LT70-868 Terminal User Guide

1VV0301096 Rev.0 – 24/10/2013

PRODUCT
LT70-868 Terminal

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CHAPTER I.   INTRODUCTION

I.1. Aim of the Document

The aim of this document is to present the Hardware features and the application of LT70-868 radio terminal. The characteristics will be described within three distinct chapters:

- "General characteristics" describes the electrical and mechanical characteristics.
- "Mechanics and connections" details the casing, connector, cabling and power supply.

- The Software functionalities are described in the reference document [5], listing the operating modes, registers and their use.

I.2. Reference documents

[1] **EN 300 220-2 v2.4.1**	ETSI Standards for SRD , May 2012
[2] **ERC Rec 70-03**	ERC Recommendation for SRD, October 2012
[3] **2002/95/EC**	Directive of the European Parliament and of the Council, 27 January 2003
[4] **LE70-868 module : User Manual**	1vv0301037_Telit_xE70_868_RF_Module_User_Guide
[5] **Star Network Protocol : User Manual**	1vv0300873_Telit_Star_Network_Protocol_Stack_User_Guide
[6] **SR Manager Tool: User Guide**	1vv0300899_Telit_SR_Manager_Tool_User_Guide

I.3. Document change log

Revision	Date	Changes
ISSUE # 0	24/10/13	First Release

I.4. Glossary

ACP	Adjacent Channel Power
BER	Bit Error Rate
Bits/s	Bits per second (1000 bits/s = 1Kbps)
CER	Character Error Rate
dBm	Power level in decibel milliwatt (10 log (P/1mW))
EMC	Electro Magnetic Compatibility
EPROM	Electrical Programmable Read Only Memory
ETR	ETSI Technical Report
ETSI	European Telecommunication Standard Institute
FM	Frequency Modulation
FSK	Audio Frequency Shift Keying
GFSK	Gaussian Frequency Shift Keying
GMSK	Gaussian Minimum Shift Keying
IF	Intermediary Frequency
ISM	Industrial, Scientific and Medical
kbps	kilobits/s
LBT	Listen Before Talk
LNA	Low Noise Amplifier
MHz	Mega Hertz (1 MHz = 1000 kHz)
PLL	Phase Lock Loop
PROM	Programmable Read Only Memory
NRZ	Non return to Zero
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RSSI	Receive Strength Signal Indicator
Rx	Reception
SRD	Short Range Device
Tx	Transmission
SMD	Surface Mounted Device
VCO	Voltage Controlled Oscillator
VCTCXO	Voltage Controlled and Temperature Compensated Crystal Oscillator

CHAPTER II.   GENERAL CHARACTERISTICS

II.1. General Requirements

The LT70-868 terminal is a multi-channel radio terminal, delivering up to 500mW in the 868MHz ISM band (unlicensed frequency band).

It allows 'point-to-point', `multipoint' or 'mesh' functioning modes.

The "ERC recommendation 70-03" describes the different usable sub-bands in the 868MHz 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 g3	869.4 - 869.65	500	25 or wideband	10

This band is free to use but the terminal and the user must respect the 10% duty cycle limitation. This means that each terminal is limited to a total transmit time of 6 minutes per hour. It is the responsibility of the user to respect it.

Furthermore, the terminal complies with the ETSI 300-220-2 v2.4.1 (specific for SRD). The main requirements are described in chapter IV.3.

Finally, the terminal 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 g3:**_

Country	Restriction	Reason/Remark
Band g3		
Georgia	Not implemented	
Russian Federation	Not implemented	
Ukraine	Not implemented	

II.2. Temperature Characteristics

	Minimum	Typical	Maximum	Unit
Operating				
Temperature	- 40	25	+ 85	°C
Relative humidity	20		75	%
Storage				
Temperature	- 40	25	+ 85	°C
Relative humidity	0		95	%

II.3. Mechanical Characteristics

Characteristics		Unit
Connectors	Connection using terminal blocks inside the casing. Exit through cable gland	-
Dimensions Box	100x66x47	mm
Antenna length : • Removable antenna version	90	mm
LEDs	No LEDs are available	

II.4. DC Characteristics

Characteristics	6V	12V	40V	Unit
Transmission consumption 500mW / 100mW / 25mW	210(*)/TBD/TBD	105(*)/TBD/TBD	32(*)/TBD/TBD	mA
Reception consumption	16(*)	8(*)	< 3(*)	mA
Stand-by consumption	< 2(*)	< 1(*)	< 0.3(*)	µA

(*): Typical, not misured

II.5. Functional characteristics

ERC Rec 70-03 Frequency Band	Band g3: 869.400 MHz - 869.650 MHz						
RF data rate	**1.2 kbps**	**2.4 kbps**	**4.8 kbps**	**9.6 kbps**	**19.2 kbps**	**38.4 kbps**	**57.6 kbps**
Numbers of channels	1						
Channel width	250 kHz						
Channel 0	869.525 MHz						
Total Bandwidth	250 kHz						
Transmission							
Duty cycle	≤ 10%						
Modulation Format	2GFSK						
Deviation	± 0.6 kHz	± 1.2 kHz	± 7 kHz	± 7 kHz	± 10 kHz	± 20 kHz	± 30 kHz
Frequency tolerance at 25°C	+/- 2.5 kHz						
RF Output Power at 3.6V	Selectable by software (see Protocol Stack User Guide [5]) From +15 dBm to +27dBm						
Reception							
Rx filter BW	20 kHz	20 kHz	20 kHz	27 kHz	44 kHz	81 kHz	122 kHz
Sensitivity for PER < 0.8	TBD	TBD	-117dBm	-115dBm	-113dBm	-110 dBm	-108dBm

ERC Rec 70-03 Frequency Band	Band g3: 869.400 MHz - 869.650 MHz						
RF data rate	1.2 kbps	2.4 kbps	4.8 kbps	9.6 kbps	19.2 kbps	38.4 kbps	57.6 kbps
Numbers of channels	1						
Channel width	250 kHz						
Channel 0	869.525 MHz						
Total Bandwidth	250 kHz						
Transmission							
Duty cycle	≤ 10%						
Modulation Format	2GFSK						
Deviation	± 0.6 kHz	± 1.2 kHz	± 7 kHz	± 7 kHz	± 10 kHz	± 20 kHz	± 30 kHz
Frequency tolerance at 25°C	+/- 2.5 kHz						
RF Output Power at 3.6V	Selectable by software (see Protocol Stack User Guide [5])						
	From +15 dBm to +27dBm						
Reception							
Rx filter BW	15KHz						
Sensitivity [dBm] for PER < 0.8 Ch1-Ch5-Ch10	-115; -117; -116						

	Indiano Frequency Band: 865 MHz - 867 MHz			
RF data rate	**4.8 kbps**	**9.6 kbps**	**19.2 kbps**	**38.4 kbps**
Numbers of channels	10			
Channel width	200 kHz			
Channel 0	865.1 MHz			
Total Bandwidth	2 MHz			
Transmission				
Modulation Format	2GFSK			
Deviation	± 7 kHz	± 7 kHz	± 10 kHz	± 20 kHz
Frequency tolerance at 25°C	+/- 2.5 kHz			
RF Output Power at 3.6V	Selectable by software (see Protocol Stack User Guide [5]) From +15 dBm to +27dBm			
Reception				
Rx filter BW	20 kHz	27 kHz	44 kHz	81 kHz
Sensitivity [dBm] for PER < 0.8	-117	-115	-113	-110

II.6. Digital Characteristics

Function	Characteristics
µC	• 128 kB + 8 kB in system programmable flash • 8 kB RAM • 2 kB E^2PROM
Serial link	• RS232 TTL Full Duplex • 1200 to 115200 bps • 7 or 8 bits • Parity management • Flow control o Hardware (RTS/CTS)

Embedded software functionality	• Flexibility:
	    o Pre flashed
	    o Customization capability
	    o Embedded bootloader for firmware download through serial link or over the air

II.7. Ordering information

The appropriate Telit part number you need to order LT868-Terminal is **3990150524**.

II.8. Accessories

The LT868-Terminal box could be integrated with two wall fastening lugs **FIBOX MRS-28540** (product number 7028540):
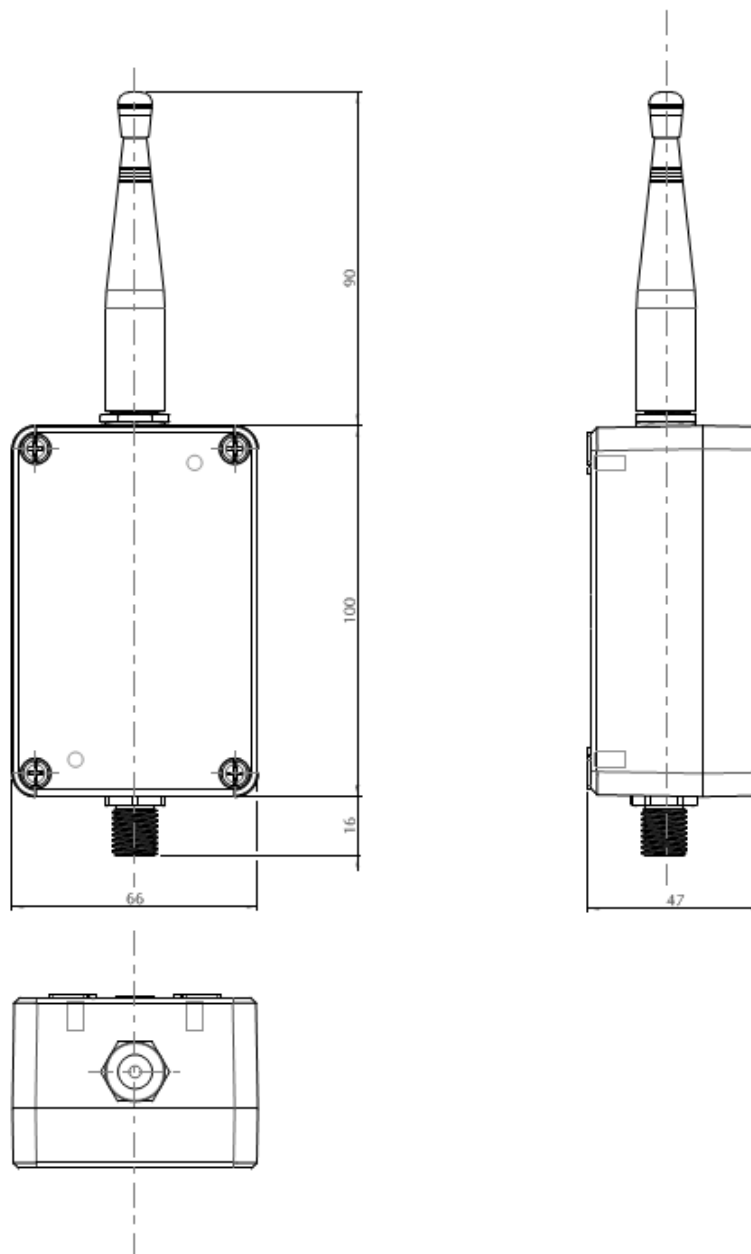
CHAPTER III.   MECHANICS AND CONNECTION
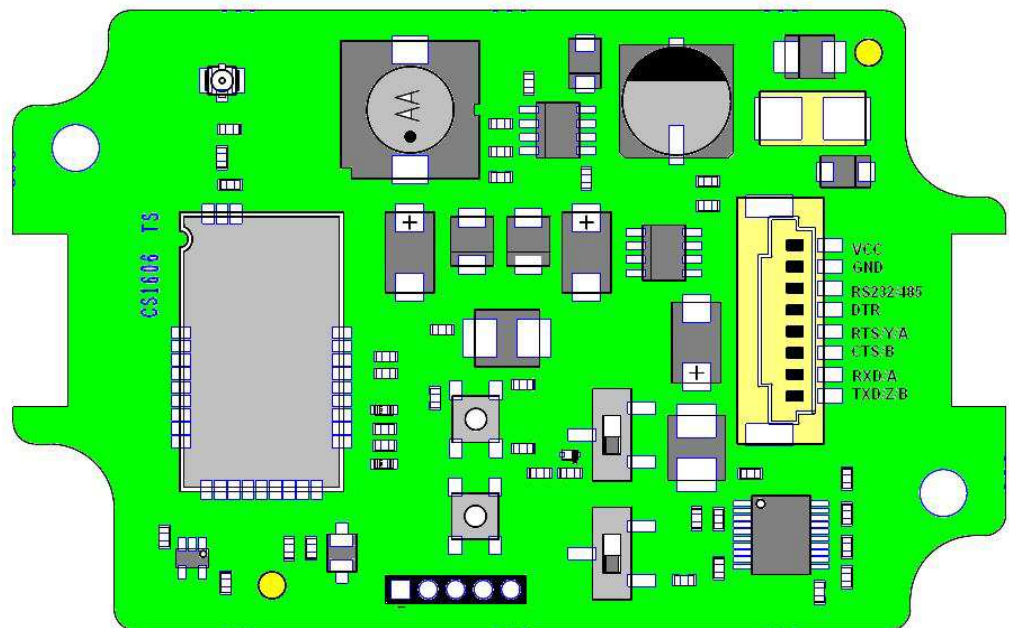
III.1. Mechanical Characteristics

- ▪ IP67 Casing

- • *Mechanical Drawings*

III.2. Connections

The terminal will communicate with the host through a cable connected to a matching connector on the mother board inside the casing (yellow part on the following drawing):

> TxD, RxD: Serial link signals in RS232 format. TxD is for the data <u>going out</u> of the Terminal while RxD is for the data <u>coming into</u> the Terminal. The logic '1' is represented by signal between –3 and –15V.

> CTS: Clear To Send: signal into the Terminal. Indicates if the Terminal can send serial data to the User (Active on '0', +3V to +15V) or not (Inactive on '1', -15V to -3V).

> RTS: Request To Send: signal going out of the Terminal. Indicates that the user can transmit serial data (Active on '0', +3V to +15V) or not (Inactive on '1', -15V to -3V).

> DTR: Stand-By signal into the Terminal. Switches the Terminal in Low-Power Mode ('1', -15V to -3V) or in Normal Mode ('0', +3V to +15V).

> RS232-485:   Used with the S215 Register, selects the type of serial link: open for RS232 (default, internal pull up 100 KΩ), GND for RS422 or RS485. Can be also made by RS232/485 switch.

> A, B, Y, Z: RS422/RS485 signals.
>   For RS422 use A (or Rx+), B (or Rx-), Y (or Tx+) and Z (or Tx-).
>   For RS485, use only A (or D+) and B (or D-).

➢ 6-40V: 6 to 40 VDC power supply. There is no internal ON/OFF switch for the power supply. The switch off capability should be external.

Internal LED:
- Green Led: it is switch on when the terminal is transmitting data
- Red Led: it is switch on when the terminal is receiving data

III.3. Cables Description

The associated cable is connected to the matching connector of the mother board and goes out of the terminal through a cable gland. The cable must be shielded and have an external diameter between 3.5 and 7mm. The conductors must have a cross section of 0.22mm² (24AWG).

- **_Case of RS-232_**

Connector (8 points)	Name Terminal Side	Color	Name PC/Automate Side	Connector Sub-D (9 points)
1	TxD (Transmit Data)	Blue	RxD (Receive Data)	2
2	RxD (Receive Data)	White	TxD (Transmit Data)	3
3	CTS (Clear To Send)	Brown	RTS (Request To Send)	7
4	RTS (Request To Send)	Yellow	CTS (Clear To Send)	8
5	DTR (Data Terminal Ready)	Green	DTR (Data Terminal Ready)	4
6	RS232/422-485	Orange	Open	
7	Gnd (ground)	Black	Gnd (ground)	5
8	Vcc (6 to 40V)	Red	Vcc (6 to 40V)	

- **Case of RS-422/485 (FULL DUPLEX):**

Connector (8 points)	Name Terminal Side	Color	Name Automate Side
1	Z or Tx- (Transmit Data)	Blue	B or Rx- (Receive Data)
2	A or Rx+ (Receive Data)	White	Z or Tx+ (Transmit Data)
3	B or Rx- (Receive Data)	Brown	Y or Tx- (Transmit Data)
4	Y or Tx+ (Transmit Data)	Yellow	A or Rx+ (Receive Data)
5	DTR	Green	Open
6	RS232/422-485	Orange	Gnd
7	Gnd (ground)	Black	Gnd (ground)
8	Vcc (6 to 40V)	Red	Vcc (6 to 40V)

- **Case of the RS-485 (HALF DUPLEX):**

Connector (8 points)	Name Terminal Side	Color	Name Automate Side
1	B (Data-)	Blue	B (Data-)
2	open	White	Open
3	open	Brown	Open
4	A (Data+)	Yellow	A (Data+)
5	DTR	Green	Open
6	RS232/422-485	Orange	Gnd
7	Gnd (ground)	Black	Gnd (ground)
8	Vcc (6 to 40V)	Red	Vcc (6 to 40V)

CHAPTER IV. ANNEXES

IV.1. Terminals' Installation: Principles and cautions

➢ You must use the power supply and serial cable provided by Telit with the terminal. Take care of the polarity for the power supply connection (red wire +Vcc, black wire GND).

➢ The ON/OFF switching capability of the power supply is external to the terminal.

➢ The radio environment should be closely studied prior to any installation with a spectrum analyzer in order to determine whether and where the installation will be optimal.

➢ In case of outdoor installations, IP casings are recommended.

➢ In case of a ceiling installation, the terminal should be mounted upside down for a better radiation

➢ A 1 m distance between two terminals should be respected under 25mW power output, at least 2 m at 100mW and 3m at 500mW.

➢ The terminals should be located as high and as free as possible so that a line of sight propagation is established between terminals.

➢ The terminal should not be surrounded by metallic masses because of the disturbances caused by a reflection phenomena.

➢ The electrical disturbances can come from various sources and should be avoided

  o Engines
  o High current devices
  o Power relays, transformers
  o Etc...

➢ The radio disturbances should also be avoided:

  o System in the same frequency band such as cars remote control systems.
  o Systems in a nearby frequency band such as high power (2 W) talkie-walkie systems.

➢ Vibrations and/or shocks can also be source of disturbances. It is therefore advised to mount the terminals in silent-blocks in order to stabilize it whenever necessary.

➢ Distances, obstacles and weather conditions can strongly affect radio communications and cause disturbances as well as communication breakdowns.

IV.2. Connection to a RS422 or RS485 interface

LT70-868 terminal is configured in RS232 mode by default (S215=0): it allows connect it directly on a PC serial port.
To configure the terminal in RS422 or RS485 mode:

- ↳ Go to Hayes Mode and configure S215 Register:
  - set to '1' for RS422
  - set to '2' for RS485 Half Duplex
  - set to '3' for RS485 Full Duplex

- ↳ Power Off the terminal.

- ↳ Connect RS485 or RS422 serial link to the terminal.

- ↳ Connect RS232-485 pin to GND or set RS232/485 switch to RS485 side.
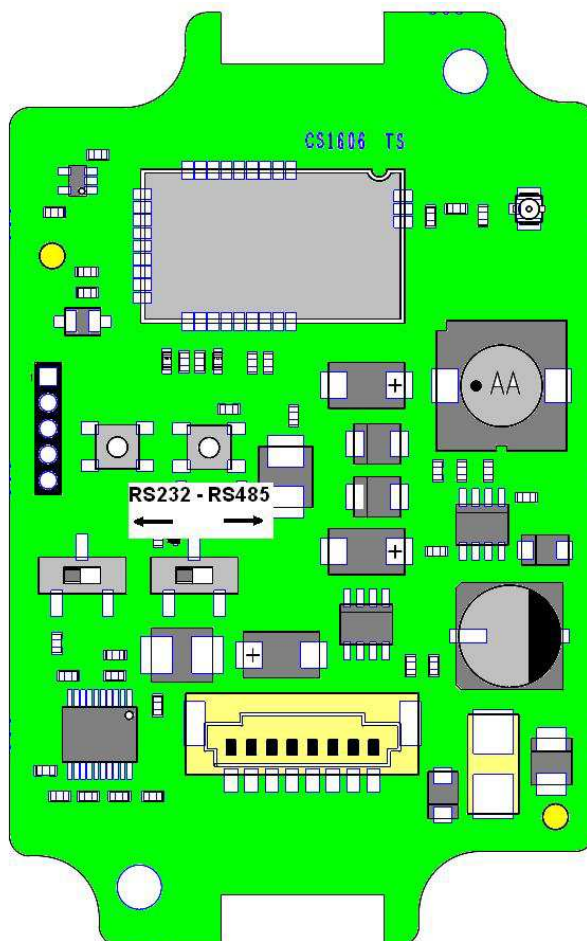
- ↳ Power On the terminal.

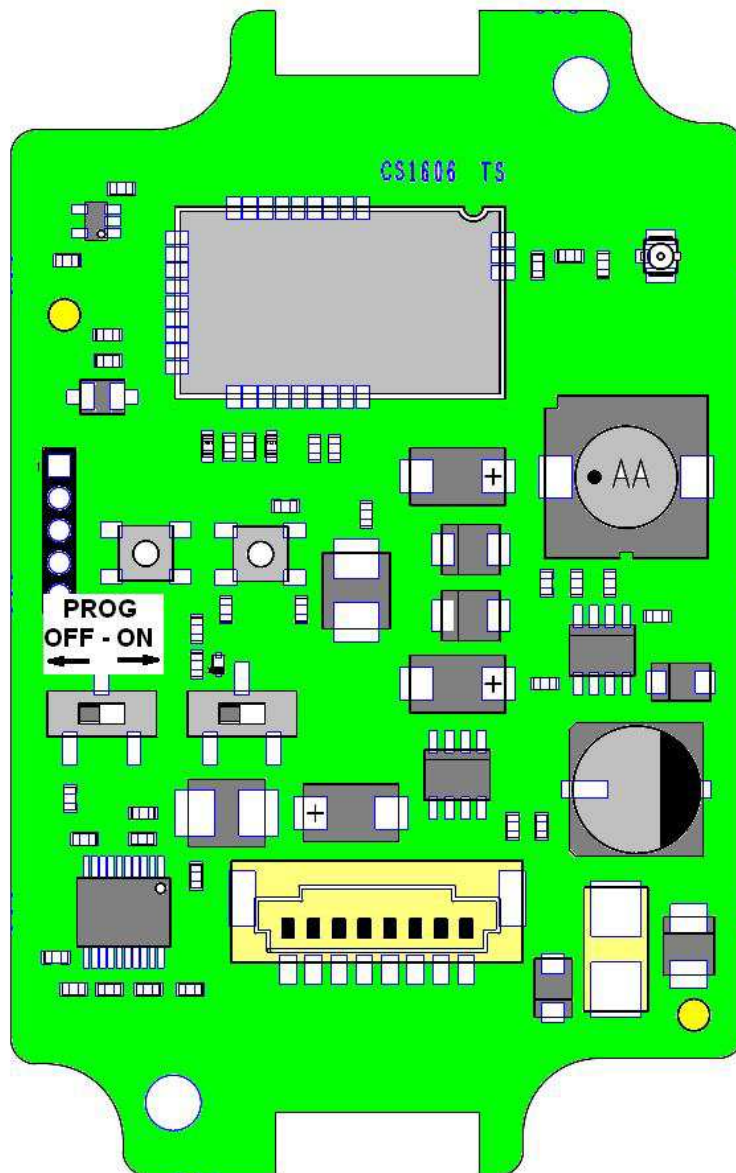N.B.: if you power off the board and set RS232-485 pin open, RS485/RS422 is inactivate and RS232 is activate.

IV.3. Terminal reflashing

LT70-868 terminals are re-flashable through the serial link.

In order to re-flash the terminal, switch off the power supply, open the casing, put the "PROG" switch on "ON" position, and switch on the power supply. Refer to its SR Manager Tool User Guide (**[6]**) for detailed explanation.

IV.4. ETSI 300 220-2 Version 2.4.1 standards (summary)

Limits allowed by ETSI standard			
Transmission			
Frequency error	+/- 12.5 kHz @ 25 kHz channelization +/- 87 kHz (+/-100 ppm) > 25 kHz channelization		
ACP for channels ≤ 25 kHz	- 37 dBm in 16 kHz "receiver" filter BW under normal test conditions - 32 dBm in 16 kHz "receiver" filter 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 dBm (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	Minimum offset between wanted and unwanted signals	
	+/-2 MHz	15 kHz	≥ 35 dB	
		25 kHz	≥ 33 dB	
		81 kHz	≥ 28 dB	
		122 kHz	≥ 26 dB	
	+/-10 MHz	15 kHz	≥ 60 dB	
		25 kHz	≥ 58 dB	
		81 kHz	≥ 53 dB	
		122 kHz	≥ 51 dB	
Spurious radiation	Below 1000 MHz		Above 1000 MHz	
	- 57 dBm (2 nW)		- 47 dBm (20 nW)	

Examples of propagation attenuation

Factor	433 MHz		868 MHz		2.4 GHz	
	Loss	Attenuation	Loss	Attenuation	Loss	Attenuation
Open office	0 %	0 dB	0 %	0 dB	0 %	0 dB
Window	< 5 %	< 1 dB	15 %	1 – 2 dB	30 %	3 dB
Thin wall (plaster)	25 %	3 dB	35 %	3 – 4 dB	50 %	5 – 8 dB
Medium wall (wood)	40 %	4 – 6 dB	50 %	5 – 8 dB	70 %	10 – 12 dB
Thick wall (concrete)	50 %	5 – 8 dB	60 %	9 – 11 dB	85 %	15 – 20 dB
Armoured wall (reinforced concrete)	70 %	10 – 12 dB	80 %	12 – 15 dB	90 %	20 – 25 dB
Floor or ceiling	50 %	5 – 8 dB	60 %	9 – 11 dB	85 %	15 – 20 dB
Armoured floor or ceiling	70 %	10 – 12 dB	80 %	12 – 15 dB	90 %	20 – 25 dB
Rain and/or Fog	90 %	20 – 25 dB	95 %	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.

IV.5. Declarations of Compliance

TBD