

ZE60-2.4 RF Module User Guide

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CHAPTER I.

INTRODUCTION

I.1. Aim of the Document

The aim of this document is to present the features and the application of the ZE60-2.4 radio module. After the introduction, the characteristics of the ZE60-2.4 radio module will be described within the following distinct chapters:

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



USA Regulation:

In the United States the FCC is responsible for the regulation of all RF devices. Our module intended for unlicensed operation is regulated by CFR 47, Part 15 [6].
The 2.4 Ghz band used for unlicensed radio equipment is regulated by section 15.247 and 15.249.

Japan regulation

In Japan the unlicensed use of short range devices in the 2.4Ghz ISM band is regulated by the ARIB standard STD-T66 [7].



II.4. Temperature Requirements

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



CHAPTER III.

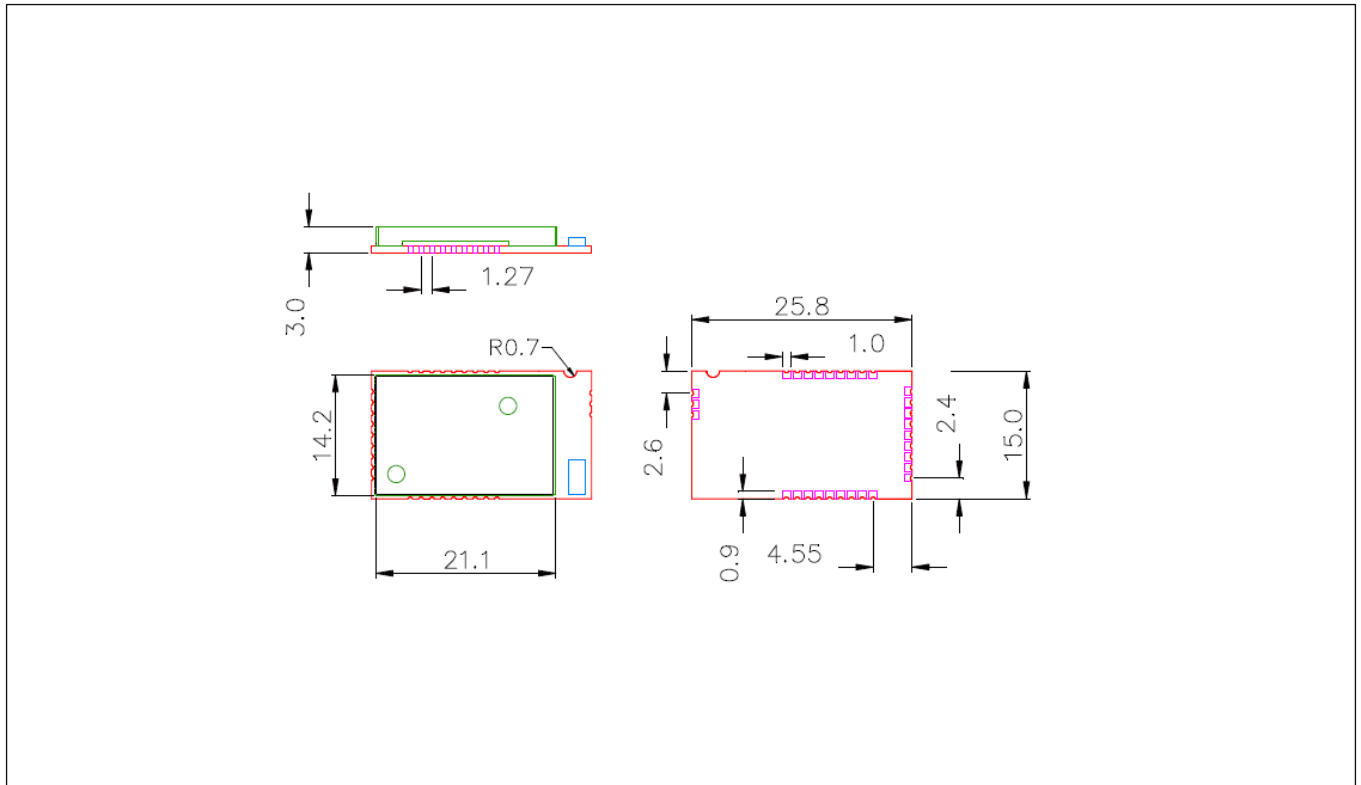
GENERAL CHARACTERISTICS

III.1. Mechanical Characteristics

Size :	Rectangular 26 x 15 mm
Height :	3 mm
Weight :	1,7 g
PCB thickness:	0.8 mm
Cover :	<ul style="list-style-type: none"> • Dimensions : 21 x 14 x 2.2mm • Thickness : 200µm
Components :	All SMD components, on one side of the PCB.
Connectors :	The terminals allowing conveying I/O signals are half-moons located around.
Mounting :	<ul style="list-style-type: none"> • SMD • Half moons on the 4 external sides
Number of pins :	30



III.2. Mechanical dimensions



III.3. DC Characteristics

Characteristics	Min.	Typ.	Max.
Power Supply (V_{DD}):	+2.4V	+3.0V	+3.6V
Consumption @3.0V :			
<i>Transmission :</i>		140mA	
<i>Reception :</i>	-	35mA	
<i>Stand-by (32.768 khz On) :</i>	-	2μA	
<i>Sleep (wake up on interruption) :</i>		1μA	
I/O low level :	GND	-	0.9 V
I/O high level :	V _{DD} - 0.7V	-	V _{DD}








III.7. Ordering information

Two different equipments can be ordered :

- The SMD version
- The DIP interface version

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.

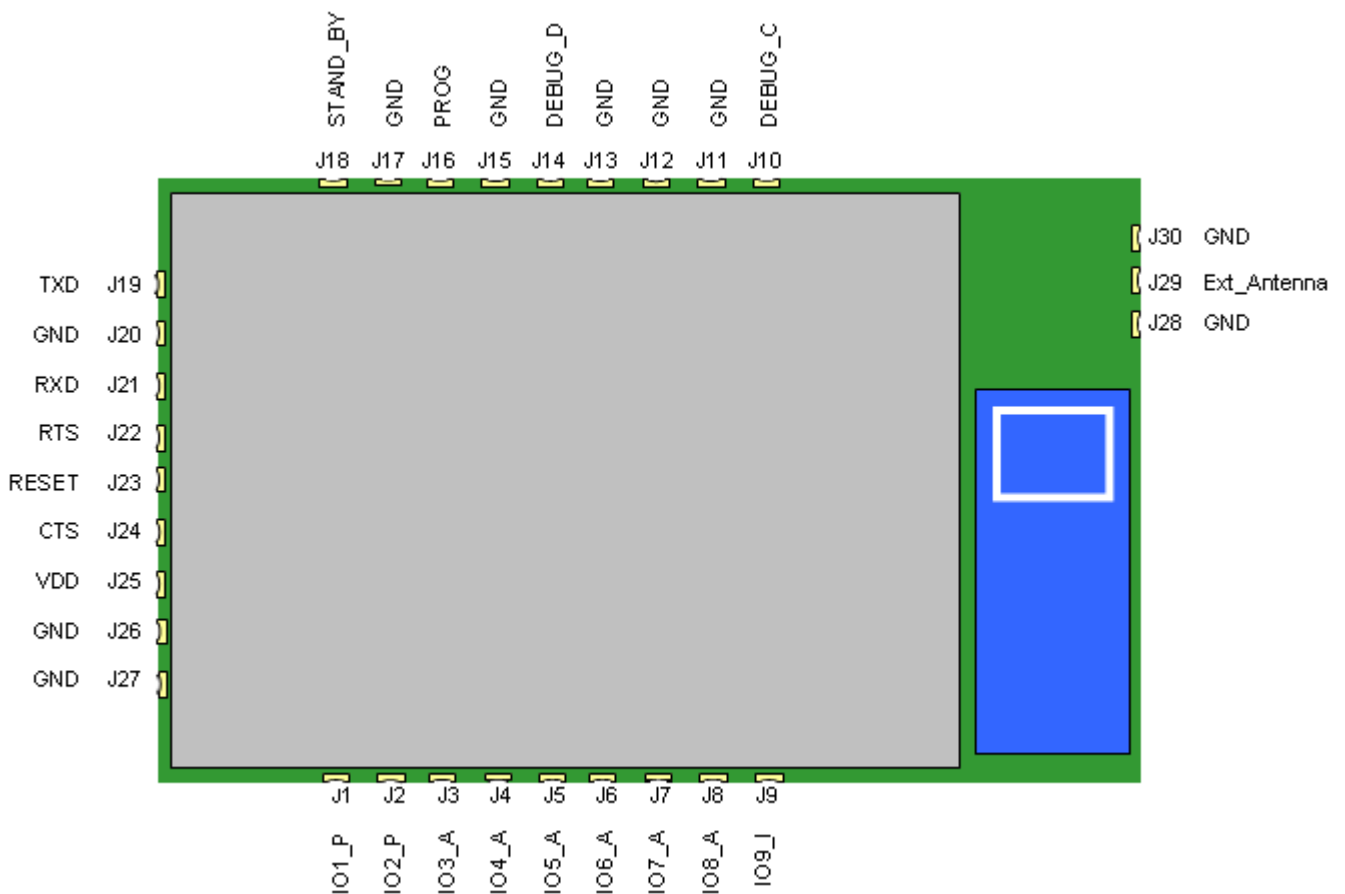
<i>Equipment and Part Number</i>	
SMD Version	
ZE60-2.4/SMD-IA (With Integrated Antenna)	ZE60-2.4/SMD-WA (Without Integrated Antenna)
	
DIP Version	
ZE60-2.4/DIP-IA (With Integrated Antenna)	ZE60-2.4/DIP-WA (Without Integrated Antenna)
	
Democase Version	
D ZE60-2.4/Demo	
	



CHAPTER IV.

TECHNICAL DESCRIPTION

IV.1. Pin-out of the SMD Module

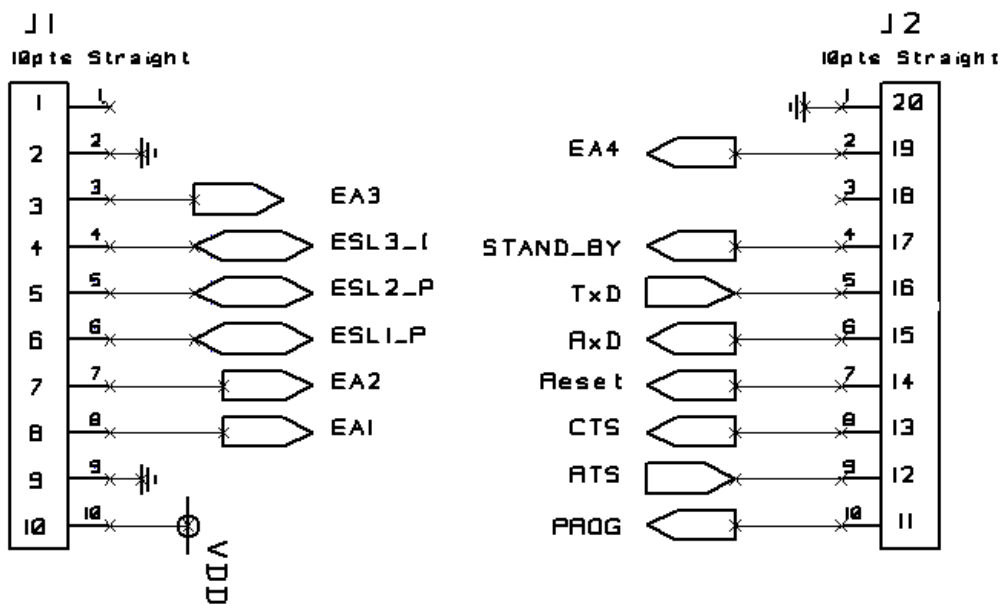
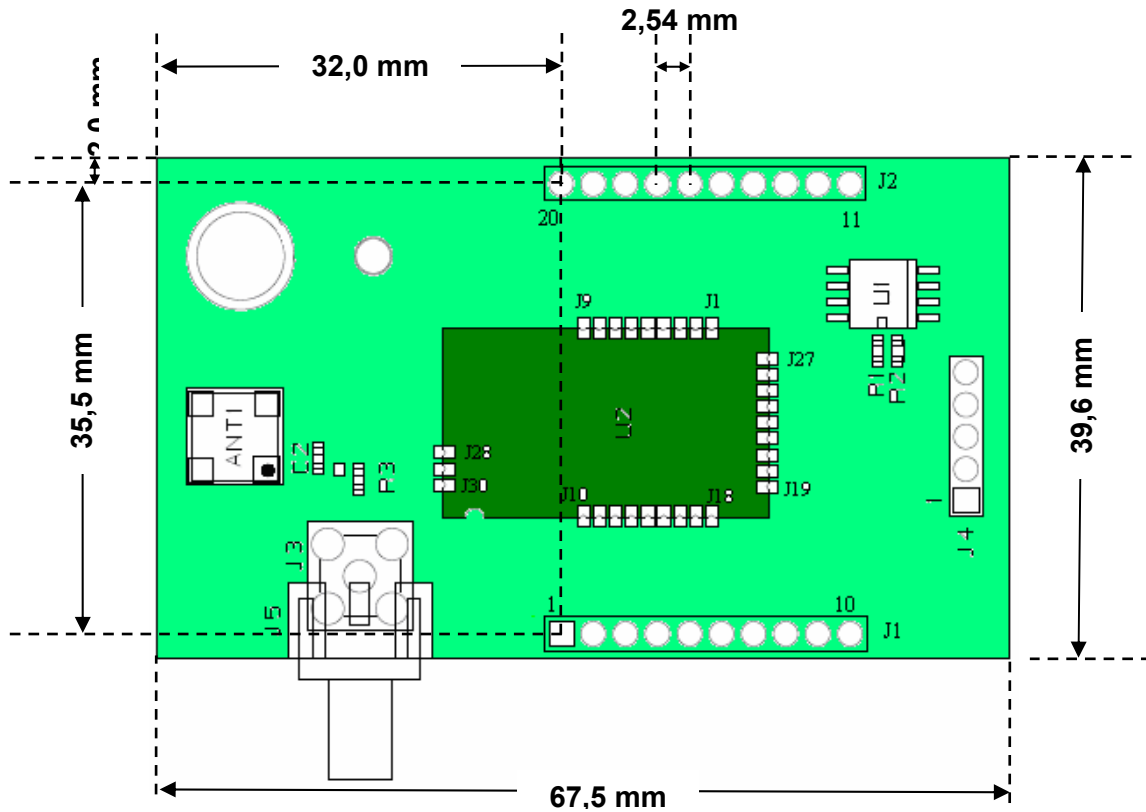


Pin	Pin name	Pin type	Signal level	Function
J30	GND	Gnd		RF Ground connection for External antenna
J29	Ext_Antenna	RF		External antenna connection
J28	GND	Gnd		RF Ground connection for External antenna
J27	GND	Gnd		Ground
J26	GND	Gnd		Ground
J25	VDD	Power		Digital and Radio part supply pin
J24	CTS	I	TTL	Clear To Send
J23	RESET	I	TTL	µC reset, active low
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
J17	GND	Gnd		Ground
J16	PROG	I	TTL	Signal for serial µC flashing, active high
J15	GND	Gnd		Ground
J14	DEBUG_D	I/O	TTL	Debug data
J13	GND	Gnd		Ground
J12	GND	Gnd		Ground
J11	GND	Gnd		Ground
J10	DEBUG_C	I/O	TTL	Debug clock
J9	RESERVED	-	-	-
J8	RESERVED	-	-	-
J7	IO7_A	I/O	analog	Analog Input N°7 (Digital I/O capability)
J6	IO6_A	I/O	analog	Analog Input N°6 (Digital I/O capability)
J5	IO5_A	I/O	analog	Analog Input N°5 (Digital I/O capability)
J4	IO4_A	I/O	analog	Analog Input N°4 (Digital I/O capability)
J3	IO3_A	I/O	analog	Analog Input N°3 (Digital I/O capability)
J2	IO2_P	I/O	TTL	Digital I/O N°2 with 20mA drive capability
J1	IO1_P	I/O	TTL	Digital I/O N°1 with 20mA drive capability

NOTE: reserved pins must not be connected



IV.2. Pin-out of the DIP Module



IV.3. Correspondence

Pin-Out correspondence between ZE60-2.4/DIP, ZE60-2.4/SMD and CC2430 SOC.

ZE60-2.4/DIP Pin-out	ZE60-2.4/SMD Pin-out	CC2430 SOC Pin-out	Comments
Pin 1 (J1): Not connected			
Pin 2 (J1): GND	GND	GND	
Pin 3 (J1): EA3	Pin J5 : IO5_A	Pin 15 : P0_4	
Pin 4 (J1): ESL3_I	Pin J9 : (reserved)	Pin 2 : P1_6	
Pin 5 (J1): ESL2_P	Pin J2 : IO2_P	Pin 8 : P1_1	
Pin 6 (J1): ESL1_P	Pin J1 : IO1_P	Pin 9 : P1_0	
Pin 7 (J1): EA2	Pin J4 : IO4_A	Pin 14 : P0_3	
Pin 8 (J1): EA1	Pin J3 : IO3_A	Pin 13 : P0_2	
Pin 9 (J1): GND	GND	GND	
Pin 10 (J2): VDD	Pin J25 : VDD	Pin 7 : DVDD	
J4 Connector for debugging and programming			
Pin 11 (J2): PROG	Pin J16 : PROG		
Pin 12 (J2): RTS	Pin J22 : RTS	Pin 5 : P1_3	
Pin 13 (J2): CTS	Pin J24 : CTS	Pin 6 : P1_2	
Pin 14 (J2): Reset	Pin J23 : Reset	Pin 10 : Reset_N	
Pin 15 (J2): RxD	Pin J21 : RxD	Pin 4 : P1_4	
Pin 16 (J2): TxD	Pin J19 : TxD	Pin 3 : P1_5	
Pin 17 (J2): STAND_BY	Pin J18 : STAND_BY	Pin 1 : P1_7	
Pin 18 (J2): Not connected			
Pin 19 (J2): EA4	Pin J6 : IO6_A	Pin 16 : P0_5	
Pin 20 (J2): GND	GND	GND	
Eeprom connections			
	SCL pin (Eeprom)	Pin 11 : P0_0	16Kbits I ² C Serial Eeprom
	SDA pin (Eeprom)	Pin 12 : P0_1	
SCL pin (Eeprom U1)	Pin J7 : IO7_A	Pin 17 : P0_6	Eeprom U1,R1 and R2 are not mounted on ZE60-2.4 DIP board
SDA pin (Eeprom U1)	Pin J8 : (reserved)	Pin 18 : P0_7	
RF connection			
J3 or J5 : SMA connector for RF Input/Output	Pin J29: Ext_Antenna		A 2.45 Ghz Half-Wave antenna is recommended
ANT1 and C2: Not mounted on ZE60-2.4/DIP			

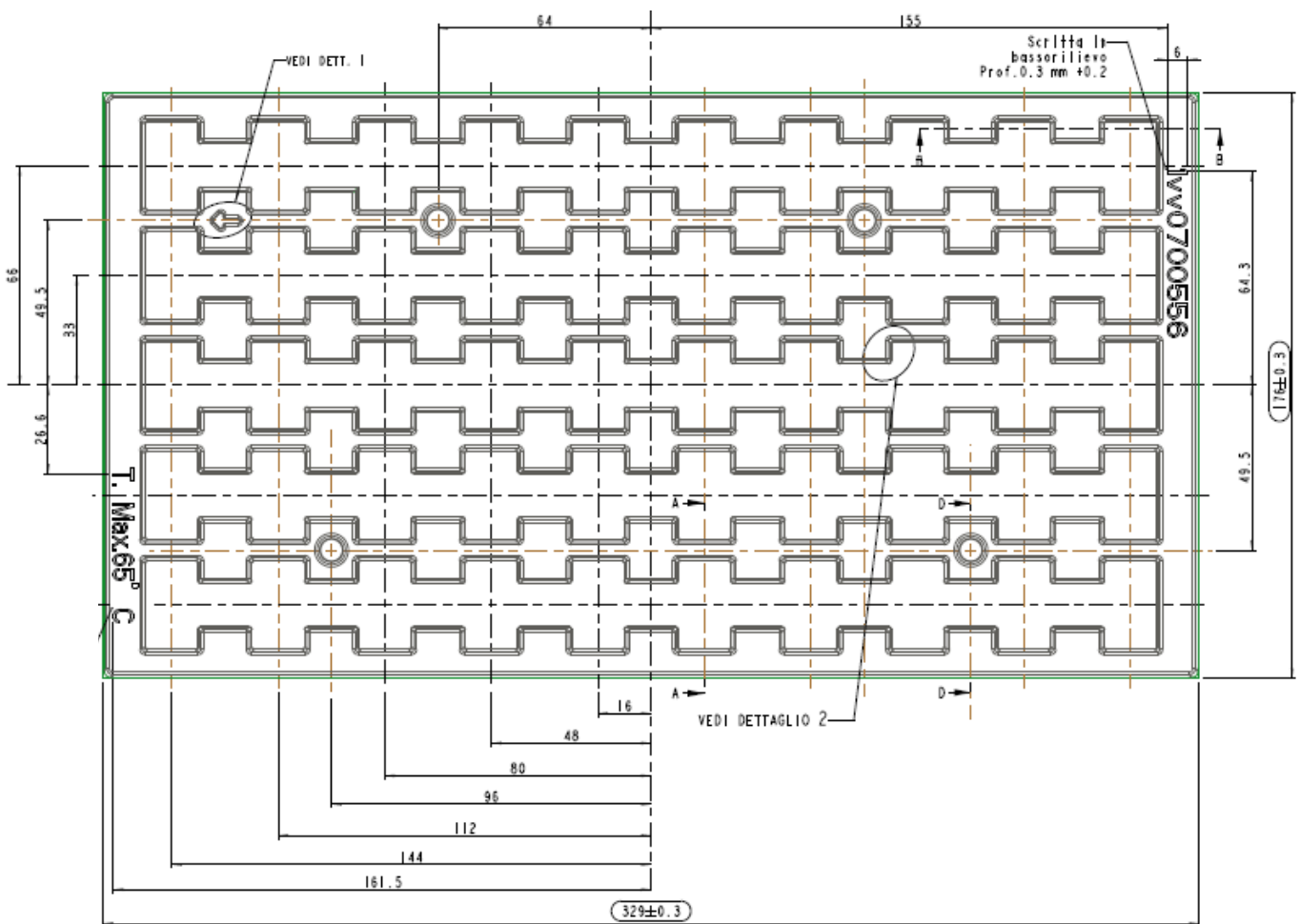


CHAPTER V.

PROCESS INFORMATION

V.1. Delivery

ZE60-2.4/SMD 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 ZE60-2.4/SMD modules should be dust free, dry and the temperature should be included between -40°C and +85°C.

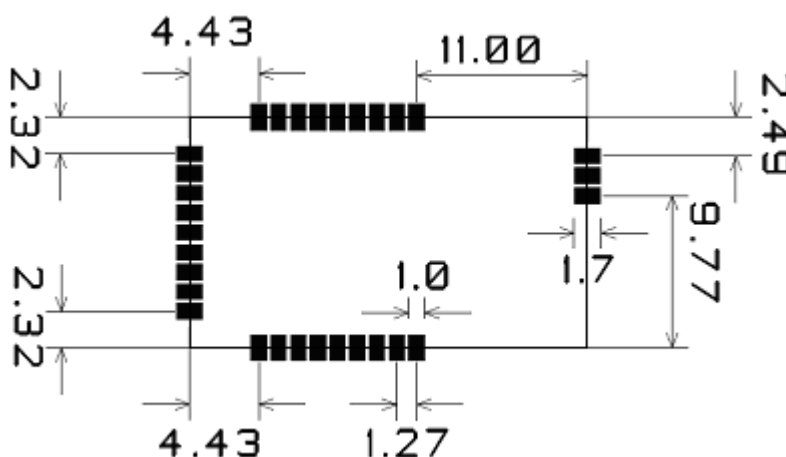
In case of a reflow soldering process, tiny radio modules must be submitted to a drying bake at +60°C during 24 hours. The drying bake must be used prior to the reflow soldering process in order to prevent a popcorn effect. After being submitted to the drying bake, tiny modules must be soldered on host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

Also, it must be noted that due to some components, ZE60-2.4/SMD 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.

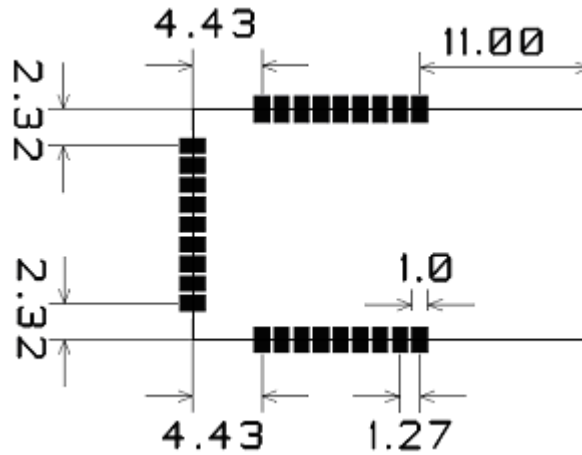
The recommended soldering pad layout on the host board for the **ZE60-2.4/SMD-WA**, is shown in the diagram below:



All dimensions in mm



The recommended soldering pad layout on the host board for the **ZE60-2.4/SMD-IA**, is shown in the diagram below:



All dimensions in mm

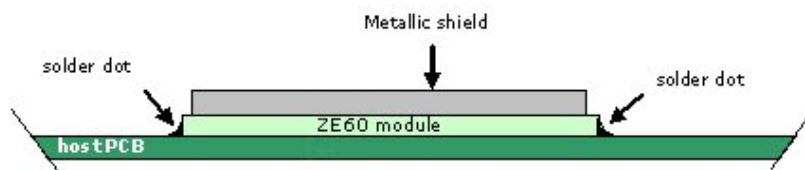
Neither via-holes nor wires are allowed on the PCB upper layer in area occupied by the module.



V.4. Solder paste composition (RoHS process)

ZE60-2.4/SMD 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 tiny integration on host PCB:



V.5. Placement

The ZE60-2.4/SMD module can be automatically placed on host boards by pick-and-place machines like any integrated circuit.



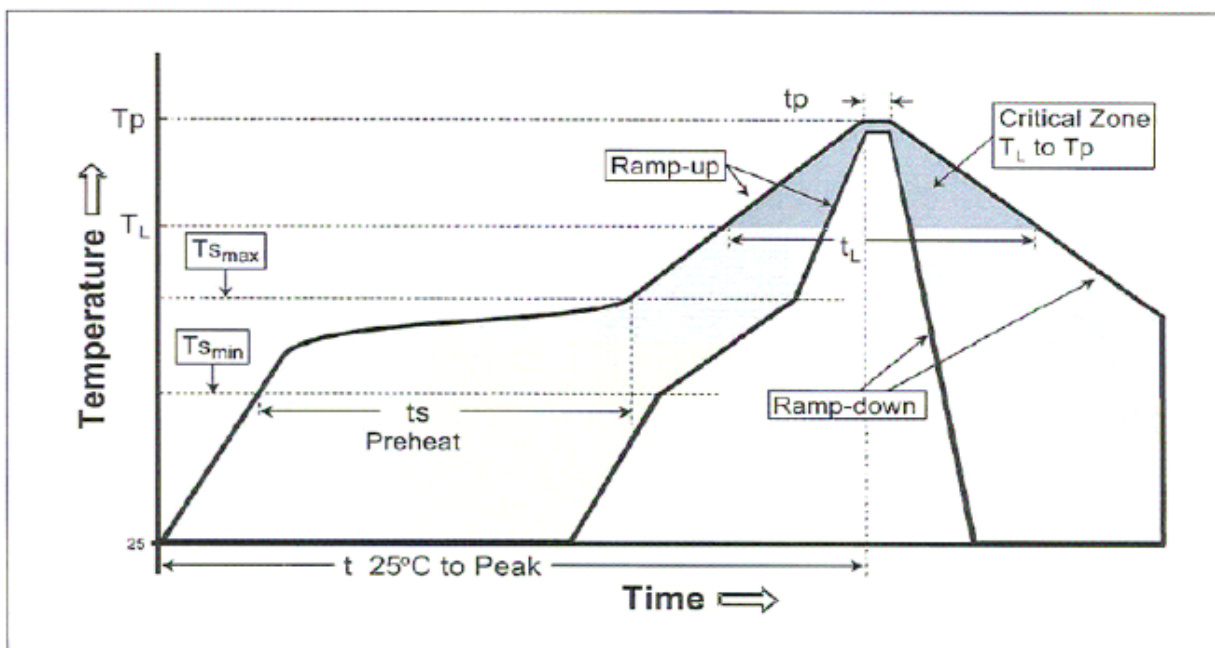
V.6. Soldering profile (RoHS process)

It must be noted that ZE60-2.4/SMD 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)	100°C	150°C
- Temperature Max (Ts max)	150°C	200°C
- Time (ts min to ts max)	60 - 120 seconds	60 - 120 seconds
Time maintained above:		
- Temperature (TL)	183°C	221°C
- Time (tL)	35 - 90 seconds	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 tiny radio module's metal shield from being in contact with the solder wave.



CHAPTER VI. BOARD MOUNTING RECOMMENDATION

VI.1. Electrical environment

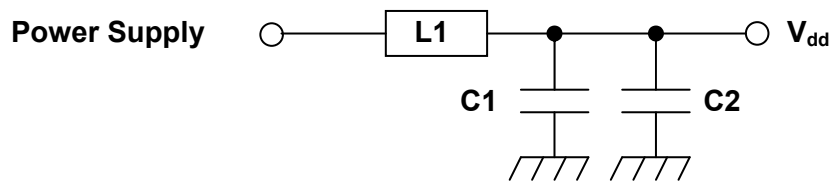
The best performances of the ZE60-2.4 module are obtained in a “clean noise” environment. Some basic recommendations must be followed :

- Noisy electronic components (serial RS232, DC-DC Converter, Display, Ram, bus,...) must be placed as far as possible from the ZE60-2.4 module.
- Switching components circuits (especially RS-232/TTL interface circuit power supply) must be decoupled with a low ESR 100 μ F tantalum capacitor. And the decoupling capacitor must be as close as possible to the noisy chip.



VI.2. Power supply decoupling on ZE60-2.4 module

The power supply of ZE60-2.4 module must be nearby decoupled. A LC filter must be placed as close as possible to the radio module power supply pin, V_{DD} .



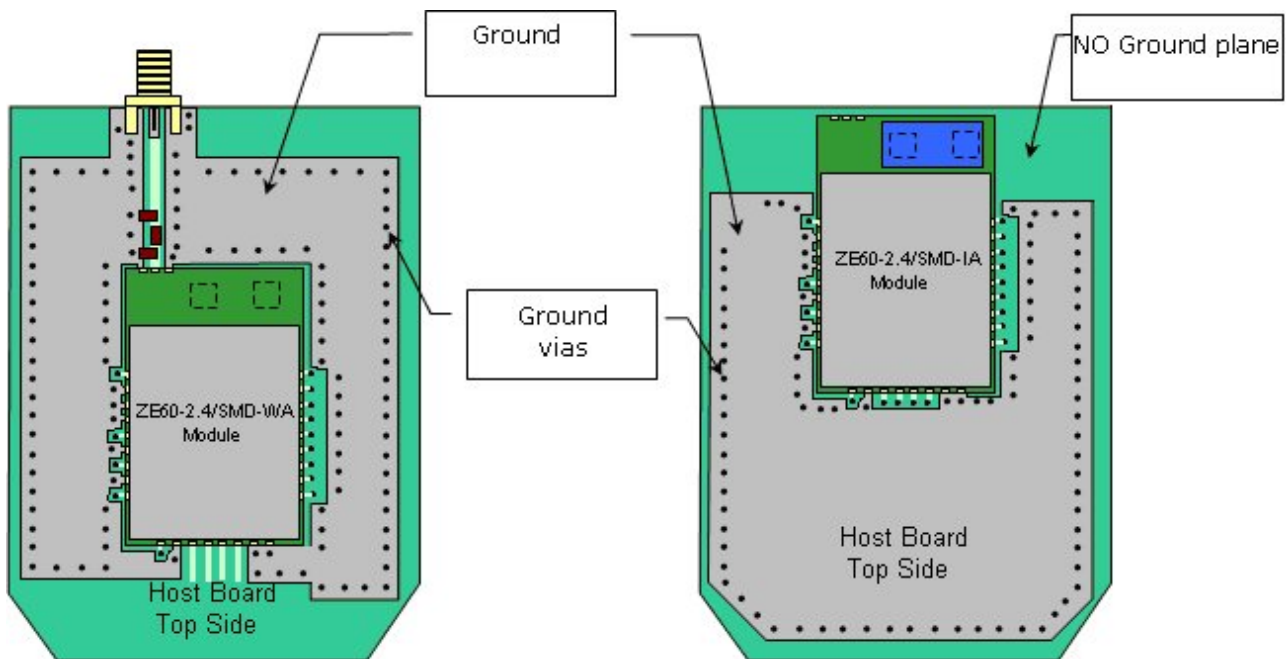
<i>Symbols</i>	<i>Reference</i>	<i>Value</i>	<i>Manufacturer</i>
L1	LQH31MN1R0K03	1 μ H	Murata
C1	GRM31CF51A226ZE01	22 μ F	Murata
C2	Ceramic CMS 25V	100nF	Multiple



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, except in case of integrated antenna (no ground plane must be placed in front of the antenna and on the bottom side).
- 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.

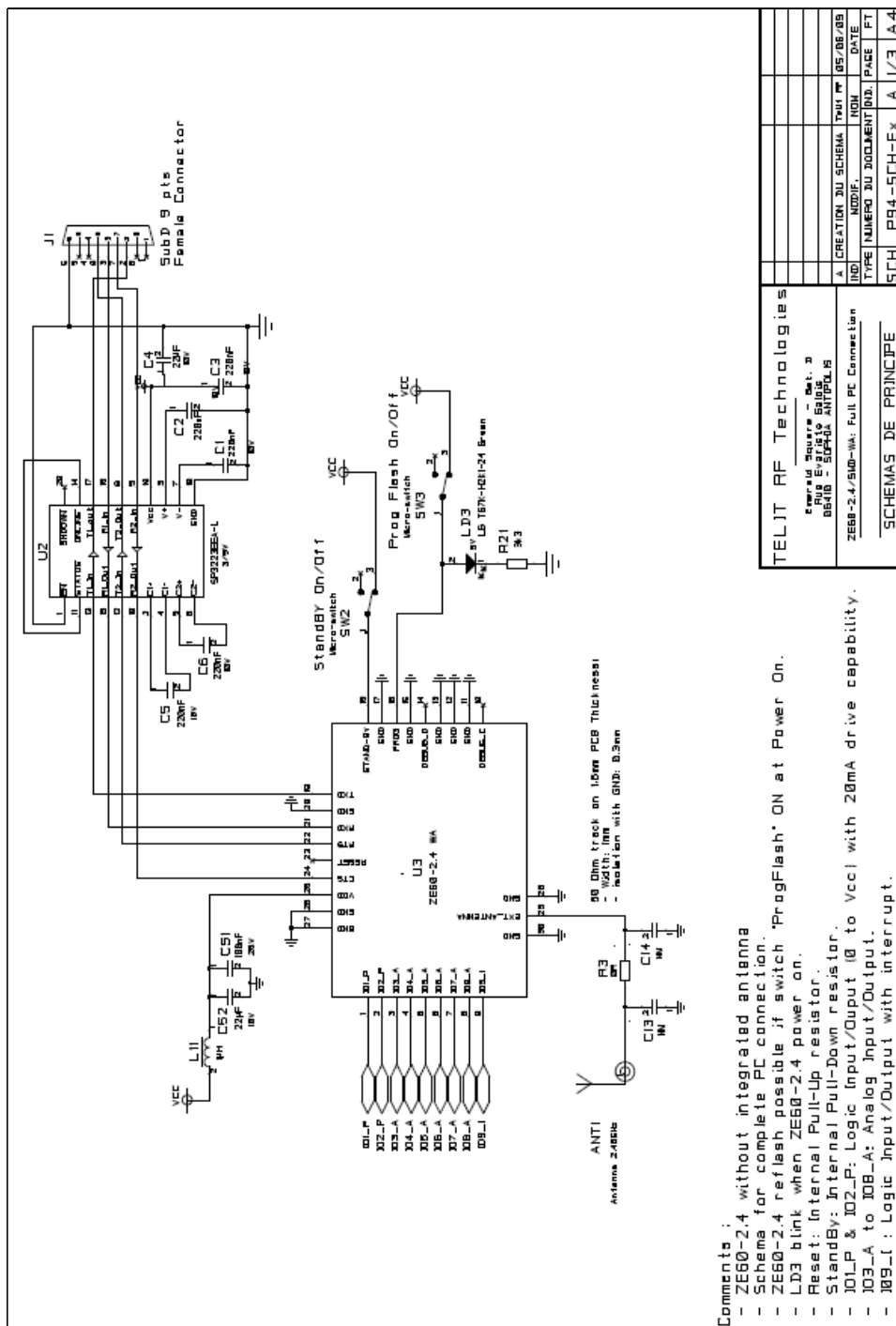


Example of GND layout Top View (with and without integrated antenna)



VI.5. ZE60-2.4 interfacing :

Example of a full RS-232 connection between a PC or an Automat (PLC) and ZE60-2.4/SMD-WA



VII.3. Antenna types

The following are the antenna examples that may be suitable for ZE60-2.4/SMD-WA applications. We distinguish two types of antenna:

- External antenna (antenna is mounted outside of the device)
- Embeddable antenna (antenna is integrated inside the device)

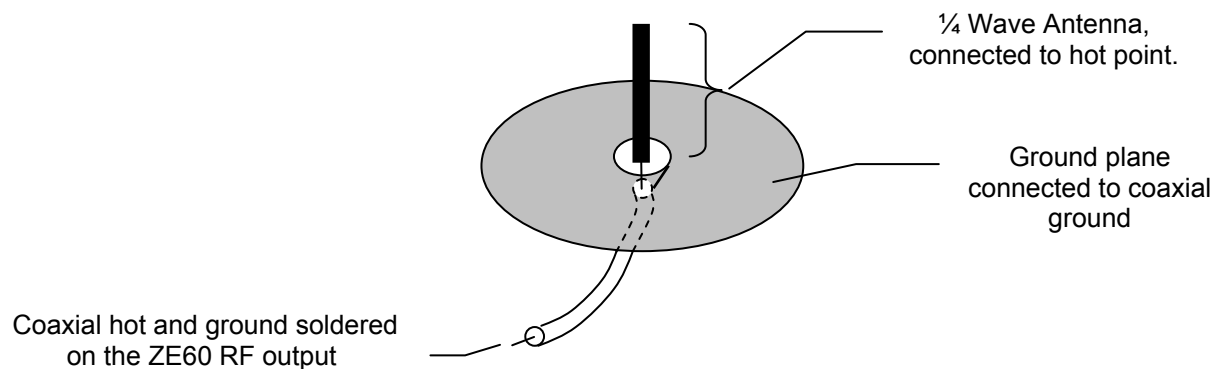
VII.4. External antenna

External antenna is recommended when the range performance is primordial. For example, for base stations and access points, where a better antenna gain may be required.

1/4 Wave Monopole antenna:

The 1/4 Wave antenna is 3 cm long @ 2.4 Ghz. Shorter compensated antennas could be used as long as they are adapted to 2.4 GHz frequency.

Best range may be achieved if the 1/4 Wave antenna is placed perpendicular in the middle of a solid ground plane measuring at least 5 cm radius. In this case, the antenna should be connected to the module via some 50 ohm characteristic impedance coaxial cable.



WARNING
The metallic plane must be ideally under the antenna (balanced radiation). Never short-circuit the hot and cold pins!

The installation directives are the following:

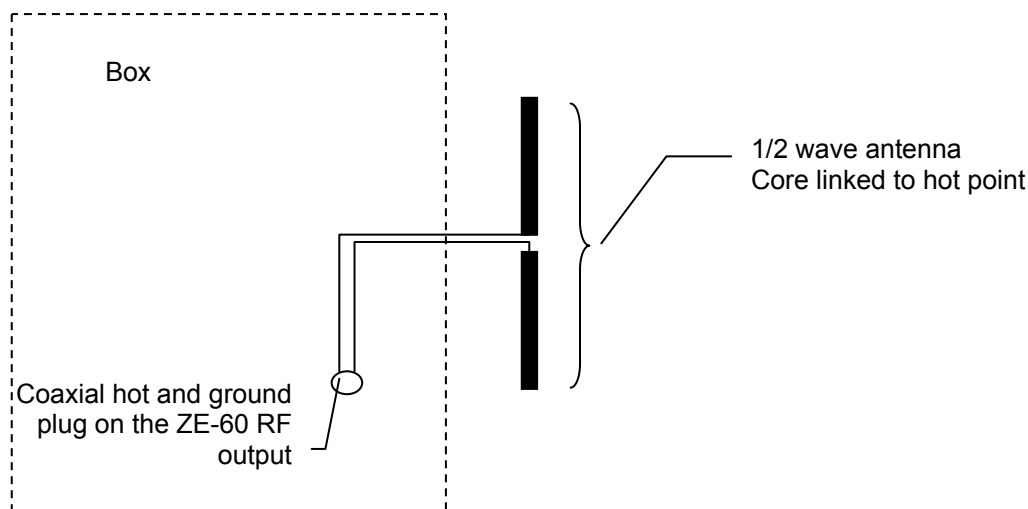
- Solder the coaxial cable on the hot and ground pad antenna (of the ZE60-2.4 module.)
- Fix the antenna on a metallic plane or on a metallic box with the metallic screw provided with the antenna.
- If the ZE60-2.4 module is integrated in a plastic box, use a metal tape (copper) glued on the plastic side under the antenna.



Half Wave Dipole antenna:

The 1/2 Wave Dipole antenna is around 6 cm long. In a 1/2 Wave Dipole antenna the metallic plane is replaced by a second 1/4 Wave antenna balancing the radiation.

Half wave monopole antenna typically offers a ground-independent design with favorable gain, excellent radiation pattern. It has a high impedance and requires an impedance-matching circuit (See paragraph IX.3)



WARNING

It is recommended to place the 1/2 wave dipole antenna away from all metallic object, which will detuned it.

Particularity it is not recommended to place this type of antenna directly on a metallic box, but the antenna can be deported away through a 50 Ohm coaxial cable.



VII.5. Embeddable antennas

In this section you will find antennas designed to be directly attached to ZE60-2.4/SMD-WA module, inside the product casing. These antennas are only used in application where security, cosmetics, size or environmental issues make an external antenna impractical. This type of antenna is used when the integration factor becomes primordial (for mobile and handheld devices) to the range performances.

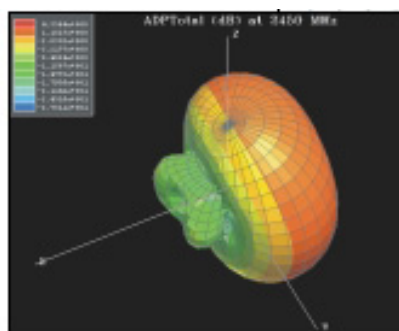
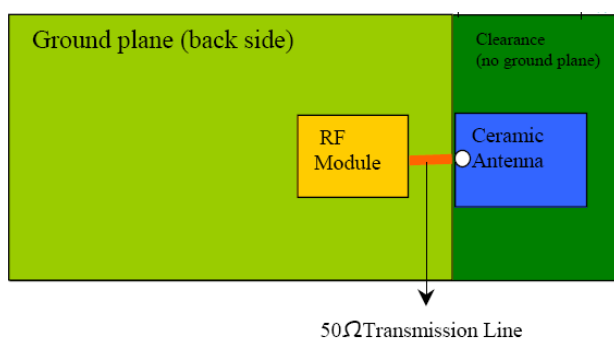
The basic recommendations are:

- The radio module must not be placed in a metallic casing or close to metallic devices.
- The internal antenna must be far from noisy electronic.

Ceramic antenna:

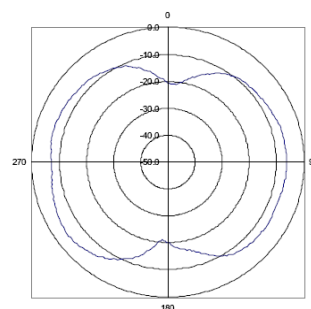
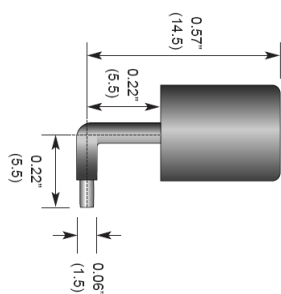
Ceramic antenna is a SMD component to be mounted directly on the PCB. It is designed so that it resonates and be 50 Ohms at the desired frequency. But we recommended placing an impedance-matching circuit (See paragraph IX.3).

The place under and around the ceramic antenna must be free of any track or ground plane (refer to the antenna constructor requirements). It usually has a hemispherical radiation pattern has described below.



Miniaturized antenna:

This type of antenna features a through-hole feed line to directly attach it to the PCB. This antenna acts like a ¼ wave antenna so that a minimum ground plane is required (follow the manufacturer recommendations).



ZE60-2.4/SMD-IA: Integrated antenna:

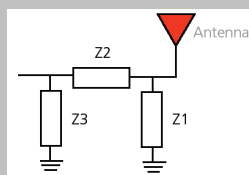
ZE60-2.4 module is available with an integrated chip antenna, allowing very compact integration for small space application.

Antenna Characteristics:

Data sheet characteristics (measured results from a reference evaluation board of 40x20 mm, with a 2 element matching network).

Matching Network Values

- Z1: Not necessary**
- Z2 : L=3.9 nH**
- Z3: C=1.8 pF**



Optimal matching network values may vary depending on the antenna environment.

Frequency range:	2.4 – 2.5 GHz
Average Efficiency :	> 45 %
Peak Gain:	> -0.5 dBi
VSWR :	< 2:1
Temperature:	-40 to +85 °C
Impedance:	50 Ω Unbalanced
Dimensions:	4.1 (L) x 2 (l) x 1 (t) mm
Clearance zone:	See user manual: UM_FR05-S1-N-0-110

It is very important to avoid ground plane around and below the antenna, so ZE60-2.4/SMD-IA must be implemented as described in paragraph VI.3 and schematics VI.5.



