Installation and Maintenance Manual
LoRa IoT Station
Wirnet Station

	Author	Approved by	Validated by
Name	Vincent LOUVEAU	Martin CHAPLET	Pierre TALVAZ
Entity	KIS / Base Station	KIS / Base Station	KIS / Programme
Initial	VLO	MCH	PTA
Date	15/11/2018	15/11/2018	15/11/2018
Visa			

Destination List

Name	Company / Service	Place	Commentary

Document history

Version	Modification	Author	Date
V0.1	Preliminary version	LLO	27/01/2014
V0.2	Adding of some precisions on the following contents: • Internet cabling and cable type • Cable gland dimensions • Auxiliary power supply • GPS and GSM considerations	SNI	06/05/2014
V0.3	Safety recommendations added	SNI	02/06/2014
V0.4	Safety recommendations added	SNI	30/06/2014
V0.5	Safety recommendations added	SNI	23/07/2014
V0.6	Recommended additional lightning protections	SNI	29/09/2014
V1.0	New mounting kit	SNI	08/04/2015
V2.0	Added specific parts for LoRa IOT stations 915 and 923	MGI	17/09/2015
V2.1	Added specific comments for LoRa IOT stations 923	MGI	22/10/2015
V2.2	Minor changes	MGI	06/11/2015
V2.3	Added information regarding certification in South Korea and India, limitations in several countries. Added references of antennas	MGI	11/12/2015
V2.4	Added reference to “Wirnet Station” Updated frequency plans according to last draft of LoRaWAN specification. Added description of the Wirgrid Debug Board Added type approval for India	MGI	25/01/2016
V2.5	Updated frequency plans according to last draft of LoRaWAN specification	MGI	26/01/2016
V2.6	Added description of the package	MGI	08/06/2016
V2.7	Added accessories and detailed lightning protections	MGI	01/08/2016
V2.8	Added information about certifications in Hong-Kong, Japan and Australia Added wires section and length of the auxiliary supply cable	MGI	12/09/2016
V2.9	Added information about certifications in NZ and Taiwan; Added detailed information about surge protections	MGI	13/12/2016
V2.10	Added information about certifications in Mexico	MGI	13/12/2016
V2.11	Added information about certifications in Brazil	MGI	14/12/2016
V2.12	Added information about Philippines	MGI	23/03/2017
V2.13	Added information about Taiwan	MGI	27/04/2017
V2.14	Added chapter 9.1 about the battery	MGI	03/05/2017
V2.15	Added cavity filters, surge protections, SOP4 versions, warnings in Chinese (NCC/Taiwan) and certifications updates	MGI	11/05/2017
V2.16	Updated cavity filter and list of accessories Updated certification paragraph (Taiwan, NZ and EU)	MGI	28/06/2017

V2.17	Updated the following items: • Certification paragraph (Europe, India, UAE, Saudi Arabia, Russia, Philippines, Australia, Singapore, Malaysia, Taiwan, Thailand, Taiwan, Brasil) • References (version of documents) • Blocking performance • Outdoor PoE injector (new reference – previous version is end of life) • Cavity filters performance Corrected several typo errors	MGI	16/04/2018
V2.18	Updated certification paragraph (Thailand)	MGI	16/05/2018
V2.19	Updated document for ANATEL certification	MGI	27/07/2018
V2.20	Updated document for ANATEL certification	MGI	05/09/2018
V2.21	Updated document for ANATEL certification	VLO	15/11/2018

Contents

Figures

1 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]	https://www.lora-alliance.org/For-Developers/LoRaWANDevelopers	LoRaWAN™ Regional Regulation Summary Version 1.5 draft 12 July 26th, 2018

2 Glossary

Keyword	Description
ADC	Analog to Digital Converter
AMR	Automatic Meter Reading
AP	Access Point
APC	Automated Power Control
API	Application Programming Interface
APN	Access Point Name
BTS	Base Transceiver Station
BW	Band Width
CAN	Control Area Network
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DDRAM	Double Data Rate RAM
DHCP	Dynamic Host Configuration Protocol
DOTA	Download Over The Air
EIRP	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
FTP	File Transfer Protocol
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communication
HTTP	HyperText Transfer Protocol
IK	Mechanical Impact
IO	In / Out
IoT	Internet of Things
IP	Internet Protocol or Ingress Protection

KLK	KERLINK
KNET	KERLINK M2M network
LBT	Listen Before Talk
LED	Light-Emitting Diode
LoRa	Long Range
LTE	Long Term Evolution
M2M	Machine to Machine
MIPS	Millions of Instructions Per Second
NFS	Network File System
NMEA	National Marine Electronics Association
PCB	Printed Circuit Board
PoE	Power over Ethernet
PU	Polyurethane
RAM	Random Access Memory
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
RTC	Real Time Clock
SAW	Surface Acoustic Wave
SI	Système d'Information
SIM	Subscriber Identity Module
SMA	SubMiniature version A
SSH	Secure Shell
TBD	To Be Defined
TCP	Transmission Control Protocol
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
UV	UltraViolet
WAN	Wide Area Network
WLAN	Wireless Local Area Network
VHF	Very High Frequency

3 Introduction

The LoRa IoT Station (Wirnet Station) is part of the global Long Range Radio fixed network to provide M2M connectivity link between low power end-point and Internet Access.

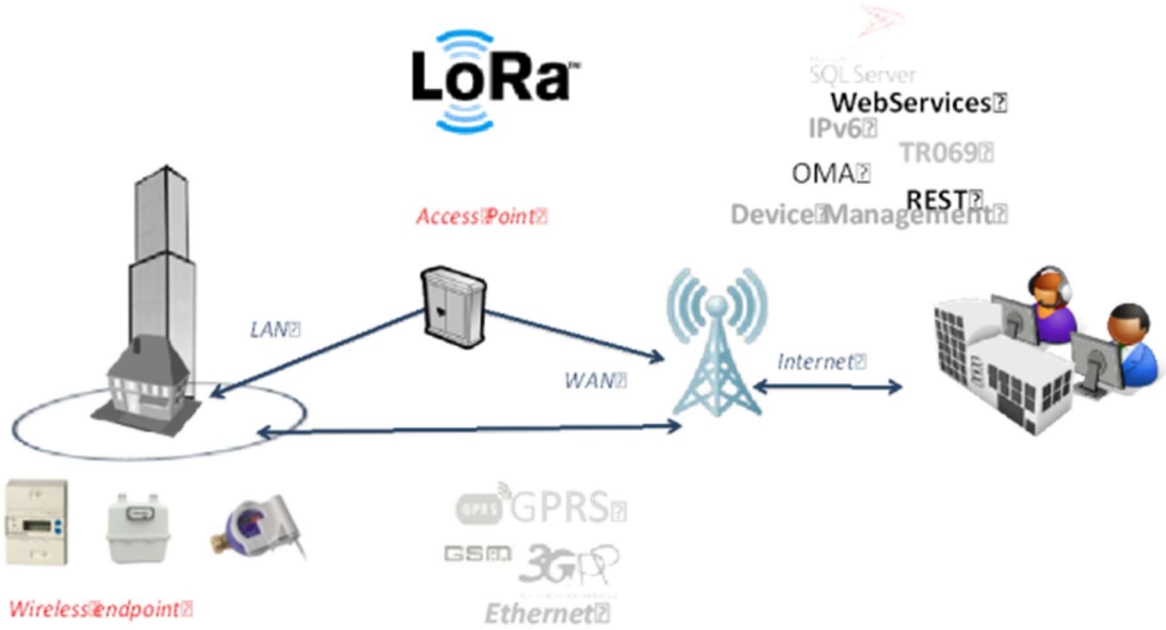


Figure 1: LoRa Network topology

The product is based on LoRa technology provided by Semtech Company.

Three different versions of LoRa IoT Stations (Wirnet Stations) are available to cover different countries and areas around the world:

	Wirnet Station 868	Wirnet Station 915	Wirnet Station 923
Geographical area	Europe Africa Middle East, India	North America : USA, Canada Central America: Mexico South America with the exception of Brazil and Argentina Philippines	Asia : Indonesia, Korea, Japan, Brunei, Papua New Guinea, Singapore, Hong-Kong, Vietnam, Malaysia, Thailand, Taiwan Oceania : Australia, New Zealand Brazil, Argentina
ISM band	863 - 876 MHz	902 - 928 MHz	915 - 928 MHz
Downstream bandwidth (Tx of the LoRa IoT Station)	863 - 873MHz	902 - 928 MHz	920 - 928 MHz
Upstream bandwidth (Rx of the LoRa IoT Station)	863 - 873 MHz	902 - 928 MHz	915 - 928 MHz
WWAN capabilities	WCDMA dual-band: 900/2100 MHz Dual-band GSM GPRS 900/1800MHz or Quad-band GSM GPRS 850/900/1800/1900MHz	WCDMA dual-band: 850/1900 MHz Quad-band GSM GPRS 850/900/1800/1900MHz	WCDMA dual-band: 900/2100 MHz Dual-band GSM GPRS 900/1800MHz or Quad-band GSM GPRS 850/900/1800/1900MHz
Antenna	3 dBi	6 dBi (3dBi on demand)	6 dBi (3dBi on demand)

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

The present document addresses all the above LoRa IoT Stations (Wirnet Stations) versions.

4 Description of the LoRa IoT Station (Wirnet Station)

4.1 Description of the package

The LoRa IoT Station (Wirnet Station) is delivered in a carton, including the following items:

- 1x LoRa IoT Station / Wirnet Station 868 or 915 or 923, screwed on its wall mount kit
- 1 x Lora antenna (868MHz or 915MHz)
- 1 x universal antenna bracket
- 1 x PoE injector PD-3501G/AC MICROSEMI with its mains supply cord
- 1 x coaxial cable, 1 meter length, N male connectors
- 1 x M8 U bolt
- 3 x M8 nuts
- 1 x M8 x 14mm bolt
- 3 x cable ties

These items are described in §4.8.

4.2 Block Diagram

The following figure describes the functional architecture:

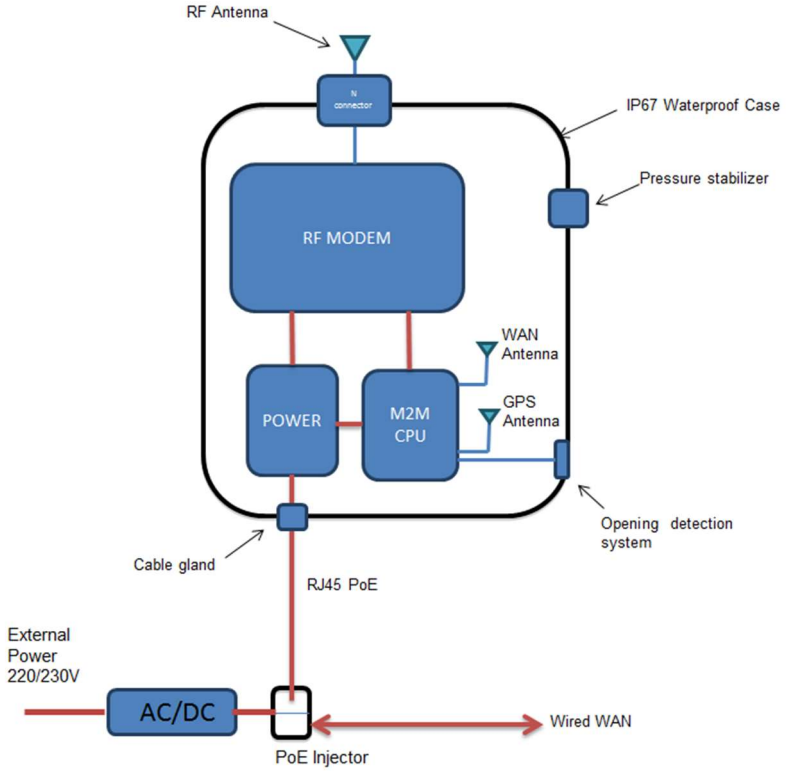


Figure 2: LoRa IoT Station (Wirnet Station) Block diagram

The RF Modem is declined in 3 different versions (868, 915, and 923) depending on the LoRa IoT Station (Wirnet Station) model.

The M2M CPU is based on a SOP3-EU, SOP3-US or SOP4-EU daughter board to address different WWAN capabilities, depending on the country and the LoRa IoT Station (Wirnet Station) model.

4.3 Technical specifications

4.3.1 LoRa IOT Station 868 (Wirnet Station 868) with SOP3-EU CPU

DATASHEET

Wirnet Station 868

LoRa gateway for IoT chain

- **868 MHz ISM band LongRange™ bidirectional communications capabilities**
- **Embedded, remote and open low power communication station**
- **Open development framework based on standard Linux OS**
- **WAN connectivity over GPRS/EDGE/3G or Ethernet**

1. Hardware Key Features

1.1 System

CPU:
- Based on ARM 926EJS core processor
- Up to 230 MIPS
- Real-time clock saved by battery
- Hardware watchdog
- Optimised power consumption management

Volatile memory:
- Low power DDRAM 128 MB
- 10 MB used for system firmware

Non-volatile memory:
- 128 MB NAND flash (40MB used for system firmware and autorecovery mechanism)

1.2 User interfaces

Internal LEDs:
- Operational status : power, GSM signal strenght level, WAN connectivity indicator

Internal push buttons:
- Manual station reset
- Manual test or installation procedure launch

USB host interface allowing :
- Local software upgrade with simple USB key
- USB/NET local configuration/maintenance access

1.3 Communication

LongRange:
- Incorporate LoRa (TM) bidirectional communications technology (RX : 863-873MHz , TX : 863-873MHz) *
- Sensitivity : up to -141 dBm
- Tx conducted power from 0dBm to +28dBm
- 49 LoRa Demodulators over 9 channels
- More than 15km range in sub-urban situation

WWAN:
- HSDPA/UMTS (900/2100MHz) : DL 3.6 Mbps / UL 384 Kbps (HSDPA), UL/DL 384Kbps (UMTS)
- GPRS/EDGE (850/900/1800/1900MHz) : UL/DL 85.6Kbps (GPRS), UL/DL 236.8Kbps (EDGE)
- IMEI inside
- Internal antenna

Ethernet :
- PowerOverEthernet IEEE 802.3af alternative B 10/100 Base T compliant

1.4 Positionning/Timing

GPS:
- Integrated GNSS high sensitivity GPS module
- NMEA 2.0 compliant
- Internal antenna

1.5 Sensors

- Embedded temperature sensor
- Door opening detection system

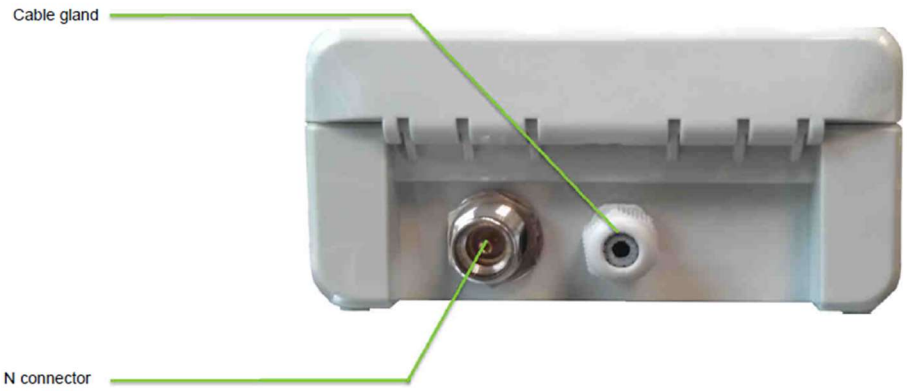
1.6 Power

- PowerOverEthernet supply : 48V class 0 (Max : 15Watts, Nominal : 3Watts (Lora Rx mode with GSM network attachement)
- DC power supply (ex : solar panel use) : 11 to 30Volts
- Power control : ignition detection, software OFF switching
- Back-up battery (up to about 1 minute allowing safe powerdown)

1.7 Mechanical

- Polycarbonate enclosure - Dimensions : 315 x 170 x 215 (including mounting kit) - Weight: about 2 kg (including mounting kit)

Connectors



1.8 Mounting

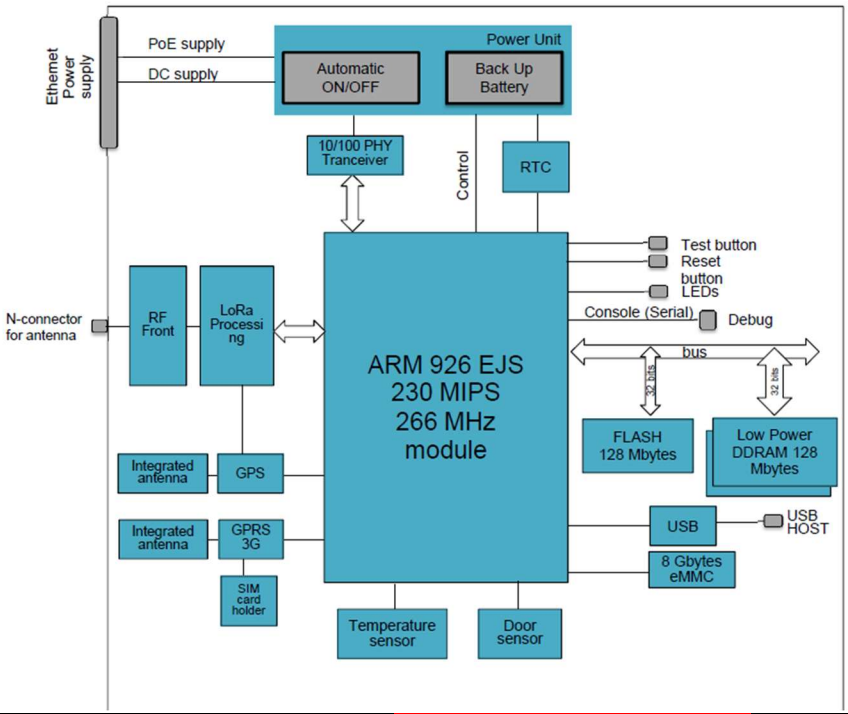
The provided mouting kit allows three different mounting options:
- Wall mounting by screwing
- Pole mounting by U-bolt (max diameter : 60mm)
- Metallic strapping mounting (tube, pipe, flue...)

The provided mouting kit can be splitted to install apart the antenna.

1.9 Environmental

- Full operating range: -20°C to +60°C
- Humidity: 95%, non condensing (protective vent)
- MTBF: 20 years (according to MIL-HDBK-217F) - *non contractual*
- Ingress protection: IP67
- Impact resistance: IK08
- UV resistance: UL508
- Flammability rating: UL94-V0

1.11 Hardware block diagram



2. Software key features

2.1 Operating system

- Standard Long Term Support Linux version 3.10
- File system YAFFS2 (NAND) and EXT4 (eMMC)
- Support of all GNU/Linux tools (cross-compiled for ARM)
- POSIX1 file system
- TCP/IP BSD4.4 socket on network bearer

2.2 Software packages included (non-exhaustive)

- PYTHON
- SQLITE

Optional

- JAVA ORACLE OJEC VM (J2M2 compliant based on CDC 1.1.2 profile)

Networking:

- DHCP client and server
- FTP server
- SSH server
- NFS client
- Firewalling (iptables) and IP routing (layer 3)
- HTTP server
- TFTP server
- L2TP tunneling

2.3 Kerlink M2M services interfaces

- Simple and reduced interface using XML format over TCP/IP socket providing value added services based on action programming
- Mobile SMS management
- System alarm (memory and CPU usage, hardware failure)
- Internal statistic delivery
- Automatic or manual bearer selection
- Power control management

Optional

- Wanesy ready to remote supervision, maintenance and HQ data transfer.

2.4 Software development tools

- C/C++ Linux cross compilation toolchain based on GNU tools (GCC 4.5.2, Glibc 2.13)
- User manual and Kerlink M2M services description
- Complete C-source code set of example for remote and embedded applications
- On-line wiki

Optional

- Debug probe

3. Optional accessories

- **Antennas** : various antennas can be proposed to adapt to environment (omnidirectionnal, directionnal, high gain).

4. In option : Wanesy Ready

Wanesy is a M2M platform provided by Kerlink to :

- interconnect devices with customer ERP
- supervise remote device (status, alarm, log...)
- maintain (remote maintenance, update and control)

Note *:

- TX frequency range (LoRa Downlink) is 863-873MHz for LoRa IoT Station (Wirnet Station) 868 V6.
  For previous versions, the TX frequency range (LoRa downlink) is limited to 866-873MHz.
- Rx frequency range (LoRa Uplink) is 863-873MHz for LoRa IoT Station (Wirnet Station) 868 V3 and above.
  For previous versions (V1 and V2), the Rx frequency range (LoRa uplink) is limited to 866-873MHz.

4.3.2 LoRa IOT Station 868 (Wirnet Station 868) with SOP4-EU CPU

DATASHEET

Wirnet Station 868

LoRa gateway for IoT chain

- 868 MHz ISM band LongRange™ bidirectional communications capabilities
- Embedded, remote and open low power communication station
- Open development framework based on standard Linux OS
- WAN connectivity over GPRS/EDGE/3G or Ethernet

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CPU:
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Volatile memory:
- Low power DDRAM 128 MB
- 10 MB used for system firmware

Non-volatile memory:
- 128 MB NAND flash (40MB used for system firmware and autorecovery mechanism)

1.2 User interfaces

Internal LEDs:
- Operational status : power, GSM signal strenght level, WAN connectivity indicator

Internal push buttons:
- Manual station reset
- Manual test or installation procedure launch

USB host interface allowing :
- Local software upgrade with simple USB key
- USB/NET local configuration/maintenance access

1.3 Communication

LongRange:
- Incorporate LoRa (TM) bidirectional communications technology (RX : 863- 873MHz , TX : 863-873MHz) *
- Sensitivity : up to -141 dBm
- Tx conducted power from 0dBm to +28dBm
- 49 LoRa Demodulators over 9 channels
- More than 15km range in sub-urban situation
- More than 2km range in urban situation

WWAN:
- HSDPA/UMTS (900/2100MHz) : DL 7,2 Mbps / UL 5,6 Mbps (HSDPA), UL/DL 384Kbps (UMTS)
- GPRS/EDGE (900/1800MHz) : UL/DL 85.6Kbps (GPRS), UL/DL 236.8Kbps (EDGE)
- IMEI inside
- Internal antenna

Ethernet :
- PowerOverEthernet IEEE 802.3af alternative B 10/100 Base T compliant

1.4 Positionning/Timing

GPS:
- Integrated GNSS high sensitivity GPS module
- NMEA 2.0 compliant
- Internal antenna

1.5 Sensors

- Embedded temperature sensor
- Door opening detection system

1.6 Power

- PowerOverEthernet supply : 48V class 0 (Max : 15Watts, Nominal : 3Watts (Lora Rx mode with GSM network attachement)
- DC power supply (ex : solar panel use) : 11 to 30Volts
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- Back-up battery (up to about 1 minute allowing safe powerdown)

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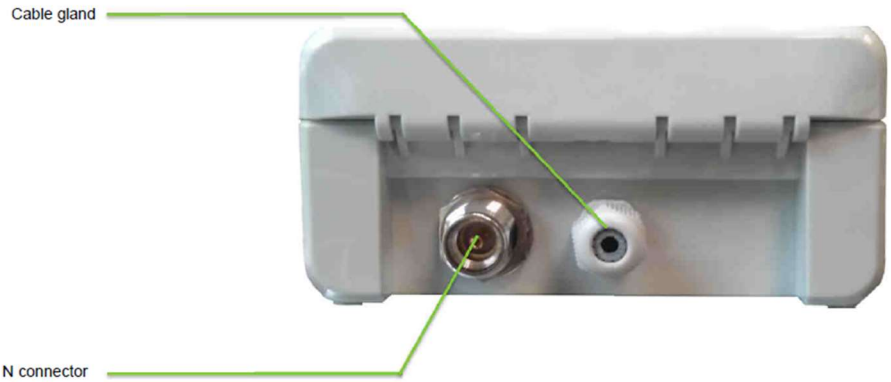

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- Humidity: 95%, non condensing (protective vent)
- MTBF: 20 years (according to MIL-HDBK-217F) - *non contractual*
- Ingress protection: IP67
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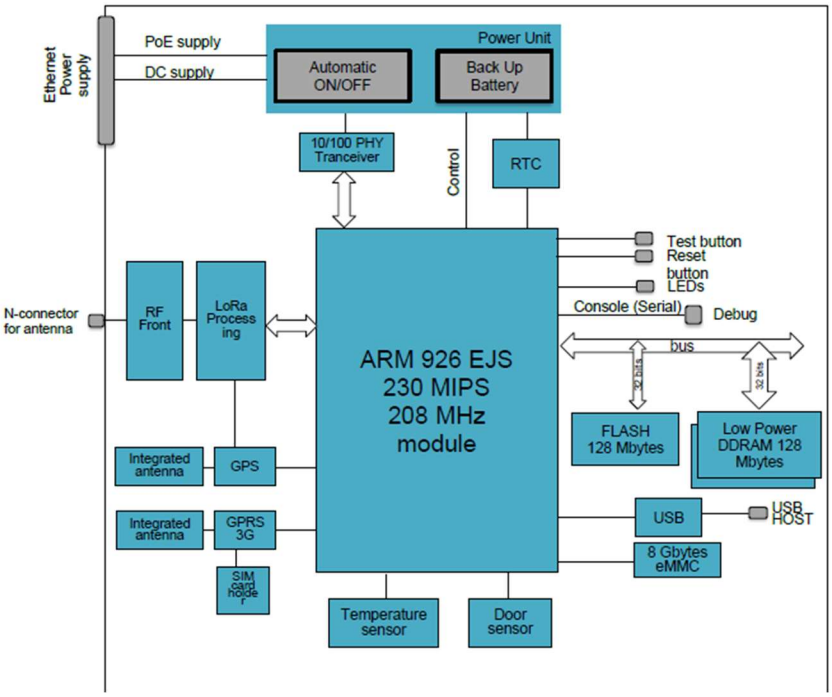
1.11 Hardware block diagram



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- SQLITE

Optional

- JAVA ORACLE OJEC VM (J2M2 compliant based on CDC 1.1.2 profile)

Networking:

- DHCP client and server
- FTP server
- SSH server
- NFS client
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4.3.3 LoRa IOT Station 915 (Wirnet Station 915) with SOP3-US CPU

kerlink m2m technologies

DATASHEET

PRELIMINARY

Wirnet Station 915

LoRa gateway for IoT chain

- **915 MHz FCC Hybrid Mode ISM band LongRange™ bidirectional communications capabilities**
- **Embedded, remote and open low power communication station**
- **Open development framework based on standard Linux OS**
- **WAN connectivity over GPRS/EDGE/3G or Ethernet**

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CPU:
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Internal push buttons:
- Manual station reset
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USB host interface allowing :
- Local software upgrade with simple USB key
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1.3 Communication

LongRange:
- Incorporate LoRa (TM) bidirectional communications technology (902-928 MHz ISM band-hybrid mode)
- Sensitivity : up to -141 dBm
- Tx conducted power from 0dBm to +30dBm
- 49 LoRa Demodulators over 9 channels
- More than 15km range in sub-urban situation

WWAN:
- HSDPA/UMTS (850/1900MHz) : DL 3.6 Mbps / UL 384 Kbps (HSDPA), UL/DL 384Kbps (UMTS)
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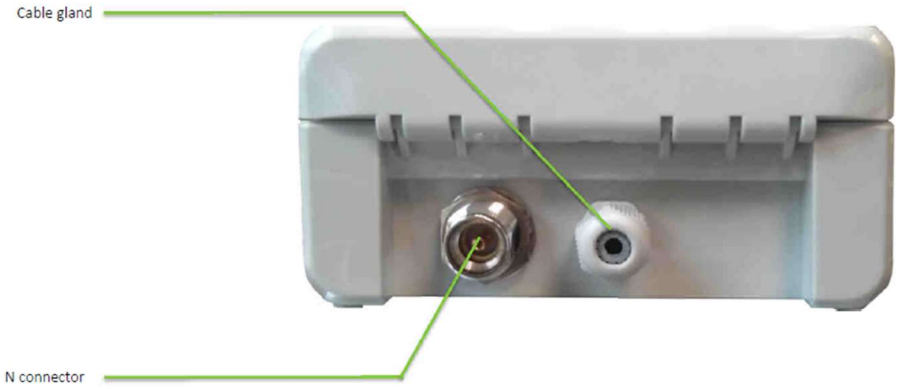

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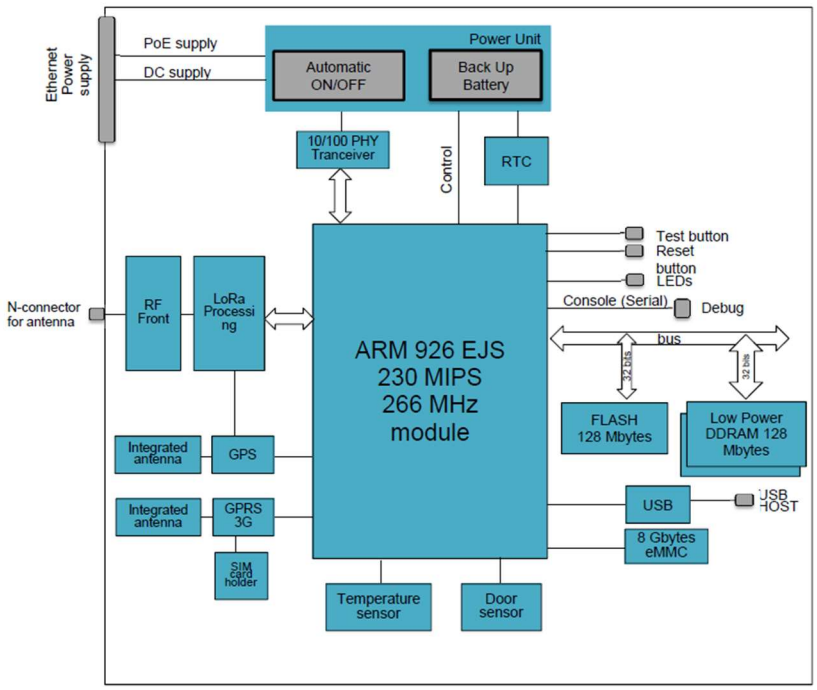

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- maintain (remote maintenance, update and control)

4.3.4 LoRa IOT Station 923 (Wirnet Station 923) with SOP3-EU CPU

DATASHEET

Wirnet Station 923

PRELIMINARY

LoRa gateway for IoT chain

- **915-928 MHz ISM band LongRange™ bidirectional communications capabilities**
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- **Open development framework based on standard Linux OS**
- **WAN connectivity over GPRS/EDGE/3G or Ethernet**

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- Hardware watchdog
- Optimised power consumption

Volatile memory:
- Low power DDRAM 128 MB
- 10 MB used for system firmware

Non-volatile memory:
- 128 MB NAND flash (40MB used for system firmware and autorecovery mechanism)

1.2 User interfaces

Internal LEDs:
- Operational status : power, GSM signal strenght level, WAN connectivity indicator

Internal push buttons:
- Manual station reset
- Manual test or installation procedure launch

USB host interface allowing :
- Local software upgrade with simple USB key
- USB/NET local configuration/maintenance access

1.3 Communication

LongRange:
- Incorporate LoRa (TM) bidirectional communications technology (RX : 915-928 MHz, TX : 920-928MHz)
- Sensitivity : up to -141 dBm
- Tx conducted power from 0dBm to +30dBm
- 49 LoRa Demodulators over 9 channels
- More than 15km range in direct sight
- More than 2km range in urban situation

WWAN:
- HSDPA/UMTS (900/2100MHz) : DL 3.6 Mbps / UL 384 Kbps (HSDPA), UL/DL 384Kbps (UMTS)
- GPRS/EDGE (850/900/1800/1900MHz) : UL/DL 85.6Kbps (GPRS), UL/DL 236.8Kbps (EDGE)
- IMEI inside
- Internal antenna

Ethernet :
- PowerOverEthernet IEEE 802.3af alternative B 10/100 Base T compliant

1.4 Positionning/Timing

GPS:
- Integrated GNSS high sensitivity GPS module
- NMEA 2.0 compliant

1.5 Sensors

- Embedded temperature sensor
- Door opening detection system

1.6 Power

- PowerOverEthernet supply : 48V class 0 (Max : 15Watts, Nominal : 3Watts (Lora Rx mode with GSM network attachement)
- DC power supply (ex : solar panel use) : 11 to 30Volts
- Power control : ignition detection, software OFF switching
- Back-up battery (up to about 1 minute allowing safe powerdown)

1.7 Mechanical

- Polycarbonate enclosure - Dimensions : 315 x 170 x 215 (including mounting kit) - Weight: about 2 kg (including mounting kit)

Connectors

1.8 Mounting

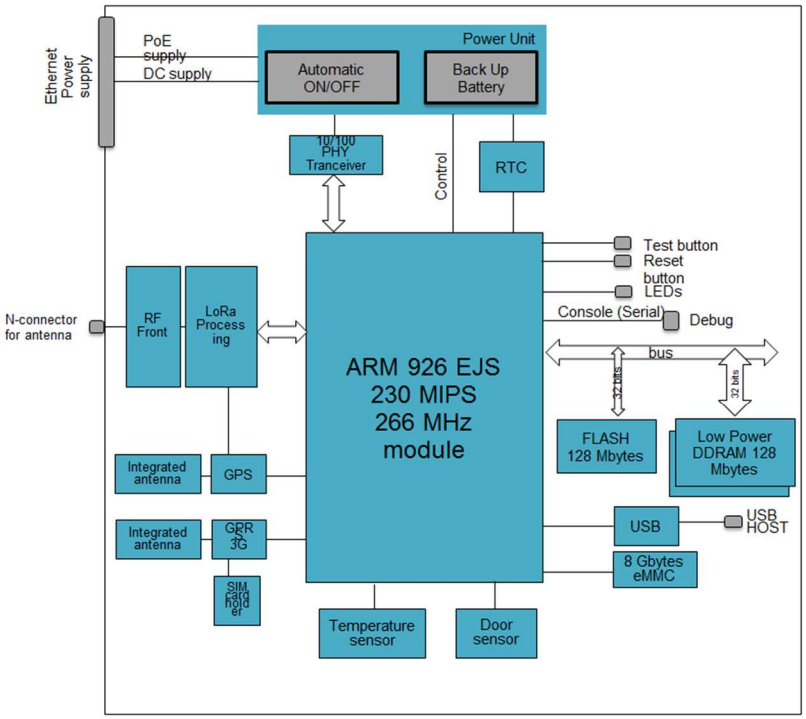
The provided mouting kit allows three different mounting options:
- Wall mounting by screwing
- Pole mounting by U-bolt (max diameter : 80mm)
- Metallic strapping mounting (tube, pipe, flue...)

The provided mouting kit can be splitted to install apart the antenna.

1.9 Environmental

- Full operating range: -20°C to +60°C
- Humidity: 95%, non condensing (protective vent)
- MTBF: 20 years (according to MIL-HDBK-217F) - *non contractual*
- Ingress protection: IP67
- Impact resistance: IK08
- UV resistance: UL508
- Flammability rating: UL94-V0

1.11 Hardware block diagram



2. Software key features

2.1 Operating system

- Standard Long Term Support Linux version 3.10
- File system YAFFS2 (NAND) and EXT4 (eMMC)
- Support of all GNU/Linux tools (cross-compiled for ARM)
- POSIX1 file system
- TCP/IP BSD4.4 socket on network bearer

2.2 Software packages included (non-exhaustive)

- PYTHON
- SQLITE

Optional

- JAVA ORACLE OJEC VM (J2M2 compliant based on CDC 1.1.2 profile)

Networking:

- DHCP client and server
- FTP server
- SSH server
- NFS client
- Firewalling (iptables) and IP routing (layer 3)
- HTTP server
- TFTP server
- L2TP tunneling

2.3 Kerlink M2M services interfaces

- Simple and reduced interface using XML format over TCP/IP socket providing value added services based on action programming
- Mobile SMS management
- System alarm (memory and CPU usage, hardware failure)
- Internal statistic delivery
- Automatic or manual bearer selection
- Power control management

Optional

- Wanesy ready to remote supervision, maintenance and HQ data transfer.

2.4 Software development tools

- C/C++ Linux cross compilation toolchain based on GNU tools (GCC 4.5.2, Glibc 2.13)
- User manual and Kerlink M2M services description
- Complete C-source code set of example for remote and embedded applications
- On-line wiki

Optional

- Debug probe

3. Optional accessories

- **Antennas** : various antennas can be proposed to adapt to environment (omnidirectionnal, directionnal, high gain).
- **External cavity filters**: Radio filtering can be adjusted adding optional external cavity filter according to specific colocation constraints

4. In option : Wanesy Ready

Wanesy is a M2M platform provided by Kerlink to :

- interconnect devices with customer ERP
- supervise remote device (status, alarm, log...)
- maintain (remote maintenance, update and control)

4.3.5 LoRa IOT Station 923 (Wirnet Station 923) with SOP4-EU CPU

DATASHEET

Wirnet Station 923

PRELIMINARY

LoRa gateway for IoT chain

- **915-928 MHz ISM band LongRange™ bidirectional communications capabilities**
- **Embedded, remote and open low power communication station**
- **Open development framework based on standard Linux OS**
- **WAN connectivity over GPRS/EDGE/3G or Ethernet**

1. Hardware Key Features

1.1 System

CPU:
- Based on ARM 926EJS core processor
- Up to 230 MIPS
- Real-time clock saved by battery
- Hardware watchdog
- Optimised power consumption

Volatile memory:
- Low power DDRAM 128 MB
- 10 MB used for system firmware

Non-volatile memory:
- 128 MB NAND flash (40MB used for system firmware and autorecovery mechanism)

1.2 User interfaces

Internal LEDs:
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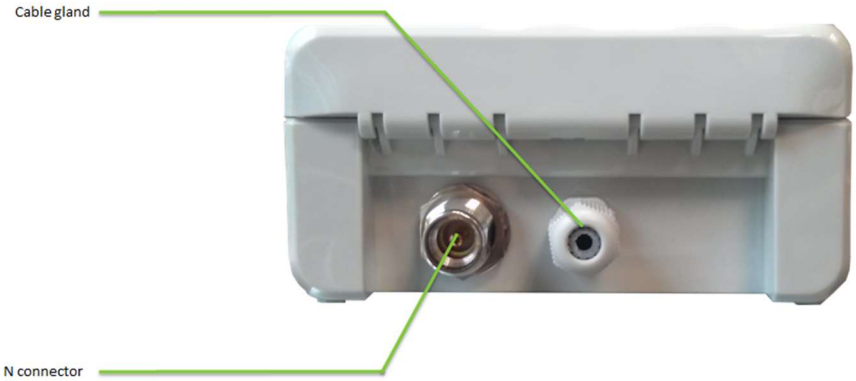

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- Humidity: 95%, non condensing (protective vent)
- MTBF: 20 years (according to MIL-HDBK-217F) - *non contractual*
- Ingress protection: IP67
- Impact resistance: IK08
- UV resistance: UL508
- Flammability rating: UL94-V0

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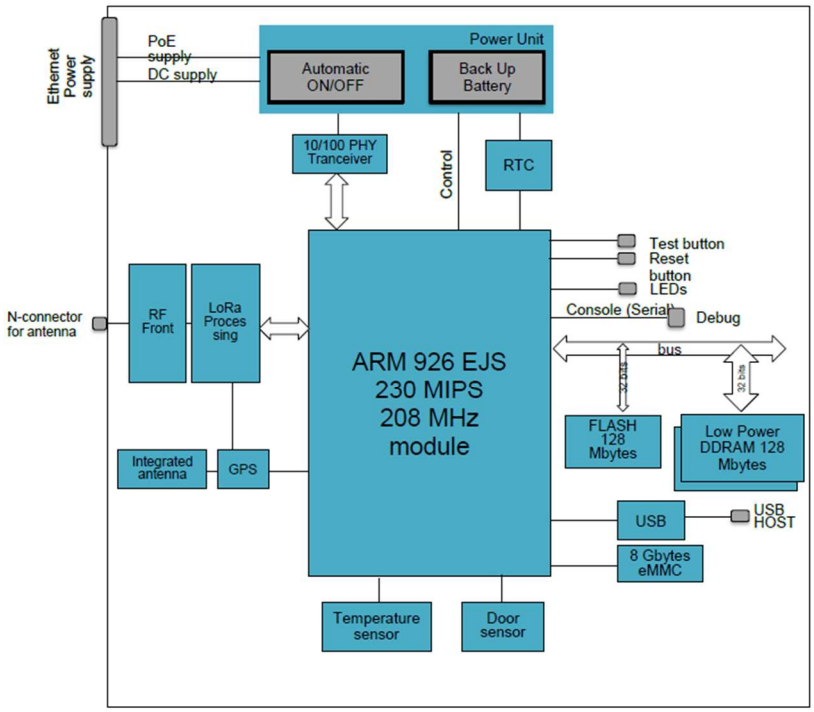

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2.2 Software packages included (non-exhaustive)

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Optional

- JAVA ORACLE OJEC VM (J2M2 compliant based on CDC 1.1.2 profile)

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4. In option : Wanesy Ready

Wanesy is a M2M platform provided by Kerlink to :

- interconnect devices with customer ERP
- supervise remote device (status, alarm, log...)
- maintain (remote maintenance, update and control)

4.4 WWAN description

The M2M CPU board is based on a SOP daughter board featuring a WAN module.
Several SOP daughter boards are available depending on the LoRa IoT Station (Wirnet Station) model and the country to be addressed.

The following table summarizes the possible configurations:

SOP version	WAN module	2G bands	3G bands	Wirnet Station model
SOP3-EU	Huawei MU509-b	850 900 1800 1900	900 2100	Wirnet Station 868 Wirnet Station 923
SOP3-US	Huawei MU509-b	850 900 1800 1900	850 1900	Wirnet Station 915
SOP4-EU	Telit UE910-EUD	900 1800	900 2100	Wirnet Station 868 Wirnet Station 923

The following data rates are supported:

SOP version	WAN module	HSPA	WCDMA	EDGE	GPRS
SOP3-EU	Huawei MU509-b	DL 3.6Mbps	UL 384kbps DL 384kbps	UL 236.8 kbps DL 236.8 kbps	UL 85.6 kbps DL 85.6 kbps
SOP3-US	Huawei MU509-c	DL 3.6Mbps	UL 384kbps DL 384kbps	UL 236.8 kbps DL 236.8 kbps	UL 85.6 kbps DL 85.6 kbps
SOP4-EU	Telit UE910-EUD	UL 5.76 Mbps DL 7.2 Mbps	UL 384kbps DL 384kbps	UL 236.8 kbps DL 236.8 kbps	UL 85.6 kbps DL 85.6 kbps

4.5 Detailed LoRa radio specifications

4.5.1 Modulations and data rates

The LoRa IoT Station (Wirnet Station) supports the following modulation schemes:

SF	BW (KHz)	Data rate (bps)
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. See also [1], [2] and [3].

4.5.2 Frequency bands and channelization

The frequency bands covered by the LoRa IoT Station (Wirnet Station) depend on the version (868, 915 or 923). The downstream frequencies and upstream frequencies are listed in the following table:

Version	Link	Frequency range start/end
868 v5 and below	Upstream (RX Wirnet Station)	863MHz / 873MHz
868 v5 and below	Downstream (TX Wirnet Station)	866MHz / 873MHz
868 v6	Upstream (RX Wirnet Station)	863MHz / 873MHz
868 v6	Downstream (TX Wirnet Station)	863MHz / 873MHz
915	Upstream (RX Wirnet Station)	902MHz / 928MHz
915	Downstream (TX Wirnet Station)	902MHz / 928MHz
923	Upstream (RX Wirnet Station)	915MHz / 928MHz
923	Downstream (TX Wirnet Station)	919MHz / 928MHz

LoRaWAN specification and regional parameters define a more accurate frequency plan and channelization, although different options could be envisaged (see [1], [2] and [3]).

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 Station)	902,3+i*0,2MHz (i=0 to 63)	125	64	200
915	Upstream (RX Wirnet Station)	903,0+i*1.6MHz (i=0 to 7)	500	8	600
915	Downstream (TX Wirnet Station)	923,3+i*0.6MHz (i=0 to 7)	500	8	600
923	Upstream (RX Wirnet Station)	915,2+i*0,2MHz (i= 0 to 63)	125	64	200
923	Upstream (RX Wirnet Station)	915,9+i*1.6MHz (i=0 to 7)	500	8	600
923	Downstream (TX Wirnet Station)	919,8+i*0,2MHz (i= 0 to 40)	125	41	200
923	Downstream (TX Wirnet Station)	920,3+i*0.6MHz (i=0 to 12)	500	13	600
868	Upstream (RX Wirnet Station)	863,1+i*0,2MHz (i= 0 to 27)	125	28	200
868	Downstream (TX Wirnet Station)	863,1+i*0,2MHz (i= 0 to 27)	125	28	200
868	Upstream (RX Wirnet Station)	868,9+i*0,2MHz (i= 0 to 1)	125	2	200
868	Downstream (TX Wirnet Station)	868,9+i*0,2MHz (i= 0 to 1)	125	2	200
868	Upstream (RX Wirnet Station)	869,525MHz	125	1	250
868	Downstream (TX Wirnet Station)	869,525MHz	125	1	250
868	Upstream (RX Wirnet Station)	869,850MHz	125	1	300
868	Downstream (TX Wirnet Station)	869,850MHz	125	1	300
868	Upstream (RX Wirnet Station)	870,1+i*0,2MHz (i= 0 to 14)	125	15	200
868	Downstream (TX Wirnet Station)	870,1+i*0,2MHz (i= 0 to 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.

4.5.3 Output Power

The conducted output power can be adjusted from 0dBm to +28dBm.
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 +28dBm
Ripple in the band	+/- 2dB
Variation over temperature range (-20°C to +55°C)	+/- 2dB

4.5.4 Out of band emissions

Due to specific RF filtering, the LoRa IoT Station (Wirnet Station) 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	LTE, UMTS or GSM band	Out of band emissions
868 v6	E-GSM900 UL (880-915MHz)	-80dBm/100KHz
868 v6	R-GSM900 UL (876-880MHz)	-60dBm/100KHz
868 v6	LTE800 (832-860MHz)	-75dBm/100KHz
868 v6	LTE800 (860-862MHz)	-70dBm/100KHz
868 v5 and below	E-GSM900 UL (880-915MHz)	-80dBm/100KHz
868 v5 and below	R-GSM900 UL (876-880MHz)	-60dBm/100KHz
868 v5 and below	LTE800 (832-862MHz)	-80dBm/100KHz
915	GSM850 DL (869-894MHz)	-85dBm/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 IoT Station (Wirnet Station) is therefore ideal in co-localization with BTS.

4.5.5 Sensitivity

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

Mode	868MHz	915MHz	923MHz
SF7/125KHz	-129dBm	-129dBm	-128dBm
SF10/125KHz	-135dBm	-135dBm	-134dBm
SF12/125KHz	-141dBm	-141dBm	-140dBm
SF7/250KHz	-126dBm	-126dBm	-125dBm
SF12/250KHz	-136dBm	-136dBm	-135dBm
SF7/500KHz	-122dBm	-122dBm	-122dBm
SF12/500KHz	-134dBm	-134dBm	-133dBm

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

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

4.5.6 RSSI and SNR

The LoRa IoT Station (Wirnet Station) is able to receive LoRa frames from -20dBm to -141dBm, depending on the LoRa BW and SF.
The LoRa IoT Station (Wirnet Station) 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:

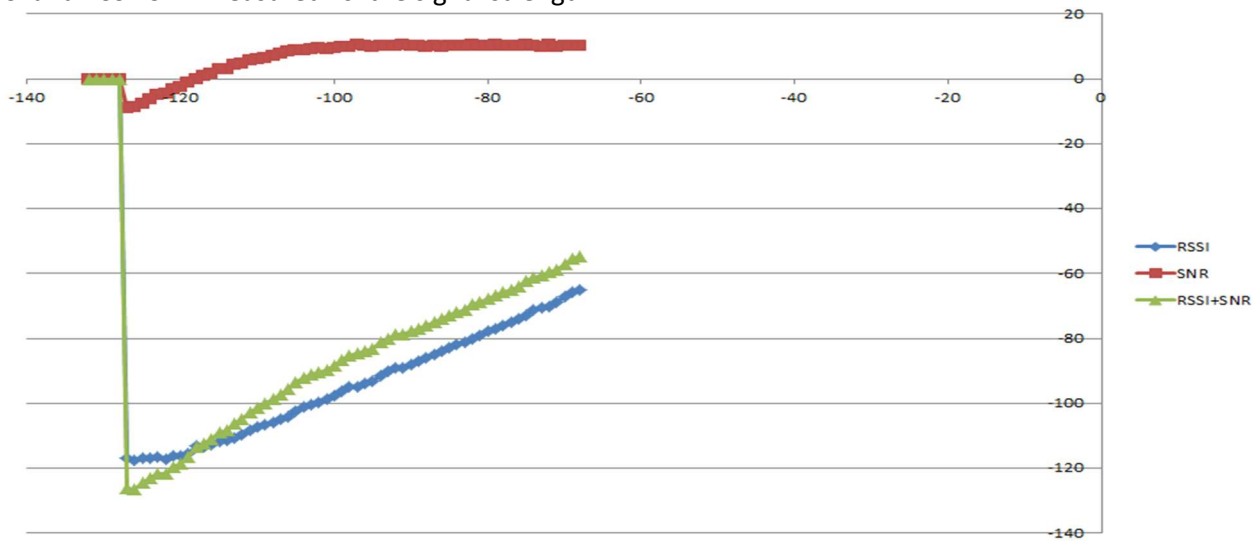


Figure 3: Example of SNR, RSSI and RSSI+SNR plots at 125KHz BW / SF7

4.5.7 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.

4.5.7.1 868MHz

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

Offset	SF7/125KHz	SF12/125KHz
+/-2MHz	-36dBm (90dB)	-48dBm (90dB)
+/-10MHz	-26dBm (100dB)	-38dBm (100dB)
821MHz	+10dBm (136dB)	+10dBm (148dB)
880MHz	-15dBm (111dB)	-20dBm (128dB)
935MHz	+10dBm (136dB)	+10dBm (148dB)
960MHz	+10dBm (136dB)	+10dBm (148dB)

4.5.7.2 915MHz

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

Offset	SF10/125KHz
+/-2MHz	-48dBm (89dB)
+/-10MHz	-37dBm (100dB)
850MHz	+10dBm (147dB)
894MHz	-27dBm (110dB)
935MHz	+10dBm (147dB)
960MHz	+10dBm (147dB)

4.5.7.3 923MHz

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

Offset	SF7/125KHz	SF12/125KHz
+/-2MHz	-45dBm (80dB)	-43dBm (94dB)
+/-10MHz	-27dBm (98dB)	-32dBm (105dB)
850MHz	+10dBm (135dB)	+10dBm (147dB)
894MHz	-20dBm (105dB)	-22dBm (115dB)
935MHz	-20dBm (105dB)	-22dBm (115dB)
960MHz	+10dBm (135dB)	+10dBm (147dB)

4.6 Mechanical implementation

The LoRa IoT Station (Wirnet Station) is based on a high impact resistant polycarbonate wall mounting cabinet that withstand harsh industrial and outdoor environments.
It offers excellent flammability rating, good UV resistance and also good chemical resistance.
The dimensions are 231 mm x 125 mm x 60 mm. It is rated IP67.
The opening system is simple: clipping (screwing is optional). See details in §7.1.

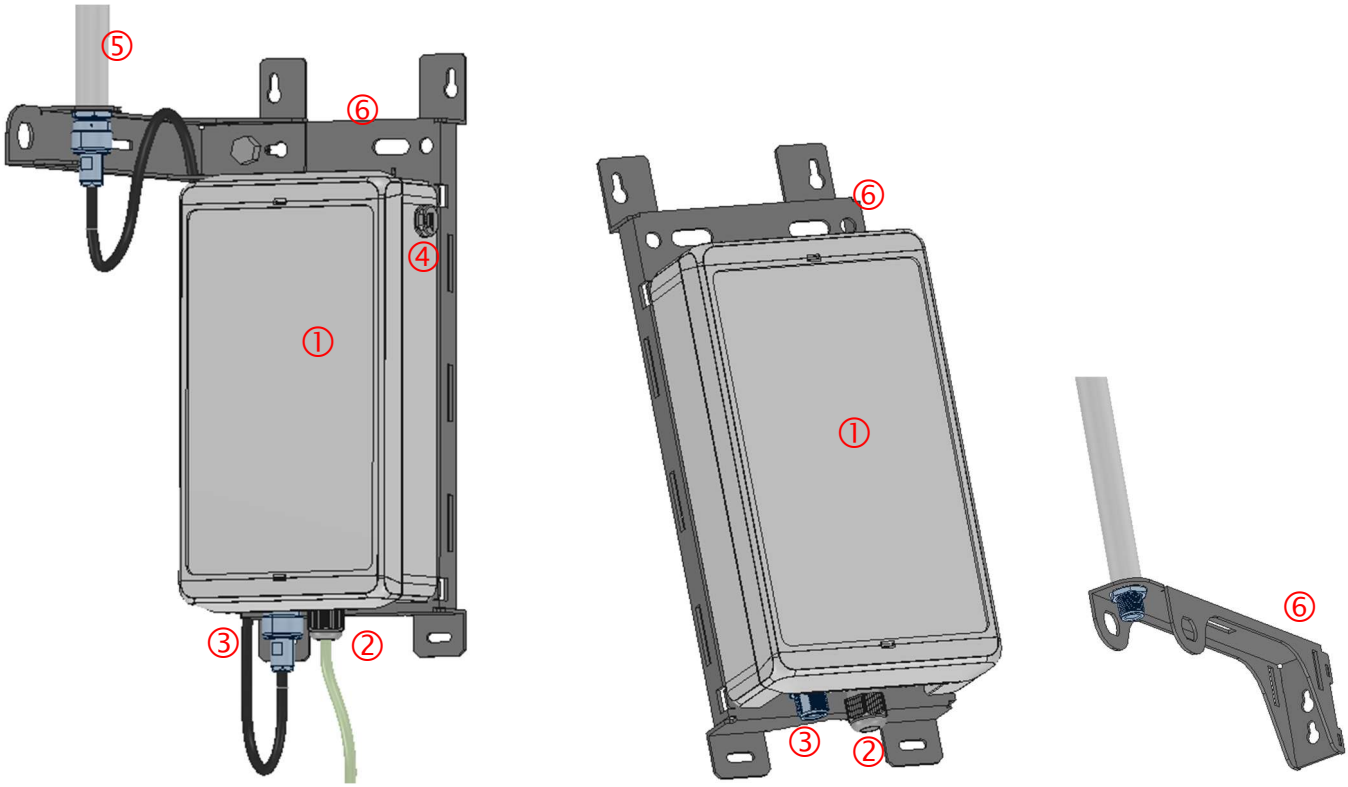


Figure 4 : LoRa IoT Station (Wirnet Station) casing - external view

Figure 5 : POE injector (example)

Figure 6 : LoRa IoT Station (Wirnet Station) casing - internal view

The LoRa IoT Station (Wirnet Station) is composed of:

- The enclosure itself including:
  - The casing (item 1)
  - 1 cable gland for RJ45 POE (item 2). The LoRa IoT Station (Wirnet Station) is delivered without RJ45 POE cable (Ethernet cable).
  - 1 N connector (item 3) to connect LoRa antenna
  - 1 pressure stabilizer for protection against condensation (item 4)
- LoRa RF antenna connection with N connector (item 5) and its coaxial cable
- A POE injector (item 7) IEEE 802.3af alternative B and its power supply cable.
- The internal shielding (item 8)
- A mounting kit (item 6) designed to answer different installation configurations:
  - Pole mounting by U-bolt (delivered by default)
  - Wall mounting
  - Metallic strapping mounting (tube, pipe, flue...)

The mounting kit owns a full independent universal antenna support that could be mounted on the enclosure support (by default) or directly on a pole, a wall …

Note: POE injector must be compliant to IEEE 802.3af alternative B. Alternative A must not be used.

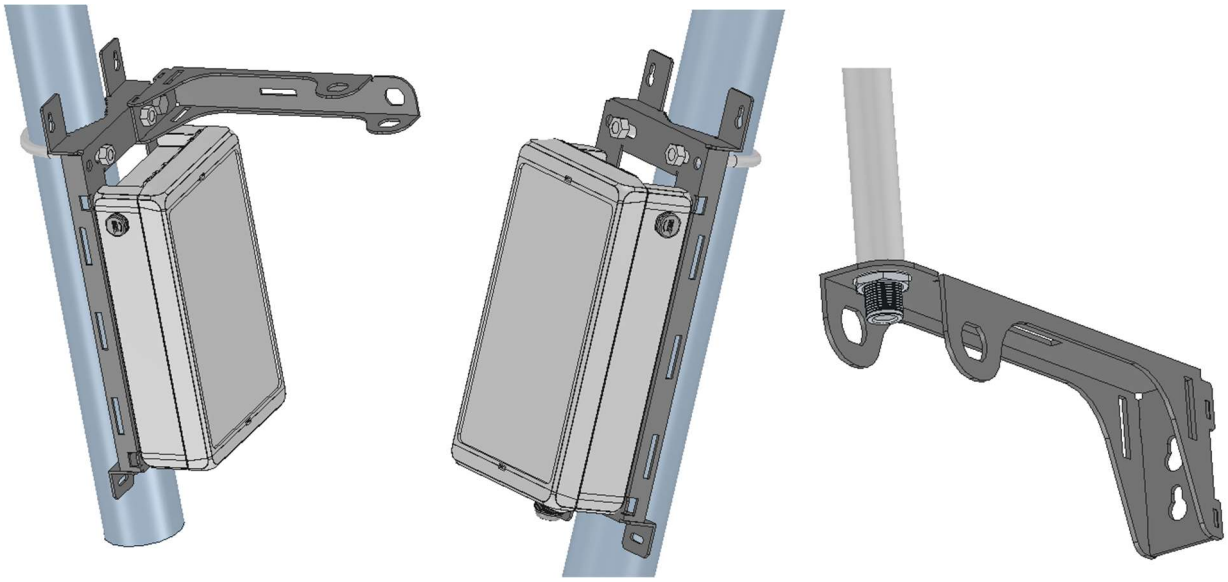


Figure 7 : Mounting kit

4.7 Stickers

The LoRa IoT Station (Wirnet Station) has stickers placed inside or outside the casing:

- A sticker on the shield, including LoRa IoT Station (Wirnet Station) serial number, regulatory markings and electrical information (item 9)
- A sticker explaining the LEDs behavior (item 10)
- A sticker outside the casing including regulatory marking and sentences depending on the countries (FCC ID, IC ID, etc …).

4.8 Accessories

4.8.1 PoE injectors

Two kinds of Midspan PoE injectors can be provided with the LoRa IoT Station (Wirnet Station):

- Indoor Midspan PoE injector 15W
- Outdoor Midspan PoE injector 30W

The Indoor Midspan PoE injector 15W is delivered by default with the LoRa IoT Station (Wirnet Station). This version is intended for indoor applications only.
The Outdoor Midspan PoE injector 60W can be ordered as an option. This version is recommended for outdoor applications.

Note: 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 LoRa IoT Station (Wirnet Station). If the ambient temperature range cannot be guaranteed below +40°C, the Midspan PoE injector may have to be re-dimensioned.

4.8.1.1 Indoor Midspan PoE injector 15W

The indoor 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 compliance	IEEE 802.3af
PoE Output Power	15.4 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 AC Input Current: 0.5A @100-240VAC AC Frequency: 47 to 63 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	Channel Power (Green)
Operating Ambient Temperature	0°C to +40°C @ 15W
Operating Humidity	Maximum 90%, Non-condensing
Storage Temperature	-20°C to +70°C
Storage Humidity	Maximum 95%, Non-condensing
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) VCCI
Safety Approvals	UL/cUL Per IEC 60950-1 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 LoRa IoT Station (Wirnet Station).

The following figure details the indoor Midspan PoE injector 15W:

Figure 8 : Indoor POE injector 15W

The indoor Midspan PoE injector 15W can be provided with E/F type cable (Europe) or B type cable (USA). See §9 to order the required version.

Note 2: this indoor PoE injector must be connected to an industrial electrical installation including lightning 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 §4.8.1.2.

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 §4.8.1.2.

4.8.1.2 Outdoor Midspan PoE injector 30W

The outdoor 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 compliance	IEEE 802.3at 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 AC Input Current: 1A @100-240VAC AC Frequency: 50 to 60 Hz
Dimensions	170 mm (W) x 140 mm (L) x 60 mm (H)
Weight	1400g
Connectors	Shielded rugged RJ-45 with gasket 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 Metal enclosure
Corrosion resistance	ASTM B-117
Regulatory compliance	RoHS WEEE CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity) EN 61000-4-5 Class 5 (6kV CM) VCCI

Surge protection	GR-1089-CORE Issue 4 ITU-T K.21 6 kV on AC lines
Safety Approvals	UL 60950-1, UL 60950-22 GS Mark

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 Station.

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

Figure 9 : Outdoor 30W 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.

4.8.2 LoRa antennas

4.8.2.1 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):

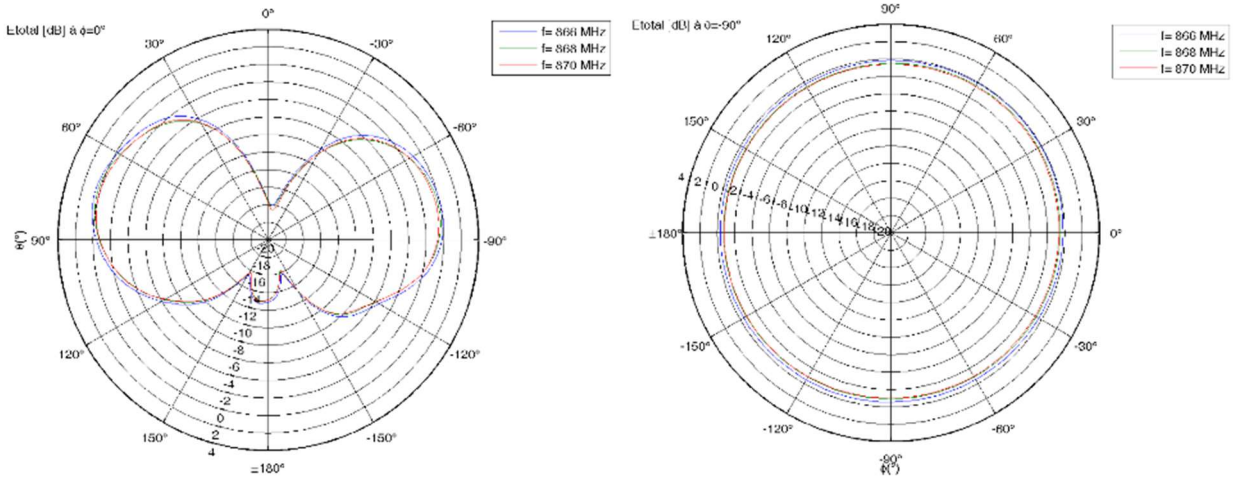


Figure 10 : Radiation pattern of omnidirectional 868MHz/3dBi antenna

4.8.2.2 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):

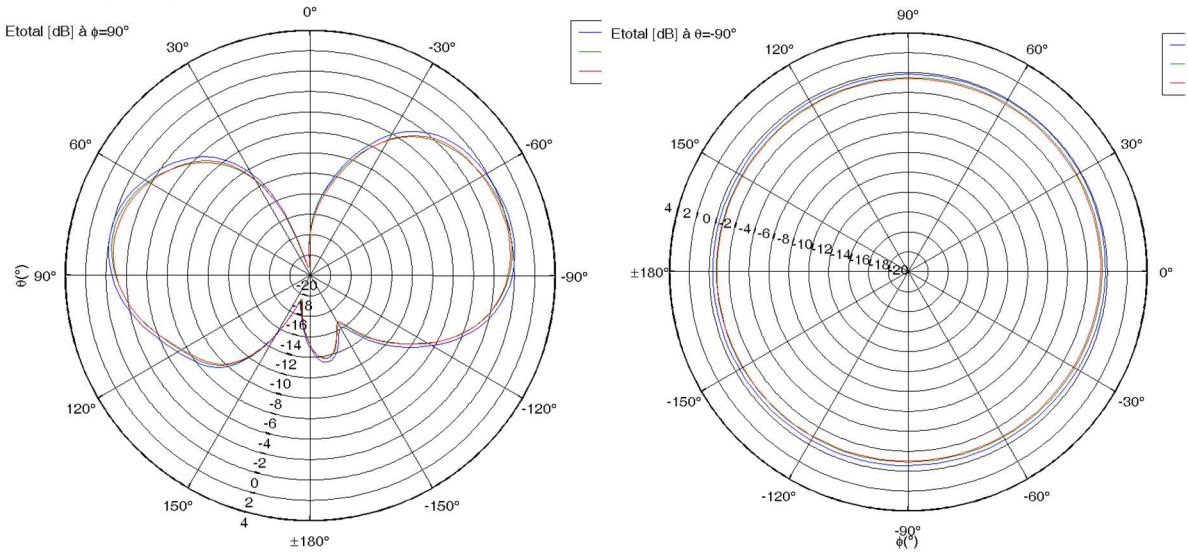


Figure 11 : Radiation pattern of omnidirectional 915MHz/3dBi antenna

4.8.2.3 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):

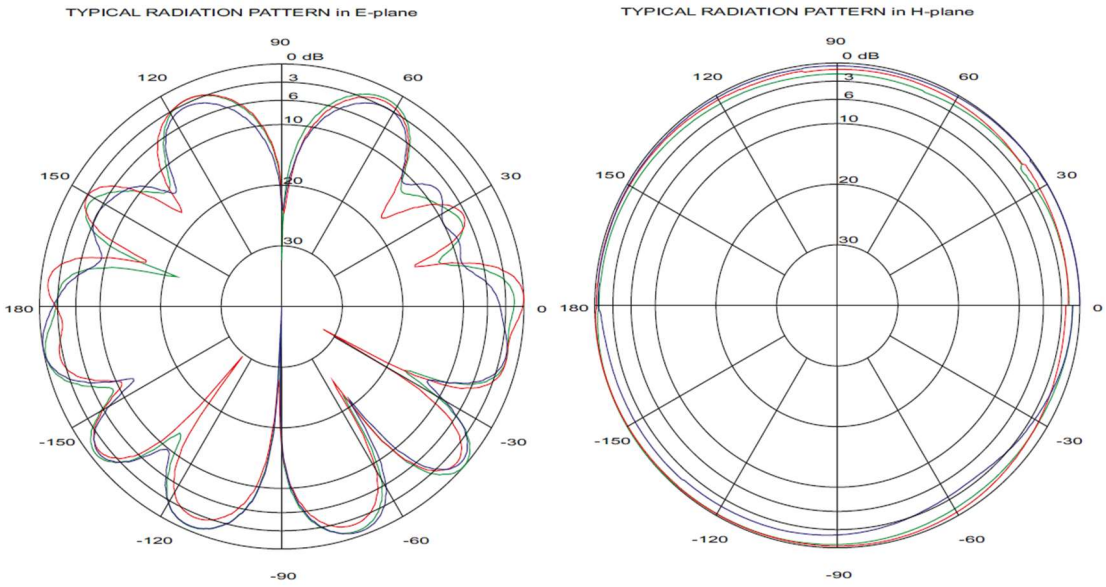


Figure 12 : Radiation pattern of omnidirectional 915MHz/6dBi antenna

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.

4.8.3 Cavity filters

4.8.3.1 865-867MHz cavity filter

The 862-867MHz 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
Center Frequency	866 MHz
Pass band	865-867MHz
Insertion losses	≤4dB
Ripple	≤1.0dB
Return Loss	≥20dB
Rejection	≥60dB @ 806-860MHz ≥40dB @ 862MHz ≥50dB @ 869MHz ≥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
Weight	< 1.2Kg
Dimensions (w/o N connectors)	196 x 104 x 50 mm

The dimensions of the 862-867MHz cavity filter are detailed hereafter:

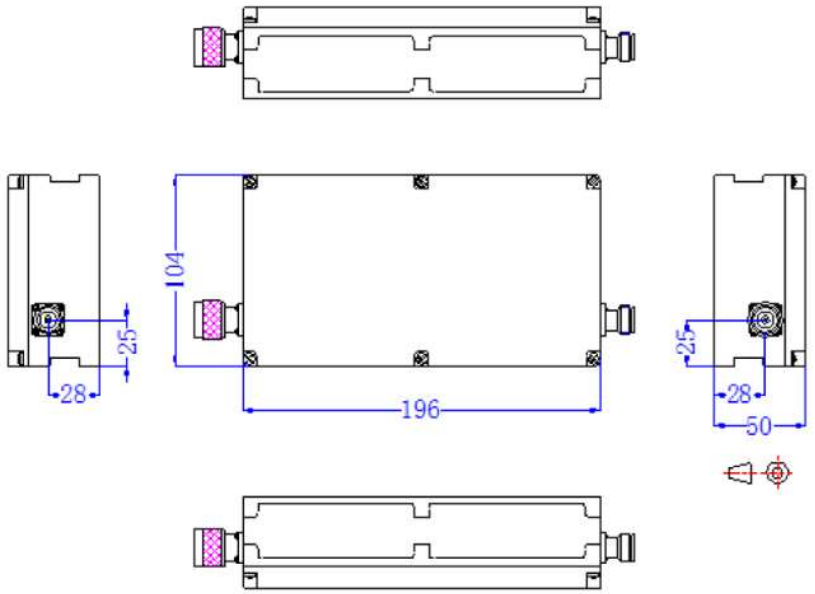


Figure 13 : Dimensions of the 865-867MHz cavity filter

The frequency response of 865-867MHz cavity filter is as follows:

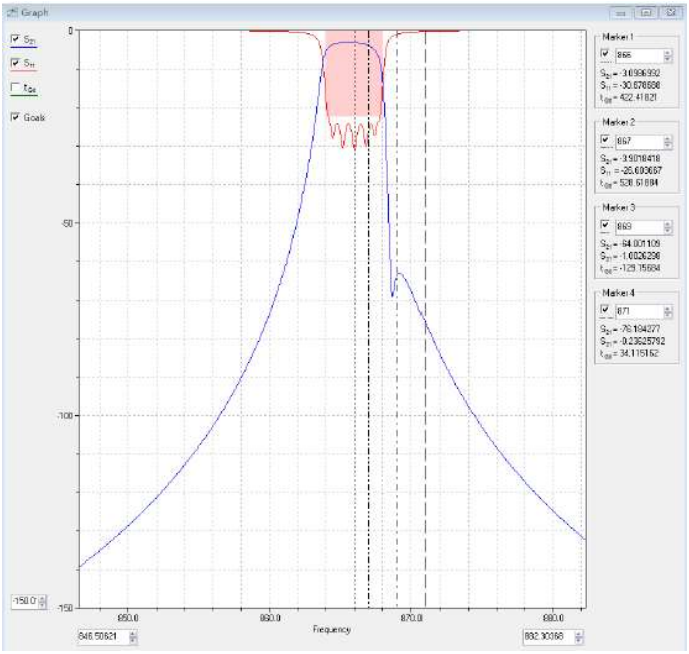


Figure 14 : Frequency response of the 865-867MHz cavity filter

4.8.3.2 865-870MHz 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 ≥20dB @ 832-862MHz ≥20dB @ 880-925MHz ≥30dB @ 925-960MHz ≥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

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

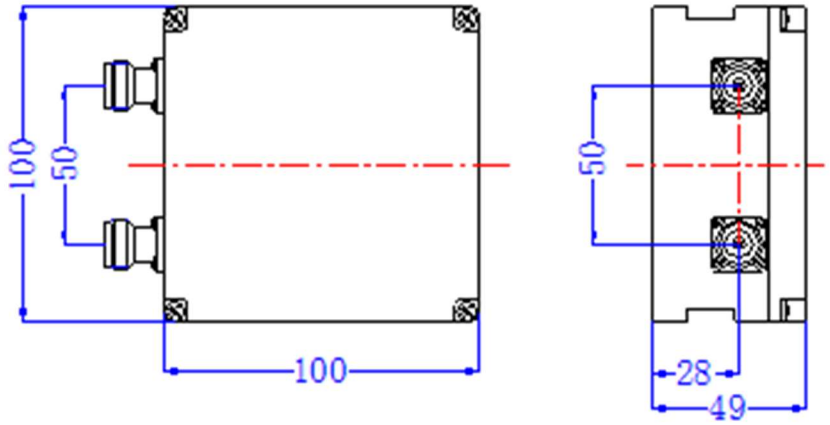


Figure 15 : Dimensions of the 865-870MHz cavity filter

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

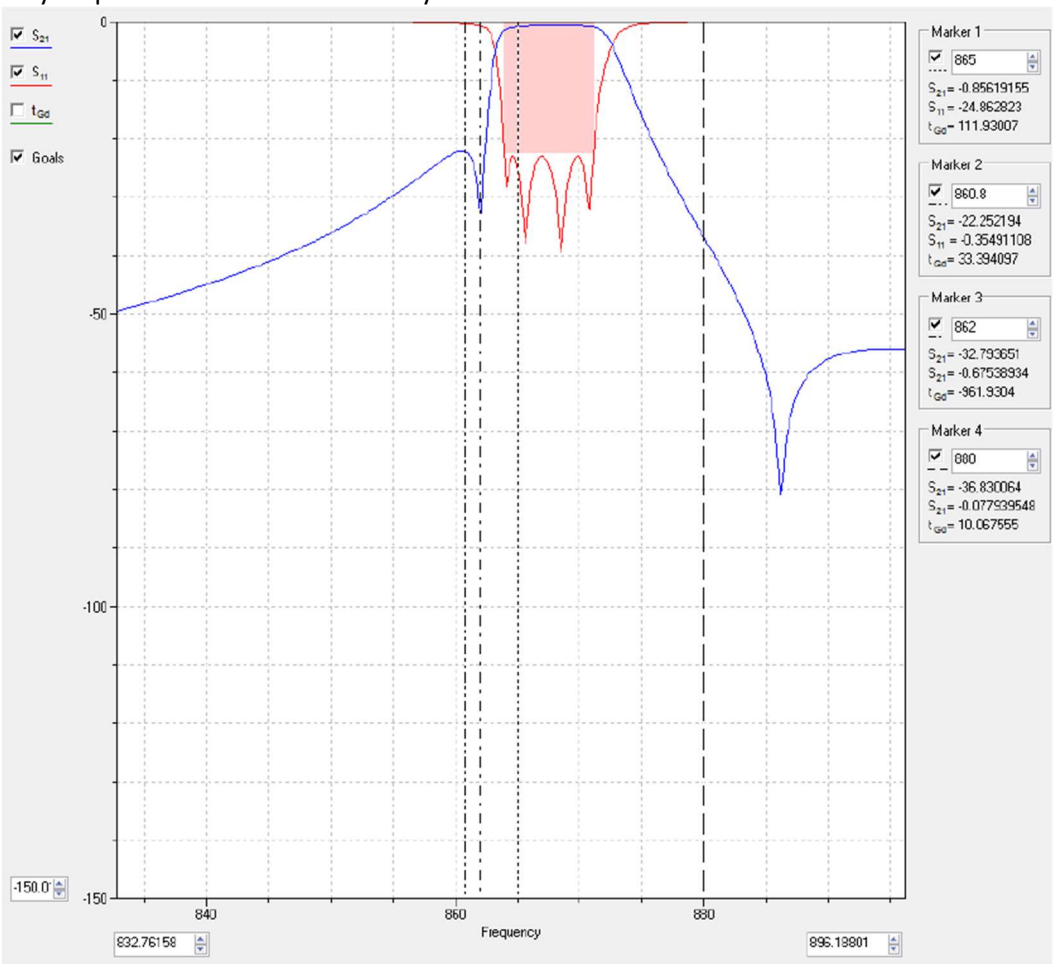


Figure 16 : Frequency response of the 865-870MHz cavity filter

4.8.3.3 863-873MHz 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 ≤1.5dB@+65°C to +85°C
Ripple	≤0.5dB ≤1dB@+65°C to +85°C
Return Loss	≥20dB ≥16dB@+65°C to +85°C
Rejection	≥80dB @ 10-700MHz ≥70dB @ 700-791MHz ≥60dB @ 791-821MHz ≥60dB @ 925-960MHz ≥70dB @ 960-1000MHz ≥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	<1200g
Dimensions (w/o N connectors)	157 x 56 x 49 mm

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

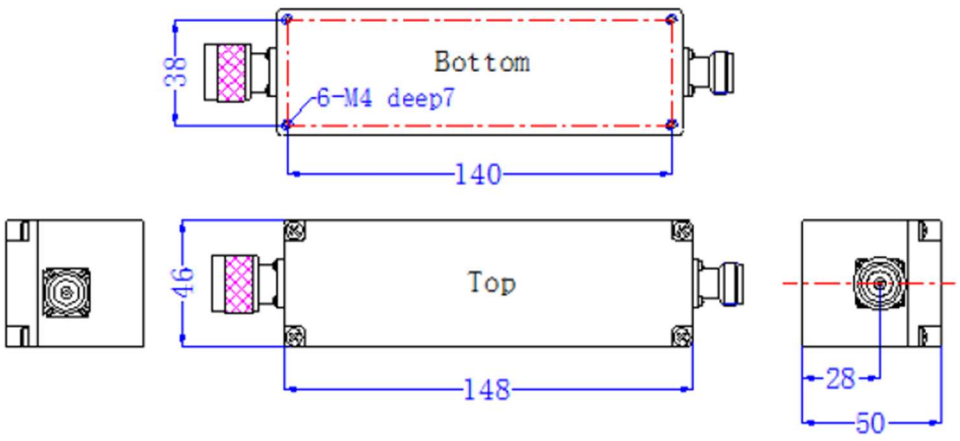


Figure 17 : Dimensions of the 863-873MHz cavity filter

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

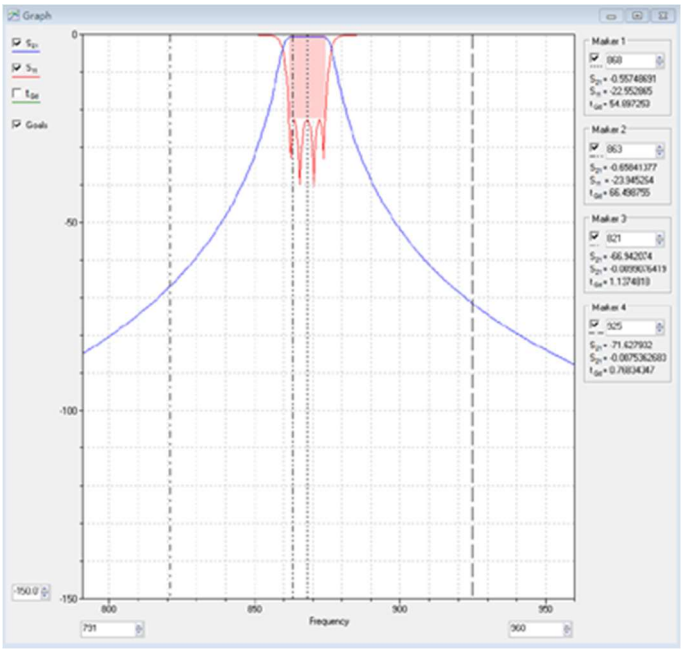


Figure 18 : Frequency response of the 863-873MHz cavity filter

4.8.3.4 915-920MHz 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:

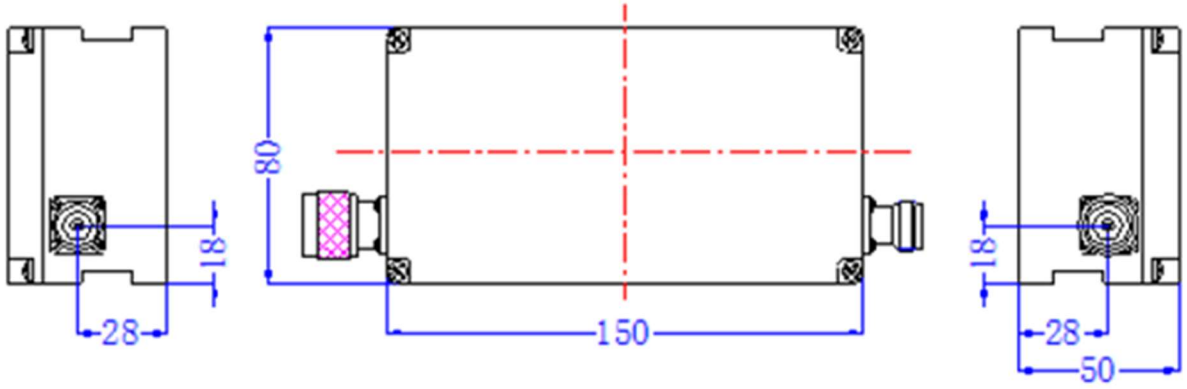


Figure 19 : Dimensions of the 915-920MHz cavity filter

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

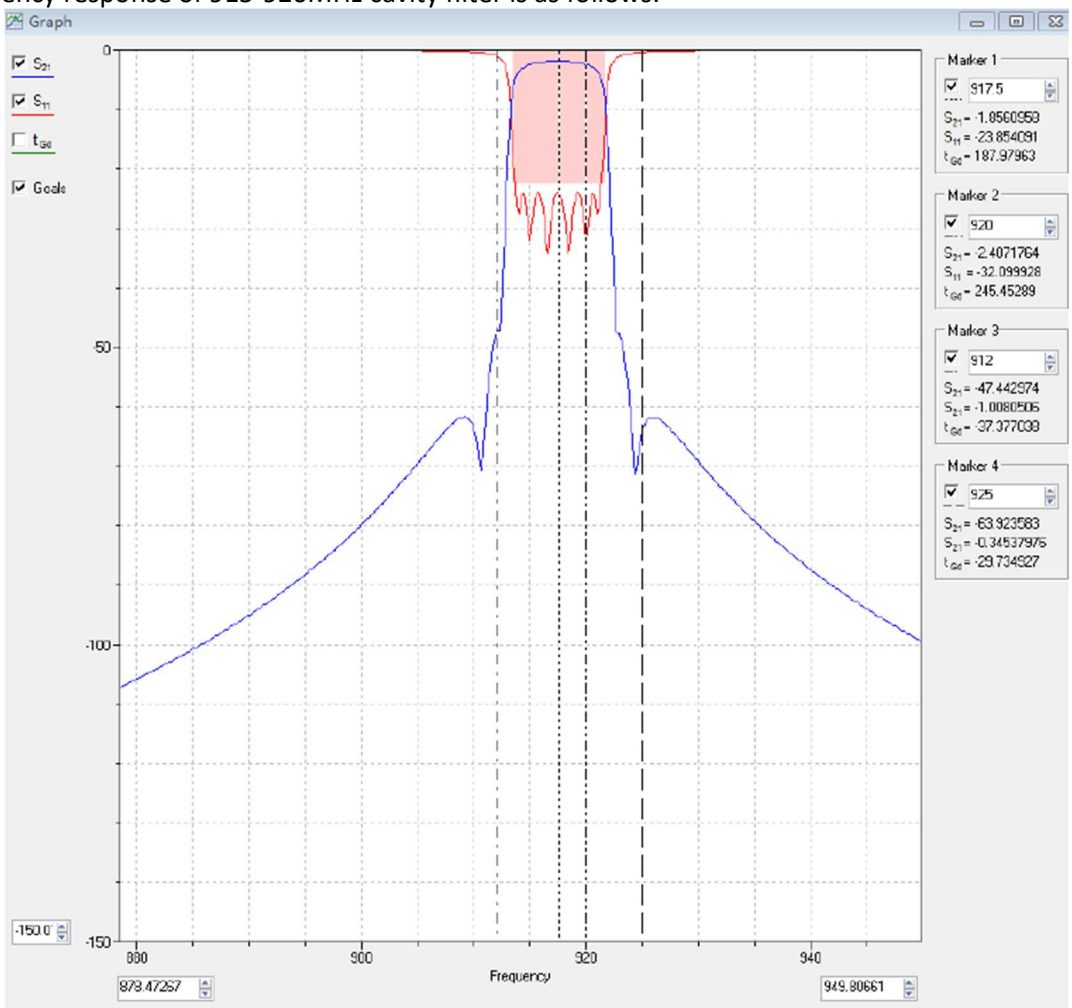


Figure 20 : Frequency response of the 915-920MHz cavity filter

4.8.3.5 918-923MHz 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:

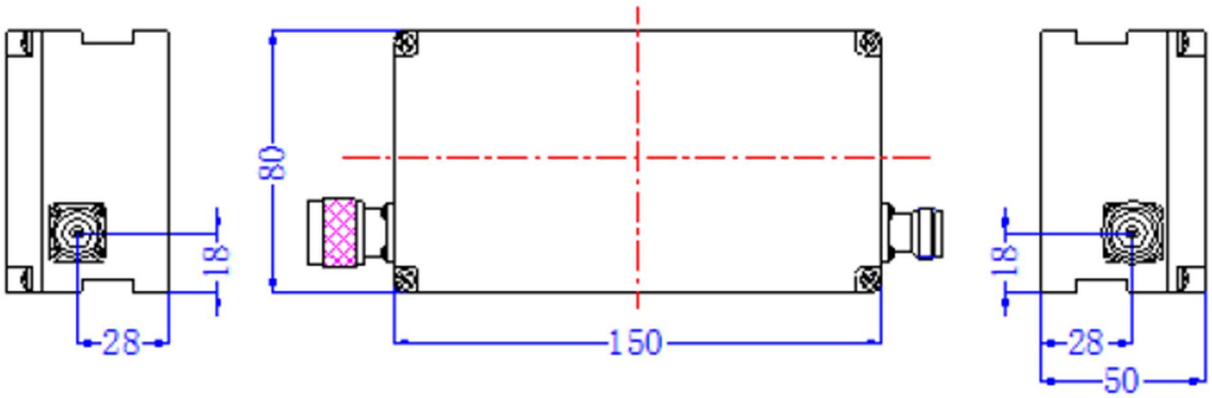


Figure 21 : Dimensions of the 918-923MHz cavity filter

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

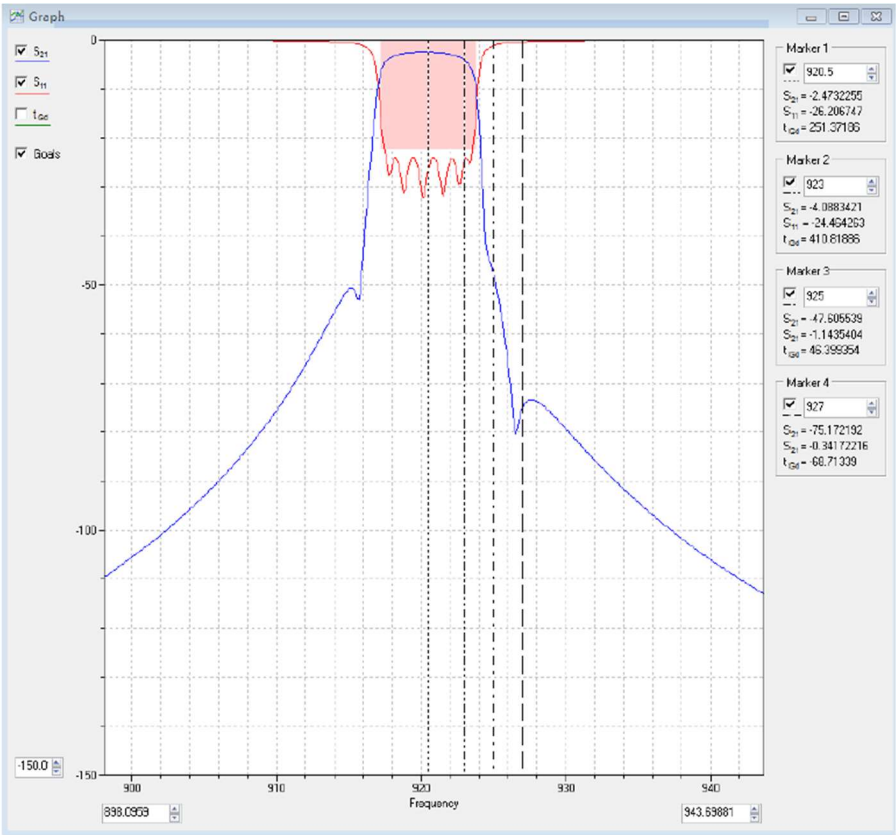


Figure 22 : Frequency response of the 918-923MHz cavity filter

4.8.3.6 920-925MHz 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 (2.0dB typ)
Ripple	≤1.0dB
VSWR	≤1.2:1
Rejection	≥60dB @ 880-915MHz ≥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:

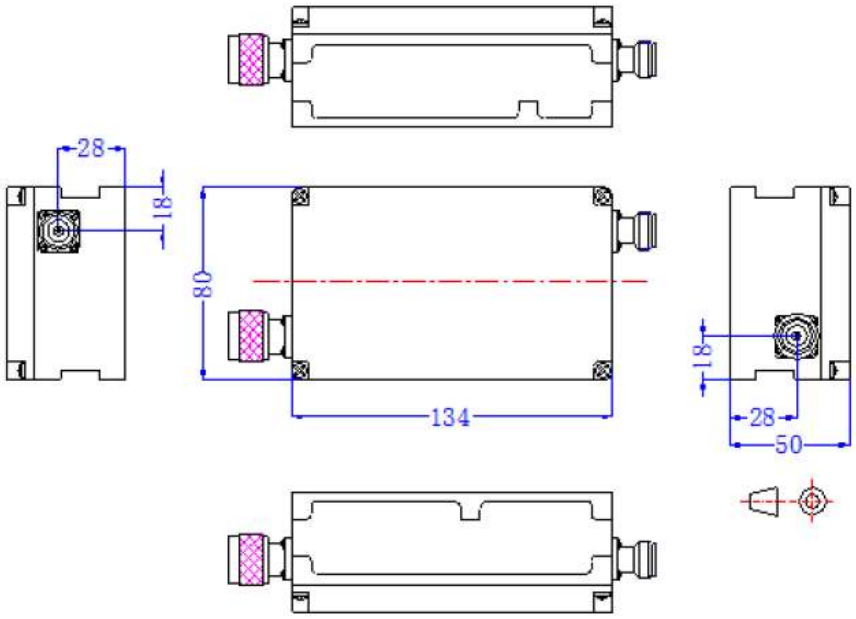


Figure 23 : Dimensions of the 920-925MHz cavity filter

The frequency response of 920-925MHz cavity filter is as follows:

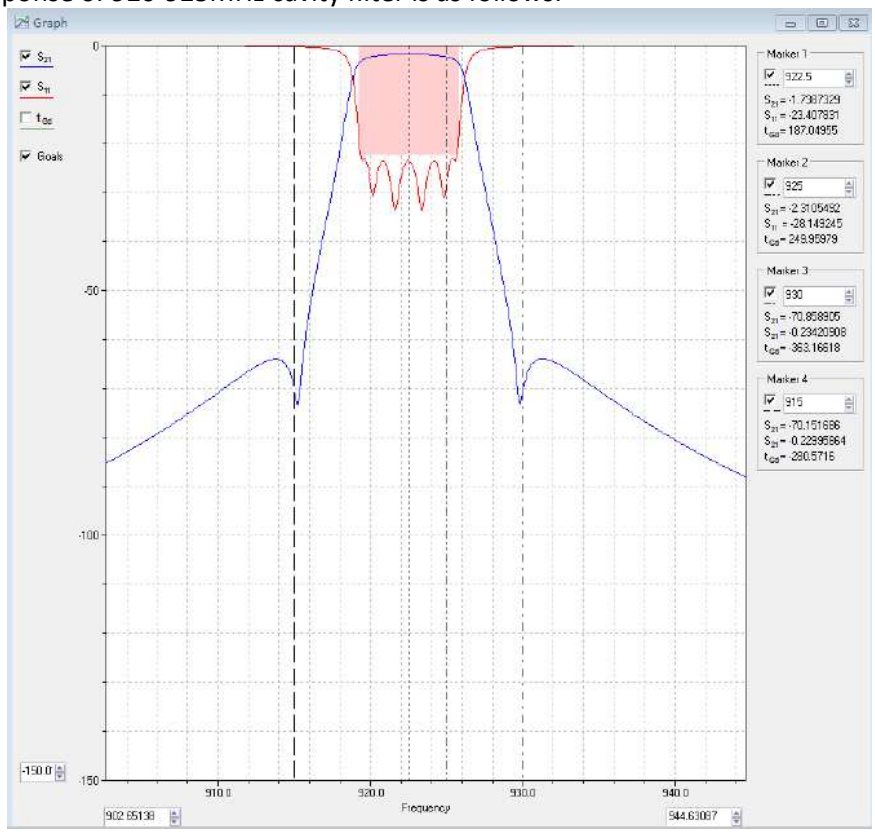


Figure 24 : Frequency response of the 920-925MHz cavity filter

4.8.3.7 920-928MHz 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:

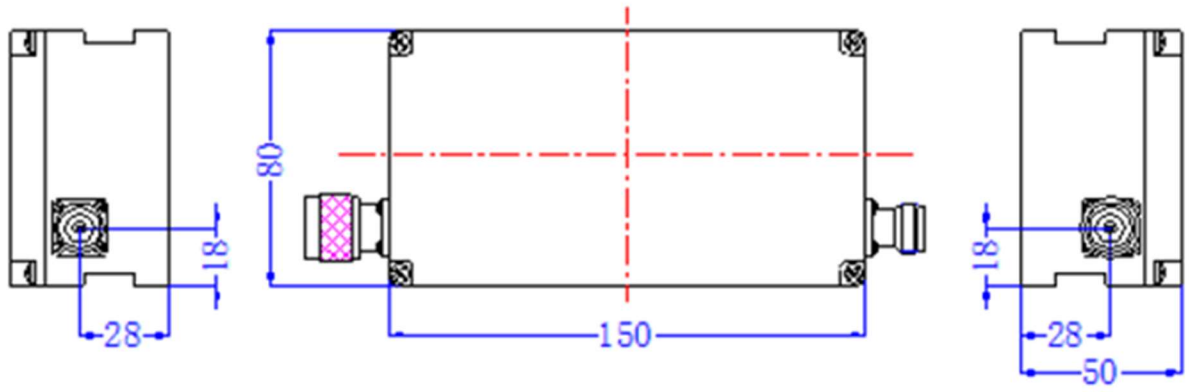


Figure 25 : Dimensions of the 920-928MHz cavity filter

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

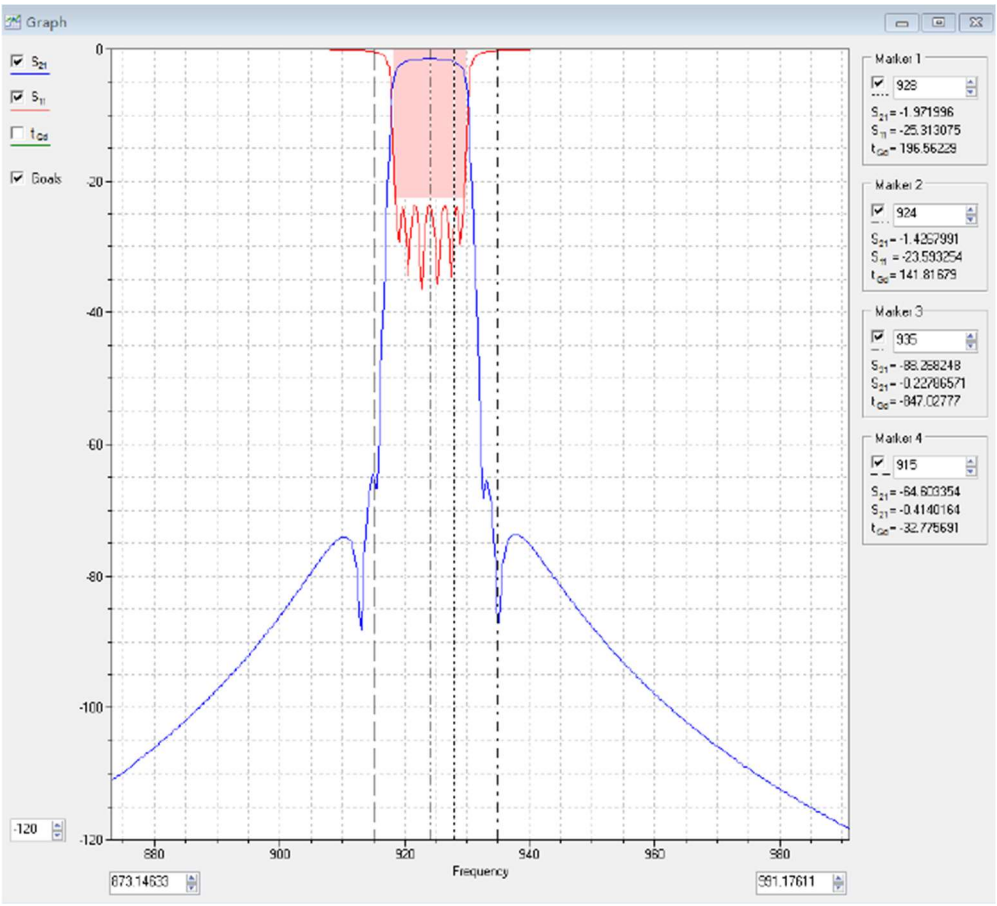


Figure 26 : Frequency response of the 920-928MHz cavity filter

4.8.3.8 902-928MHz 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 ≥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:

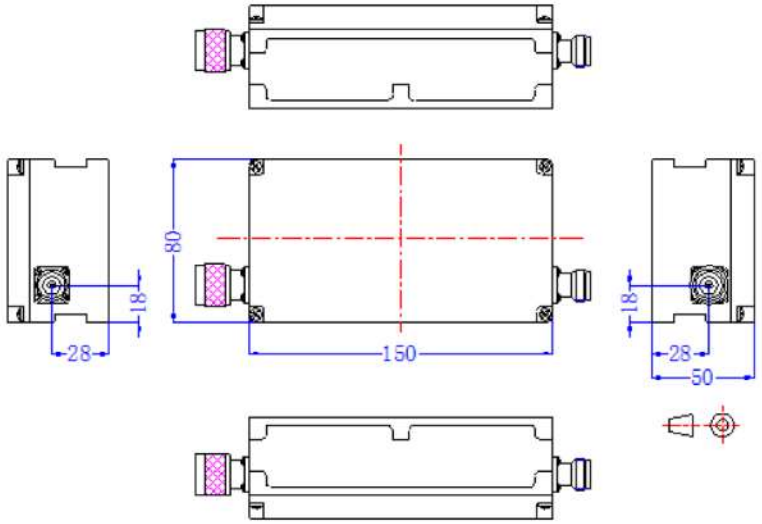


Figure 27 : Dimensions of the 902-928MHz cavity filter

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

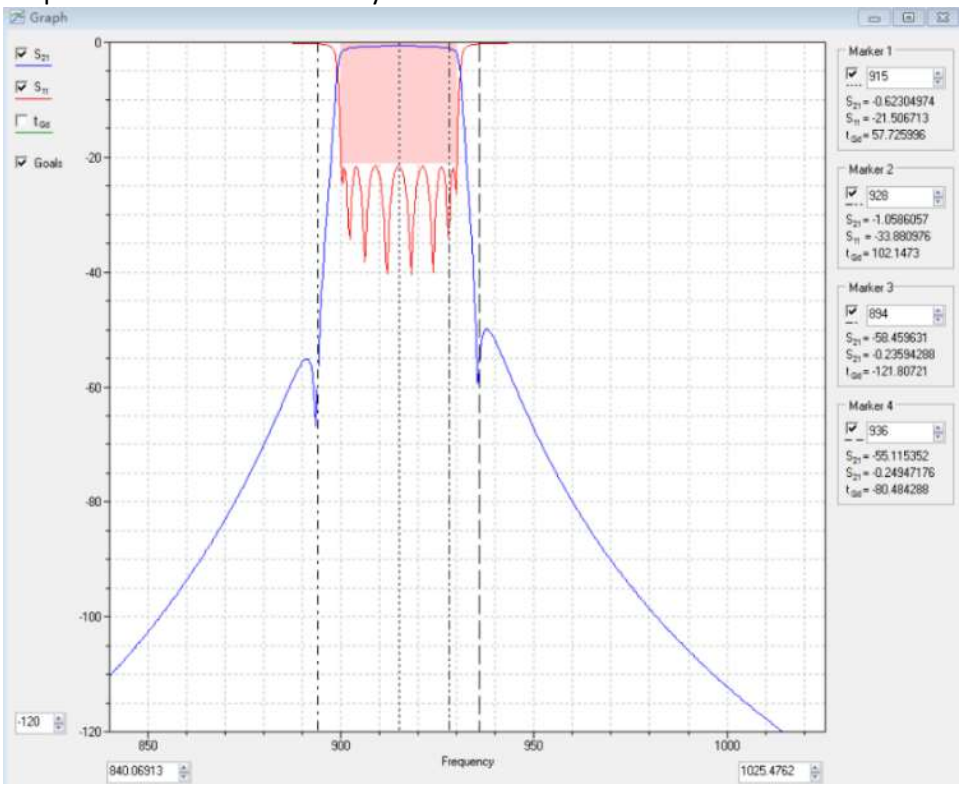


Figure 28 : Frequency response of the 902-928MHz cavity filter

4.8.4 Cables

The LoRa IoT Station (Wirnet Station) is 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.

4.8.4.1 RJ45 PoE cable

This cable is not provided with the LoRa IoT Station (Wirnet Station).
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 plugs on each side:

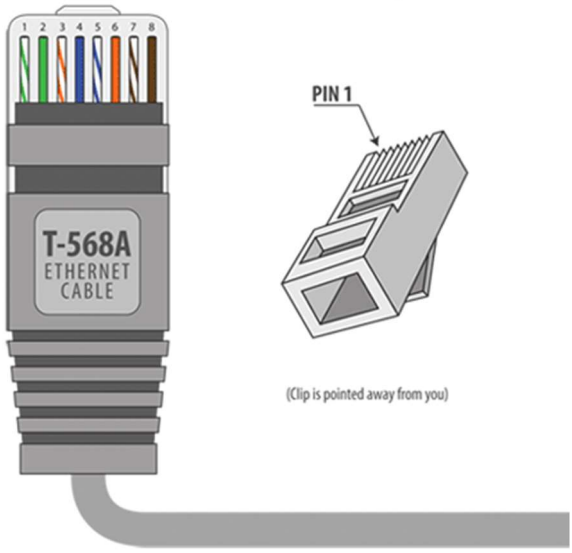


Figure 29 :RJ45 T-568A plug

4.8.4.2 Earthing cables

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

Cable description	Technical characteristics
Earthing of the LoRa IoT Station mounting kit	25mm2, copper
Earthing of the antenna brackets	25mm2, copper
Earthing of the RF coaxial surge protection	16mm2, copper
Earthing of the Ethernet surge protection	16mm2, copper
Earthing of the outdoor PoE injector	16mm2, copper

Note: the earthing cables are not provided by KERLINK

4.8.5 Surge protections

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

4.8.5.1 RF coaxial surge protection on 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 on LoRa link:

Figure 30 : PRC822S Citel

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

4.8.5.2 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 31 : 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 §4.8.4.2 for additional information.

4.8.5.3 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
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 2 x 10/350µs Test - D1 Category (Iimp)	100 A
Nominal discharge current 8/20µs Test x 10 - C2 Category (In)	5 kA
Max data rate	1000 Mbps
Certifications	IEC 61643-21 / EN 61643-21 GR1089 ITU-T K.45 UL497B IEEE 802-3ab/3at

The following picture describes the PoE surge protection:

Figure 32 : 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 §4.8.4.2 for additional information.

4.8.6 Universal antenna bracket

The universal antenna bracket is used with the following antennas:

- 868MHz, 3dBi omnidirectional (see §4.8.2.1).
- 915MHz, 3dBi omnidirectional (see §4.8.2.2).
- 915MHz, 6dBi omnidirectional, except FT-RF antenna (see §4.8.2.3).

The universal antenna bracket is presented hereafter:

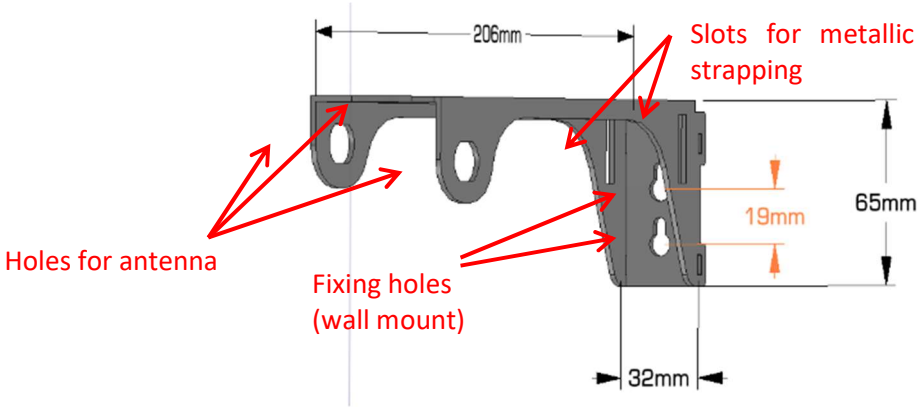


Figure 33 : Universal antenna bracket dimensions

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.

4.8.7 Debug tool

The LoRa IoT Station (Wirnet Station) has a proprietary serial debug interface named DEBUG available on the front panel. This debug interface is intended to be used by authorized and qualified personnel only.

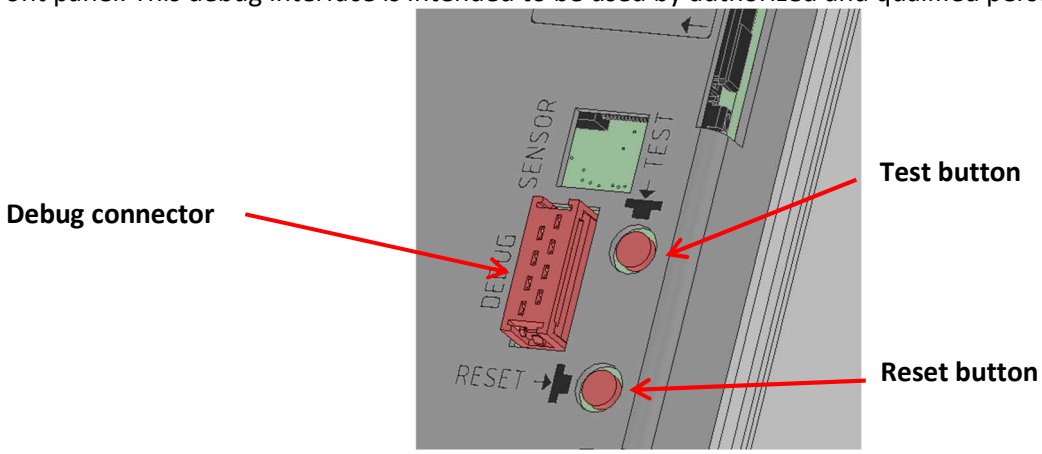


Figure 34 : Proprietary debug interface of the LoRa IoT Station (Wirnet Station)

The Wirgrid Debug Board is intended to be connected to the debug interface. It is mainly a simple UART to USB converter.
The Wirgrid Debug Board is intended to be connected to the debug interface. This board can be ordered to KERLINK (see §9 or contact your first level of support for more information).
The board is provided with a flat cable that must be directly connected to the debug connector as shown on Figure 35. A USB2.0 type A to type B male cable (not provided by KERLINK) is required to connect the Wirgrid Debug Board to a computer.

Be careful: Only specific equipment developed by KERLINK must be connected to this interface.

The main characteristics of the Wirgrid debug board are:

Characteristics	Specification
UART Interface	Micromatch 8 contacts connector
	External power supply on pin 1
	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 Wirgrid Debug Board includes 2 switches that are detailed in Figure 35:

- RESET switch
- BOOT switch

In nominal position, the dot of each switch must be visible as shown on in Figure 35.

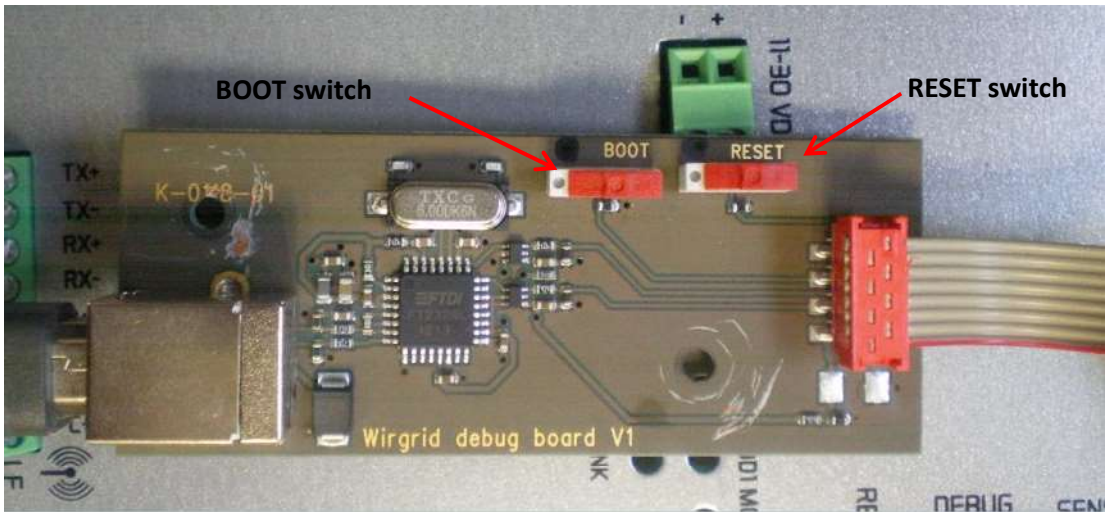


Figure 35 : Detailed view of the Wirgrid Debug board

The RESET switch allows launching a hard reboot command to the LoRa IoT Station (Wirnet Station).
When the switch is positioned on the left, the CPU is in reset mode. When the switch is positioned again to the right, the reset is released and the LoRa IoT Station (Wirne tStation) starts booting.

The BOOT switch is not used on the LoRa IoT Station (Wirnet Station).
Keep the BOOT switch in its nominal position as described on Figure 35.

See §8.3.1 about how to use the debug interface.

5 Regulations

5.1 LoRa IoT Station 868 (Wirnet Station 868)

5.1.1 Europe / CE

LoRa IoT Station 868 (Wirnet Station 868) complies with requirements listed in:

- RED Directive 2014/53/EU
- Low Voltage Directive 2014/35/EU
- Electromagnetic Compatibility Directive 2014/30/EU
- The limitation of exposure of the general public to electromagnetic fields specified in the Council Recommendation 1999/519/EC:

The LoRa IoT Station 868 (Wirnet Station 868) is considered as a category 1.5 receiver according to the EN 300 220-1.
The LoRa IoT Station 868 (Wirnet Station 868) has CE marking.

In Europe, the LoRa IoT Station 868 (Wirnet Station 868) must comply with the ERC 70-3 requirements regarding duty cycle and maximum EIRP. They are summarized in the following table:

ERC 70-03 Band	Frequency (MHz)	Power	Duty cycle
h1.2	865-868*	"14dBm erp 6,5dBm/100KHz"	1.0%
h1.4	868-868,6	14dBm erp	1%
h1.5	868,7-869,2	14dBm erp	0.1%
h1.6	869,4-869,65	27dBm erp	10%
h1.7	869,7-870	14dBm erp	1%
h2.1	870-873	14dBm erp	1%

*: not fully usable by the LoRa IoT Station 868 V5 and below (Wirnet Station 868 V5 and below) due to limited bandwidth on TX. Please use LoRa IoT Station 868 V6 (Wirnet Station 868 V6) to fully support this band.

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870MHz) as defined in [1] and [2].

If the LoRa antenna is changed, the output power must be adjusted to take into account the gain of the antenna to not overrule the ERC 70-3 regulation.

Be careful, some countries in Europe may have specific frequency range, EIRP and duty cycles regulations:

- Greece, Sweden: bands h1.2 and h2.1 must not be used
- Andorra, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, France, Germany, Spain, Netherlands, Italy, Liechtenstein, Lithuania, Latvia, Macedonia, Malta, Montenegro, Potugal, Romania, Switzerland, Serbia, Turkey: band h2.1 must not be used

Check the local regulations before installing and commissioning the LoRa IoT Station (Wirnet Station).
For other countries, outside Europe, check the frequency range, the maximum EIRP and duty cycle allowed.

5.1.2 India

The Type Approval No ETA-610/2017-RLO(SR) was granted by WPC to the LoRa IoT Station 868 (Wirnet Station 868).
However:

- Separate Import license is required to be obtained for each import as per WPC procedures,
- Record of all the equipments imported needs to be maintained and submitted to the Ministry as and when required.

The LoRa IoT Station 868 (Wirnet Station 868) is compliant to:

- Use of low power Equipment in the frequency band 865-867 MHz for (RFID) Radio Frequency Identification Devices (Exemption from Licensing Requirement) Rules
- The Gazette of India - Notification G.S.R 564(E) - July 30th, 2008
- IS 13252-1 – Information Technology Equipment – Safety – Part1 : General Requirements

In India, the LoRa IoT Station 868 (Wirnet Station 868) can be used with the following limitations:

Item	Specification
Frequency range	865-867MHz*
Max EIRP	4W**
Max conducted power with 6dBi antenna	1W**
Channelization	200KHz

*: not fully usable by the LoRa IoT Station 868 V5 and below (Wirnet Station 868 V5 and below) due to limited bandwidth on TX. Please use LoRa IoT Station 868 V6 (Wirnet Station 868 V6) to fully support this band.
**: ETA-610/2017-RLO(SR)is granted for 27dBm conducted output power

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (India 865-867MHz) as defined in [1] and [2].

5.1.3 South Africa

-ICASA Type approval required-
Several South-Africa companies already obtained Type-Approval: TA-2014/2548, TA-2015/2225

The LoRa IoT Station 868 (Wirnet Station 868) is compliant to:

- Radio Frequency Spectrum Regulations, 2015
- SANS 301489-1: Electromagnetic compatibility and Radio spectrum Matters (ERM) - ElectroMagnetic Compatibility (EMC) standard for radio equipment and services Part 1: Common technical requirements
- SANS 301489-3: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
- SANS 60950-1: Information technology equipment - Safety Part 1: General requirements

In South-Africa, the LoRa IoT Station 868 (Wirnet Station 868) can be used with the following limitations:

Frequency (MHz)	Power	Duty cycle
868-868,6	14dBm erp	1%
868,7-869,2	14dBm erp	0,1%
869,4-869,65	27dBm erp	10%
869,7-870	7dBm erp	100%

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870MHz) as defined in [1] and [2].

5.1.4 Saudi Arabia

-CITC approval required-

The LoRa IoT Station 868 (Wirnet Station 868) is compliant to:

- RI054 – Specifications for Non-specific Short Range Devices and Ancillary Equipment
- National Guideline for Human Exposure to Radiofrequency Electromagnetic Fields, 2009
- GEN001 – Technical Specification – General Requirements
- IEC 60950-1: 2005 + A1: 2009 + A2: 2013 - Information technology equipment - Safety - Part 1: General requirements

In Saudi-Arabia, the LoRa IoT Station 868 (Wirnet Station 868) can be used with the following limitations:

Frequency (MHz)	Power
863-870*	14dBm erp
869,4-869,65	27dBm erp

*: not fully usable by the LoRa IoT Station 868 V5 and below (Wirnet Station 868 V5 and below) due to limited bandwidth on TX. Please use LoRa IoT Station 868 V6 (Wirnet Station 868 V6) to fully support this band.

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870MHz) as defined in [1] and [2].

5.1.5 United Arab Emirates

-TRA Type approval required-

The LoRa IoT Station 868 (Wirnet Station 868) is compliant to:

- TRA Regulations for Ultra Wide Band and Short Range Devices, Version 2.0, Issued 18 May 2016
- TS001 – EMC and Safety Requirements
- UAE.S GSO 1799: Safety Levels With Respect To Human Exposure To Radio Frequency Electromagnetic Fields, 3 kHz To 300 GHz

In United Arab Emirates, the LoRa IoT Station 868 (Wirnet Station 868) can be used with the following limitations:

Frequency (MHz)	Power	Duty cycle
863-870*	25mW ERP	0.1%
869.4-869.65	500mW ERP	10%

*: not fully usable by the LoRa IoT Station 868 V5 and below (Wirnet Station 868 V5 and below) due to limited bandwidth on TX. Please use LoRa IoT Station 868 V6 (Wirnet Station 868 V6) to fully support this band.

The frequency channels arrangement is the same as in Europe i.e. must be compliant to the LoRaWAN specification and the regional parameters (EU 863-870MHz) as defined in [1] and [2].

5.1.6 Russia

-Minsvyaz approval and EAC marking required-

The LoRa IoT Station 868 (Wirnet Station 868) is compliant to:

- CU TR 020/2011 : Electromagnetic Compatibility of Technical Products
- CU TR 004/2011 : Safety of Low Voltage Equipment
- GOST R IEC 60950-1 - Information technology equipment. Safety. Part 1. General requirements.

In Russia, the LoRa IoT Station 868 (Wirnet Station 868) can be used with the following limitations:

Frequency (MHz)	Power	Duty cycle
864-865*	14dBm ERP*	0.1%
868.7-869.2	14dBm ERP	N/A

*: not fully usable by the LoRa IoT Station 868 V5 and below (Wirnet Station 868 V5 and below) due to limited bandwidth on TX. Please use LoRa IoT Station 868 V6 (Wirnet Station 868 V6) to fully support this band.

The frequency channels arrangement is defined in the LoRaWAN specification and the regional parameters (RU 864) as defined in [1] and [2].

5.2 LoRa IoT Station 915 (Wirnet Station 915)

5.2.1 USA / FCC

The LoRa IoT Station 915 (Wirnet Station 915) is compliant to:

- IEC 60950 -1
- IEC 60950 -22

The LoRa IoT Station 915 (Wirnet Station 915) is also compliant to CFR 47 FCC Part 15 regulations:

- FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
- FCC PART 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (frequency hopping and digitally modulated).
    - FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
    - FCC Part 15.247 intentional radiated emissions
    - FCC Part 15.215 Additional provisions to the general radiated emissions limitations

The associated FCC identifiers are:

FCC ID : 2AFYS-KLK915LOI
Model : LORA IOT STATION 915
Contains FCCID : QISMU509C
Model : MU509-c

As stated by the external sticker on the enclosure, “This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This device must be professionally installed.

Also, some specific recommendations for exposure to magnetic fields must be followed:
This equipment complies with FCC’s radiation exposure limits set forth for an uncontrolled environment under the following conditions:

1. This equipment should be installed and operated such that a minimum separation distance of 20 cm is maintained between the radiator (antenna) and user’s/nearby person’s body at all times.
2. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (US 902-928MHz) as defined in [1] and [2].

5.2.2 Canada / IC

The LoRa IoT Station 915 (Wirnet Station 915) is compliant to:

- IEC 60950 -1
- IEC 60950 -22

The LoRa IoT Station 915 (Wirnet Station 915) is also compliant to IC - RSS 247 regulations:

- RSS-Gen – Issue 4, November 2014- General requirements and Information for the Certification of radio Apparatus
- RSS-247 Issue 1, May 2015 - Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

The associated IC identifiers are:

IC : 20637-KLK915LOI
Model : LORA IOT STATION 915
Contains / Contient IC : 6369A-MU509C
Model : MU509-c

This device complies with Industry Canada's license-exempt RSSs.
Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.
L'exploitation est autorisée aux deux conditions suivantes :

1. *L'appareil ne doit pas produire de brouillage ;*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, that antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

This radio transmitter (20637–KLK915LOI) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with the device.

Antenna supplier	Antenna Reference	Antenna Gain
SCOUT	KER-915	6dBi
SCOUT	KER-915-3	3dBi
FT-RF	OA-915-M06-NF	6dBi

The antenna specifications are detailed in § 7.5.2.

The radio transmitter (20637–KLK915LOI) has been approved by Industry Canada to operate with a maximum duty cycle of 40% to not overrule the 2.784 W/m2 RF Field Strength Limits for Devices. The duty cycle, in normal conditions, is far below this limit. Do not operate the LoRa IoT Station (Wirnet Station) out of the 40% duty cycle limit.

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (US 902-928MHz) as defined in [1] and [2].

5.2.3 Mexico

The Wirnet Station 915 is compliant to "IFT-008-2015 (PROLAB-89) – Telecomunicaciones – Radiocomunicación - Sistemas de radiocomunicación que emplean la técnica de espectro disperso - Equipos de radiocomunicación por salto de frecuencia y por modulación digital a operar en las bandas 902-928 MHz, 2400-2483.5 MHz y 5725-5850 MHz - Especificaciones, límites y métodos de prueba".
The equipment is certified and registered by IFETEL under the following number:
"IFETEL: RTIKEWI17-0132

"La operación de este equipo está sujeta a las siguientes dos condiciones: (1) es posible que este equipo o dispositivo no cause interferencia perjudicial y (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada."

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (US 902-928MHz) as defined in [1] and [2].

5.2.4 Philippines

The Wirnet Station 915 is compliant to the Memorandum Circular MC 03-08-2013 amending MC 09-09-2003 for Wireless data Networks and Devices

A Type Acceptance was granted to EDMI Philippines Inc by NTC under the following number: ESD-1816454C.
The following label is sticked on the left side of the enclosure:

The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to:

- Memorandum Circular n°20-12-92 : Implementing guidelines for Cellular Mobile Telephone System (CMTS) operations in the Philippines
- Memorandum Circular n°07-08-2005 : Rules and regulations on the Allocation and Assignment of 3G Radio Frequency bands
- Memorandum Circular n°01-03-2010 : Rules on the Assignment of the Remaining Allocated 3G Radio Frequency Band
- PNS –IEC 60950-1 - Information Technology Equipment – Safety – Part 1: General requirements.

In Philippines, the LoRa IoT Station 915 (Wirnet Station 915) can be used with the following limitations:

Item	Specification
Frequency range	915-918MHz
Max ERP	250mW
Max conducted power with 3dBi antenna	+23dBm (200mW)
Max conducted power with 6dBi antenna	+20dBm (100mW)
Channelization	200KHz
Number of channels	14
Channels center frequency	915.2 MHz +n*0.2MHz (0<=n<=13)

No frequency channels arrangement defined in LoRaWAN specification and the regional parameters as defined in [1] and [2] can be applicable to Philippines. Alternate JointReq channels must be then defined.

5.3 LoRa IOT Station 923 (Wirnet Station 923)

The LoRa IoT Station 923 (Wirnet Station 923) is compliant to:

- IEC 60950-1
- IEC 60950-22
- CENELEC EN 60 950-1 (Ed. 2006/A11 : 2009/A1 : 2010/A12:2011)

The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to both FCC and CE regulations.
Applicable documents:

- CFR 47 FCC Part 15 :
  - FCC 47 CFR Part 15 : 2014 - Part 15- Radio frequency devices
  - FCC PART 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz. (frequency hopping and digitally modulated)
    - FCC Part 15.207 conducted emissions on AC mains in the band 150kHz – 30MHz
    - FCC Part 15.247 intentional radiated emissions
    - FCC Part 15.215 Additional provisions to the general radiated emissions limitations
- Article 3.2 of the RE DDirective :
  Applied standard(s):
  - EN 300 220-1, issue 3.3.1
  - EN 300 220-2, issue 3.3.1

  The LoRa IoT Station 923 (Wirnet Station 923) is considered as a category 1.5 receiver according to the EN 300 220-1.

Other specific countries regulations compliances are detailed in the following paragraphs.
Depending on the country, check the specific regulations applying, especially regarding frequency range, maximum EIRP, duty cycle allowed, maximum transmit duration, carrier sense mandatory or not, etc …

5.3.1 Australia

M2M Connectivity is the only Responsible Supplier of the Wirnet Station 923 under the ACMA registration process. The company acts as importer of the Wirnet Station 923 and agreed to let Kerlink affix the product with the RCM mark.

The Wirnet Station 923 complies with the requirements of the relevant ACMA Standards made under the Radiocommunications Act 1992 and the Telecommunications Act 1997. These Standards are referenced in notices made under section 182 of the Radiocommunications Act and 407 of the Telecommunications Act.
The applicable Standard are:

- Radiocommunications (Short Range Devices) Standard 2014
  AS/NZS 4268: 2017 : Radio equipment and systems – Short range devices – Limits and methods of measurement
- AS/CA S042.1: 2015 - Requirements for connection to an air interface of a Telecommunications Network - Part 1: General

- AS/ACIF S042.3: 2005 - Requirements for connection to an air interface of a Telecommunications Network - Part 3: GSM Customer Equipment
- AS/CA S042.4: 2015 - Requirements for connection to an air interface of a Telecommunications Network—Part 4: IMT Customer Equipment
- AS/NZS 60950.1: 2015 - Information technology equipment - Safety - General requirements

In Australia, the LoRa IoT Station 923 (Wirnet Station 923) can be used with the following limitations:

Item	Specification
Frequency range	915-928MHz
Max EIRP	1W (30dBm)
Max conducted power with 6dBi antenna	24dBm
Max conducted power with 3dBi antenna	27dBm

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (AU 915-928MHz) as defined in [1] and [2].

5.3.2 Korea (Republic of)

The LoRa IoT Station 923 (Wirnet Station 923) is certified under the Clause 2, Article 58-2 of Radio Waves Act. The following label is placed on the outside part of the enclosure:

MSIP-CRM-klk-LoRastation923

Figure 36 : KC minimum label

The full label is as follows:

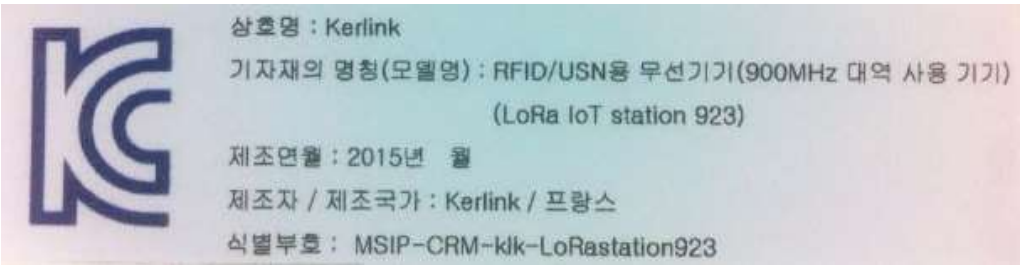


Figure 37 : KC full label

The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to:

- Regulations on Radio Equipment (KCC Public Notification 2013-01, Jan 3, 2013)
- Unlicensed Radio Equipment Established Without Notice (KCC Public Notification 2012-102, Dec 5, 2012)
- Technical Requirements of Radio Wave Application (RRA Public Notification 2012-29, Dec 28, 2012)

- Measurements of the high-frequency output of radio wave application equipment and antenna power calculation methods (RRA Announce 2012-30, Dec 28, 2012)
- Technical Requirements for Radio Equipment of Standard of Safety Facility (RRA Public Notification 2012-31, Dec 28, 2012)
- Technical Requirements for the Human Protection against Electromagnetic Waves (KCC Public Notification 2012-2, Jan 5, 2012)
- Technical Requirements for Measurement and Test Procedure of Specific Absorption Rate (RRA Public Notification 2012-23, Dec 6, 2012)
- Technical Requirements for Measurement of Electromagnetic Field Strength (RRA Public Notification 2012-21, Nov 6, 2012)
- Equipment to be subject of Test Procedure for Electromagnetic Field Strength and Specific Absorption Rate (KCC Public Notification 2012-1, Jan 5, 2012)
- Conformity Assessment Procedure of Radio Equipment (RRA Announce 2011- 32, Dec 27, 2011)
- KN 301489-1: 2012-06 – test method of common technical EMC for radio equipment
- KN 301489-3 – Test method of EMC for radio equipments of short-range.
- KN 301489-7: 2008-5 – Test method of EMC for mobile and portable radio telecommunications systems.
- KN 301489-24: 2008-5 – test method for EMC for mobile and portable radio and ancillary equipment
- K60950-1 (2.0) - Information technology equipment – Safety – Part 1: General requirements

In Republic of Korea, the LoRa IoT Station 923 (Wirnet Station 923) can be used with the following limitations:

Item	Specification
Frequency range	920.9-923.3MHz
Max EIRP	10mW (10dBm)
Max conducted power with 6dBi antenna	4dBm
Max conducted power with 3dBi antenna	7dBm
Channelization	200KHz
Number of channels	13
Channels center frequency	920.9 MHz +n*0.2MHz (0<=n<=12)
Carrier sense (LBT)	5ms / -65dBm
Transmit duration	< 4s
Pause duration	> 50 ms
Duty cycle	<2% in 20 s duration

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (KR 920-923MHz) as defined in [1] and [2].

5.3.3 New-Zealand

Due to mutual Recognition with Australia, the Wirnet Station 923 is exempted from the requirement to be the subject of a New Zealand declaration of conformity and to comply with New Zealand labelling requirements, provided the product is declared, labelled and supplied in accordance with the Radiocommunications (Compliance Labelling) Notice 2003, or a notice in replacement thereof, issued by the ACMA under section 182 of the Radiocommunications Act 1992 (Australia). See §5.3.1.

The Wirnet Station 923 is compliant to General User Radio License (GURL) for Short Range Devices (SRD) and all the applicable deviations such as item 23:
Transmissions must not exceed the following unwanted emission limits: –79 dBW (–49 dBm) e.i.r.p. within 800 – 915 MHz and –63 dBW (–33 dBm) e.i.r.p. within 928 MHz – 1 GHz. The reference bandwidth for emissions is 100 kHz. Outside the band 800 MHz – 1 GHz, the limits prescribed in applicable standards prescribed in the Radiocommunications (Radio Standards) Notice 2016 apply. In the absence of applicable standards, the limits prescribed in Table 2 of the notice apply.*

In New-Zealand, the LoRa IoT Station 923 (Wirnet Station 923) can be used with the following limitations:

Item	Specification
Frequency range	920-928 MHz
Max EIRP	4W (36dBm)
Max conducted power with 6dBi antenna	30dBm
Upstream channels	8 channels 915.9 MHz to 927.1 MHz Steps of 1.6 MHz 500 kHz BW LoRa modulation SF7 to SF12
Upstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz 125 kHz BW LoRa modulation SF7 to SF12
Downstream channels	8 channels 923.3 MHz to 927.5 MHz Steps of 600 kHz 500 kHz BW LoRa modulation SF7 to SF12

Or:

Item	Specification
Frequency range	915-928 MHz
Max EIRP	1W (30dBm)
Max conducted power with 6dBi antenna	24dBm
Max conducted power with 3dBi antenna	27dBm
Upstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz 125 kHz BW LoRa modulation SF7 to SF12
Downstream channels	64 channels 915.2 MHz to 927.8 MHz Steps of 200 kHz 125 kHz BW LoRa modulation SF7 to SF12

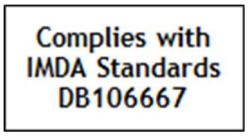
Therefore, two different frequency plans can be used:

- frequency plan and channel arrangement similar to Australia, according to the LoRaWAN specification and the regional parameters (AU 915-928MHz) as defined in [1] and [2].
- frequency plan compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

5.3.4 Singapore

The equipment is registered as "Wirnet Station 923 S" by IMDA under telecommunications (dealers) regulations. The Registration Number is N4571-17, expiring on 30/11/2022. A dealer license is required to operate the Wirnet Station 923 S in Singapore. Kerlink Singapore Dealer License is DB106667.

The following label is placed on the outside part of the enclosure:



The Wirnet Station 923 S is compliant to:

- IMDA Technical Specifications for Short Range Devices (IMDA TS SRD) – Issue 1, 1 October 2016
- IDA Technical Specifications for Cellular Mobile Terminal (IMDA TS CMT) – Issue 1, 1 October 2016
- IEC 60950-1: 2005 + A1: 2009 + A2: 2013 - Information technology equipment - Safety - Part 1: General requirements

In Singapore, the Wirnet Station 923 S can be used with the following limitations:

Item	Specification
Frequency range	920-925MHz
Max ERP	500mW
Max EIRP	29dBm
Max conducted power with 6dBi antenna	23dBm
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement must be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

5.3.5 Hong-Kong

The LoRa IoT Station (Wirnet Station) can be used in Hong-Kong, based on a Voluntary Certification Scheme.
The Wirnet iBTS 923 is compliant to:

- Hong Kong Telecommunications Equipment Evaluation and Certification (HKTEC) Scheme OFCA I 421, Issue 6, 2012, based on a Voluntary Certification Scheme.
- HKCA 1035 – Issue 7, 2016: Performance specification for radio equipment exempted from licensing

- HKCA 1049 – Issue 1, 2005: Performance specification for RFID Equipment operating in the 865-868 MHz and/or 920-925 MHz bands.
- HKCA 1078 – Issue 1, 2017: Performance specification for Radio Equipment operating in the 920-925 MHz band for the provision of public telecommunications services.
- HKCA 1033 – Issue 7, 2012: Performance Specification for Mobile Stations and Portable Equipment for use in the Global System for Mobile Communications (GSM) 900 and 1800 MHz Bands.
- HKCA 1048 – Issue 2, 2008: Performance specification for user equipment for use in the third generation (3G) mobile communication services employing CDMA Direct Spread (UTRA FDD).
- HKCA 2001 – Issue 12, 2012: Compliance test specification – Safety and Electrical Protection requirements for subscriber Telecommunications Equipment.

In Hong-Kong, the Wirnet Station 923 can be then used with the following limitations:

Item	Specification
Frequency range	920-925MHz
Max EIRP	36dBm (4W)
Max conducted power with 6dBi antenna	30dBm (1W)
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement may be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2], although Hon-Kong is not listed in the applied countries.

5.3.6 Japan

The Wirnet Station 923 is certified by C&S in Japan and registered with number CSRT160250.
The specified Radio Equipment marking is visible on the external sticker on the enclosure:

The LoRa IoT Station 923 (Wirnet Station 923) is compliant to “ARIB STD-T108 - 920MHz-Band Telemeter, Telecontrol and Data Transmission Radio Equipment”.
The certification is valid for 3dBi, 6dBi and 8dBi referenced antennas from KERLINK.
Contact Kerlink for more information.

In Japan, the LoRa IoT Station 923 (Wirnet Station 923) can be used with the following limitations:

Item	Specification
Frequency range	920.5-928.0MHz
Channelization	200KHz
Max EIRP (920.6-923.4MHz)**	500mW (27dBm)
Max conducted power (920.6-923.4MHz)**	250mW (24dBm)
Max EIRP (923.6-928MHz)*	40mW (16dBm)

Max conducted power (923.6-928.0MHz)*	20mW (13dBm)
Carrier sense (LBT) 920.6-922.2MHz**	5ms / -80dBm
Carrier sense (LBT) 922.4-923.4MHz**	128uS / -80dBm
Carrier sense (LBT) 923.6-928.0MHz*	128uS / -80dBm
Transmit duration (920.6-922.2MHz)**	< 4s
Transmit duration (922.4-923.4MHz)**	<400ms
Transmit duration (923.6-928.0MHz)*	<400ms
Pause duration (920.4-922.2MHz)	> 50 ms
Pause duration (922.4-923.4MHz)	> 10*Tx duration
Pause duration (923.6-928.0MHz)	> 10*Tx duration

*: ARIB STD-T108 Convenience Radio Station
**: ARIB STD-T108 Specified low power radio station

The frequency plan and channel allocation is defined for Japan in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to “AS 923MHz” plan.

The full frequency plan proposed by Kerlink is the following:

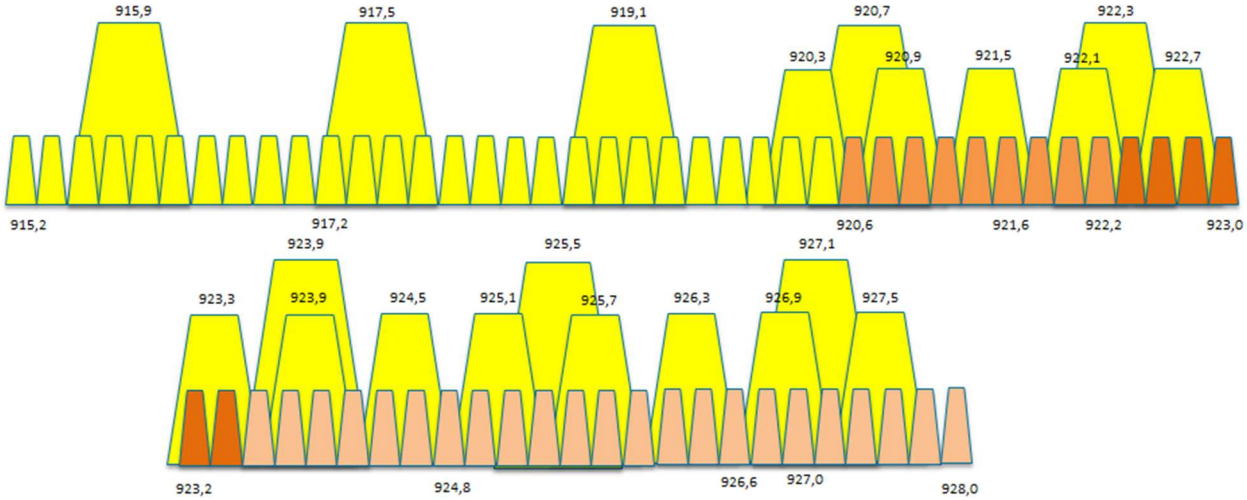


Figure 38 : Channels allocation proposal in Japan

Note:
In the above figure:

- Upstream and downstream channels are in orange: 38 channels, 200KHz spacing, 125KHz BW
- Upstream channels in medium orange:
    - 9 channels (920.6MHz to 922.2MHz)
    - SF7 to SF12
    - Max frame length=4s
    - 50 ms between frames
    - 500mW EIRP
    - 5ms min carrier sense
- Upstream channels in dark orange:
    - 6 channels (922.4MHz to 923.4MHz)

- SF7 to SF10
- Max frame length=400ms
- 10% duty cycle max
- 500mW EIRP
- 128us min carrier sense

- Upstream channels in light orange:
  - 23 channels (923.6MHz to 928.0MHz)
  - SF7 to SF10
  - Max frame length=400ms
  - 10% duty cycle max
  - 40mW EIRP
  - 128us min carrier sense
- Unused channels are in yellow

The channels allocation can be organized differently if needed.

5.3.7 Taiwan

The Wirnet Station 923 is NCC certified. The certification number is:

In Taiwan, the LoRa IoT Station 923 (Wirnet Station 923) can be used as a « digitally modulated techniques systems" according to item 1, chapter 4.8.1 of the "Low Power 0002 (LP0002)" specifications.

Item	Specification
Frequency range	920-925MHz
Max EIRP	0.5W
Max conducted power with 6dBi antenna	125mW (21dBm)

For Reducing RF Influence, Use Properly.
'減少電池波影響，請妥適使用。

注意！
依據 低功率電波輻射性電機管理辦法
第十二條 經型式認證合格之低功率射頻電機，非經許可，
公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計
之特性及功能。
第十四條 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；
經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。
前項合法通信，指依電信規定作業之無線電信。
低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性
電機設備之干擾。

The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to:

- PLMN01: GSM900 and DCS1800 Mobile Equipment Technical Specifications, rev 09-05-2012
- PLMN08: the Third Generation Mobile Telecommunication Terminal Equipment Technical Specifications
- CNS 13438: 2006 - Information technology equipment – Radio disturbance Characteristics – limits and methods of measurement.
- CNS 14336-1: 2010 - Information Technology Equipment – Safety – Part 1: General requirements.

The LoRa frequency plan and channel allocation for Taiwan is defined in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to “AS 923MHz” plan.

5.3.8 Malaysia

The Wirnet Station 923 owns a MCMC Type Approval with the identification number RBBD/14A/0817/S(17-2151). The expiry date is August 1st, 2020.
The following SLP certification mark is available on the external label:

The CID is valid only one year and may have to be renewed in case of new importation of product.

In Malaysia, the LoRa IoT Station 923 (Wirnet Station 923) is considered as a Short Range Device (SRD) according to “MCMC MTSFB TC T007: 2014, 1st Rev”.
The LoRa IoT Station 923 (Wirnet Station 923) uses the 919-924MHz band with a maximum 500mW EIRP, according to “CLASS ASSIGNMENT NO. 1 OF 2017”.

Item	Specification
Frequency range	919-923MHz
	923-924MHz (1% duty cycle)
Max EIRP	0.5W
Max conducted power with 3dBi antenna	250mW (24dBm)
Max conducted power with 6dBi antenna	125mW (21dBm)
Channelization	200KHz
Number of channels	24
Channels center frequency	919.2 MHz +n*0.2MHz (0<=n<=23)

The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to:

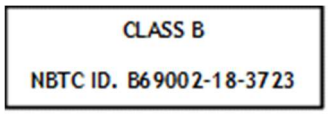
- SKMM WTS GSM-MT Rev. 1.01:2007 for the WAN / GSMpart
- SKMM WTS IMT-MT Rev. 1.01:2007 for the WAN /3G part
- MS IEC 60950-1:2007 - Information Technology Equipment – Safety – part 1: General Requirements

The LoRa frequency plan and channel allocation for Malaysia is defined in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to “AS 923” plan.

5.3.9 Thailand

The LoRa IoT Station (Wirnet Station) is compliant to "NTC TS 1033-2560 – Technical Standard for non-RFID Radio Communication Equipment 920-925 MHz.

The Wirnet Station 923 is NBTC certified as a Class B equipment. The certification number is: B69002-18
The following label is placed on the outside part of the enclosure:



The LoRa IoT Station 923 (Wirnet Station 923) is also compliant to:

- NTC TS 1004-2553 – User Equipment of Cellular land Mobile Service using GSM Technology
- NTC TS 1015-2549 - User equipment operating in cellular land mobile service using IMT-2000 CDMA Direct Spread (WCDMA) technology
- NTC TS 5001-2550 : Radiocommunication Equipment (Radio Frequency Radiation Exposure in 9 kHz-300 GHz)
- TISI 1956-2548 : Information Technology Equipment – Radio Disturbance Limits
- NTC TS 4001-2550: Electrical Safety of Telecom Terminal Equipment

In Thailand, the Wirnet Station 923 can be then used with the following limitations:

Item	Specification
Frequency range	920-925MHz
Max EIRP	33dBm (2W)
Max conducted power with 6dBi antenna	27dBm (500mW)
Duty cycle	<10%
Channelization	200KHz
Number of channels	24
Channels center frequency	920.2 MHz +n*0.2MHz (0<=n<=23)

The frequency channels arrangement in Thailand must be compliant to the LoRaWAN specification and the regional parameters (AS 923MHz) as defined in [1] and [2].

5.3.10 Brazil

The LoRa IoT Station 923 (Wirnet Station 923) is ANATEL certified. The certification number is:

Terceirização Comércio e Tecnologia em Semicondutores Ltda (TCT) is the only responsible supplier of the LoRa IoT Station 923 (Wirnet Station 923) in Brazil. The company is the holder of the ANATEL certification, commercializes the Wirnet Station 923 in Brazil and provide the warranty support consistent with Brazilian regulations and the specific conditions that may be included in agreements of sale in Brazil.

In Brazil, the LoRa IoT Station 923 (Wirnet Station 923) can be used according to « Resolução n°680 de 27 de junho de 2017– Regulamento Sobre Equipementos de Radiocomunicaçao de radiaçao Restrita.”

Item	Specification
Frequency range	915-928MHz
Max conducted power	1W (30dBm)
Max EIRP (6dBi max antenna)	4W (36dBm)
System type	DSSS / DTS

Be careful:

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados"

Este produto está homologado pela Anatel, de acordo com os procedimentos regulamentados pela Resolução 242/2000 e atende aos requisitos técnicos aplicados.Para maiores informações, consulte o site da Anatel – www.anatel.gov.br

"Este produto não é apropriado para uso em ambientes domésticos, pois poderá causar interferências eletromagnéticas que obrigam o usuário a tomar medidas necessárias para minimizar estas interferências"

The LoRa frequency plan and channel allocation for Brazil is defined in the LoRaWAN specification and the regional parameters as defined in [1] and [2], according to the Australian plan (AU 915-928MHz).

6 Key parameters to optimize the radio performance

6.1 Height of the site

A key point to have an optimized LoRa IoT Station (Wirnet Station) reception is the height of installation site and moreover the height of the LoRa antenna. The LoRa IoT Station (Wirnet Station) must be installed as high as possible to have the better reception.

The figures below shows the RSSI of the signal vs. the distance to the end point vs. the height of the Lora IoT station (Wirnet Station): 4m, 8m, 12m and 30m. Two uses cases are presented: one for a small city configuration (urban area) and one for countryside area.

The propagation model used is based on Hata model.

The frequency is 868MHz in this case but performance and conclusions at 915MHz would be almost identical.

The RSSI is the received signal by the LoRa IoT Station (Wirnet Station).

The end point EIRP is assumed to be 25mW.

The height of the end point is 1m.

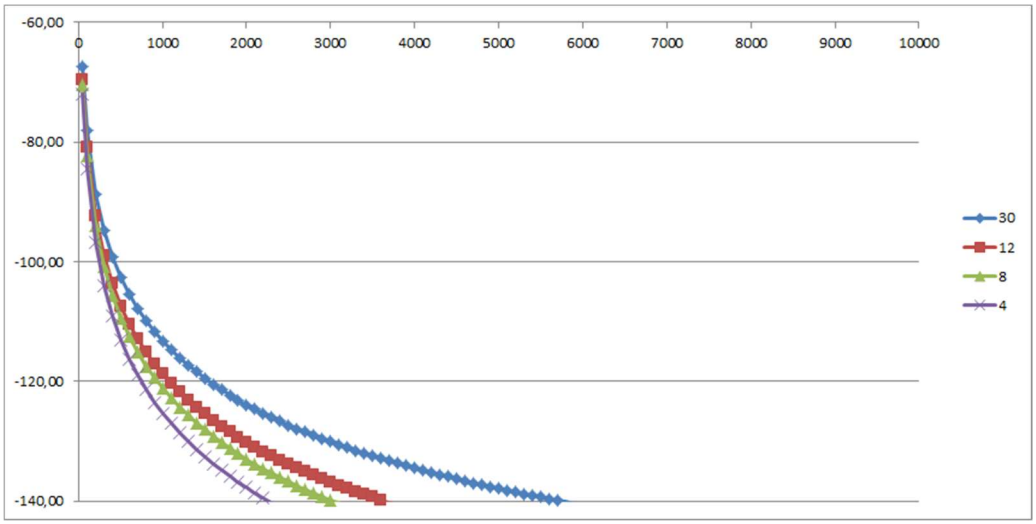


Figure 39 : Urban (small city) Hata propagation model vs height of the antenna

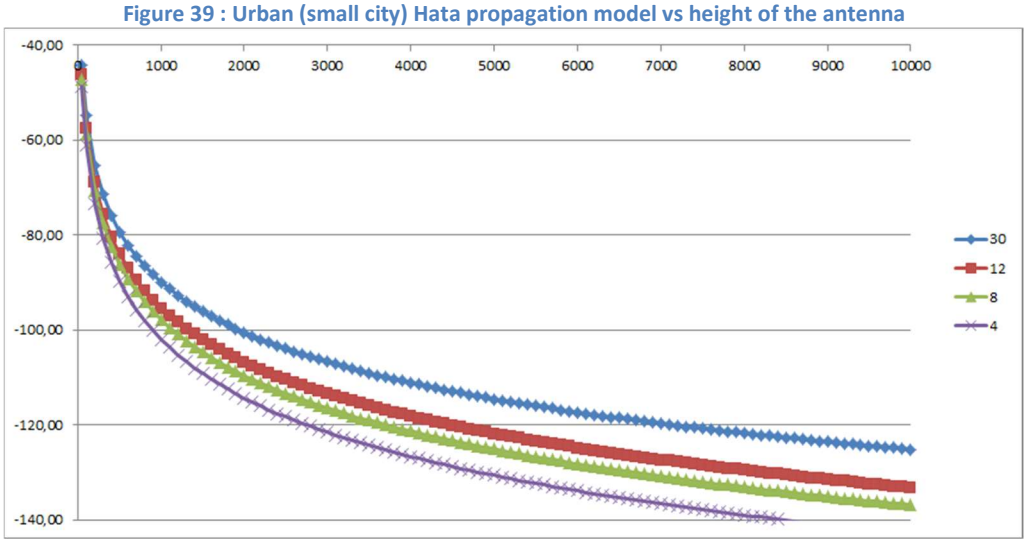


Figure 40 : Rural countryside Hata propagation model vs height of the antenna

What is noticeable is that the coverage distance at a fixed RSSI is doubled depending on the height of the antenna.

6.2 Propagation model vs area type

Predicting the RSSI and more generally the coverage of the LoRa IoT Station (Wirnet Station) depends on many factors. The propagation channel must be well defined and known to have an efficient prediction.
Radio coverage simulations are recommended before the installation of the LoRa IoT Station (Wirnet Station) to make sure the gateway would cover the expected area. Contact KERLINK for more information.
In a first approach, the figure below shows the RSSI of the signal vs. the distance to the end point vs. the type of area (urban, suburban, countryside, desert). The height of the LoRa antenna is assumed to be 12 meters.
The propagation model used is based on Hata model.
The frequency is 868MHz in this case but performance and conclusions at 915MHz would be almost identical.
The RSSI is the received signal by the LoRa IoT Station (Wirnet Station).
The end point EIRP is assumed to be 25mW.
The height of the end point is 1m.

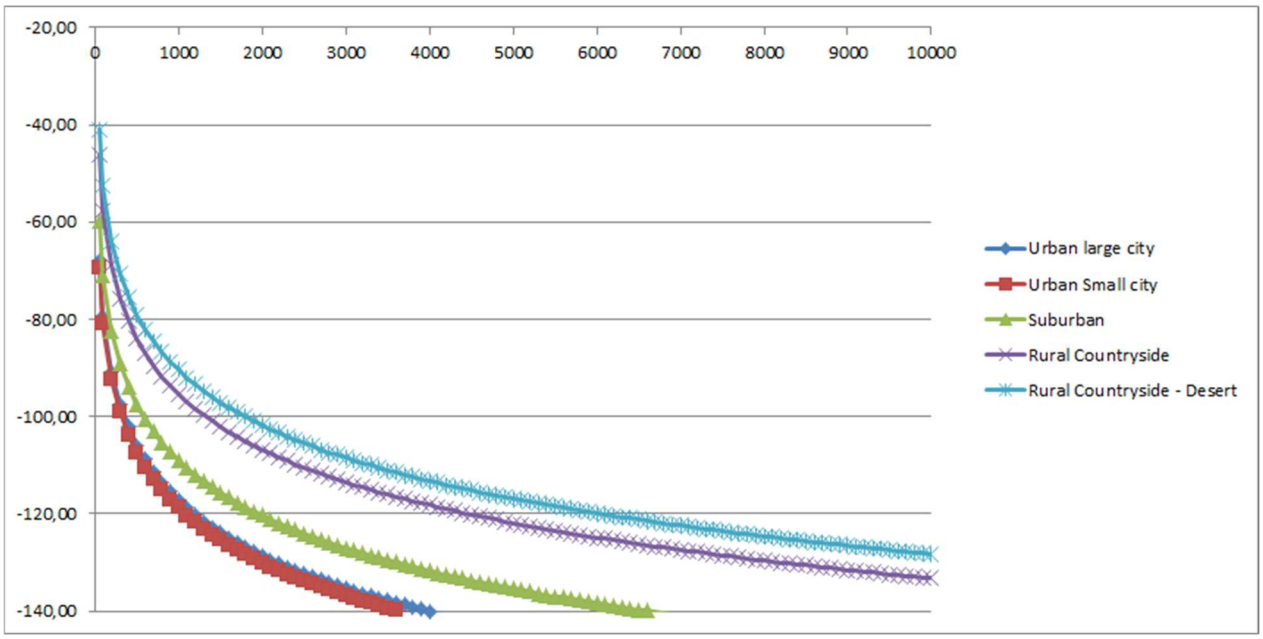


Figure 41 : Hata propagation model vs area configuration (Height = 12m)

The coverage radius of the LoRa IoT station (Wirnet Station), depending on the area type can vary from 2 km (urban areas) to 15 km (desert countryside).

6.3 Co-localization with GSM/UMTS/LTE transmitters

The LoRa IoT Station (Wirnet Station) insures good co-localization other transmitters on the same site, and especially with BTS, in two ways:

- Limited spurious and noise generated in the BTS receiver bands
- Immunity to BTS transmitter

The LoRa IoT Station (Wirnet Station) is obviously compliant to all EMC emissions and immunity regulations specific to very country. However, meeting these regulations is not sufficient to insure good coexistence with BTS when sharing the same site.
This is why KERLINK has reinforced these specifications to allow the coexistence.

KERLINK has designed the transmitter to reduce the spurious and the noise generated in the BTS RX bands below -80dBm in a 100KHz resolution bandwidth. This is then pretty much in line with BTS specifications to insure co-localization between BTS.
The measurements made on the LoRa IoT Station (Wirnet Station) show typical values of -85dBm/100KHz.

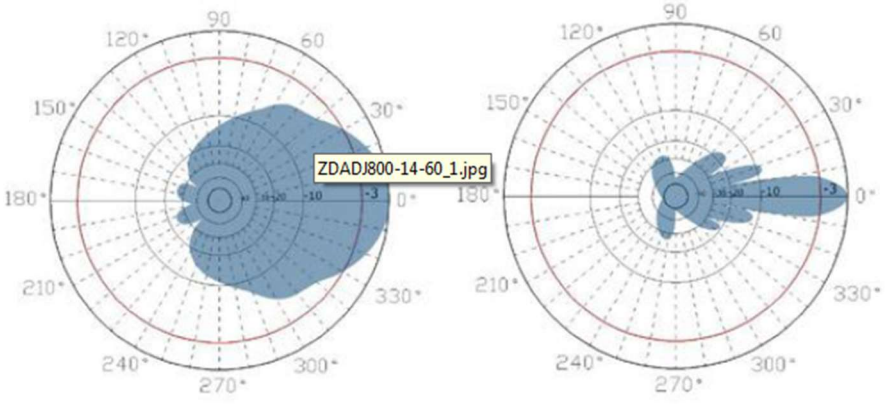
The receiver offers also high attenuation outside the receive band.
High attenuation of out of band blockers is obtained:

- >100dB at +/-10MHz
- >150dB in BTS downlink bands

This means that the blockers levels, due to the BTS, could be up to +10dBm causing no interference with the gateway.

Based on this performance, this means that about 50dB isolation is required between the LoRa IoT Station (Wirnet Station) antenna and the base station antenna to avoid desensitization of the BTS.
Specifying a minimum distance between antennas may not guarantee the 50dB isolation, unless over specifying the required distance. This is mainly due to the fact that both LoRa antenna and BTS antenna are directive antenna. This means that the antenna gain is not omnidirectional in both cases.

BTS antenna have about 10 to 15dB antenna maximum gain but the gain above or below the antenna is reduced by 20dB to 30dB as described below:

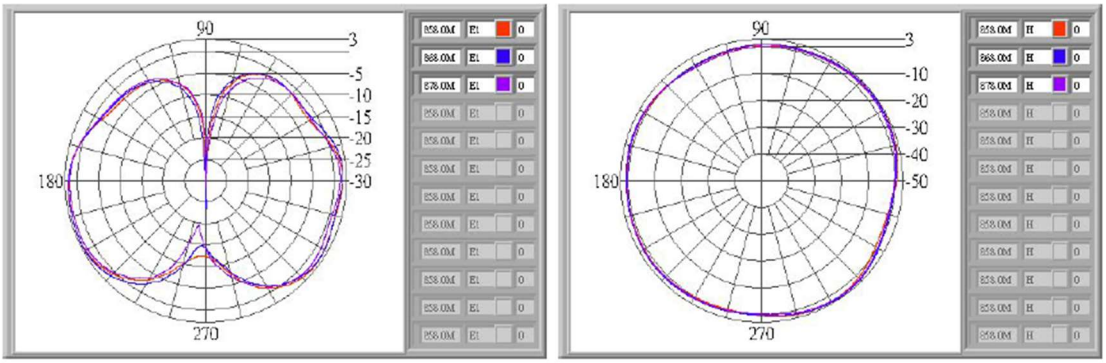


Mounting the LoRa antenna just above or below the 4G antenna allows then to get 20 to 30dB isolation among the 50dB required.

The LoRa antenna can be an omnidirectional antenna. The worst case would be a 3dBi antenna which has the “less directive” antenna pattern. An example is presented below:

Vertical Pattern
E-plane co-pol ------ 3-dB beam-width=75 Deg

Horizontal Pattern
H-plane co-pol ------ 3-dB beam-width=360 Deg

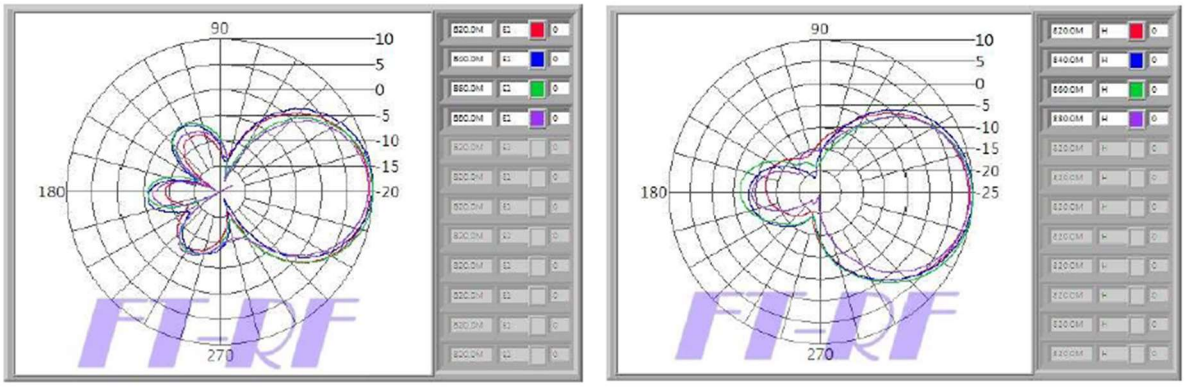


We can see that the gain on the top of the antenna or below the antenna is about -15dBi to -20dBi.

In case of sectorial antenna, the antenna gain above or below the antenna is also significantly reduced to -10 to -15dB as shown below:

Vertical Pattern
E-plane co-pol ------ 3-dB beam-width=50Deg

Horizontal Pattern
H-plane co-pol ------ 3-dB beam-width=55Deg



Then, taking into account the performance of the antenna, we need to get about 10 to 20dB more isolation to meet the 50dB isolation between antennas.
A gap of 1 meter between antennas would insure 30dB additional attenuation.

Therefore, our recommendation is to have the LoRa antenna just above the BTS antenna with 1 meter gap min.
Placing the LoRa antenna below the BTS antenna could be also possible. However, this is not recommended as reception could be impacted by metallic structures in the close area.

Note: If the required 50dB isolation between antenna cannot be guaranteed, then a cavity filter must be added to improve isolation.

6.3.1 LoRa IoT Station 868 (Wirnet Station 868)

Co-localization is possible with the following BTS:

- EGSM900, GSM1800, GSM1900
- UMTS900, UMTS2100
- LTE800, LTE 900, LTE 1800, LTE 2100, LTE 2300, LTE2600

The most difficult use case is the LTE 800 band that is very close to the 868MHz band. Actually, the end of the LTE 800 band is 862MHz whereas the beginning of the 868MHz band is 863MHz. Insuring -80dBm/100KHz at 862MHz while transmitting at 863MHz or even at 868MHz is not achievable with the state of the art of SAW filters. Therefore, the LoRa IoT Station (Wirnet Station) v5 has a limited transmit frequency range of 866-873MHz. The 863-866MHz range cannot be used on TX side.
On LoRa IoT Station (Wirnet Station) V6, a new SAW filter is available offering low insertion loss at 863MHz but sufficient attenuation at 860MHz. These SAW filters are designed specifically for KERLINK as standard SAW filters on the shelf do not achieve such performance. Based on these specific SAW filters and limitation of the TX frequency range (863MHz-873MHz) the LoRa IoT Station (Wirnet Station) is close to the -80dBm/100KHz spurious limit in the LTE 800 band, except between 860MHz and 862MHz where some extra noise is observed but limited to -70dBm/100KHz.

Co-localization is not possible with GSM850, UMTS850 and LTE850

Note 1:
In India, co-localization with CDMA800 requires usage of a specific cavity filter (see §4.8.3.1).
Contact KERLINK for more information.

Note 2:
In Europe or South-Africa, if the 50dB isolation between antenna cannot be achieved, then a cavity filter is required (see § 4.8.3.2 and §4.8.3.3).
Contact KERLINK for more information.

6.3.2 LoRa IoT Station 915 (Wirnet Station 915)

Co-localization is possible with the following BTS:

- GSM850, GSM1800, GSM1900
- UMTS850, UMTS1900, UMTS2100
- LTE700, LTE850, LTE1700, LTE 1800, LTE1900, LTE2600

Co-localization is not possible with GSM900, UMTS900 and LTE900.
In case of co-localization with GSM900, UMTS900 or LTE900, then LoRa IoT Station 923 (Wirnet Station 923) is a more suitable gateway. If LoRa IoT Station 915 (Wirnet Station 915) wants to be used when co-localized with GSM900, UMTS900 or LTE900, then a specific cavity filter is required. Contact KERLINK for more information.

Note 1:
In Philippines, co-localization with EGSM900 requires usage of a specific cavity filter (see §4.8.3.4).
Contact KERLINK for more information.

Note 2:
In North America, if the 50dB isolation with LTE850 antenna cannot be achieved, then a cavity filter is required (see § 4.8.3.8).
Contact KERLINK for more information.

6.3.3 LoRa IoT Station 923 (Wirnet Station 923)

Co-localization is possible with the following BTS:

- GSM850, GSM900, GSM1800, GSM1900
- UMTS850, UMTS900, UMTS2100
- LTE700, LTE800, LTE850, LTE 900, LTE 1800, LTE 2100, LTE 2300, LTE2500, LTE2600

Co-localization is not possible with EGSM900, only GSM900.

Note 1:
In Singapore, Indonesia and Hong-King co-localization with EGSM900 may require usage of a specific cavity filter (see §4.8.3.6).
Contact KERLINK for more information.

Note 2:
In Malaysia co-localization with EGSM900 may require usage of a specific cavity filter (see §4.8.3.5).
Contact KERLINK for more information.

Note 3:
In New-Zealand co-localization with GSM900 may require usage of a specific cavity filter in harsh environments (see §4.8.3.7).
Contact KERLINK for more information.

6.4 Fresnel ellipsoid

Radio waves generally travel in a straight line from the emitter to the receiver. This is obviously true when there are no obstacles between the transmitter and the receiver. However, there are, most of the time, some obstacles between the transmitter and the receiver. Then, the radio waves bump into the obstacles and are reflected or diffracted with dephasing. These diffracted waves when arriving on the receiver can cause phase cancelling with the straight line signals reducing the received power (fading). The fading effect depends on the distance between the receiver and the emitter, the nature of the obstacles and the associated out of phase.

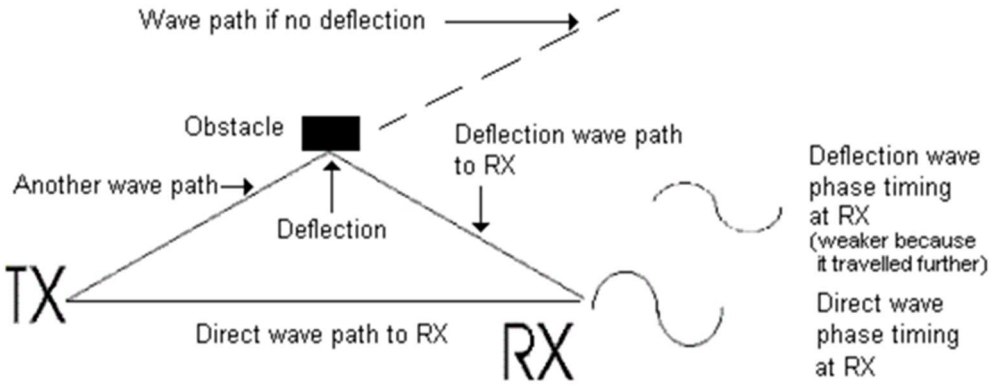


Figure 42 : Fading effects due to obstacles

To minimize the fading effects, obstacles in a "Fresnel ellipsoid" must be avoided.
The Fresnel ellipsoid is a theoretical ellipsoid located between the transmitter and the receiver.
The radius of the ellipsoid is defined as follows:

$$r1 = \sqrt{\frac{d1 * d2 * c}{f * (d1 + d2)}}$$

Where:

- d1 = distance from Tx antenna
- d2 = distance from Rx antenna
- f = frequency
- c = celerity (3E8 m/s)
- r1 = radius at the distance d1

A global rule is that 60% of the Fresnel ellipsoid must be clear of obstacles.
In case of buildings between the end point and the LoRa IoT station (Wirnet Station), the antenna height must be adjusted to make sure the building is not close to 60% of r1.

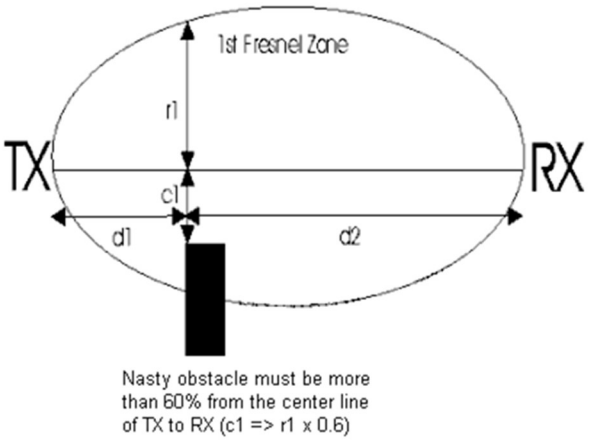


Figure 43 : Fresnel ellipsoid clearance

Be careful, if the antennas heights are not sufficient, then the ground (earth curve) can get inside the Fresnel ellipsoid and overrule the 60% criteria.

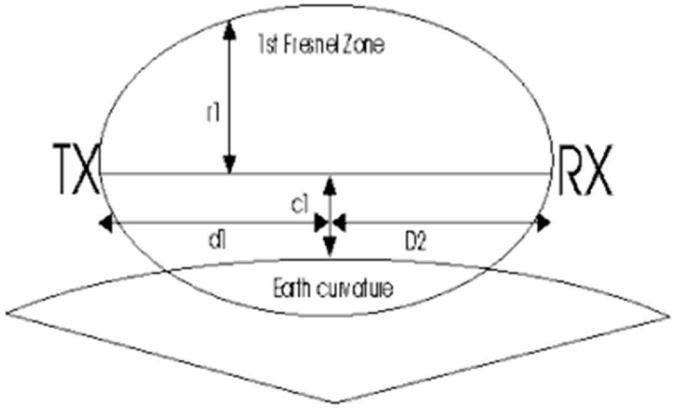


Figure 44 : Fresnel ellipsoid and earth curvature

Example:
An end point is located at 3500m from the LoRa IoT Station (Wirnet Station).
The LoRa IoT Station (Wirnet Station) is installed on the roof of a building. The building roof is 30 meters long vs 20m large.
What is the required height of the LoRa antenna for have an optimized reception?

Answer:
If we want to receive end points i.e. 360° area coverage, it should be better to have the antenna located in the mid of the building root.
The antenna is therefore at 15m from the edge of the roof.

Then we have:

- d1 = 15m
- d2 = 3600 -15 = 3585m
- f = 868MHz
- c = 3E8 m/s

So, r1 = 2.3m
The antenna must be installed at a minimum height of 2.3m from the roof top, on a mast for instance.

7 Installation procedure

This device must be professionally installed.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

7.1 How to open the enclosure

Before proceeding to the insertion of the SIM card and the connection of the power supply, the enclosure has to be opened.
Opening is a very simple as the cover of the enclosure is just clipped on the frame.

There are 2 door hinges that lock the cover. You just have to open one to open the cover like a door.
Due to the 2 hinges, there are then two open points that are noted as "A" and “B” on the picture below:

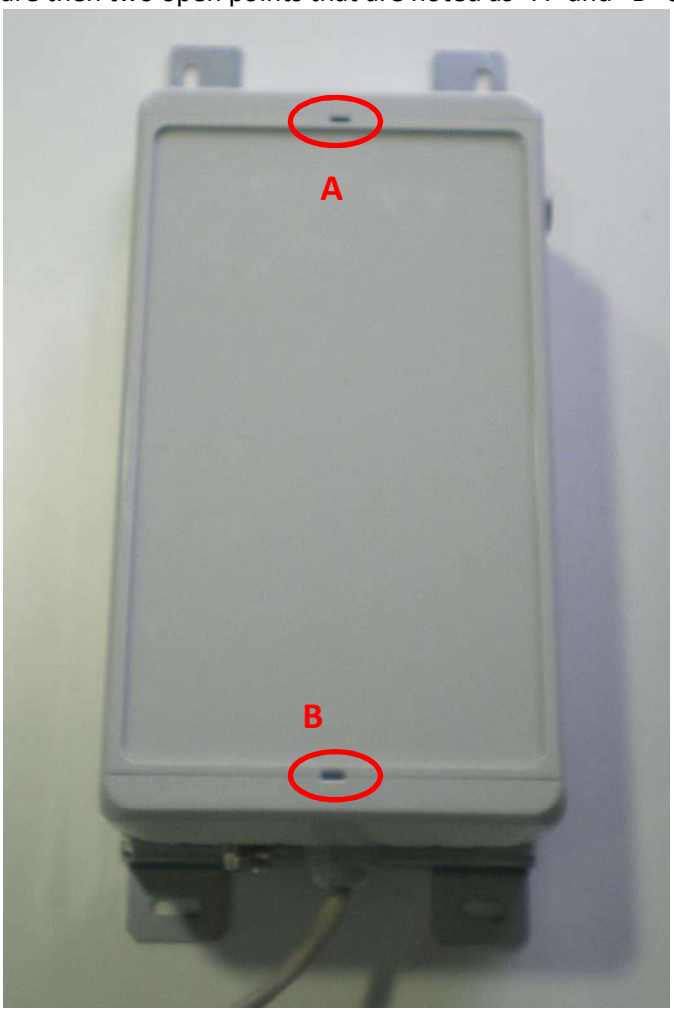


Figure 45 : Open points of the enclosure

To open the cover, you need to use a screwdriver that must be inserted in the slots A or B.
The screw driver can be a small one or a bigger one.

Small flat-blade screw driver:
Example: 64-978 3x50 Stanley
Push the screw driver into the slot A, and lift up and down, down and up, with progressive strength and going deeper. It will clip. Don't be afraid to break it, if will be opened before, if you do it step by step (progressive, to feel the point of opening).

Big flat-blade screw driver:
Example: 65-098 5,5x100 Stanley
Push the screw driver into the slot, (it won't enter completely) and lift up in turning the screw driver into the slot (like to drive screws into the slot). Here you have to use more strength because the lever arm is smaller.

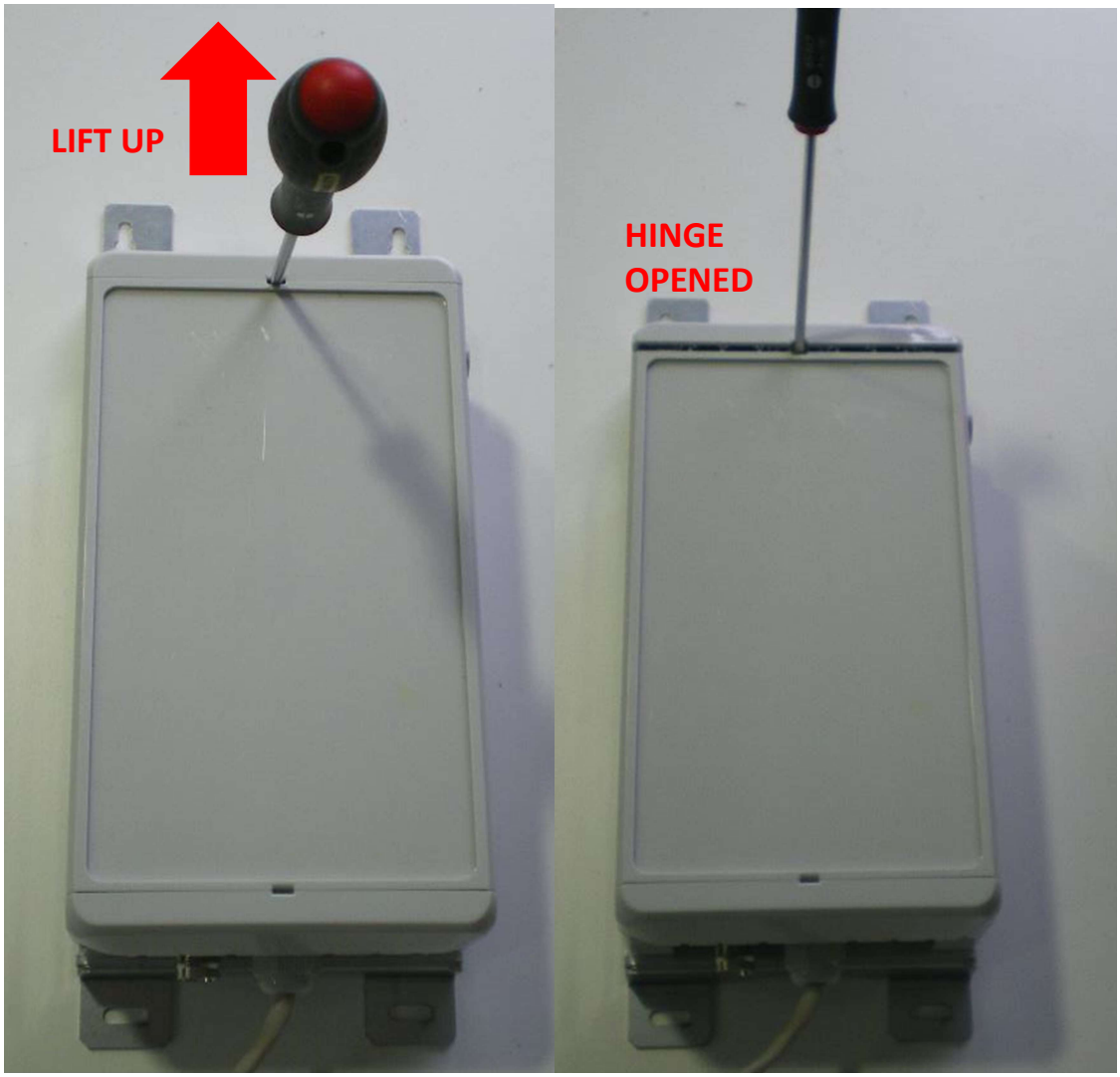


Figure 46 : Opening of the enclosure with screwdriver

7.2 Installation topology

7.2.1 Single station installation

With SIM Subscription

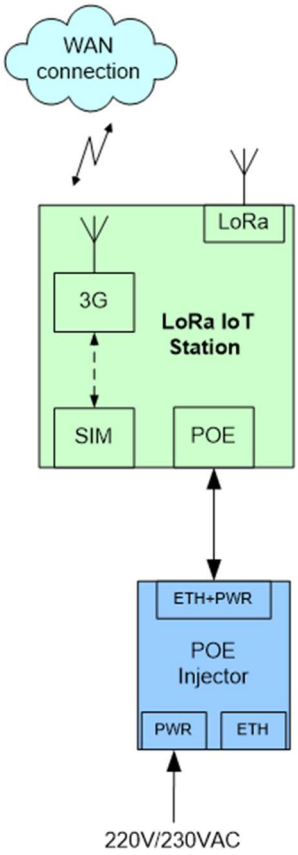


Figure 47 : Single station installation (with SIM)

Without SIM Subscription

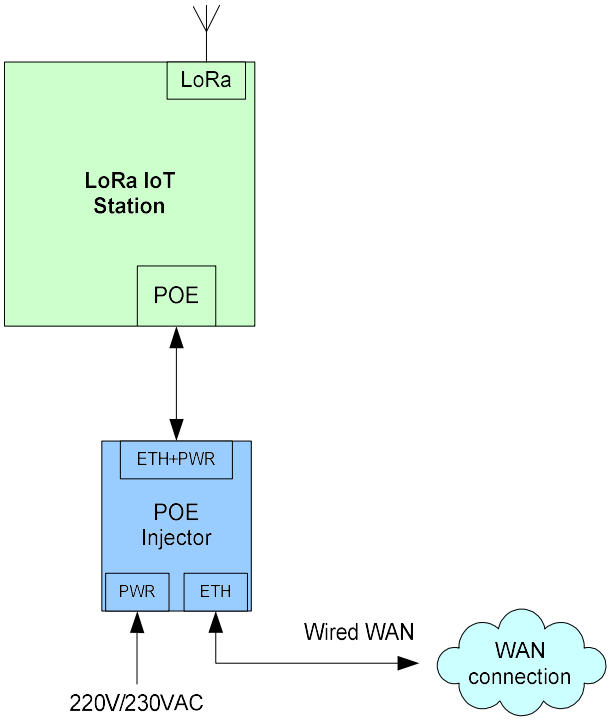


Figure 48 : Single station installation (No SIM)

7.2.2 Multi-station installation

7.2.2.1 With SIM Subscription

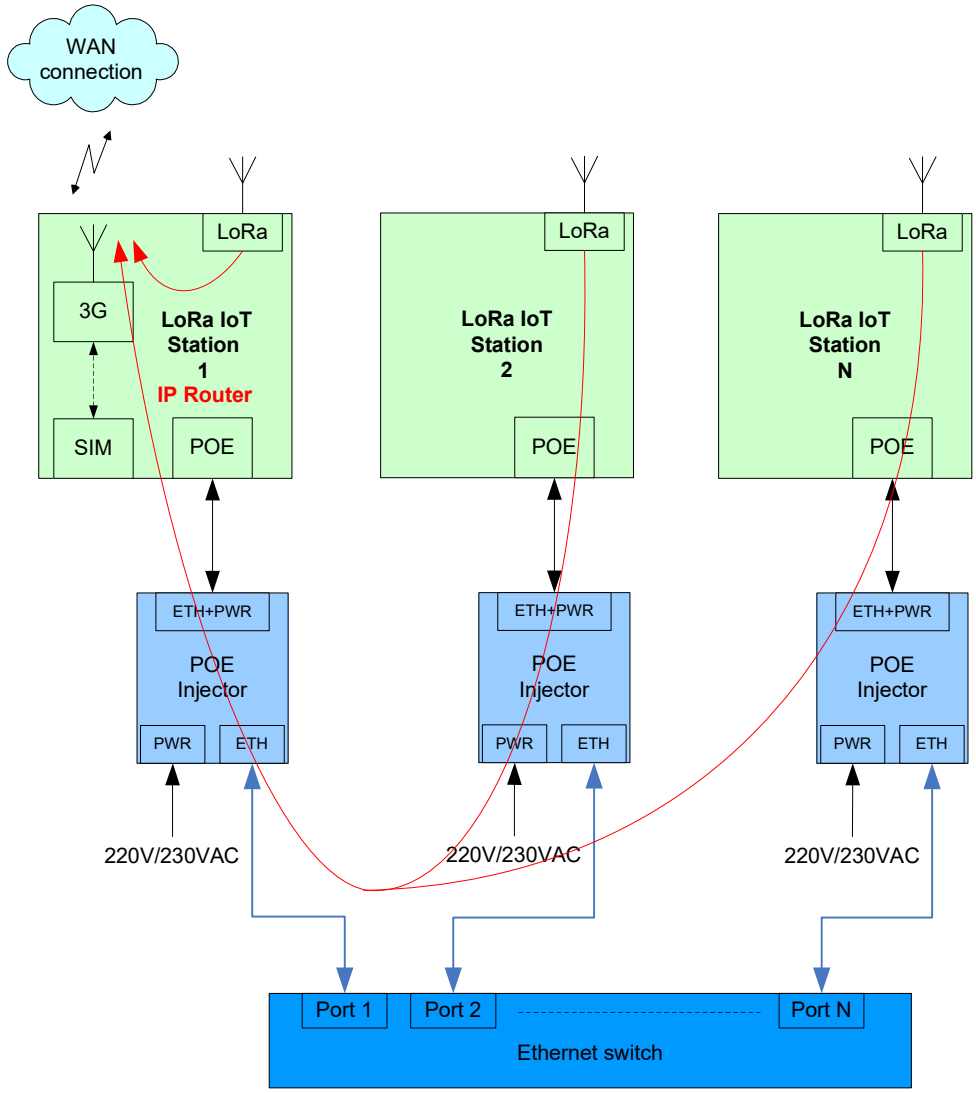


Figure 49 : Multi-station installation (with SIM)

7.2.2.2 Without SIM Subscription

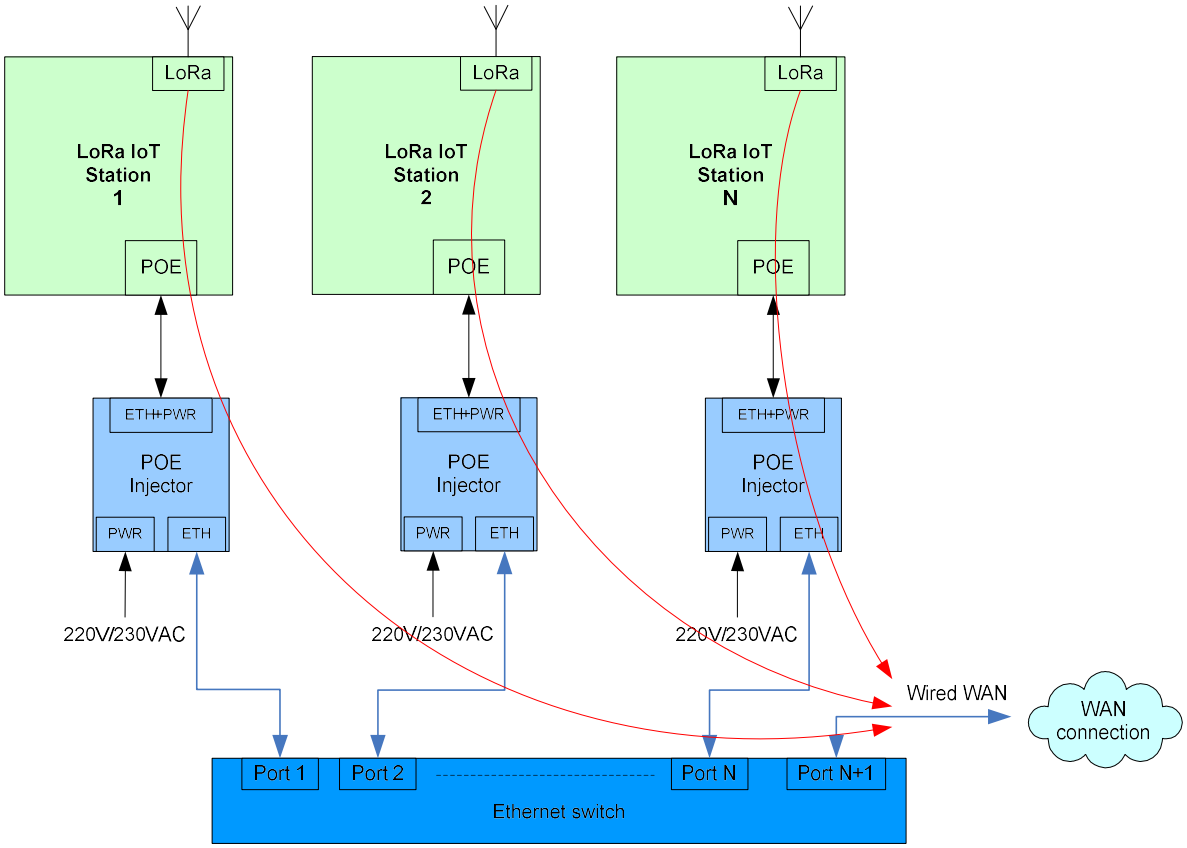


Figure 50 : Multi-station installation (No SIM)

7.3 Electric distribution to the LoRa IoT Station (Wirnet Station)

The installation must be compliant to EN 60728-11 (Cabled distribution systems standard).

Earthing is a key parameter for a secure installation.
Earthing of the installation is mandatory for:
- Indoor installation parts: mains supply, PoE injector
- Outdoor installation parts: tower, pole, Wirnet Station mounting kit, antennas.

Note: none of the earthing cables required for the installation are provided by KERLINK.

A second key parameter for a secure installation is the lightning protection. See §7.4.

The following picture describes all the required cables connections required for the installation, including power supply cables, data cables, RF coaxial cables and earthing connections.

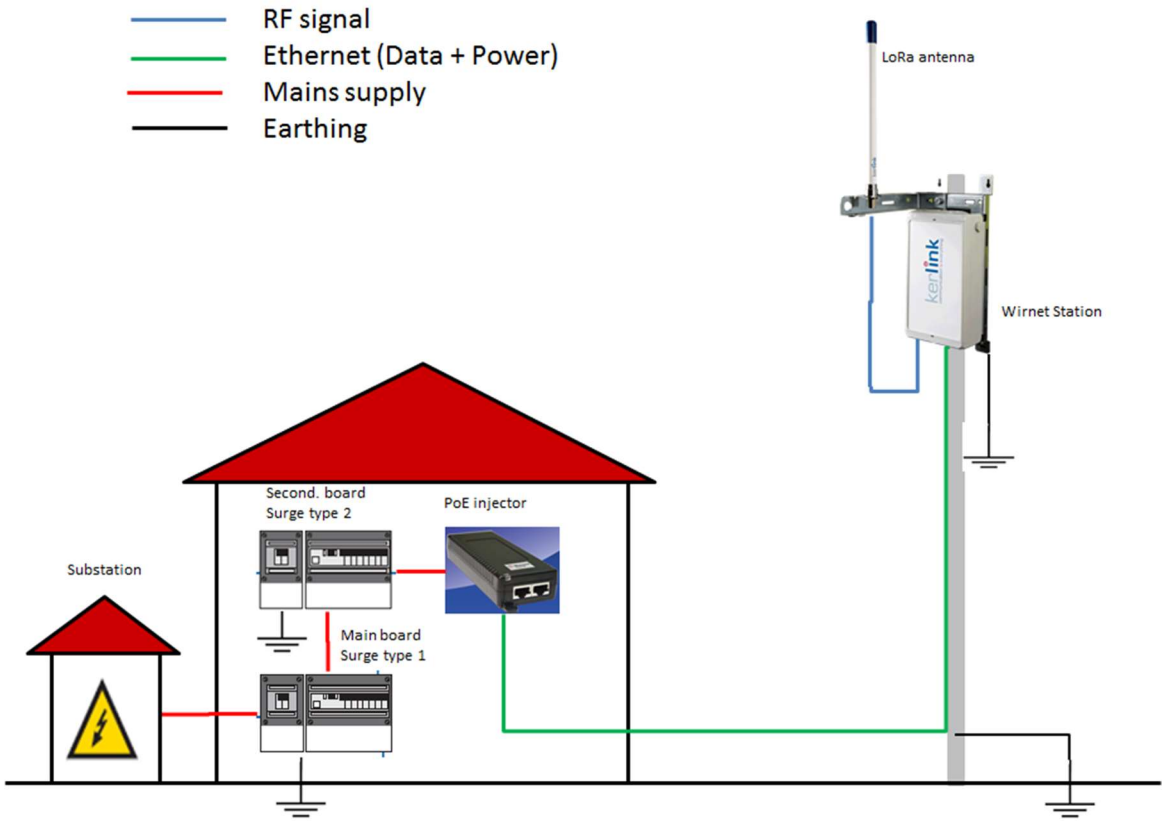


Figure 51 : Power distribution in the installation

The mains supply is not injected directly into the LoRa IoT Station (Wirnet Station) but into the PoE injector.
The mains supply must be an indoor installation composed of:

- A main electrical board including:
  - a circuit breaker
  - a surge protection type 1
  - a connection to “earth”

- A secondary electrical board including:
  - a circuit breaker
  - a surge protection type 2
  - a connection to “earth”

Surge protections type 1 and 2 are required to protect the PoE injector.

Note: in case surge protections type 1 and 2 are not available, specific PoE injector for outdoor applications is required (see §7.5.7.2).

The LoRa IoT Station (Wirnet Station) is nominally supplied through Ethernet cable: POE 48V (Max: 15 Watts)
The nominal current is about 70mA in Lora Rx mode with the GSM in a network attached mode.
KERLINK recommends a CAT6 SSTP standard Ethernet cable (see 4.8.4.1). The maximum cable length is 100m.

The LoRa IoT Station (Wirnet Station) can be also supplied with a DC power supply as a solar panel. The input voltage range is 11 to 30VDC. 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 13W.
The nominal current for a 12V power supply is about 250mA in Lora Rx Mode with the GSM in a network attached mode.

7.4 Lightning protections

In its standard configuration, the LoRa IoT Station (Wirnet Station) is provided with optimal internal surge protections. In harsh environment, additional protections must be used to improve lightning immunity. The LoRa IoT Station (Wirnet Station) is not warranted by KERLINK in case of deterioration due to lightning. KERLINK recommends adding surge protections, in high keraunic levels areas and on high points.

A lightning rod with a down conductor to earth is strongly recommended for this kind of applications, according to IEC 62305. The lightning rod avoids direct impacts on the aerials (antennas and Wirnet Station).

The lightning surge protection must be completed on three interfaces to be efficient:

- Mains supply
- Ethernet (PoE) cable
- RF coaxial cable (antenna interface)

Another key parameter for an efficient lightning surge protection is “earthing”. The earthing connection insures that the lightning surge is driven to the ground properly.
Earthing of the installation is mandatory for:

- indoor installation (mains supply, PoE injector)
- outdoor installation (tower, pole, …)

The following figure describes the lightning protections that are required in a high keraunic area configuration:

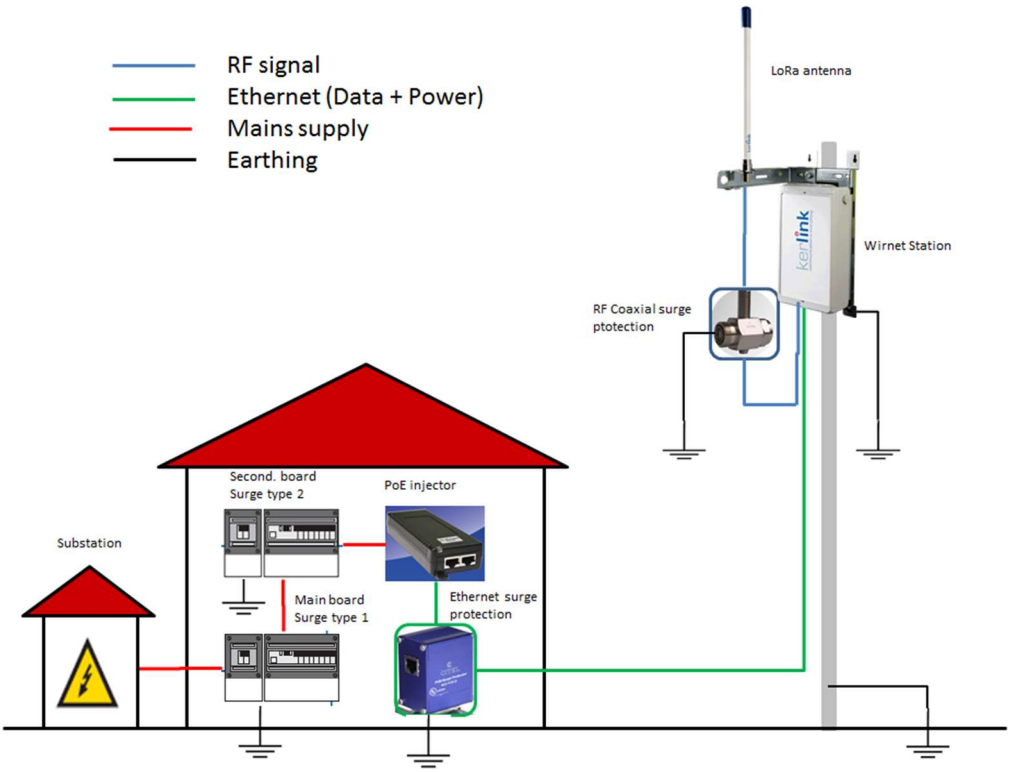


Figure 52 : Installation with recommended lightning protections

The installation is composed of two separated areas: indoor installation and outdoor installation.
The indoor installation is composed of:

- A main electrical board including:
  - a circuit breaker
  - a surge protection type 1
  - a connection to “earth”
- A secondary electrical board including:
  - a circuit breaker
  - a surge protection type 2
  - a connection to “earth”
- The PoE injector (see §4.8.1.1)
- An Ethernet surge protection, connected to “earth” (see §4.8.5.2)

The outdoor installation is composed of:

- A tower, mast or pole that must be connected to “earth”.
- The LoRa IoT Station (Wirnet Station) and its mounting kit.

The mounting kit must be connected to earth.

- The LoRa antenna with its RF coaxial surge protection (see §4.8.5.1) connected to “earth”.

Note 1: the PoE injector must be connected to the mains supply through a main electrical board with surge protections type 1 and a secondary electrical board with surge protections type 2. If the electrical installation does not meet those requirements, use an alternate PoE injector featuring better surge protection. Contact KERLINK for more information.

Note 2: the PoE injector is intended for indoor applications only.
Note 3: the Ethernet surge protection is intended for indoor applications only.

In some use cases the electrical installation does not have the required surge protections type 1 and type 2. Also, the PoE injector and Ethernet surge protection could not be installed indoor. Therefore, an alternate PoE injector and an Ethernet surge protection dedicated to outdoor applications are required. These are detailed in §4.8.1.2. In this use case, the installation is still composed of two separated areas: indoor installation and outdoor installation.

The indoor installation is composed of:

- A main electrical board including:
  - a circuit breaker
  - a surge protection type 1
  - a connection to “earth”

The outdoor installation is composed of:

- A tower, mast or pole that must be connected to “earth”.
- The Wirnet Station and its mounting kit.

The mounting kit must be connected to earth.

- The LoRa antenna with its RF coaxial surge protection (see §4.8.5.1) connected to “earth”.
- The PoE injector (see §4.8.1.2)
- An Ethernet surge protection, connected to “earth” (see §4.8.5.3.)

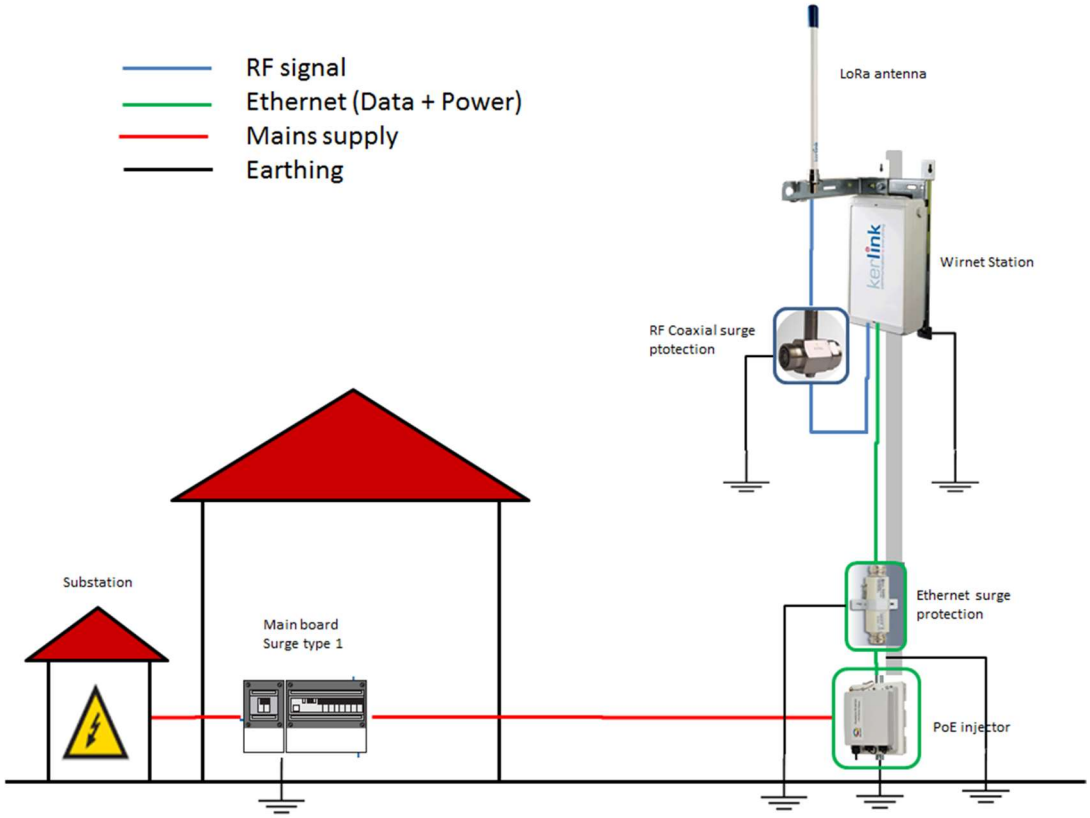


Figure 53 : Installation with recommended lightning protections / Outdoor PoE injector

Note 1: the outdoor PoE injector and Ethernet surge protectors have cable glands to insure the ingress protection. RJ45 connectors must be inserted into the POE injector through the cable glands.
Note 2: in both use cases, the earthing cables for the PoE injector, Ethernet surge protection, RF coaxial surge protection and Wirnet Station mounting kit are not provided by KERLINK.

7.5 Mounting of the enclosure

7.5.1 GPS and GSM considerations

The LoRa IoT Station (Wirnet Station) embeds a GPS and a GSM integrated solutions. Those both technologies require installing the product in an open environment to get acceptable performances.
Depending on the LoRa IoT Station (Wirnet Station) version, different WAN configurations can be used (see §4.4):

- LoRa IoT Station 868 (Wirnet Station 868): EGSM900/DCS1800/UMTS900/UMTS2100
- LoRa IoT Station 915 (Wirnet Station 915): GSM850/PCS1900/UMTS850/UMTS1900
- LoRa IoT Station 923 (Wirnet Station 923): (GSM850)/EGSM900/DCS1800/UMTS900/UMTS2100

7.5.2 General considerations

The LoRa IoT Station (Wirnet Station) must be mounted on any concrete pedestal, concrete wall or any non-flammable surface (UL94-V0).
It must not be mounted on a flammable surface.
The mounting kit delivered with the LoRa IoT Station (Wirnet Station) allows fixing the product in different ways.

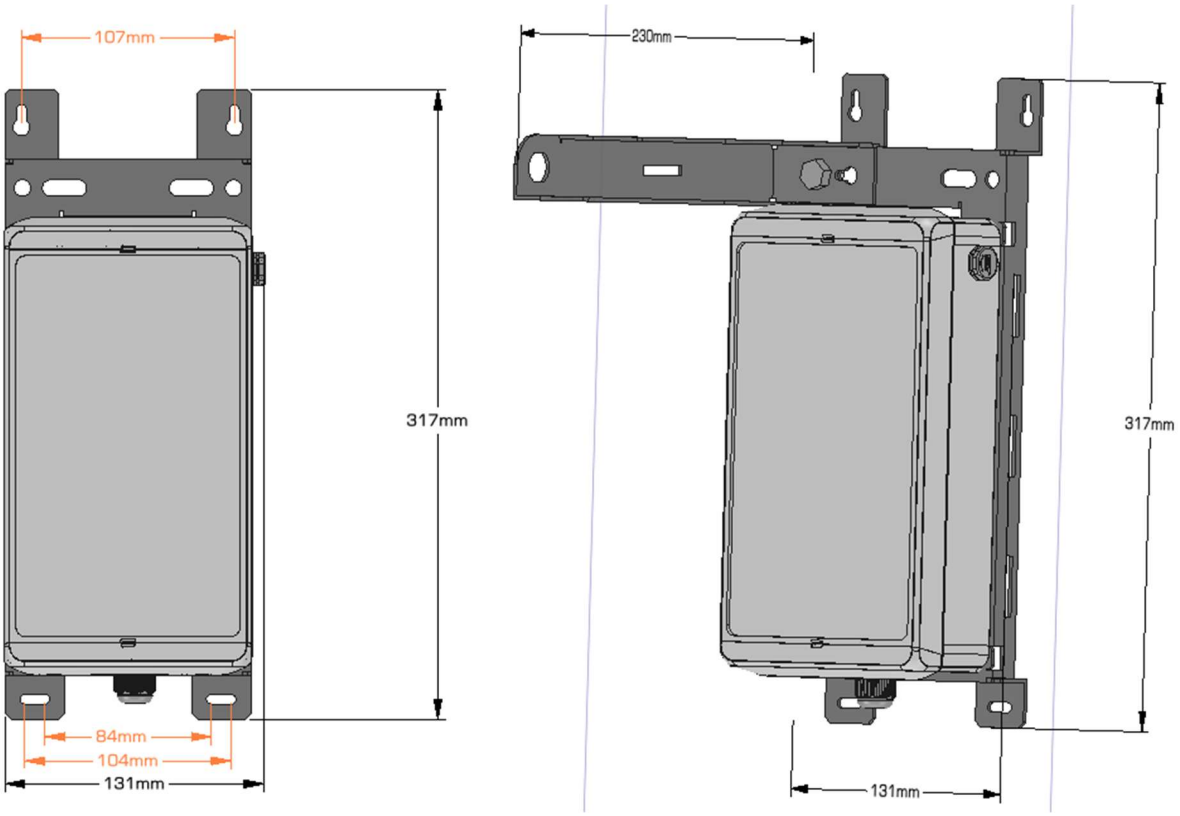


Figure 54 : Mounting kit dimensions

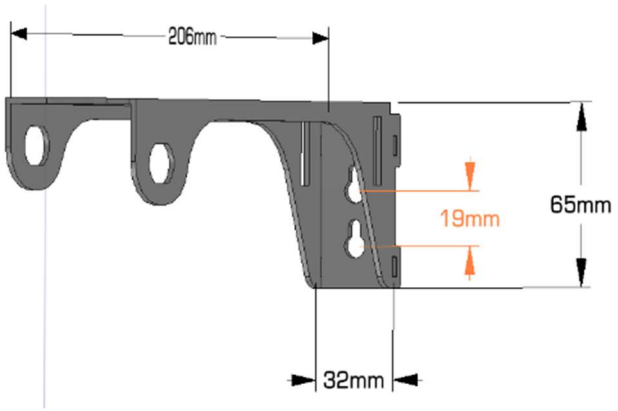


Figure 55 : Universal antenna support dimensions

7.5.3 Position of the universal antenna support vs. the enclosure

The universal antenna support as described on Figure 55 is intended for the LoRa antenna.
To optimize the colocation between the internal GSM antenna and the external LoRa antenna, a distance of 20 cm is required between both radiated parts.
Therefore, when possible we strongly recommend dissociating the universal antenna support away from the enclosure support. This is the best way to guarantee the 20 cm min distance between GSM antenna and LoRa antenna.
When the dissociation is not possible, the LoRa antenna must be placed on the opposite side of the GSM antenna as described on Figure 56.

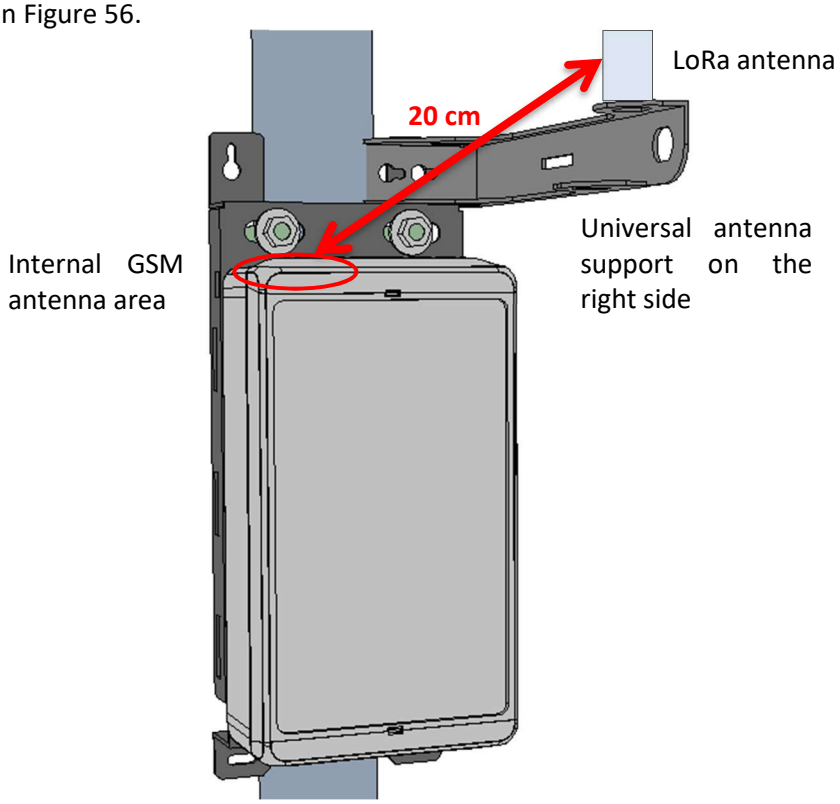


Figure 56 : Position of the universal antenna support when mounted on the enclosure support

7.5.4 Pole mounting by U-bolt

By default, the LoRa IoT Station (Wirnet Station) is delivered with a U-bolt to be mounted on a pole of a maximum diameter of 60mm.
To tighten the U-bolt, it is recommended to use nuts provided in the mounting kit.

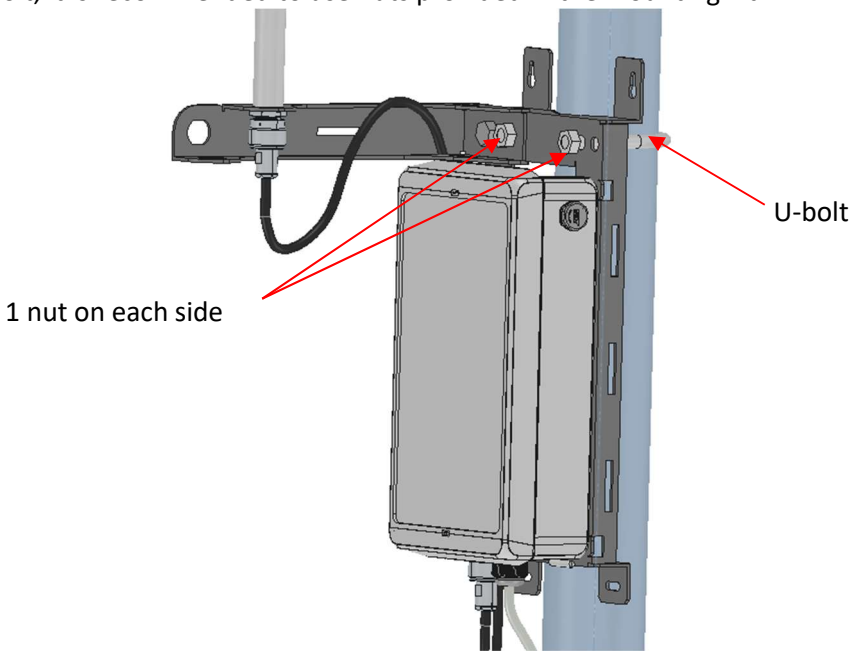


Figure 57 : Pole mount set on the enclosure

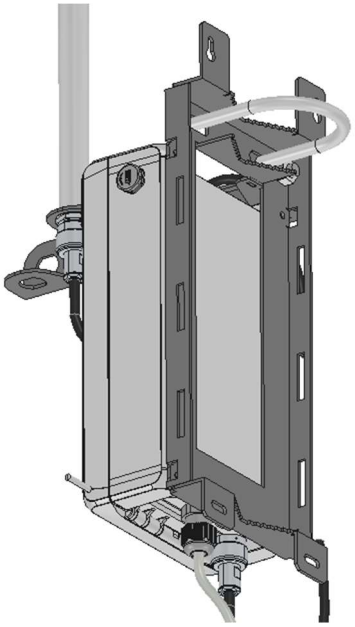


Figure 58 : Another view of the pole mounting using U-bolt (no pole represented)

For safety reason, the metallic mounting kit must own a good earth connection. This may be ensured by a good earth connection on the metallic pole since the U-bolt is conductive.

7.5.5 Wall mounting

The LoRa IoT Station (Wirnet Station) can be also mounted on a wall with M4 screws (not delivered with the mounting kit).

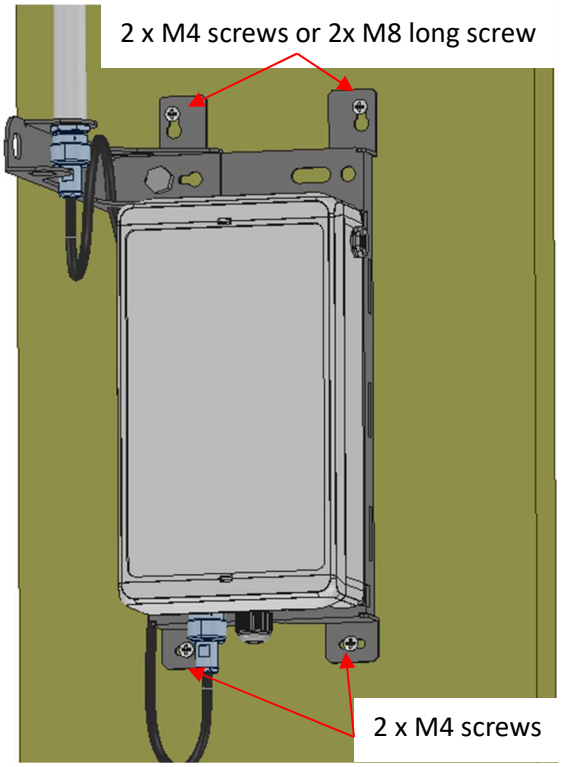


Figure 59 : Wall mount of the enclosure (front side)

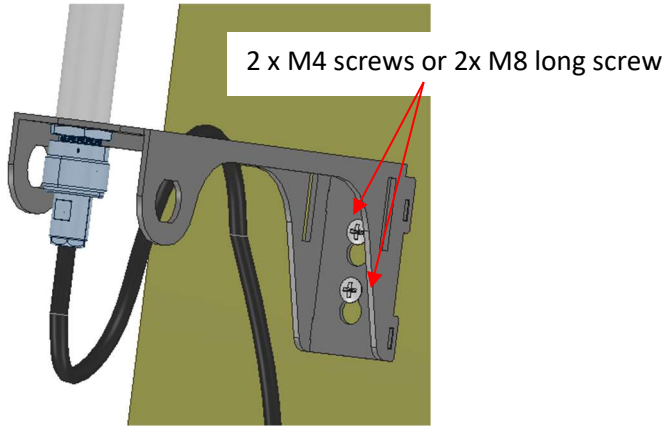


Figure 60 : Wall mount of the universal antenna support (front side)

For safety reason, the metallic mounting kit must own a good earth connection. This may be ensured by adding an earth connection on one of the four screws (fastening not delivered by default).

7.5.6 Metallic strapping mounting

The LoRa IoT Station (Wirnet Station) can be also mounted on a pole by strapping. The maximum acceptable width of the strapping is 25mm. It is recommended to use 2 metallic strappings as described on the figure below:

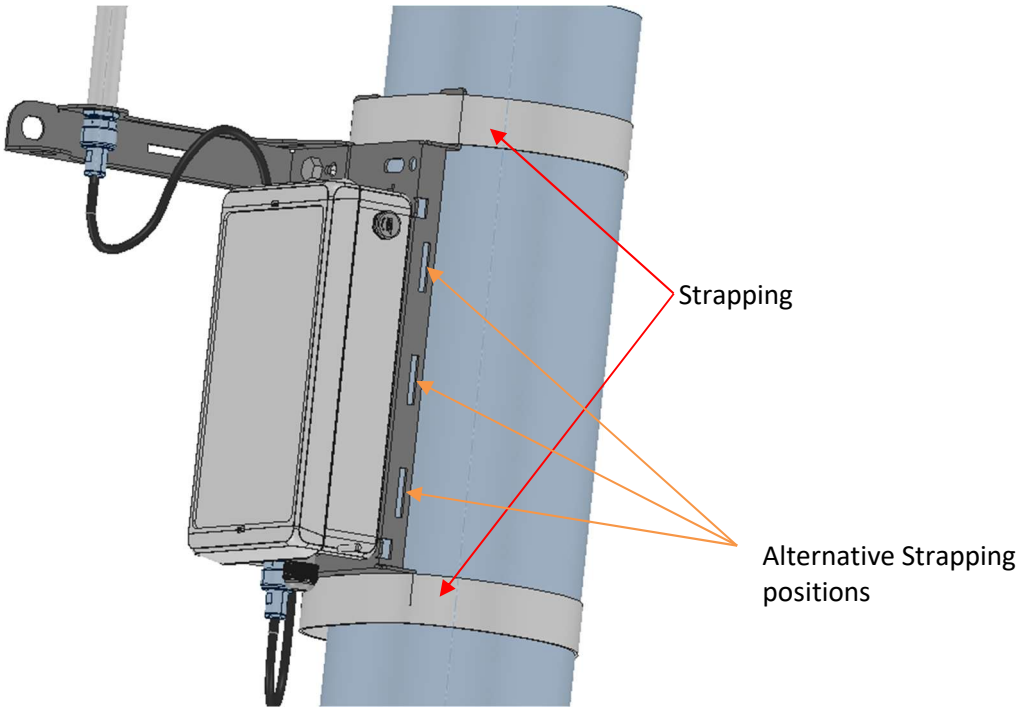


Figure 61 : Pole mount set using strapping

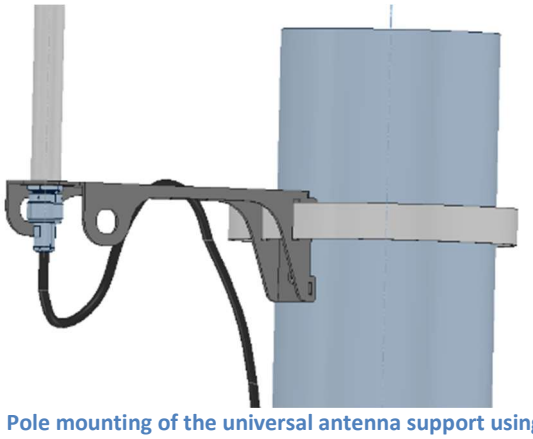


Figure 62 : Pole mounting of the universal antenna support using strapping

For safety reason, the metallic mounting kit must own a good earth connection. This may be ensured by a good earth connection on the metallic pole if strappings are conductive.

7.5.7 Mounting of the accessories

7.5.7.1 Indoor PoE injector

Indoor PoE injector described in §4.8.1.1 can be wall mounted with 2 x M3 screws.

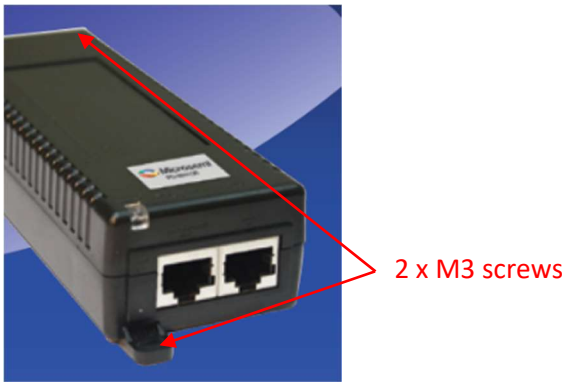


Figure 63 : Screws for indoor POE injector mounting

7.5.7.2 Outdoor PoE injectors

Outdoor PoE injectors described in §4.8.1.2 can be wall mounted using 3 x M3 screws (positions 1, 2 and 3 below):

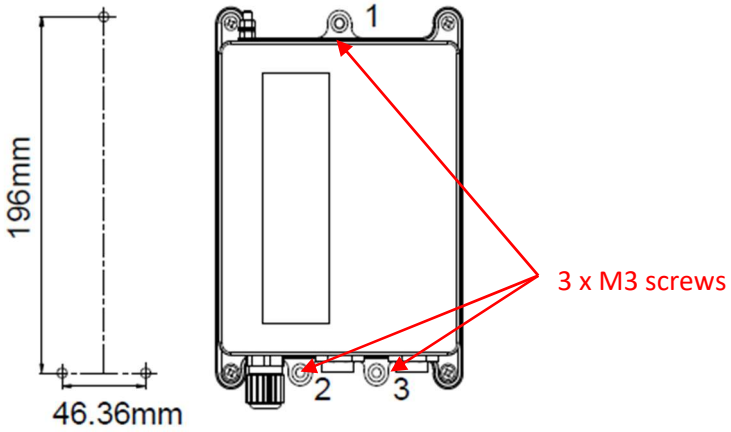


Figure 64 : Screws for outdoor POE injectors mounting

A mounting bracket kit is also available:

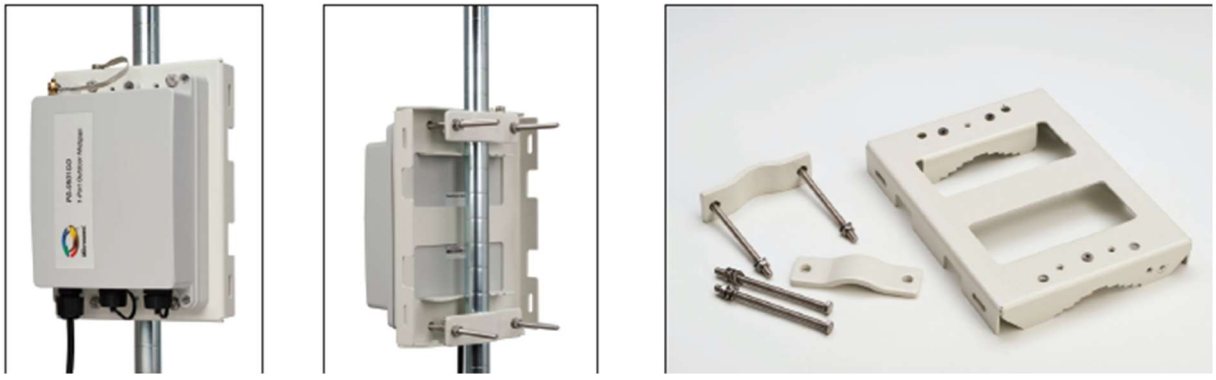


Figure 65 : Mounting bracket for outdoor POE injectors

7.5.7.3 Indoor Ethernet surge protection

The indoor Ethernet surge protection is provided with a clip dedicated to DIN rail mounting.
The DIN rail clip can be removed by unscrewing the nut:

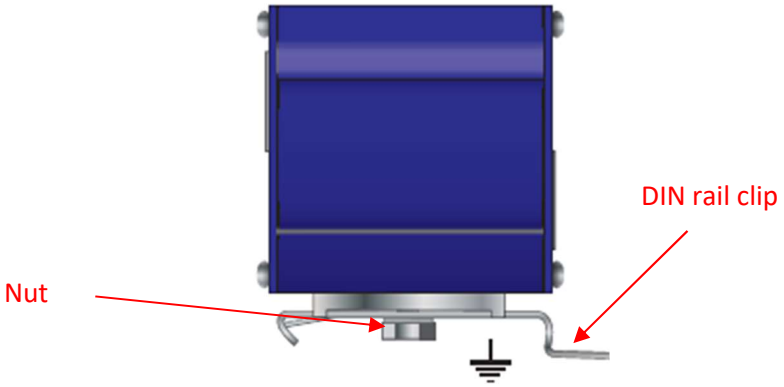


Figure 66 : Indoor Ethernet surge protection – DIN rail clip

7.5.7.4 Outdoor Ethernet surge protection

The outdoor Ethernet surge protection is provided with an “omega” bracket dedicated to wall mounting. Use 2 x M4 screws to fix to bracket on the wall:

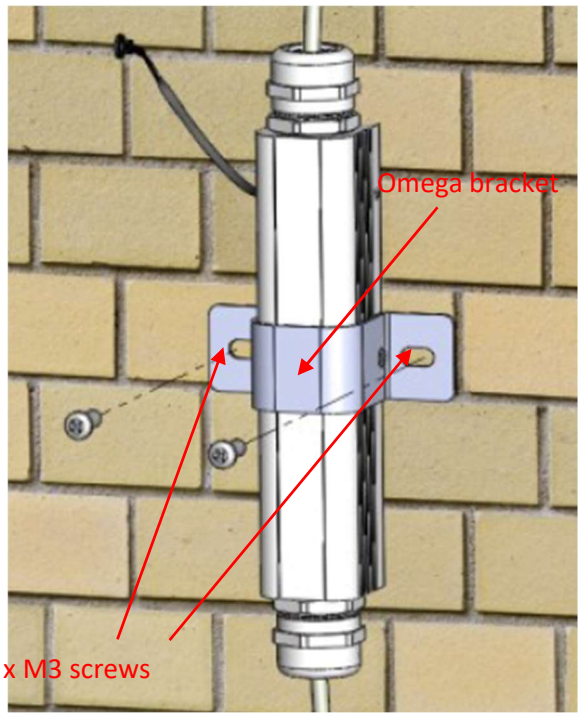


Figure 67 : Outdoor Ethernet Surge protection – wall mounting

The outdoor Ethernet surge protection can be also pole mounted with strapping.
Disassemble the “omega” bracket by unscrewing both of its screws.
Mount the surge protection on the pole and use a metallic strapping or worm gear clam to fix it:

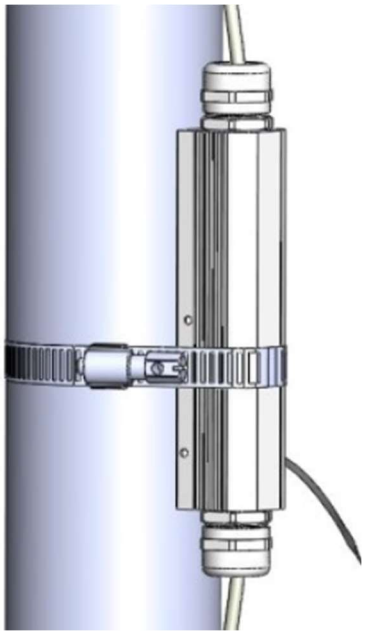


Figure 68 : Outdoor Ethernet Surge protection – pole mounting with strapping

7.5.7.5 RF coaxial surge protection

The RF coaxial surge protections are directly mounted (screwed) on the N connectors of the LoRa antenna or of the LoRa IoT Station (Wirnet Station).

7.5.7.6 Cavity filters

The cavity filters are directly mounted (screwed) on the N connectors of the antennas or of the LoRa IoT Station (Wirnet Station).
Some of them can also be wall mounted with 4 x M4 x 8 mm screws as detailed in §4.8.3.

7.6 Setting connections

7.6.1 Earthing

Several earthing cables, wires, tapes or ring tongue terminals are required to connect the installation and the materials to earth for lightning immunity and electrical security:

- Earthing of the Wirnet Station mounting kit
- Earthing of the RF coaxial surge protection
- Earthing of the Ethernet surge protection
- Earthing of the outdoor PoE injector

A M8 ring tongue terminal is provided for earthing of the Wirnet Station mounting kit.
The earthing cables characteristics are detailed in §4.8.4.2.

Note: the earthing cables are not provided by KERLINK.

7.6.1.1 Earthing of the Wirnet Station mounting kit

Earthing of the Wirnet Station mounting kit is completed through the holes dedicated to the M8 U Bolt used for pole mount or the holes dedicated to the universal antenna bracket. The earthing symbol ⏚ is placed close to dedicated holes. Two different configurations are then possible, depending on the usage of the U bolt:

1. The M8 U bolt is used (pole mount by U-bolt configuration):
   The U-bolt and the M8 nut are used to connect the ring tongue terminal
2. The M8 U bolt is not used (wall mount configuration or metallic strapping configuration):
   The M8 bolt and nut dedicated to the universal antenna bracket is used to connect the ring tongue terminal. It can be used whatever the universal antenna bracket is installed or not on the mounting kit.

The different configurations are presented below:

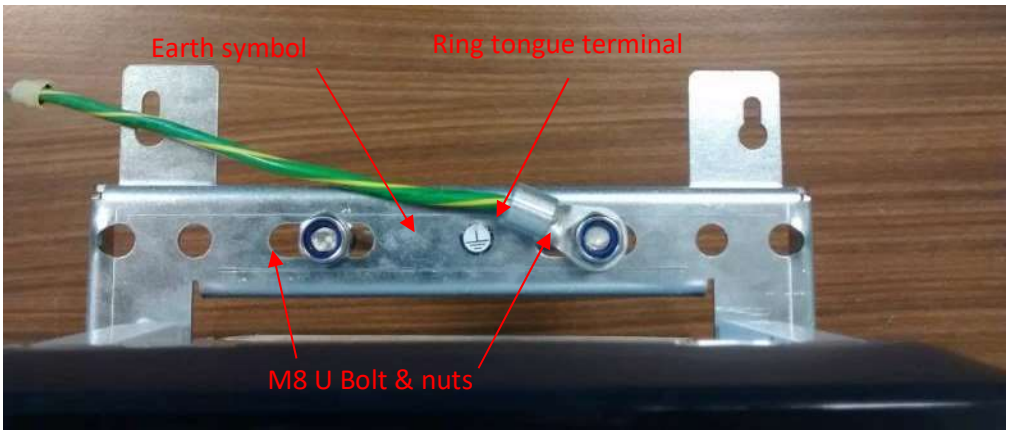


Figure 69 : Wirnet Station mounting kit – earthing with U bolt configuration

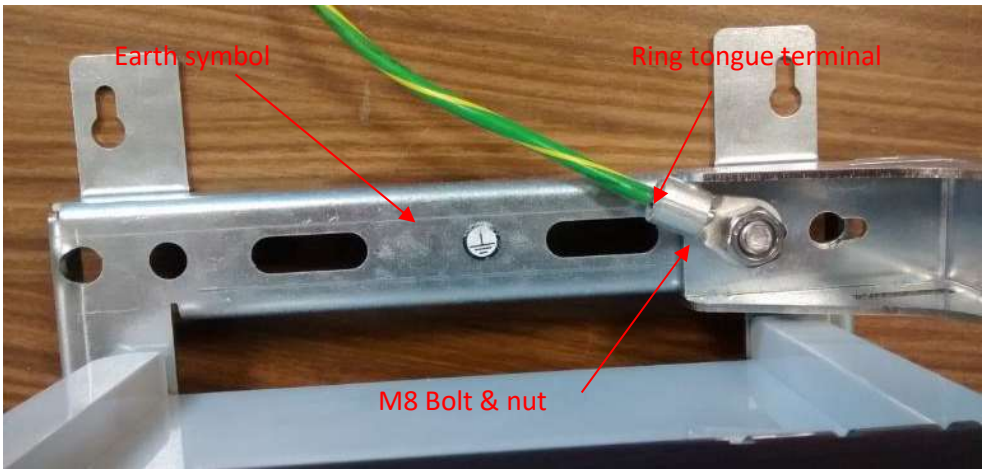


Figure 70 : Wirnet Station mounting kit – earthing without U bolt configuration

Crimp the ring tongue terminal to earthing cable with the crimping tool
Connect the ring tongue to the mounting kit with M8 bolt (or U-bolt) and nut.
Connect the other side of the earthing cable to the earthing system or lightning protection system of the of the pole, mast, … of the installation.
Note: 1 the earthing cable is not provided by KERLINK

Note 2: the earthing cable characteristics are detailed in §4.8.4.2.
Note 3: use a crimping tool to crimp the ring tongue terminal with earthing cable.

7.6.1.2 Earthing of the RF coaxial surge protection

On the RF coaxial surge protection side, the earthing connection is completed through a ring tongue terminal.
The earthing cable must be crimped inside this ring tongue terminal.
A specific crimping tool is required to perform the operation.

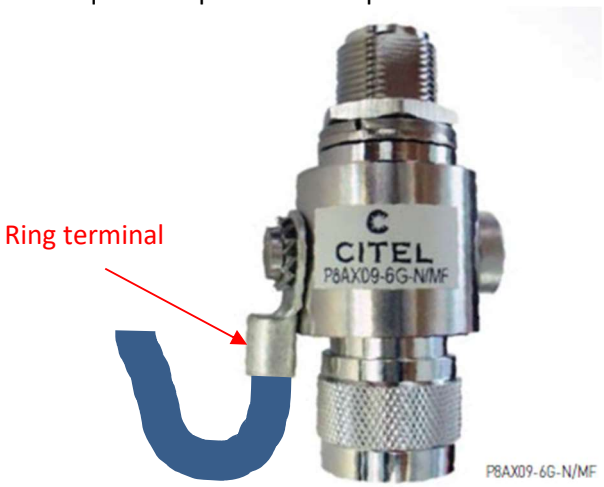


Figure 71 : Earthing of the RF coaxial surge protection

Note 1: the earthing cable is not provided by KERLINK
Note 2: the earthing cable characteristics are detailed in §4.8.4.2.
Note 3: use a crimping tool to crimp the ring tongue terminal with earthing cable.

7.6.1.3 Earthing of the Ethernet surge protection

On the indoor Ethernet surge protection side, the earthing connection is completed through the DIN rail clip.
Therefore, the earthing cable can be connected to the DIN rail itself or using the nut of the DIN rail clip.

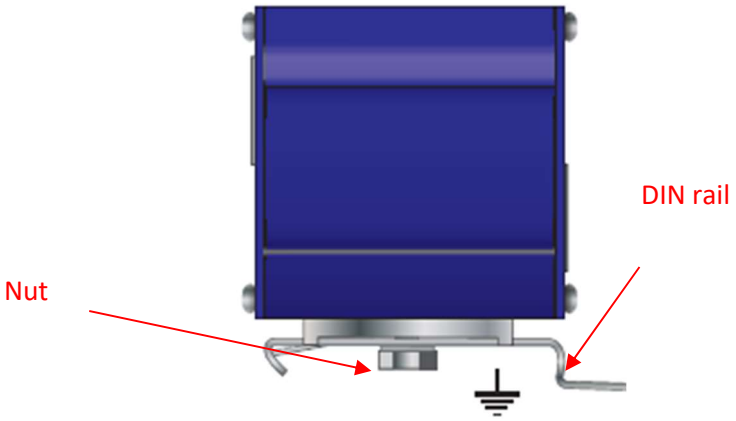


Figure 72 : Earthing of the indoor Ethernet surge protection

On the outdoor Ethernet surge protection side, the earthing connection is completed through a dedicated earthing screw. The earthing connection is completed through a ring terminal. The earthing cable must be crimped inside this ring terminal.
A specific crimping tool is required to perform the operation.

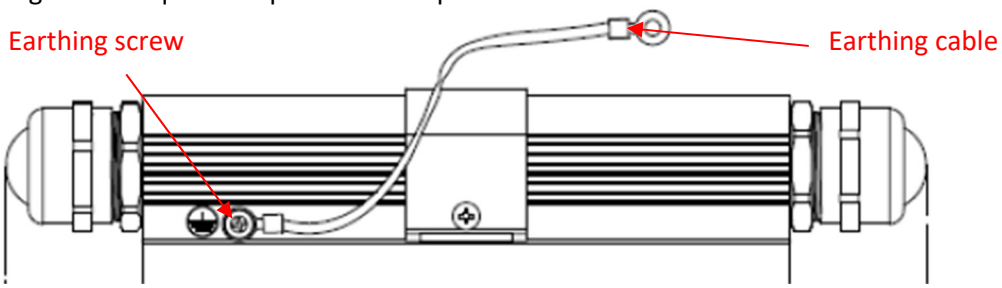


Figure 73 : Earthing of the outdoor Ethernet surge protection

Note 1: the earthing cables are not provided by KERLINK
Note 2: the earthing cables characteristics are detailed in §4.8.4.2.

7.6.1.4 Earthing of the outdoor PoE injector

On the outdoor PoE injector, the earthing connection is completed through a dedicated earthing bolt and two nuts.
The earthing connection on the cable is completed through a ring terminal. A specific crimping tool is required to perform the operation. The earthing cable must be crimped inside this ring terminal.
The ring terminal is inserted between the two nuts as follows:

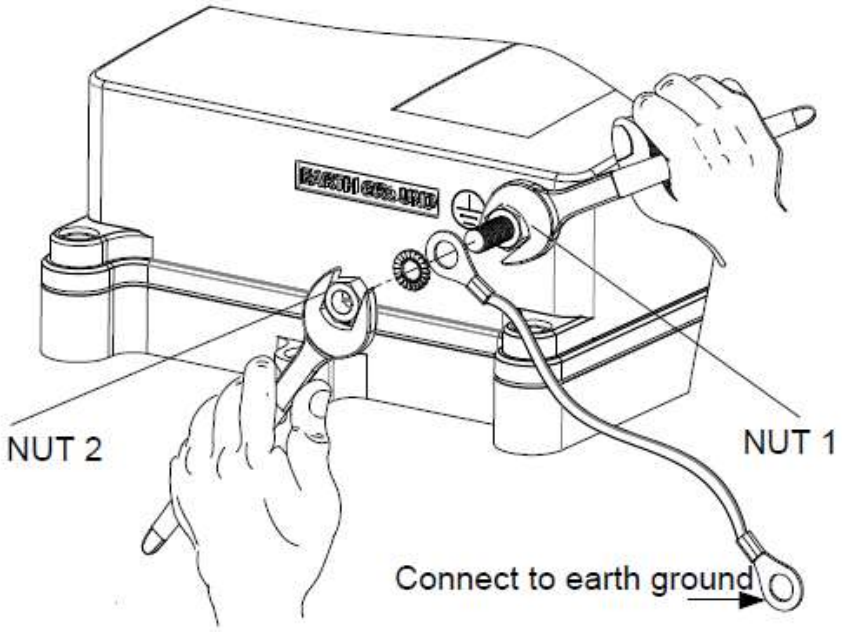


Figure 74 : Earthing of the outdoor PoE injector

Note 1: the earthing cables are not provided by KERLINK
Note 2: the earthing cables characteristics are detailed in §4.8.4.2.

7.6.2 LoRa RF Antenna connection

First, tighten the universal antenna support on the enclosure support using provided screw and nut.
Next, tighten the antenna on the mounting set:

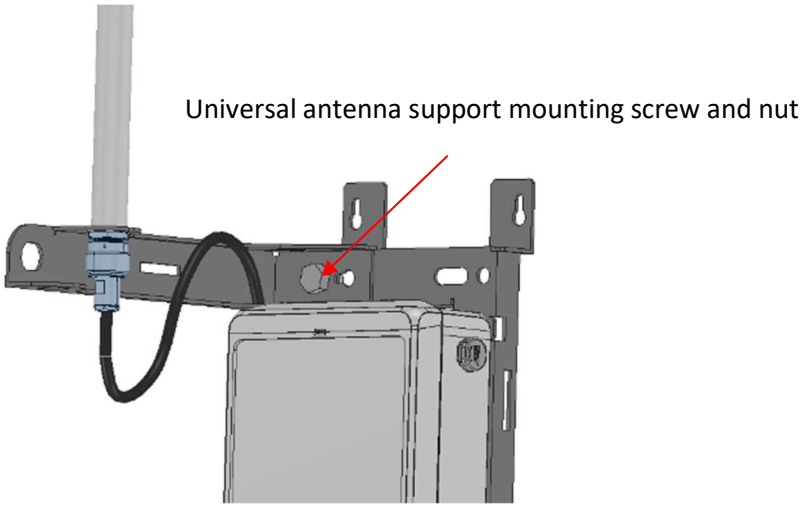


Figure 75 : attachment of the antenna on the mounting set

Once the RF antenna is fixed, connect the N connector of the antenna cable on the connector based on the bottom of the casing as described on the figure below.

For safety reason, the power supply of the product must be disconnected before plugging the N connector.

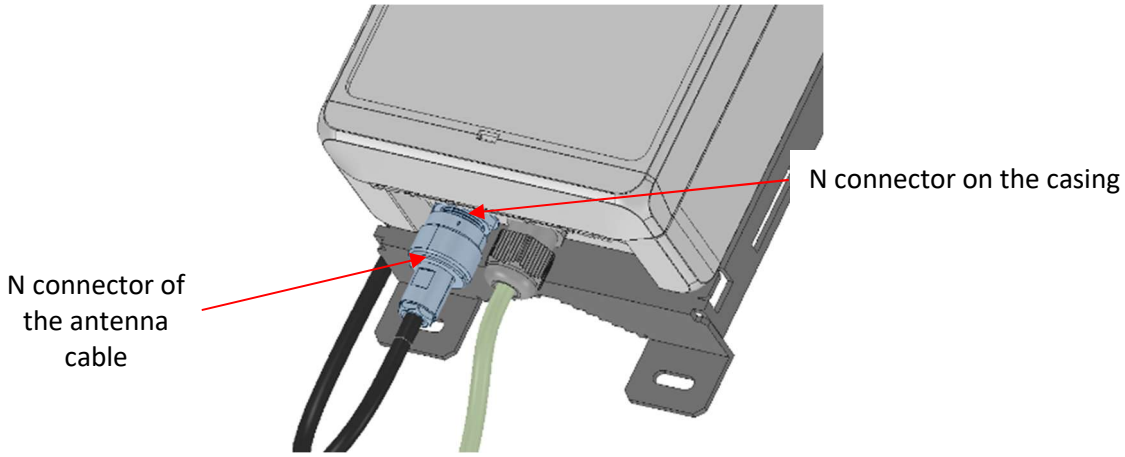


Figure 76 : connection of LoRa RF antenna (bottom view)

To improve the durability of the RF connections against environmental aggression (moisture, pollution, …), KERLINK recommends to protect connectors with an insulating tape like the reference 130C from 3M.

To tighten the antenna cable, it is possible to tighten it with cable clamp, using spaces provided for this purpose:

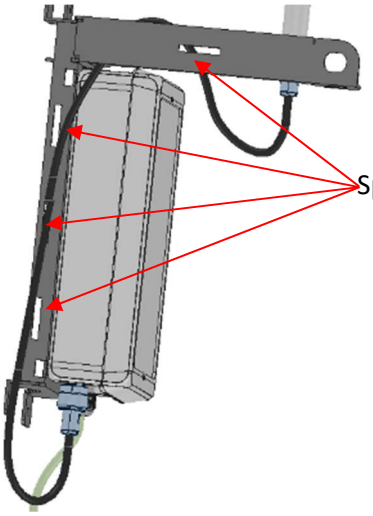


Figure 77 : attachment of the RF antenna cable

It is possible to order other antennas as an option. KERLINK proposes antennas with gain from 3dBi to 6dBi, depending on specific counties and regulations.
For more details, see §4.8.2 and §9.

7.6.3 Ethernet connection

The Wirnet Station is supplied by a PoE injector through an Ethernet cable.
The PoE injectors are detailed in §4.8.1.1 and §4.8.1.2.
The recommended Ethernet cable is detailed in §4.8.4.1. It includes two RJ45 T 568A plugs on each side

Note 1: The Ethernet cable is not provided with the Wirnet Station.

Note 2: The maximum Ethernet cable length is 100m.

Note 3: The cable gland allows external cable diameter (cable and RJ45 connector) from 4mm to 8 mm.

On LoRa IoT Station (Wirnet Station) side, the Ethernet cable must be firstly inserted through the cable gland. Then, the shield of the cable must be clamp in the “earthing clip” like in the following picture to get a good earth shielding.

Note 4: the earthing clip is screwed on the cover shield with a M3x12; head button, hexagon socket screw (B3X12/BN11252 Bossard). Use screwdriver or Allen hexagon key, 2.0mm for this screw.

The internal wires have to be connected to the terminal block as described on the picture below:

Figure 78 : Ethernet connection

On the other side of the Ethernet cable, the RJ45 connector must be inserted into the RJ45 “Data + Power” port of the POE injector.

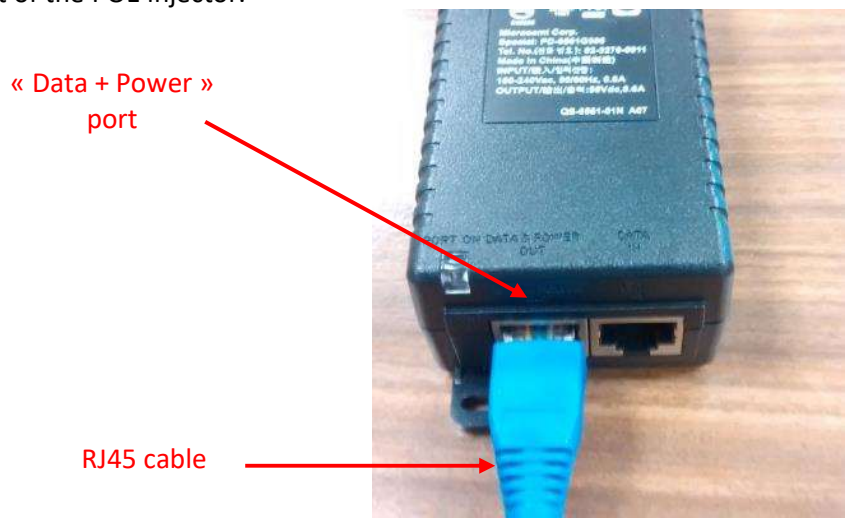


Figure 79 : Ethernet connection on PoE injector side

Note 5: the PoE injector must be connected to the mains supply through a main electrical board with surge protections type 1 and a secondary electrical board with surge protections type 2 as detailed in §7.6.4.

Note 6: the PoE injectors detailed in §4.8.1.1 are intended for indoor applications only.

Note 7: If the electrical installation does not include surge protections type 1 and 2, then an outdoor PoE injector featuring better surge protection is required. This outdoor PoE injector is detailed in §4.8.1.2.

Before connecting the Ethernet wires, ensure that the POE injector is not connected to 230VAC.

7.6.4 Mains supply

The PoE injectors detailed in §4.8.1.1 and §4.8.1.2, are provided with E/F type cable (Europe) or B type cable (USA).
Insert the plugs to the mains receptacle of the electrical installation.

Note: the E/F type or B type plugs must be inserted into the mains receptacle only once all other connections are settled and USIM card inserted.

7.6.5 Auxiliary power supply

The LoRa IoT Station (Wirnet Station) can be supplied with a DC power supply as a solar panel. The input voltage range is 11 to 30VDC. 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 13W.

After insertion through the cable gland, a 2-wire cable can be connected (screwed) to the dedicated terminal block as described on the figure below:

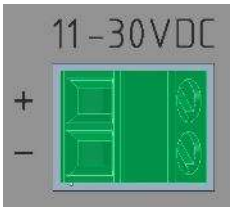


Figure 80 : DC power supply connection (temporary image)

The cable gland allows external cable diameter from 4mm to 8 mm.
The nominal section of the wires is 1 mm^2.
Considering 1mm^2 sections copper wires, the maximum recommended length of the cable is:

- 20m for a 12V DC solar system
- 50m for a 24V DC solar system

Note 1: Beware of the polarity.

Note 2: the wires must be inserted into the terminal block only once all other connections are settled and USIM card inserted).

7.7 Commissioning

7.7.1 SIM card

The SIM card is mandatory to establish the 3G/GPRS communications.
The SIM card to be used with the LoRa IoT Station (Wirnet Station) must be a 2FF format.
KERLINK recommends the usage of a M2M UICC compliant with 3GPP TS 102.671. It offers then a better temperature operating range, improved data retention and increased number of UPDATE commands.

Before inserting the SIM card, pay attention that the LoRa IoT Station (Wirnet Station) is unpowered by checking the 2 LEDs PWR are OFF, after pressing the TEST button.

Then, to insert a SIM card in the Access Point:

- Open the LoRa IoT Station (Wirnet Station) casing
- Open the internal door of the cabinet
- Then, you can remove the SIM card holder of the Lora IoT Station (Wirnet Station) by pressing with a little screwdriver, the extraction button (as shown below)
- Place the SIM card in the SIM card holder
- Insert carefully the SIM card holder with the SIM card in the LoRa IoT Station (Wirnet Station)

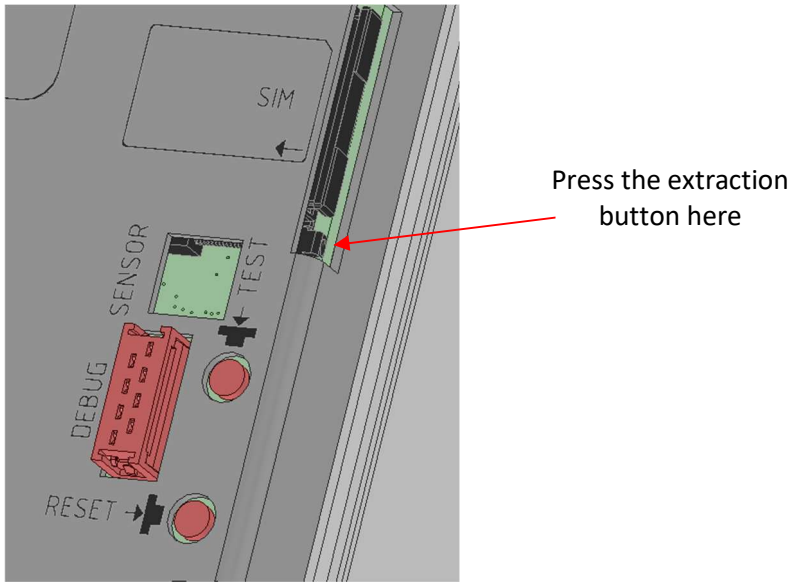


Figure 81 : SIM Card

In case of replacement of the SIM card, the power supply must be firstly switched off by disconnecting Ethernet wires or disconnecting the POE injector. For few seconds, the LoRa IoT Station (Wirnet Station) is still powered-on due to the internal backup battery. Wait and check the 2 LEDs PWR are switched off, after pressing the TEST button, before extract the SIM card.
After inserting the new SIM card as described above, the Lora IoT Station (Wirnet Station) can be re-powered on.
In case of change of mobile operator, APN and login/password must be updated. For more details, contact your first level of support.

7.7.2 Power on

Once the RF antenna and the Ethernet wires are connected and the SIM card is inserted (optional), the Lora IoT Station (Wirnet Station) can be powered on.
To POWER ON the LoRa IoT Station (Wirnet Station), connect the POE injector on the 230VAC main power supply.

7.7.3 Functional check

To ensure the LoRa IoT Station (Wirnet Station) is started up, check the 2 PWR LEDS, after pressing the TEST button: they should be switched ON. After some seconds, the LEDs switch off.
Then, to check and analyze the status of the LoRa IoT Station (Wirnet Station), the TEST button must be pressed briefly in order to activate the LEDs functionality during 1 minute. This operation can be repeated indefinitely.

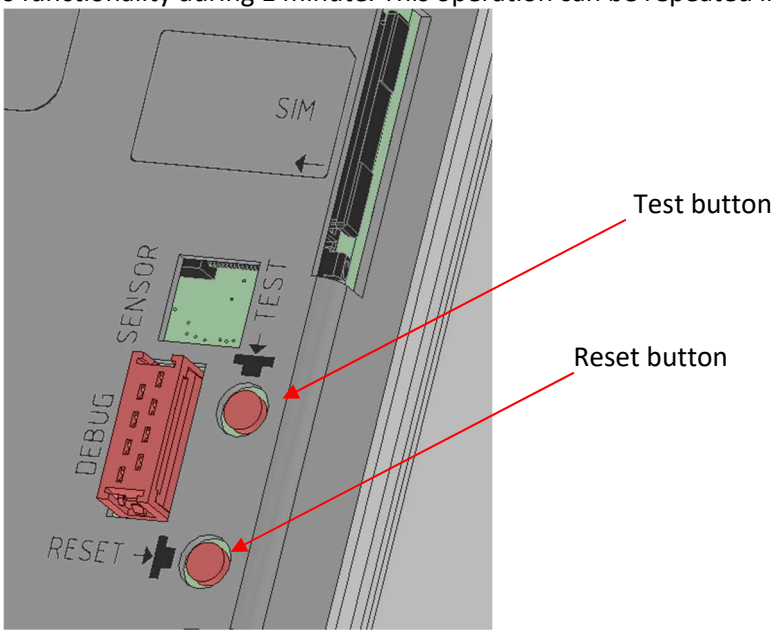


Figure 82 : Test and Reset buttons

Status of the Lora IoT Station (Wirnet Station):

Name	Color	Mode	Details
PWR (Station)	Green	Continuous	Station power indicator
PWR (Modem)	Green	Continuous	Modem power indicator
GSM1	Green	Continuous	GSM quality level Most Significant Bit
GSM2	Green	Continuous	GSM quality level Least Significant Bit

WAN quality level :

GSM1	GSM2	Status
0	0	SIM Card error
0	1	No network connection
1	0	RSSI Level < 17
1	1	RSSI Level >18

The behavior of the other LEDs depends on the application software downloaded in the LoRa IoT Station (Wirnet Station). Only Station LEDS (WAN, MOD1 and MOD2) can be controlled by the application.

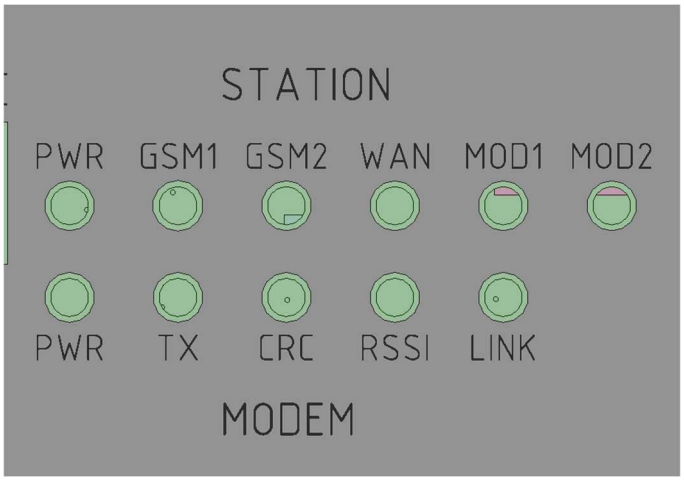


Figure 83 : LEDs indicators

8 Maintenance of the Lora IoT Station (Wirnet Station)

8.1 Battery

The Lora IoT Station (Wirnet Station) embeds a 12.5mm 48mAh Lithium Battery (BR-1225-AHBN from PANASONIC). This battery is used to supply the RTC in case of mains supply outage.
The battery is referenced as BAT600 and is located on the main board (red circle below):

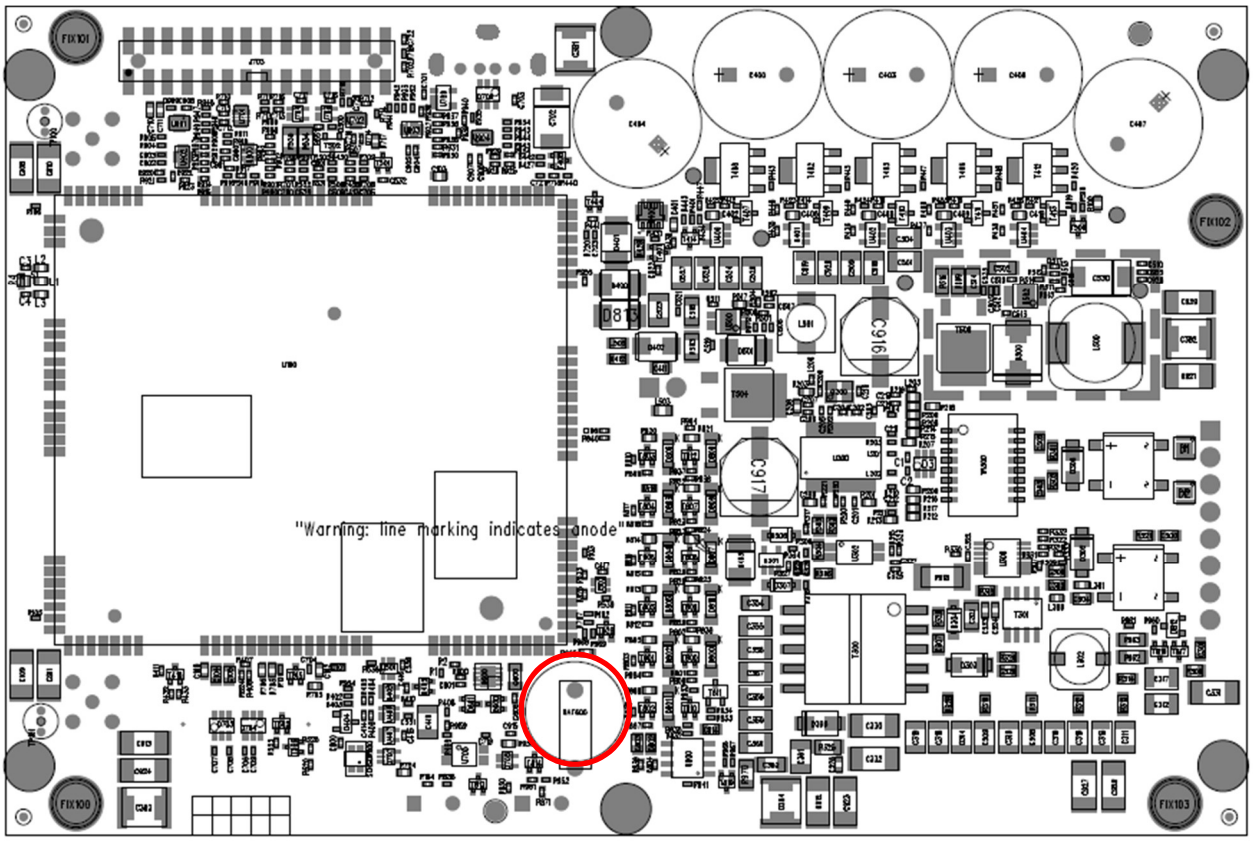


Figure 84 : Location of the BAT600

The battery does not have to be replaced or changed during the LoRa IoT Station (Wirnet Station) life.

Warning:
If you change incorrect battery type, it will have explode risk.
Please follow manufacturer's instruction to handle used battery.

如果更换不正确的电池类型，将会爆炸风险。
请按照制造商的说明处理二手电池。

8.2 Simple checks

8.2.1 LoRa IoT Station (Wirnet Station) enclosure

Check the robustness of the installation:

- Screwing of the LoRa IoT Station (Wirnet Station) on the mounting set
- Screwing of the mounting set (depends on the configuration)

Check the Ingress Protection of the enclosure:

- No trace of water inside the enclosure
- Tightening / screwing of the N connectors
- Tightening of the cable gland
- Tightening of the pressure stabilizer
- PU gasket on the door

8.2.2 Cables

Check tightening and cabling of the antenna:

- The LoRa RF antenna N connectors are well screwed and tightened on the casing and on the mounting set.
- The antenna brackets are well tightened to the wall or pole.
- The coaxial cable of LoRa antenna is not deteriorated.

Check earthing of the installation:

- Antennas + mounting kit earthing cables are connected and not deteriorated.
- Wirnet Station + mounting kit earthing cable is connected and not deteriorated.
- Surge protectors earthing cables are connected and not deteriorated.

Check cabling inside the enclosure:

- The RF coaxial cable is not deteriorated.
- RJ45/PoE cable is properly inserted into the enclosure
- Screwing of Ethernet wires
- Auxiliary supply wires (optional) are correctly inserted and screwed in the Euroblock connector of the CPU module

8.2.3 LED

Make sure the LoRa IoT Station (Wirnet Station) is working properly according to LEDs indications. See §7.7.3.

8.2.4 PoE injector

Check the RJ45 connectors of the Ethernet cables are properly inserted into the PoE injector

Check the LED indicator on the indoor 15W PoE injector:

- Green: AC Power OK and Channel Power OK -> no defect
- None: no AC Power -> defect

8.3 Interfaces for debug or maintenance purposes

8.3.1 Proprietary debug interface

The LoRa IoT Station (Wirnet Station) has a proprietary debug interface:

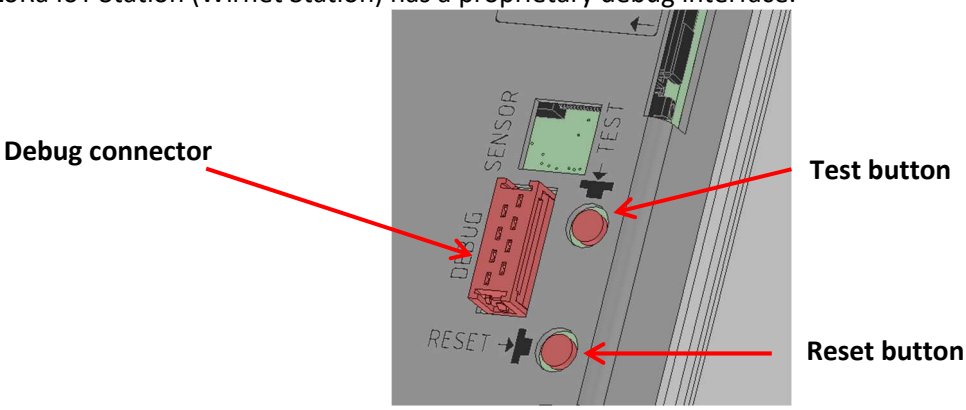


Figure 85 : Proprietary debug interface of the LoRa IoT Station (Wirnet Station)

This debug interface is intended to be used by authorized and qualified personnel only.
Be careful: Only specific equipment developed by KERLINK must be connected to this interface.

The Wirgrid Debug Board (see §4.8.7) is intended to be connected to the debug interface.
The board is provided with a flat cable that must be directly connected to the debug connector as shown on Figure 86. A USB2.0 type A to type B male cable (not provided by KERLINK) is required to connect the Wirgrid Debug Board to a computer.

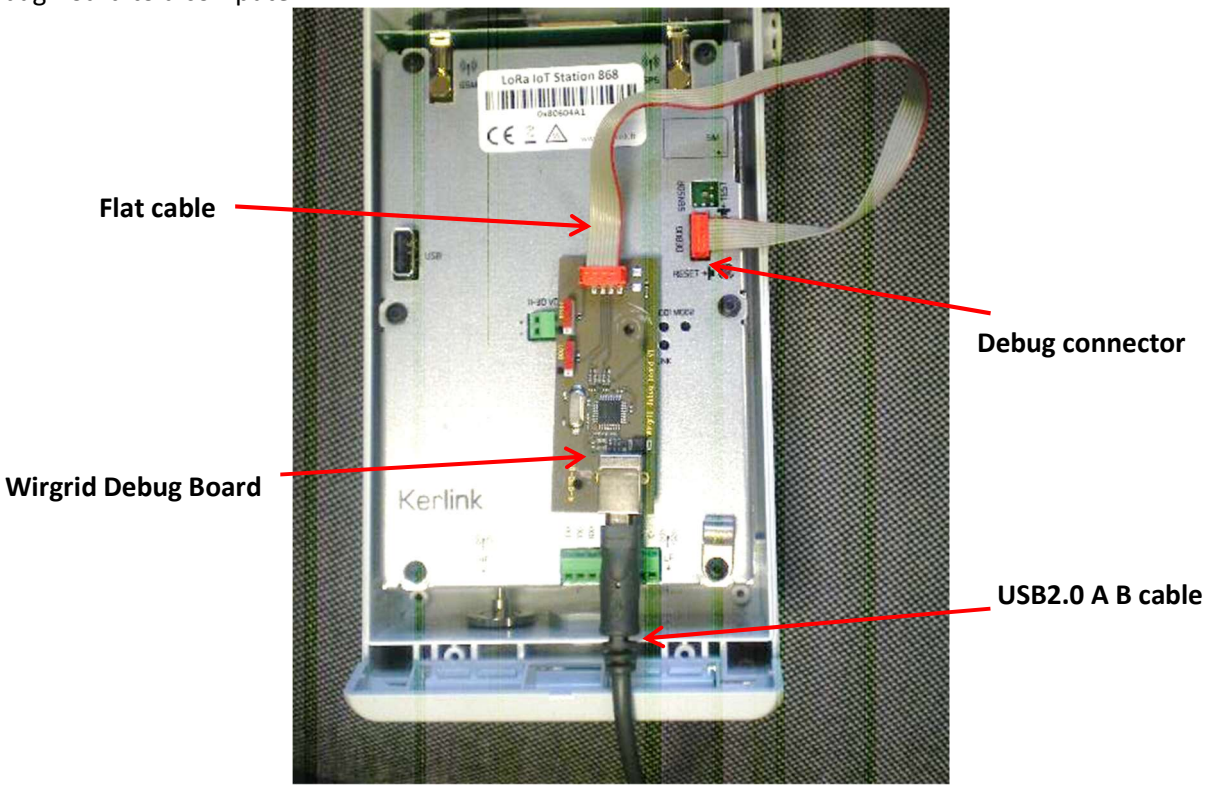


Figure 86 : Wirgrid Debug board connected to the LoRa IoT Station (Wirnet Station)

Use HyperTerminal or Teraterm on the computer to visualize the traces.

The serial port must be configured as follows:

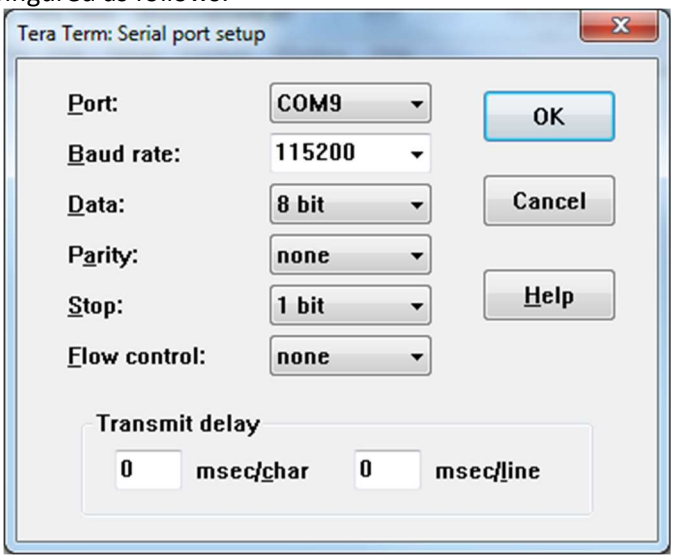


Figure 87 : Serial port configuration

Note : COM port number must be adjusted depending on which serial port is used on the computer.

The Wirgrid Debug Board includes 2 switches that are detailed in Figure 88:

- RESET switch
- BOOT switch

In nominal position, the dot of each switch must be visible as shown on in Figure 88.

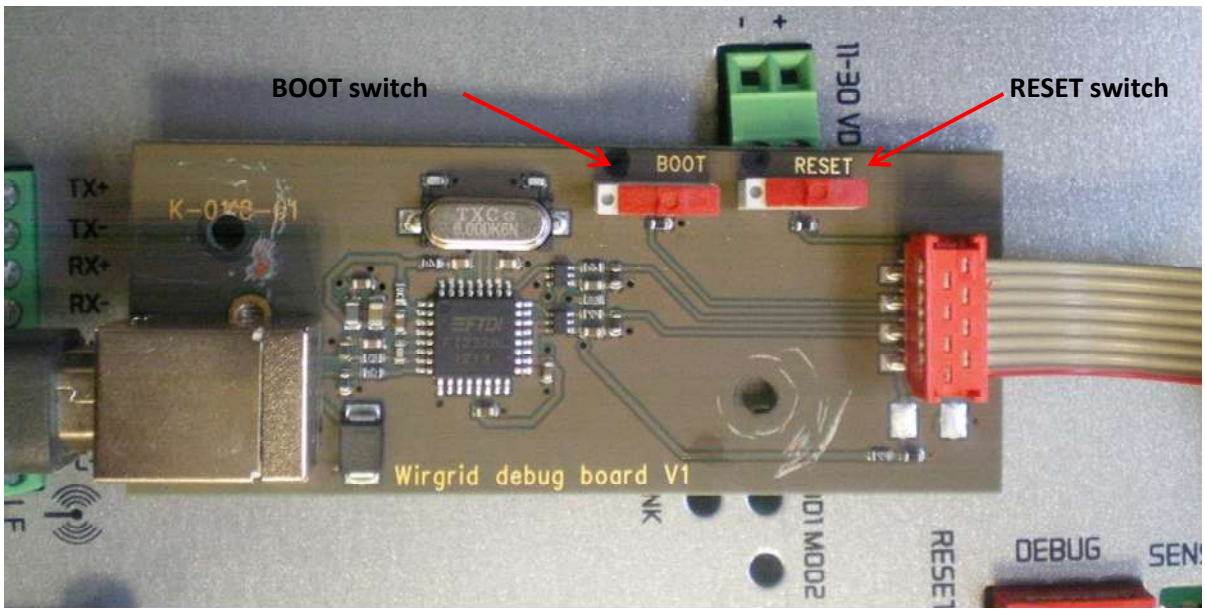


Figure 88 : Detailed view of the Wirgrid Debug board

The RESET switch allows launching a hard reboot command to the LoRa IoT Station (Wirnet Station).
When the switch is positioned on the left, the CPU is in reset mode. When the switch is positioned again to the right, the reset is released and the LoRa IoT Station (Wirnet Station) starts booting.

The BOOT switch is not used on the LoRa IoT Station (Wirnet Station).
Keep the BOOT switch in its nominal position as described on Figure 88.

Note : It is also possible to access to the debug interface by Ethernet connection by connecting directly to the POE injector or the Ethernet switch (depending on the installation topology).

8.3.2 USB and Ethernet interface

Firmware update can be performed with a USB key via the USB type A connector below:

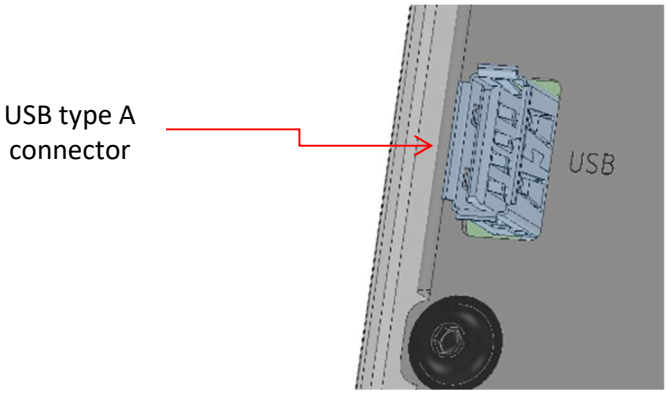


Figure 89 : USB connector of the LoRa IoT Station (Wirnet Station)

8.3.3 TEST and RESET buttons

Test and reset button are small buttons located on the top side as shown in Figure 85.

RESET button is intended to reboot and reinitialize the LoRa IoT Station (Wirnet Station) in its factory configuration.

TEST button has 2 functions:

- Short Press: LEDs functionality is activated during 1 minute
- Long Press: Activation of an auto-test sequence defined by the application software; this feature is not implemented by default by KERLINK but may be developed by the customer.

9 List of the accessories

LoRa antennas:

KERLINK Reference	Designation
ACCIOT-KAN00 (KLK02124)	Omnidirectional antenna 868MHz 3dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN01 (KLK02373)	Omnidirectional antenna 868MHz 6dBi from FT-RF with its own antenna bracket
ACCIOT-KAN03 (KLK02658)	Omnidirectional antenna 915MHz 3dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN04 (KLK02648)	Omnidirectional antenna 915MHz 6dBi kit, including: - 1 X Universal antenna bracket - 1 X 1m coaxial cable
ACCIOT-KAN02 (KLK02518)	Omnidirectional antenna 915MHz 6dBi from FT-RF with its own antenna bracket

Cavity filters:

KERLINK Reference	Designation
ACCIOT-CAV01 (KLK02522)	920-925MHz cavity filter, IP66, N connectors
ACCIOT-CAV02 (KLK02523)	865-867MHz cavity filter, IP66, N connectors
KLK02905	918-923MHz cavity filter, IP66, N connectors
KLK02906	915-920MHz cavity filter, IP66, N connectors
ACCIOT-CAV03 (KLK02909)	920-928MHz cavity filter, IP66, N connectors
KLK02915	865-870MHz cavity filter, IP66, N connectors
KLK02916	863-873MHz cavity filter, IP66, N connectors
KLK02973	902-928MHz cavity filter, IP66, N connectors

Cables:

KERLINK Reference	Designation
ACCIOT-CAB00 (KLK02460)	RF coaxial cable N-N 1m

PoE injectors:

KERLINK Reference	Designation
KLK02109	Indoor Midspan PoE injector 15W with E/F type cable (Europe)
KLK02524	Indoor Midspan PoE injector 15W with B type cable (USA)
ACCIOT-INJ00 (KLK02815)	Outdoor Midspan PoE injector 30W, IP66 – previous version – end of life
KLK02953	Outdoor Midspan PoE injector 30W, IP66 – new version

Surge protections:

KERLINK Reference	Designation
ACCIOT-RSP01 (KLK02900)	RF coaxial surge protector for LoRa link
KLK02818	PoE surge protector, indoor
KLK02817	PoE surge protector, outdoor

Debug tool:

KERLINK Reference	Designation
ACCIOT-SDE00 (KLK-C0218)	Wirgrid debug board
KLK02489	Flat cable 8 wires for micromatch, 25cm
KLK02440	USB2.0 A type / B type cable, 2m

Antenna bracket:

KERLINK Reference	Designation
KLK02453	Universal antenna bracket

10 Customer support

The LoRa IoT Station (Wirnet Station) must be installed and maintained by authorized and qualified personnel only.
In case of defect or breakdown, make sure the above recommendations detailed in this document are met.
If an issue is not addressed in this document, please contact your first level of support.

* * *

End of document