LE50-868 RF Module User Guide

1VV0300905 Rev.1 – 2011-05-18

Making machines talk.

APPLICABILITY TABLE

PRODUCT
LE50-868

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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Contents

1. Introduction

1.1. Scope

Scope of this document is to give an overview of the fonts, styles and general structure -- first chapter included -- to use when writing Telit documents. The aim of this document is to present the features and the application of the LE50-868 radio module. After the introduction, the characteristics of the LE50-868 radio module will be described within the following distinct chapters:

- Requirements
- General Characteristics
- Technical description
- Process information
- Board Mounting Recommendations
- Antenna Considerations

1.2. Audience

This document is intended for developers using Telit LE50-868 Module..

1.3. Contact Information, Support

For general contact, technical support, to report documentation errors and to order manuals, contact Telit Technical Support Center (TTSC) at:

TS-EMEA@telit.com
TS-NORTHAMERICA@telit.com
TS-LATINAMERICA@telit.com
TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/en/products/technical-support-center/contact.php

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Document Organization

This document contains the following chapters

"Chapter 1: "Introduction" provides a scope for this document, target audience, contact and support information, and text conventions.

"Chapter 2: "General Requirement" gives an overview of the limitations imposed by Reference standards.

"Chapter 3: "General Characteristics" describes in details the characteristics of the product.

"Chapter 4: "Technical Description" describes in details the signals and pin-out of the product.

"Chapter 5: "Process information" describes in details the delivery, storage, soldering and placement of the product.

"Chapter 6: "Board Mounting Recommendations" describes in details the interface and coupling of the product.

"Chapter 7: "Annexes" describe examples of propagation attenuation.

"Chapter 8: "Safety Recommendations" describes recommendation for proper usage.

"Chapter 39: "Document history" describes the revision history of the product.

1.5. Text Conventions

Danger – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.6. Related Documents

- [1] EN 300 220-2 v2.3.1, ETSI Standards for SRD , February 2010
- [2] ERC Rec 70-03, ERC Recommendation for SRD, June 2010
- [3] 2002/95/EC, Directive of the European Parliament and of the Council, 27 January 2003
- [4] Tools : User Manual, 1VV300873 Short Range Tool User Guide
- [5] Star Network User Guide, 1vv0300899 M-ONE Protocol Stack User Guide
- [6] 2006/771/EC, Harmonization of the radio spectrum for use by short-range devices
- [7] 2009/381/EC, Amending Decision 2006/771/EC on harmonization of the radio spectrum for use by short-range devices

2. Requirements

2.1. General Requirements

The LE50-868 module is a multi-band radio board, delivering up to 25 mW in the 868 MHz ISM band (unlicensed frequency band). It is dedicated to low power applications that require mesh network structure.

LE50-868 is also pin-to-pin compatible with Telit ZE Family (ZigBee 2007 and PRO stack), ME Family (Wireless M-bus) and LE Family (basic point to point, broadcast stack).

The "ERC recommendation 70-03" describes the different usable sub-bands in the 868 MHz license free band, in terms of bandwidth, maximum power, duty cycle and channel spacing. It gives the following limitations:

ERC recommendation 70-03				
Band	***Frequency band (MHz)***	***Maximum radiated power (mW)***	***Channel spacing (kHz)***	***Duty cycle (%)***
Annex1 g	863.0 – 870.0	25	=< 100 for 47 or more channels	100
Annex1 g1	868.0 – 868.6	25	No channel spacing specified	1
Annex7 a	868.6 - 868.7	10	25	1
Annex1 g2	868.7 - 869.2	25	No channel spacing specified	0,1
Annex7 d	869.2 – 869.25	10	25	0.1
Annex7 b	869.25 – 869.3	10	25	0.1
Annex7 e	869.3 – 869.4	10	25	1
Annex1 g3	869.4 - 869.65	500	25 (for 1 or more channels)	10
Annex7 c	869.65 – 869.7	25	25	10
Annex1 g4	869.7 – 870.0	5	No channel spacing specified	100

These bands are free to use but the module and the user must respect some limitations. Most of these restrictions are integrated in the conception of the module, except the duty cycle. For example, the 869.400 to 869.650 MHz band is limited to a 10% duty cycle. This means that each module is limited to a total transmit time of 6 minutes per hour. It is the responsibility of the user to respect the duty cycle.

Finally, the module complies with the new European Directive 2002/95/EC concerning the Restrictive Usage of Hazardous Substances (RoHS).

National Restrictions for non specific SR devices Annex 1 band g1-g4:

Country	Restriction	Reason/Remark
Band G		
Austria	Not Implemented	Planned
Finland	Limited Implementation	Audio, video and voice not allowed - Planned 2011
Georgia	Not Implemented	
Greece	Limited Implementation	to 863-865 MHz
Lithuania	Limited implementation	Only 863-868 MHz and duty cycle can not be increased to 1%
Norway	Not implemented	
Russian Federation	Not Implemented	864-865 MHz with max e.r.p 25 mW, duty cycle 0.1% or LBT. Forbidden to use at the airports (aerodromes)
Spain	Limited implementation	to the band 863-868 MHz
Sweden	Not Implemented	
The Netherlands	Not Implemented	Under study
Ukraine	Limited implementation	863-865 / 868-868.6 / 868.6-868.7 / 869.2-869.25 MHz
Band G1		
Georgia	Not Implemented	
Russian Federation	Not Implemented	
Ukraine	Not Implemented	e.i.r.p. ≤25 mW
Band G3		
Georgia	Not Implemented	
Russian Federation	Not Implemented	
Ukraine	Not Implemented	
Band G4		
Finland	Limited implementation	Only 5mW e.r.p. - Planned 2011
Georgia	Not Implemented	
Russian Federation	Not Implemented	
Ukraine	Not Implemented	

National Restrictions for non specific SR devices Annex 7 band a-e:

Country	Restriction	Reason/Remark
Band A		
France	Duty cycle limited to 0.1%	

Georgia	No info	
Russian Federation	Not implemented	
Ukraine	Limited implementation	The maximal transmitter power 10 mW
Band B		
Georgia	No info	
Russian Federation	Not implemented	
Ukraine	No info	
Band C		
Georgia	No info	
Russian Federation	Not implemented	
Ukraine	Not implemented	Under study
Band D		
Georgia	No info	
Russian Federation	Not implemented	
Ukraine	Limited implemented	The maximal transmitter power 10 mW
Band E		
France	Not implemented	
Georgia	No info	
Greece	Not implemented	
Macedonia	Not implemented	Planned
Russian Federation	Not implemented	
Ukraine	No info	

2.2. Functional Requirements

The LE50-868 module is a complete solution from serial interface to RF interface. The LE50-868 module has a digital part and a RF part. The radio link is a Half Duplex bi-directional link.

The digital part has the following functionalities:

- Communication interface
- I/O management
- Micro controller with embedded Telit RF proprietary Star Network stack

The RF part has the following functionalities:

- Frequency synthesis
- Front-end
- Low noise reception
- Power amplification
- Packet handling

2.3. Software

The LE50-868 module is provided pre-flashed with Telit in-house Star Network stack. Please refer to Star Network Stack User Guide [5] for detail information.

2.4. Temperature Requirements

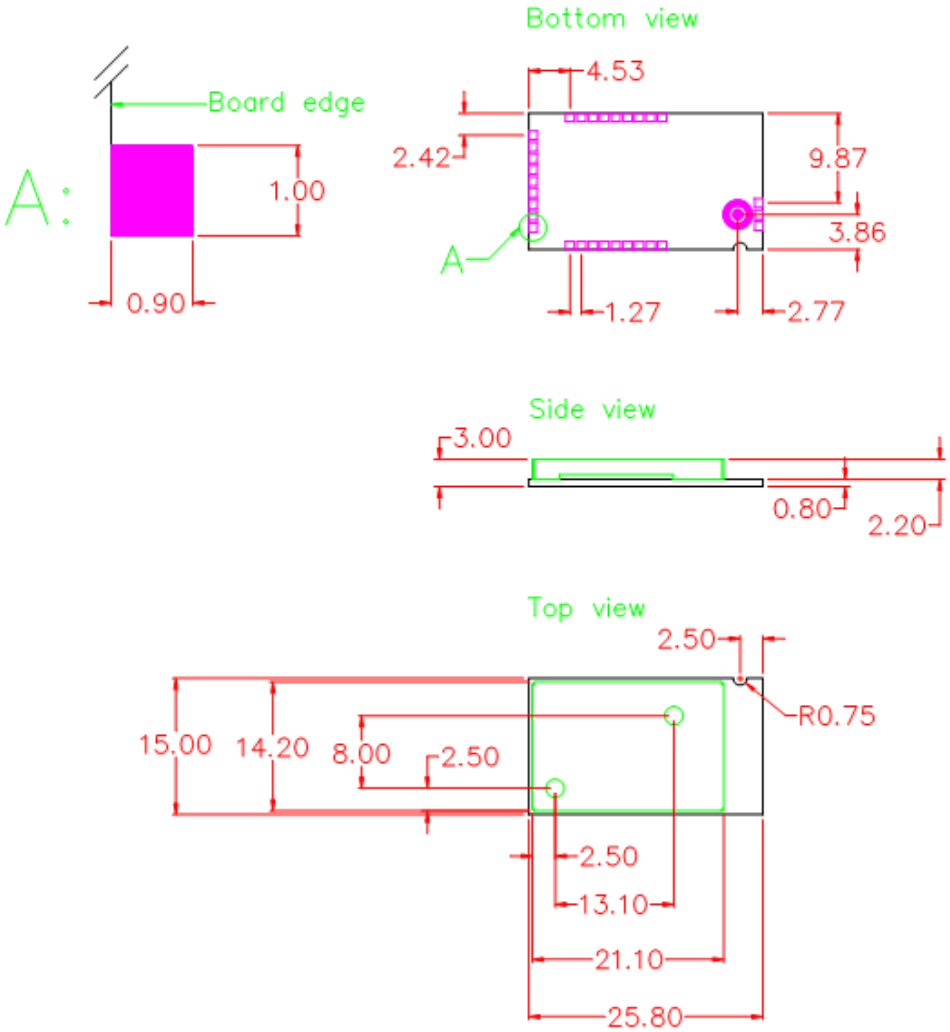
	Minimum	***Typical***	***Maximum***	***Unit***
Operating				
Temperature	- 40	25	+ 85	°C
Relative humidity @ 25°C	20		75	%
Storage				
Temperature	- 40	25	+ 85	°C

3. General Characteristics

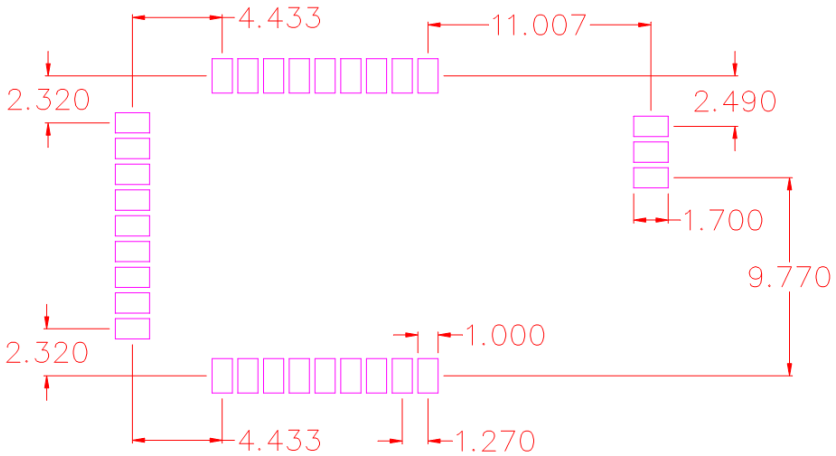
3.1. Mechanical Characteristics

Size :	Rectangular 25.8 x 15 mm
Height :	3 mm
Weight :	1.7 g
PCB thickness:	0.8 mm
Cover :	• Dimensions : 21 x 14.2 x 2.2mm • Thickness : 200µm
Components :	All SMD components, on one side of the PCB.
Connectors :	The terminals allowing conveying I/O signals are LGA
Mounting :	• SMD • LGA on the 4 external sides
Number of pins :	30

3.2. Mechanical dimensions



3.3. Recommended Land pattern



3.4. DC Characteristics

Characteristics NE50	Min.	Typ.	Max.
Power Supply (VDD):	+2.0V	+3.3V	+3.6V
Consumption			
Transmission @ 25mW:		45mA	50mA
Reception :		26mA	30mA
Stand-by (32.768 khz On) :			3µA
I/O low level :	GND	-	0.2x VDD
I/O high level :	0.8x VDD	-	VDD

3.5. Functional Characteristics

ERC/REC70-03 Frequency (MHz)	Band g 863.000 - 870.000	Band g1 868.000 - 868.600	Band g2 868.700 - 869.200	Band g3 869.400 - 869.650	Band g4 869.700 - 870.000
Global					
RF data rate	(1): 19.2 kbps (2): 38.4 kbps (3): 115.2 kbps				
Numbers of channels	20 (1) 10 (2) 0 (3)	6 (1) 3 (2) 1 (3)	5 (1) 2 (2) 1 (3)	1 (1) 1 (2) 0 (3)	3 (1) 2 (2) 0 (3)
Channel width	100 kHz (1) 200 kHz (2)	100 kHz (1) 200 kHz (2) 600 kHz (3)	100 kHz (1) 200 kHz (2) 500 kHz (3)	250 kHz	100 kHz (1) 150 kHz (2)
Channel 0	865.550 MHz (1) 865.600 MHz (2)	868.050 MHz (1) 868.100 MHz (2) 868.300 MHz (3)	868.750 MHz (1) 868.850 MHz (2) 868.950 MHz (3)	869.5250 MHz	869.750 MHz (1) 869.775 MHz (2)
Total Bandwidth	2 MHz	600 kHz	500 kHz	250 kHz	300 kHz
Transmission					
Duty cycle	≤ 1%	≤ 1%	≤ 0.1%	≤ 10%	No requirement
Modulation	GFSK with ± 10 kHz deviation (1) GFSK with ± 20 kHz deviation (2) GFSK with ± 50 kHz deviation (3)				
Max permitted e.r.p	25 mW	25 mW	25 mW	500 mW	5 mW
e.r.p	8 levels with 3dB steps from -8dBm (ATS202 = 0) to +13dBm (ATS202 = 7)				
	20 mW	20 mW	20 mW	20 mW	5 mW

Reception	
Sensitivity for PER < 10^{-3}	(1): Max - 104 dBm (2): Max - 101 dBm (3): Max - 99 dBm
Remaining PER	< 1.10^{-6}
Saturation for PER < 10^{-3}	Up to - 10 dBm

ETSI EN 300 220 V2.3.1 (2009-12)				
Transmission				
Frequency error	+/- 12.5 kHz @ 25 kHz channelization +/- 87 kHz (100 ppm) > 25 kHz channelization			
ACP	- 37 dBm in 16 kHz BW under normal test conditions - 32 dBm in 16 kHz BW under extreme test conditions			
Modulation bandwidth	Reference Bandwidth (RBW)	Limit	Lower envelope point Minimum frequency	Upper envelope point maximum frequency
	1 kHz	- 30 dBm (1 µW)	$f_{e, lower}$	$f_{e, upper}$
	1 kHz	- 36 dBm (250 nW)	($f_{e, lower}$ – 200 kHz)	($f_{e, upper}$ + 200 kHz)
	10 kHz	- 36 d m (250 nW)	($f_{e, lower}$ – 400 kHz)	($f_{e, upper}$ + 400 kHz)
	100 kHz	- 36 dBm (250 nW)	($f_{e, lower}$ – 1 MHz)	($f_{e, upper}$ + 1 MHz)
Unwanted emissions in the spurious domain	Frequency State	47 MHz to 74 MHz 7,5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies below 1 000 MHz	Frequencies above 1 000 MHz
	Operating	- 54 dBm (4 nW)	- 36 dBm (250 nW)	- 30 dBm (1 µW)
	Standby	- 57 dBm (2 nW)	- 57 dBm (2 nW)	- 47 dBm (20 nW)
Reception				
Blocking for class 2 equipments	Frequency offset of the unwanted signal	Receiver bandwidth	Frequency offset of the unwanted signal	
	+/-2 MHz	10 kHz	+/-2 MHz	
		100 kHz		
		250 kHz		
	+/-10 MHz	10 kHz	+/-10 MHz	
		100 kHz		
		250 kHz		
spurious radiation	Below 1000 MHz		Above 1000 MHz	
	- 57 dBm (2 nW)		- 47 dBm (20 nW)	

3.6. Digital Characteristic

Function	Characteristics
µC	• 32 kB + 4 kB in system programmable flash • 4 kB RAM • 2 kB E^2PROM
Serial link	• RS232 TTL Full Duplex • 1200 to 115200 bps • 7 or 8 bits • Parity management • Flow control • None • Software (Xon/Xoff) • Hardware (RTS/CTS)
Embedded software functionality	• Star Network Telit RF proprietary stack • Flexibility: • Pre flashed • Customization capability • Download over the air

3.7. Absolut Maximum Ratings

Voltage applied to Vcc, V_{DD} :	-0.3V to +3.6V
Voltage applied to "TTL" Input :	-0.3V to V_{DD}+0.3V

3.8. Ordering Information

The following equipments can be ordered:

- The SMD version
- The DIP interface version
- The Demo Kit

The versions below are considered standard and should be readily available. For other versions, please contact Telit. Please make sure to give the complete part number when ordering.

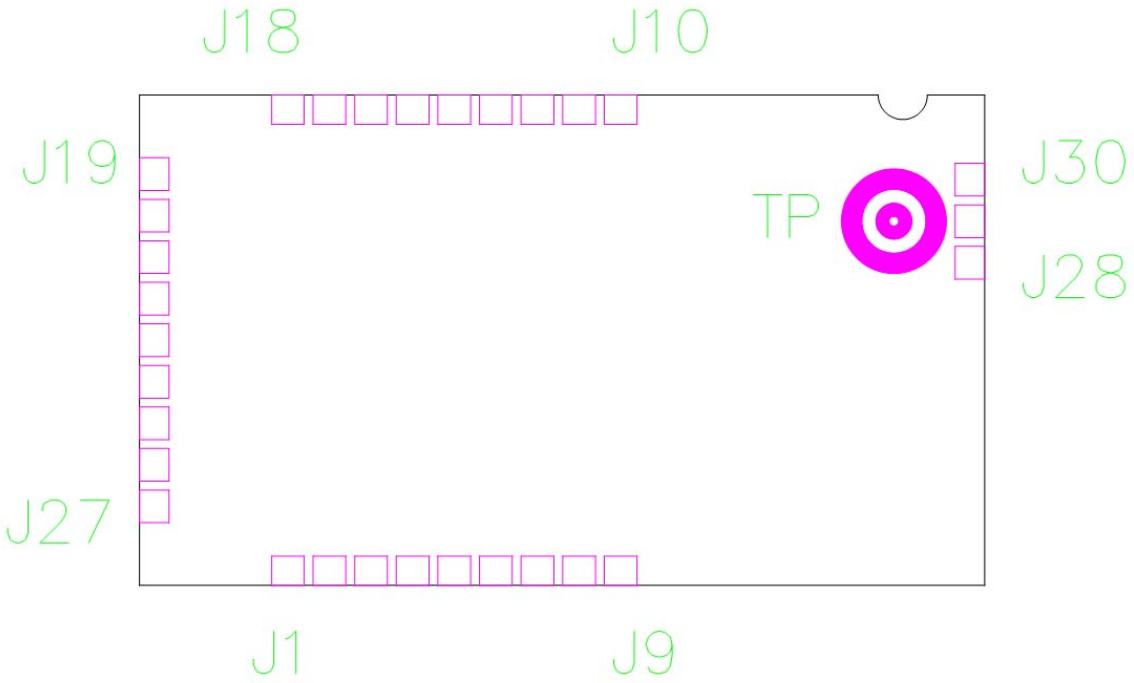
Equipment and Part Number
SMD Version
LE50-868

DIP Version
LE50-868

Demo Kit
D LE50 DEMO


4. Technical Description

4.1. Pin-out of the module



TOP VIEW (COVER SIDE)

Pin	Pin name	Pin type	Signal level	Function
J30	GND	Gnd		RF Ground connection for external antenna
J29	Ext_Antenna	RF		RF I/O connection to external antenna
J28	GND	Gnd		RF Ground connection for external antenna
J27	GND	Gnd		Ground
J26	GND	Gnd		Ground
J25	VDD	Power		Digital and Radio part power supply pin
J24	CTS	I	TTL	Clear To Send
J23	RESET	I	TTL	µC reset (Active low with internal pull-up)
J22	RTS	O	TTL	Request To Send
J21	RXD	I	TTL	RxD UART – Serial Data Reception
J20	GND	Gnd		Ground
J19	TXD	O	TTL	TxD UART – Serial Data Transmission
J18	STAND_BY	I	TTL	Standby (Active high with internal pull-down)

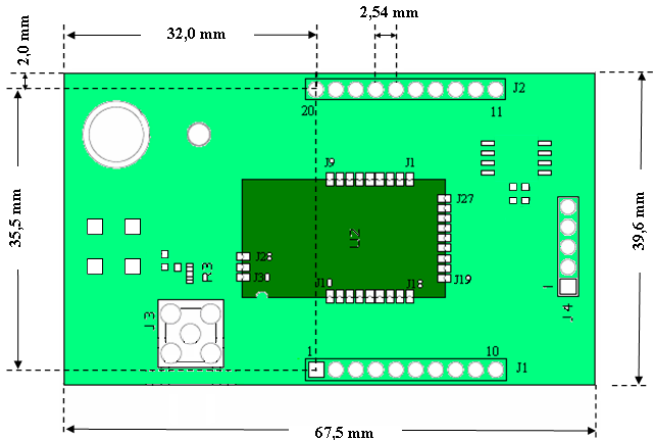
J17	GND	Gnd		Ground
J16	PROG	I	TTL	Signal for serial µC flashing (Active high with internal pull-down)
J15	GND	Gnd		Ground
J14	PDI_DATA	I/O	TTL	Program and Debug Interface DATA
J13	GND	Gnd		Ground
J12	GND	Gnd		Ground
J11	GND	Gnd		Ground
J10	PDI_CLK	I	TTL	Program and Debug Interface CLOCK
J9	IO9[1]	I/O	TTL	Digital I/O N°9 with interrupt
	Status TX/RX	O	TTL	See reference document **[5] Star Network Protocol Stack User Guide**
J8	IO8_AD_DA[2]	I/O	TTL	Digital I/O N°8 with interrupt
	ACK TX	O	TTL	See reference document **[5] Star Network Protocol Stack User Guide**
J7	IO7_A	I/O	TTL	Digital I/O N°7 with interrupt
J6	IO6_A	I/O	analog	ADC - Analog Input N°6 (Logic I/O capability)
J5	IO5_A	I/O	analog	ADC - Analog Input N°5 (Logic I/O capability)
J4	IO4_A	I/O	analog	ADC - Analog Input N°4 (Logic I/O capability)
J3	IO3_A	I/O	analog	ADC - Analog Input N°3 (Logic I/O capability)
J2	IO2_P	I/O	TTL	Logic I/O N°2 with interrupt
	RX LED	O	TTL	See reference document **[5] Star Network Protocol Stack User Guide**
J1	IO1_P	I/O	TTL	Logic I/O N°1 with interrupt
	TX LED	O	TTL	See reference document **[5] Star Network Protocol Stack User Guide**

NOTE: reserved pins must not be connected

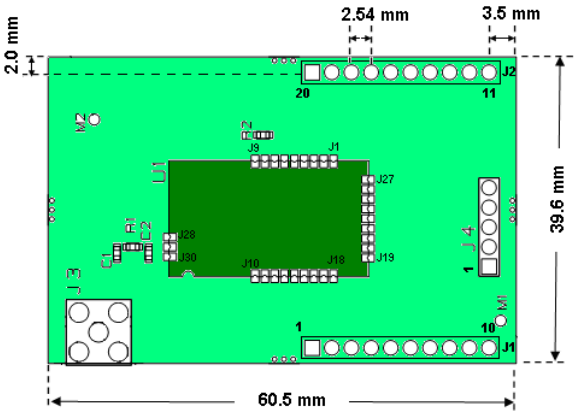
[1, 2] In case you want to use in the same application Telit ZE51 or ZE61 modules J9 and J8 should not be connected, since reserved on these modules.

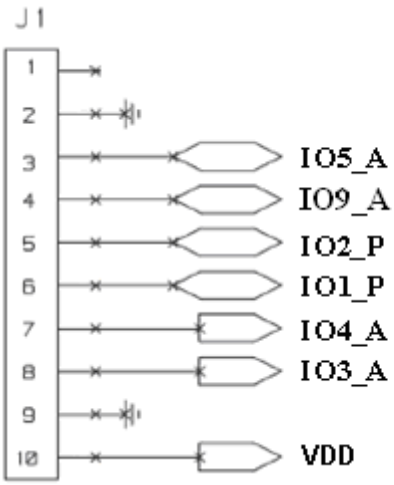
4.2. Pin-out of the DIP Module

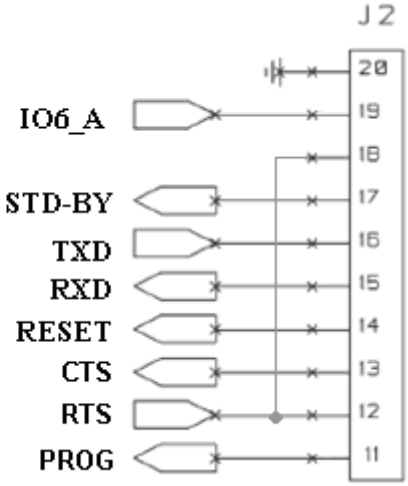
Version 1



Version 2







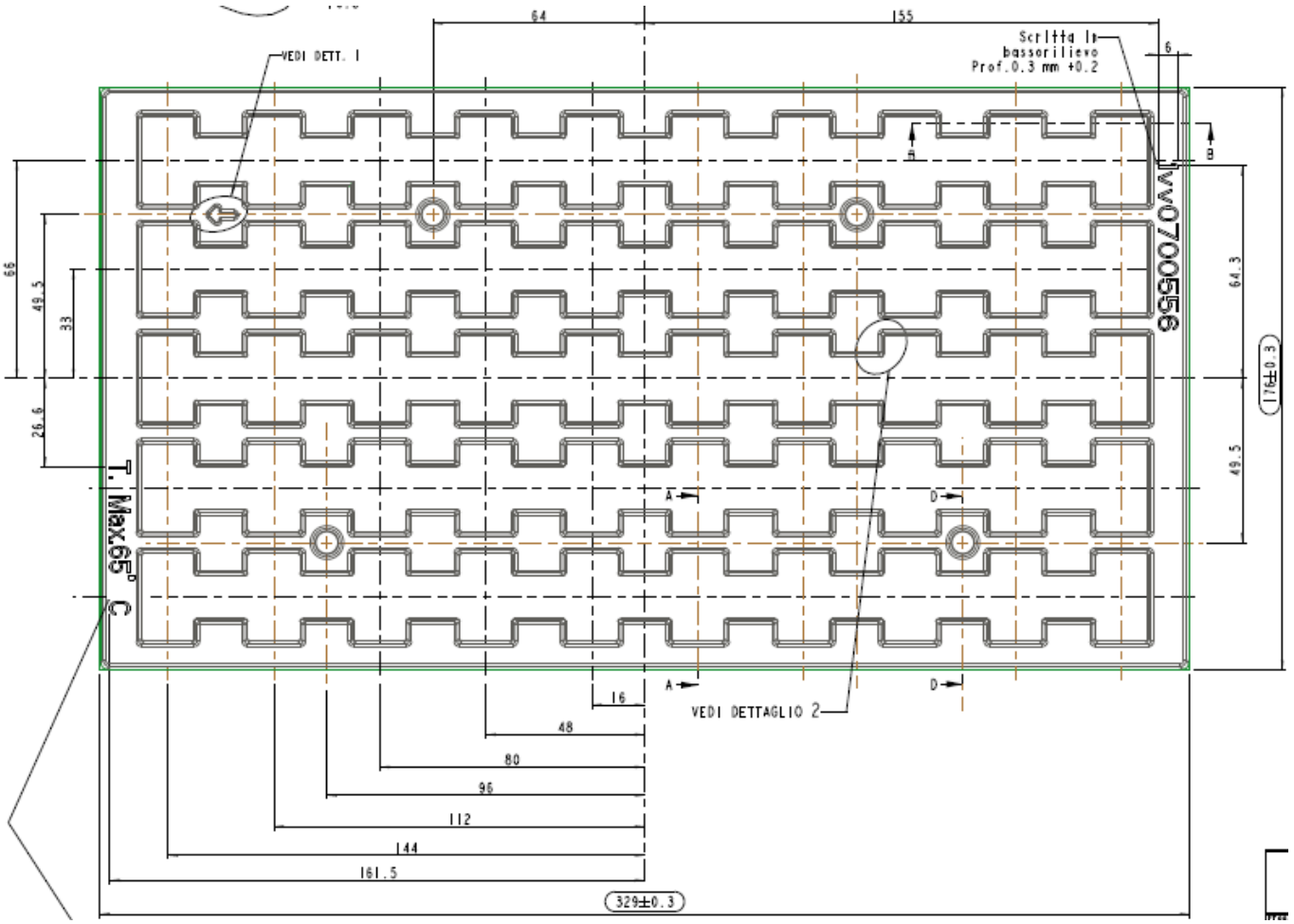
4.3. Description of the signals

Signals	Description
Reset	External hardware reset of the radio module. Active on low state.
TXD, RXD	Serial link signals, format NRZ/TTL: TXD is for outgoing data. RXD is for incoming data. The '1' is represented by a high state.
CTS	Incoming signal. Indicates whether the module can send serial data to user (Active, on low state) or not (inactive, on high state).
RTS	Outgoing signal. Indicates whether the user can transmit serial data (active, on low state) or not (inactive, on high state).
IO	I/O, configurable as input or as output. See reference document **[5]**
STAND_BY	Input signal which indicates to the module to switch to pre-selected low-power mode. See reference document **[5]**
TX LED	Output signal set to VCC during radio transmission and set to GND the rest of the time
RX LED	Output signal set to VCC as soon as a radio frame is detected with correct synchronization word. The signal returns to GND as soon as the frame reception is finished
ACK TX	In Addressed Secured mode, this signal rises to VCC when an ACK hasn't been received after frame transmission and repetition. This is the hardware version of "ERROR" serial message. It stays at VCC until next success addressed secured transmission
STATUS TX/RX	Output signal which indicates the status of the serial port. When serial port is transmitting, Status RX/TX signal goes VCC until the end of serial transmission. The signal stays to GND the rest of the time

5. Process Information

5.1. Delivery

LE50-868 modules are delivered in plastic tray packaging, each tray including 50 units. The dimensions of the tray are the following: 329 mm x 176 mm x 5.6 mm. Each unit is placed in a 26.6 mm x 16 mm location. An empty tray weights 45 g and a loaded tray weights around 130 g.



5.2. Storage

The optimal storage environment for LE50-868 modules should be dust free, dry and the temperature should be included between -40°C and +85°C.

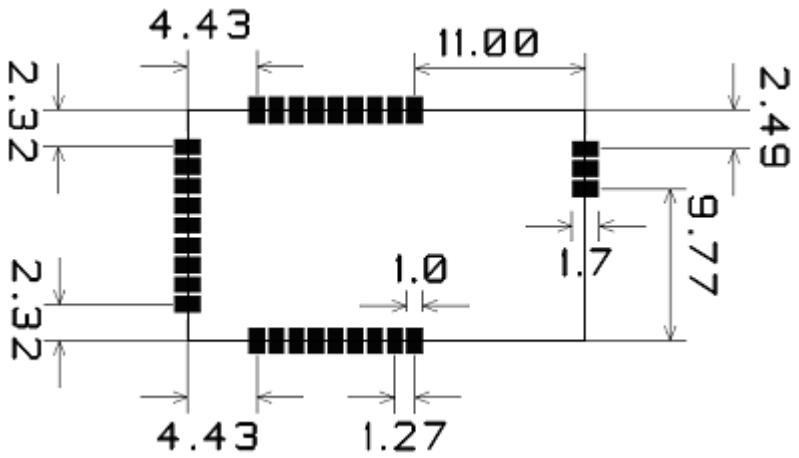
In case of a reflow soldering process, ME radio modules must be submitted to a drying bake at +60°C during 24 hours. The drying bake must be used prior to the reflow soldering process in order to prevent a popcorn effect. After being submitted to the drying bake, ME modules must be soldered on host boards within 168 hours.

Also, it must be noted that due to some components, LE50-868 modules are ESD sensitive device. Therefore, ESD handling precautions should be carefully observed..

5.3. Soldering pad pattern

The surface finished on the printed circuit board pads should be made of Nickel/Gold surface.

The recommended soldering pad layout on the host board for the LE50-868 is shown in the diagram below:



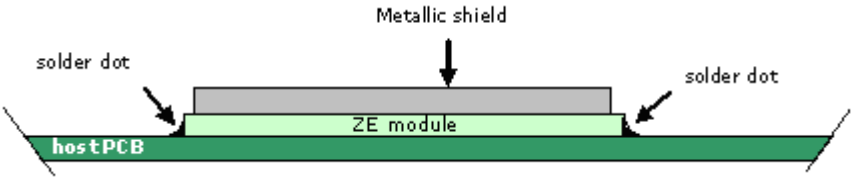
All dimensions in mm

Neither via-holes nor wires are allowed on the PCB upper layer in area occupied by the module.

5.4. Solder past

LE50-868 module is designed for surface mounting using half-moon solder joints (see diagram below). For proper module assembly, solder paste must be printed on the target surface of the host board. The solder paste should be eutectic and made of 95.5% of SN, 4% of Ag and 0.5% of Cu. The recommended solder paste height is 180 µm .

The following diagram shows mounting characteristics for ME integration on host PCB:



5.5. Placement

The LE50-868 module can be automatically placed on host boards by pick-and-place machines like any integrated circuit

5.6. Soldering Profile (RoHS Process)

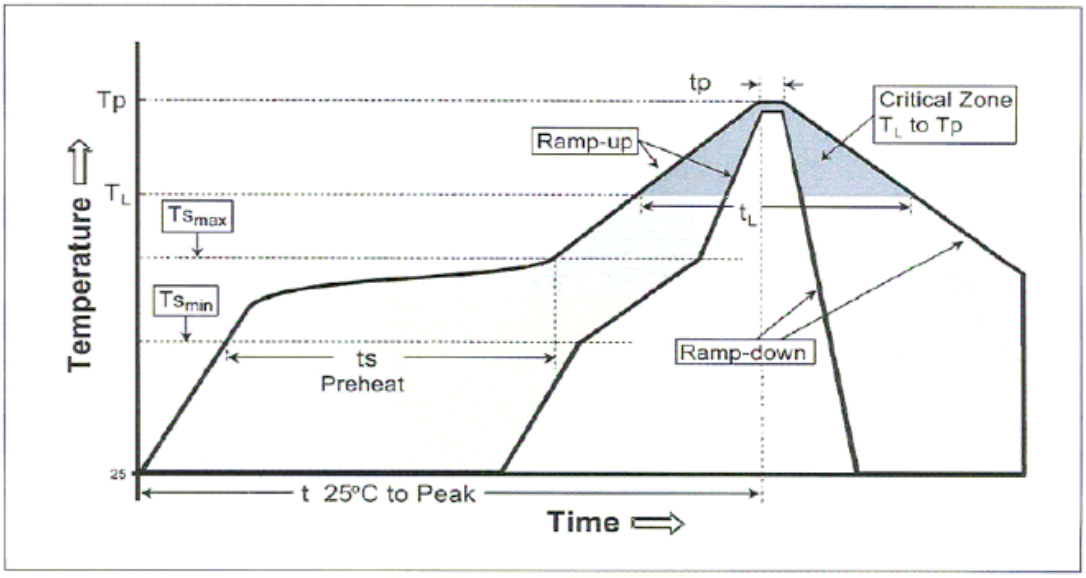
It must be noted that LE50-868 module should not be allowed to be hanging upside down during the reflow operation. This means that the module has to be assembled on the side of the printed circuit board that is soldered last.

The recommendation for lead-free solder reflow in IPC/JEDEC J-STD-020D Standard should be followed.

CAUTION
It must also be noted that if the host board is submitted to a wave soldering after the reflow operation, a solder mask must be used in order to protect the ME radio module's metal shield from being in contact with the solder wave.

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-UP Rate (Ts max to Tp)	3°C/second max.	3°C/second max.
Preheat - Temperature Min (Ts min) - Temperature Max (Ts max) - Time (ts min to ts max)	 100°C 150°C 60 - 120 seconds	 150°C 200°C 60 - 120 seconds
Time maintained above: - Temperature (TL) - Time (tL)	 183°C 35 - 90 seconds	 221°C 45 - 90 seconds
Peak/Classification Temperature (Tp)	max. Peak Temp. 225°C	max. Peak Temp. 260°C
Time within 5°C of actual Peak Temperature (tp)	10 - 30 seconds	10 seconds
Ramp-Down Rate	4°C/second max.	4°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.
Minimum Solderjoint Peak-Temperature		235°C/ 10sec.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.



The barcode label located on the module shield is able to withstand the reflow temperature.

6. Board Mounting Recommendation

6.1. Electrical environment

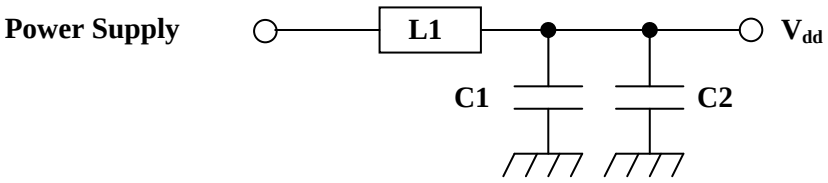
The best performances of the LE50-868 module are obtained in a "clean noise" environment. Some basic recommendations must be followed:

- Noisy electronic components (serial RS232, DC-DC Converter, Display, Ram, bus ,...) must be placed as far as possible from the LE50-868 module.

- Switching components circuits (especially RS-232/TTL interface circuit power supply) must be decoupled with a 100 µF tantalum capacitor. And the decoupling capacitor must be as close as possible to the noisy chip.

6.2. Power supply decoupling on LE50-868 module

The power supply of LE50-868 module must be nearby decoupled. A LC filter must be placed as close as possible to the radio module power supply pin, VDD .

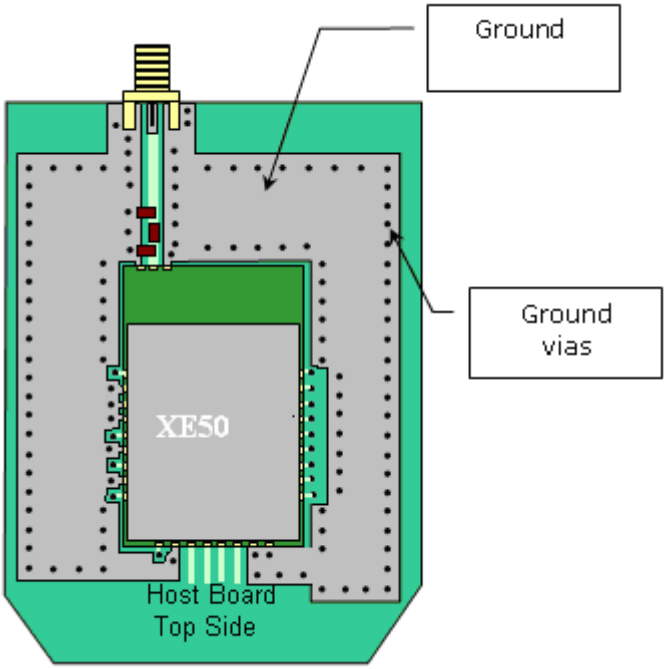


Symbols	Reference	Value	Manufacturer
L1	LQH31MN1R0K03	1µH	Murata
C1	GRM31CF51A226ZE01	22µF	Murata
C2	Ceramic CMS 25V	100nF	Multiple

6.3. RF layout considerations

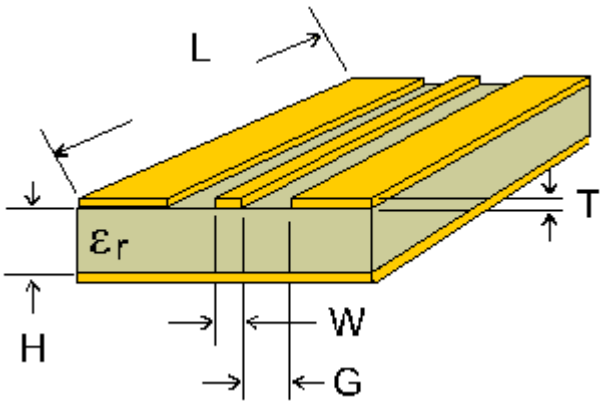
Basic recommendations must be followed to achieve a good RF layout :

- It is recommended to fill all unused PCB area around the module with ground plane
- The radio module ground pin must be connected to solid ground plane.
- If the ground plane is on the bottom side, a via (Metal hole) must be used in front of each ground pad. Especially J28 and J30 (RF Gnd) pins should be grounded via several holes to be located right next to the pins thus minimizing inductance and preventing mismatch and losses.



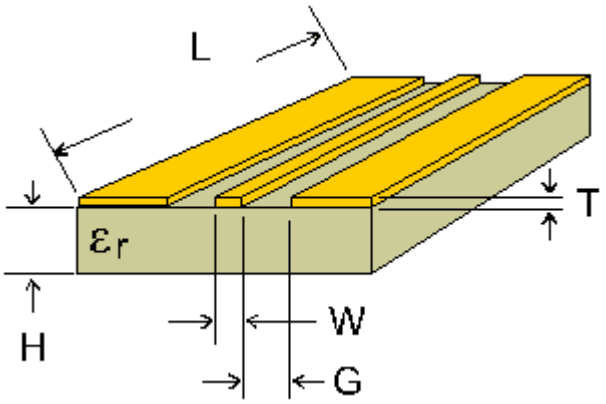
6.4. Antenna connections on printed circuit boards

Special care must be taken when connecting an antenna or a connector to the module. The RF output impedance is 50 ohms, so the strip between the pad and the antenna or connector must be 50 ohms following the tables below. Ground lines should be connected to the ground plane with as many vias as possible, but not too close to the signal line.



PCB material	PCB thickness H (mm)	Coplanar line W (mm)	Coplanar line G (mm)
FR4	0.8	1	0.3
	1.6	1	0.2

Table 1 : Values for double face PCB with ground plane around and under coplanar wave guide (recommended)

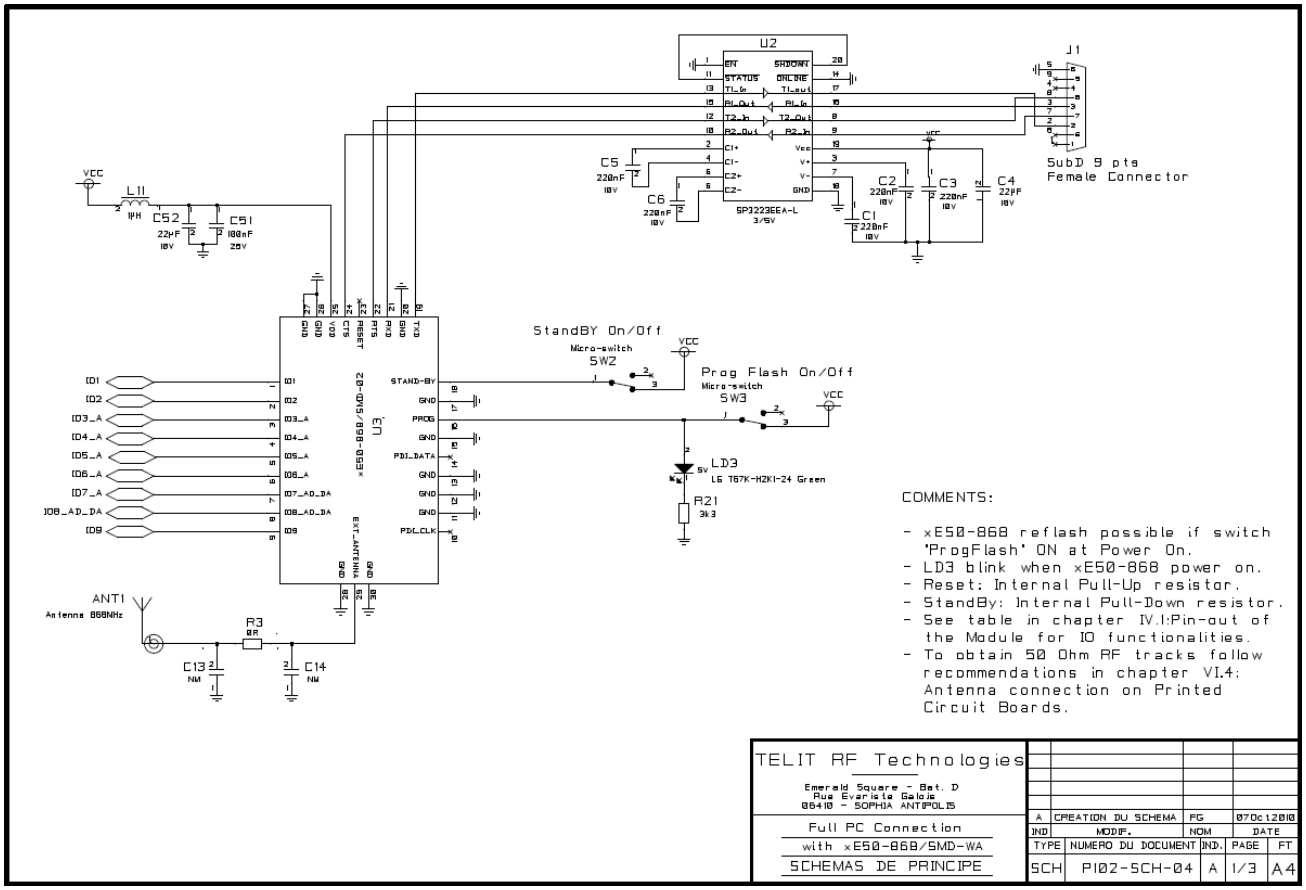


PCB material	PCB thickness H (mm)	Coplanar line W (mm)	Coplanar line G (mm)
FR4	0.8	1	0.22
	1.6	1	0.23

Table 2 : Values for simple face PCB with ground plane around coplanar wave guide (not recommended)

6.5. LE50-868 Interfacing

Example of a full RS-232 connection between a PC or an Automat (PLC) and LE50-868



7. Annexes

7.1. Examples of propagation attenuation

Factor	433 MHz	868 MHz	2.4 GHz
	Attenuation	Attenuation	Attenuation
Open office	0 dB	0 dB	0 dB
Window	< 1 dB	1 – 2 dB	3 dB
Thin wall (plaster)	3 dB	3 – 4 dB	5 – 8 dB
Medium wall (wood)	4 – 6 dB	5 – 8 dB	10 – 12 dB
Thick wall (concrete)	5 – 8 dB	9 – 11 dB	15 – 20 dB
Armoured wall (reinforced concrete)	10 – 12 dB	12 – 15 dB	20 – 25 dB
Floor or ceiling	5 – 8 dB	9 – 11 dB	15 – 20 dB
Armoured floor or ceiling	10 – 12 dB	12 – 15 dB	20 – 25 dB
Rain and/or Fog	20 – 25 dB	25 – 30 dB	?? *

* = *Attenuations increase along with the frequency. In some cases, it is therefore difficult to determine loss and attenuation value.*

Note = The table above is only indicative. The real values will depend on the installation environment itself.

8. Safety Recommendations

READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc. It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for a correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conforming to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.
The system integrator is responsible of the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as of any project or installation issue, because the risk of disturbing the GSM network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has
to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case of this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information's are available on the European Community website:

http://ec.europa.eu/enterprise/sectors/rtte/documents/

The text of the Directive 99/05 regarding telecommunication equipments is available, while the applicable Directives (Low Voltage and EMC) are available at:

http://ec.europa.eu/enterprise/sectors/electrical/

9. Glossary

ACP	Adjacent Channel Power
AFA	Adaptive Frequency Agility
bps	Bits per second
BW	Bandwidth
dB	Decibel
dBm	Power level in decibel milliwatt (10 log (P/1mW))
E^2PROM	Electrically Erasable Programmable Read Only Memory
e.r.p	Effective radiated power
ETSI	European Telecommunication Standard Institute
GFSK	Gaussian Frequency Shift Keying
I	Input
ISM	Industrial, Scientific and Medical
kB	KiloByte
kbps	Kilobits per second
kcps	Kilochips per second
kHz	Kilo Hertz
LBT	Listen Before Talk
LGA	Land Grid Array
MHz	Mega Hertz
mW	milliwatt
O	Output
PER	Packet Error Rate
ppm	Parts per million
RAM	Random Access Memory
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RxD	Receive Data
SMD	Surface Mounted Device
SRD	Short Range Device
TxD	Transmit Data
UART	Universal Asynchronous Receiver Transmitter
µC	microcontroller

10. Document History

Revision	Date	Changes
0	2011-05-18	First issue