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WMOi3 User's Guide
Hardware Specifications

Contents

Cautions:

Information furnished herein by Wavecom are accurate and reliable. However no responsibility is assumed for its use.
Please read carefully Safety precautions

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1 Introduction to the WMOi3: outstanding assets

WMOi3 integrated modem provides a quick and easy way to plug in GSM functionality to systems and terminals. Available in dual-band configurations, this full type approved integrated modem constitutes self-contained, fully integrated implementations of the GSM standard.
Smallest on the market, light, state-of-the-art designed and energy efficient, the WMOi3 incorporates one of the smallest module in the world.
The WMOi3 will be GPRS and WAP compliant at the coming time. Thanks to standard interfaces, it can be integrated into any system which offers unlimited assets. It is ready for voice, SMS, data and fax. WMOi3 integrated modem is a product with a sole connector, which puts together all the interface signals in order to facilitate its integration.
It has an integrated SIM connector as well as a standard RF connector type MMCX (Miniature Micro Connector).
For system integrators, product developers, handset and terminal manufacturers, and others, WMOi3 is the fast track to the wireless world.

1.1 Scope of the user's guide

This document describes the hardware interface and technical specifications for the WMOi3 integrated modem.
The integrated modem is referenced as WMOi3 according to the GSM 900 standard, the GSM 1800 standard and the GSM 1900 standard. This product is based on new Dual Band WISMO™ concept : every integrated modem referenced WMOi3 G900/1800 includes a G900/1800 module and every integrated modem referenced WMOi3-G900/1900 includes a G900/1900 module. This two dual-band modems have the same specifications unless otherwise specified.

1.2 General characteristics

1.2.1 General

- Dual Band GSM modem 900/1800/E-GSM or 900/1900/E-GSM
- Class 4 (2W at 900MHz)
- Class 1 (1W at 1800/1900 MHz)
- Small size and low power consumption
- Voice, SMS
- fax and data transmission without extra hardware
- Tricodec (FR/EFR/HR)
- Internal 3V SIM interface
- Easy remote control by AT commands for dedicated applications
- Fully Type Approved against GSM Phase 2 specifications
- Fully shielded and ready-to-use

1.2.2 Electrical

- Power supply: 5 VDC +/- 5% 1A
- 300 mA average in GSM 900 at Tx power max 2W
- 9 mA in idle mode

1.2.3 Physical

- Absolute maximum dimension: 46 x 64 x 12 mm
- Weight: 90 g
- Volume: 36.21 cm3
- Casing: Complete shielding-stainless steel-
- Mounting: 4 screw holes
- Operating temperature range: -20°C to + 55°C
- Storage temperature: -35°C to +85°C

1.2.4 Basic Features

1.2.4.1 telephony

- Telephony (TCH/FS) & Emergency calls
- Full Rate, Enhanced Full Rate and Half Rate
- Dual Tone Multi Frequency function (DTMF)

1.2.4.2 Short Message Service

- point to point MT & MO
- SMS Cell Broadcast
- Return Call Message

1.2.4.3 Data Features

- Data circuit asynchronous, transparent and non transparent up to 14,400 bits/s
- Automatic fax group 3 (Class 1 & 2)
- Alternate speech and fax
- V.42, V.42bis

1.2.4.4 Supplementary services

Call Forwarding
Multiparty
Call Barring
Phone Book
Fixed Dialling Number
Call waiting & Call hold
Calling Line Identity
Advice of Charge
SIM Toolkit
SIM Lock
USSD

1.2.5 Interfaces

Single antenna interface
Internal SIM interface: 3V only
External SIM interface: 3V only for engineering sample.
3V or 5V for production unit
For Data Operation:
RS-232C serial link
remote control by AT commands (GSM 07.07 and 07.05)
baud rate from 300 to 115,200 bits/s
from 2,400 up to 19,200 with autobauding

1.3 Mechanical Design Overview

The WMOi3 integrated modem will use the following casing. It includes a G900/1800 or G900/1900 WISMO™ module, a 50-pin connector, a SIM holder and a RF connector.

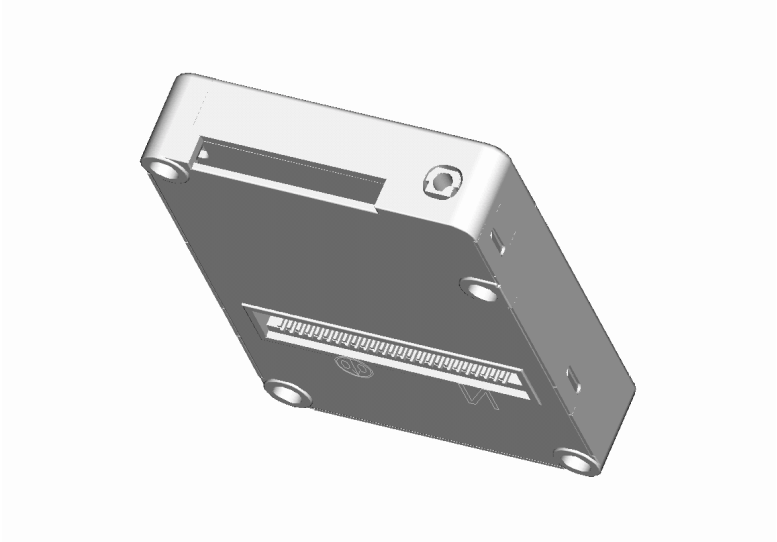


figure 1 : mechanical description

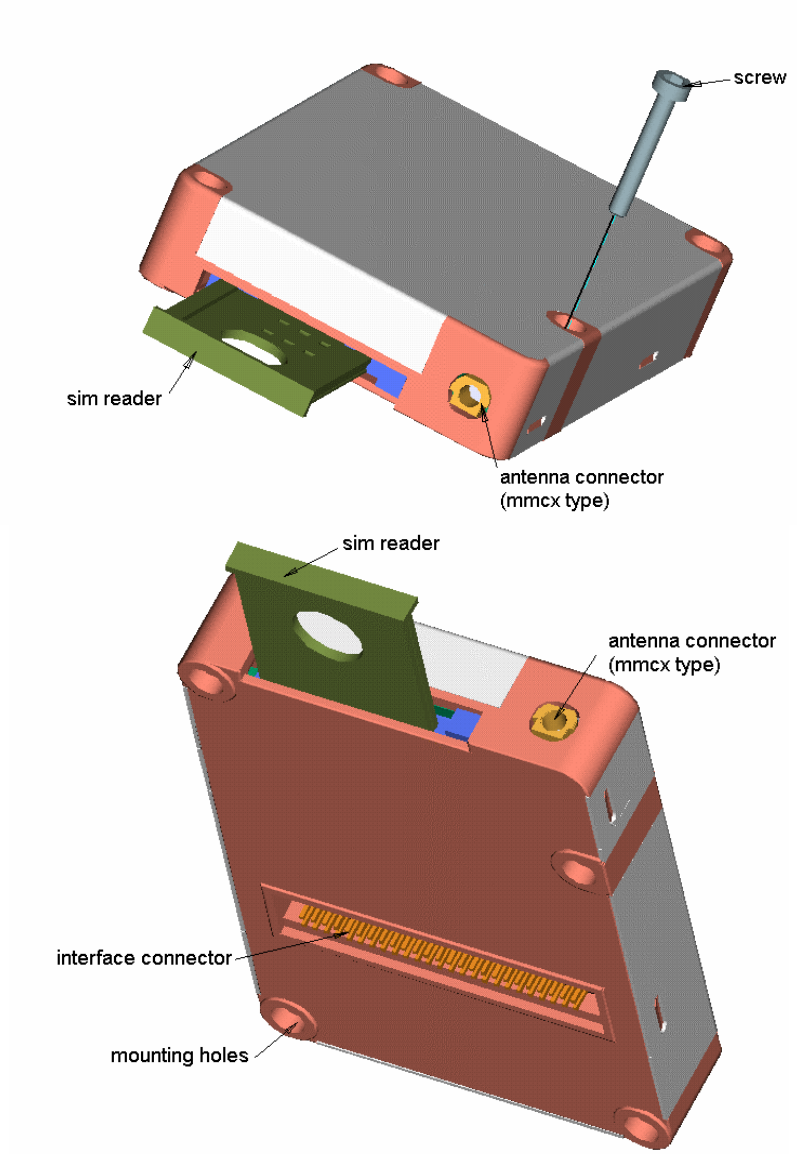


figure 2 : mechanical description II

4 screw holes fix the WMOi3 on the mother PCB. The WMOi3 can be indifferently on both sides (top or bottom) mounted.

Note: Interfaces
The integrated modem has a sole 50-pin connector which gathers all the interface signals in order to facilitate its integration.
It has an integrated SIM card holder as well as a standard RF connector type MMCX (Miniature Micro Connector)

The concept of the integrated modem has been defined to integrate a sole device:

- Only one standard easy to find connector (worldwide supplied) gathering the analog and digital interfaces
- A standard easy to find RF connector. See chapter RF connector page 34
- A SIM card holder. See chapter SIM interface page 35

2 Safety precautions

IMPORTANT
FOR THE EFFICIENT AND SAFE OPERATION OF
YOUR GSM INTEGRATED MODEM
READ THIS INFORMATION BEFORE USE

2.1 RF safety

2.1.1 General

Your WMOi3 integrated modem 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 modem is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When you use your WMOi3 integrated modem, the cellular system which handles your calls controls both the radio frequency and the power level of your cellular modem.

2.1.2 Exposure to RF energy

There has been some public concern about possible health effects of using GSM modems. 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 modem efficiently by following the below guidelines.

2.1.3 Efficient modem operation

For your modem to operate at the lowest power level, consistent with satisfactory call quality :
If your modem has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your modem operates more efficiently with the antenna fully extended.
Do not hold the antenna when the modem is « IN USE ». Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

2.1.4 Antenna care and replacement

Do not use the modem with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician.
Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the modem and may contravene local RF emission regulations or invalidate type approval.

2.2 General safety

2.2.1 Driving

Check 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 modem 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.

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.

2.2.3 Vehicle electronic equipment

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

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 modem 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.

2.2.5 Aircraft

Turn your modem 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 to have permission from a crew member to use your modem while the aircraft is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

2.2.6 Children

Do not allow children to play with your modem. 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 modem, or make calls that increase your modem bills.

2.2.7 Blasting areas

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

2.2.8 Potentially explosive atmospheres

Turn your modem OFF when in any area with a potentially explosive atmosphere. It is rare, but your modem 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 fueling 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 modem or accessories.
Before using your modem 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 to be used.

2.3 Safety standards

THIS WMOi3 INTEGRATED MODEM COMPLIES WITH ALL APPLICABLE RF SAFETY STANDARDS.
This cellular modem meets the standards and recommendations for the protection of public exposure to RF electromagnetic energy established by governmental bodies and other qualified organizations, such as the following :
Directives of the European Community, Directorate General V in Matters of Radio Frequency Electromagnetic Energy

3 Standard Compliance

3.1 GSM compliance

Reference regulations: TBR 19, TBR 20, TBR 31, TBR 32

Table 1 : Wavecom acceptance test

Tests	Applied Standard	Acceptance Criteria
Performance Test	ETSI recommendation for GSM/DCS communication.	Full conformity to the recommendation regarding the main RF parameters.
Cooking Test	-	The test continues even after the Cooking Test milestone has been reached
Stress Test	Therma shocks IEC 68-2-14.	Full conformity to the recommendation regarding the main parameters.
Vibration Test	Sinusoidal vibration IEC 68-2-6.	No performance degradation or mechanical degradation is allowed after test.
Vibration Test	Random vibration IEC 68-2-36.	No performance degradation or mechanical degradation is allowed after test.
Shock Test	IEC 68-2-27.	No performance degradation or mechanical degradation is allowed after test.
Bump Test	IEC 68-2-29.	No performance degradation or mechanical degradation is allowed after test.
Humidity Test	Corrosion test IEC 68-2-3.	No visible degradation of the product, both visual and functionnal. The unit is tested at room temperature and must be fully operative for the main RF parameters.
Warehouse Test	Low temperance IEC 68-2-1.	Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.
Warehouse Test	High temperature IEC 68-2-2.	Under normal condition (room temperature) after the test, the unit must behave in full conformity with the main RF parameters specification.
Dust Test	MIL-STD-810D, method 510-3.	No visible dust in the visible areas. No more than 50 dust particules in the cabinet of the product. The unit, tested at room temperature must be fully operative.
Light Test	UV radiation and temperature EDF HN60E03.	Visual inspection on the discoloration and other degradation effects such as cracks in the material of the unit after the test.
Fall Test	IEC 68-2-32.	Only minor casing degradation is allowed, with a maximum dimension change of 1mm. The unit must remain fully operative and full specification for the main RF parameters.
Electro Static Discharge Test	IEC 1000-4-2.	No performance degradation allowed after the test.

Salt Mist Test	IEC 68-2-11	After the test, visual inspection on the unit.
Atmosphere Test	Flowing mixed gas corrosion. IEC 68-2-60	After the test, visual inspection on the unit and inside.
Marking Test	EN 60 950	After the test, visual inspection on the unit. No degradation is allowed on the marking.

3.2 FTA Compliance

The WMOi3 has received a Full-Type Approval (against normal MS requirements) in the configuration using the internal SIM interface.

3.2.1 IMEI Number

GSM 900/1800:
TAC: 5 000 64
FAC: 11
Serial Numbers: 000000 to 999999

GSM 900/1900:
TAC: 500 100
FAC: 11
Serial Number: 000000 to 999999

3.2.2 CE Label

The WMOi3 integrated modem is CE compliant which implies that the modem is in conformity with the European Community directives and it bears the CE label

Carrying out tests:
Electro-magnetic field immunity
EN 61000-4-3
ETS 300-342—1

Radiated emission
EN 55022
ETS 300-342

ESD immunity
EN 61000-4-2
ETS 300-342-1

4 Hardware Interfaces

This chapter describes the hardware interfaces:

- The interfaces on the 50-pin general purpose connector
- The RF interface
- The SIM interface

4.1 Interfaces on the 50-pin general purpose connector

4.1.1 The 50-pin connector description

Table 2 : 50-pin connector description

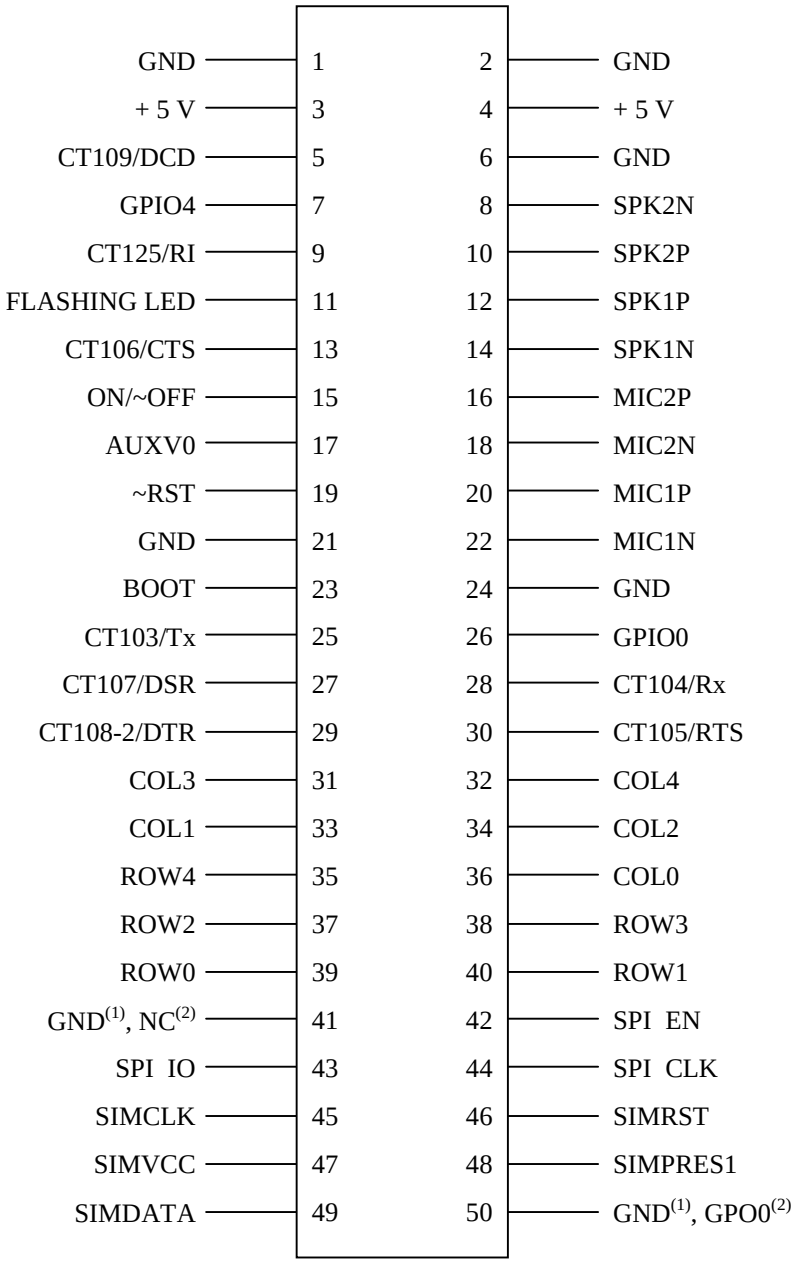
Pin #	*Name*	*I/O*	*I/O type*	*Description*	*Comment*
1	GND			GROUND	High current
2	GND			GROUND	High current
3	+5V		Supply		High current
4	+5V		Supply		High current
5	CT109/DCD	O	CMOS/2X	RS232-Data Carrier Detect	
6	GND			GROUND	High current
7	GPIO4	I/O	CMOS/2X	General Purpose I/O	
8	SPK2N	O	Analog	Speaker2 negative output	
9	CT125/RI	O	CMOS/2X	RS232-Ring Indicator	
10	SPK2P	O	Analog	Speaker 2 positive output	
11	Flashing LED	I/O	CMOS/2X	Working mode indication Led	Driven by module
12	SPK1P	O	Analog	Speaker 1 positive output	
13	CT106/CTS	O	1X	RS232 interface Clear To Send	
14	SPK1N	O	Analog	Speaker 1 negative output	
15	ON/~OFF	I		Power ON/OFF control	ON = VCC(3)
16	MIC2P	I	Analog	Microphone 2 positive input	
17	AUXV0	I	Analog	Auxiliary ADC input	
18	MIC2N	I	Analog	Microphone 2 negative input	
19	~RST	I		Reset active low	Open Collector
20	MIC1P	I	Analog	Microphone 1 positive input	
21	GND	I		Ground	
22	MIC1N	I	Analog	Microphone 1 negative input	
23	BOOT	I		BOOT	Open Collector
24	GND			GROUND	High current
25	CT103/TX	I		RS232 interface - Transmit	Pull up to VCC(3) with 100KΩ when not used
26	GPIO0	I/O	CMOS/2X	General Purpose I/O	

Pin #	*Name*	*I/O*	*I/O type*	*Description*	*Comment*
27	CT107/DSR	O	1X	RS232 interface Data Set Ready	
28	CT104/RX	O	1X	RS232 interface – Receive	
29	CT108-2/DTR	I		RS232 interface Data Terminal Ready	Pull up to VCC(3) with 100KΩ when not used
30	CT105/RTS	I		RS232 interface Request To Send	Pull up to VCC(3) with 100KΩ when not used
31	COL3	I/O	1X	Keypad column	
32	COL4	I/O	1X	Keypad column	
33	COL1	I/O	1X	Keypad column	
34	COL2	I/O	1X	Keypad column	
35	ROW4	I/O	1X	Keypad row	
36	COL0	I/O	1X	Keypad column	
37	ROW2	I/O	1X	Keypad row	
38	ROW3	I/O	1X	Keypad row	
39	ROW0	I/O	1X	Keypad row	
40	ROW1	I/O	1X	Keypad row	
41	GND(1) NC(2)			GROUND(1) No Connected(2)	High current
42	SPI_EN	O	1X	SPI enable	
43	SPI_IO	I/O	1X	I^2C Data or SPI Data	
44	SPI_CLK	O	1X	I^2C Clock or SPI Clock	
45	SIMCLK	O	2X	Clock for SIM Interface	3V mode
46	SIMRST	O	2X	Reset for SIM interface	3V mode
47	SIMVCC	O		SIM card supply	3V mode 6mA max
48	SIMPRES1	I		SIM card detect	Connected to SIM connector pin 8. Pin 4 of SIM connector must be pulled down to GND with 1 KΩ*
49	SIMDATA	I/O	3X	I/O for SIM interface	3V mode
50	GND(1), GPO0(2)**			See (1) and (2)	High current

(1) for engineering sample
(2) for production unit.
(3) VCC = application digital power supply either 5V or 2.8V
*see SIM socket diagram 4.3 SIM interface
** GPO0 is a general purpose output for selection of external SIM 3V or 5V

Table 3 : 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		0.2 V	I_{OL} = -1 mA
	2X		0.2 V	I_{OL} = -2 mA
	3X		0.2 V	I_{OL} = -3 mA
$V_{output\ high}$	1X	2.6 V		I_{OH} = 1 mA
	2X	2.6 V		I_{OH} = 2 mA
	3X	2.6 V		I_{OH} = 3 mA



(1) for engineering sample
(2) for production unit

figure 3 : 50-pin connector

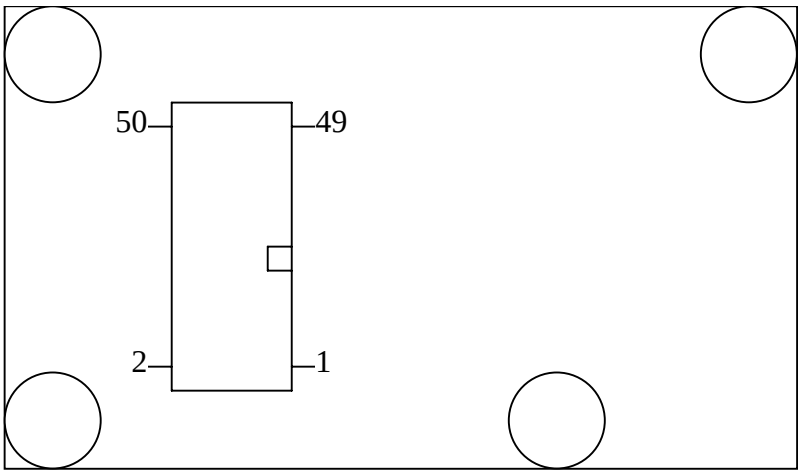


figure 4 : pin numbering/bottom view

4.1.2 Power supply

The main power supply is provided through a double connection. These connections are respectively the pin 3 and 4 for the +5V and the pins 1 and 2 for the ground (GND). The pins 6, 21, 24 and 40 are also ground connection in order to produce a proper ground plane.
A 5V +/-5% - 1A power is strictly required to supply the modem. Otherwise, serious dysfunctions may appear. However, the modem does not have to constantly deliver 1A current at 5V on this power supply.
This power supply is internally regulated to a nominal value VBATT.

Table 4 : power supply pin description

Pin number	Name	Description	Comment
1	GND	Ground	High Current
2	GND	Ground	High Current
3	+5 V	Ground	High Current
4	+5 V	Ground	High Current
6	GND	Ground	High Current
21	GND	Ground	High Current
24	GND	Ground	High Current
41*	GND	Ground	High Current
50*	GND	Ground	High Current

*for engineering sample

Table 5 : Power consumption in EGSM mode

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @ 2W	tbd	tbd
+5V	During RX bursts	tbd	tbd
+5V	Average @ 2W	320 mA	800 mA
+5V	Average @ 0.5W	tbd	tbd
+5V	Average Idle mode	9 mA	tbd

Table 6 : Power consumption in GSM 1800 and1900 mode

	Conditions	**I_{NOM}**	**I_{MAX}**
+5V	During TX bursts @ 1W	tbd	tbd
+5V	During RX bursts	tbd	tbd
+5V	Average @ 1W	tbd	tbd
+5V	Average @ 0.25W	tbd	tbd
+5V	Average Idle mode	tbd	tbd

4.1.3 Serial link

A serial link interface is available complying with V24 protocol signalling but not with V28 (electrical interface) due to a 2.8 Volts interface. TX, RTS and DTR can be either 5V or 3V.
The 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) and Data Set Ready (CT107/DSR).
The set of RS232 signals can be required for GSM DATA services application. The 2 additional signals are Data Carrier Detect (CT109/DCD) and Ring Indicator (CT125/RI).

Table 7 : Serial Link pin description

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

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

** Any of the available GND pins can be used

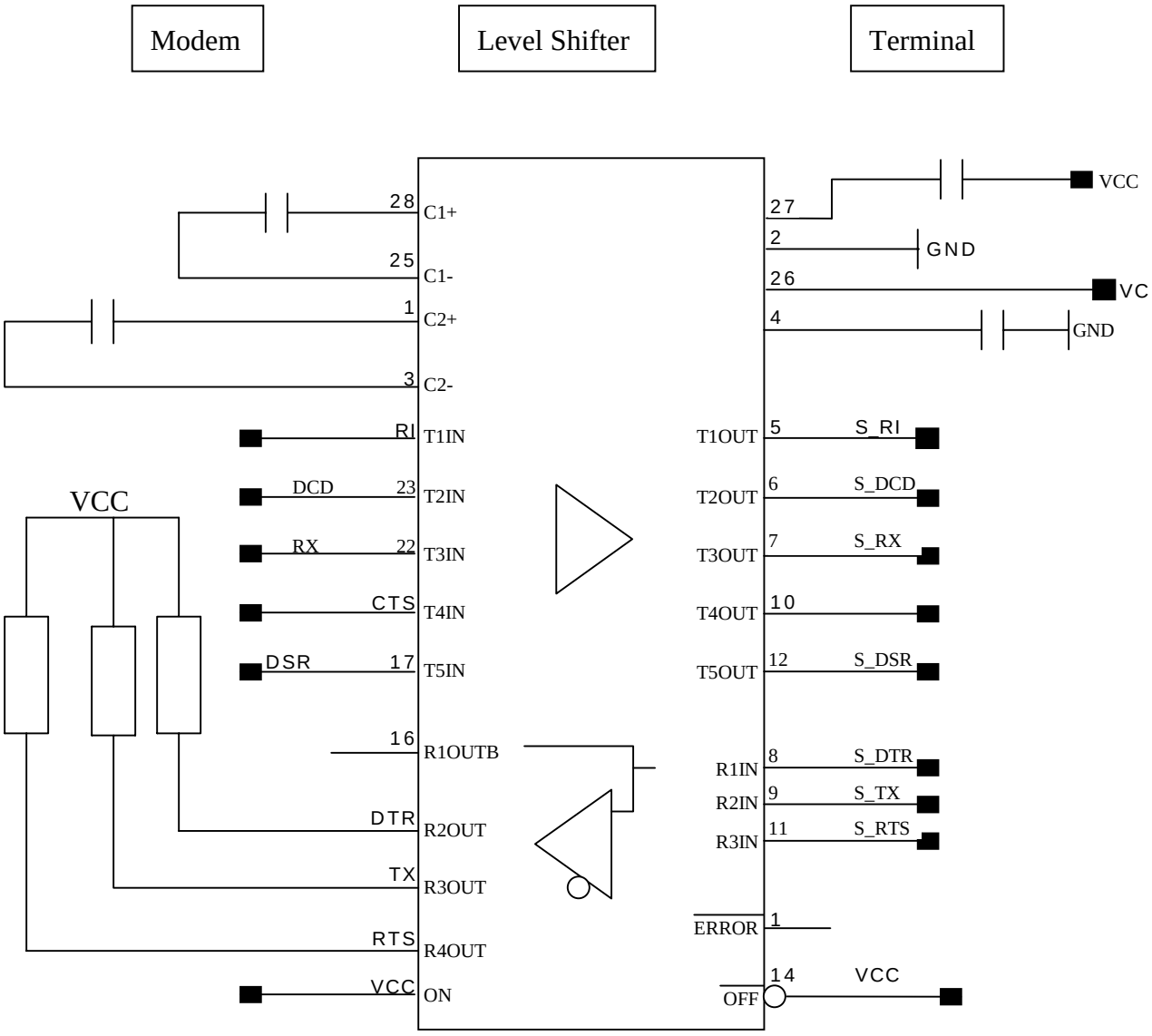


figure 5 : level shifter application diagram for serial link

4.1.4 ON / ~OFF

This input is used to switch ON or OFF the WMOi3 modem. A high level signal has to be provided on the pin ON/~OFF to switch on the modem. The level of the voltage of this signal has to be maintained to VCC during a minimum time of 1 second. When powered off, the shutdown current is roughly 60 µA.

Table 8 : ON / OFF pin description

Signal	Pin number	I/O	I/O type*	Description
ON/~OFF	15	I	CMOS	Module Power ON/OFF

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.1.4.1 Power OFF procedure

In order to power OFF the WMOi3, you have to switch OFF both via software (AT+CPOF) and hardware line. See the diagram below.

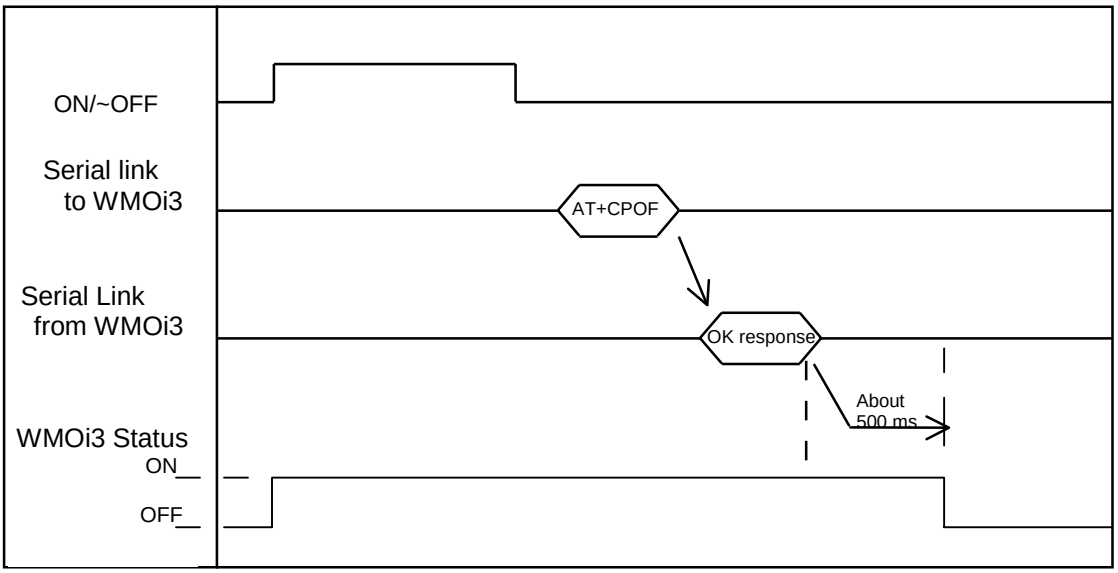


figure 6 : power OFF procedure 1

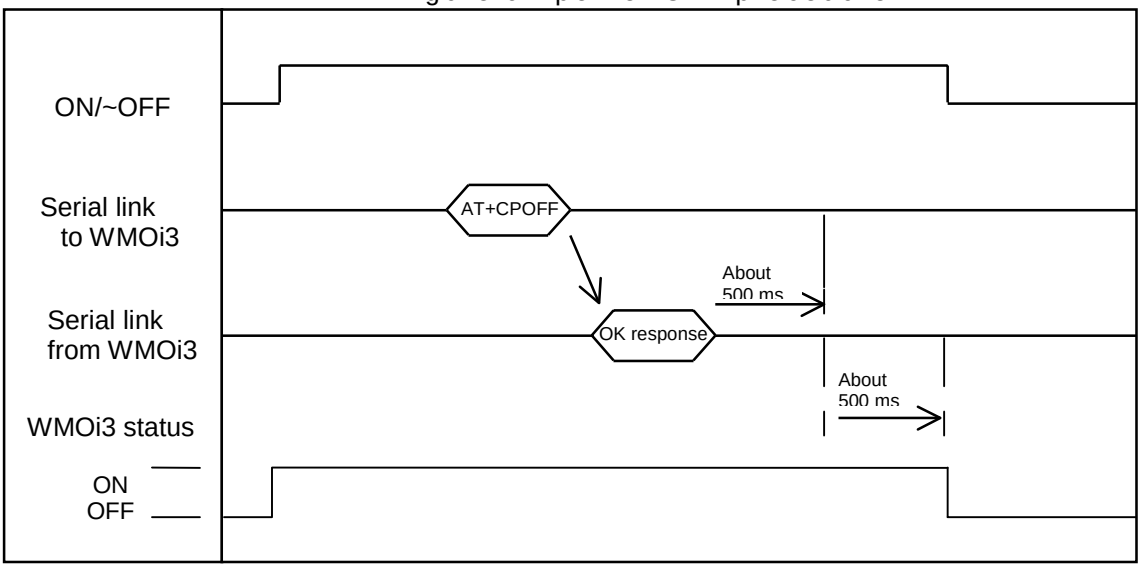


figure 7 : power OFF procedure 2

4.1.5 BOOT

This input is used to switch the WMOi3 into the download mode. The internal boot procedure is started when this pin is low during the powering on of the module. In normal mode, this pin has to be left open. if used, this input has to be driven by an open collector or an open drain. See below an example of application diagram. See also software upgrading in General Guidelines chapter 8

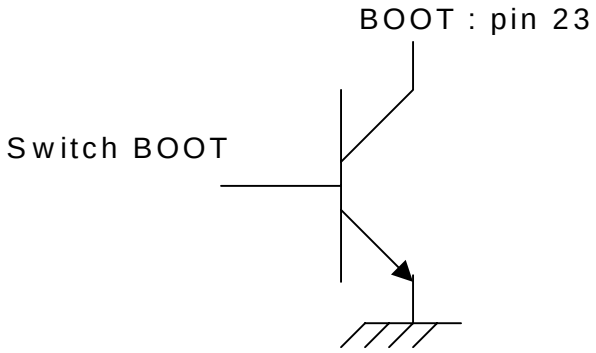


figure 8 : boot procedure

If Switch Boot = 1, Boot pin 23 = 0, to download mode
If Switch Boot = 0, Boot pin 23 = 1, to normal mode

Table 9 : BOOT pin description

Signal	Pin number	I/O	I/O type*	Description
BOOT	23	I	CMOS	SW downloading

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.1.6 Reset signal (~RST)

This signal is used to force a reset of the WMOi3. It has to be used by providing low level during approximately 2ms. This signal has to be considered as an emergency reset only. A reset procedure is already driven by an internal hardware during the power-up sequence.
This signal can also be used to provide a reset to an external device. If no external reset is necessary this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain. See below an example of application diagram.

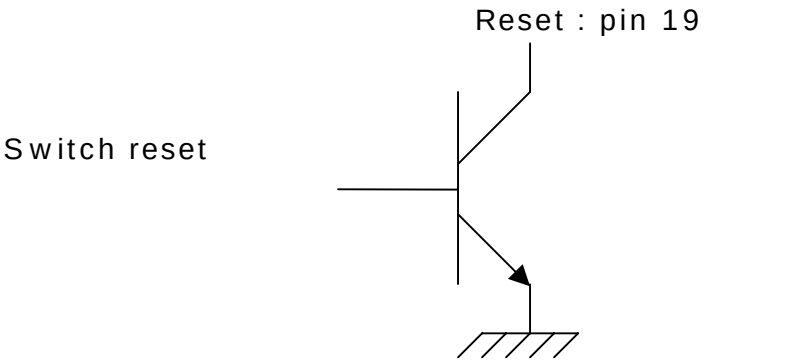


figure 9 : reset procedure

If switch Reset = 1, Reset pin 19 = 0
If switch Reset = 0, Reset pin 19 = 1

Table 10 : reset signal pin description

Signal	Pin number	I/O	I/O type*	Description
~RST	19	I/O		Module Reset

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

Table 11 : reset signal electrical characteristics

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

Table 12 : reset signal operating conditions

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

V_{T-}, V_{T+} : Hysterisis Level

4.1.7 General Purpose Input/Output

The WMOi3 provides 2 General Purpose I/O. They are used to control any external device.

Table 13 : General Purpose pin description

Signal	Pin number	I/O	I/O type*	Description
GPIO0	26	I/O	CMOS / 2X	General Purpose I/O
GPIO4	7	I/O	CMOS / 2X	General Purpose I/O

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

(1) for production unit

All digital I/O comply with 3Volts CMOS.

4.1.8 Analog to Digital Converter

Analog to Digital converter (ADC) input is provided by the WMOi3. This converter is a 10 bits one, ranging from 0 to 2.5V .

Table 14 : A/D converter pin description

Signal	Pin number	I/O	I/O type*	Description
AUXV0	17	I	Analog	A/D converter

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description description

Table 15 : A/D converter electrical characteristics

Parameter	Min	Max	Unit
Resolution	10		bits
Sampling rate	90.3		Ksps
Input signal range	0	2.5V	V
ADC Reference Accuracy	0.5		%
Integral Accuracy	+/- 1		LSB
Differential Accuracy	+/- 1		LSB
Input Impedance (R)	10		MΩ
Input Impedance (C)		50	pF

4.1.9 Audio Interface

Two different microphone inputs and two different speaker outputs are supported. The connection can be either differential or single-ended but using a differential connection in order to reject common mode noise and TDMA noise is recommended.

4.1.9.1 Microphone 2 Inputs

The MIC2 inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone 2 has to be around 2kΩ. These inputs are the standard ones for a handset design while MIC1 inputs can be connected to an external headset or a handsfree kit.
The gain of MIC2 inputs is internally adjusted. The gain can be tuned from 30dB to 51dB. The connexion to the microphone is direct. The gain control can be monitor via the At command AT+VGR.
See chapter Connector Supplier and Peripheral devices

C1 = 22pF to 100pF
33 pF recommanded

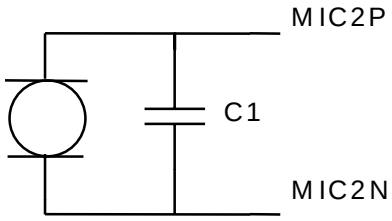


figure 10 : microphone 2 input

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

Table 16 : microphone 2 input pin description

Signal	Pin #	I/O	I/O type*	Description
MIC2P	16	I	Analog	Microphone 2 positive input
MIC2N	18	I	Analog	Microphone 2 negative input

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.1.9.2 Microphone 1 Inputs

The MIC1 inputs are differential and do not include internal bias. To use these inputs with an electret microphone, bias has to be generated outside the WMOI3 modem according to the characteristic of this electret microphone. These inputs are the standard ones used for an external headset or a handsfree kit. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.
The gain of MIC1 inputs is internally adjusted. The gain can be tuned from 30dB to 51dB.
The gain control can be monitor via the AT command AT+VGR

Differential connection

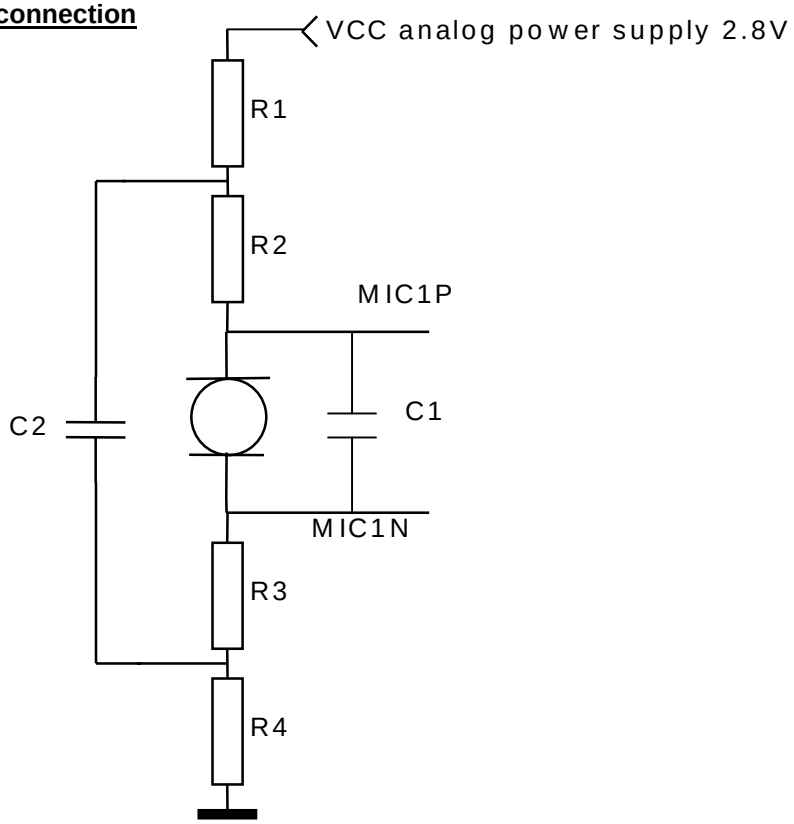


figure 11 : microphone 1 input

R1 = R4 = from 100 to 330 Ω
R2 = R3 = usually between 1KΩ and 3.3KΩ as per the microphone characteristics
C1 = 22pF to 100pF
C2 = 47µF

R1 and R4 are used as a voltage supply filter with C2.
C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

Table 17 : microphone 1 input pin description

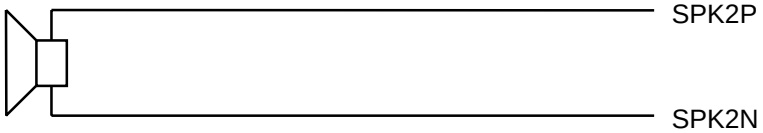
Signal	Pin #	I/O	I/O type*	Description
MIC1P	20	I	Analog	Microphone 1 positive input
MIC1N	22	I	Analog	Microphone 1 negative input

*See Table 3 "operating conditions" in subdivision 4.1.1The 50-pin connector description

4.1.9.3 Speaker 2 Outputs

Speaker outputs SPK2 are push-pull amplifiers and can be loaded down to 50 Ohms and up to 1nF. These outputs are differential and the output power can be adjusted by step of 2dB. The output can be directly connected to a speaker.
When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

Differential Connection



Single-ended Connection

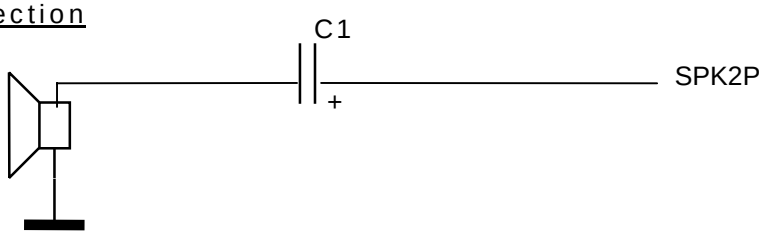


figure 12 : speaker 2 output

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

Using a single-ended connection also includes losing half of the output power compared to a differential connection.

Table 18 : speaker 2 output pin description

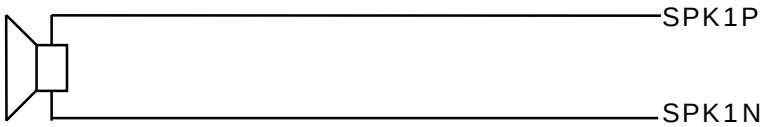
Signal	Pin #	I/O	I/O type*	Description
SPK2P	10	O	Analog	Speaker 2 positive output
SPK2N	8	O	Analog	Speaker 2 negative output

*See Table 3 "operating conditions" in subdivision 4.1.1The 50-pin connector description

4.1.9.4 Speaker 1 Outputs

Speaker outputs SPK1 are push-pull amplifiers and can be loaded down to 50 Ohms and up to 1nF. These outputs are differential and the output power can be adjusted by step of 2dB. The output can be directly connected to a speaker.
When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as a shielding in order to avoid any disturbance on the audio path.

Differential Connection



Single-ended Connection

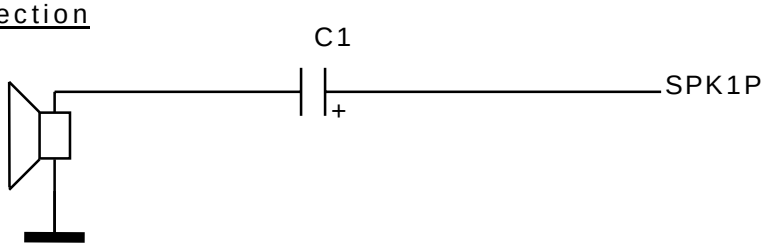


figure 13 : speaker 1 output

C1 = from 100nF to 47µF as per the speaker characteristics.
Using a single-ended connection also includes losing half of the output power compared to a differential connection.

Table 19 : speaker 1 output pin description

Signal	Pin #	I/O	I/O type*	Description
SPK1P	12	O	Analog	Speaker 1 positive output
SPK1N	14	O	Analog	Speaker 1 negative output

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.1.10 SIM interface

The external SIM interface is available through the 50-pin connector in order to use a stand-alone SIM card holder. **This interface is 3V for engineering sample and can be 5V for production unit using a level shifter.**
SIM line must not exceed 15 cm. see also "General guidelines" chapter 8
5 signals exist:
SIMVCC: SIM power supply.
SIMRST: reset.
SIMCLK: clock.
SIMDATA: I/O port.
SIMPRES1 SIM card detect. It is connected to external SIM connector at pin 8. Pin 4 of SIM connector must be pulled down to GND with 1 KΩ.
This interface is fully compliant with GSM 11.11 recommendations concerning the SIM functionality.
Transient Voltage Suppressor diodes are internally added on the signals connected to the SIM socket in order to prevent any Electro-Static Discharge. TVS diodes with low capacitance (less than 10pF) are connected on SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edge.

Table 20 : SIM interface pin description

Signal	Pin number	I/O	I/O type*	Description
SIMCLK	45	O	2X	SIM Clock
SIMRST	46	O	2X	SIM Reset
SIMDATA	49	I/O	CMOS / 3X	SIM Data
SIMVCC	47	O		SIM Power Supply
SIMPRES1	48	I	CMOS	SIM Card Detect
GPO0**	50	O	2X	SIM 3V or 5V

*See Table 3 "operating conditions" in subdivision 4.1.1The 50-pin connector description
** for production unit

Table 21 : SIM interface electrical characteristics

Parameter	Conditions	Min	Typ	Max	Unit
SIMDATA V_{IH}	I_{IH} = ± 20µA	0.7xSIMVCC			V
SIMDATA V_{IL}	I_{IL} = 1mA			0.3xSIMVCC	V
SIMRST, SIMDATA SIMCLK V_{OH}	Source current = 20µA	SIMVCC – 0.1V			V
SIMRST, SIMDATA SIMCLK V_{OL}	Sink current = -200µA			0.1	V
SIMVCC Output Voltage	I_{SIMVCC} <= 6mA	2.70	2.80	2.85	V
SIMCLK Rise/Fall Time	Loaded with 30pF			50	ns
SIMRST, SIMDATA Rise/Fall Time	Loaded with 30pF			1	µs
SIMCLK Frequency	Loaded with 30pF			3.25	MHz

Table 22 : SIM socket pin description

Signal	Pin number	Description
VCC	1	SIMVCC
RST	2	SIMRST
CLK	3	SIMCLK
CC4	4	R10 to GROUND
GND	5	GROUND
VPP	6	Not connected
I/O	7	SIMDATA
CC8	8	SIMPRES1

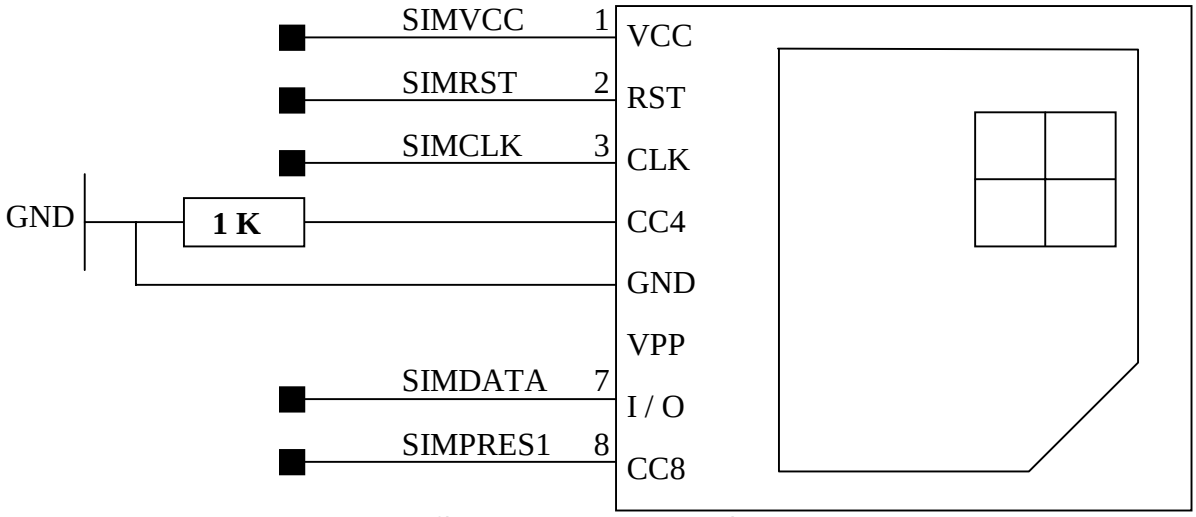


figure 14 : SIM socket

4.1.11 SPI bus

The SPI bus includes a CLK signal, an I/O signal and an EN signal complying with SPI bus standard. The maximum speed transfer is 3.25Mb/s.

Table 23 : SPI Bus pin description

Signal	Pin number	I/O	I/O type*	Description
SPI_CLK	44	O	1X	SPI Serial Clock
SPI_IO	43	I/O	CMOS / 1X	SPI Data
SPI_EN	42	O	1X	SPI Enable

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.1.12 Keypad interface

This interface provides 10 connections : 5 rows (R0 to R4) and 5 columns (C0 to C4).
The scanning is a digital one, and the debouncing is done in the integrated modem through the module. No discrete components like R,C (Resistor, Capacitor) are needed.
It is possible to scan the column and rows via the AT command : AT+ CMER
See AT command user’s guide

Table 24 : keypad interface pin description

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

*See Table 3 “operating conditions” in subdivision 4.1.1The 50-pin connector description

4.2 RF Interface

The impedance is 50 Ohms nominal.

4.2.1 RF connector

The RF connector is MMCX (Miniature Micro Connector) standard type.
An antenna can be directly connected through the matting connector or using a small adaptor. See also
GSM Antenna

4.2.2 RF performances

RF performances are compliant with the ETSI recommendation 05.05 and 11.10.
The main parameters are :

- Receiver:
- EGSM Sensitivity : < -104 dBm
- GSM 1800/GSM 1900 Sensitivity : < -102 dBm
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Dynamic range : 62 dB
- Intermodulation : > -43 dBm
- Co-channel rejection : + 9 dBc

Transmitter :

- Maximum output power (EGSM) : 33 dBm +/- 2 dB
- Maximum output power (DCS/PCS) : 30 dBm +/- 2 dB
- Minimum output power (EGSM): 5 dBm +/- 5 dB
- Minimum output power (DCS/PCS): 0 dBm +/- 5 dB
- H2 level : < -30 dBm
- H3 level : < -30 dBm
- Noise in 925 - 935 MHz : < -67 dBm
- Noise in 935 - 960 MHz : < -79 dBm
- Noise in 1805 - 1880 MHz : < -71 dBm
- Phase error at peak power : < 5 ° RMS
- Frequency error : +/- 0.1 ppm max

4.3 SIM interface

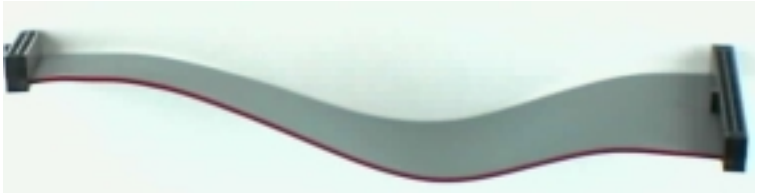
The internal SIM interface of the WMOi3 integrated modem fits with a **3V SIM card holder only.**
The part number reference of the SIM card holder supplier is MOLEX 91228-0002
The part number reference of the SIM receptacle supplier is MOLEX 91236-0002
See also subdivision The SIM card holder.

5 Connector Supplier and Peripheral devices

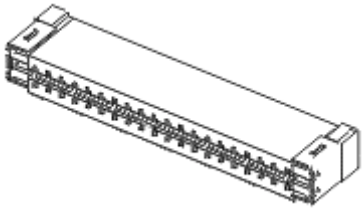
5.1 Where to find the SMD connectors

The matting connector for the main connector is made by SAMTEC France. You will find hereafter the SAMTEC web site
http://www.samtec.com/
Many SAMTEC products are available via SAMTEC dealers throughout the world.

figure 15 : high and low profile connectors



Part number : SD 25 01 N
figure 16 : flexible flat cable



Part number : FTS 125 01LDVA
figure 17 : flex cable connector

5.1.1 GSM Antenna

The integrated modem antenna connector is a MMCX connector. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier with an excellent RF performance. An additional advantage is its small physical size which is 50% of the standard MCX connector.
This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm.
The antenna manufacturer must guarantee that the antenna will be working according to the following radio frequencies:

Table 25 : radio frequencies

	EGSM 900	GSM 1800	GSM 1900
Frequency RX	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Frequency TX	880 to 915 MHz	1710 to 1785 MHZ	1850 to 1910 MHz
RF power stand	2W at 12.5 % duty cycle	1W at 12.5 % duty cycle	1W at 12.5 % duty cycle
Impedance	50 Ω		
VSWR	< 2		
Typical radiated gain	0 dBi on azimuth plane		

The WMOi3 integrated modem requires an MMCX (Miniature Micro Connector) plug to connect an antenna

figure 18 : MMCX connector example (right angle)

An antenna with matting 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/

or using a small MMCX / SMA adaptor can be ordered, for example, from :
Amphenol Socapex
http://www.amphenol.com/
Order N° : 908-31100

5.1.2 The SIM card holder

The SIM card holder used in the integrated modem is a MOLEX connector.
Part number connector: 99228-0002
Part number holder : 91236-0002
For more information about this connector :
http://www.molex.com/

It is possible to use a stand-alone SIM card holder through the 50-pin connector (the length of the SIM line must not exceed 15 cm).

6 Climatic and mechanical environment

Table 26 : climatic and mechanical environment

WM2C-G900/G1800		ENVIRONNEMENTAL CLASSES		
TYPE OF TEST	STANDARDS	STORAGE Class 1.2	TRANSPORTATION Class 2.3	OPERATING (PORT USE) Class 7.3
Cold	IEC 68-2.1 Ab test	-25° C 72 h	-40° C 72 h	-20° C (GSM) 16 h -10° C (DCS) 16 h
Dry heat	IEC 68-2.2 Bb test	+70° C 72 h	+70° C 72 h	+55° C 16 h
Change of temperature	IEC 68-2.14 Na/Nb test		-40° / +30° C 5 cycles t1 = 3 h	-20° / +30° C (GSM) 3 cycles -10° / +30° C (DCS) 3 cycles t1 = 3 h
Damp heat cyclic	IEC 68-2.30 Db test	+30° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1	+40° C 2 cycles 90% - 100% RH variant 1
Damp heat	IEC 68-2.56 Cb test	+30° C 4 days	+40° C 4 days	+40° C 4 days
Sinusoidal vibration	IEC 68-2.6 Fc test	5 - 62 Hz : 5 mm / s 62 - 200Hz : 2 m / s2 3 x 5 sweep cycles		
Random vibration wide band	IEC 68-3.36 Fdb test		5 - 20 Hz : 0.96 m2 / s3 20 - 500Hz : - 3 dB / oct 3 x 10 min	10 -12 Hz : 0.96 m2 / s3 12 - 150Hz : - 3 dB / oct 3 x 30 min

7 Application examples

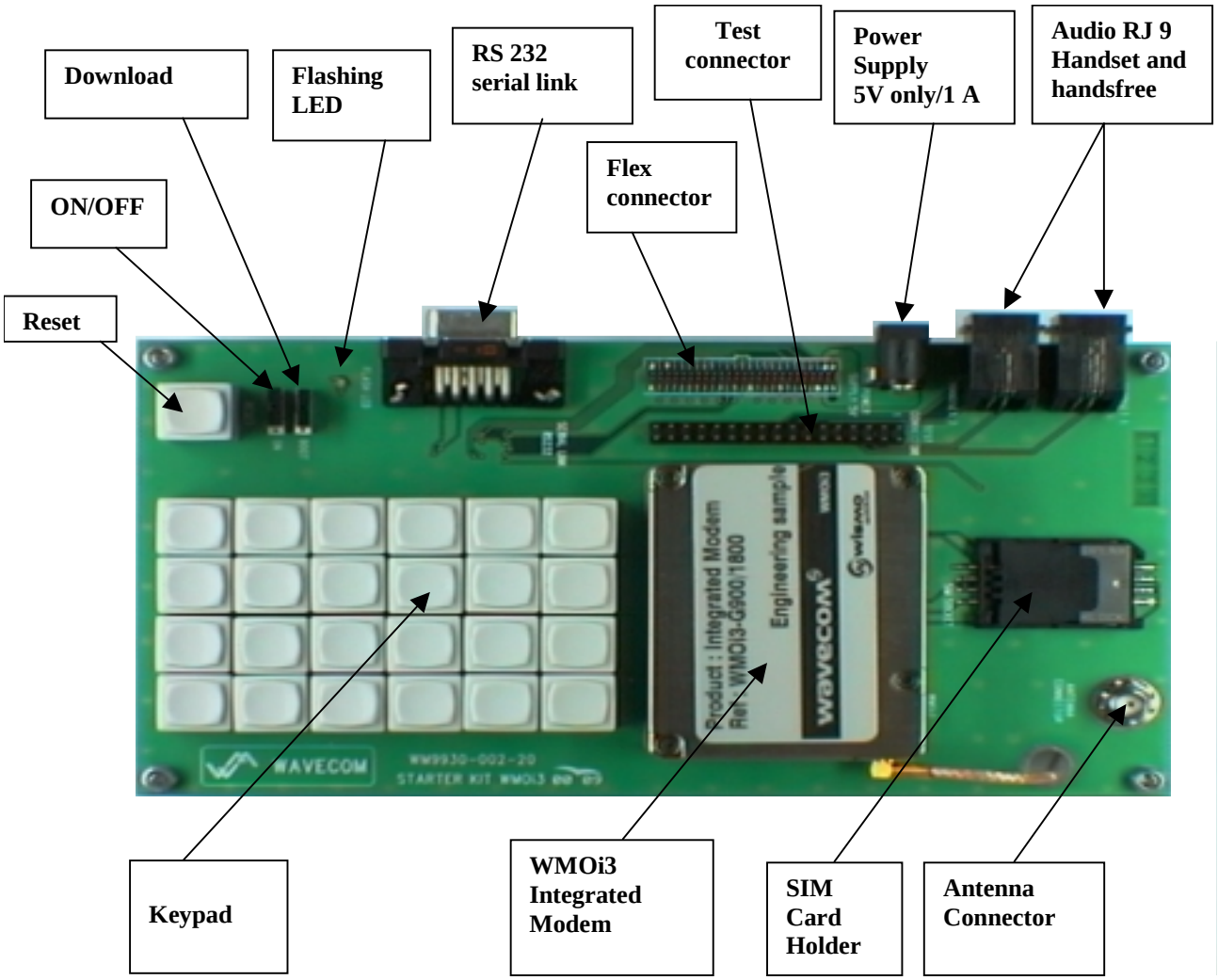


figure 19 : demoboard pattern photograph

The demoboard is manufactured at Wavecom and can also be ordered at Wavecom headquarters or directly to your distributor.

8 General guidelines for the use of the WMOi3

8.1 Key information

8.1.1 Hardware and RF

- Ground plane: Wavecom recommends to have a common ground plane for analog, digital and RF grounds.
- Length of the SIM interface lines (15 cm maximum)
- Bias of the Microphone inputs must be properly adjusted when using audio connectors (mic + speaker) 1.
- EMC protection on audio input/output (filters against 900 MHz)
- ESD protection on serial link,...
- Possible spurious emission radiated by the application to the RF receiver in the receiver band

8.1.2 The Antenna

The antenna sub-system and integration in the application is a major issue. It is a major issue in the choice of the antenna cable (type, length, performances, thermal resistance, etc.)
These elements could affect GSM performances such as sensitivity and emitted power.
The antenna should be isolated as much as possible from the digital circuitry including the interface signals.
It is recommended to shield the terminal. On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal.
Subsequently, the power emitted through the antenna could affect the application.

8.1.3 Firmware upgrade

The WMOi3 firmware is stored in flash memory and it can easily be upgraded.
Two upgrade procedures are available:

8.1.3.1 Nominal upgrade procedure

The firmware file can be downloaded into the modem using the Xmodem protocol.
To enter this mode, the AT+WDWL command (see description in the AT command manual) has to be sent to the WMOi3
The necessary serial signals to proceed with the Xmodem downloading are:
Rx, Tx, RTS, CTS, GND.

8.1.3.2 backup procedure

In case the nominal upgrade mode is not possible (due to critical corruption on the flash memory),
a backup procedure is also available. It requires a WAVECOM specific software to download the firmware file into the modem.
This tool has to run on a PC connected to the serial bus of the modem. As this procedure is very specific and needs Wavecom tools, this process has to be executed by your distributor.
The necessary signals to proceed with the downloading are: Rx, Tx, RTS, CTS, GND.
Prior to running the WAVECOM downloader, the modem has to be set in download mode.
For this, the BOOT signal has to be set to low while powering ON (or reseting) the modem.

The software upgrading is easy through the terminal: it is possible to download a new GSM software from the outside, i.e., without removing the module from the terminal.
Therefore the application must support serial speed changes, up to 115,200 bps and hardware flow control.
The software upgrading can be handled either in using the Xmodem protocol combined with the appropriate AT command AT+ WDWL through the nominal mode or in using the Wavecom firmware in emergency mode (backup procedure).

8.1.4 Getting started

8.1.4.1 Minimum hardware interface to get started

As a minimum, it is necessary to connect the following signals to properly operate the WMOi3 :

Pin number	Name	Description
1	GND	GROUND
2	GND	GROUND
3	+5V	Power supply
4	+5V	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 +5V for example

The serial link signals must be used through the implementation of the serial link level shifter. See figure 5 : level shifter application diagram for serial link

8.1.4.2 Terminal emulator setup

Here below is an example based on the Windows™ Hyperterminal application.
You use the Hyperterminal program to monitor your WMOi3 integrated modem.
Setup:
START – PROGRAMS – ACCESSORIES – HYPERTERMINAL , then
Start the software HYPERTRM
Give the name of your choice, click on the icone of your choice, then click "OK", then
choose:
Connect using : direct to COM1
Properties :
choose 9600 bps – 8 bits data – no party – 1 stop bit – hardware flow control
Click "OK"

Now your HYPERTERMINAL is opened.
Your WMOi3 is ready to receive AT commands
Please see the "Informative Example" annex in the AT command user's guide to test your WMOi3.

8.2 AT command list

For comprehensive information about AT Commands, please read the AT Commands user's guide

Table 27 : AT command list

General Commands	
+CGMI	Manufacturer Identification
+CGMM	Request Model Identification
+CGMR	Request Revision Identification
+CGSN	Product Serial Number
+CSCS	Select TE Character Set
+CIMI	Request IMSI
+CCID	Card Identification
+GCAP	Capabilities List
A/	Repeat Last Command
+CPOF	Power Off
+CFUN	Set Phone Functionality
+CPAS	Phone Activity Status
+CMEE	Report Mobile Equipment Errors
+CKPD	Keypad Control

Call Control Commands	
D	Dial command
H	Hang-up Command
A	Answer a Call
+CEER	Extended Error Report
+VTD, +VTS	DTMF Signals
ATDL	Redial Last Telephone Number
AT%Dn	Automatic Dialing with DTR
ATSO	Automatic Answer
+CICB	Incoming Call Bearer
+VGR, +VGT	Gain Control
+CMUT	Microphone Mute Control
+SPEAKER	Speaker and Microphone Selection
+ECHO	Echo Cancellation
+SIDET	Side Tone Modification
+VIP	Initialize Voice Parameters
Network Service Commands	
+CSQ	Signal Quality
+COPS	Operator Selection
+CREG	Network Registration
+WOPN	Read Operator Name
+CPOL	Preferred Operator List
Security Commands	
+CPIN	Enter PIN
+CPIN2	Enter PIN2
+CPINC	PIN Remaining Attempt Number
+CLCK	Facility Lock
+CPWD	Change Password
Phone Book Commands	
+CPBS	Select Phone Book Memory Storage
+CPBR	Read Phone Book Entries
+CPBF	Find Phone Book Entries
+CPBW	White Phone Book Entry
+CPBP	Phone Book Phone Search
+CPBN	Move Action in Phone Book
+CNUM	Subscriber Number
+WAIP	Avoid Phone Book Init

Short Message Commands	
+CSMS	Select Message Service
+CNMA	New Message Acknowledgement
+CPMS	Preferred Message Storage
+CMGF	Preferred Message Format
+CSAS	Save Settings
+CRES	Restore Settings
+CSDH	Show Text Mode parameters
+CNMI	New Message Indication
+CMGR	Read Message
+CMGL	List Message
+CMGS	Send Message
+CMGW	Write Message to Memory
+CMSS	Send Message from Storage
+CSMP	Set Text Mode Parameters
+CMGD	Delete Message
+CSCA	Service Center Address
+CSCB	Select Cell Broadcast Message Types
+WCBM	Cell Broadcast Message Identifiers
+WMSC	Message Status Modification
+WMGO	Message Overwriting
Supplementary Services Commands	
+CCFC	Call Forwarding
+CLCK	Call Barring
+CPWD	Modify SS Password
+CCWA	Call Waiting
+CLIR	Calling Line Identification Restriction
+CLIP	Calling Line Identification Presentation
+COLP	Connected Line Identification Presentation
+CAOC	Advice Of Charge
+CACM	AccumulatedCcall Meter
+CAMM	Accumulated Call Meter Maximum
+CPUC	Price Per Unit and Currency Table
+CHLD	Call Related Supplementary Services
+CLCC	List Current Calls
+CSSN	Supplementary Service Notifications
+CUSD	Unstructured Supplementary Service Data
+CCUG	Closed User Group
Data Commands	
+CBST	Bearer Type Selection
+FCLASS	Select Mode
+CR	Service Reporting Control
+CRC	Cellular Result Codes
+ILRR	DTE-DCE Local Rate Reporting
+CRLP	Radio Link Protocol Parameters
+DOPT	Others Radio Link Parameters
%C	Select Data Compression
+DS	V42 bis Data Compression
+DR	V42 bis Data Compression Report
\N	Select Data Error Correcting Mode

Fax Commands	
+FTM	Transmit Speed
+FRM	Receive Speed
+FTH	HDLC Transmit Speed
+FRH	HDLC Receive Speed
+FTS	Stop Transmission and Wait
+FRS	Receive Silence
Fax Class 2 Commands	
+FDT	Transmit Data
+FDR	Receice Data
+FET	Transmit Page Punctuation
+FPTS	Page Transfer Status Parameters
+FK	Terminate Session
+FBOR	Page Transfer Bit Order
+FBUF	Buffer Size Report
+FCQ	Copy Quality Checking
+FCR	Capability to Receive
+FDIS	Current Sessions Parameters
+FDCC	DCE Capabilities Parameters
+FLID	Local ID String
+FPHCTO	Page Transfer Timeout Parameter
V24-V25 Commands	
+IPR	Fixed DTE Rate
+ICF	DTE-DCE Character Framing
+IFC	DTE-DCE Local Flow Control
&C	Set DCD Signal
&D	Set DTR Signal
&S	Set DSR Signal
O	Back to Online Mode
Q	Result Code Suppression
V	DCE Response Format
Z	Default Configuration
&W	Save Configuration
&T	Auto-Tests
E	Echo
&F	Restore Factory Settings
&V	Display Configuration
I	Request Identification Information
SIM Toolkit Commands	
+STSF	SIM Toolkit Set Facilities
+STIN	SIM Toolkit Indication
+STGI	SIM Toolkit Get Information
+STCR	SIM Toolkit Control Response
+STGR	SIM Toolkit Give Response

Specific AT Commands	
+CCED	Cell Environment Description
+CCED	Automatic RxLev Indication
+WIND	General Indications
+ADC	Analog Digital Converters Measurements
+CMER	Mobile Equipment Event Reporting
+WLPR	Read Language Preference
+WLPW	Write Language Preference
+WIOR	Read GPIO Value
+WIOW	Write GPIO Value
+WAC	Abort Command
+WTONE	Play Tone
+WDTMF	Play DTMF Tone
+WDWL	Wavecom Downloading
+WVR	Wavecom Voice Rate
+WDR	Data Rate
+WHWV	Hardware Version
+WDOP	Date Of Production
+WSVG	Wavecom Select Voice Gain
+WSTR	Wavecom Status Request
+WSCAN	Wavecom Scan

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Numerics

10 Acronyms and Abbreviations

ADC : Analog Digital Converter
ASIC : Application Specific Integrated Circuit
BCCH : Broadcast Control Channel
CE : Communauté Européenne
CLK : Clock
CTS : Clear To send
dB : decibel
DCD : Data Carrier Detect
DCE : Data Circuit Terminating Equipment
DSR : Data Set Ready
DTE : Data Terminal Equipment
DTR : Data Terminated Ready
EFR : Enhanced Full Rate
E-GSM : Extended- GSM
EMC : Electromagnetic Conformity
EN : Enable
ETSI :
FAC : Final Assembly Code
FR : Full-Rate
FTA : Full Type Approval
GND : Ground
GPIO : General Purpose Input Output
GPRS : General Packet Radio Service
GSM : Global System for Mobile Communication
HR : Half-Rate
IMEI : International Mobile Equipment Identity
MO : Mobile Originated
MT : Mobile Terminated
OEM : Original Equipment Manufacturer
PDA : Personal Digital Assistant
PCB : Printed Circuit Board
PRES : Presence
RI : Ring Indicator
RTS : Request To Send
SIM : Subscriber Identity Module
SMD : Surface Mounted Design
SMS : Short Message Service
TAC : Type Approval Code
TDMA : Time Code Multiple Access
TE : Terminal Equipment
VSWR : Voltage Standing Wave Ratio
WAP : Wireless application Protocol

11 Reference documents

Table 28 : GSM ETSI recommendations for Phase I and Phase II.

Specification Reference	Title
GSM ph2 Radio	ETSI GSM 05.05 and GT 01 v4.2.1
DCS ph2 Radio	ETSI GSM05.05 and GT01 v4.2.1
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 an GT 01 v4.2.1
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 an GT 01 v4.2.1
GSM ph2 Layer 2	ETSI GSM 04.06 and GT 01 v4.2.1
GSM ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
DCS ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
GSM/DCS Multiband	ETSI GSM 02.07, 03.22, 04.08, 04.13, 05.05, 05.08 an GT 01 v4.2.1
GSM ph2 SIM	ETSI GSM 11.11 and GT 01 v4.2.1
GSM ph2 Teleservices	ETSI GSM 03.50 and GT 01 v4.2.1
GSM ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.1 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and G 01 v4.2.1
DCS ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.1 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and G 01 v4.2.1

You can find the documents on

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Figures

Tables