webdyn
flexitron group

ExpertLoRaWAN

Hardware User Guide

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General Notes

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Important Information

This technical description contains important information for the startup and use of the Webdyn ExpertLoRaWAN gateway. Read it carefully before you start working with the ExpertLoRaWAN device. The warranty will be void should damage occur due to non-compliance with these instructions for use. We cannot accept any responsibility for consequential loss.

Revision Information

Revision	Date	Author	Changes
1.0	2022/07	JRM	First release

Warranty

The information contained within this user guide, including but not limited to any product specification, is subject to change without notice. Webdyn provides no warranty with regard to this user guide or any other information contained herein and hereby expressly disclaims any implied warranties of merchantability or fitness for any particular purpose with regard to any of the foregoing. Webdyn assumes no liability for any damages incurred directly or indirectly from any technical or typographical errors or omissions contained herein or for discrepancies between the product and the uses guide. In no event shall Webdyn be liable for any incidental, consequential, special, or exemplary damages, whether based on tort, contract or otherwise, arising out of or in connection with this user guide or any other information contained herein or the use thereof.

RoHS Statement

ExpertLoRaWAN gateway is compliant with the 2002/95/EC (RoHS 1) and 2011/65/EC (RoHS 2) directives of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

Disposal Of Old Electrical And Electronic Equipment

This symbol, applied on our products and/or on its packaging, indicates that this product should not be treated as household waste when you wish to dispose of it. Instead, it should be handed over to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences to the environment and human health, which could otherwise be caused by inappropriate disposal of this product. The recycling of materials will help to conserve natural resources. For more detailed information about the recycling of this product, please contact your local city office, household waste disposal service or the retail store where you purchased this product.

Precautions

1. General Precautions

PLEASE READ THESE GENERAL PRECAUTIONS AND KEEP A COPY OF THEM.

- ExpertLoRaWAN as a standalone item is designed for indoor use only. For outdoor use it must be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in Technical Data.

- Avoid exposing the device to lighted cigarettes, naked flames or to extreme hot or cold temperatures.

- Never try to dismantle the device yourself. There are no components inside the modem that can be serviced by the user. If you attempt to dismantle the device, you may invalidate the warranty.

- The ExpertLoRaWAN terminal must not be neither installed nor located in areas where the surface temperature of the metallic case could exceed 85°C.

- Check that voltage and power available at installation is within range specified for modem. It can be found on this guide and labelled on gateway.

- Do not install any gateway that is obviously damaged or suspected of having been damaged.

- In order to provide strain relief and to avoid transmitting excessive vibration to the device during installation, all cables connected to ExpertLoRaWAN must be secured or clamped immediately adjacent to the device's connectors.

- To protect the power supply cables, and in order to comply with the fire safety requirements, when the unit is powered from a battery or a high current supply, a fast 1.25A fuse should be connected in line with the positive supply.

- No compatible component or product must not be connected to ExpertLoRaWAN.

- Note! ExpertLoRaWAN distributors and sales offices may refuse warranty claims where evidence of product misuse is found.

2. Safety requirements and protection regulations

PLEASE READ THESE SAFETY INSTRUCTIONS AND KEEP A COPY OF THEM.

- ExpertLoRaWAN, for any type of operation, is only accessible for instructed and skilled installers, testers and technical engineers.

- Before any type of handling of ExpertLoRaWAN, it must be ensured that it has been de-energized to allow for electrical work to be carried out and it cannot be inadvertently re-energized.

- Always ensure that use of ExpertLoRaWAN is permitted. The modem may present a hazard if used in proximity to personal electronic medical devices. As a rule, the modem must not be used in hospitals, airports or planes.

- This equipment is not suitable for use in locations where children are likely to be present.

- Never use the device at a gas station, refuelling point, blasting area or in any other environment where explosives may be present.

- Operating the device close to other electronic devices, such as antennas, television sets, and radios may cause electromagnetic interference.

- This product is intended to be used with the antenna or other radiating element at least 20cm away from any part of the human body. In applications where this rule cannot be applied, the application designer is responsible for providing the SAR measurement test report and declaration.

- You are responsible for observing your country's safety standards, and where applicable, the relevant wiring rules.

3. SIM Card Precautions

Before handling the SIM card in your application, ensure that you are not charged with static electricity. Use proper precautions to avoid electrostatic discharges.

- When the SIM card hatch is opened, the SIM card connectors lie exposed under the SIM card holder.

- Caution! Do not touch these connectors! If you do, you may release an electrical discharge that could damage the modem or the SIM card.

- When designing your application, the SIM card's accessibility should be taken into account. We always recommend that you have the SIM card protected by a PIN code. This will ensure that the SIM card cannot be used by an unauthorized person.

4. Antenna Precautions

If the antenna is to be mounted outside the device, consider the risk of lightning. Follow the instructions provided by the antenna manufacturer. Never connect more than one modem to a single antenna. The modem can be damaged by radio frequency energy from the transmitter of another modem.

- Like any mobile station, the antenna of the gateway emits radio frequency energy. To avoid EMI (electromagnetic interference), you must determine whether the application itself, or equipment in the application's proximity, needs further protection against radio emission and the disturbances it might cause. Protection is secured either by shielding the surrounding electronics or by moving the antenna away from the electronics and the external signal cable.

- The gateway and antenna may be damaged if either of them comes into contact with ground potentials other than the one in your application. Beware: ground potentials are not always what they appear to be.

5. Radio Frequency (RF) Exposure and SAR

Your wireless device is a low-power radio transmitter and receiver (transceiver). When it is turned on, it emits low levels of radio frequency energy (also known as radio waves or radio frequency fields).

Governments around the world have adopted comprehensive international safety guidelines, developed by scientific organizations such as ICNIRP (International Commission on Non-Ionizing Radiation Protection) and IEEE (The Institute of Electrical and Electronics Engineers Inc.), through periodic and thorough evaluation of scientific studies. These guidelines establish permitted levels of radio wave exposure for the general population. The levels include a safety margin designed to assure the safety of all persons, regardless of age and health, and to account for any variations in measurements.

Specific Absorption Rate (SAR) is the unit of measurement for the amount of radio frequency energy absorbed by the body when using a transceiver. The SAR value is determined at the highest certified power level in laboratory conditions, but the actual SAR level of the transceiver while operating can be well below this value. This is because the transceiver is designed to use the minimum power required to reach the network.

ExpertLoRaWAN gateway has been approved for applications where the antenna is located more than 20cm from the body of the user. In all other configurations the user is responsible for meeting the local SAR regulations.

Users of the ExpertLoRaWAN gateway are responsible for ensuring that they meet the SAR regulatory requirements of the countries in which they intend to operate the device and that their documentation contains the relevant SAR declaration, certification information and user guidance as appropriate.

6. SAR Information

Wireless Modules models: ELS81-E is marketed without a defined antenna.

The Maximum Antenna Gain when using indoor antennas depends on the distance from the antenna to any nearby persons when in normal operation. It should not exceed the values shown on the table below.

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:

The maximum measured power output in the 900 MHz band is 1995.26 mW (33 dBm).

The maximum permissible exposure defined by 47 CFR 1.1310 is f/1500 = 0.6 mW/cm².

The maximum measured power output in the 1800 MHz band is 891.25 mW (29.5 dBm).

The maximum permissible exposure is defined as 47 CFR 1.1310 with 1 mW/cm².

According to the limit in 47 CFR 1.1310, we get the value of the maximum antenna gain as follows:

$S = P*G/4\pi R^2$; $G = 4\pi R^2 (S / P)$

S = 0.6 mW/cm² or 1 mW/cm²

P = 1995.26 mW or 891.25 mW

R = 20 cm or 50cm

π = 3.1416

G(dBi)=10*log(G)

Solving for G; the maximum antenna gain is:

BAND	P (mW / dBm)	S (mW/cm²)	DISTANCE	MAX. GAIN (dBi)
900MHz	1995.26 / 33	0.6	20cm	1.7942
900MHz	1995.26 / 33	0.6	50cm	9.7530
1800MHz	891.25 / 29.5	1	20cm	7.5127
1800MHz	891.25 / 29.5	1	50cm	15.4715

7. Personal Medical Devices

Wireless devices may affect the operation of cardiac pacemakers, hearing aids and certain other implanted equipment. If a minimum distance of 15 cm (6 inches) is maintained between the ExpertLoRaWAN gateway radiating antenna and a pacemaker, the risk of interference is limited. If the user's application is likely to be situated in the vicinity of personnel, a suitable warning should be contained in the equipment manual to this effect.

8. SAR Requirements Specific to Portable Mobiles

Mobile phones, PDAs or other portable transmitters and receivers incorporating a GSM module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable ELS81 based applications to be evaluated and approved for compliance with national and/or international regulations.

Since the SAR value varies significantly with the individual product design, manufacturers are advised to submit their product for approval if designed for portable use. For European markets the relevant directives are mentioned below. It is the responsibility of the manufacturer of the final product to verify, whether further standards recommendations or directives are in force outside these areas.

Products intended for sale in US markets

EN 59005/ANSI C95.1: Considerations for evaluation of human exposure to Electromagnetic Fields (EMFs) from Mobile Telecommunication Equipment (MTE) in the frequency range 30MHz – 6GHz

Products intended for sale in European markets

EN 50360: Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz - 3GHz)

Please note that SAR requirements are specific only for portable devices and not for mobile devices as defined below:

- Portable device: A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20cm to the user's body.

- Mobile device: A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20cm is normally maintained between the transmitter's radiating structure(s) and the user's body or that of nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and cannot be easily moved to another location.

9. ES1 Requirements

The power supply connected to the ExpertLoRaWAN gateway shall be in compliance with the ES1 requirements defined in EN 62368-1.

Technical Description

1. Overview

The ExpertLoRaWAN is a LoRaWAN gateway embbeding a LoRaWAN network server to locally build up a complete private network. It can also act as a packet forwarder, connecting many endpoints to any other gateway. ExpertLoRaWAN provides Ethernet IP backhaul or 4G-LTE IP backhaul, and everything can be easily configured through its webserver interface or remotely from platform server.

ExpertLorRaWAN is industrially featured due its extended temperature operating range, self-contained into a metallic rugged enclosure with DIN rail mounting capability and equipped with its own SIM card holder, Ethernet, USB 2.0 High Speed and RS485 interfaces to minimize the need for further hardware development. This device can be used as a powerful and flexible device that can be integrated in a wide range of LoRa network applications and additionally it includes a RTC for timestamping purposes

A full list of antennas, cables and accessory supplies are available.

2. Operating Range

Electrical specifications.	Min.	Typ.	Max.
Power supply voltage	9VDC	24VDC	30VDC
Current consumption (12VDC)			400mA (Average value)
Power consumption			4.8W
Digital Inputs voltage (IN1, IN2)	0V		30VDC
"Low" digital input voltage	0V		0.8V
"High" digital input voltage	3V		30VDC
Factory Default Input voltage	0V		30VDC
RS485 baudrate			1Mbps
RS485 D+, D- common mode	-7V		12V
RS485 short circuit current			TBD
RS485 ESD protection			±12kV (HBM)
SIM card slot ESD protection			±8kV (Contact)
Ethernet speed	10Mbps		100Mbps
Ethernet port ESD protection			±15kV (Air/Contact)
USB port speed			480Mbps
USB current limit	750mA		1.25A
LTE module	Detailed parameters on chapter 1.4.1		
LTE Main antenna		50 ohms	
LTE Diversity antenna		50 ohms	
LoRa module	Detailed parameters on chapter 1.8		
LoRa antenna		50 ohms	
LoRa antenna ESD protection			±1kV (HBM) /±4kV (Contact) /±8kV (Air)
Real Time Clock backup: Internal Supercapacitor			

Mechanical and environmental specifications		
Enclosure fixing	DIN rail mounting compliant	
Operating temperature (*)	-40ºC to +85ºC	
Storage temperature	-40ºC to +85ºC	
Dimensions with DIN Rail plate	112mm x 70mm x 99mm	

Mechanical and environmental specifications	
Weight	400g
(*) LTE module extended operation	

3. Ordering Information

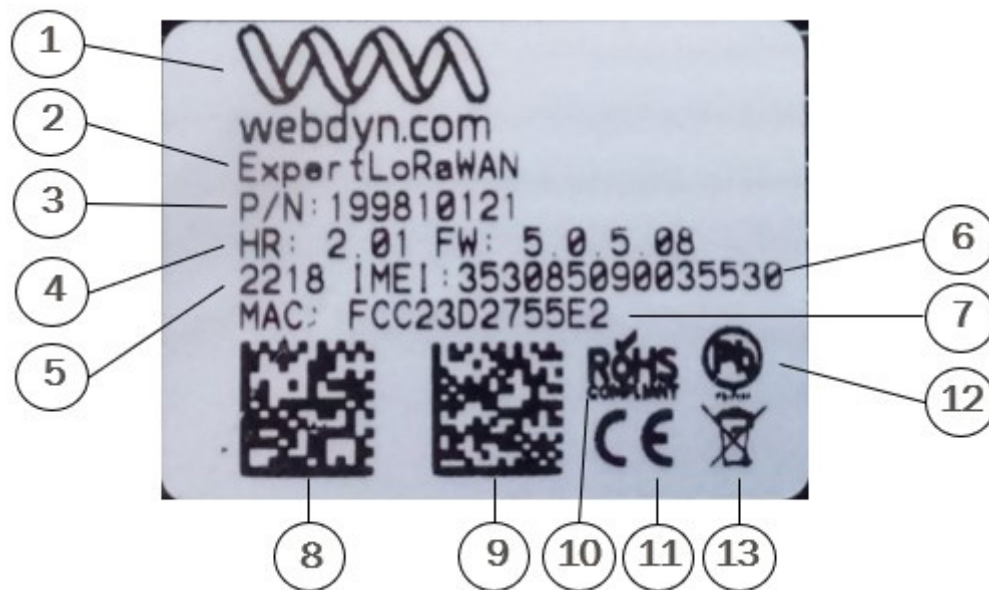| Model name	Part Number
ExpertLoRaWAN	000199810121

4. Packaging

ExpertLoRaWAN gateway is packaged without any additional accessories and through an open window on the box it allows the product label to be read when closed.
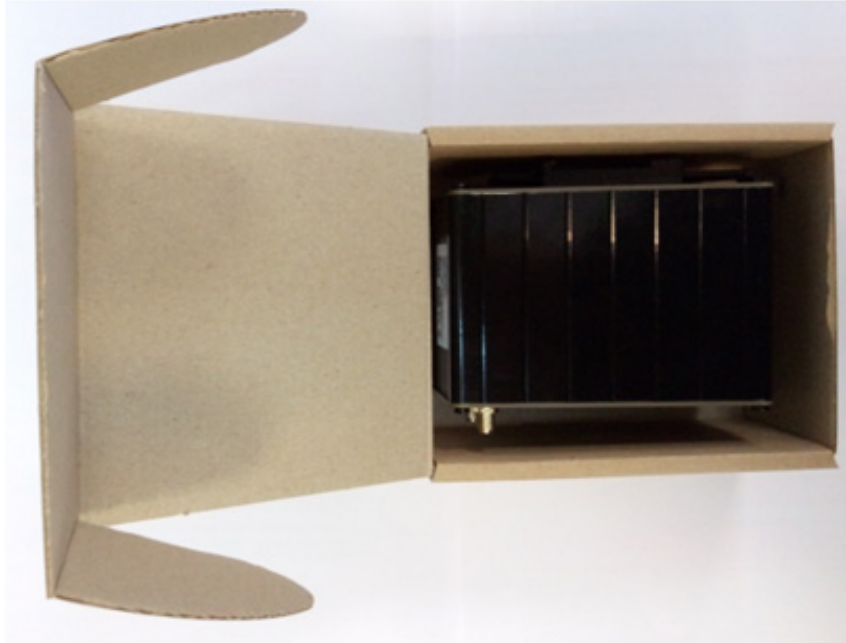
5. Product Label

The label fixed to the top of a ExpertLoRaWAN device comprises the following information:


1. Webdyn logo

2. Product name (model)

3. Part number/ordering code

4. Hardware and firmware versions

5. Year/week of fabrication

6. IMEI number

7. MAC address

8. Data matrix code (IMEI)

9. Data matrix code (MAC)

10. RoHS symbol

11. CE logo

12. Pb-free symbol

13. WEEE symbol

6. System Architecture

ExpertLoRaWAN device is based on the embedded module iMX6UL-IND family driven by the powerful iMX6UL processor, that is optimized for Industrial market, with a complete set of interfaces to build up a compact LoRa Server and the following features:
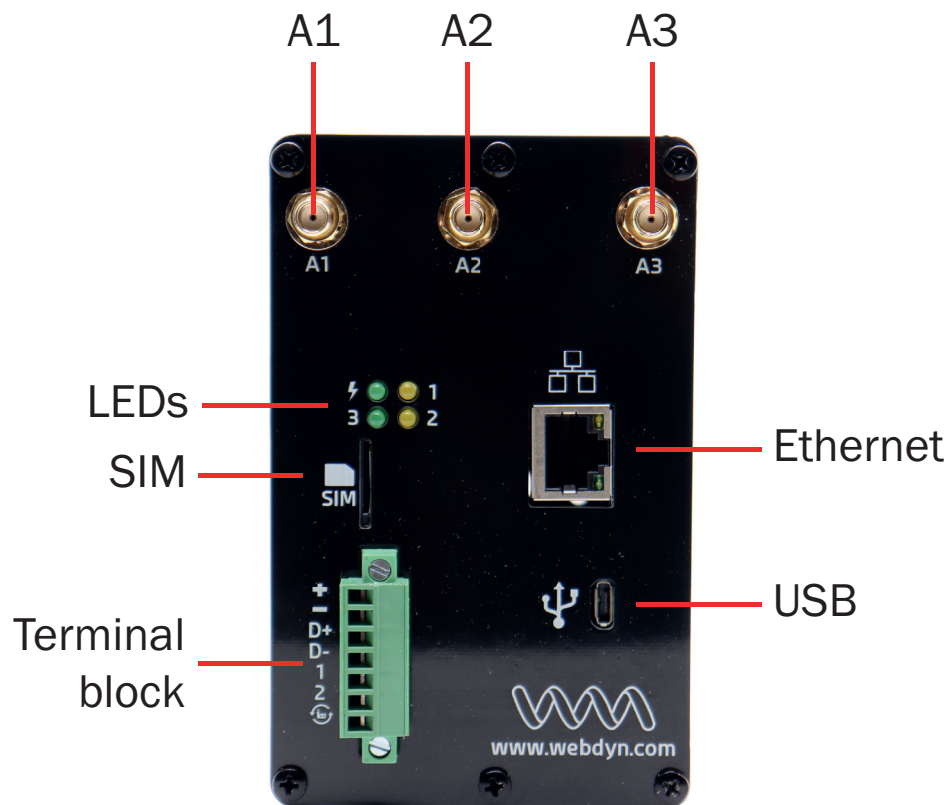
Processor	Freescale iMXUL @ 528MHz
RAM	512MB DDR3
FLASH	4GB eMMC
Temp. range	-40ºC~85ºC

Bellow picture shows a diagram block of all equipped features.
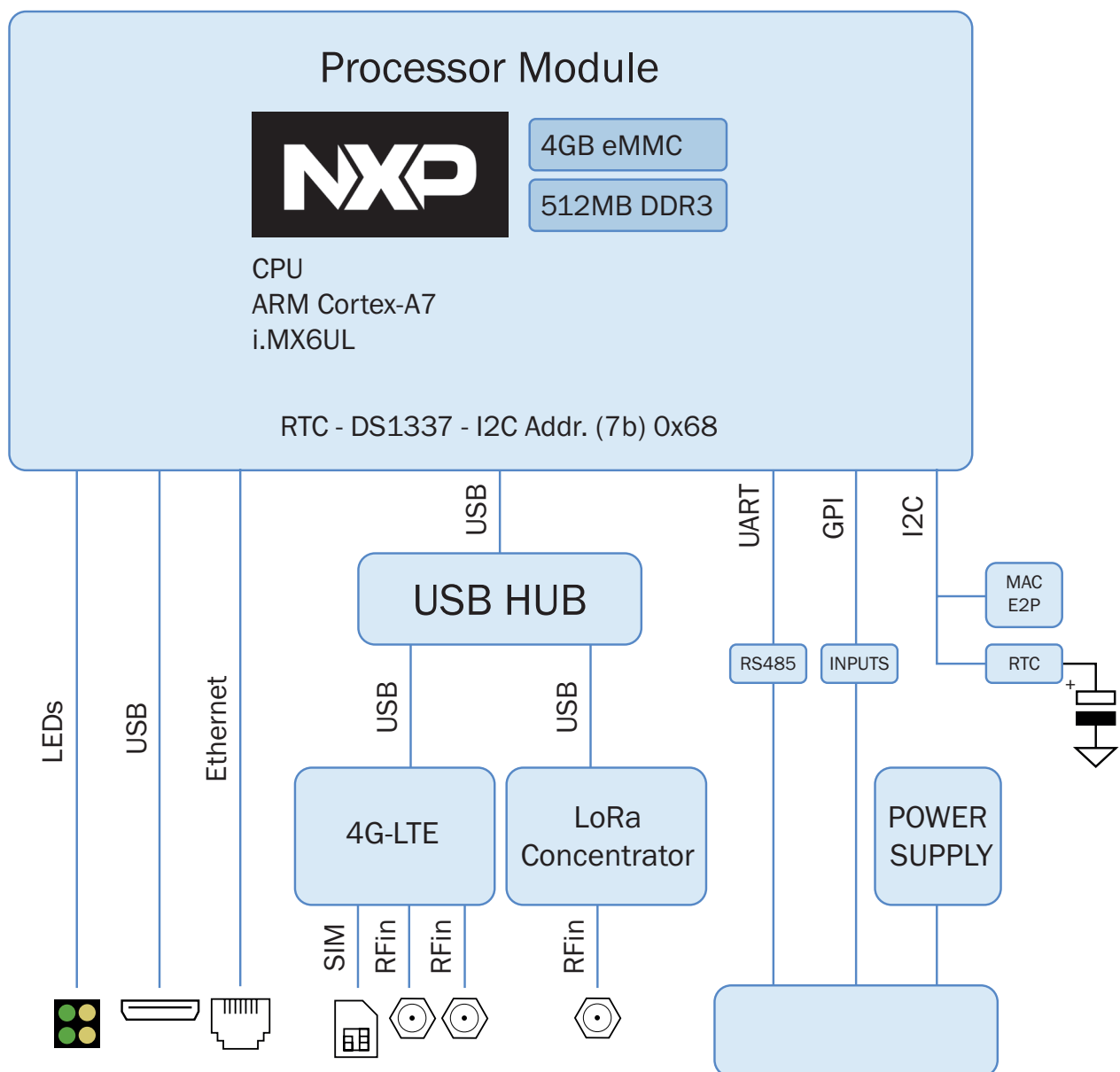
7. External Interfaces on Front Panel

- A1 – SMA-F connector for 4G main antenna.

- A2 - SMA-F connector for Rx. Diversity antenna.

- A3 - SMA F connector for LoRa antenna.

- LEDs – Four leds for operation status.

- ETHERNET – 10/100Mbps Ethernet.

- USB - USB 2.0 High Speed port on microUSB type connector.

- SIM - SIM socket for micro-SIM form factor card.

- TERMINAL BLOCK - 7-way plug-in 3.5mm pitch terminal block for:

  - Power supply input.

  - RS485 interface.

  - 2x General Purpose Digital Inputs.

  - Factory reset input to restore default parameters.

8. Internal Interfaces

ExpertLoRaWAN gateway hardware is internally organized on a stacked multiboard concept to offer a flexible way to fit with requirements.

Internal interfaces and architecture appear on bellow image, only as a reference information, as there is no need to open gateway for any type of user manipulation.

Boards are connected to each other through rugged connectors.
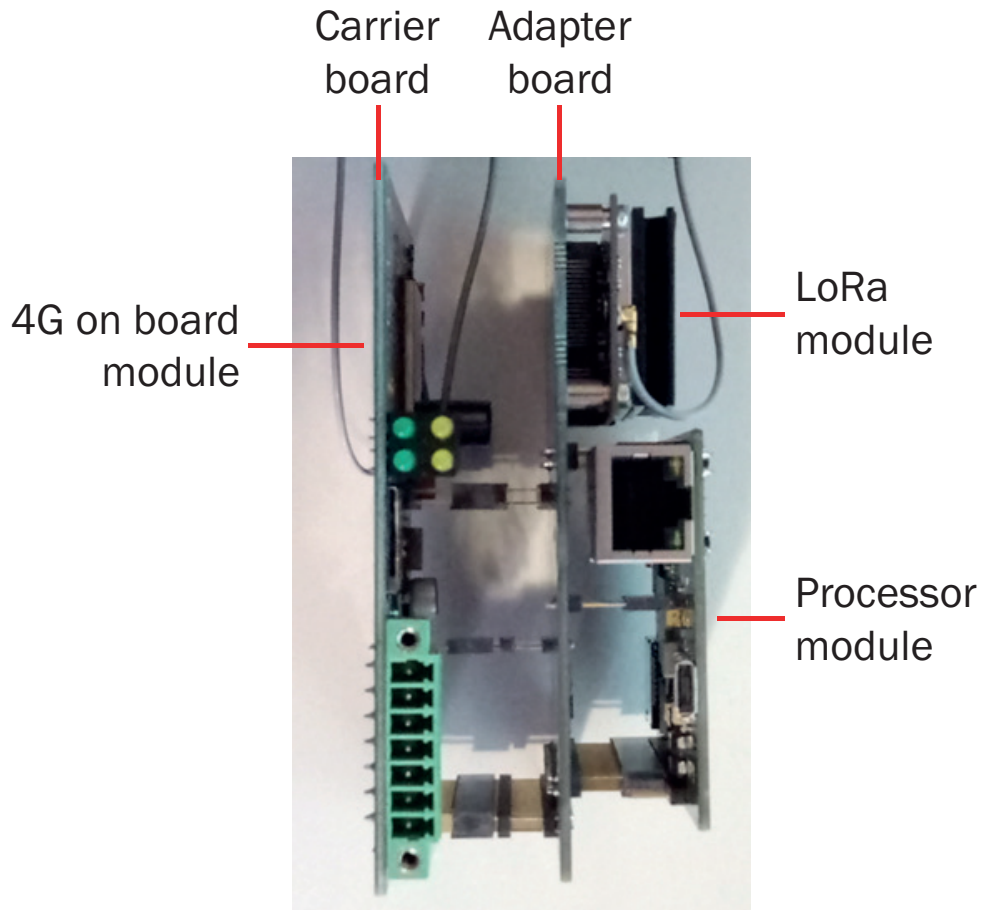
9. Terminal Block Connection

ExpertLoRaWAN gateway has a terminal block type connector with a couple of screws for fastening to front panel for power supply input, RS485 port and inputs connection.

Pin 1

Terminal block
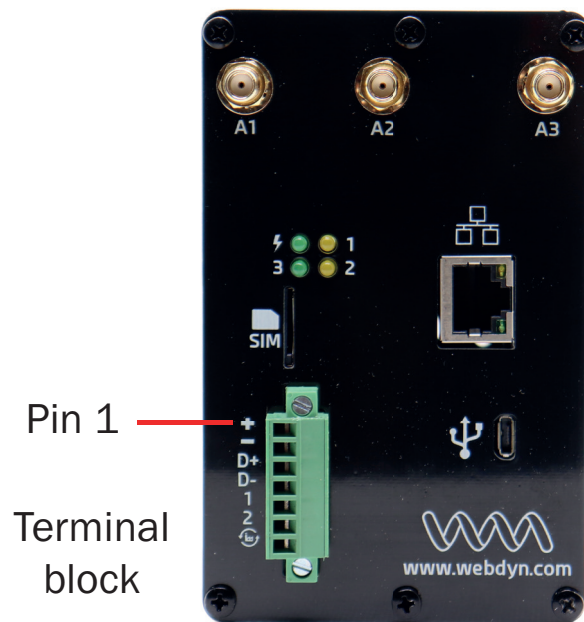
| Pin	Signal	Type	Function
1	V+	PWR	Positive power supply input
2	V-	PWR	Negative power supply input
3	D+	IO	RS485 positive line
4	D -	IO	RS485 negative line
5	1	IN	IN 1
6	2	IN	IN 2
7	FACT.	IN	Input for Factory default parameters

9.1 Power Supply

Power Supply input is externally connected on terminal block, positive signal at pin 1 and negative signal at pin 2. Operating range values are specified at Operating range.
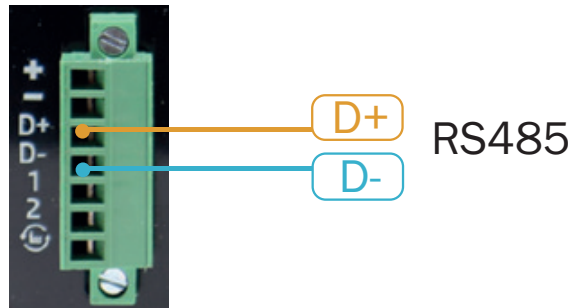
Terminal Block

Power supply
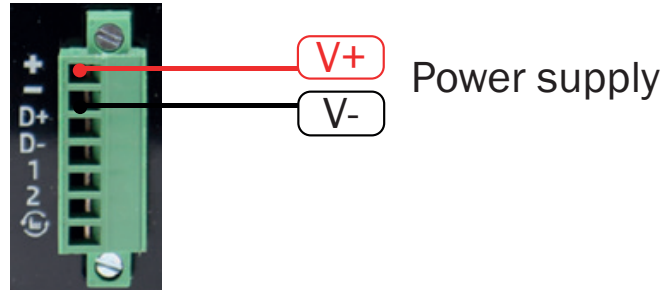
Voltage domains distribution within system is detailed on bellow picture.
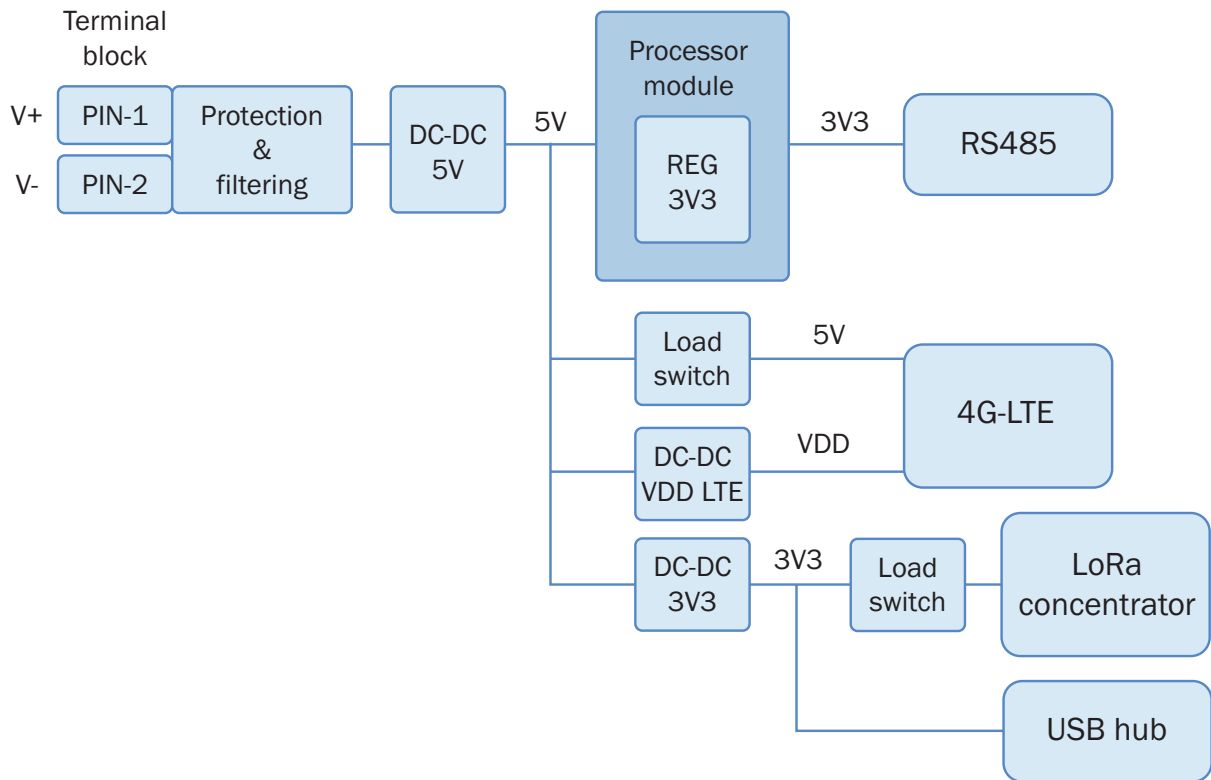
9.2 RS485

ExpertLoRaWAN gateway is equipped with a RS485 half-duplex interface with external connection on terminal block type connector. D+ signal has to be connected on pin 3 and D- signal on pin 4.

Terminal Block

Formerly, TIA/EIA-RS485 specification identifies A signal as equivalent to D- and B signal as equivalent to D+, nonetheless, some semiconductor manufacturers adopted the opposite relationship, so it is recommended to follow D+ and D- signal identification.
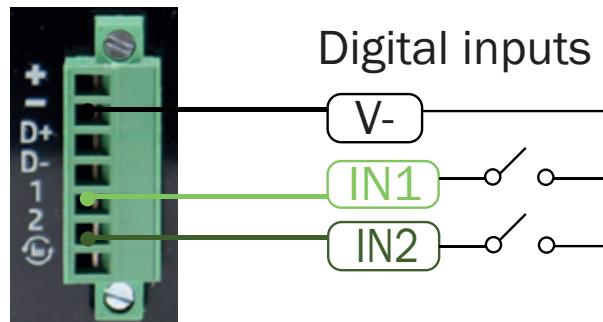
RS485 interface features ESD protection with internal network termination resistor and fail-safe polarization network.
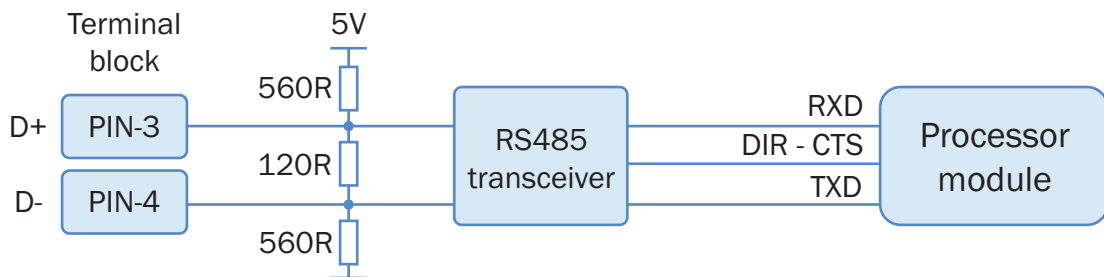
9.3 Digital Inputs

Up to two general purpose digital inputs are included within ExpertLoRaWAN gateway, both available on the terminal block type connector. IN1 on pin 5 and IN2 on pin 6.

Terminal Block

To activate any input externally, it has to be shorted to V- input on pin 2 of terminal block so it is recommended to use external dry-contact type devices, as relays or open-drain/collector transistors.
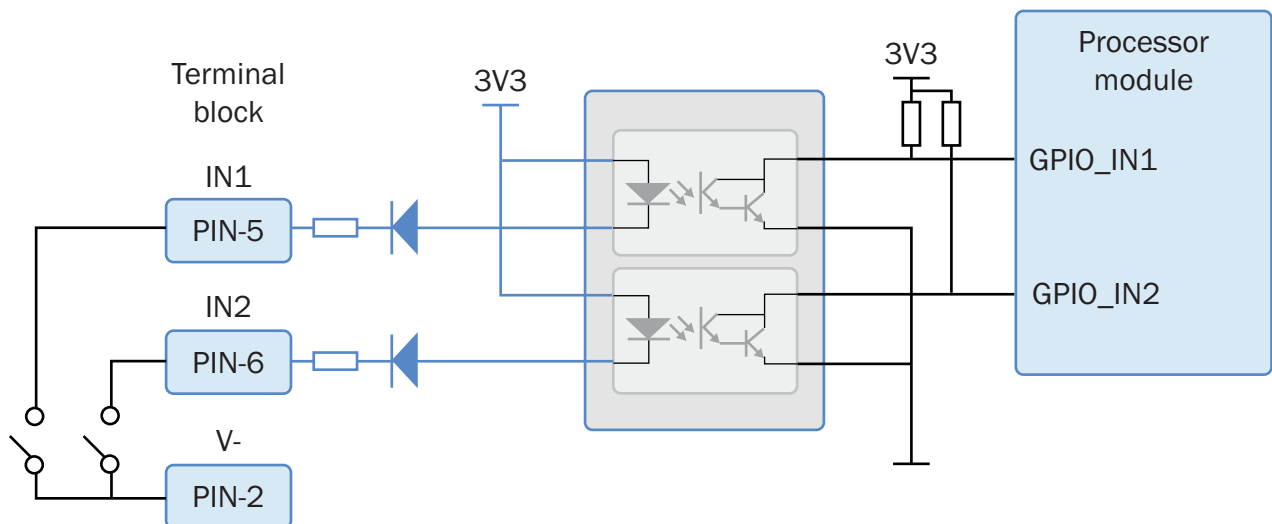
9.4 Factory Default Input

ExpertLoRaWAN gateway parameters can be restored to factory default values with an external input on terminal block connector. This input is labeled on front panel with this symbol:

To proceed to restore parameters to factory default:

- Power off the gateway.

- Short Factory Default Input (pin 7) and V- (pin 2) on terminal block connector.

- Power on the gateway.

- Wait for the gateway to restart and ready for operation to check default parameters.

- Power off the gateway.

- Remove short (between pins 2 and 7).

- Power on again.

Terminal Block

Factory default input
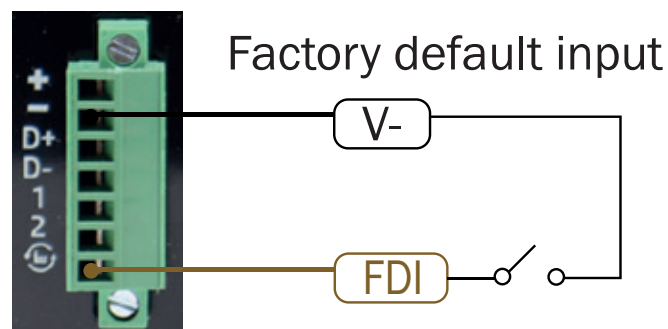
This input has the same topology of IN1 and IN2, so it is recommended to use external dry-contact type devices, such as relays or open-drain/collector transistors, if it has to be done in a controlled way. Nevertheless, it can also be done by hand.
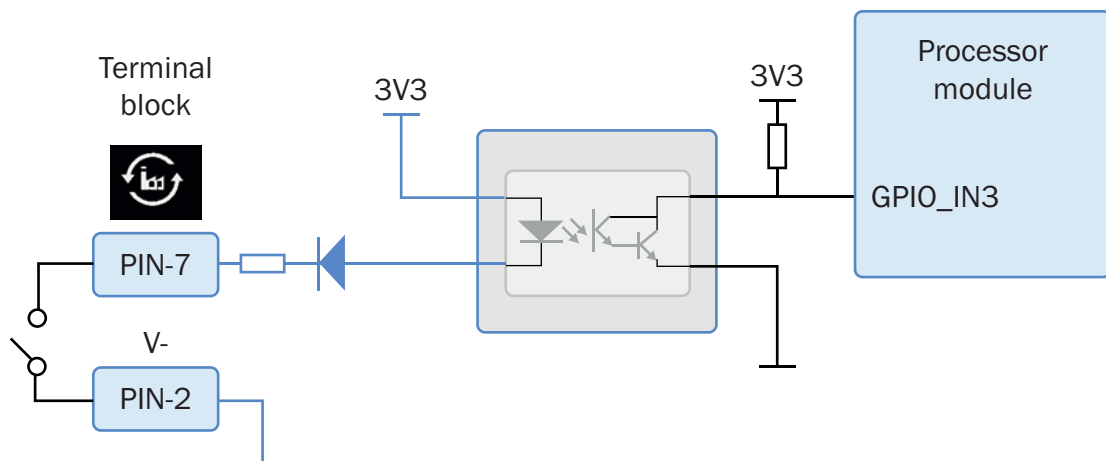
10. 4G Cat4 LTE Module

ExpertLoRaWAN is equipped with onboard Thales ELS81-E 4G Cat4 LTE module with antennas connection on SMA-F 50 ohms connectors and SIM card installation at front panel, so there is no need to open de device.

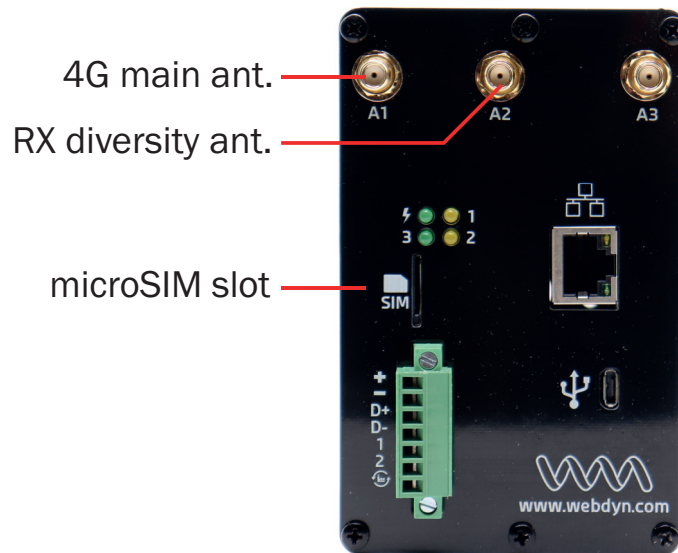SIM card holder is a push-push type. Both 3V and 1.8V SIM technologies are supported. Older 5V SIM technology is not supported.

4G main ant.

RX diversity ant.

microSIM slot

4G LTE requires both main and receive diversity antennas to be connected. Two SMA-F type RF allow assembly for both antenna and coaxial cable. When antenna is directly assembled on SMA-F connector, it is recommended to minimize coupling as much as possible between main and diversity antennas. It can be achieved by mounting both antennas orthogonally, that is, forming an angle of 90º. In case of antennas are connected far away from each other with RF coaxial cable, the minimum distance between both antennas should be at least ¼ wavelength, that is 8.3cm for a 900MHz frequency.

90º
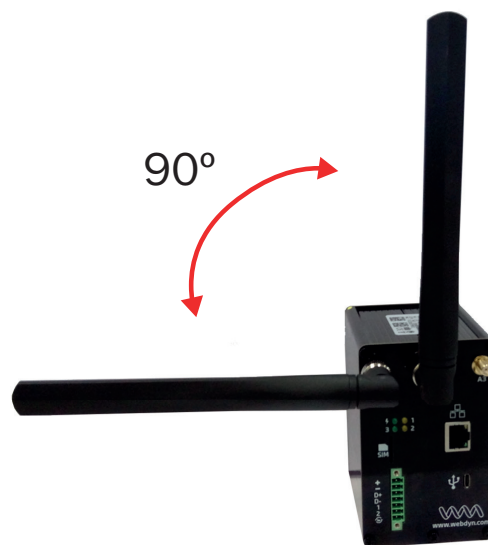
4G LTE module is internally connected to processor's USB port though an USB Hub for data transference and its power status is controlled with IGNITION and RESET signals. Additionally, 4G LTE module can be powered ON/OFF with EN_VDD signal.

SIM Card related signals are properly protected against ESD disturbances in order to prevent any type of spike due to user manipulation.
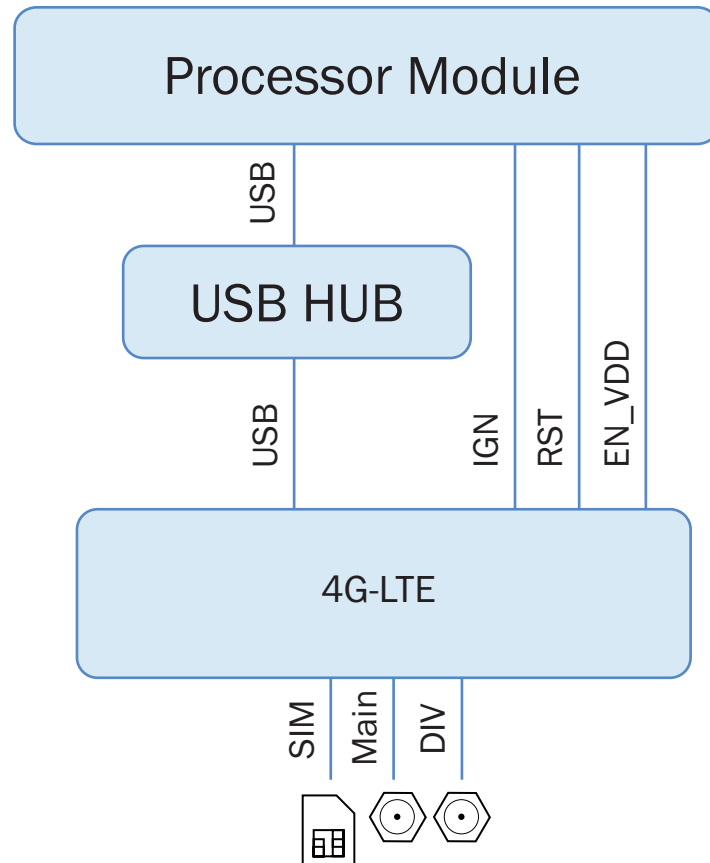
10.1 Network and Subscription

Before your application is used, you must ensure that your chosen network provides the necessary telecommunication services.

Contact your service provider to obtain the necessary information.

- If you intend to use SMS in the application, ensure this is included in your (voice) subscription.

- Consider the choice of supplementary services.

10.2 ELS81-E 4G Cat.4 LTE Features

ELS81-E 4G Cat.4 LTE Features	
Frequency bands	GSM/GPRS/EDGE: Dual band 900/1800MHz
	UMTS/HSPA+: Dual band 900 (BdVIII) / 2100MHz (BdI)
	LTE: Penta band 700 (Bd28) / 800 (Bd20) / 900 (Bd8) / 1800 (Bd3) / 2100 MHz (Bd1)
GSM class	Small MS
Output power (according to Release 99)	Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class 3 (+23.5dBm +1.5/-2.5dB) for UMTS 2100,WCDMA FDD BdI Class 3 (+23.5dBm +1.5/-2.5dB) for UMTS 900, WCDMA FDD BdVIII
Output power (according to Release 8)	Class 3 (+23dBm +1dB/-2dB) for LTE 700, LTE FDD Bd28 Class 3 (+23dBm +1dB/-2dB) for LTE 800, LTE FDD Bd20 Class 3 (+23dBm +1dB/-2dB) for LTE 900, LTE FDD Bd8 Class 3 (+23dBm +1dB/-2dB) for LTE 1800, LTE FDD Bd3 Class 3 (+23dBm +1dB/-2dB) for LTE 2100, LTE FDD Bd1
LTE 3GPP Release 9	UE CAT 4 supported DL max. 150Mbps, max. UL 50Mbps
HSPA 3GPP Release 8	DL max. 14.4Mbps, UL max. 5.76Mbps HSDPA+ Cat.12 / HSUPA Cat.6 data rates Compressed mode (CM) supported according to 3GPP TS25.212
UMTS 3GPP Release 4	PS data rate – max. 384 kbps DL / max. 384 kbps UL CS data rate – 64 kbps DL / 64 kbps UL
GSM/GPRS/EGPRS	EE/GPRS Class 12 – max. 237kbps DL / max. 237 kbps UL GPRS: • Multislot Class 12 • Full PBCCH support • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS: • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • SRB loopback and test mode B • 8-bit, 11-bit RACH • PBCCH support • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B

ELS81-E 4G Cat.4 LTE Features	
SMS	Point-to-point MT and MO Cell broadcast Text and PDU mode Storage: SIM card plus SMS locations in mobile equipment
AT commands	Hayes 3GPP TS 27.007, TS 27.005, Gemalto M2M AT commands for RIL compatibility
Java™ Open Platform	Java™ Open Platform with • Java™ profile IMP-NG & CLDC 1.1 HI • Secure data transmission via HTTPS/SSL1 • Multi-threading programming and multi-application execution The memory space available for Java programs is 30MB in the flash file system and 18MB RAM. Application code and data share the space in the flash file system and in RAM.
SIM Application Toolkit	SAT letter classes b, c, e; with BIP
Firmware update	Generic update from host application over ASC0 or USB modem.

10.3 Antenna Type

Make sure that you choose the right type of antenna for the gateway.

Consider the following requirements:

- The antenna must be designed for one of the frequency bands in use; please ask your network provider for more information:

- LTE 700/800/900/1800/2100 MHz

- UMTS 900/2100 MHz

- GSM 900/1800 MHz

- The impedance of the antenna and antenna cable must be 50Ω

- Antenna connector should be SMA-M type

- The antenna output-power handling must be a minimum of 2W

10.4 Antenna Cable

Use 50Ω impedance low-loss cable and high-quality 50Ω impedance connectors (frequency range up to 3GHz) to avoid RF losses. Ensure that the antenna cable is as short as possible. The Voltage StandingWave Ratio (VSWR) may depend on the effectiveness of the antenna, cable and connectors. In addition, if you use an adaptor between the antenna cable and the antenna connector, it is crucial that the antenna cable is a high-quality, low-loss cable. Minimize the use of extension cables, connectors and adapters. Each additional cable, connector or adapter causes a loss of signal power.

10.5 Antenna Placement

The antenna should be placed away from electronic devices and other antennas. The recommended minimum distance between adjacent antennas, operating in a similar radio frequency band, is at least 50cm. If the signal strength is weak, it is useful to face a directional antenna towards the closest radio base station. This can increase the strength of the signal received by the modem. The modem's peak output power can reach 2W.

RF field strength varies with antenna type and distance. At 10cm from the antenna the field strength may be up to 70V/m and at 1m it will have reduced to 7V/m. In general, CE-marked products for residential / commercial areas and the light industry can withstand a minimum of 3V/m.

For this reason, if LoRa antenna is assembled directly on gateway, it is recommended to install 4G Main an Rx. Diversity antennas separated from the gateway at least 1m.

10.6 Possible Communication Disturbances

Possible communication disturbances include the following:

- Noise can be caused by electronic devices and radio transmitters.

- Path-loss occurs as the strength of the received signal steadily decreases in proportion to the distance from the transmitter.

- Shadowing is a form of environmental attenuation of radio signals caused by hills, buildings, trees or even vehicles. This can be a particular problem inside buildings, especially if the walls are thick and reinforced.

- Multi-path fading is a sudden decrease or increase in the signal strength. This is the result of interference which is caused when direct and reflected signals reach the antenna simultaneously. Surfaces such as buildings, streets, vehicles, etc., can reflect signals.

- Hand-over occurs as you move from one cell to another in the GSM network. Your mobile application call is transferred from one cell to the next. Hand-over can briefly interfere with communication and may cause a delay, or at worst, disruption.

10.7 Antenna Interface Specifications

Parameter	Conditions	Min.	Typical	Max.	Unit
LTE connectivity	Band 1, 3, 8, 20, 28				
Receiver Input Sensitivity @ARP (Dual Antenna; ch. bandwidth 5MHz)	LTE 700 Band 28	-98.5	-102.5		dBm
	LTE 800 Band 20	-97	-102		dBm
	LTE 900 Band 8	-97	-103		dBm
	LTE 1800 Band 3	-97	-102		dBm
	LTE 2100 Band 1	-100	-103		dBm

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load (Board temperature < 85°C,BW:5MHz RB:25 (DL),1 (UL) QPSK)		LTE 700 Band 28	+21	+23		dBm
		LTE 800 Band 20	+21	+23		dBm
		LTE 900 Band 8	+21	+23		dBm
		LTE 1800 Band 3	+21	+23		dBm
		LTE 2100 Band 1	+21	+23		dBm
UMTS/HSPA connectivity		Band I, VIII				
Receiver Input Sensitivity @ARP		UMTS 2100 Band I	-104.7	-110		dBm
		UMTS 900 Band VIII	-103.7	-110		dBm
RF Power @ ARP with 50Ω Load (Board temperature < 85°C)		UMTS 2100 Band I	+21	+23.5		dBm
		UMTS 900 Band VIII	+21	+23.5		dBm
GPRS coding schemes		Class 12, CS1 to CS4				
EGPRS		Class 12, MCS1 to MCS9				
GSM Class		Small MS				
Static Receiver input Sensitivity@ ARP		GSM 900	-102	-110		dBm
		GSM 1800	-102	-109		dBm
RF Power @ARP with 50Ω Load	GSM	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	GPRS, 1 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 1 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
RF Power @ ARP with 50Ω Load,(ROPR = 0, i.e. no reduction)	EDGE, 2 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 3 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 4 TX	GSM 900		27		dBm
		GSM 1800		26		dBm

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load,(ROPR = 1)	GPRS, 1 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 1 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 2 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	GSM 900		31.5		dBm
		GSM 1800		28.5		dBm
	EDGE, 3 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	GSM 900		30.5		dBm
		GSM 1800		27.5		dBm
	EDGE, 4 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
RF Power @ ARP with 50Ω Load,(ROPR = 2)	GPRS, 1 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 1 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	GSM 900		30.5		dBm
		GSM 1800		27.5		dBm
	EDGE, 2 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	GSM 900		29.5		dBm
		GSM 1800		26.5		dBm
	EDGE, 3 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	GSM 900		28.5		dBm
		GSM 1800		25.5		dBm
	EDGE, 4 TX	GSM 900		27		dBm
		GSM 1800		26		dBm

| Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load,(ROPR = 3)	GPRS, 1 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 1 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	GSM 900		29.5		dBm
		GSM 1800		26.5		dBm
	EDGE, 2 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	GSM 900		27.5		dBm
		GSM 1800		24.5		dBm
	EDGE, 3 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	GSM 900		26.5		dBm
		GSM 1800		23.5		dBm
	EDGE, 4 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
RF Power @ ARP with 50Ω Load,(ROPR = 4, i.e. maximum reduction)	GPRS, 1 TX	GSM 900		32.5		dBm
		GSM 1800		29.5		dBm
	EDGE, 1 TX	GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	GSM 900		29.5		dBm
		GSM 1800		26.5		dBm
	EDGE, 2 TX	GSM 900		24		dBm
		GSM 1800		23		dBm
	GPRS, 3 TX	GSM 900		27.5		dBm
		GSM 1800		24.5		dBm
	EDGE, 3 TX	GSM 900		22		dBm
		GSM 1800		21		dBm
	GPRS, 4 TX	GSM 900		26.5		dBm
		GSM 1800		23.5		dBm
	EDGE, 4 TX	GSM 900		21		dBm
		GSM 1800		20		dBm

11. Ethernet Port

ExpertLoRaWAN is equipped with one 10/100Mbps Ethernet Port available on a RJ45 connector at the front panel.
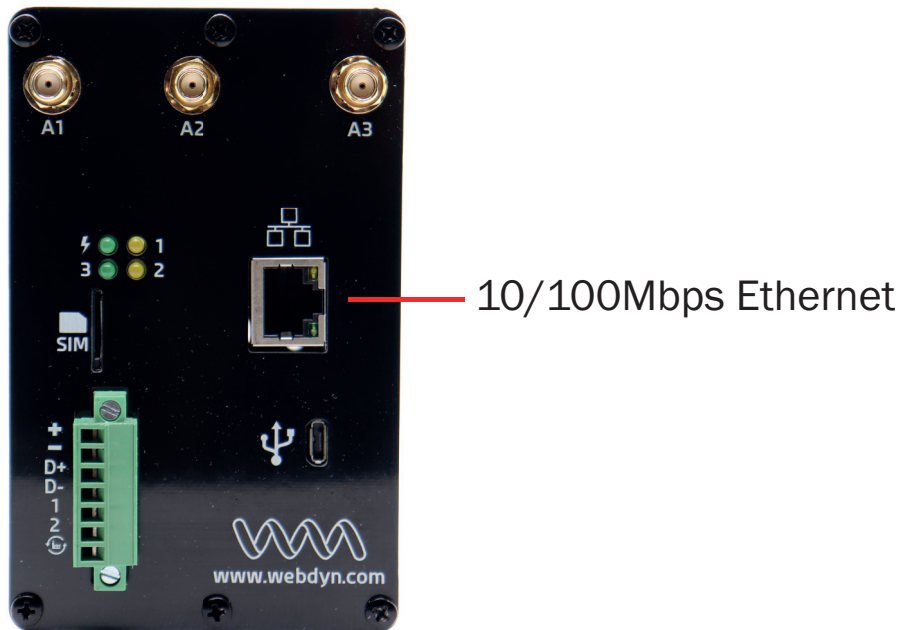
Ethernet port is magnetically isolated and properly protected against ESD, EFT and Surge disturbances.

An additional EEPROM is included on carrier board with MAC address programmed. This MAC address is assigned to MAC interface of Ethernet Port. This memory is connected to processor on its I2C internal port and can be accessed on address 0x51 for data space and on address 0x59 for MAC space.
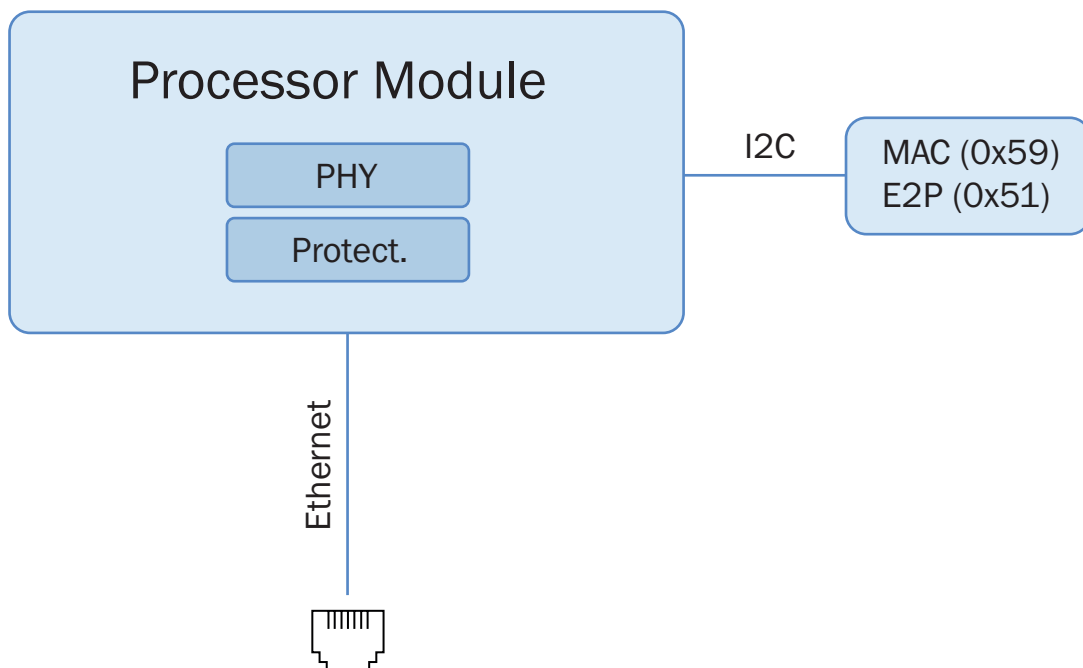
12. USB Port

ExtpertLoRaWAN includes on the front panel an USB-OTG port through a microUSB-AB type connector compliant with USB 2.0 High Speed (480Mbit/s) and Full Speed (12Mbit/s).
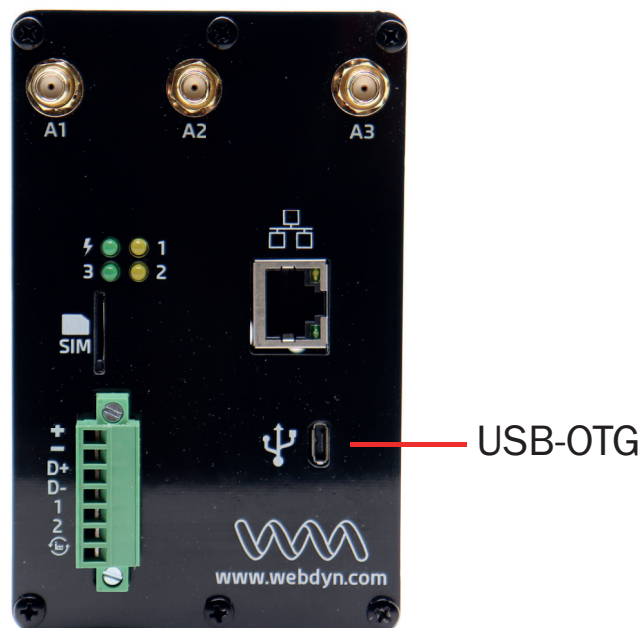

USB-OTG

Internal processor has two USB-OTG 2.0 High Speed ports, the first one is used for internal USB devices connections through an USB Hub, and the second one is available on the front panel. It is properly protected against ESD disturbances and current limited to prevent external shorts to affect the system.
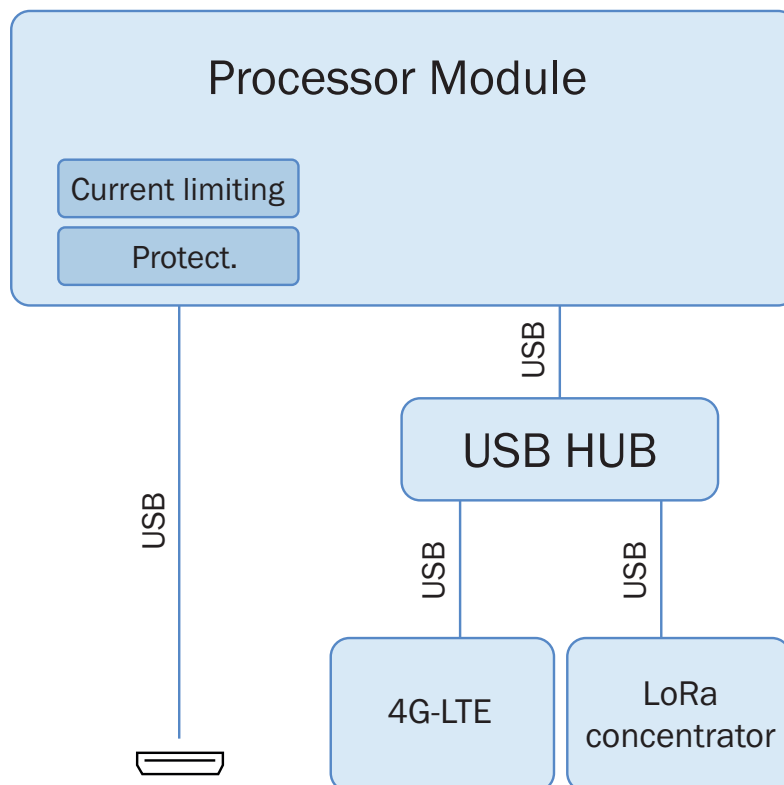
13. Status LEDs

Four LEDs on front panel are included to inform about operation status of ExpertLoRaWAN gateway.
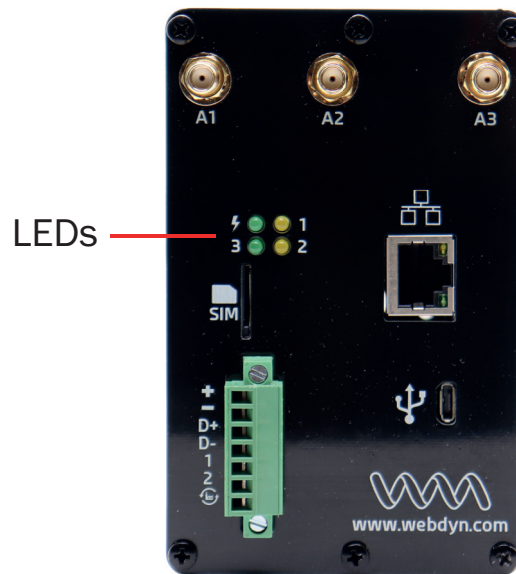
| LED	Status Remark
⚡	Lights on with proper power supply
1	General purpose indicator 1
2	General purpose indicator 2
3	General purpose indicator 3

General purpose status LEDs 1, 2 and 3 are controlled by processor and Power Status LED is activated with power supply presence on board.
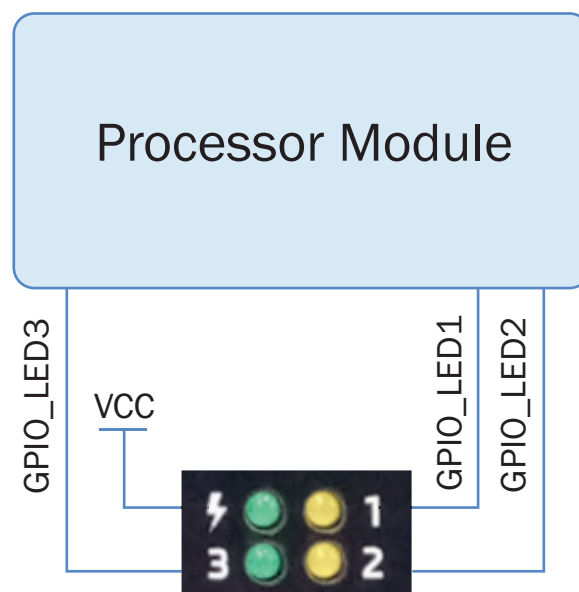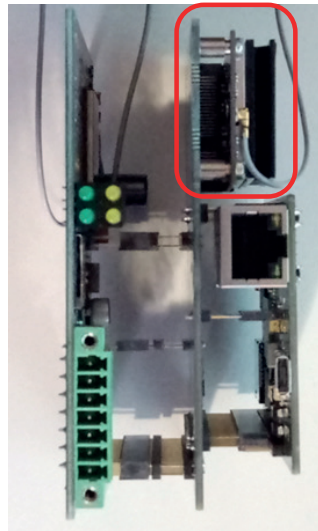
14. LoRa Concentrator

ExpertLoRaWAN gateway integrates a miniPCIe form factor LoRa concentrator module connected on internal adapter board and antenna connection is externally present on a SMA-F 50 ohms connector.

Choose antenna according to frequency bands covered for installed LoRa module.
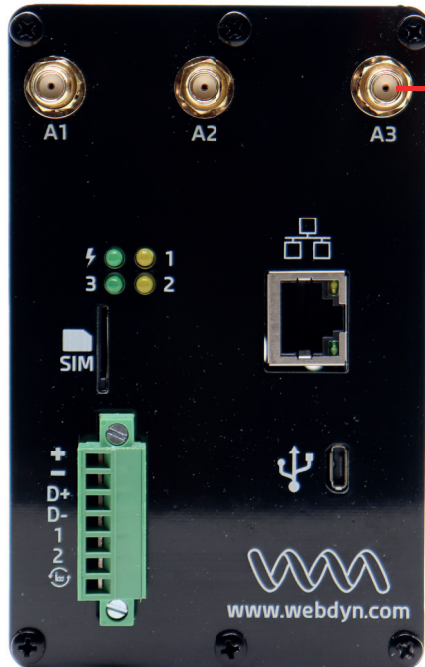
LoRa ant.

LoRa module

14.1 LoRa Main Features

LoRa concentrator module with mini-PCIe form factor is based on SX1301 chipset what enables easy integration with LoRa Gateway capabilities. It targets smart metering fixed networks and Internet-of-Things (IoT) applications with the following features:

Protocol	LoRaWAN 1.0.2
Nodes	Up to 500 nodes/km2 in an environment with moderate interference.
Processor	SX1301 emulates 49 x LoRa demodulators, 10 parallel demodulation paths.
Front-end	2 x SX125x Tx/Rx front-ends high/low frequency.
Channels	8 uplinks / 1 downlink
TX power	25dBm (Max), typical 23 dBm
RX sensitivity	-139 dBm @ SF12, BW 125 kHz
Freq. Bands	EU433, CN470, EU868, US915, AS923, AU915, KR920, IN865 and AS920
Range	Urban: 2~4km / Suburb: 5~10km, Open Area: 15km
Thermal	Assembled heat sink to improve thermal behavior.
Compliance	FCC, CE

The following table gives typically sensitivity level of the LoRa module:

Signal Bandwidth [KHz]	Spreading Factor	Sensitivity [dBm]
125	12	-139
125	7	-125
250	12	-136
250	7	-123
500	12	-134
500	7	-120

The LoRa module supports the following LoRaWAN frequency channels.

Region	Freq. (MHz)
Europe	EU433
Europe	EU868
China	CN470
North America	US915
Asia	AS920
Asia	AS923
Australia	AU915
Korea	KR920
India	IN865

14.2 Antenna Type

Make sure that you choose the right type of antenna for the LoRa module.

Consider the following requirements:

- The antenna must be designed for one of the frequency bands in use; please ask your network provider for more information:
- Frequency according to band of chosen LoRa module.
- The impedance of the antenna and antenna cable must be 50Ω.
- •Antenna connector should be SMA-M type.
- Antenna power should be at least 500mW as maximum power is 316.23mW.
- Maximum Output RF load mismatch ruggedness at antenna is 10:1 VSWR.

14.3 Antenna Cable

Use 50Ω impedance low-loss cable and high-quality 50Ω impedance connectors (frequency range up to 1GHz) to avoid RF losses. Ensure that the antenna cable is as short as possible. The Voltage StandingWave Ratio (VSWR) may depend on the effectiveness of the antenna, cable and connectors. In addition, if you use an adaptor between the antenna cable and the antenna connector, it is crucial that the antenna cable is a high-quality, low-loss cable. Minimize the use of extension cables, connectors and adapters. Each additional cable, connector or adapter causes a loss of signal power.

14.4 Antenna Placement

The antenna should be placed away from electronic devices and other antennas. The recommended minimum distance between adjacent antennas, operating in a similar radio frequency band, is at least 50cm. If the signal strength is weak, it is useful to face a directional antenna towards the closest radio base station. This can increase the strength of the signal received by the modem. The LoRa module's peak output power can reach 320mW.

RF field strength varies with antenna type and distance. At 10cm from the antenna the field strength may be up to 70V/m and at 1m it will have reduced to 7V/m. In general, CE-marked products for residential / commercial areas and the light industry can withstand a minimum of 3V/m.

For this reason, if 4G Main and Rx. Diversity antennas are assembled directly on gateway, it is recommended to install LoRa antenna separated from the gateway at least 1m.

14.5 Possible Communications Disturbances

Possible communication disturbances include the following:

- Noise can be caused by electronic devices and radio transmitters

- Path-loss occurs as the strength of the received signal steadily decreases in proportion to the distance from the transmitter

- Shadowing is a form of environmental attenuation of radio signals caused by hills, buildings, trees or even vehicles. This can be a particular problem inside buildings, especially if the walls are thick and reinforced

- Multi-path fading is a sudden decrease or increase in the signal strength. This is the result of interference which is caused when direct and reflected signals reach the antenna simultaneously. Surfaces such as buildings, streets, vehicles, etc., can reflect signals

- Hand-over occurs as you move from one cell to another in the GSM network. Your mobile application call is transferred from one cell to the next. Hand-over can briefly interfere with communication and may cause a delay, or at worst, disruption

14.6 Real Time Clock (RTC)

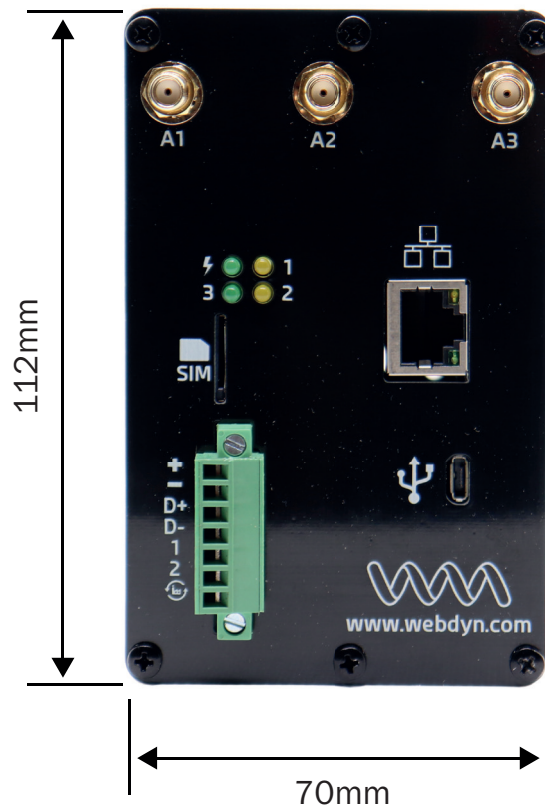ExpertLoRaWAN gateway integrates the DS1337 Real Time Clock for timestamping purposes.

It is connected to processor I2C port and can be accessed on address 0x68.

RTC power backup is based on a supercapacitor to allow the system to keep it operating for a time when external power supply is removed.
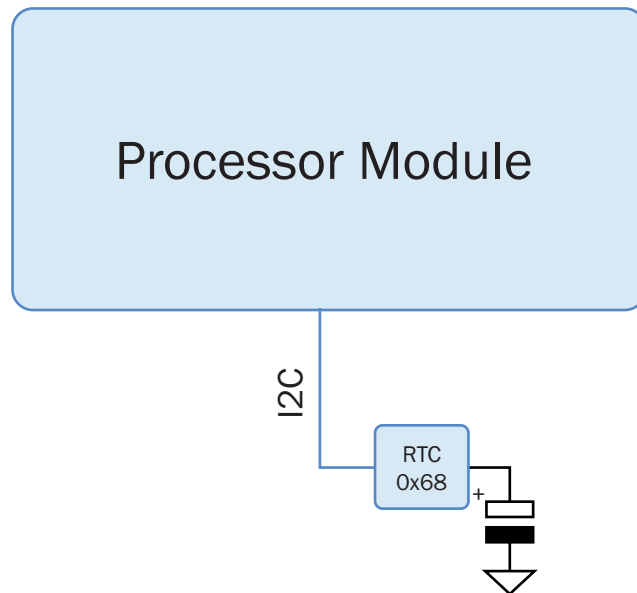
Mechanical Description

1. Dimensions

112mm

70mm

99mm

Gateway Installation

This chapter gives you advices and helpful hints on how to install the ExpertLoRaWAN gateway from a hardware perspective.

There are several conditions which need to be taken into consideration when designing your application as they might affect the modem and its function.

Please, read carefully the complete hardware user guide as there are many details to be considered for installation.

1. Installation Location

ExperLoRaWAN is intended to be installed indoor with environmental conditions as stated in the Operating range chapter.

Gateway is equipped with a DIN Rail holder on its rear-side plate lo let it be installed on a vertical flat surface, preferred into a cabinet.

It is recommended to leave a clear distance of at least 10cm around the gateway for proper air flowing.

Installation height referred to floor must guarantee proper visibility of status Leds and connection of wires, SIM card insertion and Antenna attachment.
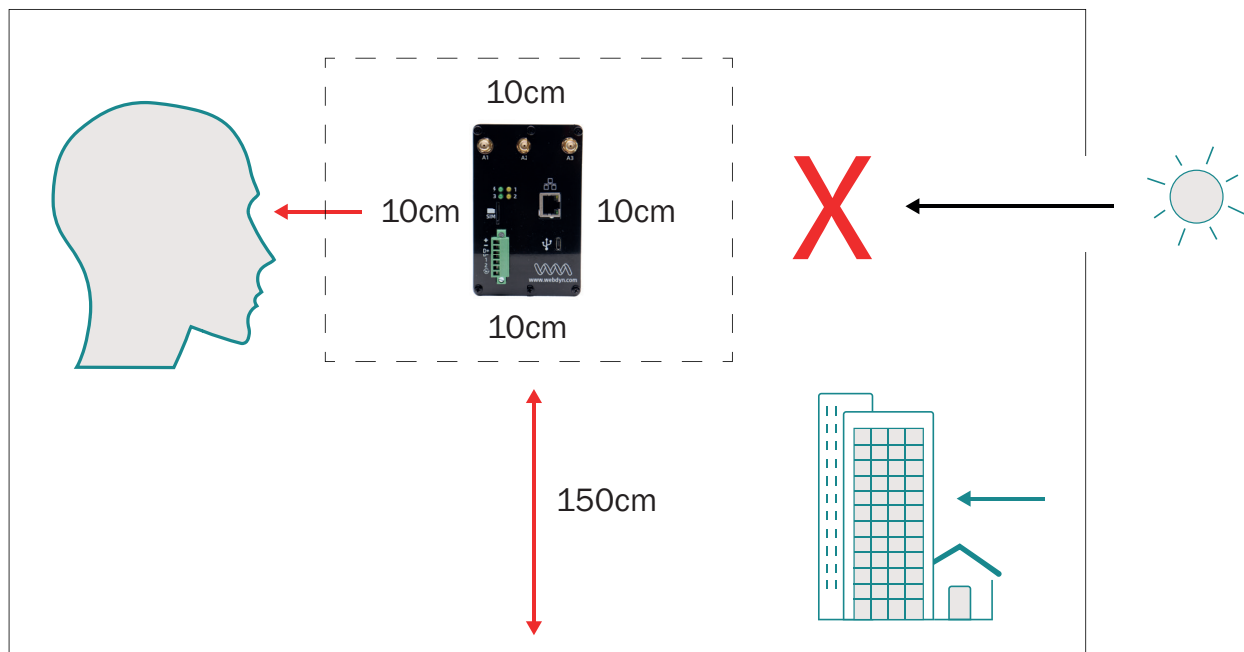
2. RF Signal Strength

The gateway has to be placed in a way that ensures sufficient signal strength. To improve signal strength, the antenna can be moved to another position. Signal strength may depend on how close the gateway is to a radio base station. You must ensure that where you intend to use the modem is within the network coverage area. Degradation in signal strength can be the result of disturbance from another source,

i.e., an electronic device in the immediate vicinity. More information about possible communication disturbances can be found in section Operation 3.5 (Possible communications disturbances).

Tip! Before installing the modem, use an ordinary mobile telephone to check a possible location for it. In determining the location for the modem and antenna, you should consider signal strength as well as cable length.

3. DIN Rail Mounting

To install gateway on the DIN Rail, position the top groove of the rear module installation adapter on the top edge of the DIN rail. Push down on the adapter until the bottom groove of the installation adapter fits under the DIN rail. Insert and push the rear module straight in to the adapter, until they lock into place.

1 - Push down

Push
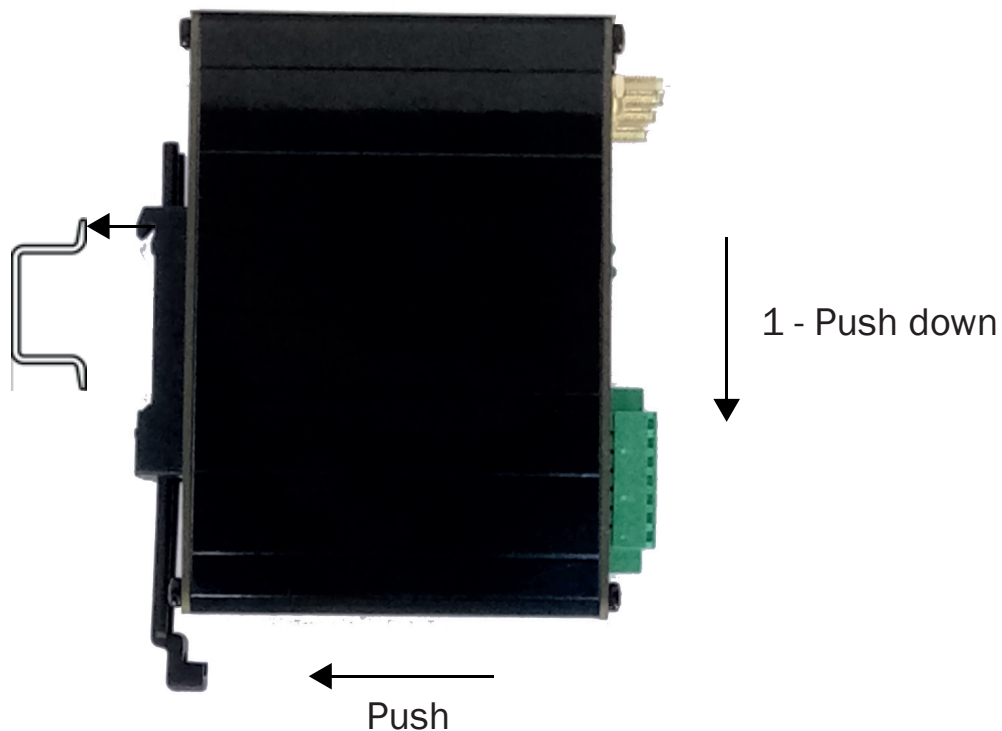
To remove gateway from de DIN Rail, pull down the latch at the bottom of the rear module, and pull the rear module straight out.

2 - Pull

1 - Pull down
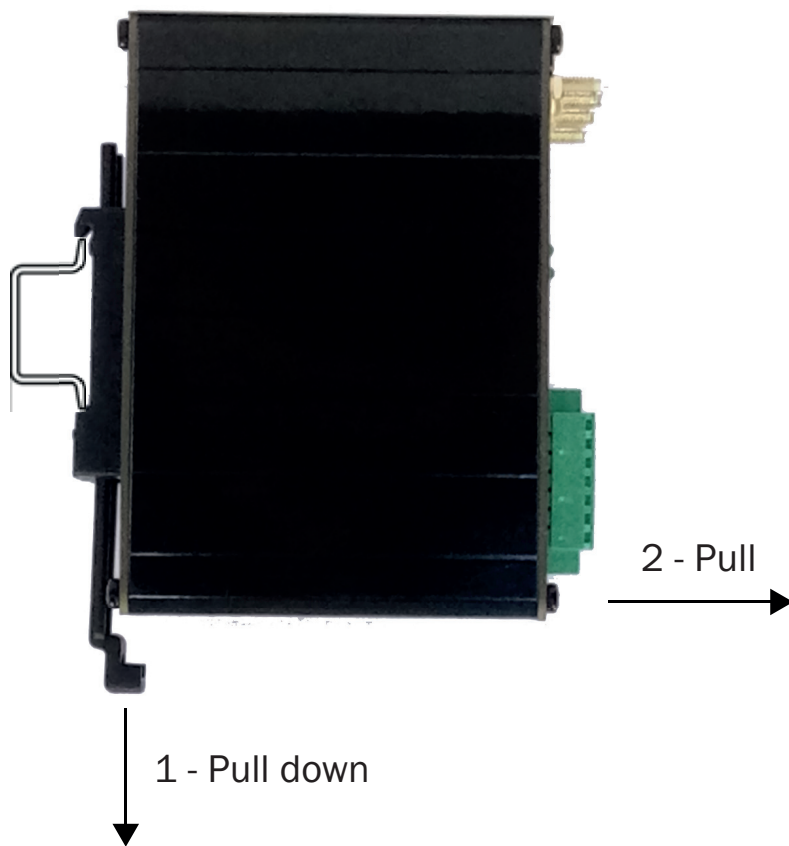
4. Connections of ExpertLoRaWAN

The user is responsible for the final integrated system. If not correctly designed or installed, external components may cause radiation limits to be exceeded. For instance, improperly made connections or improperly installed antennas can disturb the network and lead to malfunctions in the modem.

For power supply connection, use a high-quality power supply cable with low resistance. This ensures that the voltages at the connector pins are within the allowed range, even during the maximum peak current.

It is encouraged to perform installation with no external power applied, unplug the terminal block from the gateway and screw all required wirings. Plug again terminal block, fixing both fastening screws, and finally apply external power to the system.

When the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply. This protects the power cabling and gateway.

Bellow figure shows connection for all available interfaces, nonetheless, only those required for the end application are to be connected.
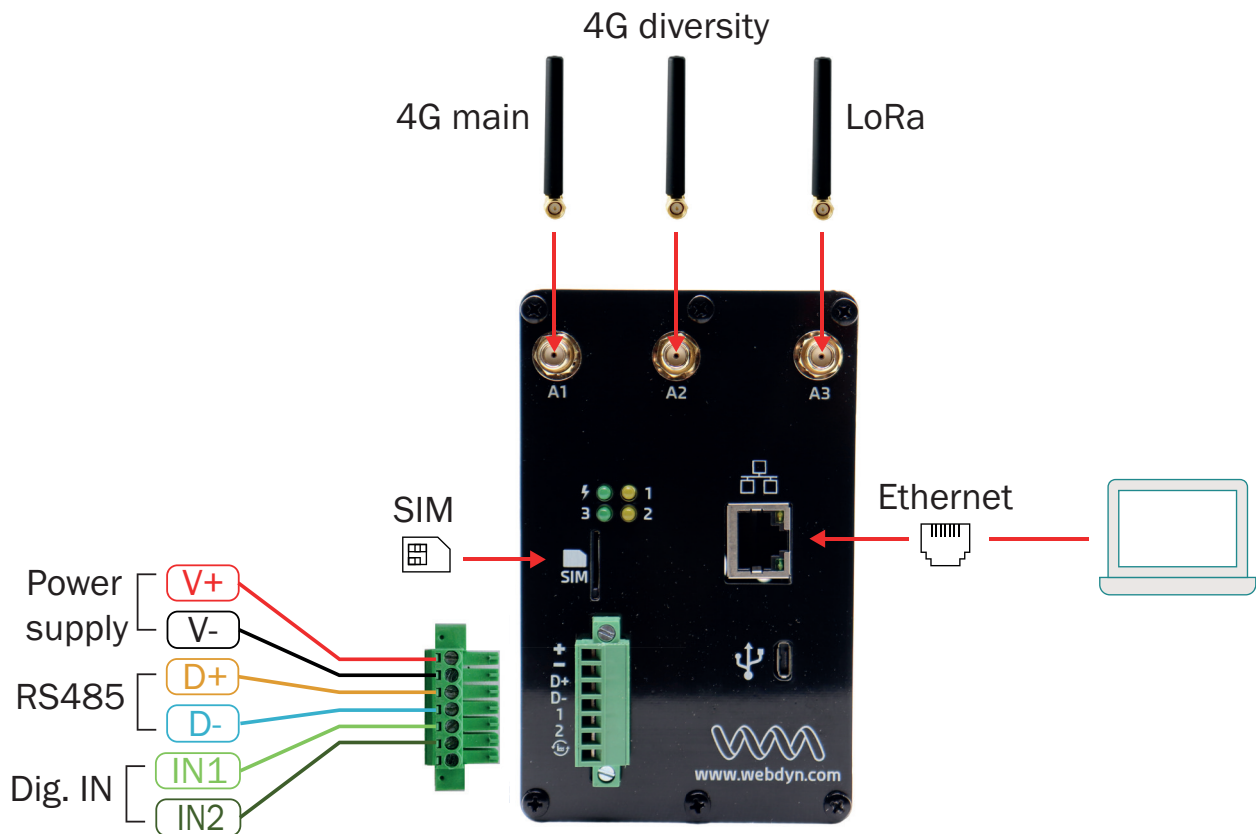
Offices & Support Contact

SPAIN

C/ Alejandro Sánchez 109
28019 Madrid

Phone: +34.915602737
Email: contact@webdyn.com

FRANCE

26 Rue des Gaudines
78100 Saint-Germain-en-Laye

Phone: +33.139042940
Email: contact@webdyn.com

INDIA

803-804 8th floor, Vishwadeep Building
District Centre, Janakpurt, 110058 Delhi

Phone: +91.1141519011
Email: contact@webdyn.com

PORTUGAL

Av. Coronel Eduardo Galhardo 7-1ºC
1170-105 Lisbon

Phone: +351.218162625
Email: comercial@lusomatrix.pt

TAIWAN

5F, No. 4, Sec. 3 Yanping N. Rd.
Datong Dist. Taipei City, 103027

Phone: +886.965333367
Email: contact@webdyn.com

SUPPORT

Madrid Offices

Phone: +34.915602737
Email: iotsupport@mtxm2m.com

Saint-Germain-en-Laye Offices

Phone: +33.139042940
Email: support@webdyn.com

Delhi Offices

Phone: +91.1141519011
Email: support-india@webdyn.com

Taipei City Offices

Phone: +886.905655535
Email: iotsupport@mtxm2m.com