

xE70-915 RF Module User Guide

1VV0301106 rev.3 - 2015-03-04



APPLICABILITY TABLE

PRODUCT
LE70-915



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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1. Introduction

1.1. Scope

Scope of this document is to present the features and the application of the Telit xE70-915 radio modules.

1.2. xE70-915 Product Description

The xE70-915 module is a multi-channel radio board, delivering up to 500mW in Frequency Hopping technology. It is compliant with the FCC Code of Federal Regulations [1] in the 915 MHz ISM unlicensed frequency band.

It is delivered with preloaded protocol stack:

“x”	Product name	Stack functionality
L	LE70-915	FH Star Network

xE70-915 is pin-to-pin compatible with LE, NE and ME modules working at different frequencies, in particular xE50-868 and xE70-868.

xE70-915 is also pin-to-pin compatible with Telit ZE Family (ZigBee 2007 and ZigBee PRO stack).

1.3. Audience

This document is intended for developers using Telit xE70-915 radio modules.

1.4. Contact Information, Support

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

TS-SRD@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>



To register for product news and announcements or for product questions contact Telit Technical Support Center (TTSC).

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.

1.5. 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] Code of Federal Regulations, Title 47, Part 15
- [2] Frequency Hopping Star Network Protocol Stack User Guide, 1vv0301059
- [3] SR Tool User Guide, 1vv0300899



2. Regulatory Conformance Information

2.1. Operational Frequency Bands

The module radio transmitter operations must be compliant with some regulatory requirements in terms of frequency bands and emitted power, as detailed below.

2.1.1. 915 MHz Band Requirements

The FCC part 15.247 regulates the frequency hopping RF devices, and gives the following requirements:

<i>Frequency Band</i>	<i>Channel spacing</i>	<i>Maximum radiated power</i>	<i>Hopping cycle</i>
902-928 MHz	25 < “20dB BW” < 250kHz	1W	<0.4s each 20s < 0.4s each 20s, 50 hop. Freq min
	250 < “20dB BW” < 500kHz	250mW	<0.4s each 10s, 25 hop. Freq. min

The main requirements of the FCC regulation are given in [1].

The xE70-915 module operates in the ISM band. This band is 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.

2.2. Other Regulatory Requirements

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

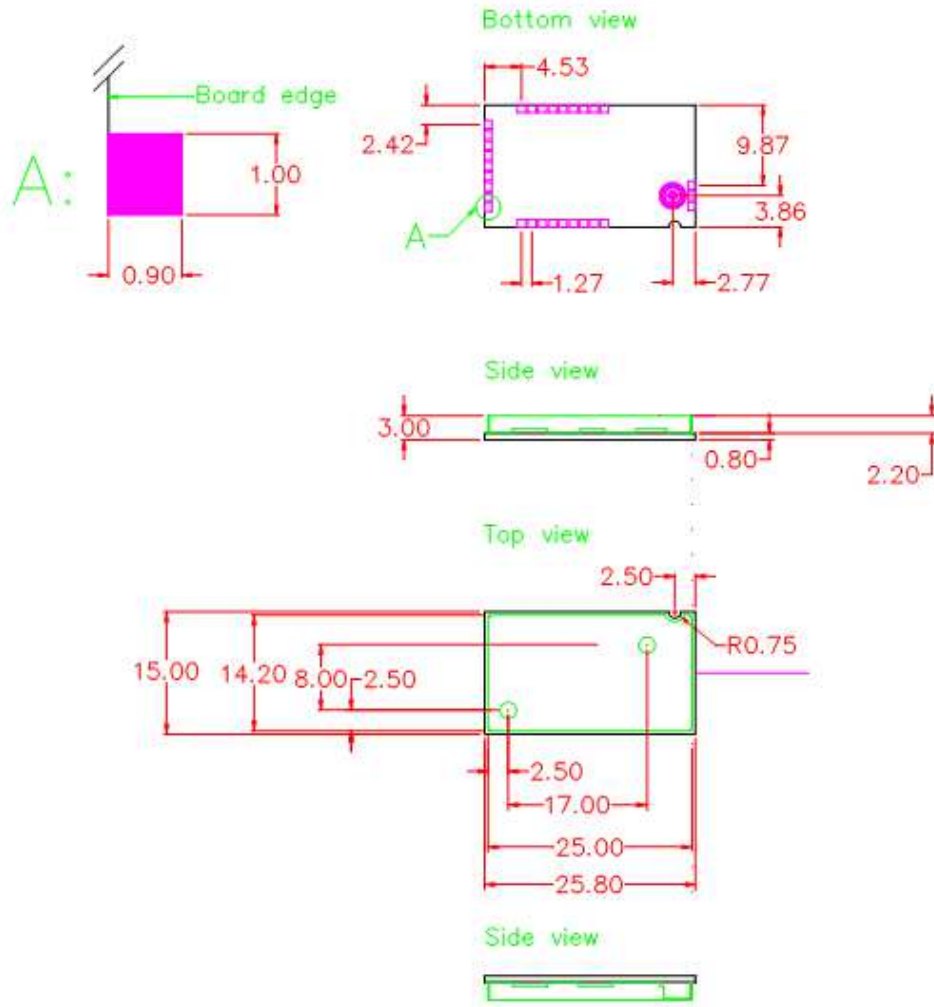


3.4. Mechanical Specifications

<i>Size</i>	Rectangular 25.8 x 15 mm
<i>Height</i>	3 mm
<i>Weight</i>	1.7 g
<i>PCB thickness</i>	0.8 mm
<i>Cover</i>	Mounted above SMD components for EMI reduction and automatic placement <ul style="list-style-type: none"> • Dimensions : 25 x 14.2 x 2.2mm • Thickness : 200µm
<i>Components</i>	All SMD components, on one side of the PCB.
<i>Mounting</i>	Suitable for RoHS reflow process <ul style="list-style-type: none"> • SMD • LGA on the 4 external sides
<i>Number of pins</i>	30



3.5. Mechanical dimensions



3.6. DC Specifications

Measured on DIP interface with $T = 25^{\circ}\text{C}$, under 50Ω impedance connected to RF port and default power register setting if nothing else stated.

Max limits apply over the entire operating range, $T = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{DD} = 2.3\text{V}$ to 3.6V and all channels.

Characteristics xE70-915	Min.	Typ.	Max.	Unit
Power Supply (V_{DD})	+2.3	-	+3.6	V
Consumption at 3.6V				
Maximum output power 500mW (+27dBm)		390	420	mA
Reception		25	30	mA
Stand-by (32.768 kHz On)		2	3	μA
I/O low level	GND	-	$0.2x V_{DD}$	V
I/O high level	$0.8x V_{DD}$	-	V_{DD}	V



3.8. Digital Specifications

Function	Characteristics
μC	<ul style="list-style-type: none"> • 128 kB + 8 kB in system programmable flash • 8 kB RAM • 2 kB E²PROM
Serial link	<ul style="list-style-type: none"> • RS232 TTL Full Duplex • 1200 to 115200 bps • 7 or 8 bits • Parity management • Flow control <ul style="list-style-type: none"> ○ Hardware (RTS/CTS)
Embedded software functionality	<ul style="list-style-type: none"> • Flexibility: <ul style="list-style-type: none"> ○ Pre flashed ○ Customization capability ○ Embedded bootloader for firmware download through serial link or over the air

3.9. Absolute Maximum Ratings

<i>Voltage applied to Vcc, VDD :</i>	-0.3V to +3.6V
<i>Voltage applied to “TTL” Input :</i>	-0.3V to V _{DD} +0.3V


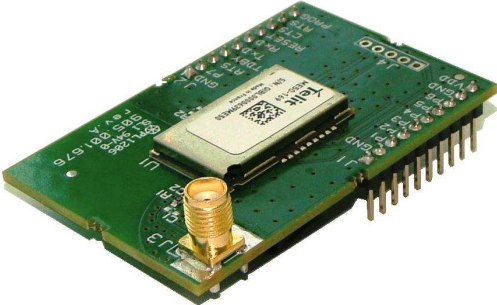

3.10. Ordering Information

The following equipments can be ordered:

- The SMD version (LE70-915)
- The DIP interface version (LE70-915)
- The Demo Kit (LE70-915) composed by n.2 EVK board, n.2 DIP interface boards, n.2 RF antennas, n.2 USB cables, n.2 batteries 9V.

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.

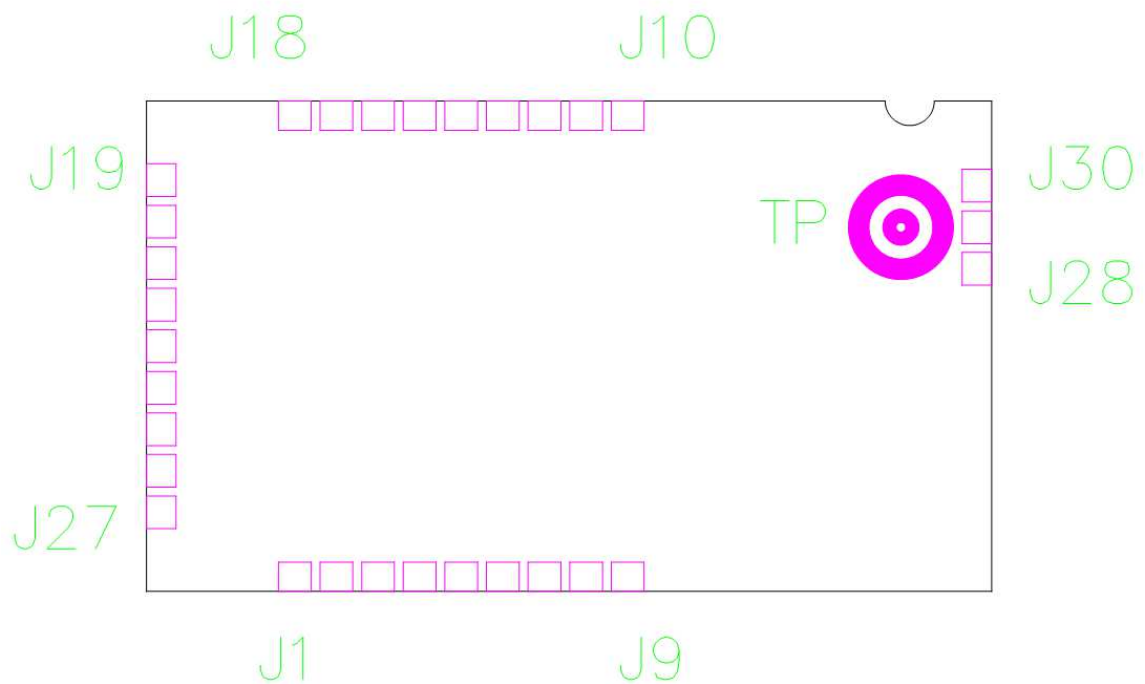


Equipment and Part Number
SMD Version B LE70-915/SMD
 <p>A surface-mount device (SMD) module. It is a small, rectangular, silver-colored component with a white label. The label features the Telit logo, the model number LE70-915, and the serial number 5/N: ENC00400001+. Below the label, it is noted that the module is 'Made in France'.</p>
DIP Version B LE70-915/DIP
 <p>A dual in-line package (DIP) module. It consists of a green printed circuit board (PCB) populated with various components. A central component is a silver-colored SMD module. The PCB has numerous gold-plated pins along one edge and a gold-plated SMA connector on the other. Text on the PCB includes 'Telit Communications S.p.A.', 'SMD Version', and 'Made in France'.</p>
Demo Case D LE70-915 DemKit
 <p>A black plastic carrying case with a handle, shown open. Inside the case, there is a green PCB module, a white USB cable, and other accessories. The interior of the case is lined with black foam for protection.</p>



4. Pin-out and Signals Description

4.1. Module Pin-out (Top View)



CAUTION: reserved pins must not be connected



CAUTION: 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 (see foot notes on Pin-Out tables).



4.2. Module Pin-out Table

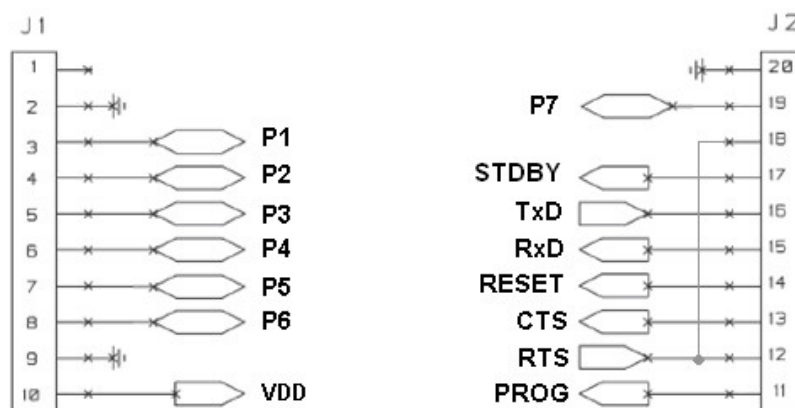
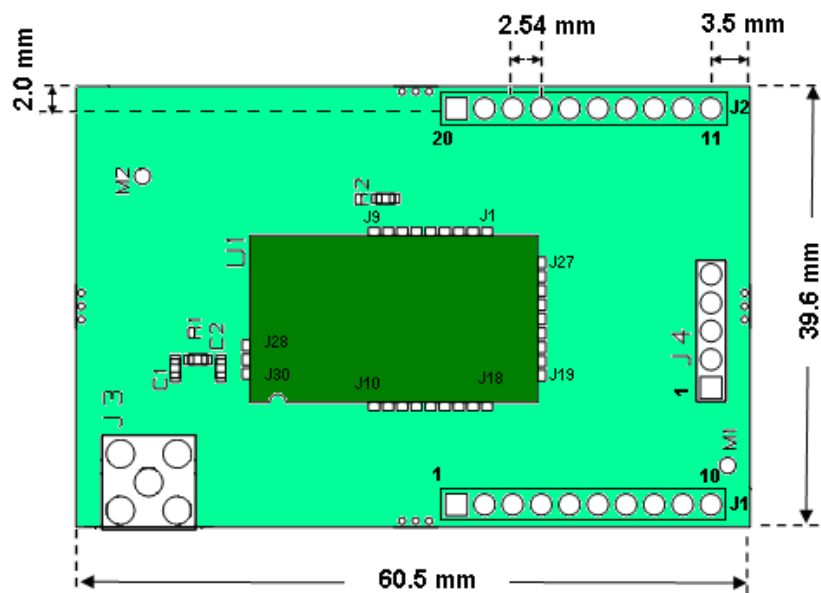
Pin	Pin name	Pin type	Signal level	Function
J30	GND	Gnd		RF Ground connection for external antenna
J29	Ext_Antenna	RF		RF I/O connection to external antenna
J28	GND	Gnd		RF Ground connection for external antenna
J27	GND	Gnd		Ground
J26	GND	Gnd		Ground
J25	VDD	Power		Digital and Radio part power supply 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: when set to 1 the module is put in stand-by)
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 [2] Frequency Hopping Star Network Protocol Stack User Guide
J8	IO8_AD_DA ²	I/O	analog	A to D and D to A I/O N°8 with interrupt (Logic I/O capability)
	ACK TX	O	TTL	See reference document [2] Frequency Hopping Star Network Protocol Stack User Guide
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)

^{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.



J2	IO2_P	I/O	TTL	Logic I/O N°2 with interrupt
	RX LED	O	TTL	See reference document [2] Frequency Hopping 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 [2] Frequency Hopping Star Network Protocol Stack User Guide

4.3. Pin-out of the Module DIP



4.4. DIP - Module Pin-out Correspondence Table

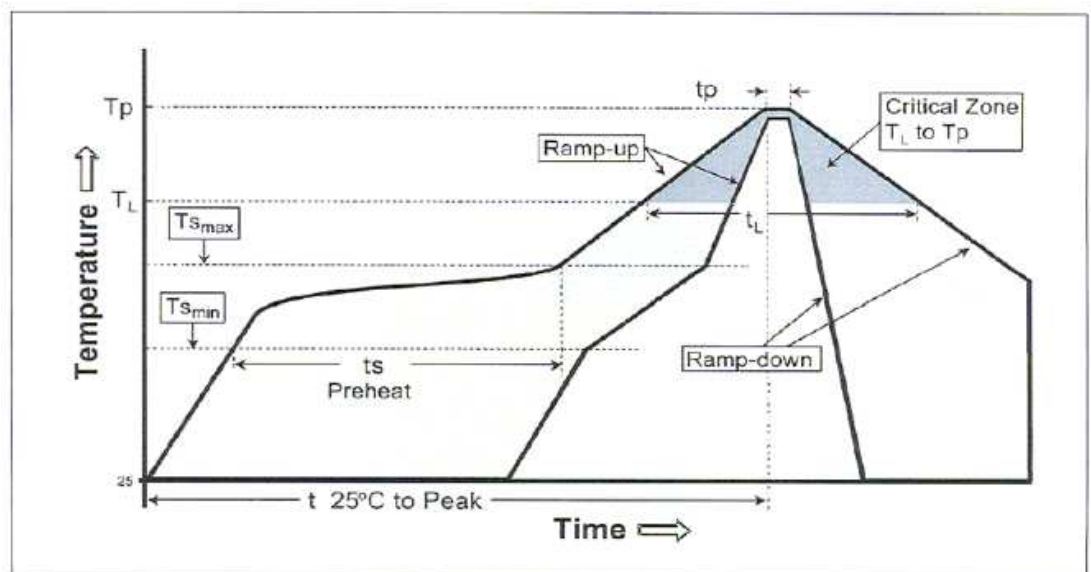
Pin-Out correspondence between xE70-915/DIP and xE70-915/SMD

xE70-915/DIP			xE70-915/SMD		Comments
Connector	Pin	Name	Pin	Name	
J1	1				Reserved Pin
	2	GND		GND	
	3	P1	J5	IO5_A	
	4	P2	J9	Status TX/RX	
	5	P3	J2	RX LED	
	6	P4	J1	TX LED	
	7	P5	J4	IO4_A	
	8	P6	J3	IO3_A	
	9	GND		GND	
	10	VDD	J25	VDD	
J2	11	PROG	J16	PROG	
	12	RTS	J22	RTS	
	13	CTS	J24	CTS	
	14	RESET	J23	RESET	
	15	RxD	J21	RxD	
	16	TxD	J19	TxD	
	17	STDBY	J18	STAND_BY	
	18	RTS	J22	RTS	
	19	P7	J6	IO6_A	
20	GND		GND		
J4	1		J14	PDI_DATA	J4 Connector for debugging and flashing
	2		J10	PDI_CLK	
	3		J23	RESET	
	4		J25	VDD	
	5			GND	
			J7	IO7_A	Reserved Pin
			J8	IO8_AD_DA	
J3	SMA connector		J29	Ext_Antenna (Unbalanced RF)	A 50 Ohm coplanar wave guide and a 0 ohm resistor are used to connect J29 to J3



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 xE70-915 radio module's metal shield from being in contact with the solder wave.



6. Board Mounting Recommendation

6.1. Electrical environment

The best performances of the xE70-915 module are obtained in a “noise free” 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 xE70-915 module.

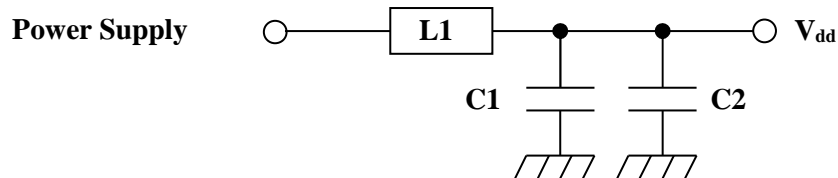


CAUTION – A particular attention must be put on power supply DC-DC converter, due to switching frequency that generates spurious into the receiver band. It can strongly decrease module performances. Therefore it is recommended to put a metallic shield covering DC conversion function.

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

6.2. Power supply decoupling on xE70-915 module

The power supply of xE70-915 module must be nearby decoupled. A LC filter is strongly recommended in case of DC-DC conversion. It must be placed as close as possible to the radio module power supply pin, VDD.



For example:

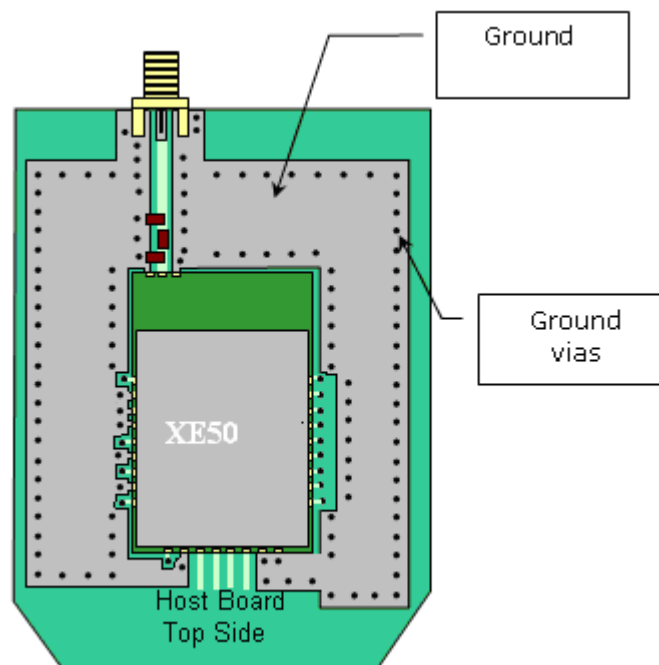
Symbols	Reference	Value	Manufacturer
L1	LQH32CN1R0M33	1 μ H	Murata
C1	GRM31CF51A226ZE01	22 μ F	Murata
C2	Ceramic CMS 25V	100nF	Multiple

L1 must be chosen carefully with very low serial resistance (ESR) in order to limit voltage drop.

6.3. RF layout considerations

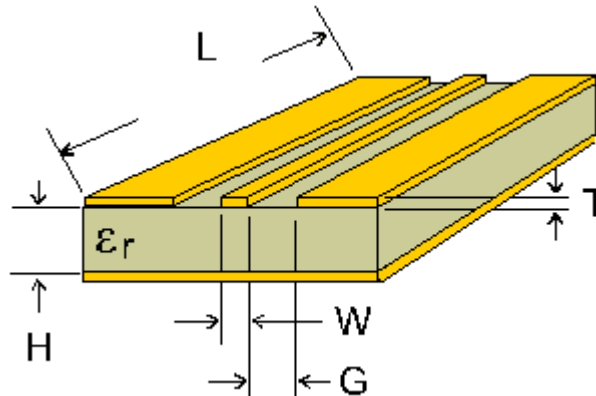
Basic recommendations must be followed to achieve a good RF layout:

- 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.



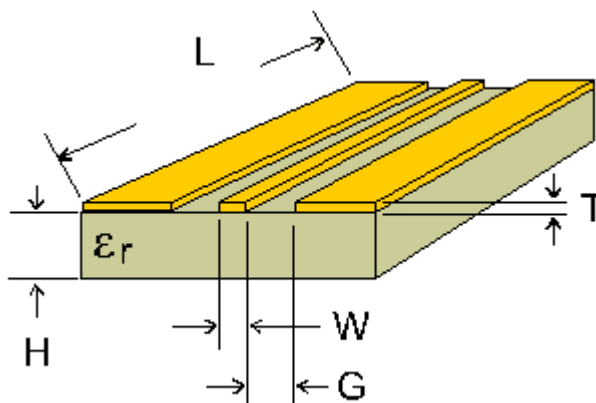
6.4. Antenna connections on printed circuit boards

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)



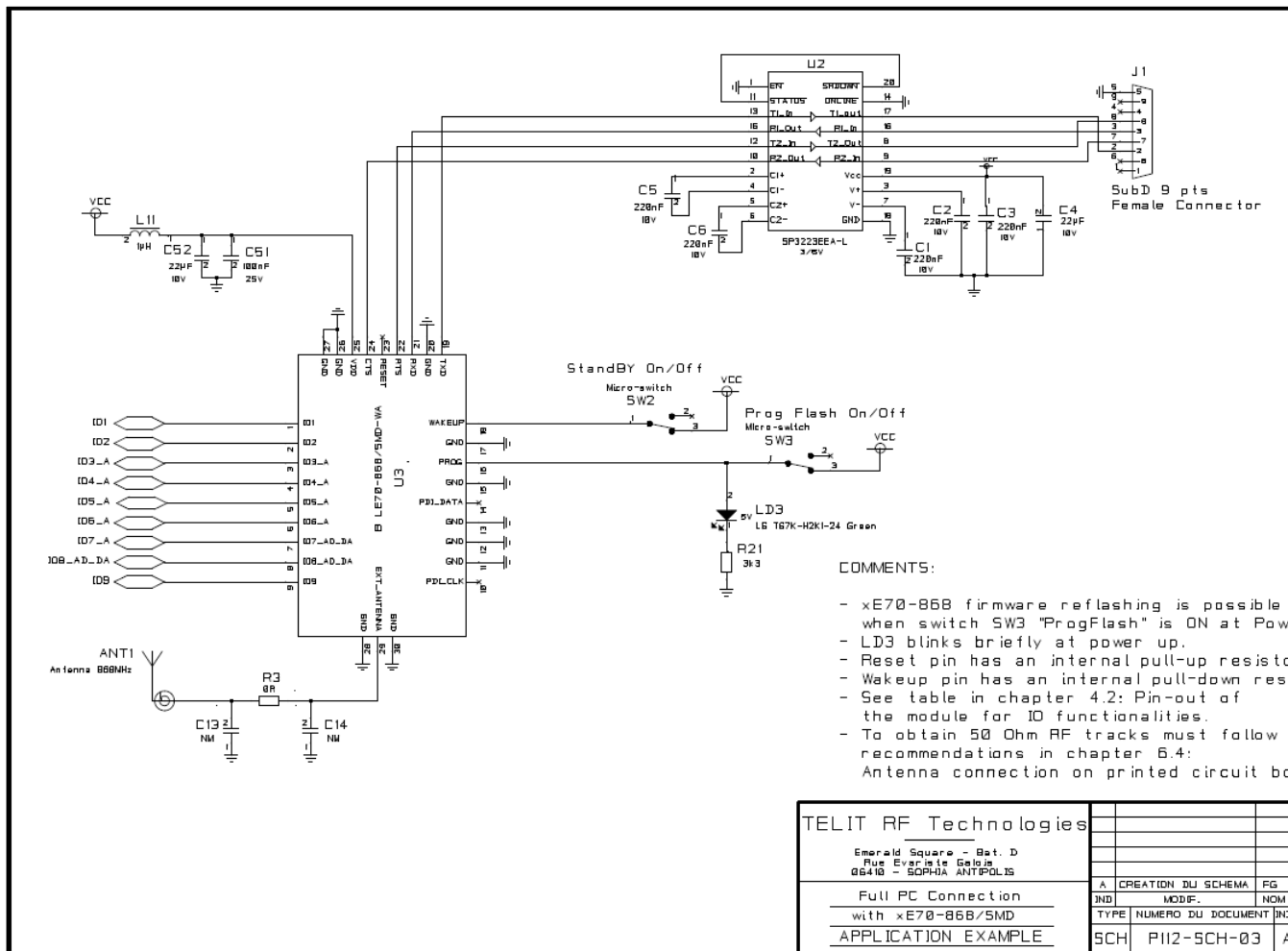
PCB material	PCB thickness H (mm)	Coplanar line W (mm)	Coplanar line G (mm)
FR4	0.8	1	0.22
	1.6	1	0.23

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

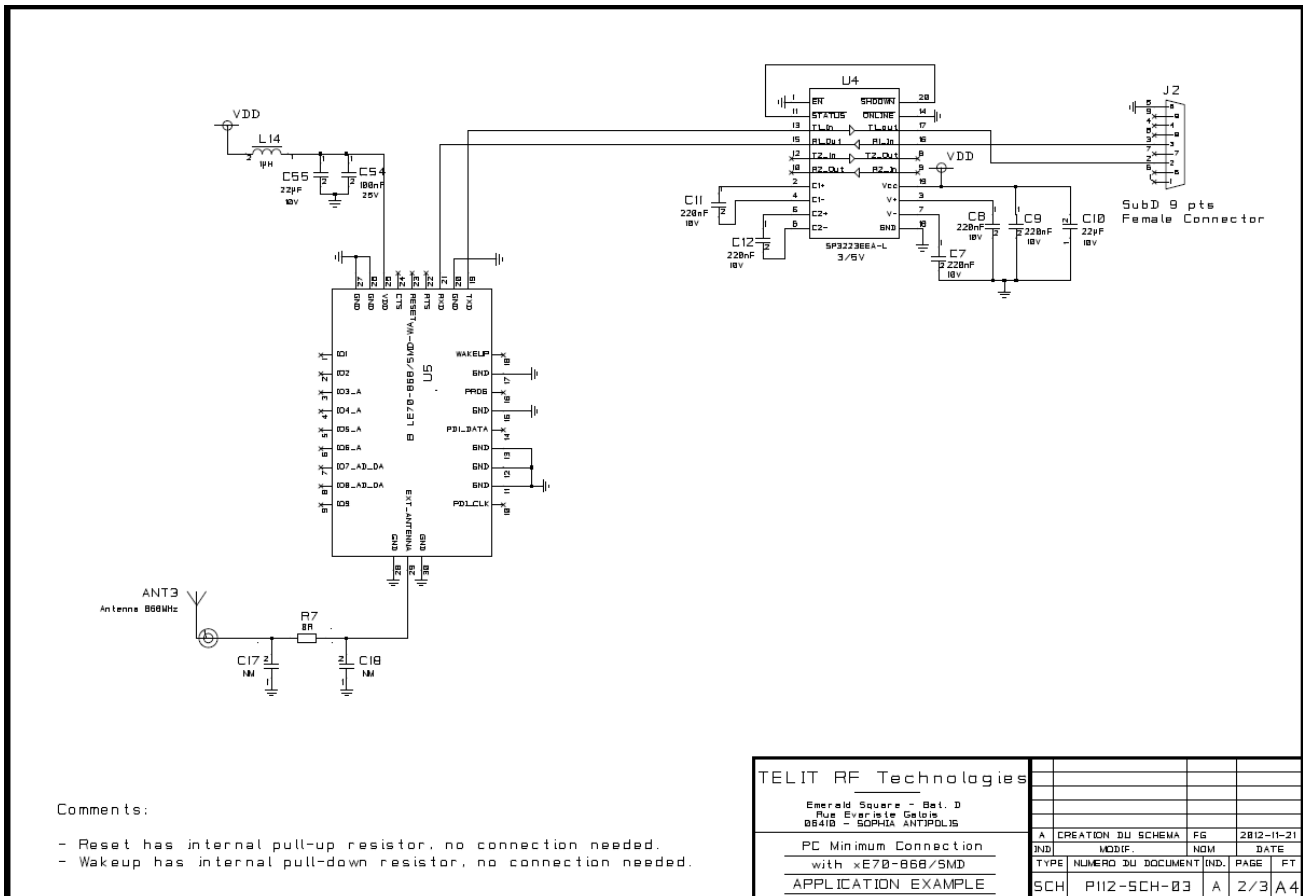


6.5. xE70-868/915 Interfacing

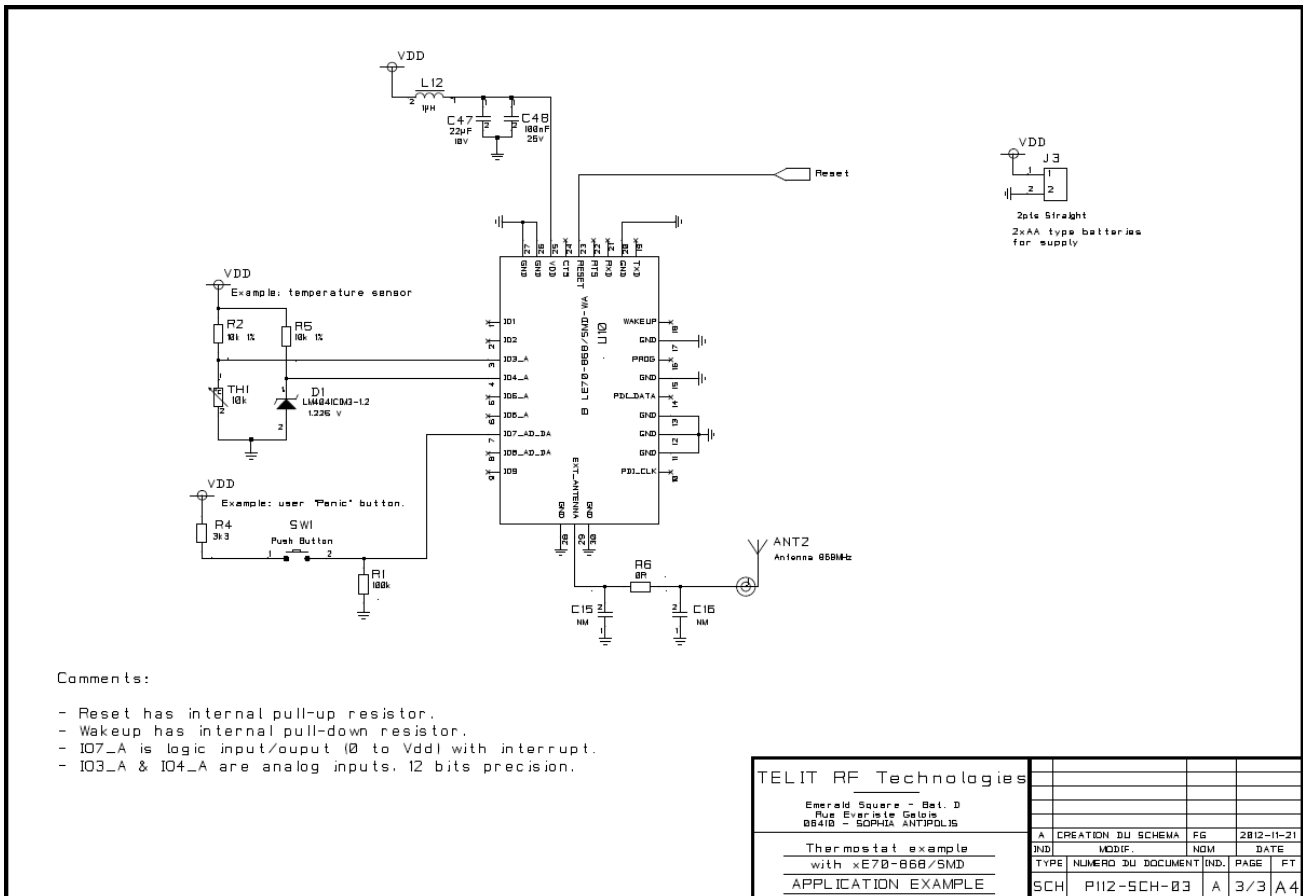
Example of a full RS-232 connection between a PC or an Automat (PLC) and xE70-868/915



Example of minimum connections for communication between a PC and xE70-868/915



Example for sensor connection with xE70-868/915



7. Conformity assessment issues FCC/IC Regulatory notices

7.1. Modification statement

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Telit n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

7.2. Interference statement

This device complies with Part 15 of the FCC Rules and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

7.3. Wireless notice

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain and type must be:

Type	Max Gain
$\lambda/2$ dipole antenna	1.9 dBi

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.



Cet appareil est conforme aux limites d'exposition aux rayonnements de l'IC pour un environnement non contrôlé. L'antenne doit être installée de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps. Gain et Type de l'antenne doit être ci-dessous:

Type	Gain maximum
Antenne dipole $\lambda/2$	1.9 dBi

L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

7.4. FCC Class B digital device notice

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

7.5. Labelling Requirements for the Host device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the FCC ID and IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains FCC ID: RI7LE70FH
Contains IC: 5131A-LE70FH

L'appareil hôte doit être étiqueté comme il faut pour permettre l'identification des modules qui s'y trouvent. L'étiquette de certification du module donné doit être posée sur l'appareil hôte à un endroit bien en vue en tout temps. En l'absence d'étiquette, l'appareil hôte doit porter une étiquette donnant le FCC ID et le IC du module, précédé des mots « Contient un



module d'émission », du mot « Contient » ou d'une formulation similaire exprimant le même sens, comme suit :

Contains FCC ID: RI7LE70FH

Contains IC: 5131A-LE70FH

7.6. CAN ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne ICES-003.



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.

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

<http://www.gpo.gov/fdsys/pkg/CFR-2010-title47-vol1/content-detail.html>



9. Glossary

ACP	Adjacent Channel Power
AFA	Adaptive Frequency Agility
bps	Bits per second
BW	Bandwidth
dB	Decibel
dBm	Power level in decibel milliwatt ($10 \log (P/1mW)$)
E²PROM	Electrically Erasable Programmable Read Only Memory
E.R.P	Effective radiated power
ETSI	European Telecommunication Standard Institute
FCC	Federal Communications Commission
FH	Frequency Hopping
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



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1VV0301106 rev.4 - 2015-06-16

10. Document History

Revision	Date	Changes
0	2013-10-11	First Release
1	2014-04-02	Updated LE70-915 Demo Kit content
2	2014-07-21	Corrected partname for L1 on page 26; updated sensitivity and current consumption values
3	2015-03-04	Updated first channel frequency; added tolerance on maximum output power; picture dimension adjusted
4	2015-06-16	Added Conformity Assessment Issue section; added dimensions for inhibit area under the module; Digital Specification table corrected

