RILHEVA II

USER MANUAL - V. 1.5

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SAFETY INFORMATION

During installation and normal operation of the device, it is necessary to respect the following rules:

- The device must be properly installed by authorized personnel
- Connection diagrams must be carefully followed during installation process
- The device must be installed inside an electric switchboard in order to make the clamps not accessible
- The switchboard wiring must be executed according to CEI regulations
- Do not power the device on while having any part damaged
- Xeo4 is not be liable for malfunction, breakdown, accidents and all other inconveniences caused by ignorance or lack of application of the guidance
- Xeo4 reserves the right to modify the product without any obligation, including the timely updating of user manuals

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GENERAL DESCRIPTION

- Rilheva platform is an innovative solution that gathers all your hardware data and transmits them to a control and monitoring server, through a platform integrating hardware, software and services.
- Rilheva II is an electronic device able to capture data through the serial ports **RS232, RS485 and Ethernet** using ModBus RTU / Modus TCP protocol and send them, via GPRS/3G modem or xDSL line, to Xeo4 Cloud servers. Here your data are stored, processed and made available to the authorized users by using a common internet browser or a smartphone app.
- This way, Rilheva II allows to monitor and control your remote sites without the necessity to **build your own control center**.
- The user has only to browse the internet, access to **www.rilheva.it** portal and authenticate himself in order to monitor and control all the data available on the remote site, in the same way as he was there.
- The Rilheva II device implements internally the master Modbus protocol, able to query up to 31 slave devices with a polling frequency up to 1 second. The device analyzes the received data (with a maximum of about 1000 variables) and send them to the Xeo4 servers. This can be done on a polling basis (user settable) or instantaneously when alert events are triggered.
- All the data and parameters are made available online through the Rilheva portal, where it is possible:
  - Configure the registers for every slave device
  - View all the registers in real time
  - View or extract historical data, trends, diagrams, analytical and summary reports
  - Set the value for a register parameter (output, set-point)
  - Build a standard configuration template (model) to be reloaded in the future
  - Access the diagnostics section to investigate any communication issue

SYSTEM ARCHITECTURE

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APPLICATIONS

- Production of energy from renewable sources (hydroelectric, wind, biogas, photovoltaic)
- Water integrated cycle management (pumping stations, treatment plants, wells, tanks, levels, flow, automation, water balances)
- Industrial plants (PLC, machinery, facilities, production lines)
- Energy management (energy analysis and business intelligence)
- Remote-reading consumption of distribution plants (power lines, pipelines, aqueducts)
- Industrial chiller management predictive analysis and efficiency index
- Monitoring of environmental parameters (weather stations, agricultural meteorology solutions, analysis of air or water quality, river or basin levels)

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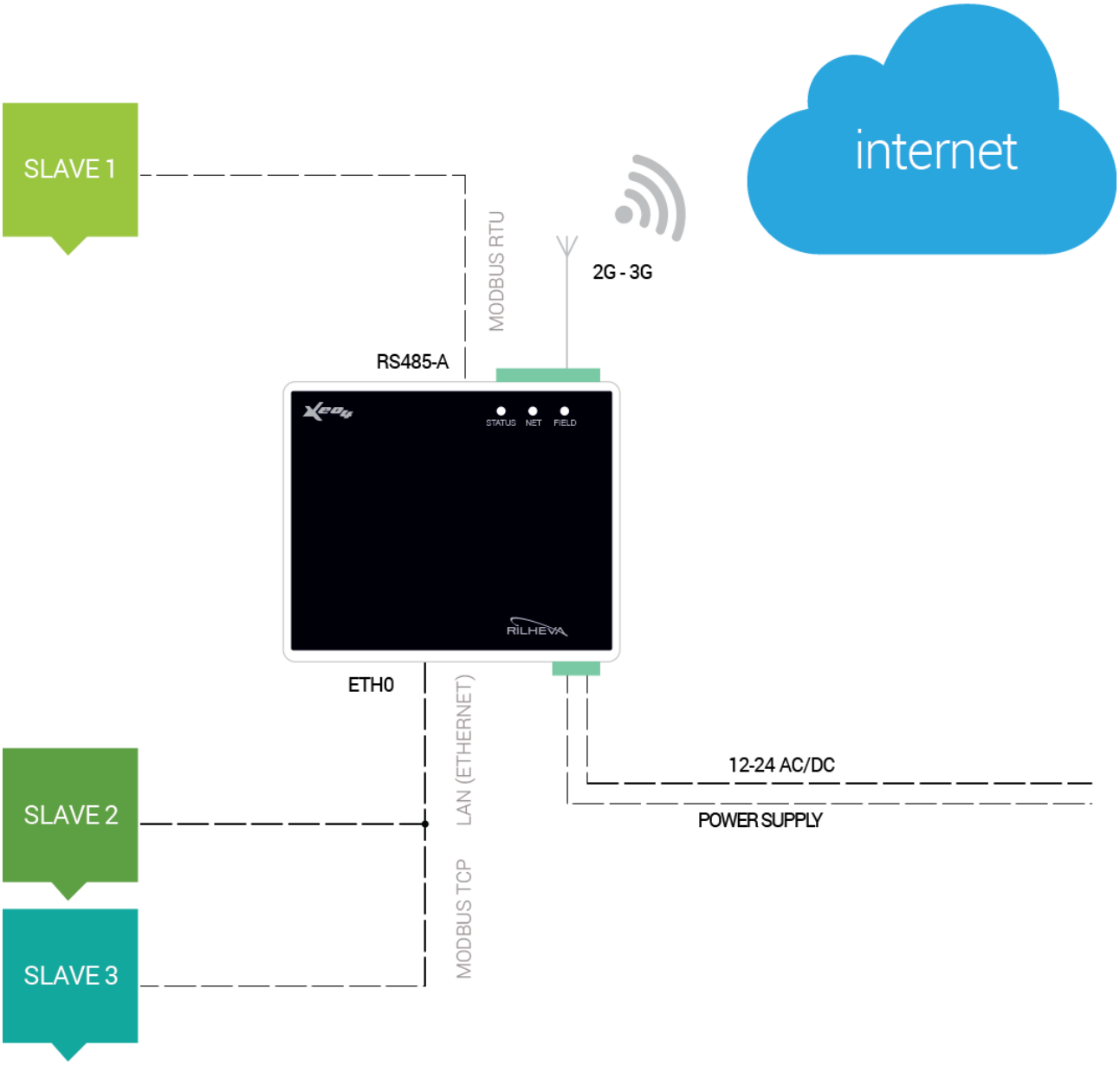
DEVICE INSTALLATION

Some installation examples follow.

Internet connectivity through GPRS/3G network



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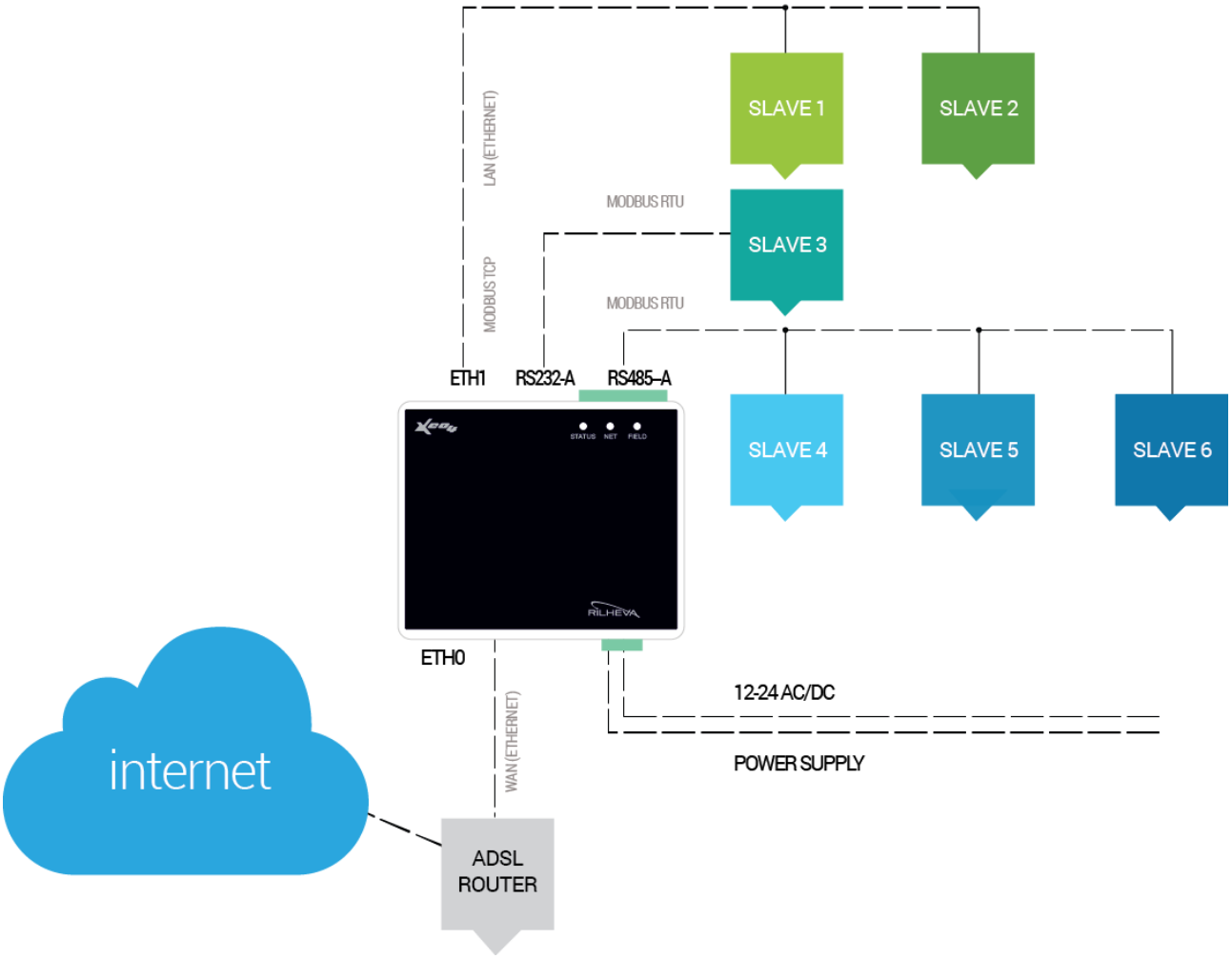
Internet connectivity through xDSL/cable network



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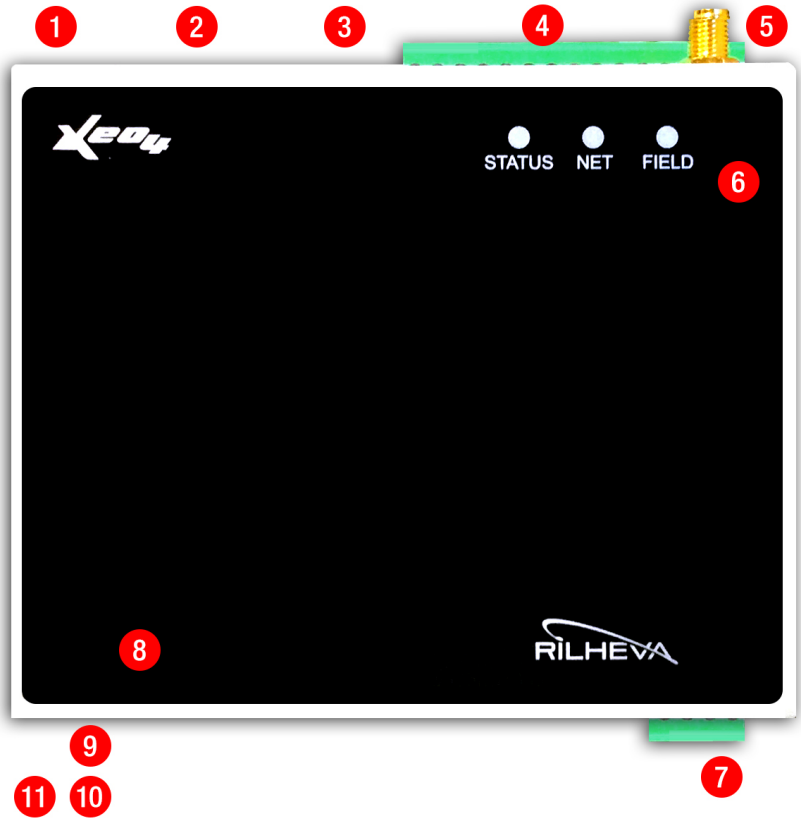
GENERAL VIEW OF THE CONNECTION PORTS



1. Ethernet port ETH1
2. Micro SD card
3. Mini USB OTG port
4. Serial connector 15 pin
5. Antenna/modem SMA F connector
6. Diagnostic LEDs
7. Digital input / Power supply
8. SIM card
9. Ethernet port ETH0
10. USB port type A
11. Factory reset button

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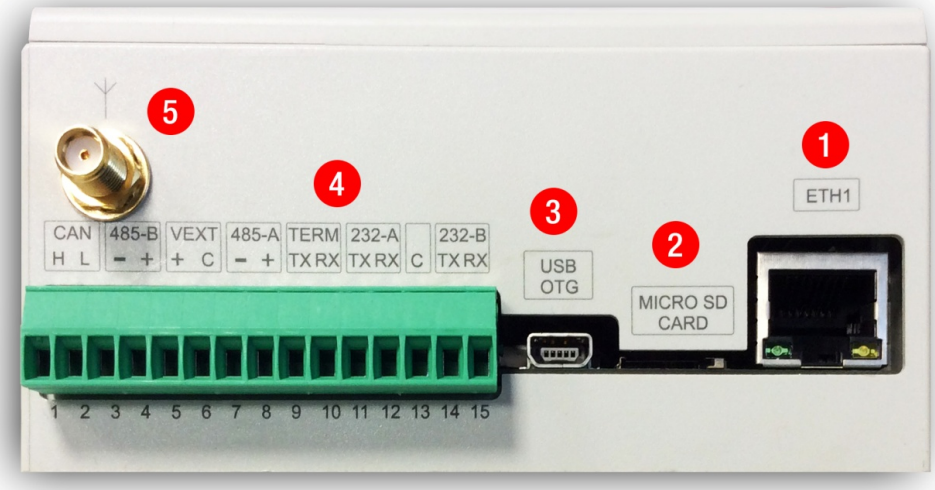
CONNECTIONS DETAIL (TOP)



1 **Ethernet port ETH1**

This is a 10/100 ethernet port that can be used as LAN (in order to access local devices on IP network)

2 **Micro SD card**

This slot can host a micro SD card (provided for future expansions related to backup or data export)

3 **Mini USB OTG port**

Through this port, implementing OTG (USB-On-The-Go standard), it will be possible connecting the Rilheva device to an external PC

4 **Serial connector 15 pin**

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PIN	DESCRIPTION	PORT
1	Can H	CAN BUS
2	Can L	
3	-	RS 485-B
4	+	
5	+	VEXT can be used for RS485 bus polarization
6	C	
7	-	RS 485-A
8	+	
9	TX	RS 232 SERVICE (diagnostics)
10	RX	
11	TX	RS 232-A
12	RX	
13	C	COMMON (GND)
14	TX	RS 232-B
15	RX	

5 Antenna/modem SMA F connector

A dual band GSM antenna (omni or directional) can be connected here

6 Diagnostic LEDs

Please see chapter “DIAGNOSTIC LEDS MEANING” for further information

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CONNECTIONS DETAIL (BOTTOM)

7 **Digital input / Power supply**

PIN	DESCRIZIONE	PORTA
1	unpolarized	POWER SUPPLY 12-24 AC/DC
2	unpolarized	
3	+	DIGITAL INPUT (opto-isolated input)
4	-	

8 **SIM card**

GSM SIM slot (format is mini-SIM)

9 **Ethernet port ETH0**

This is a 10/100 ethernet port that can be used as LAN (in order to access local devices on IP network) or WAN (for internet connection)

10 **USB port type A**

Through this port, compliant to USB DEVICE standard, it will be possible to connect a USB peripheral to Rilheva (e.g. USB key, external storage, etc.)

11 **Factory reset button**

The pinhole button allows to start the “factory reset” procedure, as explained later.

The first configuration can be done via SMS message or embedded webserver.

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DEVICE CONFIGURATION VIA SMS

For the Rilheva device being fully operating, it has to be correctly configured. The following operations must be executed:

1) Enter a valid SIM card (having GPRS service 2G/3G enabled) into the dedicated slot **while the device is powered off**.

Important: make sure that the PIN code is disabled for the SIM card used with Rilheva. If not, insert the SIM card into a GSM phone and follow the procedure to disable the PIN, ensuring that it will not be requested anymore.

Important: please disable all value added services that might be provisioned from your mobile operator and that may cause the sending of SMS messages to the SIM Cards.

2) Power-up the device

After few seconds, the 3 LEDs will blink at the same time, indicating that the device is waiting for the first configuration (e.g. configuration SMS message or web settings).

3) You can send an SMS configuration message to the device (using the SIM number installed) this way:

A[IMEI code]**[cloud server host/IP]**[cloud server port] **[provider APN]****

[username][password]**

[IMEI code]	this serial code (15 digits) is printed on the device label
[cloud server host/IP]	engine2.xeo4.it
[cloud server port]	8081
[provider APN]	depending on the GSM provider, the suggested APN must be specified. Please contact the provider in order to obtain further information
[username]	Only if requested, otherwise write “NO”
[password]	Only if requested, otherwise write “NO”

SMS message example:

A011013006419300**engine2.xeo4.it**8081**web.omnitel.it**NO**NO**

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4) Wait for a reply. After few minutes the device will reply to the sender with another SMS containing the following string:

CONFIGURAZIONE MEMORIZZATA DISPOSITIVO

The connection settings will be repeated:

[IMEI code]

[cloud server host/IP]

[cloud server port]

[provider APN]

[username]

[password]

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DEVICE CONFIGURATION VIA WEB INTERFACE

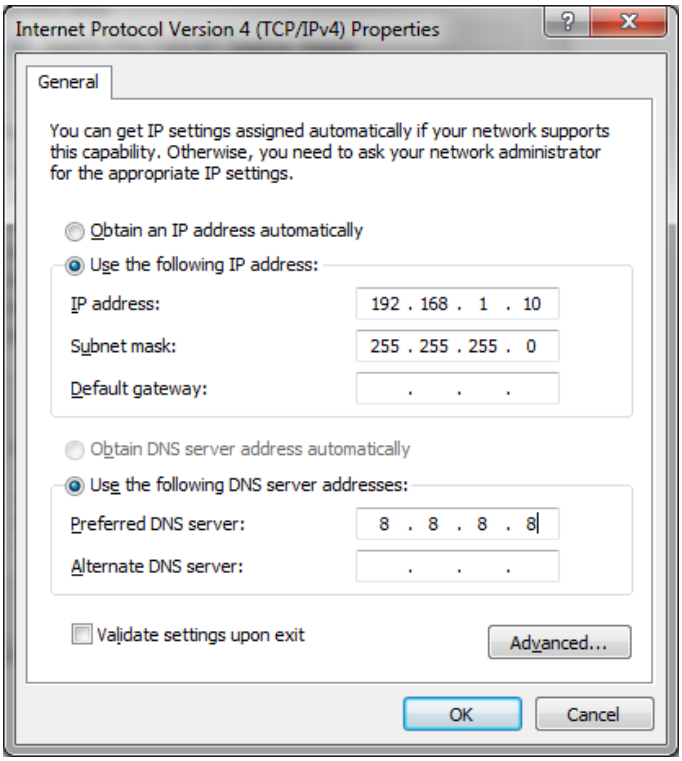
The configuration procedure varies slightly depending on the firmware version.

In order to verify which firmware version is installed on the device go to http://www.rilheva.it, select the device in the tree menu on the left. Then, in the device summary page, click on the gear icon and select the "Advanced" tab.

PROCEDURE FOR FIRMVARE VERSION UNTIL RIL2_5.9.9

In order to configure the connection parameters of the Rilheva device, please proceed as follows:

1) Connect the ETH0 port of the device to a PC, using a direct Ethernet cable (UTP5 patch).
2) On the PC, configure a static IPv4 address within the subnet 192.168.1.x (e.g. 192.168.1.10) and a subnet mask 255.255.255.0.



3) Open your internet browser and point to the following address: http://192.168.1.1

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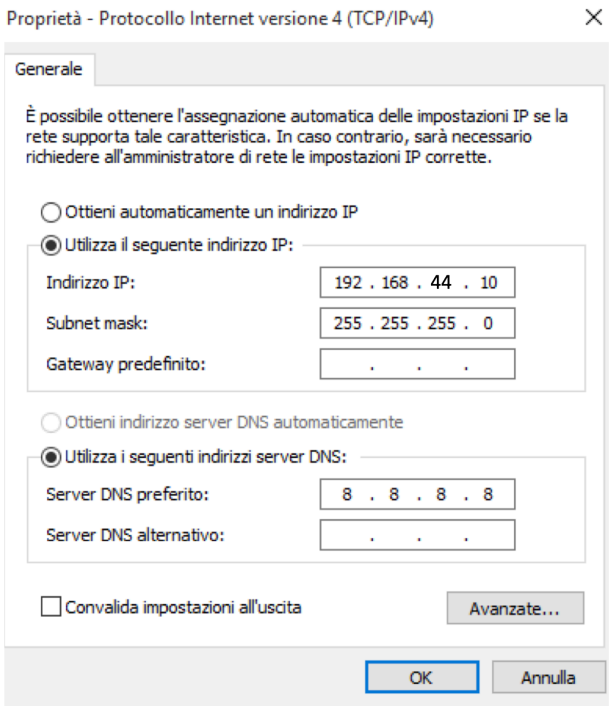
PROCEDURE FOR FIRMVARE VERSION RIL2_6.0.0 OR GREATER

In order to configure the connection parameters of the Rilheva device, please proceed as follows:

1) Connect the ETH0 port of the device to a PC, using a direct Ethernet cable (UTP5 patch).

2) On the PC, configure a static IPv4 address within the subnet 192.168.44.x (e.g. 192.168.44.10) and a subnet mask 255.255.255.0.



3) Open your internet browser and point to the following address: http://192.168.44.1

The authentication credentials are pre-configured as follows:

username: **admin**

password: **<Rilheva MAC address, no colon, lowercase >**

The MAC address of the Rilheva device is printed on a tag both inside the box and on one side of the Rilheva (**MACETH0).** See following picture.

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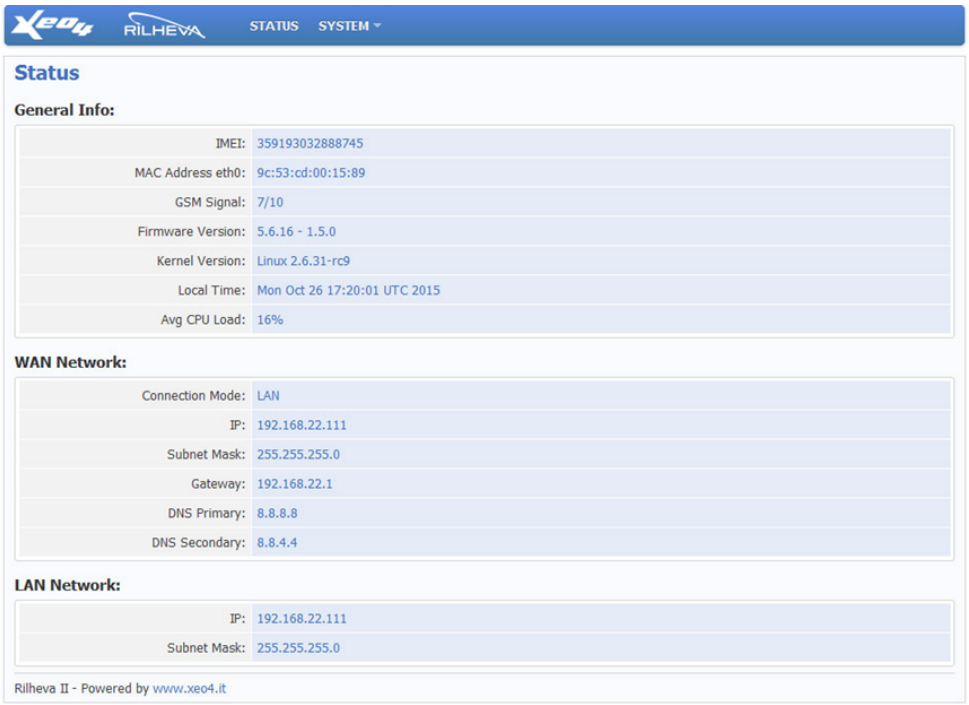
STATUS PAGE



This screen will show the main status information about Rilheva device.

In case of GPRS/3G connectivity, the GSM signal will be shown.

Moreover, it is present the firmware version and the network settings used for the Internet connection and for the local LAN access.

TALKING HARDWARE DATA
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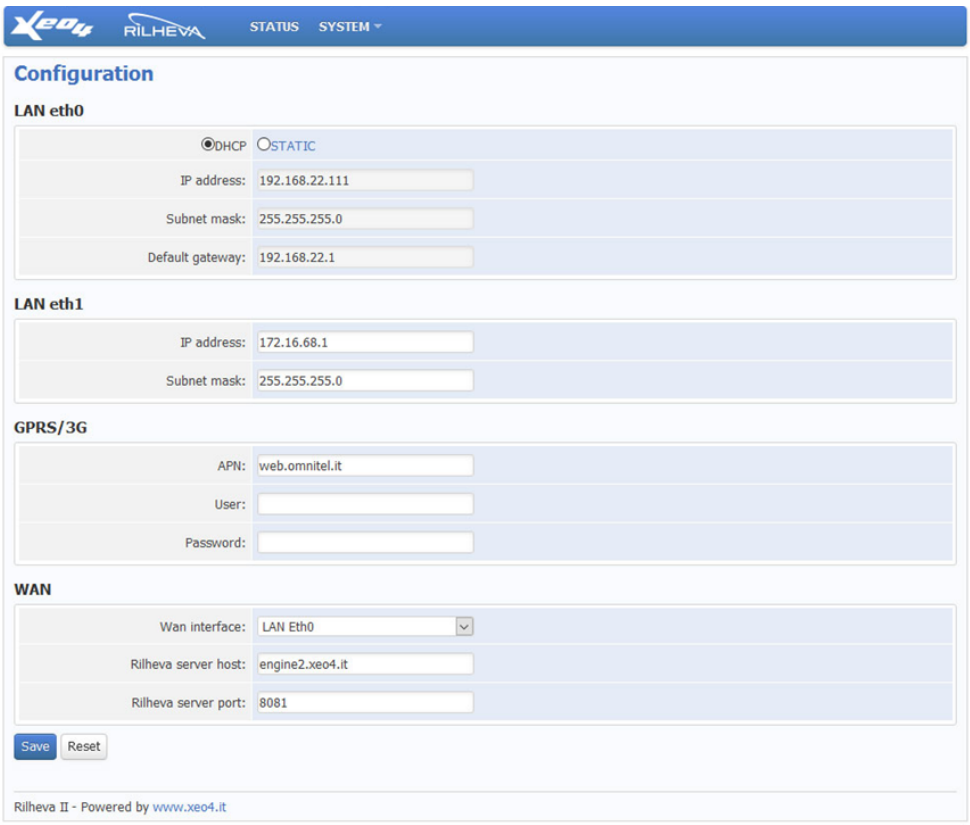
CONFIGURATION PAGE



This screen allows to configure the main settings required to perform the startup of the Rilheva device.

It is possible to assign different IP addresses to the two LAN ports (eth0 and eth1). The eth0 port can be configured either for the automatic acquisition of an IP address (via DHCP) or statically.

In the GPRS/3G section the APN parameter can be defined depending on the GSM operator chosen, and username/password (only if required, otherwise leave the field empty).

Using the “Wan interface” setting, it is possible to choose the way the device will connect to the Internet, and so to the Rilheva Cloud system.

By choosing “LAN eth0” choice, the device will use the parameters of this section in order to connect to the Internet. On the other hand, by choosing “GPRS/3G” the device will use the installed SIM card to connect to the mobile network.

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DIAGNOSTICS PAGE

This page offer some technical and diagnostic information, useful to investigate and resolve possible bugs or abnormal behavior related to the Cloud connection.

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DIAGNOSTIC LEDS MEANING

FIRST CONFIGURATION

If the device is not configured initially, the three LEDs will be simultaneously blinking, to indicate that the device is waiting for receiving the configuration SMS or the first web configuration.

This initial configuration can also be obtained by performing a device factory reset.

NORMAL OPERATION

During normal working operation, LEDs must have the following status:

LED STATUS	>	green blinking
LED NET	>	red fixed on
LED FIELD	>	off with short blinks during Modbus polling activity

MALFUNCTION INDICATIONS

Led STATUS solid orange
If the STATUS led is solid orange, an hardware error has occurred. Please contact Technical Support.

Led STATUS blinking orange/red alternately
In this case, the device is polling the slave devices via Modbus protocol, but some reading errors persist.

Led FIELD solid red
If the FIELD led is solid red, the Rilheva device is not communicating correctly with the Modbus devices.

Led NET blinking fast (about 10 flashes/sec)
This indication tells that a severe hardware error is present. Please contact Technical Support.

Led NET blinking slow (about 2 flashes/sec)
In this case, there can be some problem with the SIM card. Please check that SIM card is active, properly installed into the slot and with PIN lock feature disabled.

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FACTORY RESET PROCEDURE

In order to restore the factory conditions of the Rilheva, it is necessary to power up the device keeping the pinhole [R] pushed with a pin or paper clip, waiting until the three LEDs will start blinking sequentially (wait for about 20 seconds).

At this point, just wait 5 seconds more until the led sequence will stop and release the [R] button.

The device will reboot showing the three LEDs simultaneously blinking (see “first configuration”).

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TECHNICAL SHEET

HARDWARE

Platform:	CPU ARM 9 i.Mx25 @ 400 MHz
Operating system:	Linux 2.6.31
RAM memory:	64MB DDR2-266
FLASH memory:	256MB NAND Flash
Power supply:	9-36Vdc (12-24Vac +/-10%)
Power consumption:	~5W (Max 150mA @ 24Vac)
Operating temperature:	-20 / +60 °C
Display (optional):	TFT color Touch Screen 320x240 pixel 3,5”
Commands:	1 pinhole button for device reset
LEDs:	1 led tricolor STATUS 1 led red NET 1 led red FIELD
Modem:	mini PCI express GSM/GPRS quadband (version A) mini PCI express GSM/GPRS/UMTS HSUPA quadband (version B)
Slot per SIM CARD:	button push-push type
Expansion slot I:	mini PCI express for future expansions (Wi-Fi / zig-bee / GPS)
Expansion slot II:	proprietary slot for custom expansions
Antenna:	external SMA (MODEM 2G/3G + optional WLAN/GPS)
Case:	6 modules DIN rail plastic case
Onboard communication ports:	4 serial ports (2 x RS232 on 3 wire terminals, 2 x RS485 on 2 wire terminals (+ GND and VCC for RS485 bus polarization)) 1 serial RS232 (console) 2 Ethernet 10/100 full duplex (port with con 2 integrated LEDs) 1 USB OTG 1 USB DEVICE 1 slot for micro SD push-push 1 CAN bus
Supervision systems:	Hardware watchdog
Firmware upgrade:	Firmware upgradeable remotely (over the air)
Real Time Clock (RTC):	External RTC for wakeup - Server synchronized, with backup battery
Power supply detection:	Control of power failure through opto-isolated digital input (DI)
Audio signals:	Buzzer
I/O expansions:	Possible by adding external modules via ethernet or serial port

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MODBUS FEATURES

Serial ports (Modbus RTU)

The physical communication line is compliant with EIA-RS485 standard (2 wire half-duplex mode).

For Modbus communication, it is also possible to use the RS232 port (P2P mode).

For Modbus, protocol RTU (Remote Terminal Unit)will be used.

The serial baudrate can be selected among:

1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 28800 bps, 38400 bps, 56000 bps, 57600 bps, 115200 bps

The RTU byte is composed by 11-bit:

- 1 start bit
- 8 data bit
- 1 parity bit (NONE, ODD, EVEN)
- 1 or 2 stop bit (2-if parity is set to NONE)

Ethernet port (Modbus TCP)

It is possible to connect Modbus TCP devices to the ethernet ports eth0 and eth1.

The network configuration (device IP and subnet) has to be initially set by using the integrated web server.

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Data formats

Rilheva II supports the following Modbus datatypes:

Data format	Modbus format	Data for registers	Type	Sign	Range	Bit size
F1	Single register LSB part	2	Integer	unsigned	0-255	8
F2	Singe register MSB part	2	Integer	unsigned	0-255	8
F3	Single register	1	Integer	unsigned	0-65535	16
F4	Single register	1	Integer	signed	-32768 +32767	16
F5	Couple of registers HI-LO	1	Integer	unsigned	0- 4294967295	32
F6	Couple of registers HI-LO	1	Integer	signed	-2147483648 +2147483647	32
F7	Couple of registers	1	Floating	signed	See IEEE 754	32
F8	Single bitwise register	16	Bit	-	0-1	16
F9	Couple of registers LO-HI	1	Integer	unsigned	0- 4294967295	32
F10	Couple of registers LO-HI	1	Integer	signed	-2147483648 +2147483647	32

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Protocol datatypes

LABEL	TYPE	ACCESS	USE CASES
DISCRETES INPUT	1-bit	**READ ONLY**	Digital inputs
COILS	1-bit	**READ & WRITE**	Digital outputs
INPUT REGISTERS	16-bit	**READ ONLY**	Measures
HOLDING REGISTERS	16-bit	**READ & WRITE**	Working parameters, set-points

NB: the same data can be accessed by different access type

Data addressing

All the datatypes addressed by Modbus protocol (registers and coils) are zero based. The first register of any kind has address 0.

Every datatype can sometime be specified with a starting prefix:

LABEL	PREFIX
COILS	1xxxx
DISCRETES INPUT	2xxxx
INPUT REGISTERS	3xxxx
HOLDING REGISTERS	4xxxx

In this case, the address that must be used at Modbus protocol level is obtained by trimming the prefix and substracting one.

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Modbus functions

The functions implemented by Rilheva Modbus are the following ones:

Access	hex code	Function name	Function description
1-bit	**0x01**	**Read Coils**	reads one or more consecutive bits starting from a specified address (can be outputs)
	0x02	**Read Discrete Inputs**	reads one or more consecutive input bits starting from a specified address (cannot be outputs)
	0x05	**Write Single Coil**	writes a single bit (ON or OFF)
	0x0f	**Force Multiple Coils**	write one or more bits (ON or OFF)
16-bit	**0x03**	**Read Holding Registers**	reads one or more consecutive registers of HOLDING type starting from a specified address
	0x04	**Read Input Registers**	reads one or more consecutive registers of INPUT type starting from a specified address
	0x06	**Write Single Register (holding)**	writes an HOLDING type register
	0x10	**Write Multiple Registers (holding)**	writes one or more consecutive HOLDING type registers
	0x07	**Read Exception Status**	reads one byte containing diagnostics about the device ("exception status output")
	0x08	**Diagnostics**	diagnostic functions for RS485 bus
	0x11	**Report Slave ID**	reports info about type and status of a slave

ACCESSORIES

• **OMNIDIRECTIONAL ANTENNA**	GSM dual Band with magnetic base
(included in the packaging)	freq. 900 and 1800 MHz gain 2.1 dBi
	SMA male connector
• **MODULAR TRANSFORMER**	230 VAC / 4-8-12 V AC 15 VA
TMC 15/12 (optional)	Part number **VN316600 (**2 DIN modules)

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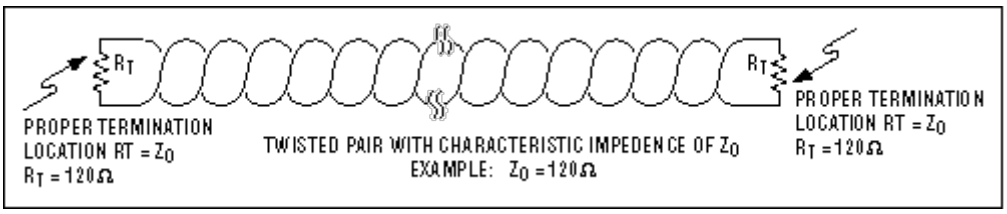
GUIDELINES FOR RS-485 BUS CONNECTION

RS-485 standard

RS-485 standard is based on a balanced signals system. This means that two signals are ideally one opposed to each other, respect to the ground.

It is strongly suggested that the transmission line will be formed by a “twisted pair” cable. This kind of cable is particularly immune to electromagnetic noise.



Transmission cable

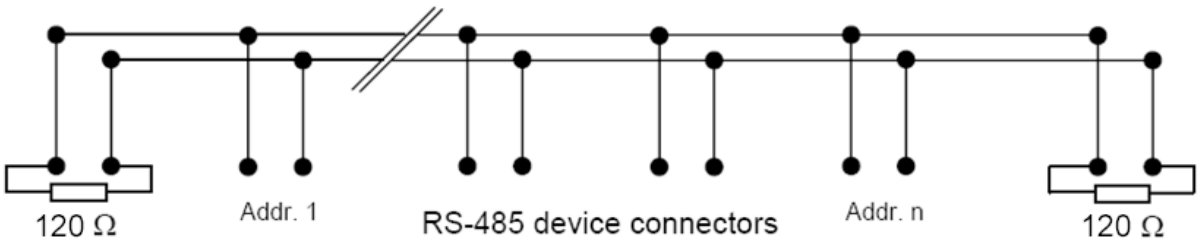
In order to prevent any interference risks, a properly shielded cable should always be used, especially if you are close to power signals (e.g. electric engines, inverters, relais).

We recommend to use cat. 5E cable or equivalent.

Generally speaking, the RS-486 transmission cable should be shielded and compliant to the following specifications:

- Cable capacity <=300pF/m
- Line impedance 100 Ω ±15 Ω
- Line resistance 140 Ω/km or 225 Ω
- Cable type: copper twisted pair

Network connection



- As far as possible, limit the RS-485 network to a main single line (one segment)
- Limit the total length of the main line to a maximum of 1000 m
- Do not connect more than 31 devices on the same RS-485 segment
- Disconnect the line termination resistors (if any) on all the slave devices connected
- For short networks (up to 30 m) no line termination resistor is needed
- For more extended networks, it could be necessary to terminate the RS-485 line in the following way:

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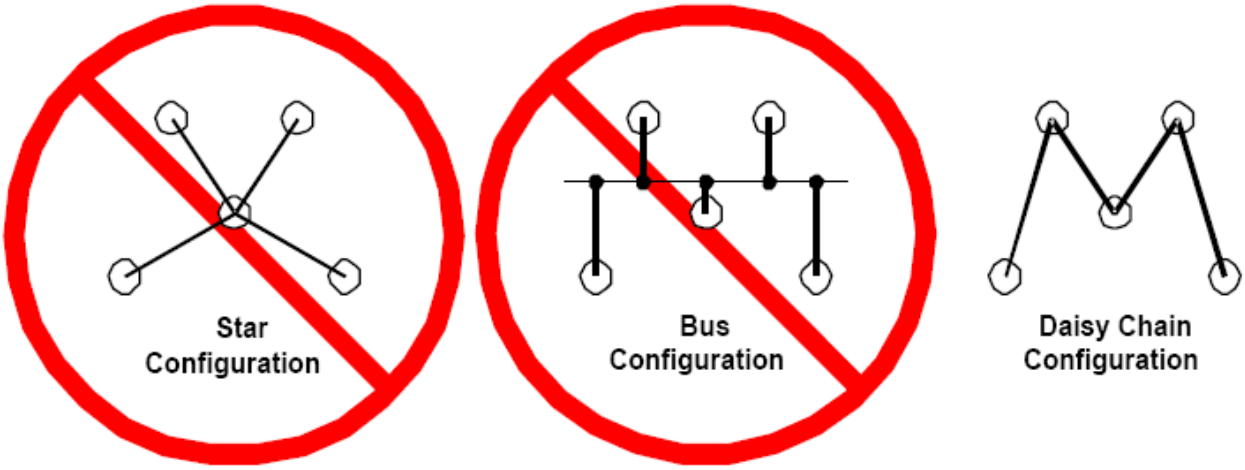
- Position a 120 Ohm resistor at the line end (after the last slave device, or directly on the device itself)

Configurations to avoid

RS-485 networks implement a so-called “daisy chain” configuration.

This means that a single main line (cable) exists and all the devices are directly connected along the line path.

By using other kinds of connection (e.g. star point, T branching), you cannot be guaranteed about the good functionality of the network, especially if electromagnetic noise is present or for long networks or high number of connected nodes.



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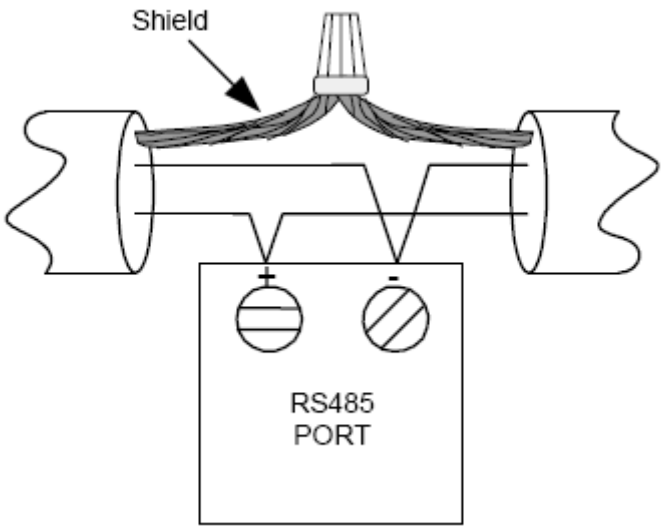
Grounding

Be sure that all the devices will use the same ground, especially if using more than one power supply. The RS485 line shield should be grounded only to a single line end.



RS-485 bus polarization

For the RS-485 bus to be working correctly, it is necessary that electric signals are polarized in a proper way.

When all the Modbus slave devices are listening and the master device (namely Rilheva) is not polling (transmitting), the RS-485 bus will remain in high-impedance status.

In this situation, sometime, the RS-485 bus may be interfered by some external electromagnetic noise that could be interpreted as real signals by the listening stations.

You can check whether the RS-485 bus is polarized properly by using a common tester (digital multimeter) and measuring the voltage between the terminals + and – (while no traffic exists on the bus) and verifying that the voltage is greater than 200 mV.

If not, you should connect two polarization resistors:

- one between terminal + (B) and terminal VEXT (+)
- one between terminal – (A) and terminal VEXT (C)

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In order to calculate the Rb resistor value, we have to bear in mind that they must maintain a voltage of about 200 mV when all the devices are listening.

Let's do an example on how to find the Rb resistance value.

We suppose to be in the following situation:

- The bus is composed by 32 nodes with input impedance equal to 12KΩ
- Two termination resistors (120Ω) are present
- Supply voltage is 5 VDC

We say Zo the impedance made by the parallel of 2 termination resistors (120Ω) and 32 input impedance of the devices (12kΩ), whose result is about 52Ω;

and we say E the power voltage for the bus polarization (5V)

Rb is calculated by the following formula:

$$Rb = \frac{\left(\left(\frac{E}{0.2} - 1\right) * Z_o\right)}{2}$$

In this case the value is about 620 Ω.

This polarization network must be connected in a single point of the bus, possibly close to the master device (Rilheva II).

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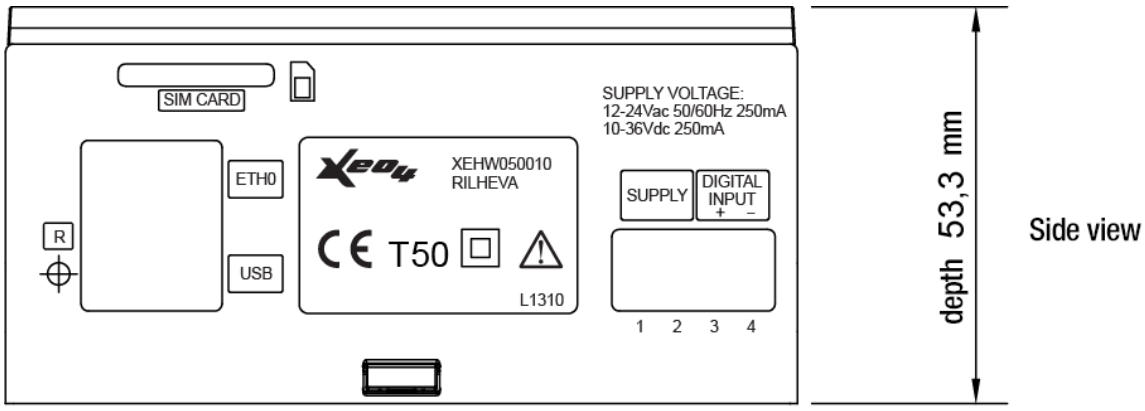
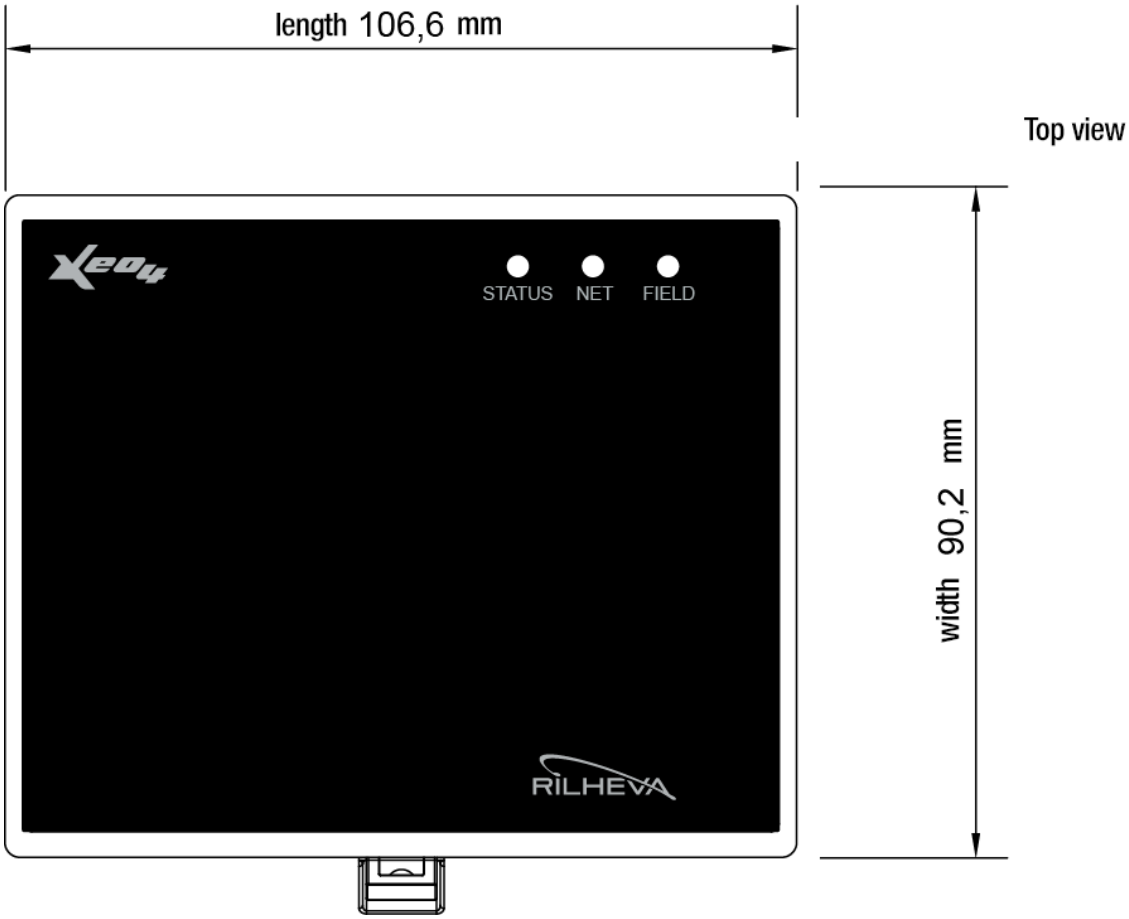
ITEM SIZES





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www.xeo4.it
info@xeo4.it
+39.0523.498721

REGULATIONS

The compliance to the EU Directive **1999/5/CE** of the European Parliament, concerning radio apparatuses and communication terminal devices, is achieved by fulfilling the following standards.

- Safety: **EN 60950-1 (2007) - LVD**
- Electromagnetic compatibility: **EN 301 489-1 (2011) - EMC**
  EN 301 489-7 (2005) - EMC
- Efficient use of spectrum: **3GPP TS 51010-1**

WARRANTY

All the products made by XEO4 S.r.l. are covered by warranty for a period of 12 months from the delivery date, excluding possible damages due to tampering, negligence, accidents, misuse or lack of proper maintenance, normal aging, damage or injury caused by improper use.

The goods, even if packaged, must be handled with care and stored in a dry place, as better explained in the technical documentation attached.

Any complaint related to manufacturing fault o product quality must be notified in writing to XEO4 S.r.l. by demonstrating that the product has been installed and maintained properly, as described in the technical documentation attached.

XEO4 S.r.l. does not accept responsibility for improper use of products (in any other manner that might mislead) as described on the catalogs and technical documentation attached.

The products are manufactured according to industry best practices in matter of safety. If installed properly by qualified personnel, used in the right way and properly maintained will ensure a level of safety for human beings, animals, things.

The products under the scope of EU directives 73/23/CEE modified by 93/68/CEE (Low voltage) and 89/336/CEE modified by 92/31/CEE and 93/68/CEE (Electromagnetic Compatibility) are complaint to its essential requirements.

XEO4 S.r.l. reserves the right make all the necessary changes, without further notice, in order to improve their functional and technical performances.

Xeo4 Srl
www.xeo4.it
info@xeo4.it
+39.0523.498721

Xeo4 s.r.l.

Via Asti, 5
29121 Piacenza - Italy

Tel. 0523 498721
Fax 0523 401738

support@xeo4.it
info@xeo4.it
www.xeo4.it