Aqua-Scope PRELWE02 LoRaWAN Pressure Monitor Instruction Manual

Contents

PRELWE02 LoRaWAN Pressure Monitor

Product Information

The LoRaWAN Pressure Monitor (PRELWE02) is a device that records the temperature and pressure of water. It consists of two parts:

- The Aqua-Scope pressure sensor
- The wired flood sensor (optional)

The device needs to be connected to a water supply using a T-shaped connector that is mounted on top of the edge valve. The Aqua-Scope pressure sensor head is then screwed into the side opening of the connector. The device reports sensor values every 15 minutes (when mains powered) or every hour (when battery operated).

Product Usage Instructions

Follow the below steps to install and use the LoRaWAN Pressure Monitor:

1. If there are two edge valves under the sink, identify the cold-water supply by opening the hot water and checking which valve warms up.
2. Close the faucet and turn the edge valve clockwise to close it.
3. Using the 19 mm wrench supplied, remove the metal hose from the edge valve. Have a towel on hand to catch any water that may leak from the end of the hose.
4. Mount the T-shaped connector on top of the edge valve and fasten it using the 19 mm wrench.
5. Connect the metal hose to the upper end of the connector and fasten it using the 19 mm wrench.
6. Screw the Aqua-Scope pressure sensor head into the side opening of the connector and fasten it by hand. Do not overtighten.
7. Turn the edge valve anti-clockwise to open it.
8. Check all three connections for leaks for a few seconds.
9. Attach the Aqua-Scope to a suitable location using double-sided tape and plug the sensor head into the water-proof screwable terminal of the main device. Attach the wired flood sensor to the small round terminal if desired.
10. Power the device using the USB C Power Plug provided.

To reset the device to its factory default state, push the button after the initial buzzer beep and keep it pushed for 5 seconds. After 5 seconds, a low-frequency sound will be heard. Release the button to complete the reset sequence. To pair the device with your LoRaWAN server, register the device with its three keys and enter the Device EUI printed on the device plus your registered email address on https://aqua-scope.com/lora to obtain the missing keys. The email address is either the account email from Aqua-Scope Shop purchases or the data provided by your Point of Sale. The LoRaWAN commands can be daisy chained into the payload up to the defined maximum payload size of 51 bytes. All uplink and downlink commands use FPort=10. For more information on LoRaWAN Payload Commands, refer to the product user manual.

Product Description

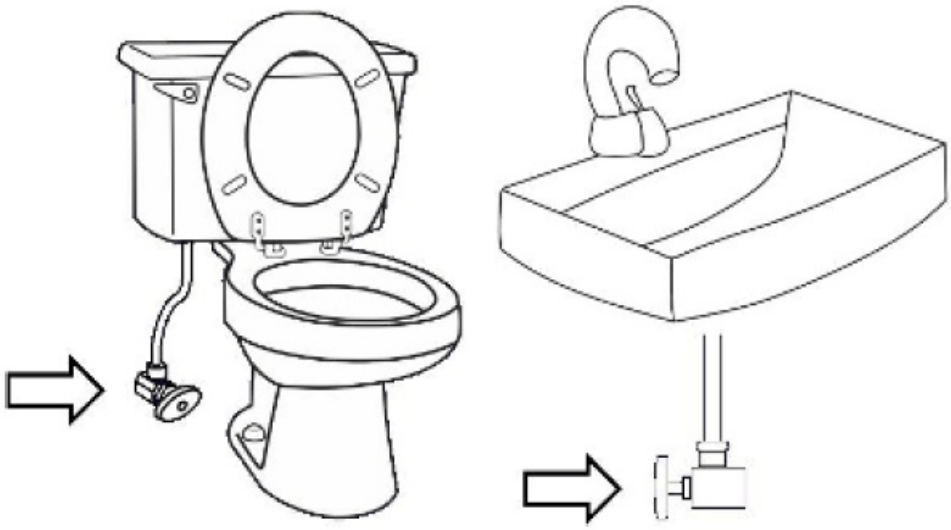
The Aqua-Scope pressure sensor records the temperature and pressure of the water. The device consists of two parts:

- Main housing for signal processing and radio communication with battery compartment.
- The external sensor head is connected to the water pipe. The stainless steel sensor head has a silicon sensor mounted in silicone oil for highly accurate and low-noise pressure measurements in a wide operating range. The measuring range for pressure is between 1 and 10 bar. The sensor values are converted into digital values directly in the measuring head to suppress interference from the connection to the main housing. In addition, the temperature of the liquid medium is measured directly at the stainless steel diaphragm and is therefore very precise.

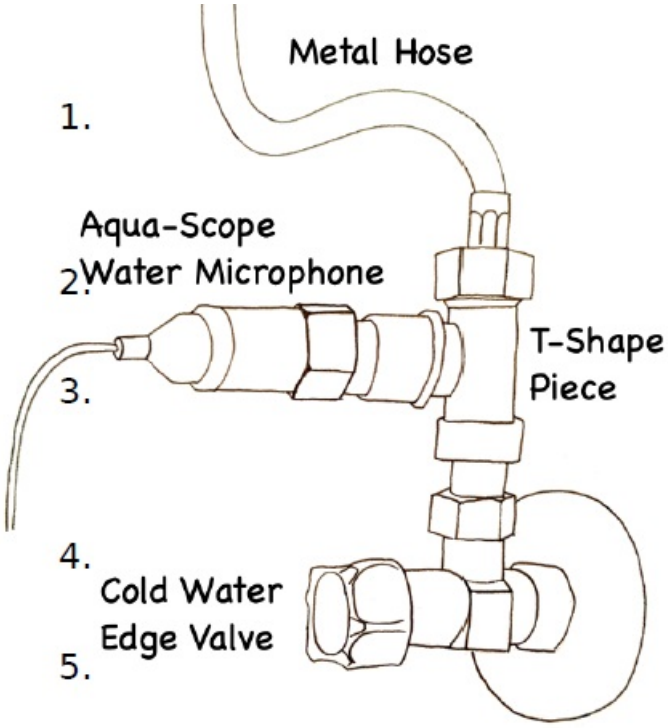
The sensor can send an alarm message if freely definable threshold values are exceeded or not reached. The sensor's polling frequency can be set between 0.1 second and several minutes and defines the battery life. For a measuring interval of 1 second, a battery life of approx. 10 years is calculated. The device communicates via LoRaWAN as a Class A device and can also be operated as a Class C device via configuration parameters. The device is powered either via an external power supply with USB-C power supply unit or via an optional internal ER26500 battery (Bobbin Cell C). Both the sensor head (IP67) and the main housing (IP65) are waterproof and can be used outdoors or in particularly humid and/or dirty environments.

Installation

The sensor head is screwed into inspection openings of existing water pipes or other suitable locations via a ¼ inch thread. If no inspection opening is available it is possible to use the edge valve below a sink or beside a toilet. For this option the installation is described below.



To make it short and easy – the video on aqua-scope.com/install explains the installation of the Aqua-Scope Sensor Head step by



1. In case there are two edge valves under the sink, please identify the cold-water supply. Just open hot water and check which valve warms up.
2. Close the faucet and close the edge valve by turning clockwise.
3. Remove the metal hose from the edge valve using the 19 mm wrench supplied. You may want to have a towel on hand to catch the water leaking from the end of the hose.
4. Mount the T-shaped connector on top of the edge valve and fasten it using the 19 mm wrench
5. Connect the metal hose to the upper end of the connector and fasten it using the 19 mm wrench
6. Screw the Aqua-Scope pressure sensor head into the side opening of the connector and fasten it by hand. There is no need to make it super-tide.
7. Re-Open the edge valve by turning the knob anti-clockwise.
8. Please check all three connections for some seconds that there are no leaks.
9. Attach the Aqua-Scope to a suitable location using double-side tape and plug the sensor head into the water-proof screwable terminal of the main device. Attach the wired flood sensor to the small round terminal if desired.
10. Power the device using the USB C Power Plug. Please use the power supply provided within the scope of delivery. This power supply has very low distortion factor required for precise measurements of pressure.

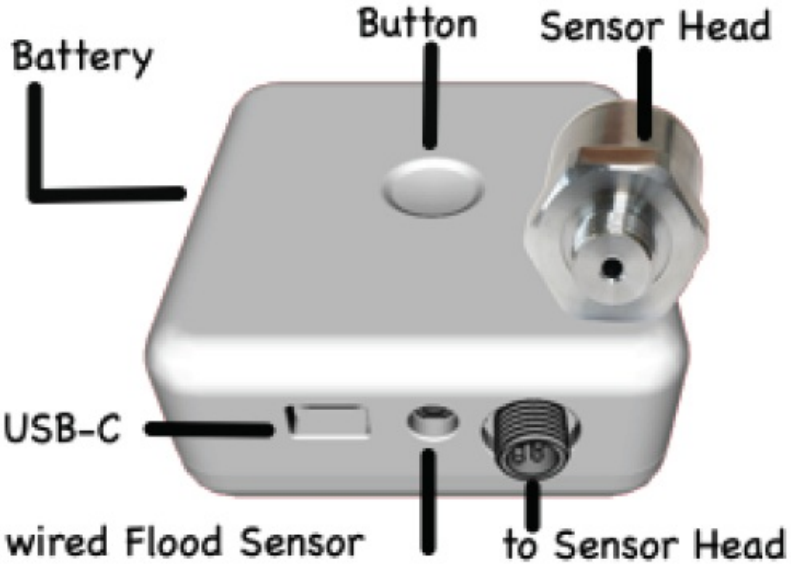
Reset to Factory Default State

The factory default state is indicated by the LEDs blinking green/red. Please push the button after the initial buzzer beep (but not earlier!) and keep it pushed for 5 seconds. After 5 seconds you hear a lowfrequency sound. Now release the button! This reset sequence will delete all settings including network access credentials.

Pairing with the LoRaWAN Network

Please register the device with its three keys with your LoRaWAN server before commissioning. You will find the Device EUI printed on the device. Enter this key plus your registered email address on **https://aqua-scope.com**/lora to obtain the missing keys. The email address is the account email from Aqua-Scope Shop purchases or the data is provided by your Point of Sale.

Functions and Usage



Every 15 minutes (when mains powered) or every hour (when battery operated) the device reports the following sensor values:

- Pressure of the water,
- Temperature of the water right at the sensor head.

The sensor values can be accessed in the Aqua-Scope App or they are reported into the network when integrated into third party systems. The device offers a low watermark and a high watermark threshold that can be defined using the mobile app. If the valued are exceeded an under pressure or overpressure alarm is issued. Beside the water-related alarms the device also reports certain device-related conditions as alarm:

- No external sensor head connected
- Head present but no contact to water
- Battery Low
- Mains Power lost
- Bad communication network quality

All these alarm conditions are monitored continuously. Alarms are indicated on the device with red LED and buzzer sound (both can be disabled in the app) and they are reported into the Aqua-Scope Cloud and shown in the Aqua-Scop App. If the alarm condition disappears the alarm is reversed but will remain in green color in the app for information. Swiping them in the apps home page finally deleted them. Further alarm reactions such as email, push notification or even a voice call can be defined in the Aqua- Scope App.

LoRaWAN Payload Commands (Payload Format)

LoRaWAN commands can be daisy chained into the payload up to the defined maximum payload size of 51 bytes.

This mean that for all commands sent to defined number of bytes in the payload is required to avoid misinterpretation of command and/or command values in the receiver side. All uplink and downlink commands use FPort=10.

- Uplink Command Hardware Version Report: 0x03 – HW – CAP_MSB CAP_LSB (4 Byte): This command reports the hardware version and a bitmap of the capabilities of the device. It is sent
- Uplink Command Configuration Report: 0x04 – IDX – VAL_MSB – VAL_LSB (4 Byte): This command reports a configuration parameter of the device: IDX is the number of the configuration parameter. The 16 Bit VAL is the parameter itself. Configuration parameters are always 16 Bit values. The table below describes the configuration parameters and their values.
- Uplink Command Sensor Report: 0x06 – ID – VAL_MSB – VAL_LSB (4 Byte): This command reports sensor values. The ID indicates the sensor type and defines the format of the 16-Bit VAL. The sensor types of this devices are listed below.
- Uplink Command Firmware Version Report: 0x0a – VER_MSB VER_2 VER_3 VER LSB (5 Byte): This command reports the 32-bit value of the current firmware. It is sent unsolicited as the first command during boot-up and as replying command to downlink command 'Hardware Version Get'.
- Uplink Command Alarm Report: 0x0b – STATE – TYPE – VAL_MSB – VAL_LSB (5 Byte): This command reports start and end of alarms. The STATE-Byte indicates the status of the alarm (0x01 = active, 0x00 = inactive). The TYPE Byte indicates the type of alarm and defines the content of the 16 Bit VAL. Possible alarm IDs and the values reported are listed below.
- Uplink Command Battery Report: 0x12 – VOLT – BAT_MSB – BAT_LSB (4 Byte): This command reports the status of the battery. VOLT is the measured voltage of the battery in 100 mV steps, the BAT value is the consumption of the current battery – as counted inside the system – in mAh.
- Downlink Command System Command: 0x01 – CMD (2 Byte): This command sends a system command to the devices. CMD defines the type of command:
    - CMD = 0x01: System restart
    - CMD = 0x02: System Reset – back to factory default
- Downlink Command Hardware Version Get: 0x03 – (1 Byte): This command calls for a Hardware Version Report sent upstream
- Downlink Command Configuration Set: 0x04 – IDX – VAL_MSB – VAL_LSB (4 Byte): This command allows setting configuration parameters of the device: IDX is the number of the configuration parameter. The 16 Bit VAL is the parameter itself. Configuration parameters are always 16 Bit Values. The table below describes the configuration parameters and its values.
- Downlink Command Sensor Get: 0x06 – ID (2 Byte): This command requests the report of sensor values. The ID indicates the sensor type. The sensor types of the devices are listed below.
- Downlink Command Alarm Clear: 0x0b – TYPE (2 Byte): This command clears an alarm. TYPE is the type of alarm to be cleared. Type = 0 clears all active alarms. For other types of alarms to be cleared please refer to the uplink command 0x0b.
- Downlink Command Configuration Get: 0x14 – IDX (2 Byte): This command allows reading the configuration value IDX. The device will respond with an upstream command Configuration Report

LoRaWAN Sensor Types

The following sensor types are supported by the Aqua-Scope Monitor.

- 0x01: Temperature: VAL is temperature in 1/10 Degree Celsius, (2-complement). Example: 0x06 0x01 0x00 0xCD => Temperature 0x00CD = 205 = 20.5 C., 0x06 0x01 0xFF 0xEA => Temperature 0xFFEA = -20 = -2 C
- 0x03: Uptime: VAL is the number of hours after last boot
- 0x10: Water Pressure: VAL is unsigned water pressure in mBar. Example: 0x10 0x011 0x0D 0x48 => Pressure 0x0D48 = 3400 = 3.4 Bar.

LoRaWAN Alarm Types

The following alarmtypes are supported by the Aqua-Scope Monitor.

- 0x0001 (Bit 00) : All Alarms
- 0x0002 (Bit 01) : Flood Sensor Tripped, VAL is 0x01 or 0x00.
- 0x0004 (Bit 02) : Freeze/Frost Danger, VAL is actual temperature.
- 0x0010 (Bit 04) : Water Underpressure, Value is actual water pressure.
- 0x0040 (Bit 06) : Water Overpressure.Value is actual water pressure.
- 0x1000 (Bit 12) : Battery Low.
- 0x2000 (Bit 13) : Lost Mains Power.
- 0x4000 (Bit 14) : Sensor Head Not Connected
- 0x8000 (Bit 15) : Sensor Head not in contact with water

LoRaWAN Configuration Parameters

All Configuration Parameters are 2 Byte values that can be set and read out using LoRaWAN ‘Configuration Get’ and ‘Configuration Set’ commands. Here is an overview of the configuration

parameters currently used:
Parameter 1 (0x01): System Register (Default: 0x5bfe = dec 23550) The bitmap defines the general behavior of the device. Bit = 1 means function enabled, bit = 0 means function disabled.

- 0x0001 (Bit 00) : Main Processor in Sleep Mode
- 0x0002 (Bit 01) : LORAWAN communication
- 0x0004 (Bit 02) : Wifi communication
- 0x0008 (Bit 03) : Serial communication
- 0x0020 (Bit 05) : Buzzer active
- 0x0040 (Bit 06) : LED active
- 0x0400 (Bit 10) : n.n.
- 0x0800 (Bit 11) : high frequency (1) versus low frequency(0)
- 0x1000 (Bit 12) : base operation interval msb
- 0x2000 (Bit 13) : base operation interval
- 0x4000 (Bit 14) : base operation interval
- 0x8000 (Bit 15) : base operation interval lsb

When High-Frequency Bit set to 1: 4 MSB defines interval in 2 * ms from 2 -32 ms (val 1 – 16). When High-Frequency Bit set to 0: 4 MSB defines interval as 125 ms power of x, ranging from x = 1 = Users and Installation Manual: LoRaWAN Pressure Monitor (PRELWE02)

- 125 ms to x = 14 = 2048 sec = 34 min , x=15 is not allowed.

Parameter 6 (0x06): Over-Pressure Alarm threshold (Default: 0x1f40 = dec 8000)
An overpressure alarm is sent as an uplink message when the current pressure exceeds this threshold. The threshold value is automatically set 24 hours after initial setup during calibration and may change from time to time as a result of ongoing calibration. The value is accepted in mBar.

Parameter 7 (0x07): Under-Pressure Alarm threshold (Default: 0x07d0 = dec 2000)
A heavy flow alarm is sent as an uplink message when the current pressure falls below this threshold for a certain time. The threshold value is automatically set 24 hours after initial setup during calibration and may change from time to time as a result of ongoing calibration. The value is accepted in mBar.

Parameter 19 (0x13): Alarm Enable/Disable (Default: 0xd806 = dec 55302)
The bitmap defines which alarm type is active and will cause an alarm status command 0x0b. Bit = 1 means function enabled, bit = 0 disables the function. The different alarm types are shown in the section ‘LoRaWAN Alarm Types’.

Parameter 29 (0x1d): Reporting Interval (Default: 0x0384 = dec 900)
This parameter defines the interval in seconds the device automatically reports sensor values and heartbeat as an uplink message.

LED-Signals

- All colors blinking: device boots up
- Yellow blinking: Devices tries to connect to network
- Red fast blinking (mains powered) or steady: Alarm
- green/red blinking: factory default
- 3 times green blinking plus buzzer: Device connected to network successfully and is ready to work
- Blue glowing (mains powered) or all LEDs off (battery operated): Device is operating

Battery Operation

If the device is battery-operated all focus in on extending battery life. The battery life depends on several factors:

- Presence of a Pressure Reduction Valve: If a PRV is present the device will draw significantly less power and the battery life extends at least by a factor of 2.
- Interval of status reporting. In mains power mode the device will report its status every 20 seconds and receive commands from the app/Cloud. In battery mode the device wakes up every hour only. Hence, every command such as open/close of the valve or setting certain parameters will be executed with delay.
- All status data such as temperature of water, consumption etc. are only reported once per hour (in mains every 15 minutes)
- The stand-by animation of blue led glowing is turned off in battery mode.

You find an estimation of the battery lifetime in the app under ‘Devices’. With PRV the battery will last about 8…10 years, without PRV the lifetime is about 4 years.

Scope of Delivery

- Water Monitor main device (without battery)
- Pressure sensor head with 80 cm cable
- 3/8 Inch water pipe connector (T-shaped)
- One external flood sensor with cable
- USB-C power cable and power supply
- 19 mm wrench to unfasten and fasten the 3/8 Inch connections of the pipe connector
- Manual

Information related to Drinking Water Directive EU 98/83/EC
The t-shaped part of the device is exposed to drinking water and therefore subject to the European Drinking Water Directive. The certified used material is called CW509L, which is in the list of approved of materials of the German Environment Agency (UBA) in the version from May 14th, 2020 under section 2.1.3.1.

Technical Data

- Power Supply: External USB Power Plug 5 V/ 1A
- Battery: Bobbin Cell C ER26500, Lithium-Thionyl Chloride
- Processor: ESP32-WROOM_32E (Xtensa Dual Core 32 Bit, 240 MHz, 520 KB RAM)
- Wireless Connection:
  - WIFI ESP Built-in 2.4 GHz 802.11 b/g/n, bitrate in 'n' mode up to 150Mbps
  - Lora: SX1261, EU868 MHz, SF 7-12, TX16 dBm, RX: – 147 dBm @ 300 bps, Class A
- Pressure Sensor Head:
  - Range : 0 … 1000 kPa (10 bar)
  - Overload: 150 Percent of maximum pressure
  - Connection: G ¼ " female
  - Communication: I2C
  - Precision:
  - Built-in High-Precision Temperature Sensor
- Dimensions (Main): 91 mm x 91 mm x 30 mm
- Weight (Main Device): 105 gr
- Weight (Sensor Head): 140 gr
- Protection: Main Device: IP 65, Sensor Head: IP 67
- User Interface: 4 colored LED, single touchless button
- Environmental Conditions:
  - Shipment and Storage: -65 °C … 125 °C
  - Operation: – 20 °C … 50 °C
  - Rel. Humidity: 0…90 %

Support and Contact

Should you encounter any problem, please give us the opportunity to address it before returning this product. Please check our website www.aqua-scope.com and particularly the support section for answers and help. You can also send a message to **info@aqua-scope.com**. While the information in this manual has been compiled with great care, it may not be deemed an assurance of product characteristics. Aqua-Scope shall be liable only to the degree specified in the terms of sale and delivery. The reproduction and distribution of the documentation and software supplied with this product and the use of its contents is subject to written authorization from Aqua-Scope.

We reserve the right to make any alterations that arise as the result of technical development.
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Declaration of Conformity

Aqua-Scope Technology OÜ, Sakala 7-2, 10141 Tallinn, Republic of Estonia, declares that this radio emitting device works on the following frequences:

Disposal Guidelines

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging health and well-being.

Documents / Resources

	Aqua-Scope PRELWE02 LoRaWAN Pressure Monitor [pdf] Instruction Manual PRELWE02 LoRaWAN Pressure Monitor, PRELWE02, LoRaWAN Pressure Monitor, Pressure Monitor, Monitor

References

- YouTube
- Oscilloscope | Keysight
- Oscilloscope | Keysight
- Install a water leakage protection system DIY: Aqua-Scope
- CE Declarations + Datasheets: Aqua-Scope
- LoRa Access Keys: Aqua-Scope