Pietro Fiorentini

AQUALOG PQ EVO

Device for water mains monitoring

Revision A - Edition 06/2025

USER MANUAL, MAINTENANCE WARNING

EN

PAGE INTENTIONALLY LEFT BLANK

1 - INTRODUCTION

FOREWORD

The manufacturer is in no way responsible for the consequences of operations carried out in a manner not in accordance with the manual.

GENERAL REMARKS

All operating, maintenance instructions and recommendations described in this manual must be followed to in order to:

- obtain the best possible performance from the equipment;
- keep the equipment in efficient conditions.

Training the personnel in charge is essential in order to:

- use and service the equipment properly;
- correctly apply the safety alerts and procedures recommended.

PAGE INTENTIONALLY LEFT BLANK

1.1 - REVISION HISTORY

Revision index	Date
A	06/2025
-	-

Tab. 1.1.

INDEX

PAGE INTENTIONALLY LEFT BLANK

2 - GENERAL INFORMATION

2.1 - MANUFACTURER IDENTIFICATION

Manufacturer	PIETRO FIORENTINI S.P.A.
Address	Via Enrico Fermi, 8/10 36057 Arcugnano (VI) - ITALY **Tel. +39 0444 968511 Fax +39 0444 960468** **www.fiorentini.com sales@fiorentini.com**

Tab. 2.2.

2.2 - IDENTIFICATION OF THE PRODUCT

Equipment	DEVICE FOR WATER MAINS MONITORING
Series	AQUALOG PQ EVO
Models	Aqualog PQ EVO - version with cable glands

Tab. 2.3.

2.3 - REGULATORY FRAMEWORK

PIETRO FIORENTINI S.P.A. with registered office in Arcugnano (Italy) - Via E. Fermi, 8/10, declares that the equipment of the series described in this manual is designed, manufactured, tested and checked in compliance with:

- the requirements of the Directives:
  - 2014/53/EU “RED”
  - 2014/30/EU 'EMC'

NOTICE!

For specific type approvals, see the appropriate section on the Manufacturer’s website: https://www.fiorentini.com

NOTICE!

The declaration of conformity in its original version is delivered together with the equipment.

2.4 - WARRANTY

PIETRO FIORENTINI S.P.A. guarantees that the equipment was manufactured using the best materials, with high quality workmanship, and complies with the quality requirements, specifications and performance set out in the order.
The warranty shall be considered null and void and PIETRO FIORENTINI S.P.A. shall not be liable for any damage and/or malfunctions:

- due to any acts or omissions of the purchaser or end-user, or any of their carriers, employees, agents, or any third party or entity;
- in the event that the purchaser, or a third party, makes changes to the equipment supplied by PIETRO FIORENTINI S.P.A. without the prior written approval of the latter;
- in the event of failure by the purchaser to comply with the instructions contained in this manual, as provided by PIETRO FIORENTINI S.P.A.

NOTICE!

The warranty conditions are specified in the commercial contract.

2.4.1 - REFERENCE OPERATING CONDITIONS

The reference operating conditions for battery life calculations are described in Tab. 2.4:

Condition operational	Reference indications
Local interface	10 minutes per month.
Sensor acquisition	• 1 piezoresistive sensor • 1 meter • 1 transmission per day
Upgrade firmware code	1 time every 5 years.
Communication	1 data transmission per day.

Tab. 2.4.

Ambient temperature has an effect on battery life. The operating profile used to calculate the battery life expectancy is indicated in Tab. 2.5:

	Reference indications
Temperature environment	0.3% of the time at +25 °C
	0.5% of the time at -20 °C
	2.6% of the time at -10 °C
	41.0% of the time at +5 °C
	43.0% of the time at +20 °C
	11.8% of the time at +35 °C
	0.5% of the time at +50 °C
	0.4% of the time at +60 °C

Tab. 2.5.

2.5 - ADDRESSEES, SUPPLY AND STORAGE OF THE MANUAL

The instruction manual is intended for qualified technicians responsible for operating and managing the equipment throughout its service life.
It contains the necessary information to properly use the equipment and keep its functional and qualitative characteristics unchanged over time. All information and warnings for safe, correct use are also provided.
The manual, as well as the declaration of conformity and/or test certificate, is an integral part of the equipment and must always accompany it whenever it is moved or resold. It is the responsibility of the qualified professionals (see paragraph 2.10) to use and manage the equipment.

⚠ WARNING!

Removing, rewriting or editing the pages of the manual and their contents is not allowed.
PIETRO FIORENTINI S.p.A. shall not be held liable for any damage to people, animals and property caused by failure to adhere to the warnings and operating procedures described in this manual.

2.6 - LANGUAGE

The original instruction manual was drawn up in Italian.
Any translations into additional languages are to be made from the original instruction manual.

HAZARD!

The translations into other languages cannot be fully verified. If any inconsistency is found, please refer to the text of the original manual.
If inconsistencies are found or the text does not make sense:

- **stop any actions;**
- **immediately contact PIETRO FIORENTINI S.p.A. at the addresses specified in paragraph 2.1 ("Identification of the manufacturer").**

WARNING!

PIETRO FIORENTINI S.p.A. shall be held liable for the information provided in the original manual only.

2.7 - SYMBOLS USED IN THE MANUAL

Symbol	Definition
	Symbol used to identify important warnings for the health and safety of the operator or safety of the equipment.
	Symbol used to identify an ELECTRICAL HAZARD to the health and safety of the operator.
	Symbol used to identify information of particular importance in the instruction manual. The information may also concern the safety of the personnel involved in using the equipment.
	Obligation to consult the instruction manual/booklet. Indicates a requirement for the personnel to refer to (and understand) the operating and warning instructions of the machine before working with or on it.

Tab. 2.6.

HAZARD!

Alerts to a hazard with a high level of risk, an imminent hazardous situation which, if not prevented, will result in death or severe damage.

WARNING!

Alerts to a hazard with a medium level of risk, a potentially hazardous situation which, if not prevented, may result in death or severe damage.

ATTENTION!

Alerts to a hazard with a low level of risk, a potentially hazardous situation which, if not prevented, could result in minor or moderate damage.

NOTICE!

Alerts to specific warnings, directions or notes of particular concern, that are not related to physical injury, as well as practices for which physical injury is not likely to occur.

2.8 - APPLIED RATING PLATES

The equipment is equipped with nameplates.
The rating plate contains the identification details of the equipment and its accessories to be cited in case of need to PIETRO FIORENTINI S.p.A.

Id.	Type of plate	Image
1	AQUALOG PQ EVO	

Tab. 2.7.

⚠ WARNING!

Removing nameplates and/or replacing them with other plates is strictly not allowed. Should the plates be unintentionally damaged or removed, the customer must notify PIETRO FIORENTINI S.p.A.

2.8.1 - DESCRIPTION OF THE NAMEPLATE

The following information, described in Tab. 2.8, is shown on the nameplate:

Pos.	Description
1	Fast Logo
2	Manufacturer's Address
3	Equipment model
4	Equipment overhaul status
5	Serial Number
6	Power supply voltage
7	Average power consumption
8	Safety pictogram
9	CE Marking

Tab. 2.8.

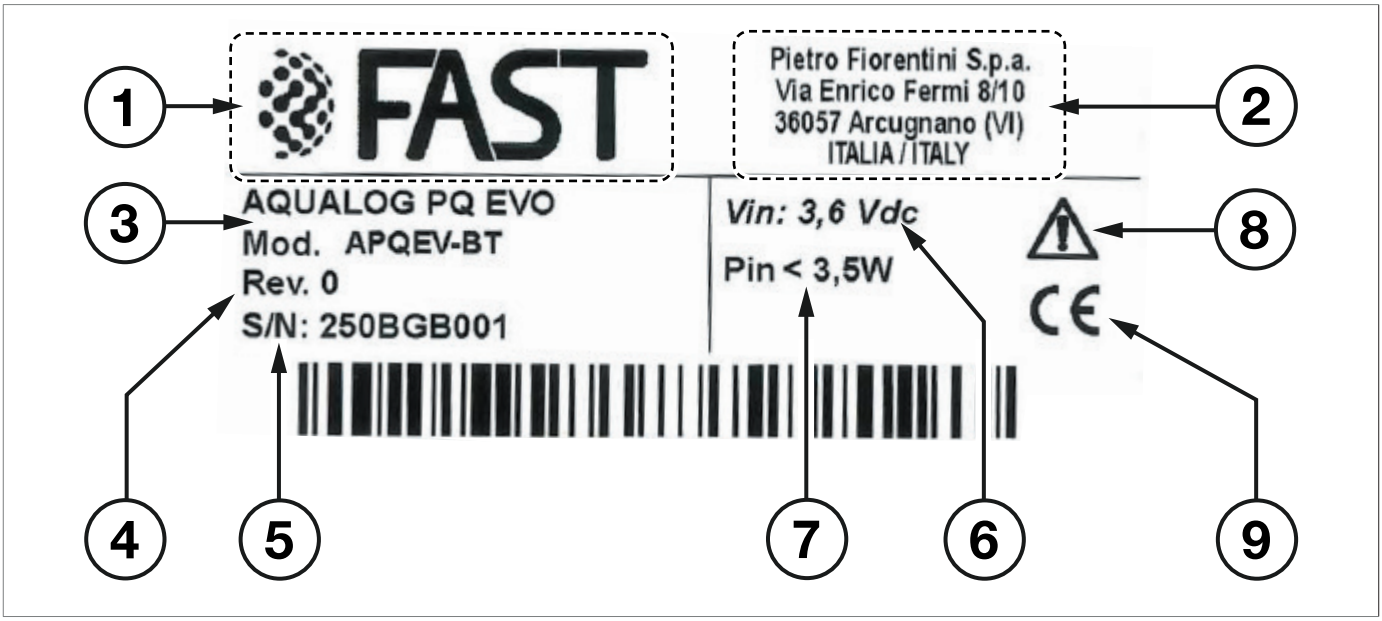


Fig. 2.1. Description of the nameplate

2.9 - GLOSSARY OF UNITS OF MEASUREMENT

Type of measurement	Unit of measurement	Description
Consumption and Volumetric flow rate	Sm^3/h	Standard cubic metres per hour
	Sm^3	Standard cubic metres
	m^3/h	Cubic metres per hour
	m^3	Cubic metres
	l/s	Litres per second
	l	Litres
Pressure	bar	Bar
	˝wc	Water column inch
	Pa	Pascal
Temperature	°C	Degree centigrade
	°F	Fahrenheit degree
	K	Kelvin
Tightening torque	Nm	Newton metre
Sound pressure	dB	Decibel
Other measurements	V	Volt
	W	Watt
	Ω	Ohm

Tab. 2.9.

2.10 - QUALIFIED PROFESSIONAL FIGURES

Qualified operators in charge of using and managing the equipment throughout its technical service life to be used as indicated:

Professional figure	Definition
Installer	Qualified operator able to: • handle materials and equipment. • carry out all the operations necessary to properly install the equipment; • perform all the operations necessary to safely operate the equipment and system; • be able to perform all the operations necessary to uninstall and subsequently dispose of the equipment in compliance with the regulations in force in the country of installation.
Technical specialised/ Maintenance technician	Trained and authorised technician on the management and use of the equipment, who must: • be able to perform all operations required for the proper functioning of the equipment and the system, and for their safety and that of any third parties present; • perform maintenance on all parts of the equipment subject to maintenance (board and batteries); • access all device parts for visual inspection, checking equipment status, making adjustments and calibrations; • have proven experience in properly using the equipment similar to that described in this manual, and be trained, informed and instructed in this regard.
Maintenance technician electric	Qualified technician able to: • perform preventive/corrective maintenance operations on all electrical parts of the device subject to maintenance or repair; • read wiring diagrams and check the correct functional cycle; • perform adjustments and operate on electrical systems for maintenance, repair and replacement of worn parts. The electrical maintenance technician can operate in the presence of voltage inside electrical panels, junction boxes, control equipment etc. only if he/she is deemed to be suitable (S.P.). For general requirements, refer to the IEC EN 50110-1:2014 standard.
Person in charge of transport, handling, unloading and placing on site	Operator qualified to: • use lifting equipment; • the safe handling (even manual) of materials and equipment. The equipment must be lifted and handled strictly in accordance with the instructions provided by the manufacturer as well as the regulations in force at the place where the equipment is installed.

Tab. 2.10.

PAGE INTENTIONALLY LEFT BLANK

3 - SAFETY

3.1 - GENERAL SAFETY WARNINGS

⚠ WARNING!

- **It is strictly forbidden to repair or make any modifications to the equipment.**
- **For information and warnings regarding replacing batteries, refer to chapter 9 in this manual.**

⚠ ATTENTION!

Authorised operators must not carry out operations or services on their own initiative that do not fall within their competence.
Never operate the equipment:

- **while under the influence of intoxicating substances such as alcohol;**
- **if you are using drugs that may slow reaction times.**

NOTICE!

The employer must train and inform operators on how to behave during operations and on the equipment to be used.

Before installation, commissioning or maintenance, operators must:

- take note of the safety regulations applicable to the place of installation they are working in;
- obtain the necessary permits to operate when required;
- wear the personal protective equipment required by the procedures described in this instruction manual:
- ensure that the required collective protective equipment and safety information are available in the area they are operating in.

3.1.1 - SAFETY INSTRUCTIONS FOR INSTALLATION

The AQUALOG PQ EVO series versions must be installed and commissioned in accordance with the applicable regulations and standards.

NOTICE!

PIETRO FIORENTINI S.p.A. shall not be liable for damage resulting from failure to comply with the instructions and from misuse.

Safety warnings

All operations on the equipment must be performed by qualified personnel.

Transformation and spare parts

Any technical changes are forbidden. Use only original spare parts intended by PIETRO FIORENTINI S.p.A.

Transport

As a rule, the equipment must be transported in an upright position and inside the original packaging box provided by PIETRO FIORENTINI S.p.A.
Upon receipt of the device, examine the supplied material.
Immediately report any shipping damage.

Storage

The equipment must be stored horizontally in a dry place at room temperature (see section 6.6.1).

WARNING!

- **Install the equipment in a compartment that meets the provisions in force on safety, away from any possible damage of mechanical origin, away from sources of heat or naked flames, in a dry place and protected from external agents.**
- **During installation, avoid mechanical stress to the inlet and outlet connections.**
- **It is strictly forbidden to repair or make any modifications to the device.**
- **The installation, removal, and any operations must be performed by qualified personnel, in compliance with the provisions in force concerning safety.**

3.2 - PERSONAL PROTECTIVE EQUIPMENT

The following table shows the Personal Protective Equipment (PPE) and its description; an obligation is associated with each symbol.
Personal protective equipment means any equipment intended to be worn by the worker in order to protect them against one or several risks that are likely to threaten their safety or health during work.
For the operators in charge, depending on the type of work requested, the most appropriate PPE from those reported in Tab. 3.11 must be used:

Symbol	Meaning
	**Obligation to use safety or insulated gloves.** Indicates a requirement for the personnel to use safety or insulated gloves.
	**Obligation to use safety goggles.** Indicates a requirement for personnel to use protective goggles for eye protection.
	**Obligation to use safety shoes.** Indicates a requirement for the personnel to use accident-prevention safety shoes.
	**Obligation to use noise protection equipment.** Indicates a requirement for the personnel to use ear muffs or ear plugs to protect their hearing.
	**Obligation to wear protective clothing.** Indicates a requirement for the personnel to wear specific protective clothing.
	**Obligation to use a protective mask.** Indicates a requirement for the personnel to use respiratory masks in the event of a chemical risk.
	**Obligation to use a protective helmet.** Indicates a requirement for the personnel to use protective helmets.
	**Obligation to wear high visibility vests.** Indicates a requirement for the personnel to use high visibility vests.

Tab. 3.11.

⚠ WARNING!

Each licensed operator is obliged to:

- **take care of his/her own health and safety and that of other people in the workplace who are affected by his/her actions or omissions, in accordance with the training, instructions and equipment provided by the employer;**
- **appropriately use the PPE made available;**
- **immediately report to the employer, the manager or the person in charge any deficiencies in the equipment and devices, as well as any dangerous conditions they may become aware of.**

3.3 - OBLIGATIONS AND PROHIBITIONS

The following is a list of obligations and prohibitions to be observed for the safety of the operator.

It is mandatory to:

- carefully read and understand the use, maintenance and warning manual;
- before installing the equipment, strictly refer to the details specified on the nameplates and in the manual;
- avoid knocks and violent impact that could damage the equipment.

It is forbidden to:

- operate in various capacities on the equipment without the PPE indicated in the work procedures described in this manual;
- operate in the presence of open flames or bring open flames close to the work area;
- smoke near the equipment or while working on it;
- use the equipment with parameters other than those indicated on the rating plate;
- use the equipment outside the operating temperature range specified in this manual;
- install or use the equipment in environments other than those specified in this manual.

3.4 - RESIDUAL RISKS

The equipment does not present residual risks for the operator related to its normal operation.

⚠ WARNING!

If there are any functional faults, do not operate.
Immediately contact PIETRO FIORENTINI S.p.A. for the necessary directions.

3.5 - SAFETY PICTOGRAMS

The equipment and/or packaging PIETRO FIORENTINI S.p.A. good bear the safety pictograms described in Tab. 3.12:

Symbol	Definition
	Symbol used to identify a GENERIC HAZARD.
	Symbol used to identify DANGERS GENERATED BY STATIC ELECTRICITY.
	Symbol applied to the packaging to identify the type of danger and risks related to the transported product, based on the classification of the European ADR agreement. Class 9 (Various dangerous substances). ADR - UN3090 (lithium metal batteries).
	The symbol indicates that the product must not be disposed of as unsorted waste but must be sent to separate collection facilities for recovery and recycling (WEEE Directive 2012/19/EU on waste electrical and electronic equipment - WEEE)

Tab. 3.12.

⚠ WARNING!

It is forbidden to remove or alter the safety pictograms on the equipment or the packaging.

3.6 - NOISE LEVEL

The AQUALOG PQ EVO series has no moving parts.
For the value of the noise generated by the equipment and further information, contact PIETRO FIORENTINI S.p.A.

⚠ ATTENTION!

The obligation to use earmuffs or ear plugs to protect the hearing of qualified professional figures (reference paragraph 2.10) remains in the event that the noise in the installation environment of the equipment (depending on specific operating conditions) exceeds the value of 85 dBA.

PAGE INTENTIONALLY LEFT BLANK

4 - DESCRIPTION AND OPERATION

4.1 - GENERAL DESCRIPTION

AQUALOG PQ EVO is a water mains monitoring datalogger suitable for operation in harsh environments. This device enables the monitoring of various physical quantities in applications characterised by hard-to-install conditions and power failures.

AQUALOG PQ EVO guarantees:

- protection rating IP 68;
- connection to the control centre via 2G/3G/4G, LoRaWAN networks, as desired.

The main applications include pressure monitoring and leakage detection in District Metering Area (DMA) networks. It operates both as a datalogger and as a pressure transmitter of the critical point and other significant network points.

The main elements are (see Fig. 4.2.):

Pos.	Description	Pos.	Description
1	Plastic enclosure	2	Cable glands
3	Clamping screws	-	-

** METROLOGICAL BATTERY not visible in the picture* *Tab. 4.13.*

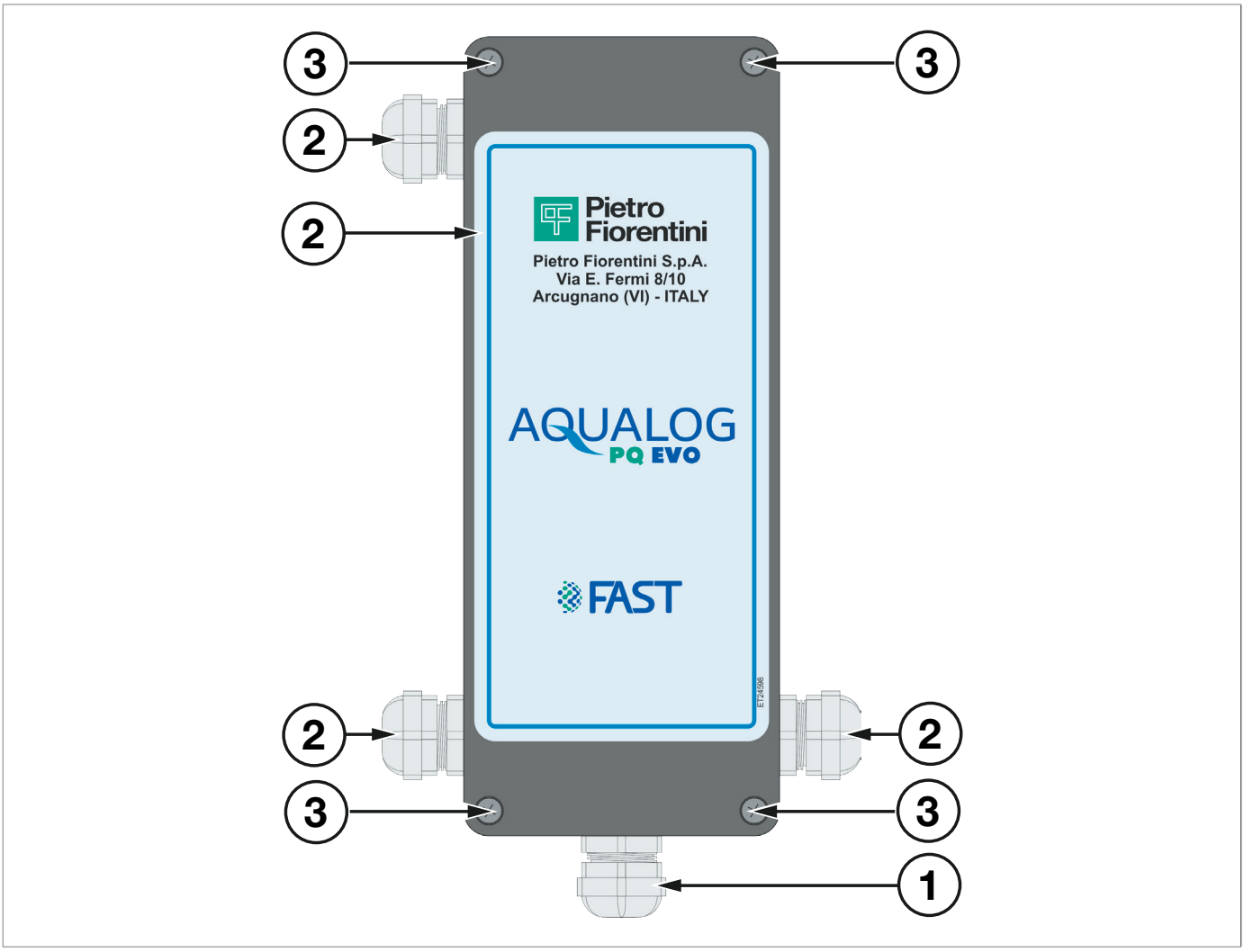


Fig. 4.2. General descriptionAQUALOG PQ EVO

4.2 - POWER SUPPLY DEVICES

The AQUALOG PQ EVO EVO appliance is powered by a battery pack equipped with two Lithium Thionyl Chloride cells, which guarantees high operating autonomy and easy installation.

AQUALOG PQ EVO can also be powered from external sources:

- photovoltaic panel
- micro-turbine
- mains power supply (230V).

4.2.1 - BATTERIES

The AQUALOG PQ EVO equipment can use the following battery models:

Features	Type	Supply
2-cell battery	Li-SOCl2	Standard

Tab. 4.14.

WARNING!

- **Only the battery models described in this manual must be used.**
- **Do not short-circuit the terminals of the battery pack.**
- **Do not attempt to open the casing.**
- **Keep away from heat sources.**
- **Do not try to recharge.**

NOTICE!

For the technical details of the battery packs and the reference operating conditions, refer to paragraph "4.4 - Technical data".

4.2.2 - CONNECTORS

4.2.2.1 - CABLE GLAND VERSION

The cable glands used to connect the equipment are metal, screwed directly onto the box, which is fitted with appropriate threaded holes. Each cable gland has an O-ring that guarantees IP68 protection.

Fig. 4.3. Cable glands, front view

Cable gland	Dimensions	Description
P1	M16x1.5	Passage of piezoresistive pressure sensor or 4-20 mA transmitter or digital signal/ meter.
P2	M16x1.5	Passage of piezoresistive pressure sensor or 4-20 mA transmitter or digital signal/ meter.
P3	M16x1.5	Passage of piezoresistive pressure sensor or 4-20 mA transmitter or digital signal/ meter.
P4	M16x1.5	Antenna Passage

Tab. 4.15.

4.3 - INTENDED USE

4.3.1 - ENVISAGED USE

The equipment in question is intended for:

Operation	Permitted	Unpermitted	Work environment
Measuring of hydraulic parameters	Monitoring of water mains	Any other type of carrier other than permitted.	Application in water network installations and nodes.

Tab. 4.16.

The equipment referred to was designed to be used exclusively within the limits specified on the nameplate and according to the instructions and limits of use specified in this manual.

Safe work conditions are as follows:

- use within the limits stated on the rating plate and in this manual;
- compliance with the user manual procedures;
- routine maintenance to be carried out when and how recommended;
- special maintenance to be carried out if required;
- do not tamper with and/or bypass the safety devices.

4.3.2 - REASONABLY FORESEEABLE MISUSE

Incorrect and reasonably foreseeable misuse means the use of the equipment in a way not foreseen in the phase but which can result from result predictable human behaviour:

- using the equipment in a manner other than that referred to under "**Intended use**".
- instinctive reaction of an operator in the event of a malfunction, accident or breakdown while using the equipment;
- behaviour resulting from carelessness;
- behaviour resulting from the use of the equipment by unauthorised and unsuitable people (children, disabled).

Any use of the equipment other than the intended use must be previously approved in writing by PIETRO FIORENTINI S.p.A.

If no written approval is provided, use shall be considered **improper**.

In the event of "improper use", PIETRO FIORENTINI S.p.A. shall not be held liable for any damage caused to people or property, and any type of warranty on the equipment shall be deemed void.

4.4 - TECHNICAL DATA

General features	
External Enclosure	Fibreglass
Casing protection rating	IP68 (immersion for 100 days at a depth of 1 metre)
Connectors	Stainless steel cable glands
Antennas	External
Operating ambient temperature range	from -25°C to + 60°C
Storage temperature range	from -25°C to + 70°C
Mechanical and electrical classes	M2 E2
Power supply voltage	3.6 Vdc
Autonomy	5 years with standard battery pack
Power supply from external source	via DC/DC kit 9 - 36 Vdc (photovoltaic, micro-turbine) and/or 230 Vac
Non-volatile memory	2MBytes

Tab. 4.17.

Communication features	
Interface	• Wi-Fi • Bluetooth
Optical port	Wi-Fi and Bluetooth activation via magnet
Registration No.	• MODBUS • IEC 60870-5-104 • LoRaWAN
Communication vector	• 2G, 3G, 4G • 868 MHz LoRaWAN (optional)
Supported SIM cards	Micro SIM
Alarms/Events	Warning and management of alarms and events generated by exceeding thresholds and/or reaching physical and logical states. Using the message service for alarm notification.
Synchronisation	Daily synchronisation via SCADA server.
Data connection	Programmable centre call, configuration, missing data download, archive, date/time alignment.
Communication	Periodic, scheduled or event-driven.

Tab. 4.18.

4.5 - I/O CHANNELS

AQUALOG PQ EVO acquires signals:

- 2 analogue inputs for mV/V cell piezoresistive sensors.
- Two 4-20 mA analogue inputs (active and passive).
- 10 digital inputs configurable as counting inputs to measure flow rates or as status inputs to monitor alarm signals.
- 1 serial input for digital transmitters (e.g. ultrasonic level transmitter).

4.6 - DATA COMMUNICATION

AQUALOG PQ EVO uses the following methods of communication:

- 2G/3G/4G modem;
- LoRaWAN modem.

The standard operating firmware uses the MODBUS protocol. Alternatively, other protocols may be requested. The alarms can also be sent by SMS.

4.7 - ANTENNAS

Antenna type	Image*
External antenna bracketed to the AQUALOG PQ EVO device Suitable for installation in a thermowell or on stations where external elements could mask the GSM field	
External antenna on the AQUALOG PQ EVO device and drivable Suitable for installation outside the thermowell with a dedicated external pocket	

* *Images are for illustration purposes only*

Tab. 4.19.

4.8 - WIRING

AQUALOG PQ EVO, can acquire the signals:

- 2 analogue inputs for piezoresistive cell sensors.
- Two 4-20 mA analogue inputs (active and passive).
- 2 digital inputs configurable as counting inputs to measure flow rates or as status inputs to monitor alarm signals.
- 1 serial input for digital transmitters (e.g. ultrasonic level transmitter).

4.8.1 - ANALOGUE PRESSURE INPUTS

Each analogue pressure input has four terminals, each with a specific function.

ANALOGUE INPUT - mV/V cell signals					
Terminal block	PIN	Terminal	Description	Connection sensor	Image
M2	11	VP1+	Positive cell power supply	IN+	
M2	12	VS1+	Positive cell signal	OUT+	
M2	13	VS1-	Negative cell signal	OUT-	
M2	14	PSW1	Negative cell power supply	IN-	
M2	15	VP2+	Positive cell power supply	IN+	
M2	16	VS2+	Positive cell signal	OUT+	
M2	17	VS2-	Negative cell signal	OUT-	
M2	18	PSW2	Negative cell power supply	IN-	

* *Note: The PINs of terminal block M1 are numbered from left to right*

Tab. 4.20.

Fig. 4.44 shows the connection of a pressure transducer to channel 1 of the device AQUALOG PQ EVO, represented as a resistor bridge.

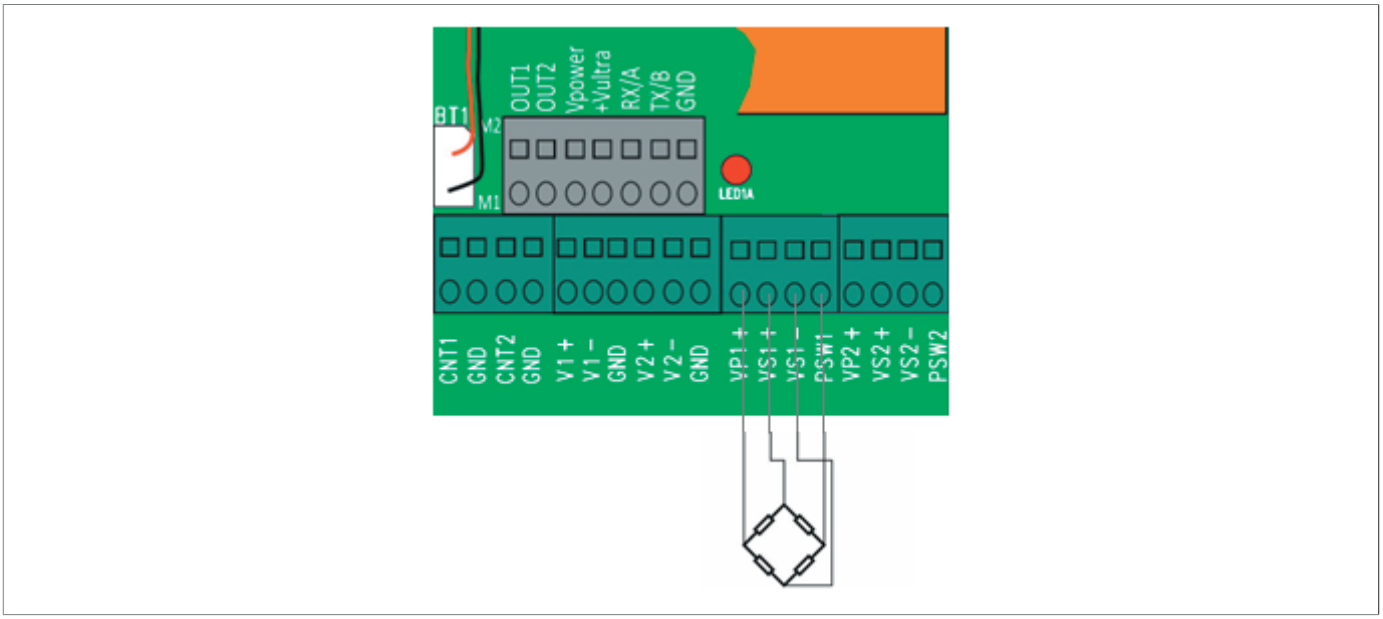
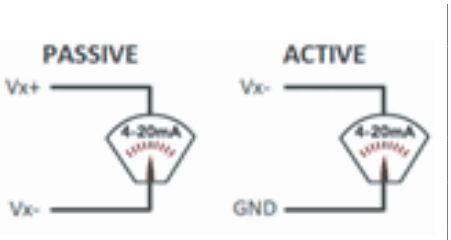


Fig. 4.4. Pressure input terminal block

4.8.2 - ANALOGUE PRESSURE INPUTS

It is possible to sequentially supply 2 4-20 mA transmitters and to read 4-20 mA signals in the following mode:

- passive: use terminals 'Vx+' to supply the current loop and 'Vx-' to connect the signal.
- active: use terminals 'Vx-' to connect the signal and 'GND' to close the current loop to the ground reference.

ANALOGUE INPUT - mV/V cell signals				
Terminal block	PIN	Terminal	Description	Image
M1	5	V1+	4-20 mA transmitter loop power supply	
M1	6	V1-	4-20 mA loop signal input	
M1	7	GND	4-20 mA transmitter loop ground	
M1	8	V2+	4-20 mA transmitter loop power supply	
M1	9	V2-	4-20 mA loop signal input	
M1	10	GND	4-20 mA transmitter loop ground	

* *Note: The PINs of terminal block M1 are numbered from left to right*

Tab. 4.21.

4.8.3 - DIGITAL INPUTS

The digital inputs must be driven via a voltage-free contact (Relay or Open Collector) which closes the input to GND. Fig. 4.5 shows the connection of a switch to the first digital input DI1.

ANALOGUE INPUT - mV/V cell signals				
Terminal block	PIN	Terminal	Description	Image
M1	1	CNT1	Status/pulse input 1	
M1	2	GND	Mass	
M1	3	CNT2	Status/pulse input 2	
M1	4	GND	Mass	

* *Note: The PINs of terminal block M1 are numbered from left to right*

Tab. 4.22.

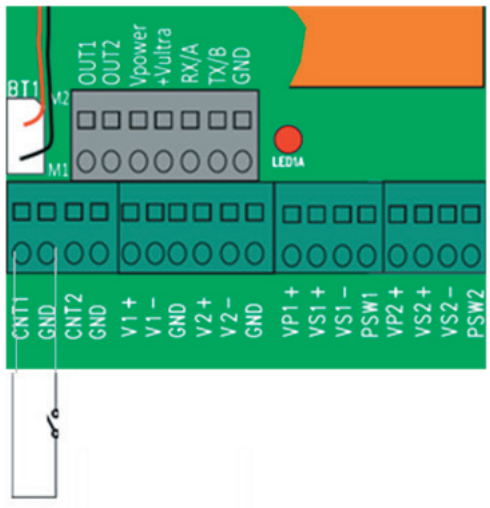


Fig. 4.5. Digital input terminal block

These digital inputs are used to acquire the status of switches present in the system and classified as single elements.

4.8.4 - SERIAL INPUT

ANALOGUE INPUT - mV/V cell signals				
Terminal block	PIN	Terminal	Description	Image
M2	1	OUT1	n.a.	-
M2	2	OUT2	n.a.	
M2	3	VPower	n.a.	
M2	4	+Vultra	Transmitter power supply	
M2	5	RX/B	Signal input	
M2	6	TX/A	n.a.	
M2	7	GND	Signal loop ground	

Tab. 4.23.

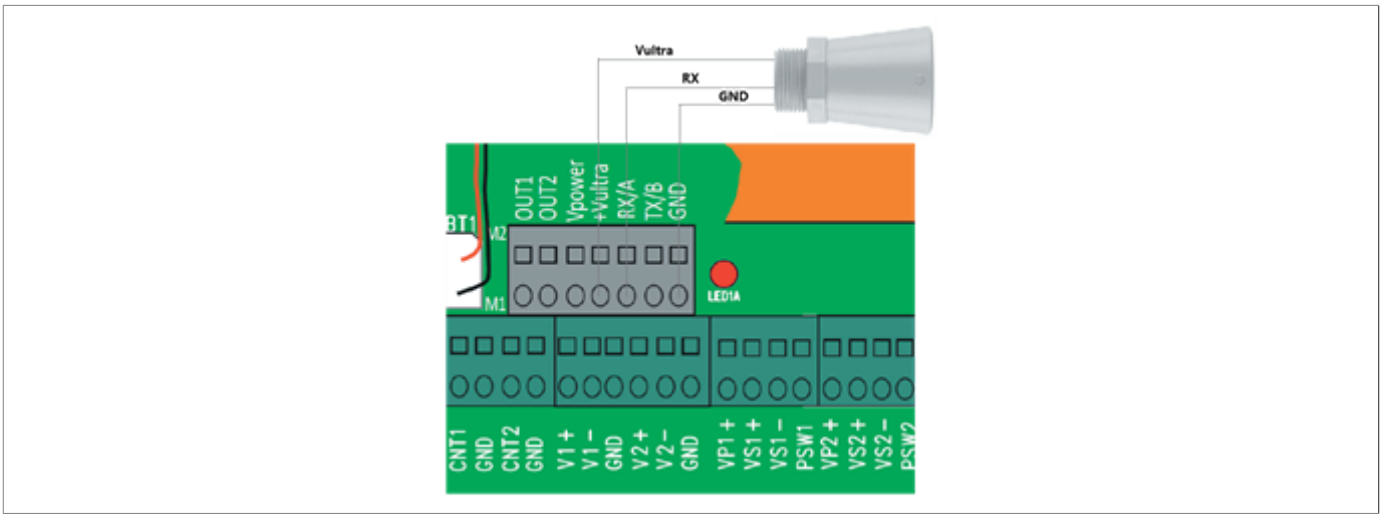


Fig. 4.6. Serial input terminal block

PAGE INTENTIONALLY LEFT BLANK

5 - USER INTERFACE

5.1 - LOCAL COMMUNICATION INTERFACE

The main local communication interfaces are:

- Wi-Fi.
- Bluetooth.

⚠ ATTENTION!

Wireless communication can be Wi-Fi or Bluetooth. The setting is performed on the RTU firmware. For changing the local communication interface, see section 5.1.3 'Changing the Wireless (Wi-Fi or Bluetooth) Communication Interface'.

5.1.1 - COMMUNICATION INTERFACE VIA WI-FI

The Wi-Fi interface allows communication with the RTU via the Rainbow software without removing the cover. A magnet and a PC with a Wi-Fi network card are required to turn on Wi-Fi.

To make a Wi-Fi connection to the machine, proceed as follows:

1. Place the magnet next to the 'WAKE UP' label (Fig. 5.7.).
2. Run the Rainbow programme from the PC.
3. Select the desired RTU and double-click the mouse.
4. Select 'RTU' in the top left-hand corner.
5. Select 'Monitor Diagnostics' from the drop-down menu.
6. Select the 'IP address (IP: 192.168.4.1; Port: 502)' in the new window.
7. Connect from PC to the Wi-Fi hotspot network created with the TAG name of the peripheral device.
8. Click the 'Connect' button.
9. Wait for connection and interact with the RTU.

Fig. 5.7. Wi-Fi enabling label

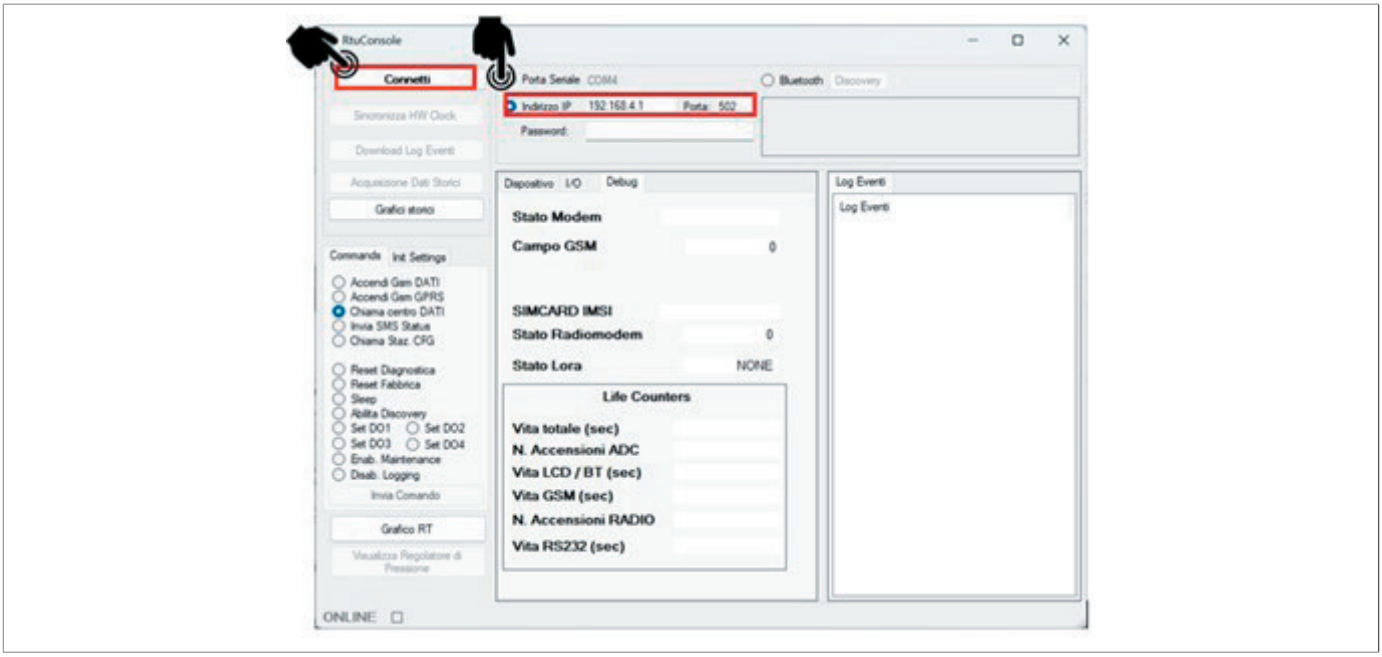


Fig. 5.8. Rainbow interface for Wi-Fi connection

5.1.2 - COMMUNICATION INTERFACE VIA BLUETOOTH

The Bluetooth interface allows communication with the RTU via the Rainbow software without removing the cover. Bluetooth start-up requires a magnet and a PC that supports the standard Bluetooth 4.0.

To make a Bluetooth connection to the machine, proceed as follows:

1. Place the magnet next to the 'WAKE UP' label (Fig. 5.9.).
2. Run the Rainbow programme from the PC.
3. Select the desired RTU and double-click the mouse.
4. Select 'RTU' in the top left-hand corner.
5. Select 'Monitor Diagnostics' from the drop-down menu.
6. Select the 'Bluetooth' button in the new window.
7. Click the 'Discovery' button and wait for the text box next to it to display the serial numbers (wait approximately 30 seconds).
8. Check that the name 'RTU' is present with the corresponding MAC Address next to it.

NOTICE!

In future versions of Rainbow, the name of the 'RTU' will replace this digit.

9. Select the name "RTU" and click "Connect".
10. Wait for connection and interact with the RTU.

NOTICE!

If there is no Bluetooth iteration between the Rainbow software and the RTU, after about 1 minute the BT communication channel is switched off and will need to be reactivated as indicated in step 1.

Fig. 5.9. Bluetooth enabling label

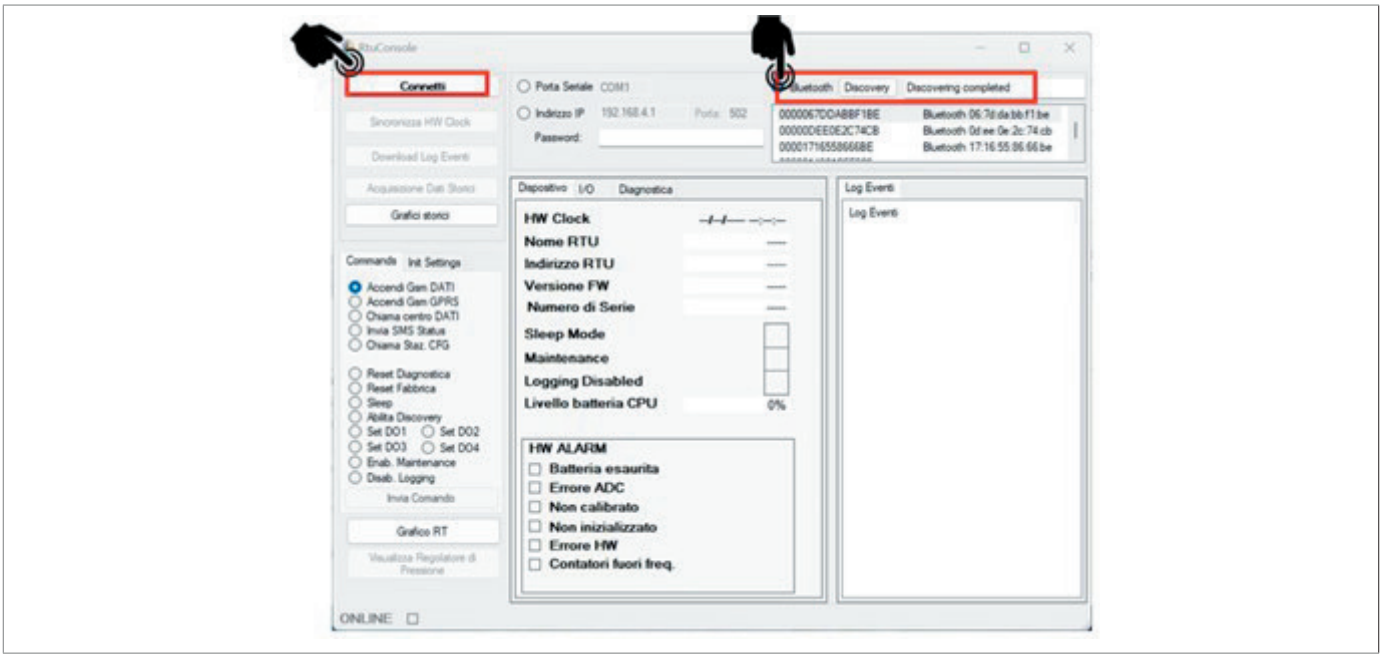


Fig. 5.10. Rainbow interface for Bluetooth connection

5.1.3 - WIRELESS COMMUNICATION INTERFACE (WI-FI OR BLUETOOTH)

Changing the wireless communication interface (from Wi-Fi to Bluetooth or vice versa) can be done via the Rainbow software.

5.1.3.1 - SWITCHING FROM WI-FI TO BLUETOOTH

1. Place the magnet next to the 'WAKE UP' label.
2. Run the Rainbow programme from the PC.
3. Select the desired RTU and double-click the mouse.
4. Select 'RTU' in the top left-hand corner.
5. Select 'Monitor Diagnostics' from the drop-down menu.
6. Select the 'IP address (IP: 192.168.4.1; Port: 502)' in the new window.

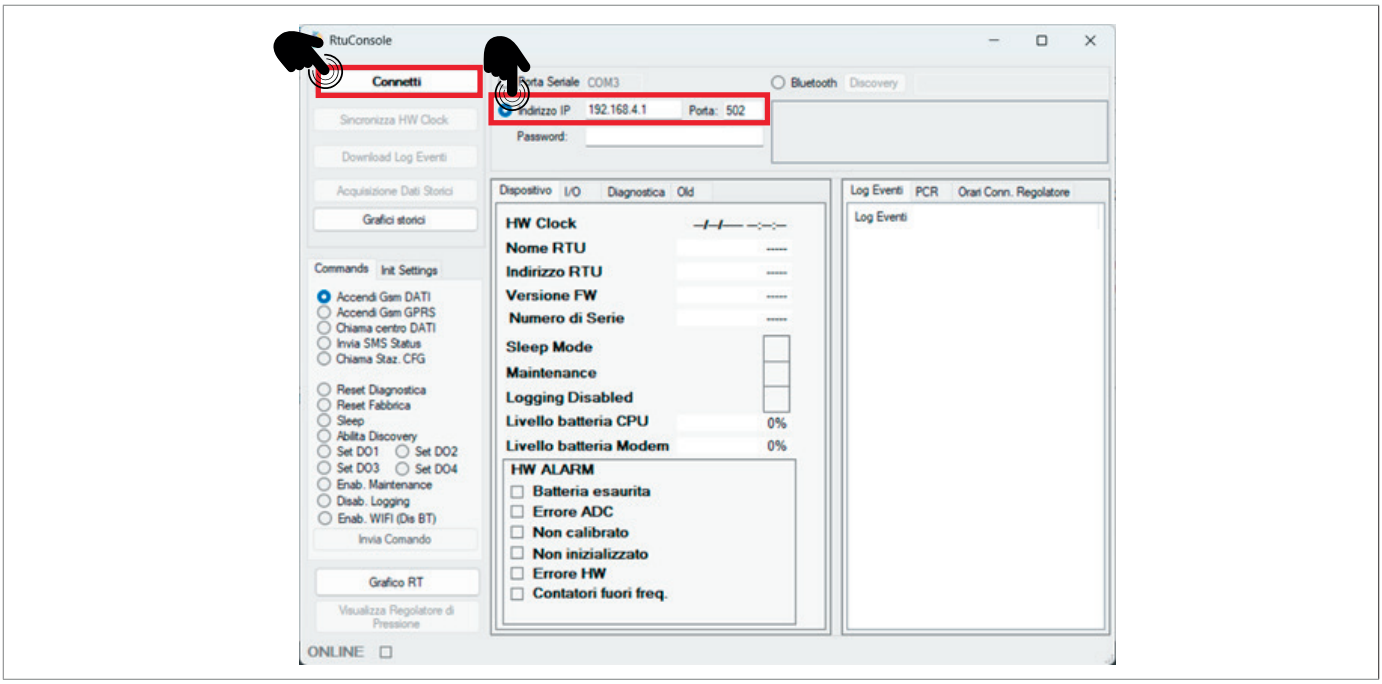


Fig. 5.11. Rainbow interface for Wi-Fi connection

7. Connect from PC to the Wi-Fi hotspot network created with the TAG name of the peripheral device.
8. Click the 'Connect' key (in the case of a failed connection via Wi-Fi, continue from section 5.1.3.2.).

9. Select the command **Enab. BT (Dis WiFi)** and press Send Command to change the connection type from Wi-Fi to Bluetooth.

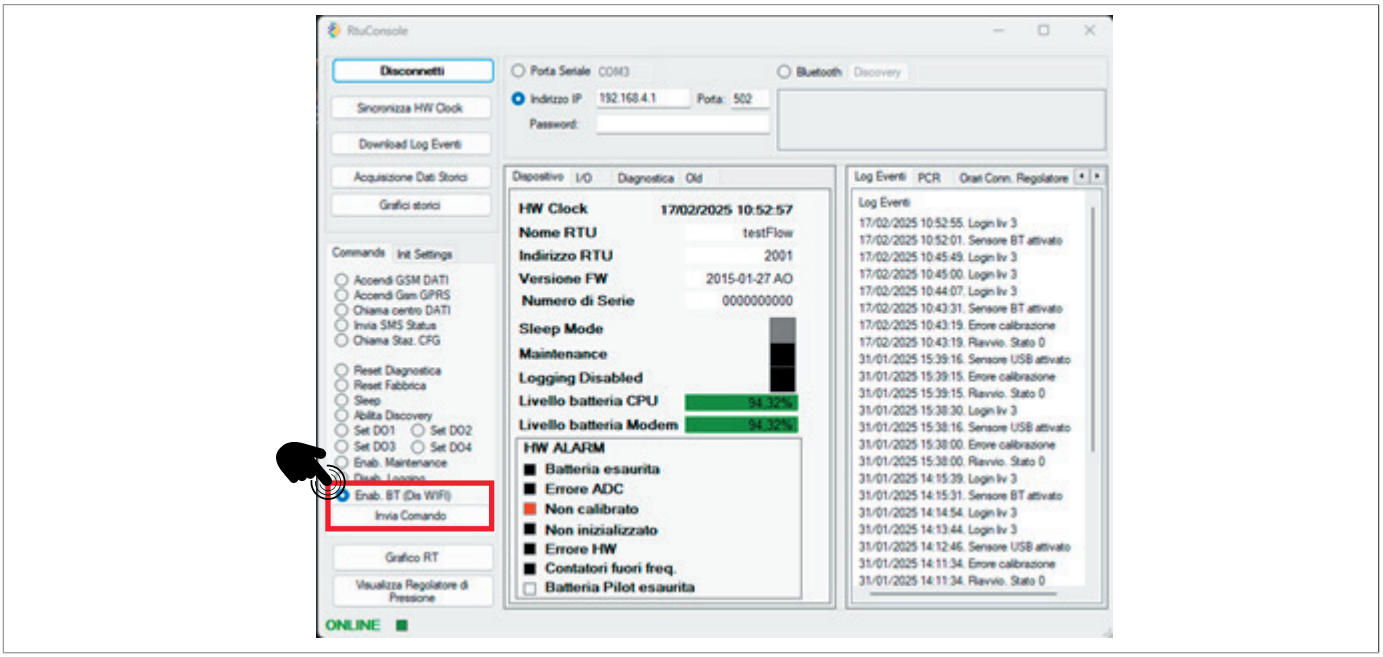


Fig. 5.12. Rainbow interface for switching to Bluetooth mode

10. If a confirmation message is returned, press OK, disconnect from the connection and wait 2 minutes (peripheral device timeout time), after which time you will be able to connect in the required mode.

5.1.3.2 - SWITCHING FROM BLUETOOTH TO WI-FI

1. Place the magnet next to the 'WAKE UP' label.
2. Run the Rainbow programme from the PC.
3. Select the desired RTU and double-click the mouse.
4. Select 'RTU' in the top left-hand corner.
5. Select 'Monitor Diagnostics' from the drop-down menu.
6. Select the 'Bluetooth' button in the new window.
7. Click the 'Discovery' button and wait for the text box next to it to display the serial numbers.

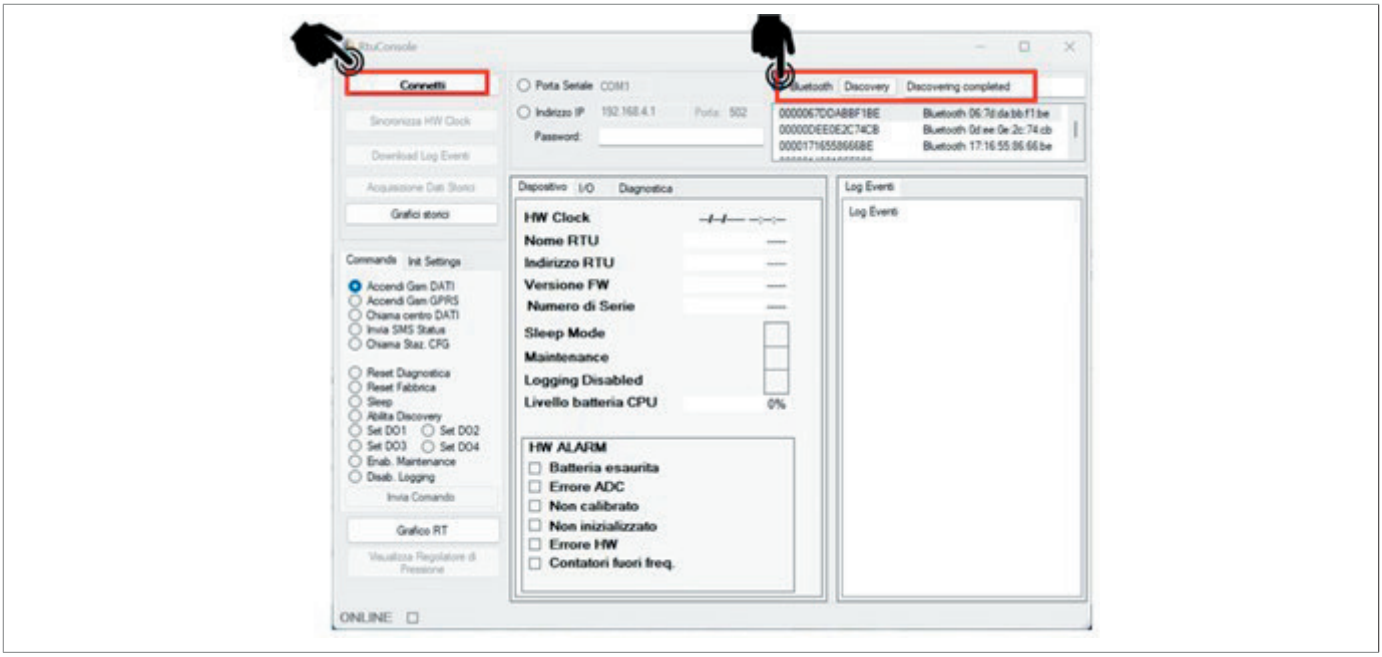


Fig. 5.13. Rainbow interface for Bluetooth connection

8. Check that the name 'RTU' is present with the corresponding MAC Address next to it NOTICE: In future versions of Rainbow, the name 'RTU' will replace this digit.
9. Select the name 'RTU' and click the 'Connect' key (in the case of a failed connection via Bluetooth, continue from section 5.1.3.1).
10. Wait for connection and interact with the RTU.

11. Select the command **Enab. BT (Dis WiFi)** and press Send Command to change the connection type from Bluetooth to Wi-Fi.

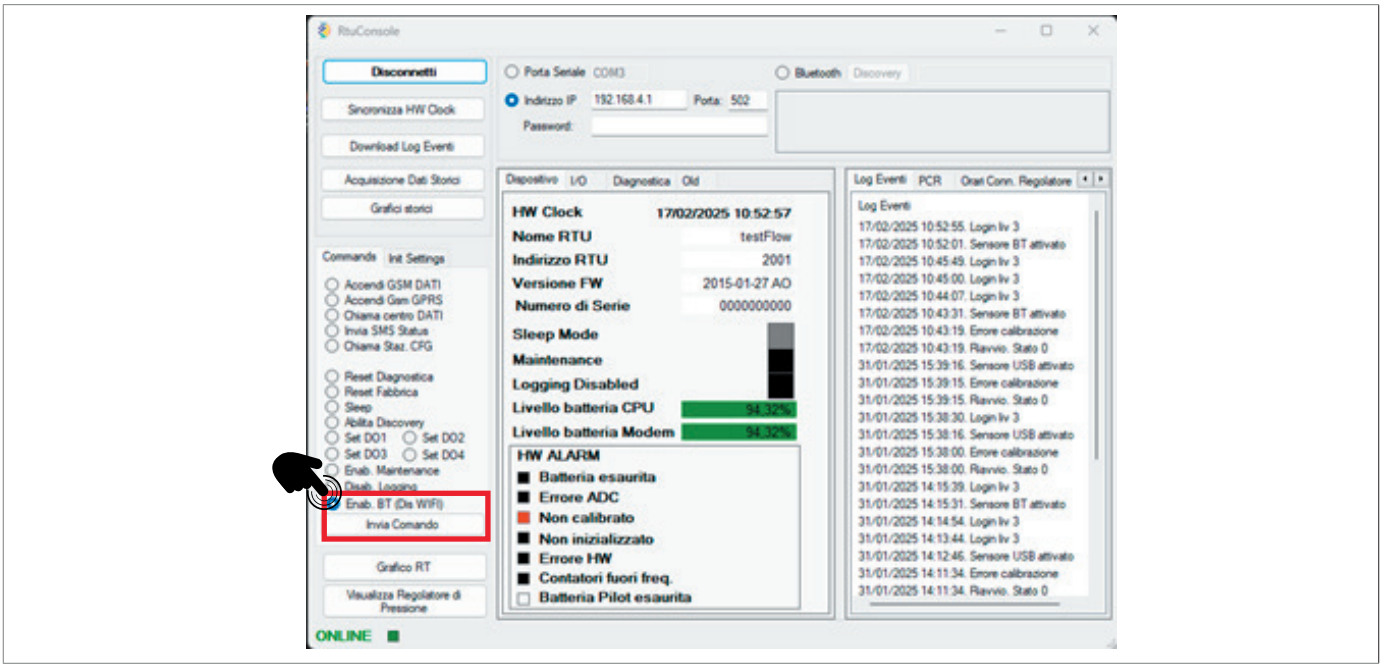


Fig. 5.14. Rainbow interface for switching to Wi-Fi mode

12. If a confirmation message is returned, press OK, disconnect from the connection and wait 2 minutes (peripheral device timeout time), after which time you will be able to connect in the required mode.

PAGE INTENTIONALLY LEFT BLANK

6 - TRANSPORT AND HANDLING

6.1 - SPECIFIC WARNINGS FOR TRANSPORT AND HANDLING

NOTICE!

Transport and handling must be carried out in compliance with the regulations in force in the country of installation by personnel who are:

- **qualified (specially trained);**
- **who are familiar with accident prevention and workplace safety regulations;**
- **authorised to use lifting equipment.**

Transport and handling	
Operator qualification	• Installer.
PPE required	 **WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE required to protect against risks associated with the workplace, installation or operating conditions, please refer to:** • **the regulations in force in the country of installation;** • **any information provided by the Safety Manager at the installation facility.**
Weights and dimensions of the equipment	For dimensions and weights please refer to “6.3 - Physical characteristics of the device”.

Tab. 6.24.

6.1.1 - PACKAGING AND FASTENERS USED FOR TRANSPORT

The transport packaging is designed and manufactured to avoid damage during normal transport, storage and handling.

The equipment must be kept in the packaging until installation.

Upon receiving the equipment, please:

- make sure that no part has been damaged during transport and/or handling;
- immediately report any damage found to PIETRO FIORENTINI S.p.A..

NOTICE!

PIETRO FIORENTINI S.p.A. shall not be liable for any damage to people or property caused by accidents due to failure to comply with the instructions provided in this manual.

Tab. 6.25 describes the types of packaging used:

Ref.	Type of packaging	Image
A	Single box	

Tab. 6.25.

6.2 - PACKAGING CONTENT

AQUALOG PQ EVO is shipped with:

- battery inside, to be connected;
- internal antenna;
- wall-mounting bracket.

6.3 - PHYSICAL CHARACTERISTICS OF THE DEVICE

6.3.1 - CABLE GLAND VERSION

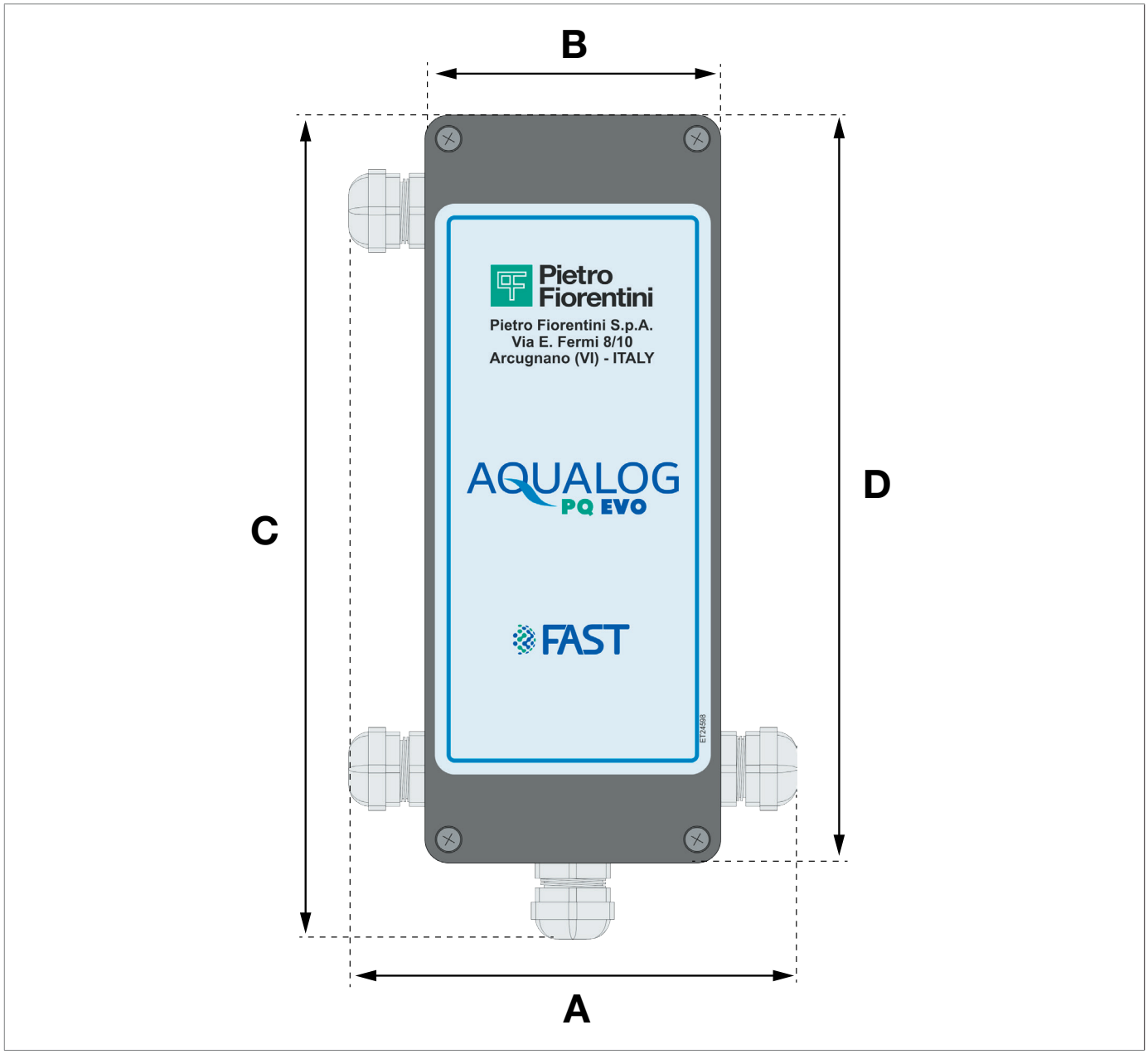


Fig. 6.15. Dimensions AQUALOG PQ EVO, front view

Weights and dimensions	
A	114 mm
B	75 mm
C	209 mm
D	190 mm
Weight	1 kg

Tab. 6.26.

6.3.2 - LOWER SIDE

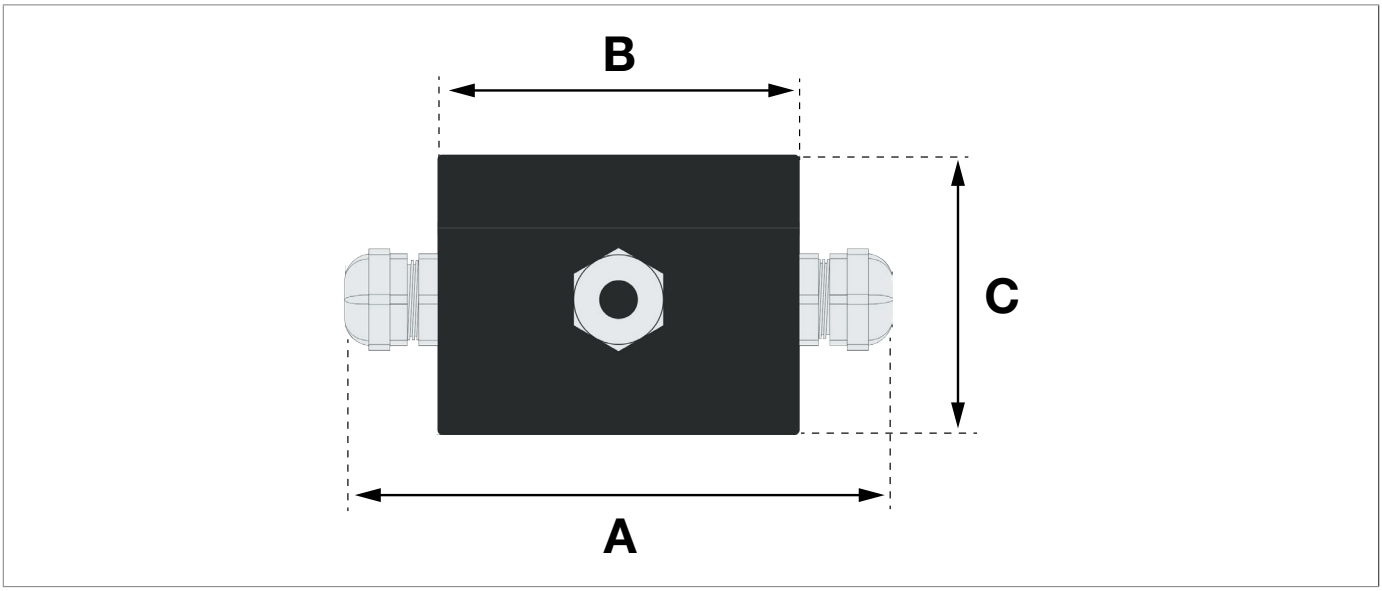


Fig. 6.16. Lower side external view

Dimensions [mm]	
A	114 mm
B	75 mm
C	58 mm

Tab. 6.27.

6.4 - EQUIPMENT ANCHORING AND LIFTING METHOD

HAZARD!

Using lifting equipment (if necessary) for unloading, carrying and handling packages is reserved only for skilled operators who have been properly trained (and are appropriately qualified if required by the regulations in force in the country of installation) and are familiar with:

- **accident prevention rules;**
- **workplace safety provisions;**
- **lifting equipment features and limits.**

HAZARD!

Before handling a load, make sure that its weight does not exceed the load capacity of the lifting equipment (and any other lifting tools) specified on the specific plate.

ATTENTION!

Before moving the equipment:

- **remove any movable or hanging component or firmly secure it to the load;**
- **protect fragile equipment;**
- **check that the load is stable;**
- **make sure to have perfect visibility along the route.**

6.4.1 - FORKLIFT HANDLING METHOD

⚠ HAZARD!

It is forbidden to:

- **transit under suspended loads;**
- **move the load over the personnel operating in the site/plant area.**

⚠ WARNING!

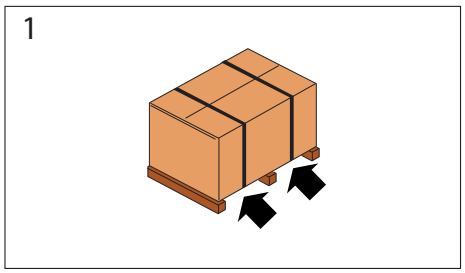
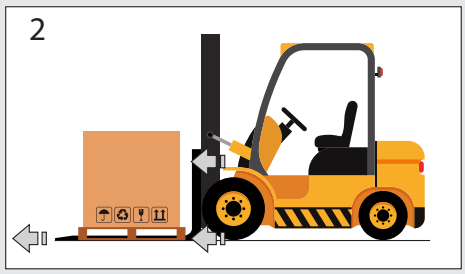
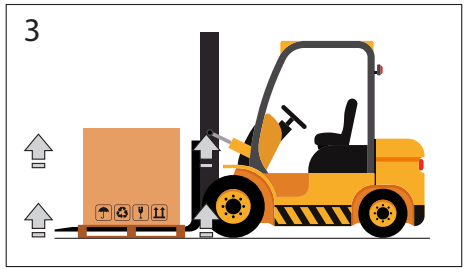
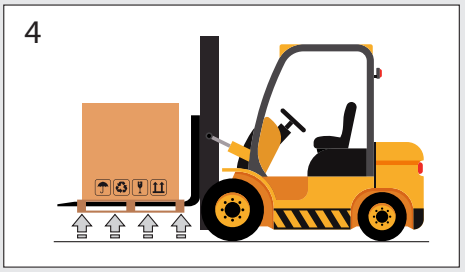
The following is not allowed on forklifts:

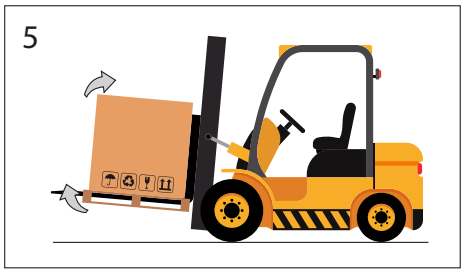
- **carrying passengers;**
- **lifting people.**

⚠ WARNING!

During all handling operations, pay close attention to avoid impact or vibrations of the equipment batteries.

If cardboard boxes (single or multiple) are carried on a pallet, proceed as indicated in Tab. 6.288:

Step	Action	Image
1	Place the forks of the forklift under the load surface.	
2	Make sure that the forks protrude from the front of the load (by at least 5 cm), far enough to eliminate any risk of the transported load tipping.	
3	Raise the forks until they are touching the load. **NOTICE!** **Fasten the load to the forks with clamps or similar devices if required.**	
4	Slowly lift the load by a few dozen centimetres and check its stability, making sure that the centre of gravity of the load is at the centre of the lifting forks.	

Step	Action	Image
5	Tilt the mast backwards (towards the driver's seat) to help the overturning moment and to ensure greater load stability during transport.	
6	Adjust transport speed according to the type of floor and load, avoiding sudden manoeuvres. **⚠ WARNING!** **In case of:** • **obstacles along the path;** • **particular operating situations;** **hinder operator visibility, the assistance of a ground operator is required, standing outside the range of action of the lifting equipment, with the task of signalling.**	-
7	Place the load in the chosen installation area.	-

Tab. 6.28.

6.5 - PACKAGING REMOVAL

Packaging removal	
Operator qualification	• Installer.
PPE required	 **WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE necessary to protect against risks associated with the workplace or operating conditions, please refer to:** • **the regulations in force in the country of installation;** • **any information provided by the Safety Manager at the installation facility.**

Tab. 6.29.

To unpack the cardboard boxes (single or multiple) supported by a pallet, proceed as described in Tab. 6.30:

Step	Action
1	Remove the stretch film around the pallet.
2	Remove the 4 support corners.
3	Move the boxes of the equipment from the pallet to their intended place. **NOTICE!** **Have at least 2 operators manually move the packages if required due to their dimensions/ weight.**

Tab. 6.30.

NOTICE!

After removing all packaging materials, check for any anomalies.
If there are anomalies:
- **do not install the equipment;**
- **contact PIETRO FIORENTINI S.p.A. and specify the details provided on the equipment rating plate.**

WARNING!

The single piece of equipment is contained in a specifically created cardboard box.
Avoid taking the equipment out of the box before its installation.

6.5.1 - PACKAGING DISPOSAL

NOTICE!

Sort the various materials making up the packaging and dispose of them in compliance with the regulations in force in the country of installation.

6.6 - STORAGE AND ENVIRONMENTAL CONDITIONS

⚠ WARNING!

Protect the equipment from blows and impacts, even accidental, until it is installed.

If the equipment needs to be stored for an extended period, the minimum environmental conditions for the intended storage are provided in Tab. 6.31. Compliance with these conditions will guarantee the declared performance:

Conditions	Data
Maximum storage period	A maximum storage period is not defined as it is only limited by the life span of the product.
Storage temperature	from -25°C to +60°C
Relative humidity	95%

Tab. 6.31.

6.6.1 - STORAGE OF THE SPARE BATTERIES

Any spare battery packs ordered must be stored:

- in their original packaging or alternatively in ADR compliant packaging, by placing the containers at ground level (do not stack above 1.2 m);
- in a place with a temperature ≤ 25°C in order to preserve its electrical characteristics;
- away from flammable material, water and rain, corrosive agents, heat sources;
- in the absence of direct sunlight;
- away from metal objects;
- so as to prevent any accidental movement;
- so as to prevent their terminals from bearing the weight of other elements stacked on them.

Battery packs must not be stored:

- with damaged batteries;
- with exhausted batteries.

NOTICE!

The packages must be labelled in accordance with ADR, i.e. with a diamond shape on the side and code UN3090.

PAGE INTENTIONALLY LEFT BLANK

7 - INSTALLATION

7.1 - GENERAL WARNINGS

WARNING!

The installation must be performed by qualified personnel, in compliance with the provisions in force concerning safety.

WARNING!

For the safe use of the equipment, respect the permitted environmental conditions and comply with the data shown on the nameplate.

WARNING!

It is forbidden to make modifications to the equipment.

WARNING!

PIETRO FIORENTINI S.p.A. is not liable for damage caused by incorrect installation of the equipment and/or otherwise different from that indicated in this manual.

7.2 - INSTALLATION PRE-REQUISITES

7.2.1 - ALLOWED ENVIRONMENTAL CONDITIONS

NOTICE!

For details on the allowed environmental conditions (temperature range and classification) refer to paragraph “4.4 - Technical data”.

WARNING!

PIETRO FIORENTINI S.p.A. is not liable for damage and/or malfunctions caused by installation in environments other than those permitted.

7.3 - CHECKS BEFORE INSTALLATION

The installation site must be suitable for the safe use of the equipment.
The equipment installation area must have lighting that guarantees the operator good visibility during the installation phases.

Before installation, it must be ensured that:

- the installation compartment meets current safety requirements
- there are no impediments that could hinder the installer's installation operations;
- the equipment connections are clean and undamaged.

Installation	
Operator qualification	• Installer.
PPE required	 **WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE required to protect against risks associated with the workplace, installation or operating conditions, please refer to:** • **the regulations in force in the country of installation;** • **any information provided by the Safety Manager at the installation facility.**
Equipment required	Keys to fix inlet and outlet connections fittings/equipment.

Tab. 7.32.

7.4 - INSTALLATION PROCEDURE

The cables supplied with the pressure sensors have a mechanically non-compact internal structure due to the presence of the compensation tube and any shielding.

This structure causes deformations to the cable and changes the circular shape when tightening the cable gland. This phenomenon weakens the tightness in long-term immersions.

For the connection of sensors and/or external equipment via digital exchange signals, use cables suitable for the installation site, with a compact internal structure.

Neoprene cables are preferred over others due to their compactness and elasticity. They ensure that tightness is maintained in the coupling with the cable gland even as it ages.

NOTICE!

Prevent weakening of the cables, or when using PVC cables or cables with compact internal structures:

- **use a tube of medium-gauge heat shrink tubing to the cable.**
- **apply an adhesive such as RayTech MTR 10/3 to coat the cable in the section inside the cable gland. The adhesive stiffens the structure.**

7.4.1 - EQUIPMENT ASSEMBLY AND SIM INSERTION

To ensure that the system is sealed against the penetration of liquids in the event of temporary immersion, take care to insert the cables correctly into the box.

Only connect sensors to the equipment with the same degree of immersion resistance.

Any junction boxes or equipment connected to the controller by cables must guarantee the same degree of immersion tightness.

Step	Action
1	Secure the device AQUALOG PQ EVO with the brackets.
2	Unscrew and remove the cover screws.
3	Remove the cover.
4	Disconnect the battery pack.
5	Connect the signal cables from the field (refer to section '4.8 - Wiring'). **NOTICE!** **The terminals used for connection are 'spring-loaded'. To perform this step:** **a. Fully press the unlock button with the relative tool.** **b. Insert the wire into the terminal.** **c. Release the unlock button.**
6	Tighten the cable glands.
7	Connect the external antenna to the appropriate connector on the outer tail.

To insert the SIM card:

Step	Action
8	Insert the SIM into the modem slot (Fig. 7.17).
9	Connect the battery pack.
10	Connect via Wireless interface.
11	Configure the equipment (refer to chapter “8 - Configuration”).
12	Check with the Rainbow instruments that the measurements are correct.
13	Make a connection test and check that communication is stable (see paragraphs “8.9 - 2G, 3G, 4G data call communication test” and “8.10 - Testing communication and sending LoRa packets”).
14	Place the cover on the box.
15	Insert all screws first and then secure them. **⚠ WARNING!** **Verify that:** **1. the cover is correctly positioned and fully flush;** **2. no cables have come out;** **then fasten the screws in order not to lose the IP68 protection rating.**

Tab. 7.33.

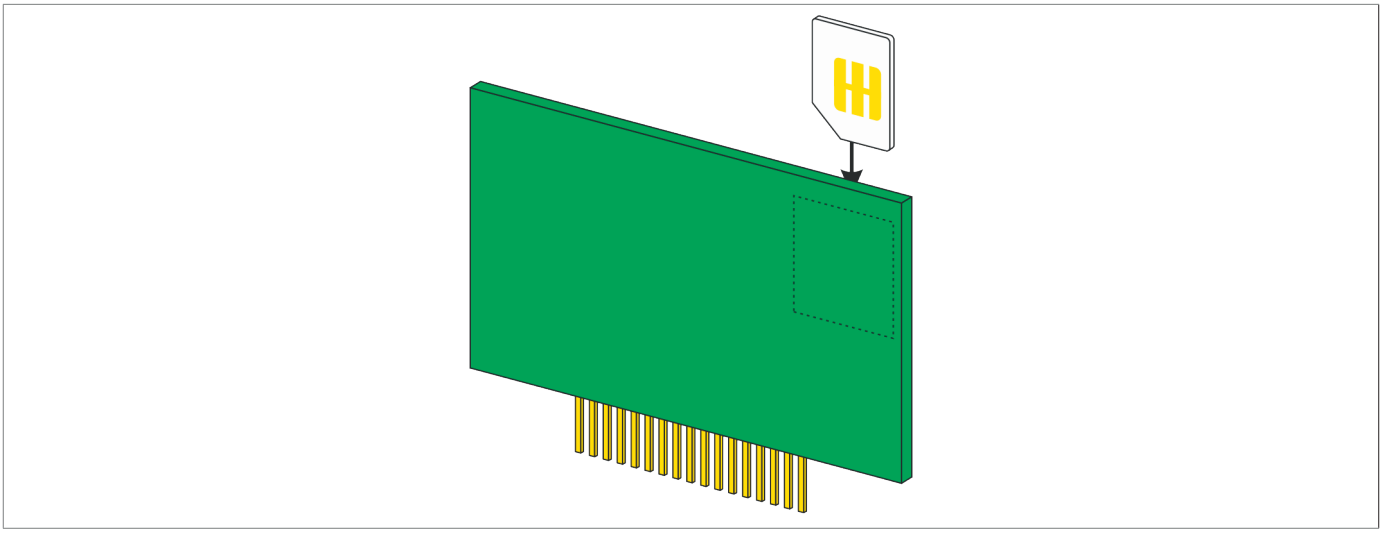


Fig. 7.17. Installation procedure

8 - CONFIGURATION

8.1 - SAFETY REQUIREMENTS FOR CONFIGURATION

Configuration	
Operator qualification	• Specialised technician. • Installer.
PPE required	 **⚠ WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE required to protect against risks associated with the workplace, installation or operating conditions, please refer to:** • **the regulations in force in the country of installation;** • **any information provided by the Safety Manager at the installation facility.**

Tab. 8.34.

8.2 - EQUIPMENT CONFIGURATION

NOTICE!

Equipment configuration must be carried out by authorised and qualified personnel.

Configuration of the AQUALOG PQ EVO dataloggers can be done via the Rainbow software. Please refer to the software manual for detailed operating instructions.

The tool's main features and advanced firmware functionality will be described below.

8.2.1 - STARTING THE RAINBOW SOFTWARE

To start the software:

1. Launch the Rainbow programme
2. Select the desired language (Fig. 8.1818)
3. Select the desired RTU (Fig. 8.1919)

NOTICE!

If the desired RTU is not present, follow the procedure outlined in section 8.2.2.

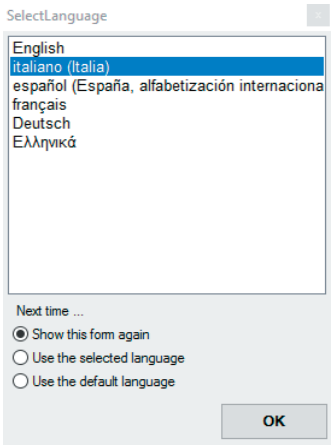


Fig. 8.18. Language selection

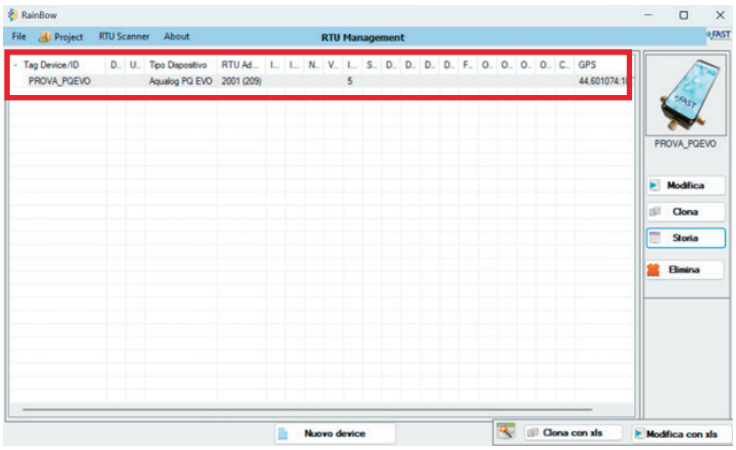


Fig. 8.19. RTU selection

8.2.2 - OPENING THE DATABASE

The list of RTUs is paired with a database saved in a file with the extension **.sdf**.

If it is necessary to select an RTU from another list, then proceed as follows:

1. Select '**File**' at the top left, then '**Open Database**' and left-click.

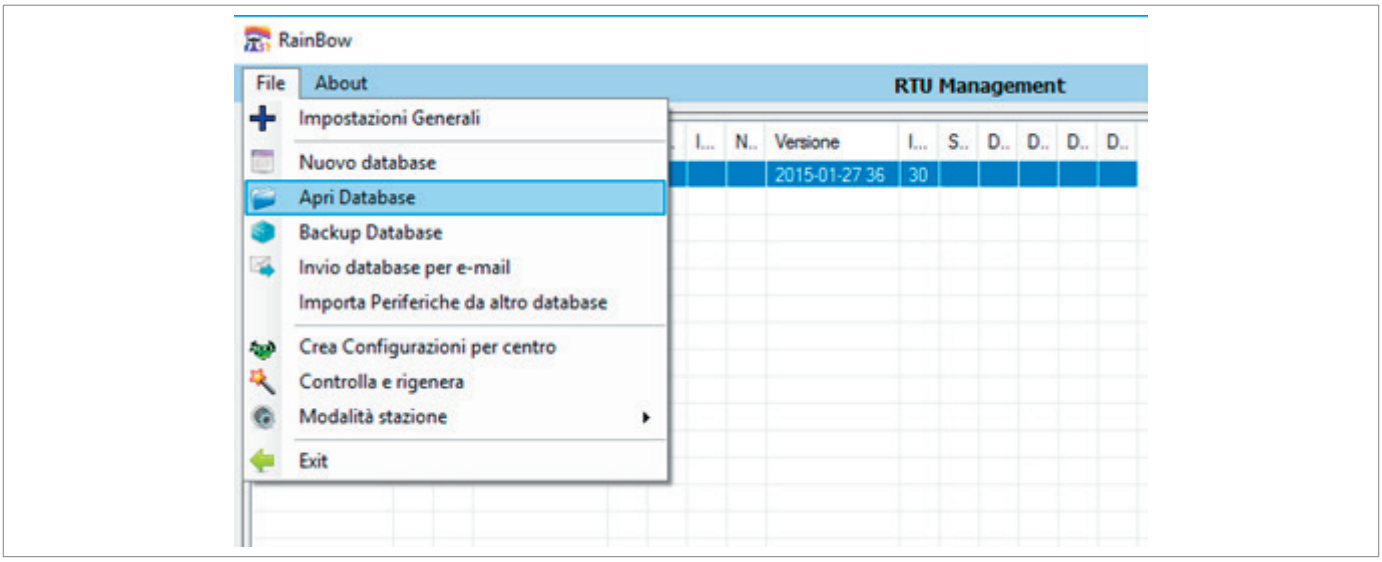


Fig. 8.20. Opening the database

2. Search the PC's network drive for the file with the extension **.sdf**, click on '**Open**'

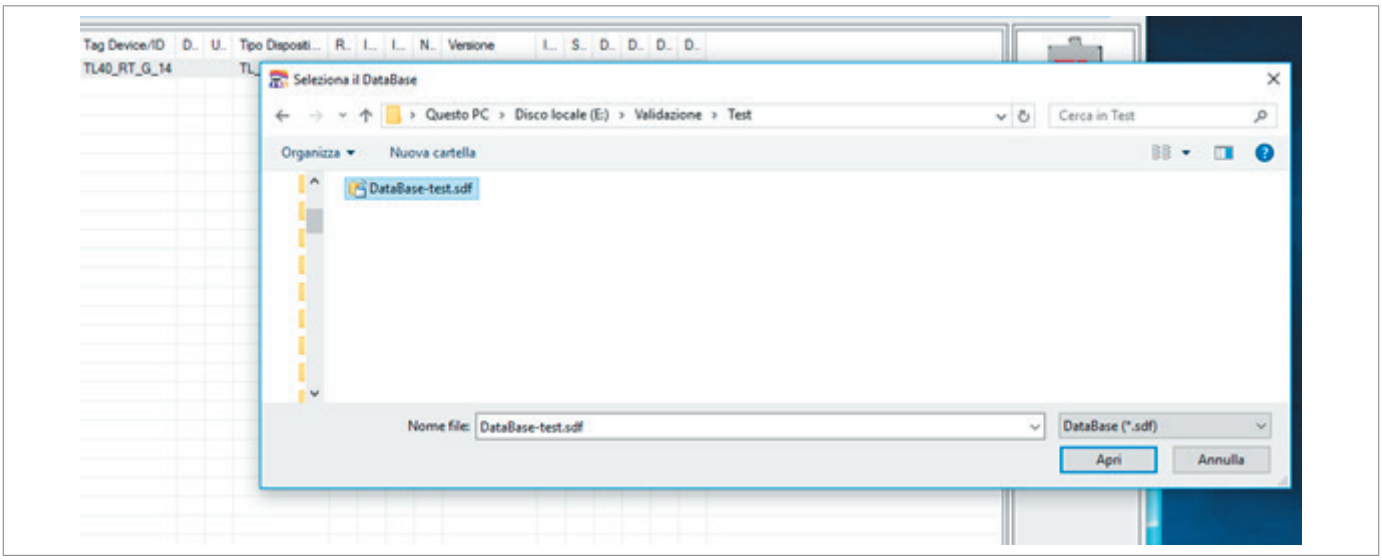


Fig. 8.21. Files .sdf

3. Check the programme screen for the correct file extension

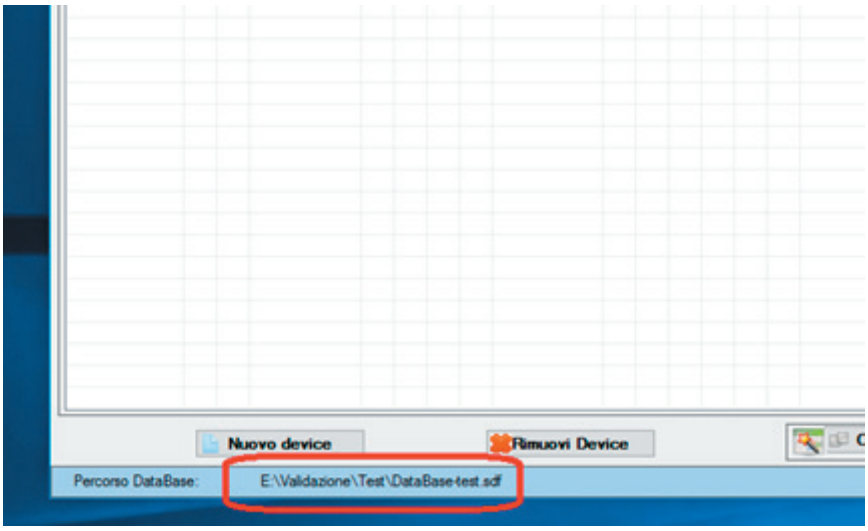


Fig. 8.22. Database verification

8.3 - RTU INTERFACE

After selecting the RTU from the initial list, the system will display the following screen:

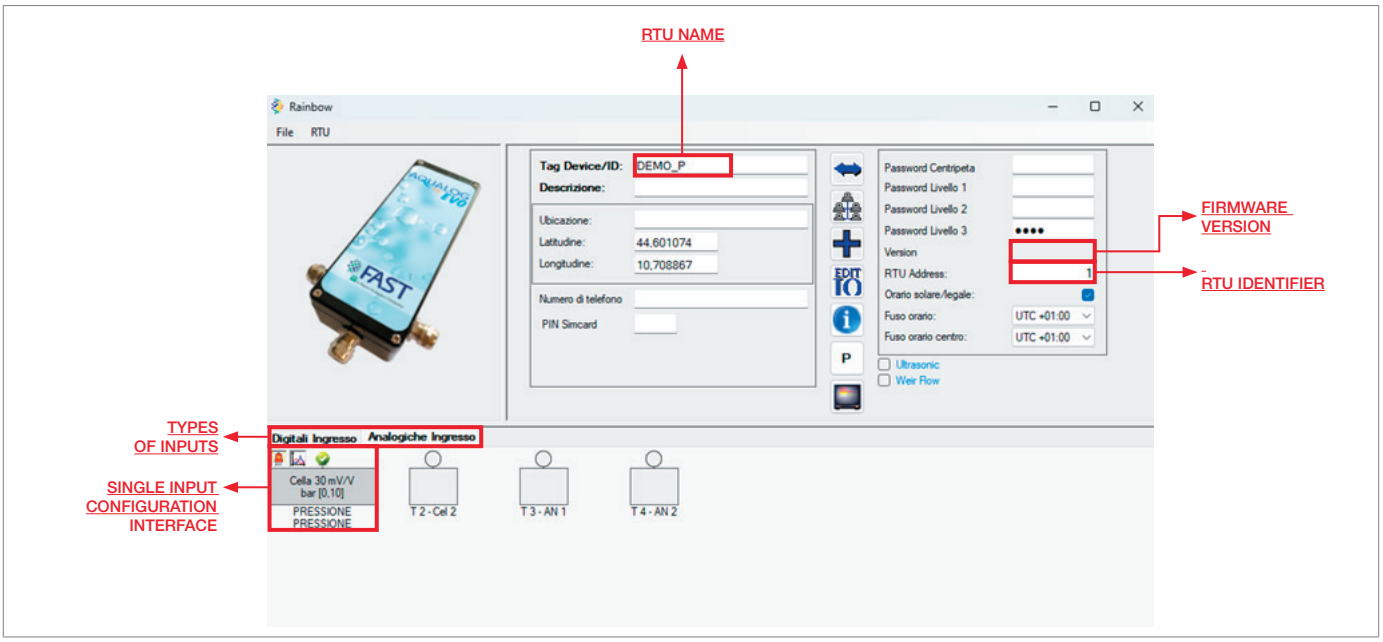


Fig. 8.23. RTU configuration

The following parameters can be configured on this page:

1. **Digital/analogue inputs**. By clicking on the individual boxes associated with the inputs, it is possible to configure and enable the chosen analogue/digital input.
2. **RTU address**. In the 'RTU Address' field, the address paired with the RTU can be changed. *Default Values*: 1.
3. **RTU Name**. The RTU can be given a name so that it can be easily paired with the device on the RAINBOW database. In the example, the name is 'DEMO_PQ'.

Once this is done, the configuration can be sent to the RTU by clicking on 'RTU: read/send RTU configuration'.

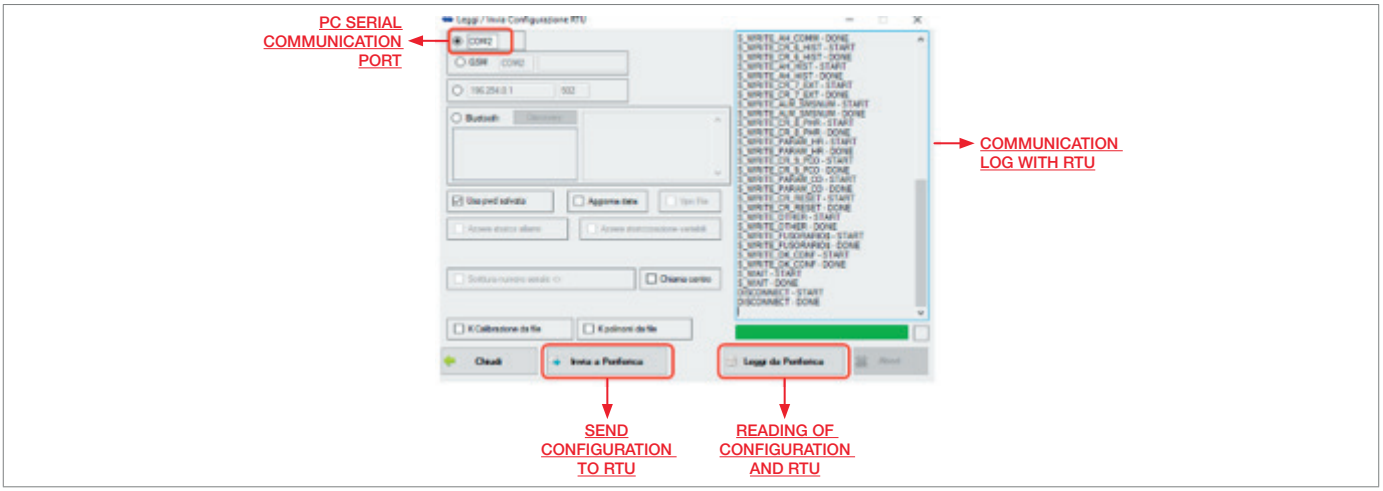


Fig. 8.24. RTU read/write configuration

To send the configuration, refer to the Wi-Fi or Bluetooth connection procedure in paragraph “5.1 - Local communication interface”.

8.3.1 - ANALOGUE INPUTS

The analogue input configuration page allows the input channel parameters to be set.

On this page, the engineering value of the measurement can be displayed on the local communication panel. Individual channels can be customised by setting a TAG and a photo.

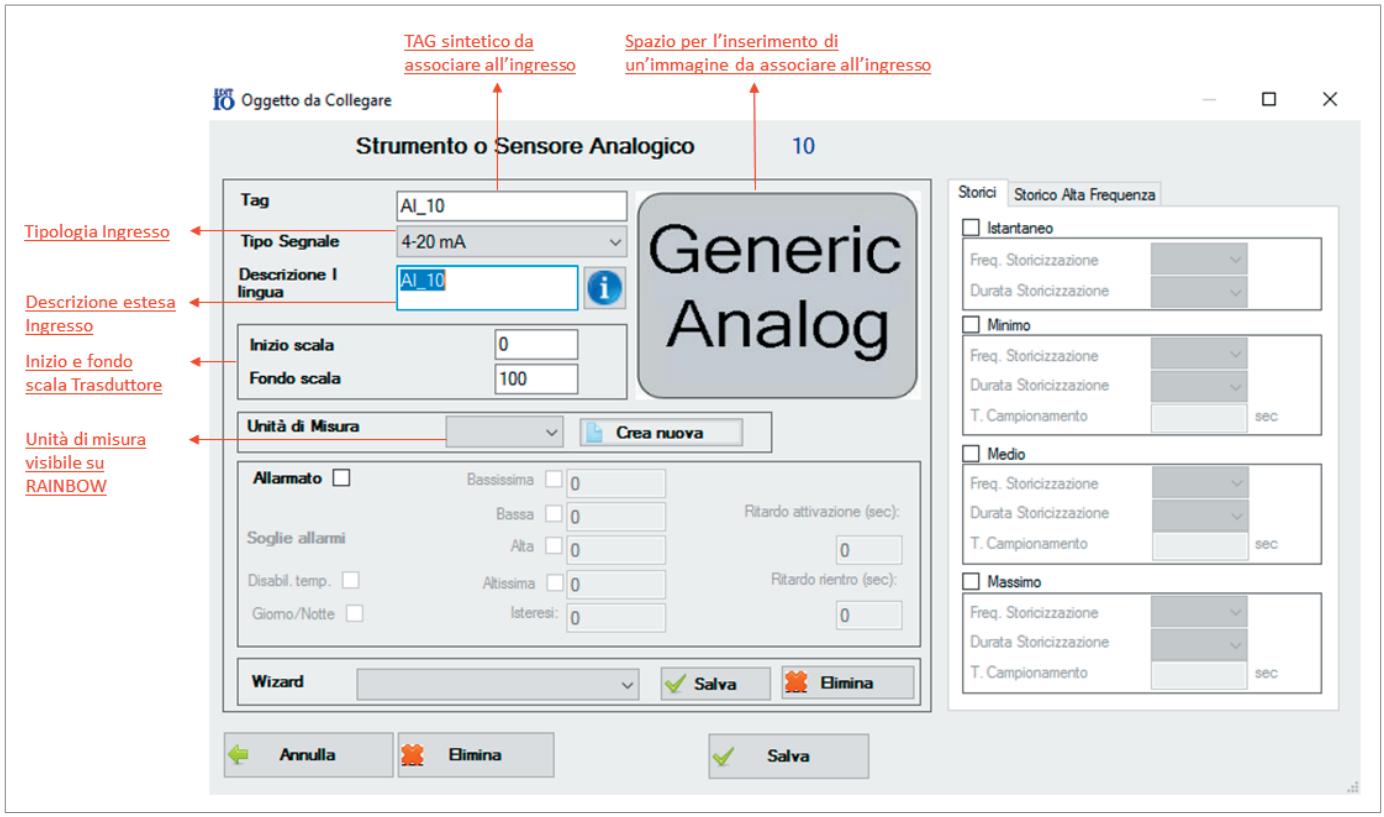


Fig. 8.25. Analogue input configuration

8.3.2 - DIGITAL INPUTS

The digital input configuration page allows you to set an alarm on the chosen input, defining polarity and delay. Individual channels can be customised by setting a TAG and a photo.

The two digital inputs can be configured as meters. These types of variables count the number of state changes on the selected input. Flow calculation is only enabled for the first six inputs configured as meters.

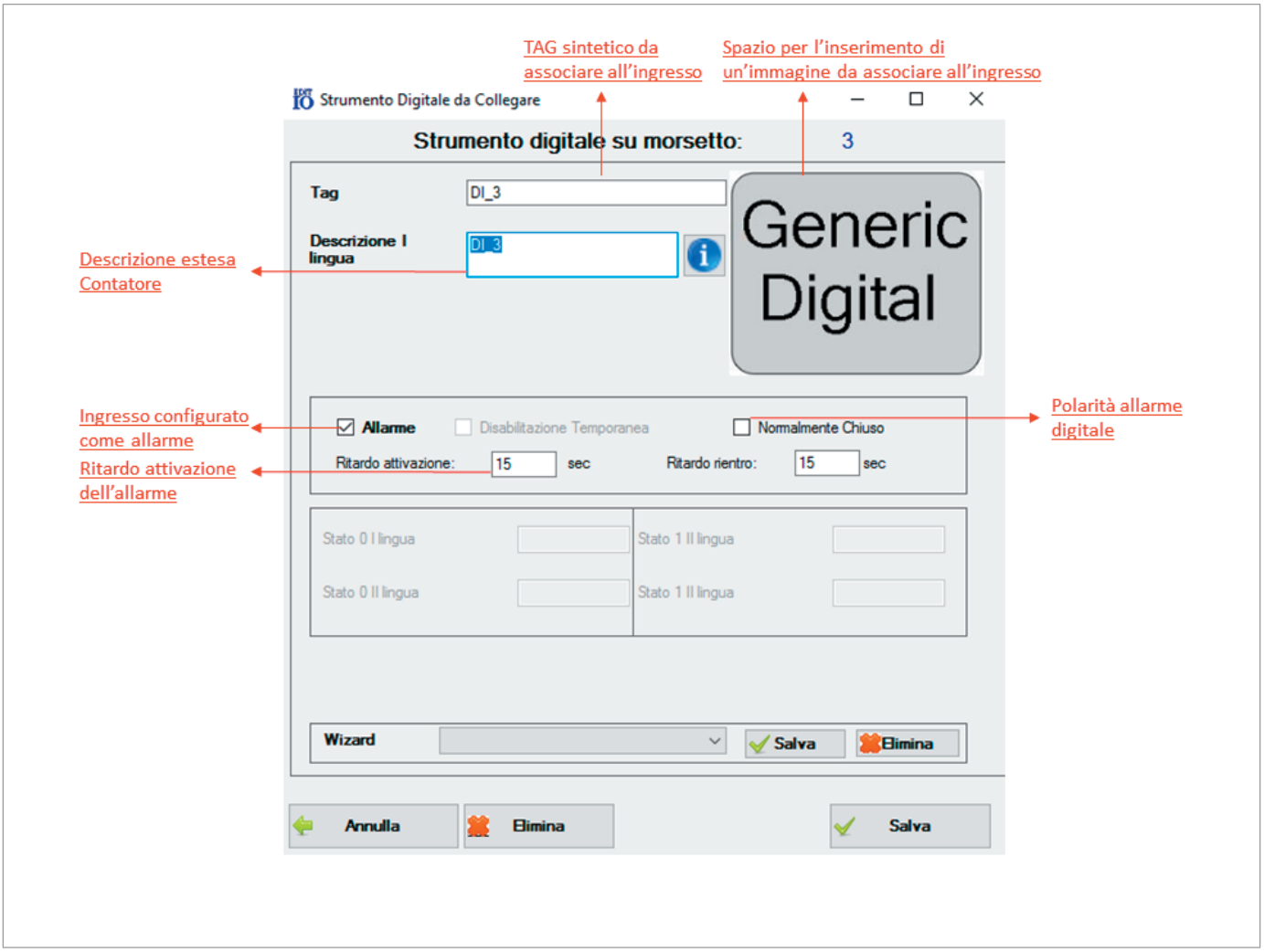


Fig. 8.26. Digital input configuration

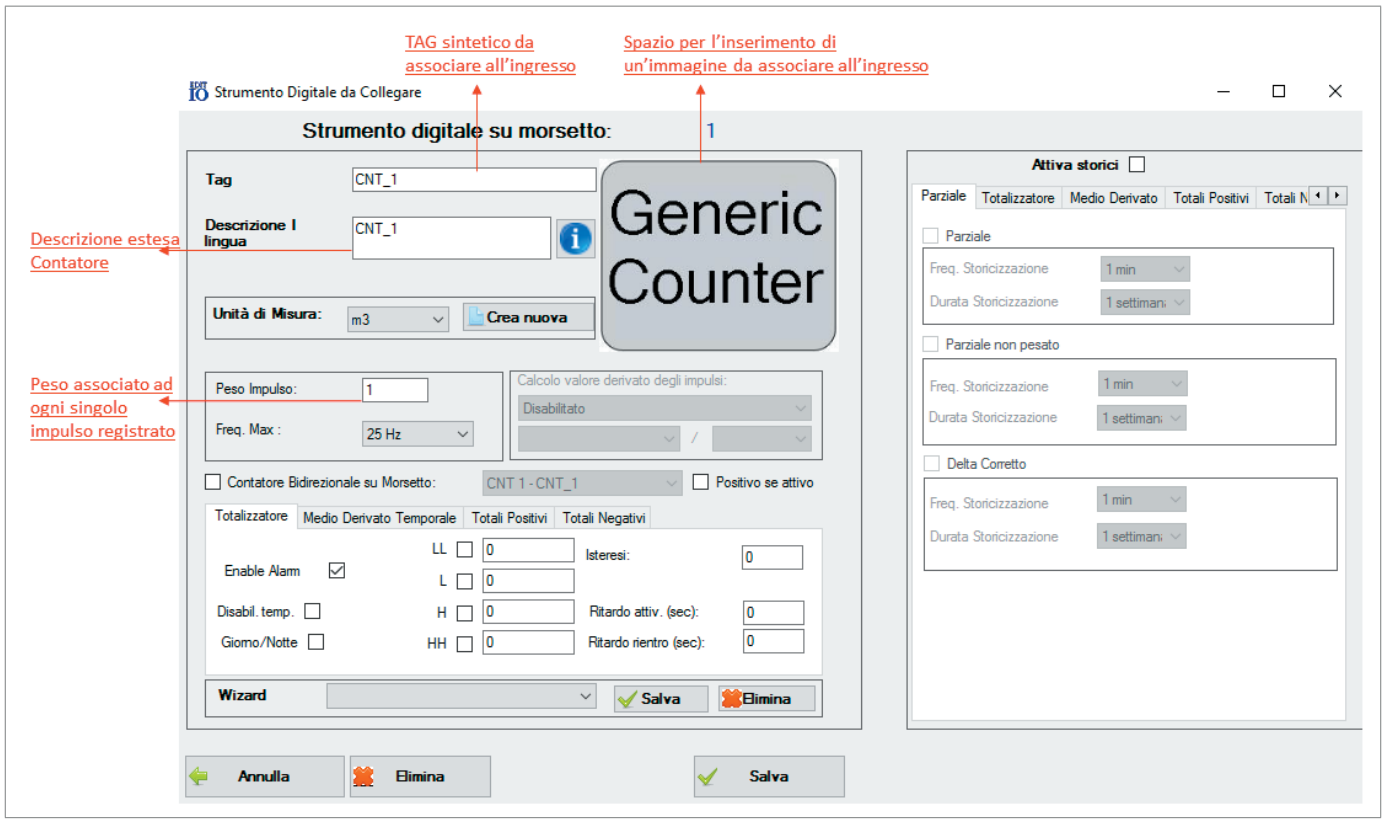


Fig. 8.27. Meter configuration

8.3.2.1 - UPDATING METERS

By navigating to '**RTU → Monitor Diagnostics**', it is possible to update the value of the equipment meters:

1. Select the tab. **"Init Settings"**
2. Select the relative meter
3. Change the meter value
4. Click the 'Meter Preset' button
5. Wait for the pop-up message confirming the completion of the operation.

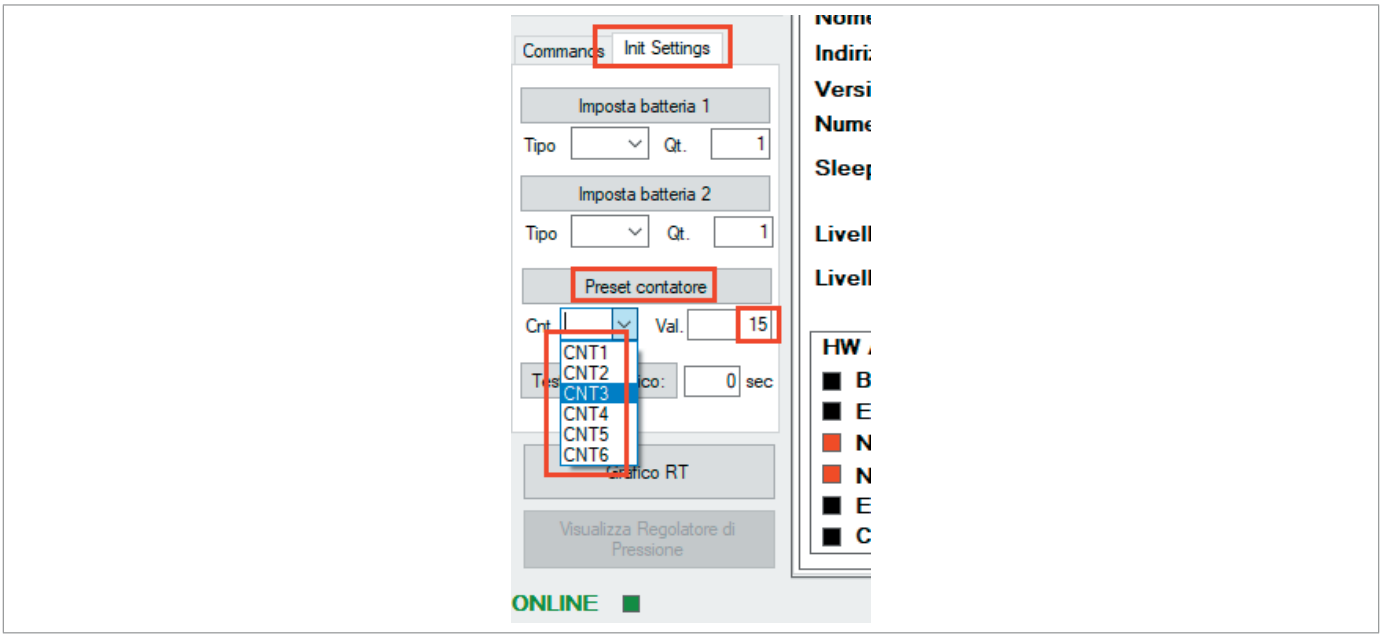


Fig. 8.28. Meter preset window

8.3.3 - SERIAL INPUT

It is possible to configure the measurable variable from an ultrasonic level transmitter. To enable the variable configuration, enable the flag in Fig. 8.29.:

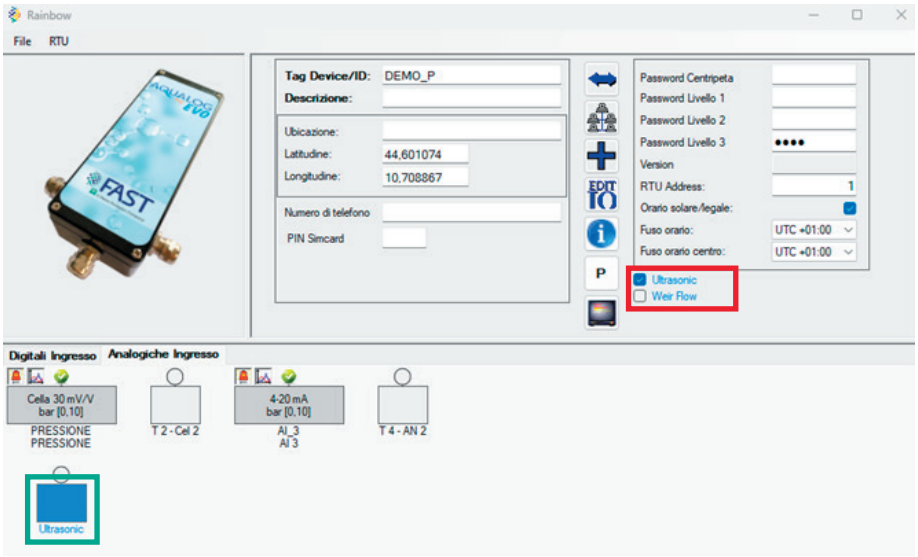


Fig. 8.29. Enabling Ultrasonic Flag

The Ultrasonic port is thus added to the configurable ports. The setting of this port is the same is that seen in the previous paragraphs.

1. Indicate in 'Bottom Distance' the distance between the level transmitter and the bottom (in mm) as shown in Fig. 8.30.
2. Indicate the measuring range of the level transmitter in mm under 'Start Scale-Full Scale' [only indicate the 5,000 or 10,000 mm full scale depending on the sensor in this box.
3. Leave the start scale at 0.
4. Indicate in Deadband, the deadband in millimetres of the transmitter [200-300-500].

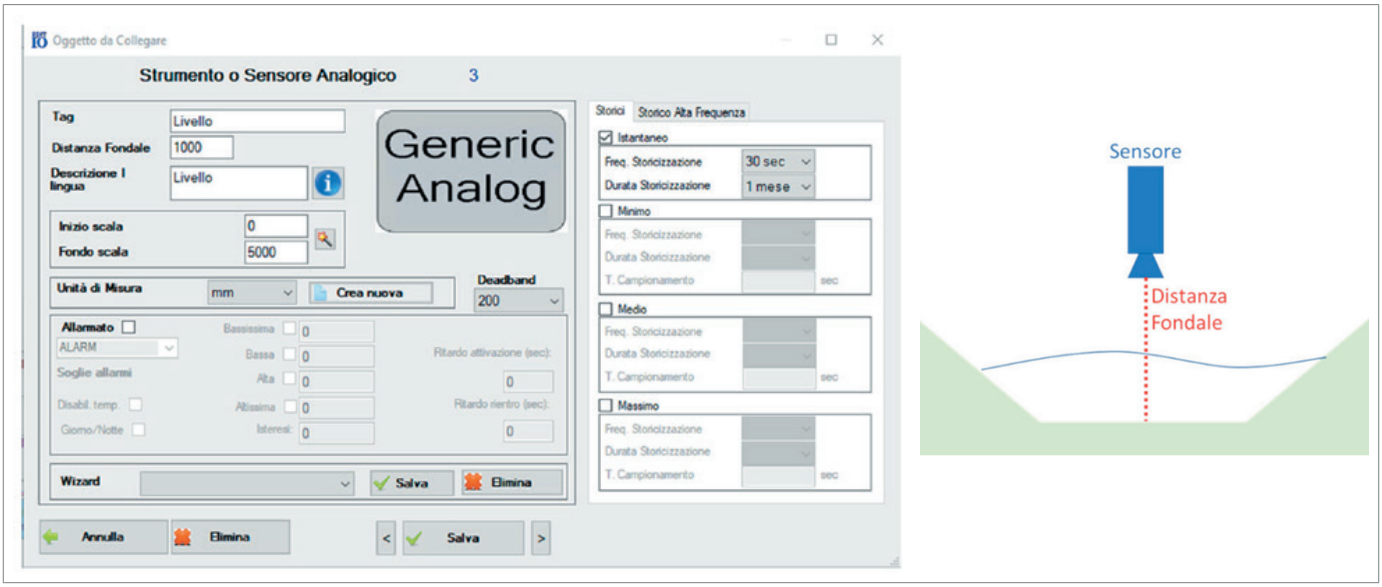


Fig. 8.30. Configuration of the flow rate variable

There are two ways to measure 'Bottom Distance'.

The first methodology is faster but less precise. Once the transmitter is installed in the field, measure the distance D between the bottom and the grey beak of the transmitter as in Fig.8.31.

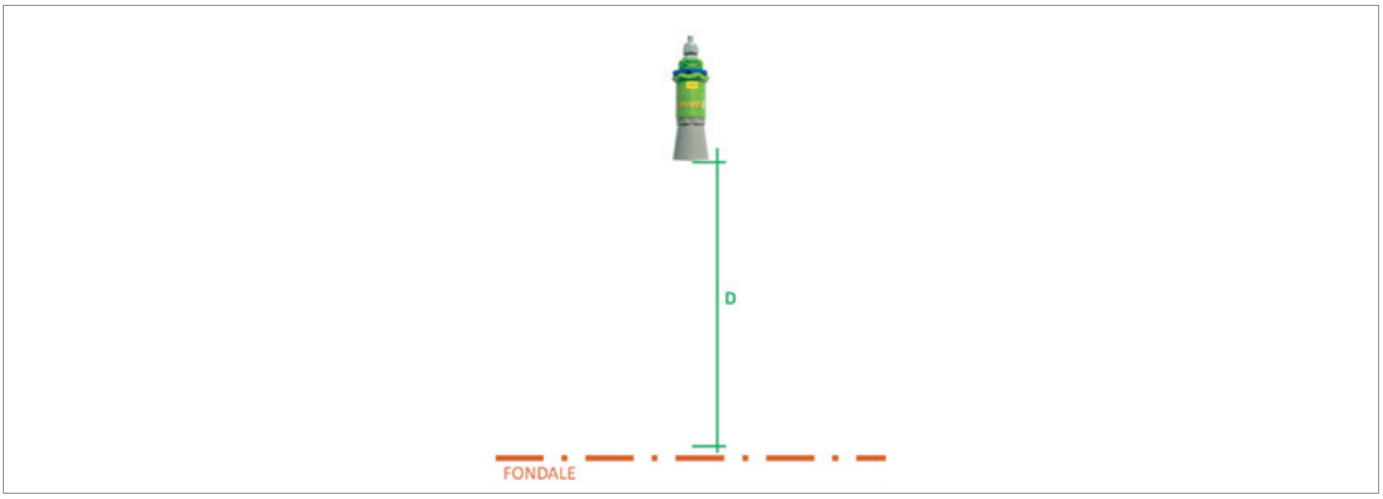


Fig. 8.31. Measuring points for calculating bottom distance

Add 55mm to the resulting measurement. The value thus obtained will be the 'Bottom Distance' value to be set on the screen in Fig.8.30. as seen above.

The second methodology is much more precise, but more time-consuming and can only be used on empty bottom channels. This methodology can also be used remotely once the transmitter has been installed, as long as one is aware of the empty state of the channel bottom.

First, a value equal to the full scale of the sensor, i.e. 10,000 or 5,000 depending on your transmitter (hence FS), must be set as the bottom distance, then reconfigure the peripheral device. Once the sensor is installed in the field, use the Diagnostic Monitor tool and note down the level value read by the sensor (hence L). The actual 'Bottom Distance' to be set on the screen in Figure xx is given by the value FS-L.

For example, having a transmitter with a full scale of 5,000 mm and a level value read by the Diagnostic Monitor of 1,000 mm, the correct 'Bottom Distance' value is FS - L = 5,000 mm - 1,000 mm = 4,000 mm.

The last settable parameters for the ultrasonic transmitter are accessible from the main screen. These are parameters to enable and manage a filter that acts on the level values read by the ultrasonic transmitter to attenuate transmitter noise.

After clicking on the button in the red box in Fig.8.32, the Additional Parameters screen will open.

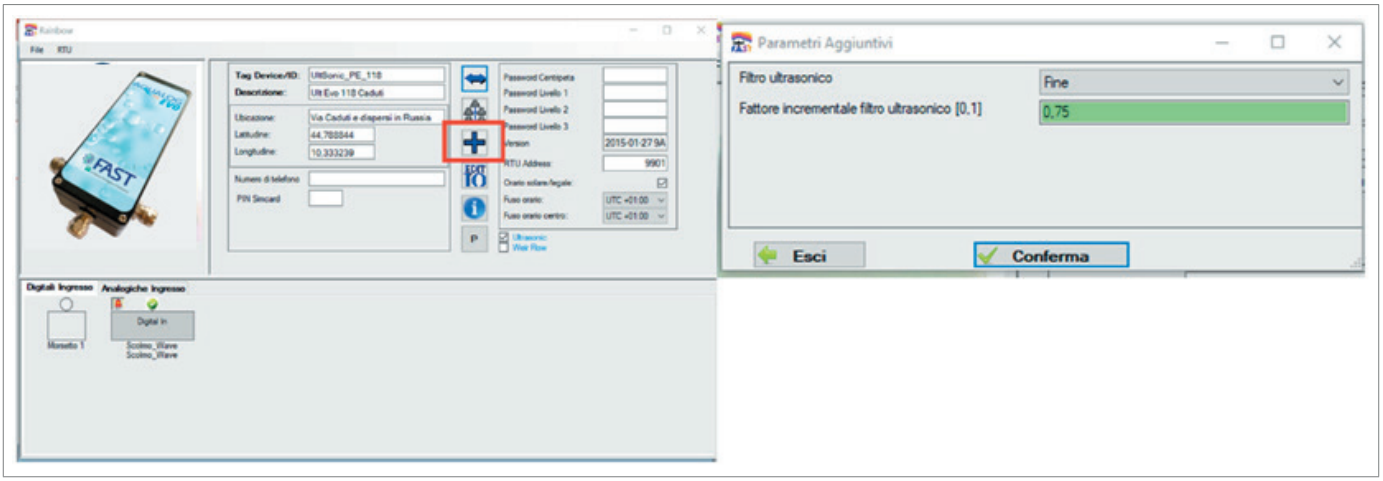


Fig. 8.32. Additional parameters of the ultrasonic transmitter

Input variables, both analogue and counting inputs (e.g. flow rates), can be alarmed and "Ultrasonic filter" can be set at:

- Disabled: The filter will not make any changes to the read values.
- Coarse: The filter will implement a mild modification on the read values.
- Fine: The filter will make a noticeable change to the read values.

The 'Incremental ultrasonic filter factor' parameter should then be a variable value between 0 and 1. If the value tends to 1, the filter behaviour will be very effective but with a slow response, vice versa if the value tends to zero. For typical applications, the value should be set at 0.75.

8.3.4 - DATALOGGER

The input variables, both analogue and calculated on the counting inputs (e.g. flow rates), can be logged according to four different strategies:

- Instantaneous value.
- Minimum.
- Medium.
- Maximum.

For each one, the storage time interval can be configured. For minimum, medium, maximum modes, it is also possible to configure the calculation period (sampling time).

The depth of the archive is configurable and is generally set at 2 weeks.

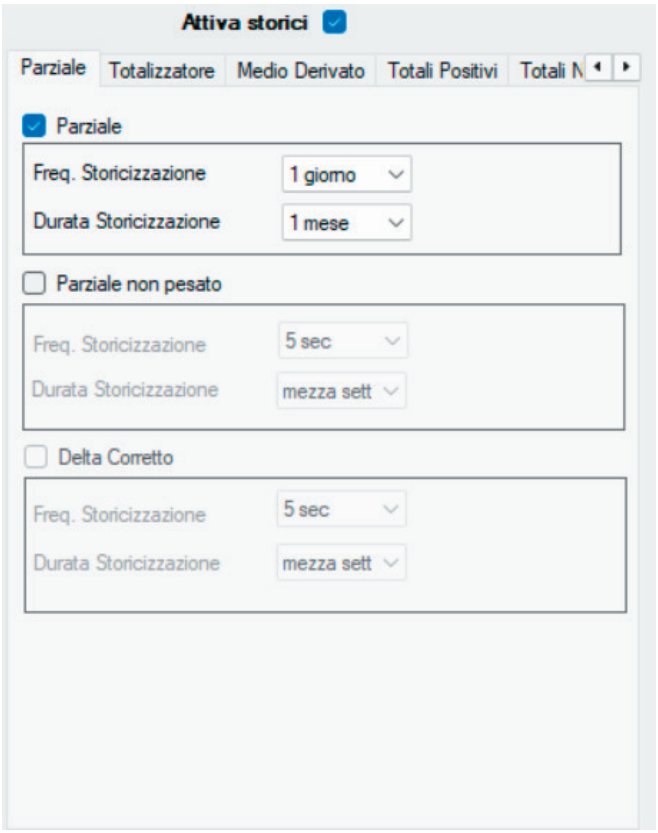


Fig. 8.33. Partial volume logging mode

The logging capacity of the device depends on the frequency and duration of logging.

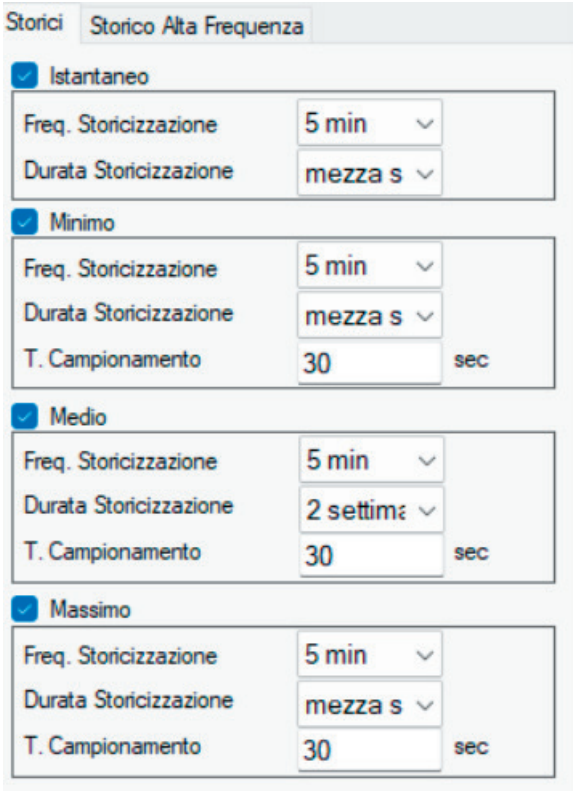


Fig. 8.34. Analogue variable logging mode

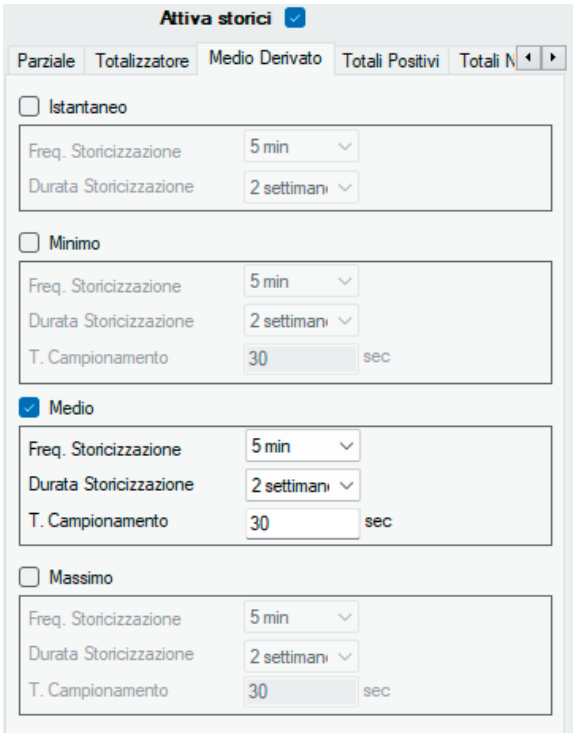


Fig. 8.35. Calculated variable logging mode

AQUALOG PQ EVO offers the possibility of high-frequency sampling of fast transients of the analogue input variable.

In water mains, the typical application is the monitoring of the so-called 'water hammer'. The functionality must be enabled in the configuration window of the analogue variables in the 'High Frequency Log' tab.

Activation of the functionality requires definition:

- of the value of the change in the variable that causes the event to begin recording;
- of the time interval within which the variation must be contained.

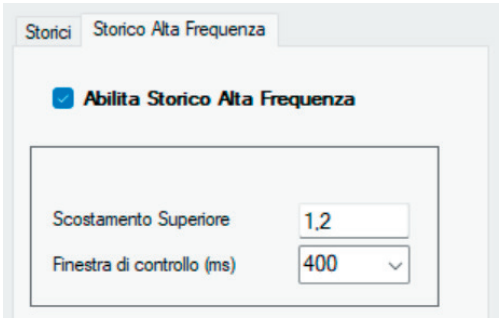


Fig. 8.36. Enabling high-frequency logging

Event recording consists of saving a trace of 1500 samples containing the measurement trend from 3 seconds before to 27 seconds after the start of the variation.

The memory ofAQUALOG PQ EVO can hold up to 100 water hammer events

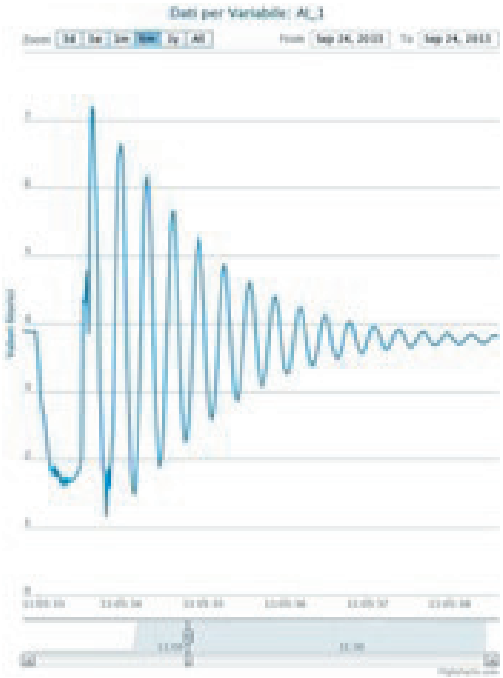


Fig. 8.37. Example of sampling graph

8.3.5 - ENABLING ALARMS ON INPUTS

Input variables, both analogue and counting inputs (e.g. flow rates), can be alarmed and thus configured for alarm triggering.

For analogue variables there are 2 minimum thresholds (very low, low) and 2 maximum thresholds (high, very high) with possible activation and clearing delays.

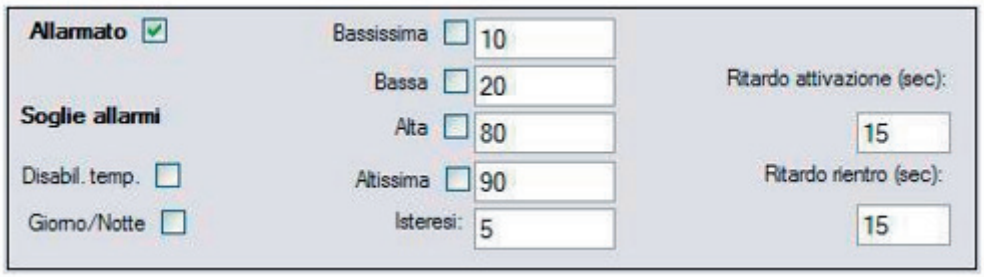


Fig. 8.38. Configuration of alarms on analogue measurements

By enabling Day/Night mode, it is possible to have different threshold setpoints for day and night. The day/night time slot change can be set in the RTU menu under ALARM CONFIGURATION. Hysteresis is expressed in engineering units and defines the deviation of the signal value from the threshold for alarm clearing.

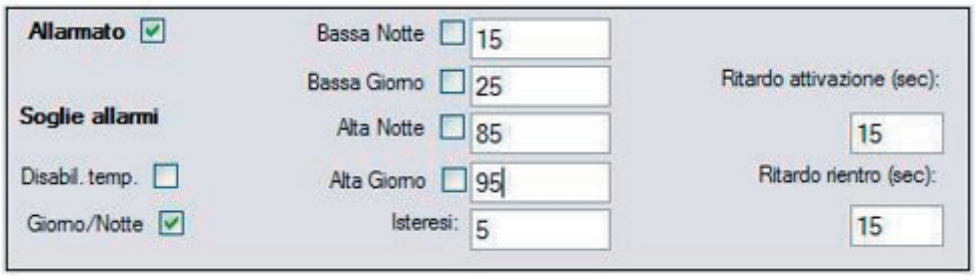


Fig. 8.39. Configuration of alarms in day/night mode on analogue measurements

Alarms can also be configured on digital signals. The alarm status (NO or NC) and the activation and clearing delays are definable by the operator.

The RTU records in a specific log in its internal memory the activation and clearing from each alarm. This information can be downloaded locally via the RAINBOW software or remotely via the SCADA centre.

Fig. 8.40. Configuring alarms on digital signals

Alarms can also be configured on calculated input variables such as pulse-derived flow rate.

Fig. 8.41. Configuration of pulse-derived flow alarms

8.4 - CONFIGURATION OF 2G/3G/4G COMMUNICATION PARAMETERS

By navigating to '**RTU ➔ Communication**' it is possible to connect the RTU with the SCADA via the 2G/3G/4G modem by setting the following connection parameters:

1. Set the '**GPRS always off**' mode in the '**Outbound**' section.
2. Set the IP and port of the centre of interest in the '**Inbound**' section.
3. Set the number of attempts greater than 0.
4. Configure the APN parameters and network username and password under **GPRS Settings**.
5. Set the communication protocol and its parameters.
6. Click '**OK**' and confirm the change of data.

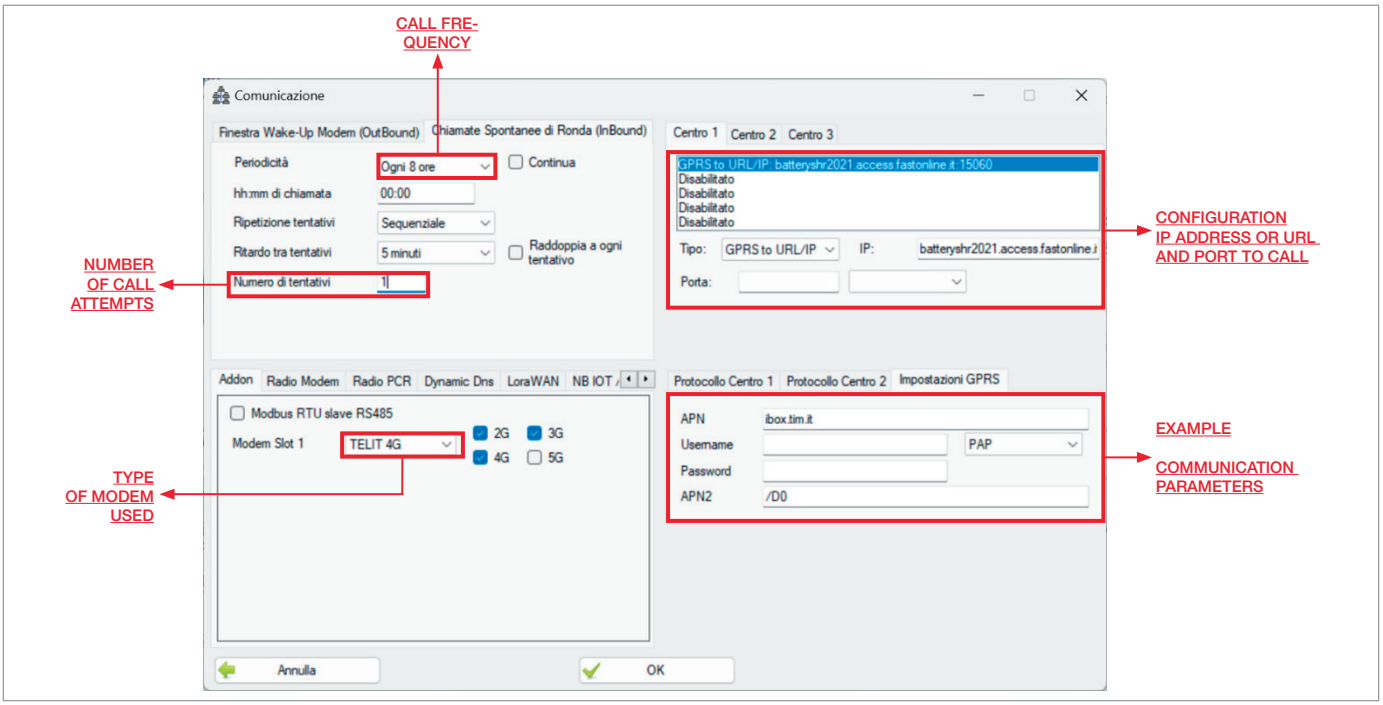


Fig. 8.42. Configuration of connection parameters for RTU with 2G/3G/4G call

The 2G/3G/4G modem is soldered onto the motherboard as shown Fig. 8.43:

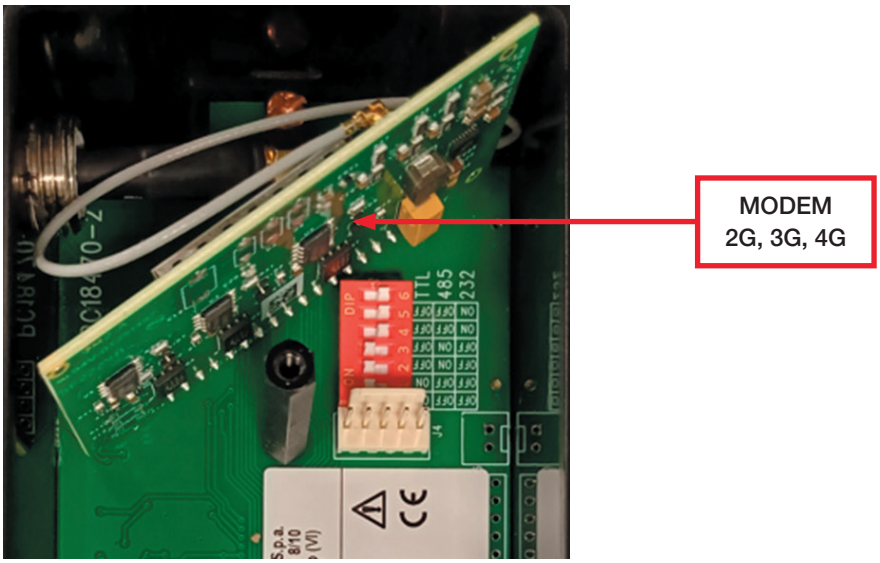


Fig. 8.43. 2G/3G/4G modem

8.5 - CONFIGURATION OF LORA COMMUNICATION PARAMETERS

By navigating to '**RTU ➔ Communication**' it is possible to connect the RTU with the SCADA via the LoRa modem by setting the following connection parameters:

1. Enable the LoRaWAN Enable flag.
2. Set the device's own Application Key under AppKey.
3. Set Join EUI under AppEUI (also called Application EUI) proper to the application.
4. Set the DevEUI item by entering the peripheral device's own Device EUI.
5. Set the communication frequency in seconds using the TX Frequency item.
6. Set the Uplink Format on the Uplink Format item according to the type of data to be transmitted. In particular:
    - HIST: packet that sends the logged value of up to 5 quantities together with the timestamp of the last data acquisition;
    - HIST_1: packet which sends the logged value of up to 8 quantities together with the timestamp of the last data acquisition; at the top of the package is information on which channels are configured.

For communication via LoRa, simply set the parameters shown in the box at Fig. 8.44:

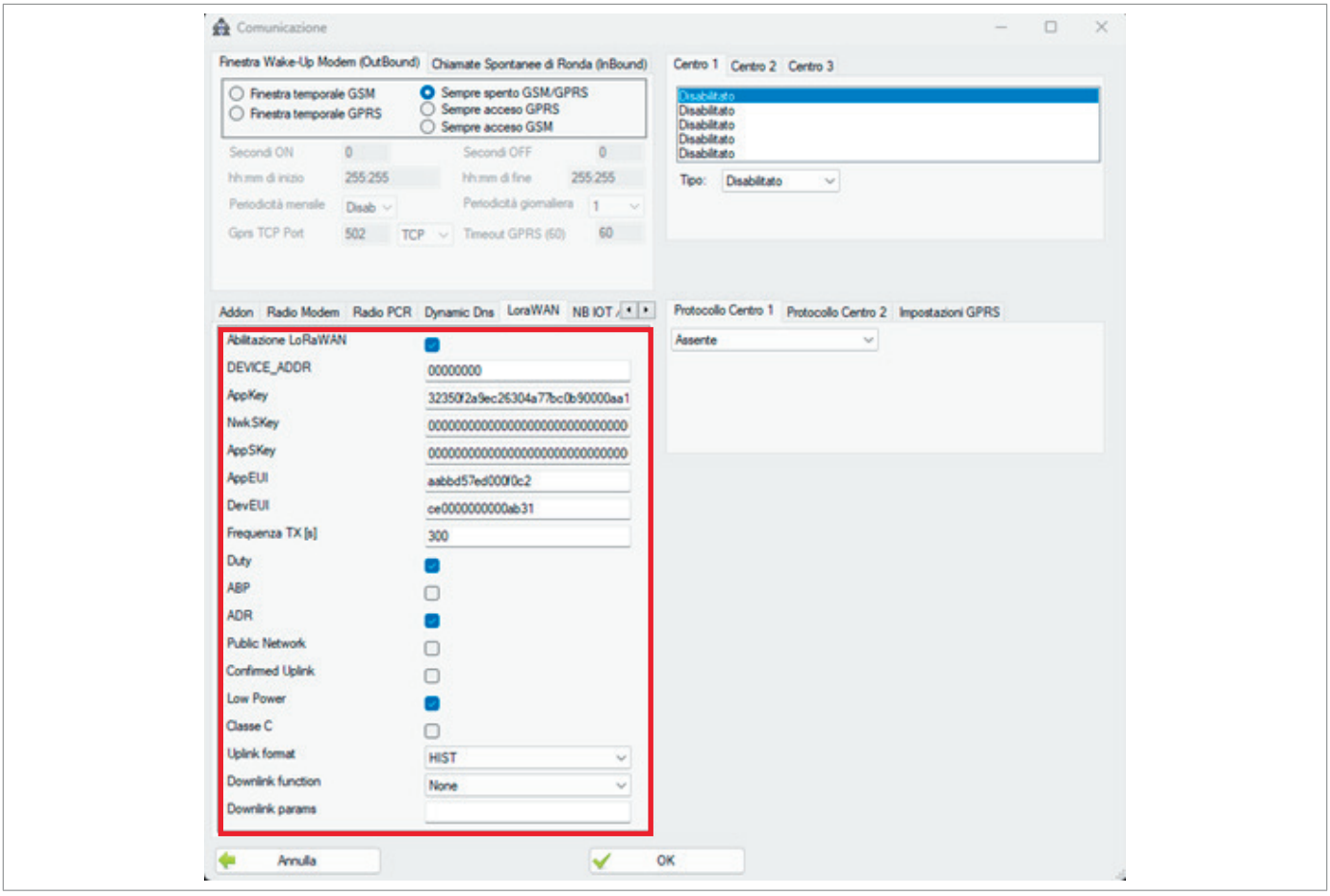


Fig. 8.44. Configuration of LoRa communication parameters

The LoRa modem is soldered onto the motherboard as shown Fig. 8.45:

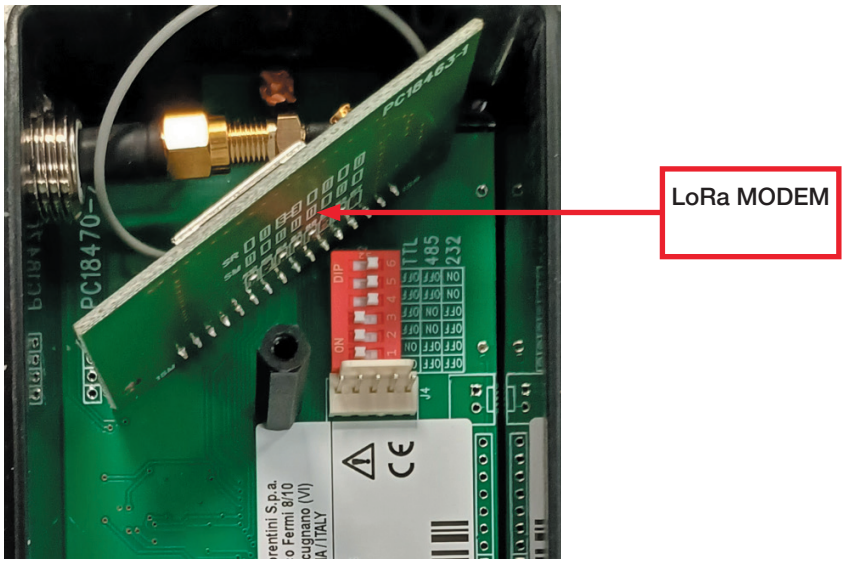


Fig. 8.45. LoRa Modem

8.6 - LOCAL COMMUNICATION

By navigating to '**RTU ➔ Monitor Diagnostics**', the local communication interface between RTU and PC can be used. This tool allows Real-Time monitoring of the machine status and all configured inputs.

To connect to the RTU, follow the connection procedure with USB, Wi-Fi or Bluetooth in “5.1 - Local communication interface” and click the "**Connect**" button.

When the white box in the bottom left-hand corner turns green, the software is connected to the machine.

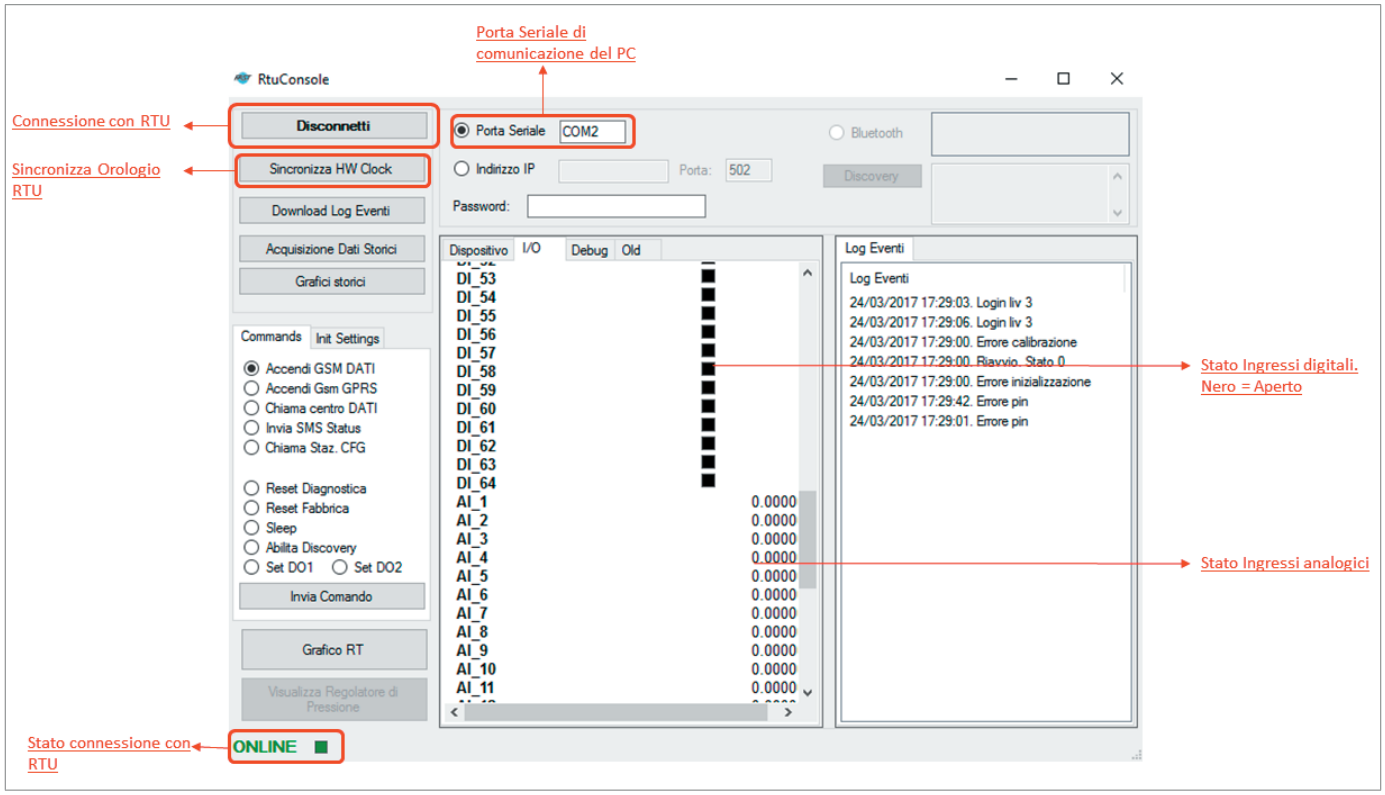


Fig. 8.46. Local communication window with RTU

8.7 - BATTERY UPGRADE

By navigating to '**RTU ➔ Diagnostic Monitor**', the remaining battery value can be initialised:

1. Select '**Init Settings**'.
2. Select '**Type**' and '**Qt**', then click '**Set battery 1**' to initialise the RTU battery.

Example: Select 'Type: 13 Ah' and 'Qt: 3" to initialise a 40 Ah battery (2-cell battery)

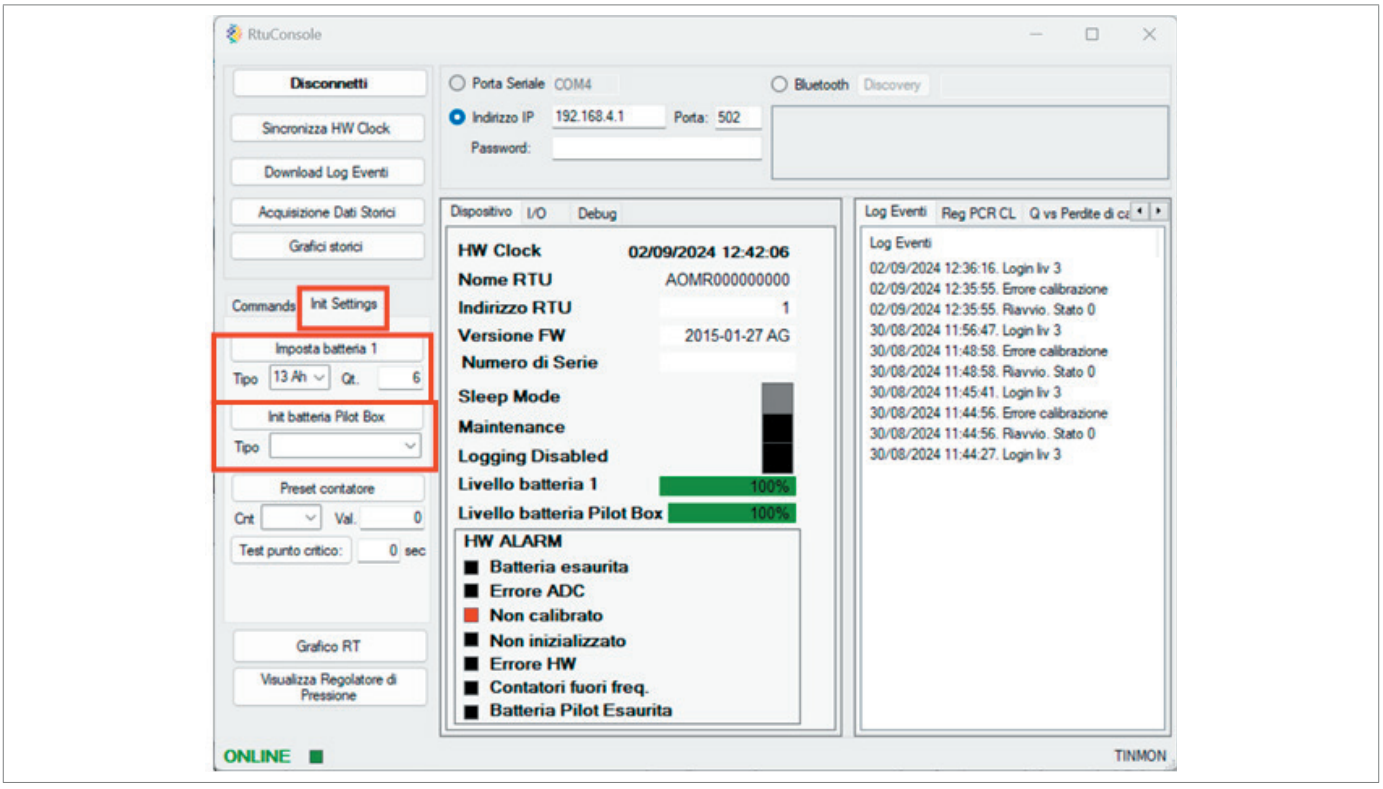


Fig. 8.47. Battery initialisation screen

8.8 - ALARM ACTION

By navigating to '**RTU ➔ Alarms Action**', it is possible to configure the operations to be performed in the event of an analogue or digital alarm. Each type of alarm can be paired with several possible operations. Changes require the device to be reconfigured.

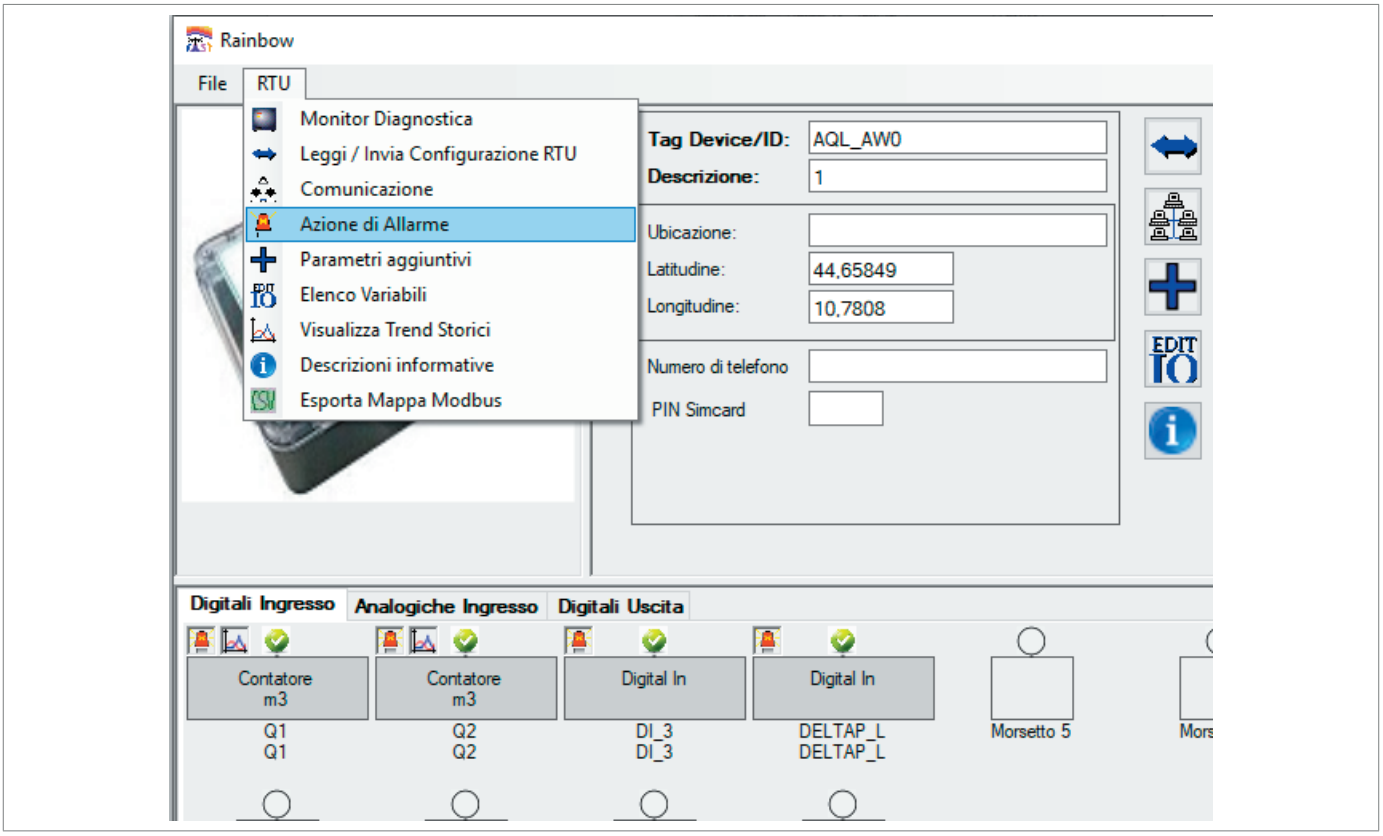


Fig. 8.48. Alarm action configuration window

8.8.1 - ADDING AN ALARM ACTION

In order to add a new alarm action, the following steps must be followed:

1. Select the AQUALOG PQ EVO to be configured from the Rainbow start page.
2. Select the 'RTU' menu at the top left of the AQUALOG PQ EVO page.
3. Select '**Alarm Action**' in the menu.
4. On the new page there should only be the 'Call Centre' item.
5. Pair the measurement to be monitored with centre call to the new alarm action.
6. Set number of attempts and interval of call repetition attempts.
7. Press '**Save**' at the bottom left.
8. Send the configuration.

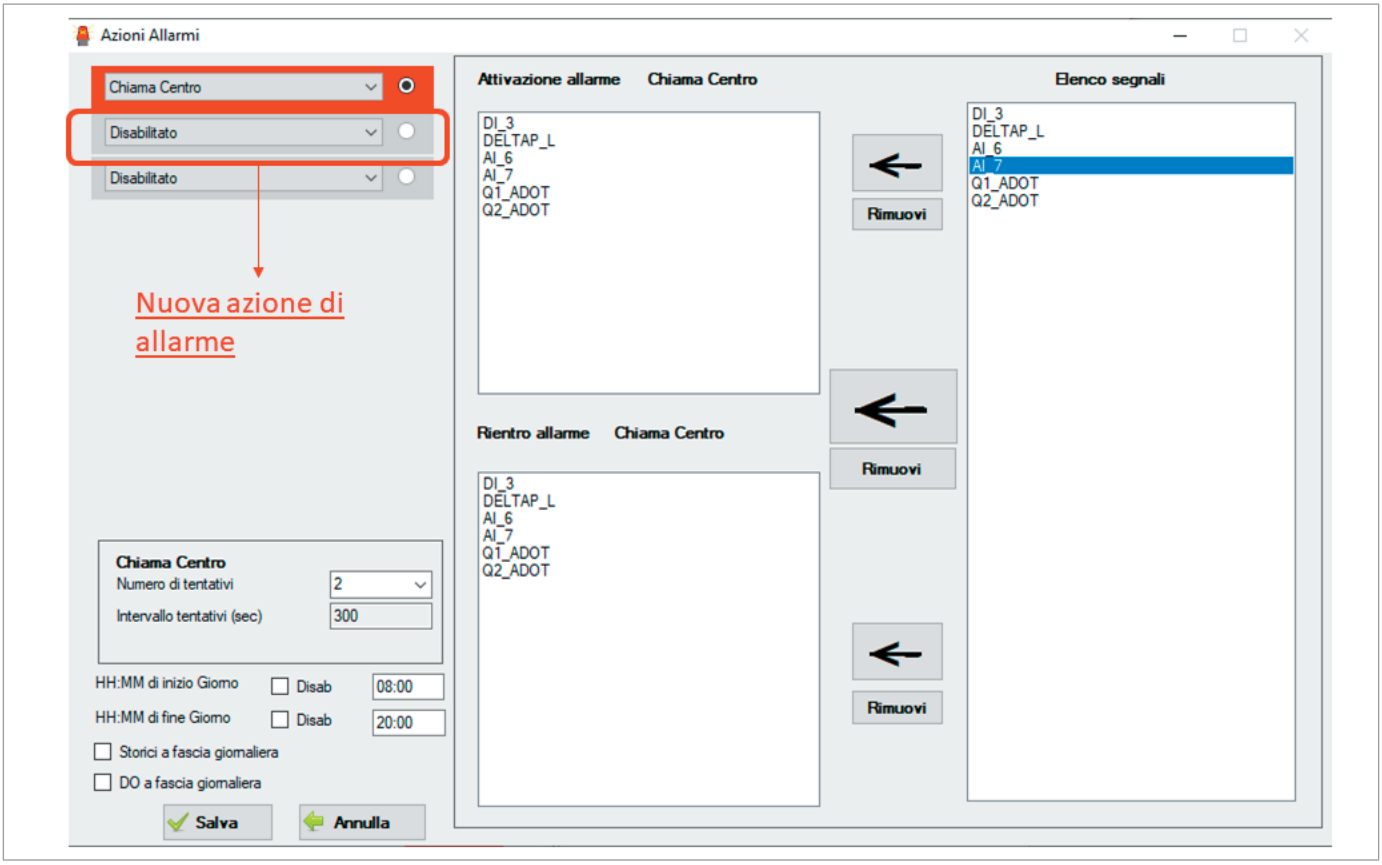


Fig. 8.49. Selecting the new alarm action

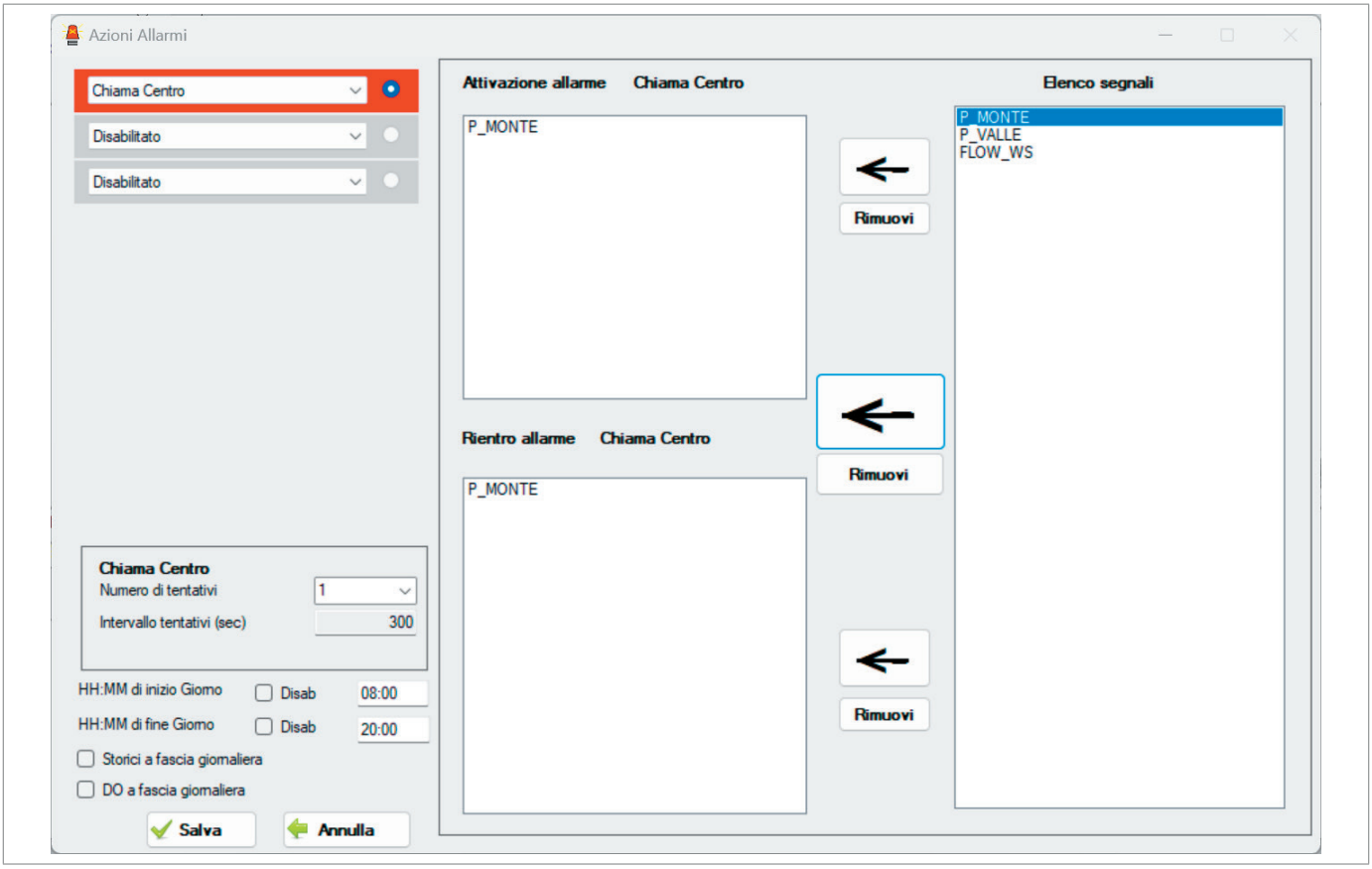


Fig. 8.50. Configuration of the new alarm action

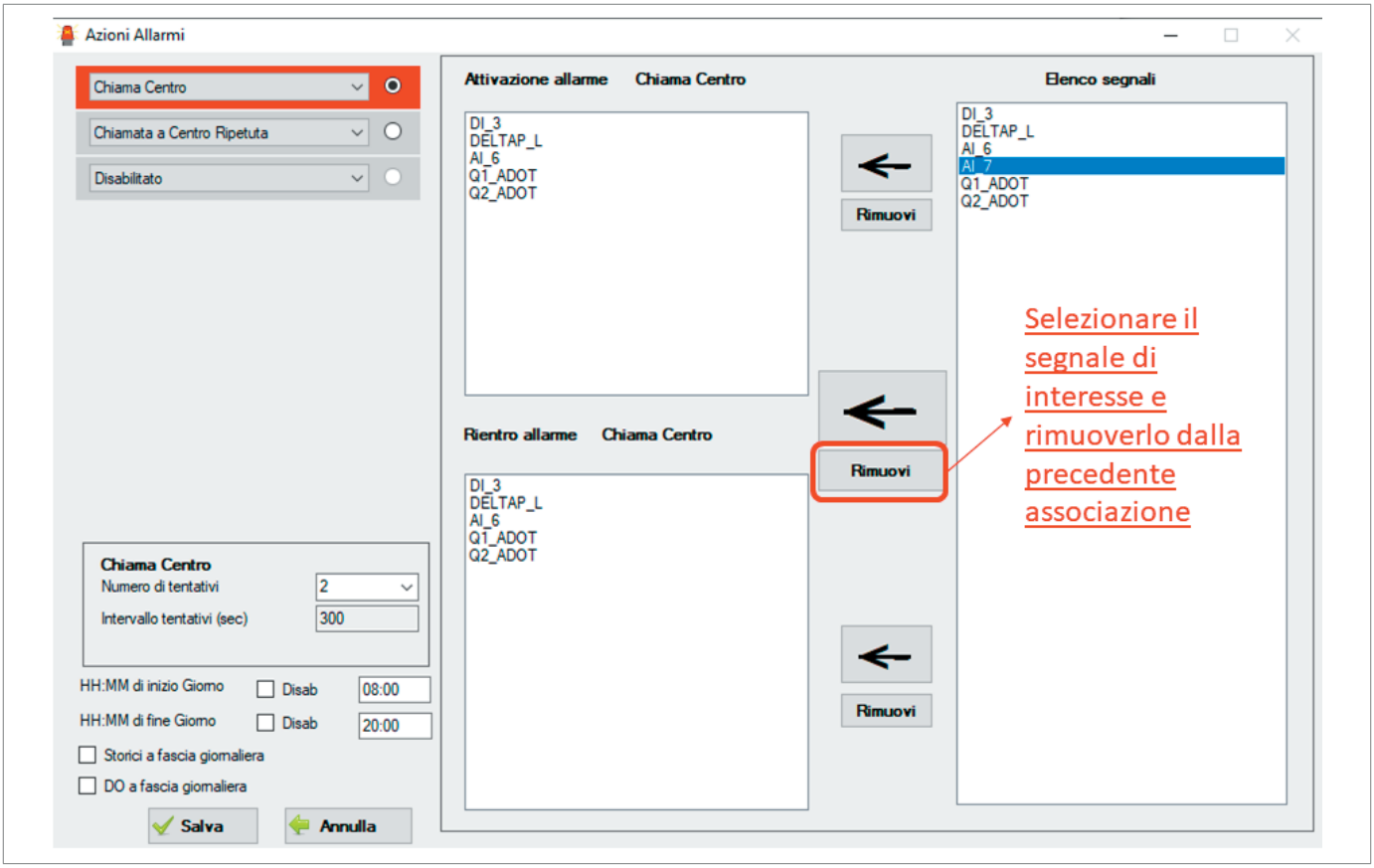


Fig. 8.51. Removing the old alarm action

8.9 - 2G, 3G, 4G DATA CALL COMMUNICATION TEST

1. Double-click on the configuration from the list on the 'Rainbow' screen.
2. Activate the local Wi-Fi connection, refer to section “5.1 - Local communication interface”.
3. Select 'Diagnostic Monitor' from the RTU menu at the top left:

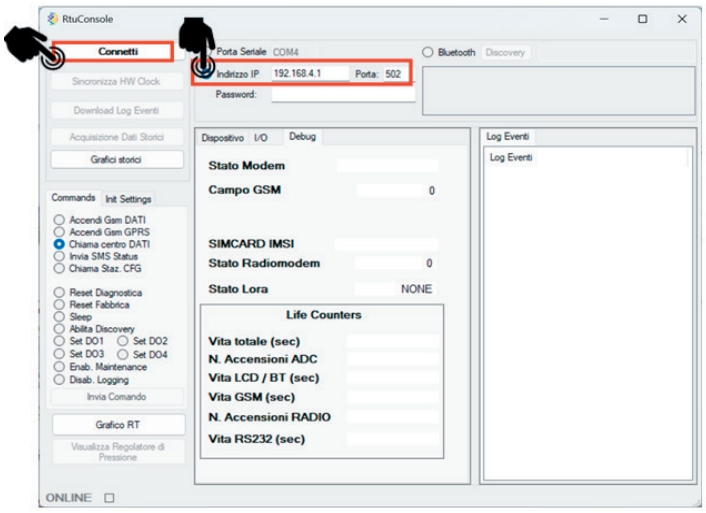


Fig. 8.52. Diagnostic monitor selection

4. Select the Wi-Fi communication channel (IP: 192.168.4.1; port: 502), then click 'Connect'.

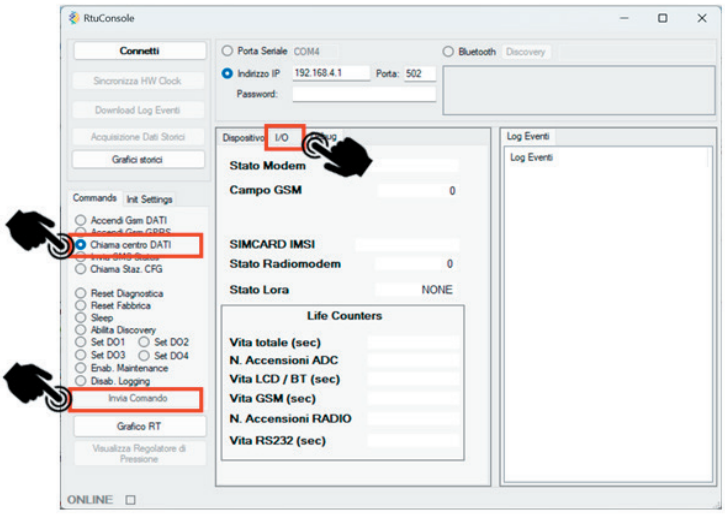


Fig. 8.53. Connection

5. Select "Call DATA Centre", then "Send Command".
6. Check the modem status from the 'Debug' window.

7. Check that the system performs the steps in the 'Diagnostics' window (refer to Tab. 8.35):

Step	Modem status
Switch-on	Modem in switch-on
Network registration	Modem in provider cell registration
GPRS registration	Attempt to touch on the APN
GPRS call	Attempt to access the centre
Data Exchange	Send packets to the centre
Connection closure	Communication closure

Tab. 8.35.

8.10 - TESTING COMMUNICATION AND SENDING LORA PACKETS

1. Double-click on the configuration from the list on the 'Rainbow' screen.
2. Activate the local Wi-Fi connection, refer to section 5.1 - 'Local Communication Interface'.
3. Select 'Diagnostic Monitor' from the RTU menu at the top left:

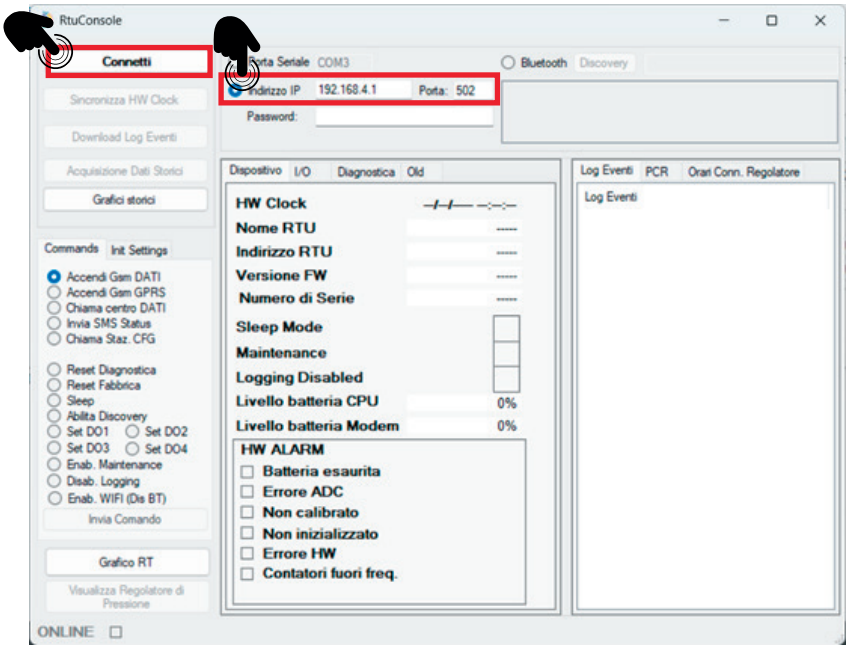


Fig. 8.54. Rainbow interface for connection

4. Check that in the debugging section, the LoRa status changes from INIT to READY.

LoRa modem states	
NONE	Off
INIT	Switching on
READY	Ready to send packets
FAIL	Attempt failed

Tab. 8.36.

5. Force a pkt send by entering the Init Setting menu by clicking on critical point test:

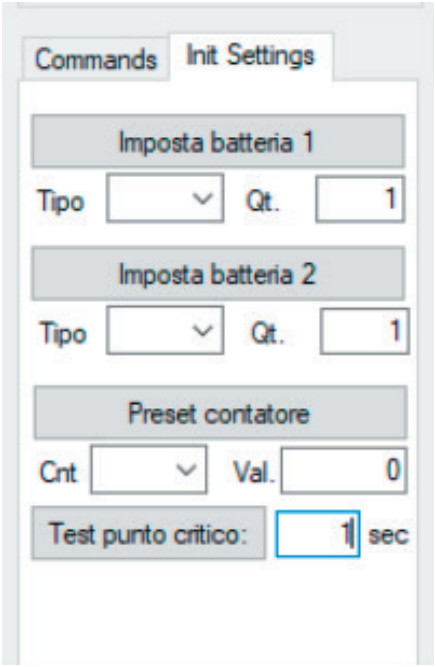


Fig. 8.55. Send test pkt menu

6. Wait a few seconds, check that a new data pkt is visible on the broker.

8.11 - RESET

There are two RTU reset modes:

RESET FACTORY: clears the internal RTU configuration while maintaining the calibration of the analogue acquisition channels. Follow the procedure:

1. Connect the USB cable to the RTU (via USB connection kit).
2. Run the 'Rainbow' software.
3. Select an RTU type AQUALOG PQ EVO.
3. Click the "**RTU → Monitor Diagnostics**" button.
4. Select the COM port paired with the USB cable and click 'Connect'.
5. Wait for the connection.
6. Select the 'Factory Reset' item and click the 'Send command' button.
7. Wait for the message 'Reset in progress'.
8. Log off.

9 - MAINTENANCE AND FUNCTIONAL CHECKS

9.1 - GENERAL WARNINGS

HAZARD!

- **Maintenance work must be carried out by qualified personnel trained on safety in the workplace and authorised to carry out equipment-related activities.**
- **Repair or maintenance work not provided for in this manual may be carried out only if approved by PIETRO FIORENTINI S.p.A.. PIETRO FIORENTINI S.p.A. shall not be held liable for damage to persons or property resulting from operations other than those described herein or carried out in ways other than as indicated.**

HAZARD!

Special maintenance:

- **requires extensive and specialised knowledge of the machines, operations required, risks involved and correct procedures to operate safely;**
- **must be provided by qualified, trained and authorised technicians.**

WARNING!

In case of doubt, do not perform any work.
Contact PIETRO FIORENTINI S.p.A. for the necessary clarifications.

NOTICE!

Before starting maintenance on the equipment, it is advisable to make sure that the authorised operator has:

- **the necessary equipment;**
- **appropriate spare parts.**

Step	Action
1	Switch off the main power switch upstream of the equipment (in the case of a 230VAC mains-powered device)
2	Unscrew and remove the cover screws
3	Open the cover
4	Disconnect the batteries
5	Disconnect the cables of any sensors or measurements wired to the instrument
6	Disassemble the device
7	Contact PIETRO FIORENTINI S.p.A.

Tab. 9.37.

The equipment maintenance operations are divided, from an operational point of view, into two main categories:

Commissioning and maintenance operations	
Routine maintenance	All those operations that the operator must preventively carry out to ensure proper operation of the device over time. **NOTICE!** **The equipment does not require routine maintenance.**
Special maintenance	All those operations to be carried out by the operator as required by the equipment.

Tab. 9.38.

9.2 - SPECIAL MAINTENANCE

9.2.1 - REPLACING THE BATTERIES

Replacing batteries	
Operator qualification	• Specialised technician. • Maintenance Technician.
PPE required	 **WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE required to protect against risks associated with the workplace, installation or operating conditions, please refer to:** **• the regulations in force in the country of installation;** **• any information provided by the Safety Manager at the installation facility.**
Equipment required	Allen key, 6 mm.

Tab. 9.39.

HAZARD!

Batteries, especially end-of-life (exhausted) batteries, are dangerous and sensitive to shock, vibration and exposure to naked flames. Failure to comply with this document may lead to the risk of explosion, fire, harmful emissions which may have serious consequences for health.

ATTENTION!

Use only battery packs supplied by PIETRO FIORENTINI S.p.A.

ATTENTION!

All operations must be carried out:

- **in the absence of an explosive atmosphere;**
- **away from heat sources;**
- **in a place protected from bad weather;**
- **as far as possible from water sources that could cause a reaction with the lithium contained inside the batteries.**

⚠ ATTENTION!

Operators should not wear jewellery or metal ornaments (rings, necklaces, bracelets and earrings) that may come into contact with electronic components and/or battery terminals to avoid potential short circuits.

⚠ ATTENTION!

The fire extinguishers to be used in the event of a fire must be of class D as they are effective in extinguishing fires in the presence of lithium.

⚠ ATTENTION!

The transport of the battery packs supplied by PIETRO FIORENTINI S.p.A. must be carried out using the original packaging, which complies with the current ADR regulations.

⚠ ATTENTION!

After replacing a battery, it is necessary to realign the remaining battery life indicators.

To **replace the battery pack**, proceed as described below:

Step	Action
1	Unscrew and remove the clamping screws.
2	Remove the cover.
3	Disconnect the battery connector from the housing (**A**) and take the battery (**B**) out of the compartment. **ATTENTION!** **Store the replaced communication battery in ADR compliant packaging.**
4	Insert the connector of the new communication battery into the housing (**A**). **NOTICE!** **Position the cables (C) in such a way that the equipment can be closed.**
5	Fit the cover.
6	Insert and secure the clamping screws.

Tab. 9.40.

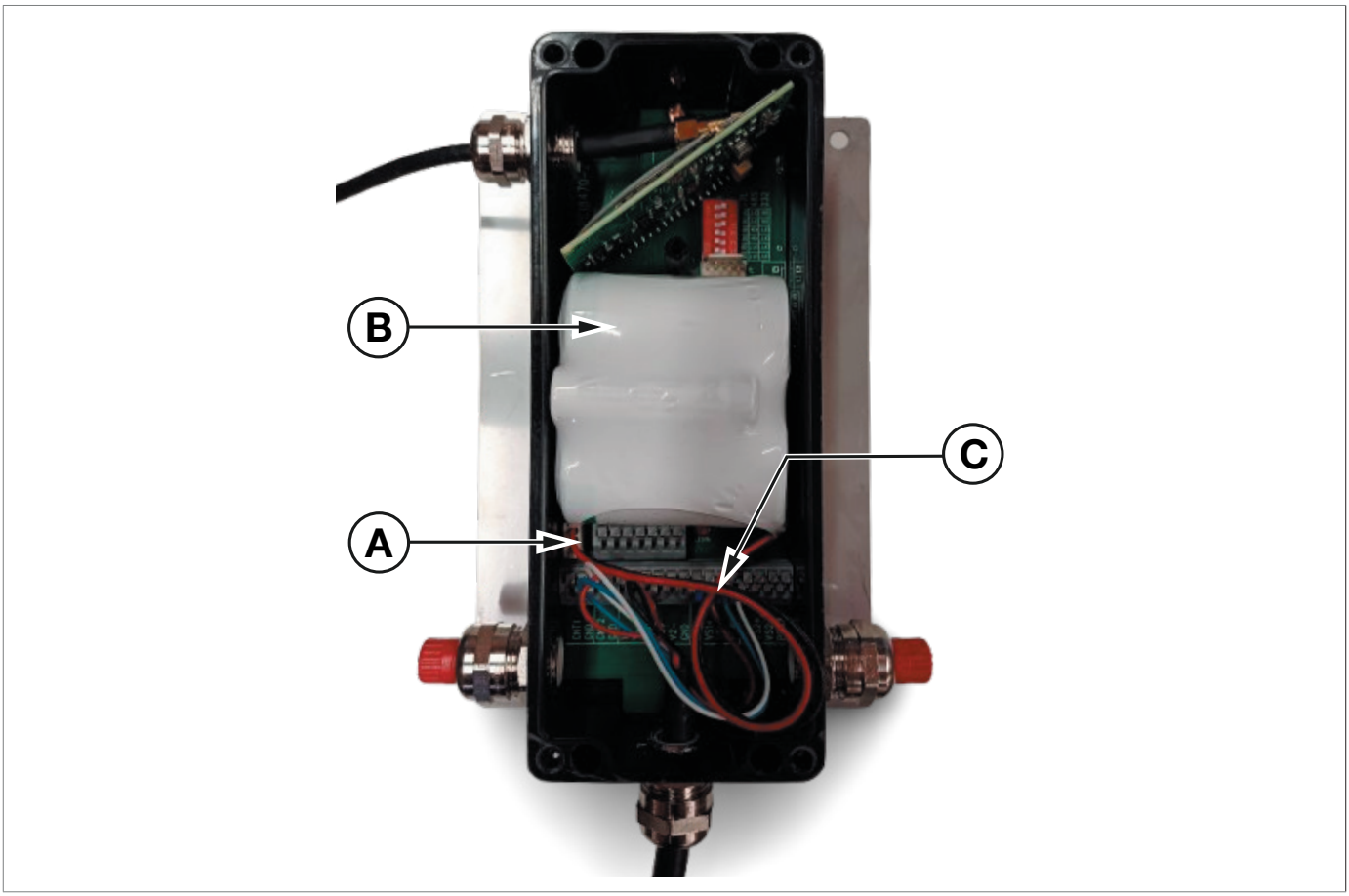


Fig. 9.56. Replacing the battery pack

10 - UNINSTALLATION AND DISPOSAL

10.1 - GENERAL SAFETY WARNINGS

HAZARD!

Make sure that there are no potentially explosive ignition sources in the work area set up to uninstall and/or dispose of the equipment.

WARNING!

Before proceeding with uninstallation and disposal, make the equipment safe by disconnecting it from any power supply.

10.2 - QUALIFICATION OF THE OPERATORS IN CHARGE

Uninstallation	
Operator qualification	• Installer.
PPE required	 **WARNING!** **The PPE listed in this table is related to the risk associated with the equipment. For the PPE required to protect against risks associated with the workplace, installation or operating conditions, please refer to:** • **the regulations in force in the country of installation;** • **any information provided by the Safety Manager at the installation facility.**
Equipment required	Keys to fix inlet and outlet connections fittings/equipment.

Tab. 10.41.

10.3 - INFORMATION REQUIRED IN CASE OF NEW INSTALLATION

NOTICE!

Should the equipment be reused after uninstallation, refer to chapters: 7 ”Tab. 10.42.” and ”8 - Configuration”.

10.4 - STORAGE OF THE BATTERIES

NOTICE!

Refer to paragraph 6.6.1 to store the batteries.

10.5 - INFORMATION REQUIRED IN CASE OF RE-INSTALLATION

NOTICE!

Should the equipment be reused after uninstallation, refer to chapter “7 - Installation”.

10.6 - DISPOSAL INFORMATION

NOTICE!

- **Proper disposal prevents damage to humans and the environment and promotes the reuse of precious raw materials.**
- **Bear in mind that the regulations in force in the country of installation must be complied with.**
- **Illegal or improper disposal involves the application of the penalties provided for by the regulations in force in the country of installation.**

The equipment was manufactured with materials that can be recycled by specialised companies.
For proper disposal of the equipment, proceed as specified in Tab. 10.4242:

Step	Action
1	Set up a large work area free from obstacles where to safely dismantle the equipment.
2	Sort the various components by type of material for easier recycling through separate collection.
3	Send the materials obtained in **Step 2** to a specialised company.

Tab. 10.42.

The equipment in any configuration consists of the materials described in Tab. 10.4343:

Material	Disposal/recycling indications
Plastic	It must be dismantled and disposed of separately
Steel	Disassemble and collect separately. It must be recycled through the specific collection centres.
Stainless steel	Disassemble and collect separately. It must be recycled through the specific collection centres
Aluminium	Disassemble and collect separately. It must be recycled through the specific collection centres
Electronic components	Disassemble and collect separately. It must be recycled through the specific collection centres.
Lithium batteries	Consult paragraph “10.1 - Disposing of the batteries”.

Tab. 10.43.

NOTICE!

The above materials refer to standard versions. Different materials can be provided for specific needs.

10.1 - DISPOSING OF THE BATTERIES

Proceed with disposal in compliance with the requirements:

- the transport and packaging requirements given in the chapter;
- of the legislation in force in the country of installation of the equipment.

⚠ WARNING!

When disposing of the batteries, they must be removed from the equipment, as indicated in Directive 2006/66/EC art.12 paragraph 3.

The transport of batteries to the intermediate treatment facilities is not subject to the provisions of ADR, if:

- a quality assurance system is implemented to ensure that the total quantity of lithium cells and batteries per transport unit does not exceed 333 kg (the total quantity of lithium cells and batteries in the batch can be determined by a statistical method included in the quality assurance system;
- a copy of the quality assurance records must be made available to the competent authority if it so requests).

NOTICE!

You can ship batteries and/or batteries for recycling or disposal under a partial exemption scheme, in accordance with special provision 636.
This exemption applies to lithium batteries/batteries of gross mass ≤ 500 g per unit.

10.1.1.1 - BATTERY PACKAGING

NOTICE!

The packages must be labelled in accordance with ADR, i.e. with a diamond shape on the side and code UN3090.

NOTICE!

The packages must bear the indication "LITHIUM BATTERIES FOR DISPOSAL" or "LITHIUM BATTERIES FOR RECYCLING".

The batteries that are removed from the equipment must be packed in such a way:

- to be protected from any damage due to transport and handling;
- to prevent any accidental movement;
- to prevent the terminals from bearing the weight of other elements;
- to be protected from short circuits.

For this purpose, the original packaging or alternatively, packaging compliant with the ADR regulations, can be used.

If batteries not removed from the equipment but still inside it are transported, the packaging may not be approved but must still be:

- sufficiently robust and able to contain and protect the equipment;
- constructed in such a way as to prevent the equipment from operating accidentally during transport.

PAGE INTENTIONALLY LEFT BLANK

11 - RECOMMENDED SPARE PARTS

11.1 - GENERAL WARNINGS

NOTICE!

If spare parts not recommended are used,PIETRO FIORENTINI S.p.A. their declared performance cannot be guaranteed.
It is recommended to use original spare partsPIETRO FIORENTINI S.p.A.
PIETRO FIORENTINI S.p.A. shall not be held liable for any damage caused by using non-original parts.

11.2 - HOW TO REQUEST SPARE PARTS

NOTICE!

For specific information, please refer to the sales network of PIETRO FIORENTINI S.p.A.

11.3 - PUTTING BACK BATTERIES

Summary of installed batteries:

Features	Type	Supply
2-cell battery	Li-SOCl2	Standard

Tab. 11.44.

TM0179ENG

Pietro Fiorentini