range
Return loss: 0 to 54 dB; 0 to 60 dB (S331D and S332D)
SWR: 1 to 65
Horizontal range (meter): 0 to (# of data points –1) x resolution, where data points = 130, 259 or 517
Horizontal resolution, rectangular windowing resolution (meter): (1.5 x 10^8) (υp)/ Δ frequency[*5]</td></tr>
<tr><td>RF power monitor (Option 5 - S113C, S114C & S251C only)</td><td colspan="5">Display range: –80 to +80 dBm, 10 pW to 100 kW
Detector range: –45 to +20 dBm, 30 μW to 100 mW
Offset range: 0 to +60 dB
Resolution: 0.1 dB or 0.1 W</td></tr>
<tr><td>RF power meter
(S331D & S332D only)</td><td>N/A</td><td colspan="4">Frequency range: 10 MHz to 3 GHz
Display range: –80 to +80 dBm, 10 pW to 100 kW
Offset range: 0 to +60 dB
Accuracy: ±1 dB max (± 0.5 dB typical) for input signal levels ≥–60 dBm, 10 MHz to 2 GHz excludes input VSWR</td></tr>
<tr><td>Bias Tee (Option 10B)
S251C only</td><td>Voltage: Switchable 15V (high voltage) OR 12V (low voltage)
Current: Switchable 1A surge/650 mA steady state (high current) OR 460 mA surge/244 mA steady state (low current)</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr>
<tr><td>Insertion Loss/Gain
S251C only</td><td>Display range: –120 to +100 dB
Resolution: 0.1 dB
Measurement Range: –90 to +50 dB</td><td colspan="2">N/A</td><td colspan="2">N/A</td></tr>
<tr><td colspan="6">Spectrum analysis</td></tr>
<tr><td>Frequency range</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">100 kHz to 1600 MHz (S114C)
100 kHz to 3000 MHz (S332D)</td></tr>
<tr><td>Accuracy</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">± 2 ppm</td></tr>
<tr><td>Aging</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">± 1 ppm/yr</td></tr>
<tr><td>Frequency span</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">1 kHz to 1.6 GHz in 1, 2, 5 step selections in auto mode, plus zero span (S114C)
10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span (S332D)</td></tr>
<tr><td>Resolution bandwidth</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">10 kHz, 30 kHz,
100 kHz, 1 MHz (S114C)
100 Hz to 1 MHz in 1-3 sequence
±5% Accuracy (S332D)</td></tr>
<tr><td>Video Bandwidth</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">100 Hz to 300 kHz in
1-3 sequence (S114C)
3 Hz to 1 MHz in 1-3 sequence
± 5% Accuracy (S332D)</td></tr>
<tr><td>SSB Phase Noise @ (1 GHz)
30 kHz offset</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –75 dBc/Hz</td></tr>
<tr><td>Spurious responses (Input related)</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –45 dBc</td></tr>
<tr><td>Spurious responses (residual)</td><td>N/A</td><td colspan="2">N/A</td><td colspan="2">≤ –95 dBm</td></tr>
</table>

Continued on next page

Model	S251C	S113C/S331D	S114C/S332D
Dynamic range	N/A	N/A	≥ 65 dB
Average noise level	N/A	N/A	100KHz to 300KHz ≤ –80 dBm 300KHz to 500KHz ≤ –92 dBm 500KHz to 3GHz ≤ –95 dBm (S114C) ≤–135 dBm typical, ≥10 MHz (preamp on) ≤–115 dBm typical, ≥500 kHz to <1 MHz ≤–110 dBm typical, <500 kHz for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
Measurement range	N/A	N/A	+20 dBm to –95 dBm (S114C) +20 dBm to –135 dBm (S332D)
Display range	N/A	N/A	2 to 15 dB/div (S114C) 1 to 15 dB/div (S332D) in 1 dB steps - 10 divisions display
Total level accuracy	N/A	N/A	± 2 dB ≥ 500 kHz, typical ± 3 dB < 500 kHz, typical (S114C) ± 1 dB ≥ 10 MHz to 3 GHz ± 3dB <10 MHz (excludes input VSWR mismatch) (S332D)
RF input VSWR	N/A	N/A	2.0:1 (S114C) RF Input VSWR: (20 dB atten.) 1.5:1 typical, (10 MHz to 2.4 GHz) (S332D)
Trace memory	Up to 200		
Instrument configuration*6	10	10 (S113C); up to 20 (S331D)	10 (S114C); up to 20 (S331D)
Markers	6 for all models		
Test port connector	Precision N female		
Maximum input level without damage			
RF OUT test port	+22 dBm, 50 Ω, +50 Vdc	+23 dBm, 50 Ω, +50 Vdc	+23 dBm, 50 Ω, +50 Vdc
RF IN test port (S251 only)	+27 dBm, 50 Ω, +50 Vdc	N/A	N/A
RF power detector (S113C, S114C & S251C only)	+20 dBm, 50 Ω, +50 Vdc	+20 dBm, 50 Ω, +50 Vdc	+20 dBm, 50 Ω, +50 Vdc
RF power meter (S331D & S332D only)	N/A	+43 dBm, 50 Ω, +50 Vd	+43 dBm , 50 Ω, +50 Vdc
RF IN Spectrum analyzer port (S114C only)	N/A	N/A	+23 dBm, 50 Ω,± 50 Vdc
RF IN Spectrum analyzer port (S332D only)	N/A	N/A	+43 dBm, 50 Ω, +50 Vdc
Temperature	Operating: –10°C to +50°C humidity 85% or less Non-operating: –20°C to +75°C (recommend battery stored separately between 0°C and +40°C for any prolonged non-operating storage period)		
Weight	2.14 kg (4.76 lbs.) nominal; <2.28 kg (< 5 lbs.) including battery (S332D)		
Size	25.4 cm x 17.8 cm x 6.1 cm (10 in x 7 in x 2.4 in)		
General	Electromagnetic compatibility: Meets European community requirements for CE marking. RS232: 9 pin D-sub, three wire serial Safety: Conforms to EN 61010-1 for Class 1 portable equipment.		

*1: All specifications apply when calibrated at ambient temperature after a five minute warm up.
*2: In most applications, immunity is typically better because interfering signals are modulated and varying in frequency rather than being CW. Measurements were made in CW mode by injecting a signal into the Site Master through a coupler.
*3: On-Frequency interference immunity is specified to within +10 kHz of the carrier frequency.
*4: On-Channel interference immunity is specified to within 1 MHz of the carrier frequency.
*5: Where υ_p is the cable's relative propagation velocity. Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.
*6: Calibration stored with instrument configuration.

InstaCal® Calibration Module*

The InstaCal calibration module is available for all one-port Site Master models (S113C, S114C, S331D and S332D). With InstaCal, users can cut the time required to calibrate the Site Master by as much as 50%. Moreover, InstaCal reduces the potential for calibration error. With discrete calibration components users are required to connect, disconnect, and reconnect the various calibration components during the calibration process, which greatly increases the potential for calibration/measurement error. With InstaCal, users are only required to connect the InstaCal calibration module once – the calibration process sequences automatically, ensuring an accurate calibration of the Site Master. The benefit is calibrated measurements in much less time.

*The InstaCal® Calibration Module exhibits slightly degraded directivity performance compared to precision loads. Users having applications that require DTF-RL measurements > | 38 dB | may want to consider using precision load calibration components in place of the InstaCal calibration module for greater measurement accuracy.

InstaCal® Module ICN50

Specifications*[1]

Model	S810C/S820C
Frequency range	3.3 to 10.5 GHz (S810C) 3.3 to 20 GHz (S820C)
Frequency accuracy (CW mode)	≤ ± 50 ppm
Frequency resolution	100 kHz
Display data points	Selectable: 130, 259, 517
RF immunity*[2]	–10 dBm
Return loss	Range: 0 to 54 dB, Resolution: 0.01 dB
SWR	Range: 1 to 65, Resolution: 0.01
Cable/Waveguide Loss	Range: 0 to 54 dB, Resolution: 0.01 dB
Distance-to-fault	Vertical range Return loss: 0 to 54 dB SWR: 1 to 65 Horizontal range: (# of data points –1) x resolution, where data points = 130, 259 or 517 Horizontal resolution, rectangular windowing resolution (meter): Coax: $(1.5 \times 10^8)(\upsilon p)/\Delta$ frequency*[3] Waveguide: $(1.5 \times 10^8)(\sqrt{(1-(F_c/F_1)^2})/\Delta$ frequency)*[4]
RF power monitor (Option 5)	Display range: –80 to +80 dBm, 10 pW to 100 kW Detector range: –45 to +20 dBm, 30 μW to 100 mW Offset range: 0 to +60 dB Resolution: 0.1 dB, 0.1 x W
Trace memory	Up to 200 traces
Instrument configuration with calibration	10 memory locations
Markers	6 for all models
Test port connector*[5]	K female or N female (option 11NF)
Maximum input without damage	N(f) test port: +22 dBm RF power detector: +20 dBm, 50 Ω
Temperature	–10°C to 50°C humidity 85% or less Non-operating –20°C to 75°C (recommended battery stored separately between 0°C and +40°C for any prolonged non-operating storage period)
Weight	2.14 kg (4.76 lbs.) nominal
Size	25.4 cm x 17.8 cm x 6.1 cm (10 in x 7 in x 2.4 in)
General	Electromagnetic compatibility: Meets European community requirements for CE marking. RS232: 9-pin D-sub, three wire serial Safety: Conforms to EN 61010-1 for Class 1 portable equipment.

*1: All specifications apply when calibrated at ambient temperature after a five minute warm up.
*2: In most applications, immunity is typically better because interfering signals are modulated and varying in frequency rather than being CW. Measurements were made in CW mode by injecting a signal into the Site Master through a coupler.
*3: Where υp is the cable's relative propagation velocity. Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.
*4: Where F_c is the waveguide's cutoff frequency (in Hz) and F_1 is the start frequency (in Hz). Δ frequency is the stop frequency minus the start frequency (in Hz). Wide frequency sweeps improve resolution but reduce maximum display range.
*5: Must specify option 11NF at the time of purchase to have N female test port connector.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
Model S113C	Site Master (2 to 1600 MHz), Built in DTF
Model S114C	Site Master (2 to 1600 MHz), Built in DTF, Spectrum Analysis (100 kHz to 1.6 GHz)
Model S251C	Site Master (625 to 2500 MHz), Built in DTF, 2-port
Model S331D	Site Master (25 to 4000 MHz), Built in DTF
Model S332D	Site Master (25 to 4000 MHz), Built in DTF, Spectrum Analysis and Power Meter (100 kHz to 3.0 GHz)
Model S810C	Site Master (3.3 to 10.5 GHz), Built in DTF
Model S820C	Site Master (3.3 to 20 GHz), Built in DTF
	Standard accessories
	User's Guide
	Soft Carrying Case
	AC-DC Adapter
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CD ROM containing Fault Location (DTF), Smith Chart, and Software Management Tools
	Serial Interface Cable
	Rechargeable battery, NiMH
	Precision ruggedized K(m) to N(f) adapter when ordered with out 11NF option (S810C and S820C only)
	Option
Option 3	Color Display – S331D & S332D
Option 5	RF Power Monitor (RF detector not included)
Option 6	Frequency Converter Control Module – S332D
Option 10B	Built-in Bias Tee – S251C
Option 11NF	N(f) test port connector – S810C & S820C
Option 21	Transmission Measurement – S332D
Option 29	RF Power Meter (requires no detector) – S331D
Option 50	T1/E1 Analyzer – S331D
	Optional accessories
FCN 4760	Frequency Converter 4.7-6 GHz
42N50A-30	Attenuator, 30 dB, DC to 18 GHz, 50 W
42N50-20	Attenuator, 20 dB, DC to 18 GHz, 5 W
ICN50	InstaCAL (S113C, S114C, S331D, S332D)
5400-71N50	RF Detector, N(m), 50Ω, 1 to 3000 MHz
560-7N50B	RF Detector, N(m), 50Ω, 10 MHz to 20 GHz
560-7K50	RF Detector, K(m), 50Ω, 10 MHz to 40 GHz
560-7VA50	RF Detector, V(m), 50Ω, 10 MHz to 50 GHz
1N50C	5W Limiter, N(m)-N(f), 18 GHz
22K50	Precision K(m) Short/Open, 40 GHz
22KF50	Precision K(f) Short/Open, 40 GHz
22N50	Precision N(m) Short/Open, 18 GHz
22NF50	Precision N(f) Short/Open, 18 GHz
SM/PL	Precision N(m) Load, 42 dB, 4.0 GHz
SM/PLNF	Precision N(f) Load, 42 dB, 4.0 GHz
OSLN50LF	Precision N(m) Open/short/Load, 42 dB, 4.0 GHz
OSLNF50LF	Precision N(f) Open/short/Load, 42 dB, 4.0 GHz
28K50	Precision N(m) Load, 40 GHz
28KF50	Precision N(f) Load, 40 GHz
28N50-2	Precision N(m) Load, 40 dB, 18 GHz
28NF50-2	Precision N(f) Load, 40 dB, 18 GHz
2000-767	Precision Open/Short/Load, 7-16 (m), 4 GHz
2000-768	Precision Open/Short/Load, 7-16 (f), 4 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 6 GHz
15NDF50-1.5C	Test Port Ext. Cable, 1.5 meters, N(m) to 7/16 DIN(f), 6 GHz
15NN50-1.5C	Test Port Ext. Cable, 1.5 meters, N(m) to N(m), 6.0 GHz
15NN50-3.0C	Test Port Ext. Cable, 3.0 meters, N(m) to N(m), 6.0 GHz
15NN50-5.0C	Test Port Ext. Cable, 5.0 meters, N(m) to N(m), 6.0 GHz
15NNF50-1.5B	Test port cable armored, 1.5 meter, N(m) to N(f), 18 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6.0 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6.0 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6.0 GHz
15KKF50-1.5A	Test port cable armored, 1.5 meter, K(m) to K(f), 26.5 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 6 GHz

Model/Order No.	Name
800-109	Detector extender cable, 7.6 m (25 ft.)
800-110	Detector extender cable, 15.2 m (50 ft.)
800-111	Detector extender cable, 30.5 m (100 ft.)
800-112	Detector extender cable, 61 m (200 ft.)
34NN50A	Precision N(m) to N(m) Adapter, 18 GHz
34NFNF50	Precision N(f) to N(f) Adapter, 18 GHz
34RKNF50	Precision Ruggedized K(m) to N(f) Adapter, 20 GHz
K220B	Precision K(m)-K(m) Adapter, 40 GHz
K222B	Precision K(f)-K(f) Adapter, 40 GHz
1091-26	Adapter N(m) to SMA(m), 18 GHz
1091-27	Adapter N(m) to SMA(f), 18 GHz
1091-80	Adapter, N(f) to SMA(m), 18 GHz
1091-81	Adapter, N(f) to SMA(f), 18 GHz
1091-172	Adapter, DC to 1.3 GHz, 50 Ω, N(m) to BNC(f)
510-90	Adapter 7-16(f) to N(m), 7.5 GHz
510-91	Adapter 7-16(f) to N(f), 7.5 GHz
510-92	Adapter 7-16(m) to N(m), 7.5 GHz
510-93	Adapter 7-16(m) to N(f), 7.5 GHz
510-96	Adapter 7/16 (m) to 7/16 (m), 7.5 GHz
510-97	Adapter 7/16 (f) to 7/16 (f), 7.5 GHz
48258	Spare Soft Carrying Case for
40-115	Spare AC/DC Adapter
806-62	Spare Automotive Cigarette Lighter/12 Volts DC adapter
800-441	Spare Serial Interface Cable
806-16	Bantam Plug to Bantam Plug
806-116	Bantam Plug to BNC
806-117	Bantam "Y" Plug to RJ48
760-215A	Transit Case for Site Master
633-27	Rechargeable battery, NiMH for "C" version Site Master
2300-347	Spare Handheld Software Tools
1030-86	Band Pass Filter, 806-869 MHz, 1.7 dB loss, N(m) to SMA(f), 50Ω
1030-87 Band	Pass Filter, 902-960 MHz, 1.7 dB loss, N(m) to SMA(f), 50Ω
1030-88 Band	Pass Filter, 1.85-1.99 GHz, 1.8 dB loss, N(m) to SMA(f), 50Ω
1030-89 Band	Pass Filter, 2.4-2.5 GHz, 1.4 dB loss, N(m) to SMA(f), 50Ω
10580-00076	Spare Site Master S810C, S820C User's Guide
10580-00060	Spare Site Master User's Guide (S113C, S114C, S331C & S332C)
10580-00065	Spare Site Master User's Guide (S251C)
10580-00077	Site Master Programming Manual (for S810C, S820C)
10580-00061	Site Master Programming Manual (for S113C, S114C, S331C, S332C)
10580-00066	Site Master Programming Manual (for S251C)
10580-00078	Site Master Maintenance Manual (for S810C & S820C)
10580-00079	Spare S331D and S332D user guide
10580-00062	Site Master Maintenance Manual (for S113C, & S331C)
10580-00067	Site Master Maintenance Manual (for S251C)
10580-00068	Site Master Maintenance Manual (for S114C & S332C)
10580-00100	S331D & S332D Programming Manual
10580-00101	S331D Maintenance Manual
10580-00102	S332D Maintenance Manual
2000-1214	HP DeskJet printer includes: serial-to-parallel interface cable, black print cartridge, and US power cable
2000-753	Spare serial-to-parallel converter cable
2000-663	Power cable (Europe) for DeskJet printer
2000-664	Power cable (Australia) for DeskJet printer
2000-665	Power cable (UK) for DeskJet printer
2000-666	Power cable (Japan) for DeskJet printer
2000-667	Power cable (So. Africa) for DeskJet printer
2000-1030	Portable antenna, SMA (m) 1.71 to 1.88 GHz
2000-1031	Portable antenna, SMA (m) 1.85 to 1.99 GHz
2000-1032	Portable antenna, SMA (m) 2.4 to 2.5 GHz
2000-1200	Portable antenna, SMA (m) 806 to 869 MHz
2000-1035	Portable antenna, SMA (m) 902 to 960 MHz
2000-1216	Black printer cartridge for DeskJet printer
2000-1217	Rechargeable battery for DeskJet printer
551-1691	Earthmate USB to serial adapter cable

Universal Waveguide Component Accessories

	Part number*2	Freq. range	Waveguide type	Compatible flanges
Precision waveguide calibration components*1	XXUM70	5.85 to 8.20 GHz	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
	XXUM84	7.05 to 10.00 GHz	WR112, WG15	CBR84, UBR84, PBR84, PDR84
	XXUM100	8.20 to 12.40 GHz	WR90, WG16	CBR100, UBR100, PBR100, PDR100
	XXUM120	10.00 to 15.00 GHz	WR75, WG17	CBR120, UBR120, PBR120, PDR120
	XXUA187	3.95 to 5.85 GHz	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
	XXUA137	5.85 to 8.20 GHz	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
	XXUA112	7.05 to 10.00 GHz	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
	XXUA90	8.20 to 12.40 GHz	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
	XXUA62	12.40 to 18.00 GHz	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
	XXUA42	17.00 to 26.50 GHz	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U
Precision waveguide-to-coaxial adapters*1	35UM70N	5.85 to 8.20 GHz	WR137, WG14	CAR70, PAR70, UAR 70, PDR70
	35UM84N	7.05 to 10.00 GHz	WR112, WG15	CBR84, UBR84, PBR84, PDR84
	35UM100N	8.20 to 12.40 GHz	WR90, WG16	CBR100, UBR100, PBR100, PDR100
	35UM120N	10.00 to 15.00 GHz	WR75, WG17	CBR120, UBR120, PBR120, PDR120
	35UA187N	3.95 to 5.85 GHz	WR187, WG12	CPR187F, CPR187G, UG-1352/U, UG-1353/U, UG-1728/U, UG-1729/U, UG-148/U, UG-149A/U
	35UA137N	5.85 to 8.20 GHz	WR137, WG14	CPR137F, CPR137G, UG-1356/U, UG-1357/U, UG-1732/U, UG-1733/U, UG-343B/U, UG-344/U, UG-440B/U, UG-441/U
	35UA112N	7.05 to 10.00 GHz	WR112, WG15	CPR112F, CPR112G, UG-1358/U, UG-1359/U, UG-1734/U, UG-1735/U, UG-52B/U, UG-51/U, UG-137B/U, UG-138/U
	35UA90N	8.20 to 12.40 GHz	WR90, WG16	CPR90F, CPR90G, UG-1360/U, UG-1361/U, UG-1736/U, UG-1737/U, UG-40B/U, UG-39/U, UG-135/U, UG-136B/U
	35UA62N	12.40 to 18.00 GHz	WR62, WG18	UG-541A/U, UG-419/U, UG-1665/U, UG1666/U
	35UA42K	17.00 to 26.50 GHz	WR42, WG20	UG-596A/U, UG-595/U, UG-597/U, UG-598A/U

*1: Call or contact Anritsu sales rep for other frequencies waveguide calibration components and waveguide-to-coaxial adapters.
*2: Part number Ordering information
Prefix (XX) 23 for 1/8 λ offset short
24 for 3/8 λ offset short
26 for Precision waveguide load
35 waveguide to coaxial adapter

5

SPECTRUM MASTER
MS2721A
100 kHz to 7.1 GHz

High Performance Handheld Spectrum Analyzer

NEW

The MS2721A is the first handheld spectrum analyzer to deliver the ability to measure very low level signals with a displayed average noise level of ≤ -153 dBm typical @ 1 GHz in a 10 Hz RBW. Coupled with a wide range of resolution bandwidth choices, you can configure the Spectrum Master to meet your most challenging measurement needs. As the spectrum becomes more and more congested, the ability to measure low level, closely spaced signals becomes more and more important not only for interference detection but also for wireless system planning.

Operating convenience is of paramount important importance when equipment is used in the field. The input attenuation value can be tied to the reference level, reducing the number of parameters a field technician may have to set. The RBW/VBW and the span/RBW ratios can be set to values that are best for the measurements being made, further easing the technician's burden and reducing the chances of errors. Thousands of traces with names up to 15 characters long may be saved in the 64 MB non-volatile compact flash memory. These traces can later be copied into a PC using the built-in USB 2.0 connector or the 10/100 MHz Ethernet connection, or by copying them to an external Compact Flash card. The MS2721A Spectrum Master has a very wide dynamic range (>80 dB), allowing measurement of very small signals in the presence of much larger signals.

Resolution bandwidth and video bandwidth can be independently set to meet a user's measurement needs. In addition the input attenuator value can be set by the user and the preamplifier can be turned on or off as needed. For maximum flexibility, sweep triggering can be set to free run, or to do a single sweep.

Light Weight

Weighing about six pounds, including a Li-Ion battery, this fully functional handheld spectrum analyzer is light enough to take anywhere, including up a tower.

With the supplied Remote Access Software you can control an MS2721A that is miles away, seeing the screen display and operating with an interface that looks exactly like the instrument itself.

The MS2721A features eight languages English, Spanish, German, French, Japanese, Chinese, Italian and Korean, plus two custom, user defined languages can be uploaded into the instrument using Master Software Tools, supplied with the instrument.

Fast Sweep Speed

The MS2721A can do a full span sweep in ≤900 milliseconds, and sweep speed in zero span can be set from less than 50 microseconds up to over 4000 seconds. This is faster and more flexible than any portable spectrum analyzer on the market today, simplifying the capture of intermittent interference signals.

+43 dBm Maximum Safe Input Level

Because the MS2721A can survive an input signal of +43 dBm – 20 watts – without damage, you can rest assured that the MS2721A can survive in even the toughest RF environments.

Spectrum Monitoring

A critical function of any spectrum analyzer is the ability to accurately view a portion of the RF and microwave spectrum. The MS2721A performs this function admirably thanks to the wide frequency range and excellent dynamic range. A built-in 64 MB compact flash memory module allows over 2000 traces to be stored. An external compact flash socket allows additional compact flash memory to expand the trace storage without limit.

Multiple Markers

Display up to six markers on screen, each with delta marker capability. In addition you may select a marker table that simultaneously shows the status of all markers. In the table you can see the frequency, and amplitude measurement value for all markers along with delta frequency and delta amplitude. Each marker can have not only a measurement reference frequency but also a delta frequency and delta amplitude, effectively giving you up to twelve markers if you need them!

Noise Markers

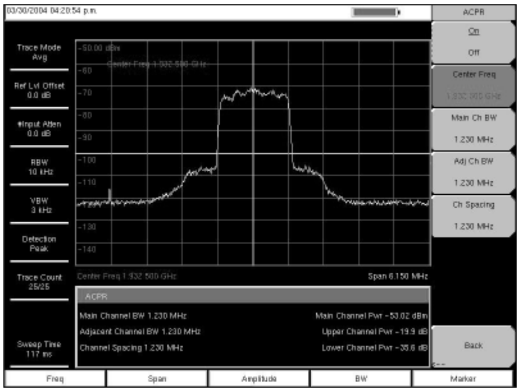
The capability to measure noise level in terms of dBm/Hz or dBµV/Hz is a standard feature of the MS2721A.

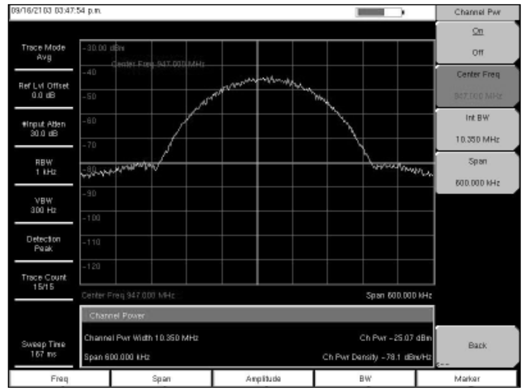
Frequency Counter Markers

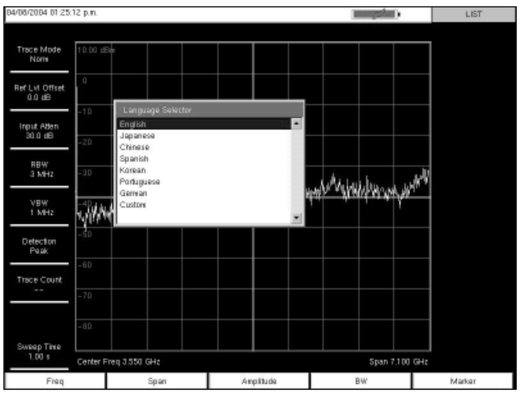
The MS2721A Spectrum Master has frequency counter markers with resolution to 1 Hz. Tie this capability to an external precision time base to get complementary accuracy and resolution.

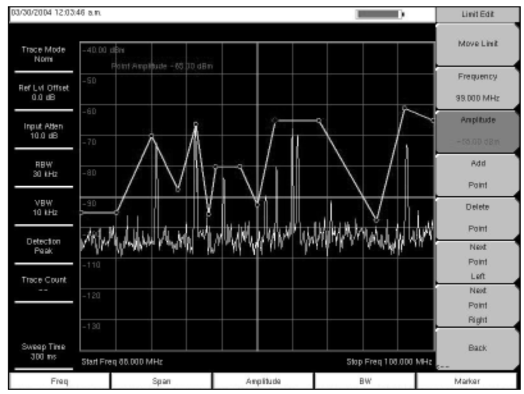
Smart Measurements

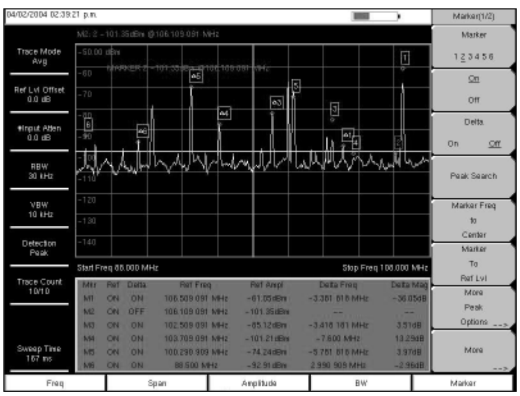
The MS2721A has dedicated routines for smart measurements of field strength, channel power, occupied bandwidth, Adjacent Channel Power Ratio (ACPR) and C/I.

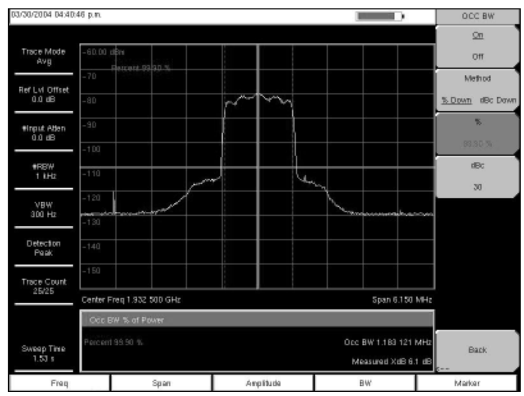

Adjacent Channel Power Ratio


Measurement of Channel Power for a GSM Signal


Multiple Language Support


Segmented Limit Line


Multiple Markers plus Multiple Delta Markers


Occupied Bandwidth

Specifications

Frequency	Frequency Range	100 kHz to 7.1 GHz (useable to 9 kHz)
	Tuning resolution	1 Hz
	Frequency Reference	Aging ±1 ppm/year Accuracy ±1 ppm (25°C ± 25°C) + long term drift
	Frequency Span	10 Hz to 7.1 GHz plus 0 Hz (zero span)
	Span Accuracy	Same as frequency reference accuracy
	Sweep Time minimum	100 ms, 50 µs in zero span
	Sweep Time Accuracy	± 2% in zero span
	Sweep Trigger	Free run, Single, Video, External
	Resolution Bandwidth (-3 dB width)	10 Hz to 3 MHz in 1-3 sequence ± 10% , 8 MHz demodulation bandwidth
	Video Bandwidth (-3 dB)	1 Hz to 3 MHz in 1-3 sequence
	SSB Phase Noise	-100 dBc/Hz max at 10, 20 & 30 kHz offset from carrier -102 dBc/Hz max at 100 kHz offset from carrier

Continued on next page

Amplitude	Measurement Range	DANL to +30 dBm
	Absolute amplitude accuracy (Power levels ≥-50 dBm, ≤35 dB input attenuation, preamp off)	100 kHz to ≤ 10 MHz ±1.5 dB >10 MHz to 4 GHz ±1.25 dB >4 GHz to 7.1 GHz ±1.75 dB
	Second Harmonic Distortion (0 dB input attenuation, -30 dBm input)	-50 dBc, 0.05 to 0.75 GHz -40 dBc, >0.75 to 1.05 GHz -50 dBc, >1.05 to 1.4 GHz -70 dBc, >1.4 to 2 GHz -80 dBc, > 2 GHz
	Third Order Intercept (TOI) (preamplifier off)	Frequency Typical 50 MHz to 300 MHz >8 dBm >300 MHz to 2.2 GHz >10 dBm >2.2 GHz to 2.8 GHz >15 dBm >2.8 GHz to 4.0 GHz >10 dBm >4.0 GHz to 7.1 MHz >13 dBm
	Displayed Average Noise Level DANL in 10 Hz RBW, dBm	Frequency Preamp On Typical Max 10 MHz to 1 GHz -153 dBm -151 dBm >1 GHz to 2.2 GHz -150 dBm -149 dBm >2.2 GHz to 2.8 GHz -146 dBm -143 dBm >2.8 GHz to 4.0 GHz -150 dBm -149 dBm >4.0 GHz to 7.1 GHz -148 dBm -146 dBm
	Noise Figure (Derived from DANL measurement) 0 dB attenuation, reference level -50 dBm, 23°C, preamplifier on	Frequency Typical 10 MHz to 1.0 GHz 11 dB >1 GHz to 2.2 GHz 14 dB >2.2 GHz to 2.8 GHz 18 dB >2.8 GHz to 4.0 GHz 14 dB >4.0 GHz to 7.1 GHz 16 dB
	Display Range	1 to 15 dB/div in 1 dB steps. Ten divisions displayed.
	Amplitude Units	Log Scale modes dBm, dBV, dBmv, dBµV
	Linear Scale Modes	nV, µV, mV, V, kV, nW, µW, mW, W, kW
	Attenuator range	0 to 65 dB
	Attenuator resolution	5 dB steps
	Input-Related Spurious	-60 dBc max*, (<-70 dBc typical), -30 dBm input, 0 dB RF attenuation *Exceptions: Input frequency Spur Level 1674 MHz -46 dBc max (-56 dBc typical), 0 to 2800 MHz >1674 to 1774 MHz -50 dBc max (-60 dBc typical) at (Finput – 1674 MHz) >1774 to 2900 MHz -48 dBc max (-68 dBc typical) at (Finput – 1674 MHz)
	Residual Spurious, preamp off	(RF input terminated, 0 dB RF attenuation) -90 dBm max**, 100 kHz to <3200 MHz -84 dBm max**, 3200 to 7100 MHz **Exceptions: Frequency Spur Level 250, 300 & 350 MHz -85 dBm max ~4010 MHz -80 dBm max (-90 dBm typical) ~5084 MHz -70 dBm max (-83 dBm typical) ~5894 MHz -75 dBm max (-87 dBm typical) ~7028 MHz -80 dBm max (-92 dBm typical)
	Residual Spurious, preamp on:	-100 dBm max (RF input terminated, 0 dB RF attenuation)
General	Maximum Continuous Input	≥10 dB attenuation, +30 dBm
	Input Damage Level	≥10 dB attenuation, >+43 dBm, ±50 Vdc <10 dB attenuation, >+23 dBm, ±50 Vdc
	RF Input VSWR	2.0:1 maximum, 1.5:1 typical (≥10 dB attenuation)
	Reference Level	Adjustable over amplitude range
	ESD Damage Level	>10 kV ≥10 dB attenuation
	Functions	Multiple Marker Display up to six markers on screen, each marker includes a delta marker. Marker Table Display a table of up to six marker frequency and amplitude values plus delta marker frequency offset and amplitude. Upper & Lower Limit Lines Each upper and lower limit can contain up to 40 segments.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS2721A	Handheld Spectrum Analyzer: 100 kHz to 7.1 GHz
	Standard Accessories
10580-00103	MS2721A User's Guide
61382	MS2721A Soft Carrying Case
2300-498	Master Products Software Tools Program CD ROM
633-44	Rechargeable Li-Ion Battery
40-168	AC-DC Adapter
806-62	Automotive Cigarette Lighter 12 Volt DC Adapter
2000-1360	USB A/mini-B Cable
2000-1371	Ethernet Cable, 7 feet (213 cm)
1091-27	Type-N male to SMA female Adapter
1091-172	Type-N male to BNC female Adapter
	Optional Accessories
42N50A-30	30 dB, 50W, Bi-dir., DC-18 GHz, N(m) to N(f) Attenuator
34NN50A	Precision Adapter, DC to 18 GHz, 50 , N(m) to N(m)
34NFNF50C	Precision Adapter, DC to 18 GHz, 50 , N(f) to N(f)
15NNF50-1.5B	Test port cable armored, 1.5 meter, N(m) to N(f), 18.0 GHz
15NNF50-1.5B	Test port cable, armored, 1.5 meter N(m) to N(f) 18 GHz
15NN50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(m), 6 GHz
15NN50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(m), 6 GHz
15NN50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(m), 6 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 6.0 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 6.0 GHz

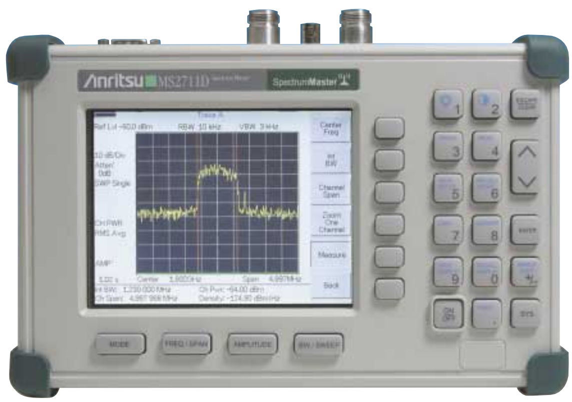
Model/Order No.	Name
510-90	Adapter, 7/16 DIN (f) to N(m), DC to 7.5 GHz, 50Ω
510-91	Adapter, 7/16 DIN (f)-N(f), DC to 7.5 GHz, 50Ω
510-92	Adapter, 7/16 DIN (m)-N(m), DC to 7.5 GHz, 50Ω
510-93	Adapter, 7/16 DIN(m)-N(f), DC to 7.5 GHz, 50Ω
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, Loss =1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, Loss =1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, Loss =1.9 dB, N(m)-SMA(f)
510-97	Adapter 7/16 DIN (f) to 7/16 DIN (f), 7.5 GHz
61382	Spare Soft Carrying Case
40-168	Spare AC/DC Adapter
806-62	Spare Automotive Cigarette Lighter 12 Volt DC Adapter
760-229	MS2721A Transit Case
2300-498	Master Software Tools Program CD ROM
10580-00103	Anritsu User's Guide, Model MS2721A
10580-00104	Anritsu Programming Manual, Model MS2721A
10580-00105	Anritsu Maintenance Manual, Model MS2721A
633-44	Rechargeable battery, Li-Ion
2000-1374	Dual Battery charger, Li-Ion with universal power supply
2000-1030	Portable antenna, 50Ω, SMA (m) 1.71-1.88 GHz
2000-1031	Portable antenna, 50Ω, SMA (m) 1.85-1.99 GHz
2000-1032	Portable antenna, 50Ω, SMA (m) 2.4-2.5 GHz
2000-1035	Portable antenna, 50Ω, SMA (m) 896-941 MHz
2000-1200	Portable antenna, 50Ω, SMA (m) 806-869 MHz
2000-1361	Portable Antenna, 50Ω, SMA (m) 5725-5825 MHz
2000-1358	64 MB Compact Flash Memory Module

SPECTRUM MASTER

MS2711D, MS2711B

100 kHz to 3.0 GHz

Fast, Accurate, Repeatable, Portable Spectrum Analysis



The MS2711B/D Handheld Spectrum Analyzers provide excellent measurement flexibility for field environments and applications requiring mobility. Unlike traditional spectrum analyzers, the MS2711B/D feature a rugged, ultra-lightweight, battery-operated design that enables users to conduct spectrum analysis measurements – anywhere, anytime.

Providing complete freedom from AC/DC power requirements, the MS2711B/D enable you to locate, identify, record and solve communication systems problems quickly and easily, without sacrificing measurement accuracy.

Whether you are installing, maintaining, or troubleshooting a modern wireless communication system, the MS2711B/D provide exceptional performance combined with ease-of-use and broad functionality – making it an ideal solution for engineers and technicians who conduct field measurements in the 100 kHz to 3.0 GHz frequency range. In fact, it is ideal for finding the source of interfering signals in modern wireless systems.

Rugged and Reliable

Because the MS2711B/D were designed specifically for field environments, they can easily withstand the day-to-day punishment of field use. Rugged packaging also keeps the MS2711B/D performing in harsh environments.

Easy-to-Use

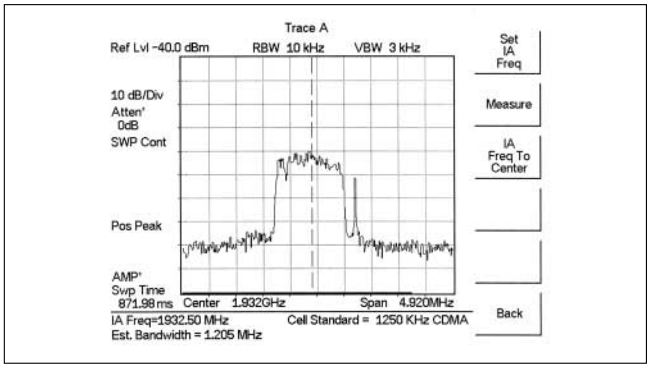
Not only are the MS2711B/D the lightest fully-functional spectrum analyzers available at 4.5 pounds (base model including battery), operation is straight-forward and driven by firmware that simplifies the process of making measurements and interpreting the results shown on the large, high-resolution LCD display. The menu-driven user interface is easy to use and requires little training.

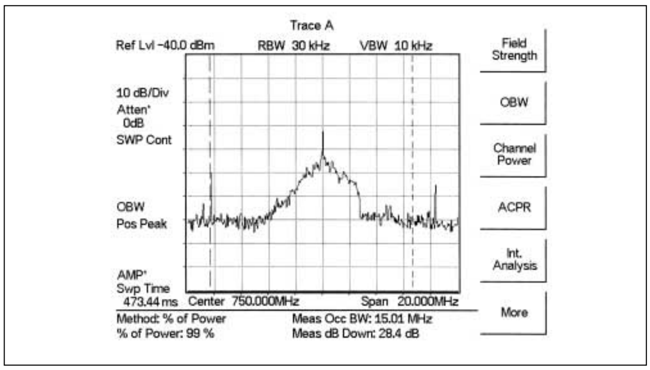
A full range of marker capabilities such as peak, center and delta functions are also provided, giving users a faster and more comprehensive measurement of displayed signals. Limit lines simplify amplitude measurements, giving users the capability to create quick, simple, pass/fail measurements. Frequency, span and amplitude functions are easily configured for optimum performance. Used together with the Save Setup feature, these functions can help to make testing easier and faster for less experienced users.

Powerful Trace Management

Users are able to store ten test setups along with 200 measurement traces internally in the unit's memory. The stored data can be easily downloaded to a personal computer (PC) or a printer via an RS-232 serial cable for further analysis. A computer can be used with the RS-232 interface for automated control and data collection in the field.

A standard preamplifier (MS2711B option 8) plus a number of available options including an internal tracking generator (option 20, MS2711B) or transmission measurement (option 21, MS2711D) expand the MS2711B/D's capabilities.





To meet the challenges of today's wireless market, Anritsu Company has incorporated a pre-amp (standard) for its revolutionary MS2711B/D Handheld Spectrum Analyzers which increases the analyzer's sensitivity and dynamic range while improving measurement time. With the built-in pre-amp feature, the MS2711B/D are particularly effective in measuring low-level signals. The handheld spectrum analyzer's sensitivity is improved to –115 dBm for MS2711B and –135 dBm for MS2711D (100 Hz RBW). With this option, the MS2711B/D can identify and make measurements on low-level signals much faster than previously possible.

The improved sensitivity, dynamic range, and measurement speed complement the existing benefits of the MS2711B/D. Weighing only 4.9 pounds (including a NiMH battery, fully loaded, base model only 4.5 pounds), the MS2711B is the world's lightest fully functional handheld spectrum analyzer with the built-in tracking generator option (option 20).

MS2711B/D have been enhanced so that they can make highly accurate channel power measurements, occupied bandwidth and Adjacent Channel Power Ratio (ACPR) measurements. These are increasingly critical measurements, particularly for power amplifiers used in wireless communication systems. With the enhancements, the MS2711B/D have dedicated one button channel power, occupied bandwidth, and ACPR measurement capability to significantly reduce test time and expense. The MS2711B/D also feature local language graphical user interface support (in English, Chinese, Japanese, French, German, and Spanish).

Features

- Lightweight (4.5 lbs - base model, 4.9 lbs with tracking generator - MS2711B option 20, or transmission measurement, MS2711D option 21)
- Synthesizer-based performance
- Wide dynamic range
- One button, ACPR, OBW, channel power, C/I measurement
- Quick zoom-in, zoom-out display
- 5 minute warm up
- Manual and automatic attenuator control
- Improved user interface, with local language support in five different languages
- Automatic overload and ESD protection
- Built-in AM/FM demodulation
- Built-in field strength measurement
- Built-in interference analysis in MS2711D
- Ability to store and recall up to six sets of antenna factors
- Full range of marker capabilities including peak, center, and delta functions
- Limit lines for quick, simple pass/fail measurements
- Rugged, reliable packaging
- Battery operated design
  - 2.5 hours of continuous operation
  - Built-in energy conservation that extends battery life beyond an eight-hour workday
  - Operation using a 12.5 Vdc source AC-DC adapter or automotive cigarette lighter adapter, which simultaneously charges the battery
  - Field replaceable battery
- Built in clock and calender
- Low cost ownership, global warranty
- Data storage and memory
  - Store up to ten test setups and 200 measurement traces in non-volatile memory
  - Stored data is easily and quickly downloaded to a personal computer (PC) or printer
- Powerful trace management
  - Automatically date/time stamped
  - Alphanumeric labeling
- PC reporting software
  - Windows® 95/98/2000/ME, XP, NT Workstation compatible
  - Supports long file names for descriptive labeling
  - Can display an unlimited number of traces for comparison to historical performance
- Monochrome or optional Color LCD display (MS2711D) with backlight capability
- Direct printer control via RS232 serial port

Applications

Convenient operating procedures, high sensitivity, and excellent repeatability enable the MS2711B/D to pinpoint the smallest system performance degradation and allow for easy verification of system compliance. Typical applications include:

- Transmitter Spectrum Analysis – occupied bandwidth, power, modulation measurements, location and identification of in-band, out-of-channel spurious and out-of-band spurious signals
- Receive Signal Analysis – locate and identify sources of interfering signals
- Modulation identification, modulation depth, deviation, and spectral mask
- Signal Strength Mapping – to determine the most suitable location for antennas, base stations, and repeaters; or pinpoint Electromagnetic (EM) leakage in broadcast systems

Specifications

	Model	MS2711B	MS2711D
Frequency	Frequency range	100 kHz to 3.0 GHz	
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm	
	Frequency span	1 kHz to 3 GHz in 1, 2, 5 step selections in auto mode, plus zero span	10 Hz to 2.99 GHz in 1, 2, 5 step selections in auto mode, plus zero span
	Sweep time	≥6500 msec full span; 500 msec zero span	≤1.1 second full span; ≤50 msec to 200 second zero span
	Resolution bandwidth (–3dB width)	10 kHz, 30 kHz, 100 kHz, 1 MHz, ±20%	100 Hz to 1 MHz in 1-3 sequence, ±5%
	Video bandwidth (–3dB)	100 Hz to 300 kHz in 1-3 sequence	3 Hz to 1 MHz in 1-3 sequence, ±5%
	SSB Phase Noise (1 GHz) @30 kHz Offset	≤–75 dBc/Hz	
	Spurious responses Input related	≤–45 dBc	
	Spurious residual responses	≤–90 dBm (≥500 kHz)	
Amplitude	Measurement range	+20 dBm to –115 dBm (with preamp on)	+20 dBm to –135 dBm (with preamp on)
	Displayed average noise level	–115 dBm (≥1 MHz typical with preamp on) ≤–95 dBm (≥500 kHz, typical) ≤–80 dBm (< 500 kHz, typical)	≤–135 dBm typical, ≥1 MHz (preamp on) ≤–115 dBm typical, ≥500 kHz to <1 MHz ≤–110 dBm typical, < 500 kHz for input terminated, 0 dB attenuation, RMS detection, 100 Hz RBW
	Dynamic range	>65 dB, typical	
	Total level accuracy	±2 dB, ≥500 kHz, typical; ±3 dB, <500 kHz, typical for input signal level ≥–60 dBm	±1 dB typical (±1.5 dB max) ≥10 MHz to 3 GHz ±2 dB typical <10 MHz for input signal level ≥–60 dBm, excludes input VSWR mismatch
	Display range	1 to 15 dB/div in 1 dB steps, Ten divisions displayed	
	Max input level without damage	+23 dBm, ±50 Vdc	+43 dBm (Peak), ±50 Vdc
	Attenuator Range	0 to 50 dB, selected manually or automatically coupled to the reference level. Resolution in 10 dB steps	0 to 51 dB, selected manually or automatically coupled to the reference level. Resolution in 1 dB steps.
	RF input	VSWR 2.0:1	1.5:1 typical, (≥20 dB atten., 10 MHz to 2.4 GHz)

Continued on next page

General	Model	MS2711B	MS2711D
	Internal trace memory	200 maximum	
	Setup storage	10 test setups	15 test setups
	Display	VGA Monochrome LCD	VGA Color or VGA Monochrome LCD
	Inputs and Outputs Ports RF In RF Out Ext trig In Ext Freq Ref In (2 MHz to 20 MHz) Serial Interface	 Type N, female, 50 Ω Type N, female, 50 Ω N/A N/A RS-232 9 pin D-sub, three wire serial	 Type N, female, 50 Ω Type N, female, 50 Ω BNC, female (5V TTL) Shared BNC, female, 50 Ω (–15 dBm to +10 dBm) RS-232 9 pin D-sub, three wire serial
	Electromagnetic compatibility	Meets European community requirements for CE marking	
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment	
	Temperature Operating Non-operating	 0°C to 50°C, humidity 85% or less –20°C to +75°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)	 –10°C to 55°C, humidity 85% or less –51°C to +71°C (recommend battery stored separately between 0°C to 40°C for any prolonged storage period)
	Power supply External DC Input Internal	 +12.5 to +15 volts dc, 1350 mA max NiMH battery: 10.8 volts, 1800 mA mAH	
	Dimensions Size (W x H x D) Weight	 25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) 2.04 kg (4.5 lbs) includes battery, 2.2 kg (4.9 lbs) includes tracking generator	 25.4 cm x 17.8 cm x 6.10 cm (10.0 in x 7.0 in x 2.4 in) <2.14 kg (4.7 lbs) includes battery, <2.28 kg (5 lbs) includes transmission measurement

MS2711B/D (Option 10) Bias Tee specifications

Bias Tee	Voltage	+18 Vdc
	Current	1 A peak 200 ms, 300 mA max steady state

MS2711D (Option 21) Transmission Measurement specifications

Frequency	Frequency range Frequency resolution	25 MHz to 3 GHz 10 Hz
Output	Output power level Output impedance	–10 dBm typical 50 Ω

FCN4760 Frequency Converter specifications

Frequency	Frequency range	4.7 GHz to 6 GHz
	Frequency resolution*1	10 Hz
	Frequency reference	Aging: ±1 ppm/yr Accuracy: ±2 ppm
	SSB Phase Noise (6 GHz) @30 kHz Offset	≤–65 dBc/Hz
	Spurious responses Input related	≤–45 dBc
	Spurious residual responses[1]	≤–90 dBm
Amplitude	Measurement range	–40 dBm to –100 dBm
	Sensitivity*1 (displayed avg. noise level)	–100 dBm
	Maximum input level without damage	–5 dBm
	RF input	VSWR 2.0:1 max
General	Inputs and Outputs Ports RF In RF Out Communication Interface	 Type N, female, 50 Ω Type N, male, 50 Ω 10 pin D sub
	Electromagnetic compatibility	Meets European community requirements for CE marking
	Safety	Conforms to EN 61010-1 for Class 1 portable equipment
	Temperature Operating Non-operating	 –10°C to 50°C, humidity 85% or less –50°C to +80°C
	Power dissipation	850 mW max
	Dimensions Size (W x H x D) Weight	 6.6 cm x 10.9 cm x 3.3 cm (2.6 in x 4.3 in x 1.3 in) <0.45 kg (< 1 lb.)

*1: Specifications apply when connected to the MS2711D spectrum analyzer

MS2711B (Option 20) Tracking generator specifications

Frequency	Frequency range	10 MHz to 3 GHz
	Frequency resolution	5 KHz
	Tracking offset range	±5 MHz
Output	Output power level	0 to –60 dBm
	Output power level resolution	0.1 dB
	Absolute level accuracy	±1.5 dB, 0 to –40 dBm ±4 dB, –40 dBm to –60 dBm
	Output flatness	≤±1.5 dB (10 MHz – 3 GHz)
	Output tracking VSWR	<2.0:1, <0 dBm
	Spurious harmonics	≤–20 dBc
	Non-Spurious	≤–20 dBc

MS2711D (Option 29) Power meter specifications

Frequency Range	3 MHz to 3.0 GHz
Total Level Accuracy	±1 dB typical (±1.5 dB max) ≥10 MHz to 3 GHz ±2 dB typical <10 MHz for input signal level ≥–60 dBm, excludes input VSWR mismatch
Measurement Range	+20 dBm to -80 dBm
Frequency Span	3 MHz to 2.99 GHz
Display Range	+80 dBm to -80 dBm
Offset Range	0 to 60 dB
Maximum Input Power	+20 dBm without input attenuator

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS2711B/8	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
MS2711D	Handheld Spectrum Analyzer: 100 kHz to 3.0 GHz
	Standard Accessories
	User's Guide, MS2711D or MS2711B
	Soft Carrying Case
	AC – DC Adapter
	Automotive Cigarette Lighter/12 Volt DC Adapter
	One Year Warranty
	CD ROM containing Software Tools
	Serial Interface Cable
	Rechargeable battery, NiMH
	Pre-amplifier (built-in)
	Option Accessories
Option 3	Color display - MS2711D only
Option 6	Frequency converter controller module for use with FCN4760 (MS2711D only)
Option 10	Bias Tee (built-in)
Option 20	Tracking generator (built-in) - MS2711B only
Option 21	Transmission measurement (built-in) - MS2711D only
Option 29	Power Meter (MS2711D only)
	Optional Accessories
FCN4760	4.7 to 6.0 GHz Down Converter (requires MS2711D/6 or S332D/6)
5400-71N50	RF Detector, N(m), 50 Ω, 1 to 3000 MHz (MS2711B only)
42N50A-30	30 dB, 50 Watt, Bi-directional, DC to 18 GHz, N(m) to N(f) Attenuator
34NN50A	Precision Adapter, DC to 18 GHz, 50 Ω, N(m) to N(m)
34NFNF50C	Precision Adapter, DC to 18 GHz, 50 Ω, N(f) to N(f)
15NN50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(m), 6.0 GHz
15NN50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(m), 6.0 GHz
15NN50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(m), 6.0 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6.0 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6.0 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6.0 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 3.5 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 3.5 GHz
510-90	Adapter 7/16 (f) to N(m), 3.5 GHz
510-91	Adapter, 7/16 DIN(f) to N(f), 7.5 GHz
510-92	Adapter, 7/16 DIN(m) to N(m) 7.5 GHz
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), 7.5 GHz
510-97	Adapter 7/16 DIN(f) to 7/16 DIN(f), 7.5 GHz

Model/Order No.	Name
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, Loss = 1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, Loss = 1.9 dB, N(m)-SMA(f)
48258	Spare soft carrying case
40-168	Spare AC/DC adapter
806-62	Spare automotive cigarette lighter/12 Volt DC adapter
800-441	Spare serial interface cable
760-229	Transit case for Anritsu Handheld Spectrum Analyzer
2300-347	Anritsu Handheld Software Tools
10580-00074	Anritsu HHSA User's Guide, Model MS2711B (spare)
10580-00071	Anritsu HHSA Programming Manual, Model MS2711B
10580-00072	Anritsu HHSA Maintenance Manual, Model MS2711B
10580-00097	Anritsu HHSA User's Guide, Model MS2711D
10580-00098	Anritsu HHSA Programming Manual, Model MS2711D
10580-00099	Anritsu HHSA Maintenance Manual, Model MS2711D
633-27	Rechargeable battery, NiMH
551-1691	USB to Serial adapter
70-28	Headset
2000-1029	Battery charger, NiMH with universal power supply
2000-1030	Portable antenna, 50 Ω, SMA (m) 1.71-1.88 GHz
2000-1031	Portable antenna, 50 Ω, SMA (m) 1.85-1.99 GHz
2000-1032	Portable antenna, 50 Ω, SMA (m) 12.4-2.5 GHz
2000-1035	Portable antenna, 50 Ω, SMA (m) 896-941 MHz
2000-1200	Portable antenna, 50 Ω, SMA (m) 806-869 MHz
	Printers
2000-1214	HP DeskJet printer Includes: interface cable, black print cartridge, and US power cable
2000-753	Spare serial-to-parallel converter cable
2000-663	Power cable (Europe) for DeskJet printer
2000-664	Power cable (Australia) for DeskJet printer
2000-666	Power cable (Japan) for DeskJet printer
2000-1218	Power cable (UK) for DeskJet printer
2000-667	Power cable (So. Africa) for DeskJet printer
2000-1217	Rechargeable battery for DeskJet printer
2000-1216	Black print cartridge for DeskJet printer

SPECTRUM ANALYZERS

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Spectrum analyzer selection guide

Model	Measurement frequency range	Measurement level range (dBm)	Resolution bandwidth	High-level accuracy	C/N (dBc/Hz)*1	RF-band harmonic distortion (dBc)*2	Third order intermodulation distortion (dBc)*2	Counter	Measure	Zone marker	AM/FM demodulation mode	QP detection	High-speed time domain	Gate	Tracking generator	GPIB	PTA	Features
MS2687B	9 kHz to 30 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz (1 Hz to 1 MHz, with Opt.*3)	√	–108*1	–90	–85	√	√	√	–	–	√	√	–	RS-232	–	Portable
MS2683A	9 kHz to 7.8 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz, 1 Hz to 1 MHz (with Opt.)	√	–108*1	–90	–85	√	√	√	–	–	√	√	–	√	–	
MS2681A	9 kHz to 3 GHz	–124 to +30	300 Hz to 3 MHz, 5, 10, 20 MHz, 1 Hz to 1 MHz (with Opt.)	√	–108*1	–70	–85	√	√	√	–	–	√	√	–	√	–	
MS2781A	100 Hz to 8 GHz	–147 to +30	0.1 Hz to 8 MHz	√	–114	–68	–90	–	√	–	–	–	√	–	–	Opt.	Windows XP	MATLAB (Opt.), Digital Demod (Opt.)
MS2668C	9 kHz to 40 GHz	–115 to +30	1 kHz to 3 MHz, 10 Hz to 3 MHz (with Opt.)	√	–90*3	–90	–75	√	√	√	√	–	Opt.	Opt.	–	√	√	Portable
MS2667C	9 kHz to 30 GHz	–115 to +30	1 kHz to 3 MHz, 10 Hz to 3 MHz (with Opt.)	√	–95*3	–60	–80	√	√	√	√	–	Opt.	Opt.	–	√	√	
MS2665C	9 kHz to 21.2 GHz	–115 to +30	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–95*3	–60	–80	√	√	√	√	–	Opt.	Opt.	–	√	√	
MS2663C	9 kHz to 8.1 GHz	–115 to +30	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–100	–75	–80	√	√	√	√	Opt.	Opt.	Opt.	Opt.	√	√	
MS2661C	9 kHz to 3 GHz	–115 to +30, –130 to +30 (with Opt.)	1 kHz to 3 MHz, 30 Hz to 3 MHz (with Opt.)	√	–100	–75	–80	√	√	√	√	Opt.	Opt.	Opt.	Opt.	√	√	
MS2661B	9 kHz to 3 GHz	–115 to +30, –130 to +30 (with Opt.)	1 kHz to 5 MHz, 30 Hz to 5 MHz (with Opt.)	√	–100	–75	–80	√	√	√	√	Opt.	Opt.	Opt.	Opt.	√	√	
MS2651B	9 kHz to 3 GHz	–110 to +30	1 kHz to 5 MHz	√	–90	–60	–70	√	√	√	√	Opt.	Opt.	Opt.	Opt.	√	√	
MS2711D	100 kHz to 3 GHz	–135 to +20	100 Hz to 1 MHz	√	–75*4	–45	–45	–	√	–	√	–	–	–	Opt.	RS-232	–	Handheld (2.28 kg)
MS2721A	100 kHz to 7.1 GHz	–143 to +30	10 Hz to 3 MHz	√	–100	–80	–80	–	√	–	√	–	–	–	–	LAN/ USB	–	Handheld (2.9 kg)

*1: 10 kHz offset
*2: At –30 dBm
*3: –95 + 20 log n (n: local harmonic order)
*4: At 30 kHz offset

Anritsu

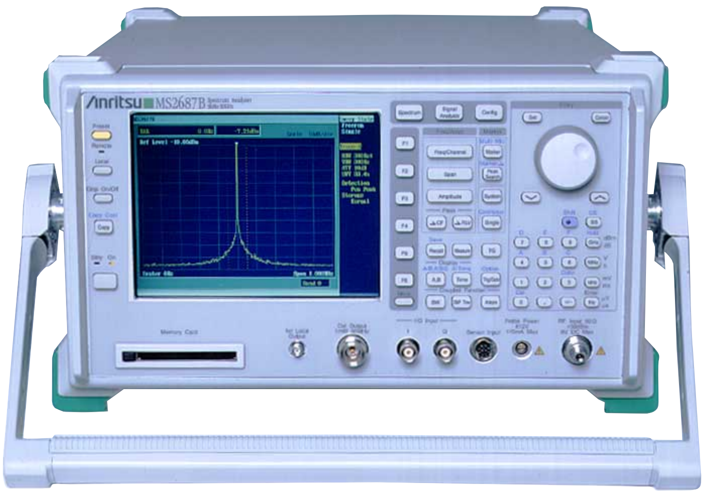
SPECTRUM ANALYZER

MS2681A/2683A/2687B

9 kHz to 3/7.8/30 GHz

CE GPIB

For Evaluation of IMT-2000, Bluetooth™, MMAC and Advanced Radio Communication Devices



The IMT-2000 (2 GHz band) service for third-generation mobile radio communication has started. Bluetooth has been adopted for close-range radio communication between portable remote terminals and peripheral equipment, and R&D of MMAC, IEEE802.11a, and HiperLAN2 (High Performance European Radio Local Area Network Type 2) for higher speed access have been conducted in various countries.

The MS2681A/2683A/2687B spectrum analyzer delivers optimum performance over a wide dynamic range (156 dB, typical value), wide resolution bandwidth (20 MHz), to high-speed sweep (refresh rate of 20 times/s), required for evaluating next-generation radio communication systems and devices.

It can be used not only as a spectrum analyzer but also to perform various measurements easily and quickly by installing measurement software.

- **Application software**

Support system	Name
W-CDMA	W-CDMA measurement software
GSM	GSM measurement software
cdmaOne, CDMA2000 1X	cdma measurement software
CDMA2000 1xEV-DO	CDMA2000 1xEV-DO measurement software
PDC/PHS/NADC (IS-136), STD-39/T79, STD-T61	π/4DQPSK measurement software
IEEE802.11a/11b, HiSWANa, HiperLAN2	Wireless LAN measurement software

Features

- Wide resolution bandwidth up to 20 MHz.
- Data transmission speed approximately 10 times faster. (GPIB transmission speed: 120 kbytes/s)
- Optional measurement software (sold separately) for high-speed modulation analysis (1.5 sec. with W-CDMA, 0.5 sec with IEEE802.11a).
- Optional narrow resolution bandwidth from 1 Hz.
- Optional rubidium reference oscillator for warm-up time of just 7 minutes.
- Optional power meter that measures up to 32 GHz.

Specifications

Specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference, and are not guaranteed.

Name	MS2681A	MS2683A	MS2687B
Frequency range	9 kHz to 3 GHz	9 kHz to 7.8 GHz	9 kHz to 30 GHz
Frequency band	—	Band 0: 9 kHz to 3.2 GHz, Band 1–L: 1.6 to 3.2 GHz (option 03), Band 1: 3.15 to 6.3 GHz, Band 1+: 6.2 to 7.8 GHz	Band 0: 9 kHz to 3.2 GHz Mixer harmonics order 1 Band 1–: 3.15 to 6.3 GHz Mixer harmonics order 1 Band 1+: 6.2 to 7.9 GHz Mixer harmonics order 1 Band 2+: 7.8 to 15.3 GHz Mixer harmonics order 2 Band 4+: 15.2 to 30 GHz Mixer harmonics order 4
Pre-selector range	—	3.15 to 7.8 GHz, 1.6 to 7.8 GHz (option 03)	3.15 to 30 GHz (band 1–, 1+, 2+, 4+)

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Name	MS2681A	MS2683A	MS2687B
Display frequency accuracy	± (Display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz)		± (Display frequency x reference frequency accuracy + span x span accuracy + resolution bandwidth x 0.15 + 10 Hz x N Hz) Normal marker: same as frequency display accuracy, Delta marker: same as span accuracy *N: Mixer harmonics order
Frequency counter resolution	1 Hz, 10 Hz, 100 Hz, 1 kHz (counts the received frequency at the peak point inside the zone)		
Frequency counter accuracy	± (Display frequency x reference frequency accuracy + 2 Hz + 1 LSD) (at S/N 20 dB or more and RBW 3 MHz or less)		± (Display frequency x reference frequency accuracy +2 Hz + 1LSD) (at S/N 20 dB or more and RBW 3 MHz or less)
Frequency span	Setting range: 0 Hz, and 5 kHz to 3.0 GHz, Accuracy: ±1.0% (at data point of 1001)	Setting range: 0 Hz, and 5 kHz to 7.8 GHz, Accuracy: ±1.0% (at data point of 1001)	Setting range: 0 Hz, and 5 kHz to 30 GHz, Accuracy: ±1.0% (band 0,1), ±2.5% (band 2, 4) At single band sweep, data point 1001
Resolution bandwidth (RBW) [3 dB bandwidth]	Setting range: 300 Hz to 3 MHz (1, 3 sequence), 5 MHz, 10 MHz, 20 MHz *Manually settable, or automatically settable according to frequency span Accuracy: ±20% (300 Hz to 10 MHz), ±40% (20 MHz) Selectivity (60 dB: 3 dB): ≤15 : 1		
Video bandwidth (VBW)	1 Hz to 3 MHz (1, 3 sequence), Off *Manually settable, or automatically settable according to RBW		
Signal purity	Noise sideband: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset)		Noise sideband: ≤–108 dBc/Hz (1 GHz, 10 kHz offset), ≤–120 dBc/Hz (1 GHz, 100 kHz offset) Spurious resulting from local cause: ≤–65 dBc (at harmonic mixing order 1)
Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤5 x 10^{-8} (after 10 minutes warm-up, with frequency after 24 hours warm-up referenced) Aging rate: ≤±2 x 10^{-8}/day, ≤±1 x 10^{-7}/year (with frequency after 24 hours of warm-up referenced) Temperature characteristics: ±5 x 10^{-8} (0˚ to +50°C, with frequency at +25°C referenced)		
Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: Continuous average power: +30 dBm (RF ATT: ≥10 dB) Peak pulse input: +47 dBm (pulse width ≤1 µs, duty ratio ≤1%, RF ATT: ≥30 dB) DC voltage: 0 Vdc		
	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in Sample detection mode [Without option 08] ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz) ≤–120 dBm + f [GHz] dB (2.5 to 3.0 GHz) [With option 08] ≤–122 dBm + 1.5f [GHz] dB (1 MHz to 2.5 GHz) ≤–120 dBm + 1.5f [GHz] dB (2.5 to 3.0 GHz) Residual response: ≤–100 dBm (1 MHz to 3.0 GHz)	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in Sample detection mode [Without option 08] ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–122 dBm + 0.5f [GHz] dB (3.15 to 7.8 GHz, band 1) [With option 08] ≤–122 dBm + 1.5f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + 1.5f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–122 dBm + 0.5f [GHz] dB (3.15 to 7.8 GHz, band 1) Residual response: ≤–100 dBm (1 MHz to 3.2 GHz, band 0), ≤–90 dBm (3.15 to 7.8 GHz, band 1)	Average noise level display RBW: 300 Hz, VBW: 1 Hz, RF ATT 0 dB, in SAMPLE detection mode ≤–124 dBm + f [GHz] dB (1 MHz to 2.5 GHz, band 0) ≤–120 dBm + f [GHz] dB (2.5 to 3.2 GHz, band 0) ≤–115 dBm (3.15 to 7.9 GHz, band 1) ≤–113 dBm (7.8 to 15.3 GHz, band 2) ≤–103 dBm (15.2 to 30.0 GHz, band 4) Residual response: RF ATT 0 dB, input terminated at 50 Ω ≤–100 dBm (1 MHz to 3.2 GHz, band 0), ≤–90 dBm (3.15 to 7.8 GHz, band 1)
Reference level	Setting range Log scale: –100 to +40 dBm, or equivalent level, Linear scale: 2.24 µV to 22.4 V Unit Log scale: dBm, dBµV, dBmV, dBµV (emf), W, V, dBµV/m Linear scale: V Reference level accuracy: ±0.5 dB (–49.9 to 0 dBm), ±0.75 dB (+0.1 to +30 dBm, –69.9 to –50 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 50 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (300 Hz to 5 MHz), ±0.5 dB (10, 20 MHz) *After calibration, with RBW 3 kHz referenced		
	Input attenuator (RF ATT) Setting range: 0 dB to 62 dB (2 dB step), manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (10 to 50 dB), ±0.5 dB (52 to 62 dB) *After calibration, with 50 MHz, RF ATT 10 dB referenced Input attenuator switching mode: 2, 10 dB step mode		Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB step), manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (10 to 50 dB), ±0.5 dB (50 to 70 dB) *With 50 MHz, RF ATT 10 dB referenced

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Name	MS2681A	MS2683A	MS2687B
Frequency response	±0.6 dB (9 kHz to 3.0 GHz) *With 50 MHz referenced (when RF ATT 10 dB, +18˚ to +28°C) ±1.0 dB (9 kHz to 3.0 GHz) *With 50 MHz referenced (when RF ATT 10 to 62 dB)	±0.6 dB (9 kHz to 3.2 GHz, band 0), ±1.0 dB (3.15 to 7.8 GHz, band 1) ±1.0 dB (option 03, 1.6 to 7.8 GHz, band 1) *With 50 MHz referenced (when RF ATT 10 dB, +18˚ to +28°C) ±1.0 dB (9 kHz to 3.2 GHz, band 0), ±2.0 dB (3.15 to 7.8 GHz, band 1) ±2.0 dB (1.6 to 7.8 GHz, band 1) *With 50 MHz referenced (when RF ATT 10 to 62 dB), after pre-selector tuning for band 1.	Relative flatness: at RF ATT 10 dB with the center point of frequency response in the band referenced ±1.0 dB (9 kHz to 3.2 GHz, band 0), ±1.5 dB (3.15 to 7.9 GHz, band 1), ±3.0 dB (7.8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 30 GHz, band 4) *After pre-selector tuning for band 1, 2, and 4 Absolute flatness: at RF ATT 10 dB with 50 MHz referenced ±5.0 dB (9 kHz to 30 GHz), *After pre-selector tuning for band 1, 2, and 4
Waveform display	Scale: 10 div (single scale) Log scale: 10, 5, 2, 1 dB/div, Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –70 dB, ≤1 kHz), ±1.2 dB (0 to –90 dB, ≤1 kHz) Linear scale: 4% of reference level Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02%		
Spurious response	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–75 dBc (0.2 to 0.85 GHz, Mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.5 GHz, Mixer input: –30 dBm) Two-signal third-order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.0 GHz) *Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm Image response: ≤–70 dBc	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–75 dBc (0.2 to 0.85 GHz, band 0, Mixer input: –30 dBm) ≤–70 dBc (0.85 to 1.6 GHz, band 0, Mixer input: –30 dBm) ≤90 dBc (1.6 to 3.9 GHz, band 1, Mixer input: –10 dBm) ≤–90 dBc (option 03, 0.8 to 3.9 GHz, band 1, Mixer input: –10 dBm) Two-signal third-order intermodulation distortion: ≤–70 dBc (10 to 100 MHz) ≤–85 dBc (0.1 to 7.8 GHz) *Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm Image response: ≤–70 dBc	2nd harmonic distortion: ≤–60 dBc (input frequency 10 to 200 MHz, Mixer input: –30 dBm) ≤–70 dBc (0.2 to 1.6 GHz, band 0, Mixer input: –30 dBm) ≤–90 dBc or lower than average noise level (1.6 to 15 GHz, band 1, 2, and 4, Mixer input: –10 dBm) Two-signal third-order intermodulation distortion (Frequency difference of two signals: ≥50 kHz, Mixer input: –30 dBm): ≤–70 dBc (10 to 100 MHz), ≤–85 dBc (0.1 to 3.2 GHz, band 0) ≤–80 dBc (3.15 to 7.9 GHz, band 1) ≤–75 dBc or lower than average noise level (7.8 to 22.5 GHz, band 2, 4) ≤–75 dBc or lower than average noise level (22.5 to 30 GHz, band 4, Typical) Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz) Multiple response/spurious outside the band: ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz)
1 dB gain compression	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz)	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, band 1), ≥0 dBm (≥3.15 GHz, band 1) ≥0 dBm (option 03: ≥1.6 GHz, band 1)	≥0 dBm (≥100 MHz), ≥+3 dBm (≥500 MHz, band 0), ≥–5 dBm (≥3150 MHz, band 1, 2, and 4)
Maximum dynamic range	1 dB gain compression to average noise level [Without Option 08] ≥124 dB – f [GHz] dB, Reference value (0.1 to 3.0 GHz) [With Option 08] ≥122 dB – 1.5f [GHz] dB, Reference value (0.1 to 3.0 GHz)	1 dB gain compression to average noise level [Without option 08] ≥124 dB – f [GHz] dB,Reference value (0.1 to 3.2 GHz, band 0) ≥122 dB – 0.5f [GHz] dB, Reference value (3.15 to 7.8 GHz, band 1) [With option 08] ≥122 dB – 1.5f [GHz] dB, Reference value (0.1 to 3.2 GHz, band 0) ≥122 dB – 0.5f [GHz] dB, Reference value (3.15 to 7.8 GHz, band 1)	—
Sweep mode	Continuous, single		
Sweep time	Setting range: 10 ms to 1000 s *Manually settable, or automatically settable according to RBW and VBW Set resolution: 5 ms (5 ms to 1 s), Top three digits (≥1 s) Accuracy: ±3%		
Trigger switch	Free run, triggered		
Trigger source	Wide IF video, external (TTL), external (±10 V), line		
Gate sweep mode	Off, random sweep mode Setting range Gate delay range: 0 to 65.5 ms (Resolution: 1 µs) Gate length range: 2 µs to 65.5 ms (Resolution: 1 µs), Gate end: Internal/external		
Zone sweep	Sweeps the indicated range in the zone only.	—	Sweeps the indicated range in the zone only.
Tracking sweep	Sweeps following the peak point inside the zone marker (zone sweep also available).	—	Sweeps following the peak point inside the zone marker (zone sweep also available).

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Name		MS2681A	MS2683A	MS2687B
Time sweep	Sweep mode	Continuous, single		
	Sweep time	Setting range/resolution: 1 to 50 µs (1, 2, 5 sequence), 100 µs to 4.9 ms (100 µs resolution), Sweep time: 5.0 ms to 1 s (5 ms resolution), 1 to 1000 s (setting of top three digits) Accuracy: ±1%		
	Trigger switch	Free run, triggered		
	Trigger source	Wide IF video, video, external (TTL), external (±10 V), line		
	Trigger delay	Pre-trigger (displays waveform before trigger occurrence point) Setting range: – time span to 0 s Trigger delay: Resolution: time span/500 or 100 ns, whichever is larger Post-trigger Setting range: 0 µs to 65.5 ms Resolution: 100 ns (sweep time: ≤4.9 ms), 1 µs (sweep time: ≥5 ms)		
Functions	Number of data points	Selectable between 501 and 1001		
	Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, AVERAGE		
	Display functions	TRACE A, TRACE B, TRACE A/BG, TRACE A/TIME Trace calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A		
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE		
	Marker	Signal search: AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL Zone marker: NORMAL, DELTA Marker functions: MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE ΔMARKER → SPAN, ZONE → SPAN Peak search: PEAK, NEXT PEAK, MIN DIP, NEXT DIP Multi marker: 10 max. (highest 10, harmonics, manually		
	Measure	Noise power: dBm/Hz, dBm/CH, dBµV/ $\sqrt{\text{Hz}}$ C/N: dBc/Hz, dBc/CH Occupied bandwidth: power N% method, X-dB down method Adjacent channel leakage power REF: total power/reference level/in-band level method Display: channel designate display: 3 channels x 2, graphic display Average power within burst signal: average power in the designated range of time domain waveform Template comparison (at time sweep): upper limit x 2, lower limit x 2 MASK (at frequency sweep): upper limit x 2, lower limit x 2		
	Correction	Frequency response can be corrected arbitrarily up to 150 points		
Others	Display	Color TFT-LCD, VGA 17 cm (6.5 type)		
	Color	Number of colors: 4096, RGB, each 16-scale settable		
	Intensity	Settable in 5 steps (display off included)		
	Contents	Scale, waveform data, setting condition, menu, title		
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card		
	Hard copy	Displayed data can be hard-copied with the printer via parallel interface (PCL level 3 or lower, or ESC/P-J83, J84 compatible models only)		
	GPIB	Meets IEEE488.2. Controllable with external controller (except for power switch) Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2		
	Parallel interface	Centronics-compatible, outputs print data to printer, D-sub 25 pin connector (jack) Data line exclusive for output: 8, Control line: 4 (BUSY, $\overline{\text{DTSB}}$, $\overline{\text{ERROR}}$, PE)		
	PC card interface	Saves and recalls setting condition and waveform data, ATA flash card accessible (3.3 V/5 V), Connector: Type I or Type II of PC card		
	RS-232C	Controllable with external controller (except for power switch) Baud rate: 1200, 2400, 4800, 9600, 19.2 k, 38.4 k, 56 k, 115 kbps		
Input/output connector		Input connector: N-J, 50 Ω nominal value Impedance: VSWR ≤1.5 Typical (RF ATT ≥10 dB) Video output: outputs analog RGB, D-sub 15-pin connector (jack) IF output: BNC connector, 50 Ω nominal value, 66/10.69 MHz Level: –10 dBm Typical (frequency 50 MHz, display scale upper edge, 50 Ω terminated) Broadband IF output: BNC connector, 50 Ω nominal value, 60.69/66 MHz Gain: 0 dB Typical (50 MHz, RF ATT: 0 dB, for RF input level) Video output (Y): BNC connector Input/output connector Level: 0 to 0.5 V ± 0.1 V Typical (log scale), 0 to 0.4 V ± 0.1 V Typical (linear scale), (50 MHz, from upper edge to lower edge at 10 dB/div or 10%/div, 75 Ω terminated) Buffered Output: BNC connector, Level: 2 to 5 V (p-p) (200 Ω terminated) Sweep Output (X): BNC connector, Level: 0 to 10 V ± 0.1 V (100 kΩ termination, from the left edge to the right edge of the display scale, single band sweep) Sweep Status Output (Z): BNC connector, Level: TTL (low level at sweep) Probe source: 4-pole connector, +12 V, –12 V, ±10% each, 110 mA max. each. Trig/Gate input: BNC connector, level: ±10 V (0.1 V resolution), or TTL level External reference input: BNC connector, Frequency: 10 MHz ±10 Hz, 13 MHz ±13 Hz, level: ≥0 dBm		
Dimensions and mass		320 (W) x 177 (H) x 411 (D) mm (handle, leg, front cover, fan cover excluded), ≤16 kg (nominal value)		
Power		100 to 120/200 to 240 VAC (–15%/+10%, 250 V max., wide range input) 47.5 Hz to 63 Hz, ≤400 VA		
Ambient temperature and humidity		0° to +50°C, RH ≤85% (no condensation allowed)		
Storage temperature range		–20° to +60°C		

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Name	MS2681A	MS2683A	MS2687B
EMC	EN61326: 1997/A2: 2001 (Class A), EN61000-3-2: 2000 (Class A), EN61326: 1997/A2: 2001 (Annex A)		
LVD	EN61010-1: 2001 (Pollution Degree 2)		

MS2687B Mainframe specifications when external mixer is used.

External Mixer	Frequency	Frequency range: 18 to 110 GHz Frequency band: Band / Frequency range / Mixer harmonics order [N] K / 18 to 26.5 GHz / 4 Ka / 26.5 to 40 GHz / 6 Q / 33 to 55 GHz / 8 U / 40 to 60 GHz / 9 or 10 V / 50 to 75 GHz / 11 or 12 E / 60 to 90 GHz / 13 or 14 W / 75 to 110 GHz / 16
	Span setting range	0 Hz, (100 x N) Hz to each bandwidth
Amplitude	Mixer transform loss setting range	15 to 85 dB
	Maximum input level	Depend of external mixer
	Average noise level	Depend of external mixer
	Frequency response	Depend of external mixer
Input/Output	Adaptive mixer	Only 2 port mixer
	Local frequency	4 to 7 GHz
	IF frequency	460.69 or 466 MHz
	Display gain	0 ±2 dB (External mixer input level –10 dBm, Mixer transform loss 15 dB)

• MS2681A Options

Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	$\leq 5 \times 10^{-8}$ (≤7 minutes, +25˚C, Typical value)
Aging rate	$\leq\pm 5 \times 10^{-10}$/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	$\leq\pm 5 \times 10^{-10}$ (With the frequency at 0˚ to +50˚C and +25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz and RF ATT is 0 dB [Without Option 08] ≤–148.3 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–146.3 dBm + f [GHz] dB Typical (2.5 to 3.0 GHz) [With Option 08] ≤–146.3 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–144.3 dBm + 1.5f [GHz] dB Typical (2.5 to 3.0 GHz)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW: ≥100 Hz), ±10% NOMINAL (RBW: ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz), ≤5:1 NOMINAL (RBW: ≤30 Hz) RBW switching uncertainty: 0.5 dB
Span setting	Minimum span setting: 1 kHz
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz and RF ATT is 0 dB [Without Option 08]: ≤–136.5 dBm + f [GHz] dB NOMINAL (1 MHz to 2.5 GHz), ≤–132.5 dBm + f [GHz] dB NOMINAL (2.5 to 3.0 GHz) [With Option 08]: ≤–134.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz), ≤–130.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.0 GHz)

Option 08: Pre-amplifier*1

Frequency range	100 kHz to 3 GHz
Gain	20 dB Typical
Noise figure	6.5 dB Typical (input frequency ≤2 GHz), 12 dB Typical (input frequency >2 GHz)
Level measurement range	Average noise level display to +10 dBm
Max. input level	CW average power: +10 dBm
Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent, Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.9 dB (–69.9 to +10 dBm), ±1.5 dB (–90 to –70 dBm) *After calibration, with 50 MHz referenced, 1 MHz span (RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±0.75 dB (52 to 62 dB) *With 50 MHz and RF ATT 10 dB referenced
Average noise level display	–137 dBm + 2.0 x f [GHz] dB (1 MHz to 3.0 GHz) *When RBW is 300 Hz, VBW is 1 Hz, RF ATT is 0 dB, and detection mode is set to SAMPLE
Frequency response	±2.0 dB (100 kHz to 3.0 GHz) *With 50 MHz referenced, when RF ATT is 10 dB to 50 dB, and temperature is +18˚ to +28˚C
Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level)
Spurious response	≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals ≥50 kHz, At pre-amplifier input level of –55 dBm*2
1 dB gain compression	≥–35 dBm (input frequency ≥100 MHz) *At pre-amplifier input level

*1 : Overall specification with pre-amplifier ON (Noise figure and gain are single performance of pre-amplifier.)
*2 : Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

Option 09: Ethernet interface

Function	Control with external controller (except for power switch)
Connector	10base-T

Option 17: I/Q balanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) In-phase voltage range: ±2.5 V (at input terminal)

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. *Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• MS2683A Options
Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8} (≤7 minutes, 25°C, Typical value)
Aging rate	≤±5 x 10^{-10}/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10}/day (With the frequency at 0˚ to +50˚C and +25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz), ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz and RF ATT is 0 dB [Without Option 08] ≤–146.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–142.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–144.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1) [With Option 08] ≤–144.5 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–140.5 dBm + 1.5f [GHz] dB Typical (2.5 to 3.2 GHz, band 1) ≤–138.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1)

Option 03: Extension of pre-selector lower limit to 1.6 GHz

Function	Extends the lowest frequency of pre-selector from 3.15 to 1.6 GHz
Frequency band	0 band: 9 kHz to 3.2 GHz, 1–L band: 1.6 to 3.2 GHz, 1– band: 3.15 to 6.3 GHz, 1+ band: 6.2 to 7.8 GHz
Pre-selector range	1.6 to 7.8 GHz (band: 1–L, 1–, 1+)
Average noise level	≤–122 dBm + 0.5f [GHz] dB (1.6 to 7.8 GHz, band 1, RBW: 300 Hz, VBW: 1 Hz, RF ATT: 0 dB)
Residual response	≤–90 dBm (1.6 to 7.8 GHz, band 1, RF ATT: 0 dB, input terminated at 50 Ω)
Frequency response	±1.0 dB (with 1.6 to 7.8 GHz, band 1, and 50 MHz referenced, when RF ATT is 10 dB and temperature is +18˚ to +28˚C) ±2.0 dB (1.6 to 7.8 GHz, band 1, RF ATT: 10 dB to 62 dB) *After pre-selector tuning for band 1
2nd harmonic distortion	≤–90 dBc (0.8 to 3.9 GHz, band 1, mixer input: –10 dBm)
1 dB gain compression	≥0 dBm (1.6 to 7.8 GHz, band 1)
Maximum dynamic range	≥–122 dB + 0.5f [GHz] dB (1.6 to 7.8 GHz, band 1)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW: ≥100 Hz), ±10% NOMINAL (RBW: ≥30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW: ≥100 Hz), ≤5:1 NOMINAL (RBW: ≤30 Hz) RBW switching uncertainty: 0.5 dB
Span setting	Minimum span setting: 1 kHz
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz and RF ATT is 0 dB [Without Option 08] ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–134.5 dBm + 0.5f [GHz] dB Typical (3.15 to 7.8 GHz, band 1) [With Option 08] ≤–134.5 dBm + 1.5 x f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–130.5 dBm + 1.5 x f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–134.5 dBm + 0.5 x f [GHz] dB Typical (3.15 to 7.8 GHz, band 1)

Option 08: Pre-amplifier*1

Frequency range	100 kHz to 3 GHz
Gain	20 dB Typical
Noise figure	6.5 dB Typical (input frequency ≤2 GHz), 12 dB Typical (input frequency >2 GHz)
Level measurement range	Average noise level display to +10 dBm
Max. input level	CW average power: +10 dBm
Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent, Linear scale: 2.24 µV to 707 mV Reference level accuracy: ±0.9 dB (–69.9 to +10 dBm), ±1.5 dB (–90 to –70 dBm) *After calibration, with 50 MHz referenced, 1 MHz span (RF, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB (300 Hz to 5 MHz), ±0.75 dB (10 MHz, 20 MHz) RF ATT switching uncertainty: ±0.5 dB (10 to 50 dB), ±0.75 dB (52 to 62 dB) *With 50 MHz referenced, when RF ATT is 10 dB
Average noise level display	–137 dBm + 2.0 x f [GHz] dB (1 MHz to 2.5 GHz, band 0) *When RBW is 300 Hz, VBW is 1 Hz, RF ATT is 0 dB, and detection mode set to SAMPLE
Frequency response	±2.0 dB (100 kHz to 3.0 GHz) *With 50 MHz referenced, when RF ATT is 10 dB to 50 dB, and temperature is +18˚ to +28˚C
Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB, RBW: ≤1 kHz), ±1.0 dB (0 to –60 dB, RBW: ≤1 kHz), ±1.5 dB (0 to –75 dB, RBW: ≤1 kHz) Linear scale (after calibration): ±5% (relative to reference level)
Spurious response	≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals ≥50 kHz, At pre-amplifier input level of –55 dBm*2
1 dB gain compression	≥–35 dBm (input frequency ≥100 MHz) *At pre-amplifier input level

*1 : Overall specification with pre-amplifier ON (Noise figure and gain are single performance of pre-amplifier.)
*2 : Pre-amplifier input level is shown by the following equation: Pre-amplifier input level = RF input level – RF ATT setting level

Option 09: Ethernet interface

Function	Exercises control with external controller (except for power switch)
Connector	10base-T

Option 17: I/Q balanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) In-phase voltage range: ±2.5 V (at input terminal)

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 Vp-p to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 34: 4 GHz LO output

Frequency	Frequency: 4 GHz Frequency accuracy: ± (4 GHz x reference frequency accuracy) ±1 Hz
Output level	–10 dBm Typical
Spurious	≤–40 dBc Typical

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. *Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

• MS2687B Options

Option 01: Precision frequency reference oscillator

Frequency	10 MHz
Start-up characteristics	≤5 x 10^{-8} (≤7 min. 25˚C, Typical)
Aging rate	≤±5 x 10^{-10}/day (With the frequency at 24 hours after the power is turned on referenced)
Temperature characteristics	≤±5 x 10^{-10} (With the frequency at 0 to +50˚C and +25˚C referenced)

Option 02: Narrow resolution bandwidths (FFT)

Resolution bandwidth	Setting range: 1 Hz to 1 kHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW = 30, 300 Hz) ±10% Typical (RBW = 1, 3, 10, 100, 1 kHz) RBW selectivity (60 dB: 3 dB): ≤5:1 RBW switching uncertainty: ±0.5 dB
Span setting	Minimum setting span: 100 Hz
Average noise level display	When RBW is 1 Hz, RF ATT is 0 dB ≤–146.5 dBm + 1.5f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–142.5 dBm + 1.5f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–137.5 dBm Typical (3.15 to 7.9 GHz, band 1) ≤–129.5 dBm Typical (7.8 to 15.2 GHz, band 2) ≤–125.5 dBm Typical (15.1 to 22.5 GHz, band 3) ≤–118.5 dBm Typical (22.4 to 30 GHz, band 4)

Option 04: Digital resolution bandwidth

Resolution bandwidth	Setting range: 10 Hz to 1 MHz (1, 3 sequence) Bandwidth accuracy: ±10% (RBW ≥100 Hz) ±10% Typical (RBW ≤30 Hz) Bandwidth selectivity (60 dB: 3 dB): ≤5:1 (RBW ≥100 Hz) ≤5:1 Typical (RBW ≤30 Hz) RBW switching uncertainty: ±0.5 dB
Detection mode	NORMAL, POSITIVE PEAK, NEGATIVE PEAK, SAMPLE, RMS RMS: displays root-mean-square value of average power between sample points
Average noise level	When RBW is 10 Hz, RF ATT is 0 dB ≤–136.5 dBm + f [GHz] dB Typical (1 MHz to 2.5 GHz, band 0) ≤–132.5 dBm + f [GHz] dB Typical (2.5 to 3.2 GHz, band 0) ≤–127.5 dBm Typical (3.15 to 7.9 GHz, band 1) ≤–119.5 dBm Typical (7.8 to 15.2 GHz, band 2) ≤–115.5 dBm Typical (15.1 to 22.5 GHz, band 3) ≤–108.5 dBm Typical (22.4 to 30 GHz, band 4)

Option 05: Rubidium reference oscillator*

Frequency	10 MHz
Start-up characteristics	±1 x 10^{-9}/7 min. (with frequency one hour after the power is turned on referenced)
Aging rate	±1 x 10^{-10}/month (with frequency one hour after the power is turned on referenced)
Temperature characteristics	±1 x 10^{-9}/day (with frequency at 0˚ to +45˚C and +25˚C referenced)
Accessories	J1066 coaxial code 0.15 m (BNC211-LP4)

* Can not be installed with option 22

Option 09: Ethernet interface

Function	Control with external controller (except for power switch)
Connector	10base-T

Option 18: I/Q unbalanced input

Connector	BNC
Impedance	Selectable between 1 MΩ (parallel capacity <100 pF) and 50 Ω
Input level range	Differential voltage range: 0.1 to 1 Vp-p (at input terminal) Changeable between DC connection and AC connection

Option 21: Power meter function

Frequency range	100 kHz to 32 GHz
Level range	–10 to +20 dBm
Applicable power sensor	MA4601A, MA4701A, MA4703A, MA4705A
Display	Selectable from W, dBm, and dB (RELATIVE), Digital 4 digit display, 20% over range, Power range: 4 range/10 dB step (Measurement level range is listed on the power sensor specifications.)
Range switching	Auto, manual (settable to arbitrary range irrespective of range hold or input level)
Accuracy	±0.7% (W mode), ±0.03 dB [dBm mode, dB (RELATIVE) mode] * Pressing ZERO ADJ key allows automatic adjustment to zero point.
Zero setting	±0.5% of full scale Typical value (100 µW range of maximum sensitivity)
Zero move between ranges	±0.2% (after zero setting at 100 µW range of maximum sensitivity)
Calibration oscillator frequency	50 MHz
Calibration oscillator level	1 mW ± 1.2% (for one year)
Averaging	Sample rate time settable in 4 steps

Option 34: 4 GHz LO output

Frequency	Frequency: 4 GHz Frequency accuracy: ± (4 GHz x reference frequency accuracy) ±1 Hz
Output level	–10 dBm Typical
Spurious	≤–40 dBc Typical

Option 46: Auto power recovery

Function	Disables the power switch on the front panel and automatically restores power after power failure. ON/OFF operation can be performed using the standby switch on the rear panel. * Power switch on the front panel of this unit does not have a latching function. Therefore, if power is interrupted in the ON status, the standby status is kept even after power is restored.

Option 47: Rack mount (IEC)

Function	Mounts the rack mount for IEC standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Option 48: Rack mount (JIS)

Function	Mounts the rack mount for JIS standard-compatible rack. When mounted, the tilt handle (standard) is eliminated.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS2681A	Spectrum Analyzer	
MS2683A	Spectrum Analyzer	
MS2687B	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
J0996B	RS-232C cable:	1 pc
JT32MA3-NT1	PC-ATA card (32 MB):	1 pc
F0014	Fuse, 6.3 A:	1 pc
MX268001A	File Transfer Utility:	1 pc
W1754AE	MS2681A/2683A/2687B operation manual:	1 copy
	Options	
MS2681A-01	Precision frequency reference (aging rate: ±5 x 10^{-10}/day)	
MS2681A-02	Narrow resolution bandwidths (FFT)	
MS2681A-04	Digital resolution bandwidth	
MS2681A-08	Pre-amplifier	
MS2681A-09	Ethernet interface	
MS2681A-17	I/Q balanced input	
MS2681A-18	I/Q unbalanced input	
MS2681A-46	Auto power recovery	
MS2681A-47	Rack mount (IEC) without handles	
MS2681A-48	Rack mount (JIS) without handles	
MS2683A-01	Precision frequency reference (aging rate: ±5 x 10^{-10}/day)	
MS2683A-02	Narrow resolution bandwidths (FFT)	
MS2683A-03	Extension of pre-selector lower limit to 1.6 GHz	
MS2683A-04	Digital resolution bandwidth	
MS2683A-08	Pre-amplifier	
MS2683A-09	Ethernet interface	
MS2683A-17	I/Q balanced input	
MS2683A-18	I/Q unbalanced input	
MS2683A-34	4 GHz LO output	
MS2683A-46	Auto power recovery	
MS2683A-47	Rack mount (IEC) without handles	
MS2683A-48	Rack mount (JIS) without handles	
MS2687B-01	Precision frequency reference (aging rate: ±5 x 10^{-10}/day)	
MS2687B-02	Narrow resolution bandwidths (FFT)	
MS2687B-04	Digital resolution bandwidth	
MS2687B-05	Rubidium reference oscillator	
MS2687B-09	Ethernet interface	
MS2687B-18	I/Q unbalanced input	
MS2687B-21	Power meter function	
MS2687B-34	4 GHz LO output	
MS2687B-46	Auto power recovery	
MS2687B-47	Rack mount (IEC) without handles	
MS2687B-48	Rack mount (JIS) without handles	
	Measurement software	
MX268101B	W-CDMA Measurement Software (for MS2681A)	
MX268301B	W-CDMA Measurement Software (for MS2683A)	
MX268701B	W-CDMA Measurement Software (for MS2687B)	
W1746AE	W-CDMA Measurement Software operation manual (MS2681A/2683A/2687B Common)	
MX268102A	GSM Measurement Software (for MS2681A)	
MX268302A	GSM Measurement Software (for MS2683A)	
MX268702A	GSM Measurement Software (for MS2687B)	
W1854AE	GSM Measurement Software operation manual (MS2681A/2683A/2687B Common)	

Continued on next page

Model/Order No.	Name
MX268103A	cdma Measurement Software (for MS2681A)
MX268303A	cdma Measurement Software (for MS2683A)
MX268703A	cdma Measurement Software (for MS2687B)
W1865AE	cdma Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268104A	1xEV-DO Measurement Software (for MS2681A)
MX268304A	1xEV-DO Measurement Software (for MS2683A)
MX268704A	1xEV-DO Measurement Software (for MS2687B)
W2090AE	1xEV-DO Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268105A	π/4DQPSK Measurement Software (for MS2681A)
MX268305A	π/4DQPSK Measurement Software (for MS2683A)
MX268705A	π/4DQPSK Measurement Software (for MS2687B)
W1866AE	π/4DQPSK Measurement Software operation manual (MS2681A/2683A/2687B Common)
MX268130A	WIRELESS LAN Measurement Software (for MS2681A)
MX268330A	WIRELESS LAN Measurement Software (for MS2683A)
MX268730A	WIRELESS LAN Measurement Software (for MS2687B)
W2080AE	WIRELESS LAN Measurement Software operation manual (MS2681A/2683A/2687B Common)
	Application parts
J0576D	Coaxial cord (N-P, 5D-2W, N-P), 2 m
J0561	Coaxial cord (N-P, 5D-2W, N-P), 1 m
J0104A	Coaxial cord (BNC-P, RG-55/U, BNC-P), 1 m
J0127C	Coaxial cord (BNC-P, RG-58A/U, BNC-P), 0.5 m
J0127A	Coaxial cord (BNC-P, RG-58A/U, BNC-P), 1 m
DGM010-02000EE	Coaxial cord (general use, N-P · N-P, DC to 18 GHz), 2 m
DGM024-02000EE	Coaxial cord (low-loss type, N-P · N-P, DC to 18 GHz), 2 m
J0911	Coaxial cord (K-P · K-P, DC to 40 GHz), 1 m
J0912	Coaxial cord (K-P · K-P, DC to 40 GHz), 0.5 m
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J1047	Ethernet cross cable
MA1612A	Four-port Junction Pad (5 MHz to 3000 MHz)
MA1621A	50 Ω → 75 Ω Impedance Transformer (75 Ω, 9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50 ↔ 70 Ω Impedance Converter (50 to 1200 MHz, 1.5 dB or lower)
J0395	Fixed attenuator for high-power (30 dB, 30 W, DC to 9 GHz)
B0472	Fixed attenuator for high-power (30 dB, 100 W, DC to 18 GHz)
J0078	High power attenuator (N type, 20 dB, 10 W, DC to 18 GHz)
34AKNF50	Ruggedized K-to-Type N Adapter
MA2507A	DC Block Adaptor (50 Ω, 9 kHz to 3 GHz, ±50 V)
J0805	DC block, N type (10 kHz to 18 GHz, made by Wineshell)
B0452A	Hard carrying case (with casters)
B0452B	Hard carrying case (without casters)
B0488	Rear panel protective pad
W1888AE	Assembling guide drawing for rear protective pad (supplied with B0488 as standard)
B0481B	Carrybone
B0479	Soft carrying case (rucksack type)
MA4601A	Power Sensor (100 kHz to 5.5 GHz, –30 to +20 dBm, N connector)
MA4701A	Power Sensor (10 MHz to 18 GHz, –30 to +20 dBm, N connector)
MA4703A	Power Sensor (50 MHz to 26.5 GHz, –30 to +20 dBm, APC3.5(P) connector)
MA4705A	Power Sensor (50 MHz to 32 GHz, –30 to +20 dBm, APC3.5(P) connector)
J0370A	Sensor connecting cord, 1.5 m (for power meter option)
J0370C	Sensor cord, 2.5 m (for power meter option)
J0370E	Sensor cord, 5 m (for power meter option)
J0370G	Sensor cord, 10 m (for power meter option)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
J0364	APC-3.5 to N conversion connector (for MA4703A and MA4605A)
	Warranty
MS2681A-90	Extended three year warranty service
MS2681A-91	Extended five year warranty service
MS2683A-90	Extended three year warranty service
MS2683A-91	Extended five year warranty service
MS2687B-90	Extended three year warranty service
MS2687B-91	Extended five year warranty service

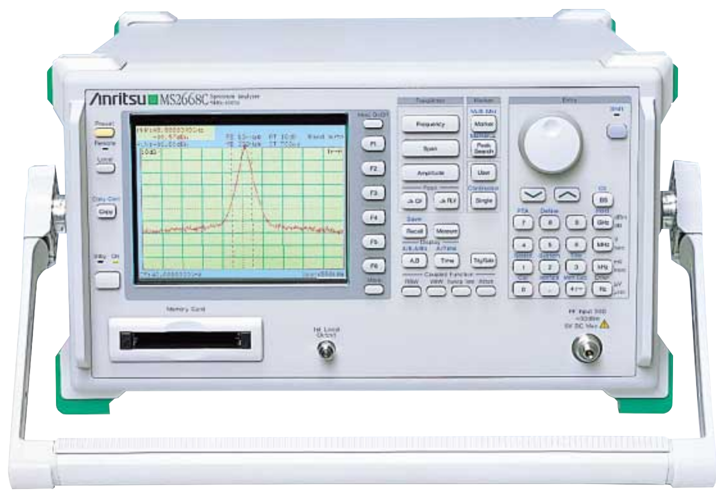
SPECTRUM ANALYZER

MS2668C

9 kHz to 40 GHz

CE GPIB

For Measuring High-Speed Communications, such as MMAC and ITS



In recent wireless communication market, the utilization of microwave/millimeter wave band frequencies is being considered in order to realize high-speed and large-capacity data communication. In the markets of ITS and ultrahigh-speed wireless LAN, aiming for the speedup of wireless LAN which began to be spread as a typical application, millimeter wave band is used for realizing collision avoidance radar.
MS2668C is a portable and high-performance spectrum analyzer that has various radio evaluation functions for microwave/millimeter wave devices and systems.

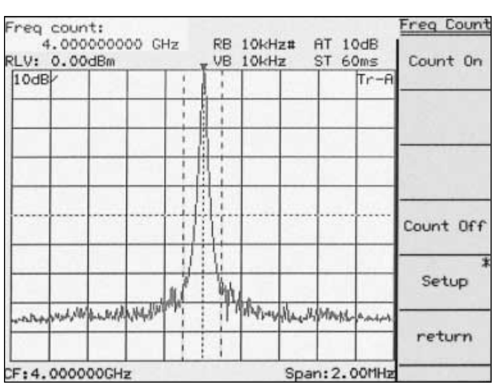
Features

- Compact and lightweight (15 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Millimeter wave applications
- Options support wide range of applications

Performance and functions

• Counter with 1 Hz resolution

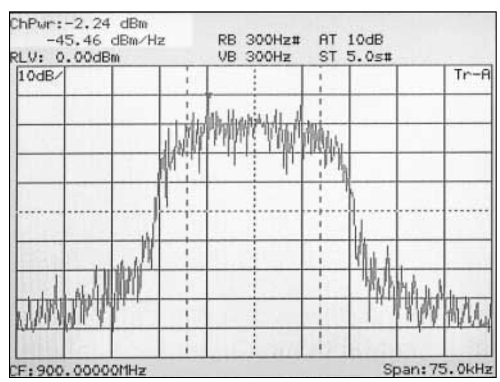
A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.



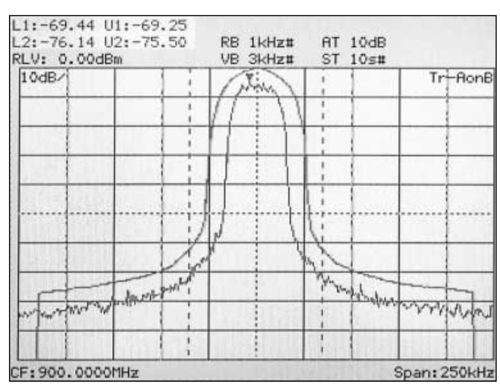
Frequency measurement (1 Hz resolution)

• Radio equipment evaluation functions ("measure" functions)

A full range of functions including measurement of power levels, frequencies, adjacent channel power, and mask and time template measurements are provided for performance evaluation of radio equipment. Key operation is simple and high-speed calculations make the measurement fast and efficient.



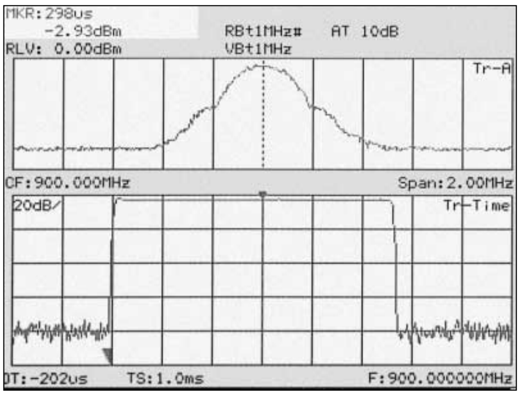
Channel power measurement



Adjacent channel power measurement

• Multi-screen display

The Trace A and Trace B waveforms are superimposed on the same screen, and two spectra with different frequencies are displayed simultaneously. In addition, it is possible to simultaneously display spectrum and time domain screens for the same signal. The multi-screen display permits efficient signal level adjustment and harmonic distortion measurement, too.
In addition to being able to display amplitude in the time domain, it is possible to display the FM demodulation waveform.

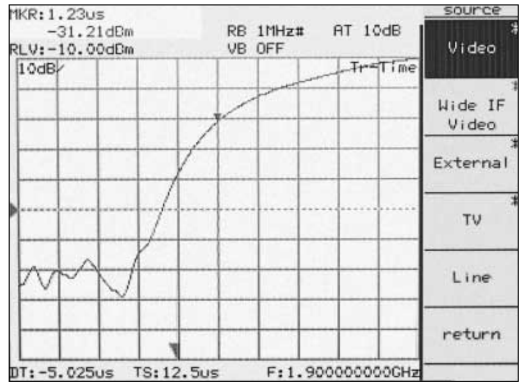


Spectrum and time domain measurement

• For testing digital mobile communication equipment

High-speed time domain sweep (Option 04)

Testing of TDMA-type radio equipment requires time domain (zero-span) measurements of antenna power, transient response characteristics of burst transmissions, transmission timing, and other characteristics. The high-speed time domain sweep option boosts sweep time to 12.5 µs and resolution to 0.025 µs. This option must be used with the trigger/gate circuit (Option 06).



High-speed time domain measurement (TS = 12.5 µs)

6

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 40 GHz
	Frequency band	Band 0: 0 kHz to 3.2 GHz (n = 1), Band 1–: 3.1 to 5.6 GHz (n = 1), Band 1+: 5.4 to 8.1 GHz (n = 1), Band 1+: 8.0 to 14.3 GHz (n = 2), Band 2–: 14.1 to 26.5 GHz (n = 4), Band 3–: 26.2 to 40 GHz (n = 6) ∗n: local harmonic order
	Pre-selector range	3.1 to 40 GHz
	Frequency setting resolution	(1 x n) Hz ∗n: local harmonic order
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, (100 x n) Hz to 40.0 GHz ∗n: local harmonic order Accuracy: ±5%
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) Option 02: 30 Hz, 100 Hz, and 300 Hz are added Option 03: 10, 30, 100, 300 Hz are added Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF ∗Manually settable, or automatically settable according to RBW
	Signal purity and stability	Noise sidebands: ≤ –95 dBc/Hz + 20 log n (1 MHz to 40 GHz, 10 kHz offset) ∗n: local harmonic order Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature; n: local harmonic order
	Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤5 x 10^{-8} /year (after 10 minutes warm-up, referenced to frequency after 24 hours warm-up) Aging rate: ≤1 x 10^{-7} /year, ≤1 x 10^{-8} /day Temperature characteristics: ±5 x 10^{-8} (0° to 50°C, referenced to frequency at 25°C)
	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz), ≤–114 dBm (3.1 to 8.1 GHz), ≤–113 dBm (8.0 to 14.3 GHz), ≤–105 dBm (14.1 to 26.5 GHz), ≤–101 dBm (26.2 to 40 GHz) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)

Continued on next page

Frequency	Reference level	Setting range Log scale: –100 to +30 dBm, Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manual settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
Amplitude	Frequency response	Relative: ±1.5 dB (9.0 kHz to 3.2 GHz), ±1.0 dB (100 kHz to 3.2 GHz), ±1.5 dB (3.1 to 8.1 GHz), ±3.0 dB (8.0 to 14.3 GHz), ±4.0 dB (14.1 to 26.5 GHz), ±4.0 dB (26.2 to 40 GHz) *After pre-selector tuning at microwave band, referenced to midpoint between highest and lowest frequency deviation in each band. Absolute: ±5.0 dB (9 kHz to 40 GHz, RF ATT: 10 dB, referenced to 100 MHz) *After pre-selector tuning at microwave band
	Waveform display	Scale (10 div.) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, mixer input: –30 dBm), ≤–90 dBc or noise level (1.55 to 20 GHz, mixer input: –10 dBm) Two signal 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), ≤–75 dBc or average noise level (8.1 to 26.5 GHz), ≤–75 dBc or average noise level (typical, 26.5 to 40 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤40 GHz) Multiple/out of band response: ≤–70 dBc(≤14 GHz), ≤–60 dBc (≤26 GHz), ≤–55 dBc (≤40 GHz)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)
Sweep	Sweep time	Setting range: 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zero sweep	Sweeps only in frequency range indicated by zone marker.
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible).
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points. POS PEAK: Displays max. point between sample points. NEG PEAK: Displays min. point between sample points. SAMPLE: Displays momentary value at sample points. Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 14 cm, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum. Trace B: Displays frequency spectrum. Trace Time: Displays time domain waveform at center frequency. Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously. Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously. Trace move/calculation: A → B, B → A, A ⟷ B, A + B → A, A — B → A, A — B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≤50 kHz/div, VBW: off, at 3 dB bandwidth) *RBW: ≥1 kHz to 3 MHz usable
	Input connector	K-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: –10 dBm (typical, 100 MHz, upper edge of scale, 50 Ω terminated), 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ± 0.1 V (typical, from lower edge to upper edge at 10 dB/div) 0 to 0.4 V± 0.1 V (typical, from lower edge to upper edge at 10%/div) BNC connector *75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ± 10 Hz, –10 to +2 dBm (50 Ω terminated), BNC connector REF BUFFERED OUTPUT: ≥0 dBm (50 Ω terminated), BNC connector 1ST LOCAL OUTPUT: 4 to 7 GHz, ≥+8 dBm, 50 Ω, SMA-J connector

Continued on next page

Functions	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, Δ MARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves setting conditions and waveform data to internal memory (max. 12) or memory card.
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer. Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch).
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA. Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) *Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS.) Connector: Meets the PCMCIA Rel. 2.0; 2 slots
External mixer	Frequency	Frequency range: 18 to 110 GHz Frequency band configuration Band K: 18 to 26.5 GHz (n = 4), Band A: 26.5 to 40 GHz (n = 6), Band Q: 33 to 50 GHz (n = 8), Band U: 40 to 60 GHz (n = 9), Band V: 50 to 75 GHz (n = 11), Band E: 50 to 90 GHz (n = 13), Band W: 75 to 110 GHz (n = 16) Span setting range: 0 Hz, (100 x n) Hz to each bandwidth *n: local harmonic order
	Amplitude	Level measurement Mixer conversion loss setting range: 15 to 85 dB Maximum input level: Depends on the external mixer used Average noise level: Depends on the external mixer used Reference level setting range: –100 dBm to (–25 to M) dBm *Log scale, M: mixer conversion loss Frequency response: Depends on the external mixer used
	Input/output	Suitable mixer: 2-port mixer only (local frequency: 4 to 7 GHz, IF frequency: 689.31 MHz) Display gain: 0 ±2 dB (external mixer input: –10 dBm, when the mixer conversion loss is 15 dB)
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≤400 VA
	Dimensions and mass	320 (W) x 177 (H) x 381 (D) mm, ≤15 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz reference)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB : 3 dB)	≤15:1

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable), 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB Linear scale: 0.2% (relative to reference level)

• Option 03: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	10 Hz, 30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz reference)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB : 3 dB)	≤15:1
Average noise level	≤–135 dBm (1 MHz to 1 GHz), ≤–135 dBm + 1.5f [GHz] dB (1 to 3.1 GHz), ≤–132 dBm (3.1 to 8.1 GHz), ≤–131 dBm (8.0 to 14.3 GHz), ≤–123 dBm (14.1 to 26.5 GHz), ≤–119 dBm (26.2 to 40 GHz) *RBW: 10 Hz, VBW: 1 Hz, RF ATT: 0 dB

• **Option 06: Trigger/gate circuit**

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s, Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms, Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval. Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• **Option 07: AM/FM demodulator**

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• **Option 10: Centronics interface*1**

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

*1: GPIB interface can not be installed simultaneously.

• **Option 15: Sweep signal output**

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• **External mixer**

Models	Frequency range	Flange	Max. input power
MA2740A	18 to 26.5 GHz	MIL-F-3922/68-001KM	100 mW
MA2741A	26.5 to 40 GHz	MIL-F-3922/68-001AM	100 mW
MA2742A	33 to 50 GHz	MIL-F-3922/67B-006	100 mW
MA2743A	40 to 60 GHz	MIL-F-3922/67B-007	100 mW
MA2744A	50 to 75 GHz	MIL-F-3922/67B-008	100 mW
MA2745A	60 to 90 GHz	MIL-F-3922/68B-009	100 mW
MA2746A	75 to 110 GHz	MIL-F-3922/68B-010	100 mW

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS2668C	Spectrum analyzer
	Standard accessories
	Power cord, 2.6 m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1335AE	MS2668C operation manual: 1 copy
B0329G	Front cover (3/4MW4U): 1 pc
	Options
MS2668C-02	Narrow resolution bandwidth
MS2668C-03	Narrow resolution bandwidth
MS2668C-04	High-speed time domain sweep
MS2668C-06	Trigger/gate circuit
MS2668C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)
MS2668C-10	Centronics interface (GPIB interface can not be used simultaneously)
MS2668C-15	Sweep signal output
	Warranty
MS2668C-90	Extended three year warranty service
MS2668C-91	Extended five year warranty service
	Application parts
J0911	Coaxial cord (K-P · K-P), 1 m (DC to 40 GHz, SUCOFLEX 102A)
J0912	Coaxial cord (K-P · K-P), 0.5 m (DC to 40 GHz, SUCOFLEX 102A)
34AKNF50	Coaxial adaptor (DC to 20 GHz, SWR: 1.5, ruggedized K-P · N-J)
J0322B	Coaxial cord (SMA-P · SMA-P), 1 m (DC to 18 GHz, SUCOFLEX 104)
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)
MP612A	RF Fuse Holder
MP613A	Fuse Element

Model/Order No.	Name
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, N-type, Weinschel product)
J0910	DC block (Model 7006, 10 kHz to 18 GHz, ±50 V, SMA-type, Weinschel product)
MA2507A	DC Block Adaptor (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)
MA8601A	DC Block Adaptor (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)
MA8601J	DC Block Adaptor (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)
MA1621A	50 Ω → 75 Ω Impedance Transformer (75 Ω, 9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25-pins, straight)
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)
J0064A	7 GHz band coaxial/waveguide adaptor (5.8 to 8.6 GHz, N-J · BRJ-7)
J0064C	10 GHz band coaxial/waveguide adaptor (8.2 to 12.4 GHz, N-J · BRJ-10)
J0004	Coaxial adaptor (N-P · SMA-J)
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz, N-type)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz, N-type)
J0078	Fixed attenuator for high power (20 dB, 10 W, DC to 18 GHz, N-type)
MP526D	High Pass Filter (400 MHz band, N-type)
MA1601A	High Pass Filter (800/900 MHz band, N-type)
MA2740A	External Mixer (18 to 26.5 GHz)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
B0421A	Carrying case (hard type, with casters)
B0421B	Carrying case (hard type, without casters)
B0435A	Carrying case (soft type)

SPECTRUM ANALYZER
MS2667C
9 kHz to 30 GHz

CE GPIB

For Evaluating LMDS Subscriber Radio Systems

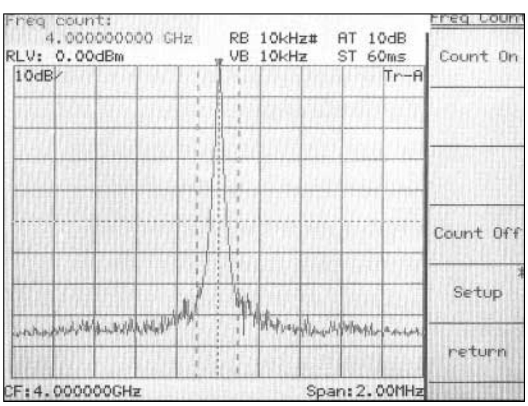
The MS2667C is a compact, lightweight, and low-price spectrum analyzer that covers a frequency range of 9 kHz to 30 GHz. It has superior basic performance, such as high C/N ratio, low distortion, and high frequency/level accuracies, and is easy to operate. A large selection of options is provided to handle a wide range of applications at reasonable cost.

Features
- Compact and lightweight (15 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Millimeter wave applications
- Options support wide range of applications

Performance and functions

• Counter with 1 Hz resolution

A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.



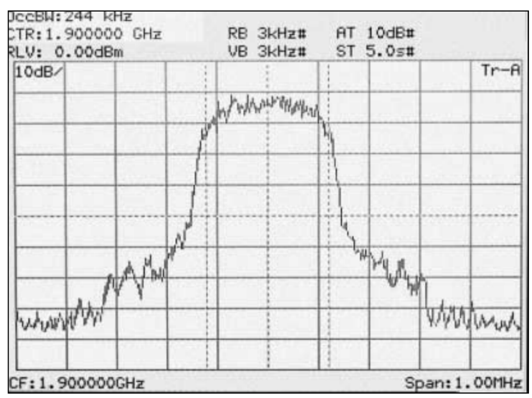
Frequency measurement (1 Hz resolution)

• 100 dB display dynamic range

For measurements requiring a wide dynamic range such as adjacent channel power measurements, the MS2667C can display nearly 90 dB on a single screen.

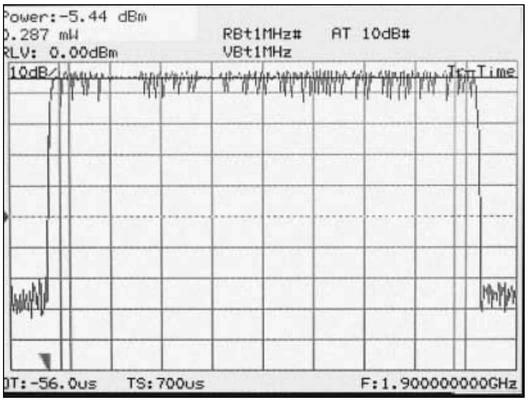
• Highly-accurate measurement

Automatic calibration ensures a high level of accuracy. A span accuracy of 5% and 501 sampling points ensure accurate occupied frequency bandwidth and adjacent channel power measurements.

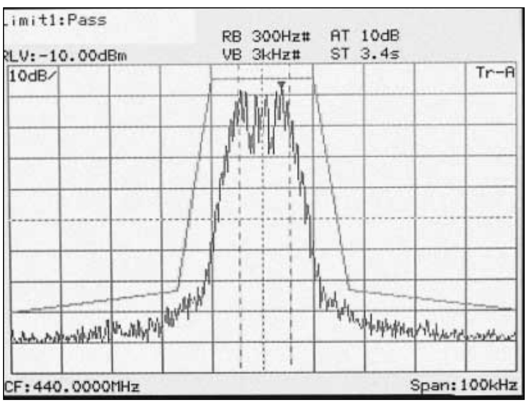


Occupied bandwidth measurement

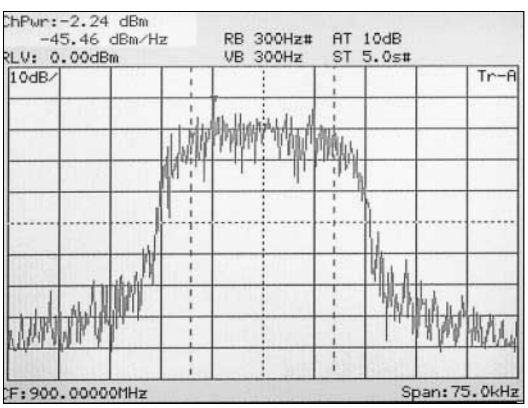
• Radio equipment evaluation functions ("measure" functions)
A full range of functions including measurement of power levels, frequencies, adjacent channel power, and mask and time template measurements are provided for performance evaluation of radio equipment. Key operation is simple and high-speed calculations make the measurement fast and efficient.



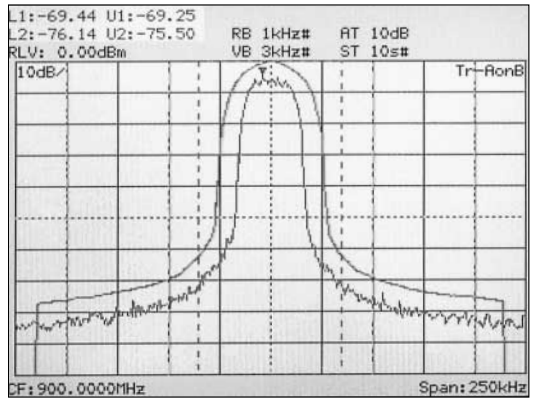
Burst average power measurement



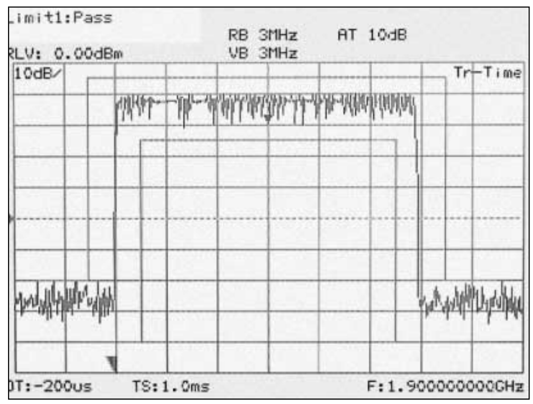
Mask measurement



Channel power measurement

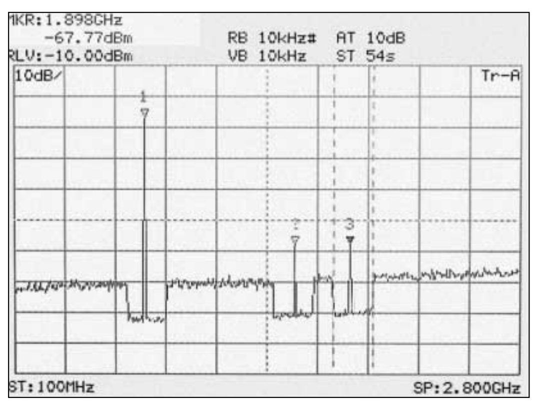


Adjacent channel power measurement



Time template measurement

• Zone sweep and multi-zone sweep functions
Sweeps can be limited to zones defined by zone markers which results in reduced sweep time. This zone sweep function can be combined with "measure" functions such as "noise measure," which can directly readout the total noise power within the zone to reduce measurement time greatly. The multi-zone sweep function enables up to 10 zones to be swept.



Multi-zone sweep

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 30 GHz
	Frequency band	Band 0: 0 to 3.2 GHz (n: 1); Band 1–: 3.1 to 6.5 GHz (n: 1); Band 1+: 6.4 to 8.1 GHz (n: 1); Band 2+: 8.0 to 15.3 GHz (n: 2); Band 3+: 15.2 to 22.4 GHz (n: 3); Band 4+: 22.3 to 30 GHz (n: 4) *n: harmonic order of the mixer
	Pre-selector range	3.1 to 30 GHz (band 1–, 1+, 2+, 3+, 4+)
	Frequency setting resolution	(1 x n) Hz *n: harmonic order of the mixer
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy) *Span: ≥ (10 x n) kHz (n: harmonic order of the mixer, after calibration)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 100 Hz to 30 GHz Accuracy: ±5%
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) *Option 02 (30 Hz, 100 Hz, 300 Hz), Option 03 (10 Hz, 30 Hz, 100 Hz, 300 Hz) are added. Measurements of noise, C/N, adjacent channel power and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF *Manually settable, or automatically settable according to RBW
	Signal purity and stability	Noise sidebands: ≤–95 dBc/Hz + 20 log n (1 MHz to 30 GHz, 10 kHz offset) *n: harmonic order of the mixer Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz x n, sweep time: ≤100 s) *After 1-hour warm-up at constant ambient temperature; n: harmonic order of the mixer
	Reference oscillator	Frequency: 10 MHz Aging rate: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: ±5 x 10^{-8} (0˚ to 50˚C, referenced to frequency at 25˚C)
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–110 dBm (3.1 to 8.1 GHz, band 1), ≤–102 dBm (8.0 to 15.3 GHz, band 2), ≤–98 dBm (15.2 to 22.4 GHz, band 3), ≤–91 dBm (22.3 to 30 GHz, band 4) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	Relative: ±1.5 dB (9 to 100 kHz, band 0), ±1.0 dB (100 kHz to 3.2 GHz, band 0), ±1.5 dB (3.1 to 8.1 GHz, band 1), ±3.0 dB (8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 22.4 GHz, band 3), ±4.0 dB (22.3 to 30 GHz, band 4) *After pre-selector tuning at band 1, 2, 3 and 4, referenced to midpoint between highest and lowest frequency deviation in each band Absolute: ±5.0 dB (9 kHz to 30 GHz, RF ATT: 10 dB, referenced to 100 MHz) *After pre-selector tuning at band 1, 2, 3 and 4
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–90 dBc or noise level (1.55 to 15 GHz, band 1/2/3/4, mixer input: –10 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), –75 dBc or average noise level (8.1 to 26.5 GHz), ≤–75 dBc or average noise level (typical, 26.5 to 30 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz) Multiple/out of band response: ≤–60 dBc (≤22 GHz), ≤–55 dBc (≤30 GHz)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)

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Sweep	Sweep time	Setting range: 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously Trace A/Time: Displays frequency spectrum and time domain waveforms at center frequency simultaneously Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) *RBW: ≥1 kHz to 3 MHz usable
	Input connector	K-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div), 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div), BNC connector *75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, –10 to +2 dBm (50 Ω terminated), BNC connector REF BUFFERED OUTPUT: ≥0 dBm (50 Ω terminated), BNC connector 1ST LOCAL OUTPUT: 4 to 7 GHz, ≥+8 dBm, 50 Ω, SMA-J connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system function.
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) *Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98® of OS.) Connector: Meets the PCMCIA Rel. 2.0, 2 slots

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External mixer	Frequency	Frequency range: 18 to 110 GHz Frequency band configuration Band K: 18 to 26.5 GHz (n: 4), Band A: 26.5 to 40 GHz (n: 6), Band Q: 33 to 50 GHz (n: 8), Band U: 40 to 60 GHz (n: 9), Band V: 50 to 75 GHz (n: 11), Band E: 60 to 90 GHz (n: 13), Band W: 75 to 110 GHz (n: 16) Span setting range: 0 Hz, (100 x n) Hz to each bandwidth ∗n: harmonic order of the mixer
	Amplitude	Level measurement Mixer conversion loss setting range: 15 to 85 dB Maximum input level: Depends on the external mixer used Average noise level: Depends on the external mixer used Reference level setting range: –100 dBm to (–25 to M) dBm ∗Log scale, M: mixer conversion loss Frequency response: Depends on the external mixer used
	Input/output	Suitable mixer: 2-port mixer only (local frequency: 4 to 7 GHz, IF frequency: 689.31 MHz) Display gain: 0 ±2 dB (external mixer input: –10 dBm, when the mixer conversion loss is 15 dB)
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, ≤400 VA
	Dimensions and mass	320 (W) x 177 (H) x 381 (D) mm, ≤15 kg (without option)
	Ambient temperature	0˚ to +50˚C (operate), –40˚ to +75˚C (storage)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB:3 dB)	≤15:1

• Option 03: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	10 Hz, 30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20%
Selectivity (60 dB:3 dB)	≤15:1
Average noise level	≤–135 dBm (1 MHz to 1 GHz, band 0), ≤–135 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–130 dBm (3.1 to 8.1 GHz, band 1), ≤–122 dBm (8.0 to 15.3 GHz, band 2), ≤–118 dBm (15.2 to 22.4 GHz, band 3), ≤–111 dBm (22.3 to 30 GHz, band 4) ∗RBW: 10 Hz, VBW: 1 Hz, RF ATT: 0 dB

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB, Linear scale: 0.2% (relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s, Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms, Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface∗1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

∗1: GPIB interface can not be installed simultaneously.

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 k Ω termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

External mixer

Model	Frequency range	Mate flange	Max. input power
MA2740A	18 to 26.5 GHz	MIL-F-3922/68-001KM	100 mW
MA2741A	26.5 to 40 GHz	MIL-F-3922/68-001AM	100 mW
MA2742A	33 to 50 GHz	MIL-F-3922/67B-006	100 mW
MA2743A	40 to 60 GHz	MIL-F-3922/67B-007	100 mW
MA2744A	50 to 75 GHz	MIL-F-3922/67B-008	100 mW
MA2745A	60 to 90 GHz	MIL-F-3922/68B-009	100 mW
MA2746A	75 to 110 GHz	MIL-F-3922/68B-010	100 mW

Ordering information

Please specify model/order number, name, and quantity when ordering.

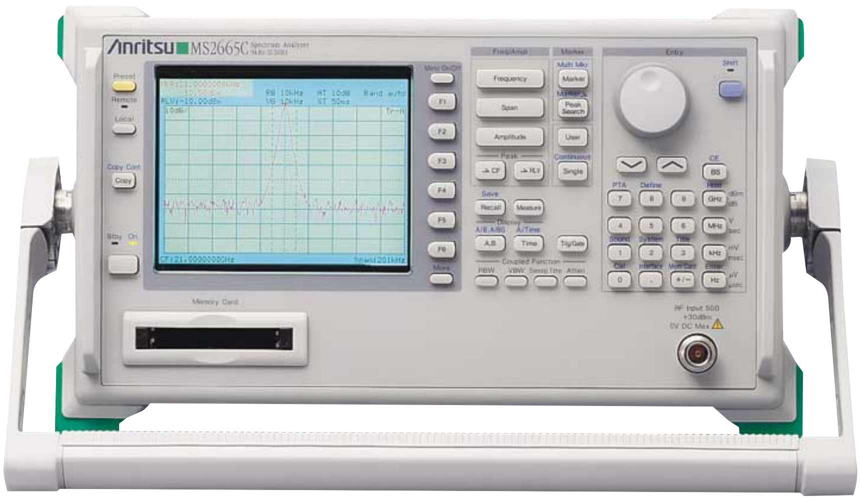
Model/order No.	Name
	Main frame
MS2667C	Spectrum Analyzer
	Standard accessories
	Power cord, 2.6m: 1 pc
F0013	Fuse, 5 A: 2 pcs
W1335AE	MS2665C/MS2667C operation manual: 1 copy
B0329G	Front cover (3/4MW4U)
	Options
MS2667C-02	Narrow resolution bandwidth
MS2667C-03	Narrow resolution bandwidth
MS2667C-04	High-speed time domain sweep
MS2667C-06	Trigger/gate circuit
MS2667C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)
MS2667C-10	Centronics interface (GPIB interface cannot be installed simultaneously)
MS2667C-15	Sweep signal output
	Warranty
MS2667C-90	Extended three year warranty service
MS2667C-91	Extended five year warranty service
	Application parts
34AKNF50	Coaxial adapter (DC to 20 GHz, SWR: 1.5, ruggedized K-P · N-J)
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m
J0322B	Coaxial cord (SMA-P · SMA-P), 1 m (DC to 18 GHz, SUCOFLEX 104A)
J0911	Coaxial cord (K-P · K-P), 1 m (DC to 40 GHz, SUCOFLEX 102A)
J0912	Coaxial cord (K-P · K-P), 0.5 m (DC to 40 GHz, SUCOFLEX 102A)
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)
MP612A	RF Fuse Holder
MP613A	Fuse Element

Model/order No.	Name
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product, N-type)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V, NC-type)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25-pins, straight)
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)
J0064A	7 GHz band coaxial/waveguide adapter (5.8 to 8.6 GHz, N-J · BRJ-7)
J0064C	10 GHz band coaxial/waveguide adapter (8.2 to 12.4 GHz, N-J · BRJ-10)
J0004	Coaxial adapter (N-P · SMA-J)
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz, N-type)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz, N-type)
J0078	Fixed attenuator for high power (20 dB, 10 W, DC to 18 GHz, N-type)
MP526D	High Pass Filter (400 MHz band)
MA1601A	High Pass Filter (800/900 MHz band, N-type)
MA2740A	External Mixer (18 to 26.5 GHz)
MA2741A	External Mixer (26.5 to 40 GHz)
MA2742A	External Mixer (33 to 50 GHz)
MA2743A	External Mixer (40 to 60 GHz)
MA2744A	External Mixer (50 to 75 GHz)
MA2745A	External Mixer (60 to 90 GHz)
MA2746A	External Mixer (75 to 110 GHz)
B0421A	Carrying case (hard type, with casters)
B0421B	Carrying case (hard type, without casters)
B0435A	Carrying case (soft type)

SPECTRUM ANALYZER
MS2665C
9 kHz to 21.2 GHz

GPIB

For Evaluating ETC Subscriber Radio Systems

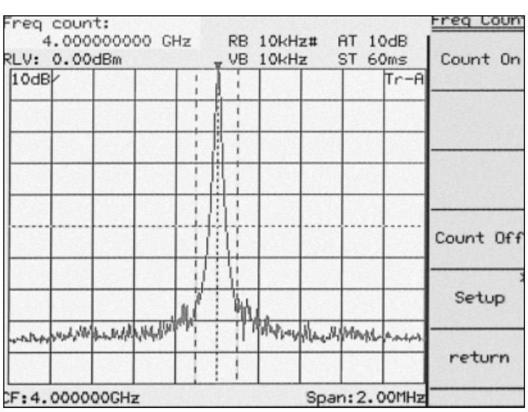


The MS2665C is a compact, lightweight, and low-price spectrum analyzer that covers a frequency range of 9 kHz to 21.2 GHz. It has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and is easy to operate. A large selection of options is provided to handle a wide range of applications at reasonable cost.

Features
- Compact and lightweight (13 kg in standard configuration)
- High C/N and superior distortion characteristics
- Easy-to-use, simple operation
- Options support wide range of applications
- Easy-to-set up automatic measurements

Performance and functions
• Counter with 1 Hz resolution

A full complement of frequency counter functions are provided. Resolution is as high as ±1 Hz even at full span, and high-speed frequency measurements can be performed. The high sensitivity compared with ordinary counters makes it easy to select one signal from many and to determine its frequency.



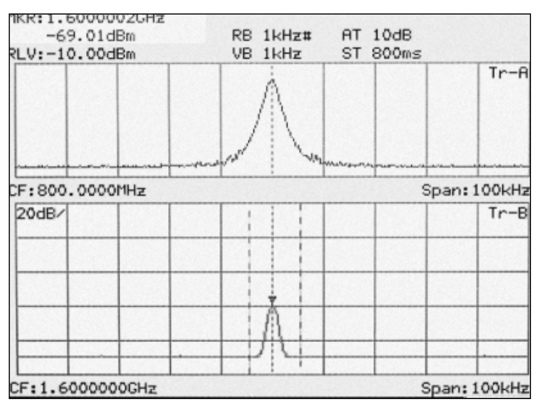
Frequency measurement (1 Hz resolution)

• 100 dB display dynamic range

For measurements requiring a wide dynamic range, such as adjacent channel power measurements, the MS2665C can display nearly 90 dB on a single screen.

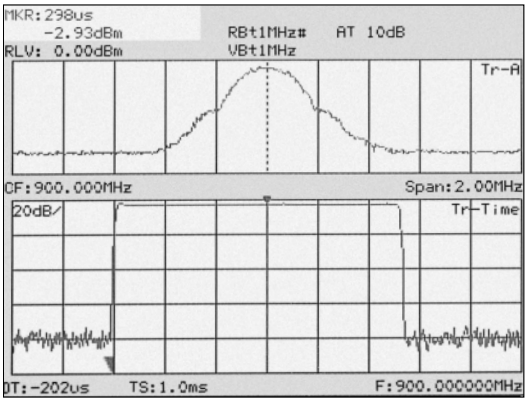
• Multi-screen display

The Trace A and Trace B waveforms are superimposed on the same screen, and two spectra with different frequencies are displayed simultaneously. In addition, it is possible to simultaneously display spectrum and time domain screens for the same signal. The multi-screen display permits efficient signal level adjustment and harmonic distortion measurement, too. Furthermore, in addition to being able to display amplitude in the time domain, it is possible to display the FM demodulation waveform.



Two traces with different frequencies

6



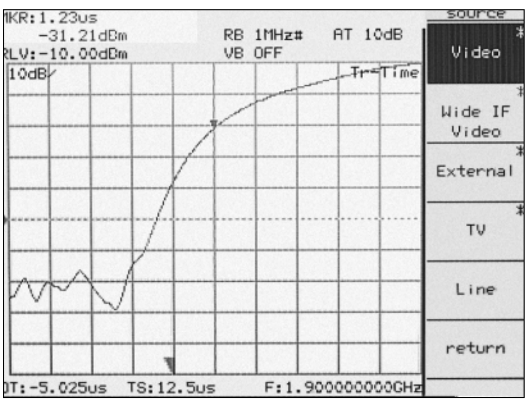
Spectrum and time domain measurement

• For testing digital mobile communication equipment

High-speed time domain sweep (Option 04)

Testing of TDMA-type radio equipment includes time domain (zero-span) measurements of antenna power, transient response characteristics of burst transmissions, transmission timing, and other quantities. The high-speed time domain sweep option boosts sweep time to 12.5 µs and resolution to 0.025 µs.

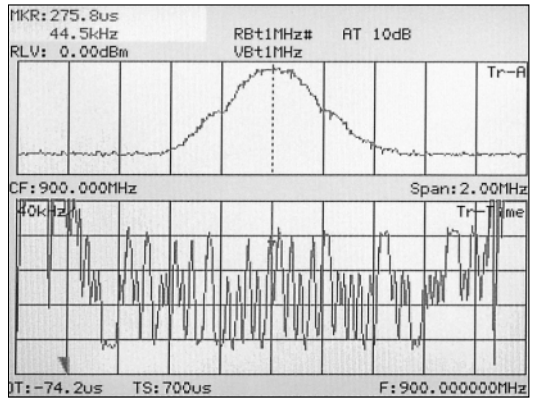
*This option must be used with the trigger/gate circuit (Option 06).



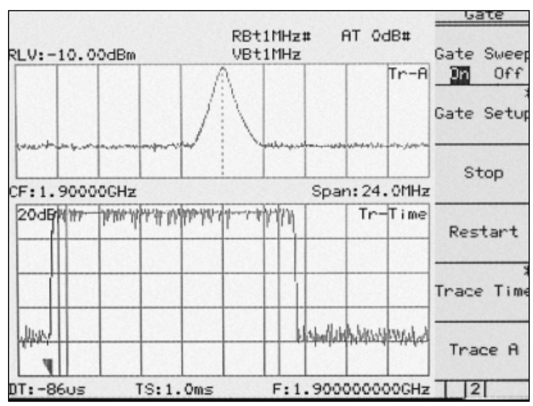
High-speed time-domain measurement (TS = 12.5 µs)

Trigger/gate circuit (Option 06)

Burst signal can be stably measured using the trigger function in time domain measurements. One of the external, video, wide IF video, or line is selectable. This makes a variety of TDMA radio equipment tests possible, including template comparison using pre-trigger and post-trigger delay functions and gate spectrum analysis using the gate sweep function. Previously, the trigger output from an external detector was required in gate spectrum analysis. However, this option for the MS2665C has a 20 MHz wide IF video trigger function, eliminating the need for trigger output from an external detector.



Wide IF video trigger function



Wide IF video trigger and gate functions

Specifications

Except where noted otherwise, specified values were obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 21.2 GHz
	Frequency band	Band 0: 0 to 3.2 GHz (n: 1); Band 1–: 2.92 to 6.5 GHz (n: 1); Band 1+: 6.4 to 8.1 GHz(n: 1); Band 2+: 8.0 to 15.3 GHz (n: 2); Band 3+: 15.2 to 21.2 GHz (n: 3) *n: harmonic order of the mixer
	Pre-selector range	2.92 to 21.2 GHz (band 1–, 1+, 2+, 3+)
	Frequency setting resolution	Frequency domain: (1 x n) Hz, Zero span: (100 x n) Hz *n: harmonic order of the mixer
	Frequency display accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz x n) *Span: ≥10 kHz x n (n: harmonic order of the mixer, after calibration)
	Marker frequency display accuracy	Normal marker: Same as display frequency accuracy; Delta marker: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 21.3 GHz Accuracy: ±2.5% (span: ≥10 kHz x n), ±5% (span: <10 kHz x n, Option 02 installed)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting rage: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) *Option 02: 30 Hz, 100 Hz, and 300 Hz are added Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF *Manually settable, or automatically settable according to RBW

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Frequency	Signal purity, stability	Noise sidebands: ≤–95 dBc/Hz + 20 log n (1 MHz to 21.2 GHz, 10 kHz offset) ∗n: harmonic order of the mixer Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 x n Hz/min (span: ≤10 kHz x n, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature; n: harmonic order of the mixer
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01 : 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5}(typical, 0° to 50˚C); Option 01: ±5 x 10^{-8} (0° to 50˚C, referenced to frequency at 25˚C)
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–110 dBm (2.92 to 8.1 GHz, band 1), ≤–102 dBm (8.0 to 15.3 GHz, band 2), ≤–98 dBm (15.2 to 21.2 GHz, band 3) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–90 dBm (RF ATT: 0 dB, input: 50 Ω terminated, 1 MHz to 8.1 GHz)
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) ∗After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) ∗After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) ∗Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	Relative: ±1.5 dB (9 to 100 kHz, band 0), ±1.0 dB (100 kHz to 3.2 GHz, band 0), ±1.5 dB (2.92 to 8.1 GHz, band 1), ±3.0 dB (8 to 15.3 GHz, band 2), ±4.0 dB (15.2 to 21.2 GHz, band 3) ∗After pre-selector tuning at band 1, 2 and 3, referenced to midpoint between highest and lowest frequency deviation in each band Absolute: ±5.0 dB (9 kHz to 21.2 GHz, RF ATT: 10 dB, referenced to 100 MHz) ∗After pre-selector tuning at band 1, 2 and 3, referenced to midpoint between highest and lowest frequency deviation in each band
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB; Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–70 dBc (0.2 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–100 dBc or noise level (1.46 to 10.6 GHz, band 1/2/3, mixer input: –10 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz), –75 dBc or noise level (8.1 to 21.2 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–65 dBc (≤18 GHz), ≤–60 dBc (>18 GHz) Multiple response: ≤–60 dBc
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±25% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable), Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies. Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously Trace A/Time: Displays frequency spectrum and time domain waveform at center frequency simultaneously Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A

Continued on next page

Functions	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) *RBW: ≥1 kHz to 3 MHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div), 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div), BNC connector *75 Ω terminated at 100 MHz input COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, Δ MARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface. Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface.
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system function.
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) *Typical value
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM (Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98®) Connector: Meets the PCMCIA Rel. 2.0; 2 slots
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤13 kg (without option)
	Ambient temperature	0° to +50˚C (operate), –40° to +75˚C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50˚C, with reference to 25˚C)
Buffer output	10 MHz, >2 Vp-p (200 Ω termination), BNC connector

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable), 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	Log scale: 0.1 dB; Linear scale: 0.2% (relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch	FREERUN, TRIGGERED
Trigger source	EXT Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/fall Connector: BNC VIDEO Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/fall WIDE IF VIDEO Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/fall LINE Frequency: 47.5 to 63 Hz (line lock)
Trigger delay	Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep	In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface*1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

*1: GPIB interface can not be installed simultaneously.

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MS2665C	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1335AE	MS2665C/MS2667C operation manual:	1 copy
B0329G	Front cover (3/4MW4U)	
	Options	
MS2665C-01	Reference crystal oscillator	
MS2665C-02	Narrow resolution bandwidth	
MS2665C-04	High-speed time domain sweep	
MS2665C-06	Trigger/gate circuit	
MS2665C-07	AM/FM demodulator (outputs to loudspeaker or earphone connector)	
MS2665C-10	Centronics interface (GPIB interface cannot be installed simultaneously)	
MS2665C-15	Sweep signal output	
	Warranty	
MS2665C-90	Extended three year warranty service	
MS2665C-91	Extended five year warranty service	
	Application parts	
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m	
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m	
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)	
B0395A	Rack mount kit (IEC)	
B0395B	Rack mount kit (JIS)	
B0391A	Carrying case (hard type, with casters)	
B0391B	Carrying case (hard type, without casters)	
MP612A	RF Fuse Holder	
MP613A	Fuse Element	
J0805	DC block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product, N-type)	
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V, N-type)	
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V, N-type)	
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V, NC-type)	
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V, NC-type)	
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 to 1200 MHz, transformer type, NC-type)	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
J0742A	RS-232C cable, 1 m (for PC-98 Personal Computer and VP-600, D-sub 25 pins, straight)	
J0743A	RS-232C cable, 1 m (for PC/AT compatible, D-sub 9-pins, cross)	
J0064A	7 GHz band coaxial/waveguide adapter (5.8 to 8.6 GHz, N-J · BRJ-7)	
J0064C	10 GHz band coaxial/waveguide adapter (8.2 to 12.4 GHz, N-J · BRJ-10)	
J0004	Coaxial adapter (N-P · SMA-J)	
DGM010-02000EE	Coaxial cord, 2 m (N-type connector, general use)	
DGM024-02000EE	Coaxial cord, 2 m (N-type connector, low-loss type)	

SPECTRUM ANALYZER
MS2663C
9 kHz to 8.1 GHz

GPIB

For Measuring up to 3rd Order Spurious of Mobile Communications Band

The MS2663C covers a frequency range of 9 kHz to 8.1 GHz. This allows measurement of spurious frequencies of up to three times greater than the frequency bands used worldwide for mobile communications. The MS2663C has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and is easy to operate. The MS2663C has a "Measure" function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function), and enables the Two-screen display and FM demodulation waveform display. The large selection of options means that a wider range of applications can be handled at a reasonable cost.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 8.1 GHz
	Frequency band	Band 0 (0 to 3.2 GHz); Band 1 – (2.92 to 6.5 GHz); Band 1 + (6.4 to 8.1 GHz)
	Pre-selector range	2.92 to 8.1 GHz (band 1–, 1+)
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 8.2 GHz Accuracy: ±2.5% (span: ≥10 kHz), ±5% (span: <10 kHz, Option 02 installed)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02: 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15 : 1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF ∗Manually settable, or automatically settable according to RBW
	Noise sideband, stability	Noise sidebands: ≤–100 dBc/Hz (1 GHz, 10 kHz offset) Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1 hour warm-up at constant ambient temperature
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0˚ to 50˚C); Option 01: ±5 x 10^{-8} (0˚ to 50˚C) ∗Referenced to frequency at 25˚C

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Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±0 Vdc Average noise level: [Without Option 08] ≤–115 dBm (1 MHz to 1 GHz, band 0), ≤–115 dBm + 1.5f [GHz] dB (1 to 3.1 GHz, band 0), ≤–115 dBm + 0.5f [GHz] dB (2.92 to 8.1 GHz, band 1) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB [With Option 08, pre-amplifier: off] ≤114 dBm (1 MHz to 1 GHz, Band 0), ≤–114 dBm + 1.5 x f [GHz] dB (1 to 3.1 GHz, Band 0), –115 dBm + 0.5 x f [GHz] dB (2.92 to 8.1 GHz, Band 1) Residual response: ≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 8.1 GHz)
	Total level accuracy	±1.3 dB (100 kHz to 3.1 GHz band 0), ±2.3 dB (2.92 to 8.1 GHz, band 1) *Level measurement accuracy after calibration using internal calibration signal Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibrated signal source accuracy
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level Accuracy: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	±0.5 dB (100 kHz to 3.2 GHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.5 dB (9 to 100 kHz, band 0, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.5 dB (2.92 to 8.1 GHz, band 1, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C) ±1.0 dB (100 kHz to 3.2 GHz, band 0, RF ATT: 10 to 50 dB) ±3.0 dB (2.92 to 8.1 GHz, band 1, RF ATT: 10 to 50 dB) *At band 1, after pre-selector tuning
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, band 0, mixer input: –30 dBm), ≤–75 dBc (0.2 to 1.3 GHz, band 0, mixer input: –30 dBm), ≤–70 dBc (1.3 to 1.55 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, band 0, mixer input: –30 dBm), ≤–100 dBc (1.46 to 4.05 GHz, band 1, mixer input: –20 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 8.1 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Image response: ≤–70 dBc, Multiple response: ≤–70 dBc (band 1)
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximum dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz, band 0), >110 dB – 1.5f [GHz] dB (1 to 3.1 GHz, band 0), >110 dB – 0.5f [GHz] dB (2.92 to 8.1 GHz, band 1) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 – 0.75f [GHz] dB (0.5 to 1.3 GHz), >82.5 – 0.75f [GHz] dB (0.8 to 1 GHz), >77.5 – 0.75f [GHz] dB (1.3 to 1.55 GHz, band 0), >97.5 – 0.25f [GHz] dB (1.46 to 4.05 GHz, band 1) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 – f [GHz] dB (1 to 3.1 GHz, band 0), >83.3 – (1/3)f [GHz] dB (2.92 to 8.1 GHz, band 1)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (manually settable, or automatically settable according to span, RBW, and VBW) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweep only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch; Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable

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Functions	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously, alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously, alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display Accuracy: ±5% of full scale (referenced to center frequency, DC-coupled. RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency range: DC (50 Hz at AC-coupled) to 100 kHz (range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth) DC (50 Hz at AC-coupled) to 500 kHz (range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth) ∗RBW: >1 kHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated), BNC connector COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display data can be output via RS-232C and GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz, typical) Antenna correction coefficients: Correct display and measurement of field strengths (dBµV/m) for specified antennas, Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C, saves/loads to/from memory card)
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98®. Connector: Meets the PCMCIA Rel. 2.0, 2 slots
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤13.5 kg (without option)
	Ambient temperature	0˚ to +50˚C (operate), –40˚ to +75˚C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0˚ to 50˚C, with reference to 25˚C)
Buffer output	10 MHz, >2 Vp-p (200 Ω termination), BNC connector

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15 : 1 (RBW: 100, 300 Hz), ≤20 : 1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface*1

Function	Outputs data to printer (Centronics standard)
Connector	D-sub 25-pin (jack)

*1: GPIB interface cannot be installed simultaneously.

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Log scale: –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line *Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 ms
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 08: Pre-amplifier*1,*2

Frequency range		100 kHz to 3 GHz
Noise figure		≤8 dB (typical, <2 GHz), ≤13 dB (typical, ≥2 GHz)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±0 Vdc
	Average noise level	≤–132 dBm (1 MHz to 1 GHz), ≤–132 dBm + 2f [GHz] dB (>1 GHz) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) *After calibration, referenced to 100 MHz, 1 MHz span (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB *After calibration, referenced to 3 kHz RBW RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals: ≥50 kHz, Pre-amplifier input*3: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input level*3)

*1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
*2: Option 20 cannot be installed simultaneously
*3: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 12: QP detector

Functions	QP detection ∗Requires Option 02.
6 dB bandwidth	200 Hz, 9 kHz, 120 kHz Accuracy: ±30% (18˚ to 28˚C)
Display	LOG scale, 5 dB/div (10 divisions) Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBμV, RF ATT: 0 dB, 18˚ to 28˚C)
Pulse response characteristics	Response to CISPR pulse (DET mode: QP, 18˚ to 28˚C)
QP on/off switching uncertainty (PEAK, QP)	≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18˚ to 28˚C)
Detection mode	QP, AVERAGE
Field strength measurement	Waveform data compensation data display for specified antenna factor, field strength (dBμV/m) Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)

Repetition frequency	Bandwidth		
	120 kHz	9 kHz	200 Hz
1 kHz	≤–8.0 ±1.0 dB	≤–4.5 ±1.0 dB	–
100 Hz	Referenced	Referenced	≤–4.0 ±1.0 dB
60 Hz	–	–	≤–3.0 ±1.0 dB
25 Hz	–	–	Referenced
20 Hz	≤+9.0 ±1.0 dB	≤+6.5 ±1.0 dB	–
10 Hz	≤+14.0 ±1.5 dB	≤+10.0 ±1.5 dB	≤+4.0 ±1.0 dB
5 Hz	–	–	≤+7.5 ±1.5 dB
2 Hz	≤+26.0 ±2.0 dB	≤+20.5 ±2.0 dB	≤+13.0 ±2.0 dB
1 Hz	≤+28.5 ±2.0 dB	≤+22.5 ±2.0 dB	≤+17.0 ±2.0 dB

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)
Connection cable connectors	Amphenol 36 pins
Connector pin layout	

No.	Item	No.	Item	No.	Item
1	GND	13	Output port B (0) LSB	25	I/O port D (0) LSB
2	Trigger input	14	Output port B (1)	26	I/O port D (1)
3	Trigger output 1	15	Output port B (2)	27	I/O port D (2)
4	Trigger output 2	16	Output port B (3)	28	I/O port D (3) MSB
5	Output port A (0) LSB	17	Output port B (4)	29	Port C status 0/1: I/O
6	Output port A (1)	18	Output port B (5)	30	Port D status 0/1: I/O
7	Output port A (2)	19	Output port B (6)	31	Write strobe signal
8	Output port A (3)	20	Output port B (7) MSB	32	Interruption signal
9	Output port A (4)	21	I/O port C (0) LSB	33	Not used
10	Output port A (5)	22	I/O port C (1)	34	+5 V power supply
11	Output port A (6)	23	I/O port C (2)	35	Not used
12	Output port A (7) MSB	24	I/O port C (3) MSB	36	Not used

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 20: Tracking generator*1

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) *100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–15 dBc (9 to 100 kHz), ≤–20 dBc (100 kHz to 3 GHz) Non-harmonic: ≤–15 dBc (9 to 100 kHz), ≤–35 dBc (100 kHz to 2 GHz), ≤–30 dBc (2 to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

*1: Option 08 can not be installed simultaneously.

• Option 21: Television monitor (Multi)*1

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

*1: Requires Option 08

• Option 24: Television monitor (Brazil)*1

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

*1: Requires Option 08

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MS2663C	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual:	1 copy
B0329G	Front cover (3/4MW4U)	
	Options	
MS2663C-01	Reference crystal oscillator	
MS2663C-02	Narrow resolution bandwidth	
MS2663C-04	High-speed time domain sweep	
MS2663C-06	Trigger/gate circuit	
MS2663C-07	AM/FM demodulator	
MS2663C-08	Pre-amplifier (Option 20 cannnot be installed simultaneously)	
MS2663C-10	Centronics interface (GPIB cannot be installed simultaneously)	
MS2663C-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)	
MS2663C-14	PTA parallel I/O (Option 10 cannot be installed simultaneously)	
MS2663C-15	Sweep signal output	
MS2663C-20	Tracking generator (Option 08 cannot be installed simultaneously)	
MS2663C-21	Television monitor (Multi)	
MS2663C-24	Television monitor (Brazil)	
	Warranty	
MS2663C-90	Extended three year warranty service	
MS2663C-91	Extended five year warranty service	
	Measurement software	
MX260002A	CDMA Cellular System Measurement Software	
MX260003A	PDC Measurement Software (for base station)	
MX260004A	GSM Measurement Software	
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System	
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System	
MX262001A	CATV Measurement Software	
MX264001A	EMI Measurement Software	
	Application parts	
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m	
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m	
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)	
B0395A	Rack mount kit (IEC)	

Model/order No.	Name
B0395B	Rack mount kit (JIS)
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (MODEL 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

SPECTRUM ANALYZER

MS2661C

9 kHz to 3 GHz

CE GPIB

For Analyzing Digital Radio Equipment and CATV Signals

The MS2661C Portable Spectrum Analyzer is for signal analysis of radio and other equipment related to improving frequency usage efficiency, higher modulation, and digitalization. This is a synthesized spectrum analyzer covering a wide frequency range from 9 kHz to 3 GHz. It has superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and is easy to operate. It has a "Measure" function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function), and which enables the two-screen display and FM demodulation waveform display. The large selection of options means that a wider range of applications can be handled at a reasonable cost.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Frequency	Frequency range	9 kHz to 3 GHz
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)
	Frequency span	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz), ±5% (span: <10 kHz, with option 02)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 3 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02 : 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Bandwidth accuracy: ±20% (1 kHz to 1 MHz), ±30% (3 MHz) Selectivity (60 dB : 3 dB): ≤15:1
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF (manually settable, or automatically settable according to RBW)
	Noise sideband, stability	Noise sideband: ≤–100 dBc/Hz (1 GHz, 10 kHz offset) Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1-hour warm-up at constant ambient temperature
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0° to 50°C); Option 01: ±5 x 10^{-8} (0° to 50°C) ∗Referenced to frequency at 25°C
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±50 Vdc Average noise level: ≤–115 dBm (1 MHz to 1 GHz), ≤–115 dBm + f [GHz] dB (>1 GHz), ≤–114 dBm (1 MHz to 1 GHz, at Option 08 pre-amplifier installed), ≤–114 dBm + 1.5f [GHz] dB (>1 GHz, at Option 08 pre-amplifier installed) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination,1 MHz to 3 GHz)
	Total level accuracy	±1.3 dB (100 kHz to 3 GHz) ∗Level measurement accuracy after calibration using internal calibration signal Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibration signal source accuracy

Continued on next page

Amplitude	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (3 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB
	Frequency response	±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.5 dB (9 to 100 kHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB), ±2.5 dB (0 to –90 dB) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB; Linear scale: 0.02% of reference level
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz), ≤–75 dBc (0.2 to 1.5 GHz), ≤–80 dBc (0.8 to 1 GHz) *Mixer input: –30 dBm Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 3 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input level)
	Maximum dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, at Option 08 pre-amplifier installed), >109 dB – 1.5f [GHz] (>1 GHz, at Option 08 pre-amplifier installed) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 – f [GHz] dB (0.5 to 1.5 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 – (2/3)f [GHz] dB (1 to 3 GHz)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (Manually settable, or automatically settable according to span, RBW and VBW) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)
	Sweep mode	Continuous, single
	Time domain sweep mode	Analog zero span, digital zero span
	Zone sweep	Sweeps only in frequency range indicated by zone marker
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)
Functions	Number of data points	501
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable
	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously at alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously at alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 3 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz *Range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth DC (50 Hz at AC-coupled) to 500 kHz *Range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth *RBW: ≥1 kHz usable
	Input connector	N-J, 50 Ω
	Auxiliary signal input and output	IF OUTPUT: 10.69 MHz, BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated, BNC connector) COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL
	Zone marker	NORMAL, DELTA
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP

Continued on next page

Functions	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display can be output via RS-232C and GPIB interface
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 KB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function : SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) ∗Typical value Antenna correction coefficients: Correct display and measurement of field strengths (dBµV/m) for specified antennas, Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C interface, saves/loads to/from memory card)
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98®. Connector: Meets the PCMCIA Rel. 2.0, 2 slots
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)
	Vibration	Meets the MIL-STD-810D
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤330 VA
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤10.8 kg (without option)
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	BNC connector, 10 MHz, >2 Vp-p (200 Ω terminated)

• Option 02: Narrow resolution bandwidth

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Resolution bandwidth accuracy	±20% (100, 300 Hz)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Trigger level (at log scale): –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line ∗Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 10: Centronics interface

Function	Outputs data to printer (Centronics standard). GPIB interface cannot be installed simultaneously.
Connector	D-sub 25-pin (jack)

• Option 08: Pre-amplifier∗1

Frequency range		100 kHz to 3 GHz, 100 kHz to 2.5 GHz (with Option 22)
Noise figure		≤7 dB (typical, <2 GHz), ≤12 dB (typical, ≥2 GHz), ≤9 dB (typical, <2 GHz, with Option 22), ≤14 dB (typical, ≥2 GHz, with Option 22)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±50 Vdc
	Average noise level	≤–134 dBm (1 MHz to 1 GHz), ≤–134 dBm + 2f [GHz] dB (>1 GHz), ≤–132 dBm (1 MHz to 1 GHz, with Option 22), ≤–132 dBm + 2f [GHz] dB (≥1 GHz, with Option 22) ∗RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV, 27.4 µV to 487 mV with Option 22 Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) ∗After calibration, referenced to 100 MHz, 1 MHz span (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB ∗After calibration, referenced to 3 kHz RBW RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) ∗After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB) ±2.0 dB (with Option 22, 100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz, 10 MHz to 2.5 GHz with Option 22) ∗Frequency difference of two signals: ≥50 kHz, Pre-amplifier input∗2: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input level∗2)

∗1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
∗2: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 12: QP detector

<table>
<tr><td>Functions</td><td>QP detection ∗Requires Option 02.</td></tr>
<tr><td>6 dB bandwidth</td><td>200 Hz, 9 kHz, 120 kHz
Accuracy: ±30% (18° to 28°C)</td></tr>
<tr><td>Display</td><td>LOG scale, 5 dB/div (10 divisions)
Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)</td></tr>
<tr><td>Pulse response characteristics</td><td>Response to CISPR pulse (DET mode: QP, 18° to 28°C)
<table>
<tr><td rowspan="2">Repetition frequency</td><td colspan="3">Bandwidth</td></tr>
<tr><td>120 kHz</td><td>9 kHz</td><td>200 Hz</td></tr>
<tr><td>1 kHz</td><td>≤–8.0 ±1.0 dB</td><td>≤–4.5 ±1.0 dB</td><td>–</td></tr>
<tr><td>100 Hz</td><td>Referenced</td><td>Referenced</td><td>≤–4.0 ±1.0 dB</td></tr>
<tr><td>60 Hz</td><td>–</td><td>–</td><td>≤–3.0 ±1.0 dB</td></tr>
<tr><td>25 Hz</td><td>–</td><td>–</td><td>Referenced</td></tr>
<tr><td>20 Hz</td><td>≤+9.0 ±1.0 dB</td><td>≤+6.5 ±1.0 dB</td><td>–</td></tr>
<tr><td>10 Hz</td><td>≤+14.0 ±1.5 dB</td><td>≤+10.0 ±1.5 dB</td><td>≤+4.0 ±1.0 dB</td></tr>
<tr><td>5 Hz</td><td>–</td><td>–</td><td>≤+7.5 ±1.5 dB</td></tr>
<tr><td>2 Hz</td><td>≤+26.0 ±2.0 dB</td><td>≤+20.5 ±2.0 dB</td><td>≤+13.0 ±2.0 dB</td></tr>
<tr><td>1 Hz</td><td>≤+28.5 ±2.0 dB</td><td>≤+22.5 ±2.0 dB</td><td>≤+17.0 ±2.0 dB</td></tr>
</table></td></tr>
<tr><td>QP on/off switching uncertainty (PEAK, QP)</td><td>≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)</td></tr>
<tr><td>Detection mode</td><td>QP, AVERAGE</td></tr>
<tr><td>Field strength measurement</td><td>Waveform data compensation data display for specified antenna factor, field strength (dBµV/m)
Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)</td></tr>
</table>

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)
Connection cable connectors	Amphenol 36 pins
Connector pin layout	See table below

Connector pin layout:

No.	Item	No.	Item	No.	Item
1	GND	13	Output port B (0) LSB	25	I/O port D (0) LSB
2	Trigger input	14	Output port B (1)	26	I/O port D (1)
3	Trigger output 1	15	Output port B (2)	27	I/O port D (2)
4	Trigger output 2	16	Output port B (3)	28	I/O port D (3) MSB
5	Output port A (0) LSB	17	Output port B (4)	29	Port C status 0/1: I/O
6	Output port A (1)	18	Output port B (5)	30	Port D status 0/1: I/O
7	Output port A (2)	19	Output port B (6)	31	Write strobe signal
8	Output port A (3)	20	Output port B (7) MSB	32	Interruption signal
9	Output port A (4)	21	I/O port C (0) LSB	33	Not used
10	Output port A (5)	22	I/O port C (1)	34	+5 V power supply
11	Output port A (6)	23	I/O port C (2)	35	Not used
12	Output port A (7) MSB	24	I/O port C (3) MSB	36	Not used

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 19: DC coupled input

Functions	DC-couples input circuit of main unit and expands lower limit of receiver frequency range to 500 Hz *Can only be installed with narrow RBW (Option 02)
Electrical characteristics	The standard specifications of the main unit are supplemented and changed as follows: Frequency range: 500 Hz to 3.0 GHz Max. input level: +30 dBm (CW, RF ATT: ≥10 dB), ±0 Vdc Average noise level: <–80 dBm (500 Hz to 10 kHz), ≤–90 dBm (10 kHz to 200 kHz), ≤–110 dBm (200 kHz to 1 MHz) *RBW: 30 Hz, VBW: 1 Hz, RF ATT: 0 dB Frequency response: ±1.2 dB (500 Hz to 100 kHz), ±0.5 dB (100 kHz to 3 GHz) *Referenced to 100 MHz frequency, RF ATT: 10 dB, 18° to 28°C

• Option 20: Tracking generator

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) *100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–20 dBc (100 kHz to 3 GHz), Non-harmonic: ≤–35 dBc (100 kHz to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

• Option 21: Television monitor (Multi)

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Function	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal; Connector: BNC

• Option 22: 75 Ω input (Option 12, 19, and 20 cannot be installed simultaneously)

Frequency range		100 kHz to 2.5 GHz
Amplitude	Level measurement	Measurement range: Average noise level to +25 dBm (+133.8 dBµV) Max. input level: +25 dBm (+133.8 dBµV, CW average power, RF ATT: ≥10 dB), ±100 Vdc Residual response: ≤–95 dBm (+13.8 dBµV, RF ATT: 0 dB, input: 75 Ω terminated, 1 MHz to 2.5 GHz)
	Total level accuracy	±1.8 dB (100 kHz to 2.5 GHz, level measurement accuracy after calibration using internal calibration signal) Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dBm) + calibration signal source accuracy
	Reference level	Setting range Log scale: +8.8 to +133.8 dBµV, Linear scale: 274 µV to 4.87 V
	Frequency response	±1.0 dB (100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C)
	Waveform display	Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB), ±1.0 dB (0 to –70 dB), ±1.5 dB (0 to –85 dB) Linear scale: ±4% (according to reference level) Marker level resolution Log scale: 0.01 dB Linear scale: 0.02% (according to reference level)
	Spurious response	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm), ≤–75 dBc (0.2 to 1.25 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, mixer input: –30 dBm) Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 2.5 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	Max. dynamic range	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, with Option 08), >109 dB – 1.5f [GHz] dB (>1 GHz with Option 08) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz) , >80 – f [GHz] dB (0.5 to 1.25 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 dB – (2/3)f [GHz] dB (1 to 2.5 GHz)
Functions	Input connector	NC-J, 75 Ω
	Auxiliary I/O	VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical; from lower edge to upper edge at 10 dB/div, 100 MHz, 75 Ω terminated) 0 to 0.4 V ±0.1 V (typical; from lower edge to upper edge at 10%/div, 100 MHz, 75 Ω terminated), BNC connector

• Option 23: 75 Ω tracking generator (Option 12, 19, and 20 cannot be installed simultaneously)

Frequency range	100 kHz to 2.5 GHz
Output level range	+44 to +104 dBµV (setting resolution: 0.1 dB)
Output level accuracy	≤±1.5 dB (100 MHz, output level: +104 dBµV)
Output level flatness	≤±1.75 dB (100 kHz to 2.5 GHz, output level: +104 dBµV, referenced to 100 MHz)
Output level linearity	≤±1.0 dB (+74 to +104 dBµV), ≤±2.0 dB (+44 to +74 dBµV) *100 kHz to 2.5 GHz, referenced to +104 dBµV
Spurious	Harmonics: ≤–20 dBc (100 kHz to 2.5 GHz), Non-harmonics: ≤–30 dBc (100 kHz to 2.5 GHz)
Tracking generator feed through	≤13.8 dBµV (spectrum analyzer input and tracking generator output connectors terminated at 75 Ω)
Output connector	NC-J, 75 Ω

• Option 24: Television monitor (Brazil)

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio *Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC *Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MS2661C	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual:	1 copy
B0329G	Front cover (3/4MW4U)	
	Options	
MS2661C-01	Reference crystal oscillator	
MS2661C-02	Narrow resolution bandwidth	
MS2661C-04	High-speed time domain sweep	
MS2661C-06	Trigger/gate circuit	
MS2661C-07	AM/FM demodulator	
MS2661C-08	Pre-amplifier	
MS2661C-10	Centronics interface (GPIB cannot be installed simultaneously.)	
MS2661C-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)	
MS2661C-14	PTA parallel I/O (Option 10 cannot be installed simultaneously.)	
MS2661C-15	Sweep signal output	
MS2661C-19	DC coupled input (requires Option 02)	
MS2661C-20	Tracking generator	
MS2661C-21	Television monitor (Multi)	
MS2661C-22	75 Ω input (Option 12, 19 and 20 can not be installed simultaneously.)	
MS2661C-23	75 Ω tracking generator (Option 12, 19 and 20 can not be installed simultaneously.)	
MS2661C-24	Television monitor (Brazil)	
	Warranty	
MS2661C-90	Extended three year warranty service	
MS2661C-91	Extended five year warranty service	
	Measurement software	
MX260002A	CDMA Cellular System Measurement Software	
MX260003A	PDC Measurement Software (for base station)	
MX260004A	GSM Measurement Software	
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System	
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System	
MX262001A	CATV Measurement Software	
MX264001A	EMI Measurement Software	
	Application parts	
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m	
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P), 1 m	
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)	
B0395A	Rack mount kit (IEC)	
B0395B	Rack mount kit (JIS)	

Model/order No.	Name
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (MODEL 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB, 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
60N50-1	Reflection bridge
60NF50-1	Reflection bridge
87A50	Reflection bridge
62N75	Reflection bridge
62NF75	Reflection bridge
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

SPECTRUM ANALYZER

MS2651B/2661B

9 kHz to 3 GHz

CE GPIB

For Maintaining CATV Circuits

The MS2651B/2661B Portable Spectrum Analyzers are for use in signal analysis of radio and other equipment related to improving frequency usage efficiency, higher modulation, and digitalization. They are synthesized spectrum analyzers covering a wide frequency range from 9 kHz to 3 GHz. They have superior basic performance such as high C/N ratio, low distortion, and high frequency/level accuracies and are easy to operate. They have the “Measure” function for evaluation of radio equipment (frequency counter, C/N, adjacent channel power, occupied frequency bandwidth, burst average power, and template decision function) and which enables the two-screen display and FM demodulation waveform display. The large selection of options means a wider range of applications can be handled at reasonable cost.

The MS2661B is designed for manufacture and installation of radio equipment and devices, while the MS2651B is used for maintenance applications.

Specifications

Except where noted otherwise, specified values are obtained after warming up the equipment for 30 minutes at a constant ambient temperature and then performing calibration. The typical values are given for reference and are not guaranteed.

Model		MS2651B	MS2661B
Frequency	Frequency range	9 kHz to 3 GHz	
	Display frequency accuracy	± (display frequency x reference frequency accuracy + span x span accuracy + 100 Hz) ∗Span: ≥10 kHz, after calibration	
	Marker frequency display accuracy	Normal: Same as display frequency accuracy; Delta: Same as frequency span accuracy	
	Frequency counter	Resolution: 1 Hz, 10 Hz, 100 Hz, 1 kHz Accuracy: Display frequency x reference frequency accuracy ±1 LSD (at S/N: ≥20 dB)	
	Frequency span	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz)	Setting range: 0 Hz, 1 kHz to 3.1 GHz Accuracy: ±2.5% (span: ≥10 kHz) ±5% (span: <10 kHz, with option 02)
	Resolution bandwidth (RBW) (3 dB bandwidth)	Setting range: 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, 1 MHz, 5 MHz (manually settable, or automatically settable according to frequency span) ∗Option 02 (MS2661B only): 30 Hz, 100 Hz, and 300 Hz are added. Measurements of noise, C/N, adjacent channel power, and channel power by measure function are executed with the calculated equivalent noise bandwidth of the RBW. Selectivity (60 dB : 3 dB): ≤10:1 (RBW: 1 to 300 kHz), ≤15:1 (RBW: 1, 5 MHz)	
	Video bandwidth (VBW)	1 Hz to 3 MHz (1-3 sequence), OFF (manually settable, or automatically settable according to RBW)	
	Noise sideband, stability	Noise sideband: ≤–90 dBc/Hz (1 GHz, 10 kHz offset)	Noise sideband: ≤–100 dBc/Hz (1 GHz, 10 kHz offset)
		Residual FM: ≤20 Hzp-p/0.1 s (1 GHz, span: 0 Hz) Frequency drift: ≤200 Hz/min (span: ≤10 kHz, sweep time: ≤100 s) ∗After 1 hour warm-up at constant ambient temperature	
	Reference oscillator	Frequency: 10 MHz Aging rate: 2 x 10^{-6}/year (typical); Option 01: 1 x 10^{-7}/year, 2 x 10^{-8}/day Temperature characteristics: 1 x 10^{-5} (typical, 0° to 50°C); Option 01: ±5 x 10^{-8} (0° to 50°C, referenced to 25°C)	

Continued on next page

	Model	MS2651B	MS2661B
Amplitude	Level measurement	Measurement range: Average noise level to +30 dBm Maximum input level: +30 dBm (CW average power, RF ATT: ≥10 dB), ±50 Vdc	
		Average noise level: ≤–110 dBm (1 MHz to 1 GHz), ≤–110 dBm + f [GHz] dB (>1 GHz) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–95 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 3 GHz)	Average noise level: ≤–115 dBm (1 MHz to 1 GHz), ≤–115 dBm + f [GHz] dB (>1 GHz), ≤–114 dBm (1 MHz to 1 GHz, at Option 08 pre-amplifier installed), ≤–114 dBm + 1.5f [GHz] dB (>1 MHz, at Option 08 pre-amplifier installed) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB Residual response: ≤–100 dBm (RF ATT: 0 dB, input: 50 Ω termination, 1 MHz to 3 GHz)
	Total level accuracy	±1.3 dB (100 kHz to 3 GHz) *Level measurement accuracy after calibration using internal calibration signal Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dB) + calibration signal source accuracy	
	Reference level	Setting range Log scale: –100 to +30 dBm; Linear scale: 224 µV to 7.07 V Unit Log scale: dBm, dBµV, dBmV, V, dBµVemf, W, dBµV/m Linear scale: V Reference level accuracy: ±0.4 dB (–49.9 to 0 dBm), ±0.75 dB (–69.9 to –50 dBm, 0.1 to +30 dBm), ±1.5 dB (–80 to –70 dBm) *After calibration, at 100 MHz, span: 1 MHz (when RF ATT, RBW, VBW, and sweep time set to AUTO) RBW switching uncertainty: ±0.3 dB (1 kHz to 1 MHz), ±0.4 dB (5 MHz) *After calibration, referenced to RBW: 3 kHz Input attenuator (RF ATT) Setting range: 0 to 70 dB (10 dB steps) *Manually settable, or automatically settable according to reference level Switching uncertainty: ±0.3 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, frequency: 100 MHz, referenced to RF ATT: 10 dB	
	Frequency response	±0.5 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.5 dB (9 to 100 kHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C) ±1.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB)	
	Waveform display	Scale (10 div) Log scale: 10, 5, 2, 1 dB/div Linear scale: 10, 5, 2, 1%/div Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz), ±2.5 dB (0 to –90 dB, RBW: ≤3 kHz) Linear scale: ±4% (compared to reference level) Marker level resolution Log scale: 0.01 dB, Linear scale: 0.02% of reference level	
	Spurious response	2nd harmonic distortion: ≤–55 dBc (10 to 100 MHz), ≤–60 dBc (0.1 to 1.5 GHz) *Mixer input: –30 dBm Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm)	2nd harmonic distortion: ≤–60 dBc (10 to 200 MHz), ≤–75 dBc (0.2 to 1.5 GHz), ≤–80 dBc (0.8 to 1 GHz) *Mixer input: –30 dBm Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 3 GHz) *Frequency difference of two signals: ≥50 kHz, mixer input : –30 dBm
	1 dB gain compression	≥–5 dBm (≥100 MHz, at mixer input)	
	Maximum dynamic range	1 dB gain compression level to average noise level: >105 dB (0.1 to 1 GHz), >105 dB – f [GHz] dB (>1 GHz) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >67.5 dB (10 to 100 MHz), >70 dB (100 to 500 MHz), >70 – f [GHz] dB (0.5 to 1.5 GHz) 3rd order intermodulation : >76.6 dB (10 MHz to 1 GHz), >76.6 – (2/3)f [GHz] dB (1 to 3 GHz)	1 dB gain compression level to average noise level: >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, at Option 08 pre-amplifier installed) >109 dB – 1.5f [GHz] (>1 GHz, at Option 08 pre amplifier installed) Distortion characteristics (RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz), >80 – f [GHz] dB (0.5 to 1.5 GHz) >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 – (2/3)f [GHz] dB (1 to 3 GHz)
Sweep	Sweep time	Setting range : 20 ms to 1000 s (Manually settable, or automatically settable according to span, RBW and VBW) Accuracy: ±15% (20 ms to 100 s), ±45% (110 to 1000 s), ±1% (time domain sweep: digital zero span mode)	
	Sweep mode	Continuous, single	
	Time domain sweep mode	Analog zero span, digital zero span	
	Zone sweep	Sweeps only in frequency range indicated by zone marker	
	Tracking sweep	Sweeps while tracing peak points within zone marker (zone sweep also possible)	
Functions	Number of data points	501	
	Detection mode	NORMAL: Simultaneously displays max. and min. points between sample points POS PEAK: Displays max. point between sample points NEG PEAK: Displays min. point between sample points SAMPLE: Displays momentary value at sample points Detection mode switching uncertainty: ±0.5 dB (at reference level)	
	Display	Color TFT-LCD, Size: 5.5 inch, Number of colors: 17 (RGB, each 64-scale settable); Intensity adjustment: 5 steps settable	

Continued on next page

Model		MS2651B	MS2661B
Functions	Display functions	Trace A: Displays frequency spectrum Trace B: Displays frequency spectrum Trace Time: Displays time domain waveform at center frequency Trace A/B: Displays Trace A and Trace B simultaneously. Simultaneous sweep of same frequency, alternate sweep of independent frequencies Trace A/BG: Displays frequency region to be observed (background) and object band (foreground) selected from background with zone marker simultaneously at alternate sweep Trace A/Time: Displays frequency spectrum, and time domain waveform at center frequency simultaneously at alternate sweep Trace move/calculation: A → B, B → A, A ↔ B, A + B → A, A – B → A, A – B + DL → A	
	Storage functions	NORMAL, VIEW, MAX HOLD, MIN HOLD, AVERAGE, CUMULATIVE, OVER WRITE	
	FM demodulation waveform display function	Demodulation range: 2, 5, 10, 20, 50, 100, 200 kHz/div Marker display accuracy: ±5% of full scale (referenced to center frequency, DC-coupled, RBW: 5 MHz, VBW: 1 Hz, CW) Demodulation frequency response: DC (50 Hz at AC-coupled) to 100 kHz ∗Range: ≤20 kHz/div, VBW: off, at 3 dB bandwidth DC (50 Hz at AC-coupled) to 500 kHz ∗Range: ≥50 kHz/div, VBW: off, at 3 dB bandwidth ∗RBW: ≥100 kHz usable	
	Input connector	N-J, 50 Ω	
	Auxiliary signal input and output	IF OUTPUT: 455 kHz (RBW: ≤30 kHz), 10.695 MHz (RBW: ≥100 kHz), BNC connector VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (100 MHz, from lower edge to upper edge at 10 dB/div or 10%/div, 75 Ω terminated, BNC connector) COMPOSITE OUTPUT: For NTSC, 1 Vp-p (75 Ω terminated), BNC connector EXT REF INPUT: 10 MHz ±10 Hz, ≥0 dBm (50 Ω terminated), BNC connector	
	Signal search	AUTO TUNE, PEAK → CF, PEAK → REF, SCROLL	
	Zone marker	NORMAL, DELTA	
	Marker →	MARKER → CF, MARKER → REF, MARKER → CF STEP SIZE, ΔMARKER → SPAN, ZONE → SPAN	
	Peak search	PEAK, NEXT PEAK, NEXT RIGHT PEAK, NEXT LEFT PEAK, MIN DIP, NEXT DIP	
	Multimarker	Number of markers: 10 max. (HIGHEST 10, HARMONICS, MANUAL SET)	
	Measure	Noise power (dBm/Hz, dBm/ch), C/N (dBc/Hz, dBc/ch), occupied bandwidth (power N% method, X-dB down method), adjacent channel power (REF: total power/reference level/in-band level method, channel designate display: 2 channels x 2 graphic display), average power of burst signal (average power in designated time range of time domain waveform), channel power (dBm, dBm/Hz), template comparison (upper/lower limits x each 2, time domain), MASK (upper/lower x each 2, frequency domain)	
	Save/recall	Saves and recalls setting conditions and waveform data to internal memory (max. 12) or memory card	
	Hard copy	Printer (HP dotmatrix, EPSON dotmatrix or compatible models): Display data can be hard-copied via RS-232C, GPIB, and Centronics (Option 10) interface Plotter (HP-GL, GP-GL compatible models): Display can be output via RS-232C and GPIB interface	
	PTA	Language: PTL (interpreter based on BASIC) Programming: Using editor of external computer Program memory: Memory card, upload/download to/from external computer Programming capacity: 192 kB Data processing: Directly accesses measurement data according to system variables, system subroutines, and system functions	
	RS-232C	Outputs data to printer and plotter. Control from external computer (excluding power switch)	
	GPIB	Meets IEEE488.2. Controlled by external computer (excluding power switch). Or controls external equipment with PTA Interface function: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C1, C2, C3, C4, C28	
	Correction	Automatic correction of insertion loss of MA1621A Impedance Transformer Correction accuracy (RF ATT: ≥10 dB): ±2.5 dB (9 to 100 kHz), ±1.5 dB (100 kHz to 2 GHz), ±2.0 dB (2 to 3 GHz) ∗Typical value Antenna correction coefficients: Correct display and measurement of field strengths (dBµV/m) for specified antennas. Internal antenna correction coefficients (MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, and four antennas user-defined; writes via GPIB or RS-232C interface, saves/loads to/from memory card)	
	Memory card interface	Functions: Saving/recalling measurement parameters/waveform data, uploading/downloading PTA programs; Applicable cards: SRAM, EPROM, Flash EPROM ∗Only SRAM writable; Card capacity: 2 MB max. The SRAM card is supported by Windows95/98®. Connector: Meets the PCMCIA Rel. 2.0, 2 slots	
Others	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)	
	LVD	EN61010-1: 2001 (Pollution Degree 2)	
	Vibration	Meets the MIL-STD-810D	
	Power (operating range)	85 to 132/170 to 250 Vac (automatic voltage switching), 47.5 to 63 Hz, 380 to 420 Hz (85 to 132 V only), ≤320 VA	
	Dimensions and mass	320 (W) x 177 (H) x 351 (D) mm, ≤10.8 kg (without option)	
	Ambient temperature	0° to +50°C (operate), –40° to +75°C (storage)	

• Option 01: Reference crystal oscillator

Frequency	10 MHz
Aging rate	≤1 x 10^{-7}/year, ≤2 x 10^{-8}/day (after power on, with reference to frequency after 24 h)
Temperature characteristics	±5 x 10^{-8} (0° to 50°C, with reference to 25°C)
Buffer output	BNC connector, 10 MHz, >2 Vp-p (200 Ω terminated)

• Option 02: Narrow resolution bandwidth (MS2661B only)

Resolution bandwidth (3 dB)	30 Hz, 100 Hz, 300 Hz
Resolution bandwidth switching uncertainty	±0.4 dB (RBW 3 kHz referenced)
Selectivity (60 dB:3 dB)	≤15:1 (RBW: 100, 300 Hz), ≤20:1 (RBW: 30 Hz)

• Option 04: High-speed time domain sweep

Sweep time	12.5 µs, 25 µs, 50 µs, 100 to 900 µs (one most significant digit settable) 1.0 to 19 ms (two upper significant digits settable)
Accuracy	±1%
Marker level resolution	0.1 dB (log scale), 0.2% (linear scale, relative to reference level)

• Option 07: AM/FM demodulator

Voice output	With internal loudspeaker and earphone connector (ø3.5 jack), adjustable volume

• Option 06: Trigger/gate circuit

Trigger switch		FREERUN, TRIGGERED
Trigger source	EXT	Trigger level: ±10 V (resolution: 0.1 V), TTL level Trigger slope: Rise/Fall Connector: BNC
	VIDEO	Trigger level (at log scale): –100 to 0 dB (resolution: 1 dB) Trigger slope: Rise/Fall
	WIDE IF VIDEO	Trigger level: High, middle, or low selectable Bandwidth: ≥20 MHz Trigger slope: Rise/Fall
	LINE	Frequency: 47.5 to 63 Hz (line lock)
	TV	Method: M-NTSC, B/G/H PAL Sync: V-SYNC, H-SYNC Sync line (NTSC) H-SYNC (ODD): 7 to 262 line, H-SYNC (EVEN): 1 to 263 line Sync line (PAL) H-SYNC (ODD): 1 to 312 line, H-SYNC (EVEN): 317 to 625 line *Option 16 required
Trigger delay		Pre-trigger (displays waveform from previous max. 1 screen at trigger occurrence point) Range: –time span to 0 s Resolution: time span/500 Post trigger (displays waveform from after max. 65.5 ms at trigger occurrence point) Range: 0 to 65.5 ms Resolution: 1 µs
Gate sweep		In frequency domain, displays spectrum of input signal in specified gate interval Gate delay: 0 to 65.5 ms (from trigger point, resolution: 1 µs) Gate width: 2 µs to 65.5 ms (from gate delay, resolution: 1 µs)

• Option 08: Pre-amplifier*1

Frequency range		100 kHz to 3 GHz, 100 kHz to 2.5 GHz (with Option 22)
Noise figure		≤7 dB (typical, <2 GHz), ≤12 dB (typical, ≥2 GHz), ≤9 dB (typical, <2 GHz, with Option 22), ≤14 dB (typical, ≥2 GHz, with Option 22)
Amplitude	Measurement range	Average noise level to +10 dBm
	Max. input level	CW average power: +10 dBm, ±50 Vdc
	Average noise level	MS2651B: ≤–130 dBm (1 MHz to 1 GHz), ≤–130 dBm + 1.5f [GHz] dB (>1 GHz) MS2661B: ≤–134 dBm (1 MHz to 1 GHz), ≤–134 dBm + 2f [GHz] dB (>1 GHz), ≤–132 dBm (1 MHz to 1 GHz, with Option 22), ≤–132 dBm + 2f [GHz] dB (≥1 GHz, with Option 22) *RBW: 1 kHz, VBW: 1 Hz, RF ATT: 0 dB
	Reference level	Setting range Log scale: –120 to +10 dBm, or equivalent level Linear scale: 22.4 µV to 707 mV, 27.4 µV to 487 mV with Option 22 Reference level accuracy: ±0.5 dB (–69.9 to –20 dBm), ±0.75 dB (–89.9 to –70 dBm, –19.9 to +10 dBm) *After calibration, referenced to 100 MHz, span: 1 MHz (RF ATT, RBW, VBW and sweep time set to AUTO) RBW switching uncertainty: ±0.5 dB *After calibration, referenced to RBW: 3 kHz RF ATT switching uncertainty: ±0.5 dB (0 to 50 dB), ±1.0 dB (0 to 70 dB) *After calibration, referenced to 100 MHz, RF ATT: 10 dB
	Frequency response	±2.0 dB (100 kHz to 3 GHz, referenced to 100 MHz, RF ATT: 10 to 50 dB) ±2.0 dB (with Option 22, 100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18° to 28°C)
	Linearity of waveform display	Log scale (after calibration): ±0.5 dB (0 to –20 dB), ±1.0 dB (0 to –60 dB), ±1.5 dB (0 to –75 dB) Linear scale (after calibration): ±5% (according to reference level)
	Spurious response	Two signals 3rd order intermodulation distortion: ≤–70 dBc (10 MHz to 3 GHz, 10 MHz to 2.5 GHz with Option 22) *Frequency difference of two signals: ≥50 kHz; Pre-amplifier input*2: –55 dBm
	1 dB gain compression	≥–35 dBm (≥100 MHz, at pre-amplifier input*2)

*1: Overall specification with pre-amplifier on (Noise figure is the simple performance)
*2: Pre-amplifier input level = RF input level – RF ATT setting level

• Option 10: Centronics interface

Function	Outputs data to printer (Centronics standard). GPIB interface cannot be installed simultaneously.
Connector	D-sub 25-pin (jack)

• Option 12: QP detector (MS2661B only)

Functions	QP detection ∗Requires Option 02. When Option 12 installed, Option 02 RBW 100 Hz 3 dB bandwidth changed to 150 Hz (typical)
6 dB bandwidth	200 Hz, 9 kHz, 120 kHz Accuracy: ±30% (18° to 28°C)
Display	LOG scale, 5 dB/div (10 divisions) Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)
Pulse response characteristics	Response to CISPR pulse (DET mode: QP, 18° to 28°C)
QP on/off switching uncertainty (PEAK, QP)	≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)
Detection mode	QP, AVERAGE
Field strength measurement	Waveform data compensation data display for specified antenna factor, field strength (dBµV/m) Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)

Repetition frequency	Bandwidth		
	120 kHz	9 kHz	200 Hz
1 kHz	≤–8.0 ±1.0 dB	≤–4.5 ±1.0 dB	–
100 Hz	Referenced	Referenced	≤–4.0 ±1.0 dB
60 Hz	–	–	≤–3.0 ±1.0 dB
25 Hz	–	–	Referenced
20 Hz	≤+9.0 ±1.0 dB	≤+6.5 ±1.0 dB	–
10 Hz	≤+14.0 ±1.5 dB	≤+10.0 ±1.5 dB	≤+4.0 ±1.0 dB
2 Hz	≤+26.0 ±2.0 dB	≤+20.5 ±2.0 dB	≤+13.0 ±2.0 dB
1 Hz	≤+28.5 ±2.0 dB	≤+22.5 ±2.0 dB	≤+17.0 ±2.0 dB

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• Option 13: QP detector (MS2651B only)

6 dB bandwidth	9 kHz, 120 kHz Accuracy: ±30% (18° to 28°C)
Display	LOG scale, 5 dB/div (10 divisions) Linearity: ≤±2.0 dB (0 to –40 dB, CW signal, reference level: 60 dBµV, RF ATT: 0 dB, 18° to 28°C)
Pulse response characteristics	Response to CISPR pulse (DET mode: QP, 18° to 28°C)
QP on/off switching uncertainty (PEAK, QP)	≤±1.0 dB (CW signal, reference level – 40 dB, after auto-calibration, 18° to 28°C)
Detection mode	QP, AVERAGE
Field strength measurement	Waveform data compensation data display for specified antenna factor, field strength (dBµV/m) Built-in antenna factors: MP534A/651A Dipole Antenna, MP635A/666A Log-Periodic Antenna, MP414B Loop Antenna, user-defined (four types writable via GPIB or RS-232C, can be saved/loaded to/from memory card)

Repetition frequency	Bandwidth	
	120 kHz	9 kHz
1 kHz	≤–8.0 ±1.0 dB	≤–4.5 ±1.0 dB
100 Hz	Referenced	Referenced
20 Hz	≤+9.0 ±1.0 dB	≤+6.5 ±1.0 dB
10 Hz	≤+14.0 ±1.5 dB	≤+10.0 ±1.5 dB
2 Hz	≤+26.0 ±2.0 dB	≤+20.5 ±2.0 dB
1 Hz	≤+28.5 ±2.0 dB	≤+22.5 ±2.0 dB

• Option 14: PTA parallel I/O

Functions	Controls external devices from PTA, cannot be installed when Option 10 installed
System variables	As follows using PTA system variables IOA: Controls 8-bit parallel output port A IOB: Controls 8-bit parallel output port B IOC: Controls 4-bit parallel input/output port C IOD: Controls 4-bit parallel input/output port D EIO: Controls I/O switching of ports C/D EXO: Controls I/O trigger
PTL statements	External interrupt control of input to I/O ports using PTA-PTL statements IOEN statement: Enables interrupt input IODI statement: Disables interrupt input IOMA statement: Masks interrupt input ON TO GOTO statement: Changes program flow at interrupt generation ON TO GOSUB statement: Changes program flow at interrupt generation
Write strobe signal	Write strobe signal (negative pulse) output externally at control of output ports C/D
Power supply	External +5 ±0.5 Vdc (max. 100 mA) supply
Signal logic levels	Negative logic, TTL level Specified current: Output ports A/B (max. output current Hi: 2.6 mA, Lo: 24 mA) Output ports C/D (max. output current Hi: 15 mA, Lo: 24 mA) Other control output lines (max. output current Hi: 0.4 mA, Lo: 8 mA)

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Connection cable connectors	Amphenol 36 pins
Connector pin layout	(see pin table below)

No.	Item	No.	Item	No.	Item
1	GND	13	Output port B (0) LSB	25	I/O port D (0) LSB
2	Trigger input	14	Output port B (1)	26	I/O port D (1)
3	Trigger output 1	15	Output port B (2)	27	I/O port D (2)
4	Trigger output 2	16	Output port B (3)	28	I/O port D (3) MSB
5	Output port A (0) LSB	17	Output port B (4)	29	Port C status 0/1: I/O
6	Output port A (1)	18	Output port B (5)	30	Port D status 0/1: I/O
7	Output port A (2)	19	Output port B (6)	31	Write strobe signal
8	Output port A (3)	20	Output port B (7) MSB	32	Interruption signal
9	Output port A (4)	21	I/O port C (0) LSB	33	Not used
10	Output port A (5)	22	I/O port C (1)	34	+5 V power supply
11	Output port A (6)	23	I/O port C (2)	35	Not used
12	Output port A (7) MSB	24	I/O port C (3) MSB	36	Not used

• Option 15: Sweep signal output

Sweep output (X)	0 to 10 V ±1 V (≥100 kΩ termination, from left side to right side of display scale), BNC connector
Sweep status output (Z)	TTL level (low level with sweeping), BNC connector

• Option 19: DC coupled input (MS2661B only)

Functions	DC-couples input circuit of main unit and expands lower limit of receiver frequency range to 500 Hz ∗Can only be installed with narrow RBW (Option 02)
Electrical characteristics	The standard specifications of the main unit are supplemented and changed as follows: Frequency range: 500 Hz to 3.0 GHz Max. input level: +30 dBm (CW, RF ATT: ≥10 dB), ±0 Vdc Average noise level: ≤80 dBm (500 Hz to 10 kHz), ≤90 dBm (10 kHz to 200 kHz), ≤–110 dBm (200 kHz to 1 MHz) ∗RBW: 30 Hz, VBW: 1 Hz, RF ATT: 0 dB Frequency response: ±1.2 dB (500 Hz to 100 kHz), ±0.5 dB (100 kHz to 3 GHz) ∗Referenced to 100 MHz frequency, RF ATT: 10 dB, 18° to 28°C

• Option 20: Tracking generator

Frequency range	9 kHz to 3 GHz
Output level range	0 to –60 dBm
Setting resolution	0.1 dB
Output level accuracy	≤±1.0 dB (at 100 MHz, 0 dBm)
Output level flatness	≤±1.5 dB (100 kHz to 3 GHz, output level: 0 dBm, referenced to 100 MHz frequency)
Output level linearity	≤±1.0 dB (0 to –30 dBm), ≤±2.0 (–30 to –60 dBm) ∗100 kHz to 3 GHz, 0 dBm output level reference
Spurious	Harmonic: ≤–20 dBc (100 kHz to 3 GHz), Non-harmonic: ≤–35 dBc (100 kHz to 3 GHz)
Tracking generator feed through	≤–95 dBm (spectrum analyzer input and tracking generator output connectors terminated at 50 Ω)
Output connector	N-J, 50 Ω

• Option 21: Television monitor (Multi)

Video	M-NTSC, B/G/H/I/D PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan, USA, Italy, UK and China; automatic setting to CATV of CCIR, Japan, and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

• Option 22: 75 Ω input (Option 12, 13, 19, and 20 cannot be installed simultaneously)

Frequency range		100 kHz to 2.5 GHz
Amplitude	Level measurement	Measurement range: Average noise level to +25 dBm (+133.8 dBμV) Max. input level: +25 dBm (+133.8 dBμV, CW average power, RF ATT: ≥10 dB), ±100 Vdc Residual response: ≤–95 dBm (+13.8 dBμV, RF ATT: 0 dB, input: 75 Ω terminated, 1 MHz to 2.5 GHz)
	Total level accuracy	±1.8 dB (100 kHz to 2.5 GHz, level measurement accuracy after calibration using internal calibration signal) Total level accuracy: Reference level accuracy (0 to –49.9 dBm) + frequency response + log linearity (0 to –20 dBm) + calibration signal source accuracy
	Reference level	Setting range Log scale: +8.8 to +133.8 dBμV, Linear scale: 274 μV to 4.87 V
	Frequency response	±1.0 dB (100 kHz to 2.5 GHz, referenced to 100 MHz, RF ATT: 10 dB, 18˚ to 28˚C)
	Waveform display	Linearity (after calibration) Log scale: ±0.4 dB (0 to –20 dB, RBW: ≤1 MHz), ±1.0 dB (0 to –70 dB, RBW: ≤100 kHz), ±1.5 dB (0 to –85 dB, RBW: ≤3 kHz) Linear scale: ±4% (according to reference level) Marker level resolution Log scale: 0.01 dB Linear scale: 0.02% (according to reference level)
	Spurious response	2nd harmonic distortion (MS2651B): ≤–55 dBc (10 to 100 MHz, mixer input: –30 dBm) , ≤–60 dBc (0.1 to 1.25 GHz, mixer input: –30 dBm) 2nd harmonic distortion (MS2661B): ≤–60 dBc (10 to 200 MHz, mixer input: –30 dBm) , ≤–75 dBc (0.2 to 1.25 GHz, band 0, mixer input: –30 dBm), ≤–80 dBc (0.8 to 1 GHz, mixer input: –30 dBm) Two signals 3rd order intermodulation distortion (MS2651B): ≤–70 dBc (10 to 2.5 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm Two signals 3rd order intermodulation distortion (MS2661B): ≤–70 dBc (10 to 100 MHz), ≤–80 dBc (0.1 to 2.5 GHz) ∗Frequency difference of two signals: ≥50 kHz, mixer input: –30 dBm
	Max. dynamic range	1 dB gain compression level to average noise level (MS2651B): >105 dB (0.1 to 1 GHz), >105 dB – f [GHz] dB (>1 GHz) 1 dB gain compression level to average noise level (MS2661B): >110 dB (0.1 to 1 GHz), >110 dB – f [GHz] dB (>1 GHz), >109 dB (0.1 to 1 GHz, with Option 08), >109 dB – 1.5f [GHz] dB (>1 GHz with Option 08) Distortion characteristics (MS2651B RBW: 1 kHz) 2nd harmonic: >67.5 dB (10 to 100 MHz), >70 dB (100 to 500 MHz) , >70 – f [GHz] dB (0.5 to 1.25 GHz) 3rd order intermodulation: >76.6 dB (0.1 to 1 GHz), >76.6 dB – (2/3)f [GHz] dB (1 to 2.5 GHz) Distortion characteristics (MS2661B RBW: 1 kHz) 2nd harmonic: >72.5 dB (10 to 200 MHz), >80 dB (200 to 500 MHz) , >80 – f [GHz] dB (0.5 to 1.25 GHz), >82.5 – f [GHz] dB (0.8 to 1 GHz) 3rd order intermodulation: >80 dB (10 to 100 MHz), >83.3 dB (0.1 to 1 GHz), >83.3 dB – (2/3)f [GHz] dB (1 to 2.5 GHz)
Functions	Input connector	NC-J, 75 Ω
	Auxiliary I/O	VIDEO OUTPUT (Y): 0 to 0.5 V ±0.1 V (typical, from lower edge to upper edge at 10 dB/div, 100 MHz, 75 Ω terminated) 0 to 0.4 V ±0.1 V (typical, from lower edge to upper edge at 10%/div, 100 MHz, 75 Ω terminated), BNC connector

• Option 23: 75 Ω tracking generator (Option 12, 13, 19, and 20 cannot be installed simultaneously)

Frequency range	100 kHz to 2.5 GHz
Output level range	+44 to +104 dBμV (setting resolution: 0.1 dB)
Output level accuracy	≤±1.5 dB (100 MHz, output level: +104 dBμV)
Output level flatness	≤±1.75 dB (100 kHz to 2.5 GHz, output level: +104 dBμV, referenced to 100 MHz)
Output level linearity	≤±1.0 dB (+74 to +104 dBμV), ≤±2.0 dB (+44 to +74 dBμV) ∗100 kHz to 2.5 GHz, referenced to +104 dBμV
Spurious	Harmonics: ≤–20 dBc (100 kHz to 2.5 GHz) Non-harmonics: ≤–30 dBc (100 kHz to 2.5 GHz)
Tracking generator feed through	≤13.8 dBμV (spectrum analyzer input and tracking generator output connectors terminated at 75 Ω)
Output connector	NC-J, 75 Ω

• Option 24: Television monitor (Brazil)

Video	M-NTSC, M PAL, color
Audio	Simultaneous monitoring of video and audio ∗Needs Option 07
Functions	Channel: Automatic setting to broadcast wave of CCIR, Japan and USA; automatic setting to CATV of CCIR, Japan and USA Trigger: Triggered sweep by V-SYNC, H-SYNC ∗Needs trigger/gate circuit (Option 06) Aux. output: Composite video signal, Connector: BNC

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MS2651B	Spectrum Analyzer	
MS2661B	Spectrum Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0014	Fuse, 6.3 A:	2 pcs
W1251AE	MS2650B, MS2660B/C series operation manual:	1 copy
B0329G	Front cover(3/4MW4U)	
	Options	
MS2651B/2661B-01	Reference crystal oscillator	
MS2661B-02	Narrow resolution bandwidth	
MS2651B/2661B-04	High-speed time domain sweep	
MS2651B/2661B-06	Trigger/gate circuit	
MS2651B/2661B-07	AM/FM demodulator	
MS2651B/2661B-08	Pre-amplifier	
MS2651B/2661B-10	Centronics interface (GPIB cannot be installed simultaneously)	
MS2661B-12	QP detector (requires Option 02, QP-BW: 0.2/9/120 kHz)	
MS2651B-13	QP detector (QP-BW: 9/120 kHz)	
MS2651B/2661B-14	PTA parallel I/O (Option 10 cannot be installed simultaneously)	
MS2651B/2661B-15	Sweep signal output	
MS2661B-19	DC coupled input (MS2661B only, requires Option 02)	
MS2651B/2661B-20	Tracking generator	
MS2651B/2661B-21	Television monitor (Multi)	
MS2651B/2661B-22	75 Ω input (Option 12, 13, 19, and 20 cannot be installed simultaneously)	
MS2651B/2661B-23	75 Ω tracking generator (Option 12, 13, 19, and 20 cannot be installed simultaneously)	
MS2651B/2661B-24	Television monitor (Brazil)	
	Warranty	
MS2651B-90	Extended three year warranty service	
MS2651B-91	Extended five year warranty service	
	Measurement software	
MX260002A	CDMA Cellular System Measurement Software	
MX260003A	PDC Measurement Software (for base station)	
MX260004A	GSM Measurement Software	
MX261001A	Low-Power Data Communication System Measurement Software conforming to issue of Direct Spread Spectrum System	
MX261002A	Low-Power Data Communication System Measurement Software conforming to issue of Frequency Hopping System	
MX262001A	CATV Measurement Software	
MX264001A	EMI Measurement Software	
	Application parts	
J0561	Coaxial cord (N-P-5W · 5D-2W · N-P-5W), 1 m	
J0104A	Coaxial cord (BNC-P · RG-55/U · N-P) , 1 m	
CSCJ-256K-SM	256 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-512K-SM	512 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-001M-SM	1024 KB memory card (meets PCMCIA Rel. 2.0)	
CSCJ-002M-SM	2048 KB memory card (meets PCMCIA Rel. 2.0)	

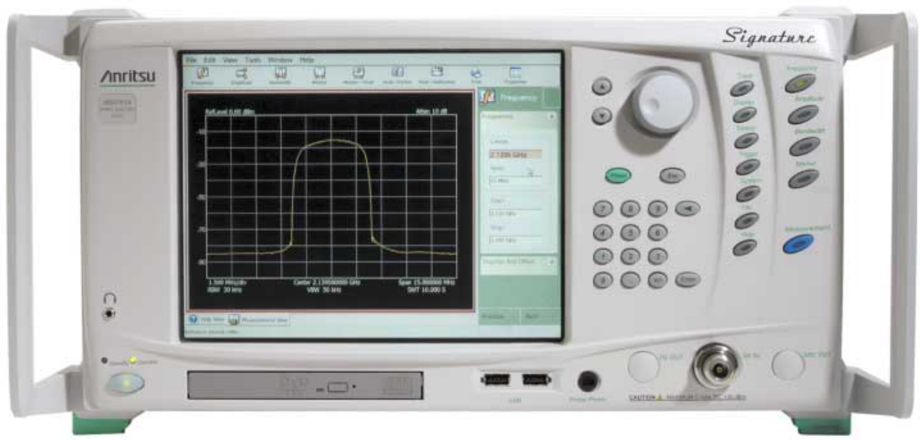
Model/order No.	Name
B0395A	Rack mount kit (IEC)
B0395B	Rack mount kit (JIS)
J0055	Coaxial adapter (NC-P · BNC-J)
J0076	Coaxial adapter (NC-P · F-J)
B0391A	Carrying case (hard type, with casters)
B0391B	Carrying case (hard type, without casters)
B0436A	Carrying case (soft type)
MP612A	RF Fuse Holder
MP613A	Fuse Element
J0805	DC Block (Model 7003, 10 kHz to 18 GHz, ±50 V, Weinschel product)
MA2507A	DC Block Adapter (50 Ω, 9 kHz to 3 GHz, ±50 V)
MA8601A	DC Block Adapter (50 Ω, 30 kHz to 2 GHz, ±50 V)
MA8601J	DC Block Adapter (75 Ω, 10 kHz to 2.2 GHz, ±50 V)
MA1621A	50 Ω → 75 Ω Impedance Transformer (9 kHz to 3 GHz, ±100 V)
MP614B	50 Ω ↔ 75 Ω Impedance Transformer
J0121	Coaxial cord (NC-P-3W · 3C-2WS · NC-P-3W), 1 m
J0308	Coaxial cord (BNC-P · 3C-2WS · NC-P-3W), 1 m
J0063	Fixed attenuator for high power (30 dB, 10 W, DC to 12.4 GHz)
J0395	Fixed attenuator for high power (30 dB , 30 W, DC to 9 GHz)
MP640A	Branch
MP654A	Branch
MP520A	CM Directional Coupler
MP520B	CM Directional Coupler
MP520C	CM Directional Coupler
MP520D	CM Directional Coupler
MP526A	High Pass Filter
MP526B	High Pass Filter
MP526C	High Pass Filter
MP526D	High Pass Filter
MP526G	High Pass Filter
MA1601A	High Pass Filter (800/900 MHz band, N)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
J0742A	RS-232C cable, 1 m [for PC-98 Personal Computer and VP-600, D-sub 25 pins (straight)]
J0743A	RS-232C cable, 1 m [for AT compatible, D-sub 9-pins (cross)]
60N50-1	Reflection bridge
60NF50-1	Reflection bridge
87A50	Reflection bridge
62N75	Reflection bridge
62NF75	Reflection bridge
MH648A	Pre-Amplifier
MP534A	Dipole Antenna
MP651A	Dipole Antenna
BBA9106/VHA9103	Biconical Antenna
MP635A	Log-Periodic Antenna
MP666A	Log-Periodic Antenna
MB9A	Tripod
MB19A	Tripod
MA2601B	EMI Probe
MA2601C	EMI Probe
KT-10	EMI Clamp
KT-20	EMI Clamp

SIGNAL ANALYZER
MS2781A Signature™
100 Hz to 8 GHz

GPIB

A New Plateau in Signal Analysis for Providing Exceptional Engineering Insight into Wireless Communication Products.

NEW

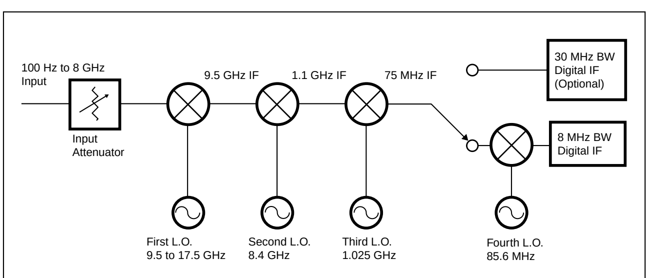


The MS2781A, Signature High Performance Signal Analyzer, is a combined high performance spectrum analyzer and a high performance vector signal analyzer. Signature expands the ability to analyze digitally modulated RF signals by offering seamless connectivity with MATLAB® and Simulink® from The MathWorks. Engineers can view measurement results through custom MATLAB and Simulink analysis giving exceptional insight into the performance of new designs. Signature can help make tomorrows communications systems a reality today.

Features
- Fundamentally mixed, single band architecture covers 100 Hz to 8 GHz.
- Capture and analyze complex modulated signals with up to 30 MHz bandwidth.
- Windows® XP Professional environment for ease-of-use and exceptional connectivity
- MATLAB® connectivity allow simultaneous analysis with measurement

Performance and functions
100 Hz to 8 GHz

The 100 Hz to 8 GHz frequency range is covered in one band as illustrated in the RF block diagram. This one-band approach improves performance. Resolution bandwidths ranging from 0.1 Hz to 8 MHz support improved sensitivity and demodulation of wideband signals.

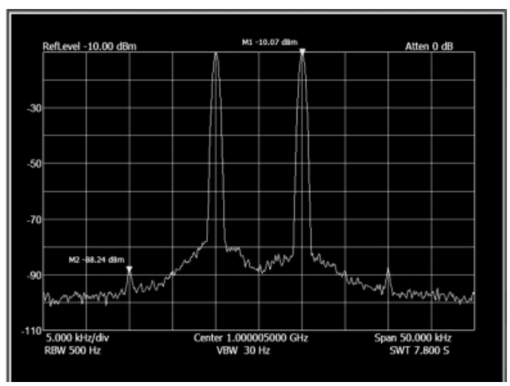


30 MHz Modulation Capture Bandwidth

Option 22 provides a 30 MHz capture bandwidth to allow vector signal analysis on wideband signals such as 802.16.

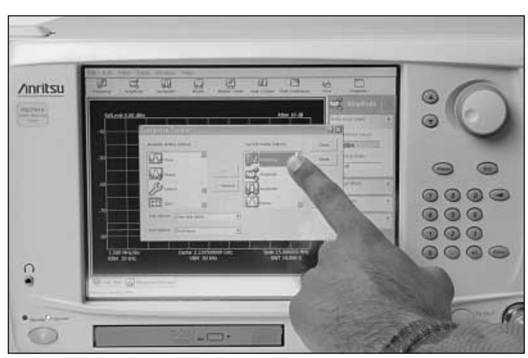
+23 dBM TOI and –145 dBm DANL

+23 dBm Third Order Intercept (TOI) performance and –145 dBm Displayed Average Noise Level (DANL) support intermodulation measurements on high performance devices such as multi-carrier power amplifiers.



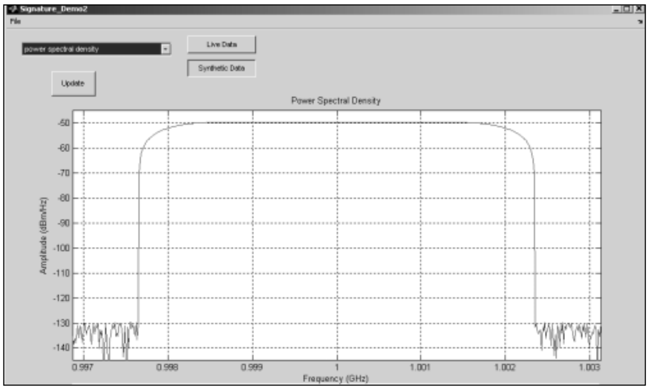
Open Windows XP

The fully functional, built-in, open Windows PC and Windows XP user interface makes the MS2781A easy to connect with and easy to use.



MATLAB Connectivity

Option 40, MATLAB connectivity, makes it possible to view custom analysis with measurements.



30 MHz Modulation Capture Bandwidth (Option 22)

Option 22 allows single FFT spectrum and I-Q vector measurements to 30 MHz and enables vector signal analysis capability (Option 38). Baseband differential I & Q inputs are also added.

Fully Integrated Vector Signal Analysis (Option 38)

Option 38, QAM/PSK Modulation Analysis, allows you to select the symbol rate, modulation type, and filtering to demodulate captured signals. Measurements include EVM, carrier leakage, and I-Q imbalance. Symbol table, constellation and vector diagrams enhance viewing of measurement results.

Integrated Compatibility with Industry-Leading Simulation Tools

Signature expands the ability to analyze RF signals with industry-leading simulation and analysis tools from The MathWorks. A 30 day free evaluation version of MATLAB is available with Signature along with example applications. See http://www.mathworks.com/anritsu for details. The MathWorks products provide analysis, visualization and modeling tools.

Specifications

The specifications presented are covered by the product warranty unless indicated as typical or nominal. Specifications apply over the 0 to 50°C operating range, and after a 30 minute warm up at ambient temperature, unless otherwise noted. Typical specifications describe expected performance beyond the warranted values. Characteristics or nominal specifications describe expected product performance as designed or performance that may not be measured in the manufacturing process.

Frequency	Frequency Range	100 Hz to 8 GHz
	Bands (Architecture)	Single-band, fundamentally mixed, image free
	Center Frequency Resolution	1 Hz
	Frequency Span Range	10 Hz to 8 GHz, 0 Hz
	Frequency Span Accuracy	0.3% of span, 1.2% for 33 MHz <span ≤80 MHz, 1.0 % for span*1
	Frequency Span Resolution	1 Hz
	Frequency Readout Accuracy	± marker freq * reference accuracy + span accuracy + 5% * RBW + 0.5 * last digit
	Resolution Bandwidth (RBW)	RBW Range: 10 Hz to 8 MHz (1/2/3/5) RBW shape factor (60 dB/3 dB), nominal: 4.6 RBW accuracy: 10 Hz-2 MHz: 5% 3 MHz-5 MHz: 10%
	Modulation Capture Bandwidth (with Option 22)	30 MHz
	FFT RBWs	0.1 Hz to 100 kHz (1,2,3,5)
	Maximum Span for FFT	Standard: 1 MHz With Option 22: 30 MHz
	FFT Span/RBW	10 to 10k
	Video Bandwidth (VBW)	1 Hz to 10 MHz (1/2/3/5)
	SSB Phase Noise (dBc/Hz @ 1 GHz)	100 Hz offset <–80, –86 Typical 1 kHz offset <–106 10 kHz offset <–114 100 kHz offset <–115 1 MHz offset <–136 5 MHz offset <–140
	Residual FM	<1 Hz in 1 second, nominal
	Reference Oscillator aging rate	5x10^{-10}/day; 1x10^{-7}/year
	Reference Oscillator temperature drift	5x10^{-9} over 0 to 50°C

Continued on next page

Amplitude	Intermodulation Distortion	Third-Order Intercept (TOI)	<100 MHz: >19 dBm ≥100 MHz: >23 dBm, >27 dBm typical
		Second Harmonic Intercept	>+38 dBm
		1 dB compression point	+10 dBm
	Noise	Displayed Average Noise Level (DANL)[*6]	10 MHz to 2.5 GHz: <–147 dBm 2.5 GHz to 7 GHz: <–145 dBm 7 GHz to 8 GHz: <–143 dBm
		Noise Figure	<29 dB typical @ 1 GHz
	Amplitude Uncertainty	Absolute Amplitude Accuracy (20 to 30°C)	Amplitude Uncertainty at 50 MHz[*2]: <0.1 dB Frequency Response at 10 dB Attenuation: <0.4 dB Frequency Response from Attenuator Switching: ≤3 GHz: <0.4 dB >3 GHz: <0.6 dB Additional Frequency Response in FFT mode: <0.15 dB Reference Level Switching Uncertainty: Without Attenuator Changes: 0.2 dB With Attenuator Changes: 0.25 dB RBW Switching Uncertainty (RBW ≤3 MHz): <0.1 dB Log Fidelity (<–10 dBm mixer level[*4], 0 to 80 dB below reference level, signal to noise >25 dB): <0.07 dB VSWR (>10 dB attenuation): ≤3 GHz: <1.3 >3 GHz: <1.5
		Combined Amplitude Accuracy (95% confidence)[*3]	<0.91 dB
	Ranges	Reference Level Range	–150 to +30 dBm in 0.01 dB steps
		Max Average power (10 dB attn.) w/o damage	+30 dBm
		Input Attenuator Range	0 to 62 dB, 2 dB steps
		Displayed Dynamic Range	120 dB typical
	Spurious	Spurious Responses (–10 dBm mixer level, span ≤3 MHz)	f <300 kHz from carrier, –70 dBc f ≥300 kHz from carrier, –80 dBc,
		Residual Responses (≥10 MHz)	<–95 dBm
		Image Rejection	<–70 dBc; <–100 dBc typical
		IF Rejection	<–70 dBc; <–100 dBc typical
	Other Amplitude Related	Calibrator Frequency	50 MHz, internal connection
		Amplitude axis units	dBm
Sweep	Trigger source(s)		Free run, Line, Ext (±10 V @ 10 kΩ), TTL, Video, Wideband IF power
	Frequency domain sweep time		Span ≤4 GHz: 8 ms to 10000 seconds Span >4 GHz: 16 ms to 10000 seconds
	Time domain (zero span) sweep time		100 µsec to 10000 seconds
	Sweep time accuracy		Span = 0 Hz: 0.1% Span > 0 Hz (Swept): 1%
Display	Detector Modes		Auto, Normal, Max Peak, Min Peak, RMS, Average, Sample (available simultaneously on a single graph)
	Trace functions		Normal, View, Max Hold, Min Hold, Average, Blank
	Traces per graph		Up to 5
Marker	Markers		Normal, Delta, Display Line
	Marker frequency resolution		0.2% of span
	Marker amplitude resolution		0.01 dB
	Marker functions		Marker to peak, …to center, …to reference level, ...to next peak.
	Peak functions		Peak to center, peak to reference level

Continued on next page

"Smart" Signal Analyzer Measurements	Channel Power	Standards Measured W-CDMA, user defined
	Occupied Bandwidth	Frequency accuracy ± Span / 500 Nominal
	Adjacent Channel Power Ratio (ACPR)	Standards Measured W-CDMA, user defined Offsets measured Up to 6 Dynamic Range(typical)*5: W-CDMA, 5 MHz offset –80 dB W-CDMA, 10 MHz offset –82 dB
	Third-order intercept (TOI)	Measure third order products and intercepts from two tones
Internal PC Functionality	Interfaces	USB (1.1), Ethernet (10BASE-T/100BASE-TX), VGA, Parallel printer
	USB Functionality	USB access to printers, CDs, disks, cameras, memory devices
	Internal Hard Disk Drive Removable Media Drive	>20 GB, "Restore" partition on internal Hard Disk Drive CD R/W + DVD-ROM
GPIB Interface (Option3)	SH1, AH1, T6, SR1, RL1, PP0, DC1, C0 or C1	
30 MHz Demodulation BW (Option 22)	Complex modulated signals with up to 30 MHz bandwidth can be captured and analyzed. Also includes baseband differential I & Q inputs. Option 22 must be factory installed and calibrated.	
	Max FFT Span	30 MHz
	Modulation analysis BW (Requires Option 38)	30 MHz
	I-Q inputs	30 MHz combined BW
QAM/PSK Modulation Analysis (Option 38, Requires Option 22)	Modulation analysis BW	30 MHz
	Symbol Rate Range	10 kHz to 20 MHz
	Modulation Formats	QPSK, π/4DQPSK, 8PSK, 3π/8-8PSK, 16QAM, 64QAM
	Filtering	Root-raised-cosine, α=0.1 to 1
	Displays	Constellation, Vector Diagram, EVM vs. Time, Eye Diagram
Connectivity to MATLAB (Option 40)	Allows seamless transfer of Signature measurements and setup information into the MATLAB workspace. Simulink® can access this information via the "To Workspace" and "From Workspace" blocks. Allows viewing of MATLAB, superimposed on the Signature measurement display. MATLAB results may be set to automatically update with current measurements. MATLAB (version R14 or greater) must be purchased from The MathWorks (www.mathworks.com).	
	Signature measurements transfered to MATLAB	Traces IQ vectors
General Specifications	Power Requirements	AC 85-264 VAC, 47-63 Hz Power Consumption 400 VA operating 30 VA standby
	Display	26.6 cm (10.4 inches) XGA Color with touch screen
	Weight	< 32 kg (70 lbs)
	Dimensions	242 H x 432 W x 508 mm D (9.5 H x 17 W x 20 D in.)
	Warranty	3 years
	Calibration Interval	1 year
	Temperature Range	Operating Temperature Range: 0 to +50°C Storage Temperature Range: –40 to +75°C
	EMI Compatibility	Meets the emission and immunity requirements of: EN61326: 1998 EN55011: 1998 / CISPR 11: 1997 Group 1 Class A EN61000-3-2: 1995 + A14 EN61000-3-3: 1995 EN61000-4-2: 1995 – 4kV CD, 8kV AD EN61000-4-3: 1997 – 3V/m EN61000-4-4: 1995 – 0.5kV SL, 1kV PL EN61000-4-5: 1995 – 0.5kV DM, 1kV CM EN61000-4-6: 1996 – 3V EN61000-4-11: 1994 – 100%/1 cycle
	Safety	Meets safety requirements of Low Voltage/SafetyStandard 72/73/EEC – EN61010-1: 2001

Continued on next page

Rear Panel Inputs and Outputs	Front Panel Inputs and Outputs	RF Input	Type-N Female, 50Ω
		Probe Power	+15 V ± 7%/130 mA, –12.6 V ± 10%/45 mA
		Touch Screen display	Contact sensitive
		Keys	Preset, Menu keys, Help key, Measurement key, Numerical entry pad, Entry Knob, Increment/decrement keys, Operate/Standby
		CD R/W + DVD-ROM	
		USB	2 ports, Type A, Version 1.1
	Rear Panel Inputs and Outputs	Power Supply Input Voltage	85-264 VAC; 47 to 63 Hz
		AC power switch	Mains power switch
		Wide Bandwidth Log Video output	2.5 V nominal, full scale into 50Ω
		IF output #1	Frequency 75 MHz nominal Level (–10 dBm @ 1st mixer) –8 dBm ± 3 dB BW > 40 MHz
		IF output #2	Frequency 10.7 MHz Level (–10 dBm @ 1st mixer) –8 dBm ± 3 dB BW Varies with RBW, 3 kHz min, 8 MHz max
		IF Input	Not used
		Reference frequency Input	Input level –6 dBm < Input signal > +10 dBm Frequency Any frequency from 1 to 25 MHz with 1 MHz resolution
		Reference frequency Output	Output level 8 dBm ± 3 dB If external reference not used: 10 MHz If external reference used: Same as external reference frequency
		Sweep Status Output	TTL, active low when sweeping
		GPIB	See option description
		Ethernet	10BASE-T, 100 BASE-TX
		External Trigger Input	BNC
		VGA Monitor Output	Matches instrument front panel display resolution
		I and Q inputs (Opt 22)	50 or 1 MΩ, unbalanced or differential switchable, 1 volt max
		Sweep Output	Not used
		USB	Type A plug, Version 1.1
		Keyboard	PS2
		Mouse	PS2
		Parallel Printer Port	ECP

*1: For swept spectrum measurements
*2: 50 MHz, 0 dBm input, Source VSWR <1.1, 10 dB input attenuation, 30 kHz RBW, +1 dBm reference level
*3: 95 % Confidence Amplitude Error Calculation, (CW Signals, 20 to 30°C) 95% confidence level is determined by rss combination of the individual standard errors. Uniform distribution is used for all contributors except VSWR error. U-shaped distribution is used for VSWR error.

	Error Specification (dB)	σ
Amplitude Uncertainty at 50 MHz [dB]	0.1	0.06
Frequency Response at 10 dB Attenuation [dB]	0.4	0.23
Frequency Response from Attenuator Switching [dB]	0.6	0.34
Reference Level Switching Uncertainty with Attenuator Changes [dB]	0.25	0.14
RBW Switching Uncertainty [dB]	0.15	0.09
Log Fidelity [dB] 0.07 0.04		
VSWR 1.5 Error (DUT VSWR 1.2)	0.15	0.11
RSS Combined Errors		0.47
95% Confidence Level for Combined Errors (Combined Errors * 1.96)		0.91

*4: Mixer level = signal level minus input attenuation
*5: Swept, with noise compensation on, (ref document 3GPP TS 25.141, test model 1, 2.14 GHz)
*6: RBW = 1 Hz, FFT mode, 0 dB attenuation, average detector

Go to www.us.anritsu.com/signature for details.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS2781A	High Performance Signal Analyzer (100 Hz to 8 GHz)	
	Standard Accessories	
	Power Cord	1pc
10920-00047	Operating Manual on CD-ROM	1pc
60004	Restore software DVD-ROM	1pc
2000-1389	USB Optical Mouse	1pc
970-635	Blank CD R/W disc	1pc
631-73	Spare Fuse	1pc
	Options	
MS2780/1	Rack Mount Adapter	
MS2780/1A	Slide Mount Adapter	
MS2780/3	GPIB Interface	
MS2780/22	30 MHz Demodulation Bandwidth (includes baseband differential I & Q inputs)	
MS2780/38	QAM/PSK modulation analysis (requires Option 22)	
MS2780/40	Connectivity to MATLAB	

Model/Order No.	Name
	Optional Accessories
10410-00252	Signature Operation Manual
10410-00253	Signature Programming Manual
10410-00256	Signature Maintenance Manual
1N50B	Limiter/DC Block, N(m), to N(f), 50Ω,1 MHz to 3 GHz.
1N50C	Limiter, N(m) to N(f), 50Ω, 10 MHz to 18 GHz
42N50A-30	30 dB Attenuator, 50 Watt N(m) to N(f)
12N50-75B	75Ω Matching Pad, DC to 3 GHz, 50Ω N(m) to 75Ω N(f)
11N50B	Power Divider, 1 MHz to 3 GHz, 50Ω, N(f) input, N(f) output
2100-1	GPIB Cable 1M
2100-2	GPIB Cable 2M

SPECTRUM MASTER

MS2721A

100 kHz to 7.1 GHz

High Performance Handheld Spectrum Analyzer

NEW

6

The MS2721A is the first handheld spectrum analyzer to deliver the ability to measure very low level signals with a displayed average noise level of ≤ -153 dBm typical @ 1 GHz in a 10 Hz RBW. Coupled with a wide range of resolution bandwidth choices, you can configure the Spectrum Master to meet your most challenging measurement needs. As the spectrum becomes more and more congested, the ability to measure low level, closely spaced signals becomes more and more important not only for interference detection but also for wireless system planning.

Operating convenience is of paramount importance when equipment is used in the field. The input attenuation value can be tied to the reference level, reducing the number of parameters a field technician may have to set. The RBW/VBW and the span/RBW ratios can be set to values that are best for the measurements being made, further easing the technician's burden and reducing the chances of errors. Thousands of traces with names up to 15 characters long may be saved in the 64 MB non-volatile compact flash memory. These traces can later be copied into a PC using the built-in USB 2.0 connector or the 10/100 MHz Ethernet connection, or by copying them to an external Compact Flash card. The MS2721A Spectrum Master has a very wide dynamic range (>80 dB), allowing measurement of very small signals in the presence of much larger signals.

Resolution bandwidth and video bandwidth can be independently set to meet a user's measurement needs. In addition, the input attenuator value can be set by the user and the preamplifier can be turned on or off as needed. For maximum flexibility, sweep triggering can be set to free run, or to do a single sweep.

Light Weight

Weighing about six pounds, including a Li-Ion battery, this fully functional handheld spectrum analyzer is light enough to take anywhere, including up a tower.

With the supplied Remote Access Software you can control an MS2721A that is miles away, seeing the screen display and operating with an interface that looks exactly like the instrument itself.

The MS2721A features eight languages English, Spanish, German, French, Japanese, Chinese, Italian and Korean, plus two custom, user defined languages can be uploaded into the instrument using Master Software Tools, supplied with the instrument.

Fast Sweep Speed

The MS2721A can do a full span sweep in ≤900 milliseconds, and sweep speed in zero span can be set from less than 50 microseconds up to over 4000 seconds. This is faster and more flexible than any portable spectrum analyzer on the market today, simplifying the capture of intermittent interference signals.

+43 dBm Maximum Safe Input Level

Because the MS2721A can survive an input signal of +43 dBm – 20 Watts – without damage, you can rest assured that the MS2721A can survive in even the toughest RF environments.

Spectrum Monitoring

A critical function of any spectrum analyzer is the ability to accurately view a portion of the RF and microwave spectrum. The MS2721A performs this function admirably thanks to the wide frequency range and excellent dynamic range. A built-in 64 MB compact flash memory module allows over 2000 traces to be stored. An external compact flash socket allows additional compact flash memory to expand the trace storage without limit.

Multiple Markers

Display up to six markers on screen, each with delta marker capability. In addition you may select a marker table that simultaneously shows the status of all markers. In the table you can see the frequency, and amplitude measurement value for all markers along with delta frequency and delta amplitude. Each marker can have not only a measurement reference frequency but also a delta frequency and delta amplitude, effectively giving you up to twelve markers if you need them!

Noise Markers

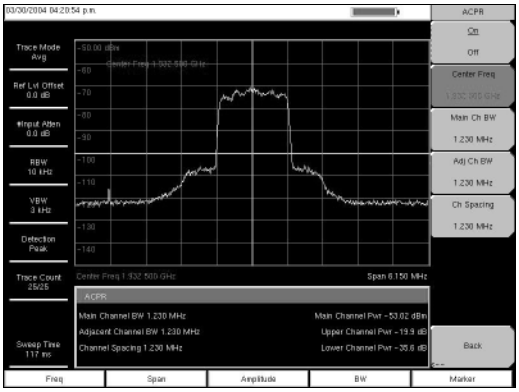
The capability to measure noise level in terms of dBm/Hz or dBµV/Hz is a standard feature of the MS2721A.

Frequency Counter Markers

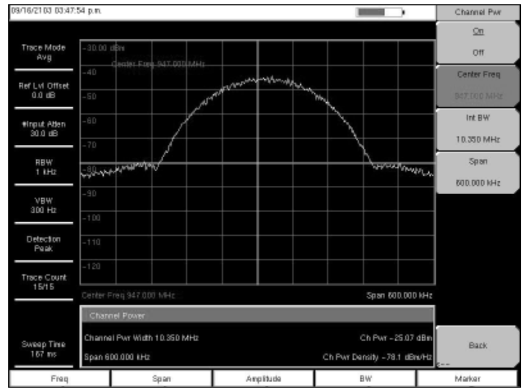
The MS2721A Spectrum Master has frequency counter markers with resolution to 1 Hz. Tie this capability to an external precision time base to get complementary accuracy and resolution.

Smart Measurements

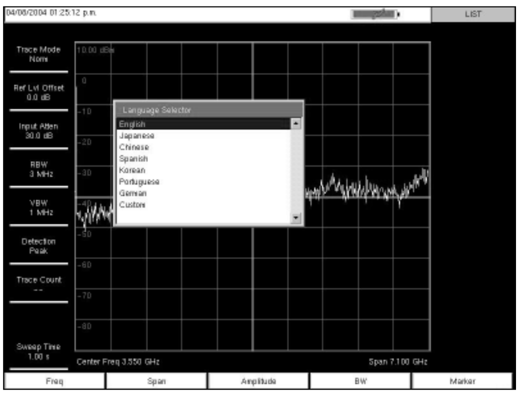
The MS2721A has dedicated routines for smart measurements of field strength, channel power, occupied bandwidth, Adjacent Channel Power Ratio (ACPR) and C/I.



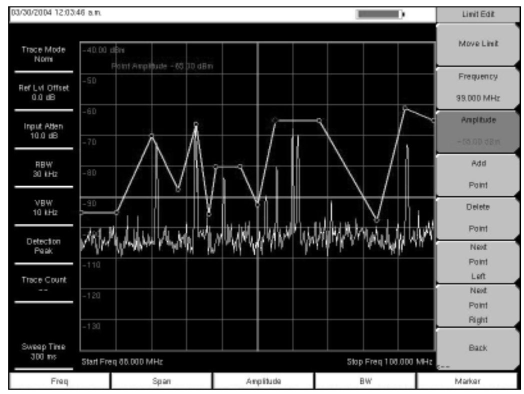
Adjacent Channel Power Ratio



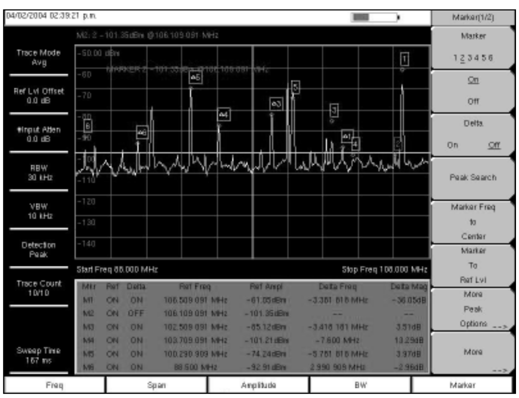
Measurement of Channel Power for a GSM Signal



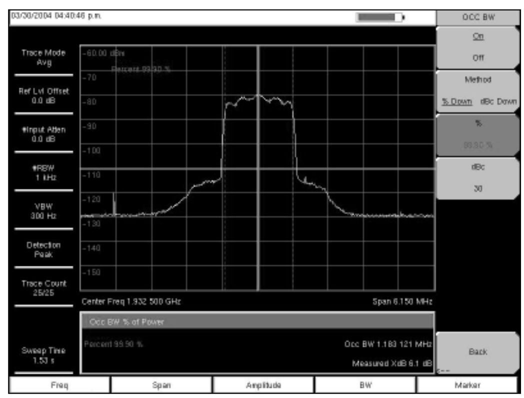
Multiple Language Support



Segmented Limit Line



Multiple Markers plus Multiple Delta Markers



Occupied Bandwidth

Specifications

Frequency	Frequency Range	100 kHz to 7.1 GHz (useable to 9 kHz)
	Tuning resolution	1 Hz
	Frequency Reference	Aging ±1 ppm/year Accuracy ±1 ppm (25°C ± 25°C) + long term drift
	Frequency Span	10 Hz to 7.1 GHz plus 0 Hz (zero span)
	Span Accuracy	Same as frequency reference accuracy
	Sweep Time minimum	100 ms, 50 µs in zero span
	Sweep Time Accuracy	± 2% in zero span
	Sweep Trigger	Free run, Single, Video, External
	Resolution Bandwidth (-3 dB width)	10 Hz to 3 MHz in 1-3 sequence ± 10% , 8 MHz demodulation bandwidth
	Video Bandwidth (-3 dB)	1 Hz to 3 MHz in 1-3 sequence
	SSB Phase Noise	-100 dBc/Hz max at 10, 20 & 30 kHz offset from carrier -102 dBc/Hz max at 100 kHz offset from carrier

Continued on next page

Amplitude	Measurement Range	DANL to +30 dBm
	Absolute amplitude accuracy (Power levels ≥-50 dBm, ≤35 dB input attenuation, preamp off)	100 kHz to ≤ 10 MHz ±1.5 dB >10 MHz to 4 GHz ±1.25 dB >4 GHz to 7.1 GHz ±1.75 dB
	Second Harmonic Distortion (0 dB input attenuation, -30 dBm input)	-50 dBc, 0.05 to 0.75 GHz -40 dBc, >0.75 to 1.05 GHz -50 dBc, >1.05 to 1.4 GHz -70 dBc, >1.4 to 2 GHz -80 dBc, > 2 GHz
	Third Order Intercept (TOI) (preamplifier off)	Frequency Typical 50 MHz to 300 MHz >8 dBm >300 MHz to 2.2 GHz >10 dBm >2.2 GHz to 2.8 GHz >15 dBm >2.8 GHz to 4.0 GHz >10 dBm >4.0 GHz to 7.1 MHz >13 dBm
	Displayed Average Noise Level DANL in 10 Hz RBW, dBm	Frequency Preamp On Typical Max 10 MHz to 1 GHz -153 dBm -151 dBm >1 GHz to 2.2 GHz -150 dBm -149 dBm >2.2 GHz to 2.8 GHz -146 dBm -143 dBm >2.8 GHz to 4.0 GHz -150 dBm -149 dBm >4.0 GHz to 7.1 GHz -148 dBm -146 dBm
	Noise Figure (Derived from DANL measurement) 0 dB attenuation, reference level -50 dBm, 23°C, preamplifier on	Frequency Typical 10 MHz to 1.0 GHz 11 dB >1 GHz to 2.2 GHz 14 dB >2.2 GHz to 2.8 GHz 18 dB >2.8 GHz to 4.0 GHz 14 dB >4.0 GHz to 7.1 GHz 16 dB
	Display Range	1 to 15 dB/div in 1 dB steps. Ten divisions displayed.
	Amplitude Units	Log Scale modes dBm, dBV, dBmv, dBµV
	Linear Scale Modes	nV, µV, mV, V, kV, nW, µW, mW, W, kW
	Attenuator range	0 to 65 dB
	Attenuator resolution	5 dB steps
	Input-Related Spurious	-60 dBc max*, (<-70 dBc typical), -30 dBm input, 0 dB RF attenuation *Exceptions: Input frequency Spur Level 1674 MHz -46 dBc max (-56 dBc typical), 0 to 2800 MHz >1674 to 1774 MHz -50 dBc max (-60 dBc typical) at (Finput – 1674 MHz) >1774 to 2900 MHz -48 dBc max (-68 dBc typical) at (Finput – 1674 MHz)
	Residual Spurious, preamp off	(RF input terminated, 0 dB RF attenuation) -90 dBm max**, 100 kHz to <3200 MHz -84 dBm max**, 3200 to 7100 MHz **Exceptions: Frequency Spur Level 250, 300 & 350 MHz -85 dBm max ~4010 MHz -80 dBm max (-90 dBm typical) ~5084 MHz -70 dBm max (-83 dBm typical) ~5894 MHz -75 dBm max (-87 dBm typical) ~7028 MHz -80 dBm max (-92 dBm typical)
	Residual Spurious, preamp on:	-100 dBm max (RF input terminated, 0 dB RF attenuation)
General	Maximum Continuous Input	≥10 dB attenuation, +30 dBm
	Input Damage Level	≥10 dB attenuation, >+43 dBm, ±50 Vdc <10 dB attenuation, >+23 dBm, ±50 Vdc
	RF Input VSWR	2.0:1 maximum, 1.5:1 typical (≥10 dB attenuation)
	Reference Level	Adjustable over amplitude range
	ESD Damage Level	>10 kV ≥10 dB attenuation
	Functions	Multiple Marker Display up to six markers on screen, each marker includes a delta marker. Marker Table Display a table of up to six marker frequency and amplitude values plus delta marker frequency offset and amplitude. Upper & Lower Limit Lines Each upper and lower limit can contain up to 40 segments.

6

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS2721A	Handheld Spectrum Analyzer: 100 kHz to 7.1 GHz
	Standard Accessories
10580-00103	MS2721A User's Guide
61382	MS2721A Soft Carrying Case
2300-498	Master Products Software Tools Program CD ROM
633-44	Rechargeable Li-Ion Battery
40-168	AC-DC Adapter
806-62	Automotive Cigarette Lighter 12 Volt DC Adapter
2000-1360	USB A/mini-B Cable
2000-1371	Ethernet Cable, 7 feet (213 cm)
1091-27	Type-N male to SMA female Adapter
1091-172	Type-N male to BNC female Adapter
	Optional Accessories
42N50A-30	30 dB, 50W, Bi-dir., DC-18 GHz, N(m) to N(f) Attenuator
34NN50A	Precision Adapter, DC to 18 GHz, 50 , N(m) to N(m)
34NFNF50C	Precision Adapter, DC to 18 GHz, 50 , N(f) to N(f)
15NNF50-1.5B	Test port cable armored, 1.5 meter, N(m) to N(f), 18.0 GHz
15NNF50-1.5B	Test port cable, armored, 1.5 meter N(m) to N(f) 18 GHz
15NN50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(m), 6 GHz
15NN50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(m), 6 GHz
15NN50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(m), 6 GHz
15NNF50-1.5C	Test port cable armored, 1.5 meter, N(m) to N(f), 6 GHz
15NNF50-3.0C	Test port cable armored, 3.0 meter, N(m) to N(f), 6 GHz
15NNF50-5.0C	Test port cable armored, 5.0 meter, N(m) to N(f), 6 GHz
15ND50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(m), 6.0 GHz
15NDF50-1.5C	Test port cable armored, 1.5 meter, N(m) to 7/16 DIN(f), 6.0 GHz

Model/Order No.	Name
510-90	Adapter, 7/16 DIN (f) to N(m), DC to 7.5 GHz, 50Ω
510-91	Adapter, 7/16 DIN (f)-N(f), DC to 7.5 GHz, 50Ω
510-92	Adapter, 7/16 DIN (m)-N(m), DC to 7.5 GHz, 50Ω
510-93	Adapter, 7/16 DIN(m)-N(f), DC to 7.5 GHz, 50Ω
510-96	Adapter 7/16 DIN (m) to 7/16 DIN (m), DC to 7.5 GHz, 50Ω
1030-86	Band Pass Filter, 800 MHz band, 806-869 MHz, Loss = 1.7 dB, N(m)-SMA(f)
1030-87	Band Pass Filter, 900 MHz band, 902-960 MHz, Loss =1.7 dB, N(m)-SMA(f)
1030-88	Band Pass Filter, 1900 MHz band, 1.85-1.99 GHz, Loss =1.8 dB, N(m)-SMA(f)
1030-89	Band Pass Filter, 2400 MHz band, 2.4-2.5 GHz, Loss =1.9 dB, N(m)-SMA(f)
510-97	Adapter 7/16 DIN (f) to 7/16 DIN (f), 7.5 GHz
61382	Spare Soft Carrying Case
40-168	Spare AC/DC Adapter
806-62	Spare Automotive Cigarette Lighter 12 Volt DC Adapter
760-229	MS2721A Transit Case
2300-498	Master Software Tools Program CD ROM
10580-00103	Anritsu User's Guide, Model MS2721A
10580-00104	Anritsu Programming Manual, Model MS2721A
10580-00105	Anritsu Maintenance Manual, Model MS2721A
633-44	Rechargeable battery, Li-Ion
2000-1374	Dual Battery charger, Li-Ion with universal power supply
2000-1030	Portable antenna, 50Ω, SMA (m) 1.71-1.88 GHz
2000-1031	Portable antenna, 50Ω, SMA (m) 1.85-1.99 GHz
2000-1032	Portable antenna, 50Ω, SMA (m) 2.4-2.5 GHz
2000-1035	Portable antenna, 50Ω, SMA (m) 896-941 MHz
2000-1200	Portable antenna, 50Ω, SMA (m) 806-869 MHz
2000-1361	Portable Antenna, 50Ω, SMA (m) 5725-5825 MHz
2000-1358	64 MB Compact Flash Memory Module

SIGNAL ANALYZERS

SIGNAL ANALYZER
MS2781A Signature™
100 Hz to 8 GHz

CE GPIB

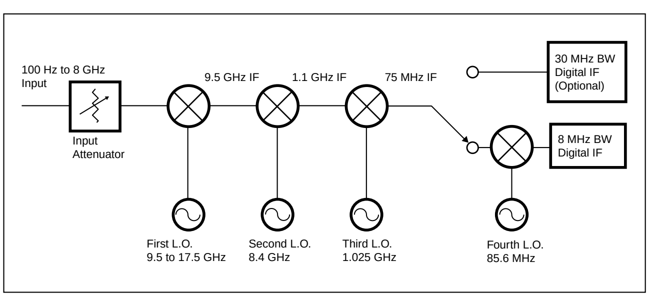
A New Plateau in Signal Analysis for Providing Exceptional Engineering Insight into Wireless Communication Products.

NEW

The MS2781A, Signature High Performance Signal Analyzer, is a combined high performance spectrum analyzer and a high performance vector signal analyzer. Signature expands the ability to analyze digitally modulated RF signals by offering seamless connectivity with MATLAB® and Simulink® from The MathWorks. Engineers can view measurement results through custom MATLAB and Simulink analysis giving exceptional insight into the performance of new designs. Signature can help make tomorrows communications systems a reality today.

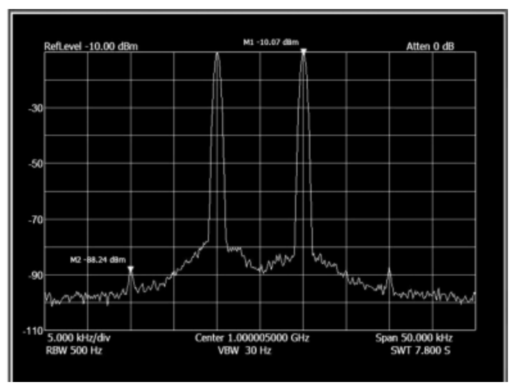
Features
- Fundamentally mixed, single band architecture covers 100 Hz to 8 GHz.
- Capture and analyze complex modulated signals with up to 30 MHz bandwidth.
- Windows® XP Professional environment for ease-of-use and exceptional connectivity
- MATLAB® connectivity allow simultaneous analysis with measurement

Performance and functions
100 Hz to 8 GHz
The 100 Hz to 8 GHz frequency range is covered in one band as illustrated in the RF block diagram. This one-band approach improves performance. Resolution bandwidths ranging from 0.1 Hz to 8 MHz support improved sensitivity and demodulation of wideband signals.

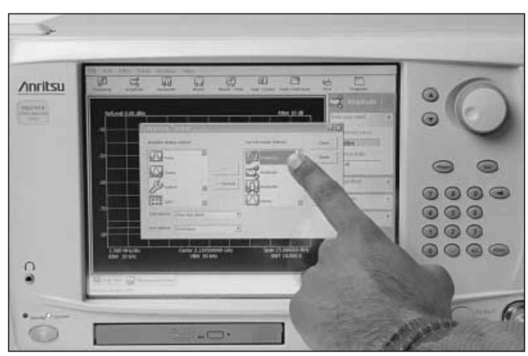


30 MHz Modulation Capture Bandwidth
Option 22 provides a 30 MHz capture bandwidth to allow vector signal analysis on wideband signals such as 802.16.

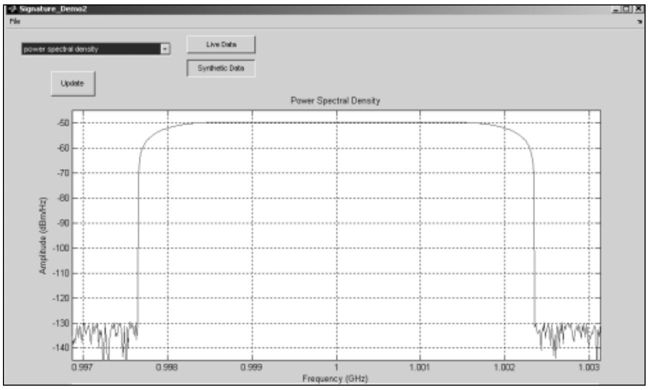
+23 dBM TOI and –145 dBm DANL
+23 dBm Third Order Intercept (TOI) performance and –145 dBm Displayed Average Noise Level (DANL) support intermodulation measurements on high performance devices such as multi-carrier power amplifiers.



Open Windows XP
The fully functional, built-in, open Windows PC and Windows XP user interface makes the MS2781A easy to connect with and easy to use.



MATLAB Connectivity
Option 40, MATLAB connectivity, makes it possible to view custom analysis with measurements.



30 MHz Modulation Capture Bandwidth (Option 22)
Option 22 allows single FFT spectrum and I-Q vector measurements to 30 MHz and enables vector signal analysis capability (Option 38). Baseband differential I & Q inputs are also added.

Fully Integrated Vector Signal Analysis (Option 38)
Option 38, QAM/PSK Modulation Analysis, allows you to select the symbol rate, modulation type, and filtering to demodulate captured signals. Measurements include EVM, carrier leakage, and I-Q imbalance. Symbol table, constellation and vector diagrams enhance viewing of measurement results.

Integrated Compatibility with Industry-Leading Simulation Tools

Signature expands the ability to analyze RF signals with industry-leading simulation and analysis tools from The MathWorks. A 30 day free evaluation version of MATLAB is available with Signature along with example applications. See http://www.mathworks.com/anritsu for details. The MathWorks products provide analysis, visualization and modeling tools.

Specifications

The specifications presented are covered by the product warranty unless indicated as typical or nominal. Specifications apply over the 0 to 50°C operating range, and after a 30 minute warm up at ambient temperature, unless otherwise noted. Typical specifications describe expected performance beyond the warranted values. Characteristics or nominal specifications describe expected product performance as designed or performance that may not be measured in the manufacturing process.

Frequency	Frequency Range	100 Hz to 8 GHz
	Bands (Architecture)	Single-band, fundamentally mixed, image free
	Center Frequency Resolution	1 Hz
	Frequency Span Range	10 Hz to 8 GHz, 0 Hz
	Frequency Span Accuracy	0.3% of span, 1.2% for 33 MHz <span ≤80 MHz, 1.0 % for span[*1]
	Frequency Span Resolution	1 Hz
	Frequency Readout Accuracy	± marker freq * reference accuracy + span accuracy + 5% * RBW + 0.5 * last digit
	Resolution Bandwidth (RBW)	RBW Range: 10 Hz to 8 MHz (1/2/3/5) RBW shape factor (60 dB/3 dB), nominal: 4.6 RBW accuracy: 10 Hz-2 MHz: 5% 3 MHz-5 MHz: 10%
	Modulation Capture Bandwidth (with Option 22)	30 MHz
	FFT RBWs	0.1 Hz to 100 kHz (1,2,3,5)
	Maximum Span for FFT	Standard: 1 MHz With Option 22: 30 MHz
	FFT Span/RBW	10 to 10k
	Video Bandwidth (VBW)	1 Hz to 10 MHz (1/2/3/5)
	SSB Phase Noise (dBc/Hz @ 1 GHz)	100 Hz offset <–80, –86 Typical 1 kHz offset <–106 10 kHz offset <–114 100 kHz offset <–115 1 MHz offset <–136 5 MHz offset <–140
	Residual FM	<1 Hz in 1 second, nominal
	Reference Oscillator aging rate	5x10^{-10}/day; 1x10^{-7}/year
	Reference Oscillator temperature drift	5x10^{-9} over 0 to 50°C

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Amplitude	Intermodulation Distortion	Third-Order Intercept (TOI)	<100 MHz: >19 dBm ≥100 MHz: >23 dBm, >27 dBm typical
		Second Harmonic Intercept	>+38 dBm
		1 dB compression point	+10 dBm
	Noise	Displayed Average Noise Level (DANL)[*6]	10 MHz to 2.5 GHz: <–147 dBm 2.5 GHz to 7 GHz: <–145 dBm 7 GHz to 8 GHz: <–143 dBm
		Noise Figure	<29 dB typical @ 1 GHz
	Amplitude Uncertainty	Absolute Amplitude Accuracy (20 to 30°C)	Amplitude Uncertainty at 50 MHz[*2]: <0.1 dB Frequency Response at 10 dB Attenuation: <0.4 dB Frequency Response from Attenuator Switching: ≤3 GHz: <0.4 dB >3 GHz: <0.6 dB Additional Frequency Response in FFT mode: <0.15 dB Reference Level Switching Uncertainty: Without Attenuator Changes: 0.2 dB With Attenuator Changes: 0.25 dB RBW Switching Uncertainty (RBW ≤3 MHz): <0.1 dB Log Fidelity (<–10 dBm mixer level[*4], 0 to 80 dB below reference level, signal to noise >25 dB): <0.07 dB VSWR (>10 dB attenuation): ≤3 GHz: <1.3 >3 GHz: <1.5
		Combined Amplitude Accuracy (95% confidence)[*3]	<0.91 dB
	Ranges	Reference Level Range	–150 to +30 dBm in 0.01 dB steps
		Max Average power (10 dB attn.) w/o damage	+30 dBm
		Input Attenuator Range	0 to 62 dB, 2 dB steps
		Displayed Dynamic Range	120 dB typical
	Spurious	Spurious Responses (–10 dBm mixer level, span ≤3 MHz)	f <300 kHz from carrier, –70 dBc f ≥300 kHz from carrier, –80 dBc,
		Residual Responses (≥10 MHz)	<–95 dBm
		Image Rejection	<–70 dBc; <–100 dBc typical
		IF Rejection	<–70 dBc; <–100 dBc typical
	Other Amplitude Related	Calibrator Frequency	50 MHz, internal connection
		Amplitude axis units	dBm
Sweep	Trigger source(s)	Free run, Line, Ext (±10 V @ 10 kΩ), TTL, Video, Wideband IF power	
	Frequency domain sweep time	Span ≤4 GHz: 8 ms to 10000 seconds Span >4 GHz: 16 ms to 10000 seconds	
	Time domain (zero span) sweep time	100 µsec to 10000 seconds	
	Sweep time accuracy	Span = 0 Hz: 0.1% Span > 0 Hz (Swept): 1%	
Display	Detector Modes	Auto, Normal, Max Peak, Min Peak, RMS, Average, Sample (available simultaneously on a single graph)	
	Trace functions	Normal, View, Max Hold, Min Hold, Average, Blank	
	Traces per graph	Up to 5	
Marker	Markers	Normal, Delta, Display Line	
	Marker frequency resolution	0.2% of span	
	Marker amplitude resolution	0.01 dB	
	Marker functions	Marker to peak, …to center, …to reference level, ...to next peak.	
	Peak functions	Peak to center, peak to reference level	

Continued on next page

"Smart" Signal Analyzer Measurements	Channel Power	Standards Measured W-CDMA, user defined
	Occupied Bandwidth	Frequency accuracy ± Span / 500 Nominal
	Adjacent Channel Power Ratio (ACPR)	Standards Measured W-CDMA, user defined Offsets measured Up to 6 Dynamic Range(typical)*5: W-CDMA, 5 MHz offset –80 dB W-CDMA, 10 MHz offset –82 dB
	Third-order intercept (TOI)	Measure third order products and intercepts from two tones
Internal PC Functionality	Interfaces	USB (1.1), Ethernet (10BASE-T/100BASE-TX), VGA, Parallel printer
	USB Functionality	USB access to printers, CDs, disks, cameras, memory devices
	Internal Hard Disk Drive Removable Media Drive	>20 GB, "Restore" partition on internal Hard Disk Drive CD R/W + DVD-ROM
GPIB Interface (Option3)	SH1, AH1, T6, SR1, RL1, PP0, DC1, C0 or C1	
30 MHz Demodulation BW (Option 22)	Complex modulated signals with up to 30 MHz bandwidth can be captured and analyzed. Also includes baseband differential I & Q inputs. Option 22 must be factory installed and calibrated.	
	Max FFT Span	30 MHz
	Modulation analysis BW (Requires Option 38)	30 MHz
	I-Q inputs	30 MHz combined BW
QAM/PSK Modulation Analysis (Option 38, Requires Option 22)	Modulation analysis BW	30 MHz
	Symbol Rate Range	10 kHz to 20 MHz
	Modulation Formats	QPSK, π/4DQPSK, 8PSK, 3π/8-8PSK, 16QAM, 64QAM
	Filtering	Root-raised-cosine, α=0.1 to 1
	Displays	Constellation, Vector Diagram, EVM vs. Time, Eye Diagram
Connectivity to MATLAB (Option 40)	Allows seamless transfer of Signature measurements and setup information into the MATLAB workspace. Simulink® can access this information via the "To Workspace" and "From Workspace" blocks. Allows viewing of MATLAB, superimposed on the Signature measurement display. MATLAB results may be set to automatically update with current measurements. MATLAB (version R14 or greater) must be purchased from The MathWorks (www.mathworks.com).	
	Signature measurements transfered to MATLAB	Traces IQ vectors
General Specifications	Power Requirements	AC 85-264 VAC, 47-63 Hz Power Consumption 400 VA operating 30 VA standby
	Display	26.6 cm (10.4 inches) XGA Color with touch screen
	Weight	< 32 kg (70 lbs)
	Dimensions	242 H x 432 W x 508 mm D (9.5 H x 17 W x 20 D in.)
	Warranty	3 years
	Calibration Interval	1 year
	Temperature Range	Operating Temperature Range: 0 to +50°C Storage Temperature Range: –40 to +75°C
	EMI Compatibility	Meets the emission and immunity requirements of: EN61326: 1998 EN55011: 1998 / CISPR 11: 1997 Group 1 Class A EN61000-3-2: 1995 + A14 EN61000-3-3: 1995 EN61000-4-2: 1995 – 4kV CD, 8kV AD EN61000-4-3: 1997 – 3V/m EN61000-4-4: 1995 – 0.5kV SL, 1kV PL EN61000-4-5: 1995 – 0.5kV DM, 1kV CM EN61000-4-6: 1996 – 3V EN61000-4-11: 1994 – 100%/1 cycle
	Safety	Meets safety requirements of Low Voltage/SafetyStandard 72/73/EEC – EN61010-1: 2001

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Rear Panel Inputs and Outputs	Front Panel Inputs and Outputs	RF Input	Type-N Female, 50Ω
		Probe Power	+15 V ± 7%/130 mA, –12.6 V ± 10%/45 mA
		Touch Screen display	Contact sensitive
		Keys	Preset, Menu keys, Help key, Measurement key, Numerical entry pad, Entry Knob, Increment/decrement keys, Operate/Standby
		CD R/W + DVD-ROM	
		USB	2 ports, Type A, Version 1.1
	Rear Panel Inputs and Outputs	Power Supply Input Voltage	85-264 VAC; 47 to 63 Hz
		AC power switch	Mains power switch
		Wide Bandwidth Log Video output	2.5 V nominal, full scale into 50Ω
		IF output #1	Frequency 75 MHz nominal Level (–10 dBm @ 1st mixer) –8 dBm ± 3 dB BW > 40 MHz
		IF output #2	Frequency 10.7 MHz Level (–10 dBm @ 1st mixer) –8 dBm ± 3 dB BW Varies with RBW, 3 kHz min, 8 MHz max
		IF Input	Not used
		Reference frequency Input	Input level –6 dBm < Input signal > +10 dBm Frequency Any frequency from 1 to 25 MHz with 1 MHz resolution
		Reference frequency Output	Output level 8 dBm ± 3 dB If external reference not used: 10 MHz If external reference used: Same as external reference frequency
		Sweep Status Output	TTL, active low when sweeping
		GPIB	See option description
		Ethernet	10BASE-T, 100 BASE-TX
		External Trigger Input	BNC
		VGA Monitor Output	Matches instrument front panel display resolution
		I and Q inputs (Opt 22)	50 or 1 MΩ, unbalanced or differential switchable, 1 volt max
		Sweep Output	Not used
		USB	Type A plug, Version 1.1
		Keyboard	PS2
		Mouse	PS2
		Parallel Printer Port	ECP

*1: For swept spectrum measurements
*2: 50 MHz, 0 dBm input, Source VSWR <1.1, 10 dB input attenuation, 30 kHz RBW, +1 dBm reference level
*3: 95 % Confidence Amplitude Error Calculation, (CW Signals, 20 to 30°C) 95% confidence level is determined by rss combination of the individual standard errors. Uniform distribution is used for all contributors except VSWR error. U-shaped distribution is used for VSWR error.

	Error Specification (dB)	σ
Amplitude Uncertainty at 50 MHz [dB]	0.1	0.06
Frequency Response at 10 dB Attenuation [dB]	0.4	0.23
Frequency Response from Attenuator Switching [dB]	0.6	0.34
Reference Level Switching Uncertainty with Attenuator Changes [dB]	0.25	0.14
RBW Switching Uncertainty [dB]	0.15	0.09
Log Fidelity [dB] 0.07 0.04		
VSWR 1.5 Error (DUT VSWR 1.2)	0.15	0.11
RSS Combined Errors		0.47
95% Confidence Level for Combined Errors (Combined Errors * 1.96)		0.91

*4: Mixer level = signal level minus input attenuation
*5: Swept, with noise compensation on, (ref document 3GPP TS 25.141, test model 1, 2.14 GHz)
*6: RBW = 1 Hz, FFT mode, 0 dB attenuation, average detector

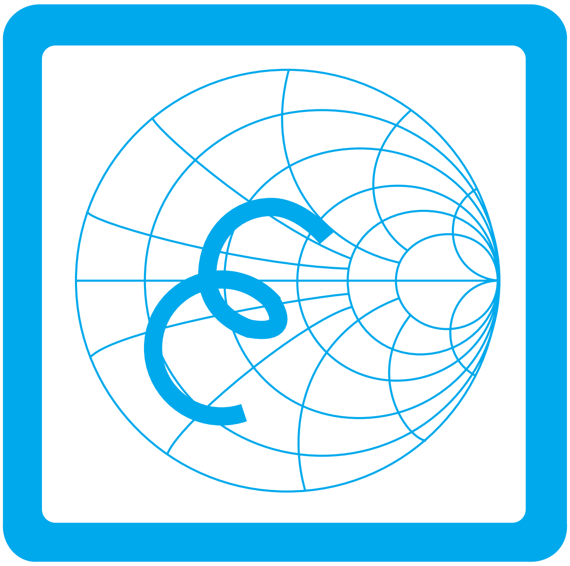
Go to www.us.anritsu.com/signature for details.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS2781A	High Performance Signal Analyzer (100 Hz to 8 GHz)	
	Standard Accessories	
	Power Cord	1pc
10920-00047	Operating Manual on CD-ROM	1pc
60004	Restore software DVD-ROM	1pc
2000-1389	USB Optical Mouse	1pc
970-635	Blank CD R/W disc	1pc
631-73	Spare Fuse	1pc
	Options	
MS2780/1	Rack Mount Adapter	
MS2780/1A	Slide Mount Adapter	
MS2780/3	GPIB Interface	
MS2780/22	30 MHz Demodulation Bandwidth (includes baseband differential I & Q inputs)	
MS2780/38	QAM/PSK modulation analysis (requires Option 22)	
MS2780/40	Connectivity to MATLAB	

Model/Order No.	Name
	Optional Accessories
10410-00252	Signature Operation Manual
10410-00253	Signature Programming Manual
10410-00256	Signature Maintenance Manual
1N50B	Limiter/DC Block, N(m), to N(f), 50Ω,1 MHz to 3 GHz.
1N50C	Limiter, N(m) to N(f), 50Ω, 10 MHz to 18 GHz
42N50A-30	30 dB Attenuator, 50 Watt N(m) to N(f)
12N50-75B	75Ω Matching Pad, DC to 3 GHz, 50Ω N(m) to 75Ω N(f)
11N50B	Power Divider, 1 MHz to 3 GHz, 50Ω, N(f) input, N(f) output
2100-1	GPIB Cable 1M
2100-2	GPIB Cable 2M



NETWORK ANALYZERS

Selection guide

Group	Model	Frequency band	Measurement function											
			S parameter	Power sweep mode	Receiver mode	Multi-source control	Time domain	Harmonics measurement	IMD measurement	Mixer measurement	Balance circuit analysis	Spectrum analyzer	DTF	Crystal unit measurement
Vector	MS4630B	10 Hz to 300 MHz	√*1											√
	MS4622A	10 MHz to 3 GHz	√*1	√	√	√	√	√	√	√				
	MS4622B	10 MHz to 3 GHz	√	√	√	√	√	√	√	√				
	MS4622C	10 MHz to 3 GHz	√	√	√	√	√	√	√	√	√			
	MS4622D	10 MHz to 3 GHz	√	√	√	√	√	√	√	√	√			
	MS4623A	10 MHz to 6 GHz	√*1	√	√	√	√	√	√	√				
	MS4623B	10 MHz to 6 GHz	√	√	√	√	√	√	√	√				
	MS4623C	10 MHz to 6 GHz	√	√	√	√	√	√	√	√	√			
	MS4623D	10 MHz to 6 GHz	√	√	√	√	√	√	√	√	√			
	MS4624A	10 MHz to 9 GHz	√*1	√	√	√	√	√	√	√				
	MS4624B	10 MHz to 9 GHz	√	√	√	√	√	√	√	√				
	MS4624C	10 MHz to 9 GHz	√	√	√	√	√	√	√	√	√			
	MS4624D	10 MHz to 9 GHz	√	√	√	√	√	√	√	√	√			
	37247D	40 MHz to 20 GHz	√	√	√	√	√			√				
	37269D	40 MHz to 40 GHz	√	√	√	√	√			√				
	37277D	40 MHz to 50 GHz	√	√	√	√	√			√				
	37297D	40 MHz to 65 GHz	√	√	√	√	√			√				
	37347D	40 MHz to 20 GHz	√	√	√	√	√			√				
	37369D	40 MHz to 40 GHz	√	√	√	√	√			√				
	37377D	40 MHz to 50 GHz	√	√	√	√	√			√				
	37397D	40 MHz to 65 GHz	√	√	√	√	√			√				
	ME7808B	40 MHz to 110 GHz	√	√			√							
Scalar	56100A	10 MHz to 50 GHz			√*2									
	54107A/54111A	1 MHz to 3 GHz			√*2								√	
	54147A/54137A	10 MHz to 20 GHz			√*2								√	
	54161A	10 MHz to 32 GHz			√*2								√	
	54169A	10 MHz to 40 GHz			√*2								√	
	54177A	10 MHz to 50 GHz			√*2								√	
Site master	S251C	625 to 2500 MHz	√*1										√	
	S113C	2 to 1200 MHz	√*3										√	
	S114C	2 to 1200 MHz	√*3									√	√	
	S331D	25 to 4000 MHz	√*3										√	
	S332D	25 to 4000 MHz	√*3									√	√	
	S810C	3.3 to 10.5 GHz	√*3										√	
	S820C	3.3 to 20 GHz	√*3										√	

*1: S11-/S21 measurement by 1 path 2 port calibration can be performed.
*2: A transmission characteristic and return loss measurement can be performed.
*3: S11 measurement by OSL calibration can be performed.

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Selection guide (Frequency range)

Model	Frequency range																						Remarks
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	200 GHz	
MS4630B																							10 Hz to 300 MHz
MS4622A																							10 MHz to 3 GHz
MS4622B																							10 MHz to 3 GHz
MS4622C																							10 MHz to 3 GHz
MS4622D																							10 MHz to 3 GHz
MS4623A																							10 MHz to 6 GHz
MS4623B																							10 MHz to 6 GHz
MS4623C																							10 MHz to 6 GHz
MS4623D																							10 MHz to 6 GHz
MS4624A																							10 MHz to 9 GHz
MS4624B																							10 MHz to 9 GHz
MS4624C																							10 MHz to 9 GHz
MS4624D																							10 MHz to 9 GHz
37247D																							40 MHz to 20 GHz
37269D																							40 MHz to 40 GHz
37277D																							40 MHz to 50 GHz
37297D																							40 MHz to 65 GHz
37347D																							40 MHz to 20 GHz
37369D																							40 MHz to 40 GHz
37377D																							40 MHz to 50 GHz
37397D																							40 MHz to 65 GHz
ME7808B																							40 MHz to 110 GHz
56100A																							10 MHz to 50 GHz
54107A/54111A																							1 MHz to 3 GHz
54147A/54137A																							10 MHz to 20 GHz
54161A																							10 MHz to 32 GHz
54169A																							10 MHz to 40 GHz
54177A																							10 MHz to 50 GHz
S251C																							625 to 2500 MHz
S113C																							2 to 1200 MHz
S114C																							2 to 1200 MHz
S331D																							25 to 4000 MHz
S332D																							25 to 4000 MHz
S810C																							3.3 to 10.5 GHz
S820C																							3.3 to 20 GHz

MICROWAVE VECTOR NETWORK ANALYZERS

37000D Series

40 MHz to 65 GHz

Ethernet CE GPIB

For Fast and Accurate S-Parameter Measurements

NEW

The Lightning D-Series Vector Network Analyzer (VNAs) are high performance test tools designed to satisfy the growing needs of defense, satellite, radar, broadband communication, and high speed component markets. The new 37000D VNAs improve upon performance while providing a wider set of standard application features to better suit the needs of R&D engineers working on next generation designs. These new features, when combined with the ease of programming through helpful software utilities and faster data transfer over Ethernet, make it an equally valuable tool for manufacturing as well.
The Lightning D-Series consists of two primary configurations built for R&D and Production applications:

Premium Models (37300D)
The Premium series are designed for active and passive device applications, where versatility is the main priority. These are high performance two-port VNAs that include step attenuators, internal bias tees, a gain compression application and wider power range as standard features. They are available in four different frequency ranges; 20 (37347D), 40 (37369D), 50 (37377D) and 65 (37397D) GHz. Each one of them can be configured as an ME7808B millimeter wave VNA by simply adding a broadband test set, two synthesizers and the desired millimeter wave modules. The 37397D is also directly upgradeable to an ME7808B Broadband VNA with single sweep coverage from 40 MHz to 110 GHz.

Economy Models (37200D)
The Economy series are basic two-port VNAs designed for passive applications. They are available in four different frequency ranges; 20 (37247D), 40 (37269D), 50 (37277D) and 65 (37297D) GHz. Each one of them can be configured as an Economy millimeter wave VNA by simply adding a broadband test set, two synthesizers and the desired mmW modules.

The 37300D Premium models include:

- Multiple Source Control and Frequency Offset
- E/O and O/E Application
- Gain Compression Application
- Internal Bias Tees
- Extended Power Range (Source Step Attenuator and Receiver Step Attenuator)
- Rear Panel IF Inputs (for upgrade to Millimeter Wave)
- NxN calibration Utility for Mixer Measurements
- Embed/De-Embed application
- High Stability Frequency Reference
- 1 Hz Frequency Resolution

The 37200D Economy models include:

- Multiple Source Control and Frequency Offset
- E/O and O/E Application
- Rear Panel IF Inputs (for upgrade to Millimeter Wave)
- NxN calibration Utility for Mixer Measurements
- Embed/De-Embed application
- High Stability Frequency Reference
- 1 Hz Frequency Resolution

Features

- **High speed data transfer and control**

For maximum efficiency, an Ethernet connection and dual GPIB ports are standard on every 37000D VNA. Ethernet connection provides high speed data transfers and remote data extraction from the VNA. The same can also be achieved via the standard GPIB interface. The second GPIB port is dedicated to control of peripheral devices such as plotters, power meters, and frequency synthesizers. The 37000D series maximize throughput by combining fast, error-corrected sweeps with high-speed data transfers.

- **Time domain analysis (Option 2A)**

Analyze impedance discontinuities as a function of time or distance with the 37000D's high-speed time domain. Isolate individual reflections in time and evaluate their effects in the frequency domain. Remove the effects of device packages and fixturing with time domain gating to see the actual performance of your designs. Use the independent display channels to view the response of your designs before, during, and after time domain processing.
The software provides four different windowing functions to optimize dynamic range and resolution. The exclusive phasor impulse mode will show you the true impedance characteristics of mismatches in waveguide, microstrip, and other band-limited media.

- **Multiple source control and set-on receiver mode**

The frequency of two sources and a receiver can be controlled without the need for an external controller using this function. Independently specify the sweep ranges and output powers of the sources and the sweep range of the receiver to accommodate mixer, swept IMD, TOI, and harmonic measurements. The 37000D's set-on receiver mode allows it to operate as a tuned receiver by phase locking all of its local oscillators to its internal crystal reference oscillator.

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• **Software tools and compatibility**
VNA Utilities, provided with every 37000D, is the ultimate solution for automated test software development. It includes fully functional application programs, re-usable calibration, set-up and data manipulation samples, and software development tools for creating custom applications. VNA Utilities includes applications such as the Capture Utility, which allows the user to extract data from the VNA in any of the supported formats (bitmap, S2P, plotter graphics, etc.).
The Calkit File Maker helps create a custom calibration kit disk from the coefficients entered by the user. And the VNA File Utility manages system software downloads and data file uploads to/from the VNA's hard disk via a PC. VNA Utilities also includes drivers and help tools for various software environments such as Visual Basic®, Labview and others.

• **NxN calibration utility**
This application is used for making error-corrected measurements of frequency translating devices such as mixers. The calibration performed requires a three mixer combination to correct for the components in the measurement path. Any one of the mixers characterized can then be used for the measurement of the DUT mixer. The standard built-in application guides the user through the set up and the calibration.

• **Embedding/De-embedding**
The de-embedding function is used for removal of test fixture contributions and other networks from measurements. The embedding function can be used to simulate matching circuits for optimizing amplifier and other designs.

• **Internally controlled AutoCal®**
One source of potential errors and inaccuracies in any network analyzer system is the calibration of that system. The Anritsu AutoCal automatic calibrator is designed to speed and simplify the calibration of your 37000D VNA. Using the built-in software support and an AutoCal module connected to the serial port on the rear panel of the instrument, you are ready to make fast, accurate, and repeatable calibrations.

• **Built-in mass storage**
Testing devices with multiple setups is now easier. A built-in hard disk drive rapidly stores and recalls frequently used front panel setups and calibrations. Store your complete test setup including limit lines and frequency markers. Create descriptive file names to assist multiple users or device types. The high storage capability of the internal hard disk means there is space for literally hundreds of calibrations, front panel setups, and data traces. In secure environments, the internal hard disk can be removed (Option 4A) and either an external drive on the SCSI port or the internal 1.44 MB floppy drive can be used for uploading proprietary setups.

• **Flexible test set (Option 15)**
All 37000D VNAs can be configured with six front panel loops: four direct receiver access loops and two auxiliary source loops (one for each port). These are useful for measurements of mixers, antennas, as well as integration with external test sets (for example, multiport).

• **Upgradeability**
The 37000D series analyzers are designed to accommodate higher frequency ranges and more powerful features as your requirements grow. Any 37000D series VNA can be upgraded to any other model in the instrument family to fit your changing requirements. In addition, any VNA can also be upgraded to the ME7808B Broadband and Millimeter Wave VNA. This provides a cost-effective approach to satisfying today's needs while providing the flexibility to meet tomorrow's demands. System software upgrades are easily performed by loading software through the floppy drive or GPIB.

• **Three-year factory warranty**
All 37000D series VNAs are backed with a no-questions-asked three-year warranty.

Applications

• **Filters**
The 37000D VNAs have built-in functions that automatically locate filter center frequency, 3 dB bandwidth, max/min insertion loss, Q, and shape factor. The analyzer's improved dynamic range can be used to measure filter rejection and input match on the same display. Sweep speed can be enhanced for tuning filters by using the instrument's tune mode. This unique feature helps users optimize sweep times in one direction for better hand-to-eye tuning while maintaining a 12-term corrected S-parameter display. The analyzer's tune mode maximizes sweep speed and accuracy, simultaneously, by allowing the user to choose when reverse parameters are updated.
Also, passband phase distortions can be measured with the automatic reference plane extension capability. A single key press can help quickly identify filter non-linear phase responses.

• **Swept Power Gain Compression - Amplifiers (37300D models only)**
The Swept Power Gain Compression application (standard on 37300D models) allows the user to easily measure amplifier gain compression vs. input power or frequency. Power meter assisted linearity and flat output power calibration, combined with a receiver port calibration, provides capability to measure output power in dBm. A 1 watt, 70 dB (60 dB on >40 GHz models) step attenuator in the port 1 path, and a 40 dB step attenuator in the port 2 path, coupled with 20 dB ALC range, give complete control to characterize virtually any amplifier. This range is reduced to 12 dB at frequencies >50 GHz. Internal bias tees simplify DC biasing of your active designs.
In addition, a front panel source loop on each port (option 15) allows external amplifier insertion, increasing port power up to 1 Watt maximum for high input power amplifiers.

• **Mixers**
Complex frequency translated device measurements such as error corrected conversion loss, group delay, and port match measurements of mixers and up/downconverters are simplified with the NxN mixer measurement application. The NxN application adjusts the VNA's 12-term calibration for the reference mixer, a Band Pass Filter, and attenuators used in the measurement setup, yielding accurate measurements of the frequency translated DUT.

• **Multiport and Balanced/Differential**
Single-ended and mixed-mode S-parameter measurements with the 37000D series VNA are accomplished using a multiport test set and an external PC running the Navigator™ Multiport software. Multiport components (diplexers, couplers, power dividers, etc.) or balanced/differential components can be easily characterized to frequencies as high as 65 GHz.

• **Microstrip devices**
The 37000D series offers complete substrate measurement solutions for both microstrip and coplanar waveguide (CPW) designs. The 37000D series analyzers accommodate the model 3680 series Universal Test Fixtures (UTF), calibration kits, and verification kits. Guaranteed system specifications provide assurance that your test results are accurate and verifiable. Internal calibration routines such as the Line-Reflect-Line (LRL) and Line-Reflect-Match (LRM) calibration capability help completely characterize connectorless devices with the Lightning VNAs. The four channel design provides true LRL/LRM error-correction yielding the highest performance available for in-fixture measurements. Highly reflective devices, along with well matched ones can also be measured with the same degree of ease. Automatic dispersion compensation improves measurement accuracy to help determine phase distortions for all microstrip designs.

• **E/O and O/E devices**
The 37000D series incorporates an E/O and O/E measurement application that simplifies VNA calibration when measuring E/O and O/E devices. The transfer function, group delay, and return loss of optical modulators (E/O) and photoreceivers (O/E) can be easily characterized using this application. An O/E calibration module (MN4765A) and a laser source are required to complete the test setup. The internal VNA application de-embeds the response of the O/E calibration module to allow direct measurement of the modulator. For O/E measurements, the O/E calibration module is used to characterize a modulator first, which is then used as the characterized reference to measure another photoreceiver.

• **Antennas**
All 37000D VNAs include rear panel IF inputs (<270 MHz) that can be used in remote mixing applications to make antenna measurements. For near field and far field measurements that require direct access to the VNA test and reference channels, Option 15 can be included on any 37000D VNA which adds the four test and reference loops on the front panel to simplify measurements.
In addition the VNAs Fast CW mode enhances data extraction over GPIB to rates of 0.8 ms/point using internal triggering, and 1.2 ms/point with external triggering or 1.5 ms/point with GPIB triggering, allowing for fast data extraction for accurate plotting of near and far field effects.

Specifications

Measurement capabilities	Number of channels	Four measurement channels
	Parameters	S_{11}, S_{21}, S_{12}, S_{22}, or user defined; analog voltage input; complex input and output impedance; complex input and output admittance; complex forward and reverse transmission
	Domains	Frequency domain, CW draw, and optional high speed time domain (Option 2A)
	Formats	Log magnitude, phase, log magnitude and phase, Smith chart (impedance), Smith chart (admittance), linear polar, log polar, group delay, linear magnitude, linear magnitude and phase, real, imaginary, real and imaginary, and SWR
	Data points	1601 maximum. System also accepts an arbitrary set of N discrete data points where $2 \leq N \leq 1601$. CW mode permits selection of a single point.
	Reference delay	Can be entered in time or in distance. Automatic reference delay adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between the reference and test is accurate and stable since measurement frequencies are always synthesized.
	Reference offset	Magnitude and phase
	Markers	Six independent markers can be used to read out measurement data. In delta-reference mode, any one marker can be selected as the reference for the other five. Markers can automatically find critical filter parameters i.e. 3 dB bandwidth, loss, center frequency, shape factor and Q.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limits	Two limit lines per data trace to indicate test limits. Limits can be either single or segmented limits for testing devices pass-fail.
	Measurement dynamic range	Table 1 gives receiver dynamic range as the ratio of typical power at Port 1 and the noise floor.
	Data averaging	Averaging of 1 to 4096 averages per data point can be selected.
	IF bandwidth	Front panel switch selects four levels of IF bandwidth: 10 kHz, 1 kHz, 100 Hz and 10 Hz
Display capabilities	Display channels	1, 2, 3 or 4 channels can be displayed. Each channel can display any S-parameter or user defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously.
	Display type	Color LCD, 8.5” diagonally, VGA display. Color of graticule, trace data and text are user definable.
	Trace overlay	Overlays two traces with the same graticule type on the same display
	Trace memory	A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division.
	Scale resolution	Log mag: 0.001 dB, linear mag: 1 pU Phase: 0.01°, group delay: 0.001 ps Time: 0.001 ms, distance: 0.1 mm SWR: 1 pU Power: 0.05 dB
	Autoscale	Automatically sets resolution and offset to display measurement data on the full display
	Reference position	Settable to any graticule line
	Annotation	Type of measurement, vertical and horizontal scale resolution, start and stop frequencies and reference position
Vector error correction	Error correction models	Full 12-term, one-path two-port, reflection only, transmission response
	LRL/LRM	Line-Reflect-Line and Line-Reflect-Match calibration models are available for coaxial, microstrip and waveguide transmission lines.
Signal source capabilities	Source power level	Source power may be set from the 37000D front panel menu.
	Flat power correction	The 37000D corrects for test port power variations using an external power meter. Once the port power has been flattened, the power meter is removed and the signal source power level may be changed within the remaining power adjustment range.
	Multiple source control	Allows a user to separately control the frequency of two sources and receiver without need for an external controller. Source #1: 37000D internal source, or any 68000C, 69000B, or MG3690A synthesizer Source #2: Any 68000C, 69000B, or MG3690A synthesizer Receiver: 37000D internal receiver
	Internal 10 MHz time base stability	Standard (1 Hz resolution) With aging: $<1 \times 10^{-9}$/day With temperature: $<5 \times 10^{-9}$ over 0° to 55°C
Hard copy	Printers	Select full screen, graphical, tabular data, and printer type. Compatible with most HP and Epson printers with a parallel port interface
	GPIB plotters	Compatible with most HP and Tektronix plotters
	Disk file	Bitmap, S2P, text, tabular data, and HPGL
Storage	Internal memory	Ten front panel states (setup) can be stored and recalled from non-volatile memory locations.
	Internal hard disk drive	Store and recall instrument setups, calibration files and trace data files. All files are MS-DOS compatible.
	Internal floppy disk drive	Store and recall instrument setups, calibration files and trace data files from 3.5 inch 1.44 MB floppy disks. All files are MS-DOS compatible.
Remote programming	Interface	GPIB (IEEE 488.2), Ethernet
	Addressing	GPIB address can be set from the front panel and can range from 1 to 30. Static IP address for Ethernet.
	Transfer formats	ASCII, 32-bit floating point and 64-bit floating point
	Speed	150 kB/sec over GPIB, up to 850 kB/sec over Ethernet
	Interface function codes	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DT1, DC0, C0
General	Test ports	GPC-7, 3.5 mm, N-type, K, and V connectors supported
	Power requirements	85 to 240 V, 48 to 63 Hz, 540 VA maximum
	Dimensions	432 (W) x 267 (H) x 585 (D) mm (10.5 x 17 x 23 in)
	Weight	27 kg (60 lbs)
	Temperature	0° to 50°C (operate), –40° to 75°C (storage)

Table 1. Dynamic Range

Model	Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
37347D	0.04 2 20	10 11 8	–82 –104 –100	92 115 108
37369D	0.04 2 20 40	10 8 3 2	–85 –107 –103 –95	95 115 106 97
37377D	0.04 2 20 40 50	10 5 2 1 –1	–88 –110 –106 –98 –94	98 115 108 99 93
37397D	0.04 2 20 40 50 65	10 5 2 1 –1 –2	–88 –110 –106 –98 –94 –82	98 115 108 99 93 80
37247D	0.04 2 20	10 11 7	–82 –104 –101	92 115 108
37269D	0.04 2 20 40	10 8 2 2	–85 –107 –104 –97	95 115 106 99
37277D	0.04 2 20 40 50	10 5 1 1 –1	–88 –110 –107 –100 –96	98 115 108 101 95
37297D	0.04 2 20 40 50 65	10 5 1 1 –1 –1	–88 –110 –107 –100 –96 –84	98 115 108 101 95 83

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
37247D	Vector Network Analyzer (40 MHz to 20 GHz)
37269D	Vector Network Analyzer (40 MHz to 40 GHz)
37277D	Vector Network Analyzer (40 MHz to 50 GHz)
37297D	Vector Network Analyzer (40 MHz to 65 GHz)
37347D	Vector Network Analyzer (40 MHz to 20 GHz)
37369D	Vector Network Analyzer (40 MHz to 40 GHz)
37377D	Vector Network Analyzer (40 MHz to 50 GHz)
37397D	Vector Network Analyzer (40 MHz to 65 GHz)
	Options
Option 1	Rack mount kit with slides
Option 1A	Rack mount kit with handles
Option 2A	High-speed time (distance) domain capability
Option 4A	External SCSI-2 hard disk drive compatibility (internal HDD removed)
Option 7A	Replaces universal K connector (standard) with universal GPC-7 (37200C/37300C only)
Option 7N	Replaces universal K connector (standard) with universal N-male (37200C/37300C only)
Option 7NF	Replaces universal K connector (standard) with universal N-female (37200C/37300C only)
Option 7S	Replaces universal K connector (standard) with universal 3.5 mm-male (37200C/37300C only)
Option 7K	Replaces universal V connector (standard) with universal K (m) (37277C/37297C/37377C/37397C models only)
Option 15	Flexible Test Set
	Calibration kits
3650	SMA/3.5 mm Calibration Kit
Option 1	Adds sliding terminations
3651	GPC-7 Calibration Kit
Option 1	Adds sliding terminations
3652	K Connector Calibration Kit
Option 1	Adds sliding terminations
3653	Type N Calibration Kit
3654B	V Connector Calibration Kit with sliding terminations
36581NNF	AutoCal, N (m) to N (f), 40 MHz to 18 GHz
36581KKF	AutoCal, K (m) to K (f), 40 MHz to 20 GHz
36582KKF	AutoCal, K (m) to K (f), 40 MHz to 40 GHz
	Verification kits
3663	Type N Verification Kit
3666	SMA/3.5 mm Verification Kit
3667	GPC-7 Verification Kit
3668	K Connector Verification Kit
3669B	V Connector Verification Kit
3656	W1 Connector Calibration/Verification Kit
	Test port cables
3670A50-1	GPC-7 semi-rigid cable, 1 foot
3670A50-2	GPC-7 semi-rigid cable, 2 foot
3670K50-1	K connector semi-rigid cable, 1 foot
3670K50-2	K connector semi-rigid cable, 2 foot
3670V50-1	V connector semi-rigid cable, 1 foot
3670V50-2	V connector semi-rigid cable, 2 foot
3671A50-1	GPC-7 flexible cables, 25 in. (1 pair)
3671A50-2	GPC-7 flexible cables, 38 in.
3671S50-1	3.5 mm flexible cables, 25 in. (1 pair)
3671S50-2	3.5 mm flexible cables, 38 in.
3671K50-1	K connector flexible cables, 25 in. (1 pair)
3671K50-2	K connector flexible cables, 38 in.
3671V50-3	V connector flexible cable, 25 in. (1 pair)
3671V50-4	V connector flexible cable, 38 in.

MICROWAVE MULTIPORT BALANCED VNA

37000D Series

40 MHz to 65 GHz

CE GPIB

For Single-Ended, Balanced-Differential and Mixed-Mode S-Parameter Measurements

NEW

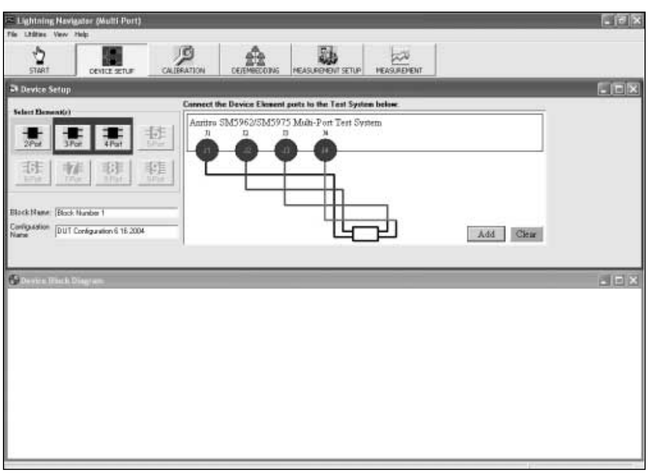
The Microwave Multiport Balanced VNA consists of a 37000D Lightning VNA, a multiport test set, and the Navigator™ Multiport software (external PC is required and is not included). The multiport test set is a 2x4 switch matrix that allows either port on the VNA to connect with any of the 4 ports on the test set. The easy-to-use Navigator™ Multiport software provides full step-by-step direction, simplifying calibration, and speeding measurement throughput.
Existing Lightning VNAs can be readily upgraded to add the new multiport test set and software. With the Lightning VNA's proven stability, the Multiport Balanced VNA provides excellent measurement repeatability and offers a cost-effective application solution for microwave multiport device characterization.

Features

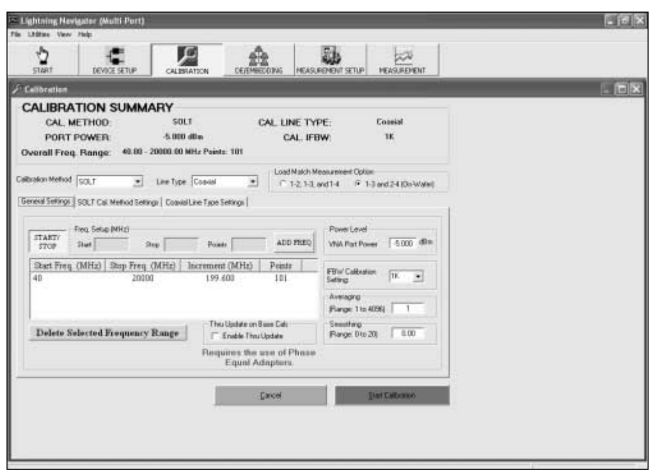
- Unparalleled flexibility to perform any 2, 3, or 4-port, single-ended and mixed-mode S-parameter measurements to 65 GHz
- Characterize passive multiport components, like couplers, diplexers, power dividers
- Measure balanced/differential components and circuits
- Evaluate two 2-port (or four 1-port) devices simultaneously
- Full 4-port calibrations provide superior accuracy (SOLT, LRL, and LRM)
- Supports entry of calibration coefficients and parameters for on-wafer measurements
- Embed/de-embed S2P files and transmission line structures
- Impedance transformation (real and complex)
- Manual test set and calibration control is available
- Powerful Navigator™ Multiport software simplifies calibrations and measurements

8

Easy-to-Use Navigator™ Multiport Software

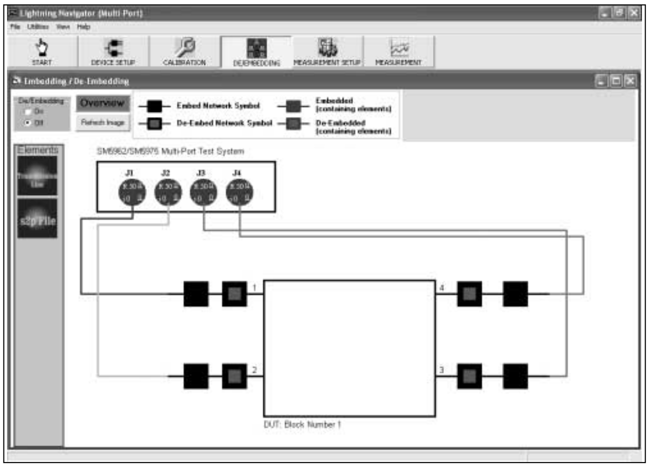


Device Setup

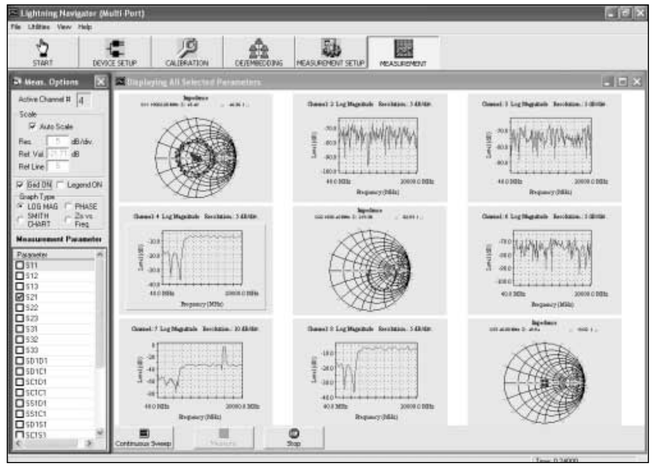


Calibration

Easy-to-Use Navigator™ Multiport Software



Embedding/De-Embedding



Measurement

Specifications*

Operating Frequency Range	40 MHz to 20 GHz		40 MHz to 65 GHz	
Test Port Connectors	K(2.92 mm) female, 50Ω		V(1.85 mm) male, 50Ω	
Test Port Power	20 GHz	–5 dBm	50 GHz 60 GHz	–12 dBm –13.5 dBm
Directivity (corrected)	0.04 GHz 2 GHz 20 GHz	42 dB 42 dB 42 dB	2 GHz 20 GHz 40 GHz 55 GHz	40 dB 40 dB 36 dB 34 dB
Source Match (corrected)	0.04 GHz 2 GHz 20 GHz	40 dB 40 dB 38 dB	2 GHz 20 GHz 40 GHz 55 GHz	36 dB 36 dB 32 dB 28 dB
System Dynamic Range	0.04 GHz 2 GHz 20 GHz	70 dB 90 dB 80 dB	2 GHz 20 GHz 40 GHz 50 GHz 60 GHz 65 GHz	95 dB 90 dB 82 dB 70 dB 62 dB 56 dB
Test Set Isolation	90 dB between any ports			
Maximum Input Power	+20 dBm (25 VDC) all ports			
Bias Tees (optional)	30 VDC, 500 mA, all ports			
Control	Windows-based PC via GPIB [IEEE 488.2] interface			
Temperature Range (Storage)	–40 to 75°C			
Temperature Range (Operating)	0 to 50°C (specifications apply at 23 ±3°C)			
AC Power (test set only)	100 VA max, 47-63 Hz, 85-240 V			
Dimensions (test set only)	153H x 443W x 500D mm (4.6 x 17.5 x 19.7 in)			
Weight (test set only)	approximately 7 kg (15.4 lbs)			

* Specifications are typical and subject to change without notice.

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
SM5962	Multiport Test Set, 20 GHz
SM5975	Multiport Test Set, 20 GHz, with bias tees
SM6000	Multiport Test Set, 65 GHz
SM6135	Multiport Test Set, 65 GHz, with bias tees

O/E CALIBRATION MODULE

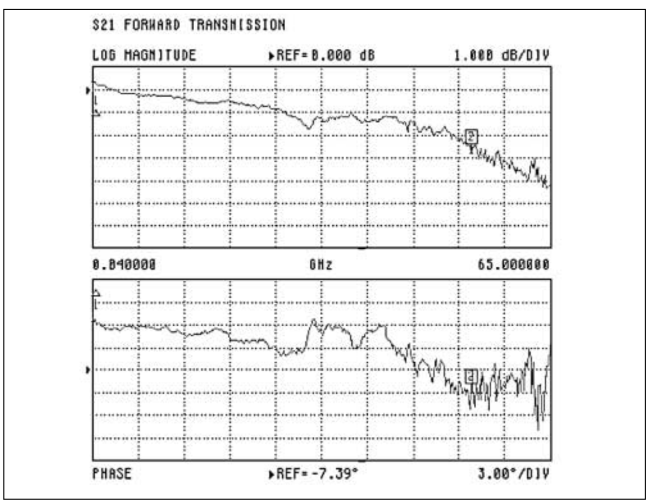
MN4765A

40 MHz to 65 GHz

CE

For Highly Accurate and Stable Optoelectronic Measurements

The MN4765A is a characterized, unamplified photodiode module. It is used as an optical receiver with the 37000D series VNAs to perform highly accurate and stable optoelectronic measurements of both modulators (E/O) and photoreceivers (O/E) to 65 GHz.
The MN4765A consists of an InGaAs photodiode that converts modulated optical signals to electrical signals, and includes additional circuitry for temperature and bias stability. The photodiode has exceptional bandwidth response to 65 GHz and a typical responsivity of 0.7A/W. The MN4765A is characterized for 1550 nm in both magnitude and phase using a NIST derived calibration standard.



Frequency response of the MN4765A

Features

- **Fast and accurate optoelectronic measurements**
  The 37000D series VNAs, when calibrated using the MN4765A module, enable error-corrected Transfer Function, Group Delay and Return Loss measurements of E/O and O/E components and subsystems.
- **NIST derived characterization to 65 GHz**
  Magnitude and phase characterization is obtained using a primary standard characterized by NIST and held in the Anritsu Calibration Lab. The magnitude and phase data is provided on a diskette with the module.
- **Temperature Stable**
  The MN4765A is thermally stabilized to eliminate drift in photodiode performance over temperature.
- **Internal Biasing**
  Accurate bias voltage to the photodiode is maintained internally. An external, multi-country, AC adapter is included for easy operation.
- **High Linearity**
  Linear operating range to +6 dBm for transfer function measurement uncertainties of < 0.5 dB at 50 GHz and < 1 dB at 65 GHz.+
- **High Responsivity**
  0.7 A/W (typical)

Specifications

	Value	Unit
Frequency Range∗1	0.04 to 65	GHz
Characterized Wavelength	1550 ±20	nm
Linear Optical Input Power∗2	< 6	dBm
Max Optical Input Power	10	dBm
Operating Temperature∗3	18 to 28	°C
Storage Temperature	–20 to 70	°C
Electrical Return Loss < 50 GHz < 65 GHz	< –8 < –5	dB
Operating Wavelength Range	1480 to 1620	nm
DC Responsivity	> 0.55	A/W
Optical Return Loss	< –24	dB

∗1. Frequency range over which the MN4765A is calibrated by Anritsu Calibration Lab.
∗2. Linear operating range over which |S21| uncertainty is < 0.25 dB.
∗3. Calibrated temperature is 23°C ± 3°C.

+ Refer to "E/O and O/E Measurements with the 37300C Series VNA" Application Note (11410-00311).

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
MN4765A	O/E Calibration module (40 MHz - 65 GHz)

BROADBAND AND MILLIMETER WAVE VECTOR NETWORK ANALYZER

ME7808B

40 MHz to 110 GHz (expandable to 325 GHz)

CE GPIB
Ethernet

Broadband S-Parameter Measurements to 110 GHz and Beyond

NEW

The ME7808B Broadband Vector Network Analyzer (VNA) is a high performance measurement solution that covers 40 MHz to 110 GHz in a single fast sweep. Built on the advanced technology of the Lightning 65 GHz VNA, the ME7808B is ideal for making accurate S-parameter measurements of components and devices to 110 GHz. The flexible system architecture of the ME7808B makes it easy to adapt to multiple measurement applications.

An alternate configuration is the ME7808B Millimeter Wave VNA, a high performance measurement solution that covers specific millimeter wave bands from 50 GHz to 325 GHz. Any of the two-port Lightning 37000D VNA models can be used as the foundation for the Millimeter Wave VNA.

The ME7808B Broadband VNA consists of:

- Lightning 37397D 65 GHz VNA
- Two Millimeter Wave Modules (3742A Series)
  – Extended W Band (WR-10), 65 to 110 GHz
- Broadband Test Set
- Two 20 GHz Ultra-Low Phase Noise Frequency Sources
- Two Multiplexing Couplers
- Equipment Console with Table

The ME7808B Millimeter Wave VNA consists of:

- Any Lightning 37200D or 37300D series VNA
- Two Millimeter Wave Modules (3740A or 3741A Series)
  – V Band (WR-15), 50 to 75 GHz
  – E Band (WR-12), 60 to 90 GHz
  – Extended E Band (WR-12), 56 to 94 GHz
  – W Band (WR-10), 75 to 110 GHz
  – Extended W Band (WR-10), 65 to 110 GHz
  – Higher frequency bands (up to 325 GHz)*
- Broadband Test Set
- Two 20 GHz Ultra-Low Phase Noise Frequency Sources
- Equipment Console with Table

* with VNA2 Frequency Extension Modules from OML, Inc.

Features

• Ultra-Low Phase Noise Frequency Sources

The ME7808B Broadband and Millimeter Wave VNAs use two 20 GHz synthesized sources with ultra low phase noise (Option 3). They provide the LO and RF drive to the mmW modules which translates to the lowest measurement trace noise available in a millimeter wave VNA.

• Single Pair of Coaxial Test Ports For Broadband Sweep

The ME7808B Broadband VNA combines the 40 MHz to 65 GHz output from the VNA and the 65 GHz to 110 GHz output from the mmW modules using a unique multiplexing coupler design. The effective system test ports for the broadband configuration are therefore two W1 coax connectors. The W1 Connector™ is compliant with the IEEE standard 1.0 mm connector. This design provides a DC path that permits bias injection from the VNA front panel bias inputs directly to the W1 coax test ports.

• Up to Three Systems in One

Using the approach of coupling the 65 GHz VNA output with that from the mmW modules, the ME7808B Broadband VNA can be operated in any of the following configurations:

1) as a broadband VNA (40 MHz to 110 GHz) with W1 Connector™ coaxial interface
2) as a stand-alone 65 GHz VNA with V Connector® coaxial interface
3) as a millimeter wave VNA (65 GHz to 110 GHz) with a WR-10 waveguide connector interface. Additional discrete mmW bands are easily supported by substituting other available mmW modules into the system.

The ME7808B Millimeter Wave VNA permits switching between the stand-alone coaxial and the millimeter wave modes, thus offering two systems in one.

Reconfiguration of the system is fast and simple using an internal software menu. When operating either the stand-alone VNA or mmW systems independently, higher output power and increased dynamic range are achievable. Wafer probe tips can be connected to any of the three interfaces to make on-wafer measurements.

• Complete Measurement Solutions

The ME7808B is compatible with leading probe stations and probe tips for making on-wafer measurements. On-wafer calibration software such as SussCal from Suss MicroTec and WinCal from Cascade Microtech have built in drivers for the Anritsu Lightning VNAs. For parameter extraction and device modeling, an instrument driver for the ME7808B is integrated in Agilent EEsof's IC-CAP 2002. In addition, a complete list of accessories is available including W1 coaxial calibration kits, waveguide calibration kits, W1 coaxial and waveguide to coaxial adapters.

Specifications

ME7808B Broadband VNA Dynamic Range

W1 Coax

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
0.04	+10	–88	98
2	+4	–109	113
20	–2	–102	100
40	–6	–91	85
50	–9	–86	77
<65	–12	–72	60
>65	–14	–77	63
75	–10	–88	78
85	–11	–91	80
100	–9	–88	79
110	–11	–85	74

V Coax

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
0.04	+10	–88	98
2	+5	–110	115
20	+2	–106	108
40	+1	–98	99
50	–1	–94	93
65	–2	–82	80

Extended W Band (WR-10) Waveguide (3742A-EW Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
65	–6	–85	79
75	–4	–94	90
85	–6	–96	90
100	–5	–92	87
110	–7	–89	82

ME7808B Millimeter Wave VNA Dynamic Range

V Band (WR-15) Waveguide (3740A-V or 3741A-V Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
50 to 75	+7	–90	97

E Band (WR-12) Waveguide (3740A-E or 3741A-E Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
60 to 90	+6	–90	96

Extended E Band (WR-12) Waveguide (3740A-EE or 3741A-EE Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
50 to 60	+5	–85	90
60 to 85	+6	–90	96
85 to 94	+4	–76	80

W Band (WR-10) Waveguide (3740A-W or 3741A-W Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
75 to 100	+5	–90	95
100 to 110	+2	–90	92

Extended W Band (WR-10) Waveguide (3740A-EW or 3741A-EW Modules)

Frequency (GHz)	Port 1 Power, Typical (dBm)	Noise Floor (dBm)	System Dynamic Range (dB)
65 to 75	–5	–90	85
75 to 100	+5	–89	94
100 to 110	+2	–87	89

System dynamic range is defined as the ratio of the typical power at Port 1 and the system noise floor. The noise floor measurement is made using 512 averages in a 10 Hz IF bandwidth, including isolation calibration.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
ME7808B	Broadband VNA, Single Sweep Coverage from 40 MHz to 110 GHz (with W1 Coax Test Ports) or Millimeter Wave VNA, Discrete Band Coverage to 325 GHz (with Waveguide Test Ports)
	Millimeter-wave modules*1
3740A-V	Transmission/Reflection Module, 50 to 75 GHz
3740A-E	Transmission/Reflection Module, 60 to 90 GHz
3740A-EE	Transmission/Reflection Module, 56 to 94 GHz
3740A-EW	Transmission/Reflection Module, 65 to 110 GHz
3740A-W	Transmission/Reflection Module, 75 to 110 GHz
	Test Port Cables
3671W1-50-1	W1 Female to W1 Male, High Performance Cable, 10 cm (1 each)
3671W1-50-2	W1 Female to W1 Male, High Performance Cable, 13 cm (1 each)
3671W1-50-3	W1 Female to W1 Male, High Performance Cable, 16 cm (1 each)
3670V50-2	Economy, Semi-rigid, V female to V male, 61 cm (2 ft.)
3671V50-3	High Performance, Flexible, phase stable, V female to V male, 63.5 cm (25 in.), one pair

Model/Order No.	Name
	Calibration Kits
3654B	V-connector calibration kit with sliding terminations
3655W	WR-10 waveguide calibration kit
3655W-1	WR-10 waveguide calibration kit with sliding terminations
3656	W1 calibration/verification kit
	Adapters (Coaxial)
SC6299	W1 Male to V Male Adapter
SC6355	W1 Male to V Female Adapter
SC6357	W1 Female to V Male Adapter
SC6356	W1 Female to V Female Adapter
33WW50	W1 Male to W1 Male Adapter
33WWF50	W1 Male to W1 Female Adapter
33WFWF50	W1 Female to W1 Female Adapter
	Adapters (Waveguide to Coaxial)
SC6216	WR-10 to W1 Male Adapter
SC6198	WR-10 to W1 Female Adapter

*1: Contact Factory for Millimeter-Wave bands above 110 GHz.

8

RF MULTI-PORT BALANCED VNA

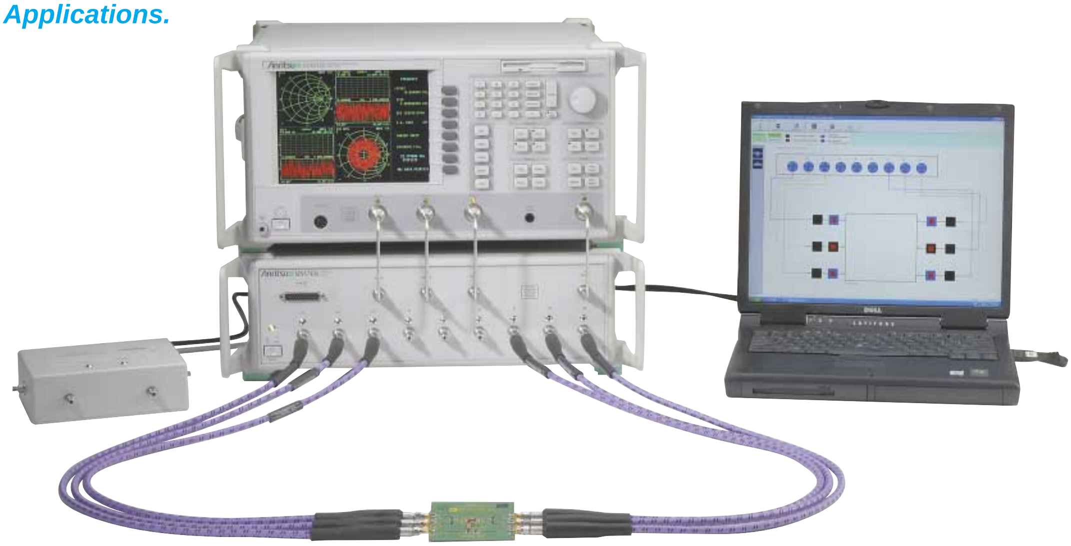
MS4624D Series

10 MHz to 9 GHz

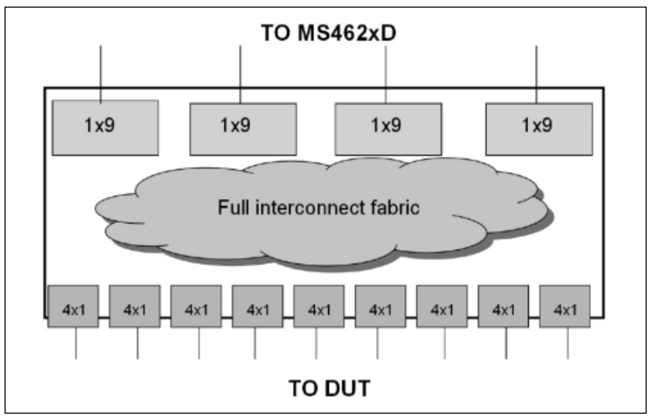
GPIB

Single Connection Differential Measurements for Signal Integrity and Multi-Port Applications.

NEW



The RF Multi-Port System consists of the Scorpion® Vector Network Measurement System, the SM5992 RF Multi-Port Test Set and Navigator™ software (external personal computer is required, but not included). Simply enter your multi-port module topology and Navigator guides you quickly and intuitively through the setup so you can accurately perform multi-port measurements. Especially suited for next generation modules with balanced interfaces, Navigator also supports full N-port calibrations for the ultimate in accuracy.

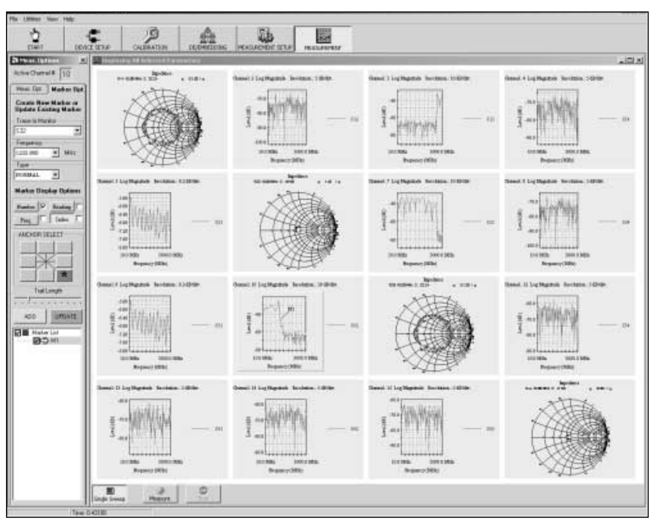


Key Benefits

- Versatility to Characterize Any Module up to 9-Ports with a Single Connection
- Full N-Port Calibrations Correct for All Load Match Artifacts
- Simplifies the Complexity of Multi-Port Measurements with Easy-to-Use Software
- Transmission Accuracy of Less Than 0.1 dB
- Scalable Solutions Possible for Modules with more than 9-Ports

Versatility to Characterize Any Module up to 9-Ports

The multi-port test set employs a full interconnect fabric to ensure maximum flexibility in connecting to your modules, both present and future. In other words, this switch fabric allows any single port of the MS462xD to connect with any of the DUT ports so you can connect your module to this measurement solution with a single connection regardless of your module's paths. In addition, multi-port measurements are now nearly effortless to perform using Navigator. As an example, the following screen capture shows one setup for the main measurement screen within Navigator.



Specifications*1

The following specifications apply at 23 ± 3°C. A warm-up time of ninety (90) minutes should be allowed prior to verifying system specifications. For further specifications, reference the Scorpion VNMS Technical Specifications and Configuration Guide (part number 11410-00288).

General	Frequency Range	10 MHz-9 GHz*2
	Damage Levels	20 dBm, 40 V DC
	DUT Test Port Interface	9 K (F) ports
	VNA Test Port Interface	4 K (F) ports
	Test Set Connectivity	Full connectivity between DUT and VNA test port
	Aux I/O to Control DUT Switch Settings	25 pin control I/O
	VNA Automation Interface	IEEE488.2 GPIB, Ethernet
	Test Set	IEEE488.2 GPIB
RF Performance	Raw return loss: DUT ports, ON state	>19 dB .1-1 GHz*2 >16 dB 1-3 GHz >12 dB 3-6 GHz >10 dB 6-9 GHz
	Raw return loss: DUT ports, OFF state	>23 dB .1-1 GHz*2 >20 dB 1-3 GHz >17 dB 3-6 GHz >12 dB 6-9 GHz
	Raw return loss: VNA ports	>17 dB .1-1 GHz*2 >13 dB 1-3 GHz >10 dB 3-6 GHz >10 dB 6-9 GHz
	Insertion loss (any path)	<2.5 dB .1-3 GHz*2 <5 dB 3-9 GHz
	Isolation (an on path to an off port, all unused ports terminated)	>100 dB .1-6 GHz*2 >90 dB 6-9 GHz
	Available power at the DUT ports (dependent on VNA and cables being used)	MS4622D, (.01-3 GHz) 7 dBm (typically up to +10 dBm) MS4623D, (.01-6 GHz) 5 dBm (typically up to +8 dBm) MS4624D, (.01-9 GHz) 3 dBm (typically up to +6 dBm)
Test Port Corrected Performance	Using a 3750R calibration kit, the following corrected parameters are obtainable from an appropriate multi-port calibration (at 23 ± 3°C).	
	Corrected Source Match	>45 dB .1-1 GHz*2 >43 dB 1-3 GHz >41 dB 3-6 GHz >36 dB 6-9 GHz
	Corrected Directivity	>48 dB .1-3 GHz*2 >47 dB 1-3 GHz >43 dB 3-6 GHz >40 dB 6-9 GHz

*1: Specifications are typical and subject to change without notice.
*2: Due to DC blocks, some degradation may be observed between 10 and 100 MHz

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
MS4624D SM5992	10 MHz – 9 GHz Balanced/Differential 4-Port RF Multiport Test Set, 9-Port

PIM-S SYSTEM (VNA AND PASSIVE INTERMODULATION TEST SYSTEM)

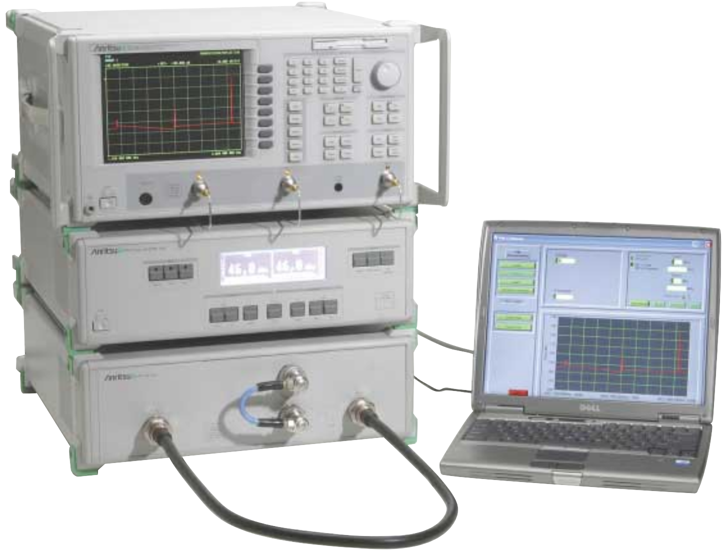
GPIB

MS4622B Series

10 MHz to 3 GHz

Single Connection Swept Frequency PIM and S-Parameters.

NEW



The PIM-S System conducts passive intermodulation distortion (PIM) and S-parameter measurements with a single connection. This innovative system consists of the MS4622B Scorpion® Vector Network Measurement System (VNMS), SM612x PIM Power Amplifier Unit, SM612x PIM Filter Unit, and SM6130 PIM-S Software (external personal computer is required, but not included). The following table shows the optimized PIM Filter Units and PIM Power Amplifier Units that are configured together for deployment with the VNA in the desired PIM frequency range. Each PIM frequency range requires the corresponding PIM Filter Unit and PIM Power Amplifier Unit in the system configuration. Our PIM testing approach conforms to industry recommendations and IEC 62037.

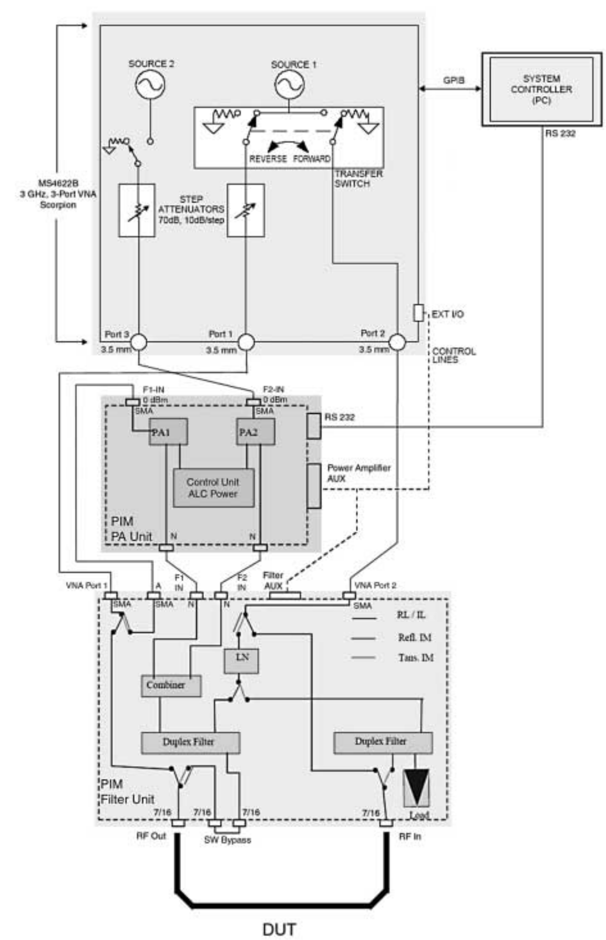
PIM Frequency Range (Base Station Transmit)	PIM Filter Unit	PIM Power Amplifier Unit
2110 - 2170 MHz	SM6121	SM6122
1930 -1990 MHz	SM6123	SM6124
1805-1880 MHz	SM6125	SM6126
925-960 MHz	SM6127	SM6128

Key Benefits

- Single Connection for Swept Frequency S-parameter and PIM measurements
- Measured PIM products: Third, fifth and seventh order
- +46 dBm Maximum Output Power (each of two tones)
- –125 dBm PIM Residual Level for both reflected and transmitted (typical)
- –135 dBm PIM Residual Level for reflected PIM measurements at the switch bypass port (typical)
- S-parameters between 10 MHz and 3 GHz (standard)

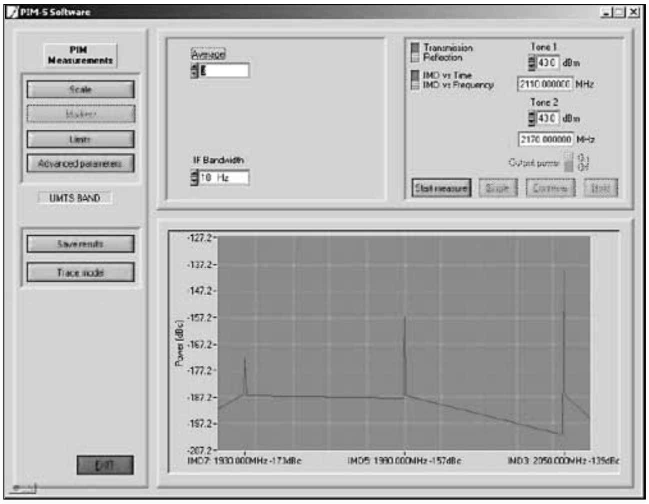
PIM-S Block Diagram

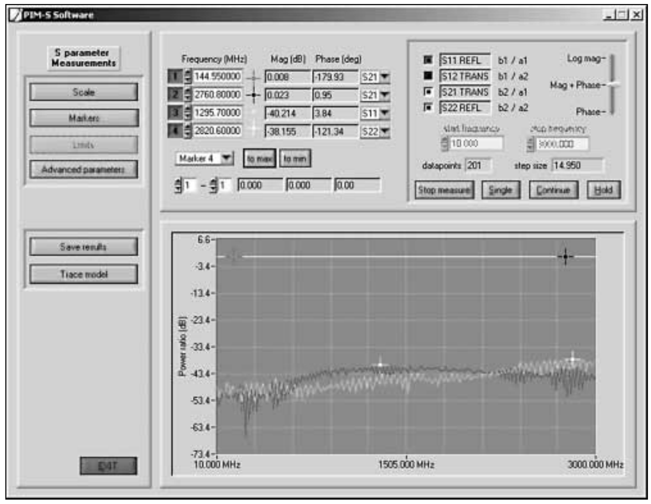
The following block diagram shows the architecture of the standard PIM-S Solution.



PIM-S Software Results

The PIM-S Solution can conduct both PIM and S-parameter measurements. A screen capture from the software shows the user interface and results for testing the 3rd, 5th and 7th order lower PIM products. The software provides an intuitive way to perform setup, calibration, measurements and results in production environments. In a similar way, the S-parameter results can be viewed without changing connections.





Specifications*1

The following specifications apply at 23 ± 3°C. A warm-up time of ninety (90) minutes should be allowed prior to verifying system specifications. For further specifications, reference the PIM-S System Brochure (part number 11410-00349) and the Scorpion VNMS Technical Specification and Configuration Guide (part number 11410-00288).

PIM Transmitter Specifications	Frequency Increment	1 Hz
	Frequency Stability	<5x10^{-6} / year
	Maximum Transmit Power per Carrier	40 W, +46 dBm
	Power Control Range	+27 dBm to +46 dBm
	Output Power Accuracy	<± 0.25 dB typical
	Reverse Power Protection	65 Watts
	Frequency Switching Speed	0.2 mS typical (30 kHz IF Bandwidth)
PIM Receiver Specifications	System residual PIM level	–125 dBm typical
	Dynamic Range	>100 dB
	Scorpion Damage Input Level	+27 dBm (Port 1)
	PIM Filter Unit Maximum Input Tone Levels	+50 dBm at 7/16 DUT Test Port Inputs (RF In, RF Out)
	PIM Filter Unit Maximum Input IM Products	+0 dBm at 7/16 DUT Test Port Inputs (RF In, RF Out)
	PIM PA Unit Input Power per Tone	+0 dBm ±3 dB (F1-IN, F2-IN)
S-Parameter Specifications	Source Power	–85 to +7 dBm
	System Dynamic Range (terminated)	125 dB
	High Level Noise	<0.008 dB rms
	Corrected Source Match	>40 dB
	Corrected Directivity	>42 dB

*1: Specifications are typical and subject to change without notice.

Ordering Information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Transmit 2110-2170 MHz Configuration:
MS4622B	10MHz – 3GHz active reversing
MS4600/3A	Adds 2nd Source and 3rd Port
SM6122	PIM Power Amplifier Unit
SM6121	PIM Filter Unit
ND63271	PIM Interconnect Accessories
	Transmit 1930-1990 MHz Configuration:
MS4622B	10MHz – 3GHz active reversing
MS4600/3A	Adds 2nd Source and 3rd Port
SM6124	PIM Power Amplifier Unit
SM6123	PIM Filter Unit
ND63271	PIM Interconnect Accessories

Model/Order No.	Name
	Transmit 1805-1880 MHz Configuration:
MS4622B	10MHz – 3GHz active reversing
MS4600/3A	Adds 2nd Source and 3rd Port
SM6126	PIM Power Amplifier Unit
SM6125	PIM Filter Unit
ND63271	PIM Interconnect Accessories
	Transmit 925-960 MHz Configuration:
MS4622B	10MHz – 3GHz active reversing
MS4600/3A	Adds 2nd Source and 3rd Port
SM6128	PIM Power Amplifier Unit
SM6127	PIM Filter Unit
ND63271	PIM Interconnect Accessories

VECTOR NETWORK MEASUREMENT SYSTEMS (VNMS)

Ethernet / GPIB

MS4622A/B/D, MS4623A/B/D, MS4624A/B/D

10 MHz to 3 GHz **10 MHz to 6 GHz** **10 MHz to 9 GHz**

Innovative Manufacturing Solutions for Measuring S-Parameters, NF, P_{1dB}, IMD, and 3 and 4-Port Devices

Anritsu's family of RF Vector Network Measurement Systems include the MS462XA, MS462XB, and the new MS462xD. Code named Scorpion®, the MS462XX line is much more capable than traditional VNAs. With Scorpion's all new measurement options of vector error-corrected Noise Figure, Intermodulation Distortion, Fourth Measurement Port, and Harmonics, they create a total test solution. When you add the standard benefits of outstanding dynamic range and blazing fast measurement speed, you have a truly innovative solution for a manufacturing test environment!

Key Benefits

- See the true performance of all your passive and active components including antennas, isolators, filters, duplexers, couplers, SAW filters, baluns, amplifiers, mixers, and multi-port components
- With a single connection perform S-parameter, Harmonics, Time Domain, Compression, Intermodulation Distortion (IMD), Noise Figure (NF), and Frequency Translated Group Delay for accurate and thorough device characterization
- Optimized for your manufacturing process with features like 2 & 4 port AutoCal® modules which simplify calibrations, sequences for automating repetitive keystrokes, enhanced markers simplify data collection, and external SCSI interface for massive storage
- Measurement speeds of 150 µsec/point and dynamic range of 125 dB

Scorpion's AutoCal® feature also provides the capability to achieve fast, accurate, and highly repeatable calibrations without the need for an external controller. By using AutoCal® standard connector types or test port cable converters, you can calibrate directly using Type N, K, 3.5 mm, or SMA connectors. Planned upgrades include adapter characterization with the ability to calibrate using 7/16 or TNC type connectors.

- **4-Port Balance/Differential Measurements**

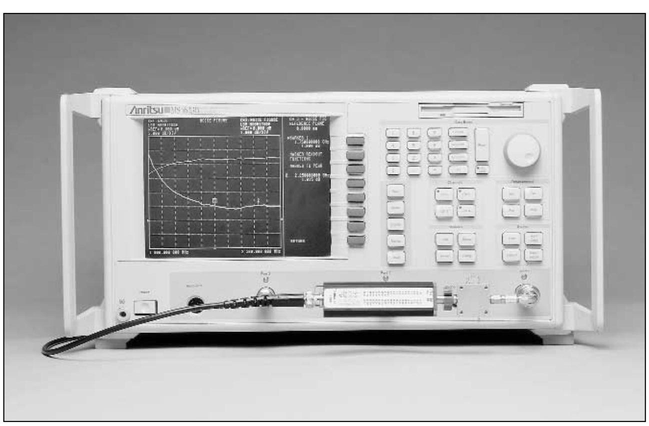
The MS462xD series of Vector Network Measurement Systems (VNMS) allow you to characterize devices like SAW filters and integrated circuits using powerful features like mixed-mode S-parameters, embedding/de-embedding, and arbitrary impedance. De-embedding utilities provide compensation techniques for typical test fixture environments to further enhance the measurement accuracy, while integrated embedding utilities, consisting of an extensive library of circuit primitives, increases time-to-market and yield when simulating the final matched behavior of components. The Scorpion's arbitrary impedance transformations also accurately handle non-50 Ω measurement scenarios typically associated with balanced devices, making the VNMS well suited for applications requiring ripple, insertion loss and amplitude imbalance measurements on the order of 0.1 dB.

• Amplifier Measurements

Some of today's most demanding VNA measurements involve the characterization and tuning of multiple port devices such as duplexers, combiners, couplers, etc. In a traditional 2-port VNA, the full characterization and tuning of such devices presents significant challenges in terms of measurement speed, calibration, and the switching of input signals and measurement ports. With the addition of the third measurement port, the simplicity and speed with which these devices can be tested is greatly enhanced. The MS4622B, MS4623, and MS4624B network analyzers not only offer the option of adding a third measurement port, they also offer the industry's first ever second internal source. This second source is completely independent from the main source that switches between ports 1 and 2. By the addition of this second source, the potential now exists for replacing the signal generators and spectrum analyzers currently needed to characterize the non-linear effects that occur when multiple tones are simultaneously present in the pass-band of an active device.

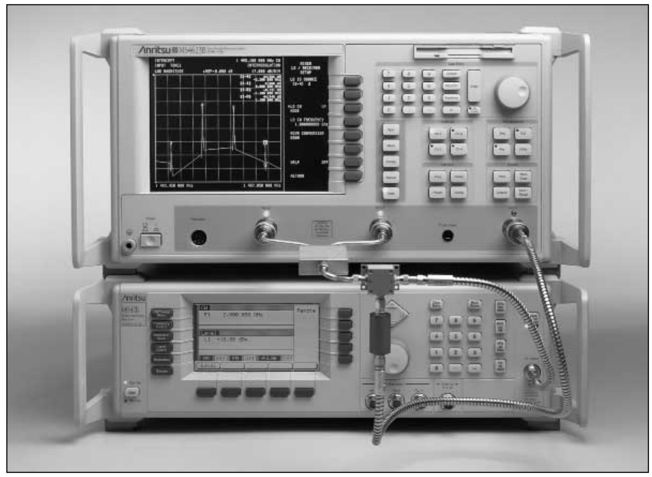
• Vector error-corrected noise figure measurements

The MS4622B, MS4623B, and MS4624B Vector Network Measurement Systems deliver the industry's first ever capability for making vector error-corrected noise figure measurements on active devices in today's hottest market – wireless communications. The Noise Figure options covering the frequency ranges of 50 MHz to 3 GHz and 50 MHz to 6 GHz, give you the functionality for making noise figure measurements much more accurately than has ever before been possible. This option allows for making S-parameter measurements and noise figure measurements with a single test connection. The measurement setup can be configured to make measurements with the noise source set in either an internal or an external mode. In the external mode, the noise source is connected directly to the DUT similar to traditional scalar noise figure measurements. In the internal mode, the noise source is connected to the VNA rear panel and internally routed to port 1. Therefore, when a 12-term calibration is applied concurrently with the noise figure calibration, you can make vector error-corrected noise figure measurements.



• Mixer measurements

Scorpion can also accurately characterize your mixers and other frequency-translating devices (FTDs) for isolation, match, conversion loss, noise figure and frequency translated group delay (FTGD). Without changing cables or instruments, Scorpion can make all these measurements quickly, easily and accurately. Add an external synthesizer and Scorpion can easily orchestrate swept frequency and swept power mixer IMD measurements. You no longer have to buy and integrate five separate instruments to perform these everyday measurements. With the integrated measurement flexibility of Scorpion, you can design and manufacture all of your passive, active, and frequency translating devices using a single instrument.



• AutoCal® Automatic Calibrators

One source of potential errors and inaccuracies in any measurement system is its calibration. A great deal of time can be wasted in a busy manufacturing environment trying to verify calibration accuracy, especially when multiple shifts run on several different test stations for the same product line. For this situation, you need a calibration system in place that offers the highest possible degree of assurance that every station on every shift is calibrated for identical results. With the Anritsu AutoCal® automatic calibrator, you get just that. Simply connect a serial cable between the AutoCal® and the rear panel of the VNA and you're ready to go. If adapters become necessary, AutoCal® can handle them with its revolutionary approach to adapter removal. This approach avoids the necessity of multiple calibrations commonly used in adapter removal calibrations. By using the AutoCal® adapter characterization process, you can calibrate in a SMA, Type N, 3.5mm, TNC, or 7/16 environment with confidence.

Specifications

Test port characteristics	Standard connector type	N female
Test port characteristics	Optional connector types	3.5 mm female, 3.5 mm male, GPC-7, N male

Test port characteristics – Measurement port characteristics

Connector	Configuration	Frequency (MHz)	Directivity (dB)	Source match (dB)	Load match (dB)
3.5 mm (MS4600/11S) (MS4600/11SF)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
	Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36
N-Type Standard N(F) (MS4600/11NM)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
	Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36
GPC-7 (MS4600/11A)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
	Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36

Source specifications

Frequency range		MS4622A/B/D, 10 MHz to 3 GHz MS4623A/B/D, 10 MHz to 6 GHz MS4624A/B/D, 10 MHz to 9 GHz
Frequency resolution		1Hz
Frequency stability (with internal time base) – aging		$<5 \times 10^{-6}$ / year
Temperature		$<5 \times 10^{-6}$ over +15°C to +50°C
Power output range		MS4622A Transmission/Reflection Test Set: +10 to –85 dBm MS4622B Active Reversing Test Set: +10 to –85 dBm MS4622B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A.: +10 to –85 dBm MS4622B (Opt 4) w/ Noise Figure: +7 to –85 dBm MS4622B (Opt 6) w/ 3rd Test Port: +10 to –85 dBm MS4622D Balanced/Differential 4-Port: +10 to –85 dBm
		MS4623A Transmission/Reflection Test Set: +10 to –85 dBm MS4623B Active Reversing Test Set: +7 to –85 dBm MS4623B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A: +7 to –85 dBm MS4623B (Opt 4) w/ Noise Figure (3 GHz only): +5 to –85 dBm MS4623B (Opt 6) w/ 3rd Test Port: +7 to –85 dBm MS4623D Balanced/Differential 4-Port: +7 to –85 dBm
		MS4624A Transmission/Reflection Test Set: +10 to –85 dBm MS4624B Active Reversing Test Set: +7 to –85 dBm MS4624B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A: +7 to –85 dBm MS4624B (Opt 6) w/ 3rd Test Port: +7 to –85 dBm MS4624D Balanced/Differential 4-Port: +7 to –85 dBm
Power control range		≥ 20 dB. The minimum absolute level for power sweep is –15 dBm while the maximum power output for a unit is +10 dBm.
Source power level		The source power (dBm) may be set from the front panel menu or via GPIB. Port 1 power level is settable from +10 dBm (on the simpler test sets, ranging to +5 dBm on the most complex) to –15 dBm with 0.01 dB resolution. In addition, the Port 1 (& Port 3) power may be attenuated in 10 dB steps using the internal 70 dB step attenuator. Port 3 step attenuator is not available in D models. Port 1 step attenuator is optional in A models.
Power level accuracy		±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).
Level test port power		The power at all sweep frequencies is leveled to within ±1 dB. Only port 1 and port 3 (if installed) can be externally leveled.
Harmonics and spurious		<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)
Sweep type		Linear, CW, Marker, or N-Discrete point sweep
Power sweep range		20 dB (minimum)
Source #2 (optional)	Frequency range	10 MHz to 3 GHz (6 GHz or 9 GHz)
	Frequency resolution	1 Hz
	Power level accuracy	±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).
	Harmonics and spurious	<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)
	Sweep type	Linear, CW, Marker, or N-Discrete point sweep
	Power sweep range	20 dB (minimum)

Continued on next page

Receiver specs	Average noise level	–100 dBm in 10 Hz IF Bandwidth (< 3 GHz); Typically > –110 dBm in narrowband sweep –90 dBm in 10 Hz IF Bandwidth (> 3 GHz); Typically > –100 dBm in narrowband sweep
	Maximum input level	+27 dBm, +20 dBm noise figure mode
	Damage level	> +30 dBm, > +23 dBm noise figure mode
Measurement speed summary		Measurement times are measured using a single trace (S_{21}) display and one average. The measurement speeds for the communications band are measured in a 25 MHz band from 824 – 849 MHz. The typical measurement times displayed are as follows:

Data points	IF bandwidth (Hz)	10 MHz to 3 GHz (ms)	10 MHz to 6 GHz (ms)	10 MHz to 9 GHz (ms)	Communications band (ms)
51	30 kHz	16	18	31	11
	10 kHz	21	23	3 5	16
	3 kHz	32	35	46	27
	1 kHz	66	69	76	61
	300 Hz	187	189	203	184
101	30 kHz	26	28	40	20
	10 kHz	35	38	48	28
	3 kHz	57	60	71	50
	1 kHz	126	129	138	120
	300 Hz	366	370	380	368
201	30 kHz	44	48	64	37
	10 kHz	61	65	81	52
	3 kHz	106	110	126	98
	1 kHz	242	246	262	234
	300 Hz	716	720	740	712
401	30 kHz	80	87	110	70
	10 kHz	114	121	146	104
	3 kHz	206	212	236	196
	1 kHz	480	484	508	468
	300 Hz	1424	1432	1448	1408
801	30 kHz	150	161	202	130
	10 kHz	218	230	270	198
	3 kHz	400	412	456	380
	1 kHz	952	960	1000	928
	300 Hz	2820	2840	2900	2800

Measurement capabilities	Parameters	S_{11}, S_{21}, S_{22}, S_{12}, S_{33}, S_{23}, S_{32}, S_{13}, S_{31}, S_{14}, S_{24}, S_{34}, S_{44}, S_{41}, S_{42}, S_{43}, Harmonics, Noise Figure, Intermodulation Distortion (IMD), and user-defined combinations of a_1, a_2, a_3, a_4, b_1, b_2, b_3, and b_4. Mixed-Mode terms, too.
	Measurement frequency range	Frequency range of measurement can be narrowed within the calibration range without recalibration. CW mode permits single frequency measurements, also without recalibration. In addition, the system accepts N discrete frequency points where 2 <N <1601.
	Domains	Frequency Domain, CW Draw, and optional High Speed Time (Distance) Domain
	Formats	Log Magnitude, Phase, Log Magnitude & Phase, Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, Log Polar, Group Delay, Linear Magnitude, Linear Magnitude and Phase, Real, Imaginary, Real & Imaginary, SWR, and Power
	Data points	1601 maximum. Number of data points can be switched to a value of 801, 401, 201, 101, 51, 15, or 3 points without recalibration (if 1601 points were used in the calibration). In addition, the system accepts an arbitrary set of N discrete data points where 2 ≤N ≤1601. CW mode permits selection of a single data point without recalibration.
	Reference delay	Can be entered in time or in distance (when the dielectric constant is entered). Automatic reference delay feature adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between reference and test is always accurate and stable since measurement frequencies are always synthesized. In addition, the system compensates reference phase delay for dispersive transmission media such as microstrip.
	Alternate sweep	Allows the ability to decouple channel 1 and 2 from channel 3 and 4 for the following parameters: correction type, start and stop frequencies, number of data points, markers, sweep time, averaging, smoothing, and IF bandwidth.
	Markers	Twelve independent markers can be used to read out simultaneous measurement data. In alternate sweep mode there are sets of markers for each frequency sweep. In delta reference marker mode, any one marker can be selected as the reference for the other eleven. Markers can be directed automatically to the minimum or maximum of a data trace.
	Enhanced markers	Marker search for a level or bandwidth, displaying an active marker for each channel, and discrete or continuous (interpolated) markers. Identifies the X dB bandwidth of amplifiers, filters, and other frequency sensitive devices.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limit lines	Either single or segmented limit lines can be displayed. Two limit lines are available for each trace.
	Single limit readouts	Interpolation algorithm determines the exact intersection frequencies of data traces and limit lines.
	Segmented limit lines	A total of 20 segments (10 upper and 10 lower) can be generated per data trace. Complete segmented traces can be offset in both frequency and amplitude.
	Test limits	Both single and segmented limits can be used for PASS/FAIL testing. PASS or FAIL status is indicated on the display after each sweep. In addition, PASS/FAIL status is output through the rear panel I/O connector as selectable TTL levels (PASS=0V, FAIL=+5V, or PASS=+5V, FAIL=0V).
	Tune mode	Tune Mode optimizes sweep speed in tuning applications by updating forward S-parameters more frequently than reverse ones. This mode lets users select the ratio of forward sweeps to reverse sweeps after a full 12-term calibration. The ratio of forward sweeps to reverse sweeps can be set anywhere between 1:1 to 10,000:1.
	Power sweep measurements	Both Swept Power Gain Compression and Swept Frequency Gain Compression modes are available.
	Sequencing	Seven measurement sequences can be created, stored, edited, and run from the front panel. Sequences can include front-panel functions as well as user-definable control statements. Sequences can be run from either the unit front panel, via GPIB, or from an AT-style keyboard plugged into the front panel.
	Harmonic measurement	Measurement/display of fundamental, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, & 9th harmonic

Continued on next page

Display capabilities	Display channels		Four, each of which can display any S-parameter or user-defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously. Each channel is also capable of displaying harmonics, noise figure, intermodulation distortion, or time domain trace. A single channel, two channels (1 and 3, or 2 and 4), or all four channels can be displayed simultaneously. Channels 1 and 3, or channels 2 and 4, can be overlaid for rectilinear graph types.
	Trace overlay		Displays two data traces on the active channel's graticule simultaneously. The overlaid trace is displayed in yellow and the primary trace is displayed in red.
	Trace memory		A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data.
	Blank frequency information		Blanking function removes all references to displayed frequencies on the LCD. Frequency blanking can only be restored through a system reset or GPIB command.
Measurement enhancements	Data averaging		Averaging of 1 to 4096 averages can be selected. The data averaging function is performed at each data point during the frequency sweep. Averaging can be toggled on or off via the front panel; a front-panel LED indicates that the data averaging function is enabled.
	IF bandwidth		Soft Key selection of IF bandwidth (30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, 30 Hz, 10 Hz)
	Trace smoothing		Computes an average over a percentage range of the data trace. The percentage of trace to be smoothed can be selected from 0 to 20% of trace.
	Group delay characteristics	Group delay	Group delay is measured by computing the phase change in degrees across a frequency step by applying the formula: $Tg = \frac{-1/360\ d(phase)}{d(frequency)}$
		Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture and the percent of the frequency range are displayed automatically.
		Range	The maximum delay range is limited to measuring no more than ±180° of phase change within the aperture set by the number of frequency points. A frequency step size of 100 kHz corresponds to 10 microseconds.
		Measurement repeatability (sweep to sweep)	For continuous measurement of a through connection, RSS fluctuations due to phase and FM noise are: $\frac{1.41 \{(Phase\ Noise)^2 + (Tg \times Residual\ FM\ Noise)^2\}^{.5}}{360\ (Aperture\ in\ Hz)}$
		Accuracy	$Error\ in\ Tg = \frac{\frac{Error\ in\ phase}{360} + (Tg \times Aperature\ Freq.\ Error\ (Hz))}{Aperture}$
		Frequency Translating Group Delay (FTGD)	Allows the measurement of group delay of mixers and other translating devices by analyzing the phase shift experienced by a modulated signal (generated internally). The above Group Delay equation applies, except that the phase change is measured across the modulating bandwidth of the test signal instead of across frequency points. The aperture is fixed at about 900 kHz and the range is limited to about 1 µs. The use of angle modulation keeps the measurement relatively immune from compression and other non-linearities.
	LRL/LRM calibration capability		The LRL calibration technique uses the characteristic impedance of a length of transmission line as the calibration standard. A full LRL calibration consists merely of two transmission line measurements, a high reflection measurement, and an isolation measurement. The LRM calibration technique is a variation of the LRL technique that utilizes a precision termination rather that a second length of transmission line. A third optional standard, either Line or Match may be measured in order to extend the frequency range of the calibration. This extended calibration is achieved by mathematically concatenating either two LRL, two LRM, or one LRL and one LRM calibration(s). Using these techniques, full 12-term error correction can be performed on the MS462XX VNA.
	Dispersion compensation		Selectable as Coaxial (non-dispersive), Waveguide, or Microstrip (dispersive)
	Reference plane		Selectable as Middle of line 1 or Ends of line 1
	Corrected impedance		Determined by Calibration Standards
	AutoCal®		The Scorpion™ family incorporates internal control of the 3658X-series AutoCal® modules.
	FlexibleCal™		Optimize throughput by performing only the sweeps required to characterize multi-port devices. Also enables convenient switching between 2, 3 and 4 port calibration without recalibration.
Hard copy	Printer		Scorpion™ supports the HP 2225C InkJet, HP QuietJet, HP DeskJet, HP LaserJet II, III, IV, & V Series, and Epson compatible printers with parallel (Centronics) interfaces. They are also compatible with the ANRITSU "VNA Capture" program (outputs bitmap file over GPIB) and provide bitmap output over front panel to disk.
	GPIB plotters		Scorpion™ supports the HP Models 7440A, 7470A, and 7475A and Tektronix Model HC100 plotters.
Storage	Internal memory		Ten front panel states (setup/calibration) can be stored and recalled from nonvolatile memory locations. The current front panel setup is automatically stored in nonvolatile memory at instrument powerdown. When power is applied, the instrument returns to its last front-panel setup. The system will be able to exchange two stored calibrations in <0.5 s.
	Internal nonvolatile memory		Used to store and recall measurement and calibration data and front panel setups. All files are MS-DOS compatible.
	Internal floppy disk drive		A 3.5 inch diskette drive with 1.44 Mb formatted capacity is used to load measurement programs and to store and recall measurement and calibration data and front panel setups.
	Measurement data		102.8 kb per 1601 point S-parameter data file
	Calibration data		187.3 kb per 1601 point S-parameter data file (12-term cal plus setup)
	Trace memory file		12.8 kb per 1601 point channel
GPIB	GPIB interfaces		2 ports
	System GPIB (IEEE-488.2)		Connects to an external controller for use in remote programming of the network analyzer. Address can be set from the front panel and can range from 1 to 30.
	Dedicated GPIB		Connects to external peripherals for network analyzer controlled operations (e.g., GPIB plotters, frequency counters, frequency synthesizers, and power meters).

Continued on next page

General	Power requirements	85-240V, 48-63 Hz, 540 VA maximum
	Dimensions	222H x 425W x 450D mm (8.75 x 16.75 x 17.75 in)
	Weight	< 23kg. (52 lb.)
Environmental	Storage temperature range	–40°C to +75°C.
	Operating temperature range	0°C to +50°C (specifications apply at 23°C ±3 °C).
	Relative humidity	5% to 95% at +40°C.
EMC	Meets the emissions and immunity requirements of	EMC Directive - 89/336/EEC
		EN50081-1:1992
		CISPR-11:1990/EN55011:1991 Group 1 Class A
		EMC Directive - 89/336/EEC per EN61326
		EMMISSIONS Standard EN55011:1991 IEC 61000-3-2 IEC 61000-3-3
		IMMUNITY Standard IEC 1000-4-2:1995/prEN50082-1:1995 - 4kV CD, 8kV AD IEC 1000-4-3:1995/ENV50140:1994 - 3V/m IEC 1000-4-4:1995/prEN50082-1:1995 -500V SL; 1000V PL IEC 1000-4-5:1995/prEN50082-1:1995 - 2kV L-E, 1kV L-L IEC 1000-4-6:1995/ENV50141:1994 IEC 1000-4-8:1995/prEN50082-1:1995 IEC 1000-4-11:1995/prEN50082-1:1995
	Safety	Meets safety requirements of Low Voltage/Safety Standard 72/23/EEC - EN61010-1:1993

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS4622A	10MHz – 3GHz transmission/reflection
MS4622B	10MHz – 3GHz active reversing
MS4622D	10MHz – 3GHz Balanced / Differential 4-Port
MS4623A	10MHz – 6GHz transmission/reflection
MS4623B	10MHz – 6GHz active reversing
MS4623D	10MHz – 6GHz Balanced / Differential 4-Port
MS4624A	10MHz – 9GHz transmission/reflection
MS4624B	10MHz – 9GHz active reversing
MS4624D	10MHz – 9GHz Balanced / Differential 4-Port
	Options
Option 1	Rack mount kit with slides
Option 2	Time domain
Option 3A	Adds to MS4622B a 2nd internal source (3 GHz source) + 3rd port
Option 3B	Adds to MS4623B a 2nd internal source (6 GHz source) + 3rd port
Option 3E	Adds to MS4624B a 2nd internal source (9 GHz source) + 3rd port
Option 4*1	Noise figure 50 MHz to 3 GHz (only for B models)
Option 4B*1	Noise figure 50 MHz to 6 GHz (only for B models)
Option 4F*1	Noise figure 50 MHz to 3 GHz (only for D models)
Option 4G*1	Noise figure 50 MHz to 6 GHz (only for D models)
Option 5	Frequency translation group delay
Option 6*2	3rd test port (B models; for use with external synthesizer)
Option 7	T/R step attenuator (only for A models, standard on B)
Option 8	Harmonic measurement
Option 11*3	Test Port connector
Option 13	Intermodulation distortion
	AutoCal®
36581NNF/2	AutoCal®, Type N, 10 MHz to 9 GHz
36581KKF/2	AutoCal®, Type K, 10 MHz to 9 GHz
36584KF	AutoCal®, 4-Port Type K, 10 MHz to 9 GHz
36584NF	AutoCal®, 4-Port Type N, 10 MHz to 9 GHz

Model/Order No.	Name
	Noise sources
NC346A	5 dB ENR noise source (3.5 mm)
NC346B	15 dB ENR noise source (3.5 mm)
	Calibration kits
3750R	SMA/3.5 mm RF Cal Kit ≤9 GHz
3750R/1	Adds a set of five Phase Equal Insertables (PEIs)
3750R/3	Adds additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations.
3751R	GPC-7 RF Cal Kit ≤9 GHz
3751R/2	Adds a third GPC-7 termination required for three port calibrations.
3751R/3	Adds two additional GPC-7 terminations required for four port calibrations.
3753R	50 Ω, Type N, RF Cal Kit ≤9 GHz
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations required for four port calibrations.
3753-75R	75 Ω, Type N, RF Cal Kit ≤9 GHz
3753-75R/3	Adds additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations.
	Verification kits
3663R	Type N verification kit
3666R	SMA/3.5 mm verification kit
3667R	GPC-7 verification kit
	Accessories
15LL50-0.3A	3.5 mm Male-Male Cable, 30 cm
15LL50-0.6A	3.5 mm Male-Male Cable, 60 cm
15LLF50-0.3A	3.5 mm Male-Female Cable, 30 cm
15LLF50-0.6A	3.5 mm Male-Female Cable, 60 cm
15NN50-0.3B	Type N Male-Male Cable, 30 cm
15NN50-0.6B	Type N Male-Male Cable, 60 cm
15NNF50-0.3B	Type N Male-Female Cable, 30 cm
15NNF50-0.6B	Type N Male-Female Cable, 60 cm

*1: Does not include noise source.
*2: Port 3 is a receiving port only, unless using an external synthesizer.
*3: Standard connector is N-female, no cost option for 3.5 mm (male), 3.5 mm (female), N-male, or GPC-7.

VECTOR NETWORK MEASUREMENT SYSTEM / DIRECT-ACCESS RECEIVER

Ethernet / GPIB

MS4622C, MS4623C, MS4624C

10 MHz to 3 GHz **10 MHz to 6 GHz** **10 MHz to 9 GHz**

For Measuring Antennas, Frequency Conversion, and Multiple-Output Devices

The MS462XC series of RF vector network analyzers are configured as direct-access receivers for antenna, frequency conversion, and multiple output device measurements. The MS462XC offers ultimate flexibility to meet most receiver measurement needs while maintaining the ability to measure all four S-parameters with the addition of a reflectometer setup at the front end of the receiver.

The MS462XC series offers three wide-band RF models covering the 10 MHz to 3 GHz, 6 GHz or 9 GHz ranges, MS4622C, MS4623C, and MS4624C, respectively.

Applications

• Mixers

Mixers are integral components of most measurement systems. Mixer measurements are complicated by the fact that an LO is required and multiple frequencies are involved in the complete measurement of a mixer. In addition, the mixer is non-linear so power levels must be carefully considered, and in many instances non-linear effects such as compression and intermodulation distortion must be measured. The MS462XC has many features that simplify mixer measurements. The MS462XC can include two built in sources, to provide both the LO and RF signal required by the mixer – the system automatically tunes the receiver to the appropriate IF frequency. The unit can control additional external sources as required for intermodulation measurements.

The setup of the sources is obviously quite important in a mixer measurement. The Mixer device type simplifies this task somewhat. It allows the quick selection of which source is to be the DUT LO. It allows simple selection of a fixed LO or fixed IF measurement scenario (and specifying that LO or IF frequency). And, it informs the receiver of what kind of DUT conversion to expect (up conversion |RF+LO|, down conversion |RF –LO|, or no conversions might be used for a quick leakage measurement). Activating the mixer device type also performs the important function of turning on both internal sources for front panel access (usually using ports 1 and 3 driving, port 2 being the receive port). Two ports are not allowed to drive simultaneously during normal S-parameter measurements.

• Antennas

Far-field measurements are enhanced with the speed of taking data over GPIB, using fast CW mode. Rates of 8,900 points per second can be achieved.

Specifications

General measurement and enhancement display capabilities are the same as those for the MS4622A/B/D, MS4623A/B/D, MS4624A/B/D.

Number of channels	Four measurement channels
Operating port power (A1, A2, B1 and B2)	–5 dBm for 0.1 dB compression
Maximum port power for no damage	+20 dBm
Noise floor	–110 dBm@10 Hz IF bandwidth (<3 GHz), typically >–120 dBm in narrowband sweep; –100 dBm@10 Hz IF bandwidth (>3 GHz), typically >–110 dBm in narrowband sweep
System dynamic range	97 dB
Power output range (ports 1, 2 and 3)	MS4622C: +10 to –85 dBm MS4623C: +7 to –85 dBm MS4624C: +7 to –85 dBm
Source match (RF1, RF2 and RF3)	–9 dB (uncorrected)
Port match (A1, A2, B1 and B2)	–12 dB (uncorrected)
Frequency range	MS4622C: 10 MHz to 3 GHz MS4623C: 10 MHz to 6 GHz MS4624C: 10 MHz to 9 GHz
2nd internal source	Optional
Intermodulation Distortion	Optional
IMD (3rd order) dynamic range	70 dB with 10 Hz IF bandwidth @ 300 kHz tone separation and @ –20 dBm tone levels
IMD accuracy	±1 dB @ > –60 dBm levels
Power measurement accuracy	±1 dB without flat power calibration ±0.1 dB with flat power calibration
Full reversing transfer switch	Provided

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Mainframe
MS4622C	10 MHz to 3 GHz direct receiver access
MS4623C	10 MHz to 6 GHz direct receiver access
MS4624C	10 MHz to 9 GHz direct receiver access
	Options
Option 1	Rack mount kit with slides
Option 2	Time domain
Option 3C	Adds to MS4622C a 2nd internal source (3 GHz source) + 3rd port
Option 3D	Adds to MS4623C a 2nd internal source (6 GHz source) + 3rd port
Option 3F	Adds to MS4624C a 2nd internal source (9 GHz source) + 3rd port
Option 4D*3	Noise figure 50 MHz to 3 GHz (only for C models)
Option 4E*3	Noise figure 50 MHz to 6 GHz (only for C models)
Option 5	Frequency translated group delay
Option 6	3rd test port (only for B and C models)
Option 7	T/R step attenuator (only for A models, standard on B)
Option 8*1	Harmonic measurement
Option 11*2	Test Port connector
Option 13	Intermodulation distortion
	Noise sources
NC346A	5dB ENR noise source (3.5 mm)
NC346B	15dB ENR noise source (3.5 mm)

*1: Subject to frequency range limitations imposed by test set.
*2: Standard connector is N-female, no cost option for 3.5 mm (male), 3.5mm (female), N-male, or GPC-7.
*3: Does not include noise source.

8

POWER AMPLIFIER TEST SYSTEM (PATS)

ME7840A

GPIB

800 to 2400 MHz, 100 Watts / 10 to 6000 MHz, 5 Watts

Easy-to-Use System for Power Amplifier Design and Manufacturing

PATS

HATS (Option 4)

The ME7840A Power Amplifier Test System (PATS) is a flexible, easy-to-use system for base station power amplifier testing and with the introduction of the new option 4 Handset Amplifier Test Set (HATS) it now provides full coverage to handle all of your power amplifier testing needs.

Key Benefits

- Versatility to characterize most power and handset amplifiers
- Consolidate multiple test stations and connections to increase productivity
- Improve accuracy and repeatability of S-parameter, Harmonics, Gain Compression, Intermodulation Distortion (IMD), and Adjacent Channel Power Ratio (ACPR) measurements
- Flexibility to accommodate future requirements with auxiliary paths
- Scorpion Navigator™ enables test executive integration in about a week

PATS consists of three distinct parts: The Scorpion Navigator Software, the MS462xC Vector Network Measurement System, and the MS4782D Test Set.

Measurement capabilities:

Measurements	CW	Swept Frequency (as fast as 150 µsecs/pt)	Swept Power (as fast as 150 µsecs/pt)
ACPR	√		√ *1
S-Parameters Hot S_{22}	√	√	√
IMD, TOI (two-tone): 3^{rd}, 5^{th}, 7^{th}, & 9^{th}	√	√	√
Gain Compression: P_1 dB AM/PM	 √ √	 √ 	 √ √
Harmonics: Magnitude Phase	√	√ √	√
Noise Figure*2	√	√	
Power Added Efficiency (PAE)	√	√	√
Drain Current	√	√	√

*1: Swept power speed is related to external source
*2: Noise Figure only available with option 4 (HATS test set)

- **Scorpion Navigator Software**

The Scorpion Navigator software is installed on your computer to orchestrate the PATS and HATS measurements. The computer should be a Pentium II at 200 MHz or equivalent system with a GPIB Card (computer not included).

- **MS462xC Vector Network Measurement System (VNMS)**

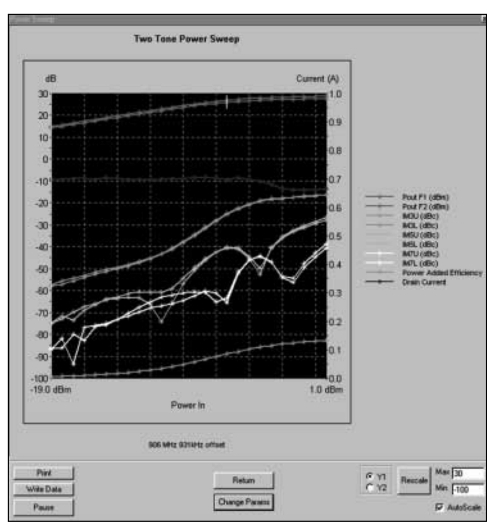
The MS462xC is the Direct Receiver Access (DRA) configuration for the MS462xx family of Vector Network Measurement Systems (VNMS). The MS462xC series is available in two wide-band RF models covering the 10 MHz to 3 GHz or 6 GHz range (MS4622C and MS4623C respectively).

- **MS4782D Test Set (Option 4, MN4783A)**

The MS4782D or MN4783A (option 4) Test Set provides the necessary hardware to interface between your power amplifier and the VNMS.

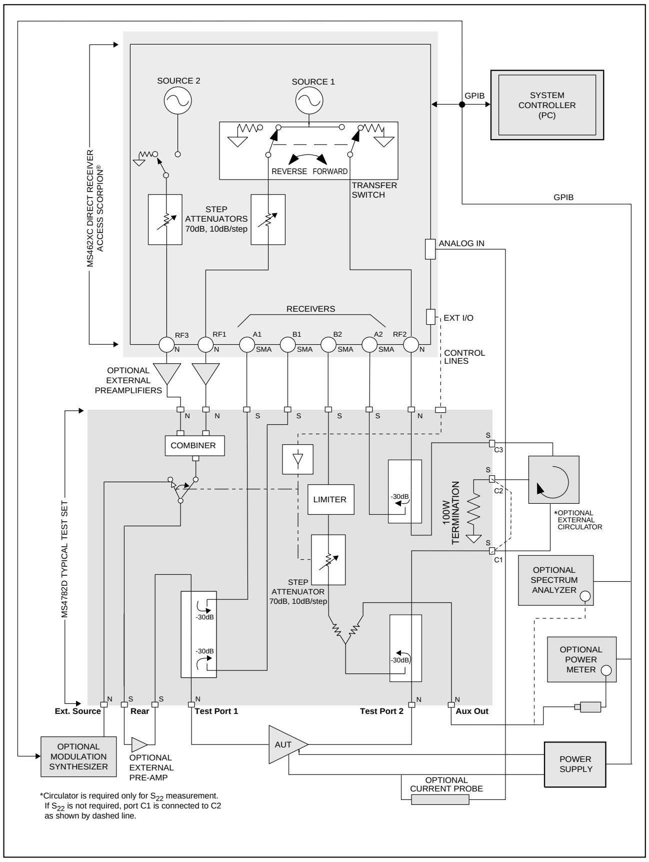
Scorpion Navigator Software Results

With frequency sweeps as fast as 150 µs/point and power sweeps as fast as 150 µs/point, you can quickly, thoroughly, and accurately characterize your power amplifiers in real-time.
Simultaneously overlay measurements in both frequency and power and see the results of over 250 data points updated twice per second.



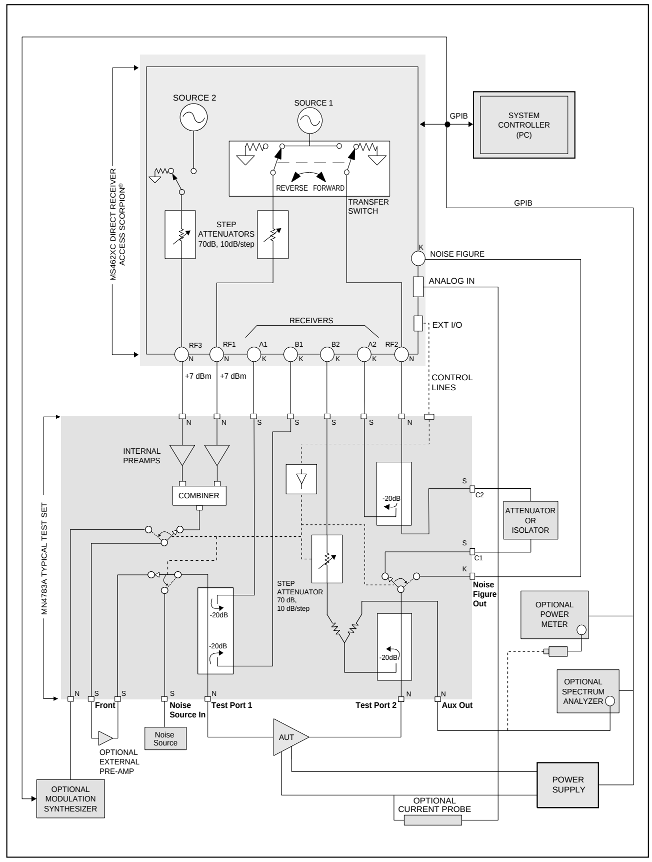
Power Amplifier Test Set Block Diagram

The following block diagram depicts the standard MS4782D Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



Handset Amplifier Test Set Block Diagram

The following block diagram depicts the standard MS4782D Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



Specifications

Characteristic	Value	Notes
Amplifier Under Test Power Output	100W max	Without Hot S_{22} provision (Contact Anritsu for custom designs for higher power)
Bandwidth through Test Set	800 MHz – 2.4 GHZ	Without S_{22} provision (Contact Anritsu for custom designs for different frequency ranges)
Amplifier Under Test Input Power range available from PATS	–85 dBm to +10 dBm	This value is for each tone, at combiner input. Provision for preamplifiers provided for greater levels
IMD (3rd order) Dynamic Range	70 dB min	With 10 Hz IF bandwidth @ 300 kHz tone separation and –20 dBm tone levels
IMD Accuracy	±1 dB max	@ >–60 dBc levels
Port Power Accuracy	±0.1 dB typical ±1 dB max	With flat power calibration Without flat power calibration
Dynamic Range	80 dB min	Over-all system including Test Set
Port Match (test ports 1 & 2)	40 dB min	Corrected value
Port Match (test ports 1 & 2)	13 dB min	Uncorrected value
Directivity	40 dB	800 MHz – 2.4 GHz, Corrected value

Specifications

Characteristic	Value	Notes
Amplifier Under Test Power Output	5W max	–
Bandwidth through Test Set	10 MHz – 6.0 GHZ	–
Amplifier Under Test Input Power range available from HATS	–65 dBm to +13 dBm	This value is for each tone, at combiner input. Provision for preamplifiers provided for greater levels
IMD (3rd order) Dynamic Range	70 dB min	With 10 Hz IF bandwidth @ 300 kHz tone separation and –20 dBm tone levels
IMD Accuracy	±1 dB max	@ >–60 dBc levels
Port Power Accuracy	±0.1 dB typical ±1 dB max	With flat power calibration Without flat power calibration
Dynamic Range	80 dB typical 70 dB typical	10 MHz to 3 GHz 3 GHz to 6 GHz
Port Match 10 MHz to 3 GHz	40 dB (corrected) 13 dB (uncorrected)	Uncorrected match for Test Port 2 is typically 20 dB
Port Match 3 GHz to 6 GHz	37 dB (corrected) 13 dB (uncorrected)	Uncorrected match for Test Port 2 is typically 18 dB
Directivity	40 dB	50 MHz – 6 GHz, Corrected value
Noise Figure	50 MHz – 6 GHz	

Ordering information

Please specify model/order number, name, and quantity when ordering. Anritsu can configure and optimize a custom test set for your specific requirements. The following information represents the standard configuration and options.

Model/Order No.	Name
	Main frame
ME7840A	PATS, 800 to 2400 MHz, 100 Watts
MS4623C*1,2	Scorpion®, DRA configuration, 10 MHz to 6 GHz
MS4600/3D	Scorpion® optional 6 GHz internal source with 3rd test port
MS4600/8	Scorpion® optional harmonic measurement application
MS4600/13	Scorpion® optional intermodulation distortion application
MS4782D	PATS Test Set (100 Watts, 800 – 2400 MHz)*3
43425	Accessories and interconnect kit
	Scorpion Navigator™
	Options
ME7840/1	Replace MS4623C with MS4622C (3 GHz option)
ME7840/2	Replace MS4782D test set with MS4782A
ME7840/3	Delete Test Set
ME7840/4	Handset Amplifier Test Set (HATS) (5 Watts, 10 – 6000 MHz)
	Circulators
	Circulators may be required for measurements of Hot S_{22}:
1000-50	Circulator, 800 – 1000 MHz, 20 dB min, 50 Watts Max AUT Power
1000-52	Circulator, 1.8 – 2.5 GHz, 20 dB min, 50 Watts Max AUT Power, (connecting cable(s) not included)
1000-53	Circulator, 1.8 – 2.5 GHz, 22 dB min, 79 Watts Max AUT Power
	Note: All circulators have 3 SMA female connectors.
	Current Probes
	Current Probes are required for drain current and Power Added Efficiency (PAE) calculations:
2000-1067	Current Probe Max current: 100mV/A:10A, 10mV/A:100A Accuracy (at lesser current range setting): 3% of reading ±50mA
2000-1085	Current Probe Max current: 1mV/mA:1A, 10mV/A:80A Accuracy (at lesser current range setting): 2% of reading ±5mA
	Calibration kits
3750R	SMA/3.5 mm RF Cal Kit ≤9 GHz
3750R/1	Adds a set of five Phase Equal Insertables (PEIs)
3750R/3	Adds additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations.
3753R	50 Ω, Type N, RF Calkit ≤9 GHz
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations required for four port calibrations.
	AutoCal®
36581NNF/2	AutoCal, Type N, 10 MHz to 9 GHz
36581KKF/2	AutoCal, Type K, 10 MHz to 9 GHz
	Economy cables
15LL50-0.3A	3.5 mm Male-Male Cable, 30 cm
15LL50-0.6A	3.5 mm Male-Male Cable, 60 cm
15LLF50-0.3A	3.5 mm Male-Female Cable, 30 cm
15LLF50-0.6A	3.5 mm Male-Female Cable, 60 cm
15NN50-0.3B	Type N Male-Male Cable, 30 cm
15NN50-0.6B	Type N Male-Male Cable, 60 cm
15NNF50-0.3B	Type N Male-Female Cable, 30 cm
15NNF50-0.6B	Type N Male-Female Cable, 60 cm

*1: ME7840A standard connector type is N-female.
*2: Scorpion® DRA rear panel Reference Channel Connectors a1, a2, b1, and b2 are SMA-female connectors.
*3: Special test sets can be configured for other power levels and frequency ranges.

Anritsu

TOWER MOUNTED AMPLIFIER TEST SYSTEM (TMATS)
ME7842B
10 to 6000 MHz

CE GPIB

Fully Characterize and Test Tower Mounted Amplifiers (TMAs) with a Single Connection

The result of working with a top infrastructure provider of Node B base station components, the ME7842B is a measurement system capable of simplifying the complexity of multi-port Tower Mounted Amplifier (TMA) test. With innovative instrumentation, flexible multi-port test set and easy-to-use software, TMATS has dramatically reduced TMA test times from hours to just minutes. The easy-to-use software, the Scorpion Navigator™, includes unprecedented features that enable integration into any manufacturing environment in about a week. The solution is now commercialized and ready to tackle your toughest TMA measurement requirements.

Key Benefits
- Versatility to characterize most TMA configurations (2 – 5 ports)
- Consolidate multiple test stations and connections to increase productivity
- Improve accuracy and repeatability of S-parameter, Harmonics, Gain Compression, Intermodulation Distortion (IMD), Noise Figure (NF), and Adjacent Channel Power Ratio (ACPR) measurements
- Flexibility to accommodate future requirements with auxiliary paths
- Scorpion Navigator enables test executive integration in about a week

TMATS consists of three distinct parts: The Scorpion Navigator software, MS462xB Vector Network Measurement System, and the MN4790A Test Set.

- **Scorpion Navigator Software**

The Scorpion Navigator software is installed on your computer to orchestrate the TMATS measurements. The computer should be a Pentium II at 200 MHz or equivalent system with a GPIB Card (computer not included).

- **MS462xB Vector Network Measurement System (VNMS)**

The MS462xB is a powerful full reversing S-parameter configuration offering performance, ease-of-use and the versatility that is required in TMA testing.
The MS462xB series is available in two wide-band RF models covering the 10 MHz to 3 GHz or 6 GHz range (MS4622B and MS4623B respectively).

- **MN4790A Test Set**

The MN4790A Test Set provides the necessary hardware to interface between your tower mounted amplifier (TMA) and the VNMS.

8

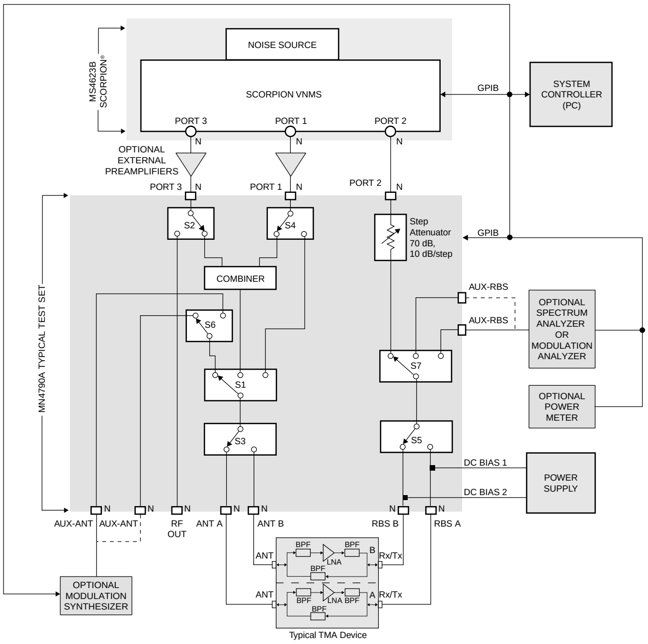
Measurement capabilities:

Measurements	CW	Swept Frequency (as fast as 150 µsecs/pt)	Swept Power (as fast as 150 µsecs/pt)
Noise Figure	√	√	
ACPR	√		√∗
S-Parameters	√	√	√
IMD, TOI (two-tone): 3rd, 5th, 7th, & 9th	√	√	√
Gain Compression: P_1 dB AM/PM	√ √	√	√ √
Harmonics: Magnitude	√	√	√
Power Added Efficiency (PAE)	√	√	√

∗ Swept power speed is related to external source

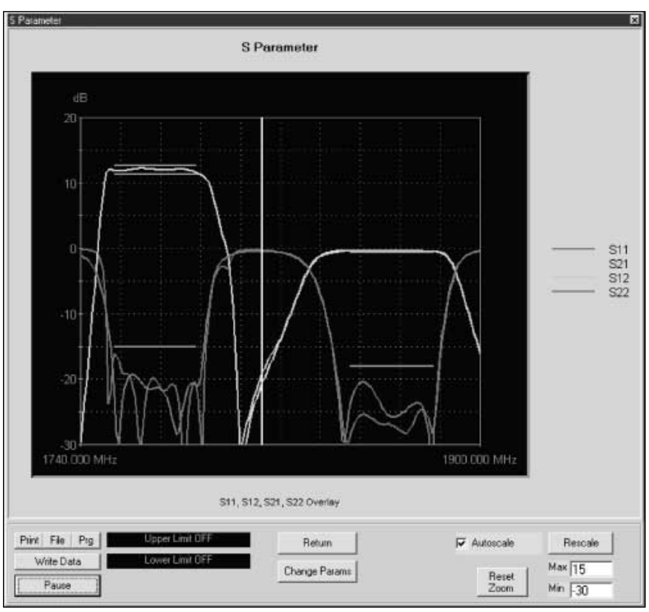
TMATS Block Diagram

The following block diagram depicts the standard MN4790A Test Set design. Anritsu can configure and optimize a custom test set for your specific requirements.



Scorpion Navigator Software Results

The Scorpion Navigator is optimized for testing both current and future TMA configurations. Once calibrated, simply choose the desired TMA path and the necessary measurement. That's all it takes to begin. Manual operation is simplified with a flexible and easy-to-use graphical user interface optimized for testing a TMA. The standard list of measurements includes: S-parameters with clear pass/fail limit lines, compression, intermodulation distortion, harmonics, noise figure and adjacent channel power ratio.



Specifications

Characteristic	Specification
Frequency, Test Set	10 MHz to 6 GHz 500 MHz to 6 GHz for IMD
Maximum Power Level	+20 dBm
Input Power Range to DUT	0 dBm to –85 dBm
IMD (3rd Order) Dynamic Range	70 dBm
IMD Accuracy	±1 dB max (at >–60 dBc Levels)
Port Power Accuracy	±0.1 dB typical (with flat power Levels)
Dynamic Range	80 dB typical
Directivity	40 dB (10 MHz to 3 GHz, corrected) 35 dB (3 GHz to 6 GHz, corrected)
Source Match	35 dB (10 MHz to 6 GHz, corrected)
Isolation between DUT Ports ANTA ↔ ANTB RBSA ↔ RBSB ANTn ↔ RBSn	 60 dB 60 dB 100 dB
Damage Level (test set)	>+27 dBm

Ordering information

Please specify model/order number, name, and quantity when ordering. Anritsu can configure and optimize a custom test set for your specific requirements. The following information represents the standard configuration.

Model/Order No.	Name
	The ME7842B* System consists of the following:
MS4623B*	Scorpion®, 10 MHz to 6 GHz
MS4600/3B	Scorpion® optional 6 GHz internal source with 3rd test port
MS4600/4B	Scorpion® optional 6 GHz noise figure
MS4600/8	Scorpion® optional harmonic measurement application
MS4600/13	Scorpion® optional intermodulation distortion application
MN4790A*	TMATS test set
ND57610	Accessories and interconnect kit includes Scorpion® Navigator Software

* ME7842B standard connector type is N-female.

The following information represents the options.

Model/Order No.	Name
	Calibration kits
3753R	Type N RF Calibration Kit (9 GHz)
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations
	AutoCal®
36581NNF/2	AutoCal, 2-Port N, 10 MHz to 9 GHz
36585NF	AutoCal, 4-Port N, 10 MHz to 9 GHz
	Economy cables
806-109	Type N Male to 7/16 Male Cable, 60 cm
15NN50-0.3B	Type N Male to Male Cable, 30 cm
15NN50-0.6B	Type N Male to Male Cable, 60 cm
15NNF50-0.3B	Type N Male to Female Cable, 30 cm
15NNF50-0.6B	Type N Male to Female Cable, 60 cm
	Noise Sources
NC346A	5 dB ENR Noise Source, 3.5 mm connector
NC346B	15 dB ENR Noise Source, 3.5 mm connector

4 PORT VECTOR NETWORK ANALYZER AUTOMATIC CALIBRATOR
36584 Series
10 MHz to 9 GHz

Automatic, High-Reliability, and High-Quality Calibrators for Multi-port Coaxial Device Measurements

The 36584 series AutoCal® modules are automatic calibrators that provide fast, repeatable, and high-quality coaxial calibrations for 2, 3, and 4-Port S-parameter requirements up to 9 GHz. These modules contain precisely characterized calibration standards that aid in the removal of normal systematic errors when using the MS46XXA/B/C/D series Vector Network Measurement System (VNMS). The 4-Port AutoCal is available in two models: 10 MHz to 9 GHz, with N (f) connectors and 10 MHz to 9 GHz, with K (f) connectors. 4-Port AutoCal modules come with a data file characterizing each standard in the calibrator module. Each module is guaranteed to perform to its specifications for six months without re-characterization. Following this period, re-characterization can be performed by the customer, or by sending the module to the nearest service center. The 4-Port AutoCal has a direct serial interface to the MS462x series of Anritsu Vector Network Measurement Systems. The control software is built-in to the VNMS.

Features

• **Calibration types**
1-port S_{11} and S_{22} calibration, and full 2-port, 12-term OSLT, 3-port, 24-term OSLT, and 4-port, 40-term OSLT calibrations can be performed with the 4-Port 36584 series AutoCal.

• **Fast**
Significantly reduces calibration time making it ideal for the manufacturing environment.

• **Reliable**
Eliminates unreliable measurements due to inaccurate manual calibrations.

• **Accurate**
Accuracy that exceeds OSLT calibration, with broadband loads. Characterized modules are traceable to NIST.

• **True thru**
Inherently, the internal calibrator thru is not as accurate as an external direct thru connection. The true thru mode offers the choice of manually removing the AutoCal module for a true thru calibration.

• **Isolation cal**
Isolation cal is offered as part of a full 2, 3, or 4-port calibration. The user is given the option of skipping isolation, using the default averaging factor during isolation, or entering a custom averaging factor.

• **Thru update**
Due to cable movements and aging, periodically updating the thru portion of a calibration is recommended. Thru update mode offers the choice of simply performing a direct manual thru step to update a current calibration. This is easily performed without having to invoke the AutoCal module.

• **Manual control**
Manual control offers the ability to connect any of the internal standards to the test ports of the VNA. This feature could be used to manually verify a calibration.

• **Adapter removal**
VNA calibration for testing non-insertable devices requires phase equal insertables. If this is not possible, or is undesirable, adapter removal calibration is the solution. Adapter removal requires two full 12-term calibrations, moving an adapter from one test port cable to the other between calibrations (a job AutoCal makes quick and easy). Internal software mathematically subtracts the effect of the adapter, yielding the desired adapter-less measurement.

Specifications

All specifications are guaranteed over the ambient temperature range of 23° ±3°C.

• Directivity

Frequency	AutoCal Module
0.01 to 1 GHz	42 dB
1 to 3 GHz	40 dB
3 to 6 GHz	36 dB
6 to 9 GHz	34 dB

• Source match

Frequency	AutoCal Module
0.01 to 1 GHz	42 dB
1 to 3 GHz	39 dB
3 to 6 GHz	35 dB
6 to 9 GHz	33 dB

General

• Serial input connector

9 pin D-sub allowing PC or direct VNA control (Serial cable supplied)

• Power supply input connector

+5V, ±15V for the electronic modules, and +5V, +24V for the electromechanical module. The modules are keyed against plugging the wrong supply. The appropriate DC supply is supplied with each AutoCal module. These universal supplies will operate at either 110V or 220V input voltages.

• Power LED

On when the DC supply is plugged in.

• Operate LED

On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations.

• Dimensions

155 (W) x 65 (H) x 90 (D) mm (6 W x 2.5 H x 3.5 D in.)

Environment

• Operating temperature

18° to 28°C

• Storage temperature

–20° to 70°C

• Relative humidity

5% to 95% at 40°C

• EMC

Conforms to the EMC Directive, 89/336/EEC per EN61326
EN55011:1991
EN61000-3-2:1995
EN61000-3-3:1995
Immunity
EN61000-4-2:1995
EN61000-4-3:1995
EN61000-4-4:1995
EN61000-4-5:1995
EN61000-4-6:1995
EN61000-4-11:1995

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	AutoCal Modules
36584KF	4-Port AutoCal, K(f) type, 10 MHz to 9 GHz
36584NF	4-Port AutoCal, N(f) type, 10 MHz to 9 GHz
	Test port converter sets
36583S	SMA type
36583L	3.5 mm type
36583K	K type

AutoCal may be sent to the nearest service center for re-characterization, or a service engineer may perform the task at the customer's site. To minimize down-time, the customer can re-characterize the AutoCal module with a Lightning or Scorpion family VNA and a traditional cal kit.

VECTOR NETWORK ANALYZER AUTOMATIC CALIBRATOR

3658 Series

10 MHz to 40 GHz

Automatic, High-Reliability, and High-Quality Calibrators for Coaxial Device Measurements

The 3658 series AutoCal® modules are automatic calibrators that provide fast, repeatable, and high-quality coaxial calibrations up to 40 GHz. These modules contain precisely characterized calibration standards that aid in the removal of normal systematic errors when using vector network analyzers (VNAs). AutoCal is available in four models: 0.04 to 18 GHz, with N (m) to N (f) connectors, 0.01 to 9 GHz and 0.04 to 20 GHz, with K (m) to K (f) connectors, and 0.04 to 40 GHz, with K (m) to K (f) connectors.

AutoCal modules come with a data file characterizing each standard in the calibrator module. Each module is guaranteed to perform to its specifications for six months without re-characterization. Following this period, re-characterization can be performed by the customer, or by sending the module to the nearest service center.

Test port cable converter sets aid the user in calibrating a VNA for testing non-insertable devices and devices with SMA or 3.5 mm connectors. Test port converter sets are available for K Connector, SMA, and 3.5 mm connectors. Adapter removal calibration is required for N type non-insertable device testing.

AutoCal has a direct serial interface to the 37xxx and MS462x series of Anritsu vector network analyzers. The control software is built-in to the VNA. For operation with the 360B and/or older generation 37xxx models, an external PC running Microsoft Windows® with a National Instruments IEEE488.2 GPIB interface card is required.

Features

- **Calibration types**

1-port S_{11} and S_{22} calibration, and full 2-port, 12-term OSLT calibrations can be performed with AutoCal.

- **True thru**

Inherently, the internal calibrator thru is not as accurate as an external direct thru connection. The true thru mode offers the choice of manually removing the AutoCal module for a true thru calibration.

- **Isolation cal**

Isolation cal is offered as part of a full 2-port calibration. The user is given the option of skipping isolation, using the default averaging factor during isolation, or entering a custom averaging factor.

- **Switch averaging**

The mechanical module uses an electromechanical switch to select the calibration standards. Switch averaging is offered to reduce the effects of the electromechanical switch's non-repeatability. A 6 dB reduction of non-repeatability can be achieved by increasing switch averaging by a factor of four, at the expense of the overall calibration time.

- **Thru update**

Due to cable movements and aging, periodically updating the thru portion of a full 12-term calibration is recommended. Thru update mode offers the choice of simply performing a direct manual thru step to update a current calibration. This is easily performed without having to invoke the AutoCal module.

- **Manual control**

Manual control offers the ability to connect any of the internal standards to the test ports of the VNA. This feature could be used to manually verify a calibration.

- **Adapter removal**

VNA calibration for testing non-insertable devices, requires phase equal insertables. If this is not possible or is undesirable, adapter removal calibration is the solution. Adapter removal requires two full 12-term calibrations, moving an adapter from one test port cable to the other between calibrations (a job AutoCal makes quick and easy). Internal software mathematically subtracts the effect of the adapter, yielding the desired adapter-less measurement.

Specifications

All specifications are guaranteed over the ambient temperature range of 23˚ ±3˚C.

• Directivity

Frequency	AutoCal module	AutoCal with 36583X
0.01 to 2 GHz	38 dB	36 dB
2 to 20 GHz	36 dB	34 dB
20 to 40 GHz	34 dB	32 dB

• Source match

Frequency	AutoCal module	AutoCal with 36583X
0.01 to 2 GHz	34 dB	32 dB
2 to 18 GHz (N)	31 dB	29 dB
2 to 20 GHz (K)	34 dB	32 dB
20 to 40 GHz	26 dB	24 dB

• Reflection tracking

Frequency	AutoCal module	AutoCal with 36583X
0.01 to 2 GHz	±0.15 dB	±0.20 dB
2 to 20 GHz	±0.20 dB	±0.25 dB
20 to 40 GHz	±0.25 dB	±0.30 dB

• Transmission tracking (Internal thru mode)

Frequency	AutoCal module	AutoCal with 36583X
0.01 to 2 GHz	±0.15 dB	±0.20 dB
2 to 20 GHz	±0.20 dB	±0.25 dB
20 to 40 GHz	±0.25 dB	±0.30 dB

• Transmission tracking (True thru mode)

Frequency	AutoCal module	AutoCal with 36583X
0.01 to 2 GHz	±0.10 dB	±0.15 dB
2 to 20 GHz	±0.10 dB	±0.15 dB
20 to 40 GHz	±0.20 dB	±0.25 dB

General

• Serial input connector

9 pin D-sub allowing PC or direct VNA control. (Serial cable supplied)

• Power supply input connector

+5V, ±15V for the electronic modules, and +5V, +24V for the electro-mechanical module. The modules are keyed against plugging the wrong supply. The appropriate DC supply is supplied with each AutoCal module. These universal supplies will operate at either 110V or 220V input voltages.

• Power LED

On when the DC supply is plugged in.

• Operate LED

On when the module's internal temperature has stabilized at an optimum temperature for accurate calibrations.

• Dimensions

155 (W) x 65 (H) x 90 (D) mm (6 W x 2.5 H x 3.5 D in.)

Environment

• Operating temperature

18˚ to 28˚C

• Storage temperature

–20˚ to 70˚C

• Relative humidity

5% to 95% at 40˚C

• EMC

Conforms to the EMC Directive, 89/336/EEC per EN61326
EN55011:1991
EN61000-3-2:1995
EN61000-3-3:1995
Immunity
EN61000-4-2:1995
EN61000-4-3:1995
EN61000-4-4:1995
EN61000-4-5:1995
EN61000-4-6:1995
EN61000-4-11:1995

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	AutoCal modules
36581NNF	N type, 40 MHz to 18 GHz
36581NNF/2	N type, 10 MHz to 9 GHz
36581KKF	K type, 40 MHz to 20 GHz
36581KKF/2	K type, 10 MHz to 9 GHz
36582KKF	K type, 40 MHz to 40 GHz
	Test port converter sets
36583S	SMA type
36583L	3.5 mm type
36583K	K type
	Service
2300-228	Re-characterization Software (for 360B's and 37000's prior to serial number 992001)

AutoCal may be sent to the nearest service center for re-characterization, or a service engineer may perform the task at the customer's site. To minimize down-time, the customer can re-characterize the AutoCal module with a Lightning or Scorpion family VNA and a traditional cal kit.

VNA AND VNMS
Calibration Kits

For Performing Precise Calibrations of Vector Network Analyzers

3753R

3656

The Anritsu Calibration Kits contain all the precision components and tools required to calibrate your VNA or VNMS for error-corrected measurements in the connector style of your choice. Components are included for calibrating male and female test ports as required. The kits support calibration with opens, shorts, and broadband loads. Option 1 adds sliding terminations and a pin depth gauge where required.

Each calibration kit is individually serialized and characterized to ensure precise calibrations. A calibration coefficients diskette is included in the kit that is directly readable into the instrument.

The following kits are for use with 37XXX Lightning VNAs.

3650 SMA/3.5 mm Calibration Kit consisting of:
- 34ASF50-2 Female Adapter (2)
- 33FSF50 Female-Female Adapter (2)*
- 33SS50 Male-Male Adapter*
- 28S50-2 B Male Termination (2)
- 28SF50-2 Broadband Female Termination (2)
- 33SSF50-Male-Female Adapter (2)*
- 24S50 Male Open
- 23SF50 Female Open
- 23S50 Male Short
- 23SF50 Female Short
- 34AS50-2 Male Adapter (2)
- Connector Thumb Wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette

Option 1

Adds the following:
- 01-212 Female Flush Short
- 01-211 Male Flush Short
- 17SF50 Female Sliding Termination
- 17S50 Male Sliding Termination

3651 GPC-7 Calibration Kit consisting of:
- 28A50-2 Broadband Termination (2)
- 24A50 Open
- 23A50 Short
- 01-200 Torque Wrench
- 01-221 Collet Extractor Tool and 4 Collets
- Calibration coefficients diskette

Option 1

Adds the following:
- 17A50 Sliding Termination
- 01-210 Reference Flat
- 01-220 Pin Depth Gauge

3652 K Connector® Calibration Kit consisting of:
- 34AKF50-2 Female Adapter (2)
- 33FKF50 Female-Female Adapter (2)*
- 33KK50 Male-Male Adapter*
- 28K50-2 Male Termination (2)
- 28KF50-2 broadband Female termination (2)
- 33KKF50-Male-Female Adapter (2)*
- 24K50 Male Open
- 23KF50 Female Open
- 23K50 Male Short
- 23KF50 Female Short
- 34AK50-2 Male Adapter (2)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-222 Pin Depth Gauge
- 01-223 Pin Depth Gauge
- Calibration coefficients diskette
- Connector thumb wheel (4)

Option 1

Adds the following:
- 17KF50 Female Sliding Termination
- 17K50 Male Sliding Termination
- 01-212 Female Flush Short
- 01-211 Male Flush Short

8

* Phase Equal Adapters

3653 Type N Calibration Kit consisting of:
- 23NF50 Female Short
- 23N50 Male Short
- 24NF50 Female Open
- 24N50 Male Open
- 28N50-2 Broadband Male Termination (2)
- 28NF50-2B Broadband Female Termination (2)
- 34AN50-2 Male Adapter (2)
- 34ANF50-2 Female Adapter (2)
- 01-213 Reference Gauge
- 01-224 Pin Depth Gauge
- Calibration coefficients diskette

3654B V Connector® Calibration Kit consisting of:
- 23V50B-5.1 Male Short 5.1mm
- 23VF50B-5.1 Female Short 5.1mm
- 24V50B Male Open
- 24VF50B Female Open
- 28V50B Male Broadband Termination (2)
- 28VF50B Female Broadband Termination (2)
- 17VF50B Female Sliding Termination
- 17V50B Male Sliding Termination
- 33VV50 Male-Male Adapter*
- 33VFVF50 Female-Female Adapter (2)*1
- 33VVF50 Male-Female Adapter (2)*1
- Calibration coefficients diskette
- Connector thumb wheel (4)
- 01-201 Torque Wrench
- 01-210 Reference Flat
- 01-322 Pin Depth Gauge
- 01-323 Female Adapter for pin gauge
- 01-204 Adapter Wrench
- 01-312 Male Flush Short
- 01-311 Female Flush Short

3655 Waveguide Calibration Kit
The 3655 Calibration Kit contains all of the precision components and tools required to calibrate your VNA for 12-term error-corrected measurements of test devices with the appropriate waveguide designation. Components are included for calibrating both module ports. The kit supports calibration with offset shorts and broadband loads. Option 1 adds a sliding termination.

Consisting of:
- Short, Flush (2)
- Offsets, 1/8 and 3/8 Wavelength
- Terminations, Fixed (2)
- Test Port Sections (2)

Option 1
Adds the following:
- Sliding Termination

3656 W1 (1.0 mm) Connector Calibration Kit and Verification Kit
The W1 calibration kit consists of precision components to calibrate the VNA to 110 GHz. The kit supports SOLT calibrations with opens, shorts and loads to 65 GHz, and Triple Offset short calibrations from 65 to 110 GHz. The kit also includes verification devices for determining system accuracy of the VNA. A diskette containing factory measured test data is supplied for comparison with customer measured data.

Consisting of:
- 23W50-1, Male Offset Short 2.02 mm
- 23WF50-1, Female Offset Short 2.02 mm
- 23W50-2, Male Offset Short 2.65 mm
- 23WF50-2, Female Offset Short 2.65 mm
- 23W50-3, Male Offset Short 3.180 mm
- 23WF50-3, Female Offset Short 3.180 mm
- 24W50, Male Open 1.510 mm
- 24WF50, Female Open 1.930 mm
- 28W50, Male Broadband Termination
- 28WF50, Female Broadband Termination
- 33WW50, Male-Male Adapter (1)
- 33WWF50, Male-Female Adapter (1)
- 33WFWF50, Female-Female Adapter (1)
- 01-401, Interchangeable Adapter Fixed Female*2
- 01-402, Interchangeable Adapter Fixed Male*2
- 18WWF50-1, 50 Ω Matched Thruline (Verification Device)
- 18WWF50-1B, Stepped Impedance Thruline (Verification Device)
- 01-504, Torque Wrench
- 01-505, End Wrench
- Calibration coefficients diskette
- Verification kit diskette

*1. Phase Equal Adapters
*2. Interchangeable adapters have one fixed end and one interchangeable end. The interchangeable end can be switched between a male and female. This preserves the calibration reference plane for non-insertable device measurements.

The following kits are for use with MS462XX Scorpion® VNMS.

3750R SMA/3.5 mm 9 GHz Calibration Kit consisting of:
- 23LF50 Female Short
- 23L50 Male Short
- 24LF50 Female Open
- 24L50 Male Open
- 28L50LF Male Termination (2)
- 28LF50LF Female Termination (2)
- Calibration coefficients diskette

Option 1
Adds the following:
- Set of five Phase Equal Insertables (PEIs)

Option 3
Adds the following:
- Additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations

3751R GPC-7 9 GHz Calibration Kit consisting of:
- 23A50 Short
- 24A50 Open
- 28A50LF Termination (2)
- Calibration coefficients diskette

Option 2
Adds the following:
- Third GPC-7 termination required for three port calibrations

Option 3
Adds the following:
- Two additional GPC-7 terminations required for four port calibrations

3753R Type N 9 GHz Calibration Kit consisting of:
- 23NF50 Female Short
- 24NF50 Female Open
- 24N50 Male Open
- 28NF50LF Female Termination (2)
- 28N50LF Male Termination (2)
- 23N50 Male Short
- Calibration coefficients diskette

Option 1
Adds the following:
- Set of five Phase Equal Insertables (PEIs)

Option 3
Adds the following:
- Additional N (female) and N (male) terminations required for four port calibrations

3753-75R Type N (75 Ω) Calibration Kit:
- Specified to 3 GHz

Option 3
Adds the following:
- Additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	37XXX Lightning VNA Calibration Kits
3650	SMA/3.5 mm calibration kit
Option 1	Adds sliding terminations
3651	GPC-7 calibration kit
Option 1	Adds sliding terminations
3652	K Connector® calibration kit
Option 1	Adds sliding terminations
3653	Type N calibration kit
3654B	V Connector® calibration kit with sliding terminations
3655	Waveguide calibration kit
Option 1	Adds sliding terminations
3656	W1 (1.0 mm) calibration and verification kit
	MS462XX Scorpion VNMS Calibration Kits
3750R	SMA/3.5 mm 9 GHz calibration kit
Option 1	Adds a set of five Phase Equal Insertables (PEIs)
Option 3	Adds an additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations
3751R	GPC-7 9 GHz calibration kit
Option 2	Adds a third GPC-7 termination required for three port calibrations
Option 3	Adds two additional GPC-7 terminations required for four port calibrations
3753R	Type N 9 GHz calibration kit
Option 1	Adds a set of five Phase Equal Insertables (PEIs)
Option 3	Adds additional N (female) and N (male) terminations required for four port calibrations
3753-75	75 Ω Type N 3 GHz calibration kit
Option 3	Adds additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations

8

VNA AND VNMS
Verification Kits

For Confirming Accuracy of Vector Network Analyzers

3669B

The Anritsu Verification Kits contain precision components with characteristics that are traceable to NIST. Used primarily by the metrology laboratory, these components provide the most dependable means of determining the system accuracy of your VNA. A disk containing factory measured test data for all components is supplied for comparison with customer-measured data.

The following kits are for use with 37XXX Lightning VNAs.

3663 Type N Verification Kit consisting of:
- 42N-50, 50 dB Attenuator
- 18N50-10, 10 cm Airline
- 42N20, 20 dB Attenuator
- 18N50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3665 Waveguide Verification Kit consisting of:
- Straight section
- Pin set
- Mismatch section
- Ball driver
- 50 dB Attenuator
- 20 dB Attenuator
- Verification kit disks

3666 SMA/3.5 mm Verification Kit consisting of:
- 19S50-7, 7.5 cm Airline
- 19SF50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- 42S-50, 50 dB Attenuator
- 42S-20, 20 dB Attenuator
- Verification kit disks

3667 GPC-7 Verification Kit consisting of:
- 42A-50, 50 dB Attenuator
- 18A50-10, 10 cm Air line
- 42A-20, 20 dB Attenuator
- 18A50-10B, 10 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3668 K Connector® Verification Kit consisting of:
- 19K50-7, 7.5 cm Airline
- 42K-50, 50 dB Attenuator
- 42K-20, 20 dB Attenuator
- 18K50-7B, 7.5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

3669B V Connector® Verification Kit consisting of:
- 42V-40, 40 dB Attenuator
- 42V-20, 20 dB Attenuator
- 19V50-5, 5 cm Airline
- 18V50-5B, 5 cm Stepped Impedance Airline (Beatty standard)
- Verification kit disks

W1 (1.0 mm) Verification Components are included in W1 Calibration kit and Verification Kit (3656). See previous section for details.

The following kits are for use with MS462XX Scorpion VNMS.

3663R Type N 9 GHz Verification Kit consisting of:
- 42N-50, 50 dB Attenuator
- 42N20, 20 dB Attenuator
- 42NOP-20 N Mismatch attenuator
- Verification kit disks

3666R SMA/3.5 mm 9 GHz Verification Kit consisting of:
- 42L-50, 50 dB Attenuator
- 42L-20, 20 dB Attenuator
- 42LOP-20 SMA/3.5 mm Mismatch Attenuator
- Verification kit disks

3667R GPC-7 9 GHz Verification Kit consisting of:
- 42A-50, 50 dB Attenuator
- 42A-20, 20 dB Attenuator
- 42AOP-20 GPC-7 Mismatch Attenuator
- Verification kit disks

Ordering information

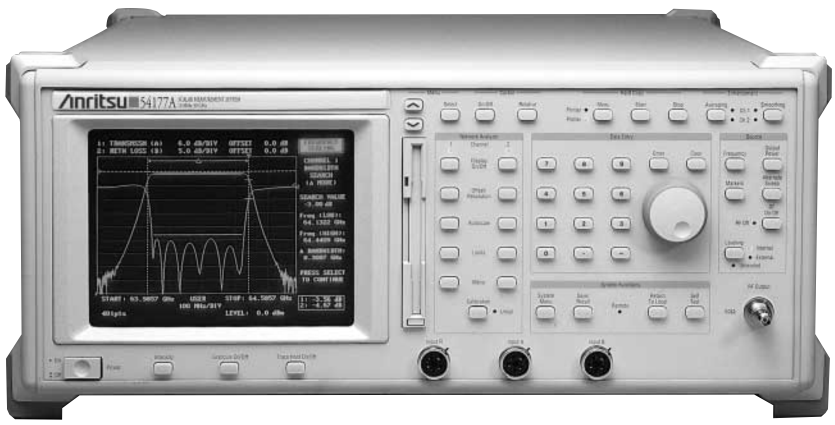
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Verification kits
3663	Type N verification kit
3665	Waveguide verification kit
3666	SMA/3.5 mm verification kit
3667	GPC-7 verification kit
3668	K connector® verification kit
3669B	V connector® verification kit
3663R	Type N 9 GHz verification kit
3666R	SMA/3.5 mm 9 GHz verification kit
3667R	GPC-7 9 GHz verification kit

NETWORK ANALYZER
54100A Series
1 MHz to 110 GHz

GPIB

Fast and Accurate Scalar Network Measurements, with Built-in Source

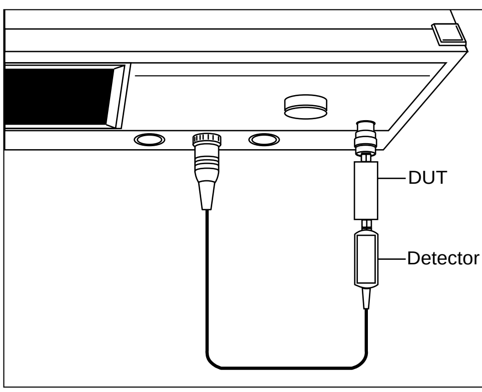


54100A series Network Analyzers provide characterization of devices such as amplifiers, antennas, attenuators, adapters, RF bridges, duplexers, couplers, attenuators, cables, waveguide transmission lines, isolators, circulators, mixers, receivers, transceivers, up/down converters, multiplexers, power dividers, VCOs, switches, and filters. Advanced hardware and software features speed productivity and improve accuracy. Speed tuning processes with automated bandwidth search functions. Fast recall mode quickly steps through test procedures and sophisticated limit line controls quickly identify conformance to specifications. Low source harmonics and high directivity SWR autotesters assure accuracy.

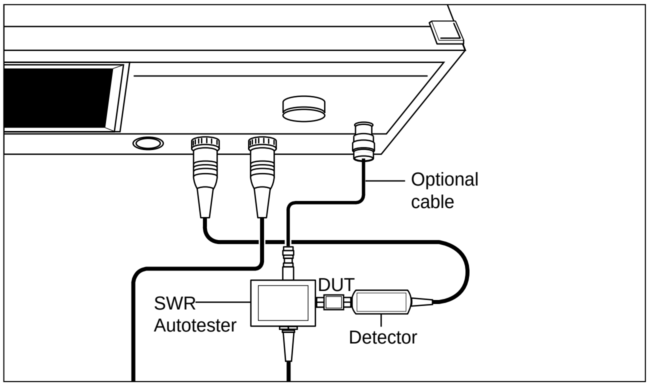
Features

- Fast, accurate measurement of transmission, return loss, precision return loss, SWR, group delay, absolute power, and distance-to-fault
- Crystal-based source for exceptional stability and accuracy
- Built-in automation features including distance-to-fault
- Built-in floppy disk drive
- Rugged, reliable chassis

• Transmission gain (loss), group delay and power measurements
The basic configuration requires a single detector. For very low transmission loss devices (<0.25 dB), a second detector should be used to monitor any source power variations.



• Transmission and return loss (or SWR)
Return loss or standing wave ratio (SWR) measurements require a high directivity SWR autotester to separate the incident signal from the RF sweep source and reflected signal from the device under test. The configuration below will simultaneously display transmission and return loss characteristics.



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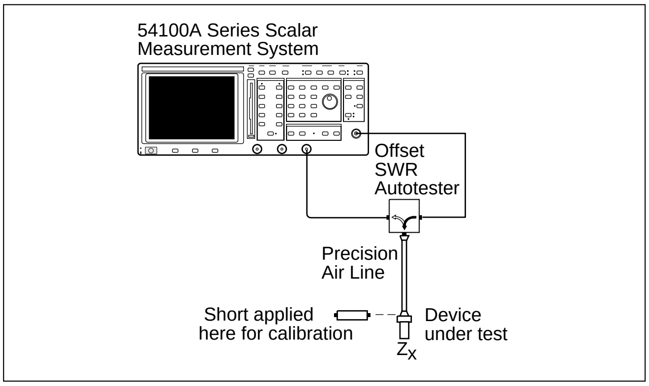
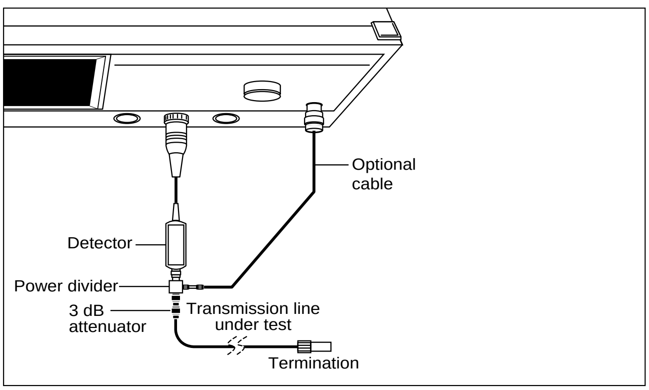
- **Adapters, attenuators, terminations, couplers, RF bridges**

The 54100A series precision return loss mode measures high return loss devices accurately traceable to NIST. The measurement system uses an offset SWR autotester and a precision airline — a physical impedance standard. Additionally, by exchanging the offset SWR autotester with a 20 dB offset termination, the directivity of couplers and RF bridges is displayed directly on the 54100A.



Distance-to-fault

The 54100A's optional distance-to-fault software accurately verifies transmission line and antenna system performance during installation, link/site commissioning, and at regular maintenance intervals. Transmission lines are typically the most common failure point in an antenna system. Finding the problem connectors, cables, and antennas before a complete failure occurs saves down-time and expense. Faulty antenna systems and transmission lines are easily diagnosed. A wide variety of coaxial and waveguide types are supported with standard catalog components.



Common causes of antenna feed problems

- **Cable and waveguide problems**
  - Cable discontinuities
  - Moisture
  - Braid wire ground shield fault (appears as a notch filter)
  - Damaged/cut ground shields
  - Dielectric fault or narrowed dielectric diameter
  - Fasteners pinch cables
- **Connector problems**
  - Corroded connectors
  - Low quality connectors
  - Connector pin offset (poor mating contact)
- **Antenna problems**
  - Antenna out of specification
  - Antenna storm/shipping damage

Performance

- **Preventing "ghost" faults**

The 54100A uses a low harmonic source and high performance anti-aliasing software to prevent the display of false or "ghost" transmission line faults. This is a common problem when the end of the DUT is unterminated or damaged. Anritsu's precision components and low harmonic sources prevent "ghost" faults, assuring accurate, repeatable results.

- **High dynamic range**

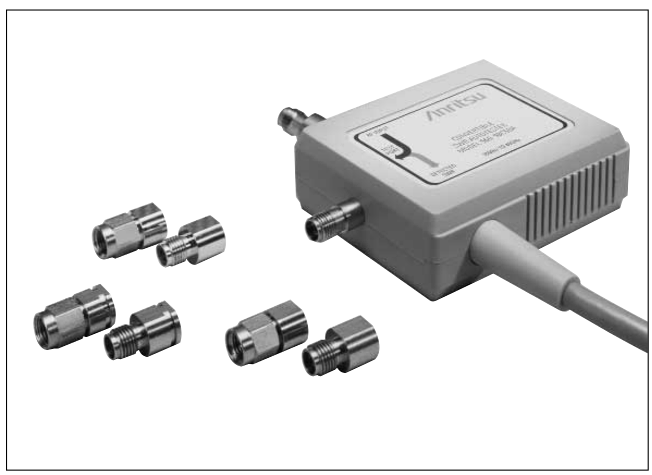
The 54100A distance-to-fault software optimizes sensitivity and accuracy. For example, a precision termination is used during calibration to achieve industry leading dynamic range. If the termination is not of high quality, it will reflect some of the source energy rather than absorb it –causing errors in the measurement process. The use of a specialized discrete fourier transform rather than a more common fast fourier transform also improves low level sensitivity. Low source harmonics also ensure that fault indications are actual transmission line and not re-reflections of source harmonic energy.

Relative group delay

Optional relative group delay software identifies signal distortion caused by bandpass devices such as filters, receivers, power amplifiers, and up/down converters. Group delay is a key cause of high bit error rate (BER). Group delay is important for (1) CDMA and spread spectrum communications, (2) phase array radars, (3) high capacity satellite and terrestrial microwave links, and (4) PAL and HDTV television components and other RF systems sensitive to phase distortion. The 54100A saves time and expense by eliminating several pieces of expensive test equipment – combining the capabilities into a single, low cost test station. Manufacturing processes save re-test/re-tuning time by utilizing a single 54100A instead of two separate tuning stations – one for scalar transmission and return loss and the other for relative phase group delay. Furthermore, the 54100A can accurately test frequency conversion devices without the wideband reference converters required with vector network analyzers or microwave system analyzers.

Convertible SWR autotester

Convertible SWR autotesters reduce capital equipment and maintenance costs. A single convertible SWR autotester accurately measures the return loss or SWR of devices with SMA, 3.5 mm, or K connectors. Six interchangeable test port heads (male and female for each connector standard) are precision tuned to the convertible SWR autotester's internal bridge circuit.



The 560-98C50 Convertible SWR Autotester improves test accuracy and reduces maintenance cost without using error prone test port adapters or connector savers.

The inexpensive test port heads save repair and calibration costs because they are interchangeable.

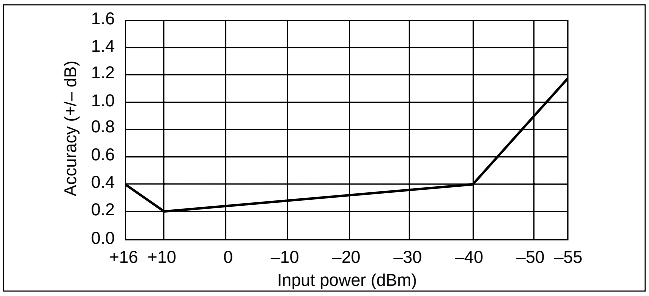
Measurement accuracy

• Transmission loss or gain measurement accuracy

Uncertainties from the frequency response of components are automatically subtracted from test data during the path calibration procedure. Overall accuracy is then:

Channel accuracy
\+ Mismatch uncertainty
\+ Distortion from source harmonics
Transmission measurement accuracy

Effects of source, test device, SWR autotester, and detector mismatch can be significant. This mismatch uncertainty is minimized by the exceptionally low reflection characteristics of Wiltron's detectors, sources, and SWR autotesters. Anritsu's ultra low source harmonics maximize the accuracy.



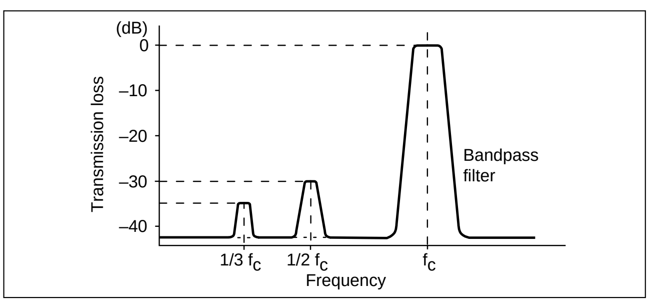
Channel accuracy (25°C)

• Distortion from source harmonics

Poor source harmonics cause large measurement errors. If the sweep range is set wide enough, at some point during the sweep, the harmonic will pass through the filter's pass band. Since the transmission detector is a broadband diode, the harmonic's signal power is measured. Thus, the analyzer displays the response of the harmonic in addition to the fundamental sweep frequency.

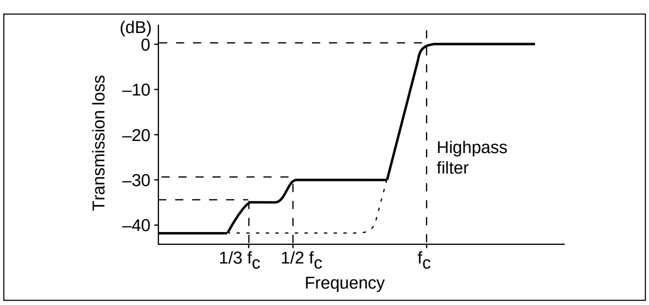
• Bandpass filter, distortion from source harmonics

If the source has a –30 dBc second harmonic and a –35 dBc third harmonic, at the beginning of the sweep, the harmonics pass through the filter's passband.



• Highpass filter, distortion from source harmonics

A highpass (or wide bandpass) filter responds similarly to the bandpass filter, except the presence of the harmonic in the filter's pass band limits the useful dynamic range of the analyzer.



Return loss measurement accuracy

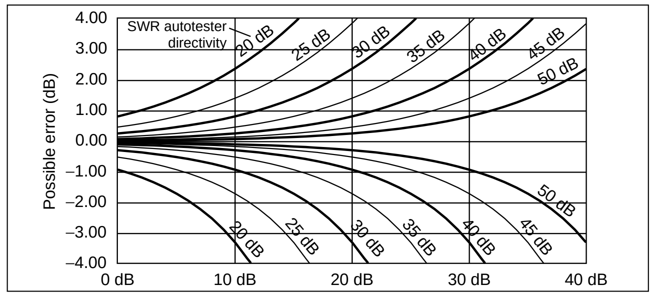
Uncertainties resulting from SWR autotester and source frequency response and from system open and short characteristics are subtracted automatically from test data. Overall accuracy is then:

Channel accuracy
\+ Autotester accuracy
\+ Distortion from source harmonics
Return loss measurement accuracy

Autotester accuracy is composed of error due to directivity and error due to test port match. Unless the DUT has very poor return loss (high SWR), test port match will be negligible. When an adapter is used at the test port, use effective directivity to determine possible errors.

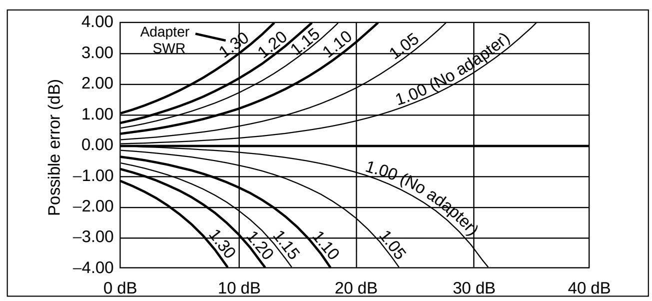
• Return loss accuracy due to directivity

Improved directivity decreases SWR (or return loss) measurement errors. The chart below identifies maximum error due to directivity.



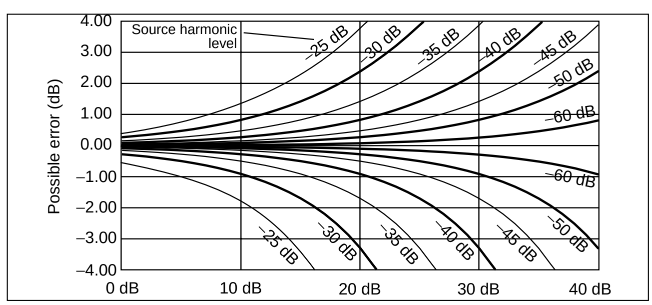
• Return loss accuracy due to effective directivity

Effective directivity is the reduction to directivity due to a test port adapter's SWR performance. Adapters severely degrade measurement directivity. The chart below shows the maximum degradation to a 40 dB directivity SWR autotester caused by test port adapters of varying quality.



• Return loss accuracy due to source harmonics

Source harmonics are a significant source of return loss measurement uncertainty when testing banded devices such as filters, receivers, transmitters, power amplifiers, and antennas. In many cases, the harmonic errors are larger than uncertainty due to directivity, which is typically assumed to be the largest uncertainty factor.



This chart assumes full reflections of a single source harmonic at the DUT input. Multiple harmonics can cause additional measurement uncertainty.

Specifications

Analyzer	Measurement modes	Transmission (dB), return loss (dB), SWR (linear SWR), optional group delay (ns), power (dBm) precision return loss (dB) and optional distance-to-fault
	Dynamic range	–55 to +16 dBm, autozeroing with DC detection
	Inputs	Three, two standard inputs, A and B, with optional third reference channel, R (Option 5)
	Display channels	Two channels are used to select and simultaneously display any two inputs from A, B, or R. The inputs can also be displayed as ratios A/R or B/R.
	Scale resolution	0.1 to 10 dB(m) per division in 0.1 dB steps
	Cursor functions	Searches for trace maximum, minimum, dB level, dB bandwidth, next marker and active marker
	Averaging	2, 4, 8, 16, 32, 64, 128, or 256
	Limit lines	Two limit lines, either single value or multi level segmented, for each trace. Segmented lines may be made from up to 10 individually editable segments.
	Auto-zero	Performs an AC modulation cycle and low level calibration during sweeper retrace
	Save/Recall	Thirteen sets of front panel set-ups and thirteen sets of trace memory can be stored in non-volatile instrument memory.
	Trace mask	A swept frequency measurement can be stored to a graticule trace mask for visual comparison to later measurements.
	Disk drive	Built-in 3.5 inch, 1.44 MB floppy disk drive
	Autosave	Automatically increments the trace data file name and reference number during successive data storage operations to the DOS disk
Source	Frequency range	1 MHz to 110 GHz, model dependent
	Alternate sweep	Sweeps alternately between frequency ranges set differently for channel 1 and channel 2
	CW	Provides single frequency output (both channels turned off)
	Frequency resolution	RF Models (54107A, 54109A, 54111A): 10 kHz, Microwave models: 100 kHz
	Output power	Maximum guaranteed levelled output power is model dependent.
	Reverse power protection	Up to 5 Watts. Limited to 1 Watt with attenuator option
Application function	Min/Max hold	Save the minimum and maximum values of successive sweeps or the combination of the two
	Cursor functions	Automatic cursor search updates the bandwidth, minimum, or maximum levels of the displayed trace.
	Compression test automation	Determines the gain compression point over the operating frequency range of an amplifier by successively incrementing the source power and measuring the amount of compression until a preset “X” dB limit is exceeded.
	Self test	Performs a self test every time power is applied or when SELF TEST pushbutton is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.
General	Operating temperature	0˚ to +50˚C
	Power	115V +10/–20%, 230V +10/–20%, 48 to 400 Hz, 300 VA
	Mass	18 kg (39 lb.)
	Printer	Parallel printer interface is compatible with the Canon BJ85 and most Epson FX-compatible printers.
	Transit case	Hard shell case with custom foam inserts, PN: 760-183
	EMC	Meets European community requirements for CE marking

Ordering information

Please specify model/order number, name, and quantity when ordering.

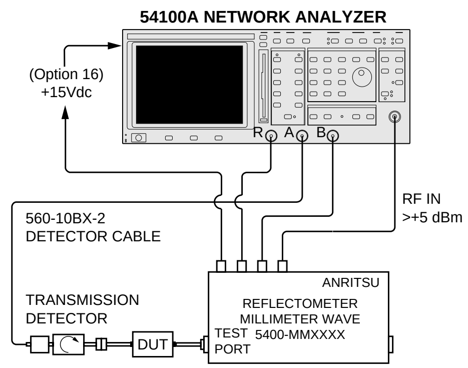
Model/Order No.	Name
	Main frame
54107A	Scalar Measurement System (0.001 to 1.5 GHz)
54109A	Scalar Measurement System (0.001 to 2.2 GHz)
54111A	Scalar Measurement System (0.001 to 3.0 GHz)
54137A	Scalar Measurement System (2 to 20 GHz)
54147A	Scalar Measurement System (0.01 to 20 GHz)
54163A	Scalar Measurement System (2 to 40 GHz)
54169A	Scalar Measurement System (0.01 to 40 GHz)
54177A	Scalar Measurement System (0.01 to 50 GHz)

Model/Order No.	Name
	Options
Option 1	Rack mounting with slides
Option 2	70 dB RF step attenuator
Option 2A	70 dB, 20 GHz MW step attenuator
Option 2C	70 dB, 40 GHz MW step attenuator
Option 2D	70 dB, 50 GHz MW step attenuator
Option 4	75 Ω source output (available to 3.0 GHz)
Option 5	Add reference channel
Option 6	Add external levelling
Option 7	Internal distance-to-fault software
Option 8	Internal relative group delay software
Option 12	Add front panel cover
Option 13	Add front mounted handles
Option 16	+15 V DC supply for millimeter wave source modules (available with <20 GHz models only)
Option 25	Maintenance manual
Option 26	Extra operation and GPIB programming manual
Option 33	Canon printer

MILLIMETER WAVE MEASUREMENT SYSTEM
54000 Series
50 GHz to 110 GHz

GPIB

Scalar Measurements to 110 GHz from an Integrated System



Millimeter wave reflectometer configuration

The Anritsu's millimeter wave reflectometers are designed to operate with the 54147A 20 GHz Network Analyzer. The milli-meter wave multiplier includes subharmonic filters and an isolator, to dramatically improve reflection accuracy.

Excellent multiplier source match provided by the internal isolators and the improved detector return loss allow accurate, simultaneous return loss and transmission measurements.

Features
- Operates with standard 54147A Analyzer
- 40 dB (typical) directivity for accurate SWR measurements
- Millimetric waveguide detectors for loss/gain measurements

8

Specifications

Reflection accuracy characteristics	Source match	<1.9 (<1.7 Typical)
	Directivity	35 dB (>40 dB Typical)
	Dynamic range	>56 dB
	Channel accuracy	Channel accuracy is degraded by ±0.4 dB from standard 54100A specifications
	Output power, minimum	Leveled or unleveled V-band: 0.0 dBm min. (+4.0 dBm Typ.) W-band: –5.0 dBm min. (+1.0 dBm Typ.)
	Power flatness, unleveled	±3.0 dB Typ.
	Required input frequency	V-band: 12.75 to 18.75 GHz, W-band: 12.75 to 18.33 GHz
	Required input harmonics	<–60 dBc
	Spurious signals	Harmonic: <–55 dBc (<–60 dBc Typical), Nonharmonic: <–55 dBc (<–60 dBc Typical)
	Frequency accuracy	Source dependent
	Frequency resolution	Source dependent
Millimeter reflectometer accessories	12" N (m) to N (m) RF input cable	PN: N120-12
	Precision attenuators	1.08: 1.0 SWR Precision loads and attenuators allow low insertion loss devices such as couplers and wavequide sections to be accurately tested. V band 3 dB: SM4784; 6 dB, SM4786 W band 3 dB: SM4785; 6 dB, SM4787
	Precision loads	1.06: 1.0 SWR V band, SM4782 W band, SM4783
	DC power connections	SM4819 Twinax (m) - Twinax (m) cable SM4816 Twinax to dual banana plug SM4818 Twinax to dual EZ hooks
Physical	Size	9.5 x 4.5 x 1.5 inches
mmWave	Maximum input power, damage level	+21 dBm

Special Waveguide Reflectometers (Reflectometers have integrated multipliers/amplifiers. Input frequency is < 20 GHz)					
Model	Frequency range	Directivity	Test port		Input connector
			SWR	Flange	
54000-6WR15	50 to 75 GHz	35 dB, 40 dB typ.	<1.9 (<1.7 typ.)	WR-15	N (f)
54000-6WR10	75 to 110 GHz	35 dB, 40 dB typ	<1.9 (<1.7 typ.)	WR-10	N (f)
Millimeter Wave Detectors					
Model	Frequency range	Dynamic range	Input port		Output connector
			Return loss	Flange	
54000-7WR15	50 to 75 GHz	> 56 dB typ.	17 dB	WR-15	BNC (f)
54000-7WR10	75 to 110 GHz	> 56 dB typ	17 dB	WR-10	BNC (f)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
54000-6WR15	50-75 GHz V band Multiplier/Autotester
54000-6WR10	75-110 GHz W band Multiplier/Autotester
54000-7WR15	WR15 Precision Detector with lead
54000-7WR10	WR10 Precision Detector with lead

NETWORK ANALYZER
MS4630B
10 Hz to 300 MHz

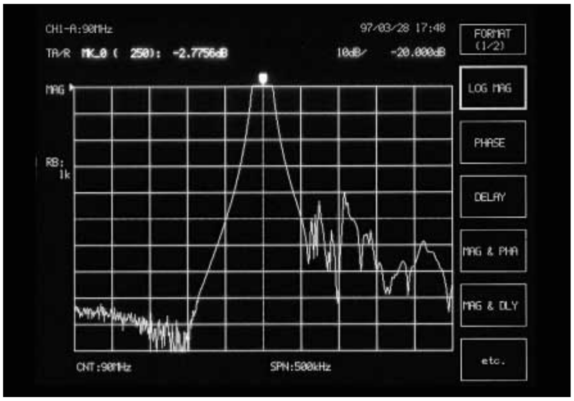
GPIB

For Fast Evaluation of IF Filters and Resonators

The MS4630B is suitable for electronics production lines demanding fast and accurate device measurements. It is particularly well suited to accurate, high-speed evaluation of IF filter resonance and group delay characteristics, as well as evaluating the impedance characteristics of resonators in AV equipment and personal computers. A fast sweep speed of 150 µs/measurement point is achieved using a high-speed synthesizer and digital signal processing (DSP) technologies. The post-processing data analysis functions have been strengthened with improved data-processing macros that have greatly increased the total production throughput.
In comparison to the earlier MS3401A/B and MS3606B network analyzers, the sweep speed is three times faster and the group delay measurement accuracy and stability have been improved by more than 10 times. In addition, the dynamic range has been improved to 120 dB (RBW: 1 kHz) while the weight of the analyzer has been dramatically reduced. The GPIB and PTA processing speed are 30 to 50% faster than the MS4630A. In addition, the sweep conditions can be set more easily by the addition of the list sweep function.

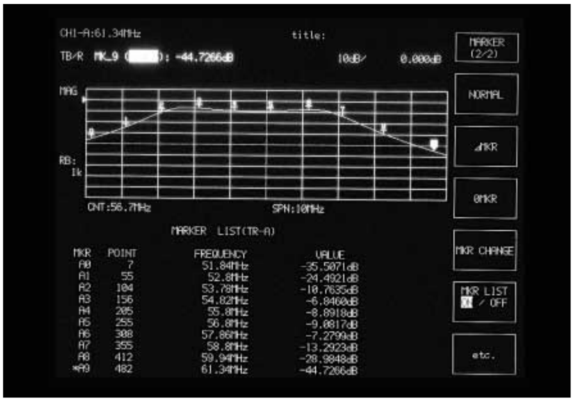
Features
- High-speed evaluation of IF filters, resonators, etc.
- Greatly increased production/inspection capacity

Performance and functions
• High dynamic range
The high dynamic range of 120 dB (RBW: 1 kHz) permits fast and accurate out-of-band measurement of filter.



Filter out-of-band attenuation measurement

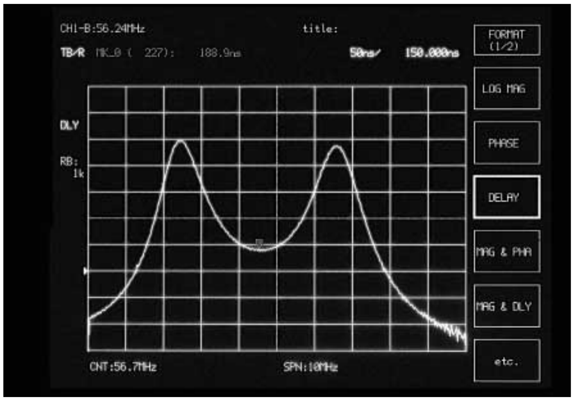
• Multi-marker function
Up to 10 markers can be set independently for each channel. The marker list function can be used to display all tabular data and waveform information simultaneously at each marker.



Multi-markers

• **High-accuracy group delay measurement**

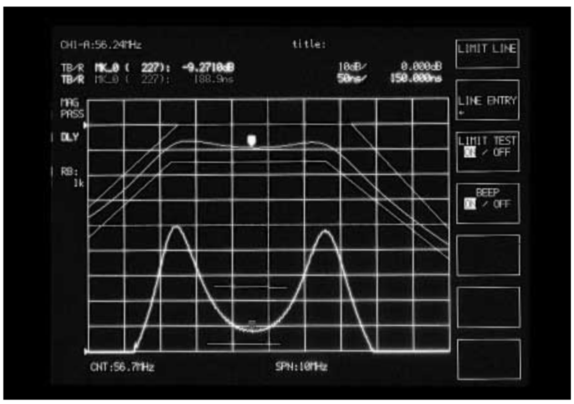
The group delay characteristics can be measured with a high degree of accuracy at a resolution of 1/10,000 of the measurement range.



Group delay characteristics

• **Limit test function**

Device pass/fail evaluation can be performed in real-time using the single and segmented limit test functions.

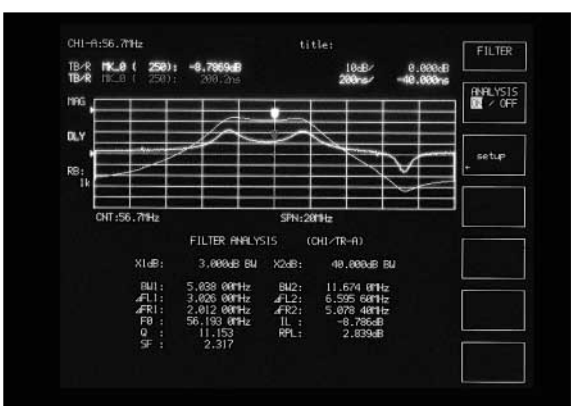


Filter pass/fail evaluation using limit test

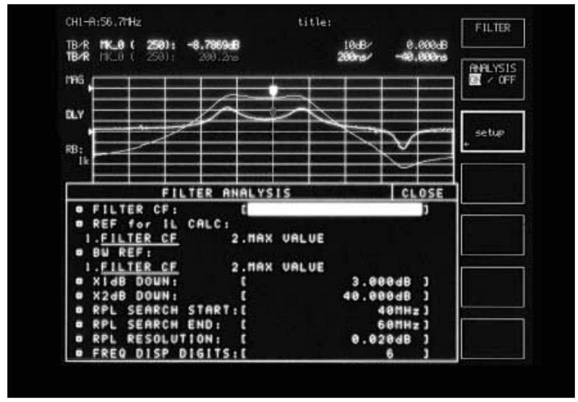
• **Filter measurement**

Filter analysis functions

Filter characteristics such as 3 dB bandwidth, center frequency (fo), in-band ripple, out-of-band attenuation, etc., are digitally processed and analyzed at high speed. User can easily enter or change default values using filter set up menu.



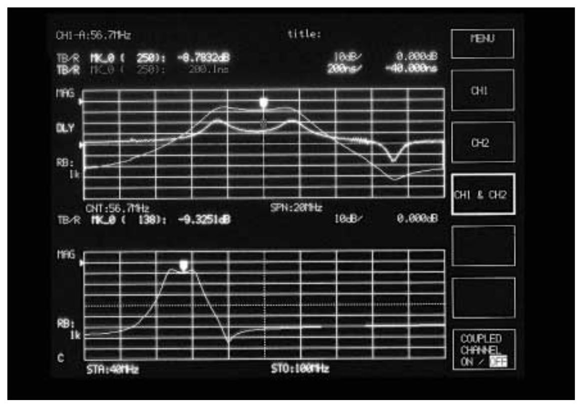
Measurement using filter functions



Set up menu for filter functions

Simultaneous in-band and spurious response data display

Previously, spurious detection and passband measurement required switching of the measurement setup. The MS4630B alternate sweeping function permits simultaneous display of the measured passband and spurious band data. The very short switching time greatly improves the measurement efficiency.

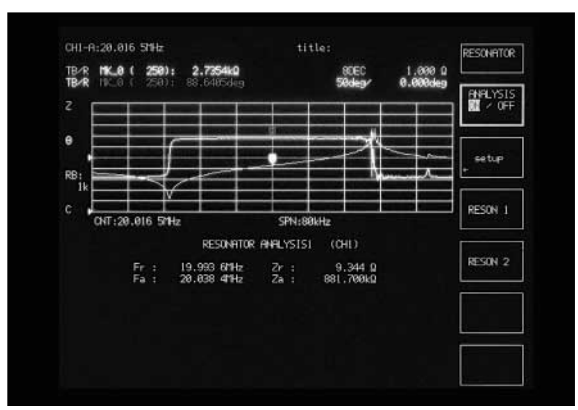


Spurious measurement using alternate sweeping

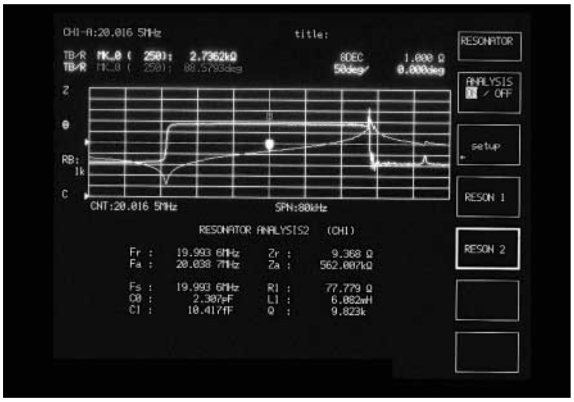
• **Resonator measurement**

High-speed measurement of resonator characteristics

The MS4630B has a number of dedicated waveform analysis functions to improve the evaluation efficiency of resonators. Resonator 1 analyzes the resonance frequency (Fr) and the resonance impedance (Zr). Resonator 2 is able to measure resonator equivalence in addition to the parameters for Resonator 1.



Resonator 1 measurement



Resonator 2 measurement

Specifications

<table>
<tr><td>Measurement items</td><td>Transmission characteristics (ratio measurement): Amplitude, phase, group delay
Reflection/impedance characteristics: Amplitude, phase (with external transducer)
Level characteristics: Absolute amplitude</td></tr>
<tr><td>Frequency</td><td>Range: 10 Hz to 300 MHz
Resolution: 0.01 Hz
Accuracy (standard)
Aging rate: ≤1 x 10^{-6}/day (15 minutes after power-on)
Temperature characteristics: ≤±5 x 10^{-6} (0˚ to +50˚C)
Accuracy (Option 13: High-stability reference oscillator)
Aging rate: ≤±2 x 10^{-8}/day (24 h after power-on)
Temperature characteristics: ≤±5 x 10^{-8} (0˚ to +50˚C)</td></tr>
<tr><td>Input</td><td>Channel No.
Standard: 2 (R, TA); Option 12: 3 (R, TA, TB)
Impedance: 50 Ω, 1 MΩ switchable (when combined with MA4605A: 75 Ω, 1 MΩ)
Input range (IRG): 0/+20 dBm
Max. input power
AC: +20 dBm; DC ±2.2 V (50 Ω)
AC: 0 dBm; DC: ±20 V (1 MΩ)
Connector: BNC-J
Probe source: +12 ±1 V, 100 mA (with protective circuit for shorts)</td></tr>
<tr><td>Average noise level</td><td>≤–120 dBm (RBW: 1 kHz, 1 to 300 MHz), ≤–110 dBm (RBW: 1 kHz, 80 kHz to 1 MHz)</td></tr>
<tr><td>Crosstalk</td><td>Between channels: ≥120 dB (80 kHz to 300 MHz), ≥110 dB (up to 80 kHz)
Between transmitter and receiver: ≥125 dB</td></tr>
<tr><td>Resolution bandwidth</td><td>3, 10, 30, 100, 500 Hz, 1, 2, 3, 4, 5, 10, 20 kHz and automatic setting</td></tr>
<tr><td>Output</td><td>Output level range
Output A: 0 to +21 dBm; Option 10: –70 to +21 dBm
Output B: –6 to +15 dBm (–9.5 to +11.5 dB when Option 14 added);
Option 10: –76 to +15 dBm (–79.5 to +11.5 dB when Option 14 added)
Output resolution: 0.01 dB
Output level accuracy: ≤±1.0 dB (frequency: 100 MHz, Output A: +10 dBm)
Output level linearity: ≤±0.5 dB (0 dBm reference, frequency: 100 MHz, Output A: 0 to +21 dBm)
Output level deviation: ≤±1.5 dB (output A: +10 dBm, 100 MHz reference)
Step error: ±0.5 dB (Option 10)
Output impedance: 50 Ω (when combined with MA4605A: 75 Ω)
Connector: BNC-J</td></tr>
<tr><td>Amplitude measurement</td><td>Measurement range: ≥120 dB
Measurement resolution: 0.001 dB
Display scale: 0.01 dB/div to 50 dB/div (1-2-5 sequence)
Dynamic accuracy
<table>
<tr><td>Level relative to IRG</td><td>80 kHz to 100 MHz</td><td>10 kHz to 300 MHz</td></tr>
<tr><td>0 to –10 dB</td><td>±0.30 dB</td><td>±0.30 dB</td></tr>
<tr><td>–10 to –60 dB</td><td>±0.05 dB</td><td>±0.05 dB</td></tr>
<tr><td>–60 to –70 dB</td><td>±0.10 dB</td><td>±0.30 dB</td></tr>
<tr><td>–70 to –80 dB</td><td>±0.30 dB</td><td>±1.00 dB</td></tr>
<tr><td>–80 to –90 dB</td><td>±1.20 dB</td><td>±4.00 dB</td></tr>
<tr><td>–90 to –100 dB</td><td>±4.00 dB</td><td>–</td></tr>
</table></td></tr>
</table>

Continued on next page

8

<table>
<tr><td>Phase measurement</td><td>Measurement range: ±180°
Measurement resolution: 0.001°
Display scale: 0.01° to 50° /div (1-2-5 sequence)
Dynamic accuracy
<table>
<tr><th>Level relative to IRG</th><th>80 kHz to 100 MHz</th><th>10 kHz to 300 MHz</th></tr>
<tr><td>0 to –10 dB</td><td>±6.0°</td><td>±6.0°</td></tr>
<tr><td>–10 to –60 dB</td><td>±0.3°</td><td>±0.3°</td></tr>
<tr><td>–60 to –70 dB</td><td>±0.8°</td><td>±2.0°</td></tr>
<tr><td>–70 to –80 dB</td><td>±2.0°</td><td>±6.0°</td></tr>
<tr><td>–80 to –90 dB</td><td>±6.0°</td><td>±20.0°</td></tr>
<tr><td>–90 to –100 dB</td><td>±20.0°</td><td>–</td></tr>
</table></td></tr>
<tr><td>Group delay measurement</td><td>DRG: $\Delta\theta/(360 \times \Delta F)$ *$\Delta\theta$: phase measurement range; ΔF: frequency span x smoothing aperture (%);
smoothing aperture: 20% to $\left(\frac{2}{\text{number measurement points}}\right) \times 100\%$
Measurement resolution: $2.78 \times 10^{-5}/\Delta F$
Display scale: 1 ps/div to 50 ms/div
Dynamic accuracy: Phase measurement accuracy/(360 x aperture frequency)</td></tr>
<tr><td>Calibration, correction</td><td>Calibration types: Frequency response, 1 port, 1 path-2 port, frequency response/isolation calibration, π-NET calibration
Calibration data interpolation:
Measurement frequency, when number of measurement points changed, based on calibration data before change, new calibration data interpolation calculation possible (except at log frequency measurement and 1001 measurement points)
Normalize: X–S
Electrical length calibration
Range: 0 to ±999999.9999999 m, Resolution: 100 nm
Phase offset range: ±180°</td></tr>
<tr><td>Sweeping</td><td>Frequency sweep: LIN (CENTER/SPAN, START/STOP), LOG (START/STOP)
Level sweep: LIN (START/STOP/STEP)
List sweep: Frequency, level, RBW, the individual setting in the waiting time
Number of measurement points: 11, 21, 51, 101, 251, 501, 1001
Break point: Anywhere between 1 and 1001
Sweep time: 150 µs/point, 38 ms/250 points full sweep (RBW: 20 kHz, normalize calibration, 1 trace)
Setting range: 1 ms to 27.5 h
Sweep functions
Sweep range: Full sweep, part sweep (between markers)
Sweep control: REPEAT/SINGLE, STOP/CONT
Sweep trigger: INT/EXT (RISE, FALL, LEVEL)</td></tr>
<tr><td>Display</td><td>Max. display screens: 2 channels, 4 traces
Display format: LOG MAG (M), PHASE (P), DELAY (D), M/P, M/D, LIN MAG (LIN), LIN/P, LIN/D, REAL (R), IMAG (I), R/I, Z, Z/θ, Q, Z/Q, POLAR, VSWR, IMPD (Z∠θ, Rs + Ls/Cs, Q/D, R + jx), ADMT (Y∠θ, Rp + Lp/Cp, Q/D, G + jB)
Display: 640 x 480 dots, 16.5 cm color LCD</td></tr>
<tr><td>Markers</td><td>Marker functions: NORMAL MKR, Δ MKR, 0 MKR, MKR → MAX, MKR → MIN, MKR → CF, Δ → SPAN, MKR → +PEAK, MKR → –PEAK, MKR TRACK + PEAK, MKR TRACK–PEAK, MKR CHANGE, MKR OFFSET
Setting: Set marker position to frequency or point
Multi-marker: Max. 10 markers for each trace
Filter function: F0, IL, passband (L, R), attenuation band (L, R), Ripple, Q, SF
Resonator function
RESON 1: Fr, Fa, Zr, Za (0 PHASE), Fm, Fn, Zm, Zn (MAX/MIN)
RESON 2: Fs, Fr, Fa, Zr, Za, Q, equivalence constant (R1, L1, C1, C0)</td></tr>
<tr><td>Trace data calculation</td><td>Averaging functions
Method: SUM, MAX, MIN, Count: 1 to 1000
Measurement data memory (max. 1001 points each memory in same format as display format)
Main trace (MT) memory: 2 each (XMEM) for Channel 1 and Channel 2
Calibration S memory: 2 each (SMEM) for Channel 1 and Channel 2
Image memory: 2 each (IMEM) for Channel 1 and Channel 2
Sub-trace (ST): Following calculation between MT and ST (traces calculation of same data as display format)
MT → ST, MT = MT–ST, MT = ST
Limit line: Single or segment (10) limit line, pass/fail evaluation against limit line</td></tr>
<tr><td>Measurement parameters auto-setting</td><td>Receive bandwidth and sweep time: Receive bandwidth set automatically for set sweep time
Automatically set to give minimum sweep time at set receive bandwidth</td></tr>
<tr><td>Auxiliary media</td><td>Saving/recalling data:
Measurement parameters, measured data, calibration data, PTA application programs saved/recalled to/from FD and PMC
Function memory
FD: 100 functions max.
PMC: 100 functions max. (depends on PMC capacity)
Drive and capacity
3.5 inch FDD: 1
Capacity: 720 KB (2DD), 1.44 MB (2HD), MS-DOS format (bmt, text file)
Option 01: PMC (32 to 512 KB)</td></tr>
<tr><td>Printing</td><td>Printing is available using video plotter, printer and FD (bitmap format).</td></tr>
</table>

Continued on next page

Back-panel I/O	Frequency: 5/10 MHz ±10 ppm Level: ≥0.7 Vp-p (AC coupling) Input impedance: 50 Ω (connector: BNC-J) Reference oscillator output Frequency: 10 MHz Level: TTL (DC coupling, connector: BNC-J) External trigger input: TTL Level (connector: BNC-J) GPIB: IEEE488.2 (24-pin Amphenol connector) I/O Port: Parallel interface for PTA (36-pin Amphenol connector) RGB output: For external monitor (15-pin D-SUB connector) Video output: Separate (8-pin DIN) Centronics (Option 02): Parallel interface for printer (25-pin D-SUB connector) RS-232C (Option 02): Serial interface (9-pin D-SUB connector)
External control	Standard: GPIB and PTA; Option 02: RS-232C
Power	100 to 120/200 to 240 Vac (–15%/+10%, 250 Vac max, 100/200 V system auto-switching), 47.5 to 63 Hz, ≤180 VA (max.)
Dimensions and mass	426 (W) x 177 (H) x 451 (D) mm, ≤15 kg
Environmental conditions	Temperature range: 0˚ to +50˚C (operating; FDD: +4˚ to +50˚C), –20˚ to +60˚C (storage)
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MS4630B	Network Analyzer	
	Standard accessories	
	Power cord, 2.6 m:	1 pc
F0013	Fuse, 5 A:	2 pcs
W1534AE	MS4630B operation manual (main frame):	1 copy
W1535AE	MS4630B operation manual (remote control):	1 copy
	Options	
MS4630B-01	PMC interface	
MS4630B-02	RS-232C, Centronics interface (printer output, external control)	
MS4630B-10	Output attenuator (70 dB, mechanical type)	
MS4630B-12	3 channel receiver	
MS4630B-13	High stability reference oscillator (aging rate: ≤±2 x 10^{-8}/day)	
MS4630B-14	3 branch output (for 3 channel receiver)	
	Optional accessories	
SC4284	Reflection Bridge	
SC4288	Reflection Bridge	
SC6267	Reflection Bridge	
SC6289	Reflection Bridge	
MA2201A	Reflection Bridge	
MA2203A	Reflection Bridge	
MA2301A	Reflection Bridge	
MA2302A	Reflection Bridge	
MA2303A	Reflection Bridge	
MA2204A	Impedance Probe	
MA2403A	Impedance Probe	
MA414A	Impedance Measurement Kit (for MA2403A)	
MA1506A	π Network (DC to 125 MHz, for resonator measurement)	
MA4605A	Impedance Adapter (for MS4630B, 10 Hz to 300 MHz, 50/75 Ω, unbalanced)	
P0005	Memory card (32 KB)	
P0006	Memory card (64 KB))	
P0007	Memory card (128 KB)	
P0008	Memory card (256 KB)	
P0009	Memory card (512 KB)	
MC3305A	PTA Key Board (JIS type)	
MC3306A	PTA Key Board (ASCII type)	
B0329C	Front cover (1MW4U)	
B0333C	Rack mount kit	
B0334C	Carrying case (hard type)	
	Optional instruments	
ME010 series	Test Fixture (PIN, SMD, tip-inductor, etc.)	

SCALAR NETWORK ANALYZER
56100A
10 MHz to 110 GHz

For Scalar Analysis

GPIB

The 56100A Scalar Network Analyzer measures insertion loss, insertion gain, or RF power with 76 dB dynamic range. Measure device match as return loss in dB or as SWR. Separate detectors can be used on all four inputs for multiple transmission measurements on duplexers or matched amplifiers.
Transmission and reflection measurements can be viewed simultaneously. Both traces can be scaled independently in dB, dBm, or SWR. Measurement of the ratio of two detector inputs may be applied to either channel for enhancing accuracy or for viewing differences. Built-in calibration allows subtraction of the unwanted transmission frequency response or the average of open/short reflections from either trace. A Volt Mode is available for displaying voltage (with volt mode adapter cable). A 0 to 10 volt sweep ramp output mode is also available.

Features
- Compatible with Anritsu 68 series, 69 series and MG3690 series signal generators
- 10 MHz to 110 GHz
- Four input channels
- Extensive cursor, markers, and limit lines
- Applications functions for improved productivity

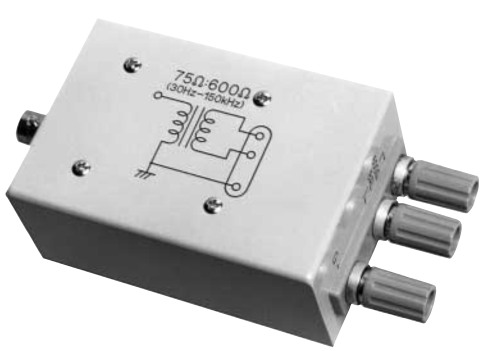
REFLECTION BRIDGES

When connected to a reflection bridge, the network analyzers can measure reflection coefficient. This system is used to measure the input and output impedance of telecommunication, video, and audio equipment, and the S-parameter (S_{11} and S_{22}) of two-port networks.

MA2401A **MA2201A**

TRANSFORMERS

The transformers are impedance-conversion devices used with the network analyzers to measure the magnitude, phase, delay, level, and spectrum of devices with balanced input and output impedances.



Features
- Input connector is a BNC-type in an unbalanced circuit
- Output connector is a terminal compatible with M-214
- Frequency response: <0.3 dB
- Return loss: >25 dB

Model	Impedance (Ω)		Frequency range
	Input	Output	
MA29A	75	600	30 Hz to 150 kHz
MA29J	50	600	30 Hz to 150 kHz
MA313A	75	75	4 kHz to 2 MHz
MA313J	50	75	4 kHz to 2 MHz
MA314A	75	135	4 kHz to 2 MHz
MA314J	50	135	4 kHz to 2 MHz
MA315A	75	150	4 kHz to 2 MHz
MA315J	50	150	4 kHz to 2 MHz
MA422A1	75	110	10 Hz to 30 kHz

SIGNAL GENERATORS

Synthesizer selection guide (measurement Function)

Group	Name	Functions																													Remarks
		Frequency extensions					Level extensions								Modulation						Others										
		10 MHz to 2 GHz	10 MHz to 2.2 GHz	0.1 Hz to 10 MHz	mm Wave (50 to 75 GHz) signal source	mm Wave (75 to 110 GHz) signal source	110 dB step attenuator (<20 GHz)	110 dB step attenuator (<40 GHz)	90 dB step attenuator (>40 GHz)	120 dB step attenuator (<10 GHz)	+18 dBm high power (<20 GHz)	+18 dBm high power(<20 GHz, with Option 13)	+18 dBm high power (<40 GHz)	+18 dBm high power (<40 GHz, with Option 13)	AM modulation (Internal signal source is another)	FM/øM modulation (Internal signal source is another)	Pulse modulation (Internal signal source is another, <40 GHz)	Pulse modulation (Internal signal source is another, >40 GHz)	For AM/FM/øM modulation (Internal signal source)	For pulse modulation (Internal signal source)	Low phase noise	Analog sweep	High stability time base	Creation software of an arbitrary waveform	IF Up-conversion	Rear panel RF output (<40 GHz)	Rear panel RF output (>40 GHz)	Delete front panel	Rack mount kit (without slides)	Rack mount kit (with slides)	
Main frame	MG3691A	√	√	√			√			√	√	√			√	√	√		√	√	√	√	√	√	√	√		√	√	√	2 to 8 GHz
	MG3692A	√	√	√	√	√	√				√	√			√	√	√		√	√	√	√	√	√	√	√		√	√	√	2 to 20 GHz
	MG3693A	√	√	√	*1	*1		√					√	√	√	√	√		√	√	√	√	√	√	√	√		√	√	√	2 to 30 GHz
	MG3694A	√	√	√	*1	*1		√					√	√	√	√	√		√	√	√	√	√	√	√	√		√	√	√	2 to 40 GHz
	MG3695A	√	√	√	*1	*1			√						√	√		√	√	√	√	√	√	√			√	√	√	√	2 to 50 GHz
	MG3696A	√	√	√	*1	*1			√						√	√		√	√	√	√	√	√	√			√	√	√	√	2 to 65 GHz
Options	1A																												√		Either selection
	1B																													√	
	2A						√																								Chooses with main frame frequency
	2B							√																							
	2C								√																						
	2E									√																					
	3																				√										
	4		√																												
	5	√																													
	6																					√									
	7																								√						<40 GHz model, the combined use with Option 18 is impossible.
	9A																									√					
	9B																										√				
	10																							√							Requires Option 23
	12															√															
	13A																√														Chooses according to main frame frequency
	13B																	√													
	14														√																
	15A										√																				Chooses according to the inclusion situation of main frame frequency and pulse modulation.
	15B											√																			
	15C												√																		
	15D													√																	
	16																						√								
	17																											√			
	18-WR15				√																										54000-4WR15 Requires mm Wave module
	18-WR10					√																									54000-4WR10 Requires mm Wave module
	22			√																											Modulation function is un-corresponding
	23																		√												Two signal for AM and FM/ΦM
	24																			√											
	25A														√	√	√		√	√											Chooses with main frame frequency
	25B														√	√		√	√	√											

*1: The maximum of frequency required for frequency extension to mm Wave is 20 GHz.
Therefore, when using it only by for mm Wave, a model 20 GHz or more is unnecessary.

Model	Frequency range	Level range	Harmonics	Non-harmonics	SSB phase noise (CW 1 GHz, 20 kHz offset)	Amplitude modulation	Frequency modulation	Phase modulation	Pulse modulation	Sine-wave	Triangular-wave	Square-wave	Sawtooth-wave	Dimensions and mass
MG3641A	125 kHz to 1040 MHz	–143 to +17 dBm	–30 dBc	–100 dBc	–130 dBc/Hz	√	√		Opt.*1	√	Opt.*1	Opt.*1	Opt.*1	20 kg
MG3642A	125 kHz to 2080 MHz	–143 to +17 dBm	–30 dBc	–100 dBc	–130 dBc/Hz	√	√		Opt.*1	√	Opt.*1	Opt.*1	Opt.*1	20 kg
MG3633A	10 kHz to 2700 MHz	–123 to +17 dBm	–30 dBc	–80 dBc	–140 dBc/Hz	√	√	√						32 kg
MG443B	10 Hz to 30 MHz	–80 to +15 dBm*2	–55 dBc*2		–105 dBc/Hz*3	√		√						15 kg
MG442A	10 Hz to 20 MHz	–51 to +15 dBm	–30 dBc											4 kg

*1: Option
*2: Be changed according to impedance.
*3: CW 20 MHz, 50 kHz offset

Synthesizer selection guide (frequency range)

Group	Name	Frequency range																								Remarks
		0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	2 MHz	5 MHz	10 MHz	20 MHz	50 MHz	100 MHz	200 MHz	500 MHz	1 GHz	2 GHz	5 GHz	10 GHz	20 GHz	50 GHz	100 GHz	200 GHz	
Main frame	MG3691A																									2 to 8 GHz
Main frame	MG3692A																									2 to 20 GHz
Main frame	MG3693A																									2 to 30 GHz
Main frame	MG3694A																									2 to 40 GHz
Main frame	MG3695A																									2 to 50 GHz
Main frame	MG3696A																									2 to 65 GHz
Options	4																									10 MHz to 2.2 GHz
Options	5																									10 MHz to 2 GHz
Options	22																									0.1 Hz to 10 MHz
Options	18-WR15/ 54000-4WR15																									50 to 75 GHz
Options	18-WR10/ 54000-4WR10																									75 to 110 GHz

Model	Frequency range																		Remarks
	0.1 Hz	1 Hz	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz	10 MHz	20 MHz	30 MHz	50 MHz	100 MHz	1 GHz	2 GHz	3 GHz	5 GHz	10 GHz	
MG3641A																			125 kHz to 1040 MHz
MG3642A																			125 kHz to 2080 MHz
MG3633A																			10 kHz to 2700 MHz
MG443B																			10 Hz to 30 MHz
MG442A																			10 Hz to 20 MHz

9

SYNTHESIZED SIGNAL GENERATOR

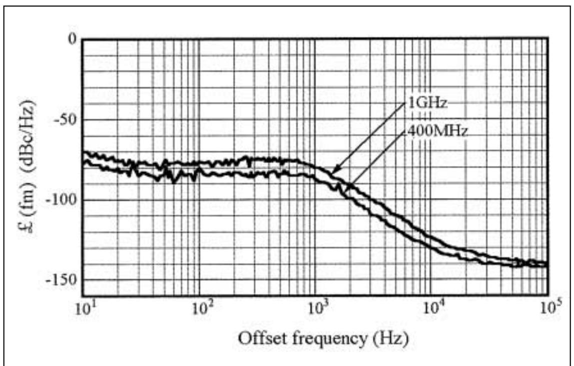
MG3641A/MG3642A

125 kHz to 1040/2080 MHz

GPIB

Economic High-Performance Signal Sources

The frequency of MG3641A/3642A is set with a resolution of 0.01 Hz across the full frequency ranges, and the non-harmonic spurious is better than –100 dBc for reliable measurement at any frequency. A low-noise YIG oscillator produces a high-purity signal with SSB phase noise of better than –130 dBc/Hz (1 GHz, 20 kHz offset) making these signal generators for interference testing of radio receivers and as sources for various local and reference signals.



SSB phase noise characteristic

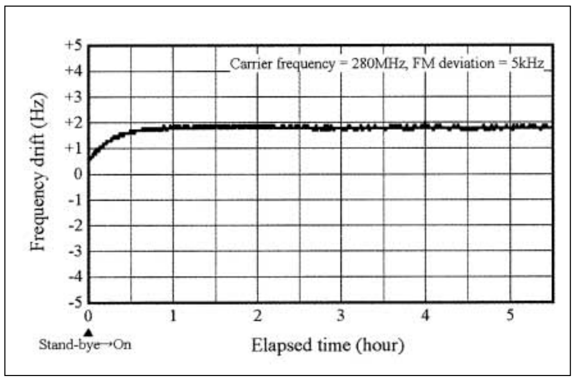
Features

- 0.01 Hz, 0.01 dB setting resolution
- High signal purity (–100 dBc spurious)
- Versatile modulation functions

Performance

• High-stable carrier frequency

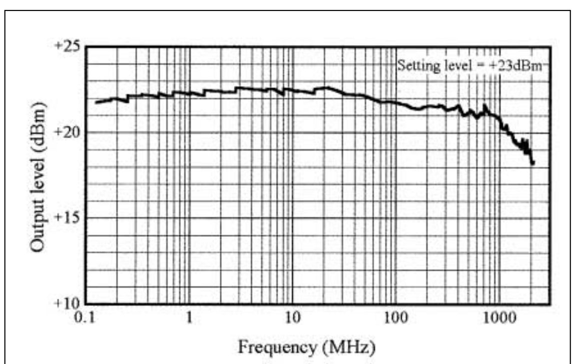
Carrier frequency is produced by a high-stability crystal oscillator. Furthermore, the carrier frequency remains phase locked even at frequency modulation. Then frequency calibration for testing FSK modulation receivers such as paging system is not necessary.



Carrier wave frequency stability at frequency modulation

• High output

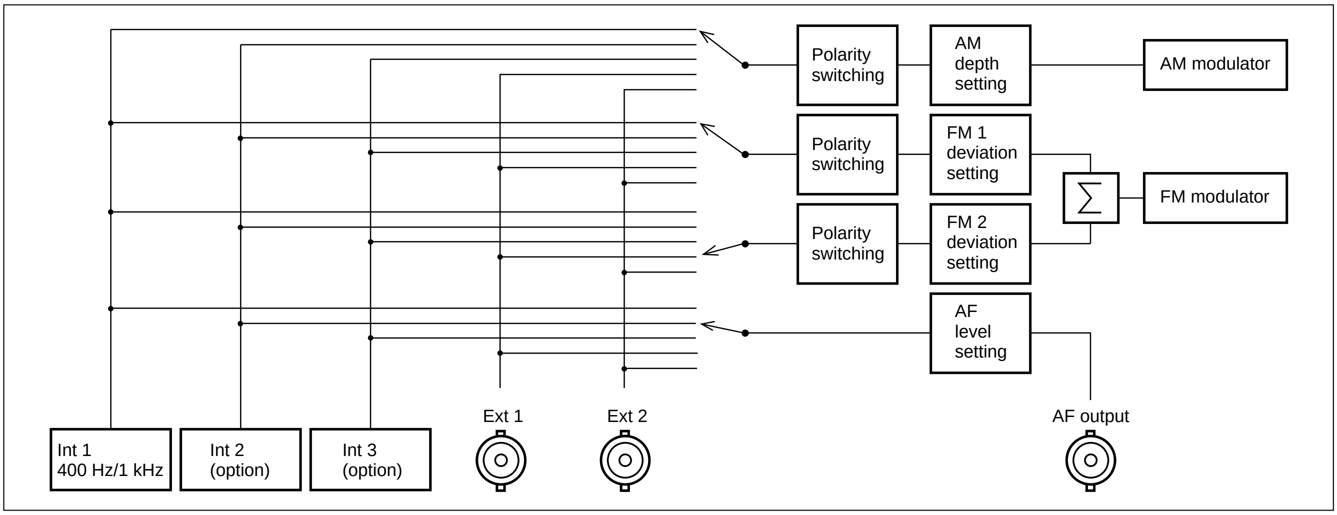
A stable signal with an output of +17 dBm can be output across the full frequency range to drive a variety of local signal sources and power amplifiers. In addition, an overdrive level up to +23 dBm can be set so as to make full use of the internal amplifier capability. If the amplifier's output power comes up to the limitation and output power does not reach the set value, a status message is displayed. This is useful for confirming the output limits.



Maximum output level

• Various modulation types

Up to three internal AF signal sources can be incorporated by adding options to the standard sine-wave oscillator (1 kHz, 400 Hz). The AF synthesizer (Option 21) is a digital synthesizer for generating sine-wave, triangular, square, and sawtooth waveforms; it can also be used as a function generator as well as a modulation signal source. In addition to permitting simultaneous one-route AM and two-route FM modulation, the modulation factor and polarity can be set independently. Installing the pulse modulator (Option 11) in the MG3641A/3642A allows them to generate high-speed pulse modulation using an external modulation signal (TTL level). The output can be used for various burst signals with an ON/OFF ratio of more than 80 dB, as well as a pseudo-random signal for radar. Installing the pattern generator (Option 23) in the MG3641A/3642A allows them to generate FSK or pulse modulation combined with FSK encoder (Option 22) or pulse modulator (Option 11) without an external instrument.

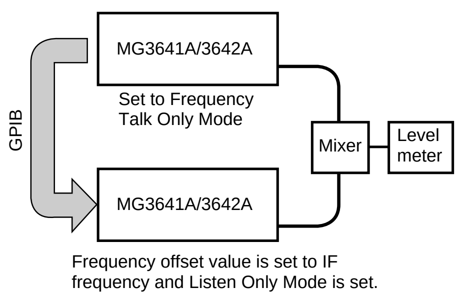


• GPIB Only-Mode linked operation

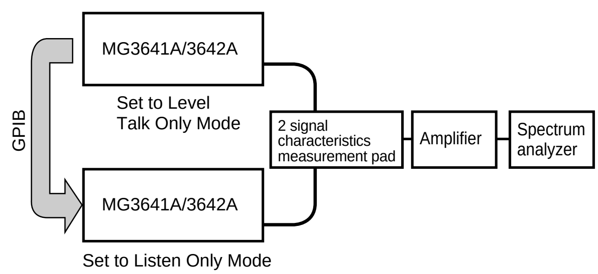
Two sets of MG3641A/3642A can be linked and operated without an external controller using the Frequency and Output Level Only Modes. The Frequency Only Mode in the frequency offset functions is used for evaluating the characteristics of mixers. The Level Only Mode is useful for evaluating the cross-modulation characteristics of non-linear devices such as amplifiers.

• Pattern generator (Option 23)

Installing the pattern generator (Option 23) in the MG3641A/3642A allows them to generate FSK or pulse modulation combined with FSK encoder (Option 22) or pulse modulator (Option 11) without an external instrument.



Measurement example of mixer characteristics using Frequency Only Mode and frequency offset



An example of amplifier IM3 measurement using Level Only Mode

Specifications

• MG3641A/3642A (main frame)

Carrier frequency	Range: 125 kHz to 1040 MHz (MG3641A), 125 kHz to 2080 MHz (MG3642A) Resolution: 0.01 Hz Accuracy: Reference oscillator accuracy; reference oscillator accuracy ±(0.3% of FM setting deviation + 5 Hz) at frequency modulation Internal reference oscillator*1 Frequency: 10 MHz; Aging rate: ±5 x 10^{-9}/day; Start-up characteristics: 1 x 10^{-7}/10 min (for 24 h after power on), Temperature stability: ±3 x 10^{-8} (0˚ to 50˚C) External reference input: 5/10 MHz, ±10 ppm, ≥0.7 Vp-p/50 Ω (AC coupling), BNC connector (rear panel) Buffer output: 10 MHz, TTL level (DC coupling), BNC connector (rear panel) Switching time: <40 ms (external control, response time from last command until becomes within ±0.1 ppm of set frequency)

Continued on next page

<table>
<tr><td>Output</td><td>Range: –143 to +17 dBm (settable range: –143 to +23 dBm)
Units: dBm, dBµ, V, mV, µV (dBµ, V, mV and µV switchable between termination voltage display and open voltage display)
Resolution: 0.01 dB
Frequency characteristics (at 0 dBm): ±0.5 dB, ±1.0 dB (pulse modulation: on)[*2]
Accuracy: ±1 dB (–127 to +17 dBm, upper limit at pulse modulation[*2]: +12 dBm), ±3 dB (<–127 dBm)
Impedance: 50 Ω (N connector), VSWR: <1.5 (≤–3 dBm), <2.5 (>–3 dBm)
Switching time: <50 ms (normal mode), <100 ms (level safety mode), <10 ms (continuous mode)
*Response time from last command until becomes within ±0.5 dB of final level
Special setting mode
Continuous mode: Variable within set value ±10 dB with no interruption of output
Safety mode: Prevent large spike signal generation when operating mechanical-type attenuator
Interference radiation: <0.1 µV (at output frequency), <1 µV (over entire frequency range, multi-menu display: OFF)
*At point 25 mm from cabinet measured with 25 mm diameter loop antenna (2 windings) terminated at 50 Ω</td></tr>
<tr><td>Signal purity</td><td>Spurious (CW mode, ≤+7 dBm)
Harmonics: <–30 dBc (2nd, 3rd)
Non-harmonic: <–100 dBc (≥15 kHz offset)
Those related power: <–40 dBc (<15 kHz offset)
SSB phase noise (CW Mode, 20 kHz offset):
<–140 dBc/Hz (10 to <256 MHz), <–136 dBc/Hz (256 to <512 MHz), <–130 dBc/Hz (512 to 1040 MHz),
<–124 dBc/Hz (>1040 MHz, MG3642A only)
Residual AM: <–80 dBc (≥500 kHz, CW mode, +7 dBm, 50 Hz to 15 kHz demodulation band)
Residual FM (CW mode)
300 Hz to 3 kHz demodulation band: <4 Hzrms (10 to <512 MHz), <8 Hzrms (512 to 1040 MHz), <16 Hzrms (>1040 MHz, MG3642A only)
50 Hz to 15 kHz demodulation band: <5 Hzrms (10 to <512 MHz), <10 Hzrms (512 to 1040 MHz), <20 Hzrms (>1040 MHz, MG3642A only)</td></tr>
<tr><td>Amplitude modulation</td><td>Range: 0% to 100%
Resolution: 0.1%
Accuracy: ±(5% of set value + 2%) *≥0.4 MHz, ≤+7 dBm, ≤90% AM, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation frequency response (output: ≤+7 dBm)
<table>
<tr><td rowspan="2">Carrier frequency</td><td colspan="2">Upper limit frequency</td><td rowspan="2">Lower limit frequency</td></tr>
<tr><td>AM: 30%</td><td>AM: 90%</td></tr>
<tr><td>0.4 to <0.5 MHz</td><td>2 kHz (±1 dB bandwidth)</td><td>1 kHz (±1 dB bandwidth)</td><td rowspan="5">DC: External DC coupling (±1 dB bandwidth)
20 Hz: External AC coupling (±1 dB bandwidth)</td></tr>
<tr><td>0.5 to <2 MHz</td><td>10 kHz (±1 dB bandwidth)</td><td>5 kHz (±1 dB bandwidth)</td></tr>
<tr><td>2 to <32 MHz</td><td colspan="2">20 kHz (±1 dB bandwidth)</td></tr>
<tr><td>32 to <64 MHz</td><td colspan="2">50 kHz (±1 dB bandwidth)</td></tr>
<tr><td>≥64 MHz</td><td colspan="2">50 kHz (±1 dB bandwidth), 100 kHz (±3 dB bandwidth)</td></tr>
</table>
Distortion: <–40 dB (30% AM), <–30 dB (90% AM) *≥0.4 MHz, ≤+7 dBm, source: Int 1 (1 kHz)
Incidental FM: <200 Hz peak *≥0.4 MHz, ≤AM: 30%, ≤+7 dBm, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation signal source: One of internal (Int 1, Int 2, Int 3) and external (Ext 1, Ext 2)
Modulation signal polarity: Positive/negative switchable</td></tr>
<tr><td>Frequency modulation</td><td>Range:
0 to 125 Hz (125 to <250 kHz)
0 to 250 Hz (250 to <500 kHz)
0 to 500 Hz (0.5 to <1 MHz)
0 to 1 kHz (1 to <2 MHz)
0 to 2 kHz (2 to <4 MHz)
0 to 4 kHz (4 to <8 MHz)
0 to 10 kHz (8 to <16 MHz)
0 to 25.6 kHz (16 to <32 MHz)
0 to 51.2 kHz (32 to <64 MHz)
0 to 102 kHz (64 to <128 MHz)
0 to 256 kHz (128 to <256 MHz)
0 to 512 kHz (256 to <512 MHz)
0 to 1024 kHz (512 to 1040 MHz)
0 to 2048 kHz (>1040 MHz, MG3642A only)
Resolution:
1 Hz (0 to 4 kHz deviation)
10 Hz (4.01 to 10 kHz deviation)
25 Hz (10.025 to 25.6 kHz deviation)
50 Hz (25.65 to 51.2 kHz deviation)
100 Hz (51.3 to 102 kHz deviation)
250 Hz (102.25 to 256 kHz deviation)
500 Hz (256.5 to 512 kHz deviation)
1 kHz (513 to 1024 kHz deviation)
1 kHz (1025 to 2048 kHz deviation, MG3642A only)
Accuracy: ± (5% of set value + 10 Hz) (0.4 to <512 MHz), ± (5% of set value + 20 Hz) (512 to 1040 MHz)
± (5% of set value + 40 Hz) (>1040 MHz, MG3642A only)
*Source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
Modulation frequency response: DC or 20 Hz[*3] to 20 kHz (0.4 to <10 MHz), DC or 20 Hz[*3] to 100 kHz (≥10 MHz) *±1 dB bandwidth
Distortion: <–40 dB *≥16 MHz, 3.5 kHz deviation, source: Int 1 (1 kHz)
<–45 dB *≥16 MHz, 22.5 kHz deviation, source: Int 1 (1 kHz)
Incidental FM: <1% peak *≥64 MHz, ≤+7 dBm, 100 kHz deviation, source: Int 1 (1 kHz), 300 Hz to 3 kHz demodulation band
External modulation group delay: <30 µs *≥10 MHz, source: external DC coupling mode, modulation rate: ≤100 kHz
Modulation signal source (FM1, FM2): One of internal (Int 1, Int 2, Int 3), and external (Ext 1, Ext 2)
Modulation signal polarity: FM1, FM2 positive/negative switchable</td></tr>
<tr><td>Pulse modulation</td><td>According to option specifications</td></tr>
<tr><td>Modulation signal source</td><td>Internal modulation (Int 1)
Frequency: 400 Hz, 1 kHz
Accuracy: Same as reference oscillator accuracy
Internal modulation (Int 2, Int 3): According to option specifications
External modulation (Ext 1, Ext 2)
Proper input level: 2 Vp-p approx.
Input impedance: 600 Ω, BNC connector
Coupling: DC/AC switchable</td></tr>
<tr><td>AF output</td><td>Output signal source: One of internal (Int 1, Int 2, Int 3), and external (Ext 1, Ext 2)
Output level: 0 to 4 Vp-p
Output level resolution: 1 mVp-p
Output level accuracy: ± (5% of setting level + 2 mVp-p) *Source: Int 1 (1 kHz)
Impedance: 600 Ω, BNC connector</td></tr>
</table>

Continued on next page

Simultaneous modulation	Excluding amplitude modulation and pulse modulation*2 combination, simultaneous modulation, modulation rate, deviation independently settable
Sweep function	Sweep parameters: Frequency, output level, memory Sweep patterns Frequency sweep (start/stop): Linear (specified step size and number of points), Log (multiplying factor: 1%) Frequency sweep (center/span): Linear (specified step size and number of points) Level sweep (start/stop, center/span): dB (specified step size and number of points) *Sweep: continuous mode (max. 20 dB width) Memory sweep: Start/stop Sweep mode: Auto, single, manual Sweep time Setting range: 1 ms to 600 s/point *Actual sweep time depends on sweep parameter (frequency, output level) Resolution: 10 µs/point Auxiliary output X-Out: Ramp waveform (sweep start point: 0 V, sweep end point: +10 V), BNC connector (rear panel) Z-Out: TTL level (H-level at sweeping), BNC connector (rear panel) Blanking-Out: TTL level (L-level at switching), BNC connector (rear panel) Maker-Out: TTL level (H-level at marker match), BNC connector (rear panel)
Functions	Relative display: Carrier frequency, output level Offset display: Carrier frequency, output level Memory: Saves/recalls 1000 panel settings; recall contents: panel, frequency, frequency/output level selection Trigger: An external trigger signal (rear panel BNC connector, TTL level) can be used to execute a previously programmed operation sequence (except power switch, preset key, local key and rotary knob operations). Max. number of sequence steps of trigger program: 20 steps Back-up: The panel settings before power-off are back-upped and displayed again at power-on, except data-input contents, GPIB data contents, remote settings, RPP operations GPIB control: All functions, except power switch, local key, rotary knobs, and resolution keys (Interface: SH1, AH1, T5, L3, TE0, SR1, RL1, PP0, DC1, DT1, C0, E2)
Reverse power protection	Max. reverse input power: ≤50 W (≤1040 MHz), ≤25 W (>1040 MHz, MG3642A only), ±50 Vdc
Power supply	*4 Vac (+10%, –15%), 47.5 to 63/380 to 420 Hz, ≤200 VA
Temperature	Operating: 0˚ to +50˚C, Storage: –30˚ to +71˚C
Dimensions and mass	320 (W) x 177 (H) x 451 (D) mm, ≤20 kg
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

*1: Can be changed to 5 x 10^{-10}/day using reference crystal oscillator (Option 01)
*2: Only with pulse modulator (Option 11) installed
*3: External DC coupling: DC, External AC coupling: 20 Hz
*4: Specify a nominal voltage of either 100 V and 240 V when ordering; the maximum operating voltage is 250 V.

• Options

Option 01 Reference oscillator	Frequency: 10 MHz Aging rate: 5 x 10^{-10}/day Temperature stability: ±5 x 10^{-9} (0˚ to 50˚C)
Option 11 Pulse modulator	Frequency: 125 kHz to 2080 MHz On/off ratio: >80 dB Rise/fall time: <100 ns Min. pulse width: <500 ns Pulse repetition rate: DC to 1 MHz Max. delay time: <100 ns Overshoot, ringing: <20% Video feed-through: <20% Pulse modulation input: 50/600 Ω, TTL (positive logic), BNC connector (rear panel)
Option 21 AF synthesizer	Frequency: 0.01 Hz to 400 kHz (sine-wave), 0.01 Hz to 50 kHz (triangular, square and sawtooth waveforms) Resolution: 0.01 Hz Waveform: Sine-wave, triangular, square and sawtooth waveforms Frequency accuracy: Same as reference oscillator accuracy
Option 22 FSK encoder	Frequency shift (Data 2^1, Data 2^0) = (0, 0): –frequency deviation setting, (Data 2^1, Data 2^0) = (0, 1): –frequency deviation setting/3, (Data 2^1, Data 2^0) = (1, 0): +frequency deviation setting, (Data 2^1, Data 2^0) = (1, 1): +frequency deviation setting/3 Frequency set Free: Frequency shift simultaneously with data input Rise trigger: Frequency shift at external clock rise time Fall trigger: Frequency shift at external clock fall time Baseband filter Filter type: 10-th order Bessel filter Cut-off frequency: 100 Hz to 30 kHz (–3 dB) Setting resolution: Upper 2 digits Frequency deviation accuracy: Depends on frequency modulation deviation accuracy of main frame (at by-pass to baseband filter) External modulation input Data 2^0/2^1: TTL level (pull-down), BNC connector (rear panel) External clock input: TTL level (pull-up), BNC connector (rear panel)

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Option 23 Pattern generator	Data pattern	Free	Number of memories: 4 (defined: 1 to 4) Memory capacity: 524,288 bits/memory Pattern output Range: Top address and data bit length can be set for the respective free-pattern memories. Top address setting range: 00000 to 65,535 Data bit length setting range: 2 to 524,288 bits (Final address of output: 65,535 or less) Memory: Saves 1-byte units via GPIB interface Saves when pattern generator output off, or idle pattern being output
		Fixed	PN9 pseudorandom pattern (conforming to ITU-T V.52), PN15 pseudorandom pattern (conforming to ITU-T O.151), 01 fixed pattern
	Idle pattern		Number of memories: 1 (idle) Memory capacity: 524,288 bits Pattern output Range: The top address and data bit length can be set. Top address setting range: 00000 to 65,535 Data bit length setting range: 2 to 524,288 bits (final address of output: 65,535 or less.) Memory: Saves 1-byte units via GPIB interface Saves when pattern generator output off
	Output method		Single: Specified data pattern output once only (PN9 and PN15 are output twice.) Continuous: Specified data pattern output continuously When the data pattern is not output, the idle pattern is output continuously.
	Output rate		Range: 1 to 99,999 bps (resolution: 1 bps) Accuracy: Same as reference oscillator of MG3641A/3642A
	Output system		1-bit NRZ output (corresponding to binary data output): Data is output to the Data 2^1 Output sequentially, one bit after another starting from the top bit. The logic of Data 2^0 is fixed to 0. 2-bit NRZ output (corresponding to quadrature data output): Data is output to the Data 2^1 Output and Data 2^0 Output sequentially, two bits after another, starting from the top bit.
	Output level		Data 2^0 Output: TTL level, Data 2^1 Output: TTL level, Clock Output: TTL level, rising

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MG3641A	Synthesized Signal Generator	
MG3642A	Synthesized Signal Generator	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
B0325	GPIB connector shielded cap:	1 pc
F0013	Fuse, 5 A (for 100 Vac mains):	2 pcs
F0012	Fuse, 3.15 A (for 200 Vac mains):	2 pcs
W1137AE	MG3641A/3642A operation manual:	1 copy
	Options	
MG364[ ]A-01	Reference oscillator (aging rate: 5 x 10^{-10}/day)	
MG364[ ]A-11	Pulse modulator (pulse repetition rate: DC to 1 MHz)	
MG364[ ]A-21*1	AF synthesizer (0.01 Hz to 400 kHz, resolution: 0.01 Hz)	
MG364[ ]A-22*1	FSK encoder (2 or 4 levels FSK)	
MG364[ ]A-23*1	Pattern generator	
	Optional accessories	
J0576B	Coaxial cord (N-P · 5D-2W · N-P), 1 m	
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m	
J0007	GPIB cable, 1 m	
J0008	GPIB cable, 2 m	
MA1612A	Four-Point Junction Pad	
MP721[ ]	Attenuator (DC to 12.4 GHz)	
B0395C	Rack mount kit (EIA/IEC)	
B0329G	Front cover (3/4MW 4U)	
B0412A	Carrying case (with casters and B0329G front cover)	
B0330B	Tilt bail (3/4MW 450D)	

*1: An option 21, 22 and 23 can be mounted to two.

Convinations

Option 21	Option 21	Analog modulations of two tones, such as a tone squelch test, can be performed.
Option 21	Option 22	FSK modulation by external data input and analog modulation can be performed.
Option 21	Option 23	
Option 22	Option 23	FSK modulation by internal data pattern can be performed.

SYNTHESIZED SIGNAL GENERATOR
MG3633A
10 kHz to 2700 MHz

GPIB

For Evaluating of Quasi-Microwaves and Measuring High-Performance Receivers

The MG3633A has excellent frequency resolution, frequency switching speed, signal purity, and a high output level, in addition to amplitude, frequency, and phase modulation functions. Also, sweep functions are provided for carrier frequency, output level, and modulation frequency so an appropriate sweep can be performed for various devices to be measured.
Also, the MG3633A has a frequency memory that can store 1000 carrier frequencies and a function memory that stores 100 panel settings. Moreover, since the maximum output level is +17 dBm, it can be used for various local signal sources.
The MG3633A is suitable for research and development of mobile communications in the quasi-microwave band, performance evaluation, characteristics testing, and adjustment of various types of radio equipment such as digital land-based mobile communications, mobile satellite communications, satellite broadcasting, and radio LANs.

Features

• Low noise
By using both the latest synthesizer and RF-device technologies and optical data links in the internal control circuit, the SSB phase noise has been cut to –140 dBc/Hz (CW, 1.1 GHz, offset 20 kHz). In particular, the MG3633A shows its power in measurement of narrow-band radio equipment S/N ratio and adjacent channel selectivity.

• High accuracy and high-output level
Low levels of –123 dBm can be set with ±1 dB accuracy by using a high-accuracy programmable attenuator. The output level can be displayed in units of dBm, dBμV, V, mV, and μV or as a relative value (dB).

• Modulation characteristics
The MG3633A has AM, FM, øM, and a combination of all three modulation functions. A DC mode is provided for FM, which makes simulation of digital transmissions for a pager possible. Also, a built-in AF oscillator with a 0.1 Hz to 100 kHz synthesizer can handle various modulations.

• Quasi-microwave output
The MG3633A covers a wide range (from 10 kHz to 2700 MHz) and is suitable for research and development, as well as production of quasi-microwave band radio equipment.

Performance

• Signal purity
The MG3633A has excellent spectral purity. As shown in the Figure 1, the SSB phase noise at 1 GHz with 20 kHz signal offset is –140 dBc/Hz. In particular, this shows its power for generating signals used for testing radio receiver selectivity, for generating high-speed clocks of A/D converters and dividers, as well as for generating standard signals for communications links. Also, since the residual FM is 0.8 Hz rms or less (1.28 GHz or less), even the S/N ratio of narrow-band mobile radio equipment can be measured with sufficient margin (Figure 2).

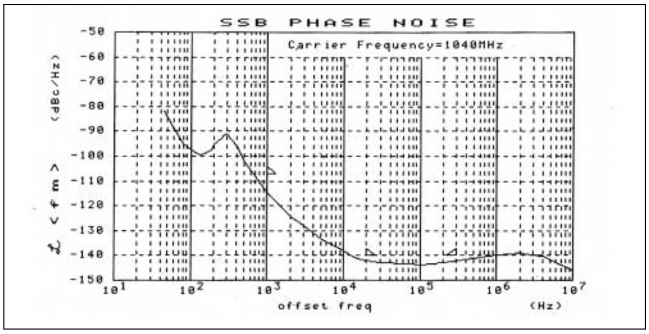

Figure 1. SSB phase noise

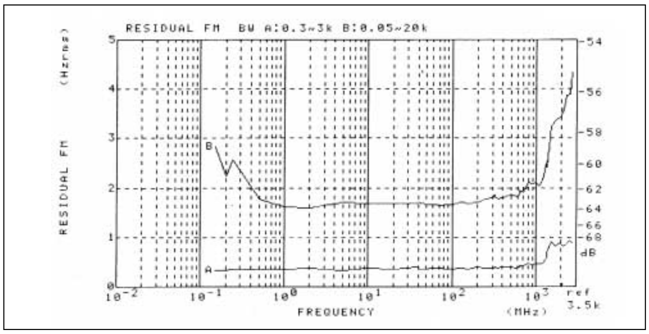

Figure 2. Residual FM

• Output level characteristics
A maximum output of +17 dBm can be obtained over a wide frequency range so 2-signal or 3-signal testing can be done easily. A high-accuracy highly-reliable programmable attenuator (life cycle over 3 million times) is used and, since flat output characteristics are obtained by internal calibration over a wide range from 10 kHz to 2.7 GHz, it is effective for testing antennas and cables (Figure 3).
Moreover, compensation data for obtaining flat levels at cable ends can be input by using a power meter, GPIB, controller, and frequency-response compensation software (option).

• Continuously variable output level
The MG3633A can output continuously-variable signals in a 20 dB range with 0.1 dB steps at any level. This is especially convenient for measuring the dynamic range of magnetic tape and squelch sensitivity of radios which produce hysteresis phenomenon as a result of level variation.

• AM
A high-accuracy AM wave is generated over a wide frequency range (Figure 4). Countermeasures against carrier-wave variation due to vibration permit even SSB radio equipment to be tested with confidence.

• FM
FM with a maximum frequency deviation of 3.2 MHz is possible (1.28 to 2.7 GHz). Also if the frequency deviation is too low, automatic operation is carried out in the stabilized DC-FM mode so even digital data transmission equipment such as papers can be tested (Figure 5).

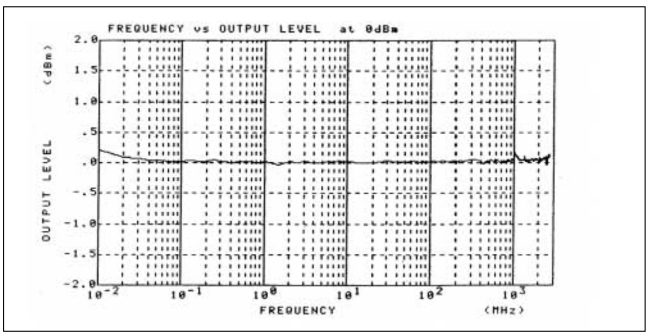

Figure 3. Output level frequency response

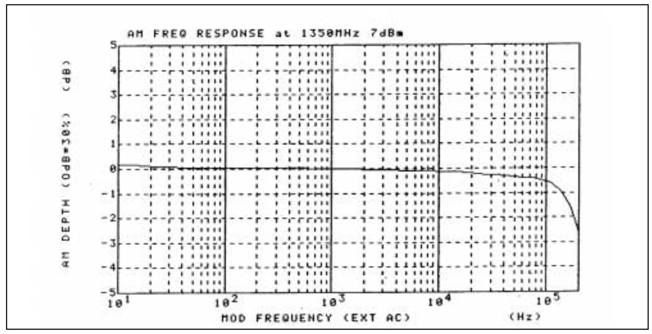

Figure 4. AM modulation frequency characteristics

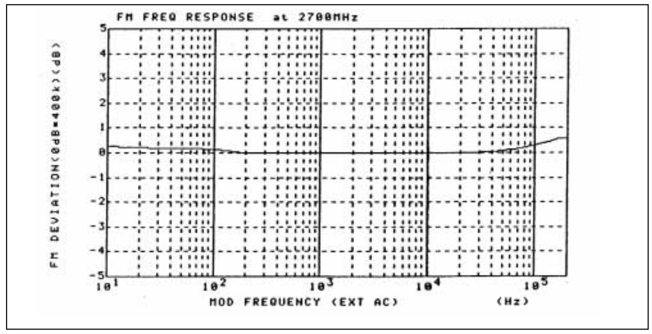

Figure 5. FM modulation frequency characteristics

Specifications

Carrier frequency	Range	10 kHz to 2700 MHz		
	Resolution	0.01 Hz		
	Accuracy	Same as that of the reference oscillator		
	Internal reference oscillator*1	Frequency: 10 MHz Start-up characteristics: After 30 minutes of operation: ≤1 x 10^{-7}/day, after 60 minutes of operation: ≤5 x 10^{-8}/day, Aging rate: After 24 hours of operation: ≤2 x 10^{-8}/day, Temperature characteristics: ±5 x 10^{-8} (0˚ to 50˚C)		
	External reference signal input	10 MHz, TTL Level, BNC connector on rear panel		
	Reference signal output	10 MHz, TTL Level, BNC connector on rear panel		
	Switching time	≤10 ms (time from last command until frequency has stabilized to within ±500 Hz of set frequency, during remote operation)		
Output	Range	–143 to +23 dBm		
	Units	dBm, dBµV, V, mV, µV (Terminated and open voltages are selectable for dBµV, V, mV or µV.)		
	Resolution	0.1 dB		
	Frequency response	±0.5 dB referred to 0 dBm (<1280 MHz), ±1 dB referred to 0 dBm (≥1280 MHz)		
	Accuracy	Output level \ Frequency	10 kHz to <1280 MHz	≥1280 MHz
		+17.1 to +23 dBm	–	–
		+15.1 to +17 dBm	±1 dB	–
		–122.9 to +15 dBm	±1 dB	±2 dB
		–132.9 to –123 dBm	±3 dB	±4 dB
		–143 to –133 dBm	–	–
	Impedance	50 Ω, N-type connector VSWR: ≤1.5 (<1280 MHz, ≤–3 dBm), ≤1.8 (≥1280 MHz, ≤–3 dBm)		
	Switching time	Time from last command until output level is stabilized, during remote operation:≤25 ms (at LEVEL NORMAL mode) ≤80 ms (when setting level is crossing over –59 dBm, at LEVEL NORMAL mode) ≤5 ms (at LEVEL CONTINUOUS mode)		
	Interference radiation	≤1 µV (Value is voltage terminated with 50 Ω load, measured 25 mm from front panel with a two-turn 25 mm diameter loop antenna.) Except sweep mode		

Continued on next page

Signal purity	Spurious	At +7 dBm, CW mode: (f_c: carrier frequency)			
		Harmonics (2nd, 3rd): ≤–30 dBc (at ≥100 kHz) Sub-harmonics (f_c/2, 3f_c/2, 5f_c/2): None (at <1280 MHz), ≤–30 dBc (at ≥1280 MHz) Non-harmonics: ≤–80 dBc (f_c<640 MHz, ≥10 kHz offset) ≤–74 dBc (640 MHz≤f_c<1280 MHz, ≥10 kHz offset) ≤–68 dBc (f_c≥1280 MHz, ≥10 kHz offset)			
	SSB phase noise	At +7 dBm, CW mode, 0˚to 35˚C			
		Offset frequency	1 kHz	20 to 300 kHz	
		0.01 to <40 MHz	–116 dBc/Hz	–140 dBc/Hz	
		40 to <300 MHz	–119 dBc/Hz	–145 dBc/Hz	
		300 to <600 MHz	–113 dBc/Hz	–143 dBc/Hz	
		600 to <1100 MHz	–107 dBc/Hz	–140 dBc/Hz	
		1.1 to <2.4 GHz	–101 dBc/Hz	–132 dBc/Hz	
		2.4 to 2.7 GHz	–97 dBc/Hz	–120 dBc/Hz	
		Floor noise: ≤145 dBc/Hz (40 to <1100 MHz)			
	Residual AM	≤0.02% rms at ≥150 kHz (demodulation band: 300 Hz to 3 kHz)			
	Residual FM	≤0.8 Hz rms at <1280 MHz (demodulation band: 300 Hz to 3 kHz) ≤4 Hz rms at <1280 MHz (demodulation band: 50 Hz to 20 kHz)			
Amplitude modulation	Range	0 to 100%			
	Resolution	0.1%			
	Internal modulation frequency	Fixed frequency: 400 Hz, 1 kHz Variable frequency: 0.1 Hz to 50 kHz, 0.1 Hz resolution Frequency accuracy: 100 ppm			
	Accuracy	± (5% of indicated value +2%) [at ≥250 kHz, ≤+7 dBm, 0 to 90% and internal 1 kHz]			
	Frequency response	At ≤+7 dBm, ±1 dB bandwidth			
		Lower modulation frequency limit	20 Hz (EXT AC mode), DC (EXT DC mode)		
		Upper modulation frequency limit	Carrier frequency \ Modulation factor	0 to 30%	30.1 to 80%
			0.25 MHz≤f_c<0.5 MHz	5 kHz	5 kHz
			0.5 MHz≤f_c<80 MHz	20 kHz	10 kHz
			80MHz≤f_c	50 kHz	20 kHz
	External modulation	Input level: Approx. 2 Vp-p ,600 Ω Input Impedance: Nominal 600 Ω			
	Depth	≤1% (at ≥1 MHz, ≤+7 dBm, internal 1 kHz, 30%) ≤3% (at ≥1 MHz, ≤+7 dBm, internal 1 kHz, 80%) ≤3% (at 250 kHz≤f_c<1 MHz, ≤+7 dBm, internal 1 kHz, 30%) ≤10% (at 250 kHz≤f_c<1 MHz, ≤+7 dBm, internal 1 kHz, 80%)			
	Incidental FM	≤200 Hz peak (at ≥250 kHz, ≤+7 dBm, 1 kHz, 30%, demodulation band 0.3 to 3 kHz)			
Frequency modulation	Range	0 to 400 kHz (1 MHz≤f_c<40 MHz) 0 to 100 kHz (40 MHz≤f_c<80 MHz) 0 to 200 kHz (80 MHz≤f_c<160 MHz) 0 to 400 kHz (160 MHz≤f_c<320 MHz)	0 to 800 kHz (320 MHz≤f_c<640 MHz) 0 to 1.6 MHz (640 MHz≤f_c<1280 MHz) 0 to 3.2 MHz (1280 MHz≤f_c)		
	Resolution	10 Hz (0 to 9.99 kHz deviation) 100 Hz (10 to 99.9 kHz deviation)	1 kHz (100 to 666 kHz deviation) 10 kHz (1 to 3.2 MHz deviation)		
	Internal modulation frequency	Fixed frequency: 400 Hz, 1 kHz Variable frequency: 0.1 to 100 kHz. 0.1 Hz resolution Frequency accuracy: 100 ppm			
	Accuracy	± (5% of indicated value +20 Hz) [internal 1 kHz]			
	Modulation frequency response	±1 dB bandwidth Frequency range: 20 Hz to 100 kHz (EXT AC mode), DC to 100 kHz (EXT DC mode)			
	External modulation	Input level: Approx. 2 Vp-p/600 Ω Input impedance: Nominal 600 Ω			
	Distortion	≤1% (internal 1 kHz, 3.5 kHz deviation)			
	Incidental AM	≤0.4% (internal 1 kHz, 22.5 kHz deviation, demodulation band 0.3 to 3 kHz)			
	Carrier frequency accuracy in DC-FM mode	±500 Hz for 30-minute period after calibration and 2-hour warm-up (at <1280 MHz, <10 kHz deviation)			
Phase modulation	Range	0 to 80 rad (1 MHz≤f_c<40 MHz) 0 to 20 rad (40 MHz≤f_c<80 MHz) 0 to 40 rad (80 MHz≤f_c<160 MHz) 0 to 80 rad (160 MHz≤f_c<320 MHz)	0 to 160 rad (320 MHz≤f_c<640 MHz) 0 to 320 rad (640 MHz≤f_c<1280 MHz) 0 to 640 rad (1280 MHz≤f_c)		
		Besides radian, deg unit is also possible for phase deviation display. However, max. 999 deg.			
	Resolution	0.01 rad (0 to 9.99 rad deviation), 1 rad (100 to 640 rad deviation), 0.1 rad (10 to 99.9 rad deviation)			
	Internal modulation frequency	Fixed frequency: 400 Hz, 1 kHz Variable frequency: 0.1 Hz to 5 kHz, 0.1 Hz resolution Frequency accuracy: 100 ppm			
	Accuracy	±(10% of indicated value +0.05 rad) [internal 1 kHz modulation]			
	Modulation frequency response	±1 dB bandwidth Frequency range: 20 Hz to 5 kHz (EXT AC mode), DC to 5 kHz (EXT DC mode)			

Continued on next page

<table>
<tr><td rowspan="2">Phase modulation</td><td>External modulation</td><td>Input level: Approx. 2 Vp-p/600 Ω
Input impedance: Nominal 600 Ω</td></tr>
<tr><td>Distortion</td><td>≤1% (internal 1 kHz, 5 rad modulation)</td></tr>
<tr><td rowspan="4">Internal modulation signal</td><td>Frequency range</td><td>400 Hz, 1 kHz (fixed oscillator)
0.1 Hz to 100 kHz (variable oscillator)
DC voltage signals equivalent peak values of internal modulating sine wave can be applied as a modulating signal using the SPECIAL FUNCTION.</td></tr>
<tr><td>Resolution</td><td>0.1 Hz</td></tr>
<tr><td>Frequency accuracy</td><td>100 ppm</td></tr>
<tr><td>Distortion</td><td>≤0.03% (fixed, 400 Hz and 1 kHz), ≤0.3% (variable, 20 Hz to 50 kHz)</td></tr>
<tr><td rowspan="2">Memory function</td><td>Frequency memory</td><td>1000 carrier frequencies (store/recall)</td></tr>
<tr><td>Function memory</td><td>100 panel settings (store recall)</td></tr>
<tr><td rowspan="5">Sweep function</td><td>Sweep mode</td><td>Carrier frequency, output level, AF frequency</td></tr>
<tr><td>Sweep pattern</td><td>
<table>
<tr><td colspan="2"></td><td>Carrier frequency</td><td>Output level</td><td>AF frequency</td></tr>
<tr><td rowspan="2">Pattern</td><td>Start/stop</td><td>√</td><td>√*2</td><td>√</td></tr>
<tr><td>Center/span</td><td>√</td><td>√*2</td><td>√</td></tr>
<tr><td rowspan="3">Step</td><td>Entering number of steps</td><td>√</td><td>–</td><td>√</td></tr>
<tr><td>Entering step size</td><td>√</td><td>√*3</td><td>√</td></tr>
<tr><td>LOG 1%</td><td>√</td><td>–</td><td>√</td></tr>
</table>
<table>
<tr><td colspan="2"></td><td>Frequency memory</td><td>Function memory</td></tr>
<tr><td rowspan="3">Pattern</td><td>Continuous address</td><td>√</td><td>√</td></tr>
<tr><td>Random address</td><td>√</td><td>√</td></tr>
<tr><td>Continuous, random mixed</td><td>√</td><td>√</td></tr>
<tr><td colspan="2">Maximum number of steps</td><td>20*4</td><td>20*4</td></tr>
</table>
</td></tr>
<tr><td>Sweep time</td><td>0.1 ms to 600 s, 0.01 ms resolution (minimum time depends on the switching time of each function.)</td></tr>
<tr><td>Marker</td><td>One movable marker</td></tr>
<tr><td>Sweep signal output</td><td>Staircase (saw-tooth waveform), Start point: 0V, Stop point: 10V</td></tr>
<tr><td rowspan="7">Other functions</td><td>Modulation signal output</td><td>Modulation signal is output when modulating.
Output level: Approx. 2 Vp-p/600 Ω</td></tr>
<tr><td>Simultaneous modulation</td><td>Simultaneous modulation is possible in combinations shown below.
<table>
<tr><td></td><td>INT AM</td><td>EXT AM</td><td>INT FM</td><td>EXT FM</td><td>INT øM</td></tr>
<tr><td>EXT øM</td><td>√</td><td>√</td><td>–</td><td>–</td><td>√*6</td></tr>
<tr><td>INT øM</td><td>√*5</td><td>√</td><td>–</td><td>–</td><td></td></tr>
<tr><td>EXT FM</td><td>√</td><td>√</td><td>√*6</td><td></td><td></td></tr>
<tr><td>INT FM</td><td>√*5</td><td>√</td><td></td><td></td><td></td></tr>
<tr><td>EXT AM</td><td>√</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Relative value display</td><td>Carrier frequency, output level</td></tr>
<tr><td>Continuously variable output level mode</td><td>Continuously variable within a ±10 dB range of the set level
Step size: 0.1 dB</td></tr>
<tr><td>Trigger function</td><td>Previously programmed operation procedure can be started by a trigger input through its input terminal (on rear panel, BNC connector, TTL level). Maximum program steps for triggered operation: 99 steps</td></tr>
<tr><td>Memory backup</td><td>Last settings are stored when power is turned off.</td></tr>
<tr><td>GPIB</td><td>Interface function: SH1, AH1, T5, L3, TE0, LE0, SR1, RL1, PP0, DC1, DT1, C0</td></tr>
<tr><td colspan="2">Reverse power</td><td>Maximum reverse input power: 50W (<1000 MHz), 25W (≥1000 MHz), ±DC 50V</td></tr>
<tr><td colspan="2">Operating temperature</td><td>0˚ to 50˚C</td></tr>
<tr><td colspan="2">Power</td><td>*7 Vac^{+10}_{-15} %, 48 to 63 Hz, ≤270 VA</td></tr>
<tr><td colspan="2">Dimensions and mass</td><td>426 (W) x 177 (H) x 451 (D) mm, ≤32 kg</td></tr>
<tr><td colspan="2">EMC</td><td>EN61326: 1997/A2: 2001 (Class A)
EN61000-3-2: 2000 (Class A)
EN61326: 1997/A2: 2001 (Annex A)</td></tr>
<tr><td colspan="2">LVD</td><td>EN61010-1: 2001 (Pollution Degree 2)</td></tr>
</table>

*1: Aging rates up to 5 x 10^{-10}/day are available as option.
*2: Step width: Max. 20 dB
*3: 0.1 dB step size only
*4: One continuous address setting is counted as 3 steps.
*5: Same one internal modulation frequency is used.
*6: Different deviation settings are possible for INT and EXT modulations (using the SPECIAL FUNCTION).
*7: Specify one nominal line voltage between 100 and 240V when ordering. However maximum operational voltage is limited to 250V.

Options

Reference oscillators		Standard model	Option 01	Option 02	Option 03
Start-up characteristics	After 30 minutes operation	1 x 10^{-7}/day	7 x 10^{-8}/day	–	–
	After 60 minutes operation	5 x 10^{-8}/day	3 x 10^{-8}/day	2 x 10^{-8}/day	–
Aging rate	After 24 hours operation	2 x 10^{-8}/day	5 x 10^{-9}/day	2 x 10^{-9}/day	–
	After 48 hours operation	–	–	–	5 x 10^{-10}/day
Temperature characteristics (0˚ to 50˚C)		±5 x 10^{-8}	±5 x 10^{-8}	±1.5 x 10^{-8}	±5 x 10^{-9}

Option 04: Rear RF output, SMA connector

Peripheral equipment

MA1610A Pulse Modulator

The MA1610A is a pulse modulator used in combination with the MG3633A Synthesized Signal Generator to generate high-speed pulse modulated signals. The MA1610A can switch RF signals with a carrier frequency ranging from 10 kHz to 2700 MHz ON and OFF using an input modulation signal (TTL level, 50 Ω terminated). Power is supplied from the MG3633A via its rear panel AUX connector.

Frequency range	10 kHz to 2700 MHz
ON,OFF ratio	≥60 dB (<1000 MHz), ≥40 dB (≥1000 MHz)
Insertion loss	≤2 dB (<1000 MHz), ≤3.5 dB (<1000 MHz)
Rise time	≤15 ns
Fall time	≤5 ns
Minimum pulse width	20 ns
Maximum repetition rate	10 MHz
Maximum delay time	40 ns
Video feed through	≤50 mVp-p
Overshoot/ringing	≤20%
RF input/output	50 Ω, N-type connector, maximum permissible input level: AC 200 mW, DC 3.5 V
Operating temperature	0˚ to 50˚C
Dimensions and mass	131 (W) x 57 (H) x 43 (D) mm, ≤600 g
Standard accessories	J0494: Coaxial cord, 0.3m (1 pc) J0495: Power cord, 1.0m (1 pc) W0508AE: MA1610A operation manual (1 copy)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MG3633A	Synthesized Signal Generator
	Standard accessories
J0025A	Coaxial cord (S-5DWP · 5D-2W · S-5DWP), 1 m: 1 pc
J0127A	Coaxial cord (BNC-P · RG58A/U · BNC-P), 1 m: 1 pc
	Power cord, 2.5 m: 1 pc
F0013	Fuse, 5 A (for 100 Vac mains): 2 pcs
F0012	Fuse, 3.15 A (for 200 Vac mains): 2 pcs
W0504AE	MG3633A operation manual: 1 copy
	Options
MG3633A-01	Reference oscillator
MG3633A-02	Reference oscillator
MG3633A-03	Reference oscillator
MG3633A-04	Rear RF output: SMA connector (however, replaces front-panel RF connector)
	Peripheral
MA1610A	Pulse Modulator (10 kHz to 2.7 GHz)
	Optional accessories
MP614B	50 Ω ↔ 75 Ω Impedance Transformer (50 Ω ↔ 75 Ω, 10 MHz to 1.2 GHz)
MA1612A	Four-Port Junction Pad (5 MHz to 3 GHz)
MP659A	Four-Port Junction Pad (40 to 1000 MHz)
Z-164A	T-pad (DC to 1000 MHz)
MB24A	Portable Test Rack

9

RF MICROWAVE SIGNAL GENERATOR
MG3690A
0.1 Hz to 65 GHz / 110 GHz

GPIB

The Ideal Signal Generator

Value without compromise
Your microwave signal generation requirements have never been tougher, and yet your capital equipment budget has never been tighter. You need the most value you can get in a synthesizer, but you can't compromise performance. You need a synthesizer that meets today's needs yet can be upgraded at a reasonable cost to satisfy future requirements without shattering your test equipment budget. Anritsu's MG3690A series of synthesizers deliver the highest performance and the highest value available today.

Features
Basic CW Generators configurable to full-featured Signal Generators.
- Broad Frequency Coverage, in a Single Output: 0.1 Hz to 65 GHz
  - 6 Models, 2 to 8.4, 20, 30, 40, 50, and 65 GHz
  - 10 MHz Coverage Optional (Analog or Digital Down-Conversion)
  - 0.1 Hz Coverage Optional
- mmW Coverage up to 110 GHz, in Waveguide
- Ultra-Low SSB Phase Noise Option
- –110 dBc/Hz (typically) at 1 kHz Offset, 10 GHz Carrier
- Excellent Harmonics and Spurious Response
- High Output Power Option
  - +19 dBm to 10 GHz
  - +17 dBm to 20 GHz
  - +14 dBm to 40 GHz
  - +3 dBm to 65 GHz
- CW and Step Sweep Modes; Analog Sweep Optional
- <5 ms Switching Time (typically) for <100 MHz steps
- 0.01 Hz standard Frequency Resolution
- Phase Offset Capability
- AM, FM/ΦM Modulations Optional
  - Internal LF Generator Optional
- Pulse Modulation Optional
  - 100 ns Leveled Width, >2 GHz
  - Internal Pulse Generator Optional
- IF Up-Conversion Option, for IQ Modulation Solutions
- Intuitive, Menu-driven Front Panel
- Small and Light
- Proven Reliability with 3 Year Standard Warranty
- Completely Configurable and Upgradable

High performance signal generators
The ultimate in full-function signal generation. They provide all the features of the other families along with comprehensive, high-performance modulation for signal simulation applications. Additional features in these units include:
- Internal pulse generator with swept delay capability for moving target simulation
- Flexible pulse triggering including free-run, delayed, gated, and composite
- 0 to 90% AM, log or linear, over DC to 100 kHz rates
- Four FM modes for up to 10 MHz deviation at 8 MHz rates or 100 MHz deviation at 100 Hz rates
- Phase modulation (ΦM) up to 400 radians deviation at 1 MHz rates
- Internal AM, FM, and ΦM generators, each with 7 modulating waveforms
- Optional user-defined, downloaded complex modulation

A new standard for a new millennium
The MG3690A leverages the proven design of earlier Anritsu synthesizers, adding new features to meet the latest needs of the new millennium. The MG3690A builds on a proven reliability record of >49,000 hours MTBF. This allows the MG3690A to offer a standard 3-year warranty. From the sleek new lines of the front panel, the larger 1/4 VGA LCD, the reduced front panel buttons and menu depth, to the 10 kg lighter and 15 cm shallower depth, the MG3690A meets the new millennium value-based needs.

Automatic Test Equipment
The MG3690A is an ideal signal generator for an A.T.E. system. It packs the highest performance available in a 13.3 cm (3u) package, with a 450 mm depth that minimizes rack space. High output power assures adequate signal strength to the device under test even after A.T.E. switching and cabling losses. Accurately leveled output power to –120 dBm in 0.01 dB steps facilitates receiver sensitivity measurements. For improved MTBF, an electronic step attenuator replaces the traditional mechanical step attenuator. Fast 5 ms switching time maximizes system throughput. Internal list mode frees the A.T.E. controller to perform measurement analysis tasks. Free application drivers, including the IVI-COM driver and National Instruments LabView® drivers, save you time and money in code generation and maintenance. For additional cost savings, Option 17 eliminates the complete front panel, including circuitry.

Interchangeable Virtual Instruments Standard
The IVI standard defines a standard instrument driver model that enables instrument interchangeability and interoperability without software changes. Anritsu's IVI-driver supported synthesizer minimizes instrument development and maintenance cost through the use of IVI-standard interfaces as well as instrument-specific interfaces for unique

instrument features. The IVI standard provides a single driver that supports the common application development environments such as Visual Basic, Visual C++, and Labview. The flexible I/O model supports new communication technologies such as USB, Ethernet, and Firewire. Anritsu Corporation leads the way with IVI technology, having released the first COM-based IVI driver supporting the Signal Generator instrument class, and includes the driver with every MG3690A series synthesizer. As an active member of the IVI Foundation, Anritsu supports the Foundation's drive toward instrument driver standardization as a powerful means of delivering interchangeable ATE instrumentation solutions.

Specifications

For detailed and most up-to-date specifications, please refer to the MG3690A data sheet, p/n 11410-00327. The latest version of this data sheet is available for down-loading in pdf format in the MG3690A section of the Anritsu website www.anritsu.com.

CW mode	Output		Twenty independent, presettable CW frequencies (F0 – F9 and M0 – M9)
	Accuracy		Same as internal or external 10 MHz time base
	Internal time base stability	With aging	<2 x 10^{-9}/day (<5 x 10^{-10}/day with Option 16)
		With temperature	<2 x 10^{-8}/°C over 0°C to 55°C (<2 x 10^{-10}/°C with Option 16)
	Resolution		0.01 Hz
	External 10 MHz reference input		Accepts external 10 MHz ±100 Hz, Φ to +20 dBm time base signal. Automatically disconnects the internal high-stability time-base option, if installed. BNC, rear panel, 50 Ω impedance
	10 MHz reference output		0.5 Vp-p into 50 Ω, AC coupled. Rear panel BNC; 50 Ω impedance
	Switching time (typical maximum)		<40 ms to be within 1 kHz of final frequency
	Phase offset		Adjustable in 0.1° steps
	Electronic Frequency Control (EFC) input		–5V to +5V input range; Fout/(2 x 10^6) Hz/v sensitivity typical; ≤250 Hz modulation BW; rear panel BNC; high impedance
Phase-locked step sweep mode	Sweep width		Independently selected, 0.01 Hz to full range. Every frequency step in sweep range is phase-locked
	Accuracy		Same as internal or external 10 MHz time base
	Resolution (minimum step size)		0.01 Hz
	Linear/log sweep		User-selectable linear or log sweep. In log sweep, step size logarithmically increases with frequency
	Steps		User-selectable number of steps or the step size
	Number of Steps		Variable from 1 to 10,000
	Step size		0.01 Hz to the full frequency range of the instrument. (If the step size does not divide into the selected frequency range, the last step is truncated.)
	Dwell time per step		Variable from 1 ms to 99 seconds
	Fixed rate sweep		Allows the user to set the total time of the sweep, including lock time. Variable from 20 ms to 99 seconds
	Switching time (typical maximum)		<15 ms + 1 ms/GHz step size or <40 ms, whichever is less, to be within 1 kHz of final frequency
Alternate sweep mode	Sweeps alternately in step sweep between any two sweep ranges. Each sweep range may be associated with a power level.		
Analog Sweep Mode (Option 6)	Sweep Width		Independently selected from 1 MHz to full frequency range. With Option 4, Digital Down Converter, analog sweep is only available •500 MHz. Analog sweep is not available <10 MHz with option 22.
	Accuracy		The lesser of ± 30 MHz or (± 2 MHz + 0.25% of sweep width) for sweep speeds of ≤50 MHz/ms.
	Sweep Time Range		30 ms to 99 seconds
Manual sweep mode	Provides stepped, phase-locked adjustment of frequency between sweep limits. User-selectable number of steps or step size.		
List sweep mode	Under GPIB control or via the front panel, up to 4 tables with 2000 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. One table of 2000 points is stored in non-volatile memory, all other tables are stored in volatile memory.		
	Switching time (typical maximum)		<25 ms to be within 1 kHz of final frequency
Programmable frequency agility	Under GPIB control, up to 3202 non-sequential frequency/power sets can be stored and then addressed as a phase-locked step sweep. Data is stored in volatile memory.		
	Switching time (typical maximum)		<25 ms to be within 1 kHz of final frequency
Markers	Up to 20 independent, settable markers (F0 – F9 and M0 – M9)		
	Video markers		+5V or –5V marker output, selectable from system menus. AUX I/O connector, rear panel
	Marker accuracy		Same as sweep frequency accuracy
	Marker resolution		1 kHz (0.1 Hz with Option 11)
Sweep triggering	Sweep triggering is provided for step frequency sweep, list frequency sweep, and CW power sweep.		
	Auto		Triggers sweep automatically
	External		Triggers a sweep on the low-to-high transition of an external TTL signal. AUX I/O connector, rear panel
	Single		Triggers, aborts, and resets a single sweep. Reset sweep may be selected to be at the top or bottom of the sweep

Continued on next page

General	Stored setups		Stores front panel settings and nine additional front-panel setups in a non-volatile RAM. A system menu allows for saving and recalling instrument setups. Whenever the instrument is turned on, control settings and values are the same as when last turned off.
	Memory sequencing input		TTL low-level signal provides sequencing through ten stored setups. AUX I/O connector, rear panel
	Self-test		Instrument self-test is performed when Selftest soft-key is selected. If an error is detected, an error message is displayed in a window on the LCD identifying the probable cause and remedy.
	Secure mode		Disables all frequency and power level state displays. Stored setups saved in secure mode remain secured when recalled. Mode selectable from a system menu and via GPIB.
	Parameter entry		Instrument-controlled parameters can be entered in three ways—keypad, rotary data knob, or the "^" and "∨" touch pads of the cursor-control key (use up/down-arrow symbol). The keypad is used to enter new parameter values; the rotary data knob and the cursor-control key are used to edit existing parameter values. The "<" and ">" touch pads of the cursor-control key move the cursor left and right one digit under the open parameter. The rotary data knob or the "<" and ">" touch pads will increment or decrement the digit position over the cursor. Controlled parameters are frequency, power level, sweep time, dwell time, and number of steps. Keypad entries are terminated by pressing the appropriate soft key. Edits are terminated by exiting the edit menu
	Reset		Returns all instrument parameters to predefined default states or values. Any pending GPIB I/O is aborted. Selectable from the system menu
	Master/slave operation		Allows two output signals to be swept with a user-selected frequency offset. One instrument controls the other via AUX I/O and SERIAL I/O connections. Requires a Master/Slave Interface Cable Set (Part No. ND36329)
	User level flatness correction		Provides compensation for path loss due to external switching and cables. Compensation may come from a power table in a GPIB power meter, or it may be from calculated data. When user level correction is activated, entered power levels are delivered at the point where calibration was performed. Supported power meters are Anritsu ML2437A, ML2438A, and ML4803A and HP 437B, 438A, and 70100A. Five user tables are available with up to 801 points/table
	Warm up time	From standby	30 minutes
		From cold start (0°C)	120 hours to achieve specified frequency stability with aging. Instruments disconnected from ac line power for more than 72 hours require 30 days to return to specified frequency stability with aging
	Power		90-264 Vac, 48-440 Hz, 250 VA maximum
	Standby		With AC line power connected, unit is placed in standby when front panel power switch is released from the OPERATE position
	Weight		18 kg maximum
	Dimensions		133 H x 429 W x 450 D mm
Remote operation	All instrument functions, settings, and operating modes (except for power on/standby) are controllable using commands sent from an external computer via the GPIB (IEEE-488 interface bus)		
	GPIB address		Selectable from a system menu
	IEEE-488 Interface Function Subset	Source handshake	SH1
		Acceptor handshake	AH1
		Talker	T6
		Listener	L4
		Service request	SR1
		Remote/local	RL1
		Parallel poll	PP1
		Device clear	DC1
		Device trigger	DT1
		Controller capability	C0, C1, C2, C3, C28
		Tri-state driver	E2
	GPIB Status Annunciators	When the instrument is operating in remote, the GPIB status annunciators (listed below) will appear in a window on the front panel display	
		Remote	Under GPIB control (all instrument front panel keys except for the SYSTEM key and the RETURN TO LOCAL soft-key will be ignored)
		LLO (local lockout)	Disables the RETURN TO LOCAL soft-key. Instrument can be placed in local mode only via GPIB or by cycling line power
	Emulations		The instrument responds to the published GPIB commands and responses of the Anritsu Models 6600, 6700, and 6XX00-series signal sources. When emulating another signal source, the instrument will be limited to the capabilities, mnemonics, and parameter resolutions of the emulated instrument
Environmental	Storage temperature range		-40 to +75°C
	Operating temperature range		0 to +50°C
	Relative humidity		5% to 95% at 40°
	Altitude		4,600 meters, 43.9 cm Hg
	EMI		EMI: Meets the emission and immunity requirements of EN61326: 1998 EN55011:1991/CISPR-11:1990 Group 1 Class A EN61000-4-2: 1995 – 4 kV CD, 8 kV AD EN61000-4-3: 1997 – 3 V/m EN61000-4-4: 1995 – 0.5 kV SL, 1 kV PL EN61000-4-5: 1995 – 1 kV – 2 kV L-E EN61000-4-6: 1996 EN61000-4-11: 1994

Spectral purity

All specifications apply at the lesser of +10 dBm output or maximum specified leveled output power, unless otherwise noted.

Spurious signals

Harmonic and harmonic helated

Frequency range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤100 MHz (Option 4)	<–40 dBc
>100 MHz to ≤2.2 GHz (Option 4)	<–50 dBc
10 MHz to ≤50 MHz (Option 5)	<–30 dBc
>50 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤20 GHz	<–60 dBc
>20 GHz to ≤40 GHz	<–40 dBc
>40 GHz to ≤50 GHz (MG3695A)	<–40 dBc
>40 GHz to ≤65 GHz (MG3696A)	<–25 dBc

Harmonic and harmonic related (for models with Option 15, at maximum specified leveled output power)

Frequency range	Standard
0.1 Hz 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤100 MHz (Option 4)	<–40 dBc
>100 MHz to ≤2.2 GHz (Option 4)	<–50 dBc
10 MHz to ≤50 MHz (Option 5)	<–30 dBc
>50 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤20 GHz	<–50 dBc
>20 GHz to ≤40 GHz	<–30 dBc*

* Typical

Non-harmonics

Frequency range	Standard
0.1 Hz to 10 MHz (Option 22)	<–30 dBc
10 MHz to ≤2.2 GHz (Option 4)	<–60 dBc
10 MHz to ≤2 GHz (Option 5)	<–40 dBc
>2 GHz (2.2 GHz w/Option 4) to ≤65 GHz	<–60 dBc

Power line and fan rotation spurious emissions (dBc)

Frequency range	Offset from carrier		
	<300 Hz	300 Hz to 1 kHz	>1 kHz
≥10 to ≤500 MHz (Option 4)	<–68	<–72	<–72
>500 to =1050 MHz (Option 4)	<–62	<–72	<–72
>1050 to ≤2200 MHz (Option 4)	<–56	<–66	<–66
≥0.01 to ≤8.4 GHz	<–50	<–60	<–60
>8.4 to ≤20 GHz	<–46	<–56	<–60
>20 to ≤40 GHz	<–40	<–50	<–54
>20 to ≤65 GHz	<–34	<–44	<–48

Residual FM (CW and Step Sweep modes, 50 Hz - 15 kHz BW)

Frequency range	Residual FM (Hz RMS) option 3,4	Standard
≥0.01 to ≤8.4 GHz	<40	<120
>8.4 to ≤20 GHz	<40	<220
>20 to ≤40 GHz	<80	<440
>40 to ≤65 GHz	<160	<880

Residual FM (Analog Sweep and Unlocked FM modes, 50 Hz - 15 kHz BW)

Frequency range	Residual FM (kHz RMS)	
	Unlocked Narrow FM mode	Unlocked Wide FM mode or Analog Sweep
>0.01 to <20 GHz	<5	<25
>20 GHz to <40 GHz	<10	<50
>40 GHz to <65 GHz	<20	<100

AM noise floor

Typically <–145 dBm/Hz at 0 dBm output and offsets >5 MHz from carrier.

Single-sideband phase noise

Single-sideband phase noise (dBc/Hz)

Frequency range	Offset from carrier			
	100 Hz	1 kHz	10 kHz	100 kHz
≥0.1 Hz to <10 MHz (Option 22)	–90	–120	–130	–130
≥10 MHz to <500 MHz (Option 4)	–94	–106	–104	–120
≥500 MHz to <2200 MHz (Option 4)	–82	–94	–92	–108
≥10 MHz to <2 GHz (Option 5)	–77	–88	–85	–100
≥2 GHz to ≤6 GHz	–77	–88	–86	–102
>6 GHz to ≤10 GHz	–73	–86	–83	–102
>10 GHz to ≤20 GHz	–66	–78	–77	–100
>20 GHz to ≤40 GHz	–60	–75	–72	–94
>40 GHz to ≤65 GHz	–54	–69	–64	–88

Single-sideband phase noise (dBc/Hz) – Option 3

Frequency range	Offset from carrier					
	10 Hz	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
≥0.1 Hz to <10 MHz (Option 22)	–60	–90	–120	–130	–130	–130
≥10 MHz to <15.625 MHz (Option 4)	–105	–126	–139	–142	–141	–145
15.625 MHz to ≤31.25 MHz (Option 4)	–99	–120	–134	–137	–137	–145
>31.25 MHz to ≤62.5 MHz (Option 4)	–90	–114	–129	–136	–136	–144
>62.5 MHz to ≤125 MHz (Option 4)	–84	–108	–127	–135	–133	–144
>125 MHz to ≤250 MHz (Option 4)	–88	–102	–125	–132	–130	–143
>250 MHz to ≤500 MHz (Option 4)	–77	–99	–123	–125	–124	–142
>500 MHz to ≤1050 MHz (Option 4)	–71	–93	–118	–121	–119	–138
>1050 MHz to ≤2200 MHz (Option 4)	–66	–86	–112	–115	–113	–135
≥10 MHz to <2 GHz (Option 5)	–64	–83	–100	–102	–102	–111
≥2 GHz to ≤6 GHz	–54	–87	–104	–108	–107	–130
>6 GHz to ≤10 GHz	–52	–73	–100	–107	–107	–128
>10 GHz to ≤20 GHz	–45	–68	–94	–102	–102	–125
>20 GHz to ≤40 GHz	–45	–63	–92	–98	–98	–119
>40 GHz to ≤65 GHz	–37	–57	–86	–92	–90	–113

RF output

Power level specifications apply at 25° ±10°C.

Maximum leveled output power

Model number	Configuration	Frequency range (GHz)	Output power (dBm)	Output power with step attenuator (dBm)	Output power with electronic step attenuator (dBm)
MG3691A	With option 4	≤2.2 GHz	+17.0	+15.0	+13.0
	With option 5	≤2 GHz	+17.0	+15.0	+13.0
	Standard	>2 to ≤8.4 GHz	+13.0	+11.0	+9.0
MG3692A	With option 4	≤2.2 GHz	+17.0	+15.0	Not available
	With option 5	≤2 GHz	+17.0	+15.0	
	Standard	>2 to ≤8.4 GHz	+13.0	+11.0	
	Standard	>8.4 to ≤20 GHz	+13.0	+11.0	
MG3693A	With option 4	≤2.2 GHz	+13.0	+11.0	Not available
	With option 5	≤2 GHz	+13.0	+11.0	
	Standard	>2 to ≤20 GHz	+9.0	+7.0	
	Standard	>20 to ≤30 GHz	+6.0	+3.0	
MG3694A	With option 4	≤2.2 GHz	+13.0	+11.0	Not available
	With option 5	≤2 GHz	+13.0	+11.0	
	Standard	>2 to ≤20 GHz	+9.0	+7.0	
	Standard	>20 to ≤40 GHz	+6.0	+3.0	
MG3695A	With option 4	≤2.2 GHz	+12.0	+10.0	Not available
	With option 5	≤2 GHz	+12.0	+10.0	
	Standard	>2 to ≤20 GHz	+10.0	+8.0	
	Standard	>20 to ≤50 GHz	+3.0	+0.0	
MG3696A	With option 4	≤2.2 GHz	+12.0	+10.0	Not available
	With option 5	≤2 GHz	+12.0	+10.0	
	Standard	>2 to ≤20 GHz	+10.0	+8.0	
	Standard	>20 to ≤65 GHz	+3.0	+0.0	

Maximum leveled output power with option 15 (high power) installed

Model number	Configuration	Frequency range (GHz)	Output power (dBm)	Output power with step attenuator (dBm)	Output power with electronic step attenuator (dBm)
MG3691A	With option 4	≤2.2 GHz	+19.0	+18.0	+15.0
	With option 5	≤2 GHz	+19.0	+18.0	+15.0
	Standard	>2 to ≤8.4 GHz	+19.0	+18.0	+13.0
MG3692A	With option 4	≤2.2 GHz	+19.0	+18.0	Not available
	With option 5	≤2 GHz	+19.0	+18.0	
	Standard	>10 to ≤10 GHz	+19.0	+18.0	
	Standard	>20 to ≤20 GHz	+17.0	+15.0	
MG3693A	With option 4	≤2.2 GHz	+15.0	+14.0	Not available
	With option 5	≤2 GHz	+15.0	+14.0	
	Standard	>2 to ≤10 GHz	+15.0	+14.0	
	Standard	>10 to ≤20 GHz	+12.0	+10.0	
	Standard	>20 to ≤30 GHz	+14.0	+12.0	
MG3694A	With option 4	≤2.2 GHz	+15.0	+14.0	Not available
	With option 5	≤2 GHz	+15.0	+14.0	
	Standard	>2 to ≤10 GHz	+15.0	+14.0	
	Standard	>10 to ≤20 GHz	+12.0	+10.0	
	Standard	>20 to ≤40 GHz	+14.0	+12.0	

Leveled output power range	Standard units	Without an attenuator	Maximum leveled output power to –15 dBm (–20 dBm typical)
		With an attenuator	Maximum leveled output power to –120 dBm
		With an electronic attenuator	Maximum leveled output power to –140 dBm
	Units with option 15, high power	Without an attenuator	Maximum leveled output power to –5 dBm (–10 dBm typical)
		With an attenuator	Maximum leveled power to –115 dBm (–120 dBm typical). For units with Option 15A, minimum settable power is –105 dBm (–110 dBm typical)
		With an electronic attenuator	Maximum leveled power to –115 dBm (–110 dBm typical)
Unleveled output power range (typical)		Without an attenuator	>40 dB below max power
		With an attenuator	>130 dB below max power
Power level switching time (to within specified accuracy)		Without change in step attenuator	<3 ms typical
		With change in step attenuator	<20 ms typical
		With change in electronic step attenuator	<3 ms typical. Power level changes across –70 dB step will result in 20 ms delay

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Accuracy and flatness	Accuracy specifies the total worst case accuracy. Flatness is included within the accuracy						
	Step sweep and CW modes	Attenuation below max power		Frequency (GHz)			
				≤40	40-50	50-60	60-65
		Accuracy*2	0-25 dB 25-60 dB >60 dB	±1.0 dB ±1.0 dB ±1.0 dB	±1.5 dB ±1.5 dB ±1.5 dB*1	±1.5 dB ±3.5 dB*1 ±3.5 dB*1	±1.5 dB N/A N/A
		Flatness*2	0-25 dB 25-60 dB >60 dB	±0.8 dB ±0.8 dB ±0.8 dB	±0.8 dB ±0.8 dB ±0.8 dB*1	±1.1 dB ±3.1 dB*1 ±3.1 dB*1	±1.1 dB N/A N/A
	Analog sweep mode (typical)	Attenuation below max power		Frequency (GHz)			
				0.01-0.05	0.05-20	20-40	40-65
		Accuracy	0-12 dB 12-30 dB 30-60 dB 60-122 dB	±2.0 dB ±3.5 dB ±4.0 dB ±5.0 dB	±2.0 dB ±3.5 dB ±4.0 dB ±5.0 dB	±2.0 dB ±4.6 dB ±5.2 dB ±6.2 dB	±3.0 dB ±5.6 dB ±6.2 dB ±7.2 dB
		Flatness	0-12 dB 12-30 dB 30-60 dB 60-122 dB	±2.0 dB ±3.5 dB ±4.0 dB ±5.0 dB	±2.0 dB ±3.5 dB ±4.0 dB ±5.0 dB	±2.0 dB ±4.1 dB ±4.6 dB ±5.2 dB	±2.5 dB ±5.1 dB ±5.6 dB ±6.2 dB
Other output power specifications	Output units		Output units selectable as either dBm or mV. Selection of mV assumes 50 Ω load. All data entry and display are in the selected units				
	Output power resolution		0.01 dB or 0.001 mV				
	Source impedance		50 Ω nominal				
	Source SWR (internal leveling)		<2.0 typical				
	Power level stability with temperature		0.04 dB/°C typical				
	Level offset		Offsets the displayed power level to establish a new reference level				
	Output on/off		Toggles the RF output between an off and on state. During the off state, the RF oscillator is turned off. The on or off state is indicated by two LEDs located below the OUTPUT ON/OFF key on the front panel				
	RF on/off between frequency steps		System menu selection of RF on or RF off during frequency switching in CW, step sweep, and list sweep modes				
	RF on/off during retrace		System menu selection of RF on or RF off during retrace				
	Internal leveling		Power is leveled at the output connector in all modes				
	External leveling	External detector	Levels output power at a remote detector location. Accepts a positive or negative 0.5 mV to 500 mV input signal from the remote detector. EXT ALC ADJ adjusts the input signal range to an optimum value. BNC connector, front and rear panel				
		External power meter	Levels output power at a remote power meter location. Accepts a ±1 V full scale input signal from the remote power meter. EXT ALC ADJ adjusts the input signal range to an optimum value. BNC connector, rear panel				
		External leveling bandwidth	30 kHz typical in detector mode. 0.7 Hz typical in power meter mode				
		User level flatness correction	Number of points: 2 to 801 points per table Number of tables: 5 available Entry modes: GPIB power meter or computed data				
CW power sweep	Range		Sweeps between any two power levels at a single CW frequency				
	Resolution		0.01 dB/step (Log) or 0.001 mV (Linear)				
	Accuracy		Same as CW power accuracy				
	Log/linear sweep		Power sweep selectable as either log or linear. Log sweep is in dB; linear sweep is in mV				
	Step size		User-controlled, 0.01 dB (Log) or 0.001 mV (Linear) to the full power range of the instrument				
	Step dwell time		Variable from 1 ms to 99 seconds. If the sweep crosses a step attenuator setting, there will be a sweep dwell of approximately 20 ms to allow setting of the step attenuator				
Sweep frequency/ step power	A power level step occurs after each frequency sweep. Power level remains constant for the length of time required to complete each sweep						

*1: Typical
*2: 0 to 25 dB or to minimum rated power whichever is higher.

Frequency/Phase Modulation (Option 12)

Option 12 adds frequency and phase modulation, driven externally via a rear panel BNC connector, 50Ω. For internal modulation, add LF Generator Option 23. Frequency/Phase Modulation is not available <10 MHz with Option 22.

FM Sensitivity: Continuously variable from ±10 kHz per volt to ±20 MHz per volt (Locked, Locked Low Noise and Unlocked Narrow FM modes), or ±100 kHz per volt to ±100 MHz per volt (Unlocked Wide FM mode), selectable from modulation menu.

ΦM Sensitivity: Continuously variable from ±0.0025 radians per volt to ±5.0 radians per volt (Narrow ΦM mode) or ±0.25 radians per volt to ±500.0 radians per volt (Wide ΦM mode), selectable from modulation menu.

Maximum Input: ±1V

Frequency Generator Multiplication/Division Ratios	Frequency Range	Divide Ratio, n
	<10 MHz (Option 22)	modulation not available
	≥10 to ≤15.625 MHz (Option 4)	256
	>15.625 to ≤31.25 MHz (Option 4)	128
	>31.25 to ≤62.5 MHz (Option 4)	64
	>62.5 to ≤125 MHz (Option 4)	32
	>125 to ≤250 MHz (Option 4)	16
	>250 to ≤500 MHz (Option 4)	8
	>500 to ≤1050 MHz (Option 4)	4
	>1050 to ≤2200 MHz (Option 4)	2
	>10 to ≤2000 MHz (Option 5)	1
	>2 to ≤20 GHz	1
	>20 to ≤40 GHz	1/2
	>40 to ≤65 GHz	1/4

	Parameter	Modes	Conditions	Specifications
Frequency Modulation	Deviation	Locked Locked Low-noise Unlocked Narrow Unlocked Wide	Rate= 1 kHz to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= 50 kHz to Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to 100 Hz	±[Lesser of 10 MHz or 300 * (mod rate)]/n ±[Lesser of 10 MHz or 3 * (mod rate)]/n ±(10 MHz)/n ±(100 MHz)/n
	Bandwidth (3 dB)	Locked Locked Low-noise Unlocked Narrow Unlocked Wide	100 kHz rate 100 kHz rate 100 kHz rate DC rate	1 kHz to (Lesser of 10 MHz or 0.03 * Fcarrier) 30 kHz to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to 100 Hz
	Flatness	Locked	Rate= 10 kHz to (Lesser of 1 MHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz
	Accuracy	Locked and Low-noise Unlocked Narrow	Rate= 100 kHz, Sinewave, Int. or 1Vpk Ext.	10% (5% typical)
	Incidental AM	Locked, Low-noise, Unlocked Narrow	Rate and Dev.= Lesser of 1 MHz or 0.01 * Fcarrier	<2% typical
	Harmonic Distortion	Locked	Rate= 10 kHz, Dev.= ±(1 MHz)/n	<1%
	External Sensitivity	Locked Locked Low-noise Unlocked Narrow Unlocked Wide		±(10 kHz/V to 20 MHz/V)/n ±(100 kHz/V to 100 MHz/V)/n
Phase Modulation	Deviation	Narrow Wide	Rate= DC to (Lesser of 8 MHz or 0.03 * Fcarrier) Rate= DC to (Lesser of 1 MHz or 0.03 * Fcarrier)	±[Lesser of 3 rad or (5 MHz)/(mod rate)]/n ±[Lesser of 400 rad or (10 MHz)/(mod rate)]/n
	Bandwidth (3 dB)	Narrow Wide	100 kHz rate 100 kHz rate	DC to (Lesser of 10 MHz or 0.03 * Fcarrier) DC to (Lesser of 1 MHz or 0.03 * Fcarrier)
	Flatness	Narrow Wide	Rate= DC to (Lesser of 1 MHz or 0.01 * Fcarrier) Rate= DC to (Lesser of 500 kHz or 0.01 * Fcarrier)	±1 dB relative to 100 kHz rate ±1 dB relative to 100 kHz rate
	Accuracy	Narrow and Wide	100 kHz, Int. or 1Vpk Ext., sine	10%
	External Sensitivity	Narrow Wide		±(0.0025 rad/V to 5 rad/V)/m ±(0.25 rad/V to 500 rad/V)/n

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Amplitude Modulation (Option 14)

All amplitude modulation specifications apply at 50% depth, 1 kHz rate, with RF level set 6 dB below maximum specified leveled output power, unless otherwise noted. Amplitude Modulation is not available <10 MHz with Option 22.

AM Depth (typical)	0-90% linear; 20 dB log	
AM Bandwidth (3 dB)	DC to 50 kHz minimum DC to 100 kHz typical	
Flatness (DC to 10 kHz rates)	±0.3 dB	
Accuracy	±5%	
Distortion	<5% typical	
Incidental Phase Modulation (30% depth, 10 kHz rate)	<0.2 radians typical	
External AM Input	Log AM or Linear AM input, rear-panel BNC, 50 Ω input impedance. For internal modulation, add LF Generator Option 23.	
	Sensitivity	Log AM: Continuously variable from 0 dB per volt to 25 dB per volt.
		Linear AM: Continuously variable from 0% per volt to 100% per volt.
	Maximum Input	±1V

LF Generator (Option 23)

Two internal waveform generators are added, one providing a frequency or phase modulating signal and the other an amplitude modulating signal. This Low Frequency (LF) Generator option can only be ordered in combination with either FM/ΦM or AM options, 12 and 14 respectively.

Waveforms	Sinusoid, square-wave, triangle, positive ramp, negative ramp, Gaussian noise, uniform noise. (Check Option 10 for User-Defined)
Rate	0.1 Hz to 1 MHz sinusoidal 0.1 Hz to 100 kHz square-wave, triangle, ramps
Resolution	0.1 Hz
Accuracy	Same as instrument timebase
Output	Two BNC connectors on the rear panel, FM/ΦM OUT and AM OUT

External Pulse Modulation (Option 13)

Pulse modulation specifications apply at maximum rated power, unless otherwise noted. Pulse modulation is not available <10 MHz with Option 22.

On/Off Ratio	>80 dB			
Minimum Leveled Pulse Width	100 ns, ≥2 GHz*1 1 µs, <2 GHz1			
Minimum Unleveled Pulse Width	<10 ns			
Level Accuracy Relative to CW (100 Hz to 1 MHz PRF)	±0.5 dB, ≥1 µs pulse width ±1.0 dB, <1 µs pulse width			
Pulse Delay (typical)	External Mode: 50 ns			
PRF Range	DC to 10 MHz, unleveled 100 Hz to 5 MHz, leveled			
Frequency Range	Rise & Fall Time (10% to 90%)	Overshoot	Pulse Width Compression	Video Feedthrough
≥10 to <31.25 MHz (Opt. 4)	400 ns*	33%*	40 ns*	±70 mV*
≥31.25 to <125 MHz (Opt. 4)	90 ns*	22%*	12 ns*	±130 mV*
≥125 to <500 MHz (Opt. 4)	33 ns*	11%*	12 ns*	±70 mV*
≥500 to <2200 MHz (Opt. 4	15 ns	10%*	12 ns*	±15 mV*
≥10 to <1000 MHz (Opt. 5)	15 ns / 10 ns*	10%*	8 ns*	±15 mV*
≥1 to <2 GHz (Opt. 5)	10 ns / 5 ns*	10%*	8 ns*	±15 mV*
≥2 to ≤65 GHz	10 ns / 5 ns*	10%*2	8 ns*	
External Input	Rear-panel BNC. For internal modulation, add Pulse Generator Option 24.			
	Drive Level	TTL compatible input		
	Input Logic	Positive-true or negative-true, selectable from modulation menu.		

Pulse Generator (Option 24)

Pulse Generator option is not available without Pulse Modulation Option 13.

Modes	Free-run, triggered, gated, delayed, singlet, doublet, triplet, quadruplet.	
Parameter	Selectable Clock Rate	
	40 MHz	10 MHz
Pulse Width	25 ns to 419 ms	100 ns to 1.6
Pulse Period*3	250 ns to 419 ms	600 ns to 1.6s
Variable Delay Singlet Doublet Triplet Quadruplet	 0 to 419 ms 100 ns to 419 ms 100 ns to 419 ms 100 ns to 419 ms	 0 to 1.6s 300 ns to 1.6s 300 ns to 1.6s 300 ns to 1.6s
Resolution	25 ns	100 ns
Accuracy	10 ns (5 ns typical)	
Inputs/Outputs	Inputs/Outputs: Video pulse and sync out, rear-panel BNC connectors	

*1: 2.2 GHz with Option 4, DDC.
*2: For 50 and 65 GHz units, overshoot >40 GHz is 20% typical at rated power.
*3: Period must be longer than the sum of delay and width by 5 clock cycles minimum.

* Typical

Millimeter Wave Multipliers (54000 Series plus Option 18)

External multipliers can be added to the MG3690A to provide coverage as high as 110 GHz. Please call us for solutions beyond 110 GHz.

Parameter	54000-4WR15, 54000-5WR15	54000-4WR10, 54000-5WR10
Frequency	50-75 GHz	75-110 GHz
Waveguide Output	WR15	WR10
Flange	UG-387/U	UG-385/U
Source Match	<1.7 typical	<1.7 typical
Output Power	0.0 dBm (+4 dBm typical)	–5 dBm (+1 dBm typical)
Power Flatness, Unleveled	±3.0 dB typical	±3.0 dB typical
Power Flatness, Leveled (54000-5WRxx)	±1.0 dB typical	±1.0 dB typical
Power Leveling Range (54000-5WRxx)	10 dB typical	10 dB typical
Required Input Frequency	12.75 to 18.75 GHz	12.75 to 18.75 GHz
Multiplication Factor	x4	x6
Frequency Accuracy	Synthesizer Accuracy x4	Synthesizer Accuracy x6
Frequency Resolution	Synthesizer Resolution x4	Synthesizer Resolution x6
Filters FL1 (Through) FL2 FL3	 50 to 75 GHz 50 to 58 GHz 57 to 75 GHz	 75 to 110 GHz 75 to 92 GHz 89 to 110 GHz
Spurious with FL2, FL3 with FL1 (Through)	 –50 dBc –20 dBc typical	 –50 dBc –20 dBc typical
Input	N(f)	N(f)

Inputs and Outputs

EXT ALC IN	Provides for leveling the RF output signal externally with either a detector or power meter. Signal requirements are shown in the RF Output specifications.
RF OUTPUT	Provides for RF output from 50 Ω source impedance. K Connector, female. Option 9 moves the RF Output connector to the rear panel.
10 MHz REF IN	Accepts an external 10 MHz ±100 Hz, 0 to +20 dBm time-base signal. Automatically disconnects the internal high-stability time-base option, if installed. 50 Ω impedance.
10 MHz REF OUT	Provides a 0.5 Vp-p, AC coupled, 10 MHz signal derived from the internal frequency standard. 50 Ω impedance.
HORIZ OUT (Horizontal Sweep Output)	Provides 0V at beginning and +10V at end of sweep, regardless of sweep width. In CW mode, the voltage is proportional to frequency between 0V at low end and +10V at the high end of range. In CW mode, if CW RAMP is enabled, a repetitive, 0V to +10V ramp is provided.
EFC IN:	Provides the capability to frequency modulate the internal crystal oscillator, allowing phase locking the synthesizer inside an external lock loop.
AUX I/O (Auxiliary Input/Output)	Provides for most of the rear panel BNC connections through a single, 25-pin, D type connector. Supports master-slave operation with another synthesizer or allows for a single-cable interface with the Model 56100A Scalar Network Analyzer and other Anritsu instruments.
SERIAL I/O (Serial Input/Output)	Provides access to RS-232 terminal ports to support service and calibration functions and master slave operations.
IEEE-488 GPIB	Provides input/output connections for the General Purpose Interface Bus (GPIB).
mmW BIAS	Provides the bias for the external waveguide multipliers for coverage up to 110 GHz.
RF, LO, IF	Provides access to an internal IF up-conversion mixer, Option 7.
PULSE TRIG IN	Accepts an external TTL compatible signal to pulse modulate the RF output signal or to trigger or to gate the optional internal pulse generator. Available with Option 13, Pulse Modulation.
PULSE SYNC OUT	Provides a TTL compatible signal, synchronized to the internal pulse modulation output, Option 24.
PULSE VIDEO OUT	Provides a video modulating signal from the internal pulse generator, Option 24.
AM IN	Accepts an external signal to amplitude modulate the RF output signal, Option 14. 50 Ω impedance
FM/ΦM IN	Accepts an external signal to frequency or phase modulate the RF output signal, Option 12. 50 Ω impedance
AM OUT	Provides the amplitude modulation waveform from the internal LF generator, Option 23.
FM/ΦM OUT	Provides the frequency or phase modulation waveform from the internal LF generator, Option 23.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Models
MG3691A	2 – 8.4 GHz CW Generator
MG3692A	2 – 20 GHz CW Generator
MG3693A	2 – 30 GHz CW Generator
MG3694A	2 – 40 GHz CW Generator
MG3695A	2 – 50 GHz CW Generator
MG3696A	2 – 65 GHz CW Generator
	Options and accessories
MG3690A/1A	Rack Mount with slides – Rack mount kit containing a set of track slides (90 degree tilt capability), mounting ears, and front panel handles to let the instrument be mounted in a standard 19-inch equipment rack.
MG3690A/1B	Rack Mount without slides – Modifies rack mounting hardware to install unit in a console that has mounting shelves. Includes mounting ears and front panel handles.
MG3690A/2X	Mechanical Step Attenuator – Adds a 10 dB/step attenuator. Rated RF output power is reduced. (This option comes in different versions, based on instrument configuration.)
MG3690A/2E	Electronic Step Attenuator – Adds a 10 dB/step electronic attenuator with a 120 dB range for the MG3691A. Rated RF output power is reduced.
MG3690A/3	Ultra Low Phase Noise, main band – Adds new modules to significantly reduce SSB phase noise.
MG3690A/4	10 MHz to 2.2 GHz RF coverage, Ultra-Low Phase Noise version – Uses a digital down converter to significantly reduce SSB phase noise.
MG3690A/5	10 MHz to 2 GHz RF coverage – Uses an analog down converter.
MG3690A/6	Analog Sweep Capability (limited to •500 MHz when used with Option 4)
MG3690A/7	IF Up-Conversion – Adds an internal 40 GHz mixer for up-converting an IF signal. (Not available with MG3695A, MG3696A, or with Option 18)
MG3690A/9X	Rear Panel Output – Moves the RF output connector to the rear panel. (This option comes in different versions, based on instrument configuration.)
MG3690A/10	User-Defined Modulation Waveform Software – External software package provides the ability to download user-defined waveforms into the memory of the internal waveform generator, serially or via GPIB. External PC and an instrument with LF Generator, Option 23, are required. This external software package can only be used with Option 10 enabled instruments.
MG3690A/12	Frequency and Phase Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 23.
MG3690A/13X	Pulse Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally Pulse Generator, Option 24. (This option comes in different versions, based on instrument configuration.)
MG3690A/14	Amplitude Modulation – External, via a rear panel BNC connector. For internal modulation capability, requires additionally LF Generator, Option 23.
MG3690A/15X	High Power – Adds high-power RF components to the instrument to increase its output power level. (This option comes in different versions, based on instrument configuration.)

Model/Order No.	Name
MG3690A/16	High Stability Time Base – Adds an ovenized, 10 MHz crystal oscillator as a high-stability time base.
MG3690A/17	Delete Front Panel – Deletes the front panel for use in remote control applications where a front panel display and keyboard control are not needed.
MG3690A/18	mmW Bias Output – Adds a rear panel BNC Twinax connector required to bias the 5400-xWRxx millimeter wave source modules, sold separately (Not available with Option 7).
MG3690A/22	0.1 Hz to 10 MHz Audio coverage – Uses a DDS for coverage down to approximately DC. When adding Option 22, the output power is derated by 2 dB. The frequency resolution below 10 MHz is 0.02 Hz. No modulation is available in the 0.1 Hz to 10 MHz band (Not available without Option 4 or 5).
MG3690A/23	LF Generator – Provides modulation waveforms for internal AM, FM, or ΦM (Not available without Option 12 or 14).
MG3690A/24	Pulse Generator – Provides pulse waveforms for internal Pulse Modulation (Not available without Option 13).
MG3690A/25X	Analog Modulation Suite – For ease of ordering and package pricing, this option bundles Options 12, 13, 14, 23 and 24, offering internal and external AM, FM, ΦM, and Pulse Modulation. (This option comes in different versions, based on instrument configuration.)
	Accessories
34RKNF50	DC to 20 GHz, Ruggedized Type N female adapter for units with a K connector output
ND36329	Master/Slave interface cable set
760-212A	Transit case
2300-469	IVI Driver, includes LabView® driver
806-97	Aux I/O cable, 25 pin to BNC: Provides BNC access to V/GHz and Sequential Sync connections and other AUX I/O data lines
	Millimeter wave accessories (requires MG3690A/18)
54000-4WR15	50 to 75 GHz, V band X4 multiplier-source module, (includes A36599 power cable and 3 filters).
54000-5WR15	50 to 75 GHz, V band X4 multiplier-Ssource module with internal reference coupler/detector (includes A36599 power cable, 3 filters, and 560-10BX-2 detector adapter cable).
54000-4WR10	75-110 GHz, W band X6 multiplier-source module (includes A36599 power cable and 3 filters).
54000-5WR10	75-110 GHz, W band X6 multiplier-source module with internal reference coupler/detector (includes A36599 power cable, 3 filters, and 560-10BX-2 detector adapter cable).
N120-6	Semi-rigid cable, N(m) to N(m), 15 cm long, connects synthesizer's RF output to multiplier's RF input. (Also requires 34RKNF50 or 34RVNF50 Adapter).
	Upgrades
	Economical upgrades are available to upgrade any model to any higher performing model. Consult Anritsu for details.

SYNTHESIZER/LEVEL GENERATOR
MG443B
10 Hz to 30 MHz

For Frequency Tracking with ML422C

GPIB

The MG443B is carefully designed. Its output level is highly stable, so it can be used for applications within the telecommunications industry without the need for a separate standard level meter.

Features
- Wide frequency range with 1 Hz resolution
- As many as 20 panel settings can be memorized; memory sweep capability
- High output level characteristics
  Flatness: ±0.07 dB (0° to +50°C)
  Level accuracy: ±0.15 dB (0° to +50°C)
- High precision output level setting of 0.01 dB
- Continuous output level variable within approximately 4.5 dB
- Variety of output impedances
  Unbalanced: 50, 75 Ω
  Balanced: 75, 135, 150, 600 Ω

SYNTHESIZED LEVEL GENERATOR
MG442A
10 Hz to 20 MHz

Compact and Lightweight

The MG442A is a compactly designed level generator with excellent stability and accuracy in frequency and output level. Because it is a synthesized level generator, its output frequency is highly stable. It has an excellent output level accuracy and a superb frequency response unrivaled by similar level generators.
The MG442A can be used for many applications as a measurement signal source where high frequency stability and level accuracy are required.The MG442A is best suited for use as a signal source for measuring baseband circuits from audio to video and various types of communications systems.
With its ease of operation and excellent portability, it can be utilized for many purposes as a fundamental measuring instrument in laboratories and manufacturing plants.

Features
- Universal output impedance
- Excellent operation: Digital frequency setting with 4 digits and output level with 3 digits
- Compact and lightweight

9

RF MICROWAVE MEASURING INSTRUMENTS

RADAR TEST SYSTEM (RTS)

ME7220A

76 to 77 GHz

Target Simulation & Signal Analysis for Automotive Radar
Exceptional Performance at an Affordable Price

Description

The ME7220A Radar Test System (RTS) accurately and repeatedly characterizes 76-77 GHz automotive radar modules and systems, in a confined and controlled environment, to ensure quality and optimum functionality. The RTS is designed to work with current and future generations of automotive radar, including Adaptive Cruise Control (ACC) radar and collision warning or avoidance radar. The test system provides a simulated radar target response with one of two set target ranges with an adjustable target Radar Cross Section (RCS). The signal response can be Doppler shifted to simulate the speed of a moving target. The system also allows the measurement of the power characteristics or Effective Isotropic Radiated Power (EIRP) of the transmitted radar signal as well as its spectral characteristics (bandwidth, spurious signals, AM/FM Noise, etc.).
The ME7220A RTS is the ideal solution for your testing environment, including research and development, radar module manufacturing, or vehicle manufacturing. Whether you are involved in the development of components and systems, setting up for production of sensors, or installing modules on automobiles, you will find that the ME7220A is an essential tool for dramatically reducing your development and test times and for helping you deliver a superior product.

Features

- Verifies operation under realistic conditions by simulating moving targets (other vehicles or roadside objects) at multiple target distances
- Fully characterizes the radar module by quantifying transmitter, receiver and antenna performance
- Integrated functionality allows radar signal power and frequency measurements without external equipment. Interfaces with external test accessories including spectrum analyzers and power meters for complete test flexibility
- Suited for stand-alone, bench-top or anechoic-chamber testing, but easily integrates with other instruments into an automated test bench or into standard production lines for complete testing of the radar modules
- Built-in laser allows accurate alignment of the radar-under-test to the RTS antennas without additional mechanical fixtures
- Speeds automobile production by simplifying functional testing and alignment of the radar sensor (antenna) when installed on the vehicle
- Easily controlled from an external computer (via RS-232) or by using the included handheld manual controller

Specifications

General	Frequency range*1			76 GHz to 77 GHz
	Antenna E-field polarization			Horizontal standard (other polarization options available)
	Alignment laser			Class II laser, 600-700 nm, output power <1 mW (alignment laser shuts off above 40°C)
Radar signal analysis	Received radar power (at RTS waveguide input)			–10 dBm, specifications below apply
	Measured radar power	Internal meter	Range	30 dB, minimum
			Accuracy	±2 dB accuracy
		External meter	Range	35 dB, minimum (50 dB, typical, with option 5)
			Accuracy	±1 dB accuracy, including IF measurement and EIRP Cal Factor
	Maximum radar occupied frequency			Full band 76 to 77 GHz (translated to IF of 4.7 to 5.7 GHz)
	Radar transmit frequency spectrum	External spectrum analyzer		Accuracy of 76-77 GHz frequency limited by spectrum analyzer external reference and specifications. If RTS internal reference is used, accuracy is 50 ppm.
		Internal frequency measurement		Accuracy of displayed frequency is ±50 MHz, maximum
	Spurious signals, in-band			38 dBc maximum, referenced to output signal

Continued on next page

Target simulation	Received radar power (at RTS waveguide input)		–15 dBm, specifications below apply
Target simulation	Radar occupied bandwidth		300 MHz, maximum, in the 76-77 GHz range
Target simulation	Number of simultaneous targets		1 (either near target or far target)
Target simulation	Target distance*2	Near target	3.5m nominal (+ distance from RTS to radar)
		Far target	116.5m nominal (+ distance from RTS to radar)
		Distance accuracy	NEAR Target = ±0.5m, maximum FAR Target = ±2.0m, maximum
		Distance from RTS to DUT radar	1.5 meter, minimum
Target simulation	Radar cross section (RCS)	Maximum RCS	–4 dBsm, minimum (near target)
			50 dBsm, minimum (far target)
		RCS adjustment range	50 dB, 1 dB steps
		RCS accuracy	±0.75 dB ± 5% of attenuation, maximum (measured at a single frequency of 76.5 GHz
			±2.5 dB, maximum (measured over 76-77 GHz)
Target simulation	Target speed simulation (Doppler frequency)	Speed range	0 to ±250 km/h, minimum (0 to ±35 kHz, minimum)
		Speed step size	0.1 km/h, minimum (15 Hz, minimum)
		Speed error	0.2 km/h, maximum (30 Hz, maximum)
		Doppler carrier & sideband suppression	40 dBc, minimum
Target simulation	Signal Characteristics: Spurious signals (measured at waveguide output)	In-band responses	40 dBc, maximum
		Out of band	Local oscillator signal: –5 dBm, maximum (at 70.8 to 71.8 GHz)
			Image response: –3 dBc, maximum (65.6 to 66.6 GHz)
Target simulation	Signal Characteristics: RF noise density (CW)	Local oscillator phase noise	–80 dBc/Hz @ 100 kHz offset, maximum
		AM noise for target simulation	–130 dBm/Hz @ 2 MHz offset, maximum
Display module		Display screen	160 x 128 dot matrix monochrome LCD, with backlight
		Cable from main module	1 meter
Power requirements		Primary power	85 - 240 Volts AC, 50-60 Hz, 200 VA maximum
Environmental		Operating temperature range	+15°C to +35°C (0°C to +50°C, with reduced performance)
		Operating humidity	5% to 95% at 40°C
		Warm-up time	30 minutes, maximum, for ambient +15°C to +35°C
		Storage temperature	–15°C to 75°C
		EMC & safety	Meets European community requirements for CE marking
Size and weight		Dimensions	197.6 x 485.6 x 553.6 mm, main module 178.8 x 228 x 76.5 mm, display module
		Weight	10 kg, main module 1 kg, display module
Front panel connectors		Antenna input/output	WR12 waveguide, 0 dBm maximum no damage
Rear panel connectors		Power meter port	N (F), 50 Ω, 10 dBm maximum output
		Spectrum analyzer port	N (F), 50 Ω, 10 dBm maximum output
		10 MHz reference input	BNC (F), 50 Ω, +15 dBm to –5 dBm, 25 V DC, max
		RS-232 serial port	D-Sub 9-pin (M)
		IF external loop	2 SMA (F), 0 dBm maximum input/output

*1: 24 GHz or other frequency range options available – contact factory.
*2: Other target distance options available – contact factory.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
ME7220A	Radar Test System includes, in addition to the main and display modules, the following accessories: - WR12 Horn Antennas, quantity 2 - Operation and programming manual - N-type, 50 Ω termination - Display interface cable - Serial interface cable - Power cord
	Options
1A	Rack mount kit with handles
2A	Antenna polarization – vertical
2B	Antenna polarization – 45° slant left
2C	Antenna polarization – 45° slant right
3A	Input/Output port waveguide extensions, 5.08 cm (2.0 in)
5	Wider dynamic range at power meter port using external bandpass filter

Model/Order No.	Name
	Recommended accessories to increase the measurement capabilities of the ME7220A:
MS2663C	Spectrum Analyzer, 9 kHz to 8.1 GHz
ML2437A	Power Meter, Single Channel
MA2472B	Power Sensor, 10 MHz to 18 GHz
	Optional accessories:
15NN50-1.5C	50 Ω Cable, N(M)-N(M), 1.5m, 6 GHz
15NN50-3.0C	50 Ω Cable, N(M)-N(M), 3.0m, 6 GHz
15NN50-5.0C	50 Ω Cable, N(M)-N(M), 5.0m, 6 GHz

MICROWAVE FREQUENCY COUNTER

MF2400B Series

10 Hz to 20/27/40 GHz

GPIB

For Measuring CW Frequency and Pulse Width of Burst Signals

The MF2400B series consists of three frequency counters: the MF2412B (20 GHz), the MF2413B (27 GHz), and the MF2414B (40 GHz). They are ideal for evaluating mobile radio communications devices and circuits, with the ability to measure the carrier frequency and pulse width of burst signals. In addition to displaying measurement results on a 12-digit LCD, the frequency values can be read using the analog display function, which is ideal for monitoring evaluation and especially for frequency adjustment, etc., as in the case of various types of oscillators.
Furthermore, the template function is useful for assessing quickly whether or not the measurement results fall within the upper and lower frequency limit specifications; the evaluation result is output from the AUX connector on the rear panel as a Go/No-go signal. An easy-to-use automatic measurement system can be configured using the GPIB function.

Features

- Measures carrier frequency and pulse width of burst signals
- Analog frequency display
- Pass/Fail evaluation for frequency range specified by template function
- Measurement of any burst section using gating function

Functions

• Wide band measurement
The three counters, with upper frequency limits of 20, 27 and 40 GHz, meet every usage requirement. In addition, a high-frequency fuse holder and fuse element protects the input circuit from excessively powerful signals, and a variety of adapters are available for coupling each connector.

• High-accuracy burst measurement
The carrier frequency, burst width, and burst repetition rate of a 100 ns to 0.1 s burst signal input from INPUT 1 can be measured quickly with high accuracy.

• Save and recall functions added
Up to a maximum of 10 setups can be stored in the internal memory, and these can be freely recalled. Storing complex setups in advance, such as burst triggers and gate settings, makes it possible to recall them immediately when needed for measurement, which makes it possible to reduce the measurement setup time and to prevent malfunctions from setup mistakes.

• Analog display function
Using this function, the entire LCD becomes an analog meter and the measured values are indicated by the position of the meter needle. In addition to measuring changes in the frequency, this permits faster frequency adjustment and Go/No-go judgement of oscillators, which had to be read many digits of measured data before. This analog meter also solves problems associated with misreading frequency values.

Moves left/right and indicates frequency value

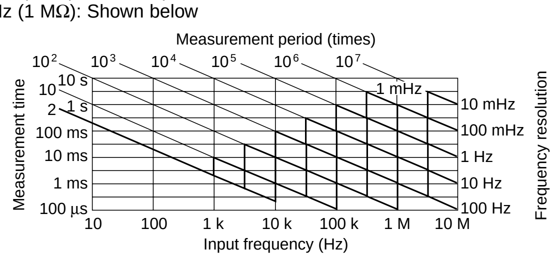
• Template function
After the upper and lower frequency limits have been preset, if the measured frequency is within the preset range, Go is displayed; if it is out of range, No-go is displayed. In addition, the Go/No-go signal can be output from the AUX connector on the back panel as a TTL signal. This is very useful for configuring an automatic device Pass/Fail evaluation system (using analog display).

• High-speed transient measurement
Frequency counters have an interval when measurement is not performed (sample rate), so that sudden frequency changes during this period cannot be measured. However, the MF2400B series overcomes this problem by capturing frequency changes at speeds of up to 10 µs and saving a maximum of 2000 sampling points. When it is combined with a host computer, frequency changes can be displayed graphically. This is very effective for measuring VCO start-up characteristics and PLL lock times.

• Gating function
With burst signal measurements, the carrier frequency may be different at the start, middle, and end of the burst. In the MF2400B series, the carrier signal frequency at any position of the signal (delay time from trigger signal leading edge) and at any specified time (gate time) can be measured using a combination of the gating and trigger delay functions.

Specifications

• MF2400B series

<table>
<tr><td rowspan="5">Input</td><td>Frequency range</td><td colspan="3">INPUT 1
MF2412B: 600 MHz to 20 GHz, MF2413B: 600 MHz to 27 GHz, MF2414B: 600 MHz to 40 GHz
INPUT 2
10 MHz to 1 GHz (50 Ω), 10 Hz to 10 MHz (1 MΩ)</td></tr>
<tr><td rowspan="2">Input level range
(sine wave input)</td><td>MF2412B INPUT 1
–33 to +10 dBm (<12.4 GHz),
–28 to +10 dBm (≤20 GHz)</td><td>MF2413B INPUT 1
–33 to +10 dBm (<12.4 GHz),
–28 to +10 dBm (<20 GHz),
–25 to +10 dBm (≤27 GHz)</td><td>IMF2414B NPUT 1
–33 to +10 dBm (<12.4 GHz),
–28 to +10 dBm (<20 GHz),
–25 to +10 dBm (≤26.5 GHz),
[0.741 x frequency (GHz)]
–44.6 to +10 dBm (≤40 GHz)</td></tr>
<tr><td colspan="3">INPUT 2: 25 mVrms to 2 Vrms (50 Ω), 25 mVrms to 10 Vrms (1 MΩ)</td></tr>
<tr><td>Impedance, coupling</td><td colspan="3">INPUT 1: 50 Ω, AC couple
INPUT 2: 50 Ω or ≥1 MΩ (≤35 pF), AC couple</td></tr>
<tr><td>Connector</td><td colspan="3">INPUT 1
MF2412B: N-type, MF2413B: SMA-type, MF2414B: K-type
INPUT 2: BNC-type</td></tr>
<tr><td rowspan="3">Gating function</td><td>Trigger mode</td><td colspan="3">INT: Triggered by measurement signal
EXT: Triggered by external signal
*Trigger level: 1.5 V ± (2 to 10 Vp-p), Trigger pulse width: ≥1 µs, Impedance: ≥100 Ω, Coupling: DC
LINE: Triggered by AC line signal</td></tr>
<tr><td>Trigger delay</td><td colspan="3">20 ns to 0.1 s*1, off
(≤320 ns in 20 ns steps, and <1 µs in 40 ns steps variable; ≥1 µs in continuously variable as effective two digits)</td></tr>
<tr><td>Gate width</td><td colspan="3">100 ns to 0.1 s (<1 µs in 20 ns steps variable; ≥1 µs in continuously variable as effective two digits</td></tr>
<tr><td rowspan="6">Pulse modulation wave measurement</td><td>Frequency range</td><td colspan="3">MF2412B: 600 MHz to 20 GHz, MF2413B: 600 MHz to 27 GHz, MF2414B: 600 MHz to 40 GHz</td></tr>
<tr><td>Pulse width</td><td colspan="3">100 ns to 0.1 s (NARROW), 1 µs to 0.1 s (WIDE)</td></tr>
<tr><td>Pulse repetition frequency</td><td colspan="3">10 Hz to 4 MHz (pulse off time: ≥240 ns)</td></tr>
<tr><td>Carrier frequency measurement*2</td><td colspan="3">Max. resolution: 10 kHz (pulse width: 100 ns to 1 µs), 1 kHz (pulse width: 1 to 10 µs), 100 Hz (pulse width: 10 to 100 µs), 10 Hz (pulse width: 0.1 to 1 ms), 1 Hz (pulse width: 1 to 10 ms), 0.1 Hz (pulse width: 10 to 100 ms)
Measurement time: (T or T_S whichever is greater) x $\{1/(f_R \times TGW)\}^2$ *3
<table>
<tr><td>Resolution</td><td>1 Hz</td><td>10 Hz</td><td>100 Hz</td><td>1 kHz</td><td>10 kHz</td><td>100 kHz</td><td>1 MHz</td></tr>
<tr><td>Measurement time</td><td>200 s</td><td>20 s</td><td>2 s</td><td>200 ms</td><td>20 ms</td><td>5 ms</td><td>5 ms</td></tr>
</table>
*Measurement carrier frequency: 1 GHz (TGW*3 = $0.1/f_R$)
Accuracy: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error*5 ±1/TGW*3</td></tr>
<tr><td>Pulse width measurement</td><td colspan="3">Resolution: 1 ns
Accuracy: ±20 ns ±time base accuracy x measurement pulse width ±trigger accuracy
Unit indication: µs (fixed)</td></tr>
<tr><td>Pulse period measurement</td><td colspan="3">Resolution: 1 ns
Accuracy: ±20 ns ±time base accuracy x measurement period ±trigger accuracy
Unit indication: µs (fixed)</td></tr>
<tr><td rowspan="2">Carrier wave frequency measurement</td><td>Resolution, gate time</td><td colspan="3">INPUT 1
NORMAL: 1 MHz/1 µs to 0.1 Hz/10 s
FAST: 1 MHz/0.18 µs to 0.1 Hz/1.8 s (typical)
INPUT 2
10 MHz to 1 GHz (50 Ω): 1 MHz/1 µs to 0.1 Hz/10 s
10 Hz to 10 MHz (1 MΩ): Shown below

</td></tr>
<tr><td>Measurement accuracy</td><td colspan="3">INPUT 1
NORMAL: ±1 count ±time base accuracy x measurement frequency ±residual error*4
FAST: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy ±residual error*5
INPUT 2
10 MHz to 1 GHz: ±1 count ±time base accuracy x measurement frequency
10 Hz to 10 MHz: ±1 count ±time base accuracy x measurement frequency ±trigger accuracy</td></tr>
<tr><td colspan="2">Auto/manual measurement</td><td colspan="3">Auto
FM tolerance: 35 MHzp-p, Acquisition time: ≤50 ms
Manual (CW measurement)
Input allowable frequency range: ±30 MHz (600 MHz to 1 GHz), ±40 MHz (≥1 GHz)
Acquisition time: ≤15 ms
Manual (Burst measurement)
Input allowable frequency range:
±30 MHz (600 MHz to 1 GHz, pulse width mode: WIDE), ±20 MHz (≥1 GHz, pulse width mode: NARROW),
±40 MHz (≥1 GHz, pulse width mode: WIDE)
Acquisition time: ≤15 ms</td></tr>
</table>

Continued on next page

Functions	Template: Inputs in upper/lower limit of frequency, judged on GO/NO-GO Frequency offset: +offset, –offset, ppm Statistical processing: mean, maximum, minimum, p-p Save/recall: 10 panel settings (Max.)
AUX output	Output for GO/NO-GO, count end, input level detection, internal gating, restart, and acquisition signal
Sample rate	1 ms to 10 s (1-2-5 steps), hold
High-speed sample period/ frequency resolution	INPUT 1: 10 µs/10 kHz, 100 µs/1 kHz, 1 ms/100 Hz INPUT 2: 10 µs/100 kHz, 100 µs/10 kHz, 1 ms/1 kHz ∗Measurement frequency: 100 MHz
Memory back up	Store in non-volatile memory at instrument power-down
Display	Display digits: 12 digits and 1 digit (– mark) LCD: 248 x 60 dots (with back light)
Reference crystal oscillator	Frequency: 10 MHz Warm-up: ≤±5 x 10^{-8}/day (after 30 min. warm-up) Aging rate: ≤±2 x 10^{-8}/day (after 24 h warm-up) Temperature characteristics: ±5 x 10^{-8} (0˚ to 50 ˚C)
External reference input	1/2/5/10 MHz, Input voltage: 1 to 5 Vp-p (AC coupling), Input impedance: ≥1 kΩ
External reference output	1/2/5/10 MHz∗6, Output voltage: ≥2 Vp-p (open end, AC coupling), Output impedance: ≤400 Ω
External control	GPIB (conforms to IEEE488.2 standards): SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
Power	85 to 132/170 to 250 V (auto switch), 47.5 to 63 Hz, ≤90 VA MAX.
Operating temperature	0˚ to +50 ˚C
Dimensions and mass	213 (W) x 88 (H) x 350 (D) mm, ≤5 kg
EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
LVD	EN61010-1: 2001 (Pollution Degree 2)

∗1: Delay time until counter started by trigger detection
∗2: MANUAL measurement mode
∗3: f_R; frequency resolution, TGW; gate width, Ts; processing time (50 µs), T; period ($2/f_R$)
∗4: Measurement frequency (GHz)/10 count (rms)
∗5: Measurement frequency (GHz)/2 count (rms)
∗6: 10 MHz when using internal reference signal; outputs signal based on this signal (1/2/5/10 MHz) when using external reference signal

• Options 01/02/03: Crystal oscillator

Option number	01	02	03
Frequency	10 MHz		
Aging rate	5 x 10^{-9}/day, 5 x 10^{-8}/month, 7.5 x 10^{-8}/year ∗After power on, with reference to frequency after 24 h	2 x 10^{-9}/day, 3 x 10^{-8}/month, 4.5 x 10^{-8}/year ∗After power on, with reference to frequency after 24 h	5 x 10^{-10}/day, 1 x 10^{-8}/month, 1.5 x 10^{-8}/year ∗After power on, with reference to frequency after 48 h
Temperature characteristics	±5 x 10^{-8}	±1.5 x 10^{-8}	±5 x 10^{-9}
	–10˚ to +60˚C (with reference to +25˚C)		

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/order No.	Name	
	Main frame	
MF2412B	Microwave Frequency Counter	
MF2413B	Microwave Frequency Counter	
MF2414B	Microwave Frequency Counter	
	Standard accessories	
	Power cord, 2.5 m:	1 pc
F0012	Fuse, 3.15 A:	2 pcs
W1520AE	MF2412B/2413B/2414B operation manual:	1 copy
	Options	
MF2412B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2413B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2414B-01	Crystal oscillator (5 x 10^{-9}/day)	
MF2412B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2413B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2414B-02	Crystal oscillator (2 x 10^{-9}/day)	
MF2412B-03	Crystal oscillator (5 x 10^{-10}/day)	
MF2413B-03	Crystal oscillator (5 x 10^{-10}/day)	
MF2414B-03	Crystal oscillator (5 x 10^{-10}/day)	
	Maintenance serivce	
MF2412B-90	Extended three year warranty service	
MF2412B-91	Extended five year warranty service	
MF2413B-90	Extended three year warranty service	
MF2413B-91	Extended five year warranty service	
MF2414B-90	Extended three year warranty service	
MF2414B-91	Extended five year warranty service	

Model/order No.	Name
	Optional accessories
K224B∗1	Coaxial adapter (K-P · K-J, SMA compatible, DC to 40 GHz, SWR: 1.2)
34RKNF50	Coaxial adapter (ruggedized K-P · N-J, DC to 20 GHz, SWR: 1.25)
J0060	Coaxial adapter (N-J · SMA-P)
J0526	Coaxial adapter (N-J · SMA-J)
J0527	Coaxial cord (K-P · K-P), 2 ft
J0127A	Coaxial cord (BNC-P · RG-58A/U · BNC-P), 1 m
J0853	Coaxial cord (N-P · SF104P · N-P), 2 m
J0854	Coaxial cord (APC3.5-P · SF104P · APC3.5-P), 2 m
MP612A∗2	Fuse Holder (N-P · N-J, DC to 1 GHz)
MP613A∗2	Fuse Element (DC to 1 GHz, Power rating: +17 dBm, Blow rating: ≥+35 dBm)
J0007	GPIB cable, 1 m
J0008	GPIB cable, 2 m
B0426A	Carrying bag (soft type)
B0409	Carrying case (with B0329L protection cover)
B0329L	Protection cover
B0390G	Rack mount kit (19 inch type, one unit)
B0411A	Rack mount kit (19 inch type, two units, side by side)

∗1: The K224 adapter is used to prevent damage to the input connector.
∗2: The MF2400B series has the MP612A Fuse Holder (with MP613A Fuse Element) to prevent input of excessive power. In addition, the MP612A Fuse Holder has an N-type connector, so an adapter is required according to the coupled connector type.

WIDEBAND PEAK POWER METERS

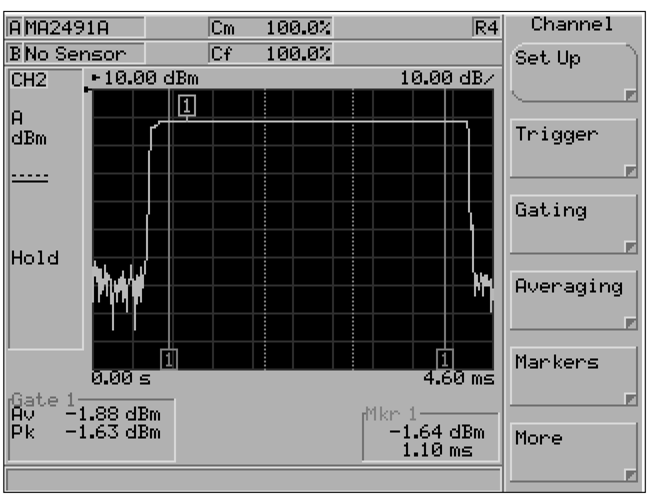
ML2480A Series

10 MHz to 50 GHz*

CE GPIB

For High Speed Modulated and Pulsed Power Measurements

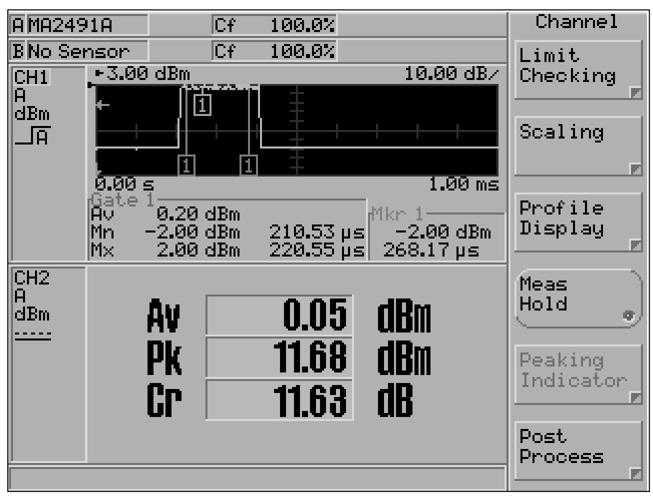
The ML2480A series Power Meters are especially designed for accurate power measurements on high speed modulated measurements. The power meter combines advances in diode sensor technology with DSP to produce a compact and economical high speed peak power meter. A new color display is used to display the results in graphical or numerical format. The power meter incorporates features normally found in digital oscilloscopes to produce an easy to use high speed peak power meter. A high speed GPIB interface can be used for the rapid automation of the power measurement.
The ML2480A series have been designed to use the new MA2491A Wideband Sensor. The ML2480A is fully compatible with the wide range of Anritsu diode, fast thermal and universal sensors. See the section on the ML2430A Series Power Meters for more details on these sensors. Two versions of the product are available; the ML2487A Single Input unit and the ML2488A Dual Input unit.



Performance

The ML2480A has a 20 MHz signal amplifier bandwidth and a sampling rate of 64 MS/s. This makes the power meter especially suitable for measuring signals with high modulation rates such as WLAN, 3G or EDGE signals as well as providing fast rise times for examining pulsed signals such as radar.

The new MA2490A /91A wideband sensors have been designed for a variety of applications. With a selectable 5/20 MHz bandwidth, measurements can be made on the rising edges of pulsed systems as well as CDMA waveforms. The new sensors have a dynamic range of –60 dBm to +20 dBm in CW mode and a range of –25dBm to +20dBm in pulse modulated mode.
The new power meter combines the very best of high-speed measurement technology and CW stability.



Profile or Readout Displays can be chosen

Features

- **Dual Display Channel**

The ML2480 supports dual display channels. Each display channel is a measurement set up and can use any selection or combination of the sensor inputs. The instrument can be configured to view one display channel or two. The instrument can be switched between display channels quickly and simply via the CH1/CH2 "hot" key on the front panel. The user can choose to view the measurement results as a graph profile or numerical readout.

* Frequency range is sensor dependent.

• Measurement Gates
At the heart of the new power meter's signal processing lies the measurement gate facility. The new power meter supports up to four independently set gates or eight gates repeated in a pattern. The gate allows the user to capture the relevant information from the signal under test. The wide bandwidth and high speed A/D allow the positioning of the gate very accurately within the signal profile. The user can choose between several measurements performed within the gate. Average, peak, crest, max and min are available as selections for the output.
The max and min data are time stamped so that the position of these signals is recorded within the gate and can be used to record the overshoot and undershoot of a pulsed signal.
Exclusion zones within the measurement gate are also available. Termed fences, these can be used to exclude sections of the signal from the measurement gate. Particularly useful for excluding mid-burst training sequences. Each gate has a switchable fence associated with it.

• Markers
Four independent markers are available for denoting points of interest on the signal profile. The active marker can be scrolled directly from the front panel. A delta marker can be set independently from the active marker to read the difference or the average power result. The delta marker can linked to provide continuous scrolling through the signal.
A set of specialized automatic marker functions has been provided to ease the measurement of pulsed systems. These functions are automatic pulse rise time, pulse fall time, off time and pulse repetition interval.

• Trigger facilities
High speed measurements require precise triggering. The ML24380A series offer the following trigger modes:
Continuous, internal trigger on the rising or falling edge of either input A or input B and external TTL trigger. The external trigger allows the power meter to be synchronized to external equipment. Data collection can be delayed for a pre-determined time after the trigger point. The trigger facility incorporates a settable hold off facility which prevents the trigger from being re-armed and re-triggering on a noisy signal. A pre-trigger facility allows the capture and display of pre-trigger information on the signal.
The single shot trigger facility can be used to capture specific one off events.

• Test Limits
The ML2480 series has two different types of automatic test limits. For many applications a simple power limit can be set up to test the upper and /or lower boundaries of the signal. For pulsed systems such as RADAR, TDMA phone systems or WLAN, a time varying limit line can be set up to test all aspects of the pulse profile. The power meter can be set up to indicate pass or fail and to hold the measurement display on failure which is important when trying to track down intermittent faults. An internal limit editor enables the user to create and select their own limit profiles.

• Presets
The ML2480 offers a number of radio system presets. Each preset configures the power meter settings to measure a radio system. GSM, GPRS, W-CDMA, WLAN and Bluetooth are some of the examples of radio systems supported by this facility.

• Settings stores
The power meter has 20 settings stores. These provide a convenient way of having application specific measurement set ups for easy recall by the user.

• Remote Interfaces
The ML2480A series supports GPIB and RS-232 as standard.

• Secure mode
The ML2480A series has a secure mode for operations in security sensitive areas. Once activated the secure mode wipes all information stored in the non-volatile RAM on power up.

Applications

• Radar
The high bandwidth and sample rate of the ML2480A provide accurate peak measurements on a variety of RADAR, Radio navigation and Radio location systems.
The ML2480A series has a number of features tailored for peak power measurement on pulsed systems. The power meter can be easily set up to trigger on a pulse or sequence of pulses. Up to four independent gates can be set to measure the average, max and min powers on a sequence of pulses. The data for the max and min includes the timestamp and gives the user automatic display of the position and value of the maximum overshoot and minimum undershoot in each pulse.
A set of automatic marker functions gives pulse rise time, fall time, off time and Pulse Repetition Interval. The Delta marker can be set up to measure the droop of the pulse top.
A single shot trigger is available to capture one-off pulse events.
The offset table function corrects the power meter reading to read the true output power when the power meter is being used with a coupler or high power attenuator in the radar test system.

• WLAN
The ML2480A series is the ideal power meter for all variants of the 802.11 WLAN specification. The 20 MHz bandwidth allows users for the first time to get an accurate peak power reading without having to resort to manual correction of the peak reading due to bandwidth limitations. The wide bandwidth of the signal channel allows for the accurate placement of the gate to measure precise selections of the signal such as the OFDM training sequence at the start of the 802.11g signal.

• GSM/EDGE /GPRS
The graphical display and the measurement gates make the measurement of GSM and PCS systems straightforward.
The power meter is set up to trigger on the GSM pulse. The active gate is set up to measure the power within the 10% to 90% section of the burst profile. An automatic limit can be used to give pass or fail indication. The display shows the results from the active gate, indicating the average power within the burst.
GPRS and GSM test modes can be tested easily with the use of the multiple gates. A GSM gate pattern can be repeated up to eight times to allow the power meter to capture and read back the power from each of the slots, giving up to eight simultaneous measurements.
EDGE measurements are quick and simple to make. The high sample rate leads to improved settling time and the use of the trigger hold off facility prevents re-triggering on the symbol transitions. PHS and IS-136 systems can also be measured effectively and quickly in this way.

• 3G-CDMA
The ML2488A has been designed to measure the peak power of all the major CDMA systems in the world including those that use Time Division Duplexing such as TD-SCDMA. The display can be configured to measure Average, Peak and Crest Factor. The measurement period can be set for accurate results. TDD systems can be displayed as a graph profile and the measurement gates can be set to measure and display the peak and crest factor during the transmission.
CCDF, CDF and PDF statistical functions are supported on the CDMA measurements and enable the designers of power amplifiers to correctly estimate the margins on the peak power handling capabilities of the amplifiers.

• Amplifier and Return Loss Measurements
Use the dual input ML2488A to measure the gain or the return loss of an amplifier under its correct operating conditions. Power amplifiers designed for peak applications, whether pulsed or CDMA , cannot operate at full peak power with CW test inputs. The gain and output power can only be measured accurately using a peak power meter under representative conditions. The return loss of amplifiers and other devices can only be evaluated under high power pulsed conditions with a peak power meter connected to a high directivity coupler.

• MA2490A and MA2491A Wideband Sensors
The MA2490 series sensors are wideband sensors suitable for pulse and CDMA applications. They have a selectable 5/20 MHz bandwidth. The MA2490A covers the range 50 MHz to 8 GHz and the MA2491A extends the range to 18 GHz. Rise time on this sensor is 18 ns. The sensor incorporates a 'chopper' which extends the RMS measurement range to –60 dBm. Upper limit is +20 dBm.

• MA2411A Pulse Sensor
The MA2411A Pulse sensor is specifically designed for fast measurements on pulsed systems. The bandwidth of this sensor is 50 MHz and has a rise time of 8 ns. This sensor covers the frequency range 300 MHz to 40 GHz. Requires 1 GHz Calibrator option no. ML2400A/15.

Specifications

	Frequency Range	100 kHz to 65 GHz, sensor dependent
	Power Sensors	Meter compatible with the MA2400 A/B series sensors
	Sensor Dynamic Range	–70 dBm to +20 dBm for standard MA2400 A/B Sensor Range in CW –25 dBm to +20 dBm in pulse/modulated mode
	Power Measurement Range	–70 to +200 dBm dependent upon sensor range, external coupler or attenuator
	Channel Bandwidth	20 MHz, CW and lower bandwidth mode sensors supported
	Sampling Rate	Up to 64 MS/s dependent upon settings
	Instrumentation Accuracy	<0.5% ±0.02 dB absolute Accuracy ±0.04 dB relative Accuracy
	Display Resolution	Selectable from 0.1 to 0.001 dB
	Display Units	Linear: nW to W, % Log: dBm, dBW, dB
Power Reference	Output Level	1.00 mW, Nominal 50 MHz,Traceable to National Standards
	Connector	Type N female
	VSWR	1.04
Sensor/Channel Control	Operating Modes	Readout Dual Display Channel RF power Profile CDMA Average, Peak Power, Crest factor CDF,PDF and CCDF
	Limit Lines	Simple pass/ fail as per ML24XX Profile shape for pulsed and TDMA systems Profiles can be stored in the instrument
	Markers	4 Markers Delta Marker Marker to Max/Min Pulse Rise/Fall time, off period and PRI
	Gates	4 Independently set Gates or 8 Repeated Gates 1 Fence per Measurement Gate Gate Measurement supports Average, Peak, Crest, Max and Min
Triggering	Trigger Sources	Continuous, Internal, External TTL, GPIB or external Bus.
	Delay Range	0-999 ms, dependent on trigger capture range
	Delay Resolution	0.5% of display period or 16 ns
	Internal Trigger Range	–15 dBm to +20 dBm
Interfaces	GPIB Speed	>400 reading/sec. in CW mode >350 readings/sec. in Fast mode, 1 µs gate width

System Configuration	Display	LCD, Color
	Save / Recall	20 settings stores Preset accessible on Front Panel Offset tables
	Secure Mode	Wipes non-volatile ram on power up when active
	Interfaces	GPIB, RS232
General Specifications	General	MIL-T28800F, Class 3
	Operating Temperature Range	0 to +50°C
	Storage Temperature Range	–40 to +70°C
	Power Requirements	AC 90V to 250 VAC, 47 to 440 Hz, 80 VAmax.
	EMI	Complies with requirements for CE Marking
	Warranty	1 year Standard 3 year Optional
	Dimensions	8.39 inches (213mm) wide, 3.46 inches (88mm) high, 9.84 (390mm) inches deep

Ordering information

Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name
	Main frame
ML2487A	Power Meter, Single Input
ML2488A	Power Meter, Dual Input
	Options
ML2400A-01	Rack Mount, single unit
ML2400A-03	Rack Mount, side by side
ML2400A-05	Front Bail Handle
ML2480A-06	Rear Mount input A
ML2480A-07	Rear Input A and Reference
ML2480A-08	Rear Mount inputs A,B and Reference
ML2480A-09	Rear Mount Inputs A and B
ML2400A-12	Front Panel Cover
ML2480A-15	1 GHz Calibrator (for use with MA2411A Sensor)
ML2480A-17	Blank Front Panel
ML2400A-20	Spare 1.5m Sensor Cable
ML2400A-21	0.3m Sensor Cable
ML2400A-28	Bootload Cable
ML2419A	Range Calibrator
ML2480A-33	Extra Operating Manual ML2487/8A
ML2480A-34	Extra Programming Manual ML2487/8A
ML2480A-98	Premium cal to Z540 ISO guide 25
ML2480A-99	Service cal to Z540 ISO guide 25
760-209	Hardside Transit Case
D41310	Soft Carry Case with Shoulder Strap
MA2418A	50 MHz Reference Oscillator with Power Supply

POWER METERS
ML2400A/2430A Series

CE GPIB

For Measuring Wide Dynamic Range Power

The ML2430A series Power Meters combine the advantages of thermal meter accuracy, diode meter speed, and peak power meter display graphics. The result is a single instrument that achieves 90 dB dynamic range with a single sensor. The ML2430A series includes graphics display capability as a standard feature. The ruggedized housing and optional high-capacity NiMH battery bring convenience and accuracy to field service applications.

Performance

• Speed and dynamic range

The 90 dB range MA2470A series Power Sensors' high sensitivity reaches stable power readings to –70 dBm. 35 kHz sample rates profile cellular, PCS, and other pulsed signals to 0.1 µsec resolution. Modern connector technology achieves industry-leading return loss for improved accuracy through 50 GHz. The 87 dB range MA2440A series High Accuracy Sensors further improve return loss performance by adding a matching circuit to the MA2470A series' front end.

New power sensor technology achieves industry leading measurement linearity and high sensitivity.

• Universal power sensors

The new MA2480A series Universal Power Sensor will measure any modulated or multi-tone signal thanks to a patented sensor architecture with three diode pairs. Universal power sensors deliver over 80 dB of dynamic range with speed and accuracy.

Average power measurements on W-CDMA signals can now be made without the need for special power meters. Universal sensors are also ideal for power measurements on other digitally modulated carriers such as HDTV, DAB or QAM modulated radio links.

The sensor architecture ensures that one of the diode pairs is always operating in its square law region. The meter selects the diode pair operating in its square law region and is designed so that even the peaks of CDMA signals are measured accurately. Anritsu's three stage diode pair approach leads to a very much faster measurement time than the two stage approach used in previous generations of average power sensors. No slowing of measurement speed is observed at switching points, making them transparent to the user.

Universal power sensors are also ideal for applications where multiple signals are present, such as intermodulation measurements and satellite multi carrier power loading measurements.

A unique additional capability of the Anritsu Universal power sensor is the ability to use it as a standard diode sensor for fast CW measurements and pulse or TDMA measurements. In this mode the fast response of diode sensors is maintained across the full dynamic range of the sensor, meaning that for the majority of users it is the only sensor that they will ever need - a truly Universal Power Sensor.

• Fast thermal sensors

Anritsu's latest semiconductor processing technology produces thermal power sensors with speed increased by an order of magnitude. Improvements in connector technology reduce measurement mismatch uncertainty through 50 GHz to levels previously attained only to 20 GHz. The fabrication technique, as well as the ML2430A's sampling and DSP technology, optimize measuring speed to 4 ms rise and fall times.

• GPIB speed

Industry leading speed of >600 continuous readings per second is achieved under a variety of operating conditions including averaging settings, sensor control settings, triggering conditions, operating mode, sensor type, and GPIB interface manufacturer. The ML2430A series offers the ability to measure and transfer a high-speed burst of 200 data points using profile operating mode with sampling rates of 35k per second.

• GPIB emulation

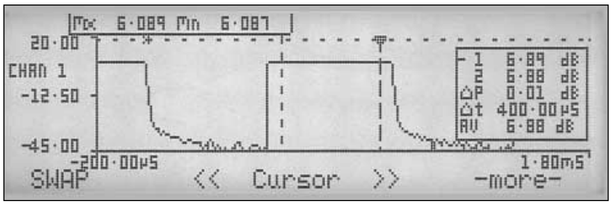
With 99.9% emulation of older meters, the ML2430A series improves ATE system productivity. Typical test system speed improvement is 2 to 10 times faster system speed depending upon the number of measurements taken during the test, the minimal use of wait statements within the code, and the meter model emulated.

• Triggering controls

What use is high speed without triggering and sample controls? Data acquisition event arming and triggering functions traditionally found on expensive peak power meters are standard in the ML2430A series. Triggering delay and the sample integration time per reading can be directly controlled by the operator. Trigger sources include, continuous, internal, external TTL, and manual. Thus, data acquisition can be optimally controlled for synchronization with other test equipment.

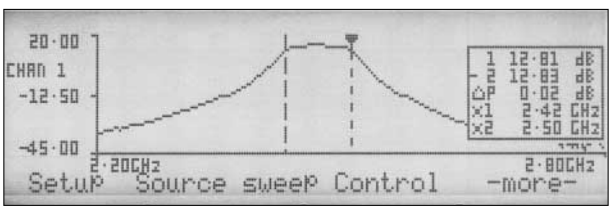
10

• Burst profile graphics display
The ML2430A features random repetitive sampling for high resolution of fast signals. A time domain graphic display profiles pulsed signals over a power range of –40 dBm to +20 dBm. 35 kHz sampling speed produces clear power profiles of cellular and PCS signals including TDMA, PHS, GSM, and DCS-1800. Pulse top power is easily and repeatably measured using between cursor averaging. Measure pulse-top power over >80 dB dynamic range in readout mode at GPIB speeds >200 readings per second.



• Power vs. time graphics display
The power versus time mode is a strip chart style display for monitoring gain and output power variations over time/temperature, supply voltage, or a component tolerance. In service applications, measurement of power versus time aids trouble shooting of unusual conditions, such as intermittent switches or abnormal power control in a mobile telephone base stations. The power versus time mode provides a clear strip chart display of RF power variation.

• Source sweep graphic display
Power Sweep or frequency sweep data are acquired at more than 10 sweeps per second over GPIB. Synchronization with synthesizers requires connection (BNC) of a 0.0 V sweep ramp input and an RF blanking/dwell input.



• Parallel printer connector
Many deskjet series printers can be connected directly to the ML2430A for fast documentation of performance on the bench or in the field. Meter calibration, triggering, and averaging settings are listed with the display printout. Thus, evidence of DUT (device under test) anomalies can be duplicated quickly.

• 90 dB dynamic range
Typical communications industry ATE systems operate over a 60 to 80 dB dynamic range. The MA2470A series' 90 dB dynamic range replaces two 50 dB sensors. Furthermore, an RF switch is no longer needed for the two sensors. This reduces software control complexity and further speeds test execution.

• Sensor EEPROM
All MA2400A series sensors are equipped with internal EEPROMs for storage of calibration factor data vs. frequency. This allows the power meter to interpolate and correct readings automatically, improving accuracy and convenience.

• High reliability
A rugged polycarbonate chassis handles drop shocks and rough field treatment. The absence of vent holes makes the meter splash resistant. A front cover panel and softcase are optional for further environmental protection. Power sensors are also ruggedized for rough handling.

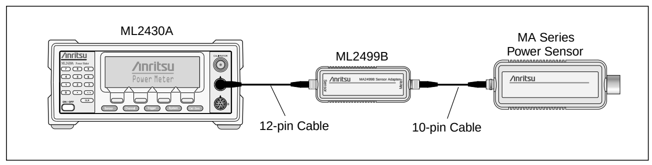
• Improved accuracy
Mismatch uncertainty is typically the largest source of error. The MA2400A series Power Sensors offer a typical 5 to 6 dB improvement in sensor return loss, typically cutting mismatch uncertainty in half. The MA2440A series High Accuracy Sensors incorporate a matching pad which further improves return loss by 5 to 6 dB — again halving mismatch uncertainty.

• Offset table for path loss correction
Compensating for the true frequency response of attenuators, couplers, cables, switches, and other test setup devices improves measurement accuracy. For this reason, the ML2430A series can apply an offset table of attenuation-versus-frequency in addition to the traditional fixed dB offset capability. When a power sensor connection is preceded with a new 1N series wideband power limiter, the offset table compensates for frequency response. Thus, the combination achieves an accurate, "burnout-proof" sensor.

• Softkey menu control
Softkey menus simplify instrument control by making the user interface easier to understand. The numerical keypad simplifies the operator interface.

• Battery
The optional NiMH "Smart" battery supports high charge density for a typical 8 hour day of operation. Accurate fuel gauging, <2 hour fast charge cycling, and the elimination of NiCd style memory effect further enhance the convenience of this battery technology.

• Voltmeter
The ML2430A series also supports high-speed voltage measurement. A rear panel BNC measures voltage or operates as V/GHz input supporting automated sensor calibration factor correction.

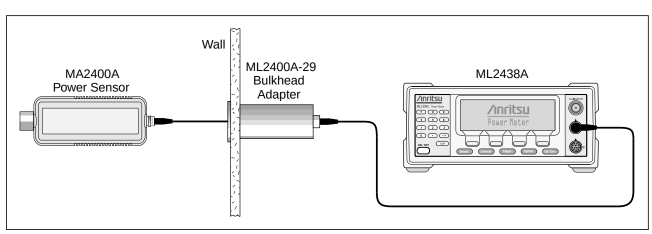


• Sensor Adapter, MA2499B
The ML2499B Sensor Adapter operates with older (10-pin) MA Series Power Sensors. An internal EEPROM allows storage of up to 9 sets of sensor calibration factor tables. Each table is individually selectable from the sensor menu. MP series waveguide power sensors are also compatible when used with the MA4002A adapter.

• High power applications
Traditional high power sensors are expensive and have degraded accuracy specifications. Further, their annual calibration requires more time and expense. Anritsu's new User Calibration Factor Tables avoid these problems. Any attenuator or coupler can be compensated by entering frequency and attenuation values into the MA2400A Series Power Sensors internal EEPROM. The attenuation device can be semi-permantly attached; the power meter automatically applies compensation during the 0.0 dBm, 50 MHz calibration reference process. The User Calibration Factor Tables are easily deactivated – allowing the power sensor to be used stand-alone also.

• Remote monitoring by telephone
Monitor transmitter performance remotely with standard telephone lines using the ML2430A's full duplex RS-232 and dial-out capabilities. When the ML2430A detects a high or low limit line violation, it will automatically dial a phone number. The meter's data acquisition settings can adjust to monitor average power or the burst power of specific timeslots. The RS-232 port uses the same commands as the GPIB. Contact your Anritsu representative for PC compatible software.

• Locate power sensors remotely
Some power meter applications require the sensor and meter to be separated by long distances or physical barriers. There is no requirement to perform a 0.0 dBm reference with the power meter; however, the lack of a reference may cause a small offset error. When a reference is desired, the MA2418A Reference Osillator (0.0 dBm. 50 MHz) provides a convenient solution. DC power supply, and small size allows the MA2418A to be embedded in switch matrices or other enclosoures. When a power sensor's cable must pass through walls or shielded enclosures, the ML2400A/29 Bulkhead Adapter provides a convenient connection between two sensor cables.



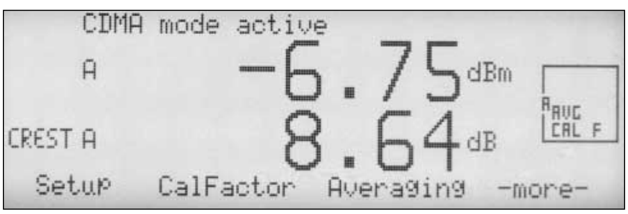
• N-CDMA Power Measurements

The Anritsu ML2407A power meter and MA2460B/C series power sensor have been specifically designed to make the exacting measurements required on N-CDMA signals. Today's digital radio standards employ a variety of techniques to enhance performance and increase spectral efficiency. Application of Code Division Multiple Access (CDMA) technology enables multiple users to share the same spectrum, with a channel bandwidth of 1.2288 MHz. Having a much wider channel bandwidth than earlier generation analog or TDMA systems has created new challenges for radio and component equipment manufacturers.

The Anritsu MA2460B/C series power sensor has a video bandwidth of 1.25 MHz. When used with the ML2407A (single channel) or ML2408A (dual channel) power meters, it is able to correctly characterize IS-95 waveforms and accurately measure average power. Advanced signal processing with fast sampling speeds facilitate measurements of peak power and crest factor.

The dual diode MA2460B/C series power sensor is both fast and accurate. It delivers over 80 dBs of dynamic range, making it suitable for both open and closed loop power control testing. A built-in EEPROM automates sensor calibration factor correction to simplify test set up and reduce human error.

EEPROM correction also corrects for sensor linearity across a range of temperatures, providing test engineers with unmatched measurement accuracy under all operating conditions.

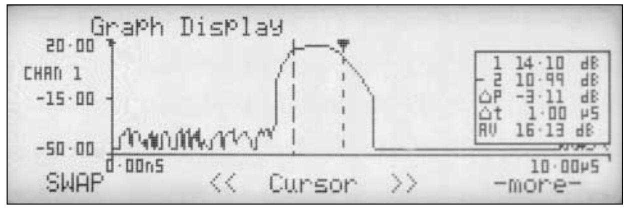


• Power Meter ML2407A

For automated measurements under GPIB control, the ML2407A power meter offers many class-leading features. Over 600 readings per second are available in fast mode, reducing total test time. Programmers have control over low-level averaging, sensor setting, and noise reduction for optimization of program speed. The sensors internal AC detection circuitry delivers a guaranteed noise floor of –60 dBm with typical performance to –70 dBm, even when measuring CDMA signals.

When testing transmitters and amplifiers it is often necessary to measure crest factor. If an amplifier is unable to cope with the peaks within the signal they will be attenuated and information lost.

Amplifiers are often tested across a range of average powers to ensure that the crest factor is maintained. This provides a simple way of ensuring that the amplifier is maintaining linearity across its full dynamic range. The Anritsu ML2407A facilitates tuning of amplifiers through the use of a crest factor time window. The period of time for which a peak will be stored is set by the user. Thus the change in crest factor can be monitored as the average power into an amplifier is increased.



• Fast Pulse Analysis

The MA2460B/C series sensor also benefits from improved pulse response times. Pulses down to 1 µs can now be captured and displayed thanks to a sensor rise time of 0.6 µs. It is becoming increasingly common for amplifiers to be tested by analyzing their responses to short pulses. The ML2407A in profile mode can graphically display the pulse shape. Two cursors can be positioned on the trace and cursor readouts show the power at each cursor position plus the average power between the cursors.

Triggering for pulse analysis is from a TTL input or from a rising or falling edge. Variable trigger delay provides the ability to view the whole pulse profile or exactly the portion of the pulse of interest. With the ML2408A dual channel power meter, the pulsed gain of an amplifier can be measured directly.

• PowerSuite

PowerSuite software runs on a standard PC running Windows® 95 (or higher). PowerSuite adds the following measurements to the capability of the Anritsu ML2400A series power meters:

- Statistical power analysis
  - Probability Density Function (PDF)
  - Cumulative Density Function (CDF)
  - Inverse Cumulative Function (1-CDF)
- Pulse characterization (pulse width, rise time, peak power, pulse power, overshoot repetition, and period)
- GSM (and other TDMA) time slot power analysis
- Automated amplifier compression analysis
  - Single frequency compression
  - Compression vs frequency

Statistical analysis of power distribution can reveal important information to optimize CDMA system design. PDF displays the percentage of time (or samples) that the power is at a specific value. CDF takes the same data but displays the percentage of time (or samples) that the power is at or below a specific value. Analyzing this data can reveal how a system or device may be distorting the signal that it is transmitting. Comparison of the CDF plots from an amplifier at differing average power levels validates linearity and reveals the potential introduction of data errors.

PowerSuite is a very flexible package that provides full user control over measurement settings. The screen can be set for continuous update so that changes to the device or system under test can be viewed instanty. Alternatively plots can be archived for later analysis.

Specifications ML2400A and ML2430A Series

Frequency range		100 kHz to 90 GHz (sensor dependant)
Power sensors		Meter specifications apply to MA2400A/B series Power Sensors. Compatible with MA and MP series sensors.
Sensor dynamic range		MA2420A/B Series Thermal Sensors: 50 dB MA2440A Series High Accuracy Power Sensors: 87 dB CW, >57 dB Peak MA2460B/C Series Fast Diode Sensors: 80 dB MA2470A Series Power Sensors: 90 dB CW, >60 dB Peak MA2480A Series Universal Sensors: 80 dB
Power measurement range		–70 to +47 dBm (0.1 nW to 50 W), sensor/attenuator dependent. Use couplers for higher power levels.
Voltage measurement range		0.00 to 20.00 V, nominal
Display range		–99.999 to +99.999 dB
Display resolution		Selectable from 0.1 dB to 0.001 dB limited to 0.01 dB in graphical display modes; Linear power units, 3 to 6 digit, 1 - 3 digits selectable to right of decimal nW - W; Voltage, 1 - 2 digits selectable to right of decimal.
Offset range		–99.999 to +99.999 dB. Fixed value or frequency dependent table.
Display units		dBm, dB, dBr, dBmV, dBuV, W, %, Volts
Instrumentation accuracy		<0.5%
Zero set and drift		ML2437/8A <0.5% of full scale in most sensitive range, measured over one hour with maximum averaging after one hour warm up at constant temperature. ML2407/8A <1.8% of full scale in most sensitive range, measured over one hour with maximum averaging after one hour warm up at constant temperature.
Noise		ML2437/8A <0.5% of full scale in most sensitive range, ML2407/8A <1.8% of full scale in most sensitive range, both measured over a one minute interval with maximum averaging, two standard deviations at constant temperature after hour warm up, typical. MA 2470 series, 20 pW typical.
1.00 mW power reference		Frequency: 50 MHz nominal Output level: 1.00 mW, ±1.2%/year, ±0.9% RSS, NIST Traceable Maximum input: +20 dBm continuous or peak, ±50 V dc VSWR: <1.04 Connector: Type N female
Sensor/channel control	Operating modes	Readout, dual channel. RF power or voltage. Power versus time: Single channel graphic of readout data Profile: Single channel RF peak power graphic display for analysis of repetitive pulse or transient waveforms Source sweep: Single channel power sweep or ferquency sweep NCDMA Average Power, Peak Power and Crest Factor - ML2407/8A only.
	Range hold	Current range or selectable 1 through 5.
	Averaging	Auto-averaging: Automatically increases moving averaging at low power ranges. Averaging types: Auto, Manual (Moving, Repeat) Manual average range: 1 to 512 Low-level averaging: Low, Medium, and High settings apply post average low pass filter to improve visibility at high display resolution.
	Limit lines	Fixed value high and low limits with audible, rear panel TTL output, and/or visible Pass/Fail alarm indication. Failure indication can latch for transient failure detection.
	Cursors	Two manually adjustable cursors with power, delta cursor power, between cursor power average, and delta time readout display.
	Delta t resolution	0.5% of display period or 100 ns
Triggering	Trigger sources	Internal, External TTL, GPIB, Manual, Continuous
	Delay range	0.0 to 999.0 Milliseconds
	Delay resolution	0.5% of display period or 100 ns
	Internal trigger range	–15 to +20 dBm, all diode sensors. Selectable to –25 dBm.
	Internal trigger level accuracy	1.0 dB, typical
	External trigger range	TTL rising or falling edge trigger. BNC input
	Manual trigger	Front panel softkey
Channel bandwidth		ML2437/38A 100 kHz nominal ML2407/08A 1.4 MHz nominal

Continued on next page

System configuration	Display		LCD graphic display with backlight and adjustable contrast.
	Save/Recall		10 storage registers plus RESET default settings
	Secure mode		Erases memory information upon power ON. Default condition is secure mode OFF.
	Rear panel inputs/ outputs	Cal factor voltage input (BNC)	Operating modes Voltage: Display voltage reading on selected channel Voltage proportional to frequency for sensor calibration factor compensation Blanking input: TTL levels only. Selectable positive or negative polarity. Input range: 0 to 20 V Resolution: 0.5 mV Control: Adjustable voltage to frequency relationship
		Analog output (BNC): two outputs configurable to log or lin	Operating modes: Analog out: Selectable channel adjusted for calibration factors and other power reading correction settings. Pass/Fail: Selectable TTL High or Low Channel output: Near real time analog. Uncalibrated. AC modulation output: Output 1 only. Dwell output: Output 2 only Output range: –5.0 to 5.0 V Resolution: 0.1 mV
		Trigger input	Operating modes: External TTL or RF Blanking.
		GPIB interface	IEEE-488.2 and IEC-625
		RS-232	Supports software download and modem dial-out.
		Parallel printer output	Compatible with Deskjet 540 and 310 models. Other 500 series and 300 series and later are typically compatible. Also Canon BJC 80. See manual for DIP switch settings.
General specifications	General		MIL-T28800E, Type 3, class 5, Style E
	Display		Flat panel monochrome LCD graphic with backlight
	Operating temperature range		0.0 to +50°C.
	Storage temperature range		–40 to +70°C
	Moisture		Splash and rain resistant, 95% humidity non-condensing.
	Power requirements		AC: 90 to 250 Vac, 47 to 440 Hz, 40 VA maximum DC: 12 to 24 Vdc, Reverse protected to –40. Maximum input 30 V. Battery: >6 hr usable with 3000 mAhr battery
	Replaceable battery (Option)		3000 mAhr NiMH
	EMI		Complies with requirements for CE marking.
	Warranty		1 to 2 year additional available
	Dimensions		8.39 inches (213 mm) wide, 3.46 inches (88 mm) high, 9.84 inches (390 mm) deep
	Weight		<6.6 lbs (<3 kg)

Power sensor specifications

Model	Frequency range	Dynamic range (dBm)	SWR	Rise time*1 (ms)	Sensor linearity	RF connector*2
Standard diode sensors						
MA2472B	10 MHz - 18 GHz	–70 to +20	<1.17; 10 - 150 MHz (MA2472B only) <1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.12; 0.15 - 2 GHz <1.22; 2 - 12.4 GHz <1.25; 12.4 - 18 GHz <1.35; 18 - 32 GHz <1.50; 32 - 40 GHz <1.63; 40 - 50 GHz	<0.004	1.8%, <18 GHz 2.5%, <40 GHz 3.5%, <50 GHz	N (m)
MA2473A	10 MHz - 32 GHz					K (m)
MA2474A	10 MHz - 40 GHz					K (m)
MA2475A	10 MHz - 50 GHz					V (m)
Fast thermal sensors						
MA2421B	0.1 MHz - 18 GHz	–30 to +20	<1.10; 0.1 MHz - 2 GHz <1.15; 2 - 12.4 GHz <1.20; 12.4 - 18 GHz	<4.0	1.3%, <18 GHz 1.5%, <40 GHz 1.8%, <50 GHz	N (m)
MA2422B	10 MHz - 18 GHz		<1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.10; 0.15 - 2 GHz <1.15; 2 - 12.4 GHz <1.20; 12.4 - 18 GHz <1.25; 18 - 32 GHz <1.30; 32 - 40 GHz <1.40; 40 - 50 GHz			N (m)
MA2423B	10 MHz - 32 GHz					K (m)
MA2424B	10 MHz - 40 GHz					K (m)
MA2425B	10 MHz - 50 GHz					V (m)
High accuracy diode sensors						
MA2442B	10 MHz - 18 GHz	–67 to +20	<1.17; 10 - 150 MHz (MA2442B only) <1.90; 10 - 50 MHz <1.17; 50 - 150 MHz <1.08; 0.15 - 2 GHz <1.16; 2 - 12.4 GHz <1.21; 12.4 - 18 GHz <1.29; 18 - 32 GHz <1.44; 32 - 40 GHz <1.50; 40 - 50 GHz	<0.004	1.8%, <18 GHz 2.5%, <40 GHz 3.5%, <50 GHz	N (m)
MA2444A	10 MHz - 40 GHz					K (m)
MA2445A	10 MHz - 50 GHz					V (m)
Fast diode sensors						
MA2468B*3	10 MHz - 6 GHz	–60 to +20	<1.17; 10 - 150 MHz <1.12; 0.15 - 2 GHz <1.22; 2 - 12.4 GHz <1.25; 12.4 - 18 GHz	<0.0006	1.8%	N (m)
MA2469C*3	10 MHz - 18 GHz					
Universal power sensors						
MA2481B	10 MHz - 6 GHz	–60 to +20	< 1.17; 10 - 150 MHz < 1.12; 0.15 - 2 GHz < 1.22; 2 - 12.4 GHz < 1.25: 12.4 - 18 GHz	<0.004 (with option 1 only)	10 MHz to 6GHz 3% -60 to +20 dBm 6 to 18 GHz 3% -60 to 0 dBm 3.5% 0 to +20 dBm (1.8% CW with option 1)	N (m)
MA2482A	10 MHz - 18 GHz					
MA2480/01	Adds fast CW mode to Universal Power Sensors for high speed measurements of CW signal plus TDMA and pulse measurements.					

*1: 0.0 dBm, room temperature.
*2: Each MA2400A/B series sensor incorporates precision RF connectors with hexagon coupling nut for attachment by industry standard torque wrench.
*3: MA2460B/C Fast Diode Sensors must be used with ML2407/08A Power Meters for NCDMA and Fast Pulse measurements.

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main Frame
ML2437A	Power Meter, single input
ML2438A	Power Meter, dual input
ML2407A	NCDMA Power Meter, single input
ML2408A	NCDMA Power Meter, dual input
	Power meter options
ML2400A-01	Rack Mount, single unit
ML2400A-03	Rack Mount, side-by-side
ML2400A-05	Front Bail Handle
ML2400A-06	Rear Mount Input A on ML2437A/ML2407A
ML2400A-07	Rear Mount Input A and Reference on ML2437A/ML2407A
ML2400A-08	Rear Mount Input A, B and Reference
ML2400A-09	Rear Mount Input B on ML2438A
ML2400A-11	Ni-Mh Battery with desk top charger
ML2400A-11A	Ni-Mh Battery with desk top charger - For use in Japan only
ML2400A-12	Front Panel Cover
ML2400A-20	Extra 1.5 Meter Sensor Cable (P/N D41346-2)
ML2400A-21	0.3 Meter Sensor Cable
ML2400A-22	3 Meter Sensor Cable
ML2400A-23	5 Meter Sensor Cable
ML2400A-24	10 Meter Sensor Cable
ML2400A-25	30 Meter Sensor Cable
ML2400A-26	50 Meter Sensor Cable
ML2400A-27	100 Meter Sensor Cable
ML2400A-28	Bootload cable
ML2400A-29	Bulkhead Adapter
ML2400A-30	Option 30, Extra Operation/Prog manual ML2437/38A
ML2400A-31	Option 31, Extra Operation/Prog manual ML2407/08A
ML2400A-32	Power Meter Maintenance Manual (for ML2430A Series)
ML2400A-33	Option 33, Portable Printer (P/N: 2000-766) 100-240VAC, with interface cable and print cartridge included - Not approved for Japan
ML2400A-98	Calibration to Z540, ISO Guide 25
ML2400A-99	Option 99, Premium Calibration

Options 1 to 5 are mutually exclusive for any given ML2430A unit. Options 6, 7, 8 and 9 above are mutually exclusive for any given ML2430A unit. Options 25, 26, 27 cannot be used with ML2407/8A.

Model/Order No.	Name
	Power meter accessories
760-209	Hardside transit case
D41310	Soft carry case with shoulder strap
10585-00001	Extra operation manual for ML2430A series
10585-00013	Power meter operations manual (for 2400A Sensors)
ML2419A	Power meter, range calibrator
MA2418A	50 MHz Reference Oscillator with power supply
MA2472B	Power Sensor 10 MHz to 18 GHz
MA2473A	Power Sensor 10 MHz to 32 GHz
MA2474A	Power Sensor 10 MHz to 40 GHz
MA2475A	Power Sensor 10 MHz to 50 GHz
MA2421A	Thermal Sensor 0.1 MHz to 18 GHz
MA2422B	Thermal Sensor 10 MHz to 18 GHz
MA2423B	Thermal Sensor 10 MHz to 32 GHz
MA2424B	Thermal Sensor 10 MHz to 40 GHz
MA2425B	Thermal Sensor 10 MHz to 50 GHz
MA2442B	High Accuracy Sensor 10 MHz to 18 GHz
MA2444A	High Accuracy Sensor 10 MHz to 40 GHz
MA2445A	High Accuracy Sensor 10 MHz to 50 GHz
MA2468B	Fast Diode Sensor 10 MHz to 6 GHz
MA2469C	Fast Diode Sensor 10 MHz to 18 GHz
MA2481B	Universal Power Sensor 10 MHz to 6 GHz
MA2482A	Universal Power Sensor 10 MHz to 18 GHz
	Sensor options & accessories
MA2497A	HP Sensor Adaptor
MA2499B	Anritsu Sensor Adaptor
2300-243	LabView driver
MA2418A	50 MHz Reference Oscillator with power supply
ML2419A	Power Meter, range calibrator
MA2499B	Sensor Adapter (10 to 12 pin)
1N75C	5W Limiter, 0.01 to 3 GHz, Nm-f, 75 Ω
1N50C	5W Limiter, 0.01 to 18 GHz, Nm-f, 50 Ω
1K50A	5W Limiter, 0.01 to 20 GHz, Km-f, 50 Ω
1K50B	3W Limiter, 0.01 to 26 GHz, Km-f, 50 Ω
42N75-20	5 Watt attenuator, Nm-f, 75 Ω
42N50-20	5 Watt attenuator, Nm-f, 50 Ω
42N50-30	50 Watt attenuator, Nm-f, 50 Ω

CALIBRATION RECEIVER

ML2530A

100 kHz to 3 GHz

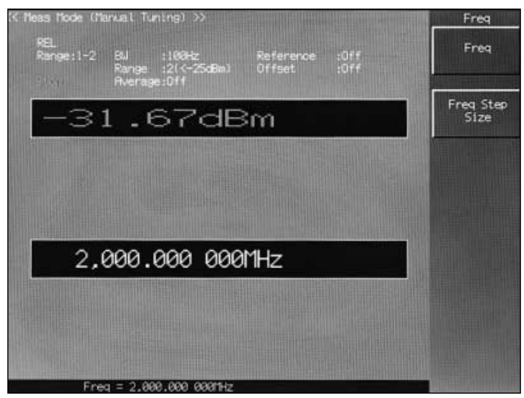
GPIB

Measuring Level while Observing Signals under Test

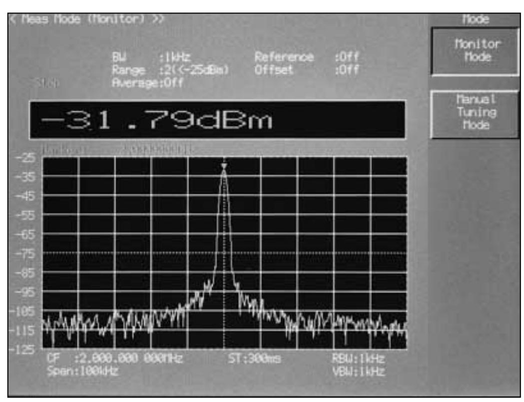
The ML2530A is a receiver for calibrating the output power level of such devices as signal generators and attenuators, covering the range of 100 kHz to 3 GHz. It is suitable for use as a reference level meter for the RF communications bands used by the world's mobile communications markets. High linearity is achieved by using a level detector that uses DSP technology. The level can be measured while observing the signal waveform to be measured by using the spectrum monitor function.

Features

- Wide dynamic range of –140 to +20 dBm and high linearity
- Provides measurement bandwidth of 1 Hz to 100 kHz, so that even signals with large residual FM can be measured using the 1 Hz bandwidth.
- Supports level units



Manual tuning mode



Monitor mode

Specifications

• ML2530A (main frame)

General	Frequency range	0.1 to 3000 MHz
	Level range	–140 to +20 dBm
	RF input connector	Connector: N-J Impedance: 50 Ω VSWR: ≤1.25 (Range 1), ≤1.40 (Range 2), ≤1.50 (Range 3) Max. input level: +20 dBm, 0 Vdc
	CAL output*1	Connector: N-J Impedance: 50 Ω Frequency: 50 MHz ±500 kHz Level: 1.000 mW Level accuracy: ±1.2% (RSS: ±0.9%) Harmonic frequency: ≤–50 dBc
	Reference oscillator	Frequency: 10 MHz Start-up characteristics: ≤±5.1 x 10^{-8}/day (10 minutes after power on, with reference to frequency at 24 hours after power on) Aging rate: ≤±2.1 x 10^{-8}/day, ≤±10.1 x 10^{-8}/year (with reference to frequency at 24 hours after power on) Temperature characteristics: ≤±5.1 x 10^{-8} (with reference to frequency at 25˚C in 0˚ to 50˚C temperature range) Accuracy: ≤±15.1 x 10^{-8} (24 hours after power on, within 6 months of calibration)
	External reference input	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz ±10 Hz Level: 0.5 to 5.0 Vp-p
	Internal reference output	Connector: BNC-J Impedance: 50 Ω Frequency: 10 MHz Frequency accuracy: Same as reference oscillator Level: 2.1 V ±0.6 Vp-p (when 2 m coaxial cable terminated with 50 Ω)
Level measurement	Measurement modes	Manual tuning: Measures level of frequency input directly by ten keys and encoder Monitor: Measures level of frequency specified by marker on spectrum monitor
	Measured frequencies	Range: 100 kHz to 3000 MHz, Resolution: 1 Hz
	Measurement bandwidth	Range: 1 Hz to 100 kHz (1-10 sequence) Filter: Gaussian type Accuracy (3 dB width): ±20% (BW: 1 Hz), ±5% (BW: 10 Hz to 100 kHz)
	Measured level	Range: –140 to +20 dBm Resolution: 0.1, 0.01, 0.001 dB
	Range	Range 1: –35 to +20 dBm, Range 2: –80 to –25 dBm, Range 3: –140 to –70 dBm
	Error*2	Total relative error: In-range linearity + range switching error + noise floor error +1 digit error Total absolute error: Total relative error + CAL output level accuracy + mismatch error at CAL + sensor module calibration factor uncertainty + calibration receiver linearity + sensor module insertion loss reproducibility + mismatch error In-range linearity: ±0.05 dB/55 dB (BW: 1/10/100 Hz, RSS: ±0.03 dB/55 dB) ±0.09 dB/55 dB (BW: 1/10 kHz, RSS: ±0.07 dB/55 dB) ±0.22 dB/55 dB (BW: 100 kHz, RSS: ±0.20 dB/55 dB) *In same range, BW: 100 kHz, frequency: ≥1 MHz Range switching error: ±0.01 dB (at range switch point: –30, –75 dBm) Noise floor (BW: at 100 Hz): ≤–70 dBm (Range 1, ≤11 MHz), ≤–80 dBm (Range 1, >11 MHz), ≤–115 dBm (Range 2, ≤11 MHz), ≤–120 dBm (Range 2, >11 MHz), ≤–125 dBm (Range 3, ≤11 MHz), ≤–135 dBm (Range 3, >11 MHz), Noise floor error: ±0.05 dB (S/N: ≤35 dB), ±0.04 dB (S/N: ≤25 dB), not specified (S/N: ≤10 dB) Frequency drift error: ±0.007 dB (1% of BW frequency drift relative to set signal frequency) BW switching error: ±0.01 dB (BW: 1 Hz to 10 kHz), ±0.05 dB (BW: 1 Hz to 100 kHz, frequency: ≥1 MHz) *Excluding effect of measured signal residual FM
	Average	Measurement times: 1 to 256
	Display units	dBm, dB, dBµ, dBµ (emf) W, mW, µW, pW, fW, aW (automatically chosen best unit for measured value) V, mV, µV, nV, pV (automatically chosen best unit for measured value)
	Display digits	dB units: 0.1, 0.01, 0.001 dB W/V units: 3, 4, 5 digits
	Reference	Set any value: –180 to +60 dBm Meas → Ref: Obtain current measured value
	Offset	Setting range: –100 to +100 dB
	Calibration	Calibration frequency count: 300 Calibration level: 0 dBm +3/–4 dB (relative level calibration at Range 1, using MA2540A) –30 dBm +3/–4 dB (calibration between Range 1 and Range 2) –75 dBm +3/–4 dB (calibration between Range 2 and Range 3)
Spectrum monitor	Center frequency	100 kHz to 3000 MHz, Min. setting resolution: 1 Hz
	Frequency span	10 kHz to 1 MHz, Setting resolution: 1 Hz
	Resolution bandwidth	300 Hz to 100 kHz (1-3 sequence)
	Video bandwidth	10 Hz to 100 kHz (1-3 sequence)
	Sweep time	100 ms to 1000s
	Reference level	Range 1: +20 dBm, Range 2: –25 dBm, Range 3: –70 dBm

Continued on next page

Spectrum monitor	Markers	Functions MKR → PEAK: Moves marker to max. level in monitored range MKR → CNTR: Sets marker frequency to center frequency of monitored range PEAK → CNTR: Sets max. level frequency to center frequency of monitored range Frequency readout level Range 1: ≥–35 dBm, Range 2: ≥–80 dBm, Range 3: ≥–100 dBm Zone marker width: Spot, 1, 5, 10 div.
	Auto-tune	Signal detection frequency range: 30 to 3000 MHz Signal detection level: ≥–30 dBm
Other	Save/recall	Save count: 100
	Panel lock	Function: Disables all key and encoder functions except power switch and panel lock key
	GPIB	Function: Used to control ML2530A as device from controller Interface functions: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E2
	Power	100 to 120 V/200 to 240 V (auto-switching), 47.5 to 63 Hz, ≤120 VA
	Dimensions and mass	426 (W) x 221.5 (H) x 451 (D) mm, ≤17.9 kg
	Environmental conditions	Operating temperature range: 0˚ to +50˚C Storage temperature range: –20˚ to +60˚C
	EMC	EN61326: 1997/A2: 2001 (Class A) EN61000-3-2: 2000 (Class A) EN61326: 1997/A2: 2001 (Annex A)
	LVD	EN61010-1: 2001 (Pollution Degree 2)

∗1: At constant temperature in operating range of +15˚ to +35˚C
∗2: At fixed temperature in ambient temperature range of +15˚ to +35˚C, and level calibration after 1 hour warm-up

MA2540A Sensor Module

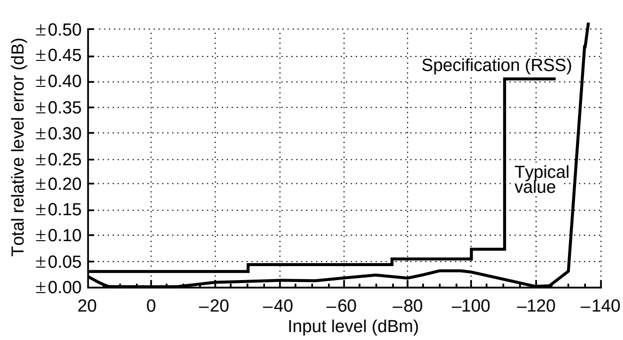
Frequency range	100 kHz to 3000 MHz
Level	Level range: –140 to +20 dBm, Max. input level: +20 dBm
RF input connector	Type: N-J Nominal impedance: 50 Ω VSWR (power sensor side): ≤1.30 (100 to 300 kHz), ≤1.20 (0.3 to 1 MHz), ≤1.36 (1 to 3000 MHz) VSWR (through side): ≤1.12 (0.1 to 100 MHz), ≤1.35 (100 to 3000 MHz)
RF output connector	Type: N-J, Nominal impedance: 50 Ω
RF input/output characteristics	Through side insertion loss: ≤0.7 dB Through side insertion loss reproducibility: ±0.006 dB
Dimensions and mass	63 (W) x 54 (H) x 206 (D) mm, ≤1 kg
Environmental conditions	Same as the ML2530A

Sensor module calibration factor uncertainty

Frequency	Simple total	RSS total
0.1 MHz	±3.0%	±1.4%
10 MHz	±2.4%	±1.1%
100 MHz	±2.4%	±1.1%
1000 MHz	±3.0%	±1.4%
2000 MHz	±3.0%	±1.4%
3000 MHz	±3.2%	±1.5%

Total level error

The total level error is the total of each error source. For example, the total relative level error at a frequency of 1 GHz and a BW of 100 Hz is as shown below.



The absolute level error for a measured signal at a frequency of 1 GHz, measurement bandwidth of 100 Hz, device under test VSWR of 1.5, and signal level of –100 dBm is as follows.

Source of uncertainty	NIST traceable uncertainty
Relative level error at –100 dBm	1.6% (±0.07 dB)
CAL output level error	±0.93%
Mismatch error at calibration	±0.23%
Sensor module calibration factor error at measured frequency	±1.4%
Linearity error of the ML2530A power measurement section	±1.0%
Sensor module relay repeatability	±0.14% (±0.006 dB)
DUT mismatch error sensor module + calibration receiver VSWR: 1.2 (typ.)	±3.7%
Total (RSS)	±4.5 (±0.19 dB)

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name	
	Main frame	
ML2530A	Calibration Receiver	
	Standard accessories	
	Power cord, 2.6m:	1 pc
F0012	Fuse, 3.15A:	2 pcs
W1492AE	ML2530A operation manual:	1 copy
	Optional accessories	
MP721A	Fixed attenuator (3 dB, 2W)	
MP721B	Fixed attenuator (6 dB, 2W)	
MP721C	Fixed attenuator (10 dB, 2W)	
MP721D	Fixed attenuator (20 dB, 2W)	
MP721E	Fixed attenuator (30 dB, 2W)	
MP721F	Fixed attenuator (40 dB, 2W)	
MP721G	Fixed attenuator (50 dB, 2W)	
MP721H	Fixed attenuator (60 dB, 2W)	
J0078	High power fixed attenuator (20 dB, 10W)	
J0063	High power fixed attenuator (30 dB, 10W)	
J0395	High power fixed attenuator (30 dB, 30W)	
J0007	GPIB cable, 1m	
J0008	GPIB cable, 2m	
J0431F	Coaxial cable (BNC-P · RG55A/U · BNC-P), 1m	
J0431G	Coaxial cable (BNC-P · RG55A/U · BNC-P), 2m	
J0903A	Coaxial cable (NP · RG-142B/U · N-P), 1.5m	
J0904A	Sensor module cable, 1.5 m (for MA2540A control)	
B0333D	Rack mount kit	
B0329D	Front cover	
B0331D	Front handle (2 pcs/set)	
B0332	Joint plate (4 pcs/set)	
B0334D	Carrying case (hard type, with protective cover and casters)	
	Peripheral instruments	
MG3633A	Synthesized Signal Generator (10 kHz to 2700 MHz)	
	Sensor module	
MA2540A	Sensor Module	
	Standard accessories	
J0903A	Coaxial cable (N-P · RG-142B/U · N-P), 1.5 m:	1 pc
J0904A	Sensor module cable, 1.5 m (for MA2540A control):	1 pc
W1491AE	MA2540A operation manual:	1 copy

ELECTRONIC VOLTMETER
ML69B
10 kHz to 1000 MHz

Popular High-Frequency Voltmeter

Custom-made product

The ML69B is a high-sensitivity, high-frequency electronic voltmeter using semiconductor diodes and a high-sensitivity chopper amplifier. It can measure high-frequency voltages ranging from 10 kHz to 1000 MHz with a full-scale sensitivity of 1 mV. It has a pen-type Probe MA61B, which can measure at high impedance with minimal effect on the device under test.

Features
- High input impedance
- Easy measuring operation
- Multipurpose usage with accessories
- DC output

INTERFERENCE/FIELD STRENGTH METER
ML428B
9 kHz to 30 MHz

For Measuring Noise Field Strength (in Conformance with CISPR Specifications)

GPIB

The ML428B not only enables measurement of the field strength of general broadcasts and radio communications, but it can also perform measurements of interference waves in accordance with CISPR, VDE, FCC, or other specifications. The ML428B possesses a local synthesizer and high-precision sine-wave comparison oscillator to obtain data with excellent repeatability. In addition, the built-in microprocessor allows level calibrations and attenuator operation to be automatically performed to enable direct reading of the field strength and efficient measurement.

Features
- Correct interference measurement can be performed in accordance with CISPR specifications.
- The use of a frequency synthesizer in the local oscillator enables a high degree of frequency stability to be gained.
- Allows direct reading of the field strength.
- Up to a maximum of any 100 frequencies can be stored.
- Prompt measurement is possible through use of the auto-range function.
- Direct readout of field strength is possible arbitrarily for conventional antenna by memorizing its coefficient via GPIB.
- Convenient outdoor operation through the use of a DC power source.

RESISTANCE ATTENUATOR
MN510C/D
DC to 500 MHz

Custom-made product

MN510D

These are variable resistance attenuators for measurement of 50 Ω (MN510C) and 75 Ω (MN510D) impedance systems. Each of these attenuators has a wide frequency range and is highly accurate, compact, lightweight with good articulation, and easy to handle. Moreover, comparison measurement can be made far more smoothly when used in conjunction with a key box.

PROGRAMMABLE ATTENUATOR

MN63A, MN65A, MN72A, MN64B

DC to 2 GHz DC to 6 GHz DC to 18 GHz DC to 1 GHz

For Configuring Automated Measurement Systems

MN63A

GPIB

The MN63A/65A/72A/64B provide GPIB as a standard feature and are suitable for automatic measuring system components used in R&D, inspection, or production. The 50 Ω models are available in three different frequency ranges, which can be selected to match the application for maximum economy. The attenuation calibration value is stored in the internal memory and can be uploaded to the system controller for checking against measured values, permitting a significant increase in system accuracy. A relative setting function is also provided, which allows measurement to be referenced to any arbitrary level. Rotary encoders are standard, allowing simple, smooth setting under manual control.

Features

- Wide frequency range
- High accuracy
- Long operating life
- High-speed switching
- Readout of attenuation calibration via GPIB
- Relative attenuation display function
- Rotary encoders for smooth manual setting

PRE-AMPLIFIER

MH648A

100 kHz to 1200 MHz

For Amplifying Low-Level Signals

The MH648A is a pre-amplifier for improving sensitivity in spectrum analyzers, field strength meters, frequency counters, etc.

10

EMI PROBE

MA2601B/C

The MA2601B/C is a compact loop antenna to use with a spectrum analyzer or a field strength meter for EMI measurement. The combination is used to locate noise sources and to compare relative noise source levels.

Features

- Exact detection of magnetic field components (because MA2601B/C is electrostatically shielded)
- Approximately flat magnetic-field detection characteristics in the range from 100 to 1000 MHz (MA2601B)

Applications

- Sensing magnetic fields when it is connected to a spectrum analyzer, etc.
- Noise immunity testing of electronic components or electrostatic shield-effect testing with using a signal generator

EMI PROBE KIT
MA8611A

In addition to the MA8610A Pre-amplifier that can be directly mounted on the input connector of the MS610C and MS2601B Spectrum Analyzers, this kit also includes MA2601B/C EMI Probes and connecting cables.

Specifications (MA8610A Pre-amplifier)

Frequency range	9 kHz to 2.2 GHz, 50 Ω
Gain	20 dB
Frequency response	±0.5 dB (20 kHz to 1 GHz)
Noise figure	6 dB typ. (≤1 GHz)

DIPOLE ANTENNA
MP534A/B, MP651A/B, MP663A
25 to 520 MHz 470 to 1700 MHz 300 to 1000 MHz

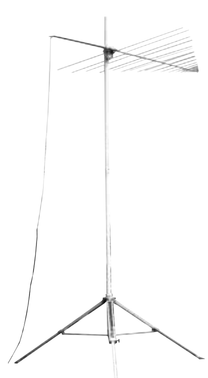
*Tripod sold separately

MP534A

MP663A

Those half-wavelength dipole antennas are reference antennas, but the element length must be adjusted for each frequency to be measured.

LOG-PERIODIC ANTENNA
MP635A, MP666A
80 to 1000 MHz 200 to 2000 MHz



The gain remains roughly constant over a wide range so the element length does not require adjustment. Compared with dipole antennas, these antennas have a gain of 5 dB.

Specifications

Model	MP635A	MP666A
Frequency range	80 to 1000 MHz	200 to 2000 MHz
Input impedance	50 Ω (connector: N-type)	
VSWR	≤2.5	
Average relative again	5 dB	
Maximum input power	10 W	
Front-to-back ratio	≥15 dB	
Dimensions and mass	200 x 200 x 1750 mm, ≤7 kg	Φ140 x 900 mm, ≤5 kg

LOOP ANTENNA, ROD ANTENNA
MP414B, MP415B

MP414B MP415B

The MP414B/415B can be used with the ML428B Interference Field Strength Meter.

MICROWAVE REPEATER CHECKER
MS75B

For Maintaining Microwave Repeaters

The Microwave Repeater Checker (MRC) is an integrated microwave measuring instrument packed in a handy carrying case. It consists of three devices most frequently used for the maintenance of microwave communications systems: a power meter (10 MHz to 14 GHz) and frequency counter (10 Hz to 18 GHz) are standard accessories, and a signal generator is sold separately. The signal generator can be changed according to the frequency band to be measured. There are two difference generators available for the frequency range 6.3 to 7.8 GHz and 12 to 13 GHz.

Features
- Maintains and adjusts microwave line repeaters
- All parts and accessories are contained in the carrying case so the measurement procedure is less time-consuming.
- When removed from the carrying case, the power meter can be mounted independently in a specially designed case (optional accessory). It can run on either batteries or AC line power when used separately.

10

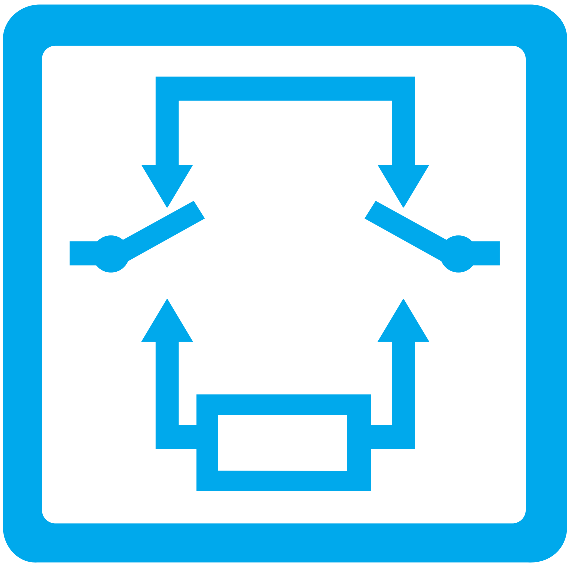
SIGNAL GENERATOR
MG724E1/G1
6.3 to 7.8 GHz (MG724E1), 12 to 13 GHz (MG724G1)

For Maintaining and Adjusting Microwave Links

Custom-made product

The MG724E1/G1 are a compact lightweight microwave signal generator, designed for medium – and small – capacity microwave line repeater maintenance or adjustment. The instrument is best suited to measure AGC characteristics, squelch function, and signal-to-noise ratio. Its high signal purity and frequency stability also enable it to be used as a general-purpose signal source for microwave receiver adjustment on a production line.

Features
- High signal purity
- High frequency stability
- Wide output level range
- Low price
- Small and lightweight



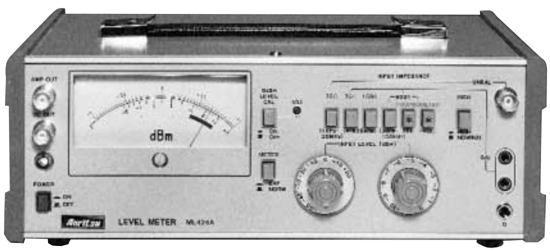
ANALOG TRANSMISSION CHARACTERISTICS MEASURING INSTRUMENTS

LEVEL METER

ML424A, ML424B

10 Hz to 20 MHz **10 Hz to 30 MHz**

For Constructing and Maintaining FDM Communication Lines



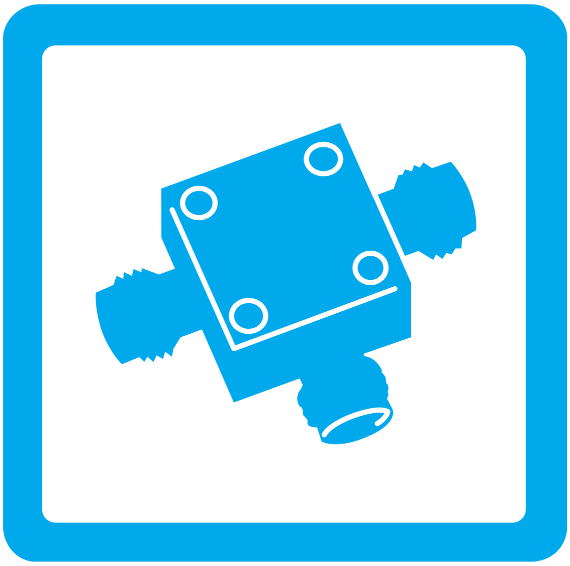
Custom-made product

The ML424A/B is a compactly designed level-meter of high level-measuring accuracy with a calibration signal internally provided. It is also capable of measuring noise levels in conformity with the ITU-T Recommendations with the necessary psophometer option.

Features

- Excellent frequency response of ±0.1 dB over the range from 100 Hz to 13 MHz
- High measuring accuracy of ±0.2 dB including the frequency response, attenuator step accuracy, and temperature stability
- A psophometer option can be incorporated (option 01) for measuring noise levels of telephone and sound program circuits. The characteristics of the weighting filters conform to the ITU-T Recommendations P.53 and J.16.
- The ML424B provides true RMS detection

11



COMPONENTS

FIXED ATTENUATOR FOR HIGH POWER MEASUREMENT

Order No.	Attenuation	Frequency range	Remarks
J0063	30 dB	DC to 12.4 GHz	N-type connector, permissible max. power 10W (+40 dBm), 50 Ω
J0078	20 dB	DC to 18 GHz	
J0395	30 dB	DC to 9 GHz	N-type connector, permissible max. power 30W (+44.7 dBm), 50 Ω
B0472	30 dB	DC to 18 GHz	N-type connector, permissible max. power 100W (+50 dBm), 50 Ω

50 Ω ↔ 75 Ω IMPEDANCE TRANSFORMER

MP614B, MB-009

50 to 1200 MHz DC to 2 GHz

The MP614B is used over the range from 50 to 1200 MHz mainly for changing the impedance of a measuring signal source such as a signal generator. It is a transformer type, so that it has a smaller loss than a resistance attenuator type, and does not lower the signal source level. When the output level of a signal generator is shown in a power unit as in dBm, the output level after impedance transforming by the MP614B will have a value which is obtained by subtracting the insertion loss (dB) of the impedance transformer from the output level of the signal generator.
The MB-009 is constructed so that the central connector will not be damaged if a 50 Ω N-type plug is connected by mistake to the 75 Ω side.

CM DIRECTIONAL COUPLER

MP520 series

25 to 1700 MHz

MP520A

This coupler is used in the measurement of fundamental frequency power and spurious power which supplies coaxial feeders in VHF and UHF bands. Various models are provided in accordance with feeder impedance and frequency. It is also capable of measuring the VSWR of antenna systems.

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DIRECTIONAL COUPLER
MP654A, MP655A
0.8 to 3 GHz **3.0 to 4.4 GHz**

MP654A MP655A

The MP654A and MP655A are used to branch one part of the transmitted output for such measurements as those of fundamental wave and higher harmonic spurious characteristics using a spectrum analyzer. The MP654A is used for measuring personal radio transceivers and automobile telephones while the MP655A is used for measuring microwave band ratio equipment.

Specifications

Model	MP654A	MP655A
Frequency range	0.8 to 3 GHz	3 to 4.4 GHz
Impedance	50 Ω (N connector)	
Coupling	Approx. 30 dB*	
Input power (max.)	50W	

* Calibration data reattached

T-PAD
Z-164A, Z-164B
DC to 1 GHz **DC to 200 MHz**

Z-164A

The Z-164A/B is used as a matching pad for applying the mixed output of two signal generators to the input terminal of a receiver for measuring two-signal characteristics (such as the blocking and intermodulation characteristic) of the receiver.

Specifications

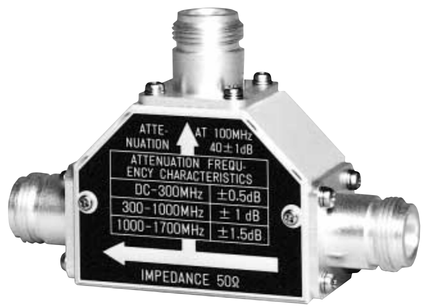
Model	Z-164A	Z-164B
Frequency range	0 to 1000 MHz	0 to 200 MHz
Insertion loss	6±0.5 dB (voltage ratio)	
Impedance characteristics	50 Ω VSWR: ≤1.3 (up to 500 MHz) ≤1.5 (≥500 MHz)	75 Ω VSWR: ≤1.2 (up to 200 MHz)
Connector	N (S)-J	M-J
Operating temperature	0° to 45°C	

Note: The maximum allowable power is 0.5 W

FOUR-PORT JUNCTION PAD
MP659A, MA1612A
40 MHz to 1 GHz **5 MHz to 3 GHz**

The MP659A and MA1612A are used as an impedance matching box applying the mixed output of three RF signal generators to a receiver input terminal for measurement of three-signal characteristics (such as receiver SINAD performance).

BRANCH
MP640A
DC to 1700 MHz



The MP640A is used for branching a part of the transmitted signal in measuring the spurious characteristics of a transmitter with a field strength meter or a spectrum analyzer. Its frequency characteristics of attenuation is flat over DC to 1700 MHz, so that it can be conveniently utilized for measurement without taking the frequency characteristic into consideration. The maximum allowable input power is 16W.

HIGH-PASS FILTER
MP526 series
27/60/150/250/400 MHz bands

The MP526 series is for measuring the spurious characteristics with a field strength meter or a spectrum analyzer. Eliminating the fundamental signal by using a filter prevents the internal spurious of the field strength meter or spectrum analyzer due to an excessive input to facilitate measurement. A, B, C, D, and G are available to suit the five different frequency bands. The maximum allowable input level is +10 dBm.

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BAND PASS FILTER
MA2512A
1.92 to 2.17 GHz

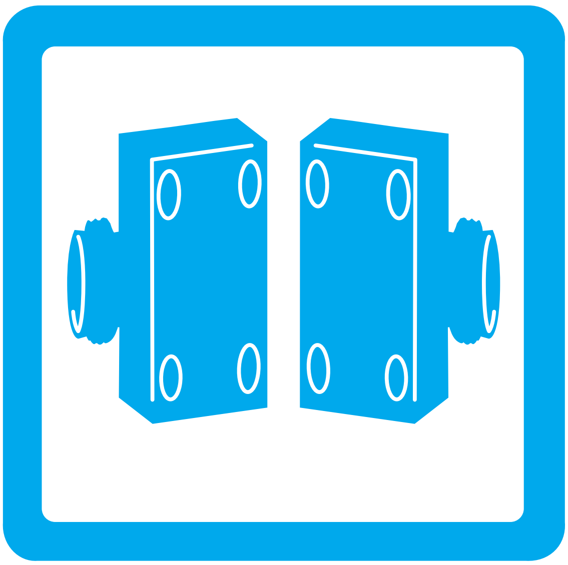
When the signal generator outputs an IMT-2000 test signal, sometimes spurious signals generated by the circuits in the signal generator are an obstacle for tests. In this case, connect the MA2512A to filter these unwanted signals. The MA2512A has excellent amplitude ripple and group delay characteristics in the frequency band of IMT-2000, because the MA2512A does not degrade modulation accuracy of the signal generator.

Specifications

Pass band	Frequency range: 1.92 to 2.17 GHz Insertion loss: ≤3.5 dB Ripple: ≤0.2 dB (at 5 MHz bandwidth) Group delay: ≤1 ns (at 5 MHz bandwidth) Impedance: 50 Ω Return loss: ≥15 dB
Filter band	Frequency range: DC to 1.5 GHz, 2.58 to 7 GHz Attenuation: ≥20 dB (<5 GHz), ≥10 dB (≥5 GHz)
I/O connector	N-J
Max. input power	1 W
Dimensions and mass	148 x 35 x 31 mm, ≤500g

Ordering information
Please specify model/order number, name and quantity when ordering.

Model/Order No.	Name	
	Main frame	
MA2512A	Band Pass Filter	
	Standard accessory	
W1876AE	MA2512A Operation Manual:	1 copy
	Peripherals	
MG3681A	Digital Modulation Signal Generator	



MICROWAVE COMPONENTS

OUTLINE OF MICROWAVE COMPONENTS

Precision Components-Precision Measurements

Anritsu is a leader in the design and production of precision microwave components.

- Precision Coaxial Connector Systems to 65 GHz
- Precision Coaxial and Waveguide to Coax Adapters
- High Directivity SWR Autotesters and Bridges
- RF Detectors
- Precision Terminations and Air lines
- Precision Fixed Attenuators
- Precision Step Attenuators
- Precision Power Dividers and Splitters
- Precision Bias Tees
- Broadband Microwave Limiters

Connector Design Leadership

Anritsu is the leader in high frequency microwave connector technology and is driven by an ongoing commitment to exceed customer needs. Anritsu created and trademarked the K Connector® with coverage to 40 GHz, along with a complete family of 40 GHz test equipment. It was an immediate success and today is used on many commercial components, test fixtures, and military systems.

The V Connector® offers coaxial coverage to 65 GHz and uses a 1.85 mm geometry endorsed by the International Electrotechnical Commission (IEC). It mates with commercially available 2.4 mm connectors.

Anritsu continues its leadership role with the introduction of the Integrated V Connector, which combines compatibility with V Connectors with easy installation and consistent excellent performance.

The VP™ Connector delivers push-on simplicity with excellent performance to 65 GHz.

A recent introduction to Anritsu's connector line is the W1 Connector, which gives mode-free performance to 110 GHz and is based on IEEE Std 287.

Coaxial and Waveguide to Coax Adapters

A series of precision measurement adapters are available to adapt one connector type to another. Poor adapter VSWR (or poor return loss) can be a major source of measurement error and, therefore, adapters must be carefully selected. Anritsu precision adapters typically have 6-12 dB better return loss than competitive units. Waveguide-to-Coax Adapters are available to 65 GHz.

Precision Terminations and Air Lines

Anritsu is recognized as the leader in the field of impedance standards. Anritsu air lines and terminations are unsurpassed for accuracy and impedance matching. Not only do these products increase measurement accuracy, they also provide the only method of certifying the performance of SWR Autotesters, bridges, directional couplers, and other devices.

Precision Fixed Attenuators

Anritsu attenuators offer superior performance in a low cost package. The low VSWR (excellent return loss) minimizes signal reflections and simultaneously reduces ripple effects in the output frequency response. This assures flat, consistent attenuation characteristics regardless of other devices reflection characteristics. One of the simplest ways to improve impedance match is to insert a precision attenuator between the device under test and the source or RF detector. The 41K and 41V Series attenuators are specifically designed for such applications where accuracy is a basic requirement.

In addition to being available as individual units of 3, 6, 10, or 20 dB, the 41K and 41V Series Fixed Attenuators are also available in sets with certified calibration data. Available frequency ranges cover DC to 26.5 GHz, 40 GHz, or 60 GHz.
Many other attenuator applications have as their principal objective the reduction of power. Since the attenuator might not be inserted at a measurement point, the measurement precision discussed earlier is not required. In such a power-reducing system application, attenuators are often required in large quantities, making price an important consideration. The 43K Series includes models covering DC to 26.5 GHz, and DC to 40 GHz. All are available with 3, 6, 10, or 20 dB attenuation values. All have the Anritsu K Connectors and are compatible with SMA connectors.
Whatever your fixed attenuator needs might be, Anritsu provides the solution.

Precision Step Attenuators
Anritsu offers low loss, high precision step attenuators. These programmable step attenuators are available with 10 dB steps from 0 to 70 dB or 0 to 110 dB ranges. DC to 40 GHz frequency range ensures the broadest attenuation and frequency coverage available. Contact Anritsu for needs above 40 GHz.

Precision Power Dividers and Splitters
Anritsu produces precision V Connector® dividers and splitters to 60 GHz and precision K Connector® dividers and splitters to 40 GHz.
All Anritsu power dividers are 3-resistor symmetrical designs with excellent amplitude and phase tracking. Anritsu power splitters are 2-resistor designs, used to accurately split signals for ratio measurements.

Precision Bias Tees
Anritsu Bias Tees are used to combine DC and RF for active device measurements. Low RF throughline loss and low SWR ensure negligible effect on measurements from 50 kHz to 60 GHz.

Broadband Microwave Limiters
Anritsu broadband microwave limiters provide the widest frequency range available in a limiter. Designed to protect sensitive microwave equipment, these limiters incorporate unique single-side limiting to provide soft limiting characteristics over 10 MHz to 26.5 GHz.

High Directivity SWR Autotesters and Bridges
SWR Autotesters and SWR Bridges are directional measurement devices that separate the incident and the reflected signals of a device under test. The reflected component can then be compared to the incident signal to determine the difference between the device's impedance and its characteristic impedance.
An SWR bridge has a precision termination inside the bridge, eliminating the need for an external reference. An autotester further simplifies the user interface by incorporating a detector into the RF output that provides a DC output proportional to the DUT mismatch.
The directivity of the SWR Autotester or bridge is the measure of how well the incident and reflected signals can be separated. For example, 40 dB directivity means that the error signal in the output is 40 dB below the reflected signal to be measured.
Anritsu's high directivity bridges and autotesters set the standards for reflection measurements. High directivity translates to accurate measurements. Anritsu high directivity bridges are available for GPC-7, 50Ω and 75Ω Type N. High directivity autotesters are available with GPC-7, Type N, and SMA, 3.5, K Connectors®, and V Connectors®.

RF Detectors
Just as directivity is the principal error contributor in reflection measurements, the impedance match of the signal source and RF detector is a significant error contributor in transmission measurements.
Anritsu offers a complete line of coaxial RF detectors covering from 100 kHz to 50 GHz with the lowest SWR available. The excellent impedance match of the detectors, along with that of the test port on the SWR Autotesters and bridges, minimize errors when making simultaneous transmission and measurements.

Calibration and Verification Kits
Anritsu offers calibration kits which contain all the precision components and tools required to calibrate an Anritsu VNA in a connector style of your choice.

Specials
Anritsu also manufactures assemblies and components to meet specific customer requirements in both coaxial and waveguide structures. These include such components as Connectors, Bias Tee, Step Attenuator, Detector, Power Sensors, Waveguide, Coaxial Adapters, and RF Cables.
When requesting quotations on special assemblies, as a minimum please provide: frequency range, electrical characteristics, mechanical details and outline dimensions if any.

For a full catalog of Anritsu components, visit www.us.anritsu.com.

PERIPHERAL EQUIPMENT

PORTABLE TEST RACK
MB23A, MB24A

MB23A MB24A

The MB23A and MB24A can be folded so they can be transported easily and used in places with space limitations. Metal fittings to accommodate both current and new cabinet designs are included.

MB23A

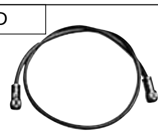
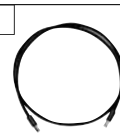
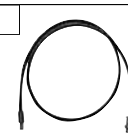
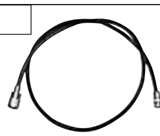
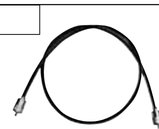
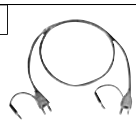
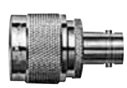
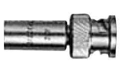
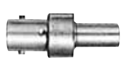
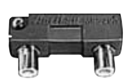
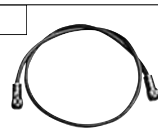
- By easy operation of the lever, the table can be inclined at five different angles for optimum instrument viewing ease.
- Thanks to Anritsu's exclusive construction, just a light touch of the lever is all it takes to move the angle safely up to 45˚.

MB24A

- The table is fixed in a horizontal position.
- Since the rack can support up to 80 kg, several instruments may be stacked.

COAXIAL CORDS, ADAPTERS

	Impedance	Figure No.	Name			Order No.
			Item	Composition (connector · cable · connector)	Length	
Connecting cords	50 Ω	1	Coaxial cord	N-P · 5D-2W · N-P	1m 2m	J0576B J0576D
		30	Coaxial cord	S-5DWP · 5D-2W · S-5DWP	1m 2m	J0025A J0025C
		2	Coaxial cord	3CA-P2 · TG-58A/U · 3CA-P2	1m 2m	J0133A J0133C
		3	Clip conversion pad	N-J · Clip		J0047
		4	Coaxial cord	3CA-P2 · TG-58A/U · Alligator clip	1m	J0054A
	75 Ω	5	Coaxial cord	3CV-P2 · 3C-2V · 3CV-P2	1m 2m	J0026A J0081
		6	Coaxial cord	SP-3CP · 3C-2WS · SP-3CP	1m 2m	J0028A J0028B
		7	Coaxial cord	SP-3CP · 3C-2WS · 3CW-P	1m 2m	J0029A J0029B
		8	Coaxial cord	P-5CP · 5C-2W · P-5CP	1m 2m	J0030A J0030B
		9	Coaxial cord	M-P-3 · 3C-2V · 3CV-P2	1m 2m	J0027A J0027B
		10	Coaxial cord	M-P-5 · 5C-2V · M-P-5	1m 2m	J0031A J0031B
	(balanced)	11	Balanced cord	I-214APS · C1UUS shielded connecting cord · I-214APS	1m 2m	J0032 J0033
		12	Balanced cord	M-214S · Shielded connecting cord · M-214S	1m	J0050A
		13	CS1-MM2 shielded connecting cord		2m	J0034
Conversion connectors	50 Ω	14	Coaxial adapter	N-P · N-P	–	J0038
		15	Coaxial adapter	N-J · N-J	–	J0039
		16	Coaxial adapter	N-P · BNC-J	–	J0040
		17	Coaxial adapter	N-J · BNC-J	–	J0044
		18	Coaxial adapter	N-J · BNC-P	–	J0043
	–	19	Coaxial adapter	N-P · M-J		J0041
		20	Coaxial adapter	N-J · M-P	–	J0042
	75 Ω	21	Coaxial adapter	NC-P · SP-3CJ	–	J0046
		22	Coaxial adapter	NC-P · BNC-J	–	J0055
		23	Coaxial adapter	BNC-P · M-J	–	J0045
		24	Coaxial adapter	SP-3CJ · 3C-P (BNC-P)	–	J0053
		25	Coaxial adapter	SP-3CP · 3C-J (BNC-J)	–	J0052
U-link	75 Ω	26	MP529A U-Link		–	–
Coaxial T-connectors	50 Ω	27	Coaxial T-connector	S (N)-type	–	J0048
	70 Ω	28	Coaxial T-connector	M-type	–	J0049

Order Number Item/Composition	J0576B/D 1  Coaxial cord 1 m/2 m N-P · 5D-2W · N-P	J0133A/C 2  Coaxial cord 1 m/2 m 3CA-P2 · RG-58A/U · 3CA-P2	J0047 3  Clip conversion pad, N-J · clip
J0054A 4  Coaxial cord 1 m 3CA-P2 · RG-58A/U · Alligator clip	J0026A J0081 5  Coaxial cord 1 m/2 m 3CV-P2 · 3C-2V · 3CV-P2	J0028A/B 6  Coaxial cord 1 m/2 m SP-3CP · 3C-2WS · SP-3CP	J0029A/B 7  Coaxial cord 1 m/2 m SP-3CP · 3C-2WS · 3CW-P
J0030A/B 8  Coaxial cord 1 m/2 m P-5CP · 5C-2W · P-5CP	J0027A/B 9  Coaxial cord 1 m/2 m M-P-3 · 3C-2V · 3CV-P2	J0031A/B 10  Coaxial cord 1 m/2 m M-P-5 · 5C-2V · M-P-5	J0032 J0033 11  Balanced cord 1 m/2 m I-214APS · C1UUS shielded connecting cord · I-214APS
J0050A 12  Balanced cord 1 m, M-214S · shielded connecting cord · M-214S (compatible with I-214APS)	J0034 13  CS1-MM2 shielded connecting cord, 2 m	J0038 14  Coaxial adapter N-P · N-P	J0039 15  Coaxial adapter N-J · N-J
J0040 16  Coaxial adapter N-P · BNC-P	J0044 17  Coaxial adapter N-J · BNC-J	J0043 18  Coaxial adapter N-J · BNC-P	J0041 19  Coaxial adapter N-P · M-J
J0042 20  Coaxial adapter N-J · M-P	J0046 21  Coaxial adapter NC-P · SP-3CJ	J0055 22  Coaxial adapter NC-P · BNC-J	J0045 23  Coaxial adapter BNC-P · M-J
J0053 24  Coaxial adapter SP-3CJ · 3C-P (BNC-P)	J0052 25  Coaxial adapter SP-3CP · 3C-J (BNC-J)	– 26  MP529A U-Link	J0048 27  Coaxial T-connector, 50 Ω, S (N) type
J0049 28  Coaxial T-connector, 75 Ω, M type	J0025A/C 29  Coaxial cord 1 m/2 m S-5DWP · 5D-2W · S-5DWP		

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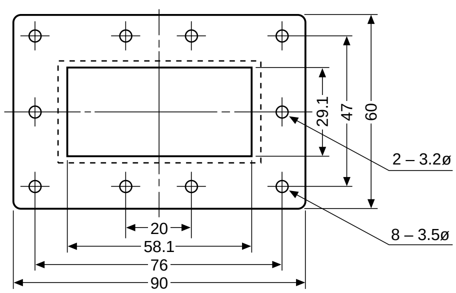
List of principal coaxial cables

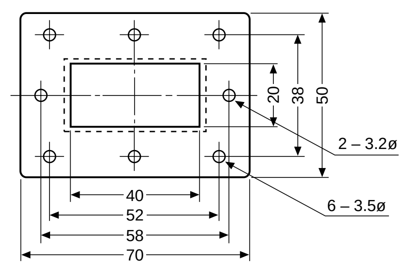
Coaxial cable	Characteristic impedance	Nominal attenuation (10 MHz)	Nominal capacitance	Finished diameter	Mass (g/m)	Suitable connector	Remarks
3C-2V	75 ±3 Ω (10 MHz)	0.042 dB/m	67 pF/m	5.8 mm	48	3C connector	Single outer conductor, PVC covered
3C-2W				6.5 mm	75		Double outer conductor, PVC covered
3C-2Z				3.8 mm	28	3C connector	Single outer conductor, No PVC covered
3C-2T		(0.013 dB/m, 1 MHz)		7.4 mm	110		Triple outer conductor, PVC covered
3C-2WS	75 ±1 Ω (10 MHz)	0.048 dB/m		6.6 mm	76	SP connector	Double outer conductor, PVC covered
5C-2V	75 ±3 Ω (10 MHz)	0.027 dB/m		7.8 mm	75	5A connector plug for 1 V type, connector for 1 V type	Single outer conductor, PVC covered
5C-2W				8.5 mm	110		Double outer conductor, PVC covered
5C-2Z				5.8 mm	48		Single outer conductor, No PVC covered
3D-2W	50 ±2 Ω (10 MHz)	0.047 dB/m	100 pF/m	6.4 mm	75		Double outer conductor, PVC covered
5D-2V		0.031 dB/m		7.5 mm	85	S connector	Single outer conductor, PVC covered
5D-2W				8.2 mm	120		Double outer conductor, PVC covered
RG-55/U	53.5 ±2.5 Ω (4 MHz)	0.0328 dBm	93.5 pF/m	5.25 mm	55	BNC	Double outer conductor, PE covered
RG-58/U				4.95 mm	50	BNC, N	Single outer conductor, PVC covered
RG-58A/U	50 ±2 Ω (10 MHz)	0.0427 dB/m					

Dimensions of waveguide flanges

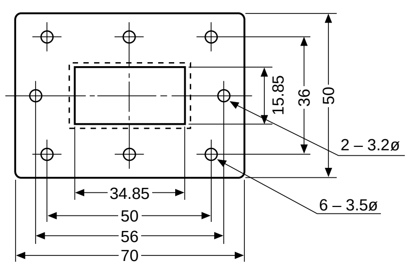
BRJ-4 (3.30 to 4.90 GHz)



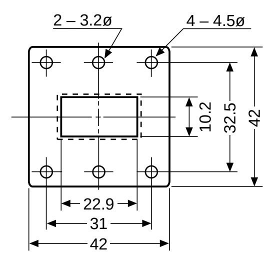
BRJ-6 (4.90 to 7.05 GHz)



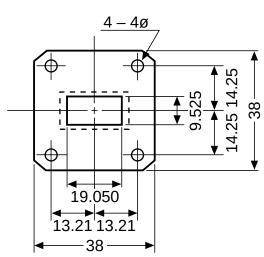
BRJ-7 (5.85 to 8.20 GHz)



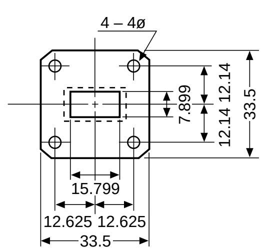
BRJ-10 (8.20 to 12.40 GHz)



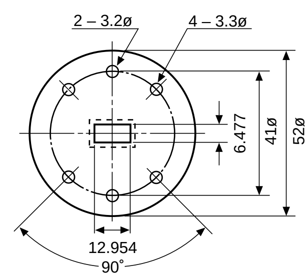
BRJ-120 (9.84 to 15.0 GHz)



BRJ-140 (11.9 to 18.0 GHz)



BRJ-18 (14.5 to 22.0 GHz)

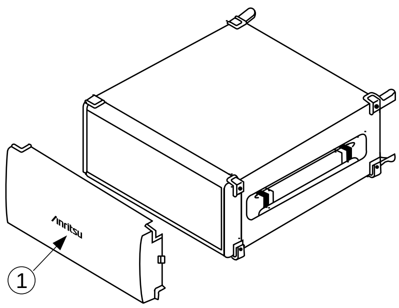


(Unit: mm)

ACCESSORIES FOR F-SERIES CABINETS

Anritsu's F-series cabinet was designed using basic dimensions that conform to EIA and IEC racking specifications, permitting compatible equipment to be easily stacked up to form a system, or to be mounted on the EIA/IEC standard rack.
The accessories of the F-series cabinet are easy to mount and use, and blend with the design of the cabinet. The F-series can be identified by its green feet.

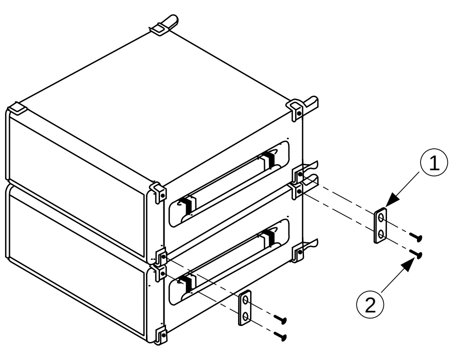
• Protective cover
Protects front of cabinet



No.	Description	Quantity
①	Protective cover	1

Item	Order No.
Protective cover 1MW2U	B0329A
Protective cover 1MW3U	B0329B
Protective cover 1MW4U	B0329C
Protective cover 1MW5U	B0329D
Protective cover 3/4MW3U	B0329F
Protective cover 3/4MW4U	B0329G
Protective cover 2/3MW4U	B0329K
Protective cover 1/2MW2U	B0329L

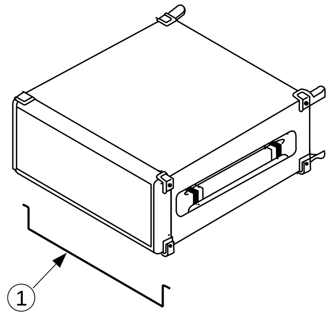
• Coupler
To mount two or more F-series cabinets in a stack



No.	Description	Quantity
①	Coupler	4
②	Screw	8

Item	Order No.
Coupler	B0332

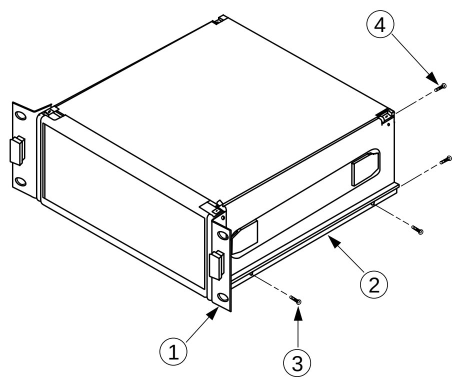
• Tilt stand
Allows cabinet to be used at an angle



No.	Description	Quantity
①	–	1

Item	Order No.
Tilt stand 1MW450D	B0330A
Tilt stand 3/4MW450D	B0330B
Tilt stand 3/4MW350D	B0330C
Tilt stand 2/3MW350D	B0330D

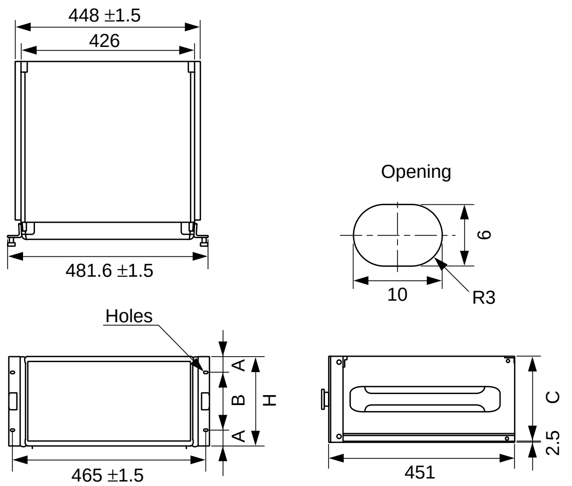
• Rack mount kit
The rack mount accessory is for use with 1MW450D cabinet.
For EIA/IEC standard rack



No.	Description	Quantity
①	Rack flange	2
②	Side rail	2
③	5NPS25S7 + SW	2
④	4NPS6S7 + SW	4

Item	Order No.
Rack mount kit 2U	B0333A
Rack mount kit 3U	B0333B
Rack mount kit 4U	B0333C
Rack mount kit 5U	B0333D

• F-series cabinet rack mount dimensions

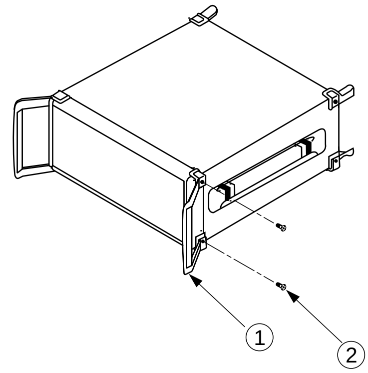


Unit: mm

Cabinet height	H	A	B	C
2U	88	5.9	76.2	85.5
3U	132.5	37.7	57.1	130
4U	177	37.7	101.6	174.5
5U	221.5	37.7	146.1	219

• Front handle

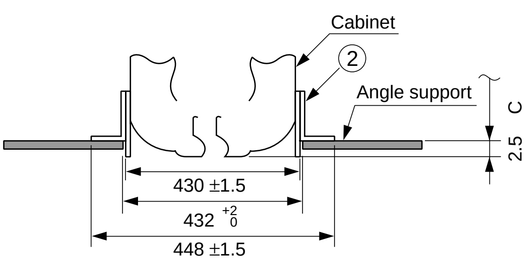
Protects the front section



No.	Description	Quantity
①	Front handle	2
②	Screw	4

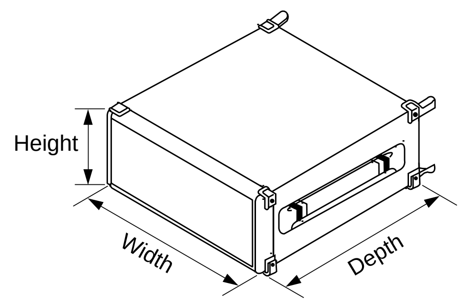
Item	Order No.
Front handle 2U	B0331A
Front handle 3U	B0331B
Front handle 4U	B0331C
Front handle 5U	B0331D

• Cabinet angle support dimensions



Note: Merely attaching the equipment to the rack with rack mount kit does not provide enough support. Use either angle supports or shelves to provide the necessary support.

• Symbol and dimensions of F-series cabinet



Height

Symbol	Dimension (mm)
2U	88
3U	132.5
4U	177
5U	221.5
6U	266

Width

Symbol	Dimension (mm)
1MW	426
3/4MW	320
2/3MW	284
1/2MW	213

Depth

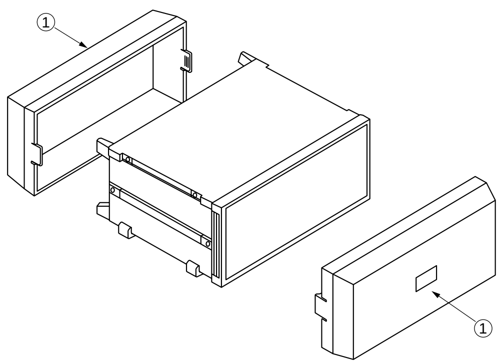
Symbol	Dimension (mm)
250D	251
350D	351
450D	451

Note: Knobs, handles, and feet are not included in cabinet external dimensions.

ACCESSORIES FOR E-SERIES CABINETS

Anritsu's E-series cabinet was designed using basic dimensions that conform to EIA and IEC racking specifications, permitting compatible equipment to be easily stacked up to form a system, or to be mounted on the EIA/IEC standard rack. Featuring a balanced design, the E-series cabinet accessories provide ease of mounting and use. The E-series cabinet can be identified by the four silver metal sections between its top and side surfaces.

• Front/rear cover

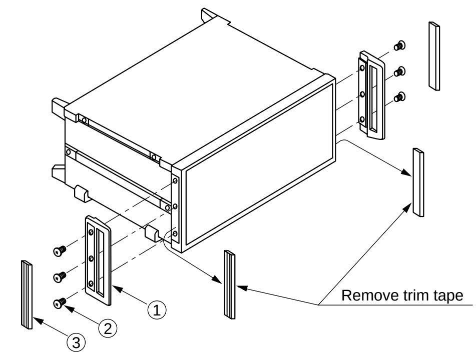


Protects front and back of cabinet.
Due to projections, the rear cover may not be usable with some equipment. Front handles and front cover cannot be used simultaneously.

No.	Description	Quantity
①	Front/rear cover	1

Item	Order No.
Front/rear cover 1MW2U	B0018
Front/rear cover 1MW3U	B0019
Front/rear cover 1MW4U	B0020
Front/rear cover 1MW5U	B0021
Front/rear cover 1MW6U	B0022
Front/rear cover 2/3MW2U	B0023
Front/rear cover 2/3MW3U	B0024
Front/rear cover 2/3MW4U	B0025
Front/rear cover 1/2MW2U	B0026
Front/rear cover 1/2MW3U	B0027

• Front handle kit



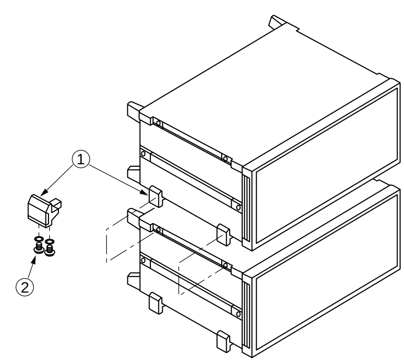
Front cover cannot be used.

No.	Description		Quantity
①	Front handle		2
②	Screw	2U to 3U*1	4
		4U to 6U	6
③	Trim tape		2

*1: Denotes height of cabinet

Item	Order No.
Front handle kit 2U	B0036
Front handle kit 3U	B0037
Front handle kit 4U	B0038
Front handle kit 5U	B0039
Front handle kit 6U	B0040

• Stacking foot



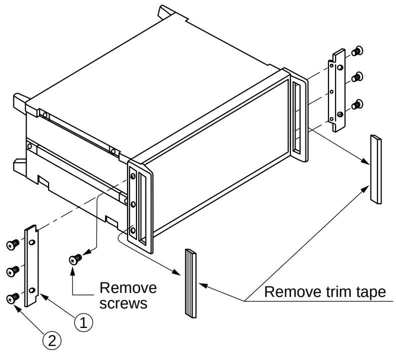
These one-touch lock feet replace the standard molded feet for use when stacking equipment of the same width and depth, and when mounting the equipment on a portable test rack.

No.	Description	Quantity
①	Stacking foot	4
②	Screw	8

Item	Order No.
Stacking feet	B0029

Note: By replacing the standard molded feet with stacking feet (B0029), the 1MW cabinet can be used with Anritsu's portable test racks MB23A and MB24B.

• Rack flange kit



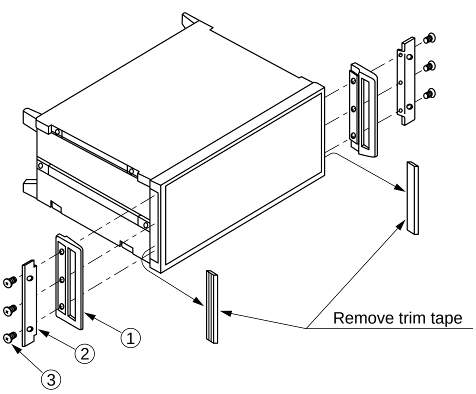
The rack mount accessory is for use with equipment having 1MW cabinet width providing front handles.

No.	Description		Quantity
①	Rack flange		2
②	Screw	2U to 3U	4
		4U to 6U	6

Item	Order No.
Rack flange kit 2U	B0046
Rack flange kit 3U	B0047
Rack flange kit 4U	B0048
Rack flange kit 5U	B0049
Rack flange kit 6U	B0050

Note: • For 1MW cabinets
• When assembled, the panel width is suitable for 19-inch racks.
• For EIA/IEC standard rack

• Rack mount kit



The rack mount accessory is for use with equipment having 1MW cabinet width.

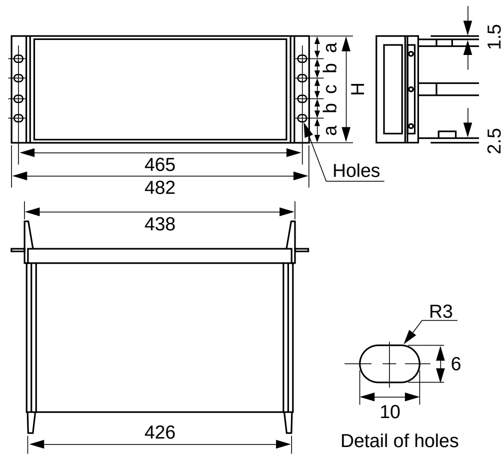
Note: Merely attaching the equipment to the rack with rack mount kit does not provide enough support. Use either angle supports or shelves to provide the necessary support.

No.	Description		Quantity
①	Front handle		2
②	Rack flange		2
③	Screw	2U to 3U	4
		4U to 6U	6

Item	Order No.
Rack mount kit 2U	B0041
Rack mount kit 3U	B0042
Rack mount kit 4U	B0043
Rack mount kit 5U	B0044
Rack mount kit 6U	B0045

Note: • For 1MW cabinets
• When assembled, the panel width is suitable for 19-inch racks.
• For EIA/IEC standard rack

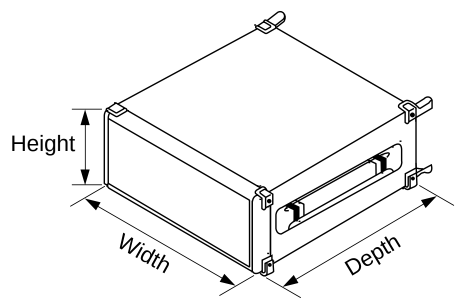
• E-series cabinet rack mount dimensions



Cabinet height	H (mm)	a	b	c
2U	88	5.9	–	76.2
3U	132.5	37.7	–	57.1
4U	177	37.7	–	101.6
5U	221.5	37.7	–	146.1
6U	266	37.7	57.1	76.2

Note: This space provides room to attach a flange for supporting the equipment.

• Symbol and dimensions of E-series cabinet



Height

Symbol	Dimension (mm)
2U	88
3U	132.5
4U	177
5U	221.5
6U	266

Width

Symbol	Dimension (mm)
1MW	426
3/4MW	320
2/3MW	284
1/2MW	213

Depth

Symbol	Dimension (mm)
250D	251
350D	351
450D	451

Note: Knobs, handles, and feet are not included in cabinet external dimensions.

ISO9000/14000

IP Network, Wireless and Precision products contained in this catalogue are manufactured under a quality system and environment management system in conformance to the ISO international standard.

Factory name	Conformed standard	Qualification number	Qualified date	Qualification organization
Atsugi factory	ISO9001	JQA-0316	Nov. 15, 1993	Japan Quality Assurance Organization (JQA)
	ISO14001	JQA-EM0210	Aug. 28, 1998	
Tohoku Anritsu	ISO9002	JQA-0737	Dec. 28, 1994	
	ISO14001	JQA-EM0560	Oct. 22, 1999	
England factory	ISO9001	FS22679	May 24, 1999	BSI Quality Assurance
	ISO14001	EMS54120	Mar. 15, 2000	
U.S.A factory	ISO9001	6495	Apr. 17, 2001	The Seal of National Quality Assurance Limited

Quality and Reliability Assurance for Products

• Planning stage

Management resources are focused on measuring instruments related to growing fields such as mobile Internet, WDM and digital broadcasting, System solutions, precision measurement business and device businesses. New products are planned to provide solutions whenever required by users.

• Design stage

To realize a design with high-safety and high-reliability, several levels of design assessments are performed. Power consumption is reduced from the viewpoint of environment considerations, starting with evaluation of specifications, legal regulations and used parts. Evaluations are also implemented for improving the recycling ratio and so forth, and the design quality is improved.
Anritsu engages a design that targets customer satisfaction.

• Evaluation stage

In addition to safety, reliability and environment considerations of test models for the new product, functions and performance are verified by an operating environmental conditions test and operability, uncertainty, maintainability and flexibility of design are evaluated fully. After passing these tests, the products can be commercialized.

• Manufacturing and inspection stages

Based on our policy, “post-processing is the customer,” the product is manufactured by experienced employees according to the work standards. In the adjustment and inspection stage, automatic measurement is promoted. An expert will be in charge of the adjustment if high-skilled adjustment is required.

• After sold

In each service department, traceability assurance by calibrations based on high-technical capabilities , as well as rapid repair and preventive maintenance are performed.

Parts standardization and improving activities for quality and reliability

For parts generally used in each measuring instrument, quality improvement and standardization are actively promoted. All field data are analyzed, arranged and completely made known to each department while required actions are taken for reliability improvement. In addition, failure rate, MTBF observation and parts failure rate are calculated based on this information.

Traceability assurance

As defined in the International Vocabulary of Basic and General Terms in Metrology (VIM; 1993), traceability is defined as "the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons."
Anritsu's system to ensure traceability is shown below.
Measurements made by Anritsu's laboratory's are traceable to national, international, or intrinsic standards, where such standards are available.