Plug & Play Wireless CPU®

Integra M2106+
Product Specification

Reference: **WA_DEV_M2106+_PTS_003**
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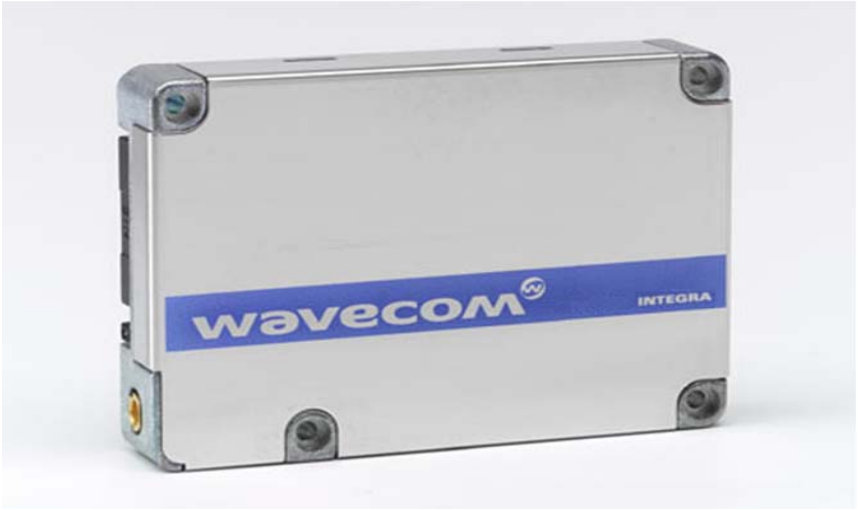
Date: **April, 2007**



Supports Open AT® embedded ANSI C applications

Document Information

Revision	Date	History of the evolution	
001	April 2007	Creation	

Caution

Information furnished herein by Wavecom is accurate and reliable. However, no responsibility is assumed for its use. Please read carefully the safety precautions for an application based on the Integra M2106+ Wireless CPU®.

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Overview

This document defines and specifies the Integra M2106+ Plug & Play Wireless CPU®. It also contains guidelines for application design and recommendations to use the Integra development kit.

This Plug and Play Wireless CPU® is an E-GSM/GSM - GPRS Class 10 900/1800 product, based on the Q24 Wireless CPU® which supports Open AT® by default.

Open AT® is the world's most comprehensive cellular development environment, which allows embedded standard ANSI C applications to be natively executed directly on the Wireless CPU®.

This Product Specification document covers the Wireless CPU® alone and does not include the programmable capabilities provided via the use of Open AT® Software Suites.

For detailed software programming guides, refer to the documents shown in the "Reference Documents" section.

Contents

List of Figures

1 References

1.1 Reference Documents

Note: All below documents are related to V3.12 Open AT® Software and 6.57a Open AT® Firmware. Wavecom recommends that the developer should check the web site for the latest documentation

1.1.1 Open AT® Software Documentation

[1] Getting started with Open AT® (Ref. WM_ASW_OAT_CTI_00001)

[2] Open AT® Tutorial (Ref. WM_ASW_OAT_UGD_00001)

[3] Tools Manual (Ref. WM_ASW_OAT_UGD_00003)

[4] Open AT® Basic Development Guide (Ref. WM_ASW_OAT_UGD_00002)

[5] Open AT® ADL guide (Ref. WM_ASW_OAT_UGD_00006)

[6] Open AT® V3.12 Customer Release Note (Ref. WM_DEV_OAT_DVD_165)

1.1.2 AT Software Documentation

[7] AT commands Interface Guide for X57 Release
(Ref. WM_ASW_OAT_UGD_00044)

[8] Open AT® 6.57a FW Release Note (Ref. WM_DEV_OAT_DVD_237)

1.1.3 Other Documents

[9] Environmental conditions and environmental tests for telecommunication equipment - ETS 300 019

[10] Wavecom Acceptance and Verification Plan (Ref. WAVE Plan, Release 1.4)

[11] Power Consumption Modes Application note (Ref. WM_ASW_OAT_APN_012)

.

1.2 List of Abbreviations

Abbreviation	Description
AC	**A**lternating **C**urrent
ADC	**A**nalog to **D**igital **C**onverter
A/D	**A**nalog to **D**igital conversion
AT	**AT**tention (prefix for modem commands)
AUX	**AUX**iliary
CBS	**C**ell **B**roadcast **S**ervice
CLK	**CL**oc**K**
CMOS	**C**omplementary **M**etal **O**xide **S**emiconductor
CTS	**C**lear **T**o **S**end
dB	**D**eci**b**el
DC	**D**irect **C**urrent
DCD	**D**ata **C**arrier **D**etect
DCS	**D**igital **C**ellular **S**ystem
DSR	**D**ata Set **R**eady
DTR	**D**ata **T**erminal **R**eady
E-GSM	**E**xtended **GSM**
EN	**EN**able
ESD	**E**lectro**S**tatic **D**ischarges
ETSI	**E**uropean **T**elecommunications **S**tandards **I**nstitute
GND	**G**rou**ND**
GPIO	**G**eneral **P**urpose **I**nput **O**utput
GPO	**G**eneral **P**urpose **O**utput
GPRS	**G**eneral **P**acket **R**adio **S**ervice
GSM	**G**lobal **S**ystem for **M**obile communications
Hi Z	**Hi**gh impedance (**Z**)
I/O	**I**nput / **O**utput
KSPS	**K**ilo **S**amples **P**er **S**econd
LED	**L**ight **E**mitting **D**iode
LSB	**L**ess **S**ignificant **B**it
MAX	**MAX**imum
MIC	**MIC**rophone
MIN	**MIN**imum
MO	**M**obile **O**riginated
MS	**M**obile **S**tation

MT	**M**obile **T**erminated
PC	**P**ersonal **C**omputer
PCB	**P**rinted **C**ircuit **B**oard
PCS	**P**ersonal **C**ommunications **S**ervice
RAM	**R**andom **A**ccess **M**emory
RF	**R**adio **F**requency
RI	**R**ing **I**ndicator
RST	**R**e**S**e**T**
RTS	**R**equest **T**o **S**end
RX	**R**eceive
SAR	**S**pecific **A**bsorption **R**ate
SIM	**S**ubscriber **I**dentification **M**odule
SMS	**S**hort **M**essage **S**ervice
SPI	**S**erial **P**eripheral **I**nterface
SPK	**SP**ea**K**er
SRAM	**S**tatic **RAM**
TAC	**T**ype **A**pproval **C**ode
TDMA	**T**ime **D**ivision **M**ultiple **A**ccess
TU	**T**ypical **U**rban fading profile
TUHigh	**T**ypical **U**rban, **High** speed fading profile
TVS	**T**ransient **V**oltage **S**uppressor
TX	**T**ransmit
TYP	**TYP**ical
UART	**U**niversal **A**synchronous **R**eceiver-**T**ransmitter
USSD	**U**nstructured **S**upplementary **S**ervice **D**ata
VSWR	**V**oltage **S**tationary **W**ave **R**atio
WAP	**W**ireless **A**pplication **P**rotocol

2 General Description

2.1 Presentation

The Integra M2106+ Wireless CPU® is a self-contained E-GSM/GSM-GPRS 900/1800 dual-band Wireless CPU® and is GPRS class 10 capable.

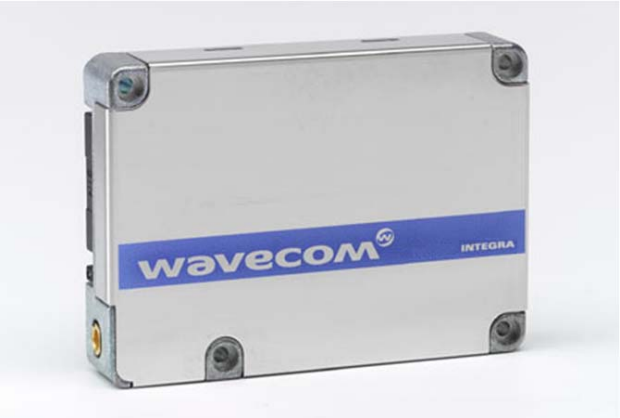


Figure 1: M2106+ view

It includes a Quik Q24 Wireless CPU® and its interfaces are available through:

- A 50-pin connector for Baseband analog and digital interfaces (General Purpose Connector)
- A RF connector, MMCX type
- A SIM card holder

Figure 2: Integra M2106+ Wireless CPU® connectors

The mating connectors for the General Purpose connector and RF connector are standard and easy-to-find.

2.2 Key Features

Integra M2106+ Wireless CPU® features:

- Open AT® programmable:
  - Native execution of embedded standard ANSI C applications,
  - Custom AT command creation,
  - Custom application library creation,
  - Standalone operation.
- Overall dimensions: 46 x 64 x 12 mm,
- Complete shielding,
- 2-Watt E-GSM 900 radio section,
- 1-Watt GSM1800 radio section,
- Full GSM or GSM / GPRS software stack,
- GPRS class 10,
- 32 Mbits of Flash memory and 16 Mbits of SRAM,
- Internal 3V/1.8V SIM interface,
- Real Time Clock (RTC) with calendar,
- Echo cancellation + noise reduction,
- Complete interfacing through a 50-pin General Purpose Connector:
  - Power supply,
  - Serial link,
  - Audio interface,
  - SIM card interface,
  - Keyboard interface,
  - GPIO.

2.3 Difference between M2106B and M2106+ Wireless CPU®

The Integra M2106+ Wireless CPU® is designed for replacing Integra M2106B Wireless CPU®. There are some feature differences between these two.

	M2106B Wireless CPU®	M2106+ Wireless CPU®
SIM Interface	3V only	3V / 1V8
SRAM size	4 Mbits	16 Mbits
RF functionalities	Dual band capability (E-GSM900 / 1800)	Quad band capability* (GSM850/ E-GSM900 / DCS1800 / PCS1900)
Signal description	--	I/O type and Reset state See section 3.1.2 details

(*) See section 2.5.2 for further details

2.4 GSM/GPRS Services

The basic services provided by the Integra M2106+ Wireless CPU® are listed in the table below:

Standard	• 900 MHz, E-GSM compliant; Class 4 (2 W). • 1800 MHz ; Class 1 (1 W) • GSM phase 2 • GPRS Class 10
Interface	• Serial interface V.24/CMOS • AT command set based on V.25ter and GSM 07.05 & 07.07. • Auto-bauding function between 2400 bits/s and 19200 bits/s • No auto-framing available
Audio	• Half rate / Full rate / Enhanced Full rate operation • Accessories (options): Handset, Car Kit
SMS	• Mobile Originated (MO) and Mobile Terminated (MT) • Mode Text & PDU point to point • Cell broad cast • In accordance with GSM 07.05
Data	• Asynchronous 2400, 4800, 9600, 14400 bits/s • Transparent and Non Transparent mode • In Non Transparent Mode: 300, 1200, 1200/75 bauds • Mode 3.1 kHz (PSTN) and V110 (ISDN)
Fax	• 2400/4800/7200/9600 bits/s, GSM teleservice 62 in Transparent Mode • Class 1 & Class 2 • Group 3 compatible
GPRS	• Class 10 • Coding schemes: CS1 to CS4 • Compliant with SMG31bis
SIM	• Plug-In SIM 3V/1.8V • Full compatible with GSM 11.11 • SIM Toolkit Release 97

2.5 Functional Description

2.5.1 Block Diagram

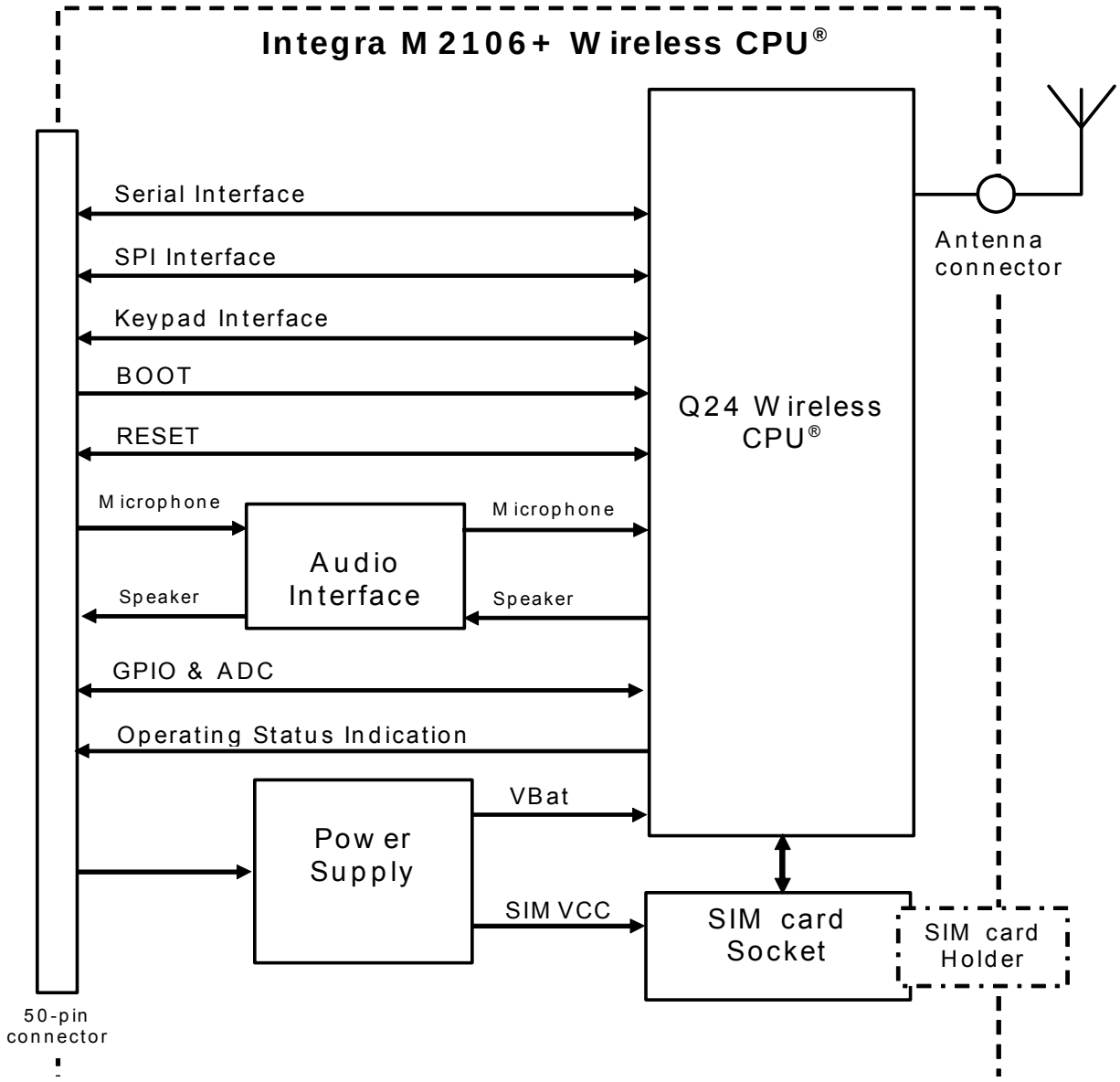


Figure 3: Functional architecture

2.5.2 RF Functionalities

The Radio Frequency (RF) functionalities comply with the Phase II E-GSM 900 / DCS 1800 recommendations.

The frequencies are:

	Transmit band (TX)	Receive band (RX)
EGSM 900	880 to 915 MHz	925 to 960 MHz
DCS 1800	1710 to 1785 MHz	1805 to 915 MHz

The Integra M2106+ Wireless CPU® also gives a quad band capability (GSM850, EGSM900, DCS 1800 and PCS 1900) and it is qualified by Wavecom.

Warning:

The Integra M2106+ Wireless CPU® is not certified for American market for operation band of GSM850 and PCS1900. Customers wishing to sell the Integra M2106+ Wireless CPU® in American region shall be wholly responsible for any certifications and carrier approval required.

2.5.3 Firmware

The Integra M2106+ Wireless CPU® is designed to integrate into various types of applications. For applications using an external processor to control the Wireless CPU®, the firmware offers a software interface based on AT commands.

A development kit for the Integra M2106+ Wireless CPU® is also available to test customer software applications.

2.6 CE Conformity

The Integra M2106+ Wireless CPU® bears the CE marking. This symbol guarantees the compliance of the design and implementation of the Integra M2106+ Wireless CPU® with the R&TTE directive.

2.7 RoHS Compliance

The Integra M2106+ Wireless CPU® is now compliant with RoHS (Restriction of Hazardous Substances in Electrical and Electronic Equipment) Directive 2002/95/EC which sets limits for the use of certain restricted hazardous substances. This directive states that “from 1st July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)”.

3 Interfaces

This chapter describes the hardware interfaces of the Integra M2106+ Wireless CPU®.

3.1 General Purpose Connector

A 50-pin standard connector provides the baseband analog and digital interfaces.

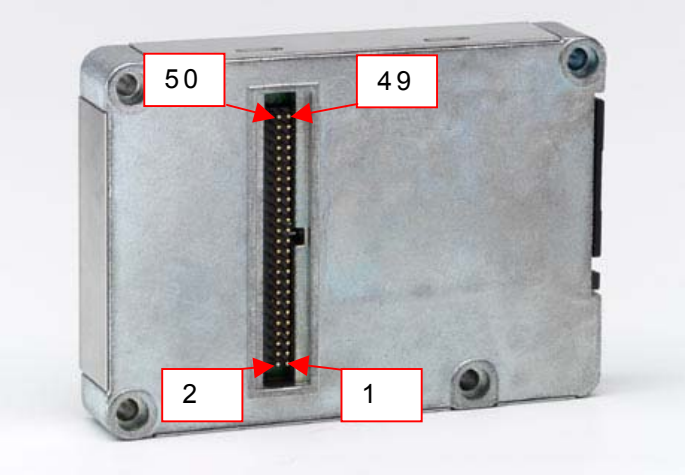


Figure 4: 50-pin connector

3.1.1 Pin Allocation

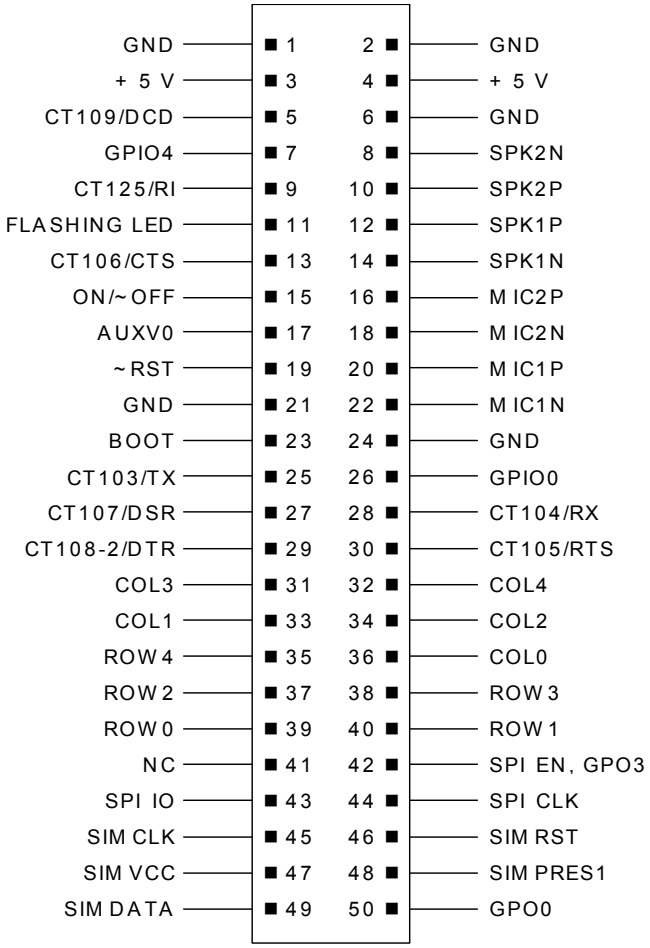


Figure 5: Pin allocation

3.1.2 Signal Description

The following table presents the main characteristics of the 50-pin connector.

Pin #	Name	I/O	Reset State	I/O type	Description	Comment
1	GND		--		Ground	High current
2	GND		--		Ground	High current
3	+ 5 V	I	--	Supply		High current
4	+ 5 V	I	--	Supply		High current
5	CT109/DCD	O	High Z	2X	Serial Link Data Carrier Detect	
6	GND		--		Ground	High current
7	GPIO4	I/O	High Z	CMOS/2X	General Purpose I/O	
8	SPK2N	O	High Z	Analog	Speaker2 negative output	
9	CT125/RI	O	High Z	2X	Serial Link Ring Indicator	
10	SPK2P	O	High Z	Analog	Speaker 2 positive output	
11	Flashing LED	I/O	High Z	CMOS/2X	Operating mode indication LED	Driven by Wireless CPU®
12	SPK1P	O	High Z	Analog	Speaker 1 positive output	
13	CT106/CTS	O	High Z	1X	Serial Link Clear To Send	
14	SPK1N	O	High Z	Analog	Speaker 1 negative output	
15	ON/~OFF	I	Pull down	--	Power control signal	ON = VCC
16	MIC2P	I	High Z	Analog	Microphone 2 positive input	
17	AUXV0	I	HZ	Analog	Auxiliary ADC input	Can be tied to GND if not used
18	MIC2N	I	High Z	Analog	Microphone 2 negative input	
19	~RST	I/O	--	SCHMITT	Reset active low	To be driven by an Open Collector. Internal pull-up 4.7 kΩ.
20	MIC1P	I	High Z	Analog	Microphone 1 positive input	
21	GND		--		Ground	High Current
22	MIC1N	I	High Z	Analog	Microphone 1 negative input	

Pin #	Name	I/O	Reset State	I/O type	Description	Comment
23	BOOT	I	Pull up	CMOS	Alternative download mode selection	To be driven by Open Collector Internal pull-up 100 kΩ
24	GND		--		Ground	High current
25	CT103/TX	I	Pull down	CMOS	Serial Link - Transmit	Pull up to +5V with 100kΩ when not used
26	GPIO0	I/O	High Z	CMOS/2X	General Purpose I/O	
27	CT107/DSR	O	Output high	1X	Serial Link Data Set Ready	
28	CT104/RX	O	Output high	1X	Serial Link – Receive	
29	CT108-2/DTR	I	Pull down	CMOS	Serial Link Data Terminal Ready	Pull up to +5V with 100 kΩ when not used
30	CT105/RTS	I	Pull down	CMOS	Serial Link Request To Send	Pull up to +5V with 100 kΩ when not used
31	COL3	I/O	Pull up	CMOS/1X	Keyboard column	
32	COL4	I/O	Pull up	CMOS/1X	Keyboard column	
33	COL1	I/O	Pull up	CMOS/1X	Keyboard column	
34	COL2	I/O	Pull up	CMOS/1X	Keyboard column	
35	ROW4	I/O	Pull down	CMOS/1X	Keyboard row	
36	COL0	I/O	Pull up	CMOS/1X	Keyboard column	
37	ROW2	I/O	Pull down	CMOS/1X	Keyboard row	
38	ROW3	I/O	Pull down	CMOS/1X	Keyboard row	
39	ROW0	I/O	Pull down	CMOS/1X	Keyboard row	
40	ROW1	I/O	Pull down	CMOS/1X	Keyboard row	
41	NC		--		Not connected	
42	SPI_EN or GPO3	O	Output high	1X or 3X	SPI enable or General purpose output	Multiplexed
43	SPI_IO	I/O	Pull up	CMOS/1X	SPI Data	
44	SPI_CLK	O	Pull up	1X	SPI Clock	

Pin #	Name	I/O	Reset State	I/O type	Description	Comment
45	SIM_CLK	O	Output low	--	Clock for SIM Interface	3V /1.8V mode
46	SIM_RST	O	Output low	--	Reset for SIM interface	3V /1.8V mode
47	SIM_VCC	O	--	Supply	SIM card supply	3V /1.8V mode 6 mA max
48	SIM_PRES	I	High Z	CMOS	SIM card detect	Connected to SIM connector pin 8. Pin 4 of SIM connector must be pulled down to GND with 1 kΩ
49	SIM_DATA	I/O	Output low	--	I/O for SIM interface	3V /1.8V mode
50	GPO0*	O	Output high	3X	General purpose output	Multiplexed

* GPO0 is a general purpose output for selection of external 3 V or 5 V SIM.

Table 1: Integra M2106+ operating conditions

Parameter	I/O type	Min	Max	Condition
$V_{input\ low}$	CMOS	-0.5 V	0.8 V	
$V_{input\ high}$	CMOS	2.1 V	3.0 V	
$V_{output\ low}$	1X	0 V	0.2 V	I_{OL} = -1 mA
	2X	0 V	0.2 V	I_{OL} = -2 mA
	3X	0 V	0.2 V	I_{OL} = -3 mA
$V_{output\ high}$	1X	2.6 V	2.86 V	I_{OH} = 1 mA
	2X	2.6 V	2.86 V	I_{OH} = 2 mA
	3X	2.6 V	2.86 V	I_{OH} = 3 mA
I clamp	CMOS		40µA	Vf max = 0.33V

3.2 Power Supply

The main power supply is provided through four pins of the General Purpose Connector:

- Pins 3 and 4 for the + 5 V
- Pins 1 and 2 for the ground (GND)

Pins 6, 21, and 24 are also the ground connection for the correct ground plane required for correct RF functionality.

A 5 V ± 5% - 1.5 A power unit is required to supply the Wireless CPU® in order to avoid serious RF malfunctions. However, the Wireless CPU® does not need a constant 1.5 A current at 5 V on this power supply.

Pin description

Pin number	Name	Reset state	Description	Comment
1	GND	--	Ground	High Current
2	GND	--	Ground	High Current
3	+ 5 V	--	Supply	High Current
4	+ 5 V	--	Supply	High Current
6	GND	--	Ground	High Current
21	GND	--	Ground	High Current
24	GND	--	Ground	High Current

3.3 ON/~OFF Control

3.3.1 General Description

This input is used to switch ON or OFF the Integra Wireless CPU®.

A high level signal must be provided on the ON/~OFF pin to switch ON the Wireless CPU®.

To switch OFF, the ON/~OFF signal must be reset and an AT+CPOF command must be sent to the Wireless CPU®.

Pin description

Signal	Pin number	I/O	Reset State	I/O type	Description
ON/~OFF	15	I	Pull down	--	Power Control Signal

Electrical characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	47		kΩ
Input Impedance (C)		50	pF

Operating conditions

Parameter	I/O type	Min	Max	Unit
V_{IL}	--	0	0.6	V
V_{IH}	--	3.4	5.6	V

Warning:

All external signals must be inactive when the Wireless CPU® is OFF to avoid any damage when starting and allow Integra Wireless CPU® to start and stop correctly.

3.3.2 Operating Sequences

3.3.2.1 Power-ON

Once the Wireless CPU® is supplied the ON/~OFF signal must be asserted high during a delay of $\mathbf{T_{on\text{-}hold}}$ (Hold delay on the ON/~OFF signal) to power-ON.

After this delay, once the firmware has completed its power-up sequence, an internal logic maintains the Wireless CPU® in power ON condition.

You must not de-assert this ON/~OFF signal before this internal logic is internally asserted by the firmware; the Wireless CPU® would not start-up otherwise

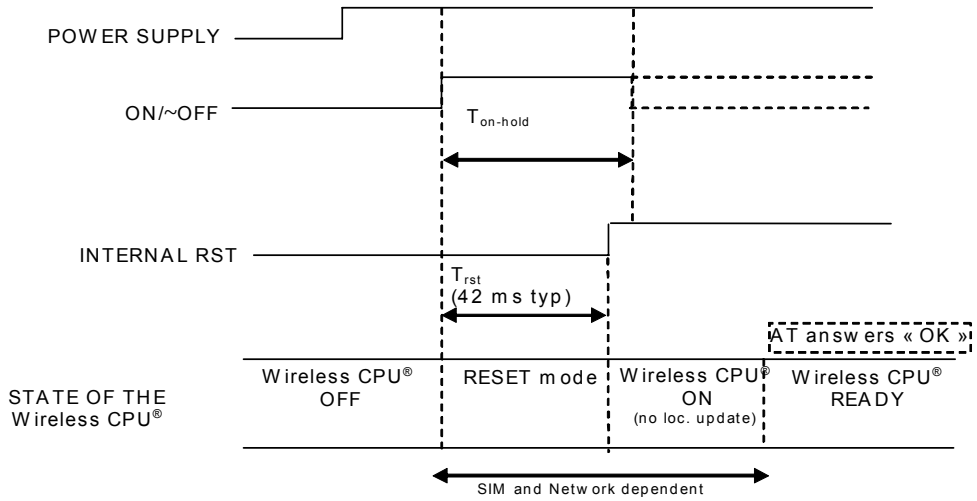


Figure 6: Power-ON sequence diagram (no PIN code activated)

The duration of the firmware power-up sequence depends on several factors:

- firmware version used by the Wireless CPU®,
- need to perform a recovery sequence if the power has been lost during a flash memory modification.

Other factors have a minor influence

- number of parameters stored in EEPROM by the AT commands received so far
- ageing of the hardware components, especially the flash memory
- temperature conditions

The *recommended* way to de-assert the ON/~OFF signal is to use either an AT command or WIND indicators: the application must detect the end of the power-up initialization and de-assert ON/~OFF afterwards.

- Send an “AT” command and wait for the “OK” answer: once the initialization is complete the AT interface answers « OK » to “AT” message[1].
- Wait for the “+WIND: 3” message: after initialization, the Wireless CPU®, if configured to do so, will return an unsolicited “+WIND: 3” message. The generation of this message is enabled or disabled via

[1] If the application manages hardware flow control, an AT command can be sent during the initialisation phase.

an AT command.

Note:

See also “AT Commands Interface Guide” [7] for more information on these commands.

Proceeding thus – by software detection - will always prevent the application from de-asserting the ON/~OFF signal too early.

If WIND indicators are disabled or AT commands unavailable or not used, it is still possible to de-assert ON/~OFF after a delay long enough ($T_{on\text{-}hold}$) to ensure that the firmware has already completed its power-up initialization.

The table below gives the minimum values of $T_{on\text{-}hold}$ for all firmware versions:

$T_{on\text{-}hold}$ minimum values

Open AT® Firmware	$T_{on\text{-}hold}$
	Safe evaluations of the firmware power-up time
6.57 & above	8 s

The above figures take the worst cases into account: power-loss recovery operations, slow flash memory operations in high temperature conditions, and so on. But they are safe because they are large enough to ensure that ON/~OFF is not de-asserted too early.

Additional notes:

1. Typical power-up initialization time figures for best cases conditions (no power-loss recovery, fast and new flash memory…) approximate 3.5 seconds in every firmware version. But releasing ON/~OFF after this delay does not guarantee that the application will actually start-up if for example the power plug has been pulled off during a flash memory operation, like a phone book entry update or an AT&W command.
2. The ON/~OFF signal can be left at a high level until switch OFF. But this is not recommended as it will prevent the AT+CPOF command from performing a clean power-off. (see also Note in section 3.3.2.2 Power-OFF for an alternate usage).
3. When using a battery as power source, it is not recommended to let this signal high:
   If the battery voltage is too low and the ON/~OFF signal at low level, an internal mechanism switches OFF the Wireless CPU®. This automatic process prevents the battery to be over discharged and optimize its life span.
4. During the power-ON sequence, an internal reset is automatically performed by the Wireless CPU® for 42 ms (typical). Any external reset should be avoided during this phase.

3.3.2.2 Power-OFF

To properly power-OFF the Integra Wireless CPU®, the application must reset the ON/~OFF signal to low and then send the AT+CPOF command to de-register from the network and switch off the Wireless CPU®.

Once the « OK » response is issued by the Wireless CPU®, the external power supply can be switched off.

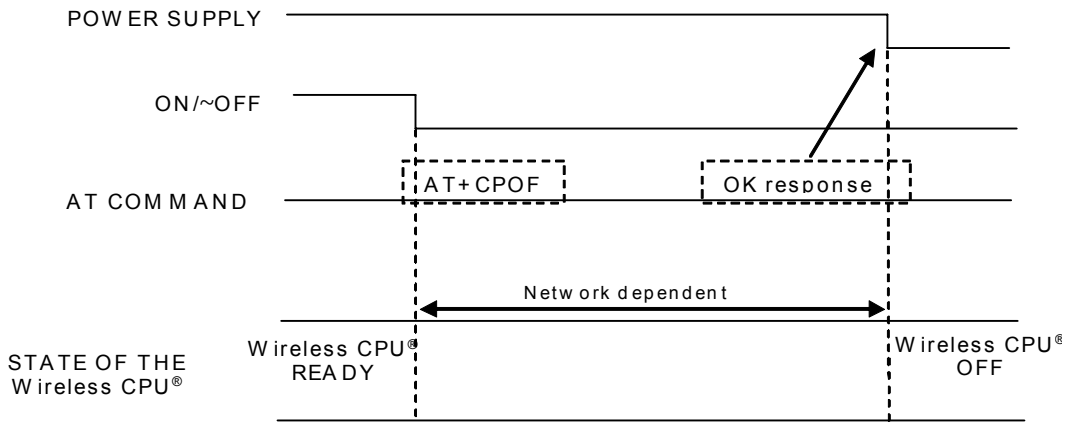


Figure 7: Power-OFF sequence diagram

Note:

- If the ON/~OFF pin is maintained to ON (High Level) then the Wireless CPU® can't be switched OFF and after using AT+CPOF command through the firmware, the Wireless CPU® enters in a Open AT® Max power consumption Mode (please refer to the "Power Consumption Modes" Application Note [11]).

3.4 Alternative Download Control (BOOT pin)

If the standard X-modem download procedure does not work correctly, an alternative download procedure can be selected with the BOOT pin. This alternative procedure requires a specific downloading software tool. See section 6.1, "Firmware Upgrade" for details.

Pin description

Signal	Pin #	I/O	Reset State	I/O type	Description
BOOT	23	I	Pull up	CMOS	Alternative download mode selection

The alternative download procedure starts when this input is low during the Wireless CPU® power-ON. In normal mode, this pin must be left open.

If used, this input must be driven either by an open collector or an open drain. See the example application diagram below.

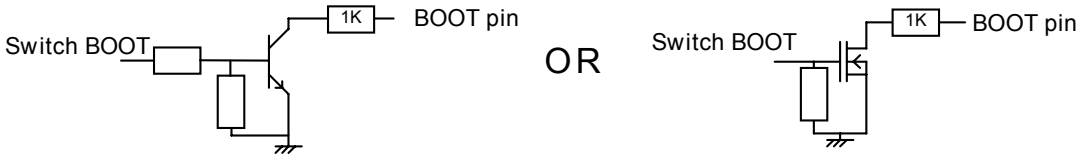


Figure 8: BOOT application schematic

- If BOOT pin = 1, the Wireless CPU® is in normal mode
- If BOOT pin = 0, the Wireless CPU® is in alternative download mode

3.5 Reset Signal (~RST)

3.5.1 General Presentation

This signal is used to force a reset procedure by providing a low level for at least 500 µs.

This signal must be considered as an emergency reset only. A reset procedure is automatically driven by an internal hardware component during the power-up sequence.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
~RST	19	I/O	--	SCHMITT	Reset

This signal can also be used as an output to provide a reset to an external device. If no external reset is necessary, this input can be left open. If it is used (emergency reset), it must be driven either by an open collector or an open drain output:

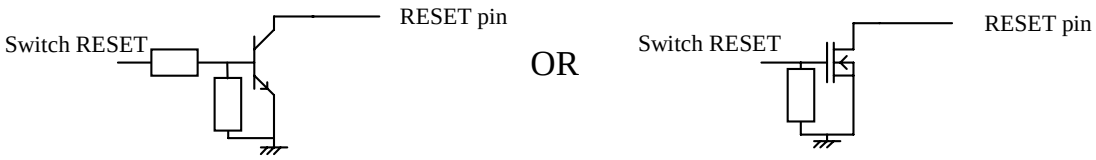


Figure 9: Reset application schematic

- ~RST pin 19 = 0, to activate Reset,
- ~RST pin 19 = 1, to deactivate Reset.

Reset signal electrical characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	4.7		kΩ
Input Impedance (C)		10	nF

Reset signal operating conditions

Parameter	Min	Max	Condition
*V_{T-}	1.1 V	1.2 V	
*V_{T+}	1.7 V	1.9 V	
V_{OL}		0.4 V	I_{OL} = -50 µA
V_{OH}	2.0 V		I_{OH} = 50 µA

* VT-, VT+: Hysteresis thresholds

- **Additional comments on Reset procedure:**

The Reset process is activated either by the external ~RST signal or by an internal signal (coming from a reset generator). This automatic reset mode is activated at Power-up.

The Wireless CPU® remains in Reset mode as long as the Reset signal is held low.

- **This signal should be used only for "emergency" resets:**

  A software reset is always preferred to a hardware reset.

3.5.2 Reset Sequence

To activate the « emergency » reset sequence, the ~RST signal must be set to low for 500 µs minimum.

As soon as the reset is completed, the AT interface answers « OK » to the application. For this, the application must send AT↵ to get the "OK" response.

If the application manages hardware flow control, the AT commands can be sent during the initialization phase. Another solution is to use the AT+WIND command to obtain an unsolicited status from the Wireless CPU®.

For further details, refer to the AT commands Interface Guide documentation [7].

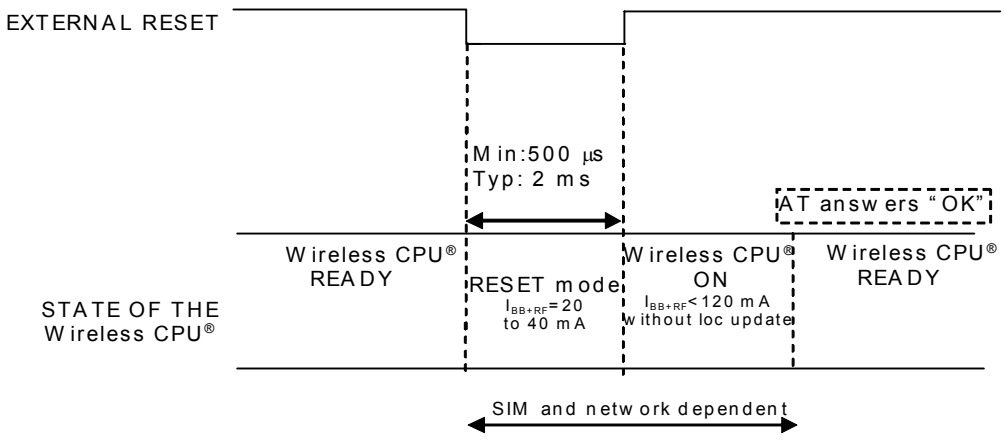


Figure 10: Reset sequence diagram

3.6 Serial Link

3.6.1 Interface Description

A serial link interface is available on the Integra M2106+ Wireless CPU®. It is compliant with V24 signaling protocol with a 2.8 V electrical interface except TX, RTS, and DTR inputs, which can be either 5 V or 3 V. This means the serial link not compliant with the V28 standard and a level shifter is required to connect to a PC.

The available signals are:

- Tx data (CT103/TX),
- Rx data (CT104/RX),
- Request To Send (CT105/RTS),
- Clear To Send (CT106/CTS),
- Data Terminal Ready (CT108-2/DTR),
- Data Set Ready (CT107/DSR).

Two additional signals are necessary to have the complete RS232 signal set:

- Data Carrier Detect (CT109/DCD),
- Ring Indicator (CT125/RI).

Pin description

Signal	Pin #	I/O	Reset State	I/O type	Description
CT103 / TX	25	I	Pull down	CMOS	Transmit serial data
CT104 / RX	28	O	Output high	1X	Receive serial data
CT105 / RTS	30	I	Pull down	CMOS	Request To Send
CT106 / CTS	13	O	Output high	1X	Clear To Send
CT107 / DSR	27	O	Output high	1X	Data Set Ready
CT108-2 / DTR	29	I	Pull down	CMOS	Data Terminal Ready
CT109 / DCD	5	O	High Z	2X	Data Carrier Detect
CT125 / RI	9	O	High Z	2X	Ring Indicator
CT102 / GND	21,24…*		--		Ground

* Any of the available GND pins can be used.

3.6.2 Application Note with Level Shifter

A level shifter (MAX3238, for example) can be used for an application requiring V28 levels.

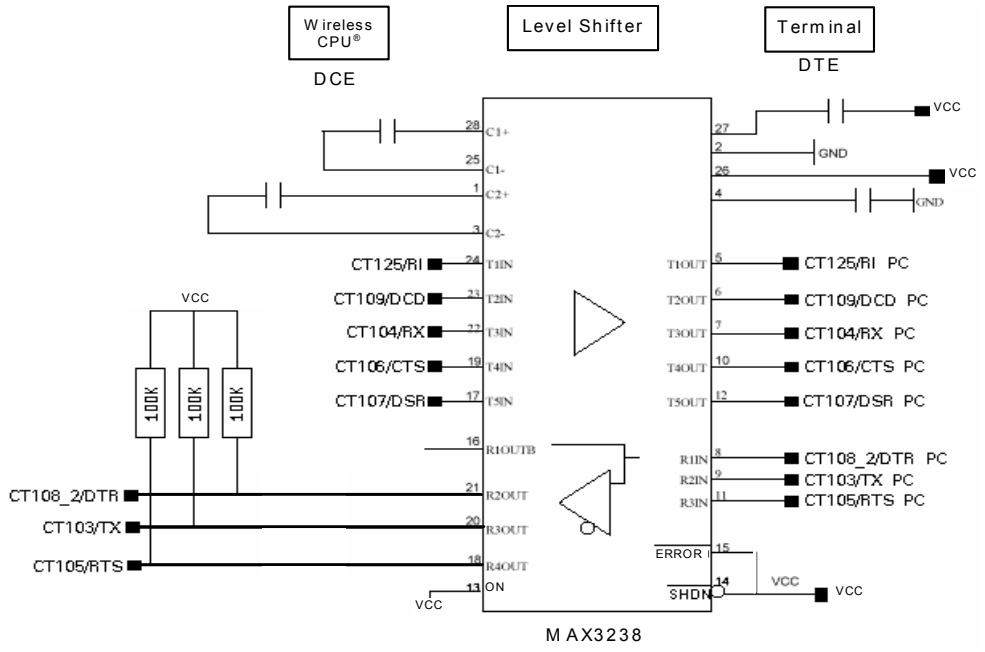


Figure 11: Level shifter application diagram for serial link*

* This application note is valid for VCC ≥ 3.0 Volt (see MAX3238 specifications). Auto shutdown mode is not used in this example.

3.7 SPI Bus

The SPI bus includes a clock signal (SPI_CLK), an I/O signal (SPI_IO), and an enable signal (SPI_EN) complying with the SPI bus standard.

Pin description

Signal	Pin #	I/O	Reset State	I/O type	Description
SPI_CLK	44	O	Pull up	1X	SPI Serial Clock
SPI_IO	43	I/O	Pull up	CMOS / 1X	SPI Data
SPI_EN*	42	O	Output high	1X	SPI Enable

* Multiplexed with GPO3.

3.8 Keyboard Interface

This interface provides 10 connections:

- 5 rows (R0 to R4) and
- 5 columns (C0 to C4).

Digital scanning and debouncing are performed within the M2106+ Wireless CPU®. No discrete components such as R, C (Resistor, Capacitor) are required.

Pin description

Signal	Pin #	I/O	Reset State	I/O type	Description
ROW0	39	I/O	Pull down	CMOS / 1X	Row scan
ROW1	40	I/O	Pull down	CMOS / 1X	Row scan
ROW2	37	I/O	Pull down	CMOS / 1X	Row scan
ROW3	38	I/O	Pull down	CMOS / 1X	Row scan
ROW4	35	I/O	Pull down	CMOS / 1X	Row scan
COL0	36	I/O	Pull up	CMOS / 1X	Column scan
COL1	33	I/O	Pull up	CMOS / 1X	Column scan
COL2	34	I/O	Pull up	CMOS / 1X	Column scan
COL3	31	I/O	Pull up	CMOS / 1X	Column scan
COL4	32	I/O	Pull up	CMOS / 1X	Column scan

WARNING:

This interface is not fully available with AT commands.

An AT command allows the input key code to be obtained (see AT+CMER command description). This code must then be processed by the application. See the AT commands Interface Guide documentation [7] for details.

3.9 Audio Interface

Two different microphone inputs (MIC1 and MIC2 inputs) and two different speaker outputs (SPK1 and SPK2 outputs) are supported.

The connection can be either differential or single-ended but the use of a differential connection in order to reject common mode noise and TDMA noise is strongly recommended. When a single-ended connection is used, ensure to have a good ground plane, good filtering as well as shielding, in order to avoid any disturbance on the audio path.

The Integra Wireless CPU® also includes an echo cancellation feature, which allows hands-free function.

In some cases, ESD protection must be added on the audio interface lines.

3.9.1 Microphone Inputs

The MIC2 inputs already include the biasing for an electret microphone allowing easy connection to a handset.

The MIC1 inputs do not include an internal bias. MIC1 is appropriate for a hands-free system, headset or car kit. However, MIC1 can also be used for a handset with external biasing.

3.9.1.1 Common Microphone Input Characteristics

Both microphone inputs are designed with the following audio transmit characteristics:

Internal audio filter characteristics

Frequency	Gain
0-150 Hz	< -22 dB
150-180 Hz	< -11 dB
180-200 Hz	< -3 dB
200-3700 Hz	0 dB
> 4000 Hz	< -60 dB

The gains in the MIC inputs are internally adjusted and can be tuned from -6.5dB to 51.3dB by using AT commands. Two different gain ranges (controller1 and controller2) are available and can be selected with AT command software (refer to the AT commands Interface Guide documentation [7] for details).

The two microphone inputs are composed of a 1st order high pass filter with a cut-off frequency of 330Hz.

Table 2: Microphone gain vs Max input voltage*

Using Controller 1		Using Controller 2	
Transmit Gain (dB)	**Max Vin (mVrms)**	**Transmit Gain (dB)**	**Max Vin (mVrms)**
+ 30	43.80	-6.5	3031
+ 33	31.01	-6	2861
+ 36	21.95	0	1434
+ 39	15.54	+9.5	480
+ 42	11.00	+10	454
+ 45	7.79	+30.3	43.80
+ 48	5.51	+30.8	41.36
+ 51	3.90	+50.8	41.14
-	-	+51.3	3.90

* For further details, refer to the AT commands documentation [7]

3.9.1.2 Main Microphone Inputs (MIC2)

The MIC2 inputs are differential ones. They already include the convenient biasing for an electret microphone (1 mA and 2 volts). This electret microphone may be directly connected to these inputs. The impedance of the microphone on MIC2 must be around 2 kΩ.

These MIC2 characteristics are the standard for a handset design.

The input impedance is around 1.4kΩ +/- 20% between 400Hz and 4000Hz.

AC coupling is already embedded in the Wireless CPU®.

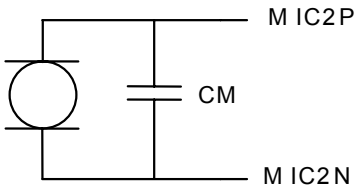


Figure 12: MIC2 input connection

CM = 22 pF to 100 pF; 33 pF recommended

CM must be as close to the microphone as possible. Microphone manufacturers provide this capacitor directly soldered on the microphone.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
MIC2P	16	I	High Z	Analog	Microphone 2 positive input
MIC2N	18	I	High Z	Analog	Microphone 2 negative input

3.9.1.3 Auxiliary Microphone Inputs (MIC1 Inputs)

The MIC1 inputs are differential and do not include internal bias. These inputs are the standard for an external headset or a hands-free kit.

To use these inputs with an electret microphone, bias has to be generated outside the Wireless CPU® according to the characteristics of this electret microphone.

These inputs are provided either for an external headset or a hands-free kit.

The input impedance is around 10kΩ +/- 30% between 400Hz and 4000Hz.

AC coupling is already embedded in the Wireless CPU®.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
MIC1P	20	I	High Z	Analog	Microphone 1 positive input
MIC1N	22	I	High Z	Analog	Microphone 1 negative input

Differential connection

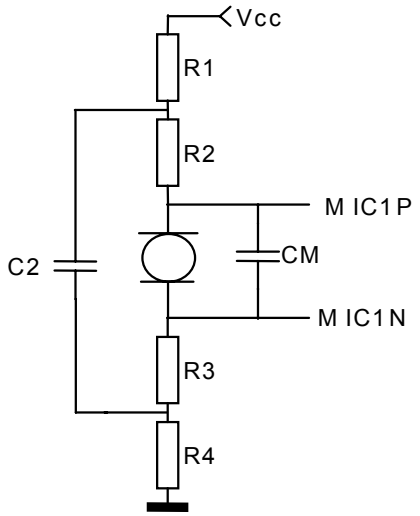


Figure 13: MIC1 differential connection

Vcc = 2.8 V from the analog power supply.

R1 = R4 = from 100 to 330 Ω.

R2 = R3 =1 kΩ to 3.3 kΩ according to the microphone characteristics.

CM = 22 pF to 100 pF.

C2 = 47 µF

R1 and R4 are used as a voltage supply filter with C2.

CM must be as close to the microphone as possible. Microphone manufacturers provide this capacitor directly soldered on the microphone.

3.9.2 Speaker Outputs

3.9.2.1 Common Speaker Output Characteristics

The connection can be differential or single-ended but the use of a differential connection to reject common mode noise and TDMA noise is strongly recommended. Moreover in single-ended mode, ½ of the power is lost. When using a single-ended connection, ensure to have a good ground plane, good filtering as well as shielding, in order to avoid any disturbance on the audio path.

Both SPK1 and SPK2 speaker outputs are push-pull amplifiers and can be loaded down to 32 Ω and up to 1 nF. The impedance of the speaker amplifier output in differential mode is: **R ≤ 1 Ω±10 %.**

These outputs are differential and the output power can be adjusted in steps of 2 dB (see details in Table 3: Speaker gain vs Max output voltage). The output can be directly connected to a speaker.

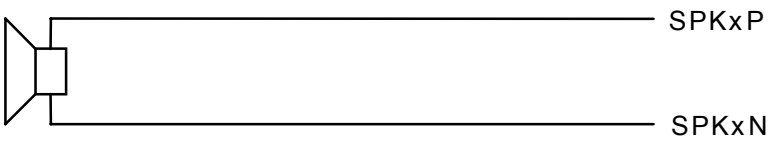


Figure 14: Speaker differential connection

In case of a single-ended connection, only half of the output power is available when compared to a differential connection.

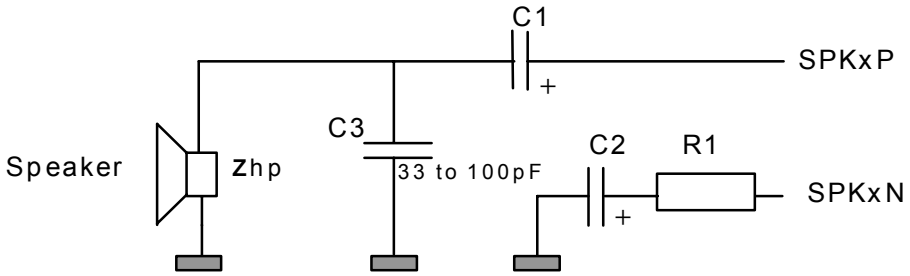


Figure 15: Speaker single-ended connection

C1 = from 100 nF to 47 µF as per the speaker characteristics.

C2=C1

R1 = Speaker impedance

Nevertheless, in a 32 Ω speaker case, it is possible to use a cheaper and smaller solution: R1=82 Ω and C2=4.7 µF ceramic.

The gain in the speaker outputs are internally adjusted and can be tuned by using an AT command (refer to the AT commands documentation [7] for details).

Table 3: Speaker gain vs Max output voltage

Receive Gain (dB)*	Max output level (Vrms)	Min Speaker load (Ω)
+2	1.74	150
0	1.38	50
-2	1.099	32
-4	0.873	32
-6	0.693	32
-8	0.551	32
-10	0.437	32
-12	0.347	32
-14	0.276	32
-16	0.219	32
-18	0.174	32
-20	0.138	32
-22	0.110	32
-24	0.087	32
-26	0.069	32

* Analog gain: may not be significant

3.9.2.2 Speaker 2 Output

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
SPK2P	10	O	High Z	Analog	Speaker 2 positive output
SPK2N	8	O	High Z	Analog	Speaker 2 negative output

3.9.2.3 Speaker 1 Output

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
SPK1P	12	O	High Z	Analog	Speaker 1 positive output
SPK1N	14	O	High Z	Analog	Speaker 1 negative output

3.10 General Purpose Input/Output

Integra M2106+ Wireless CPU® provides 2 General Purpose I/Os (GPIOs). These are useful to control any external device.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description

GPIO0	26	I/O	High Z	CMOS/ 2X	General Purpose I/O
GPIO4	7	I/O	High Z	CMOS/ 2X	General Purpose I/O

All digital I/Os comply with 3 volts CMOS.

Both GPIO0 and GPIO4 are low level at reset.

You can access (write or read) the GPIO value via AT+WIOW and AT+WIOR commands. See the AT commands Interface Guide documentation [7] for more details.

3.11 Analog to Digital Converter (ADC)

An Analog to Digital Converter is provided by the Integra M2106+ Wireless CPU®. This converter is 10-bit resolution, ranging from 0 to 2.8 V. You can see the measurements via the AT+ADC command. See the AT commands Interface Guide documentation [7] for more details and sampling rate.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
AUXV0	17	I	HZ	Analog	Auxiliary ADC input

A/D converter electrical characteristics

Parameter	Min	Max	Unit
Resolution	10		bits
Input signal range	0	2.8	V
ADC reference accuracy	0.75	2	%
Integral accuracy	+/- 1		LSB
Differential accuracy	+/- 1		LSB
Input impedance (R)	10		MΩ
Input impedance (C)		100	nF

3.12 Activity Status Indication (Flashing LED)

The activity status indication signal can be used to drive a Flashing LED through an open-collector transistor according to Wireless CPU® activity status.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
Flashing LED	11	I/O	High Z	CMOS/2X	Activity status indication

Operating status

LED status	Integra M2106+ Wireless CPU® status

OFF	Wireless CPU® in download mode or Wireless CPU® switched OFF.	
ON	Permanent	Wireless CPU® switched ON, not registered on the network
	Slow flash LED ON for 200 ms OFF for 2 s	Wireless CPU® switched ON Registered on the network Idle mode
	Quick flash LED ON for200 ms OFF for 600 ms	Wireless CPU® switched ON Registered on the network Communication in progress

3.13 RF Interface

3.13.1 RF Interface Characteristics

The nominal impedance value is 50 Ω. The DC impedance is 0 Ω, connected to GND.

The RF connector is a MMCX (Miniature Micro Connector) type. (See section "Supplier Information", 8.1.2)

MMCX connector characteristics and benefits:

- Standard type
- Small physical size type
- Easy-to-find product

An antenna can be directly connected through the mating connector or using a small adaptor if necessary (MMCX-SMA for example) (see section "Supplier Information", 8.1.2).

The MMCX connector incorporates a 'snap-on' latching action in order to make connection easier with excellent RF performance. This type of connector is suitable for the standard ranges of flexible and semi-rigid cables.

3.13.2 RF Performance

RF performance is compliant with the GSM 05.05 recommendation.

The main **Receiver** parameters are:

- E-GSM900 Reference Sensitivity = -104 dBm Static & TUHigh
- DCS1800 Reference Sensitivity = -102 dBm Static & TUHigh
- Selectivity @ 200 kHz: > +9 dBc
- Selectivity @ 400 kHz: > +41 dBc
- Linear dynamic range: 63 dB
- Co-channel rejection: >= 9 dBc

The main **Transmitter** parameters are:

- Maximum output power (E-GSM 900): 33 dBm ± 2 dB at ambient temperature
- Maximum output power (DCS 1800): 30 dBm ± 2 dB at ambient temperature
- Minimum output power (E-GSM 900): 5 dBm ±- 5 dB at ambient temperature
- Minimum output power (DCS 1800): 0 dBm ±- 5 dB at ambient temperature

3.13.3 Antenna Specifications

The antenna connected to the Integra M2106+ Wireless CPU® antenna via the MMCX connector should have the following characteristics:

Table 4: Antenna requirements

		EGSM 900	DCS 1800
Frequency RX		925 to 960 MHz	1805 to 1880 MHz
Frequency TX		880 to 915 MHz	1710 to 1785 MHz
RF power stand		2 W at 2/8 duty cycle	1 W at 2/8 duty cycle
Impedance		50 Ω	
VSWR	**Rx max**	1.5 : 1	
	Tx max	1.5 : 1	
Typical radiated gain		0 dBi in one direction at least	

3.14 SIM Card Interface

Integra M2106+ has an embedded SIM reader. This embedded SIM interface is for 3 V / 1V8 micro-SIM cards. If the application requires ISO SIM cards interface or 5 V SIM cards, the SIM interface signals are available on the General Purpose Connector.

The Integra M2106+ Wireless CPU® SIM interface consists of 5 signals:

- SIMVCC: SIM power supply
- SIMRST: Reset
- SIMCLK: Clock
- SIMDATA: I/O port
- SIMPRES1: SIM card presence detection

The SIM interface controls a 3V / 1V8 SIM (and a 5V SIM through an external SIM driver). This interface is fully compliant with the GSM 11.11 recommendations concerning SIM functionality.

To be fully compliant with GSM 11.11 recommendations concerning SIM functions, please add shielding for each SIM signals on the PCB

Electrical characteristics

Parameters	Conditions	Min	Typ	Max	Unit
SIM_DATA VIH	IIH = ± 20 µA	0.7xSIMVCC			V
SIM_DATA VIL	IIL = 1 mA			0.3xSIMVCC	V
SIM_RST, SIM_CLK VOH	Source current = 20 µA	0.9xSIMVCC			V
SIM_DATA	Source current = 20 µA	0.8xSIMVCC			V
SIM_RST, SIM_DATA, SIM_CLK VOL	Sink current = -200 µA			0.4	V
SIM_VCC* Output Voltage	SIMVCC = 2.9V	2.84	2.90	2.96	V
	SIMVCC = 1.8V	1.77	1.8	1.86	V
SIM_CLK Rise/Fall Time	Loaded with 30 pF		20		ns
SIM_RST, Rise/Fall Time	Loaded with 30 pF		20		ns
SIM_DATA, Rise/Fall Time	Loaded with 30 pF		0.7		µs
SIM_CLK Frequency				3.25	MHz

* Given for a 3 V interface. An external level shifter is needed to handle 5 V SIMs.

Transient Voltage Suppressor diodes are internally added on the signals connected to the SIM socket in order to prevent any damage by electrostatic discharge. TVS diodes with low capacitance (less than 10 pF) are used on SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edges.

3.14.1 Internal SIM Card Interface

This interface supports 3V / 1V8 Micro-SIM cards.

The SIM card (micro-SIM) is inserted in the extractible holder. In order to extract or insert the micro SIM card, press with a sharp element (a pen for example) the SIM card holder ejector.

Caution:

If this procedure is not respected, the SIM card holder could be destroyed.

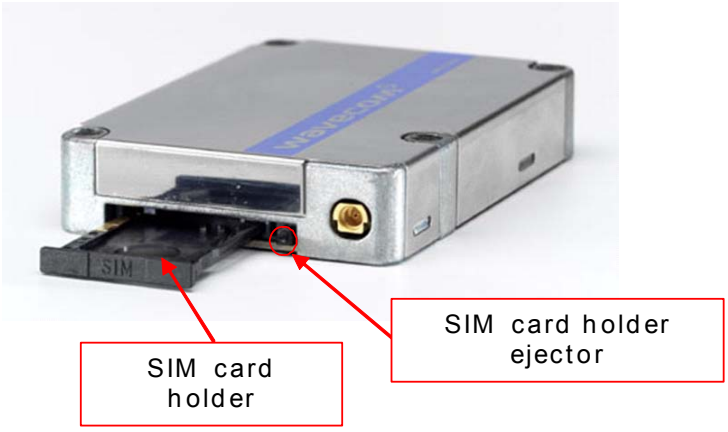


Figure 16: SIM card holder extraction

WARNING:

Adding a capacitor between SIM_VCC and the ground may cause the Wireless CPU® to malfunction.

3.14.2 External SIM Card Interface

The external SIM interface is available through the General Purpose Connector in order to use a stand-alone SIM card holder. This interface is 3V / 1V8, but **5 V SIMs can be driven by using an external level shifter.** See the application schematics in section 6.3.

Each SIM line must not exceed a length of 10 cm on the application PCB.

Although an internal ESD protection inside the Integra M2106+, there is a certain distance between the internal ESD protection circuitry and the external SIM card holder. This distance gives the electrostatic effect to other digital signals around.

Wavecom recommends adding Transient Voltage Suppressor diodes (ESD diode) on the external SIM signals, which are placed near to the external SIM socket. TVS diodes with low capacitance (less than 10 pF) are used on SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edges.

Pin description

Signal	Pin #	I/O	Reset state	I/O type	Description
SIM_CLK	45	O	Output low	2V9/1V8	SIM Clock
SIM_RST	46	O	Output low	2V9/1V8	SIM Reset
SIM_DATA	49	I/O	Output low	2V9/1V8	SIM Data
SIM_VCC	47	O	--	2V9/1V8 Supply	SIM Power Supply
SIM_PRES	48	I	High Z	2V8 CMOS	SIM Card Detect
GPO0	50	O	Output high	2V8 3X	SIM 3 V or 5 V

SIM socket pin description

Signal	Pin number	Description
VCC	1	SIMVCC
RST	2	SIMRST
CLK	3	SIMCLK
CC4	4	Resistor connected to GROUND
GND	5	GROUND
VPP	6	Not connected
I/O	7	SIMDATA
CC8	8	SIMPRES1

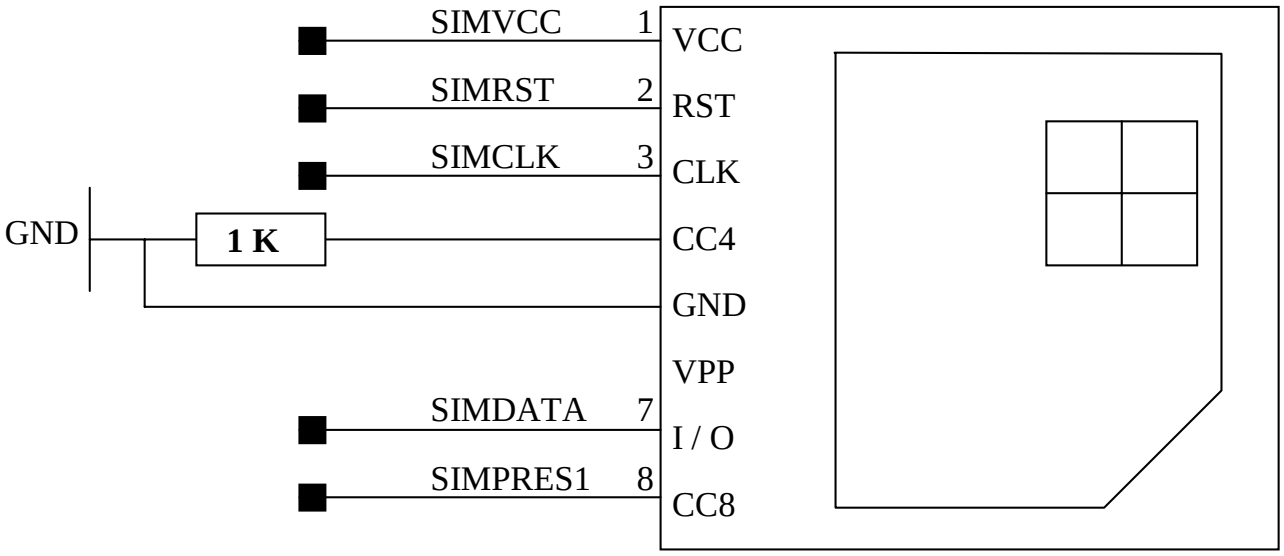


Figure 17: Schematic for external SIM card holder

When the external SIM card is used, the internal SIM card must be removed.

When no SIM card detection is required on the application, SIMPRES1 must be tied to VCC.

When SIM card detection is required on the application:

- A **low-to-high** transition means that the SIM card is inserted
- A **high-to-low** transition means that the SIM card is removed

4 Technical Specifications

4.1 Environmental Constraints

Conditions	Temperature range
Operating / Full GSM specification compliant	-20°C to + 55°C
Storage	-30°C to +85°C

4.2 Mechanical Specifications

4.2.1 Mechanical Overview

Integra is encased as shown in the figure below.

Figure 18: Mechanical overview 1/3

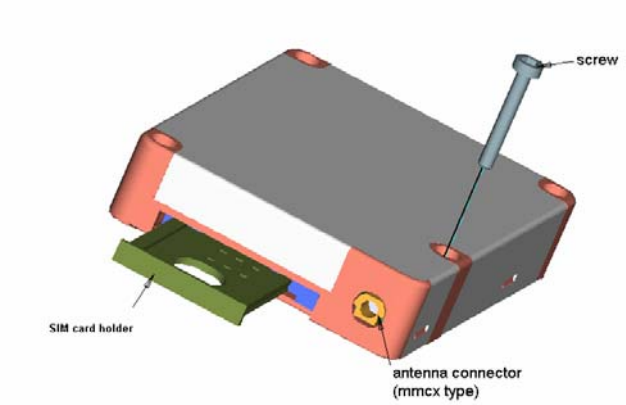


Figure 19: Mechanical overview 2/3

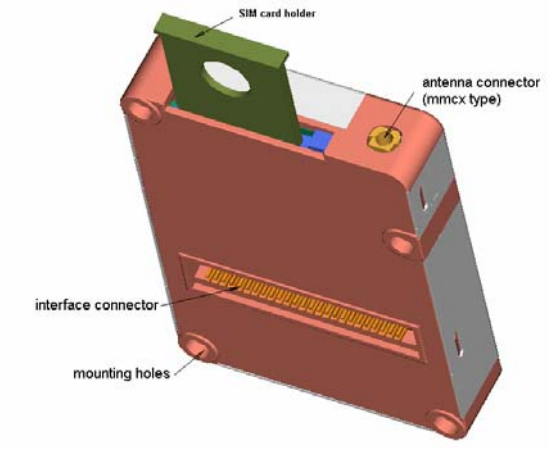


Figure 20: Mechanical overview 3/3

4.2.2 Mechanical Characteristics

Overall dimensions	46 x 64 x 12 mm
Weight	81 g
Volume	36.21 cm^3
Casing	Complete shielding - stainless steel
Mounting	4 screw holes

For the M2106+ assembly on an application board, see the section 6.4.

4.2.3 Mechanical Drawings

The following page shows the Integra M2106+ Wireless CPU® mechanical drawings.

PAGE RESERVEE

Insérer ici dans le PDF le fichier : wmoi3_assembly_A.pdf

4.3 Electrical Specifications

4.3.1 Power Mode

The Integra M2106+ Wireless CPU® supports different power consumption modes:

Working modes	Comments
OFF mode	The Wireless CPU® is in OFF mode.
FAST idle mode	The Wireless CPU® is synchronized with an RF GSM/GPRS network. The internal 26 MHz of the Wireless CPU® is constantly active.
SLOW idle mode	The Wireless CPU® is synchronized with an RF GSM/GPRS tester. The internal 26 MHz of the Wireless CPU® is not constantly active.
FAST Standby mode	The SIM and Radio interface are deactivated via AT command or Open AT API: -The embedded application is running -The serial port remains active (AT commands are available). The internal 26 MHz of the Wireless CPU® is constantly active.
SLOW Standby mode	This mode is similar to the FAST Standby mode. All the features are disabled (no GSM, no GPRS, no SIM and no Serial port). The internal 26 MHz of the Wireless CPU® is not constantly active.
Communication mode	A GSM/GPRS communication is established with a RF GSM/GPRS network.

The power consumption depends on the configuration used. It is for this reason that the following power consumption values are given for each modes, **RF bands and software used (AT or Open AT®).**

All the following information is given, by assuming a **50 Ω** RF output.

5.0 VDC power supply value is used to measure the consumption.

For more information on power consumption measurement, hardware configuration, SIM used, and software Dhrystone application, see the AT command Interface Guide documentation [7].

4.3.2 Power Consumption without Open AT® Processing

The following measurement results are relevant only when:

- There is no Open AT® application,
- The Open AT® application is disabled,
- No processing is required by the Open AT® application.

Power supply: 5 V DC ± 5%, 1.5 A

Operating mode		Parameters		I_{NOM} average	I_{MAX} peak	Unit
OFF Mode				16	NA	µA
Fast Idle Mode		Paging 9		18.2	150_{RX}	mA
		Paging 2		20.4	150_{RX}	mA
Slow Idle Mode		Paging 9		10.3	150_{RX}	mA
		Paging 2		13.3	150_{RX}	mA
Fast Standby				17	-	mA
Slow Standby				9.4	-	mA
Connected Mode		EGSM900	PCL5	226	1100_{TX}	mA
			PCL19	102	240_{TX}	mA
		DCS1800	PCL0	158	620_{TX}	mA
			PCL15	99	220_{TX}	mA
GPRS	**Transfer Mode Class 8 (4Rx/1Tx)**	EGSM900	Gamma 3	212	1100_{TX}	mA
			Gamma 17	92	210_{TX}	mA
		DCS1800	Gamma 3	145	590_{TX}	mA
			Gamma 18	88	190_{TX}	mA
	Transfer Mode Class 10 (3Rx/2Tx)	EGSM900	Gamma 3	377	1300_{TX}	mA
			Gamma 17	134	240_{TX}	mA
		DCS1800	Gamma 3	242	690_{TX}	mA
			Gamma 18	127	220_{TX}	mA

$_{TX}$ means that the peak current is measured during a TX transmission burst

$_{RX}$ means that the peak current is measured during a RX reception burst

4.3.3 Power Consumption with Open AT® Processing

The power consumption with Open AT® software used is the Dhrystone application and the following consumption results were measured while performing on the Dhrystone application.

Power supply: 5 V DC /1.5 A

Operating mode		Parameters		INOM average	IMAX peak	Unit
OFF Mode				TBC	TBC	
Fast Idle Mode		Paging 9		TBC	TBC	
		Paging 2		TBC	TBC	
Slow Idle Mode		Paging 9		TBC	TBC	
		Paging 2		TBC	TBC	
Fast Standby				TBC	TBC	
Slow Standby				TBC	TBC	
Connected Mode		GSM850	PCL5	TBC	TBC	
		EGSM900	PCL19	TBC	TBC	
		DCS1800	PCL0	TBC	TBC	
		PCS1900	PCL15	TBC	TBC	
GPRS	**Transfer Mode Class 8 (4Rx/1Tx)**	GSM850	Gamma 3	TBC	TBC	
		EGSM900	Gamma 17	TBC	TBC	
		DCS1800	Gamma 3	TBC	TBC	
		PCS1900	Gamma 18	TBC	TBC	
	Transfer Mode Class 10 (3Rx/2Tx)	GSM850	Gamma 3	TBC	TBC	
		EGSM900	Gamma 17	TBC	TBC	
		DCS1800	Gamma 3	TBC	TBC	
		PCS1900	Gamma 18	TBC	TBC	

4.3.4 Current Consumption Waveform

The consumption waveforms are given for an EGSM900 network configuration with AT software running on the Wireless CPU®.

Power supply: 5 V DC /1.5 A

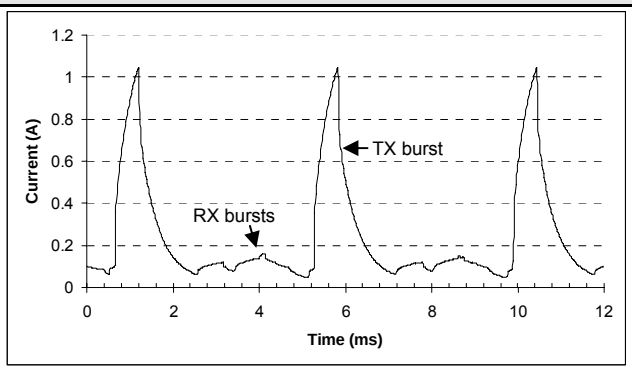
Four significant operating mode consumption waveforms are described as:

- **Connected mode** with one TX and one RX burst at PCL5 (33dBm)
- **GPRS class 10 transfer mode** with two TX bursts and three RX burst at Gamma 3 (33dBm)
- **Slow Idle mode** with a paging 9 (every 2 seconds)
- **Fast Idle mode** with a paging 9 (every 2 seconds)

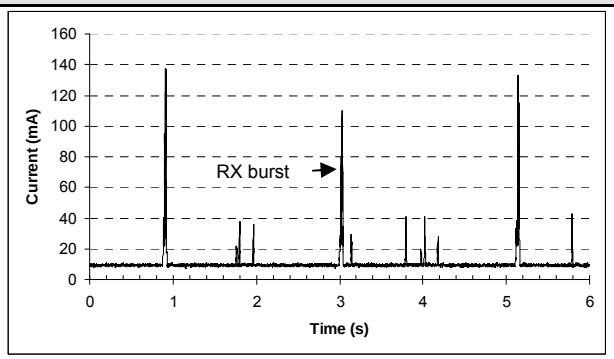
The following waveform shows only the current form versus time:

Current Waveform

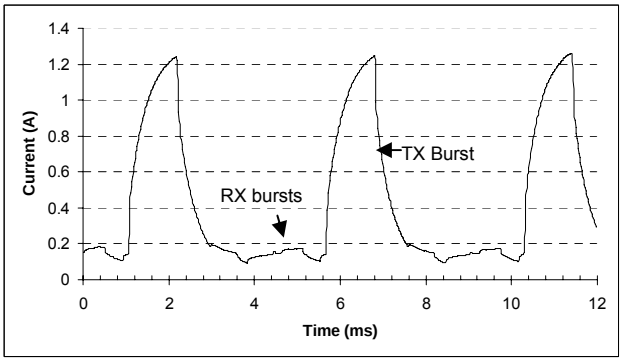
Connected mode with One TX burst at PCL5 and one RX burst



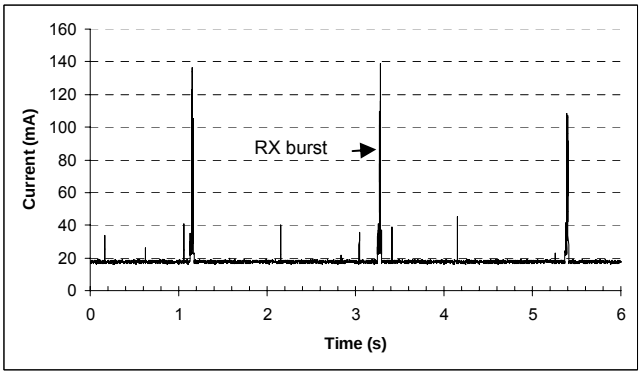
Slow idle mode paging 9



GPRS Class 10 Transfer mode with two TX bursts at PCL5 and three RX burst



Fast idle mode paging 9



5 Applicable Normative Documents

5.1 Normative Specifications

Integra M2106+ Wireless CPU® is compliant with the applicable GSM ETSI, 3GPP and GCF recommendations for GSM/GPRS phase2.

5.2 Environmental Specifications

Environmental Tests (IEC TR 60721-4)		Environmental Classes (IEC 60721-3)			
Tests	Standards	Storage (IEC 60721-3-1) Class IE13	Transportation (IEC 60721-3-2) Class IE23	Operation	
				Stationary (IEC 60721-3-3) Class IE35	Non-Stationary (IEC 60721-3-7) Class IE73
Cold	IEC 60068-2-1: Ab/Ad	-25°C, 16 h	-40°C, 16 h	-5°C, 16 h	-5°C, 16 h
Dry heat	IEC 60068-2-2: Bb/Bd	+70°C, 16 h	+70°C, 16 h	+55°C, 16 h	+55°C, 16 h
Change of temperature	IEC 60068-2-14: Na/Nb	-33°C to ambient 2 cycles, t1=3 h 1 °C.min^{-1}	-40°C to ambient 5 cycles, t1=3 h t2<3 min	-5°C to ambient 2 cycles, t1=3 h 0,5 °C.min^{-1}	-5°C to ambient 5 cycles, t1=3 h t2<3 min
Damp heat	IEC 60068-2-56: Cb	+30°C, 93% RH 96 h	+40°C, 93% RH 96 h minimum	+30°C, 93% RH 96 h	+30°C, 93% RH 96 h
Damp heat, cyclic	60068-2-30: Db Variant 1 or 2	+40°C, 90% to 100% RH One cycle Variant 2	+55°C 90% to 100% RH Two cycles Variant 2	+30°C, 90% to 100% RH Two cycles Variant 2	+40°C 90% to 100% RH Two cycles Variant 1
Vibration (sinusoidal)	IEC 60068-2-6: Fc	1-200 Hz 2 m.s^{-2} 0,75 mm 3 axes 10 sweep cycles	1-500 Hz 10 m.s^{-2} 3,5 mm 3 axes 10 sweep cycles	1-150 Hz 2 m.s^{-2} 0,75 mm 3 axes 5 sweep cycles	1-500 Hz 10 m.s^{-2} 3,5 mm 3 axes 10 sweep cycles
Vibration (random)	IEC 60068-2-64: Fh	-	10-100 Hz/ 1,0 m^2.s^{-3} 100-200 Hz / -3 dB.octave^{-1} 200-2000 Hz / 0,5 m^2.s^{-3} 3 axes 30 min	-	-
Shock (half-sine)	IEC 60068-2-2: Ea	-	-	50 m.s^{-2} 6 ms 3 shocks 6 directions	150 m.s^{-2} 11 ms 3 shocks 6 directions
Bump	IEC 60068-2-29: Eb	-	250 m.s^{-2} 6 ms 50 bumps vertical direction	-	-
Free fall	ISO 4180-2	-	Two falls in each specified attitude	-	2 falls in each specified attitude 0,025 m (<1kg)
Drop and topple	IEC 60068-2-3: Ec	-	One drop on relevant corner One topple about each bottom edge	-	One drop on each relevant corner One topple on each of 4 bottom edges

Notes:

Short description of Class IE13 (*For more information see standard IEC 60721-3-1.)*

"Locations without controlled temperature and humidity, where heating may be used to raise low temperatures, locations in buildings providing minimal protection against daily variations of external climate, prone to receiving rainfall from carrying wind"

Short description of Class IE23 (*For more information see standard IEC 60721-3-2.)*

"Transportation in unventilated compartments and in conditions without protection against bad weather, in all sorts of trucks and trailers in areas of well developed road network, in trains equipped with buffers specially designed to reduce shocks and by boat"

Short description of Class IE35 (*For more information see standard IEC 60721-3-3.)*

"Locations with no control on heat or humidity where heating may be used to raise low temperatures, to places inside a building to avoid extremely high temperatures, to places such as hallways, building staircases, cellars, certain workshops, equipment stations without surveillance"

Short description of Class IE73 (*For more information see standard IEC 60721-3-7.)*

"Transfer to places where neither temperature nor humidity are controlled, but where heat may be used to raise low temperatures, to places exposed to water droplets, products can be subjected to ice formation; these conditions are found in hallways and building staircases, garages, certain workshops, factory building and places for industrial processes and hardware stations without surveillance"

WARNING:

The specification in the above table applies to the Integra M2106+ Wireless CPU® product only. Customers are advised to verify that the environmental specification of the SIM Card used is compliant with the M2106+ environmental specifications. Any application must be qualified by the customer with the SIM Card in storage, transportation and operation.

Notes:

- The use of standard SIM cards may drastically reduce the environmental conditions in which the Product can be used. These cards are particularly sensible to humidity and temperature changes. These conditions can produce oxidation of the SIM card metallic layers and cause, in the long term, electrical discontinuities. This is particularly true in left alone applications, where no frequent extraction/insertion of the SIM card is performed.
- In case of mobility when the application is moved through different environments with temperature variations, some condensation may appear. These events have a negative impact on the SIM and can favor oxidation.

If no solution other than the use of standard SIM card, with exposition to the environmental conditions described above, is possible, special attention must be paid in the integration of the final application in order to minimize the impact of these conditions. The solutions that can be proposed are:

- Lubrication of the SIM card to protect the SIM Contact from oxidation.
- Putting the Wireless CPU® in a waterproof enclosure with desiccant bags.

Lubrication of the SIM card had been tested by Wavecom (using Tutela Fluid 43EM from MOLYDUVAL) and gives very good results.

If waterproof enclosure with a desiccant solution is used, check with your desiccant retailer the quantity that must be used according to enclosure dimensions. Ensure humidity has been removed before sealing the enclosure.

Any solution selected must be qualified by the customer on the final application.

Note: To minimize oxidation problem on the SIM card, its manipulation must be done with the greatest precautions. In particular, the metallic contacts of the card must never bee touched with bare fingers or any

matter which can contain polluted materials liable to produce oxidation (such as, e.g. substances including chlorine). In case a cleaning of the Card is necessary a dry cloth must be used (never use any chemical substance).

6 Using the Integra Wireless CPU®

6.1 Firmware Upgrade

The Integra firmware is stored in flash memory and can easily be upgraded.

The upgrade procedure is based on the X-modem protocol, but an emergency mode (backup procedure) based on a Wavecom specific downloader is also available.

6.1.1 Nominal Upgrade Procedure

The firmware file can be downloaded to the Wireless CPU® using the X-modem protocol.

To enter this mode, the AT+WDWL command (see description in the AT command Interface Guide documentation [7]) must be sent to the Wireless CPU®.

The serial signals required to proceed with X-modem downloading are:

Rx, Tx, RTS, CTS and GND.

6.1.2 Alternative Procedure

If nominal upgrade mode cannot be used (due to critical corruption on the flash memory), an alternative procedure is available. This procedure requires Wavecom specific software to download the firmware file to the Wireless CPU®.

This tool must be run on a PC connected to the Wireless CPU® serial bus. As this procedure is highly specific and required Wavecom tools, the process must be executed by your distributor.

The signals required to proceed with downloading are: Rx, Tx, RTS, CTS and GND.

Prior to running the Wavecom downloader, set the Wireless CPU® to download mode: the BOOT signal must be set to low while powering ON (or resetting) the Wireless CPU®.

The application must support serial speed changes of up to 115,200 bps and hardware flow control (RTS/CTS connected).

6.2 Guidelines for Application Design

6.2.1 Hardware Recommendations

When designing the application board, specific attention must be paid to the following points:

- Having a common ground plane for analog, digital and RF grounds
- Length of the SIM interface lines: 10 cm maximum
- Bias of the Microphone inputs properly adjusted when using audio connectors (microphone + speaker) 1
- EMC protection on audio input/output (filters against 900 MHz)
- ESD protection on the serial link
- Avoid placing application processor or local oscillator circuits near the Wireless CPU® or the antenna cable, in order to avoid any spurious emissions from the application
- Avoid placing the audio interface near the application antenna to reduce the risks of TDMA noise on the audio

6.2.2 Antenna

The choice of the antenna sub-system (type, performance, cable length and thermal resistance, etc.) and its integration in the application is a major issue. These elements could affect the performance of the GSM features such as sensitivity and transmitted power.

It is recommended to shield the application.

For applications including an antenna, poor shielding could dramatically affect the sensitivity of the terminal. Therefore, the antenna should be isolated to the maximum extent possible from the digital circuitry (application digital circuits and Integra Wireless CPU® interface). If not, the power transmitted through the antenna could affect the application.

Product used within 20 cm from the head or body is required to undergo SAR testing. Because of the industrial application of the Integra M2106+, the Wireless CPU® has not been qualified for SAR. Customer should make sure that the antenna placed is having a minimum distance of 20cm from human body.

6.2.3 Minimum Hardware Interface to Get Started

As a minimum, it is necessary to connect the following signals to operate the Integra M2106+ Wireless CPU® correctly within an application:

Minimum signals required to operate the Integra Wireless CPU®:

Pin #	Signal	Description
1	GND	GROUND
2	GND	GROUND
3	+5 V	Power supply
4	+5 V	Power supply
6	GND	GROUND
13	CT106/CTS	Clear To Send
15	ON/OFF	Power On/OFF*
21	GND	GROUND
24	GND	GROUND
25	CT103/TX	Transmit
28	CT104/RX	Receive
30	CT105/RTS	Request To Send

* Connected to + 5 V for example

See section 3.6 for implementation of the serial link level shifter

6.3 3 V/5 V SIM Management

The figure below shows the schematic for a SIM level shifter to manage 5 V SIM cards.

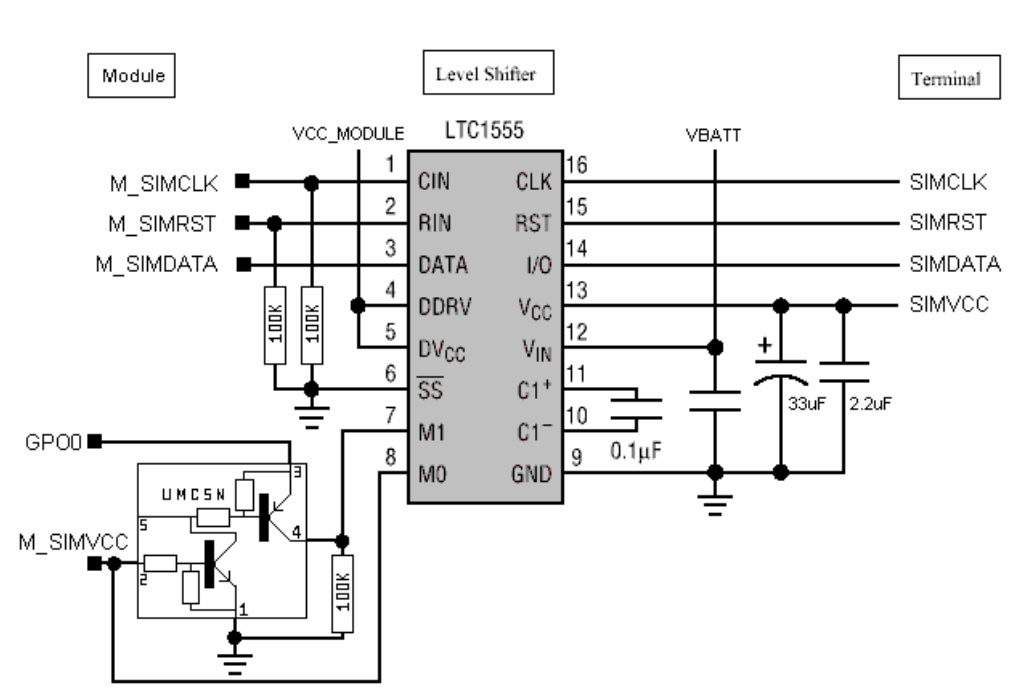


Figure 21: Schematic for a SIM level shifter to manage 5 V SIM cards

6.4 Installation of the Integra M2106+ Wireless CPU® on an Application Board

The Integra M2106+ Wireless CPU® can be mounted on the application PCB in two ways:

- The bottom side of the Wireless CPU® is assembled on the application PCB. The 50-pin connector of the Wireless CPU® is directly connected to the mating connector assembled on the application PCB
- The top side of the Wireless CPU® is assembled on the application PCB. The 50-pin connector is connected to the application board via a flex cable connector

Note:

The bottom side of the Wireless CPU® on the application is the recommended mounting option, because of better Wireless CPU® immunity to noise generated on the application board.

For installation of the Integra M2106+ Wireless CPU® on an application board, Wavecom recommends:

- Use the recommended footprint described in Figure 22, if the bottom side of the Wireless CPU® is on the application and reverse it, if the top side is on the PCB
- Connect the metallic pads around the fixing holes (1, 2, 3 & 4) of the Wireless CPU® to the application board ground

Notes:

- If the connection of the 4 holes is not possible, at least 2 holes on opposite corners (e.g. 1 & 3 or 2 & 4) must be connected to the ground board
- For a better ground connection, it is recommended to use a ground plane on the application board
- If the Integra M2106 Wireless CPU® is assembled bottom side on the application PCB, Wavecom strongly recommends using fastening systems, which allows enough clearance to connect the Wireless CPU®
- Do not use fastening systems, which do not allow a minimum clearance (such as threaded holes directly on the PCB for example). This may result of being impossible to connect the Wireless CPU®
- If the Wireless CPU® is mounted bottom side on the application PCB, use a low-profile connector as the mating connector to the Wireless CPU® 50-pin connector (See section 8.1.1 “General Purpose Connector” for connector recommended reference)
- For Wireless CPU® fastening on the application use:
  - Stainless steel material
  - Screw: Chc M2x16 (Qty=4)
  - Washer: flat or curved spring M2 (Qty=4)
  - Hex Nut: HM2 (Qty=4)

- Do not put any components under the Wireless CPU®.
- For the overall dimensions of the Wireless CPU®, see section 4.2.3 (Mechanical drawings).

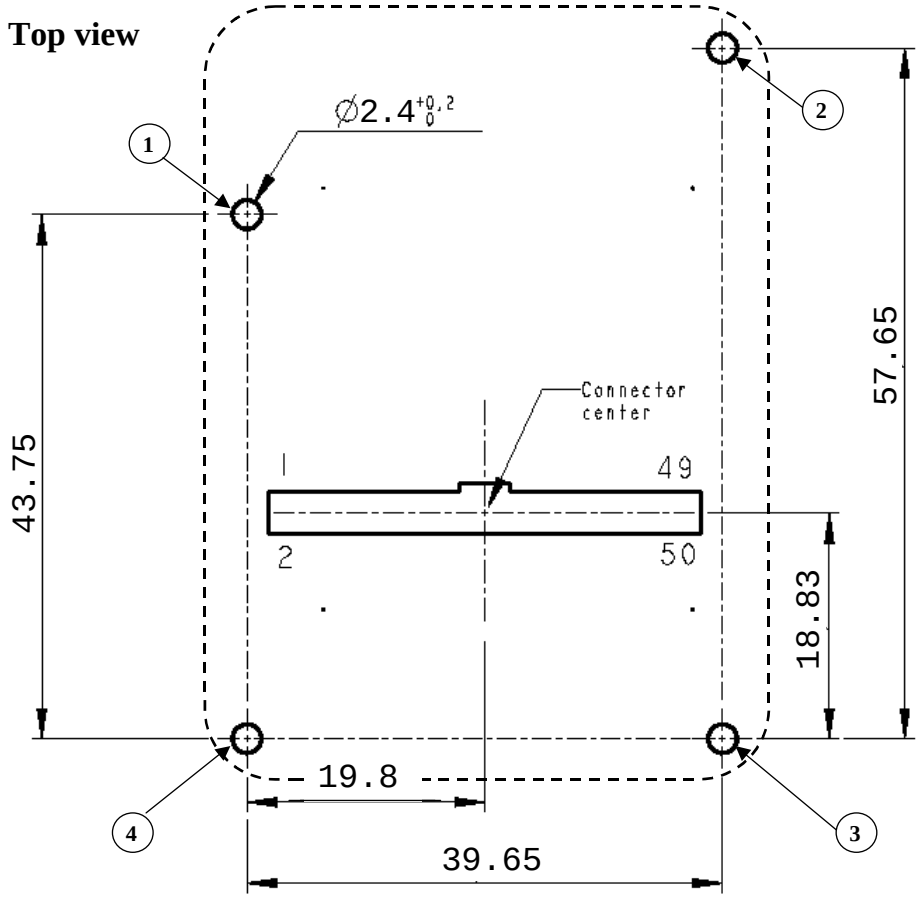


Figure 22: Recommended footprint

(Integra M2106 Wireless CPU® bottom side on application board)

6.5 Integra Development Kit Board Presentation

The quickest way of getting started with the Integra Wireless CPU® is by using the Wavecom development kit board, also called as development kit board.

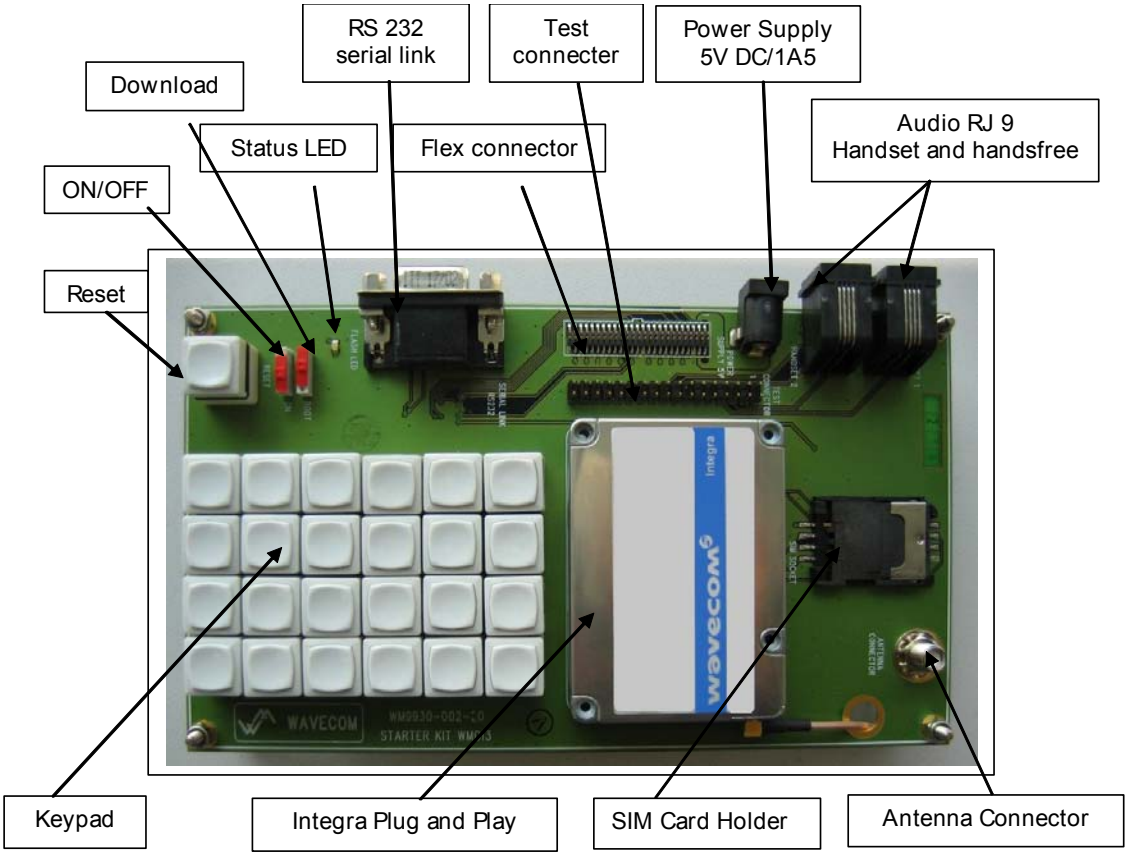


Figure 23: Integra development kit board description

The development kit board is manufactured by Wavecom. It can be ordered either directly from Wavecom or from your distributor.

6.5.1 Getting Started

To use the Integra M2106+ Wireless CPU® with a Development kit board:

1. Mount the Integra Wireless CPU® on the Development kit board.
2. Insert one SIM card in the holder internal or external) and verify the SIM card fits in the holder correctly.
3. Connect the antenna to the Integra M2106+ RF connector.
4. Plug the handset into the RJ9 connector (HANDSET1).
5. Connect the RS232 cable to the Development kit board and Terminal (PC COM1 port, for example).
6. Ensure that:
   - download Switch is not in the BOOT position,
   - ON/OFF switch is ON.
7. Connect the power supply (DC 5 V) to the Development kit board.
8. After a short time, the status indication LED should come on.

The Wireless CPU® is now ready to operate.

The next section explains how to configure the PC for data exchange.

6.5.2 Setting up Terminal Emulator

An example based on the Windows™ HyperTerminal application (terminal emulator program) is given below.

Setup:

1. START>PROGRAMS>ACCESSORIES>COMMUNICATION>HYPERTERMINAL, then run HYPERTRM.
2. Enter the name of your choice, and click an icon, then click “OK”
3. Select “Connect” using: direct to COM1 (or any other free serial port).
4. Set the following properties:
   - 115,200 bps
   - 8 bits data
   - no parity
   - 1 stop bit
   - hardware flow control

   and Click “OK”

Once HyperTerminal is open and configured, it can be used to send AT commands to the Integra M2106+ Wireless CPU®.

6.5.3 Example of AT Commands

This section gives examples to get started with AT commands. Refer to the AT commands Interface Guide documentation [7] for details.

6.5.3.1 Example of AT commands for Quick Starting the Wireless CPU®

The table below lists the main AT commands required to start the Wireless CPU®.

Description	AT commands	Wireless CPU®'s response	Comment
Enter PIN Code	AT+CPIN=1234	OK	PIN Code accepted.
		+CME ERROR: 16	Incorrect PIN Code (with +CMEE= 1 mode).
		+CME ERROR: 3	PIN already entered (with +CMEE= 1 mode).
Wireless CPU® synchronization checking	AT+CREG?	CREG= <mode>,1	Wireless CPU® synchronized on the network.
		CREG= <mode>,2	Synchronization lost, re-synchronization attempt.
		CREG= <mode>,0	Wireless CPU® not synchronized on the network, no synchronization attempt.
Receiving an incoming call	ATA	OK	Answer the call.
Initiate a call	ATD<phone number>; (Don't forget the «;» at the end for « voice » call)	OK	Communication established.
		+CME ERROR: 11	PIN code not entered (with +CMEE= 1 mode).
		+CME ERROR: 3	AOC credit exceeded or the communication is already established.
Initiate an emergency call	ATD112; (Don't forget the «;» at the end for « voice » call)	OK	Communication established.
Communication loss		NO CARRIER	
Hang up	ATH	OK	
Store the parameters in EEPROM	AT&W	OK	The configuration settings are stored in EEPROM.

Example of set of AT commands, which can be used for quickly getting started with the Integra Wireless CPU®:

- **AT+CGMI**: Wireless CPU® response is “WAVECOM MODEM” when serial link is OK.
- **AT+CPIN=<Pin Code>:** enter a PIN code (if activated).
- **AT+CSQ**: to check received signal strength.
- **AT+CREG?**: to check the registration of the Wireless CPU® on the network.
- **ATD<phone number>;** - to initiate a call.
- **ATH**: to hang up (end of call).

For further information on these AT commands and their associated parameters, refer to the AT commands Interface Guide documentation [7].

6.5.3.2 Checking Received Signal Strength

The Integra Wireless CPU® establishes a call only if the received signal is sufficiently strong.

To check received signal strength:

- Enter the command AT+CSQ by using communication software such as the HyperTerminal program. The value appears for the received signal strength.
- Check the result by comparing it with the values listed in the table below.

Received signal strength values

Received signal strength value (AT+CSQ response) (RSSI)	Interpretation of received signal strength
0 - 10	Insufficient*
11 - 31	Sufficient*
Greater than 99	Insufficient*

* Based on general observations.

6.5.3.3 Checking Wireless CPU® Network Registration

To check Wireless CPU® network registration:

5. Make sure a valid SIM card is previously inserted in the Wireless CPU® SIM card holder.
6. Enter the AT+CREG? command by using communication software such as the HyperTerminal program, The value appears as a response.
7. Check the result by comparing it with the values listed in the table below.

Network registration values

Value*	Network registration
0,1	Yes
0,5	Yes (registered roaming)

* Refer to the AT commands Interface Guide documentation [7] for further information about the other returned values and their meaning.

If the Wireless CPU® is not registered, perform the following procedure:

- Check the connection between the Wireless CPU® and the antenna.
- Check signal strength to determine the strength of the received signal (refer to section 6.5.3.2).

7 Troubleshooting

This section describes:

- Problems that may be encountered when using the Integra Wireless CPU®
- Possible causes
- Possible solutions

To review other troubleshooting information, refer to the 'FAQs' (Frequently Asked Questions) page either at www.wavecom.com or use the following link:

http://www.wavecom.com/modules/movie/scenes/support/

7.1 Not Connecting Through the Serial Link

If the Wireless CPU® does not answer through the serial link on attempted transmission of data, refer to the table below for possible causes and solutions:

Table 5: Solutions for no connection through the serial link

If the Wireless CPU® returns:	Then ask:	Corrective Action:
Nothing	Is the Wireless CPU® correctly powered?	Provide a power supply to the Wireless CPU®.
	Is the serial cable correctly connected to the Wireless CPU® and PC sockets?	Connect the cable.
	Is the communication program correctly configured?	Ensure the following Wireless CPU® settings: • Data bits = 8 • Parity = none • Stop bits = 1 • Baud = 9600 bps
	Is there another program interfering with the communication program?	Close the application in conflict on the communication port (e.g. mouse or printer driver)

7.2 Receiving 'no carrier' Messages

If the Wireless CPU® returns a '**no carrier**' message on an attempted transmission of data or voice signals, refer to the next table for possible causes and solutions.

Table 6: Solutions for no carrier message

If the Wireless CPU® returns	Then ask	Corrective Action
No carrier	Is the received signal strong enough?	Refer to section 6.5.3.2 to check the strength of the received signal.
	Is the antenna in accordance with requirements and correctly connected?	Refer to Table 4 for antenna requirements and antenna connection check.
No carrier (when trying to issue a voice communication)	Is the semicolon (;) entered immediately after the phone number in the ATD command?	Make a new attempt with the semicolon at the end of the AT command: e.g. ATD 1234;
No carrier (when trying to issue a data or fax communication)	Is the SIM card configured for data/fax calls?	Contact your network provider for activation of Data Fax services.
	Is the selected bearer type supported by the called party and by the network?	Check bearer type with the called party and the network provider. Try bearer selection by AT command: AT+CBST=0,0,3

If the Integra Wireless CPU® returns a **'no carrier'** message, and there is no solution in Table 6, investigate the **extended error code** by using the ***AT+CEER*** command. Refer to the following table for interpretation of the **extended error code**.

Table 7: Interpretation of extended error codes for "no carrier"

Error Code	Diagnostic	Hint
1	Unallocated phone number	Not applicable
16	Normal call clearing	
17	User busy	
18	No user responding	
19	User alerting, no answer	
21	Call rejected	
22	Number changed	
31	Normal, unspecified	
50	Requested facility not subscribed	Check your subscription (data subscription available?).
68	ACM equal or greater than ACMmax	The credit of your pre-paid SIM card is expired.
252	Call barring on outgoing calls	Not applicable
253	Call barring on incoming calls	
3, 6, 8, 29, 34, 38, 41,42, 43, 44, 47, 49, 57, 58, 63, 65, 69, 70, 79, 254	Network causes	Call the network provider.

See the AT commands Interface Guide documentation [7] for further details.

7.3 Receiving error Messages

If the Wireless CPU® returns an **'error'** message on an attempted transmission of data or voice signals, refer to the table below for possible causes and solutions:

Table 8: Solutions for error messages

If the Wireless CPU® returns	Then ask	Corrective Action
Error	Is the Wireless CPU® registered on the network?	Refer to section 6.5.3.3 to check that the Wireless CPU® is registered on the network.
	Is the Wireless CPU® receiving an incoming call or is it already in communication?	End any communication using the ATH command.
	Is the selected bearer type supported by the called party and the network?	Ensure that the selected bearer type is supported by the called party and the network. Ensure that the semicolon (;) is typed immediately after the phone number in the AT command. e.g. ATD######;
	Is the received signal strong enough?	Refer to section 6.5.3.2 to check the strength of the received signal.
	Is the antenna compliant with requirements and correctly connected?	Refer to Table 4 for antenna requirements and antenna connection check.

If the Integra Wireless CPU® returns an **'error'** message and there is no solution in Table 8, investigate the **extended error code** by using the ***AT+CMEE*** command. Refer to the table below for interpretation of the **extended error code**.

Table 9: Interpretation of extended error codes

Error Code	Diagnostic	Hint
0	Phone failure	Call technical support.
3	Operation not allowed	No action
4	Operation not supported	
10	SIM not inserted	Do one of the following: • Insert the SIM card in the SIM card holder of the Wireless CPU® • Check that the SIM card is clean and correctly inserted in the holder
11	SIM PIN required	Enter PIN code
12	SIM PUK required	Enter PUK code Note: Call your network provider if you do not know this code.
13	SIM failure	Check the validity of your SIM card. If the SIM is damaged, call your network provider.
16	Incorrect password	Check the code you entered.
17	SIM PIN2 required	Enter PIN2 code.
18	SIM PUK2 required	Enter PUK2 code. Note: Call your network provider if you do not know this code.
26	Dialing string too long	Check the phone number (max. 20 digits).
30	No network service	No action

8 Annexes

8.1 Supplier Information

8.1.1 General Purpose Connector

The mating connector for the Integra M2106+ Wireless CPU® General Purpose Connector is made by SAMTEC France (http://www.samtec.com/).

Many SAMTEC products are available via SAMTEC dealers throughout the world.

Figure 24: High and low profile CLP connectors

For better fastening of the M2106+ on the application, Wavecom recommends the use of a low-profile connector.

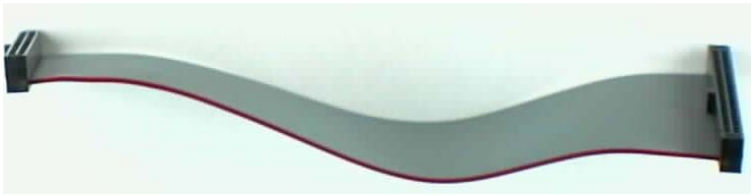


Figure 25: Flexible flat cable (Part number: FFSD-20-S-10-01-N)

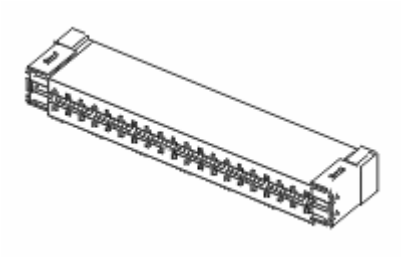


Figure 26: Flex cable connector (Part number: FLE 125 01LDVA)

8.1.2 Antenna connector

The Integra M2106+ Wireless CPU® antenna connector is an MMCX connector (Miniature Micro Connector).

A mating MMCX connector for a cable or a mattng MMCX/SMA adaptor can be used for antenna connection.

Figure 27: MMCX connector example (right angle)

An antenna with mating connector can be ordered, for example, from:

IMS Connectors Systems GMBH
Obere Hauptstrasse 30
D-79843 Löffingen
Germany
Tel: +49 76 54 90 10
Fax: +49 76 54 90 11 99
http://www.imscs.com/

A MMCX/SMA adaptor can be ordered, for example, from:

Amphenol Socapex
http://www.amphenol.com/
Part Number: 908-31100

8.1.3 SIM Card Holder

The SIM card connector used in the Integra M2106+ Wireless CPU® is a MOLEX connector. It is possible to order only the SIM card holder if it is lost.

- Connector part number: 99228-0002
- Holder part number: 91236-0002

For more information on this connector: http://www.molex.com/

8.2 Safety Recommendations (for information only)

IMPORTANT

FOR THE EFFICIENT AND SAFE OPERATION OF YOUR

INTEGRA WIRELESS CPU®,

PLEASE READ THIS INFORMATION CAREFULLY

8.2.1 RF Safety

8.2.1.1 General

Your GSM terminal based on Integra Wireless CPU® is based on the GSM standard for cellular technology. The GSM standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard.

Your GSM terminal is actually a low power radio transmitter and receiver. It sends out as well as receives radio frequency energy. When a GSM application is used, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular Wireless CPU®.

8.2.1.2 Exposure to RF Energy

There has been some public concern about possible health effects of using GSM terminals. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM.

After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was fitted for use.

If you are concerned about exposure to RF energy there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular terminal efficiently by following the below guidelines.

8.2.1.3 Efficient Terminal Operation

For your GSM terminal to operate at the lowest power level, consistent with satisfactory call quality:

- If your terminal has an extendable antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However, your GSM terminal operates more efficiently with the antenna when it is fully extended.
- Do not hold the antenna when the terminal is « IN USE ». Holding the antenna affects call quality and may cause the Wireless CPU® to operate at a higher power level than needed.

8.2.1.4 Antenna Care and Replacement

Do not use the GSM terminal with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. You may repair antenna to yourself by following the instruction manual provided to you. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.

Buy or replace the antenna only from the approved suppliers list. Using of unauthorized antennas, modifications or attachments could damage the terminal and may contravene local RF emission regulations or invalidate type approval.

8.2.2 General safety

8.2.2.1 Driving

Check with the laws and the regulations regarding the use of cellular devices in the area where you have to drive as you always have to comply with them. When using your GSM terminal while driving, please:

- give full attention to driving,
- pull-off the road and park before making or answering a call if driving conditions so require.

8.2.2.2 Electronic Devices

Most electronic equipment, for example in hospitals and motor vehicles, is shielded from RF energy. However, RF energy may affect some improperly shielded electronic equipment.

8.2.2.3 Vehicle Electronic Equipment

Check with your vehicle manufacturer/representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

8.2.2.4 Medical Electronic Equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc) to determine if they are adequately shielded from external RF energy.

Turn your terminal **OFF** in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

8.2.2.5 Aircraft

Turn your terminal OFF before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you should have prior permission from a crew member to use your terminal while the aircraft is on the ground. In order to prevent interference with cellular systems, local RF regulations prohibit using your Wireless CPU® while airborne.

8.2.2.6 Children

Do not allow children to play with your GSM terminal. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the Wireless CPU®, or make calls that increase your Wireless CPU® bills.

8.2.2.7 Blasting Areas

To avoid interfering with blasting operations, turn your unit OFF when you are in a « blasting area » or in areas posted: « turn off two-way radio ». Construction crew often uses remote control RF devices to set off explosives.

8.2.2.8 Potentially Explosive Atmospheres

Turn your terminal **OFF** in any area with a potentially explosive atmosphere. It is rare, but your Wireless CPU® or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle which contains your terminal or accessories.

Before using your terminal in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is used.

8.2.3 Safety Standards

This Wireless CPU® complies with all applicable RF Safety Standards.

This cellular Wireless CPU® meets the standards and recommendations for the protection of public exposure to RF electromagnetic energy established by governmental bodies and other qualified organizations.