TereScope 1

Fast Ethernet Photonic Air Link

User Manual

Standards Compliance

This equipment is designed to comply with UL 1950; CSA 22.2 No 950; FCC Part 15 Class B; CE-89/336/EEC, 73/23/EEC, IP-66.

FCC Notice

WARNING: This equipment has been designed to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct for the interference at his own expense.

The user is cautioned that changes and modifications made to the equipment without approval of the manufacturer could void the user's authority to operate this equipment.

It is suggested that the user use only shielded and grounded cables when appropriate to ensure compliance with FCC Rules.

CE Mark

The CE mark symbolizes compliance with the EMC directive of the European Community. Such marking is indicative that the specified equipment meets or exceeds the following technical standards:

- EN 55022 – Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
- EN 50081-1 – Electromagnetic compatibility of Radio Interference Characteristics of Information Technology Equipment – Generic Emission standard Part 1: Residential commercial and light industry environment
- EN 50082-1 – Electromagnetic compatibility – Generic immunity standard Part 1: Residential, commercial and light industry environment
- EN61000-4-2 (previously IEC 1000-4-2) – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 2: Electrostatic discharge requirements
- EN61000-4-3 (previously IEC 1000-4-3) – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 3: Radiated electromagnetic field requirements
- EN61000-4-4 (previously IEC 1000-4-4) – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 4: Electrical fast transient/burst requirements
- EN61000-4-5 – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 5: Surge Immunity requirements
- EN61000-4-6 – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 6: Immunity to conducted disturbances induced by radio frequency fields
- EN61000-4-8 – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 8: Power frequency magnetic field immunity requirements
- EN61000-4-11 – Electromagnetic compatibility for industrial-process measurement and control equipment – Part 4, Section 11: Voltage dips short interruptions and voltage variations immunity requirements
- EN61000-3-2 – Harmonic standard
- EN61000-3-3 – Voltage Fluctuation and Flicker standard
- CISPR 22 – Radiated and Line-conducted Class B
- EN 60950 – ITE Safety

A 'Declaration of Conformity', in accordance with the above standards, has been made and is on file at *MRV*®.

MRV® Laser Safety Certification

The TereScope 1 is designed, built, and tested to be eyesafe, even if the output beams are viewed directly, provided that no magnifying optics are used.

This product is Class 1 according to the American National Standard for Safe Use of Lasers ANSI Z136.1-1993 provided that there is no reasonable probability of accidental viewing with optics in the direct path of the beam where the TereScope 1 is installed.

This product is Class 1M according to the International Standard of the International Electrotechnical Commision IEC 60825-1, Amendment 2, January 2001 entitled "Safety of laser products." The following explanatory label is applicable to these products:

LASER RADIATION
DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS
(BINOCULARS OR TELESCOPES)
CLASS 1M LASER PRODUCT

This product complies with United States FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50 as published in June, 2001, which allows for the use of the IEC 60825-1 classification standard. Under this standard, these products are Class 1M.

A 'Declaration of Conformity', in accordance with the above standards, has been made and is on file at *MRV*.

Disclaimer

MRV® reserves the right to make changes to any technical specifications in order to improve reliability, function or design.

MRV reserves the right to modify the equipment at any time and in any way it sees fit in order to improve it.

MRV provides this document without any warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose.

The user is advised to exercise due discretion in the use of the contents of this document since the user bears sole responsibility.

Trademarks

All trademarks are the property of their respective holders.

TereScope® is a registered trademark of MRV Inc.

Document Number: ML46508 **Document Revision:** Rev. 05 **Release Date:** October 2004

Contact Information

For customer support, you can:

- Contact your local MRV representative
- E-mail us at InternationalSupport@mrv.com
- Visit our MRV Web site at http://www.mrv.com

Contents

Figures

Tables

About this Manual

Purpose

This manual is intended for the user who wishes to install, operate, manage, and troubleshoot the TereScope 1[1] photonic air link.

Audience

Qualifications

Users of this manual are expected to have working knowledge of:

- Fiberoptic Cabling
- LAN equipment (Layer 2)

Training

Installers are required to do a training course on *MRV* TereScopes that includes:

- IR links (site survey, installation equipment, alignment, etc.)
- Indoors and outdoors installation
- On-the-job-training
- Proficiency tests

Experience

Installers are required to have experience in LAN installation and IR equipment installation.

Authorization

When all the requirements specified above (namely, Qualifications, Training, and Experience) have been met, the installer is required to receive authorization from *MRV* certifying eligibility.

Latest Revision

The latest revision of the user manual can be found at:

ftp.international.mrv.com/support/tech_data

Related Documents

- Release Notes for TereScope 1 – if applicable. (This document contains information not found in the User Manual and/or overriding information.)
- TereScope Installation Guide (Publication No. 46366)
- OptiSwitch User Manual (Publication No. 46215)
- MegaVision NMS User Manual (Publication No. 46654)

[1] TereScope is a trademark of *MRV*.

Acronyms

CATV	Cable Antenna TeleVision
CLI	Command Line Interpreter
GPS	Global Positioning System
IR	Infra-Red
MTBF	Mean Time Between Failures
NA	Numerical Aperture
PVC	PolyVinyl Chloride
RSSI	Receiver Signal Strength Indication
STP	Shielded Twisted-Pair
TELNET	(dial-up) TELephone NETwork (connection protocol)
UTP	Unshielded Twisted-Pair

Safety Requirements

> **Caution!**
>
> To reduce risk of injury and to maintain proper operation, ensure that the safety requirements stated hereunder are met!

When Installing

- Ensure, by visual inspection, that no part of the TereScope 1 is damaged.
- Avoid prolonged eye contact with the laser beam.
- Ensure that the system is installed in accordance with ANSI Z136.1 control measures (engineering, administrative, and procedural controls).
- Ensure that the system is installed in accordance with applicable building and installations codes.
- Install the TereScope 1 in a restricted location as defined in this manual since it is a Class 1M FSOCS transmitter and receiver. A restricted location is a location where access to the transmission equipment and exposed beam is restricted and not accessible to the general public or casual passerby. Examples of restricted locations are: sides of buildings at sufficient heights, restricted rooftops, and telephone poles. This definition of a restricted location is in accordance with the proposed IEC 60825-I Part 12 requirements.
- Avoid using controls, adjustments, or procedures other than those specified herein as they may result in hazardous radiation exposure.

During Operation

Avoid prolonged eye contact with the laser beam.

Overview

General

TereScope 1 is a wireless optical communication link for transferring data over a distance of up to 470 m (1540 ft) at 17 dB/km.

The TereScope 1 is unique in that data transmission and reception is *fully optical*. Most wireless links have an interface unit for transferring data between the transmission lines and air transciever. In the TereScope 1, optical data is *directly* transferred between a special fiberoptic cable and the air, using appropriate beam-shaping optics, without any intermediate processing electronics. This technology eliminates all the disadvantages of electrical components (e.g., electric power, RFI/EMI, etc.) while providing all the inherent advantages of optics (e.g., large bandwidth, greater reliability, higher security, etc.).

The TereScope 1 is used with a special fiberoptic cable and electro-optic module provided by *MRV*. The fiberoptic cable has differing transmit and receive fibers. The module can be a plug-in module for the OptiSwitch family of OSI Layer 2 and 3 compliant switches, or a standalone media converter switch.

The Terescope 1 has a special proprietary coating on the lenses in order to prevent condensation effects on the lenses. As an additional safety measure against moisture build-up on its lenses, the TereScope 1 system also includes an optional heating element. This heating element is powered by a power supply (supplied with the TereScope 1 system) located near the switch/media converter via an *extra-low-voltage* power limiting circuit and two copper conductors integrated into the supplied optical cable.

For convenience, it is recommended that at least the rooftop portion of the heating installation (cabling and connections) be made so that if heating is required, only the indoor power connection needs to be made.

Models

Two models of the TereScope 1 are available. *Table 1* specifies the differences between the models.

Table 1: Models of TereScope 1

Characteristic	Model	
	TS1/A/DST (Model A)	TS1/C/DST (Model C)
Link Length (max) (Link Length =lengths of two fiberoptic cables + distance between the two TereScope 1s.)	240 m (800 ft) at 17 dB/km	470 m (1540 ft) at 17 dB/km
Receive (at Switch) Fiber Core/Cladding Diameters	400/430 μm	600/630 μm
Beam Divergence	6 mrad	3.65mrad
Fiber-coupled power	4 dBm	8 dBm

In this manual, TS1/A/DST is referred to as Model A and TS1/C/DST is referred to as Model C.

Advantages

- MTBF – over 10 years
- Secure transmission
- No electric power needed
- No need for electrical grounding or lightning protection
- No opto-electronic transducers needed
- No EMI/RFI either to or from the TereScope 1.
- Immediate deployment
- Temporary or permanent installation
- Installable in harsh terrain and over obstacles (rivers, highways, etc.)
- License-free

Applications

- Point-to-Point and Mesh network topologies
- Last-mile connectivity
- Cellular network
- LAN/WAN environments
- Fiber backup
- Disaster recovery backup

Figure 1 shows a typical application of the TereScope 1.

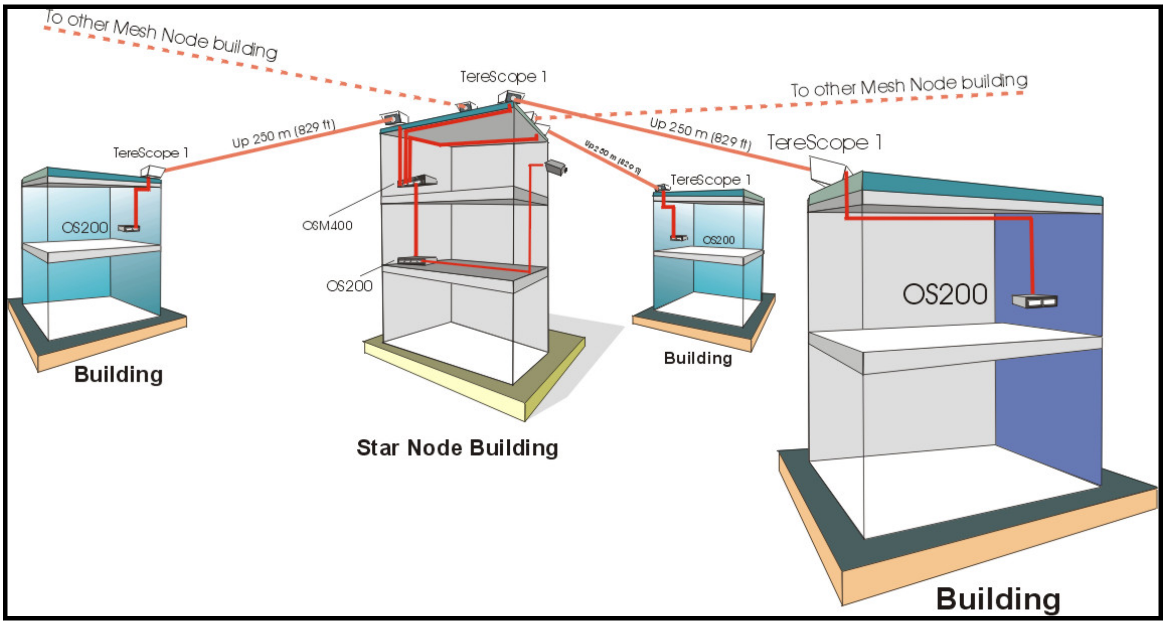


Figure 1: Typical Application of TereScope 1

Layout

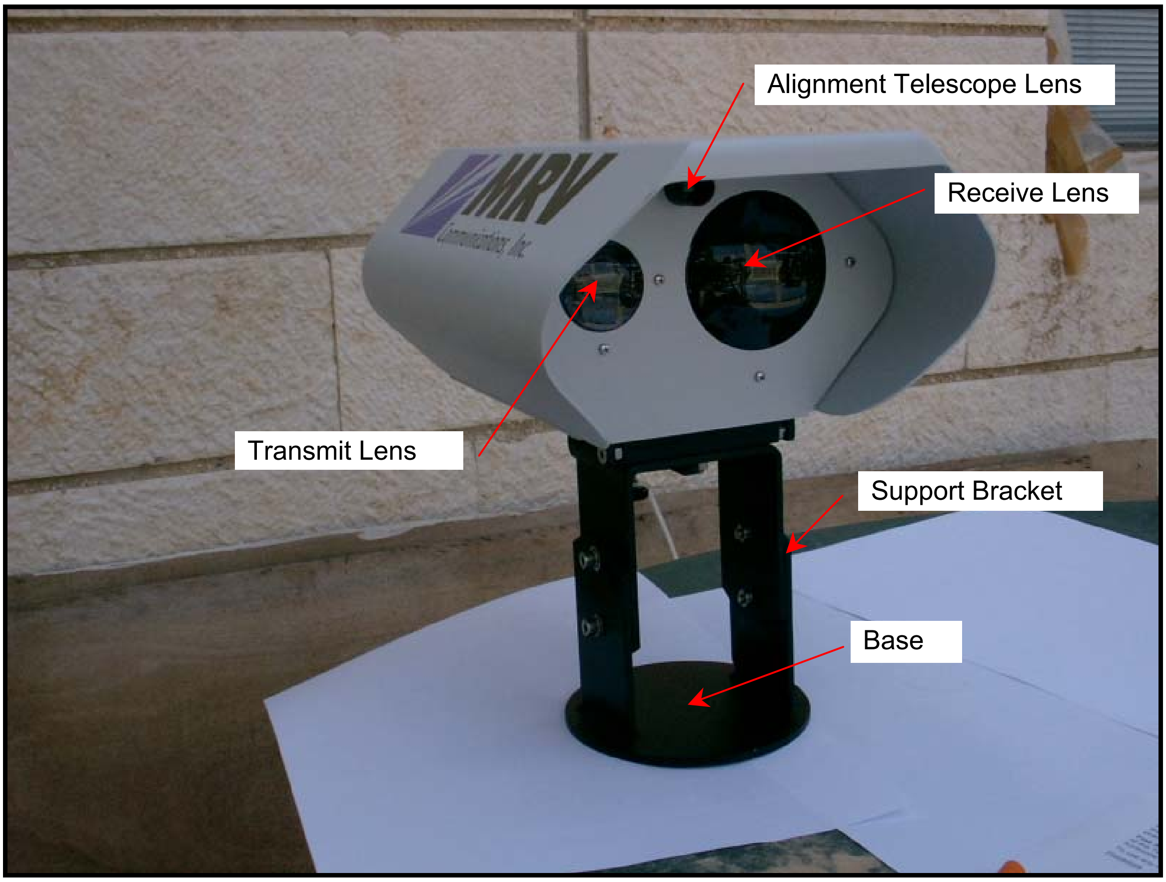


Figure 2: Front View of TereScope 1

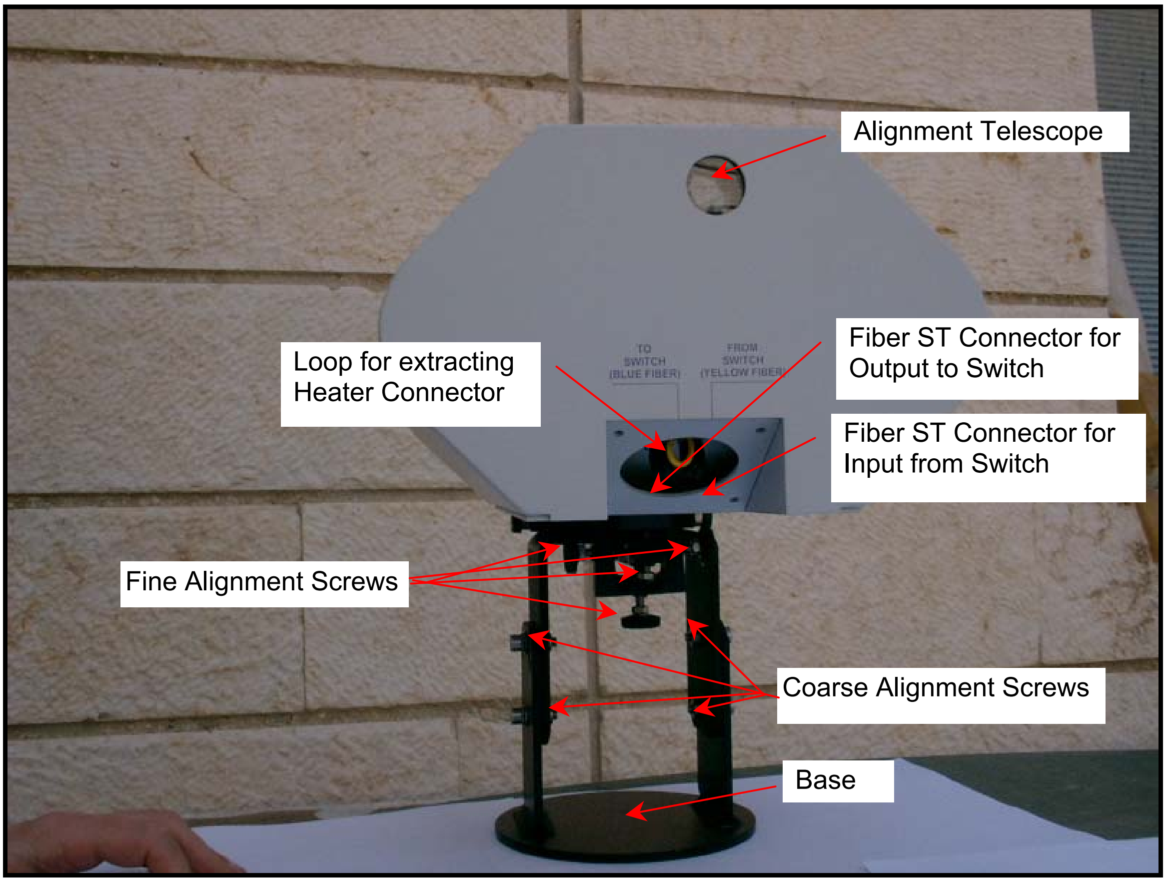


Figure 3: Rear View of TereScope 1

Pre-Installation

General

Site survey is ***key*** for finding a suitable geographical area for an optical wireless link. A good site survey, which covers all aspects of the installation requirements, is a pre-requisite for satisfactory link installation and operation. Accordingly, it is important:

- To determine the optimal geographical location for the link elements.
- That customers recognize their responsibilities prior to installation.

On completion of the link design, the *Site Survey Form* (shown in *Appendix C: Site Survey Form*) should be filled out to assure complete coverage of all installation aspects.

Tools & Equipment

The following equipment are useful in performing a successful and accurate site survey:

- Rangefinder binoculars
- Digital camera

- Compass
- GPS receiver
- 3m' tape measure.
- Site Survey Form (shown in *Appendix C: Site Survey Form*)

Site Survey Procedure

Site Suitability

1. Try to avoid East-West directions for links because even if 0.5º of the sun disk overlaps the receiver telescope, errors may occur on a few days in a year for a few minutes each day.
2. Choose buildings of medium height. Avoid tops of skyscrapers because of their large sway. In suburban areas, you should choose the tallest building in the area that is not too tall.

Line of Sight

1. Make sure that no obstacles cross the line of sight between the two TereScope 1s.
   Examples of obstacles are: Growing trees, New buildings, Crane movement, Bridges over which tall vehicles may pass, Birds nesting, Hot surfaces (such as metal or black roofs), Exhaust gases or dust clouds, Smoke from chimneys.
2. **Photograph** the line of sight view from the rooftops.

> **Note**
>
> It is important to photograph the view containing the line of sight from the elevation at which you are going to mount the TereScope 1s. The photograph can be used to: Recheck the location for details that may have been overlooked during the survey, Show it for consultation, etc.

Range and Location

1. Referring to the data in *Appendix A: Product Specification*, under ***Operating Range***, choose and record the distance between the two TereScope 1s of the link. (You can use any of the following equipment to determine the distance: rangefinder laser binoculars, GPS receiver, maps, etc.)
2. Noting that the length of fiberoptic cabling (interconnecting a TereScope 1 and OptiSwitch or Media Converter) should not exceed 50 m (164 ft), choose and record the acceptable distance between each TereScope 1 and the OptiSwitch (or Media Converter).
3. Noting that two TereScope 1s are required per link, record the quantity of each model of the TereScope 1 required. Each OptiSwitch module supports up to two links, and the OptiSwitch may support several modules depending on the model. Accordingly, one OptiSwitch may be sufficient for connecting several (possibly all) TereScope 1s at one end of the links provided the maximum fiber cable length, specified in Step 2 above, is not exceeded.
4. Record the bearing to the opposite site by compass.

5. Record the number of links to be installed at the site.
6. Note whether additional sheltering is needed for the TereScope 1s, for e.g., against strong winds (120km/h or more) – see *Appendix C: Site Survey Form* for details.

Figure 4 and *Figure 5* show optimal and acceptable locations for the TereScope 1 links. Notice that in both figures the TereScope 1s are mounted on rooftop edges and high enough above the ground.

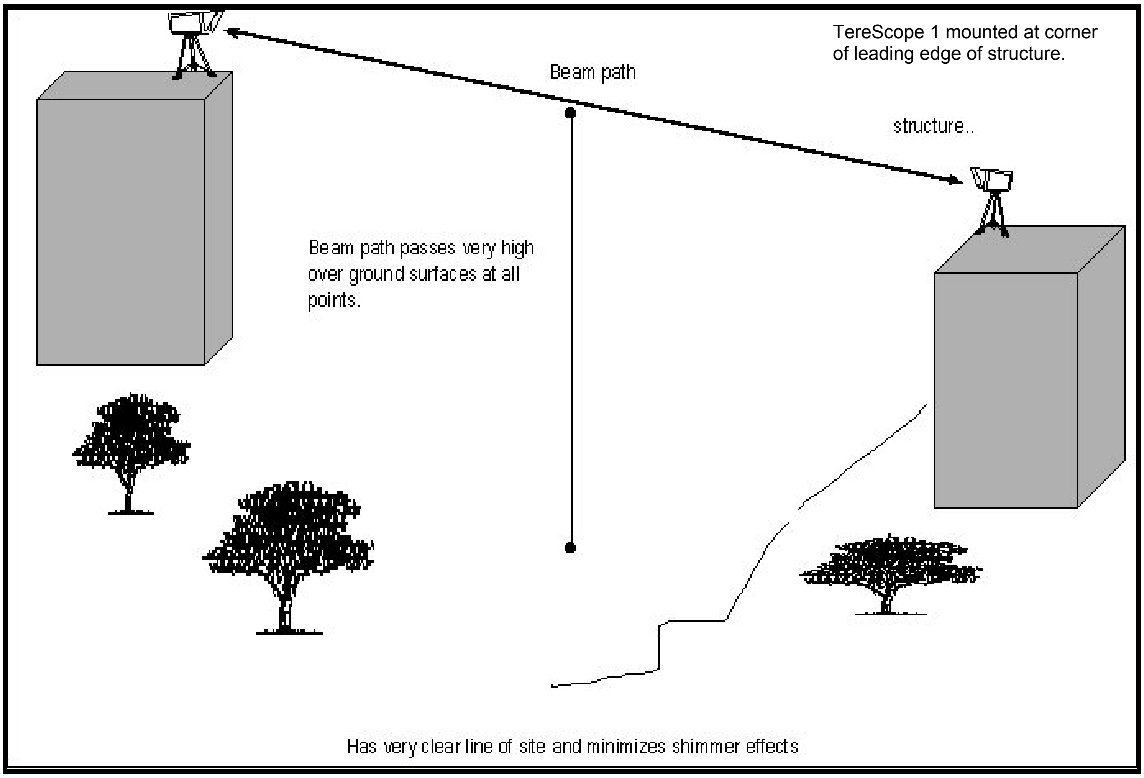


Figure 4: Optimal Mounting

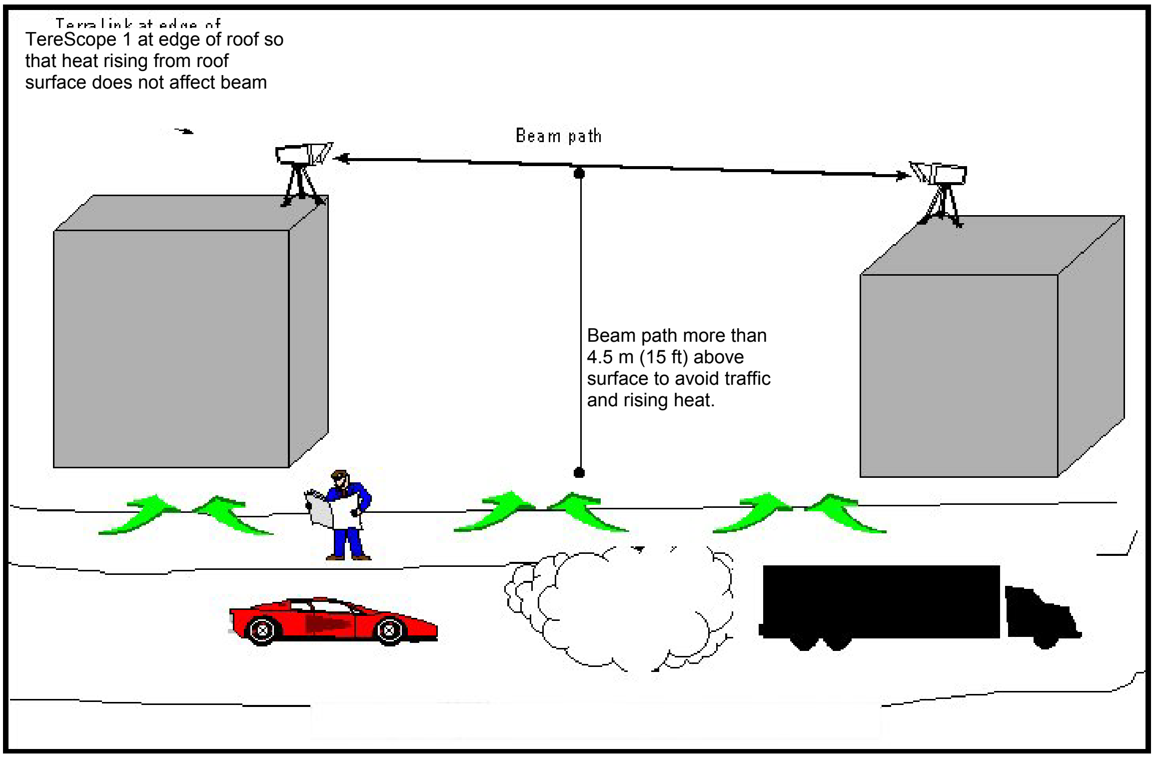


Figure 5: Acceptable Mounting

Figure 6 shows an unrecommended TereScope 1 link location because of interference by IR. Notice that the TereScope 1s are mounted far from the rooftop edges or are too close to the ground.

Figure 7 shows an *unacceptable* TereScope 1 link location because of interference by passing vehicles. Notice that the TereScope 1s are mounted far from the rooftop edges and not high enough above the ground.

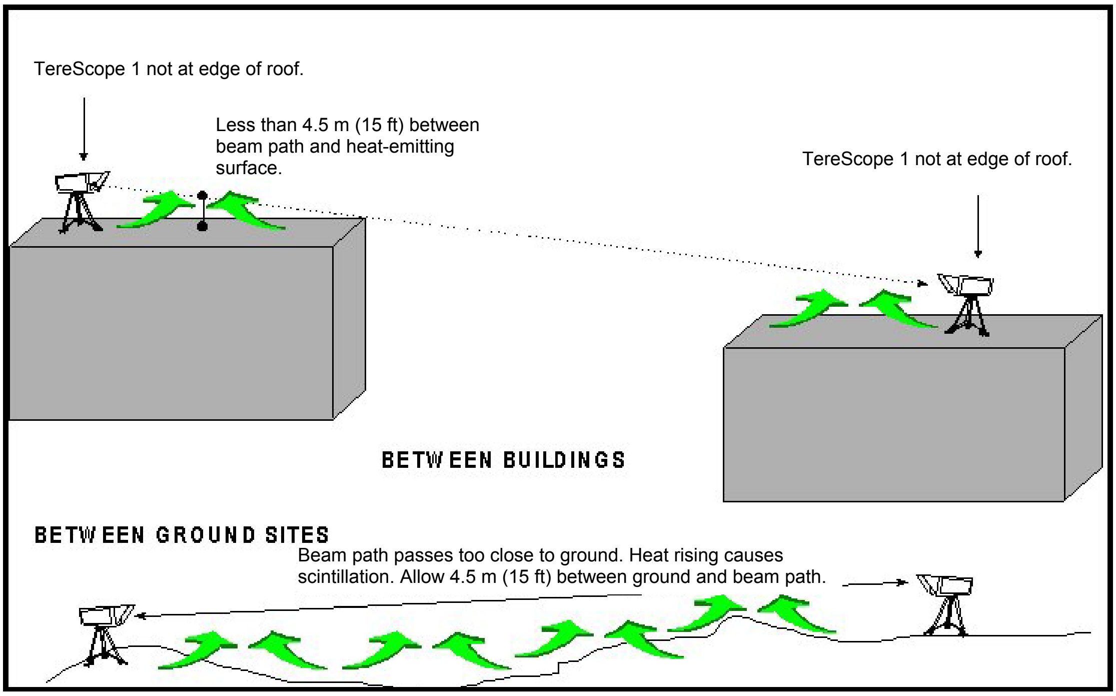


Figure 6: Unrecommended Mounting

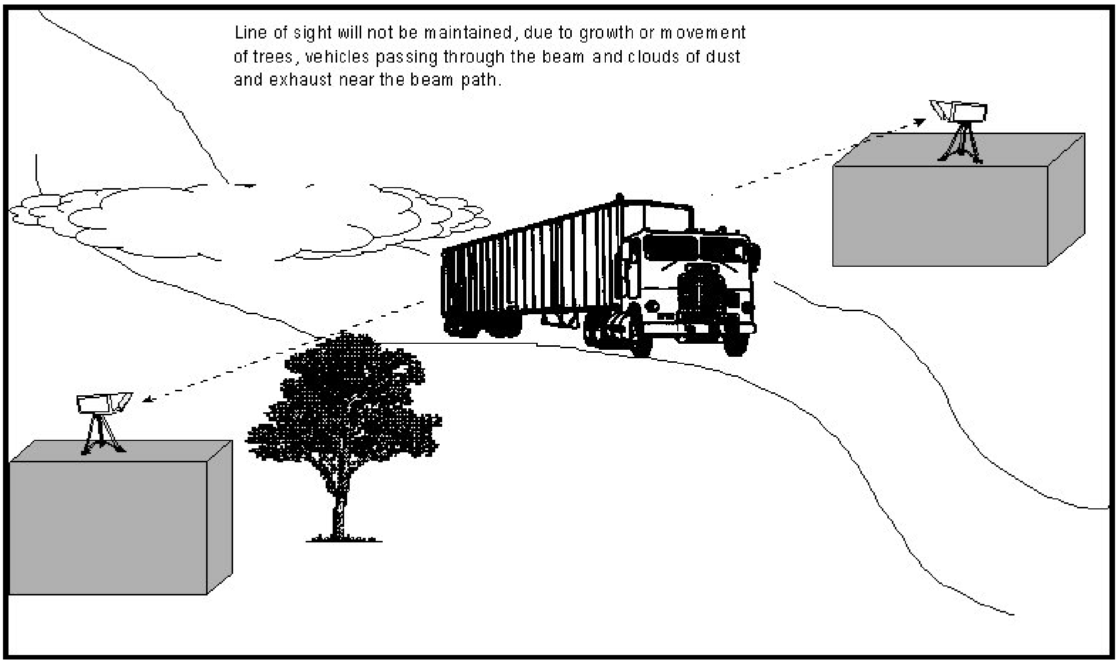


Figure 7: Unacceptable Mounting

Mounting Environment & Stability

1. When deciding the mounting location, you should look on the rooftop for vibration sources such as compressors, elevators, motors, and try to avoid them.
2. Photograph the mounting location so as to select the best mounting option.
   Figure 8 shows mounting locations on a rooftop in descending order of preference. Location **1** is the best; location **7** is the worst.

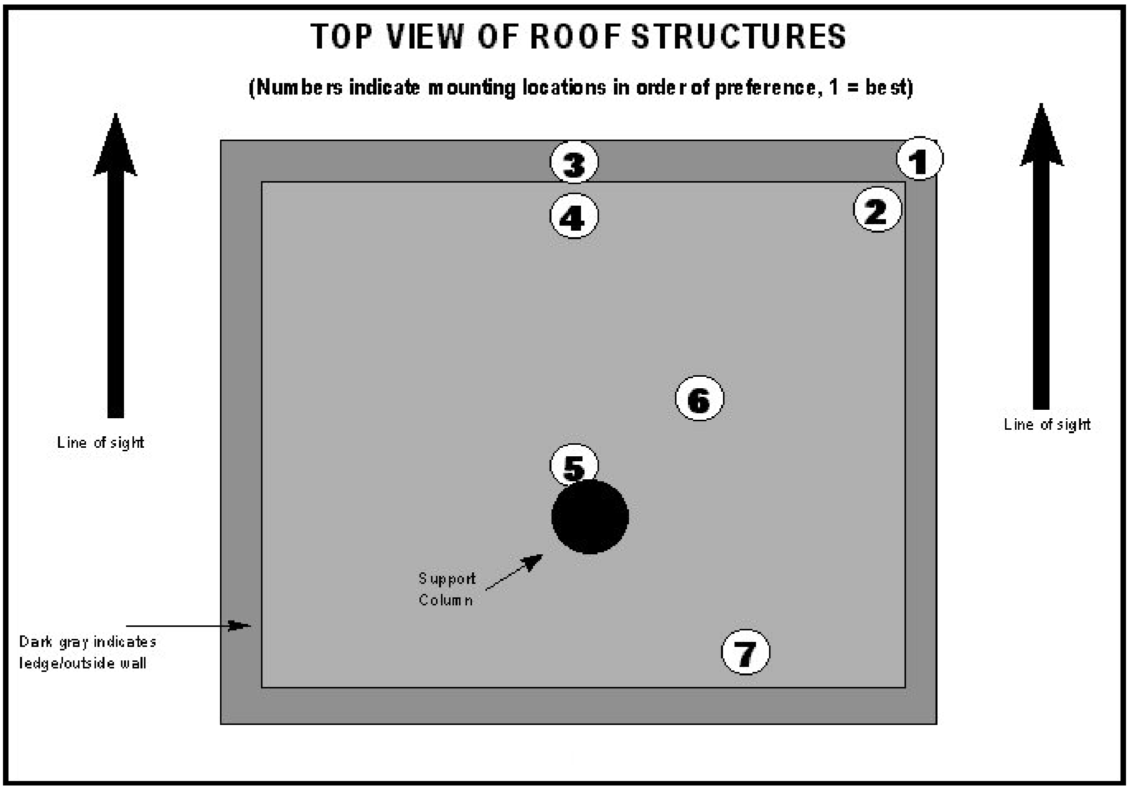


Figure 8: Mounting Locations in Order of Preference

3. Avoid surfaces with high reflectivity (e.g., white walls) behind the TereScope 1 so as to reduce interference with the optical signal.
4. Get customer approval for the *exact* positions where the TereScope 1s will be mounted. Using paint, mark these positions.
5. Note the height that each TereScope 1 will be above or aside the rooftop.
6. Identify the type/quality of the floor or wall and dimensions of the location at which the TereScope 1 is planned to be mounted.
7. For each TereScope 1, select one of the following mounting options[2] and record it.
   a. **Parapet/Ledge Mounting** (*Figure 9*) – This is a standard mounting option that uses only the Plate (JMP).
   b. **Wall Mounting** (*Figure 10*) – This is a standard mounting option that uses the Plate (JMP) as well as the two Mounting Brackets (JMBs).
   c. **Floor Pedestal Mounting** (*Figure 11*) – This is a non-standard mounting option that uses the Plate (JMP) as well as a Floor Pedestal (e.g., M015C).
   d. **Wall Pedestal Mounting** (*Figure 12*) – This is a non-standard mounting option that uses the Plate (JMP) as well as a Wall Pedestal (e.g., M054C).

[2] For more information on these mounting options, refer to *TereScope Installation Guide* (Publication No. 46366).

e. **Extended Wall Mounting** (*Figure 13*) – This is a non-standard mounting option that uses the Plate (JMP) as well as an Extended Wall (e.g., M062C).

Figure 9: Parapet/Ledge Mounting (using JMP only)

Figure 12: Wall Pedestal Mounting (using JMP and M054C)

Figure 10: Wall Mounting (using JMP and JMB)

Figure 13: Extended Wall Mounting (using JMP and M062C)

Figure 11: Floor Pedestal Mounting (using JMP and M015C)

Transmitting through a Window

1. Determine the number of surfaces the beam transits or is reflected from, the reflectivity of each surface, and condensation/precipitation collection areas.
2. Use the data below to determine whether the light beam attenuation is acceptable.
   - 4% attenuation for each surface of light reflection.
   - 15% attenuation for a double pane window.
   - Attenuation due to tint in windowpane must be taken into consideration in choosing the right TereScope 1 model. (The % attenuation depends on the tint and must be measured.)
3. Ensure that the angle of incidence[3] of the beam striking the windowpane is between 1º and 45º, preferably closer to 1º for greater beam penetration.

	Note
	On high buildings, for indoor window installation, the user should consider that occasionally the window-cleaning elevator might block the link beam.

Figure 14 shows the arrangement for transmitting through a window.

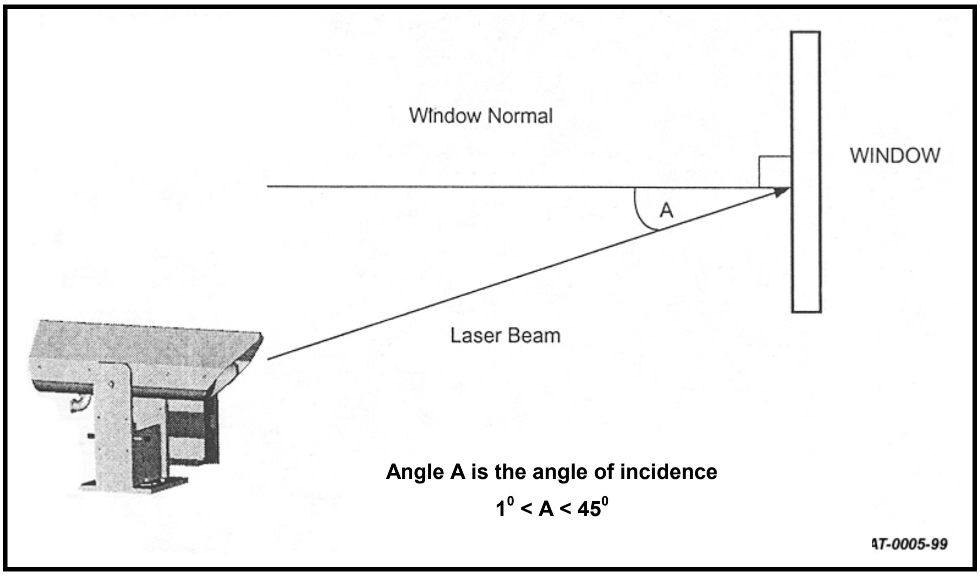


Figure 14: Arrangement for Transmitting through a Window

Routine Checks for Adjustments

Ensure that all rooftop sites are visited about two or three weeks prior to the installation of the system. Make sure that no changes took place, which may

[3] Angle which the light beam makes with the perpendicular to the windowpane.

have a direct effect on the planned installation. Note the relevant changes and make sure that timely adjustments are implemented in the system, to accommodate these changes.

Ordering Equipment

Using the results of the survey, *Appendix A: Product Specification*, *Appendix B: Required Materials*, and *Appendix C: Site Survey Form*, place orders for the required *MRV* equipment and materials for the installation process.

Note

For insurance, it is advisable to order a longer fiberoptic cable than that required by measurement.

Installation

Fiberoptic Cable

General

MRV supplies a special fiberoptic cable for carrying optical data between the OptiSwitch (or Media Converter) and the TereScope 1. The cable contains both a transmit fiber and a receive fiber, each of different type. The TereScope 1 has no light source, detector, or amplifier inside. Therefore the cable plays a crucial role in the link, as any loss in the cable translates into an equal loss in the received signal strength.

The cable also contains two wires of gauge #20 AWG for connecting an optional indoors heating power supply to a heating circuit in the outdoor unit.

The fiberoptic cable is an outdoor cable having two active fibers, two copper wires of gauge #20 AWG, and one vacant sheath. The vacant sheath (together with the active fibers) is needed to give the cable a cylindrical shape for robustness. The cable has four connectors, two at each end, for interconnecting a TereScope 1 and OptiSwitch (or Media Converter). Each end of the cable is protected with a heat-shrink sleeve, part of which is shrunk around the cable end and the portion around the connectors is left unshrunk for protection of the connectors until they are safely connected. during the installation process. The cable is available in various lengths. (The specification of the cable is given in *Appendix A: Product Specification*.)

Handling

The fiberoptic cable should be handled with care since fiberoptic cables, in general, are fragile. In particular,

- Do not bend any part of the fiberoptic cable to a radius that is smaller than the minimum permitted according to the manufacturer's specification (usually 210 mm or 8.25 in).
- Do not apply physical stress that is greater than the maximum permitted according to the manufacturer's specification.

Caution!

Handle the fiberoptic cable and optical jumper ends with care even when the connectors are protected.

Testing

General

Before laying the fiberoptic cables, the attenuation of each fiber should be measured to determine if it is acceptable.

Tools and Equipment

The following tools and equipment are required for testing the fiberoptic cables.

- Fiberoptic cables.
- Optical-power meter – shown in *Figure 15*. (If the readings are in dBm, the difference between the input and output power gives the power attenuation of the fiber in dB.)
- 850 nm light source[4] – shown in *Figure 15*.
- 100/140 µm patch jumper fiberoptic cable[5] (supplied by *MRV*[6] on customer order).
- ST-ST adapter.

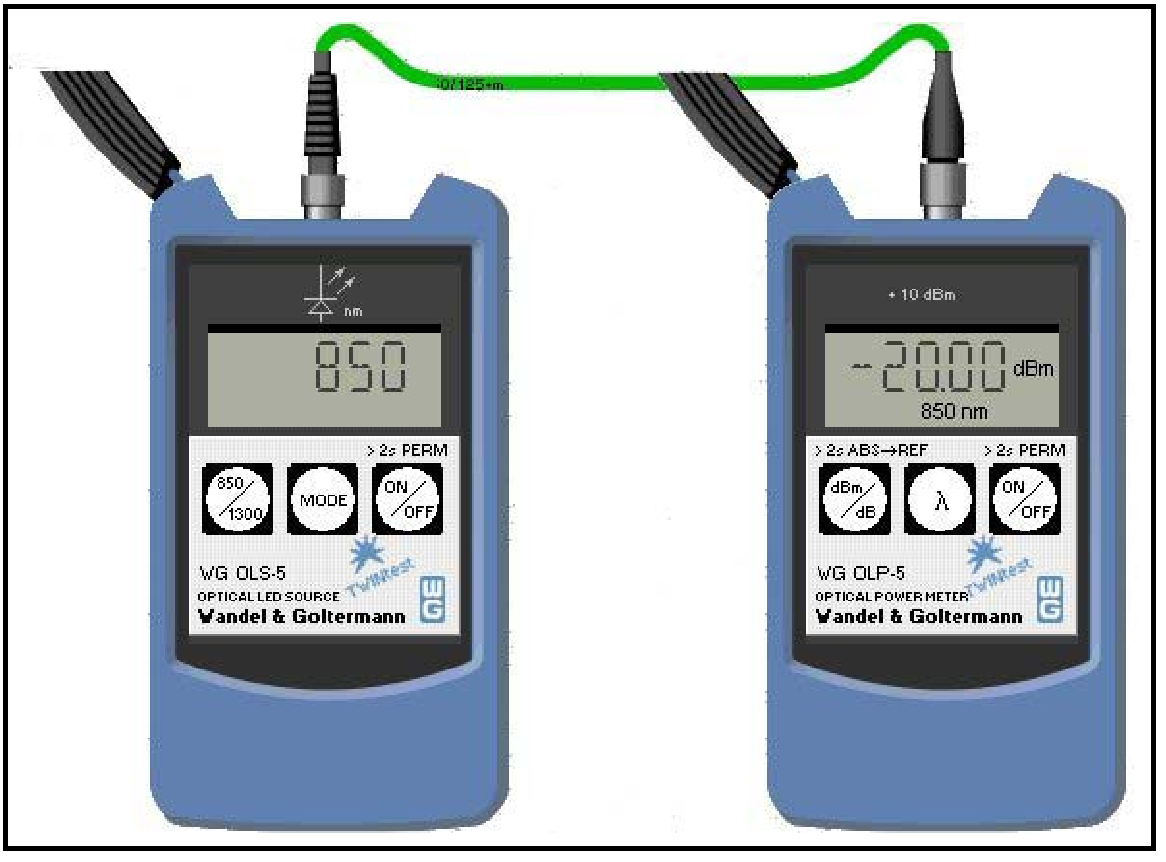


Figure 15: Light Source (left) and Optical-Power Meter (right) – Examples

---

[4] An OptiSwitch module or a Media Converter may be used.

[5] A patch jumper cable is short, has connectors at both ends, and has negligible attenuation.

[6] Instead, the following fiberoptic patch cables may be used:
*For **Model A**:* 50/125 µm or 62.5/125 µm.
*For **Model C**:* 50/125 µm. (The 62.5/125 µm patch cable is not suitable for Model C because it introduces measurement errors.)

Procedure

1. Connect the optical power meter to the light source with the patch cable. Measure the power (in dBm). Disconnect the patch cable from the power meter but leave its other end connected to the light source.
2. Connect one end of the transmit fiber (yellow-sheathed) of the fiberoptic cable under test to the patch cable with an ST-ST adapter. Connect its other end to the optical power meter. Measure the power (in dBm).
3. Note the difference in the two measurements in Steps *1* and *2*. This is the attenuation of the fiber in dB. Stick a label with the attenuation value on the fiber.
4. Repeat Steps 1 to 3 for the receive fiber (blue-sheathed) of the fiberoptic cable.
5. For each fiber, the attenuation needs to be between 0.3 dB and 1 dB, depending on the cable length.
6. Repeat Steps *1* to *5* for all fiberoptic cables.

Laying

It is strongly recommended to run the fiberoptic cable on roofs and in buildings in cable canals (made of PVC) and not to pull them through ducts because of the risk of applying too much frictional stress.

For each bend of the cable at a corner, use a short piece of flexible plastic tubular duct (the same type supplied with the TereScope 1 – see *Figure 24*). The duct serves a double purpose. It ensures that no damaging stress will be applied to the cable, and that the cable will be accessible for troubleshooting if needed.

Preparation

Each end of each cable is fitted with two ST type optical connectors and protected with a heat shrink sleeve. After laying the fiberoptic cable, *carefully* cut off the unshrunk portion of the heat shrink sleeve with scissors or an exactor knife to reveal the cable fibers and their attached connectors and also the two copper wires.

Note

If your TereScope 1 is Model **A**, do not bend the cable fiber to a radius smaller than 60 mm (2^1/2 in).

If your TereScope 1 is Model **C**, do not bend the cable fiber to a radius smaller than 120 mm (5 in).

Connection

The fiberoptic cables are connected after alignment is completed as described in the section Connecting the TereScope 1s, Media Converters, and Switches.

Mounting

This section shows how to mount the TereScope 1 and accessories at a site. For required materials, refer to *Appendix B: Required Materials*.

> **Note**
>
> Avoid surfaces with high reflectivity (e.g., white walls) behind the TereScope 1 so as to reduce interference with the optical signal.

Mounting Accessories

Standard

The following standard mounting accessories are available for the TereScope 1:

1. Mounting Plate (***JMP***) and Mounting Ring – shown in *Figure 16*. These are used for mounting on a horizontal concrete surface, and are supplied with all TereScope 1s. The Mounting Plate is *always* required.

2. Mounting Brackets (***JMB***s) – shown in *Figure 17*. They are used for mounting on a vertical surface, and are supplied on customer order.

Non-Standard

These are additional accessories required for special mounting options, and are supplied on customer order. The mounting options are shown in *Figure* 11*, Figure 12,* and *Figure 13*.

Mounting Procedure

1. If you are going to use an *MRV* standard mount, disassemble the mounting plate and mounting ring (shown in *Figure 16*) – if they are joined to each other – from the TereScope 1.
2. Secure the mounting plate to a parapet, ledge, or an *MRV* mounting bracket, possibly with additional non-standard accessories. (When mounting the TereScope 1 on an *MRV* non-standard mount, do not disassemble the mounting plate from the ring – just connect the mounting plate with the supplied 4 x 8 mm bolts).
3. Place the TereScope 1 on the mounting plate.
4. Secure the TereScope 1 with bolts and washers, with the mounting ring outside the bolts – see *Figure* 16. Do not tighten the bolts so that the TereScope 1 can be rotated. Tighten them only after coarse alignment has been performed as described in the section *Coarse Alignment*.

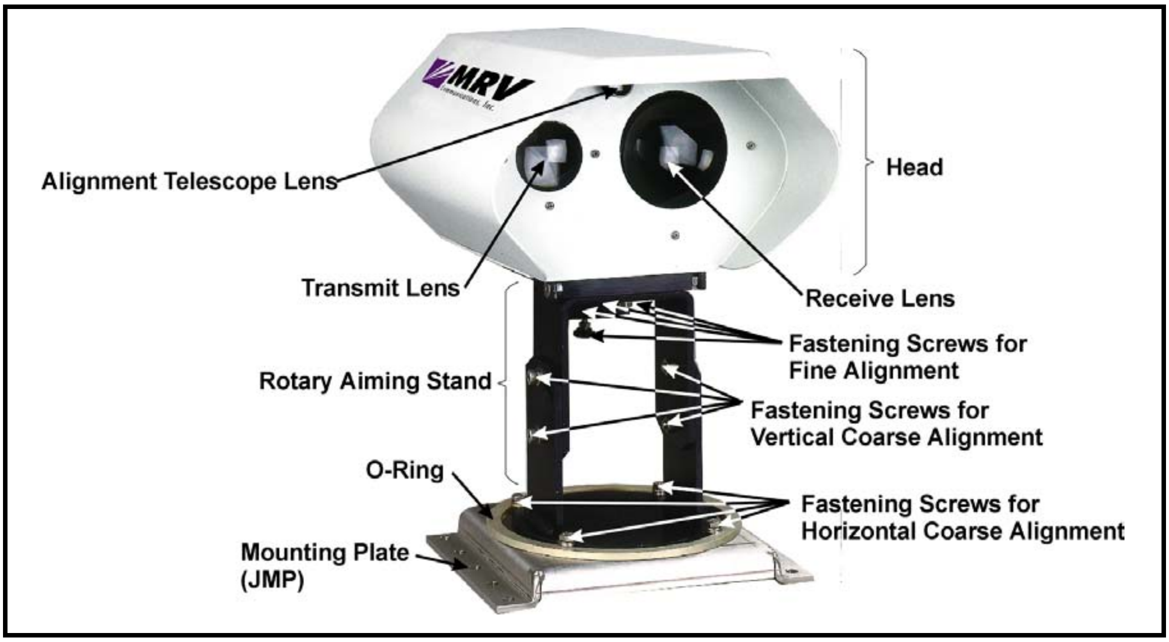


Figure 16: TereScope 1 with Mounting Plate and O-Ring

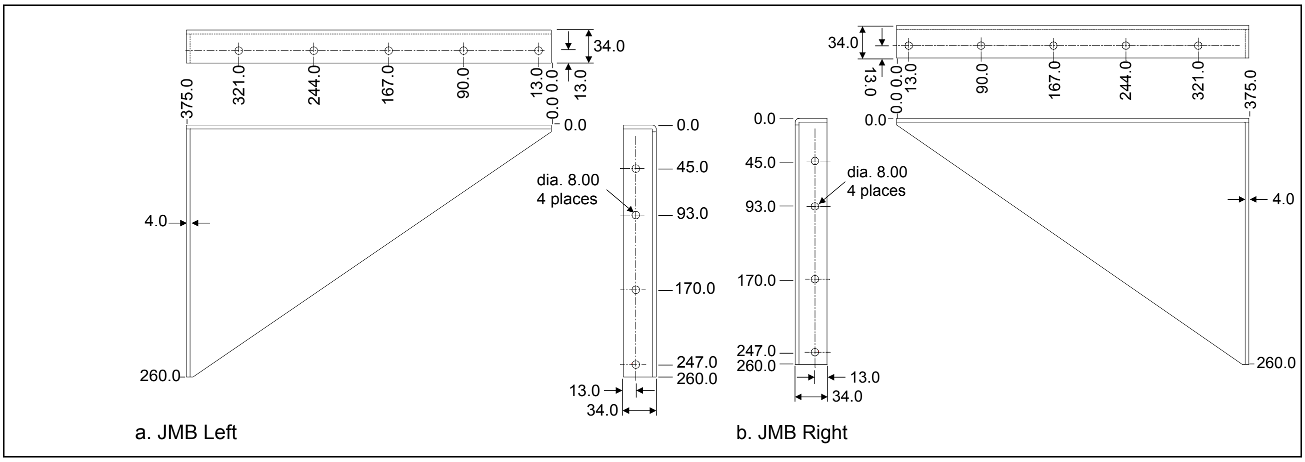


Figure 17: Drawing of Vertical Mounting Brackets (JMBs)

Special Mounting Techniques

This section describes two widely used mounting options*:*

- Mounting on the Floor
- Mounting on a Fragile/Crumbly Wall

Mounting on the Floor

On roofs with a metallic parapet or without a parapet, drilling holes in the roof floor is not recommended. In such cases, the only place where the installation is practicable or authorized is on the floor.

The technique for mounting on such roof floors – illustrated in *Figure 18* – is as follows:

1. Prepare a small concrete slab (60 cm x 60 cm x 15 cm). (This slab will be used to stabilize the pedestal[7] for the TereScope 1.)
2. When the slab solidifies, secure the floor pedestal with screws passed through holes drilled into the slab.
3. Remove any intervening extraneous material, such as asphalt, present between the slab/tower base and the floor. After mounting is completed, restore the roof waterproofing around the slab with appropriate sealing material.

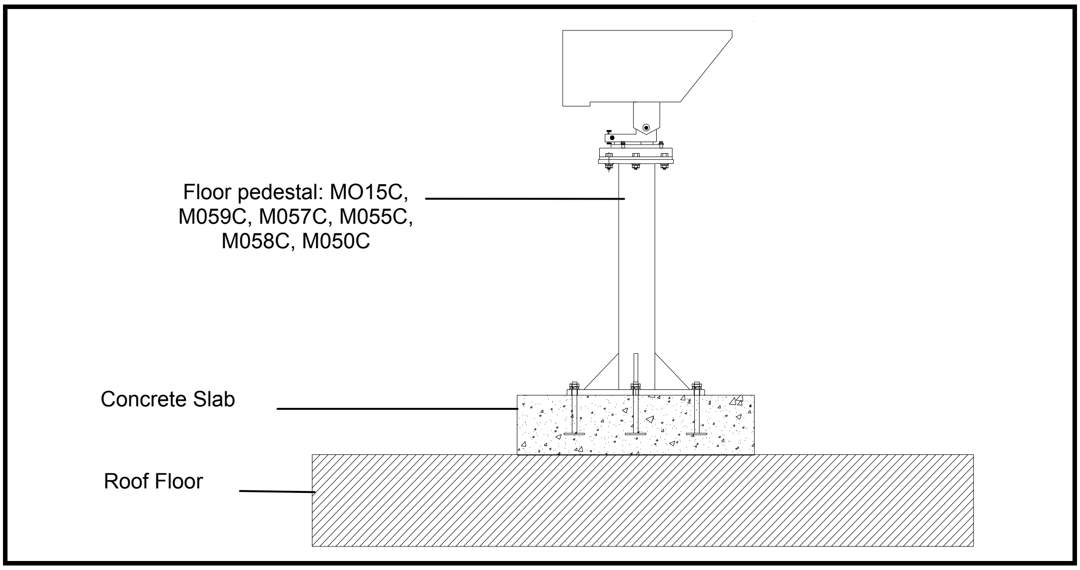


Figure 18: Mounting on a Concrete Slab

Mounting on a Fragile/Crumbly Wall

At sites where installation on fragile (pre-fab) or crumbly (old or red brick) walls is unavoidable, the best way to securely fix the vertical mounting brackets is to use a metallic clamping plate[8]. The clamping plate provides greater rigidity and stability.

The technique for mounting on such walls is illustrated in *Figure 19*.

[7] The pedestal is supplied by *MRV* ™ on customer order.

[8] The metallic clamping plate is supplied by *MRV* ™ on customer order.

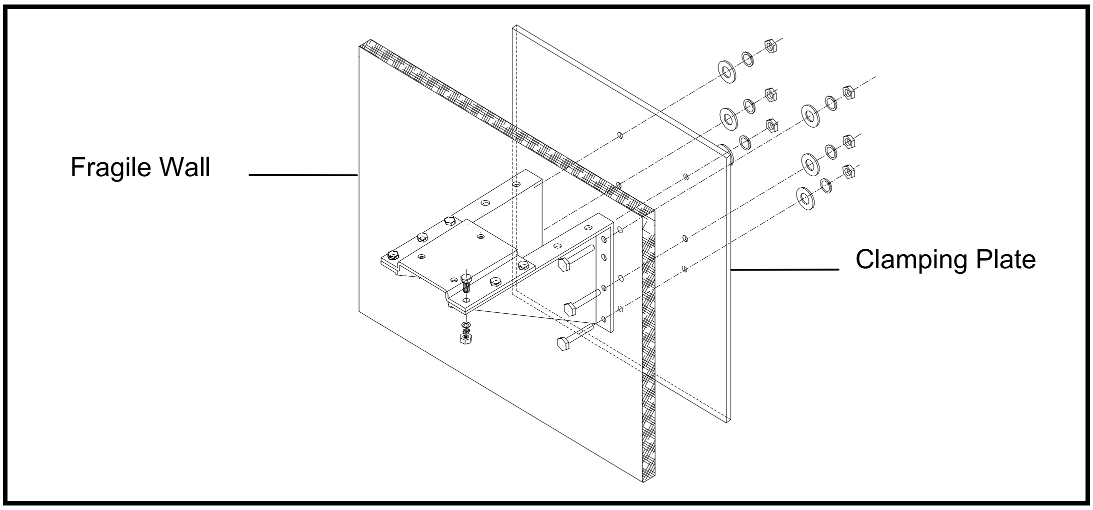


Figure 19: Mounting on a Fragile Wall

Alignment

General

Point-to-point connections require face-to-face orientation of both transceiving ends of the link. With wireless optical links, the beam spot should be positioned symmetrically on the remote receiver, as accurately as possible.

Tools and Equipment

Note

The customer can order patch cables and high-output portable source from *MRV*.

The following tools and equipment are required at each link end:

- A communication device (mobile phone or walkie-talkie)
- 850 nm fiberoptic light source with 4 to 8 dBm output power to be launched into the 100 μm fiber. The precise output power required depends on the cable attenuation.
- Optical-power meter, preferably giving readings in milliwatts/microwatts rather than in dBm.
- Patch jumper fiberoptic cable (100/140 μm) – for the light source
- Patch jumper fiberoptic cable (400/430 μm or 600/630 μm) – for the power meter.

If there is no other light source available, the OptiSwitch module or Media Converter transmitter (**Tx** port) may be used as the light source. The Tx port emits rated power upon power-up. No data transmission is required.

> **Caution!**
>
> Cover the fiber output from view or turn off the light source until ready to connect it to the link.

Procedure

The alignment procedure is done in two stages:

- Coarse Alignment
- Fine Alignment

Coarse Alignment

1. Slightly loosen the Horizontal Motion Locking Bolts and the Vertical Motion Locking Bolts (two on each support bracket) – see *Figure 16*.
2. To enable maximum flexibility during the fine alignment stage, rotate the fine alignment screws (*Figure 20*) until the alignment bar is centered.
3. While looking (see note below) through the telescope, rotate and tilt the TereScope 1 to bring the telescope crosshairs on the telescope lens of the opposite TereScope 1.

> **Note**
>
> The laser used in the Opto-electronic modules is Class 1M and sighting it through the telescope from 10 m (33 ft) is not harmful. Even so, exposure time should be minimized.

4. Tighten the four coarse alignment screws and four bolts by applying a torque less than 20 Newton-meter.

Fine Alignment

General

The purpose of fine alignment is to position the center of the transmitted beam spot on the center of the TereScope 1 receiver – in both directions. This is achieved by adjusting the horizontal and vertical motion screws (shown in *Figure* 20) until maximum power is received at the opposite TereScope 1.

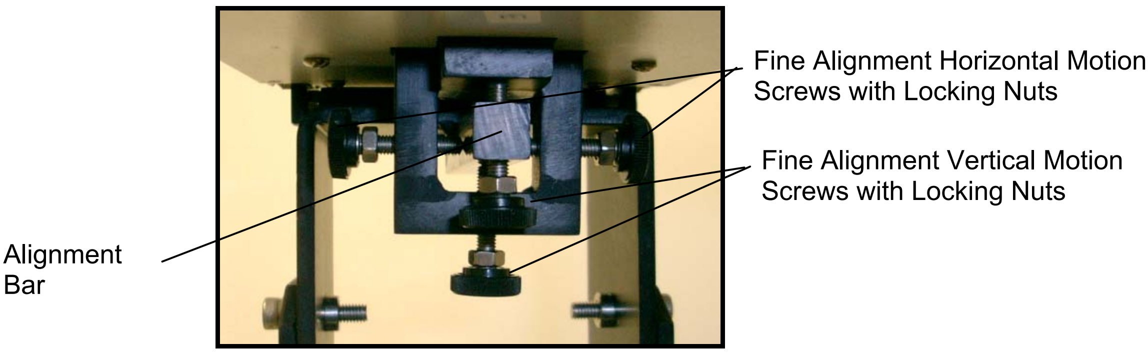


Figure 20: Fine Alignment Motion Screws – Rear View

Fine Alignment Vertical Motion Screws – Two screws. Used for fine rotation of the TereScope 1 in the *vertical* plane. Both screws are required to lock a vertical position.

Fine Alignment Horizontal Motion Screws – Two screws. Used for fine rotation of the TereScope 1 in the *horizontal* plane. Both screws are required to lock a horizontal position.

To use *any* fine alignment screw, its nut must first be released.

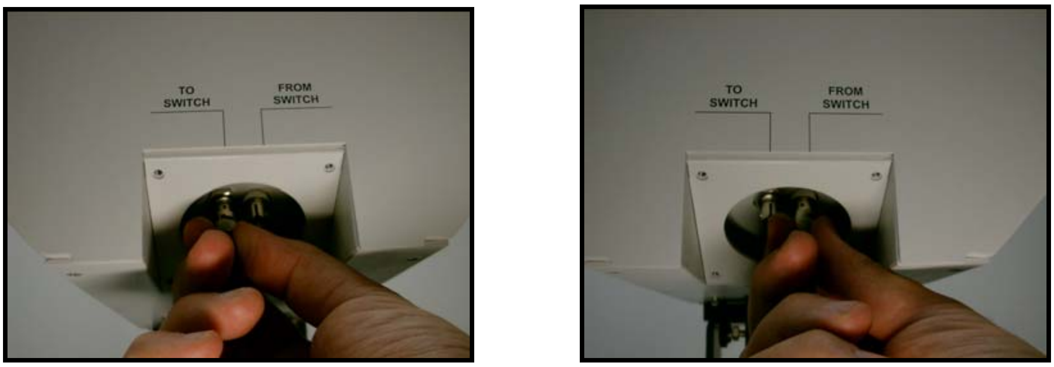
<u>Procedure</u>

Note

Two installers are required for fine alignment, one at each TereScope 1 site.

The fine alignment procedure is as follows:

1. Make certain the power meter is set for 850 nm wavelength.
2. At one TereScope 1 (Site A), remove the flange and duct (shown in *Figure 24*). Referring to *Figure* 21, do either <u>one</u> of the following:
    a. Connect one end of the yellow-sheathed cable to an OptiSwitch module or Media Converter and the other end to the TereScope 1's **FROM SWITCH** connector, as shown in *Figure 29* and *Figure 30* <u>or</u>
    b. Connect a light source with a 100/140 µm patch cable to the **FROM SWITCH** connector.
3. At the other TereScope 1 (Site B), remove the flange and duct. Referring to *Figure 21*, use the patch cable (400/430 µm for Model A and 600/630 µm for Model C) to interconnect the optical power meter and the **TO SWITCH** connector.



TO SWITCH Connector **FROM SWITCH** Connector

Figure 21: Connectors for Fiberoptic Cables

4. At Site A, turn the horizontal motion screws until the installer at Site B reports maximum received power. (This assures that the beam spot is positioned symmetrically in the left-right direction about the TereScope1 receiver located behind the telescope lens, as shown in *Figure 22*.) Close the screws lightly – do *not* tighten!

5. At Site A, turn the vertical motion screws until the installer at Site B reports maximum received power. (This assures that the beam spot is now positioned at the center of the TereScope1 receiver located behind the telescope lens, as shown in *Figure 23*. The received power should be *about* the same as the expected power given in *Table* 3 of *Appendix F: Received Signal Power vs Distance*. *Table* 3 shows expected power for various distances.) Record the maximum received power in μW.

> **Note**
>
> This power reading is the sum of both signal and background light.
> On a sunny day, for long air links, the background light may add significantly to the true signal power. The problem is resolved in Steps 8 and 9.

6. Repeat the horizontal and then the vertical alignment to ensure maximum reading.
7. Tighten all the fine alignment screws and locking nuts.
8. Disconnect or turn off the light source, then measure and record the background light power in dBm.
9. Subtract the background reading from the recorded maximum received power in Step *5* to get the signal power. This signal power should be *close* to the expected power given in *Appendix F: Received Signal Power vs Distance*.
10. Repeat Steps *1* to *9* for the opposite direction.

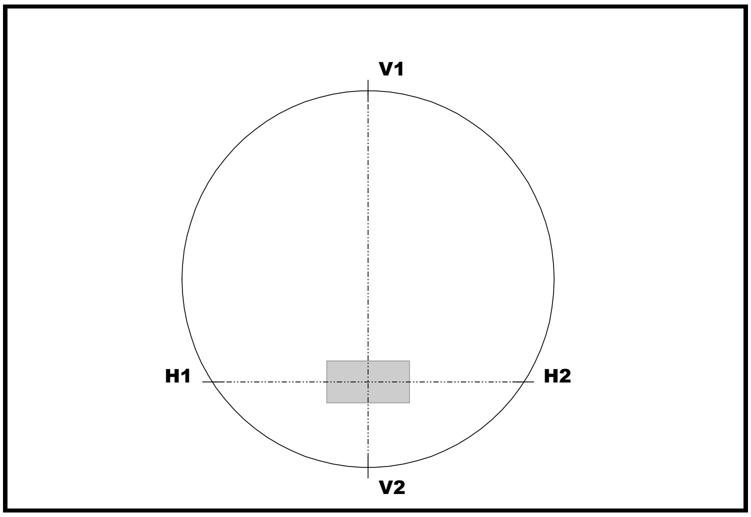


Figure 22: Beam (circle) *on* Receiver (rectangle) after Horizontal Alignment

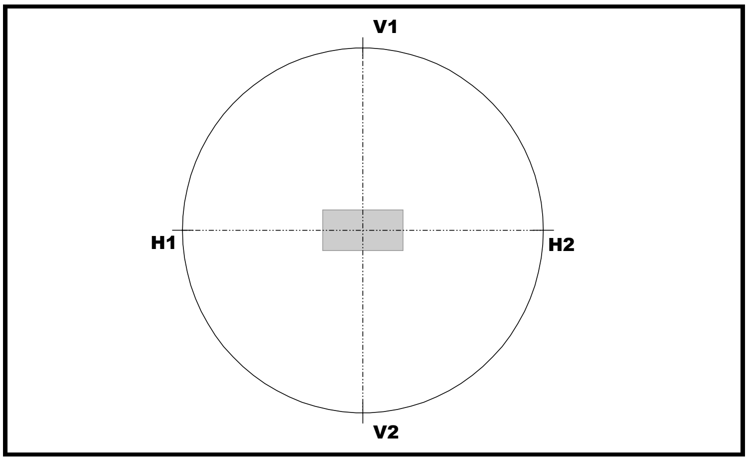


Figure 23: Final Beam after Horizontal and Vertical Alignment

Connecting the TereScope 1s, Media Converters, and Switches

1. At one of the two TereScope 1s of the link, release the flange and duct (shown in *Figure 24*) by unscrewing the flange.

Figure 24: Flange and Fiberoptic Cable Duct

2. After cutting off the unshrunk portion of the sleeve on the fiberoptic cable end, carefully slip the cable through the duct and flange.

3. To connect the heating circuit (recommended option):

   a. Extract the green pluggable terminal block from the socket in the TereScope 1 as shown in *Figure 25*.

Figure 25: Extracting the Terminal Block by the Yellow Wire Loop

   If the yellow wire loop is missing or slips when trying to extract it, use a pair of pliers as shown in *Figure 26*.

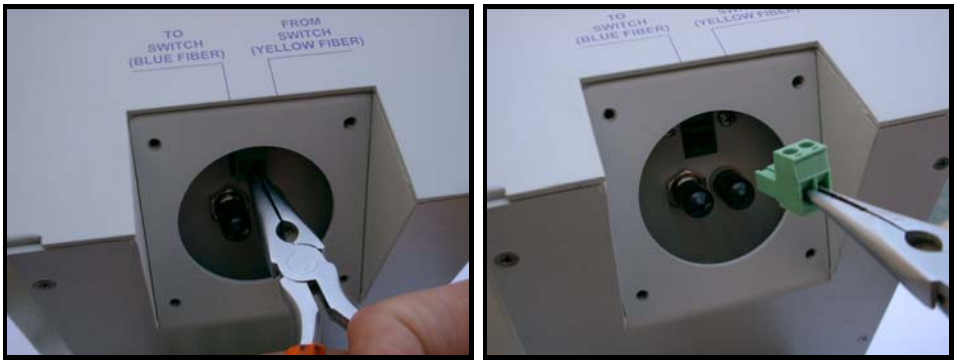


Figure 26: Extracting the Terminal Block by a Pair of Pliers

   b. Remove and trash the yellow wire loop attached to the terminal block.

   c. Strip the two copper wires and, using a screwdriver, connect them to the two prongs of the terminal block.

   d. Plug the terminal block back into the green socket in the TereScope 1 as shown in *Figure 27.*

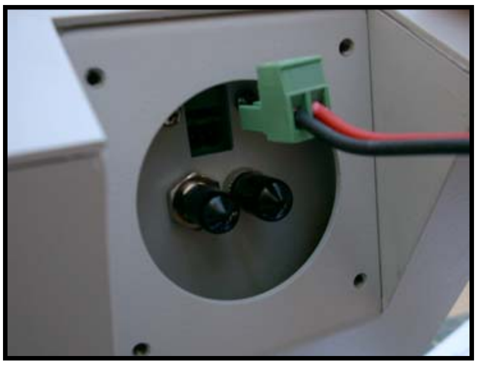


Figure 27: Insertion of the Terminal Block

4. Connect the transmit fiber (yellow-sheathed) to the **FROM SWITCH** connector, and the receive fiber (blue-sheathed) to the **TO SWITCH** connector.
5. Verify that the connectors are coupled well.
6. Screw the flange back into place, making sure it is firmly tightened.
7. Repeat Steps *1* to *6* for the other TereScope 1 of the link.
8. If you have MRV[9] OptiSwitches, connect the TereScope 1s as shown in *Figure 29*.
   If you do not have OptiSwitches, connect the TereScope 1s to switches via MRV MC102/P as shown in *Figure 30*.
9. If the heater is to be used, do the following at the indoor end of the cable:
   a. Strip the two copper wires of the cable.
   b. Strip the two copper wires of the output of the MRV heater power supply (15 V, cat no. 1406700).
   c. Connect each power supply output wire to one cable wire using the wire-nuts provided as shown in *Figure 28*.

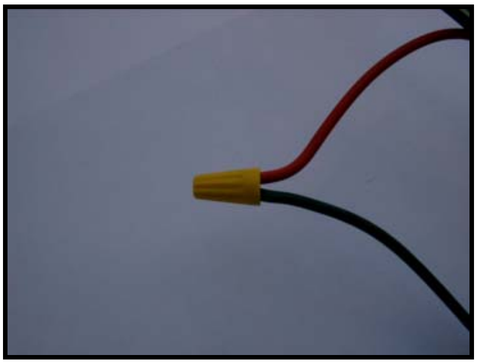
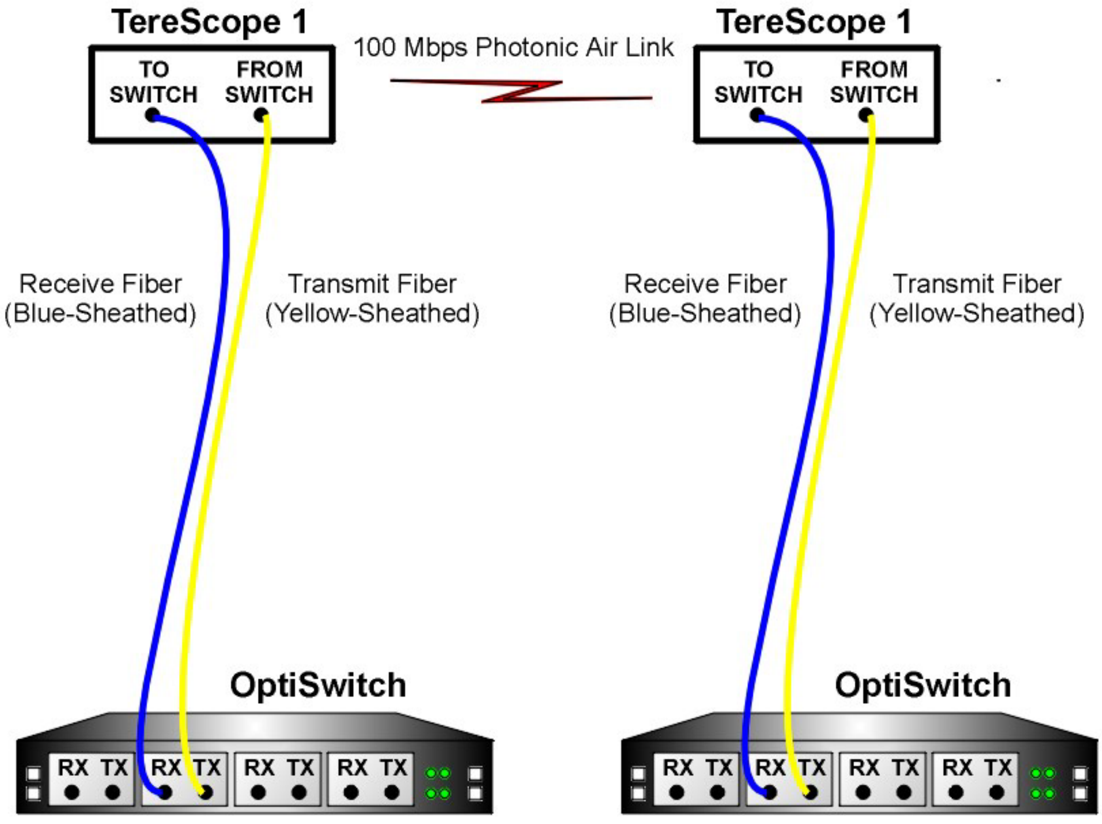


Figure 28: Connection of the Wires from the TereScope 1 to the Heating Power Supply Connector

   d. Plug the power supply into a wall socket using a standard IEC 320/C8 (shaver and stereo style) cord (not supplied by MRV).

[9] MRV Communications Inc.



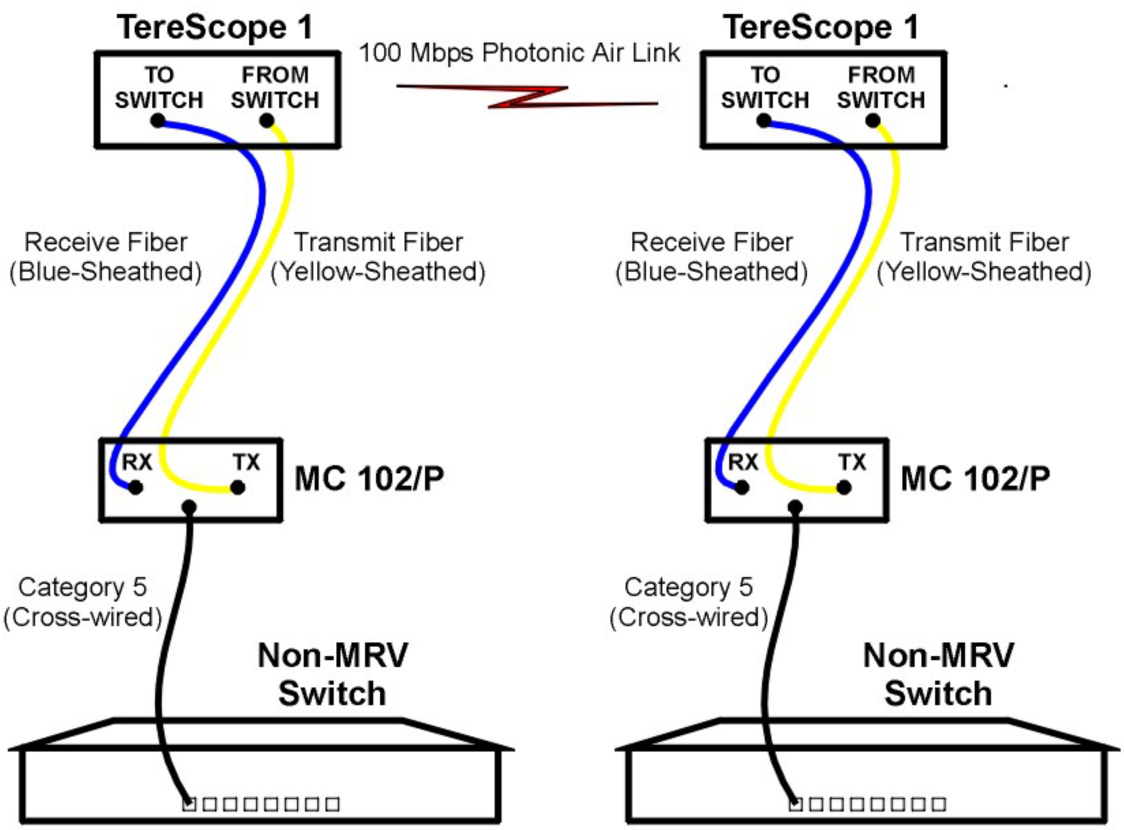
TereScope 1

Characteristic	Model	
	A	C
Operating Range (max)	240 m (800 ft) at 17 dB/km	470 m (1540 ft) at 17 dB/km
Transmitter Core/Cladding Diameters	100/140 μm	100/140 μm
Receiver Core/Cladding Diameters	400/430 μm	600/630 μm
Beam Divergence	6 mrad	3.65 mrad

OptiSwitch

Module	Model	
	A	C
	EM 2003-2PAL/A	EM 2003-2PAL/C

Figure 29: Interconnection of TereScope 1s and OptiSwitches



TereScope 1

Characteristic	Model A	Model C
Operating Range (max)	240 m (800 ft) at 17 dB/km	470 m (1540 ft) at 17 dB/km
Transmitter Core/Cladding Diameters	100/140 μm	100/140 μm
Receiver Core/Cladding Diameters	400/430 μm	600/630 μm
Beam Divergence	6 mrad	3.65 mrad

MC 102/P

MC 102/P/A	Applicable to TereScope 1 Model A
MC 102/P/C	Applicable to TereScope 1 Model C

Non-MRV Switch

The non-MRV switch port to which the MC102/P is connected must be able to operate at 100 Mbps and in full-duplex mode.

Figure 30: Interconnection of TereScope 1s, Media Converters, & Non-MRV Switches

Link Test

For OptiSwitch

In the network in Figure 29, perform ping test for the remote OptiSwitch to check if link connectivity is OK.

For Media Converter

In the network in Figure 30, perform ping test for the remote Non-MRV switch to check if link connectivity is OK.

Installation Log

In the Installation Log, record all the information about the installation (including the optical power received power at the OptiSwitch. This power reading can be obtained using the OptiSwitch CLI command `get-pal-port-optical-power`). For the MC102/P, the received power reading appears at the top left hand corner on the front panel, in the same scale as that of the Optiswitch). This information will be a valuable reference for future maintenance and troubleshooting.

Operation and Management

The TereScope 1 becomes fully operational as soon as it is installed.

TereScope 1 operation can be monitored through the OptiSwitch's CLI with either of the following management stations:

- ASCII terminal/emulator (e.g., VT100 terminal or emulator)
- TELNET station
- SNMP NMS
- Web-based NMS

For connection and setup details for ASCII terminal/emulator or TELNET station, refer to the OptiSwitch User Manual.

For Web-based monitoring of the TereScope 1, refer to *MRV* MegaVision NMS User Manual.

Table 2 lists and describes the CLI commands for the TereScope 1. These commands are in the **`port-cfg`** menu of the OptiSwitch CLI.

Table 2: CLI Commands for TereScope 1

No.	Command	Description
1	**`get-pal-port-optical-power`**	Show the reading of the received optical signal power at the port of the pal (TereScope 1). `[arg #`[10]`0]` Ports Argument choices are: **<slot #>.<port # in slot>-<slot #>.<port # in slot>-** etc (i.e., individual ports.) **<slot #>.<port # in slot>..<slot #>.<port # in slot>** (i.e., range of ports) Readings of the optical signal power are limited to the range 0 to 15. To determine the reading in dBm, use Figure 31.
2	**`set-pal-sampling-rate`**	Set the pal (TereScope 1) optical power sampling rate. **opt.[arg #0]** <Time interval in minutes>. Default: **1**. **opt.[arg #1]** <Time interval in seconds>. Default: **0**. Example: To set the sampling time interval to 3 minutes and 35 seconds, type **`set-pal-sampling-rate 3 35`**.

Figure 31 shows how to convert the received optical signal power *reading* obtained with the CLI command `get-pal-port-optical-power`. The vertical axis shows the reading and the horizontal axis shows its value in dBm. The reading is accurate to ± 1 dB.

[10] # is number.

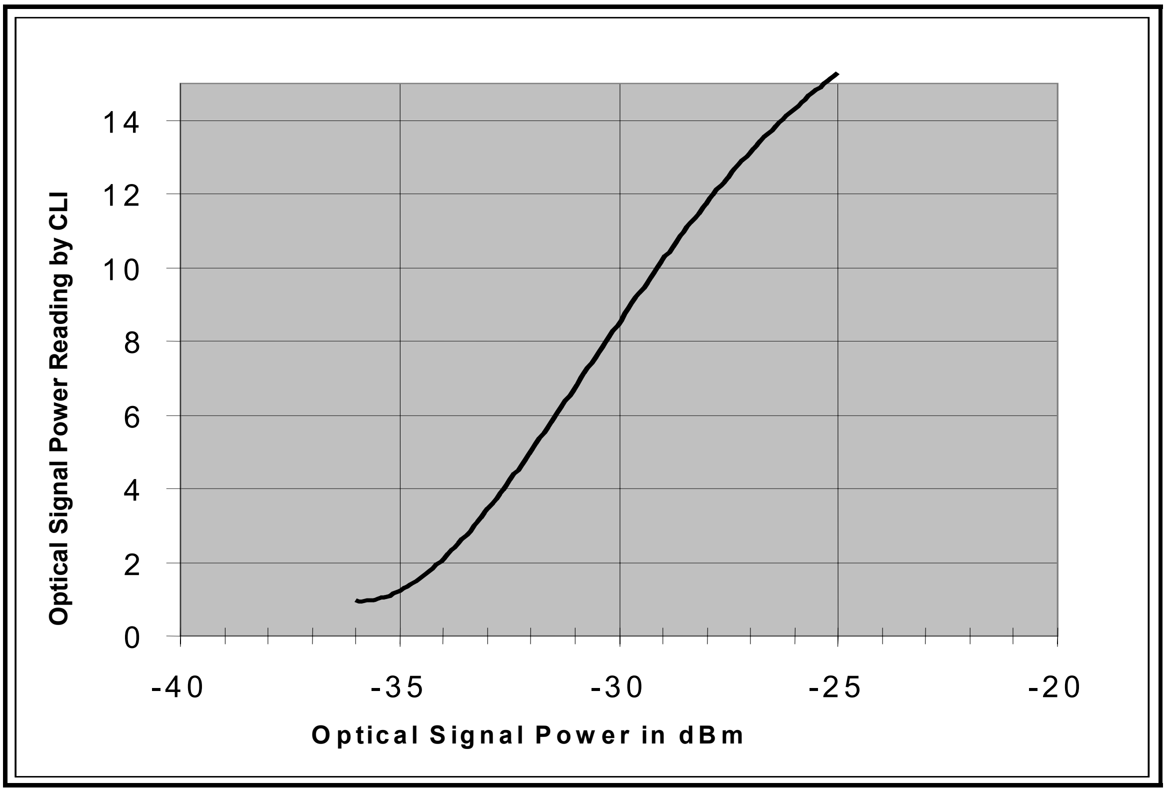


Figure 31: Conversion of Optical Signal Power Reading by CLI or MC102/P Front Panel to dBm

Troubleshooting

Since the TereScope 1 is a passive device, it is unaffected by EMI, RFI, power cuts, etc. Only violent physical disturbances or faulty optical power input from the OptiSwitch module may cause the device to malfunction.

The following procedure shows how to troubleshoot a faulty optical power input. Follow the steps in the order given until the problem is resolved. If the problem persists, consult your *MRV* representative.

1. Ensure that the fiberoptic cable at the OptiSwitch is properly connected.
2. Invoke the CLI command **`get-pal-port-optical-power`** for the OptiSwitch module port connected to the TereScope 1. For MC102/P, check the reading on its front panel.
   If the power is too low, first make sure that there are no interferences with the air link (e.g., fog, smoke, dust, etc.).
3. Ensure that the fiberoptic cable at the TereScope 1 is properly connected.
4. Ensure that the fiberoptic cable (connectors, etc.) is not physically damaged.
5. Ensure that there are no unnecessary bends or pressure on the optical cable anywhere in the building or on the roof.
6. Ensure that there is no physical damage to the TereScope 1.
7. Ensure that the optical link attenuation is less than the power budget of the OptiSwitch module.
8. Repeat Steps *1* to *7*, above, for the other TereScope 1 of the link.

Appendix A: Product Specification

Protocol			
Fast Ethernet			
Link Beam			
Transmitted Beam Divergence Model A Model C	 6 milliradians 3.65 milliradians		
Receiver Aperture Diameter	85 mm		
Receiver Field-of-View	6 milliradians		
Operating Range			
Attenuation	**Weather Condition**	**Maximum Range**	
		Model A	**Model C**
17 dB/km	Moderate rain	240 m	470 m
30 dB/km	Blizzard, cloudburst	200 m	360 m
Management			
MegaVision ™ (SNMP), TELNET, Serial/RS-232			
Fiberoptic Cable			
Maximum length	Up to 50 meters at each link end		
Attenuation	10 dB/km		
Transmit Fiber: Sheath Core/Cladding Diameters: Model A Model C	 Yellow 100/140 μm 100/140 μm		
Receive Fiber Sheath Core/Cladding Diameters: Model A Model C	 Blue 400/430 μm 600/630 μm		
Copper Wires	2 (one black the other red), #20 AWG		
Fiber Bend Radius (min. permitted) Model A Model C	 60 mm (2 1/2 in) 120 mm (5 in)		
Cable Bend Radius (min. permitted)	210 mm (8.25 in)		
Fiber Connectors	ST ™		
Heating System			
Power supply	<u>Use only MRV Cat. No. 1406700</u> 15 V @ 1.0 or 1.2 A		

	Class II double insulated (3000 VAC) Class 2 power limited output UL, cUL, TUV approved 1950 or 60950
Power supply input connector	IEC 320/C8 (2 prong shaver type)
Environmental	
Temperature Operating: Storage:	 -40 to +60 °C (-40 to 140 °F) -40 to +60 °C (-40 to 140 °F)
Humidity (non-condensing)	Less than 90%
Housing	Weatherproof (IP-66)
Physical	
Dimensions (W x H x D)	248 x 155 x 375 mm ^{3} ($9^3/_4$ x $6^1/_8$ x $14^3/_4$ in^3)
Weight (including mounting accessories)	4.5 kg (10 lb)
Torque applicable to Coarse Alignment Screws (max)	20 Newton-meter
Standards Compliance	
Media Access Safety	IEEE 802.3u CSMA/CD Designed to comply with UL-1950; CSA 22.2 No. 950; FCC Part 15, Class B; CE-89/336/EEC, 73/23/EEC, IEC 1M Laser safety, IP-66
Part Numbers	
Model A	TereScope100/A/DST
Model C	TereScope100/C/DST

Appendix B: Required Materials

Electro-Optic Modules

The electro-optic modules are designed to send and receive optical data through the link. The following two types of electro-optic modules are available:

OptiSwitch Module

The OptiSwitch module is a special plug-in module for use in *MRV'* OptiSwitch family of OSI Layer 2 and 3 compliant switches. For more information, please refer to the relevant OptiSwitch manual.

Media Converter

The media converter is designed to convert between the TereScope 1 format and fiberoptic 100Base-FX (or copper 100Base-T) format. For more information, please refer to the manuals of the media converter and your network equipment.

Installation Tools

- Electric drill with impact action for masonry, reversible motion, speed control, and a 0-13 mm adjustment chuck.
- Concrete carbide drill bits: 6 mm, 12 mm, and long (30 cm) 12 mm for penetrating concrete walls.
- Power screwdriver.
- Threading equipment.
- Toolbox containing: "Hex driver (Allen) set; open-ended wrench from 6 mm to 17 mm; hammer (200 g); regular pliers; long-nose pliers; cutter; flat-tip screwdrivers, Philips screwdrivers; exactor knife; Socket wrench for 8 mm, 10 mm, 11 mm, 12 mm, 14 mm, ½-inch, etc.

Equipment for Fiber Test and Link Alignment

- Fiberoptic power meter for 850 nm (e.g. of EXFO or ACTERNA).
- Fiberoptic multi-mode light source of 850 nm wavelength for multimode fibers (e.g. of EXFO or ACTERNA).
- Visual fault locator.
- Fiberoptic jumper – 1 m, 100/140 μm core/cladding diameters
- Fiberoptic jumper – 1 m, 400/430 or 600/630 μm core/cladding diameters

Appendix C: Site Survey Form

MRV Communications, Inc.		TereScope® LINK SITE SURVEY FORM	
City		Date	________/________/2004
Street Address		Company Name	

Line of Sight		NOTES
Check Path for:	√	
Trees		
Growing trees		
Birds nesting		
Power line movement		
Local atmospheric disturbances		
Hot surfaces		
Pedestrian or vehicle traffic		
Exhaust or dust clouds		
Exhaust vents		
Photo taken of underlying terrain (Photo of area below line of sight)		
Photo taken of "line-of-sight"		
Photo taken of rooftop		

Transmission through a Window	
Number of window surfaces	
Reflective coating on window	
Precipitation collection areas	
Beam angle to window	

Range & Location Information	
Distance between sites (m)	
Method used to measure distance: (GPS, laser binoculars, maps, other)	
Number of links to be installed at the site	
Bearing to the receiving site (as measured with compass)	E__________ ° W__________ °

Cabinets for Routers & Switches (if applicable)	
19" rack mount space (in U, 1U = 1 $^{3}/_{4}$ in)	
Large cabinet	Yes/No
Small cabinet	Yes/No

Mounting Environment & Stability	
Vibration Sources	
Compressors or Motors	
Elevators	
Mounting area, wall type	Concrete/ red brick/ block/ Marble Other__________
Expected minimum and maximum temperatures	
Microwave dishes	
Electromagnetic interference sources	
Antennas	
Other electronic equipment	
Additional shelter requirements	
Photo taken of mounting location	

Mount Placement (Best available mount placement on building)	
Mounting Brackets Part # s	M001, M015C, M022C, M050C M051C, M053C, M054C, M055C M056C, M057C, M058C, M059C M062C, M063C, M064C, PCL3 PCL4, PCL5, PCL6, JMP
Elevation angle	______ °
Mounting adaptor needed	
Dimensions for adaptor	

Power	
Power Source	Main and/or UPS
Voltage & Frequency (AC)	110Vac/60Hz or 220 Vac/50Hz
Voltage (DC)	24 Vdc, 48 Vdc, other_________
TereScope Lightning Rod (Recommended optional accessory)	Yes / No
Cable Length for TS 1 PAL	25 m, 50 mother_______

Data Interface	
Data Rate (Mbps)	1Gbps, 622 Mbps, 155 Mbps, 100 Mbps, 34 Mbps, 10 Mbps, E1, T1, 4E1, other____
Host Network Equipment	
Fiber Wavelength	850 nm, 1310 nm, MM, SM
Optical Connector	SC/PC, ST/PC, other_________
Other connectors	RJ45, RJ48, BNC, other_______

TereScope Model Required____________________

Appendix D: Cleaning Optical Connectors

General

Intrusions (e.g., dust, grease, etc.) at the interface of two optical fibers, such as at a pair of coupled connectors, attenuate the signal through the fiber. Consequently, optical connectors must be cleaned before they are coupled with other connectors.

Tools and Equipment

Following are tools and equipment required for cleaning connectors.

- **Dust caps**
  Caps for protecting the connector from intrusions. A cap is usually made from flexible plastic. When placing a cap over a connector, avoid pressing it against the fiber ferula surface in the connector so as to prevent contamination.
- **Isopropyl alcohol**
  Solvent for contaminants.
- **Tissues**
  Soft multi-layered fabric made from non-recycled cellulose.

Procedure

The procedure for cleaning connectors is as follows:

1. If no stains are present, using a new clean dry tissue, gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove dust.
2. If stains are present,
   A. Moisten a new clean dry tissue with isopropyl alcohol and gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove the stains.
   B. Using a new clean *dry* tissue, gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove the dissolved stains and excess isopropyl alcohol.
   C. If a connector is *not* to be coupled with another immediately, cover it with a dust cap.

Appendix E: Installation Log

E.1. Client/Dealer Information

	Customer	Dealer
Company Name		
Address City Country		
Contact Person		
Tel		
Fax		
E-mail		

E.2. Application Information

Type of network	☐ T1 , ☐ E1 , ☐ Ethernet , ☐ Token Ring , ☐ Fast Ethernet ,☐ FDDI , ☐ ATM , ☐ Other (Specify)
Product	
Evaluated distance by customer	
Address of installation at Site A	
Address of installation at Site B	

E.3. Area Sketch

E.4. Installation

Done by	
Customer representative	
Date	

		Site A	Site B
System model			
Serial number			
Location: (Should be the same as by site survey, if not provide details)			
Accessories: (Should be the same as by site survey, if not provide details)			
Received Signal Strength	Total Received Power		
	Background Light Power		
	Signal Power		
Telescope calibration : if cannot , sketch the telescope view			
BER test			
BER equipment type			
Loopback location			
Error type (random, burst)			
Brief interruption test			

E.5. System failure

Visit made by	
Customer representative	
Date	

	Site A	Site B
Sketch of telescope view		

Received Signal Strength	Total Received Power		
	Background Light Power		
	Signal Power		
Failure detail			
Action items			

Visit made by	
Customer representative	
Date	

	Site A	**Site B**
Sketch of telescope view		
Digital readout		
Failure detail		

Action items		

Appendix F: Received Signal Power vs Distance

This table is provided to give the installer an estimate of the expected received signal power after fine alignment. The values given apply when an OptiSwitch or Media Converter transceiver module is used as a light source and the patch cables are as specified in the section *Tools and Equipment* under *Alignment*.

Table 3: Air Link Distance vs Minimum Required Received Signal Power

Air Link Distance (m)	Received Power for Model A		Received Power for Model C	
	μW	*dBm*	*μW*	*dBm*
10	270	-5.7		
50	*32*	*-15*	*330*	*-4.8*
100	*8*	*-21*	*84*	*-10.8*
150	*3.6*	*-24.5*	*37*	*-14.3*
200	*2*	*-27*	*21*	*-16.8*
240	*1.4*	*-28.5*	*15*	*-18.4*
300			*9.3*	*-20.3*
350			*6.8*	*-21.7*
400			*5.2*	*-22.8*
470			*3.8*	*-24.2*

Figure 32 shows the relation between the air link distance and expected received power (in dB) graphically.

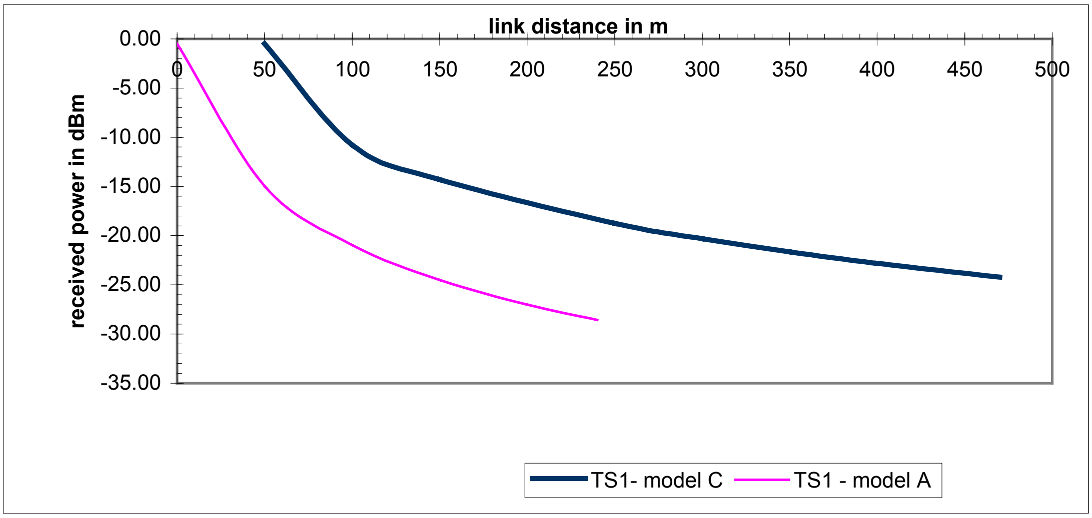


Figure 32: Air Link Distance vs Expected Received Signal Power

Appendix G: EM2003-2PAL

General

The EM2003-2PAL is used to connect up to two TereScope 1 links to the OptiSwitch with special fiberoptic cables provided by *MRV ™*. These fiberoptic cables are described in Appendix A: Product Specification.

Models

Model EM2003-2PAL/A is used with TereScope 1 Model A.

Model EM2003-2PAL/C is used with TereScope 1 Model C.

Layout

Figure 33: EM2003-2PAL Layout

Captive Screws

Two captive screws for fastening the EM2003-2PAL in the OptiSwitch.

100Base-FX Ports

Table 4: Ports of EM2003-2PAL

Protocol	100Base-FX
Number of ports (**TX**, **RX** connector pair)	Two (for two TereScope 1 links)
Connector Type	ST
Port Speed/Duplexity	100Mbps/Full-Duplex
Operating Wavelength	850 nm VCSEL
Transmitter Power (Fiber-coupled power)	Model A: 4 dBm Model C: 7 dBm
Receiver Sensitivity	-33 dBm

LEDs

Table 5: Front Panel LEDs of EM2003-2PAL

LED	Status	Significance
L 1	ON	Port **P 1** link *OK*.
	OFF	Port **P 1** link *absent* or *faulty*.
A 1	ON	Port **P 1** activity[11] *present*.
	OFF	Port **P 1** activity *absent*.
L 2	ON	Port **P 2** link *OK*.
	OFF	Port **P 2** link *absent* or *faulty*.
A 2	ON	Port **P 2** activity *present*.
	OFF	Port **P 2** activity *absent*.

Ambient Temperature

The required ambient temperature ranges for the EM2003-2PAL are as follows:

Operating: 0 to 40 °C
Storage: -10 to +50 °C

Mounting

To mount an EM2003-2PAL, do the following:

1. **Make sure that the power to the OptiSwitch is OFF.**
2. Select any available slot in the OptiSwitch.
3. If a Blank Panel is covering the slot, remove it by loosening the two screws.
4. Holding the EM2003-2PAL by the panel, place the two side edges of its metal base in the rails of the slot. Then slide it until its panel is level with the front panel of the OptiSwitch. (This assures that the module is properly inserted.)
5. Fasten the EM2003-2PAL with its two captive screws (shown in *Figure 33*).

Removing

1. ***Make sure that the power to the OptiSwitch is OFF.***
2. Loosen the two captive screws on the EM2003-2PAL (shown in *Figure 33*) and gently pull out the EM2003-2PAL.

Cabling

The yellow-sheathed fiber of an MRV special cable is connected to a **TX** connector. The blue-sheathed fiber of an MRV special cable is connected to a **RX** connector. The two copper wires are for connection of the optional MRV power supply #1406700 for heating the outdoor TereScope 1. The polarity of the wires may be ignored when connecting the wires.

[11] transmission/reception

Appendix H: MC102/P

General

The MC102/P is used to connect a TereScope 1 link to a non-MRV switch with special fiberoptic cables provided by *MRV* ™. These fiberoptic cables are described in Appendix A: Product Specification.

The MC102/P supports ordinary, VLAN, MPLS, and jumbo frames.

Models

Model MC102/P/A is used with TereScope 1 Model A.

Model MC102/P/C is used with TereScope 1 ModelC.

Layout

Figure 34: MC102/P Layout

Power Port

3-prong receptacle with universal power supply for 90-260 Vac and 60/50Hz line (mains) power input.

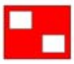
100Base-TX Port *P1*

Protocol	100Base-TX/Full-Duplex
Connector Type	RJ45 8-pin female
Pinout (MDI-X)	1→Tx+; 2→Tx-; 3→Rx+; 6→Rx-

100Base-FX Port *P2*

Protocol	100Base-FX/Full-Duplex
Connector Type	ST
Operating Wavelength	850 nm
Transmitter Power	Model A: 4 dBm ModelC: 7 dBm
Receiver Sensitivity	-33 dBm

Table 6: DIP Switch Setting

DIP Switch Toggles Position	Function
FULL 100 HALF  OFF LIN ON	Set Port **P1** to operate at 100 Mbps in *full*-duplex mode *without* LIN and *with* FEF[12] .
FULL 100 HALF  OFF LIN ON	Set Port **P1** to operate at 100 Mbps in *full*-duplex mode *with* LIN and *without* FEF.
FULL 100 HALF  OFF LIN ON	Set Port **P1** to operate at 100 Mbps in *half*-duplex mode *without* LIN and *with* FEF.
FULL 100 HALF  OFF LIN ON	Set Port **P1** to operate at 100 Mbps in *half*-duplex mode *with* LIN and *without* FEF.

Note

The MC102/P operates at 100 Mbps in full-duplex mode at both ports. Accordingly, the switch port connected to Port **P1** must be able to operate at 100 Mbps and in full-duplex mode.

Table 7: Front Panel LEDs

LED	Status	Significance
P1 L	ON	Port **P 1** link *OK*.
	OFF	Port **P 1** link *absent* or *faulty*.
P2 L	ON	Port **P 2** link *OK*.
	OFF	Port **P 2** link *absent* or *faulty*.
P1 A	ON	Port **P 1** activity *present*.
	OFF	Port **P 1** activity *absent*.
P2 A	ON	Port **P 2** activity *present*.
	OFF	Port **P 2** activity *absent*.
LIN (for P1 and P2)	ON	LIN functionality enabled for ports **P1** and **P2**.
	OFF	LIN functionality disabled for ports **P1** and **P2**.

Ambient Temperature

The required ambient temperature ranges for the MC102/P are as follows:

Operating: 0 to 40 °C
Storage: -10 to +50 °C

[12] FEF is Far-End Fault protocol

Mounting

The MC102/P is to be mounted on a wall or desktop (flat, stable, non-conductive static-free surface).

Cabling

Fiberoptic

The yellow-sheathed fiber of a special MRV cable is connected to the **TX** connector and the blue-sheathed fiber is connected to the **RX** connector. The two copper wires are for connection of the optional MRV power supply #1406700 for heating the outdoor TereScope 1. The polarity of the wires may be ignored when connecting the wires.

Electrical

The MC102/P's electrical port is connected using an electrical cable with the following specifications:

Type: Straight-wired (for connection to a DTE, e.g., PC, etc.) or a cross-wired (for connection to a DCE, e.g., switch, hub, etc.), Category 5, STP or UTP, 2-pair – see **Wiring** below.

Length: Up to 100m (330 ft)

Connector: RJ45 male 8-pin.

Wiring: The wiring of a *straight-* and *cross-wired* cable are shown in Figure 35.

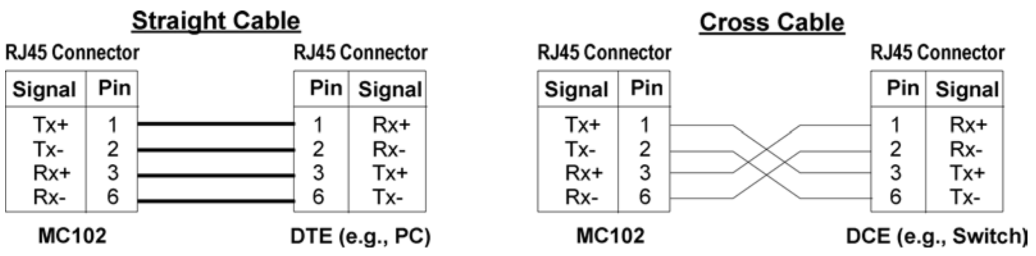


Figure 35: Cable Wiring