ME50-868 RF Module User Guide

1VV0300892 Rev.1 – 2011-02-03

This document is related to the following product :

DISCLAIMER

The information contained in this document is the proprietary information of Telit Communications S.p.A. and its affiliates ("TELIT"). The contents are confidential and any disclosure to persons other than the officers, employees, agents or subcontractors of the owner or licensee of this document, without the prior written consent of Telit, is strictly prohibited.

Telit makes every effort to ensure the quality of the information it makes available. Notwithstanding the foregoing, Telit does not make any warranty as to the information contained herein, and does not accept any liability for any injury, loss or damage of any kind incurred by use of or reliance upon the information.

Telit disclaims any and all responsibility for the application of the devices characterized in this document, and notes that the application of the device must comply with the safety standards of the applicable country, and where applicable, with the relevant wiring rules.

Telit reserves the right to make modifications, additions and deletions to this document due to typographical errors, inaccurate information, or improvements to programs and/or equipment at any time and without notice. Such changes will, nevertheless be incorporated into new editions of this document.

Copyright: Transmittal, reproduction, dissemination and/or editing of this document as well as utilization of its contents and communication thereof to others without express authorization are prohibited. Offenders will be held liable for payment of damages. All rights are reserved.

CONTENTS

CHAPTER I. INTRODUCTION

I.1. Aim of the Document

The aim of this document is to present the features and the application of the ME50-868 radio module. After the introduction, the characteristics of the ME50-868 radio module will be described within the following distinct chapters:

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

I.2. Reference 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] SR Manager Tool User Guide	1vv0300899
[5] Wireless Mbus User Guide	1vv0300819
[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
[8] EN 13757-4 2005-12	Wireless M-Bus Part4, December 2005

I.3. Document change log

Revision	Date	Changes
ISSUE # 0	2010-11-29	First Release
ISSUE # 1	2011-02-03	Update of general characteristics. Updated pin-out table

I.4. 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

CHAPTER II. REQUIREMENTS

II.1. General Requirements

The ME50-868 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 Wireless M-Bus application.

ME50-868 is also pin-to-pin compatible with Telit ZE Family (ZigBee 2007 and PRO stack), NE Family (Mesh low power) 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.

Furthermore, the module complies with the ETSI 300-220-2 v2.3.1 standards (specific for SRD) which main requirements are described in Appendix 1. It also complies which EN 13757-4 standards (Wireless M-Bus Part4).

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	

11.2. Functional Requirements

The ME50-868 module is a complete solution from serial interface to RF interface. The ME50-868 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 Wireless M-Bus stack

The RF part has the following functionalities:

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

11.3. Software

The ME50-868 module is provided pre-flashed with Telit in-house Wireless M-Bus stack. Please refer to Wireless M-Bus User Guide [5] for detail information.

11.4. Temperature Requirements

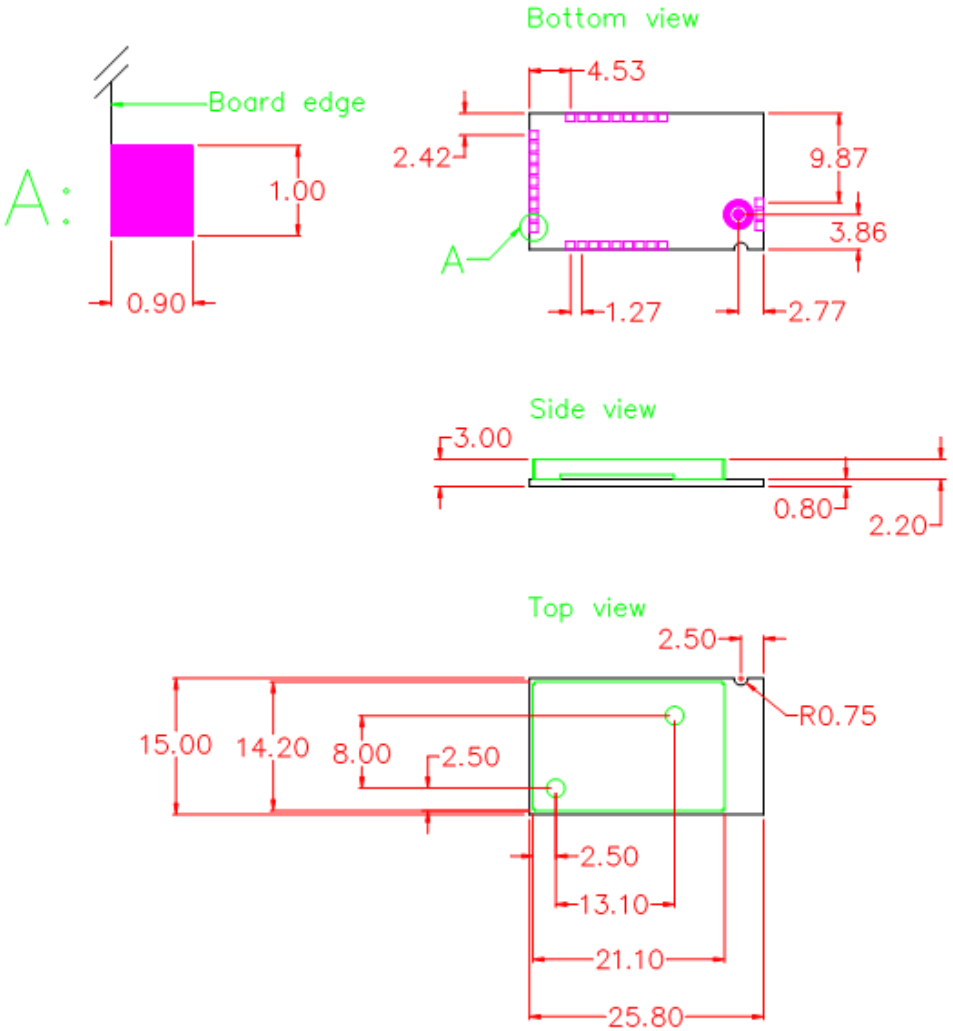
	Minimum	*Typical*	*Maximum*	*Unit*
Operating				
Temperature	- 40	25	+ 85	°C
Relative humidity @ 25°C	20		75	%
Storage				
Temperature	- 40	25	+ 85	°C

CHAPTER III. GENERAL CHARACTERISTICS

III.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

III.2. Mechanical dimensions



III.3. DC Characteristics

Characteristics ME50	Min.	Typ.	Max.
Power Supply (V_{DD}):	+2.0V	+3.3V	+3.6V
Consumption			
Transmission @ 25mW:		45mA	50mA
Reception :		26mA	30mA
Stand-by (32.768 khz On) :			3µA
Sleep (wake up on interruption) :			1µA
I/O low level :	GND	-	0.2x V_{DD}
I/O high level :	0.8x V_{DD}	-	V_{DD}

III.4. Functional characteristics

		Min.	Typ.	Max.	Unit	Note
Center frequency	Mode S	868.278	868.3	868.322	MHz	~ 25 ppm
	Mode T	868.90	868.95	869.00		~ 60 ppm
	Mode R	868.313	868.330	868.347		~ 20 ppm
Radio channel	Mode S	-	1	-	-	-
	Mode T	-	1	-		-
	Mode R	-	10	-		868.03 + (n x 0.06) (868.03 to 868.57 MHz)
Output power	Mode S	-	+ 13	+ 14	dBm	▪ ETSI EN 300 220 V2.3.1 (2009-12) ▪ Selectable by software from -5 to +14 dBm
	Mode T					
	Mode R					
Radio chip rate	Mode S	-	32.768	-	kcps	± 1.5%
	Mode T	90	100	110		-
	Mode R	-	4.8	-		± 1.5%
FSK deviation	Mode S	± 40	± 50	± 80	kHz	▪ NF EN 13757-4 (2005-12)
	Mode T	± 40	± 50	± 80		
	Mode R	± 4.8	± 6	± 7.2		
Duty cycle	Mode S	-	0.02	1	%	▪ ETSI EN 300 220 V2.3.1 (2009-12) ▪ NF EN 13757-4 (2005-12)
	Mode T	-	-	0.1		
	Mode R	-	-	1		
Sensitivity	Mode S	-	- 100	-	dBm	▪ NF EN 13757-4 (2005-12)
	Mode T	-	- 101	-		
	Mode R	-106	- 107	-108		
Rx BW	Mode S	-	80	-	kHz	-
	Mode T	-	200	-		
	Mode R	-	10	-		
Blocking	Mode S	28 min @ ± 2 MHz 53 min @ ± 10 MHz			dB	▪ ETSI EN 300 220 V2.3.1 (2009-12) ▪ NF EN 13757-4 (2005-12)
	Mode T	24 min @ ± 2 MHz 49 min @ ± 10 MHz				
	Mode R	37 min @ ± 2 MHz 62 min @ ± 10 MHz				

III.5. Digital Characteristics

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

III.6. Absolute 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

III.7. Ordering information

The following equipments can be ordered:

- The SMD version
- The DIP interface version
- The Demo Case

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.

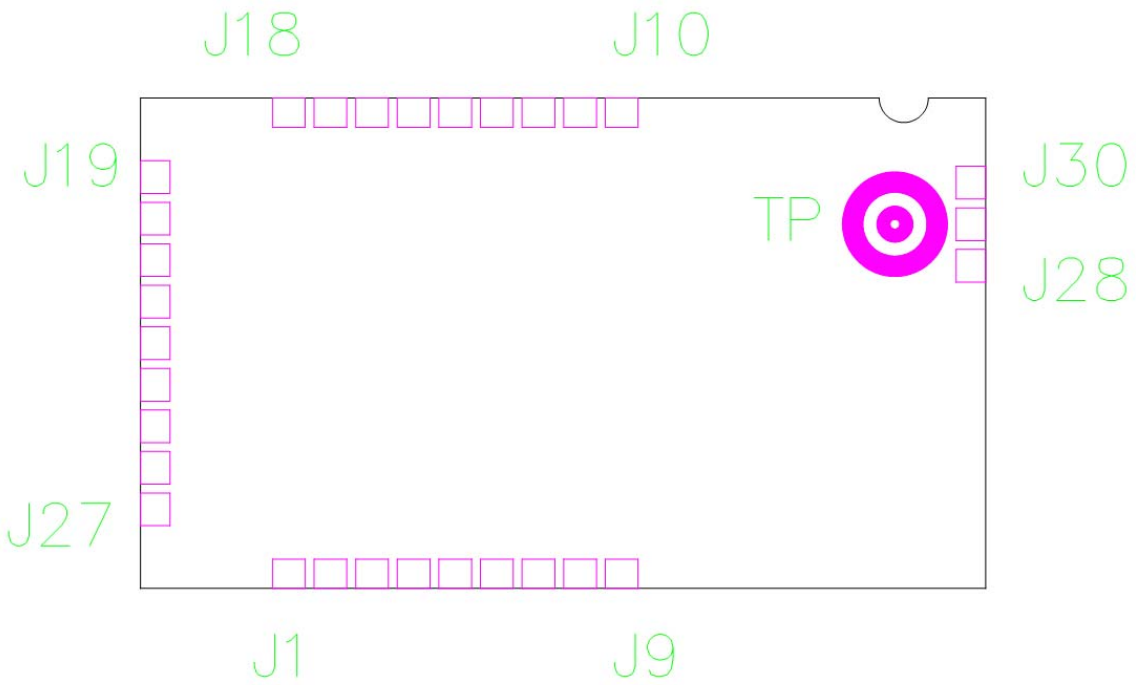
Equipment and Part Number
SMD Version
ME50-868

DIP Version
ME50-868

Demo Case
D ME50 DEMO


CHAPTER IV. TECHNICAL DESCRIPTION

IV.1. Pin-out of the Module



TOP VIEW (COVER SIDE)

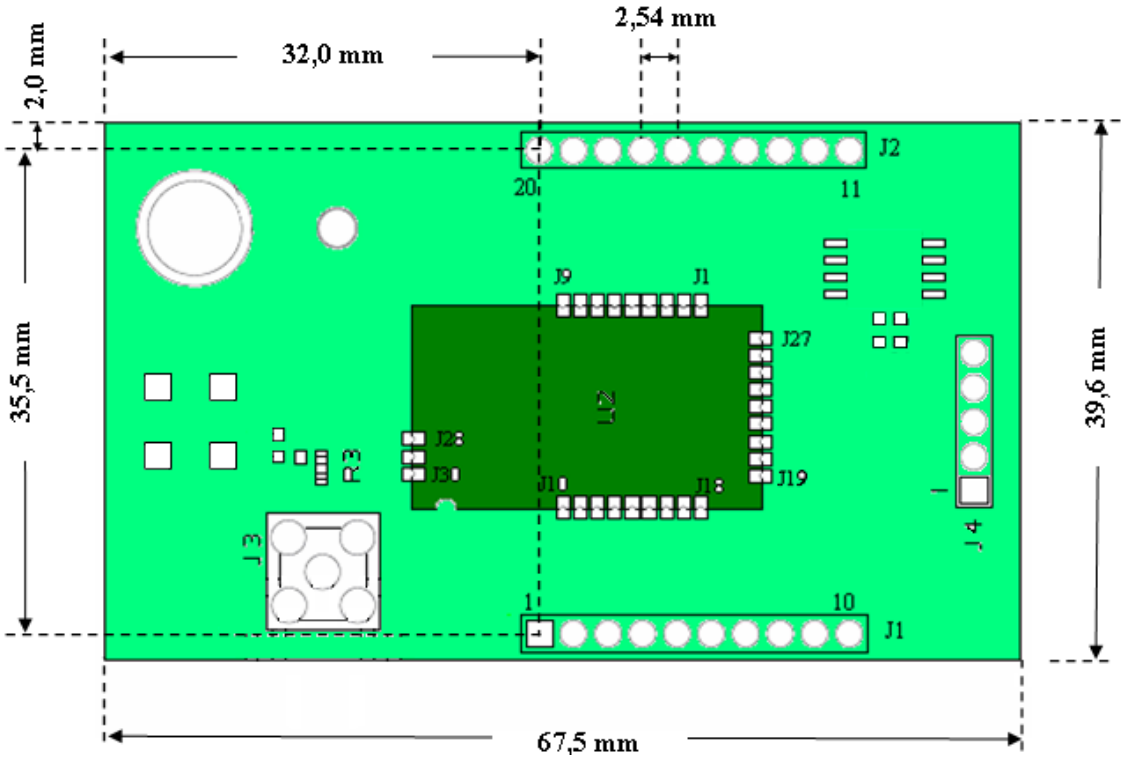
Pin	Pin name	Pin type	Signal level	Function
J30	GND	Gnd		RF Ground connection for external antenna
J29	Ext_Antenna	RF		RF I/O connection to external antenna
J28	GND	Gnd		RF Ground connection for external antenna
J27	GND	Gnd		Ground
J26	GND	Gnd		Ground
J25	VDD	Power		Digital and Radio part power supply 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	-	Digital I/O N°9 with interrupt
J8	IO8_AD_DA[2]	I/O	-	A to D and D to A I/O N°8 with interrupt (Logic I/O capability)
J7	IO7_A	I/O	analog	Analog Input N°7 (Logic I/O capability)
J6	IO6_A	I/O	analog	Analog Input N°6 (Logic I/O capability)
J5	IO5_A	I/O	analog	Analog Input N°5 (Logic I/O capability)
J4	IO4_A	I/O	analog	Analog Input N°4 (Logic I/O capability)
J3	IO3_A	I/O	analog	Analog Input N°3 (Logic I/O capability)
J2	IO2_P	I/O	TTL	Logic I/O N°2 with interrupt

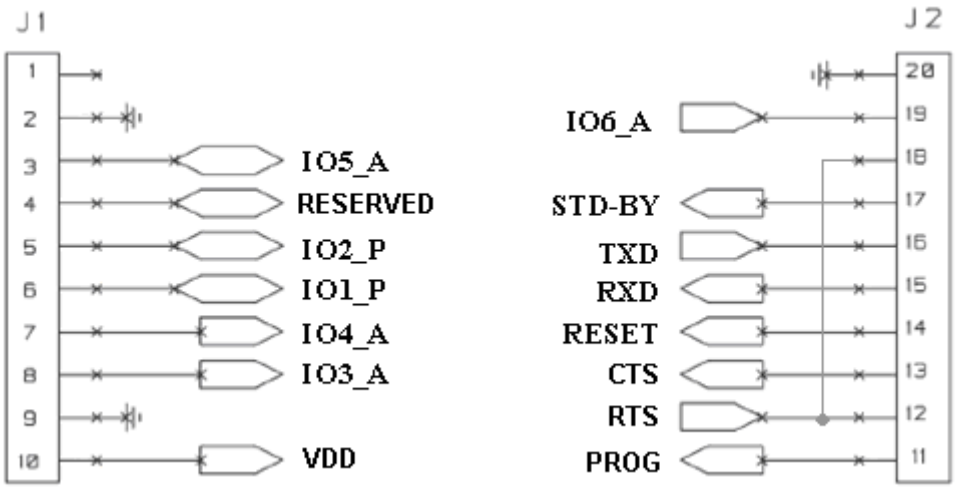
[1, 2] In case you want to use in the same application Telit ZE51 or ZE61 modules J9 and J8 should not be connected, since reserved on these modules.

J1	IO1_P	I/O	TTL	Logic I/O N°1 with interrupt

NOTE: reserved pins must not be connected

IV.2. Pin-out of the DIP Module





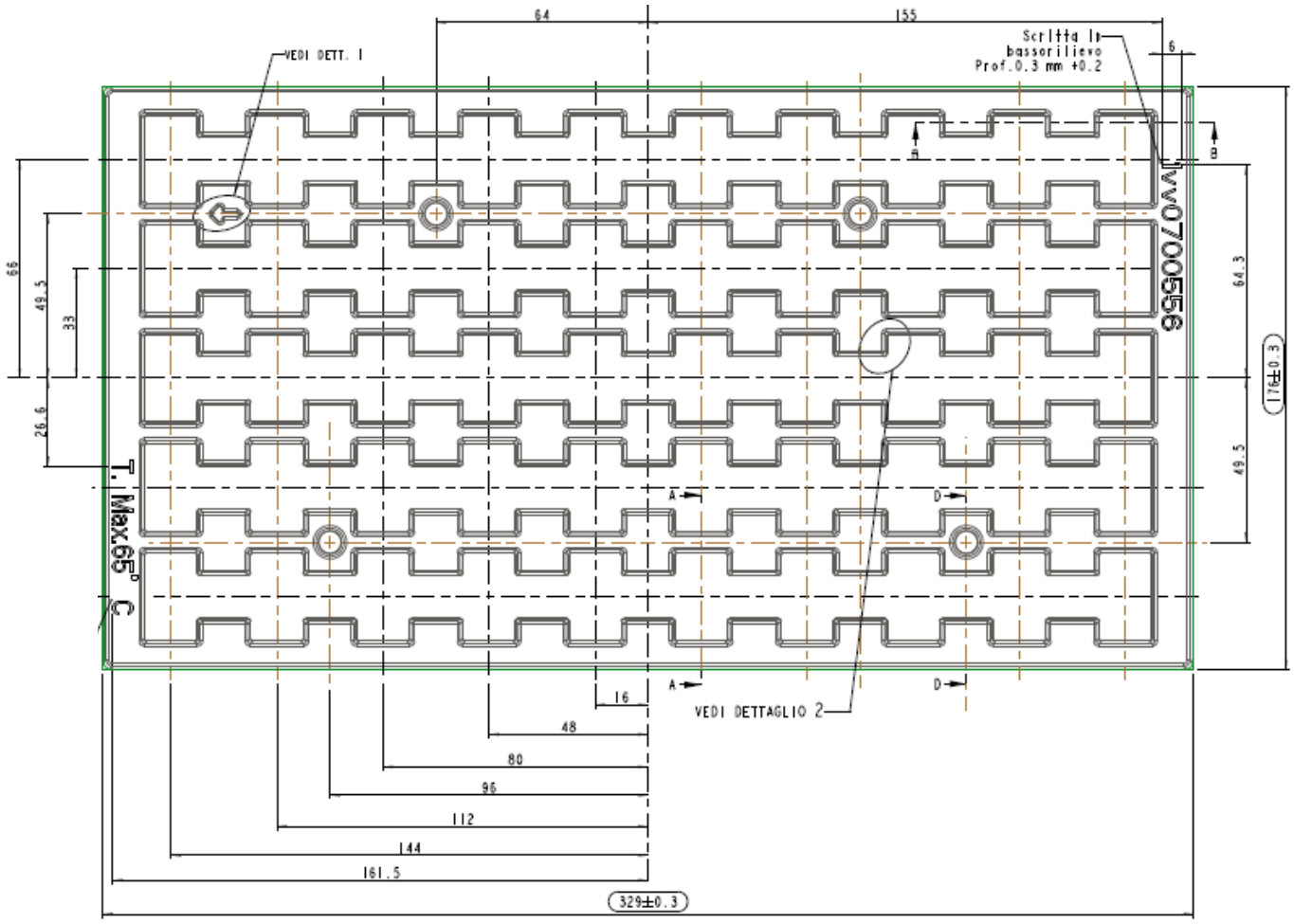
IV.3. Description of the Signals

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. (Available upon request only)
STAND_BY	Indicates to the module to switch to pre-selected low-power mode. (Available upon request)

CHAPTER V. PROCESS INFORMATION

V.1. Delivery

ME50-868 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.



V.2. Storage

The optimal storage environment for ME50-868 modules should be dust free, dry and the temperature should be included between -40°C and +85°C.

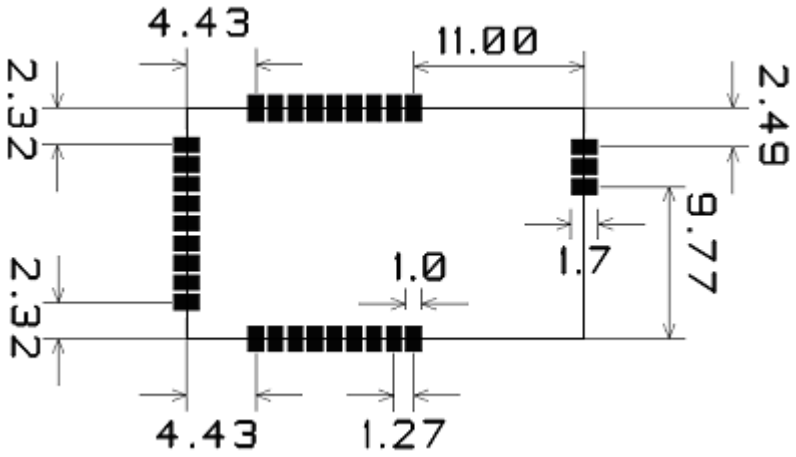
In case of a reflow soldering process, ME radio modules must be submitted to a drying bake at +60°C during 24 hours. The drying bake must be used prior to the reflow soldering process in order to prevent a popcorn effect. After being submitted to the drying bake, ME modules must be soldered on host boards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

Also, it must be noted that due to some components, ME50-868 modules are ESD sensitive device. Therefore, ESD handling precautions should be carefully observed.

V.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 **ME50-868** is shown in the diagram below:



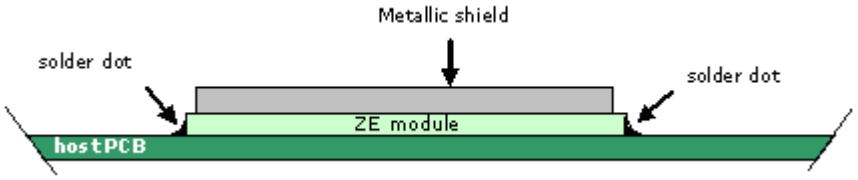
All dimensions in mm

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

V.4. Solder paste composition (RoHS process)

ME50-868 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:



V.5. Placement

The ME50-868 module can be automatically placed on host boards by pick-and-place machines like any integrated circuit.

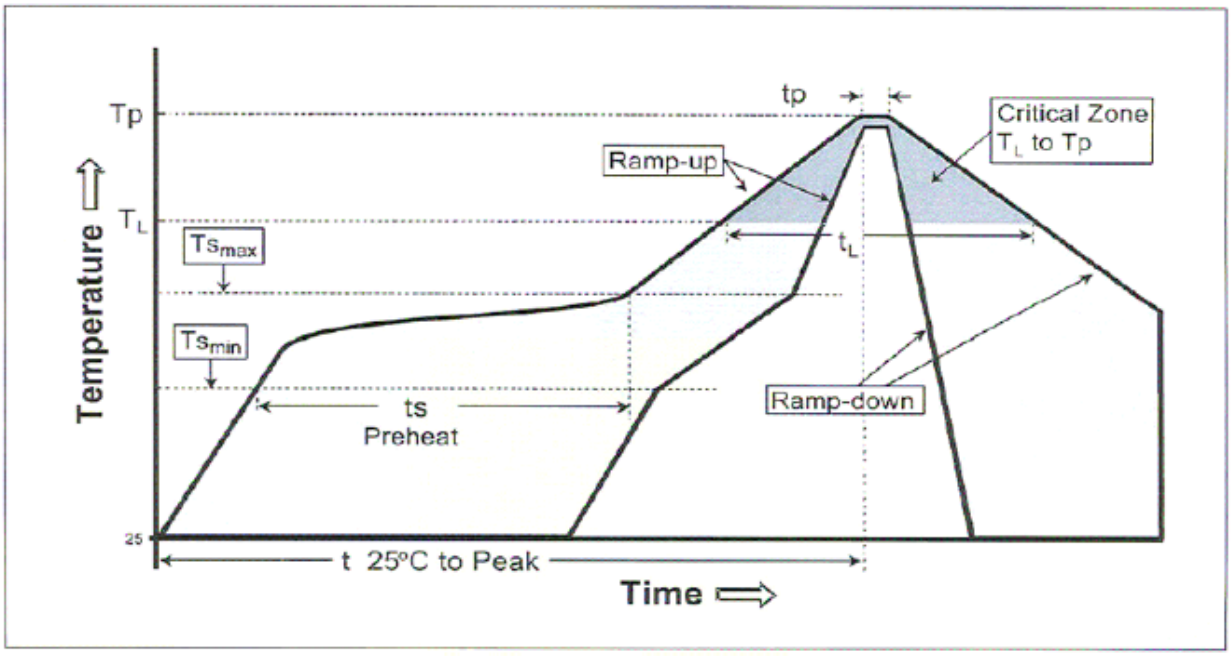
V.6. Soldering profile (RoHS process)

It must be noted that ME50-868 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.

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.

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.

CHAPTER VI. BOARD MOUNTING RECOMMENDATION

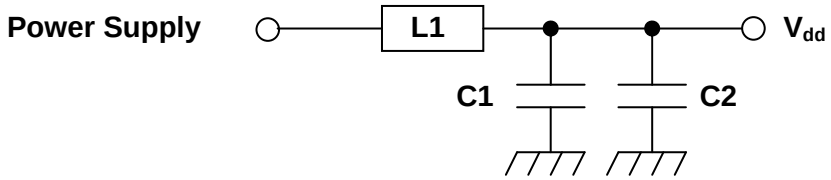
VI.1. Electrical environment

The best performances of the ME50-868 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 ME50-868 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.

VI.2. Power supply decoupling on ME50-868 module

The power supply of ME50-868 module must be nearby decoupled. A LC filter must be placed as close as possible to the radio module power supply pin, V_{DD} .



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

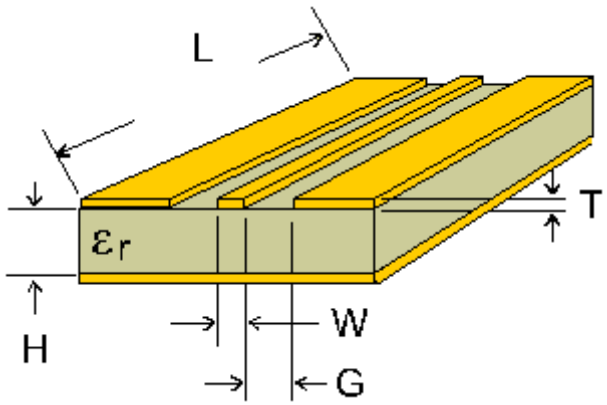
VI.3. RF layout considerations

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.

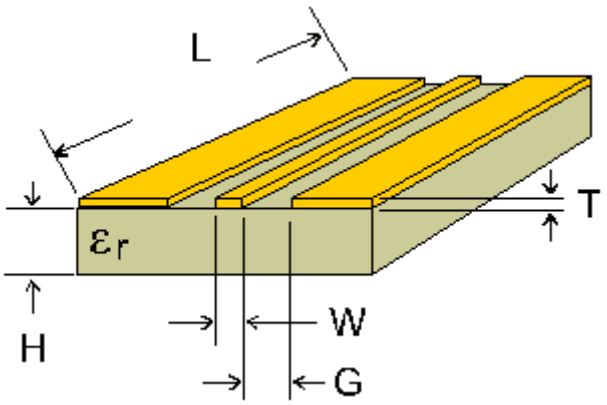
VI.4. Antenna connection on Printed Circuit Boards

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)

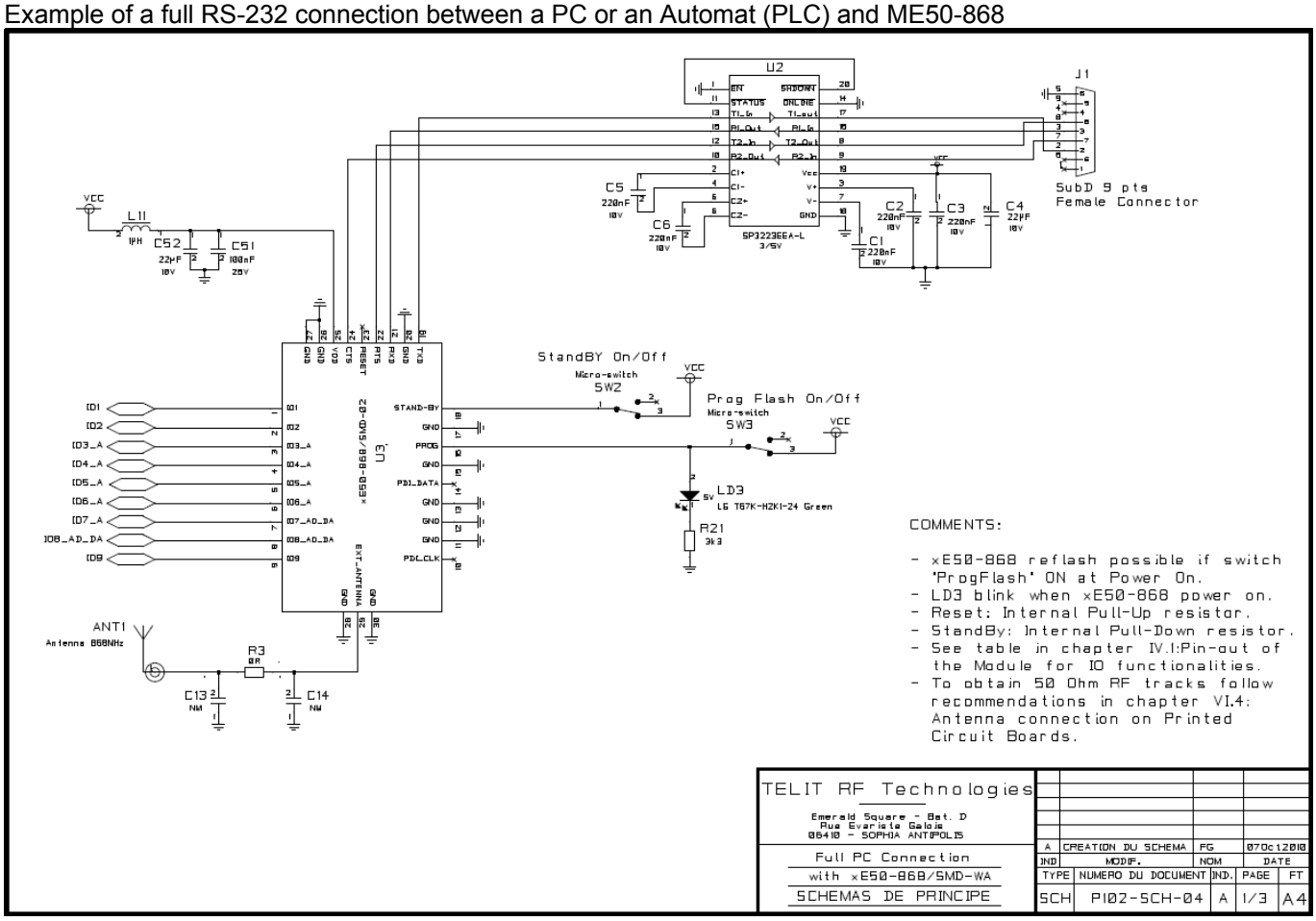


PCB material	PCB thickness H (mm)	Coplanar line W (mm)	Coplanar line G (mm)
FR4	0.8	1	0.22
	1.6	1	0.23

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

VI.5. ME50-868 interfacing :

Example of a full RS-232 connection between a PC or an Automat (PLC) and ME50-868



CHAPTER VII. ANNEXES

VII.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.