# INSTALLATION AND MAINTENANCE MANUAL

# WIRNET IBTS

| | Written by | Approved by | Approved by | Validated by |
|---|---|---|---|---|
| Name | VLO | BLT | SNI | MCH |
| Entity | DRD | DRD | DRD | DRD |
| Date | 30/04/2019 | 30/04/2019 | 30/04/2019 | 30/04/2019 |

# HISTORY

| Date | Modification | Author | Version |
|---|---|---|---|
| 03/17/2016 | Preliminary version | MGI | 0.1 |
| 04/06/2016 | Removed specification part | MGI | 0.2 |
| 06/08/2016 | Updated accessories list | MGI | 0.3 |
| 07/05/2016 | Updates for IEC 60950-1 compliance | MGI | 0.4 |
| 07/11/2016 | Updates for FCC and IC certification | MGI | 0.5 |
| 08/30/2016 | Minor updates after internal review | MGI | 0.6 |
| 09/08/2016 | Updated regulation section | MGI | 0.7 |
| 10/01/2017 | Remove all references to DIN rail<br>Add draft chapter for WAN module Dual SIM version | PTA | 0.8 |
| 11/01/2017 | New POE injector references<br>Power supply recommendations<br>WAN dual SIM (additional information) | SNI | 0.9 |
| 20/02/2017 | Update of WAN module Dual SIM version | PTA | 0.10 |
| 08/03/2017 | Dual WAN module adding<br>LoRa Link lightning protection recommendations | SNI | 0.11 |
| 13/03/2017 | Official version | SNI | 1.0 |
| 15/05/2017 | Completed Dual WAN module and LoRa Link lightning protections,MC7430 and cavity filters<br>Updated Certifications | MGI | 1.1 |
| 25/07/2017 | Updated certifications, cavity filters, insertion of modules and ON/OFF button | MGI | 1.2 |
| 25/04/2018 | Updated LoRa radio performance, certifications, accessories | MGI | 1.3 |
| 25/04/2018 | Added NBTC certification (Thailand)<br>Added Wirnet iBTS 64 Highway | MGI | 1.4 |
| 15/10/2018 | Amend spectrum analysis possibility (§3); adapt §4.8.4 to | BCA | 1.5 |

| | | | |
|---|---|---|---|
| | web interface configuration (with screenshot); fix web interface reference in §4.8.3 and §5.3.4<br><br>Updates Mechanical implementation (§1.3) | SNI | |
| 04/12/2018 | Official version | SNI | 2.0 |
| 30/04/2018 | Rename FDx in 64 Highway<br>Updates certification | VLO | 2.1 |
| | | | |


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## FIGURES

# REFERENCES

| Reference | Document / link | Description |
|---|---|---|
| [1] | https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers | LoRaWAN™ Specification V1.0.3 2018 March 19th |
| [2] | https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers | LoRaWAN™ 1.1 Regional Parameters Revision B, 2018 January |
| [3] | | E-CON-Product_Description_Wirnet_iBTS-V1.4.docx |
| [4] | https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers | LoRaWAN™ Regional Regulation Summary Version 1.5 draft 8 February 12th, 2018 |


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## GLOSSARY

| Abbreviation | Description |
|---|---|
| **ADC** | Analog to Digital Converter |
| **AES** | Advanced Encryption Standard |
| **AGC** | Automatic Gain Control |
| **AMR** | Automatic Meter Reading |
| **ANATEL** | Agência NAcional de TELecomunicações (Brazilian agency of telecommunications) |
| **AP** | Access Point |
| **APAC** | Asia PACific |
| **APC** | Automated Power Control |
| **API** | Application Programming Interface |
| **APN** | Access Point Name |
| **ARM** | Advanced RISC Machine |
| **BER** | Bit error Rate |
| **BLER** | Block Error rate |
| **BTS** | Base Transceiver Station |
| **BW** | Band Width |
| **CAN** | Control Area Network |
| **CDMA** | Code Division Multiple Access |
| **CMOS** | Complementary Metal Oxide Semiconductor |
| **CPU** | Central Processing Unit |
| **DAC** | Digital to Analog Converter |
| **DDR** | Double Data Rate |
| **DDRAM** | Double Data Rate RAM |
| **DHCP** | Dynamic Host Configuration Protocol |
| **DIN** | Deutsches Institut für Normung (German Institute for Standardization) |
| **DOTA** | Download Over The Air |
| **DSP** | Digital Signal Processor |
| **DVFS** | Dynamic Voltage and Frequency Scaling |
| **EDGE** | Enhanced Data rates for GSM Evolution |
| **EIRP** | Equivalent Isotropically Radiated Power |
| **EMC** | ElectroMagnetic Compatibility |
| **eMMC** | Embedded Multi Media Card |
| **FCC** | Federal Communications Commission |
| **FER** | Frame Error Rate |
| **FPGA** | Field Programmable Gate Array |
| **FTP** | File Transfer Protocol |
| **GNSS** | Global Navigation Satellite System |


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| | |
|---|---|
| **GMSK** | Gaussian Minimum Shift Keying |
| **GPIO** | General Purpose Input Output |
| **GPRS** | General Packet Radio Service |
| **GPS** | Global Positioning System |
| **GSM** | Global System for Mobile communication |
| **HSPA** | High Speed Packet Access |
| **HTTP** | HyperText Transfer Protocol |
| **IC** | Integrated Circuit or Industry Canada |
| **IK** | Mechanical Impact |
| **IO** | In / Out |
| **IoT** | Internet of Things |
| **IP** | Internet Protocol or Ingress Protection |
| **IrDA** | Infrared Data Association |
| **ISM** | Industrial Scientific and Medical |
| **I2C** | Inter Integrated Circuit |
| **I2S** | Inter IC Sound |
| **KLK** | KERLINK |
| **KNET** | KERLINK M2M network |
| **LBT** | Listen Before Talk |
| **LDO** | Low Drop Out |
| **LED** | Light-Emitting Diode |
| **LNA** | Low Noise Amplifier |
| **LoRa** | Long Range |
| **LSZH** | Low Smoke Zero Halogen |
| **LTE** | Long Term Evolution |
| **LUT** | Look Up table |
| **LVDS** | Low Voltage Differential Signaling |
| **M2M** | Machine to Machine |
| **MIPS** | Millions of Instructions Per Second |
| **MFLOPS** | Million FLoating-point Operations Per Second |
| **NFS** | Network File System |
| **NMEA** | National Marine Electronics Association |
| **PA** | Power Amplifier |
| **PC** | Personal Computer or Polycarbonate |
| **PCB** | Printed Circuit Board |
| **PCI** | Peripheral Component Interconnect |
| **PER** | Packet Error Rate |
| **PLL** | Phase Locked loop |
| **PoE** | Power over Ethernet |

| | |
|---|---|
| **PU** | Polyurethane |
| **RAM** | Random Access Memory |
| **RF** | Radio Frequency |
| **RSSI** | Received Signal Strength Indicator |
| **RTC** | Real Time Clock |
| **RX** | Receive |
| **SAW** | Surface Acoustic Wave |
| **SDIO** | Secure Digital Input Output |
| **SI** | Système d'Information |
| **SIM** | Subscriber Identity Module |
| **SMA** | SubMiniature version A |
| **SMB** | SubMiniature version B |
| **SNR** | Signal to Noise Ratio |
| **SPDT** | Single Pole Double Throw |
| **SPI** | Serial Peripheral Interface bus |
| **SSH** | Secure Shell |
| **SSTP** | Screened Shielded Twisted Pair |
| **STP** | Shielded Twisted Pair |
| **TBD** | To Be Defined |
| **TCP** | Transmission Control Protocol |
| **TDOA** | Time Difference On Arrival |
| **TPE** | ThermoPlastic Elastomer |
| **TX** | Transmit |
| **UART** | Universal Asynchronous Receiver Transmitter |
| **UFL** | Miniature coaxial RF connector manufactured by Hirose Electric Group |
| **UICC** | Universal Integrated Circuit Card |
| **UMTS** | Universal Mobile Telecommunications System |
| **USB** | Universal Serial Bus |
| **USIM** | Universal Subscriber Identity Module |
| **UV** | UltraViolet |
| **VLIW** | Very Long Instruction Word |
| **WAN** | Wide Area Network |
| **WLAN** | Wireless Local Area Network |
| **VHF** | Very High Frequency |
| **3G** | Third generation of mobile telecommunications technology |
| **3GPP** | 3rd Generation Partnership Project |
| **4G** | Fourth generation of mobile telecommunications technology |
| **8PSK** | Eight Phase shift Keying |


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# INTRODUCTION

The Wirnet iBTS gateway is part of the global Long Range Radio fixed network to provide M2M connectivity link between low power end-point and Internet access.
The gateway architecture is specifically designed for the needs of public networks operators.

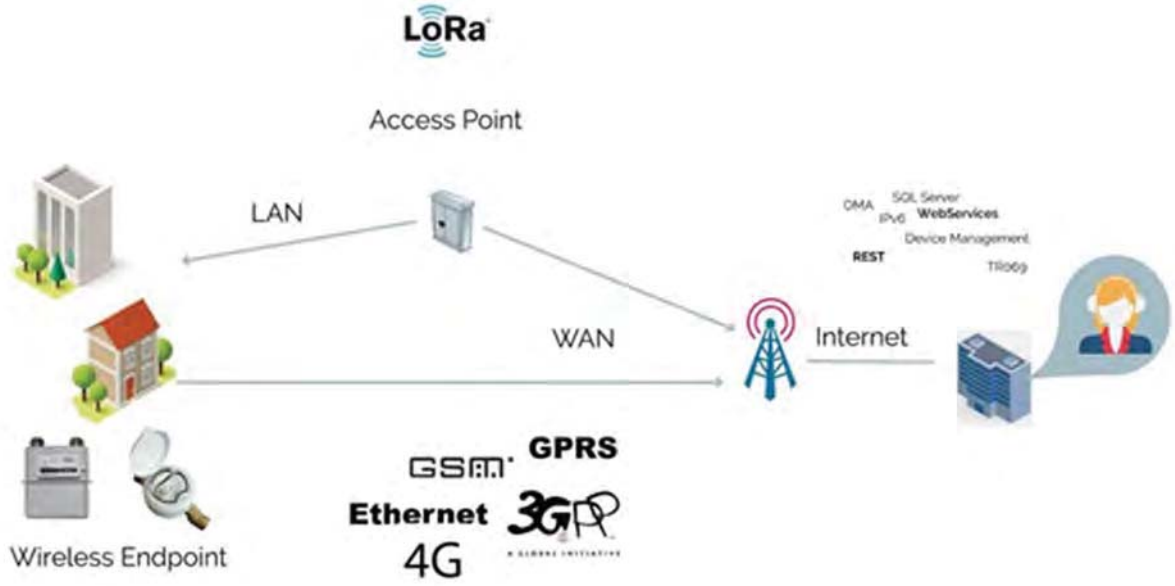


Figure 1: LoRa Network topology

The Wirnet iBTS is based on “Next Generation LoRa” technology provided by Semtech Company. It is compatible and interoperable with existing LoRa LPWAN and offers GPS-free geolocalization features compatibility.
Wirnet iBTS architecture is completely modular and upgradable to offer multiple configurations to cover different countries and areas around the world:

| | Wirnet iBTS 868 | Wirnet iBTS 915 | Wirnet iBTS 64 Highway | Wirnet iBTS 923 |
|---|---|---|---|---|
| **Geographical area** | Europe, Russia<br>Africa<br>Middle East, India | North America<br>Central America<br>South America<br>Philippines | North America | Asia : Indonesia, Malaysia, Korea, Japan, Taiwan, Hong Kong, Thailand, Vietnam, Papua New Guinea, Singapore<br>Oceania : Australia, New Zealand<br>Latin America: Brazil, Argentina, Colombia |
| **ISM band** | 863 - 876 MHz | 902 - 928 MHz | 902 - 928 MHz | 915 - 928 MHz |
| **Downstream band** | 863 - 873MHz | 902 - 928 MHz | 923 - 928 MHz | 919 - 928 MHz |
| **Upstream band** | 863 - 873 MHz | 902 - 928 MHz | 902 - 915 MHz | 915 - 928 MHz |

| | | | | |
|---|---|---|---|---|
| **WWAN capabilities** | LTE B1, B3, B7, B8 and B20<br>HSPA B1, B2, B5 and B8<br>GSM/GPRS/EDGE 850, 900, 1800 and 1900 | LTE B2, B4, B5, B13, B17 and B25<br>CDMA BC0, BC1 and BC10<br>HSPA B1, B2, B4, B5 and B8<br>GSM/GPRS/EDGE 850, 900, 1800 and 1900 | LTE B2, B4, B5, B13, B17 and B25<br>CDMA BC0, BC1 and BC10<br>HSPA B1, B2, B4, B5 and B8<br>GSM/GPRS/EDGE 850, 900, 1800 and 1900 | LTE B1, B3, B5, B7, B8, B18, B19, B20, B21, B28, B38, B39, B40 and B41<br>HSPA B1, B2, B5, B6, B8, B9 and B19<br>TD-SCDMA B39<br>GSM/GPRS/EDGE 850, 900, 1800 and 1900 |
| **Certifications** | CE (Europe)<br>WPC (India) | FCC (USA)<br>IC (Canada)<br>CB scheme for : Philippines, Mexico, Chile, Colombia | FCC (USA)<br>IC (Canada) | ACMA (Australia, New-Zealand)<br>MIC (Japan)<br>OFCA (Hong-Kong)<br>CB scheme for : Thailand, Korea, Singapore, Indonesia, Malaysia, Brazil, Argentina |
| **Filters for installation in already existing telco-area** | Usage in India requires a specific cavity filter for coexistance with CDMA800 | Not able to share the same installation site with GSM900/HSPA900/LTE900 BTS (if necessary, use a specific cavity filter)<br>Usage in Philippines requires a specific cavity filter. | Embedded cavity duplexer<br>Not able to share the same installation site with GSM900/HSPA900/LTE900 BTS | Usage in Singapore, Hong-Kong and Malaysia requires a specific cavity filter. |

Please check the appropriate version for the dedicated country. Contact KERLINK if required.

The present document addresses all the above Wirnet iBTS versions.

# 1. Description of the Wirnet iBTS

## 1.1 Modular architecture

The Wirnet iBTS has a modular architecture allowing the operator to configure and upgrade the gateway to fulfill its needs.
Thanks to the modularity the operator is able to choose:

- The backhaul network: Ethernet or GPRS/EDGE/HSPA/CDMA/LTE
- The unlicensed band (ISM) where to operate the LoRa LPWAN: 863-873MHz (aka 868MHz), 902-928MHz (aka 915MHz)or 915-928MHz (aka 923MHz)
- The number of channels to operate the LoRa LPWAN: 8 to 64
- The antenna interface: single (omnidirectional), dual (space diversity or dual polarization) or tri (sectorization)

Four different modules can be integrated in the Wirnet iBTS:

- CPU Module, which includes the main following features:
  - Power management of the Wirnet iBTS
  - CPU
  - Memories
  - GNSS receiver (GPS)
- WAN Module, which provides the backhaul functionality:
  - Backup battery
  - 4G modem declined in 3 versions depending on the geographical area:
    - Europe
    - Americas
    - APAC
- LoRa module – LoRa LOC, which can be also derived in 4 versions :
  - 868MHz (863-873MHz)
  - 915MHz (902-928MHz)
  - 915MHz 64 Highway (902-915MHz uplink, 923-928MHz downlink)
  - 923MHz (915-928MHz)

The Wirnet iBTS can integrate from one to four « LoRa modules ». In this particular “4 LoRa modules” configuration, a specific “front-end” board and mechanical lid are used to combine the four “LoRa modules” together (see §1.4.3 for further details).
In its maximum size configuration, the Wirnet iBTS can then integrate six modules: one “CPU module”, one “WAN module” and four “LoRa modules”.

The Figure 2 below shows an external view of the Wirnet iBTS:


Figure 2: Wirnet iBTS external view

The Figure 3 below shows an internal view of the Wirnet iBTS, featuring three “LoRa modules”, one “CPU module” and one “WAN module”:

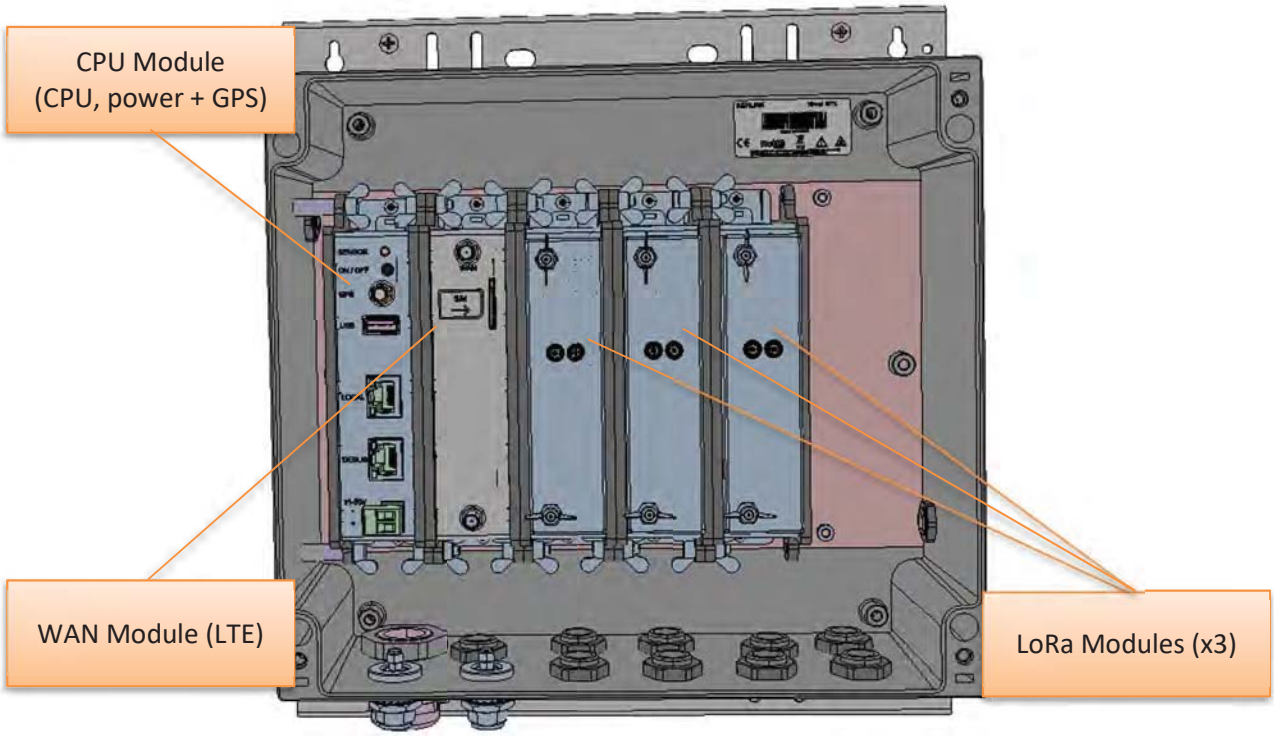


Figure 3: Wirnet iBTS internal view

A dual cavity (or simple) duplexer is embedded in the Wirnet iBTS 64 Highway above the other modules
The Figure 4 below shows an internal view of the Wirnet iBTS 64 Highway, featuring three "LoRa modules", one "CPU module" one "WAN module" and the dual duplexer:

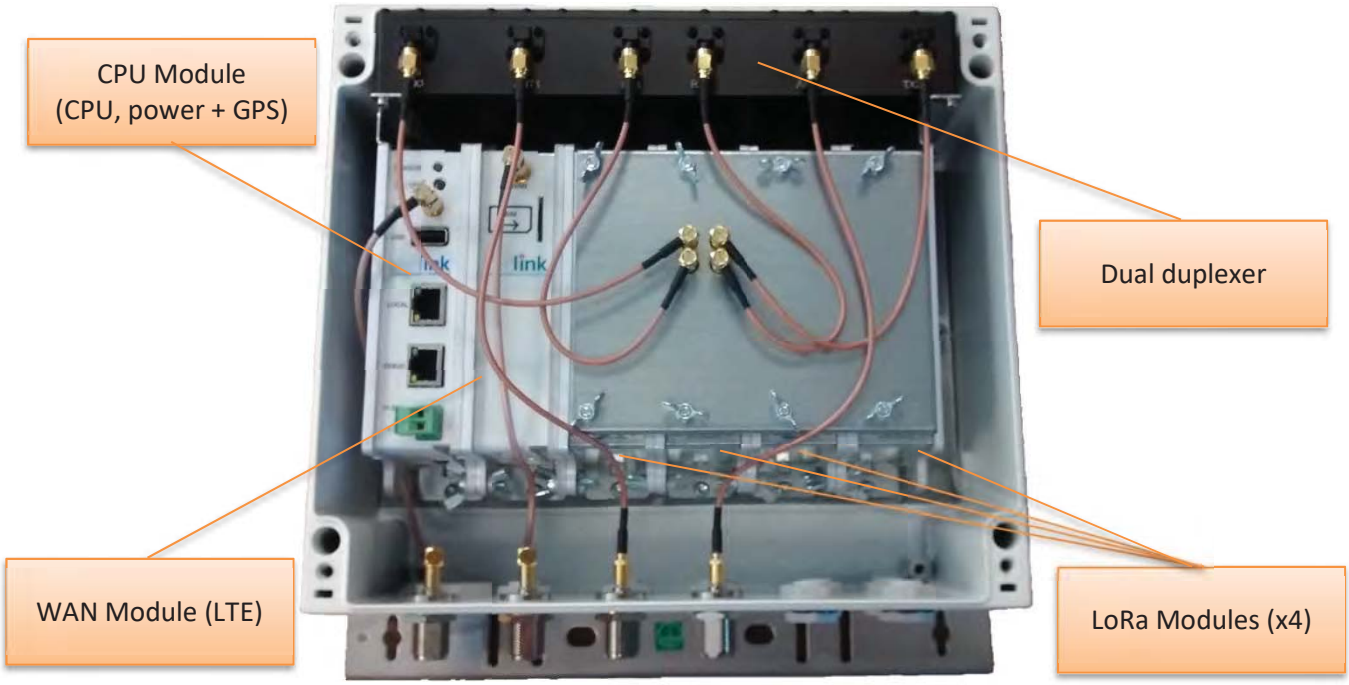


Figure 4: Wirnet iBTS 64 Highway internal view

As part of the Wirnet iBTS modularity, many accessories can be provided for configuration purpose:

- GNSS antennas
- LTE antennas
- LoRa antennas
- RF cavity filters
- PoE injectors
- Surge protections

The full list of accessories is detailed in §1.8 and §6.

## 1.2 Mechanical implementation for standard casing

### *1.2.1 Standard casing*

The Wirnet iBTS station is built on a robust IP66 aluminum enclosure of 280 x 250 x 120 mm. It is composed of two separated parts: the frame and a lid. The lid tightens to the frame trough M5 screws, hidden by two plastic clip-on design covers.

A mounting kit is screwed on the back of the enclosure, allowing several mounting configurations: wall mount, pole mount and metallic strapping.

The left and right sides of the enclosure integrate two waterproof screw-in vents to equalize the pressure inside and outside. This reduces condensation by allowing air to flow freely into and out of the sealed enclosure. At the same time, they provide a durable barrier to protect the internal modules from contaminants like dust, sand, water, etc … improving reliability, safety and longer product life.

The bottom side of the enclosure is dedicated for the connectors:

- 1 x M25 cable gland used to introduce the Ethernet cable (PoE) inside the enclosure
- 3 x N-SMB adapters used as RF interfaces for the antennas:
  - 1 for GNSS antenna (GPS)
  - 1 for WAN antenna (GSM/HSDPA/LTE)
  - 1 for LoRa antenna. The number of LoRa antenna interfaces can be extended to 6.
- 8 x M16 blind stops. They are considered as provisions for N-SMB connectors to be used for additional antennas (LoRa or WAN) or external power supply cable gland.

Blind threaded standoffs are inserted in the rear side the enclosure. They are used to screw and maintain the modules inside the enclosure. The modules can be easily inserted and extracted for maintenance and upgradability purposes.

The Figure 5 below shows the different components inside the enclosure.

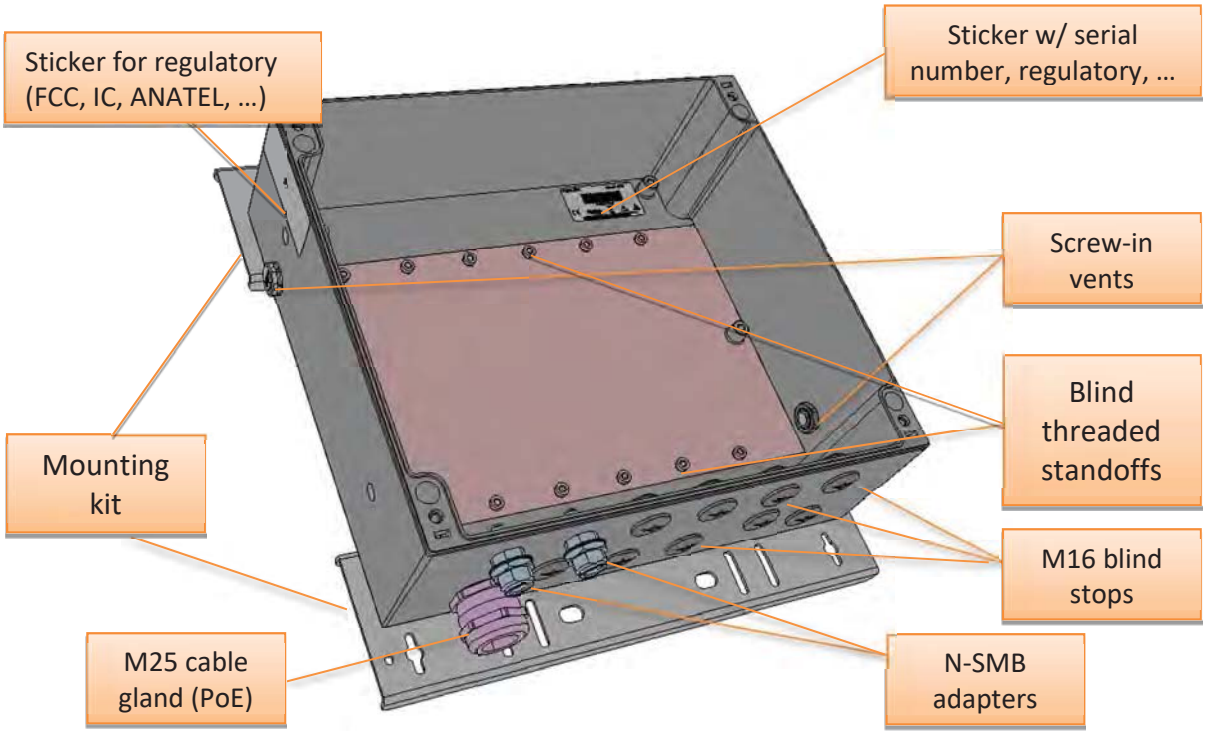


Figure 5: Enclosure internal view

The main characteristics of the enclosure are detailed hereafter:

| Description | Specification |
|---|---|
| **Enclosure material** | Aluminum |
| **Gasket material** | TPE |
| **Mounting kit material** | Stainless steel |
| **Color** | RAL 9010 |
| **Dimensions with connectors** | 300 x 280 x 120 mm |
| **Dimensions with connectors + mounting kit** | 300 x 320 x 125 mm |
| **Weight – no modules** | 5.4 Kg |
| **Weight – 3 modules configuration** | 7.2 Kg |
| **Weight – 64 Highway version** | 10Kg |
| **Ingress protection** | IP66 / EN 60529 |
| **Humidity** | 95% non-condensing |
| **Impact resistance** | IK08 |
| **Flammability rating** | UL94-V0 |
| **Number of pressure equalizer** | 2 |
| **Enclosure temperature range** | -40°C to +120°C |
| **Wirnet iBTS operating temperature range** | -20°C to +55°C |
| **Connectors** | 1 x M25 cable gland (PoE)<br>3 x N-SMB adapters (extension to 11 max)<br>8 x M16 blind stops (provisions for N-SMB or cable gland) |

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The modules are screwed on the blind threaded standoffs to build the Wirnet iBTS according to customer requirements.
The modules are tightened all together with two mechanisms:

- the back panel board connectors,
- the wing screws assembling the mechanical sides (radiators) of the modules

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

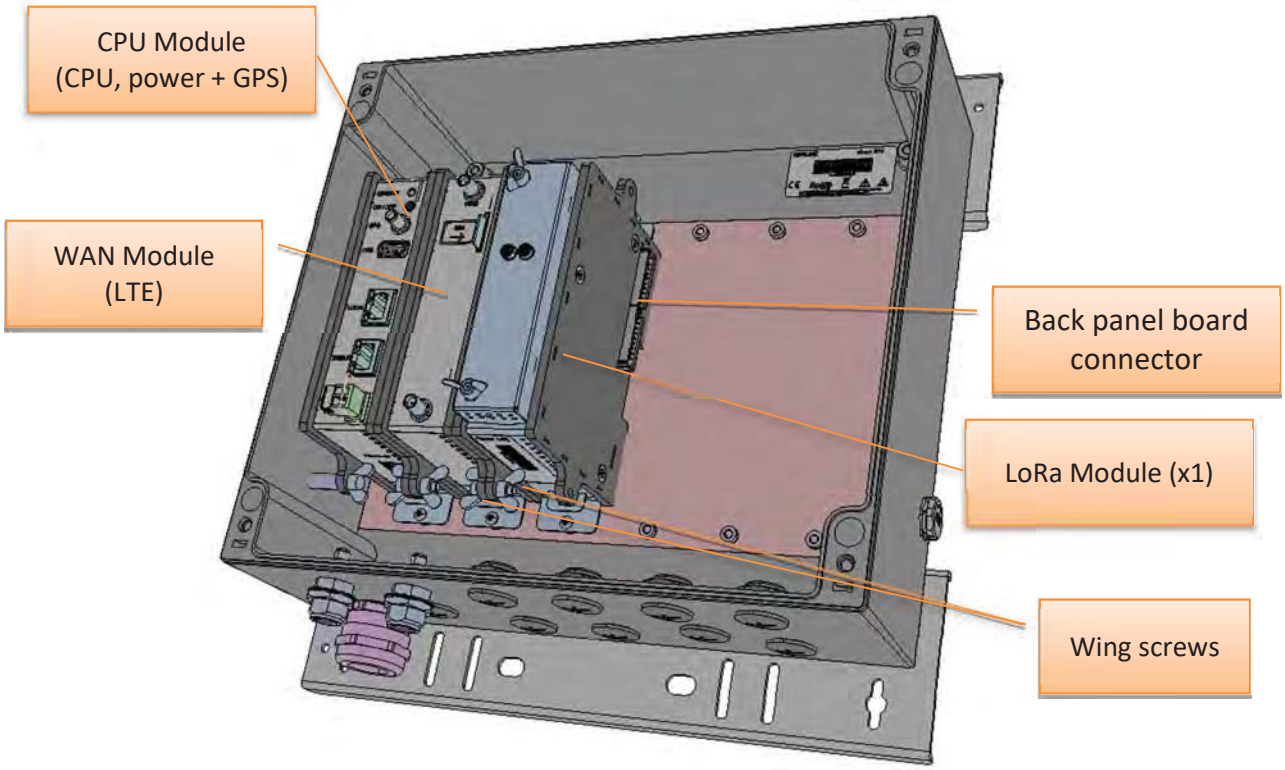


Figure 6: Insertion of the modules inside the enclosure

The modules are also screwed on the blind threaded standoffs to build the Wirnet iBTS 64 Highway.
The dual duplexer is assembled to the modules with a specific mounting kit.

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

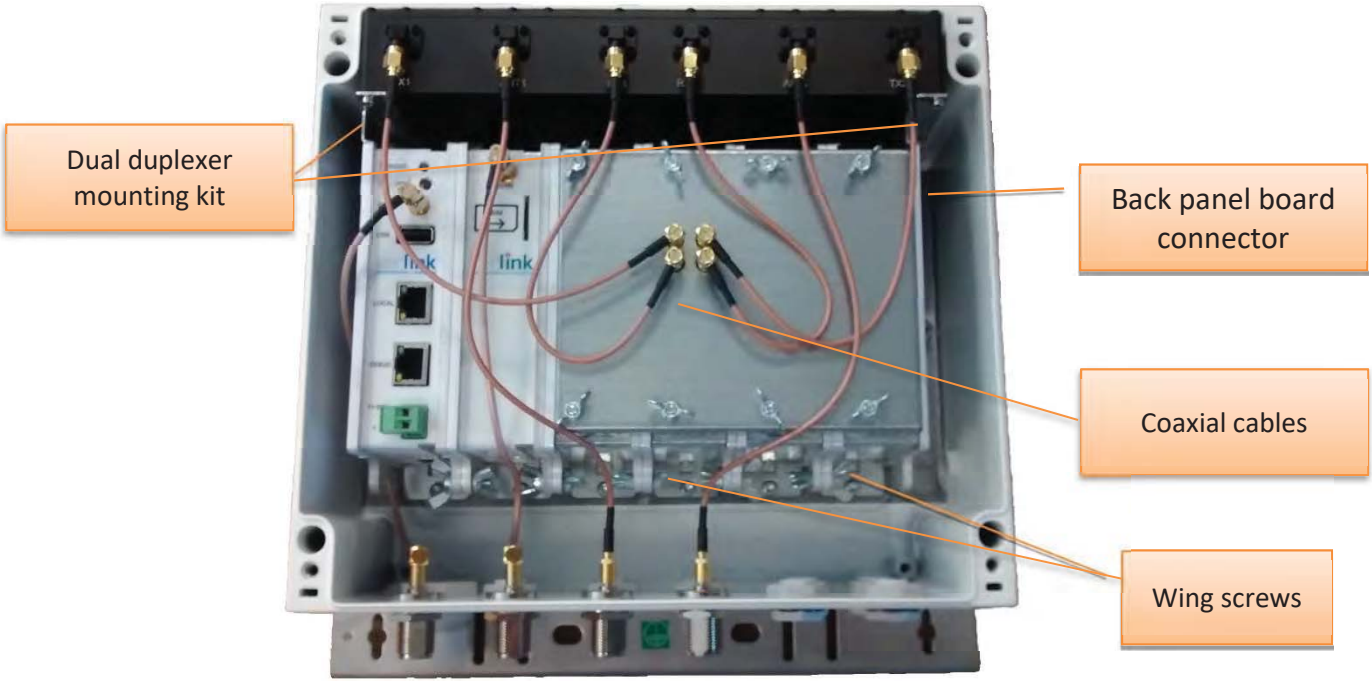


Figure 7: Insertion of the modules inside the enclosure

### *1.2.2 Stickers*

The Wirnet iBTS has two stickers placed inside and outside the casing:

- A sticker on the rear of the Wirnet iBTS enclosure including serial number, regulatory markings and electrical information.
- A sticker outside the enclosure including regulatory marking, logo and sentences depending on the countries (FCC, IC, ANATEL, etc …).

The placement of the stickers is described on Figure 5.

## 1.3 Mechanical implementation for compact casing

### *1.3.1 Compact casing*

The Wirnet iBTS Compact station is built on a high impact resistant IP67 polycarbonate wall mounting cabinet that withstands harsh industrial and outdoor environments.
It offers excellent flammability rating, good UV resistance and also good chemical resistance.
The dimensions of the cabinet are 260 mm x 170 mm x 120 mm.
It is composed of two separated parts: the frame and a lid. The lid tightens to the frame trough two hinges that can be opened or closed by simple clipping. No screws are required but only optional.

A mounting kit, with embedded antenna brackets, is screwed on the back of the enclosure, allowing several mounting configurations: wall mount, pole mount and metallic strapping.

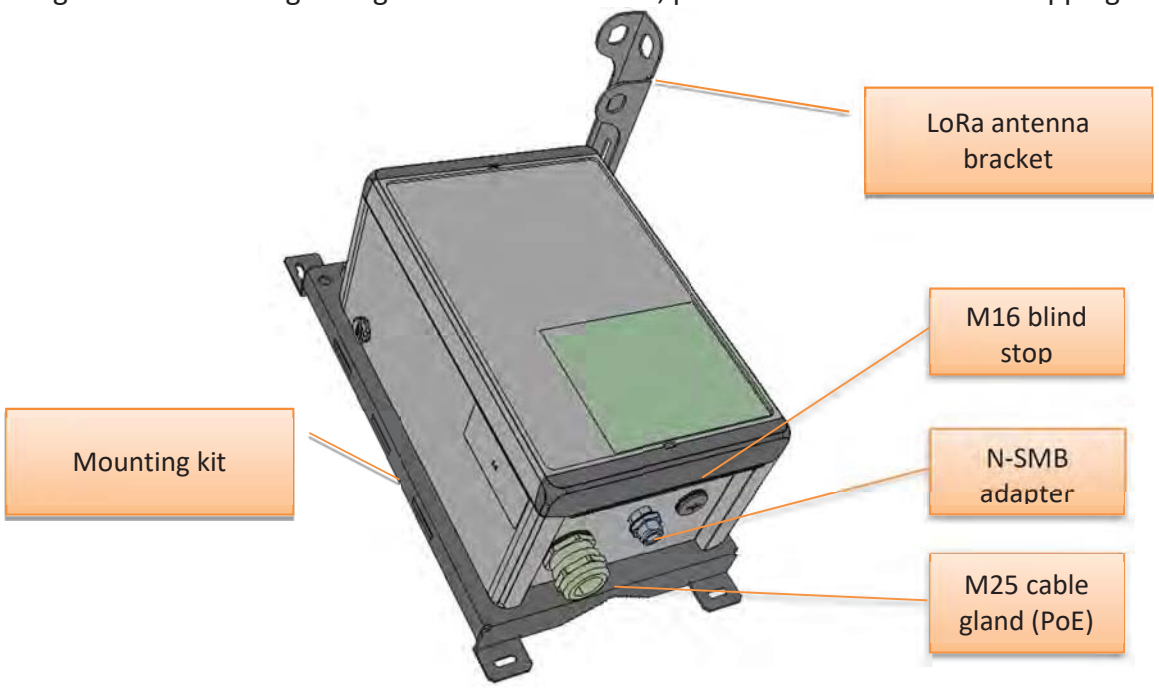


Figure 8: Wirnet iBTS Compact external view

The left and right sides of the enclosure integrate two waterproof screw-in vents to equalize the pressure inside and outside. This reduces condensation by allowing air to flow freely into and out of the sealed enclosure. At the same time, they provide a durable barrier to protect the internal modules from contaminants like dust, sand, water, etc … improving reliability, safety and longer product life.

The bottom side of the enclosure is dedicated for the connectors:

- 1 x M25 cable gland used to introduce the Ethernet cable (PoE) inside the enclosure
- 1 x N-SMB adapters used as RF interfaces for LoRa antenna. The number of LoRa antenna interfaces can be extended to two.

- 1 x M16 blind stop. It is considered as provision for an N-SMB connector to be used for additional LoRa antenna or external power supply cable gland.

An internal metal plate features a GNSS/LTE antenna bracket. An internal GNSS/LTE magnetic mount antenna is placed on this bracket.
Blind threaded standoffs are inserted in the rear side the enclosure. They are used to screw and maintain the modules inside the enclosure. The modules can be easily inserted and extracted for maintenance and upgradability purposes.

The Figure 9 below shows the different components inside the enclosure.

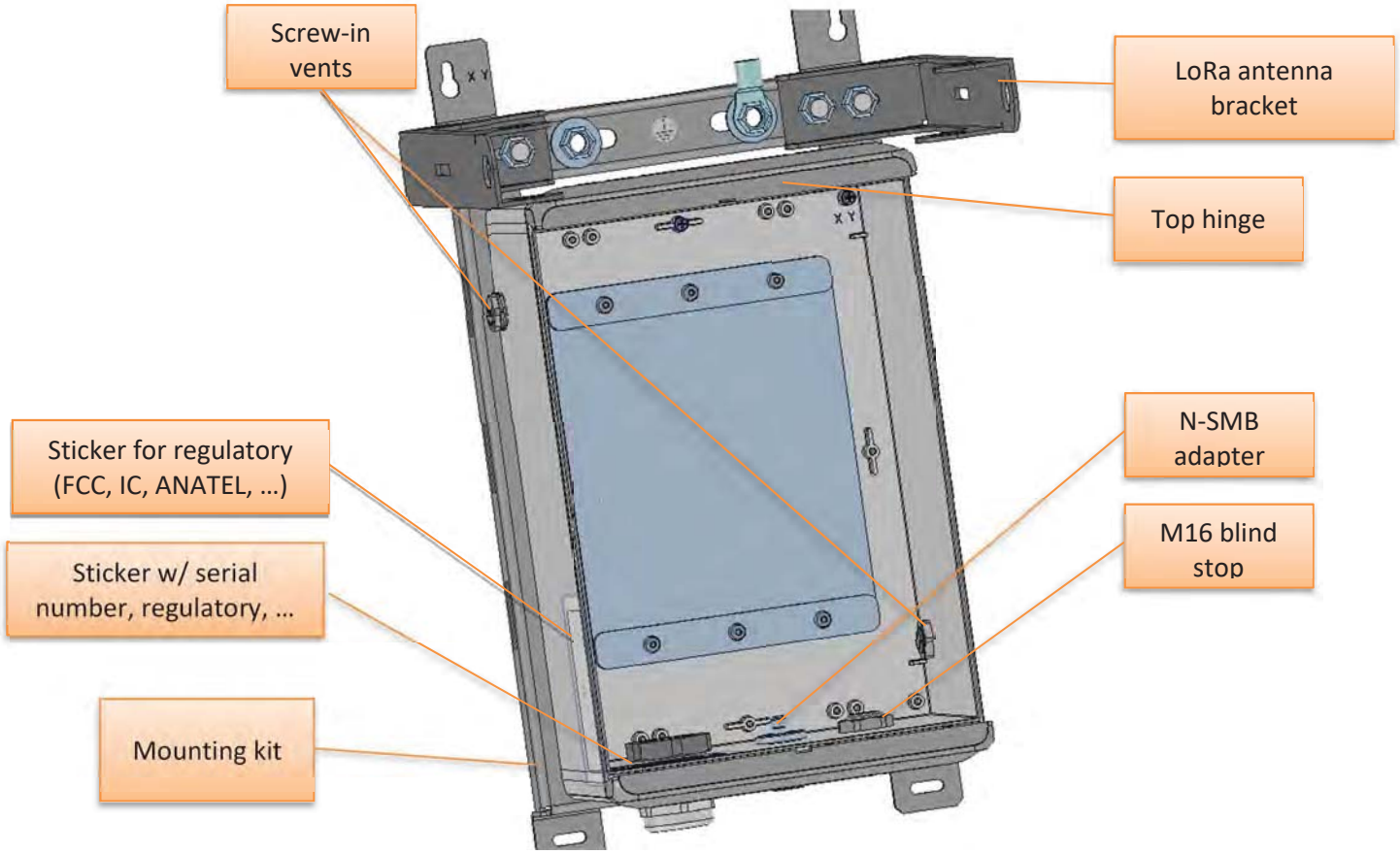


Figure 9 : Wirnet iBTS Compact internal view

The main characteristics of the cabinet are detailed hereafter:

| Description | Specification |
|---|---|
| **Enclosure material** | Polycarbonate (PC) |
| **Gasket material** | Polyurethane (PU) |
| **Mounting kit material** | Stainless steel |
| **Color** | RAL 7035 |
| **Dimensions with connectors** | 280 x 170 x 120 mm |
| **Dimensions with connectors + mounting kit** | 360 x 190 x 150 mm |
| **Weight – 3 modules configuration** | 3 Kg |
| **Ingress protection** | IP66 / EN 60529 |
| **Humidity** | 95% non-condensing |
| **Impact resistance** | IK08 |
| **Flammability rating** | UL94-V0 |
| **Number of pressure equalizer** | 2 |
| **Cabinet temperature range** | -40°C to +105°C |
| **Wirnet iBTS operating temperature range** | -20°C to +55°C |
| **Connectors** | 1 x M25 cable gland (PoE)<br>1 x N-SMB adapters (extension to 2 max)<br>1 x M16 blind stops (provision for N-SMB or cable gland) |

The modules are screwed on the blind threaded standoffs to build the Wirnet iBTS Compact according to customer requirements.
The Wirnet iBTS Compact can embed up to 3 modules.
The modules are tightened all together with two mechanisms:

- the back panel board connectors,
- the wing screws assembling the mechanical sides (radiators) of the modules

SMB-SMB cables are provided to interconnect the RF interfaces of the modules to the SMB-N adapters, on the bottom side of the enclosure.

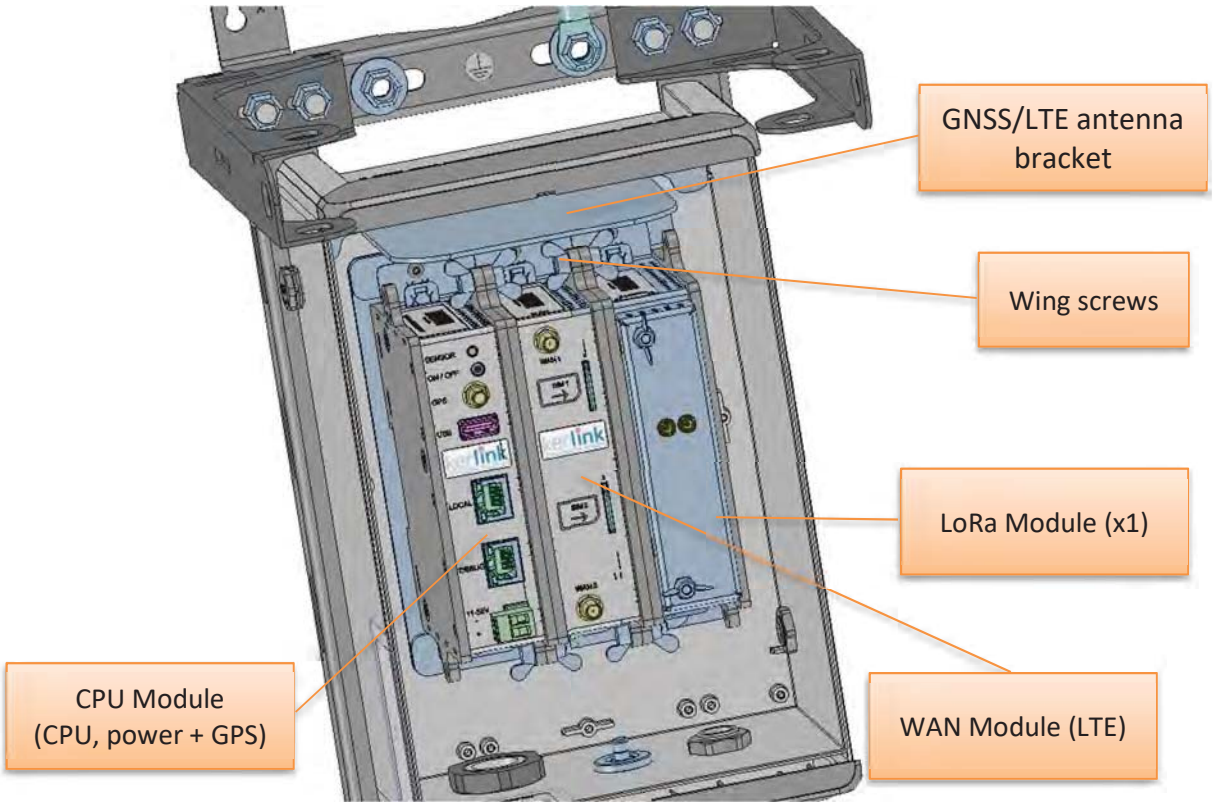


Figure 10: Insertion of the modules inside the cabinet

Depending on Wirnet IBTS compact versions, two kind of internal antennas are used:

- A combo Cellular/GPS antenna with a dedicated internal mounting bracket
- One single GPS antenna and a single cellular Antenna

Performances of both configurations are very similar.

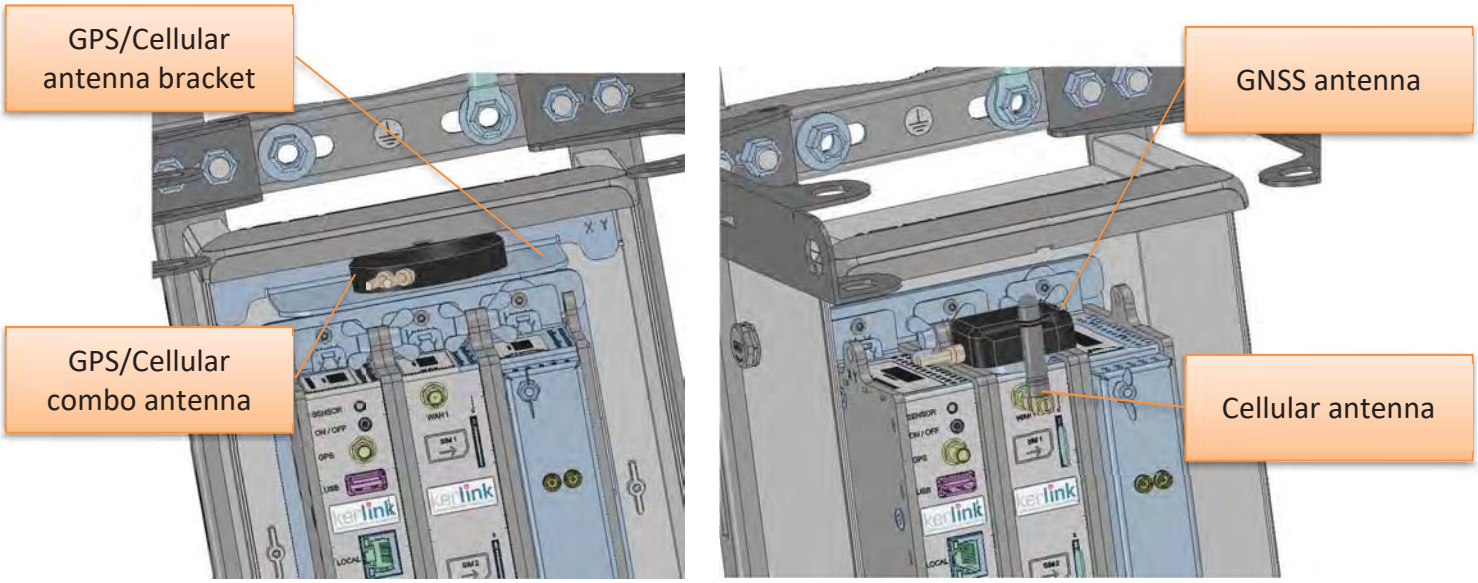


Figure 11: Wirnet iBTS Compact internal antennas

### 1.3.2 Stickers

The Wirnet iBTS Compact has two stickers placed inside and outside the casing:

- A sticker on the bottom of the Wirnet iBTS Compact cabinet including serial number, regulatory markings and electrical information.
- A sticker outside the cabinet including regulatory marking, logo and sentences depending on the countries (FCC, IC, ANATEL, etc …).

The placement of the stickers is described on Figure 9.

## 1.4 Block Diagram

### 1.4.1 Common functionalities

The following figure describes the hardware architecture and basic principles that are common to the many Wirnet iBTS versions. In this particular case, we consider a configuration with one “CPU module”, one “WAN module” (or “Dual WAN module”) and one “LoRa Module”.

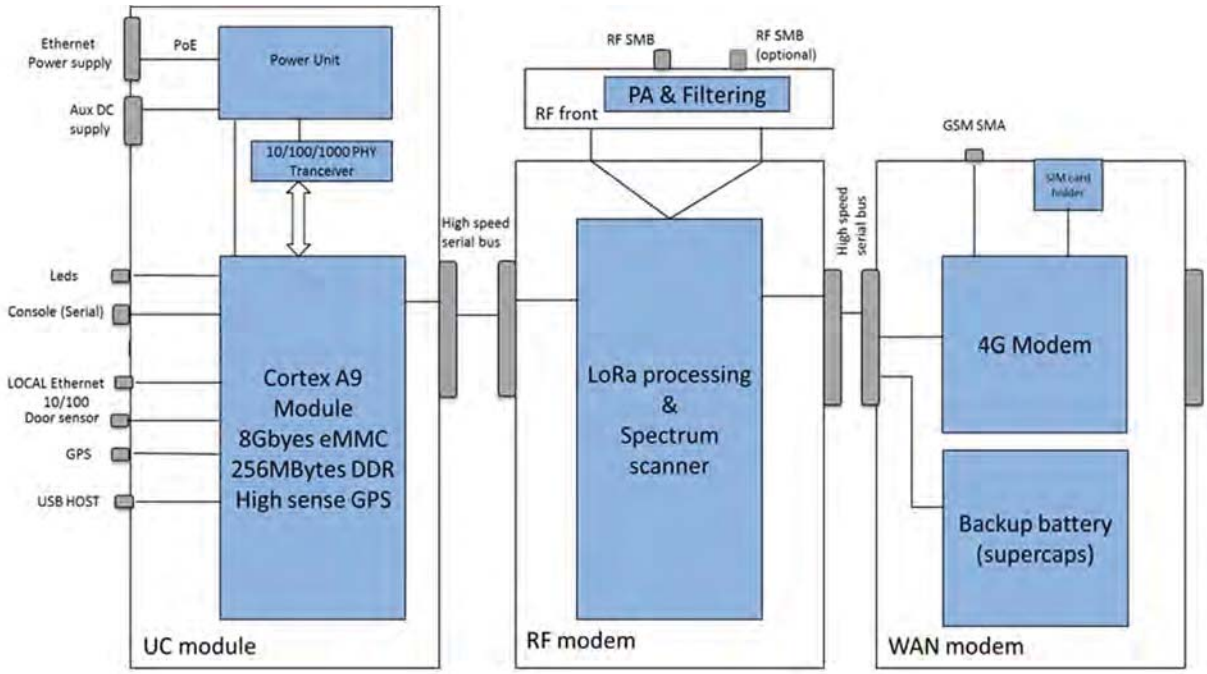


Figure 12: Common Wirnet iBTS block diagram

The Wirnet iBTS is power supplied by a PoE injector through the RJ45 cable.
The RJ45 cable is introduced into the enclosure through the M25 cable gland and connected to the RJ45 connector of the CPU module.
An alternate option of power supply consists in using an auxiliary power supply (11V-55V DC) and connects it to the Euroblock connector of the CPU module.

The CPU Module insures the main followings features:

- Power management unit
- Cortex A9 CPU
- Memories (8GB eMMC and 256Mb DDR)
- GNSS receiver (GPS) with one RF SMA connector to connect the GNSS antenna

The CPU module is connected to the other modules through a back panel board allowing, the management of all the modules inside the Wirnet iBTS.

The “WAN Module” provides the backhaul functionality. It includes:

- Backup battery
- A 4G Mini PCI Express module that can be declined in 3 versions depending on the geographical area:
  - Europe
  - APAC
  - Americas
- The USIM card holder
- A RF SMA connector to connect a LTE antenna
- A 868MHz or 915MHz notch filter to avoid desensitization of the LoRa receivers

The “Dual WAN Module” is an alternative of the “WAN Module”. It provides also the backhaul functionality but includes:

- Backup battery
- Two 4G Mini PCI Express module dedicated to Europe
- Two USIM card holder
- Two RF SMA connectors to connect LTE antennas
- Two 868MHz notch filters to avoid desensitization of the LoRa receivers

The “LoRa modules” can be derived in 4 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 915MHz 64 Highway (902-915MHz uplink, 923-928MHz downlink)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels).

### 1.4.2 Standard version of Wirnet iBTS

The following figure describes the functional architecture for the standard Wirnet iBTS version i.e. including from one to three "LoRa Modules":

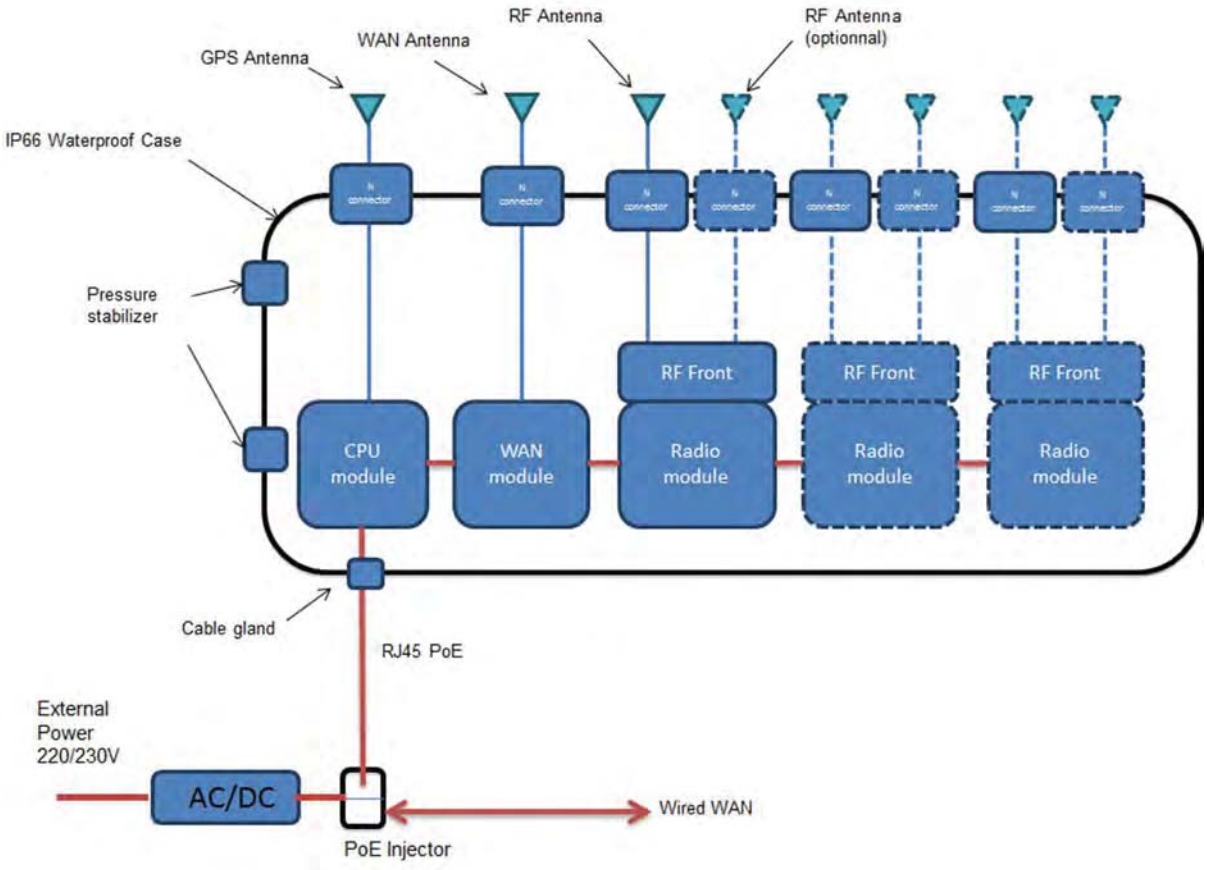


Figure 13: Standard Wirnet iBTS block diagram

The RF front-end board of the "Lora modules" can be derived in 3 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels). This could lead then to a "six LoRa antennas" configurations in the maximum use case (tri-sectors, dual polarization antenna for instance).

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. All antennas are external antennas.

### 1.4.3 *"Four Lora Modules" version of Wirnet iBTS*

The following figure describes the functional architecture for a "4 LoRa modules" version, featuring a maximum of 64 channels.

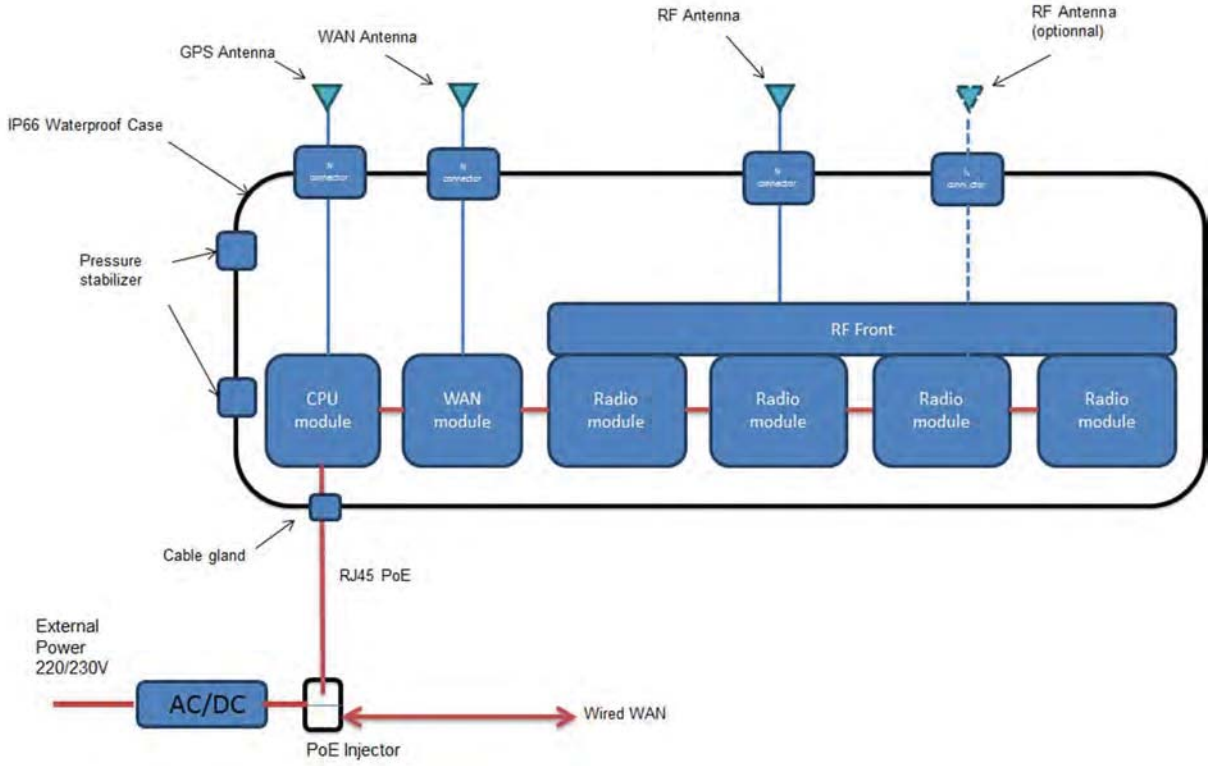


Figure 14: Wirnet iBTS "4 LoRa modules" block diagram

In this particular configuration, the mechanical front-end lids and front-end boards of each individual "LoRa Module" are removed. They are replaced by a bigger RF front end board and front-end lid that combine the 4 LoRa modules together.
This bigger RF front-end board can be derived in 2 bands versions to address different countries:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The 868MHz band is not available in this configuration.
The bigger RF front-end board is configured to support a single antenna (64 channels) or two antennas (2x32 channels).

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. The antennas are all external antennas.

### 1.4.4 Compact version of Wirnet iBTS

The following figure describes the functional architecture of the Wirnet iBTS Compact:

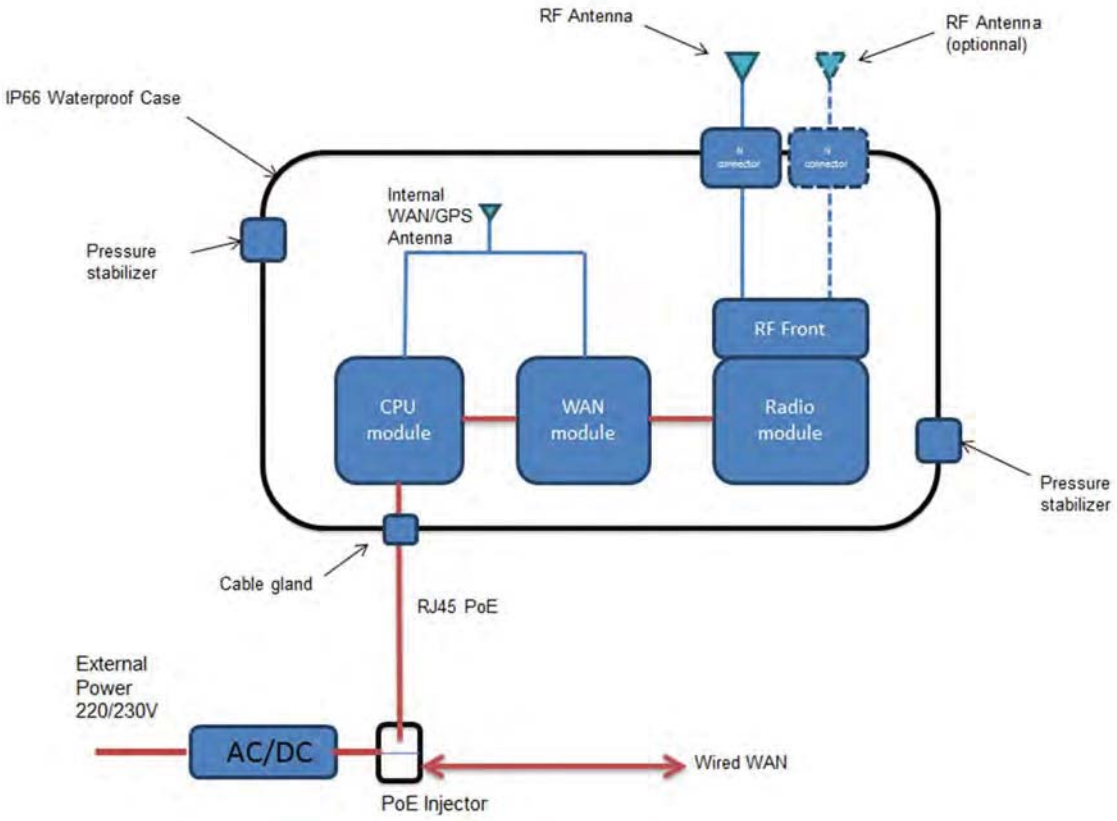


Figure 15: Wirnet iBTS Compact block diagram

The RF front-end board of the “Lora modules” can be derived in 3 bands versions to address different countries:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The RF front-end board is configured to support a single antenna (16 channels) or two antennas (2x8 channels).

The Wirnet iBTS Compact embeds an internal GPS (GNSS) / WAN (LTE) combo antenna compared to external antenna for standard enclosure.

The LoRa connectors are available on the bottom side of the enclosure. The LoRa antennas are external antennas.

### 1.4.5 Wirnet iBTS 64 Highway

The following figure describes the functional architecture of a 64 Highway version, featuring a maximum of 72 Rx channels and 8 Tx channels.

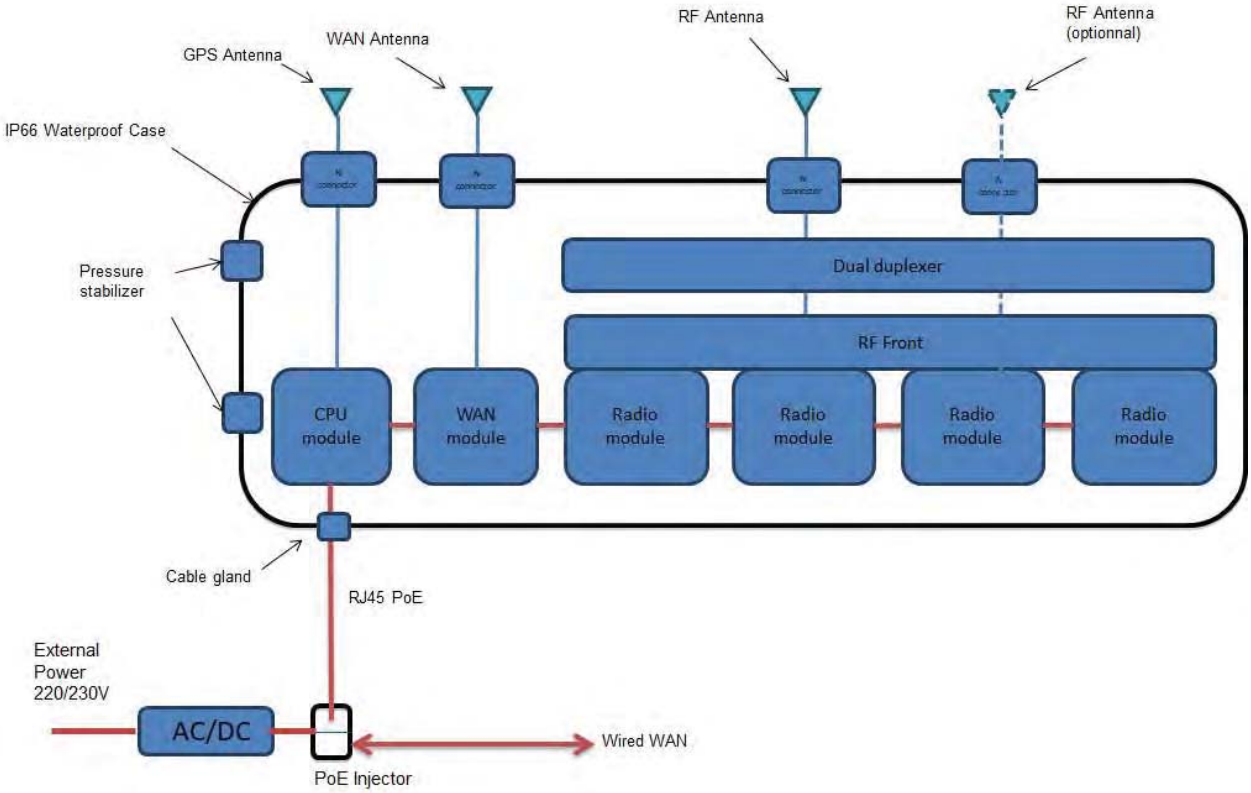


Figure 16: Wirnet iBTS 64 Highway block diagrams

In this particular configuration, the mechanical front-end lids and front-end boards of each individual “LoRa Module” are removed. They are replaced by a bigger RF front end board and front-end lid that combine the 4 LoRa modules together.
The bigger RF front-end board is configured to support a single antenna (72 Rx channels, 4 Tx channels) and two antennas (2x36 Rx channels, 2x4 Tx channels).

A dual cavity (or simple) duplexer is used for RF filtering and duplexing.

The GPS (GNSS) connector, the WAN (LTE) connector and LoRa connectors are available on the bottom side of the enclosure. The antennas are all external antennas.

## 1.5 Description of the modules

### *1.5.1 CPU module*

#### 1.5.1.1 Mechanical description

The CPU module is composed of four main mechanical parts:

- A “three-sides” flange including:
  - the connectors and interfaces placement
  - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

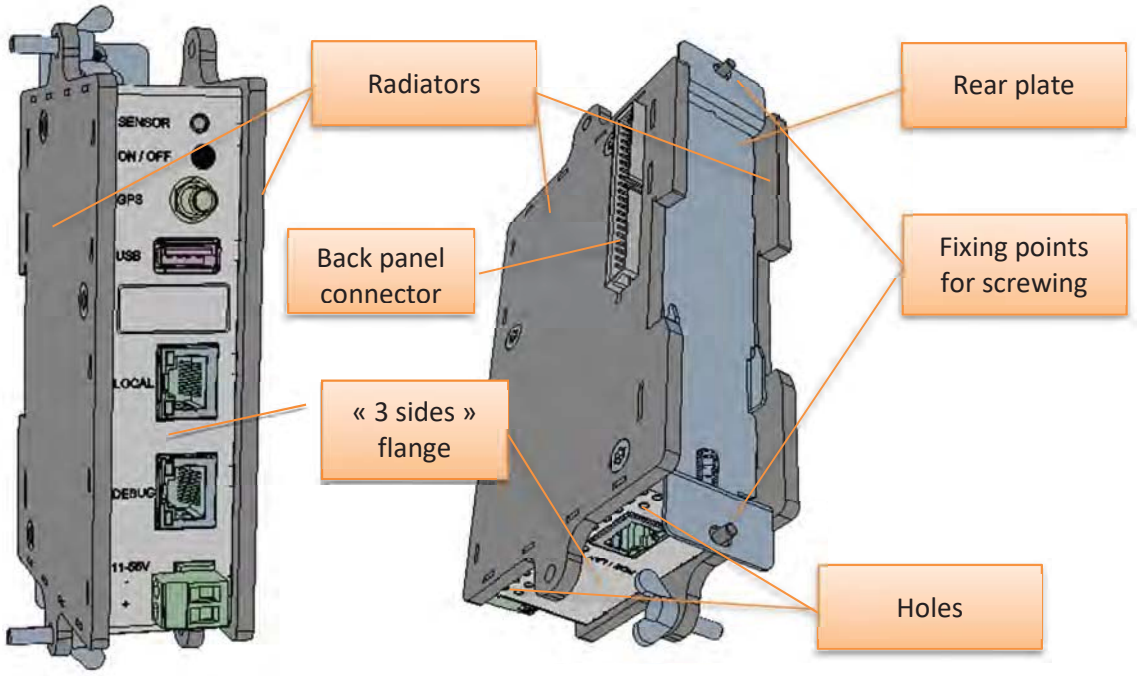


Figure 17: Mechanical description of the CPU module

The main mechanical characteristics of the CPU module are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Other flanges material** | Galvanized Steel |
| **Dimensions** | 156 mm x 88 mm x 38 mm |
| **Weight** | 500 g |

| | |
|---|---|
| **Ingress protection** | IP30 |

#### 1.5.1.2 Connectors and user interfaces

The CPU module includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | Sensor | Light sensor to detect aperture of the enclosure |
| **Front side** | ON/OFF button | Press this button to power ON and power OFF the CPU module and therefore the Wirnet iBTS |
| **Front side** | GPS SMA RF connector | GPS input signal to be connected to the GPS antenna (internal or external) |
| **Front side** | USB type A connector | Used for firmware upgrade with a USB stick |
| **Front side** | RJ45 Local connector | Local Ethernet connection – interface to portable PC |
| **Front side** | RJ45 Debug connector | Serial debug interface – use debug tool described in §1.8.7 |
| **Front side** | 11-56V Euroblock connector | Auxiliary power supply.<br>Polarity indicated on the front panel |
| **Right side** | Back panel HE10 40 contacts connector | Distributes the power supplies and high speed serial bus to other modules |
| **Bottom side** | RJ45 PoE connector | Ethernet + powers supply coming from PoE injector and introduced in the enclosure through the M25 cable gland |

The three RJ45 connectors (PoE, LOCAL and debug) integrates 2 LEDs, one green and one orange. The behavior of the LEDs is detailed hereafter:

| Connector | LED | Description |
|---|---|---|
| **LOCAL** | Green | Ethernet data activity |
| **LOCAL** | Orange | Ethernet Link |
| **PoE/LAN** | Green | Ethernet data activity |
| **PoE/LAN** | Orange | Ethernet Link |
| **DEBUG** | Green | Power status |
| **DEBUG** | Orange | Software status/ activity |


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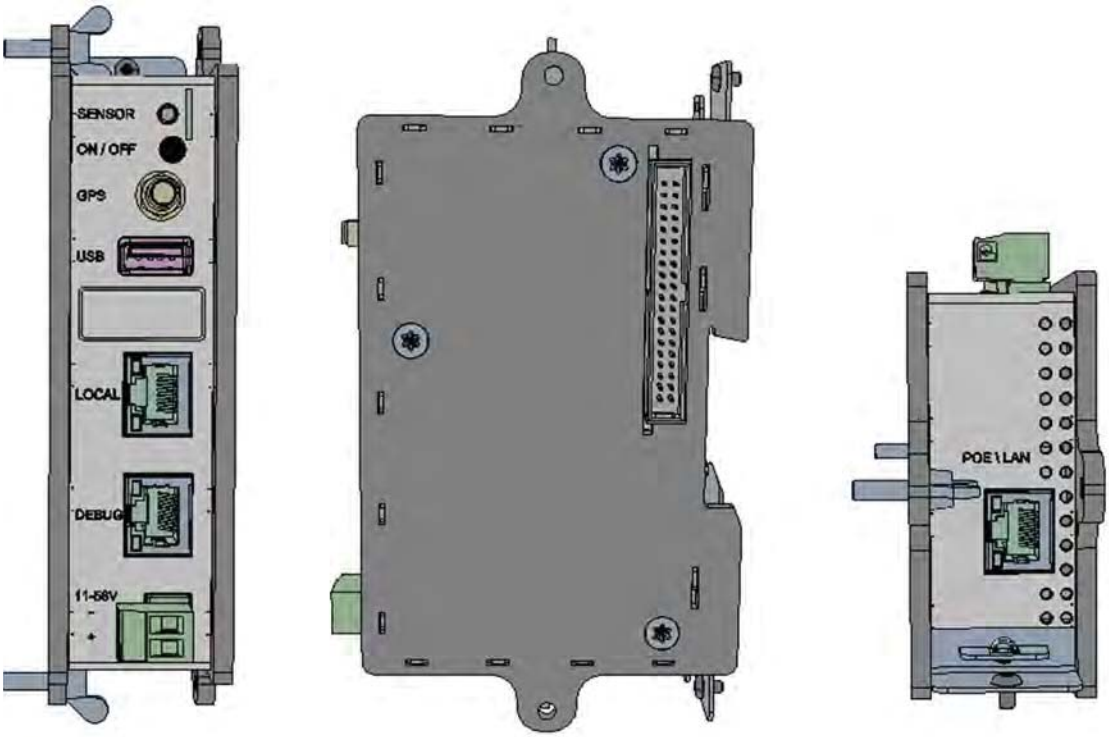


Figure 18: Connectors and user interfaces of the CPU module

**Note:** The debug interface is intended to be used by authorized and qualified personnel only. Only specific equipment developed by KERLINK must be connected to this interface (see §1.8.7.)

### 1.5.1.3 CPU module characteristics

The CPU module includes the following features:

| Feature | Description |
|---|---|
| **Processor** | ARM Cortex A9, 800MHz core |
| **Memories** | 256MB DDRAM – Volatile memory |
| | 8GB eMMC– Non-volatile memory |
| **Watchdog** | Hardware type |
| **Security** | Secure core<br>Information encryption<br>Secure Boot<br>Secure software download |
| **RTC** | RTC clock saved by back-up battery |
| **GPS** | Integrated high sensitivity GNSS module<br>GPS L1C/A, GLONASS L1OF, BeiDou B1, QZSS L1C/A, SBAS L1C/A and Galileo E1B/C ready |

| | |
|---|---|
| | NMEA 0183, version 4.0 |
| | Time pulse (PPS) accuracy < 20ns for LoRa geolocalization |
| **Power** | PoE controller 48V IEEE 802.3af/at |
| | LTPoE |
| | Auxiliary 11-56 VDC |
| | Backup-battery for RTC saving |
| | Integrated power management unit in CPU |
| **Ethernet** | 10/100/1000 Base-T |
| | PoE IEEE802.3af/at and LTPoE++ |
| | IEEE1588 version 2 time stamping compatible |
| | Automatic polarity correction |
| | 1 x RJ45 WAN/POE |
| | 1 x RJ45 LOCAL, interface to Portable PC |
| **USB** | USB HS type A Slave |
| **DEBUG** | UART interface |
| | Debug tool to be used for UART to USB adaptation |
| **Sensors** | Light sensor to detect aperture of the enclose |
| | Temperature sensor |
| **Auto test** | Internal power supplies check |
| | Interfaces and peripherals check |
| **User interface** | LED used for diagnostic (see §1.5.1.2) |
| | ON/OFF button |
| **Operating temperature range** | -20°C to +85°C |
| **Current drain @48V** | 12mA in Power OFF mode (required to maintain PoE supply) |
| | 35mA @ 20% load CPU + Ethernet Gbits (PoE) |
| | 43mA @ 20% load CPU + Ethernet Gbits (PoE) + Local Ethernet |

### *1.5.2 WAN module*

#### 1.5.2.1 Mechanical description

The WAN module is composed of four main mechanical parts:

- A “three-sides” flange including:
  - the connectors and interfaces placement
  - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

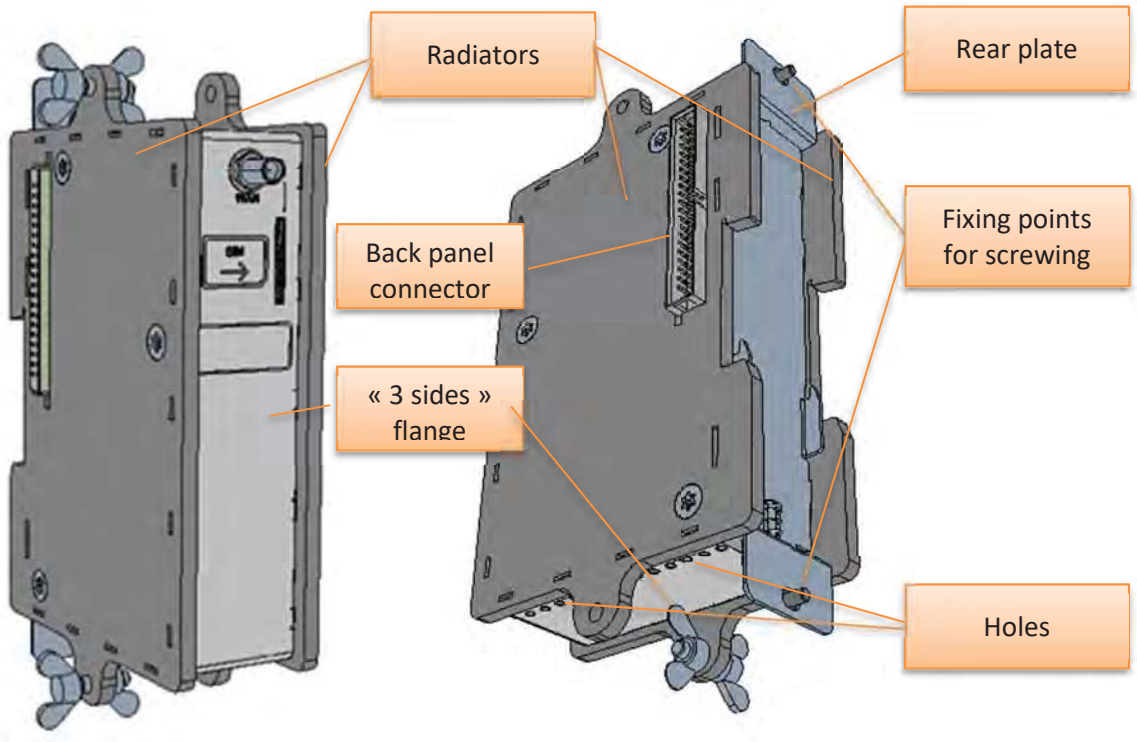


Figure 19: Mechanical description of the WAN module

The main mechanical characteristics of the WAN module are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Other flanges material** | Galvanized Steel |
| **Dimensions** | 156 mm x 88 mm x 38 mm |
| **Weight** | 500 g |
| **Ingress protection** | IP30 |

#### 1.5.2.1 Connectors and user interfaces

The WAN module includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | WAN RF connector | WAN 4G RF signal to be connected to the LTE antenna (internal or external) |
| **Front side** | USIM connector | Push-push connector<br>Insert USIM according to the besides picture |
| **Right side** | Back panel HE10 male 40 contacts connector | Transmit the power supplies and high speed serial bus to the next module |
| **Left side** | Back panel HE10 female 40 contacts connector | Receive the power supplies and high speed serial bus from the previous module |

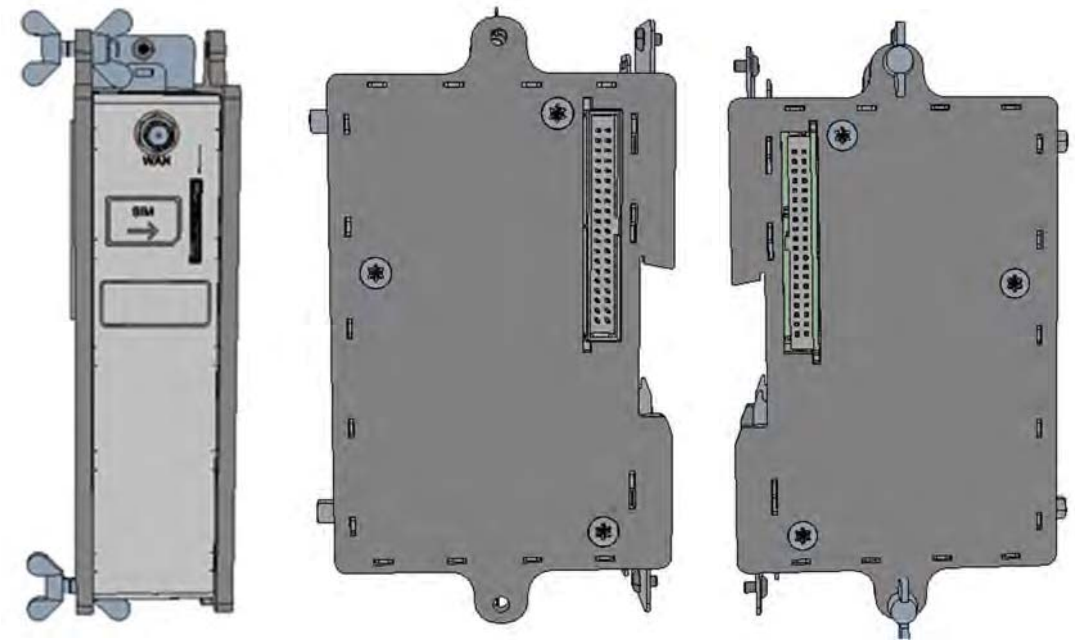


Figure 20: Connectors and user interfaces of the WAN module

**Note:** UFL to SMA coaxial cables are used to connect the Mini PCI Express card to the antennas.

#### 1.5.2.2 WAN module characteristics

The WAN module supports the following features:

| Feature | Description |
|---|---|
| **Mini PCI Express Interface** | USB only (no PCI Express interface available) |
| | Full Mini Card form factor (F1, F2) |
| | 2 versions available (see § 1.5.2.3) |
| **Backup battery** | 5 x 25F/2.7V supercapacitors |
| | 15 minutes charging time |
| | Up to one minute capacity to ensure safe power down of the Wirnet iBTS |
| **Operating temperature range** | -20°C to +85°C |
| **Current drain @48V** | 21mA HSPA Rx (attached) |
| | 72mA HSPA Tx@Pout max |

The WAN module is then based on a Mini PCIe card allowing some flexibility and evolutivity regarding the supported technologies and bands.
Several Mini PCIe cards are currently supported to address diffrent countries. They are detailed in the paragarph 1.5.2.3.

#### 1.5.2.3 Supported mini PCIe cards

The WAN module embeds a Mini PCI express board which is a LTE modem that can be declined in 3 versions:

- One for Europe (and APAC), based on Sierra Wireless MC7304
- One for (Europe and) APAC, based on Sierra Wireless MC7430
- One for Americas, based on Sierra Wireless MC7354

##### 1.5.2.3.1 LTE - Europe and APAC Mini PCI Express card – MC7304

The first 4G Mini PCI Express card is dedicated to the European and APAC markets.
The reference is MC7304.
This module is already GCF approved and meets the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive of the European Union.

The bands and data rate supported by the module are the following:

| Technology | Band | Data rate |
|---|---|---|
| **LTE 3GPP Release 9** | Band 1 (2100MHz)<br>Band 3 (1800MHz)<br>Band 7 (2600MHz)<br>Band 8 (900MHz)<br>Band 20 (800MHz) | Category 3<br>• Downlink:<br>  ○ 100Mbps (20MHz BW)<br>  ○ 50Mbps (10MHz BW)<br>• Uplink:<br>  ○ 50Mbps (20MHz BW) |

| | | |
|---|---|---|
| | | ○ 25Mbps (10MHz BW) |
| **UMTS**<br>**HSPA**<br>**3GPP Release 8** | Band 1 (2100MHz)<br>Band 2 (1900MHz)<br>Band 5 (850MHz)<br>Band 8 (900MHz) | HSPA+ rates:<br>• Downlink: up to 42Mbps (category 24)<br>• Uplink: up to 5.76Mbps (category 6) |
| **GSM**<br>**GPRS**<br>**EDGE**<br>**3GPP Release 99** | GSM 850 (850MHz)<br>EGSM 900 (900MHz)<br>DCS 1800 (1800MHz)<br>PCS 1900 (1900MHz) | GPRS Multislot class 10<br>GPRS Multislot class 12<br>CS1 to CS4<br>MCS1 to MCS9<br>EDGE throughput up to 236kbps |

Compared to the MC7430 MiniPCIe card, the MC7304 offers one major advantage: GPRS and EDGE modes are supported. This MiniPCIe card is then suitable in rural areas for instance where 4G or 3G coverage is poor.

#### 1.5.2.3.2 LTE - Europe and APAC Mini PCI Express card – MC7430

The first 4G Mini PCI Express card is dedicated to the European and APAC markets.
The reference is MC7430.
This module is already GCF approved and meets the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive of the European Union. The module is also already certified in Japan, Brazil, Korea, Taiwan and Korea.

The bands and data rate supported by the module are the following:

| Technology | Band | Data rate |
|---|---|---|
| **LTE**<br>**3GPP Release 11**<br>**FDD and TDD** | B1 (2100) - FDD<br>B3 (1800+) - FDD<br>B5 (850) - FDD<br>B7 (2600) - FDD<br>B8 (900) - FDD<br>B18 (800 lower) - FDD<br>B19 (800 upper) - FDD<br>B21 (1500 upper) - FDD<br>B28 (700APT) - FDD<br>B38 (2600) – TDD<br>B39 (1900+) – TDD<br>B40 (2300) – TDD<br>B41 (2500) - TDD | Category 6<br>• Downlink:<br>○ FDD: 300Mbps<br>○ TDD: 222Mbps<br>• Uplink:<br>○ FDD: 50Mbps<br>○ TDD: 26Mbps |
| **UMTS**<br>**HSPA**<br>**3GPP Release 9** | B1 (2100)<br>B5 (850)<br>B6 (850 UMTS only)<br>B8 (900)<br>B9 (1800) | HSPA+ rates:<br>• Downlink: up to 42Mbps (category 24)<br>• Uplink: up to 5.76Mbps (category 6) |

| | | |
|---|---|---|
| | B19 (800 upper) | |
| **TD-SCDMA** | B39 (1900+) | Data rates:<br>• Downlink: Up to 2.8 Mbps<br>• Uplink: Up to 2.2 Mbps<br><br>Spreading rate:<br>• Downlink: 1.28 Mcps |
| **GSM**<br>**GPRS**<br>**EDGE**<br>**3GPP Release 99** | None | N/A |

Compared to the MC7304 MiniPCIe card, the MC7430 supports more 3G and 4G bands. This MiniPCIe card is then suitable in urban areas for instance where 4G or 3G coverage excellent.

#### 1.5.2.3.1 LTE - Americas Mini PCI Express card – MC7354

The next 4G Mini PCI Express card is dedicated to the American market.
The reference is Sierra Wireless MC7354.
This module is already PTCRB and CDG2 approved.
It is also FCC and IC certified:

- FCC ID: N7NMC7355
- IC ID: 2417C-MC7355

The bands and data rate supported by the module are the following:

| Technology | Band | Data rate |
|---|---|---|
| **LTE**<br>**3GPP Release 9** | Band 2 (1900MHz)<br>Band 4 (1700/2100MHz)<br>Band 5 (850MHz)<br>Band 13 (700MHz)<br>Band 17 (700MHz)<br>Band 25 (1900MHz) | Category 3<br>• Downlink:<br>○ 100Mbps (20MHz BW)<br>○ 50Mbps (10MHz BW)<br>• Uplink:<br>○ 50Mbps (20MHz BW)<br>○ 25Mbps (10MHz BW) |
| **CDMA**<br>**EVDO release 0**<br>**EVDO release A** | BC0 (800MHz)<br>BC1 (1900MHz)<br>BC10 (800MHz) | CDMA IS-856 (1xEV-DO Release A)<br>• Up to 3.1 Mbps forward channel<br>• Up to 1.8 Mbps reverse channel<br>CDMA IS-2000<br>• Up to 153 kbps, simultaneous forward and reverse channel<br>Circuit-switched data bearers up to 14.4 kbps |
| **UMTS** | Band 1 (2100MHz) | HSPA+ rates: |

| | | |
|---|---|---|
| **HSPA**<br>**3GPP Release 8** | Band 2 (1900MHz)<br>Band 4 (1700/2100MHz)<br>Band 5 (850MHz)<br>Band 8 (900MHz) | • Downlink: up to 42Mbps (category 24)<br>• Uplink: up to 5.76Mbps (category 6) |
| **GSM**<br>**GPRS**<br>**EDGE**<br>**3GPP Release 99** | GSM 850 (850MHz)<br>EGSM 900 (900MHz)<br>DCS 1800 (1800MHz)<br>PCS 1900 (1900MHz) | GPRS Multislot class 10<br>GPRS Multislot class 12<br>CS1 to CS4<br>MCS1 to MCS9<br>EDGE throughput up to 236kbps |

### *1.5.3 Dual WAN Module*

#### 1.5.3.1 Mechanical description

The Dual WAN module is composed of four main mechanical parts:

- A “three-sides” flange including:
  - the connectors and interfaces placement
  - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges

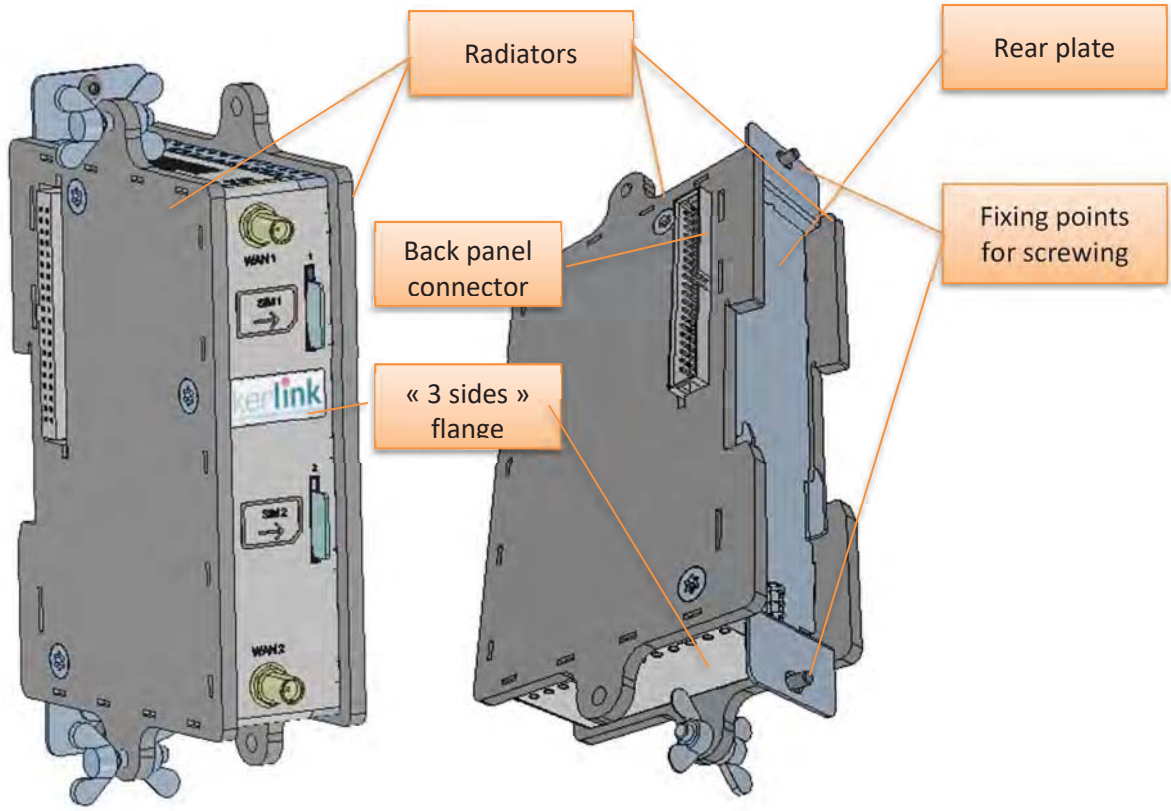


Figure 21: Mechanical description of the Dual WAN module

The main mechanical characteristics of the Dual WAN module are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Other flanges material** | Galvanized Steel |
| **Dimensions** | 156 mm x 88 mm x 38 mm |
| **Weight** | 500 g |
| **Ingress protection** | IP30 |

### 1.5.3.2 Connectors and user interfaces

The Dual WAN module includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | WAN1 RF connector | WAN 4G RF signal to be connected to the LTE antenna (internal or external) |
| **Front side** | WAN2 RF connector | WAN 4G RF signal to be connected to the LTE antenna (internal or external) |
| **Front side** | USIM1 connector | Push-push connector<br>Insert USIM according to the besides picture |
| **Front side** | USIM2 connector | Push-push connector<br>Insert USIM according to the besides picture |
| **Right side** | Back panel HE10 male 40 contacts connector | Transmit the power supplies and high speed serial bus to the next module |
| **Left side** | Back panel HE10 female 40 contacts connector | Receive the power supplies and high speed serial bus from the previous module |

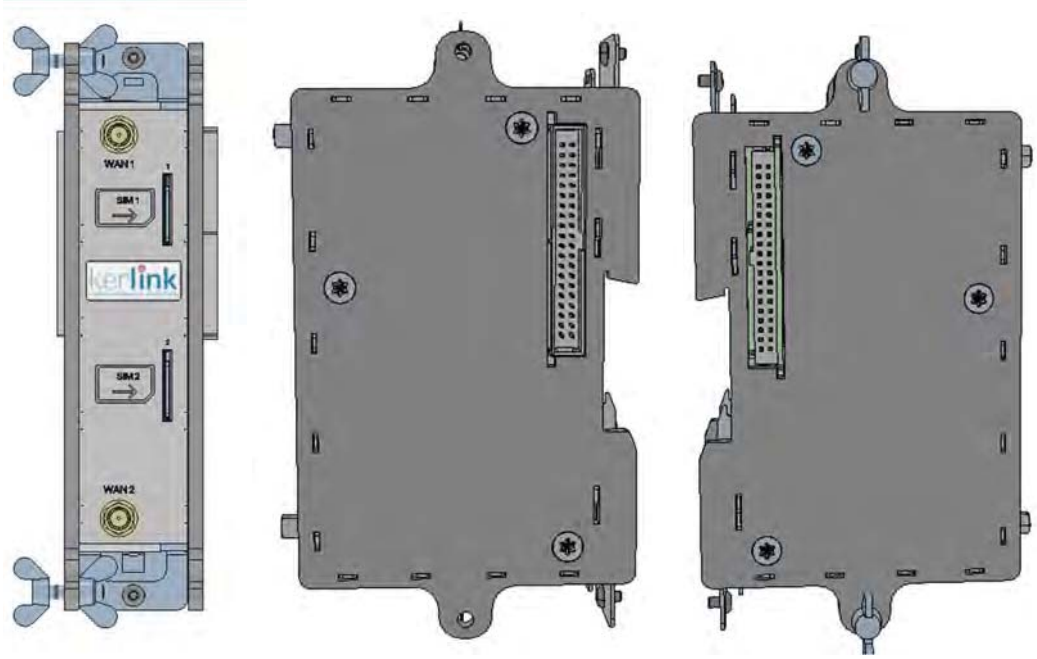


Figure 22: Connectors and user interfaces of the Dual WAN module

#### 1.5.3.3 Dual WAN module characteristics

The Dual WAN module supports the following features:

| Feature | Description |
|---|---|
| **2x Mini PCI Express Interfaces** | USB only (no PCI Express interface available)<br>Full Mini Card form factor (F1, F2)<br>Only one frequency bands dependent version is available<br>Both WAN 4G Mini PCI board may be active in parallel, i.e. attached to the network at the same time. |
| **Backup battery** | 5 x 25F/2.7V supercapacitors<br>15 minutes charging time<br>Up to one minute capacity to ensure safe power down of the Wirnet iBTS |
| **Operating temperature range** | -20°C to +85°C |
| **Current drain @48V / PCI express interface** | 21mA HSPA Rx (attached)<br>72mA HSPA Tx@Pout max |

#### 1.5.3.4 Supported Mini PCIe cards

The Dual WAN module embeds two Mini PCI express boards.
So far, only one Mini PCIe board / LTE modem dedicated for Europe and APAC is available: MC7304 from Sierra Wireless. This MiniPCIe card is described in chapter 1.5.2.3.1.
If other Mini PCI express boards are required, contact KERLINK.

### *1.5.4 LoRa module – LoRa LOC*

#### 1.5.4.1 Mechanical description

##### 1.5.4.1.1 Single “LoRa-LOC” module

The LoRa-LOC module is composed of five main mechanical parts:

- A “three-sides” flange including:
  - the connectors and interfaces placement
  - venting of internal boards through many holes
- A rear plate with fixing points for screwing on the blind threaded standoffs
- Two radiators used as right and left side flanges
- A front-end lid, used as a shield for the front-end board

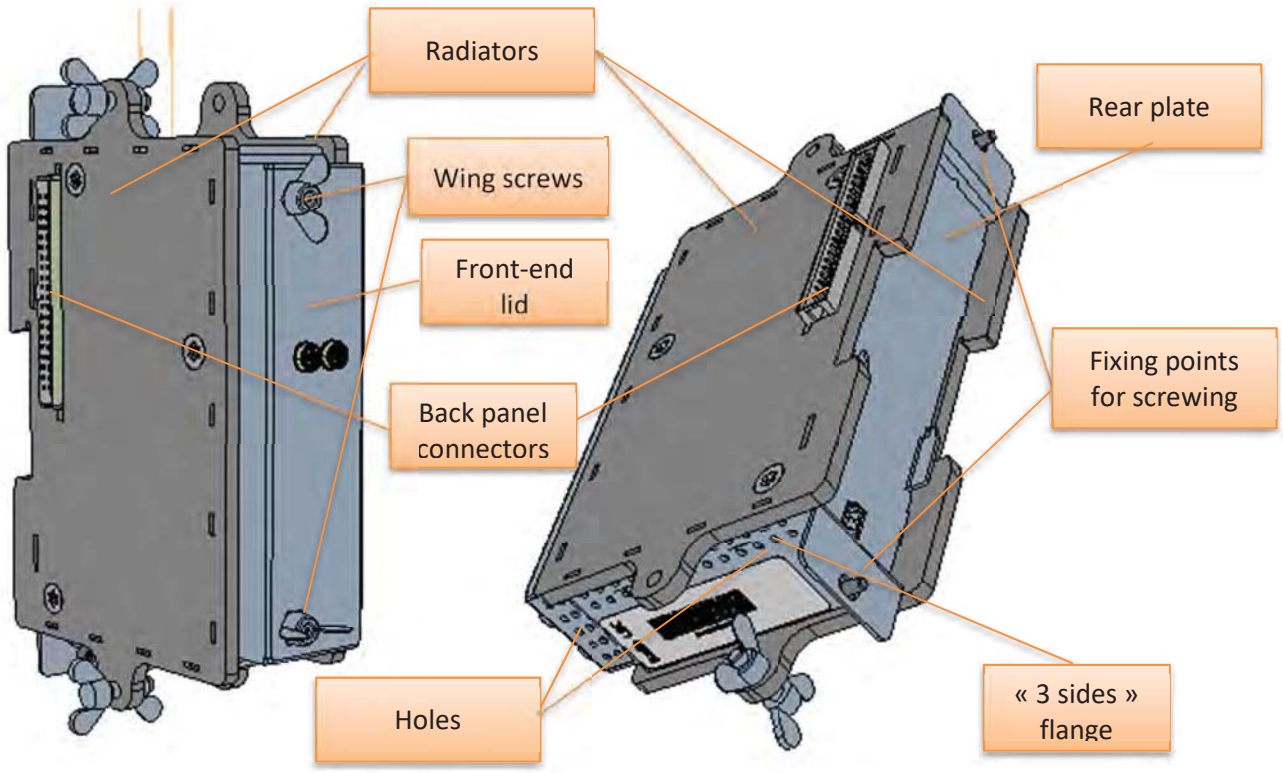


Figure 23: Mechanical description of the LoRa – LOC module

The rear plate and the two radiators side flanges are the same as the one used for the CPU module or the WAN module. The “three-sides” flange is different from the one used for the CPU module or WAN modules due to different interfaces and connectors but dimensions are the same.
The front-end lid is then a particular mechanical part dedicated only for the LoRa modules.
The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Other flanges and lid material** | Galvanized Steel |
| **Dimensions** | 156 mm x 102 mm x 38 mm |
| **Weight** | 600 g |
| **Ingress protection** | IP30 |

The LoRa-LOC board integrates the LoRa-LOC modem based on the AD936x transceiver (Analog Devices) and SX1301 (Semtech) + DSP as demodulators.

A front-end board embeds the radio transmitters and receivers. Three versions are derived to support the different unlicensed bands:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

#### 1.5.4.1.2 Four "LoRa-LOC" modules

The four "LoRa-LOC" modules version is composed of 4 single LoRa-LOC RF modules.
The front-end board and the front-end lid of each individual module are removed and replaced by a single common front-end board and front-end lid, covering and combining the four modules together.

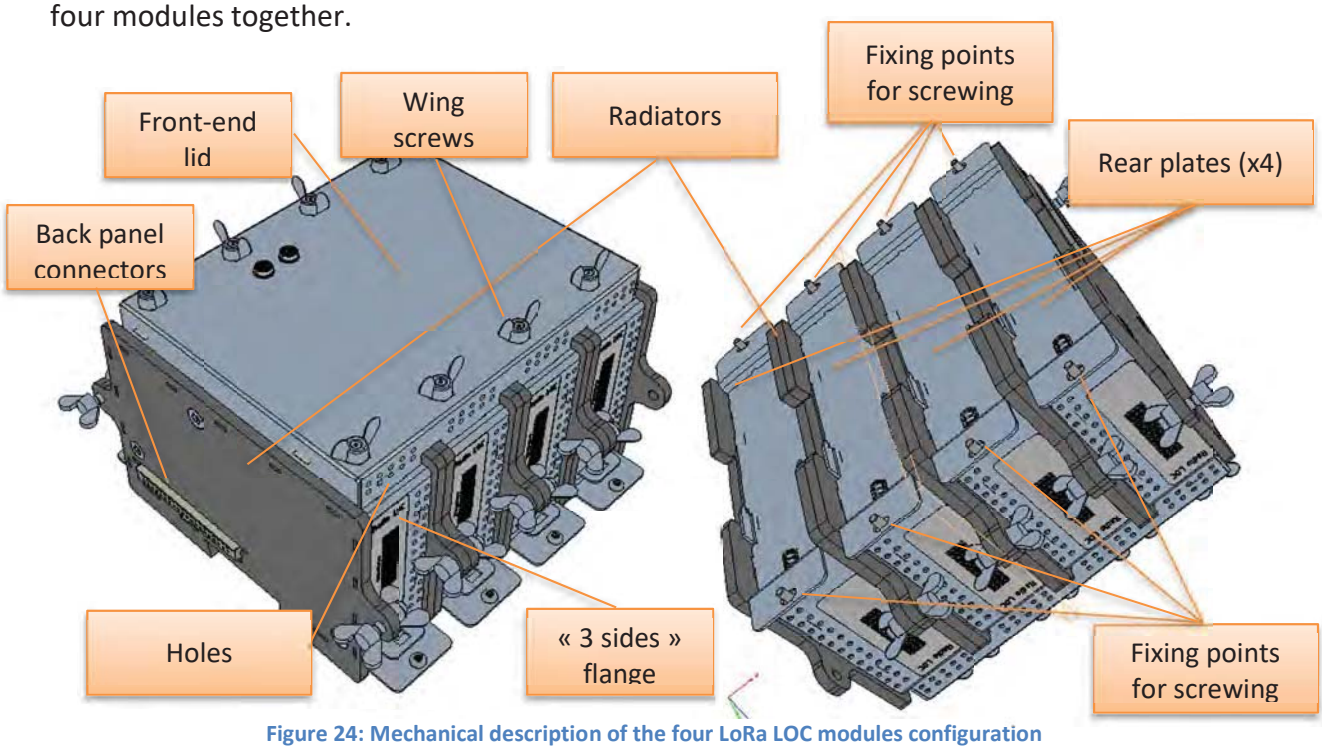


Figure 24: Mechanical description of the four LoRa LOC modules configuration

The rear plates and the two radiators side flanges are still unchanged.
The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Other flanges and lid material** | Galvanized Steel |
| **Dimensions** | 156 mm x 102 mm x 152 mm |
| **Total weight** | 1700 g |
| **Ingress protection** | IP30 |

Four Lora LOC boards are used. They integrate the AD936x transceiver and SX1301 + DSP as demodulators, as described previously.
A front-end board embeds the radio transmitters and receivers. Two versions are declined to support the different unlicensed bands:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

#### 1.5.4.1.3 Four "LoRa-LOC-64 Highway" modules

The four "LoRa-LOC-64 Highway" modules version is composed of 4 single LoRa-LOC RF modules.
The front-end board and the front-end lid of each individual module are removed and replaced by a single common front-end board and front-end lid, covering the four modules together.

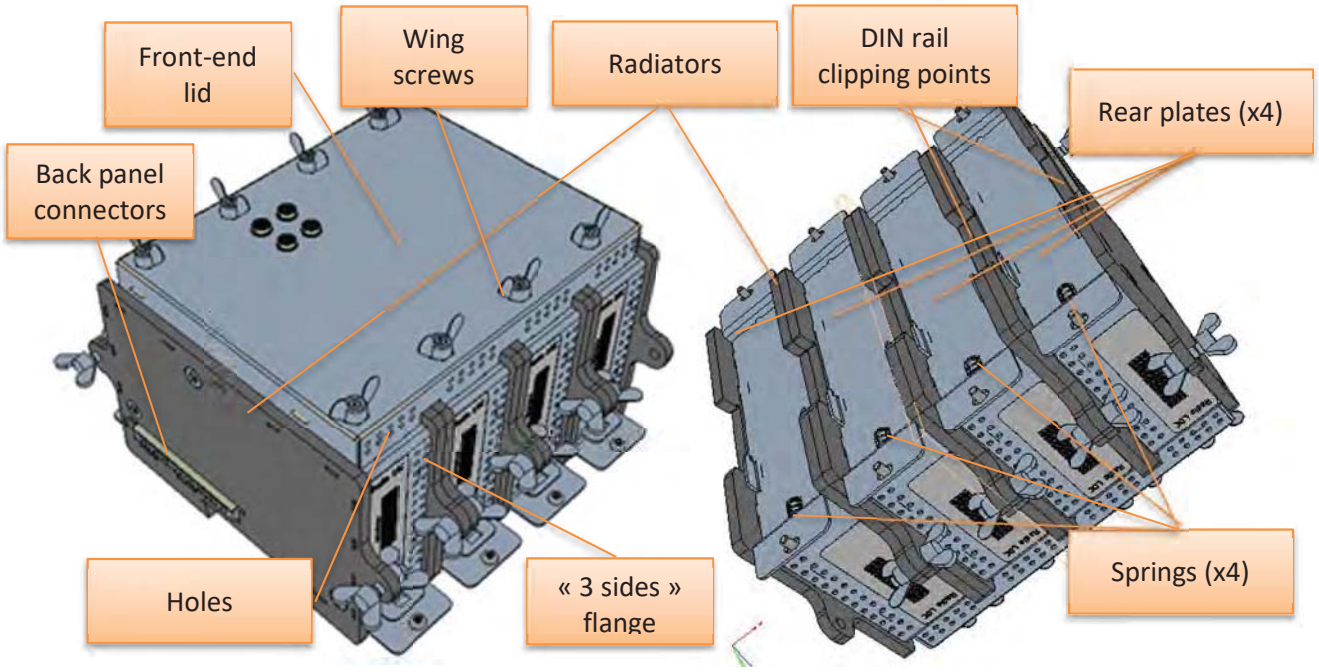


Figure 25: Mechanical description of the four LoRa LOC-64 Highway modules configuration

The rear plates and the two radiators side flanges are still unchanged.
The front-end lid is tightened to the other mechanical parts through the wing screws on the front.

The main mechanical characteristics of the Lora module are detailed hereafter:

| Description | Specification |
|---|---|
| Radiators material | Aluminum |

| | |
|---|---|
| **Other flanges and lid material** | Galvanized Steel |
| **Dimensions** | 156 mm x 102 mm x 152 mm |
| **Total weight** | 1700 g |
| **Ingress protection** | IP30 |

Inside the mechanical parts, the four “LoRa-LOC-64 Highway” modules version is composed of 9 boards:

- 4 back panel boards
- 4 LoRa-LOC modem boards
- A single front-end 64 Highway radio board

The back panel boards connect the four LoRa modems together and also to the CPU module. This board is the same as the one used in the WAN module and single LoRa module. The board will not be further more detailed.

Four Lora LOC boards are used. They integrate the AD936x transceiver and SX1301 + DSP as demodulators, as described previously.

The front-end board embeds the radio transmitters and receivers to support the ISM915 unlicensed bands (902-928MHz).
The front-end board is connected to the LoRa-LOC modules trough SMB RF connectors and a HE10 14 contacts. The first Lora-LOC board is plugged directly on the front-end board through the SMB connectors. The other LoRa-LOC boards are connected to the front-end board through SMB coaxial cables.

### 1.5.4.2 Connectors and user interfaces

#### 1.5.4.2.1 Single LoRa-LOC module

The LoRa LOC module includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | LoRa RF SMB connector # RF1 | LoRa RF signal to be connected to the LoRa antenna # 1 |
| **Front side** | LoRa RF SMB connector # RF2 | LoRa RF signal to be connected to the LoRa antenna # 2 |
| **Right side** | Back panel HE10 male 40 contacts connector | Transmit the power supplies and high speed serial bus to the next module |
| **Left side** | Back panel HE10 female 40 contacts connector | Receive the power supplies and high speed serial bus from the previous module |

The LoRa SMB RF connector's # RF1 and # RF2 are connected to the SMB/N adapters on the bottom side of the Wirnet iBTS via SMB coaxial cables.

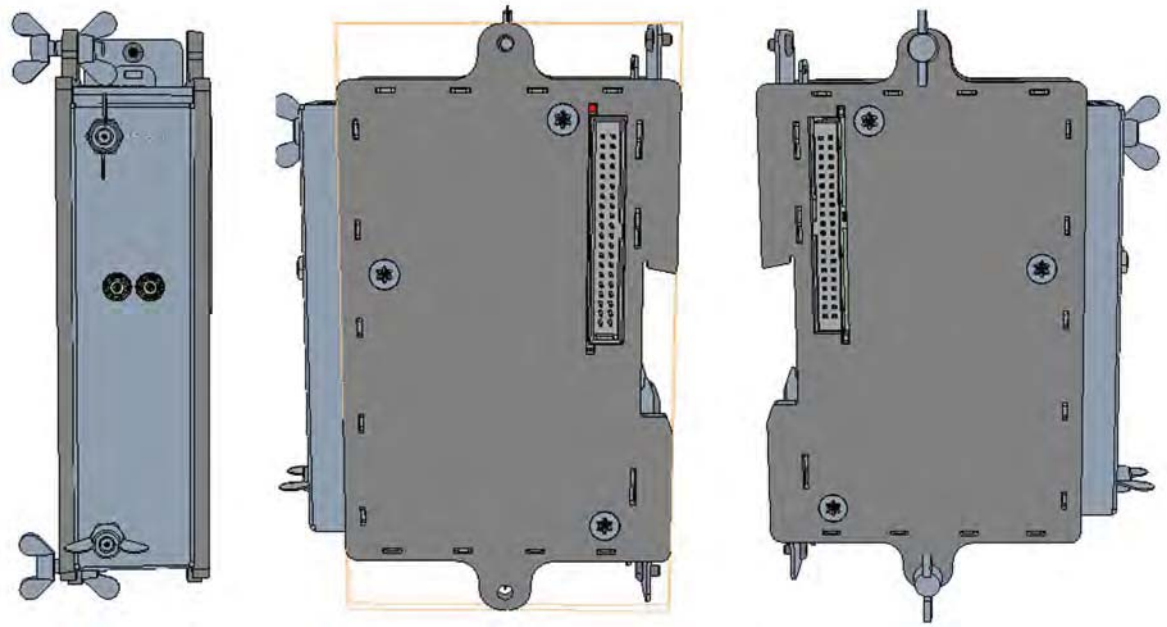

Figure 26: Connectors and user interfaces of the LoRa LOC module

The RF1 connector is on the left side of the front-end lid.
The RF2 connector is on the right side of the front-end lid.
The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module as follows:

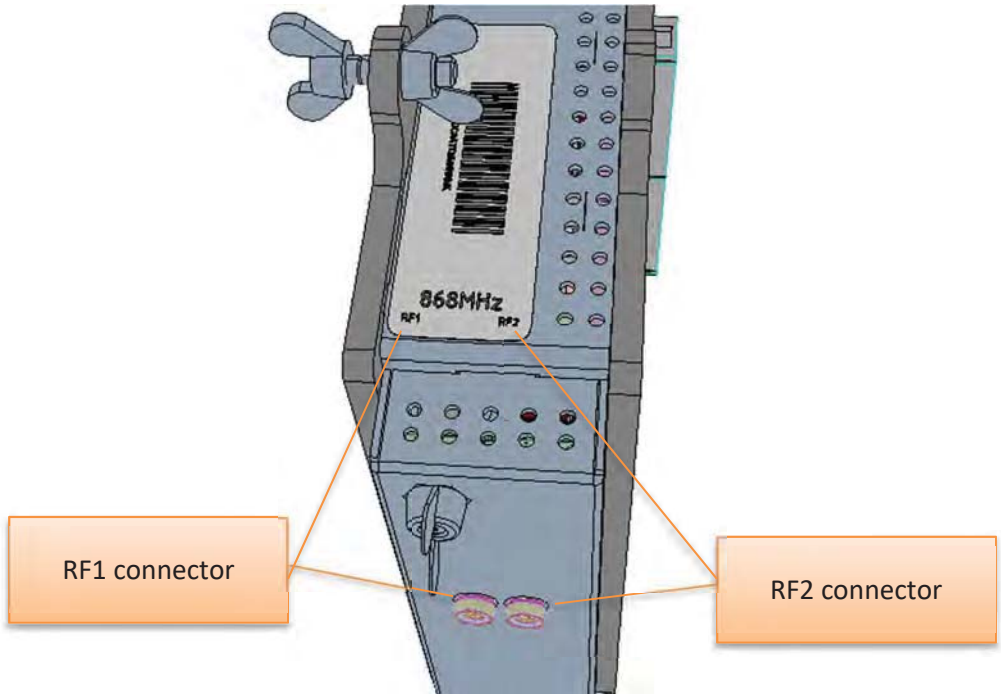


Figure 27: RF1 and RF2 connectors of the LoRa LOC module

**Note:** RF1 stands for RF path 1, RF2 stands for RF path 2.

#### 1.5.4.2.2 Four LORA-LOC modules

The LoRa LOC "4 modules" configuration includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | LoRa RF SMB connector # RF1 | LoRa RF signal to be connected to the LoRa antenna # 1 |
| **Front side** | LoRa RF SMB connector # RF2 | LoRa RF signal to be connected to the LoRa antenna # 2 |
| **Right side** | Back panel HE10 male 40 contacts connector | Transmit the power supplies and high speed serial bus to the next module |
| **Left side** | Back panel HE10 female 40 contacts connector | Receive the power supplies and high speed serial bus from the previous module |

The LoRa SMB RF connector's # RF1 and # RF2 are connected to the SMB/N adapters on the bottom side of the Wirnet iBTS via SMB coaxial cables.

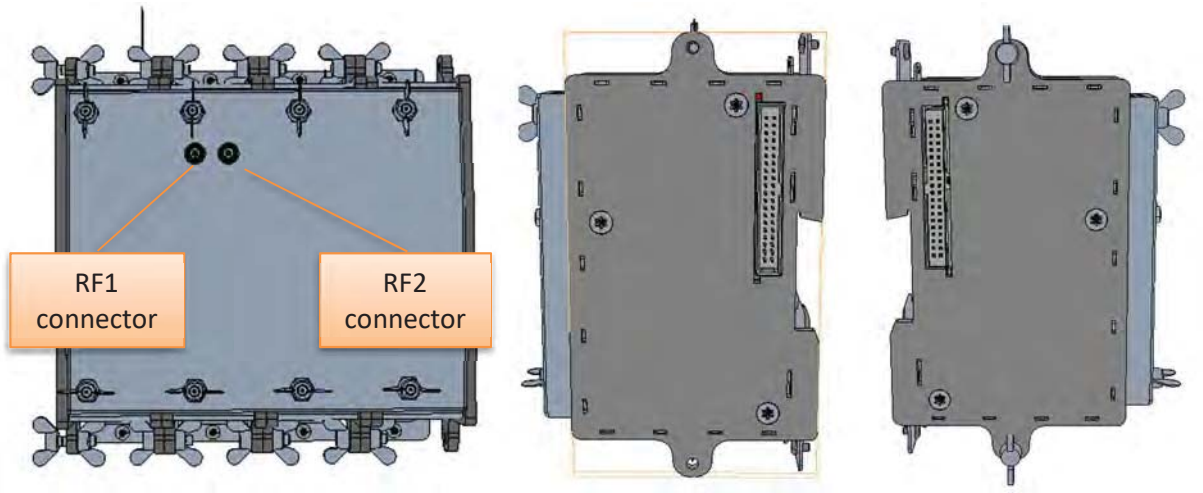


Figure 28: Connectors and user interfaces of the 4 LoRa LOC modules

The RF1 connector is on the left side of the front-end lid.
The RF2 connector is on the right side of the front-end lid.
The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module (similar to single LoRa LOC module).

**Note:** RF1 stands for RF path 1, RF2 stands for RF path 2.

#### 1.5.4.2.3 Four “LoRa-LOC-64 Highway” modules

The LoRa LOC 64 Highway “4 modules” configuration includes the following user interfaces and connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Front side** | LoRa RF TX SMB connector # RF1 | LoRa RF transmit signal to be connected to the duplexer # 1 |
| **Front side** | LoRa RF TX SMB connector # RF2 | LoRa RF transmit signal to be connected to the duplexer # 2 |
| **Front side** | LoRa RF RX SMB connector # RF1 | LoRa RF receive signal to be connected to the duplexer # 1 |
| **Front side** | LoRa RF RX SMB connector # RF2 | LoRa RF receive signal to be connected to the duplexer # 2 |
| **Right side** | Back panel HE10 male 40 contacts connector | Transmit the power supplies and high speed serial bus to the next module |
| **Left side** | Back panel HE10 female 40 contacts connector | Receive the power supplies and high speed serial bus from the previous module |

The LoRa SMB TX/RX RF connectors # RF1 and # RF2 are connected to the dual duplexer via SMB/SMA coaxial cables.

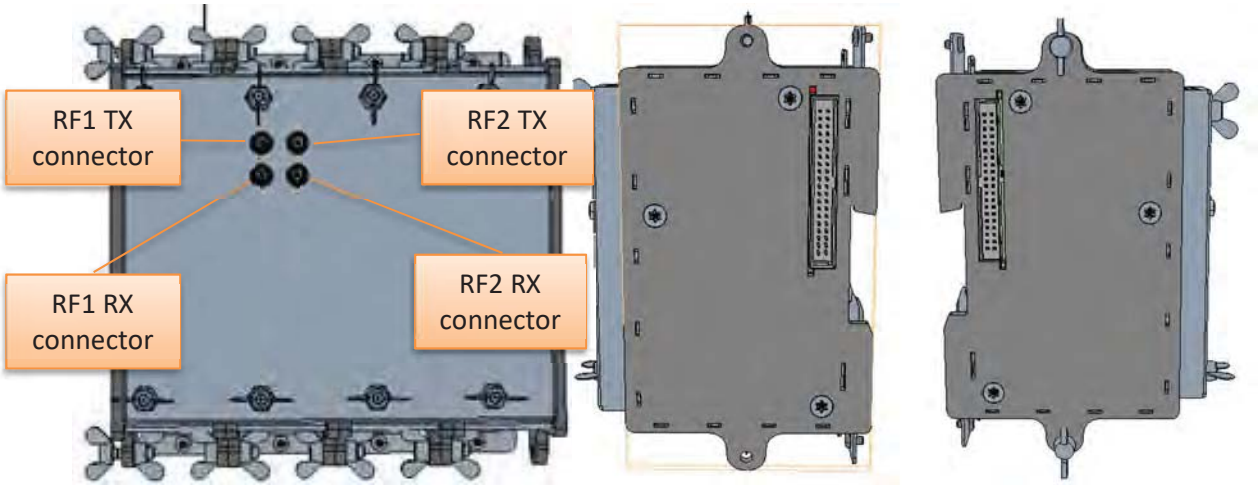


Figure 29: Connectors and user interfaces of the 4 LoRa LOC modules

The RF1 connectors are on the left side of the front-end lid.
The RF2 connectors are on the right side of the front-end lid.
The TX connectors are on the top side and RX connectors on the bottom side.

The positions of the RF1 and RF2 connectors are indicated on the sticker on top of the LoRa LOC module (similar to single LoRa LOC module).

**Note:** RF1 stands for RF path 1, RF2 stands for RF path 2.

#### 1.5.4.3 LoRa LOC modem characteristics

The mains characteristics of the LoRa-LOC modem are detailed in the following table:

| Feature | Description |
|---|---|
| **LoRa demodulator (x2)** | Based on SX1301 digital signal processing engine from Semtech |
| | True antenna diversity or simultaneous dual-band operation |
| | 10 programmable parallel receive paths |
| | Emulates 49 x LORA demodulators and 1 x (G)FSK demodulator per SX1301:<br>• 8 x LoRa demodulator at dynamic data rate with 125KHz BW<br>• 1 x LoRa demodulator at fixed data rate<br>• 1 x (G) FSK demodulator |
| | Dynamic data-rate (DDR) adaptation<br>Detect simultaneously 8 preambles corresponding to all data rates (Spreading Factor) at LoRa 125KHz BW |
| | 2 MHz baseband BW |
| | FSK or LORA modulator |
| **Geolocalization Ready** | Outdoor and indoor environments |
| | Synchronization with GPS PPS clock |
| | Combines RSSI and TDOA measurements |
| | Accuracy < 50m (90% confidence, high density coverage) |
| **Transceiver** | Based on Analog Devices AD9361/AD9363 |
| | 70MHz to 6000MHz / 325MHz to 3800MHz frequency range |
| | 200 kHz to 56 MHz / 200 kHz to 20 MHz channel BW |
| | Integrated fractional-N synthesizers |
| | 2 × 2 transceiver with integrated 12-bit DACs and ADCs<br>- Dual transmitters: 4 differential outputs<br>- Dual receivers: 6 differential or 12 single-ended inputs |
| | Highly linear broadband transmitter |
| | +8dBm typ. output power |
| | 90dB output power control range |
| | 164dBc/Hz Signal to Noise performance at 90MHz offset |
| | Receiver Noise Figure of 2 dB |
| | +40dBm IIP2 at max gain |
| | -18dBm IIP3 at max gain |

| | |
|---|---|
| | Independent automatic gain control |
| | DC offset correction, quadrature correction and digital filtering |
| | Very low LO leakage |
| **Sniffer (x2)** | Based on Semtech SX1239 |
| | 300MHz to 1020MHz frequency range |
| | FSK, GFSK, MSK, GMSK and OOK demodulator |
| | FSK Bit rates up to 300 kb/s |
| | Digital filtering, demodulation, AGC, AFC, synchronization and packet handling |
| | Accurate RSSI measurements through automatic gain calibration |
| | 115dB Dynamic Range RSSI |
| | +35dBm to +75dBm IIP2 depending on AGC configuration |
| | -18dBm to +20dBm IIP3 depending on AGC configuration |
| | 66 dB typ. CW interferer rejection at 1 MHz offset |
| | 79 dB typ. CW interferer rejection at 10 MHz offset |
| **Auto test** | Check of the LoRa LOC module power supplies by MCU |
| **Operating temperature range** | -20°C to +85°C |
| **Current drain @48V** | 130mA in Receive Mode (all demodulators activated) |
| | 120mA in Transmit mode@27dBm |

#### 1.5.4.4 Front-end boards

##### 1.5.4.4.1 Front-end board - Single module

The following block diagram details the architecture of the front-end board, in a single module configuration:

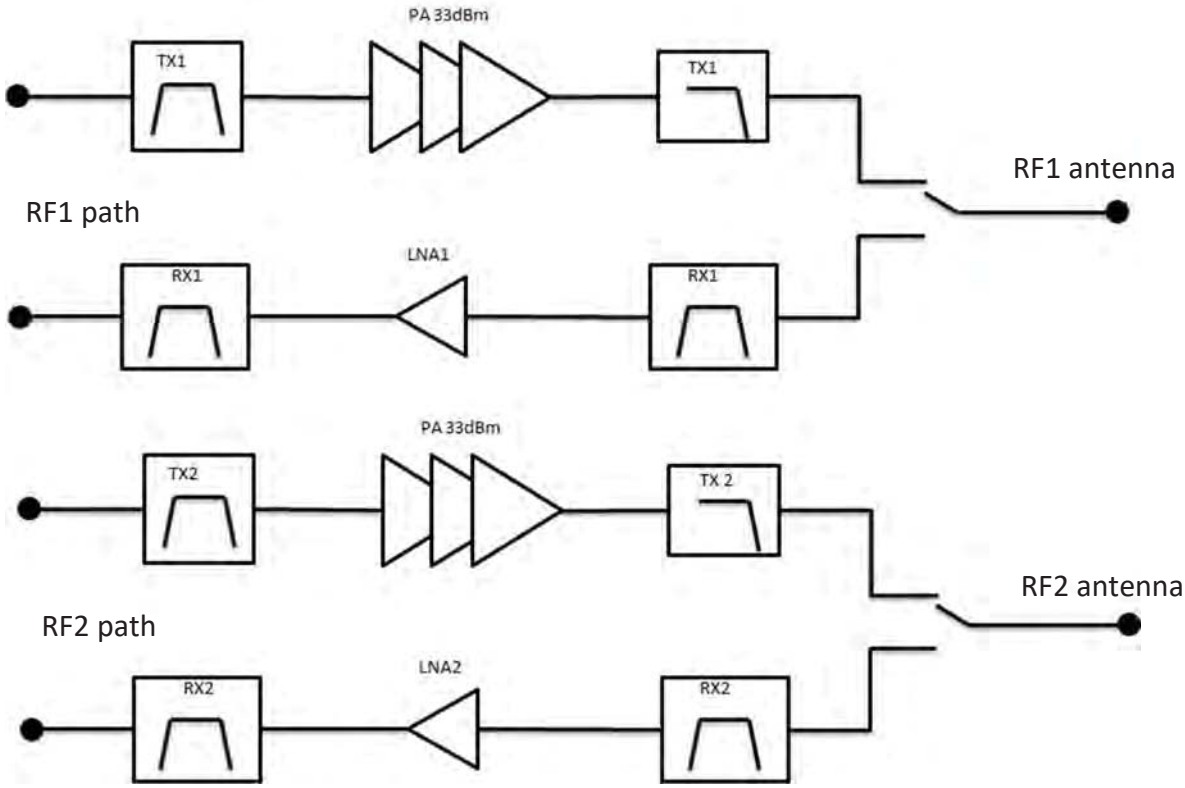


Figure 30: Front-end board block diagram

The front-end board integrates two duplicated TX and Rx paths (RF1 path and RF2 path). Each TX/RX path is connected to one SMB antenna port, referenced as RF1 and RF2.
Each path is detailed hereafter:

The front-end board is derived in three different versions to cover the unlicensed bands:

- 868MHz (863-873MHz)
- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

#### 1.5.4.4.2 Front-end board - Four modules

The following block diagram details the architecture of the front-end board, in a four modules configuration:

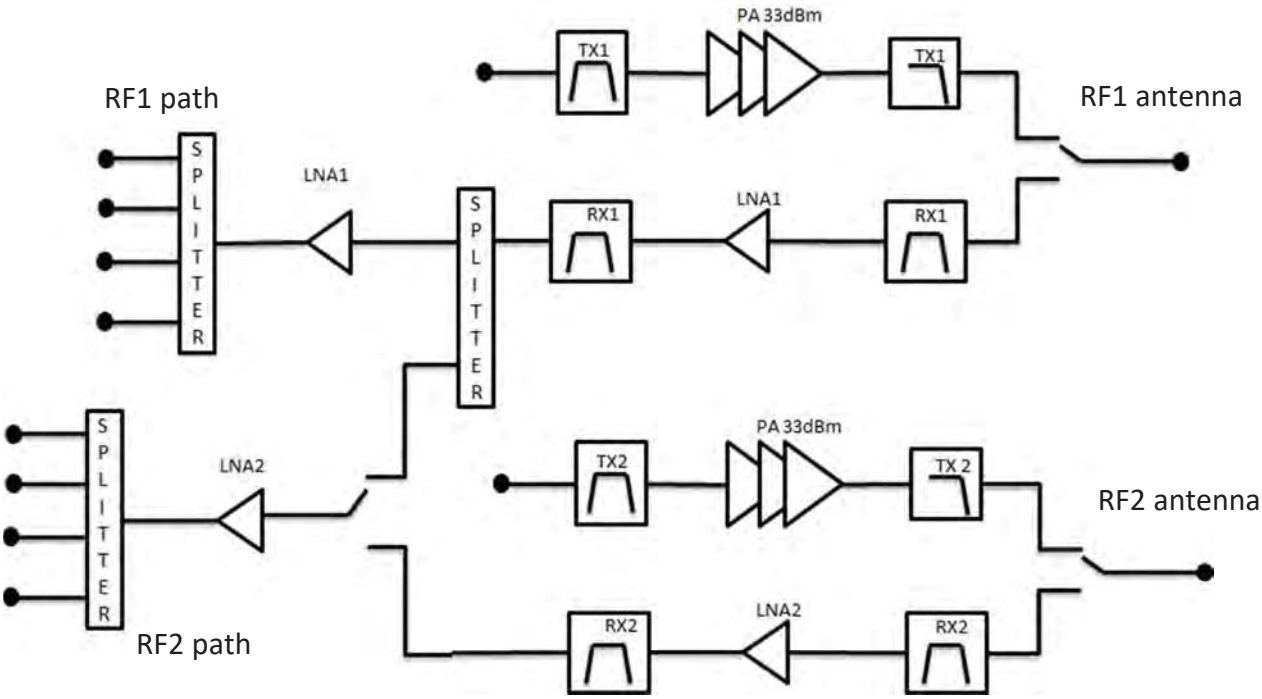


Figure 31: Front-end 4 modules board block diagram

The front-end board integrates two TX and two Rx paths (RF1 path and RF2 path). Each TX/RX path is connected to one SMB antenna port (RF1 and RF2 respectively).
The front-end board is derived in two different versions to cover the unlicensed bands:

- 915MHz (902-928MHz)
- 923MHz (915-928MHz)

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

#### 1.5.4.4.3 Front-end board- Four modules 64 Highway

The following block diagram details the architecture of the front-end board, in a four modules 64 Highway configuration:

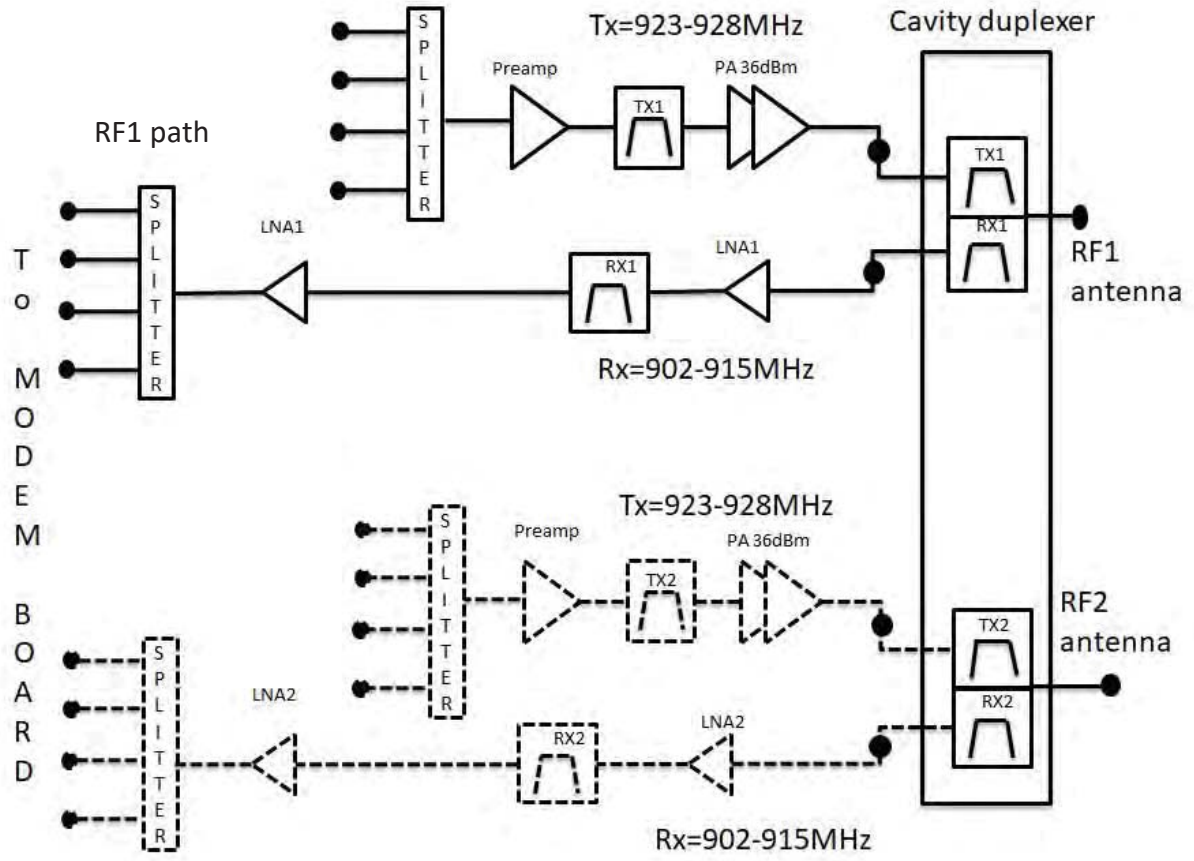


Figure 32: Front-end 4 modules 64 Highway board block diagram

The front-end board integrates two TX and two Rx paths (RF1 path and RF2 path). Each TX and RX path is connected to one SMB antenna port.

The two TX paths are similar and are detailed hereafter:

- The TX signal(s), coming from the 4 LoRa LOC board(s), is injected in a pre-amplifier filter via a combiner (splitter). The amplifier has very high linearity to minimize intermodulation.
- The signals are then injected into a RF band-pass filter. The main goal of this RF filter is to reject the harmonics and shape the noise outside the band pass, especially in the WAN bands.
- The TX signal is amplified by a 2W power amplifier. This amplifier has an excellent linearity to minimize intermodulation.

The front-end is then able to transmit 4 RF signals simultaneously per RF antenna port.

The receive paths are also similar.
The Rx path includes:

- A first LNA with a very low noise figure, in order to not degrade the sensitivity of the receiver.

- A band pass filter offers higher attenuation of the out of band blockers.
- The signal is then transmitted to a second LNA used to compensate the insertion losses of the next 4 ways power splitter to not degrade the receiver noise figure.

The details of the frequency bands, channelization, out of band rejection are detailed in §1.5.4.6.

### 1.5.4.5 Modulations and data rates

The LoRa LOC module supports the following modulation schemes:

| SF | BW (KHz) | Data rate (kbps) |
|---|---|---|
| **7** | 500 | 21875 |
| **8** | 500 | 12500 |
| **9** | 500 | 7031 |
| **10** | 500 | 3906 |
| **11** | 500 | 2148 |
| **12** | 500 | 1172 |
| **7** | 250 | 10938 |
| **8** | 250 | 6250 |
| **9** | 250 | 3516 |
| **10** | 250 | 1953 |
| **11** | 250 | 1074 |
| **12** | 250 | 586 |
| **7** | 125 | 5469 |
| **8** | 125 | 3125 |
| **9** | 125 | 1758 |
| **10** | 125 | 977 |
| **11** | 125 | 537 |
| **12** | 125 | 293 |

**Note :** Payload may have to be adjusted to not overrule 400ms frame length, depending on the local regulations. In this case, SF11/125KHz and SF12/125KHz are not used.

### 1.5.4.6 Frequency bands and channelization

The frequency bands covered by the Wirnet iBTS depends on the version of the front-end module used (868, 915 or 923).
The downstream frequencies and upstream frequencies are listed in the following table:

| Version | Link | Frequency range start/end |
|---|---|---|
| **868** | Upstream (RX Wirnet iBTS) | 863MHz / 873MHz |
| **868** | Downstream (TX Wirnet iBTS) | 863MHz / 873MHz |
| **915** | Upstream (RX Wirnet iBTS) | 902MHz / 928MHz |
| **915** | Downstream (TX Wirnet iBTS) | 902MHz / 928MHz |
| **915 64 Highway** | Upstream (RX Wirnet iBTS 64 Highway) | 902MHz / 915MHz |
| **915 64 Highway** | Downstream (TX Wirnet iBTS 64 Highway) | 923MHz / 928MHz |
| **923** | Upstream (RX Wirnet iBTS) | 915MHz / 928MHz |
| **923** | Downstream (TX Wirnet iBTS) | 920MHz / 928MHz |

LoRaWAN specification defines a more accurate frequency plan and channelization, although different options could be envisaged.
The channels are summarized in the following table:

| Version | Link | Channel frequency | LoRa BW (KHz) | Number of channels | Channel BW (KHz) |
|---|---|---|---|---|---|
| **915** | Upstream (RX Wirnet iBTS) | 902,3+i*0,2MHz (i=0 à 63) | 125 | 64 | 200 |
| **915** | Upstream (RX Wirnet iBTS) | 903,0+i*1.6MHz (i=0 à 7) | 500 | 8 | 600 |
| **915** | Downstream (TX Wirnet iBTS) | 923,3+i*0.6MHz (i=0 à 7) | 500 | 8 | 600 |
| | | | | | |
| **915 64 Highway** | Upstream (RX Wirnet iBTS 64 Highway) | 902,3+i*0,2MHz (i=0 à 63) | 125 | 64 | 200 |
| **915 64 Highway** | Upstream (RX Wirnet iBTS 64 Highway) | 903,0+i*1.6MHz (i=0 à 7) | 500 | 8 | 600 |
| **915 64 Highway** | Downstream (TX Wirnet iBTS 64 Highway) | 923,3+i*0.6MHz (i=0 à 7) | 500 | 8 | 600 |
| | | | | | |
| **923** | Upstream (RX Wirnet iBTS) | 915,2+i*0,2MHz (i= 0 à 63) | 125 | 64 | 200 |
| **923** | Upstream (RX Wirnet iBTS) | 915,9+i*1.6MHz (i=0 à 7) | 500 | 8 | 600 |
| **923** | Downstream (TX Wirnet iBTS) | 919,8+i*0,2MHz (i= 0 à 40) | 125 | 41 | 200 |
| **923** | Downstream (TX Wirnet iBTS) | 920,3+i*0.6MHz (i=0 à 12) | 500 | 13 | 600 |
| | | | | | |
| **868** | Upstream (RX Wirnet iBTS) | 863,1+i*0,2MHz (i= 0 à 27) | 125 | 28 | 200 |

| | | | | | |
|---|---|---|---|---|---|
| **868** | Downstream (TX Wirnet iBTS) | 863,1+i*0,2MHz (i= 0 à 27) | 125 | 28 | 200 |
| **868** | Upstream (RX Wirnet iBTS) | 868,9+i*0,2MHz (i= 0 à 1) | 125 | 2 | 200 |
| **868** | Downstream (TX Wirnet iBTS) | 868,9+i*0,2MHz (i= 0 à 1) | 125 | 2 | 200 |
| **868** | Upstream (RX Wirnet iBTS) | 869,525MHz | 125 | 1 | 250 |
| **868** | Downstream (TX Wirnet iBTS) | 869,525MHz | 125 | 1 | 250 |
| **868** | Upstream (RX Wirnet iBTS) | 869,850MHz | 125 | 1 | 300 |
| **868** | Downstream (TX Wirnet iBTS) | 869,850MHz | 125 | 1 | 300 |
| **868** | Upstream (RX Wirnet iBTS) | 870,1+i*0,2MHz (i= 0 à 14) | 125 | 15 | 200 |
| **868** | Downstream (TX Wirnet iBTS) | 870,1+i*0,2MHz (i= 0 à 14) | 125 | 15 | 200 |

**Note :** in South Korea, the channels defined for the "923" version must be shifted by 100KHz to meet Korean regulations i.e. 917.1MHz to 923.3MHz with 200KHz steps.

#### 1.5.4.7 Output Power

The conducted output power can be adjusted from 0dBm to +30dBm.
This offers a wide range of adjustment to cover all specific countries EIRP requirements.
Antenna gain has to be considered to adjust the conducted output power to not overrule the max allowed EIRP.

| Description | Specification |
|---|---|
| **Conducted output power range** | 0dBm to +30dBm |
| **Ripple in the band** | +/- 2dB |
| **Variation over temperature range (-20°C to +55°C)** | +/- 2dB |

For Wirnet iBTS 64 Highway, depending on the number of simultaneous Tx, the power of each carrier must be adjusted to not overrule the max +30dBm total power.
The Wirnet iBTS 64 Highway is able to transmit 4 RF signals simultaneously at each RF antenna port.

#### 1.5.4.8 Out of band emissions

Due to the very low noise transmitter, the LoRa LOC module is able to achieve excellent out of band emissions levels in the LTE, UMTS and GSM uplink or downlink bands.

The performances are summarized in the following table:

| Version LoRa LOC module | LTE, UMTS or GSM band | Out of band emissions |
|---|---|---|
| **868** | E-GSM900 UL (880-915MHz) | -85dBm/100KHz |
| **868** | R-GSM900 UL (876-915MHz) | -75dBm/100KHz |
| **868** | LTE800 (832-862MHz) | -80dBm/100KHz |
| **915** | GSM850 DL (869-894MHz) | -85dBm/100KHz |
| **915 64 Highway** | GSM850 DL (869-894MHz) | -125dBm/100KHz |
| **923** | GSM900 UL(890-915MHz) | -85dBm/100KHz |
| **923** | GSM900 DL(935-960MHz) | -85dBm/100KHz |

The performances detailed here are worst case i.e. when transmitting at maximum output power at the edge of the band.
Out of band emissions in other LTE, UMTS or GSM bands are not detailed but are obviously better.
The LORA-LOC module is therefore ideal in co-localization with BTS.

#### 1.5.4.9 Sensitivity

The typical sensitivity performance, depending on the version, at 10% PER, 20 bytes payload is the following:

| Mode | 868 | 915 | 915 64 Highway | 923 |
|---|---|---|---|---|
| **SF7/125KHz** | -128dBm | -127dBm | -127dBm | -128dBm |
| **SF10/125KHz** | -136dBm | -136dBm | -135dBm | -134dBm |
| **SF12/125KHz** | -141dBm | -141dBm | -140dBm | -140dBm |
| **SF7/250KHz** | -125dBm | - | - | -125dBm |
| **SF12/250KHz** | -138dBm | - | - | -135dBm |
| **SF7/500KHz** | -121dBm | -121dBm | -121dBm | -122dBm |
| **SF12/500KHz** | -135dBm | -134dBm | -134dBm | -134dBm |

The sensitivity may vary over the frequency band and over temperature as follows:

| Description | Specification |
|---|---|
| **Sensitivity variation over the band** | +/- 2dB |
| **Sensitivity variation over temperature range (-20°C to +60°C)** | +/- 1dB |

#### 1.5.4.10 RSSI and SNR

The Wirnet iBTS is able to receive LoRa frames from -20dBm to -141dBm, depending on the LoRa BW and SF.

The Wirnet iBTS provides for each received frame, the RSSI and the SNR.
The RSSI is the "signal + noise" measurement of the received frame. Due to the wide spreading modulation, the LoRa receiver is able to demodulate signals below the noise floor i.e. with negative SNR.
To estimate the signal strength of the received frame, both SNR and RSSI have to be considered. As a rough estimate:

- If SNR >0, the signal strength = RSSI (dBm)
- If SNR <0, the signal strength = RSSI+SNR (dBm)

RSSI varies from -20dBm to -120dBm. -120dBm is the noise floor measured in a 200KHz BW.
SNR is between 10 to 15dB for strong signals. It is close to 0dB when the signal strength approaches -120dBm. It can decrease down to -7dB or -20dB depending on the SF:

| Spreading Factor | LoRa demodulator SNR |
|---|---|
| **SF7** | -7.5dB |
| **SF8** | -10dB |
| **SF9** | -12.5dB |
| **SF10** | -15dB |
| **SF11** | -17.5dB |
| **SF12** | -20dB |

The following picture is an example of LoRa receiver characterization at SF7 / 125KHz BW. It describes the SNR, RSSI and RSSI+SNR measured vs. the signal strength:

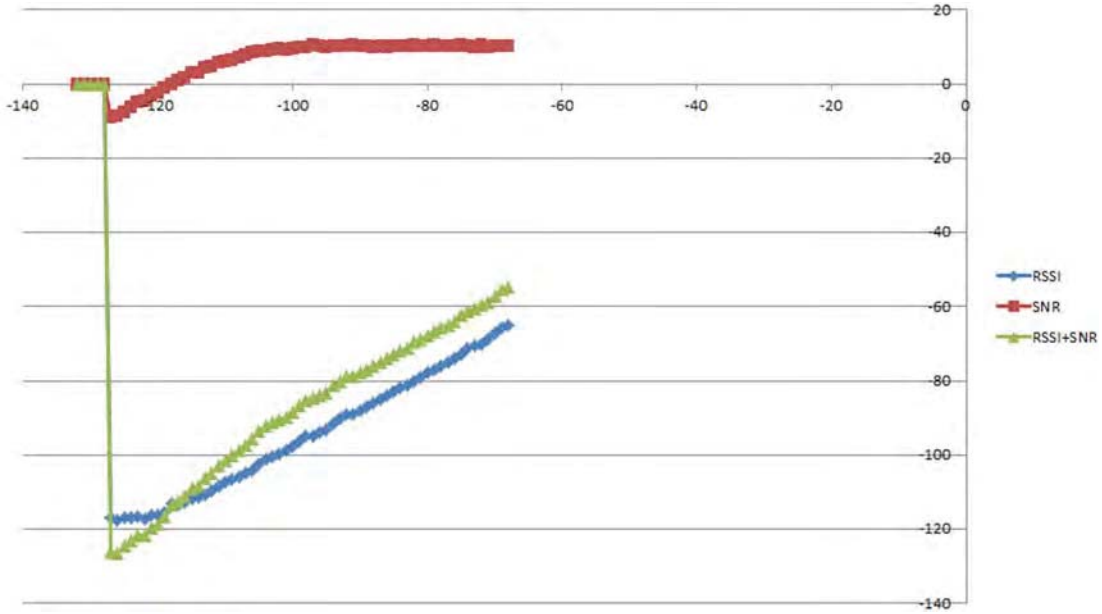


Figure 33: Example of SNR, RSSI and RSSI+SNR plots at 125KHz BW / SF7

#### 1.5.4.11 Out of band blockers rejection

In the following tables, the out of band rejection is measured with a useful signal (LoRa) adjusted 3dB above the sensitivity. The blocker level (CW) is adjusted to reach 10% PER.
The level of the blockers is noticed in the table and also the difference (in dB) with the useful LoRa signal.

##### 1.5.4.11.1 868MHz

The useful signal is adjusted at 869.525MHz.
The blockers rejections, at SF12 are the following:

| Offset | SF12/125KHz |
|---|---|
| **+/-2MHz** | 100dB |
| **+/-10MHz** | 125dB |
| **821MHz** | >150dB |
| **880MHz** | 130dB |
| **935MHz** | >150dB |
| **960MHz** | >150dB |

##### 1.5.4.11.2 915MHz

The useful signal is adjusted at 915MHz.
The blockers rejections, at SF10 are the following:

| Offset | SF10/125KHz |
|---|---|
| **+/-2MHz** | 90dB |
| **+/-10MHz** | 100dB |
| **850MHz** | 140dB |
| **894MHz** | 110dB |
| **935MHz** | 110dB |
| **960MHz** | 140dB |

##### 1.5.4.11.1 915MHz 64 Highway

The useful signal is adjusted at 908.5MHz.
The blockers rejections, at SF10 are the following:

| Offset | SF10/125KHz |
|---|---|
| **+/-2MHz** | 90dB |
| **+/-10MHz** | 120dB |
| **850MHz** | 140dB |
| **894MHz** | 140dB |
| **935MHz** | 140dB |
| **960MHz** | 140dB |

#### 1.5.4.11.2 923MHz

The useful signal is adjusted at 923MHz.
The blockers rejections, at SF12 are the following:

| Offset | SF12/125KHz |
|---|---|
| **+/-2MHz** | 100dB |
| **+/-10MHz** | 115dB |
| **850MHz** | >150dB |
| **894MHz** | 140dB |
| **910MHz** | 120dB |
| **935MHz** | 130dB |
| **960MHz** | >150dB |

### *1.5.5 Dual duplexer*

The dual duplexer is used only in the Wirnet iBTS 64 Highway.

#### 1.5.5.1 Mechanical description

The dual duplexer features two duplexers in the same enclosure.
The main mechanical characteristics of the dual duplexer are detailed hereafter:

| Description | Specification |
|---|---|
| **Radiators material** | Aluminum |
| **Dimensions** | 236 mm x 100 mm x 40 mm |
| **Weight** | 1300 g |

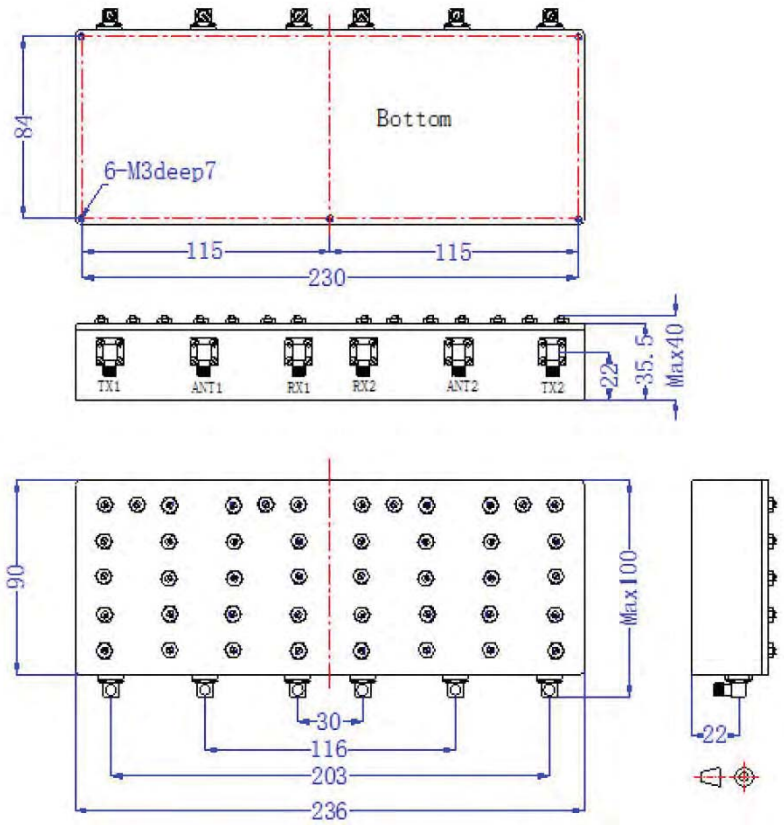


Figure 34: Dimensions of the dual duplexer

#### 1.5.5.2 Connectors

The dual duplexer includes the following connectors:

| Module side | Connector / interface | Description |
|---|---|---|
| **Top side** | ANT1 RF connector (SMA) | LoRa RF signal #1 to be connected to the LoRa antenna # 1 |
| **Top side** | TX1 RF connector (SMA) | LoRa TX signal #1 to be connected to the front-end RF # 1 TX |
| **Top side** | RX1 RF connector (SMA) | LoRa RX signal #1 to be connected to the front-end RF # 1 RX |
| **Top side** | ANT2 RF connector (SMA) | LoRa RF signal #2 to be connected to the LoRa antenna # 2 |
| **Top side** | TX2 RF connector (SMA) | LoRa TX signal #2 to be connected to the front-end RF # 2 TX |
| **Top side** | RX2 RF connector (SMA) | LoRa RX signal #2 to be connected to the front-end RF # 2 RX |

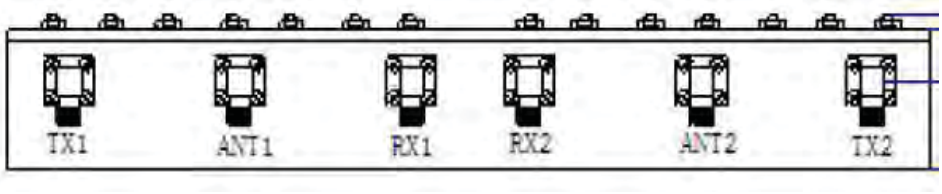


Figure 35: Connectors of the dual duplexer

**Note:** SMB to SMA coaxial cables are used to connect the duplexer to the antenna connectors.

#### 1.5.5.3 Technical performance

The main RF characteristics of the dual duplexer are detailed hereafter:

| Description | Specification RX band | Specification TX band |
|---|---|---|
| **Band pass frequency range** | 902-915 MHz | 923-928 MHz |
| **Center frequency** | 908.5 MHz | 925.5 MHz |
| **Return Loss** | >20dB | >20dB |
| **Ripple** | <1.0dB | <0.5dB |
| **Insertion losses** | <2.0dB | <2.0dB |
| **Rejection** | ≥70 dB@923-928 MHz | ≥70 dB@902-915 MHz |
| | ≥60 dB@50-850 MHz | ≥60 dB@50-850 MHz |
| | ≥50 dB@850-894 MHz | ≥60 dB@850-894 MHz |
| | ≥60 dB@935-960 MHz | ≥50 dB@935-960 MHz |
| | ≥60 dB@960-2000 MHz | ≥60 dB@960-2000 MHz |
| | ≥50 dB@2000-3000 MHz | ≥50 dB@2000-3000 MHz |
| **Isolation TX/Rx** | >70dB | |
| **Connector** | SMA F right angle | |
| **Power handling** | 10W CW | |
| **Impedance** | 50 ohms | |
| **Operating temperature** | -40°C to +85°C | |

The amplitude / frequency response of the duplexer is presented below:

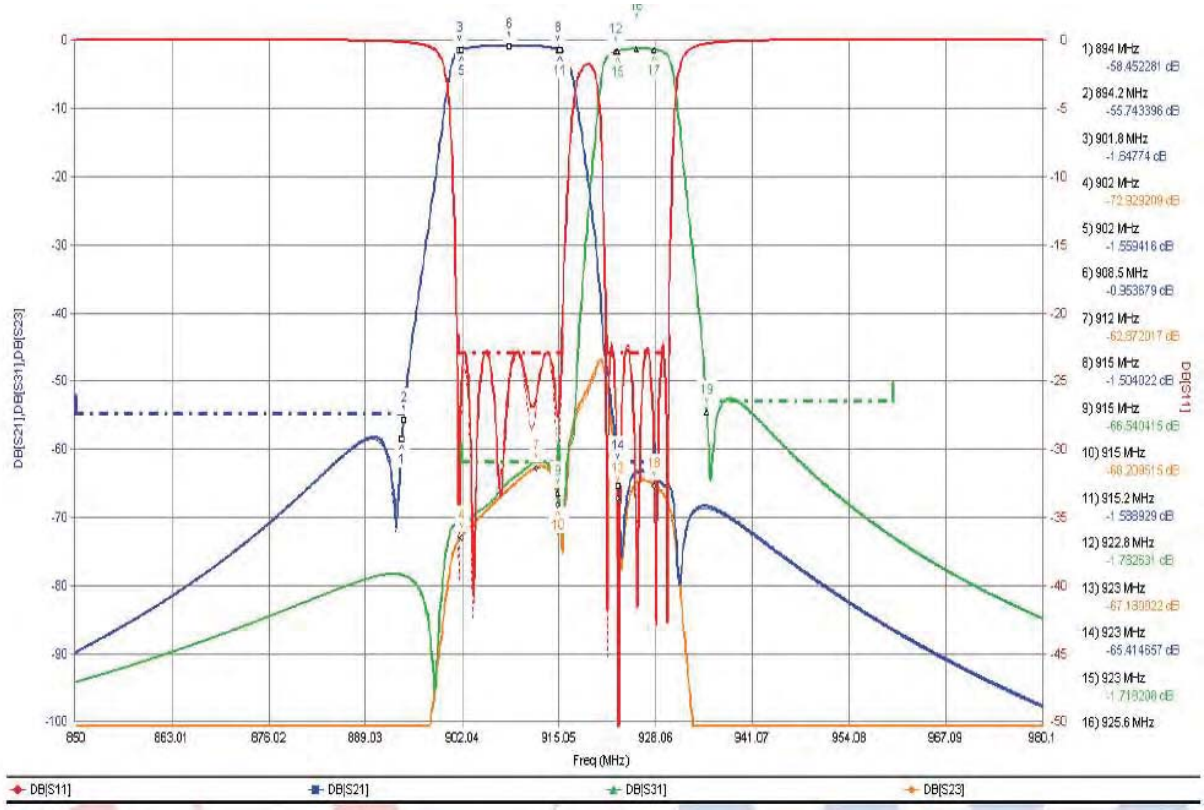


Figure 36: S parameters of the dual duplexer

## 1.6 Power supply

### *1.6.1 PoE injectors*

One Midspan PoE injector among the following list is provided with each Wirnet iBTS:

- Indoor AC/DC Midspan PoE injector 30W
- Indoor AC/DC Midspan PoE injector 60W
- Indoor DC/DC Midspan PoE injector 30W
- Indoor DC/DC Midspan PoE injector 60W
- Outdoor AC/DC Midspan PoE injector 30W
- Outdoor AC/DC Midspan PoE injector 60W
- Outdoor DC/DC Midspan PoE injector 60W

Detailed characteristics of those references are done on the following chapters.
Customers have to select the good reference during the ordering.

The Midspan PoE injector 30W is dedicated to the Wirnet iBTS Compact.
The Midspan PoE injector 60W is dedicated to the Wirnet iBTS gateways.
Both versions can be declined for indoor applications or outdoor applications.

AC/DC vs. DC/DC choice is application dependent.
In case only 110/220VAC is available, AC/DC solution is preferred.
In case additional DC backup (type 48V) is available, DC/DC solution may be envisaged.

**Note 1:** beware of the operating ambient temperature of the Midspan PoE injectors. Output power derating over +40°C has to be carefully considered to insure proper supply of the Wirnet iBTS. If the ambient temperature range cannot be guaranteed below +40°C, the Midspan PoE injector may have to be re-dimensioned. A 60W PoE injector could be then recommended instead of a 30W PoE injector.

**Note 2:** the power supply of the Wirnet iBTS must be a limited power source. All the PoE injectors listed below must then considered as limited power sources.

#### 1.6.1.1 PoE injectors recommendations

Kerlink recommends using only the validated references of the provided list.

Some POE solutions may not be compatible with the Wirnet iBTS.
This is particularly true for specific DC application where the Wirnet iBTS is in power supply colocation with other equipments. In such cases, some equipment may have connection between earthing system and the power supply connection (either “+” or “-“ wire) dependent if the application is in +48VDC or -48VDC. As the electrical ground of the Wirnet

iBTS is directly connected to the earthing system of the installation, dysfunction may occur without POE insulation.

The following drawing shows the insulation importance of the PoE injector.

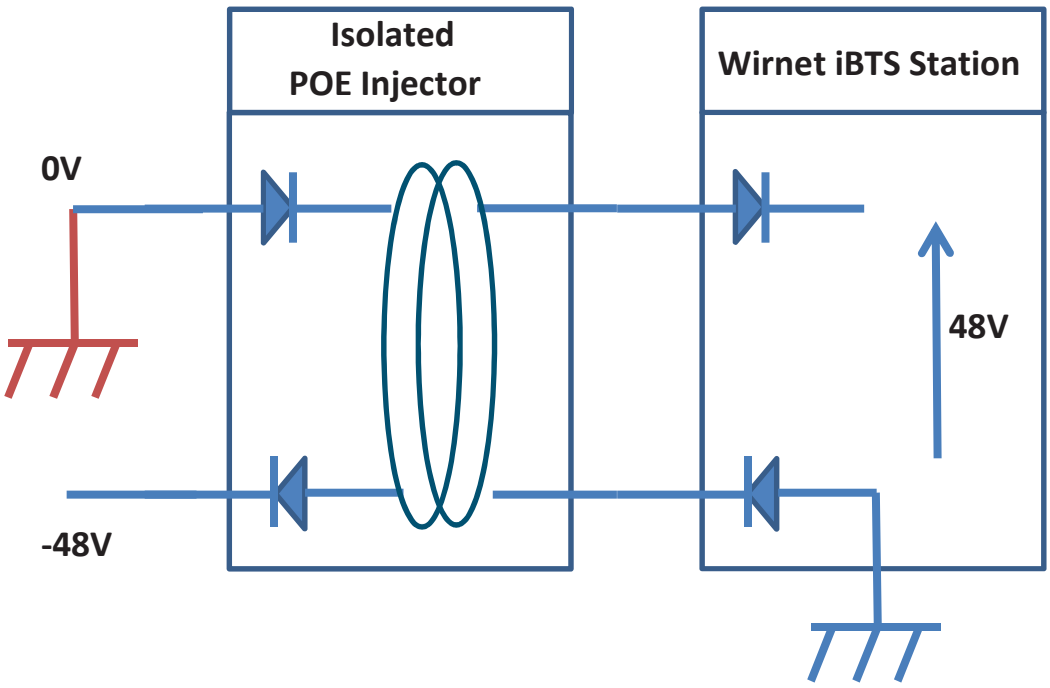


Figure 37 : Required isolation on PoE injector

### 1.6.1.2 Indoor AC/DC Midspan PoE injector 30W

The indoor AC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af backward compatible |
| **PoE Output Power** | 30 Watts (Guaranteed) |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | 4/5 (+), 7/8 (–) |
| **Input Power Requirements** | AC Input Voltage: 100 to 240 VAC<br>AC Input Current: 0.8A @100-240VAC<br>AC Frequency: 50 to 60 Hz |
| **Dimensions** | 53 mm (W) x 32.5 mm (H) x 140 mm (L) |

| | |
|---|---|
| **Weight** | 200g |
| **Connectors** | Shielded RJ-45, EIA 568A and 568B |
| **Indicator** | AC Power (Yellow)<br>Channel Power (Green) |
| **Operating Ambient Temperature** | -20°C to +40°C @ 30W<br>-20°C to +55°C @ 25W |
| **Operating Humidity** | Maximum 90%, Non-condensing |
| **Storage Temperature** | -20°C to +70°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions)<br>EN 55024 (Immunity)<br>VCCI |
| **Safety Approvals** | UL/cUL Per IEC 60950-1<br>GS Mark Per IEC 60950-1 |

**Note 1:** beware of the operating ambient temperature. Output power derating over +40°C has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor AC/DC Midspan PoE injector 30W:

Figure 38 : indoor 30W AC/DC POE injector

The indoor AC/DC Midspan PoE injector 30W can be provided with E/F type cable (Europe) or B type cable (USA). See §6 to order the required version.

**Note 2:** this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.
If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.6.

**Note 3:** this PoE injector is intended for indoor applications only.
In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.6.

### 1.6.1.3 Indoor AC/DC Midspan PoE injector 60W

The indoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af compatible |
| **PoE Output Power** | 60 Watts over 4 pairs |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | Data Pairs 1/2 (-) and 3/6 (+)<br>Spare Pairs 7/8 (-) and 4/5 (+) |
| **Input Power Requirements** | AC Input Voltage: 100 to 240 VAC<br>AC Input Current: 1.2A @100-240VAC<br>AC Frequency: 50 to 60 Hz |
| **Dimensions** | 62 mm (W) x 38 mm (H) x 151 mm (L) |
| **Weight** | 320g |
| **Connectors** | Shielded RJ-45, EIA 568A and 568B |
| **Indicator** | AC Power (Yellow)<br>Channel Power delivered over 4 pairs (Green) |
| **Operating Ambient Temperature** | -10°C to +40°C @ 60W<br>-10°C to +55°C @ 30W |
| **Operating Humidity** | Maximum 90%, Non-condensing |
| **Storage Temperature** | -20°C to +70°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions) |

| | |
|---|---|
| | EN 55024 (Immunity)<br>VCCI |
| **Safety Approvals** | UL/cUL Per IEC 60950-1<br>GS Mark Per IEC 60950-1 |

**Note 1:** beware of the operating ambient temperature. Output power derating over +40°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor AC/DC Midspan PoE injector 60W:

Figure 39 : indoor 60W AC/DC POE injector

The indoor AC/DC Midspan PoE injector 60W can be provided with E/F type cable (Europe) or B type cable (USA). See §6 to order the required version.

**Note 2:** this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.
If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

**Note 3:** this PoE injector is intended for indoor applications only.
In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

#### 1.6.1.4 Indoor DC/DC Midspan PoE injector 30W

The indoor DC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at |
| **PoE Output Power** | 30 Watts over 4 pairs |
| **PoE Output Voltage** | 55 VDC<br>54-57 VDC under all conditions |
| **PoE Pin Assignment and Polarity** | Data Pairs 1/2 (-) and 3/6 (+)<br>Spare Pairs 7/8 (-) and 4/5 (+) |
| **Input Power Requirements** | DC Input Voltage: 36-72VDC<br>DC Input Current: 0.6A |
| **Dimensions** | 65 mm (W) x 36 mm (H) x 140 mm (L) |
| **Weight** | 200g |
| **Connectors** | Shielded RJ-45, EIA 568A and 568B |
| **Indicator** | Green LED 1: Input power “ON”<br>Green LED 2: Valid IEEE8-2.3at load detected and connected “PoE PLUS”<br>Green LED 3: Valid IEEE802.3af load detected and connected |
| **Operating Ambient Temperature** | -20°C to +50°C |
| **Operating Humidity** | Maximum 90%, Non-condensing |
| **Storage Temperature** | -25°C to +85°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions) |
| **Immunity** | ESD: EN61000-4-2. Level 3<br>RS: EN61000-4-3. Level 3<br>EFT: EN61000-4-4. Level 2<br>Surge: EN61000-4-5. Level 3<br>CS: EN61000-4-6. Level 3 |

**Note 1:** beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor DC/DC Midspan PoE injector 30W:

Figure 40 : indoor 30W DC/DC POE injector

The indoor DC/DC Midspan PoE injector 30W is provided with Euroblock plug.

**Note 2:** this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.
If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

**Note 3:** this PoE injector is intended for indoor applications only.
In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

### 1.6.1.5 Indoor DC/DC Midspan PoE injector 60W

The indoor DC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af compatible |
| **PoE Output Power** | 60 Watts over 4 pairs |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | Data Pairs 1/2 (-) and 3/6 (+)<br>Spare Pairs 7/8 (-) and 4/5 (+) |
| **Input Power Requirements** | DC Input Voltage: 36-60VDC<br>DC Input Current: 2A |
| **Dimensions** | 87 mm (W) x 43 mm (H) x 166 mm (L) |

| | |
|---|---|
| **Weight** | 450g |
| **Connectors** | Shielded RJ-45, EIA 568A and 568B |
| **Indicator** | DC Power (Green)<br>Channel Power delivered over 4 pairs (Green) |
| **Operating Ambient Temperature** | -20°C to +40°C @ 60W<br>-20°C to +50°C @ 30W |
| **Operating Humidity** | Maximum 90%, Non-condensing |
| **Storage Temperature** | -20°C to +70°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions)<br>EN 55024 (Immunity)<br>VCCI |
| **Safety Approvals** | UL/cUL Per IEC 60950-1<br>GS Mark Per IEC 60950-1 |

**Note 1:** beware of the operating ambient temperature. Output power derating over +40°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the indoor DC/DC Midspan PoE injector 60W:

Figure 41 : indoor 60W DC/DC POE injector

The indoor DC/DC Midspan PoE injector 60W is provided with Euroblock plug.

**Note 2:** this indoor PoE injector must be connected to an industrial electrical installation including lighting protections. It must include a main board with surge protections type 1 and a secondary board with surge protections type 2.
If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection as detailed in §1.6.1.7.

**Note 3:** this PoE injector is intended for indoor applications only.
In case the PoE injector cannot be installed indoor, use an alternate PoE injector dedicated to outdoor applications as detailed in §1.6.1.7.

### 1.6.1.6 Outdoor AC/DC Midspan PoE injector 30W

The outdoor AC/DC Midspan PoE injector 30W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af backward compatible |
| **PoE Output Power** | 30 Watts (Guaranteed) |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | 4/5 (+), 7/8 (–) |
| **Input Power Requirements** | AC Input Voltage: 100 to 240 VAC<br>AC Input Current: 1A @100-240VAC<br>AC Frequency: 50 to 60 Hz |
| **Dimensions** | 170 mm x 140 mm x 60 mm |
| **Weight** | 1400g |
| **Connectors** | Shielded rugged RJ-45 with gasket<br>EIA 568A and 568B |
| **Indicator** | None |
| **Operating Ambient Temperature** | -40°C to +65°C |
| **Operating Humidity** | Maximum 95%, Non-condensing |
| **Storage Temperature** | -40°C to +85°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Ingress protection** | IP66, NEMA 4X |
| **Corrosion resistance** | ASTM B-117 |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions)<br>EN 55024 (Immunity)<br>EN 61000-4-5 Class 5 (6kV CM)<br>VCCI |
| **Surge protection** | GR-1089-CORE Issue 4<br>ITU-T K.20 6 kV on AC lines |
| **Safety Approvals** | UL 60950-1, UL 60950-22<br>GS Mark |

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**Note 1:** beware of the operating ambient temperature. Output power derating over +55°C has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor AC/DC Midspan PoE injector 30W:

Figure 42 : Outdoor 30W AC/DC POE injector

**Note 2:** this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

#### 1.6.1.7 Outdoor AC/DC Midspan PoE injector 60W

The outdoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af compatible |
| **PoE Output Power** | 60 Watts over 4 pairs |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | Data Pairs 1/2 (-) and 3/6 (+)<br>Spare Pairs 7/8 (-) and 4/5 (+) |
| **Input Power Requirements** | AC Input Voltage: 100 to 240 VAC<br>AC Input Current: 2A @100-240VAC<br>AC Frequency: 50 to 60 Hz |
| **Dimensions** | 170 mm x 140 mm x 60 mm |
| **Weight** | 1400g |


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| | |
|---|---|
| **Connectors** | Shielded rugged RJ-45 with gasket<br>EIA 568A and 568B |
| **Indicator** | None |
| **Operating Ambient Temperature** | -40°C to +65°C |
| **Operating Humidity** | Maximum 95%, Non-condensing |
| **Storage Temperature** | -40°C to +85°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Ingress protection** | IP66, NEMA 4X |
| **Corrosion resistance** | ASTM B-117 |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions)<br>EN 55024 (Immunity)<br>EN61000-4-5 Class 5 (6kV CM)<br>VCCI |
| **Surge protection** | GR-1089-CORE Issue 4<br>ITU-T K.20 6 kV on AC lines |
| **Safety Approvals** | UL 60950-1, UL 60950-22<br>GS Mark |

**Note 1:** beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor AC/DC Midspan PoE injector 60W:

Figure 43 : Outdoor 60W AC/DC POE injector

**Note 2:** this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

#### 1.6.1.8 Outdoor DC/DC Midspan PoE injector 60W

The outdoor AC/DC Midspan PoE injector 60W characteristics are detailed in the following table:

| Description | Specification |
|---|---|
| **Ethernet data rates** | 10/100/1000Base-T |
| **Number of ports** | 1 |
| **PoE compatibility** | IEEE 802.3at<br>IEEE 802.3af compatible |
| **PoE Output Power** | 60 Watts over 4 pairs |
| **PoE Output Voltage** | 55 VDC |
| **PoE Pin Assignment and Polarity** | Data Pairs 1/2 (-) and 3/6 (+)<br>Spare Pairs 7/8 (-) and 4/5 (+) |
| **Input Power Requirements** | DC Input Voltage: 36 to 60 VDC<br>DC Input Current: 2.2A |
| **Dimensions** | 150 mm (W) x 70 mm (H) x 214 mm (L) |
| **Weight** | 750g |
| **Connectors** | Shielded rugged RJ-45 with gasket<br>EIA 568A and 568B |
| **Indicator** | None |
| **Operating Ambient Temperature** | -40°C to +50°C @ 60W<br>-40°C to +55°C @ 30W |
| **Operating Humidity** | Maximum 95%, Non-condensing |
| **Storage Temperature** | -40°C to +85°C |
| **Storage Humidity** | Maximum 95%, Non-condensing |
| **Ingress protection** | IP66, NEMA 4X |
| **Corrosion resistance** | ASTM B-117 |
| **Regulatory compliance** | RoHS<br>WEEE<br>CE |
| **Electromagnetic Emission & Immunity** | FCC Part 15, Class B<br>EN 55022 Class B (Emissions)<br>EN 55024 (Immunity)<br>EN61000-4-5 Class 5 (6kV CM)<br>VCCI |
| **Surge protection** | GR-1089-CORE Issue 4 |
| **Safety Approvals** | UL 60950-1, UL 60950-22<br>GS Mark |

**Note 1:** beware of the operating ambient temperature. Output power derating over +50°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS.

The following figure details the outdoor DC/DC Midspan PoE injector 60W:

Figure 44 : Outdoor 60W DC/DC POE injector

**Note 2:** this PoE injector must be connected to an industrial electrical installation including at least a main board with surge protections type 1.

### *1.6.2 Auxiliary power supply*

The Wirnet iBTS can be also supplied with an auxiliary DC power supply as a solar panel for instance. The input voltage range is 11 to 56VDC. A 24V DC solar system is then recommended for optimized performance.
The power supply must be qualified as a limited power source.
The maximum power is 30W.
The nominal current for a 24V power supply is about 1.2A in the following configuration:

- HSPA in a network attached mode
- 4 LoRa LOC modules / all demodulators activated
- 20% CPU load

A two-wires cable is required to interconnect the auxiliary power supply connector.
The installation of the cable is detailed in §4.6.5.

Specific DC applications where the Wirnet iBTS is in power supply colocation with other equipments require precautions. In such cases, some equipment may have connection between earthing system and the power supply connection (either "+" or "-" wire) dependent if the application is in +48VDC or -48VDC. As the electrical ground of the Wirnet

iBTS is directly connected to the earthing system of the installation, dysfunction may occur without additional insulation. In such casing, Kerlink recommends using additional isolated DC/DC.

The following drawing shows the insulation importance of an additional isolated DC/DC power supply:

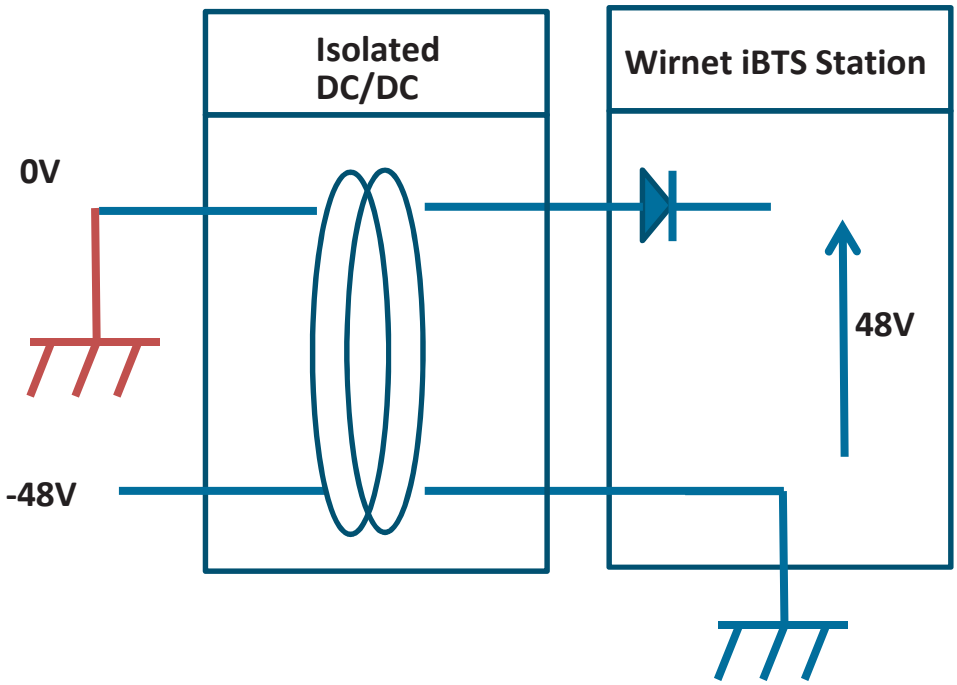


Figure 45 : Required isolation on auxiliary power supply input

An example of 40W isolated DC/DC converter is provided in the chapter 1.6.3

### *1.6.3 Isolated DC/DC converter 40W*

As detailed in paragraph 1.6.2, some specific installation using -48V DC supply require an isolated DC/DC converter.

The characteristics of a 40W isolated DC/DC converter are detailed in the following table:

| Description | Specification |
|---|---|
| **Input Voltage** | 48V DC typ.<br>18-75V DC range |
| **Input current at full load** | 0.93A |
| **Undervoltage Lockout** | ON at >18V<br>OFF at <16V |
| **Remote On/Off** | On: Logic High (3.5-12 V) or open circuit<br>Off: Logic Low (<1.2 V) or short pin 1 to pin 2 |

| | |
|---|---|
| **Output Voltage** | 48 VDC +/- 2% |
| **Output Power** | 40 Watts<br>> 30W at +60°C |
| **Efficiency** | Up to 90% |
| **Maximum capacitive load** | 150uF |
| **Line Regulation** | ±0.5 % |
| **Load Regulation** | 1 % (0 - 10% load) |
| **Ripple and noise** | 200 mV pk-pk 20MHz BW |
| **Short Circuit Protection** | Trip & Restart (hiccup mode), auto recovery |
| **Overload Protection** | 150 % (Trip & Restart, hiccup mode) |
| **Overvoltage Protection** | 120 % (Zener diode clamp) |
| **Temperature Coefficient** | 0.02 %/ °C |
| **Isolation** | 2500 VDC for 60 s |
| **Isolation Resistance** | 1000 MΩ at 500 VDC |
| **Dimensions** | 63.8 mm (W) x 25.6 mm (H) x 112 mm (L) |
| **Weight** | 162g |
| **Pins connections** | 1 Remote On/Off<br>2 -Vin<br>3 +Vin<br>4 +Vout<br>5 No Connection<br>6 -Vout<br>7 No Connection\<br>8 No Connection |
| **Operating Ambient Temperature** | -40°C to +70°C |
| **Operating Humidity** | Maximum 95%, Non-condensing |
| **Storage Temperature** | -50°C to +125°C |
| **Electromagnetic Emission** | EN 55022 Class A (Emissions) |
| **Thermal Impendance** | 4.25°C/W |
| **Immunity** | EN55024<br>ESD: EN61000-4-2, ±4 kV Contact, ±8 kV Air<br>RS: EN61000-4-3, 10 V/m<br>EFT: EN61000-4-4, Level 3<br>Surge: EN61000-4-5, Level 3<br>CS: EN61000-4-6, 10 Vm<br>MF: EN61000-4-8, 30 A/m |

**Note 1:** the 40W isolated DC/DC converter must be used with Wirnet iBTS Compact version. Do not use it with Wirnet iBTS version due to power limitations.

**Note 2:** beware of the operating ambient temperature. Output power derating over +60°C is critical and has to be carefully considered to insure proper supply of the Wirnet iBTS Compact.

The following figure details the 40W indoor DC/DC converter:

Figure 46 : Isolated 40W DC/DC converter

## 1.7 Power consumption

The maximum power consumption of each individual module is detailed hereafter:

| Module | Power consumption |
|---|---|
| **CPU module (20% load)** | 1.8W max |
| **WAN module (HSPA, 25% Tx, 75% Rx)** | 1.7W max |
| **LoRa LOC module (Rx mode)** | 6.5W max |
| **Four LoRa LOC module (Rx mode)** | 20W |
| **Four LoRa LOC module (Rx + Tx mode - 64 Highway)** | 25W |

The maximum power consumption per day of the Wirnet iBTS is then the following:

| Wirnet iBTS | Power consumption |
|---|---|
| **Wirnet iBTS Compact (1 LoRa LOC Module)** | 237Wh max |
| **Wirnet iBTS with 2 x LoRa LOC Modules** | 392Wh max |
| **Wirnet iBTS with 3 x LoRa LOC Modules** | 547Wh max |
| **Wirnet iBTS with 4 x LoRa LOC Modules** | 702Wh max |
| **Wirnet iBTS 64 Highway** | 720Wh max |

**Note:** the power supply of the Wirnet iBTS must be a limited power source.

## 1.8 Description of the accessories

### *1.8.1 LoRa antennas*

#### 1.8.1.1 Omnidirectional antenna 868MHz 3dBi

The specifications of the omnidirectional 868MHz / 3dBi antenna are the following:

| Item | Specification |
|---|---|
| **Frequency range** | 868MHz +/- 5MHz |
| **Impedance** | 50 ohms |
| **Technology** | Half wave |
| **VSWR** | <1.3:1 |
| **Max gain** | 3dBi |
| **Polarization** | Vertical |
| **Power handling** | 50W |
| **DC ground** | Yes |
| **Whip material** | Fiberglass |
| **Connector** | N female |
| **Length** | 30 cm |
| **Weight** | 75g |
| **IP rating** | IP66K |
| **Shock resistance** | IK08 |
| **Wind resistance** | 150MPH |
| **Operating temperature range** | -20°C to +60°C |
| **Salt, fog** | EN 60068-2-52, severity 1 |

The radiation patterns are presented here after. They are measured at 870MHz (red), 868MHz (green) and 866MHz (blue):

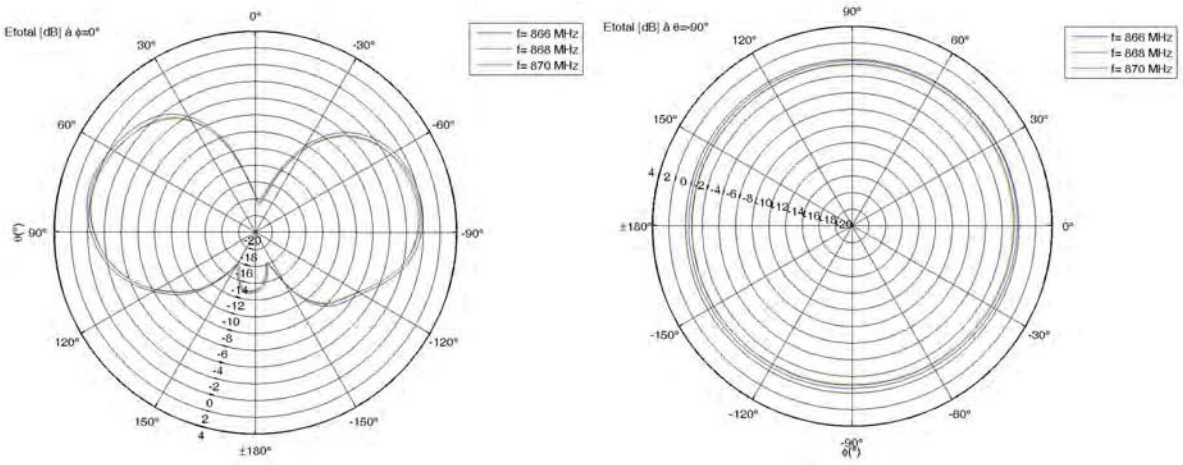


Figure 47 : Radiation pattern of omnidirectional 868MHz/3dBi antenna

#### 1.8.1.2 Omnidirectional antenna 868MHz 6dBi

The specifications of the omnidirectional 868MHz / 6dBi antenna are the following:

| Item | Specification |
|---|---|
| **Frequency range** | 865MHz +/- 5MHz |
| **Impedance** | 50 ohms |
| **Technology** | Collinear, dipole array |
| **VSWR** | <1.5:1 at 868MHz<br><2.0:1 at 860-870MHz |
| **Max gain** | 6dBi |
| **Polarization** | Vertical |
| **Vertical Beam width** | 25° |
| **Power handling** | 100W |
| **DC ground** | Yes |
| **Whip material** | Fiberglass |
| **Connector** | N female |
| **Length** | 110 cm |
| **Weight** | 540g |
| **IP rating** | IP66K |
| **Shock resistance** | IK08 |
| **Wind resistance** | 150MPH |
| **Operating temperature range** | -20°C to +60°C |
| **Salt, fog** | EN 60068-2-52, severity 1 |

The radiation patterns are presented here after. They are measured at 858MHz (red), 868MHz (blue) and 878MHz (purple):

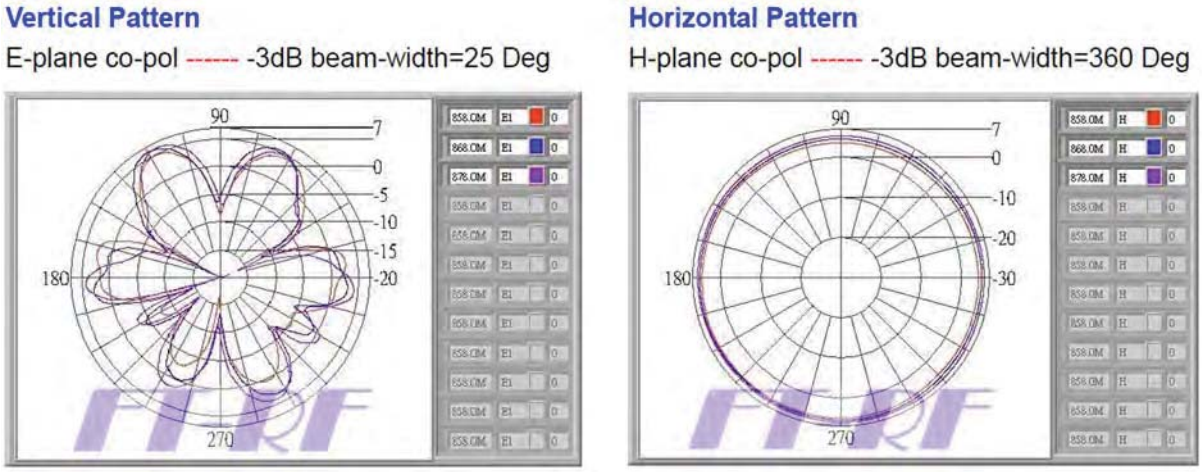


Figure 48 : Radiation pattern of omnidirectional 868MHz/6dBi antenna

**Note:** this antenna can not be installed on the universal antenna bracket but is provided with its own mounting kit.

### 1.8.1.3 Omnidirectional antenna 915MHz 3dBi

The specifications of the omnidirectional 915MHz / 3dBi antenna are the following:

| Item | Specification |
|---|---|
| **Frequency range** | 915MHz +/- 15MHz |
| **Impedance** | 50 ohms |
| **Technology** | Half wave |
| **VSWR** | <1.3:1 |
| **Max gain** | 3dBi |
| **Polarization** | Vertical |
| **Power handling** | 50W |
| **DC ground** | Yes |
| **Whip material** | Fiberglass |
| **Connector** | N female |
| **Length** | 30 cm |
| **Weight** | 75g |
| **IP rating** | IP66K |
| **Shock resistance** | IK08 |
| **Wind resistance** | 150MPH |
| **Operating temperature range** | -20°C to +60°C |
| **Salt, fog** | EN 60068-2-52, severity 1 |

The radiation patterns are presented here after. They are measured at 930MHz (red), 915MHz (green) and 900MHz (blue):

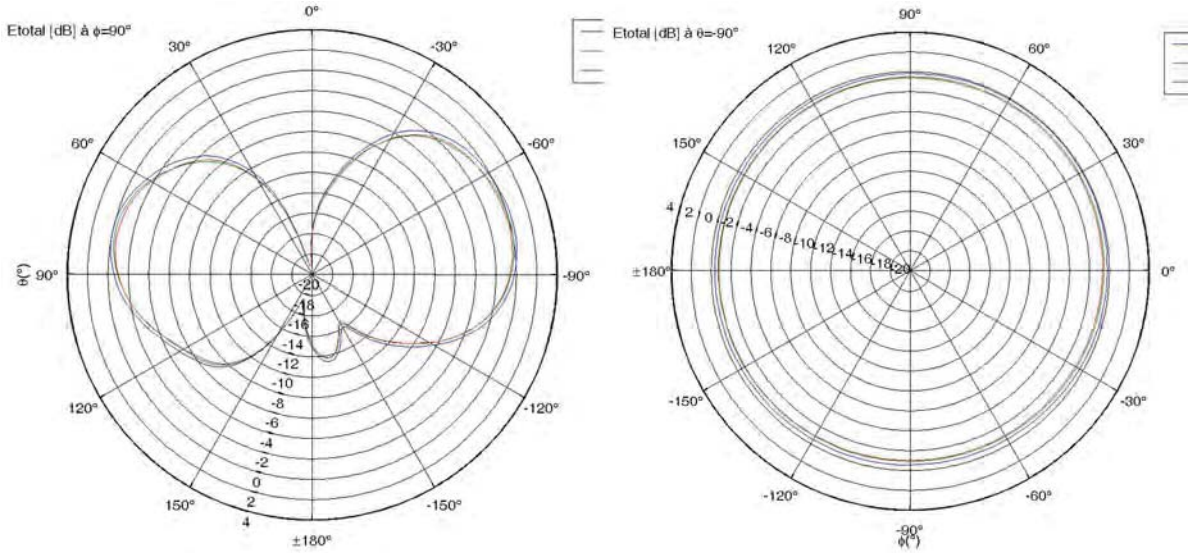


Figure 49 : Radiation pattern of omnidirectional 915MHz/3dBi antenna

#### 1.8.1.4 Omnidirectional antenna 915MHz 6dBi

The specifications of the omnidirectional 915MHz / 6dBi antenna are the following:

| Item | Specification |
|---|---|
| **Frequency range** | 915MHz +/- 15MHz |
| **Impedance** | 50 ohms |
| **Technology** | Collinear, dipole array |
| **VSWR** | <1.2:1 |
| **Max gain** | 6dBi |
| **Polarization** | Vertical |
| **Power handling** | 50W |
| **DC ground** | No |
| **Whip material** | Fiberglass |
| **Connector** | N female |
| **Length** | 100 cm |
| **Weight** | 380g |
| **IP rating** | IP66K |
| **Shock resistance** | IK08 |
| **Operating temperature range** | -20°C to +60°C |
| **Salt, fog** | EN 60068-2-52, severity 1 |

The radiation patterns are presented here after. They are measured at 900MHz (red), 915MHz (green) and 930MHz (blue):

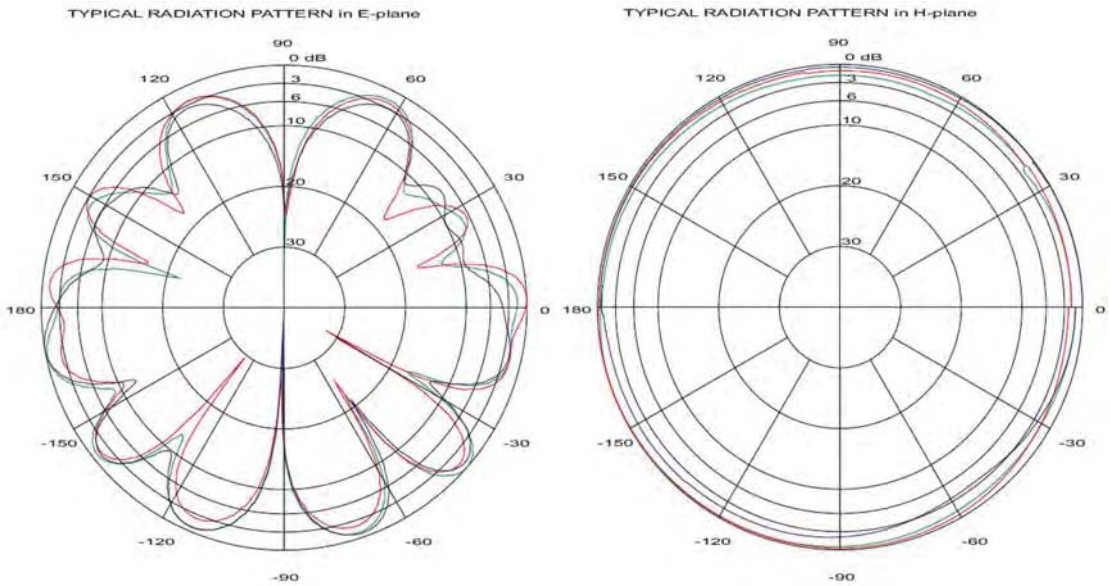


Figure 50 : Radiation pattern of omnidirectional 915MHz/6dBi antenna

KERLINK can provide two distinct references of 915MHz / 6dBi antennas, from two different suppliers. The first one must be installed on the universal antenna bracket whereas the second one has its own mounting kit. The second one cannot be installed on the universal antenna bracket.

### *1.8.2 GNSS and WAN antennas*

#### 1.8.2.1 GNSS antenna

The GNSS antenna is required for the Wirnet iBTS standard casing only, when featuring a "CPU module".
The Wirnet iBTS Compact embeds a GNSS/LTE internal antenna detailed in §1.8.2.3 and therefore does not require the GNSS antenna.

The GNSS antenna characteristics are detailed in the following table:

| Characteristics | Detail | Specification |
|---|---|---|
| **Frequency range** | | 1572 - 1606 MHz |
| **Antenna peak gain** | | 3dBic |
| **Typical VSWR** | | <2.0:1 |
| **Impedance** | | 50 ohms |
| **Polarization** | | RHCP |
| **Noise figure** | | 1.5dB typ |
| **Total gain** | | 27dB typ |
| **Out of band rejection** | | 30dB min at +/-100MHz |
| **IIP3** | | -10dBm |
| **IP1dB** | | -15dBm |
| **Input voltage** | | 3.0V - 5.5V |
| **Current drain** | | 11mA at 3V |
| **Cable length** | | 5 m |
| **Cable type** | | RG58 |
| **Connector type** | | N male |
| **Dimensions (DxH)** | Diameter and Height | 80 mm (D) x 42 mm (H) |
| **Operating temperature** | | -40°C to +85°C |
| **Wind resistance** | | > 200 km/h |
| **IP rating** | | IP66 |

**Note:** a dome antenna bracket is provided with the GNSS antenna, allowing wall mounting, pole mounting and metallic strapping. Screws, nuts, U-bolt and metallic strapping are not provided by KERLINK.

#### 1.8.2.2 LTE antenna

The LTE antenna is required for the Wirnet iBTS standard casing only, when featuring a "WAN module".
The Wirnet iBTS Compact embeds a GNSS/LTE internal antenna detailed in §1.8.2.3 and therefore does not require the LTE antenna.

The LTE antenna characteristics are detailed in the following table:

| Characteristics | Detail | Specification |
|---|---|---|
| **Frequency range** | Band 1 | 698-960 MHz |
| | Band 2 | 1700-2700MHz |
| **Peak gain** | Band 1 | 4dBi |
| | Band 2 | 2dBi |
| **Typical VSWR** | Band 1 & 2 | <2.4:1 |
| **Impedance** | | 50 ohms |
| **Polarization** | | Linear, Vertical |
| **Radiation pattern** | | Omnidirectional |
| **Type** | | No ground plane required |
| **Power handling** | | 10W min |
| **Cable length** | | 5 m |
| **Cable type** | | RG58 |
| **Connector type** | | N male |
| **Dimensions (DxH)** | Diameter and Height | 80 mm (D) x 42 mm (H) |
| **Operating temperature** | | -40°C to +85°C |
| **Wind resistance** | | > 200 km/h |
| **IP rating** | | IP66 |

**Note:** a dome antenna bracket is provided with the LTE antenna, allowing wall mounting, pole mounting and metallic strapping. Screws, nuts, U-bolt and metallic strapping are not provided by KERLINK.

#### 1.8.2.3 GNSS/LTE magnetic antenna

The GNSS/LTE magnetic antenna can be used with the Wirnet iBTS Compact casing only.
It is not required for the Wirnet iBTS standard casing.

The GNSS/LTE magnetic antenna characteristics are detailed in the following table:

| Characteristics | Description | Detail | Specification |
|---|---|---|---|
| **LTE antenna** | Frequency range | Band 1 | 698-960 MHz |
| | | Band 2 | 1700-2700MHz |
| | Peak gain | Band 1 | 1dBi |
| | | Band 2 | 0dBi |
| | Typical VSWR | Band 1 & 2 | <2.0:1 |
| | Impedance | | 50 ohms |
| | Polarization | | Vertical |
| | Radiation pattern | | Omnidirectional |
| | Type | | No ground plane required |

| | | |
|---|---|---|
| **GNSS antenna** | Power handling | 10W |
| | Frequency range | 1574 - 1606 MHz |
| | Peak gain | 3dBic |
| | Typical VSWR | <2.0:1 |
| | Impedance | 50 ohms |
| | Polarization | RHCP |
| | Type | Passive<br>No ground plane required |
| | DC block | Yes |
| **Mechanical** | Mounting type | Magnetic mount |
| | Cable length (x2)* | 15 cm |
| | Cable type (x2) | RG174 |
| | Connector type (x2)* | SMA male, right angle |
| | Dimensions (DxH) | 63 mm (D) x 16 mm (H) |
| | Operating temperature | -40°C to +85°C |

**Note:** the antenna must be mounted on the internal GNSS/LTE bracket, a mechanical part provided as standard with the Wirnet iBTS Compact (see §1.3.1 and Figure 10).

#### 1.8.2.4 Internal LTE antenna

The internal LTE antenna is required for the Wirnet iBTS Compact casing only, when featuring a “Dual WAN module”. It is not required for the Wirnet iBTS standard casing.

The internal LTE antenna characteristics are detailed in the following table:

| Characteristics | Detail | Specification |
|---|---|---|
| **Frequency range** | Band 1 | 824-960 MHz |
| | Band 2 | 1700-2300MHz |
| **Peak gain** | Band 1 & 2 | 0dBi |
| **Typical VSWR** | Band 1 & 2 | <2.5:1 |
| **Impedance** | | 50 ohms |
| **Polarization** | | Linear, Vertical |
| **Radiation pattern** | | Omnidirectional |
| **Type** | | Monopole |
| **Power handling** | | 10W min |
| **Connector type** | Right angle | SMA male |
| **Dimensions** | | 45 mm x 17.4 mm |
| **Operating temperature** | | -30°C to +75°C |

**Note:** the internal LTE antenna is directly mounted (screwed) on the SMA female connector of the Dual WAN module.

### *1.8.3 Cavity filters*

#### 1.8.3.1 865-867MHz cavity filter

The 865-867MHz cavity filter is typically dedicated to the Indian market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located LTE850 or CDMA800 base stations.

The 862-867MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Pass band** | 865-867MHz |
| **Insertion losses** | ≤4dB |
| **Ripple** | ≤1.0dB |
| **Return Loss** | ≥18db |
| **Rejection** | ≥60dB @ 806-860MHz<br>≥40dB @ 862MHz<br>≥50dB @ 869MHz<br>≥70dB @ 871-960MHz |
| **Impedance** | 50 ohms |
| **Power Handling** | ≤10W |
| **Temperature** | -30°C to+60°C |
| **Connectors** | N-Female / N-Male |
| **Waterproof** | IP66 |
| **Surface Finish** | Black Paint |
| **Dimensions (w/o N connectors)** | 196 x 104 x 50 mm |

The dimensions of the 865-867MHz cavity filter are detailed hereafter:

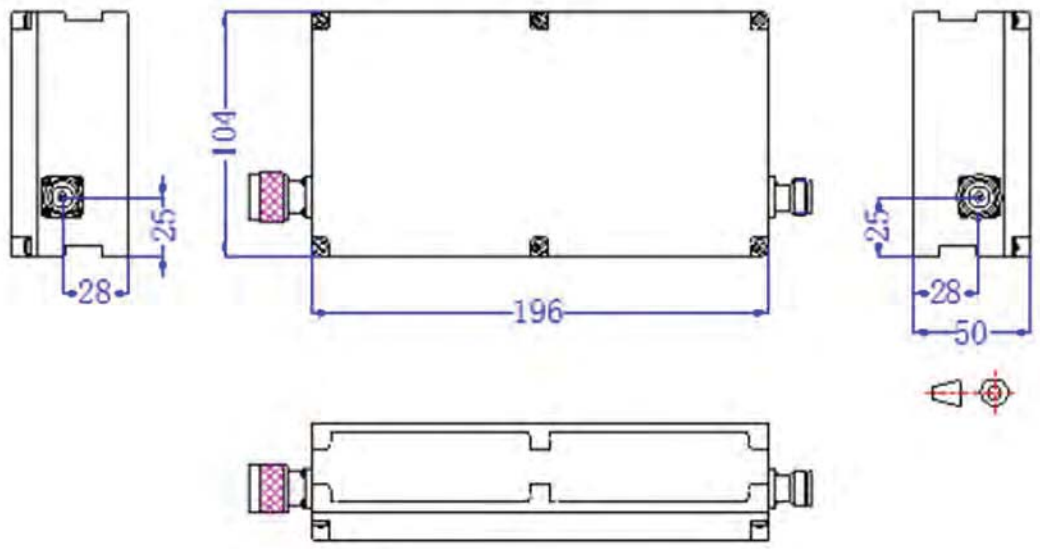


Figure 51 : Dimensions of the 865-867MHz cavity filter

The frequency response of 862-867MHz cavity filter is as follows:

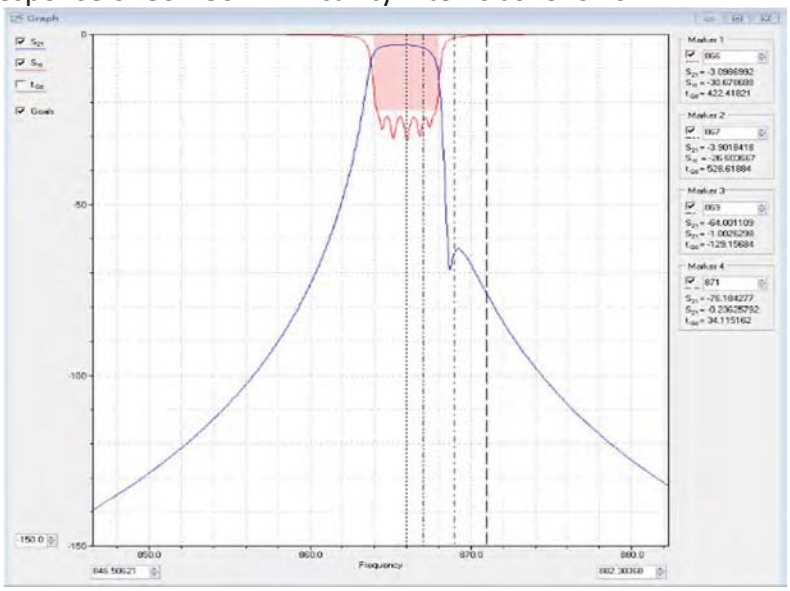

Figure 52 : Frequency response of the 865-867MHz cavity filter

### 1.8.3.2 865-870MHz cavity filter

The 865-870MHz cavity filter is typically dedicated to the European market. The purpose of this filter is to allow co-located LTE800 base stations, in case of poor isolation between antennas (less than 50dB).

The 865-870MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Center Frequency** | 867.5 MHz |
| **Pass band** | 865-870MHz |
| **Insertion losses** | ≤1dB |
| **Ripple** | ≤0.5dB |
| **Return Loss** | ≥20dB |
| **Rejection** | ≥30dB @ 10-824MHz<br>≥20dB @ 832-862MHz<br>≥20dB @ 880-925MHz<br>≥30dB @ 925-960MHz<br>≥30dB @ 960-3000MHz |
| **Impedance** | 50 ohms |
| **Power Handling** | ≤10W |
| **Temperature** | -30°C to+60°C |
| **Connectors** | N-Female / N-Male |
| **Waterproof** | IP66 |
| **Surface Finish** | Black Paint |
| **Weight** | <650g |
| **Dimensions (w/o N connectors)** | 100 x 100 x 49 mm |


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The dimensions of the 865-870MHz cavity filter are detailed hereafter:

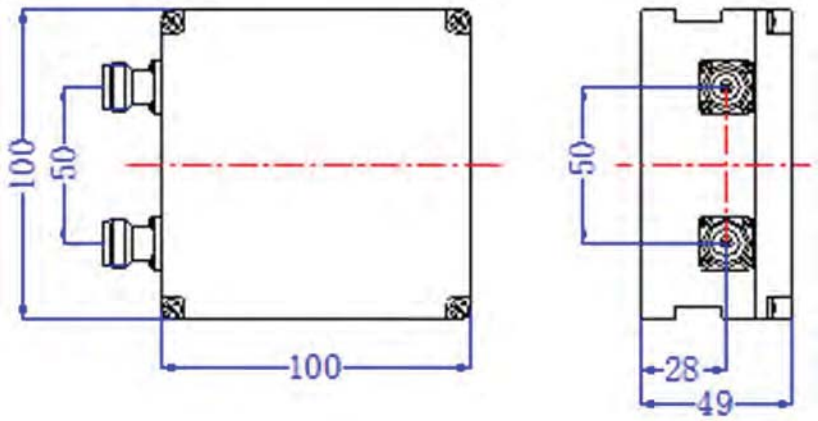


Figure 53 : Dimensions of the 865-870MHz cavity filter

The frequency response of 865-870MHz cavity filter is as follows:

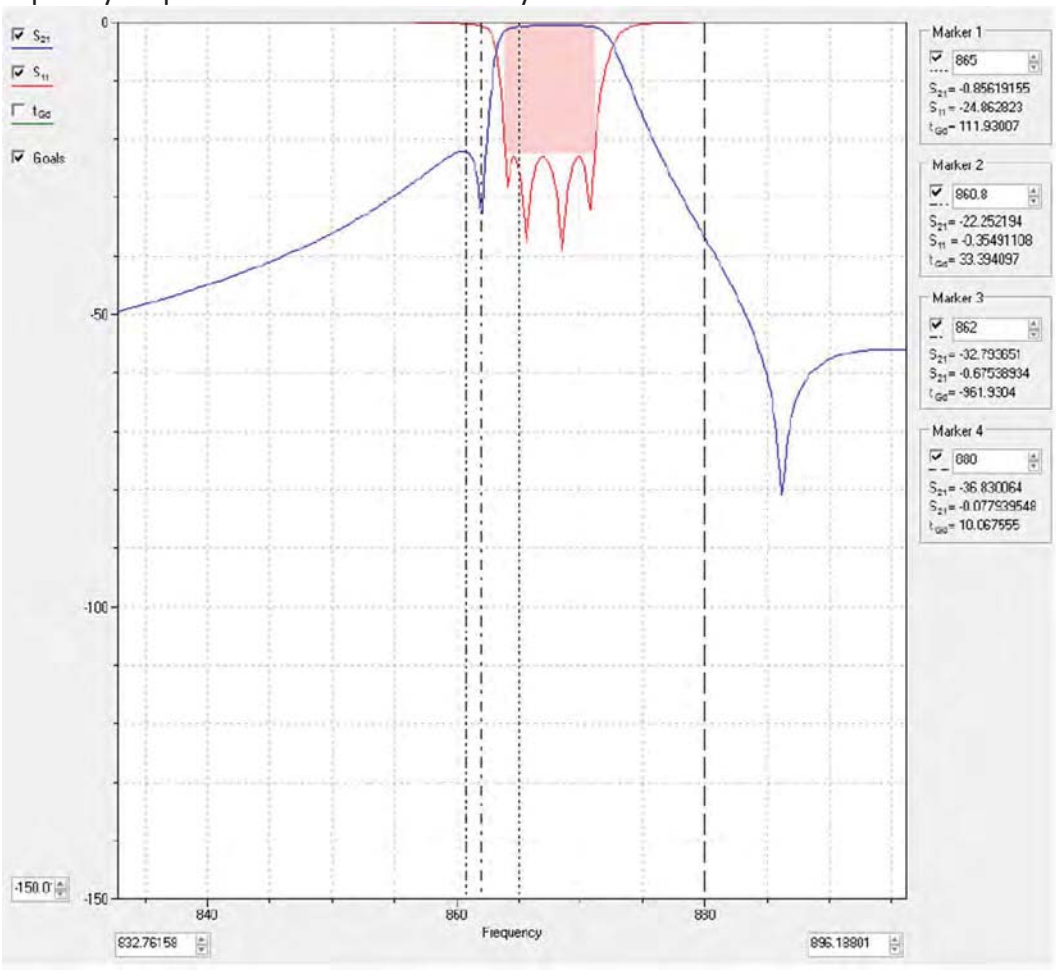


Figure 54 : Frequency response of the 865-870MHz cavity filter

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#### 1.8.3.3 863-873MHz cavity filter

The 863-873MHz cavity filter is typically dedicated to the European market. The purpose of this filter is to allow co-located high power emitters (DVB-T, BTS), in case of poor isolation between antennas (less than 50dB).

The 863-873MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Center Frequency** | 868 MHz |
| **Pass band** | 863-873MHz |
| **Insertion losses** | ≤1dB |
| **Ripple** | ≤0.5dB |
| **Return Loss** | ≥20dB |
| **Rejection** | ≥80dB @ 10-700MHz<br>≥70dB @ 700-791MHz<br>≥60dB @ 791-821MHz<br>≥60dB @ 925-960MHz<br>≥70dB @ 960-1000MHz<br>≥80dB @ 1000-2700MHz |
| **Impedance** | 50 ohms |
| **Power Handling** | ≤20W |
| **Temperature** | -40°C to+85°C |
| **Connectors** | N-Female / N-Male |
| **Waterproof** | IP66 |
| **Surface Finish** | Black Paint |
| **Weight** | <600g |
| **Dimensions (w/o N connectors)** | 148 x 46 x 50 mm |

The dimensions of the 863-873MHz cavity filter are detailed hereafter:

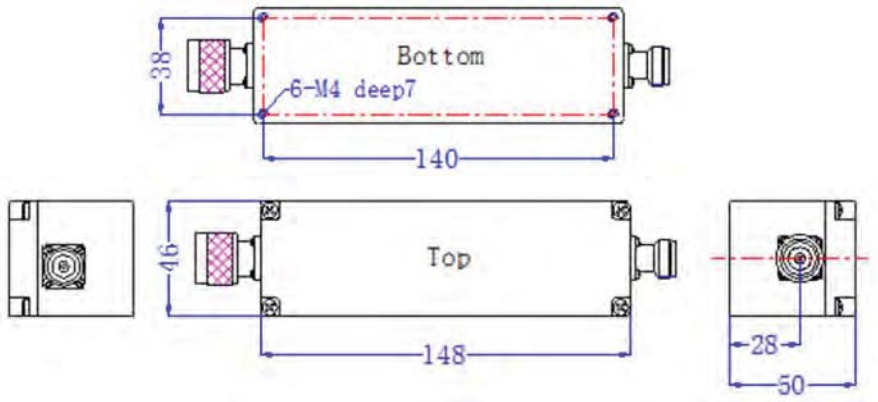


Figure 55 : Dimensions of the 863-873MHz cavity filter

The frequency response of 863-873MHz cavity filter is as follows:

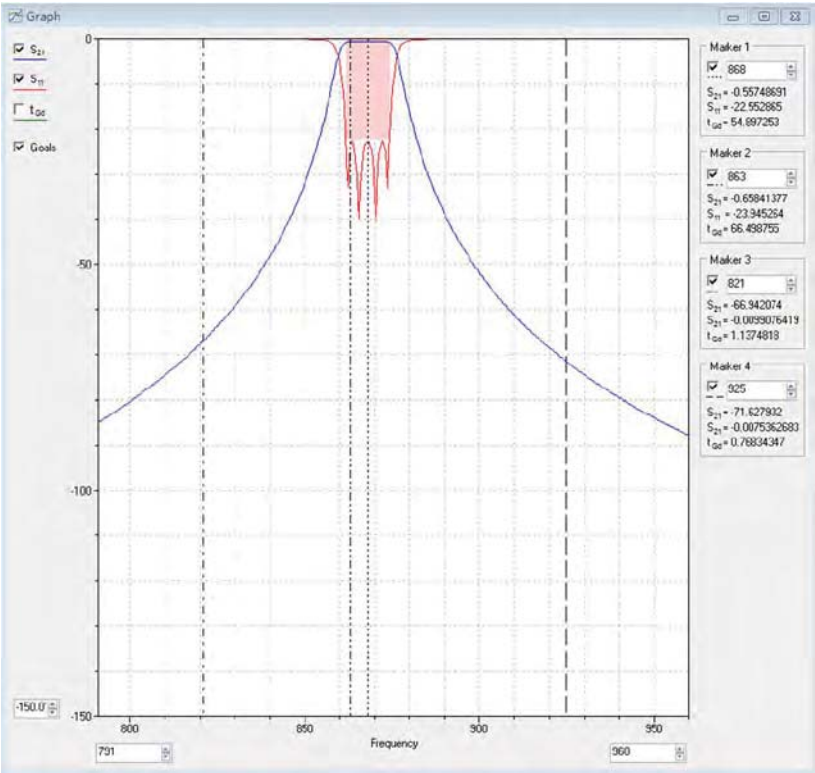


Figure 56 : Frequency response of the 863-873MHz cavity filter

#### 1.8.3.4 915-920MHz cavity filter

The 915-920MHz cavity filter is typically dedicated to the Philippines market. It could be also used in Israel. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 915-920MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Band pass** | 915 to 920MHz |
| **Center Frequency (Fc)** | 917,5MHz |
| **Frequency bandwidth** | 5MHz |
| **Insertion Loss** | <2.8dB @full temp |
| **Band Ripple** | <1dB |
| **Out of Band Rejection** | >40dB @923MHz |
| | >40dB @912MHz |
| | >60dB @925MHz |
| | >60dB @910MHz |
| **Return Loss** | >20dB |
| **Input and Output Impedance** | 50 Ohm |
| **Max Input Power** | 10W CW |
| **Temperature range** | -30°C / +60°C |
| **Ports** | In N male / Out N female |

| | |
|---|---|
| **Positions of the ports** | Opposite sides (right / left) |
| **Dimensions** | 150mm x 80mm x 50 mm |
| **Weight** | <1Kg |
| **Waterproof** | IP66 min |

The dimensions of the 915-920MHz cavity filter are detailed hereafter:

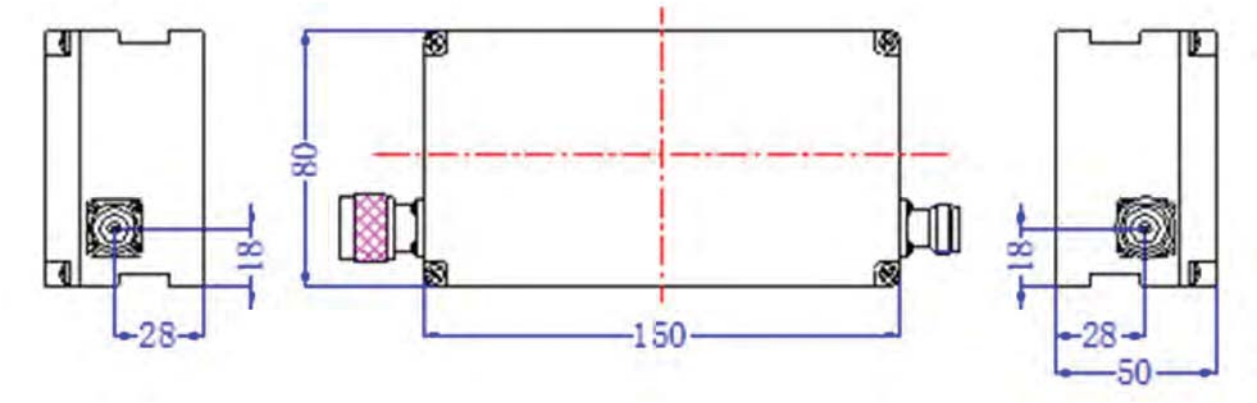


Figure 57 : Dimensions of the 915-920MHz cavity filter

The frequency response of 915-920MHz cavity filter is as follows:

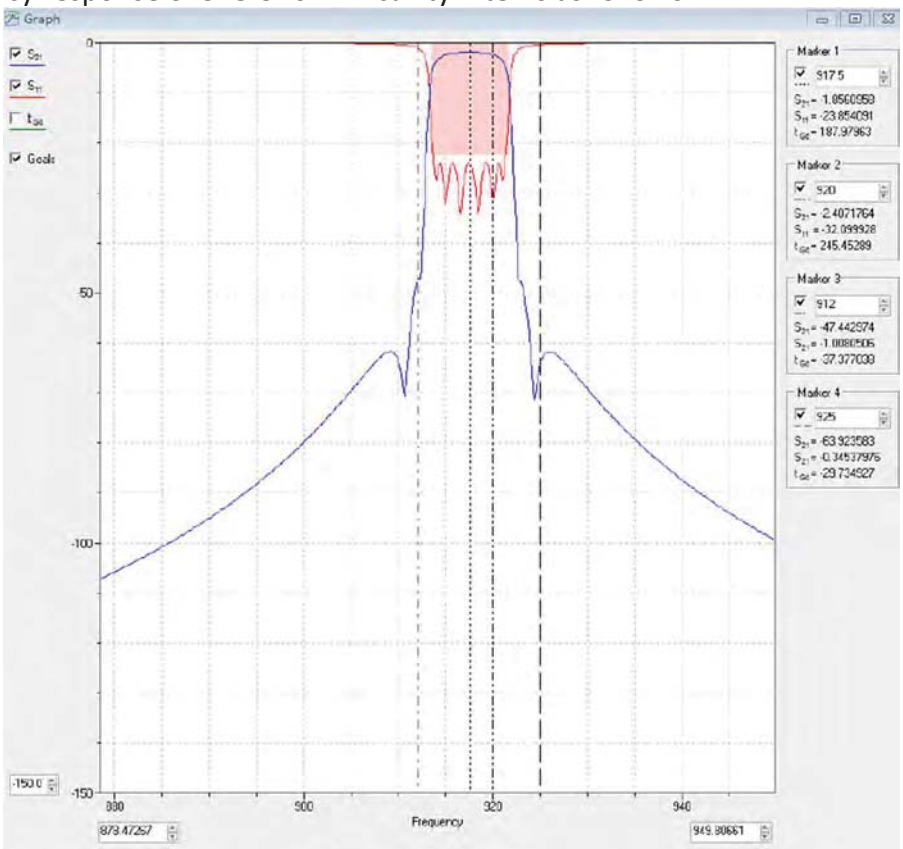


Figure 58 : Frequency response of the 915-920MHz cavity filter

#### 1.8.3.5 918-923MHz cavity filter

The 918-923MHz cavity filter is typically dedicated to Malaysia market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 918-923MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Band pass** | 918 to 923MHz |
| **Center frequency (Fc)** | 920,5MHz |
| **Frequency bandwidth** | 5MHz |
| **Insertion Loss** | <3dB @25°C |
| | <5.7dB @full temp |
| **Band Ripple** | <1.8dB @25°C |
| | <3.2dB @full temp |
| **Out of Band Rejection** | >40dB @925MHz |
| | >40dB @915MHz |
| | >70dB @927MHz |
| | >70dB @910MHz |
| **Return Loss** | >20dB |
| **Input and Output Impedance** | 50 Ohm |
| **Max Input Power** | 10W CW |
| **Temperature range** | -30°C / +60°C |
| **Ports** | In N male / Out N female |
| **Positions of the ports** | Opposite sides (right / left) |
| **Dimensions** | 150mm x 80mm x 50 mm |
| **Weight** | <1Kg |
| **Waterproof** | IP66 min |

The dimensions of the 918-923MHz cavity filter are detailed hereafter:


Figure 59 : Dimensions of the 918-923MHz cavity filter

The frequency response of 918-923MHz cavity filter is as follows:

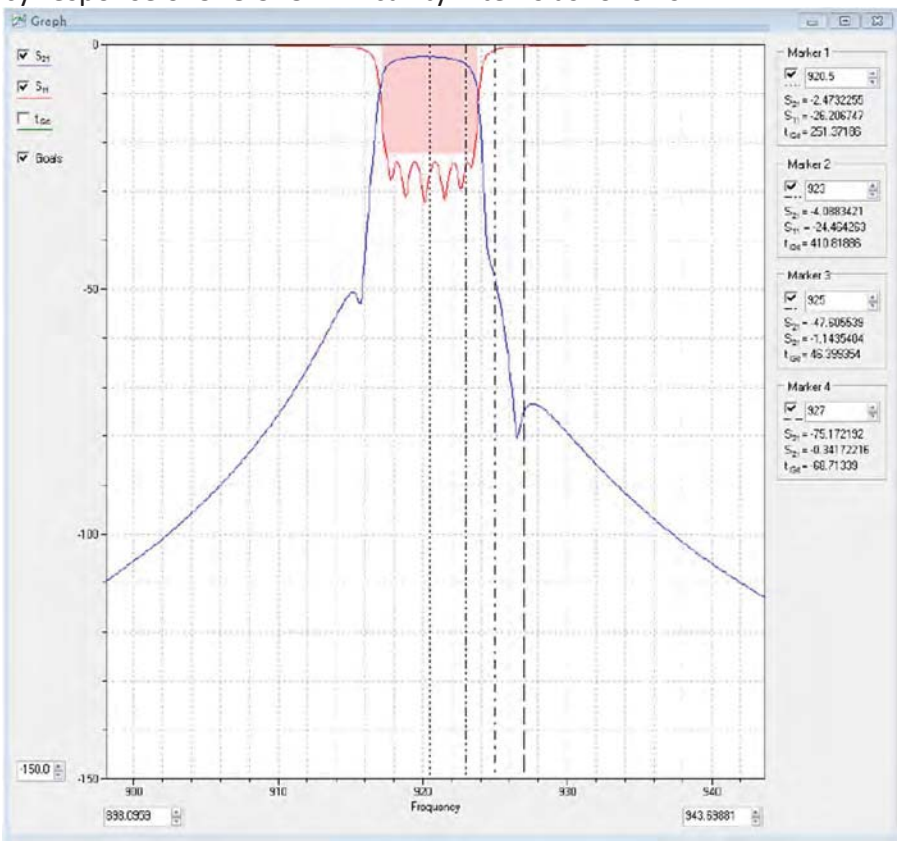


Figure 60 : Frequency response of the 918-923MHz cavity filter

### 1.8.3.6 920-925MHz cavity filter

The 920-925MHz cavity filter is typically dedicated to the Singapore market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located EGSM900 base stations.

The 920-925MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Center Frequency** | 922.5 MHz |
| **Pass band** | 920-925MHz |
| **Insertion losses** | ≤3dB |
| **Ripple** | ≤1.2dB |
| **VSWR** | ≤1.3:1 |
| **Rejection** | ≥60dB @ 880-915MHz<br>≥60dB @ 930-960MHz |
| **Impedance** | 50 ohms |
| **Power Handling** | ≤10W |
| **Temperature** | -30°C to+60°C |
| **Connectors** | N-Female / N-Male |

| | |
|---|---|
| **Waterproof** | IP66 |
| **Surface Finish** | Black Paint |
| **Dimensions (w/o N connectors)** | 134 x 80 x 50 mm |

The dimensions of the 920-925MHz cavity filter are detailed hereafter:

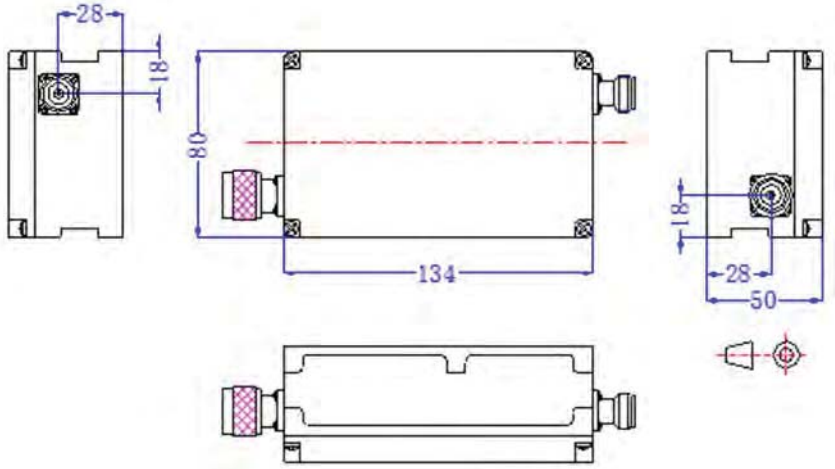


Figure 61 : Dimensions of the 920-925MHz cavity filter

The frequency response of 862-867MHz cavity filter is as follows:

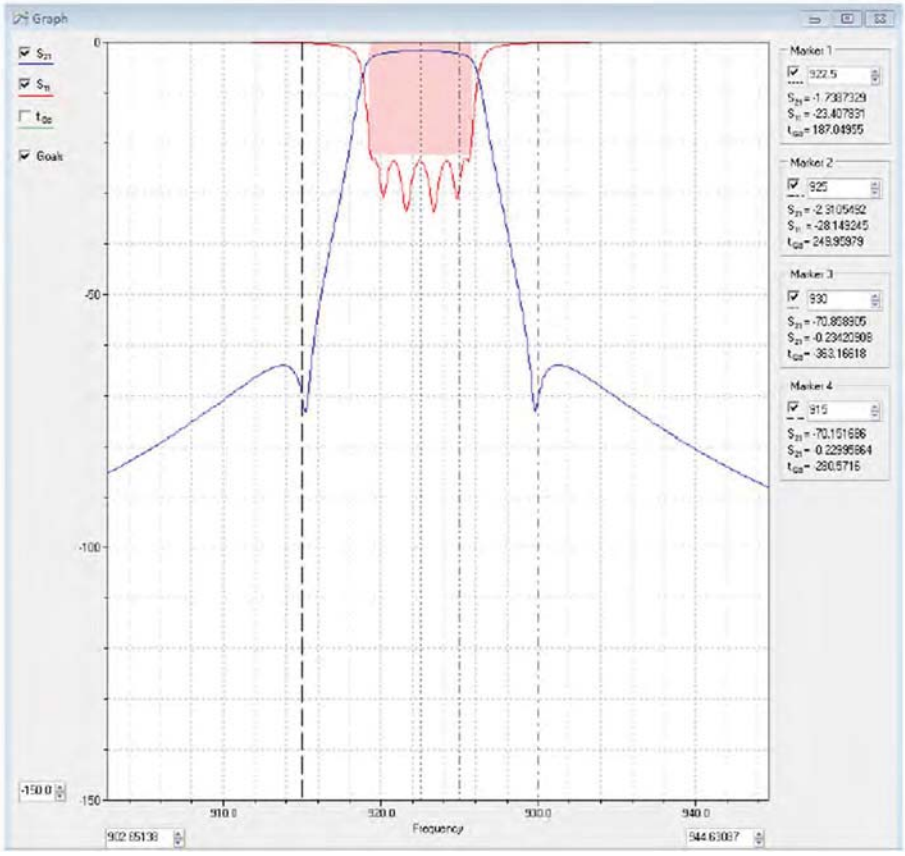


Figure 62 : Frequency response of the 920-925MHz cavity filter

#### 1.8.3.7 920-928MHz cavity filter

The 920-928MHz cavity filter is typically dedicated to the New-Zealand market. The purpose of this filter is to avoid saturation and desensitization of the LoRa receiver due to co-located GSM900 base stations.

The 920-928MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Band pass** | 920 to 928MHz |
| **Center frequency (Fc)** | 924MHz |
| **Frequency bandwidth** | 8MHz |
| **Insertion Loss** | <3dB |
| **Band Ripple** | <1dB |
| **Out of Band Rejection** | >60dB @935-960MHz |
| | >60dB @880-915MHz |
| **Return Loss** | >20dB |
| **Input and Output Impedance** | 50 Ohm |
| **Max Input Power** | 10W CW |
| **Temperature range** | -30°C / +60°C |
| **Ports** | In N male / Out N female |
| **Positions of the ports** | Opposite sides (right / left) |
| **Dimensions** | 150mm x 80mm x 50 mm |
| **Weight** | <1Kg |
| **Waterproof** | IP66 min |

The dimensions of the 920-928MHz cavity filter are detailed hereafter:

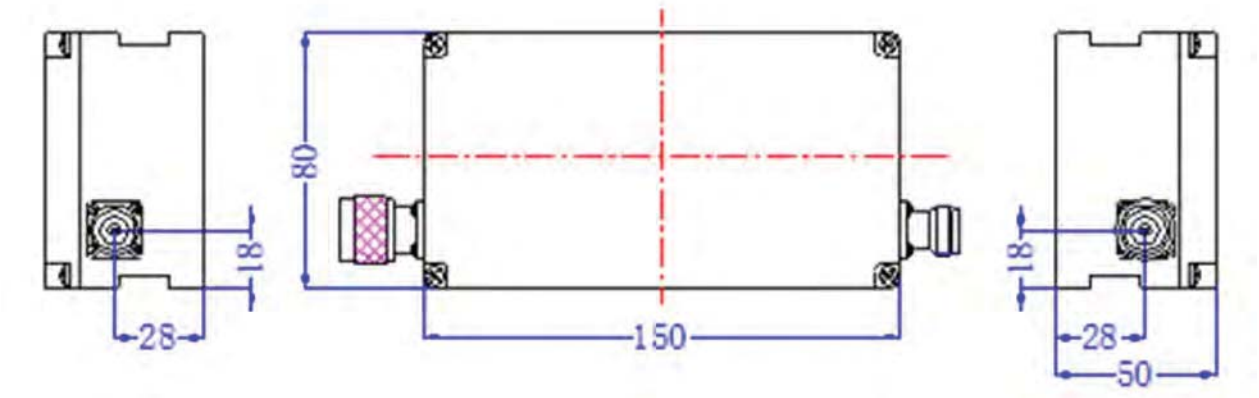


Figure 63 : Dimensions of the 920-928MHz cavity filter

The frequency response of 920-928MHz cavity filter is as follows:

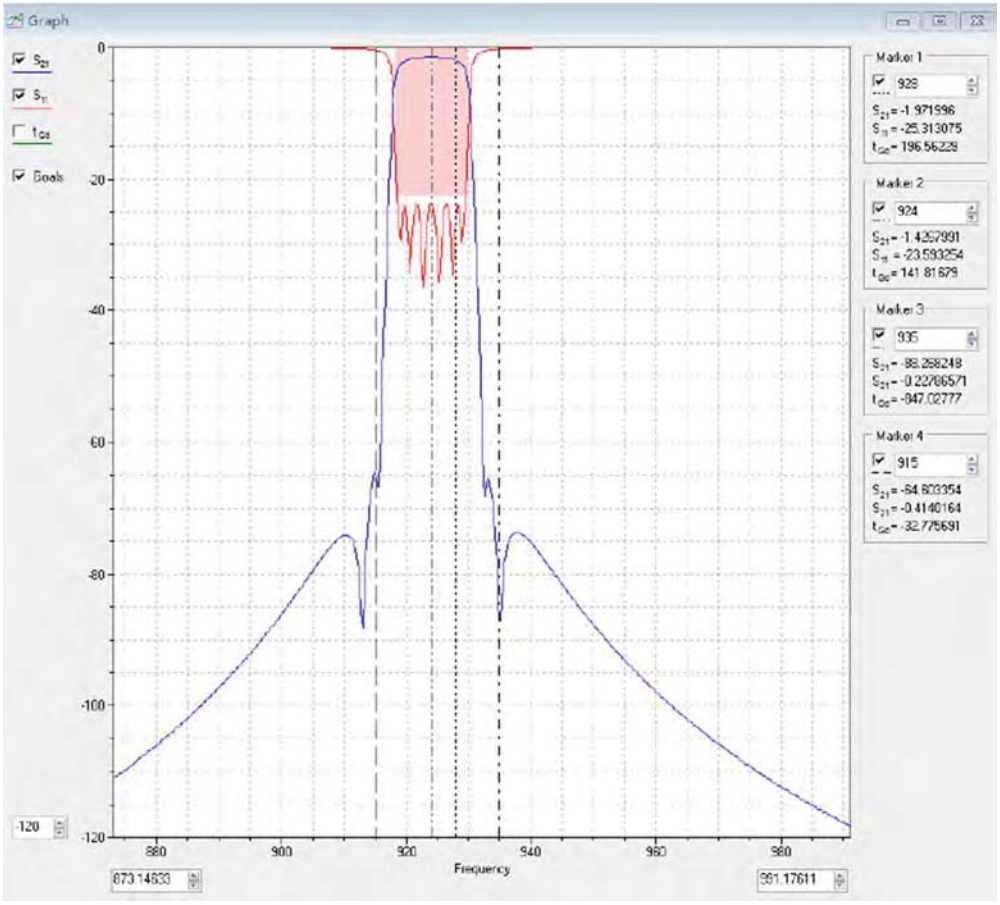


Figure 64 : Frequency response of the 920-928MHz cavity filter

### 1.8.3.8 902-928MHz cavity filter

The 902-928MHz cavity filter is typically dedicated to the North American market. The purpose of this filter is to allow co-located LTE850 base stations, in case of poor isolation between antennas (less than 50dB).

The 902-928MHz cavity filter characteristics are detailed in the following table:

| Characteristics | Specification |
|---|---|
| **Center Frequency** | 915 MHz |
| **Pass band** | 902-928MHz |
| **Insertion losses** | ≤1.5dB |
| **Ripple** | ≤0.7dB |
| **Return Loss** | ≥20dB |
| **Rejection** | ≥45dB @ 850-894MHz<br>≥45dB @ 935-960MHz |
| **Impedance** | 50 ohms |
| **Power Handling** | ≤10W |
| **Temperature** | -40°C to+85°C |

| | |
|---|---|
| **Connectors** | N-Female / N-Male |
| **Waterproof** | IP66 |
| **Surface Finish** | Black Paint |
| **Weight** | <1Kg |
| **Dimensions (w/o N connectors)** | 150 x 80 x 50 mm |

The dimensions of the 902-928MHz cavity filter are detailed hereafter:

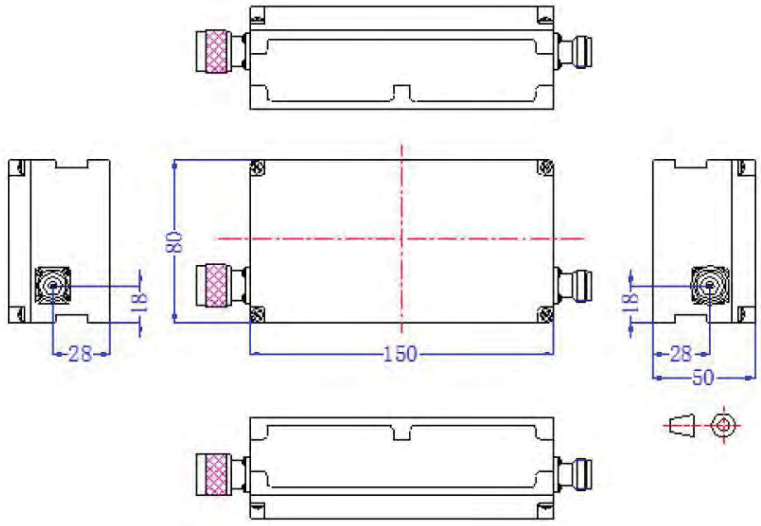


Figure 65 : Dimensions of the 902-928MHz cavity filter

The frequency response of 902-928MHz cavity filter is as follows:

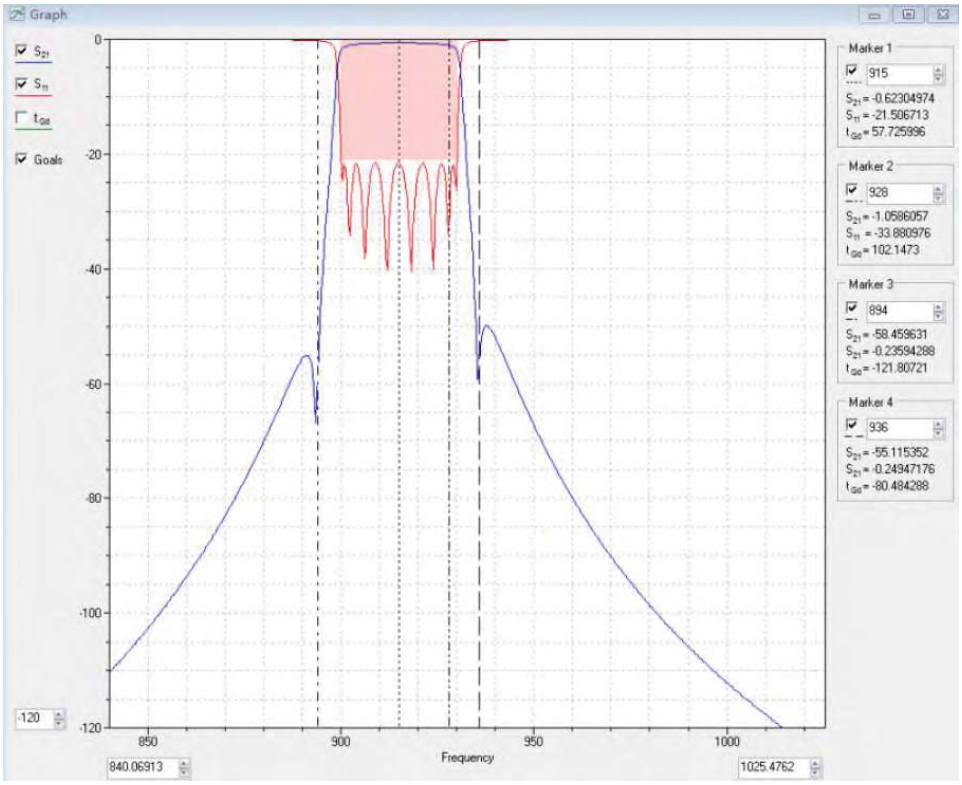


Figure 66 : Frequency response of the 902-928MHz cavity filter

### *1.8.4 Cables*

The Wirnet iBTS are delivered with all required cables to start and operate the gateway, except the power supplies cables:

- RJ45 PoE cable is not provided by KERLINK
- Auxiliary power supply cable is not provided by KERLINK

The LoRa antennas are provided with 1m coaxial cable.
Specific installations may require deporting the LoRa antenna further. Extension coaxial cables are not provided by KERLINK.

The GNSS and LTE antennas are provided with 5m coaxial cable.
Specific installations may require deporting the GNSS antenna or LTE antenna further.
Deporting the GNSS antenna may be required to have a better sky view to optimize the reception of the satellites.
Deporting the LTE antenna may be required to optimize the LTE reception or improve isolation with other radio equipment's on the site.
Extension coaxial cables are not provided by KERLINK.

#### 1.8.4.1 RJ45 PoE cable

This cable is not provided with the Wirnet iBTS.
It neither can be delivered as an accessory.

KERLINK recommends using a PoE cable with the following characteristics:

| Characteristics | Specification |
|---|---|
| **Category** | 6A |
| **Shielding** | STP (U/FTP) or SSTP (S/FTP) |
| **Section conductors** | AWG26 or bigger |
| **External jacket** | LSZH or PUR |
| **Maximum length** | 100 meters |
| **Operating temperature range** | -20°C to +60°C |

KERLINK recommends the following reference:
TELEGARTNER AMJ 500 U/FTP 4x2x0.55 LSZH Cat. 6A IEC 600332-1

The Ethernet cable must be provided with two RJ45 T 568A (or 568B) plugs on each side:

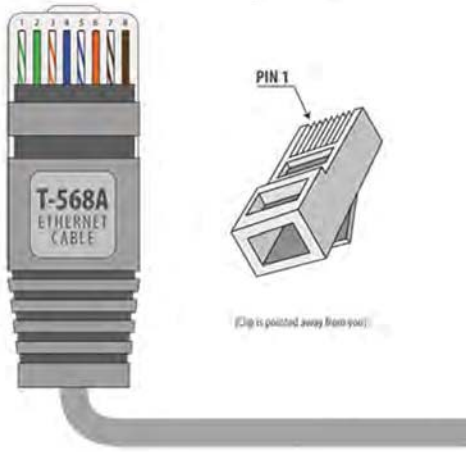


Figure 67 :RJ45 T-568A plug

#### 1.8.4.2 Earthing cables

Several earthing cables, wires or tapes are required to connect the installation and the materials to earth for lighting immunity and electrical security.
The earthing cables are detailed hereafter with recommended wires and sections:

| Cable description | Technical characteristics |
|---|---|
| **Earthing of the Wirnet iBTS mounting kit** | 25mm$^2$, copper |
| **Earthing of the antenna brackets (LoRa antenna, GNSS antenna, LTE antenna)** | 25mm$^2$, copper |
| **Earthing of the RF coaxial surge protection** | 16mm$^2$, copper |

| | |
|---|---|
| **Earthing of the Ethernet surge protection** | 16mm$^2$, copper |
| **Earthing of the DC surge protection** | 16mm$^2$, copper |
| **Earthing of the outdoor PoE injector** | 16mm$^2$, copper |

**Note:** the earthing cables are not provided by KERLINK

### *1.8.5 Surge protections*

In harsh environment, additional protections must be used to improve lightning immunity.
The Wirnet iBTS is not warranted by KERLINK in case of deterioration due to lighting.
KERLINK recommends adding surge protection, in high keraunic levels areas.

#### 1.8.5.1 RF coaxial surge protection

##### 1.8.5.1.1 GNSS, LTE Links

For the antenna links (GNSS, LTE), KERLINK recommends the P8AX09-6G-N/MF series from CITEL.
Protections must be installed in accordance to its own specifications.

The following picture describes the RF coaxial surge protection:


Figure 68 : P8AX Citel

**Note:** the RF coaxial surge protector must be connected to the Lightning Protection System down conductor, connecting the lighting rod to the earth. No cables are provided by KERLINK for that purpose.

##### 1.8.5.1.1 LoRa Link

For the LoRa antenna link, KERLINK recommends the PRC822S-N/MF series from CITEL.
Protections must be installed in accordance to its own specifications.

The following picture describes the RF coaxial surge protection:


Figure 69 : PRC822S Citel

**Note:** the RF coaxial surge protector must be connected to the Lightning Protection System down conductor, connecting the lighting rod to the earth. No cables are provided by KERLINK for that purpose.

### 1.8.5.2 DC surge protection, 1 pole

Kerlink recommends using the DS71R-48DC reference from CITEL.
A picture of the DS71R-48DC is presented below:


Figure 70 : DC surge protections (1 pole and 2 poles)

The following schematic shows electrical connections of the unipolar DC surge protection to the Wirnet iBTS and the isolated DC/DC converter:

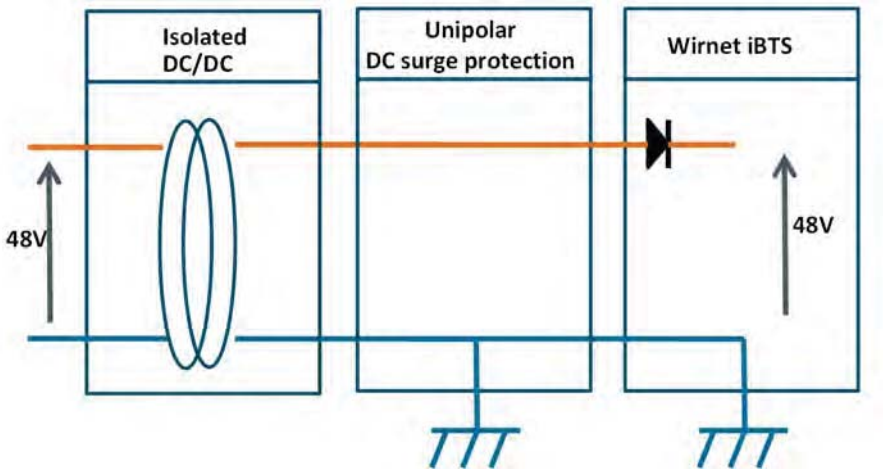


Figure 71 : DC surge protection 1 pole schematic

An example of connections is described below, while the DC surge protection is integrated in the Compact casing :

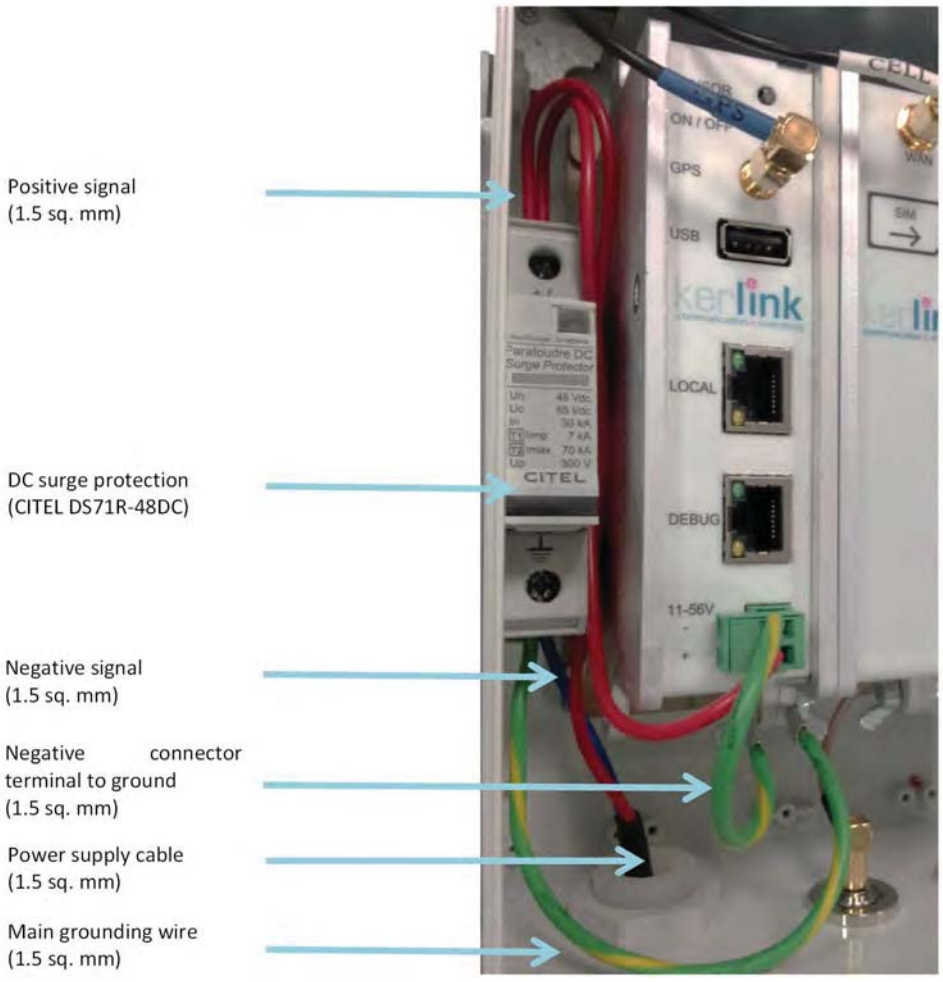


Figure 72 : Example of DC surge protection cabling

To connect grounding cable to the metal heatsink of the product, Kerlink recommends using tongue terminals. Those terminals must be tightened with wing nuts.

Regarding the DC surge protection integration process inside the Wirnet iBTS enclosure, Kerlink recommends using the following guideline:

1. DS71R-48DC must be inserted on the left side of the UC module.
   The mechanical holding must be ensured by using a double face tape.
   Note: It is important to avoid any enclosure deformation which may imply ingress protection issue.
2. The M25 cable gland must be used to introduce the power supply cable inside the enclosure. As mentioned on the installation guide of the Wirnet iBTS product, the external cable diameter must be between 5 to 8 mm to insure a good ingress protection.
   The power supply cable is a 1.5 sq. mm cable.
3. The positive wire of the power supply cable must be connected to the surge protector and then to the Wirnet iBTS connector.
4. The negative wire of the power supply cable must be connected to the Ground side of the surge protector.
5. A ground connection must be done between the ground side of the surge protector and the metal heatsink of the product. The best solution is to use tongue terminal.
6. A ground connection must be done between the metal heatsink of the product and the Wirnet iBTS connector.

Figure 73 : Tongue terminal

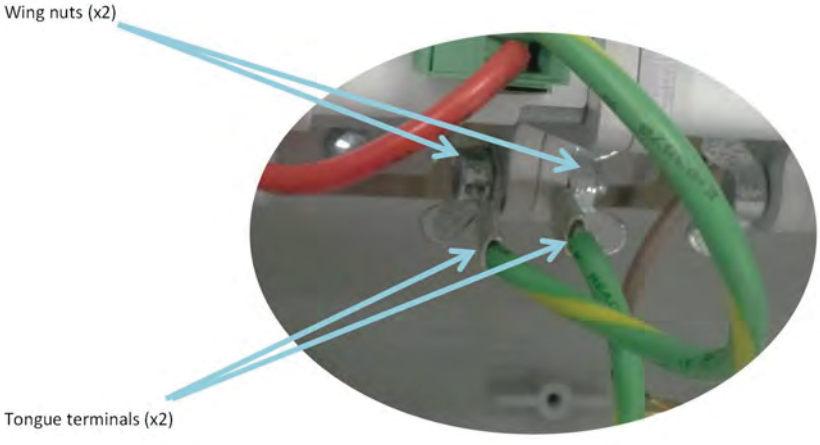


Figure 74 : Tongue terminal assembly

### 1.8.5.3 DC surge protection, 2 poles

To avoid any lightning introduction inside the shelter Kerlink recommends using the following bipolar DC surge protection: DS72R-48DC from CITEL.
A picture of DS72R-48DC is presented in Figure 70.

The following schematic shows electrical connections of the biipolar DC surge protection to the Wirnet iBTS and the isolated DC/DC converter:

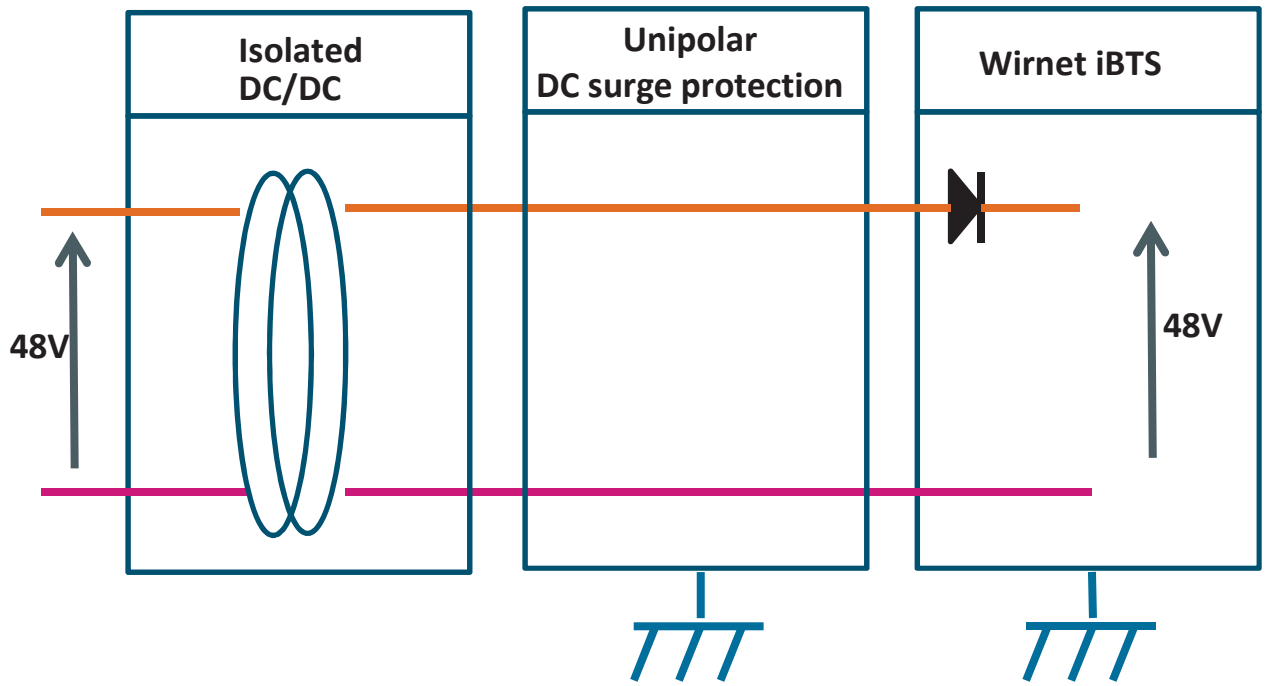


Figure 75 : DC surge protection 2 poles schematic

Kerlink recommends realizing a good direct connection between the Bipolar DC surge protection and the earthing system of the installation. The used earthing cable must be as short as possible (< 50 cm, 4 sq. mm).
The principles of cablig remain identical to those described in §1.8.5.2.

### 1.8.5.4 Indoor Ethernet surge protection

For the Ethernet link, KERLINK recommends the MJ8-POE-A reference from CITEL.
This surge protection must be installed indoor, according to its own specifications.

The following picture describes the PoE surge protection:


Figure 76 : MJ8-POE-A Citel

**Note:** the PoE surge protector must be connected to the earth. No cables are provided by KERLINK for that purpose. See §1.8.4.2 for additional information.

### 1.8.5.5 Outdoor Ethernet surge protection

In case the Ethernet surge protection cannot be installed indoor, then KERLINK recommends the PD-OUT/SP11 reference from Microsemi.
This surge protection can be installed indoor, according to its own specifications.

The main characteristics of the PoE surge protection are:

| Characteristics | Specification |
|---|---|
| **Network** | POE and Gigabit Ethernet, High POE (95W) |
| **Technology** | Clamping diode |
| **SPD configuration** | 4 pairs + shielded |
| **Connection to Network** | RJ45 shielded connector female input/output |
| **Format** | Metallic box with connectors input/output |
| **Mounting** | Wall or pole mount |
| **Operating temperature** | -40°C to +85°C |
| **Dimensions** | 30 x 30 x 190 mm |
| **Weight** | 270g |
| **Protection rating** | IP66 |
| **Outdoor application** | Yes |


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| | |
|---|---|
| **Failsafe behavior** | Short-circuit |
| **Disconnection indicator** | Transmission interrupt |
| **Remote signaling of disconnection** | None |
| **Nominal line voltage (Un)** | 48 Vdc |
| **Max. DC operating voltage (Uc)** | 60 Vdc |
| **Max. line current (IL)** | 2A |
| **Protection level (Up)** | 500V |
| **Nominal discharge voltage 8/20µs** | 10 kV |
| **Impulse current**<br>**2 x 10/350µs Test - D1 Category (Iimp)** | 100 A |
| **Nominal discharge current**<br>**8/20µs Test x 10 - C2 Category (In)** | 5 kA |
| **Max data rate** | 1000 Mbps |
| **Certifications** | IEC 61643-21 / EN 61643-21<br>GR1089<br>ITU-T K.45<br>UL497B<br>IEEE 802-3ab/3at |

The following picture describes the PoE surge protection:


Figure 77 : PD-OUT/SP11 Microsemi

**Note:** the PoE surge protector must be connected to the earth. No cables are provided by KERLINK for that purpose. See §1.8.4.2 for additional information.

### *1.8.6 Mounting kits*

#### 1.8.6.1 Notched V-shaped pole mounting kit

The notched V-shaped pole mounting kit includes a notched V shaped plate and a U bolt with 2 nuts.
This mounting kit can be used in conjunction with the dome antenna brackets for pole mounting (see §1.8.6.3). The maximum diameter of the pole is 70mm.

The dimensions of the notched V shaped plate part are detailed hereafter:

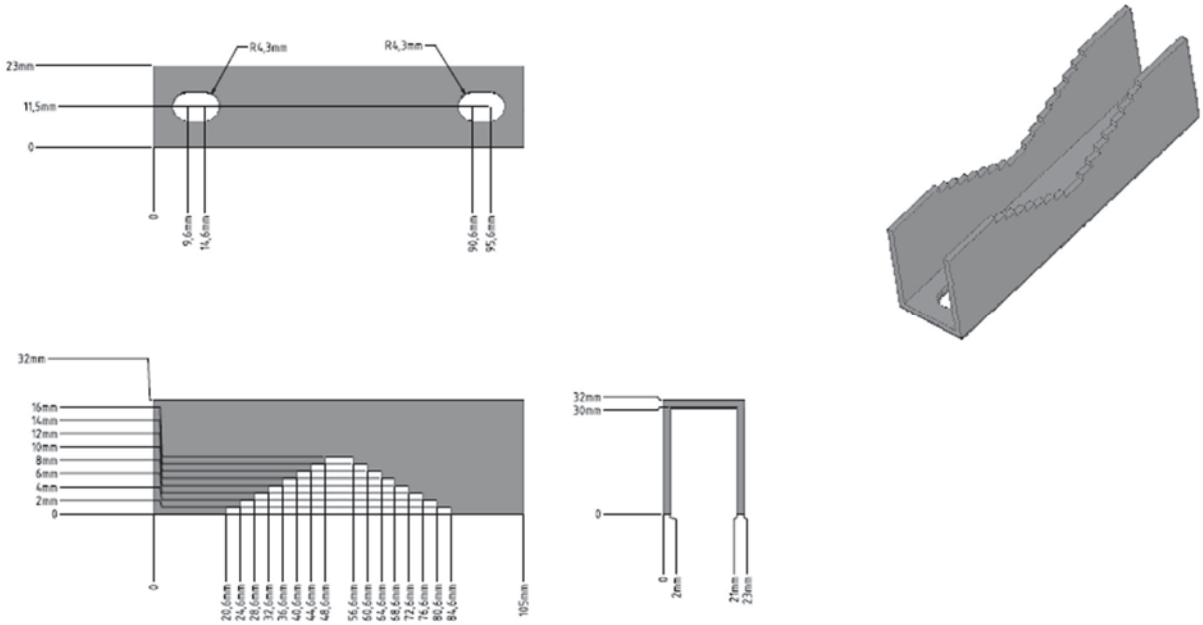


Figure 78 : Dimensions of the notched V shaped plate

#### 1.8.6.2 Universal antenna bracket

The universal antenna bracket is used with the following antennas:

- 868MHz, 3dBi omnidirectional (see §1.8.1.1).
- 915MHz, 3dBi omnidirectional (see §1.8.1.3).
- 915MHz, 6dBi omnidirectional, except FT-RF antenna (see §1.8.1.4).

The universal antenna bracket is presented hereafter:

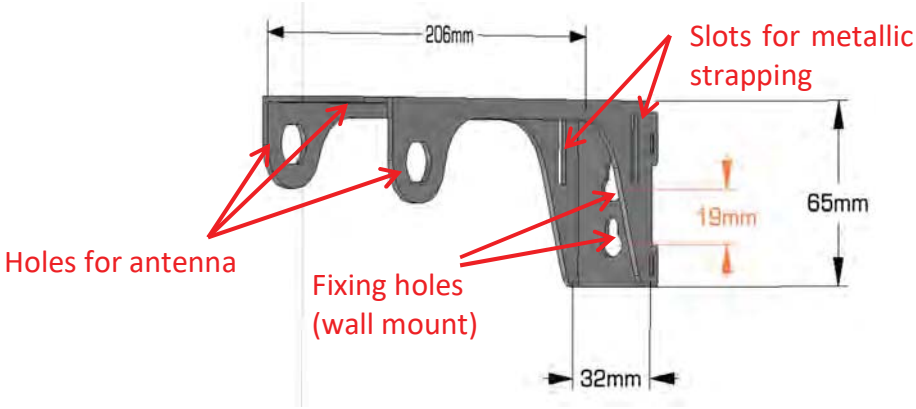


Figure 79 : Universal antenna bracket dimensions

The universal antenna bracket has 3 holes dedicated to the LoRa antenna N connector. The bracket can be then oriented in 3 different positions without compromising the antenna position.
The universal antenna bracket can be mounted:

- On a wall: use in this case two M4 screws separated by 19mm.
- On a pole: use metallic strapping through the two 5mm x 25mm slots.
- On the compact casing mounting kit, with 2 x M8 bolts and screws.

#### 1.8.6.3 Dome antenna bracket

The dome antenna bracket is used for the following antennas:

- GNSS antenna (see §1.8.2.1)
- LTE antenna (see §1.8.2.2)
- GNSS/LTE combo antenna (see §1.8.2.3)

The dome antenna bracket is presented hereafter:

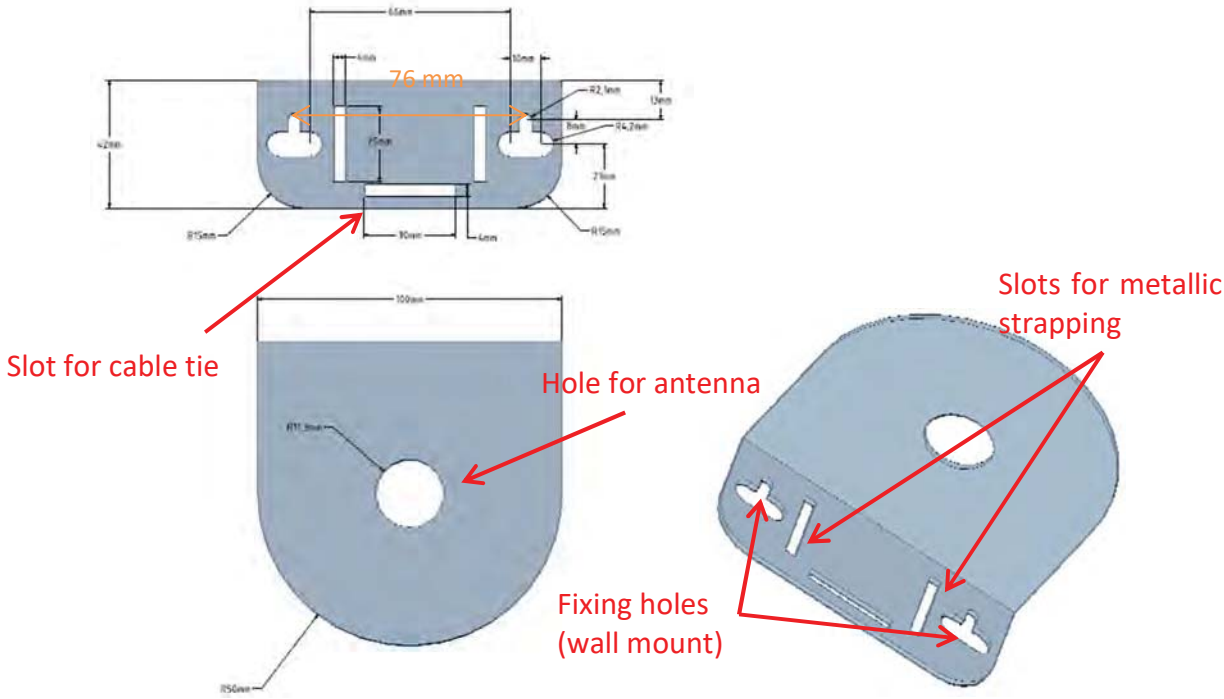


Figure 80 : Dome antenna bracket dimensions

The dome antenna bracket has a single hole dedicated to the LTE and / or GPS M22 screw.
The dome antenna bracket can be mounted:

- On a wall: use in this case 2 x M4 screws separated by 76mm (see figure above).
- On a pole: use metallic strapping through the two 4mm x 25mm slots (see figure above).
- On a pole: alternate option is to use the “notched V shaped plate and a U-bolt” as detailed in §1.8.6.1. The two parts are presented on the figure below. The maximum diameter of the pole is 60mm.

Another slot is available. It can be used for cable ties to tighten the RF coaxial cable to the antenna bracket.

**Note 1:** the M4 screws, the metallic strapping are not provided by KERLINK.

**Note 2:** the cables ties are not provided by KERLINK.

**Note 3:** the notched V shaped plate and a U-bolt can be provided by KERLINK as accessories (see §1.8.6.1).

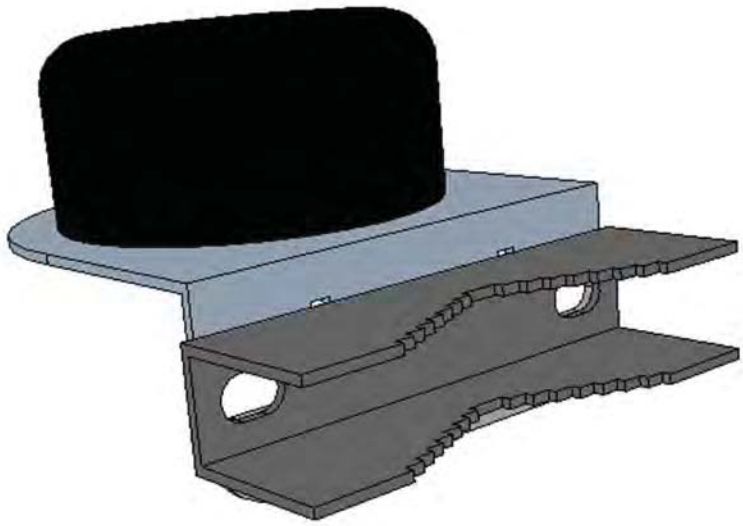

Figure 81 : Dome antenna bracket with notched V shaped bolt

### 1.8.7 Debug tool

The Wirnet iBTS has a proprietary serial debug interface named DEBUG available on the front panel of the CPU module.
This debug interface is intended to be used by authorized and qualified personnel only.
The WIRMA2 Debug tool is intended to be connected to the debug interface. It is mainly a simple UART to USB converter.

The main characteristics of the Wirma2 debug tool are:

| Characteristics | Specification |
|---|---|
| **UART Interface** | RJ45 female |
| | 3.3V internal LDO |
| | Up to 1Mb/s |
| **USB2.0 interface** | USB 2.0 A type |
| | USB Self Bus Powered at 5V |
| | Full Speed (12Mb/s) |
| **Operating temperature range** | 0°C to +60°C |
| **Chipset** | FT232BL (FTDI) |

The debug tool must be used with an Ethernet cable and a USB2.0 type A to type B male cable. They can be provided by KERLINK as options as detailed in §6.
The USB cable must be connected to a computer where must be installed HyperTerminal or Teraterm to visualize the traces.