THINGSLOG

User Manual

Low power mobile data logger

ThingsLog LPMDL-110X

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Contents

1 Overview

ThingsLog LPMDL-110X is a universal, low power mobile data logger able to meter various kinds of pulse meters, analog sensors and i2c and 1-wire sensors through their digital inputs. The logger is transmitting the metered data over 2/3/4G, NB-IoT and LoRaWAN.

LPMDL-110X has the following key characteristics:

Optimal data transmissions - LPMDL-110X is able to transmit the data over a two-way LoRa/LoRaWAN network in an optimal for the battery way. That allows the logger to meter per minute, to transmit a couple of times per day and still to achieve more than 10 years of battery life.

Intelligence - the data is transmitted over a widely distributed, cellular network and is automatically gathered in ThingsLog platform.

Pulse metering - **LPMDL-110X** has ability for an independent counting of pulse output meters for water, gas, electricity and heating. With a single data logger, you can meter two meters for example for cold and hot water or if your meters are in proximity distance you can meter with a single device gas, electricity and heating.

Analog sensors metering - LPMDL-110X has two extra inputs for connecting analog sensors with 4-20 mA output. An example could be connecting two pressure sensors or one pressure and one temperature sensor.

Combined monitoring - LPMDL-110X can fulfill use cases where with a single logger have to be monitored one water meter and two pressure sensors. For example monitoring of pressure reduction areas by measurements of pressure sensors before and after the pressure reduction valve and its water meter.

Alarms and notifications - LPMDL-110X together with the ThingsLog platform is able to monitor consumption and notify the customer or the utility company for leaks, high or low consumption, fraud or thresholds bridging of certain sensor value or a combination of a sensor and metered value.

Application - LPMDL-110X fulfills various use-cases in Water, Electricity and Gas distribution utilities but also many other use-cases in property management, hotel, manufacturing, condominium sub-metering or in common need is spread.

Ability to work in any environment - **LPMDL-110X** has IP68 dust and leakage protection and is suitable for any kind of home or industrial usage.

2 Technical specification

Technical parameter	Value
Length	132.3 mm / 5.2 in 155 mm / 6.1 in

Height	52 mm / 2.04 in
Width	70 mm / 2.75 in
Weight	130 gram
Temperature range:	-40 - +60 °C
Transmit power	+20 dBm
Sensitivity	-142 dBm
Cable length	1m, 2m, 3m, 4m, 5m
Physical data transmission layer	GSM
MAC layer	GPRS Class 12
Dust & Water protection	IP68
Battery power	4.5 V, 3xAA 1.5 batteries
External sensor battery packs	6x1.5V batteries - up to 9V, fits inside the logger Anything else – in an external battery holder

Table I Technical specification

3   Communication technical characteristics

3.1   2/3/4G

Table 1 2G transmission characteristics

Technical parameter	Value
Sensitivity	GSM850: -109dBm GSM900: -109dBm DCS1800: -109dBm PCS1900: -109dBm
Physical data transmission layer	GSM
MAC transmission layer	GPRS Class 12

3.2   NB-IoT

Table 2 NB-IoT transmission characteristics

Technical parameter	Value
Transmission power	23dBm±2dB
Sensitivity	129dBm±1dB: -
Cable length	1m, 2m, 3m, 4m, 5m
Physical data transmission layer	NB IoT
MAC transmission layer:	Single Tone: DL: 25.2kbps UL: 15.625kbps
	Multi Tone: DL: 25.2kbps UL: 54kbps
	TBS/2 HARQ*: DL 125kbps UL 150kbps

3.3 LoRa/LoRaWAN

Table 3 LoRa/LoRaWAN transmission characteristics

Technical parameter	Value
Maximum transmission power	+20 dBm
Sensitivity	-142 dBm
Physical transmission layer	LoRa
MAC transmission layer:	LoRaWAN

4 Functional specification

- **Pulse metering:** the logger supports pulses generated by reed contacts, hol sensors or S0 pulse outputs of water, gas and electricity meters
- **Analog sensor metering:** The logger supports analog sensors with output from 4 to 20 mA or 0-3V
- **Digital sensor metering:** i2c and 1-wire
- **Data transmission:** LPMDL-110X supports 2/3/4G, NB-IoT and LoRaWAN
- **Low powered:** Preinstalled interchangeable long-life battery able to support more than 5000 transmissions of millions of individual counter values
- **Average battery life:** 5 years
- **Antenna: Internal or optional external SMA**
- **Secured configuration**

● **Certified for both industrial and home usage**

5 Safe and Healthy instructions

Important information	Please read the complete information, the specifications, the installation instruction and the electrical interconnect schema prior to working with this product. For your own health and safety and for the equipment to function correctly please ensure that you understand completely the contents of this guide, prior installation, configuration, operations or prophylactics.
CE	From license point of view, unauthorized modifications or additions are not authorized.
Terms of use	The data logger is intended for use in the following environmental conditions: ● for use indoors or outdoors without prolonged exposure to direct UV radiation ● for altitudes up to 2000 m ● for ambient temperatures from -40 ° C to + 60 ° C, with continuous exposure to temperatures of -20 to -40 ° C not recommended ● for relative humidity of 4% to 100% ● for supply voltage deviation of up to + 20% and -15% of declared voltage ● for use under the overvoltage category I; ● for environment with pollution degree 3 (PD3).
Health and safety rules for installation	All installation work has be performed in accordance with the local regulations on health and safety at work in electrical systems as well as the regulations governing the electrical system and networks. Only engineers or technicians with product expertise that has previously read and understood this guide should install this product.

Installation and maintenance	Installation is done in accordance with the instructions in this document. Incorrect installation may cause damage to the logger and inaccurate measurements. That is why the installation, the initial configuration must be done with due attention. Incorrect installation results in violation of warranty conditions and failure of the warranty. An example of improper installation is to connect the pulse or analog input of the device shortly or to a power source. If you need to connect the logger to an equipment in an ATEX zone 0, 1,2 please do so outside the zone and through an external IC circuit barrier.
Transport and storage	Store in dry rooms without access to water or other liquids at temperatures not lower than -20 ° C and not higher than 60 ° C in the original package. Transportation is allowed to happen accidentally at temperatures below -20 ° C but not more than 8 hours. Protect against shocks and avoid extreme conditions.
Subsequent maintenance	Once installed, the data logger should be cleaned using a dry or lightly moistened cloth, explicitly prohibiting the use of aggressive and abrasive detergents. Every six months, it is desirable for the user of the logger to check the enclosure integrity and the integrity and waterproofness of the cable and connecting terminals to the measured device or sensor.
Recycling	When recycling the product and its disposal, local and national legislation and regulations must be observed. If you hesitate, please return the appliance, we will recycle it for you.

Table II Health and safety instructions

6 Physical installation
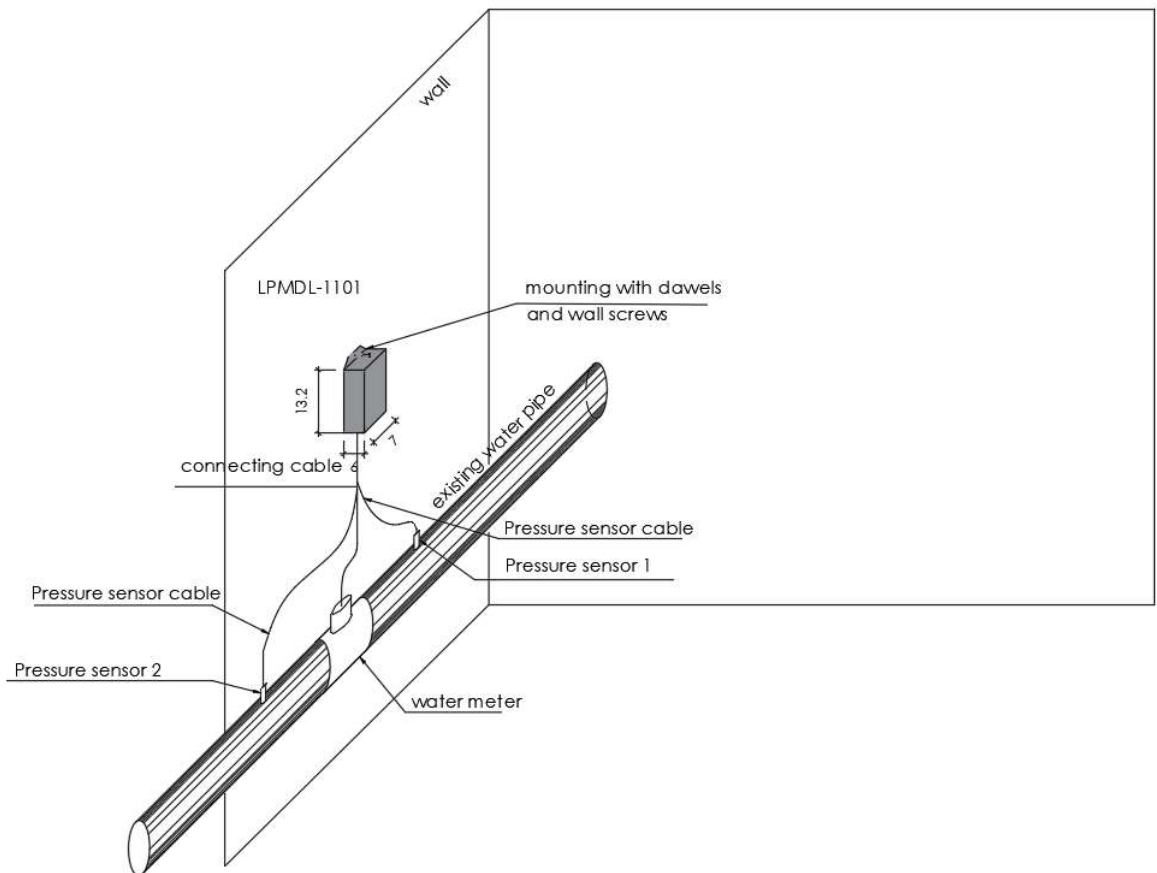

Figure 1 LPMDL-110X Logger outlook

Figure 2 Example installation schema for interconnecting LPMDL-110X with a water meter

- Prior to install the logger please review the health and safety instructions described in chapter 4.
- The data logger is coming with an installation manual and an optional attachment kit
- In order to attach the logger you will need a wall with stiff, flat surface close to the meter or the sensor that you would like to measure.
- Mark and drill holes with size 4x25 mm for attaching the logger to the wall.
- Attach the logger input/outputs to the connecting cable.
- Attach the corresponding connecting cable input/outputs to the meters/sensors.

7 Input/output ports

LPMDL-110X has 14 input/output ports.
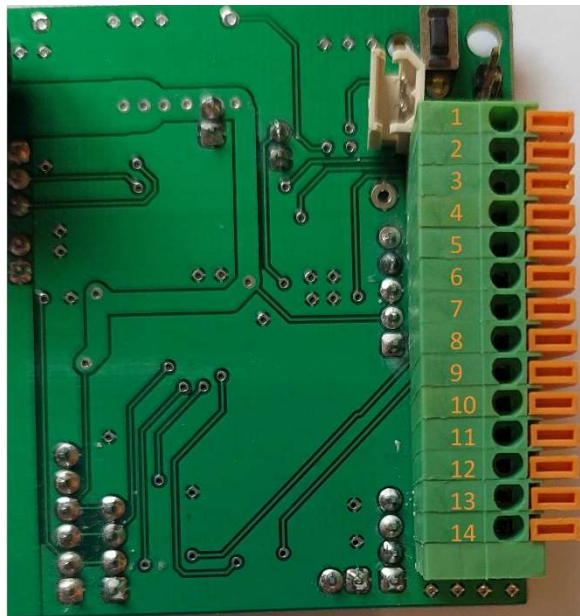
Figure 3 Logger input/output ports

1) Power supply:
   a) output for external sensors - for models: LPMDL-110-XX-YYYY-ZZZZ-LLLL-EE-S12/LAS/LNS.
      (1) S12 is 12V power supply. It is switched by the logger for a short period of time (settling time parameter) configured in the logger, during the measurements.
      (2) LAS is 3.6V or 4.5V depending on the logger battery. It is switched by the logger for a short period of time, during the measurements.
      (3) LNS is 3.6V or 4.5V depending on the logger battery. I is not switched by the logger so the sensors should be low power.
   b) input from external source – for models: LPMDL-110-XX-YYYY-ZZZZ-LLLL-L1/L0-000
      (1) The external power supply can be in range from 5-12V.
   c) not connected – for models: LPMDL-110-XX-YYYY-ZZZZ-LLLL-00-000
2) Ground
3) ON/OFF alarm input 1. Alarm on transition from OFF (opened circuit - the pin is not grounded) to ON (closed circuit - the pin is grounded)

4) ON/OFF alarm input 2. Alarm on transition from OFF (opened circuit - the pin is not grounded) to ON (closed circuit - the pin is grounded)
5) Ground
6) Pulse input 2
    a) can be dry contact (reed contact) – for models: LPMDL-110-XX-2R0S-ZZZZ-LLLL-EE-SSS
    b) S0 (open collector) – for models LPMDL-110-XX-0R2S/1R1S-ZZZZ-LLLL-EE-SSS
7) Pulse input 1
    a) can be dry contact (reed contact) – for models: LPMDL-110-XX-2R0S/1R1S-ZZZZ-LLLL-EE-SSS
    b) S0 (open collector) – for models: LPMDL-110-XX-0R2S-ZZZZ-LLLL-EE-SSS
8) Ground
9) ON/OFF output 1 (open collector)
10) ON/OFF output 2 (open collector)
11) Analog input 4
    a) 4-20 mA - for models: LPMDL-110-XX-YYYY-0V4C/1V3C/2V2C/3V1C-LLLL-EE-SSS
    b) 0-3 V - for models: LPMDL-110-XX-YYYY-4V0C-LLLL-EE-SSS
    c) Not connected – for models: LPMDL-110-XX-YYYY-0000-LLLL-EE-SSS
12) Analog input 3
    a) 4-20 mA - for models: LPMDL-110-XX-YYYY-0V4C/1V3C/2V2C-LLLL-EE-SSS
    b) 0-3 V - for models: LPMDL-110-XX-YYYY-4V0C/3V1C-LLLL-EE-SSS
    c) Not connected – for models: LPMDL-110-XX-YYYY-0000-LLLL-EE-SSS
13) Analog input 2
    a) 4-20 mA - for models: LPMDL-110-XX-YYYY-0V4C/1V3C-LLLL-EE-SSS
    b) 0-3 V - for models: LPMDL-110-XX-YYYY-4V0C/3V1C/2V2C-LLLL-EE-SSS
    c) Not connected – for models: LPMDL-110-XX-YYYY-0000-LLLL-EE-SSS
14) Analog input 1
    a) 4-20 mA - for models: LPMDL-110-XX-YYYY-0V4C-LLLL-EE-SSS
    b) 0-3 V - for models: LPMDL-110-XX-YYYY-4V0C/3V1C/2V2C/1V3C-LLLL-EE-SSS
    c) Not connected – for models: LPMDL-110-XX-YYYY-0000-LLLL-EE-SSS

7.1 Nomenclatures

The name of the logger is formed as follows:

LPMDL-110-XX-YYYY-ZZZZ-LLLL-EE-SSS

1. **XX – Modem**
    a. 10 – GSM
    b. 20,21 - NB-IoT (00 EU, 01 NA)
    c. 30,31,32 - LoRa (30-EU, 31 - NA, 32 AU/AS)

2. **YYYY – Pulse input**
    a. 2R0S - 2 reed switch
    b. 0R2S - 2 S0
    c. 1R1S - 1 reed, 1 S0

3. **ZZZZ – Analog input**
   a. 4V0C - 4 voltage (0-3V)
    b. 0V4C - 4 current (4-20mA)
    c. 2V2C - 2 voltage, 2 current

   d. 1V3C - 1 voltage, 3 current
   e. 3V1C - 3 voltage, 1 current
   f. 0000 - no analog inputs

4. **LLLL - Logger Power supply**
   - 45XX is GSM only, not compatible with other models
   a. 45NB - Ni Mh, LR6, battery pack, 4.5V (GSM model only)
   b. 45NH - Ni Mh, LR6, battery holder, 4.5V (GSM model only)
   c. 45LB - Li. FR6, battery pack, 4.5 V (GSM model only)
   d. 45LH - Li. FR6, battery holder, 4.5 V (GSM model only)
   e. 36CH - Li-SOCl2, Battery, 3.6V, C SAFT, ESH
   f. 36CS - Li-SOCl2, Battery, 3.6V, C SAFT, 26500
   g. 36CE - -SOCl2, Battery, 3.6V, EVE, C 26500
   h. 0000 - no-battery (customer provided battery)

5. **EE - External Power supply**
   - L0 is not compatible with any of the options in LLLL
   a. 00 - No external power supply
   b. L0 - No battery, only external power supply 5-12V
   c. L1 - With battery, and external power supply 5-12V

6. **SSS - Output power supply for sensors**
   - S12, LAS are non-compatible with L0 or L1
   a. LNS - Sensor is powered by logger power supply (Sensor should be low power)
   b. LAS - Sensor is powered by logger power supply only for configurable settling time
   c. S12 - Sensor is powered with 12V power supply generated by the logger (configurable settling time)
   d. 000 - Sensor is not power by the logger

7.2 Example connection circuits

1. Connect 2 reed pulse inputs

   a. You need following logger models: LPMDL-110-XX-2R0S-0000-LLLL-EE-SSS

   b. Circuit
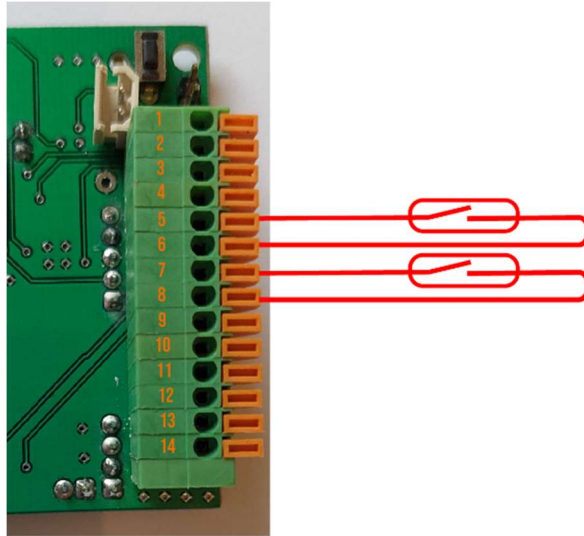
2. Connect 1 reed and 1 S0 pulse input, 3 analog 4-20 mA inputs. The analog sensors are power by 12 V supply, generated by the logger
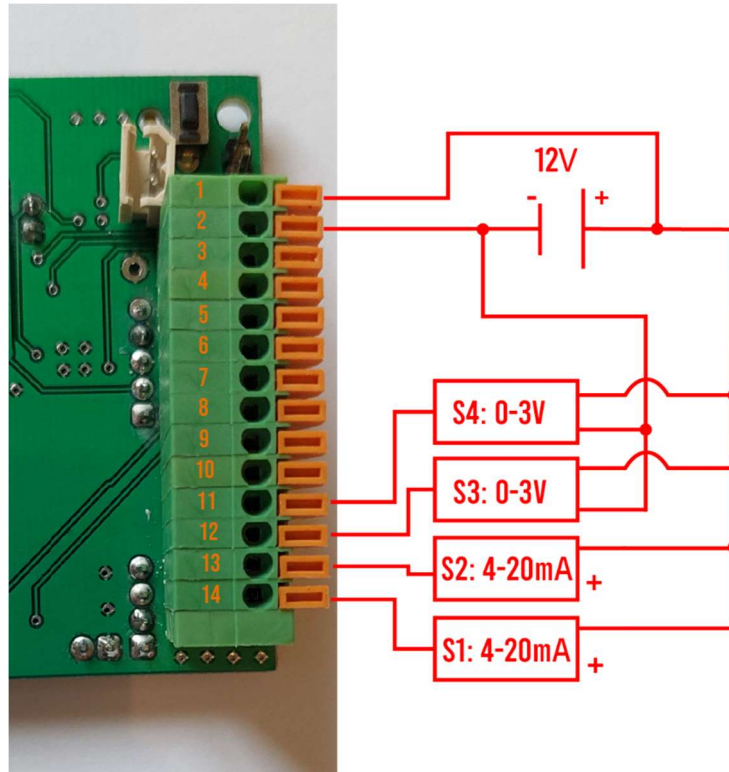
   a. You need following logger models: LPMDL-110-XX-1R1S-1V3C/0V4C-LLLL-00-S12
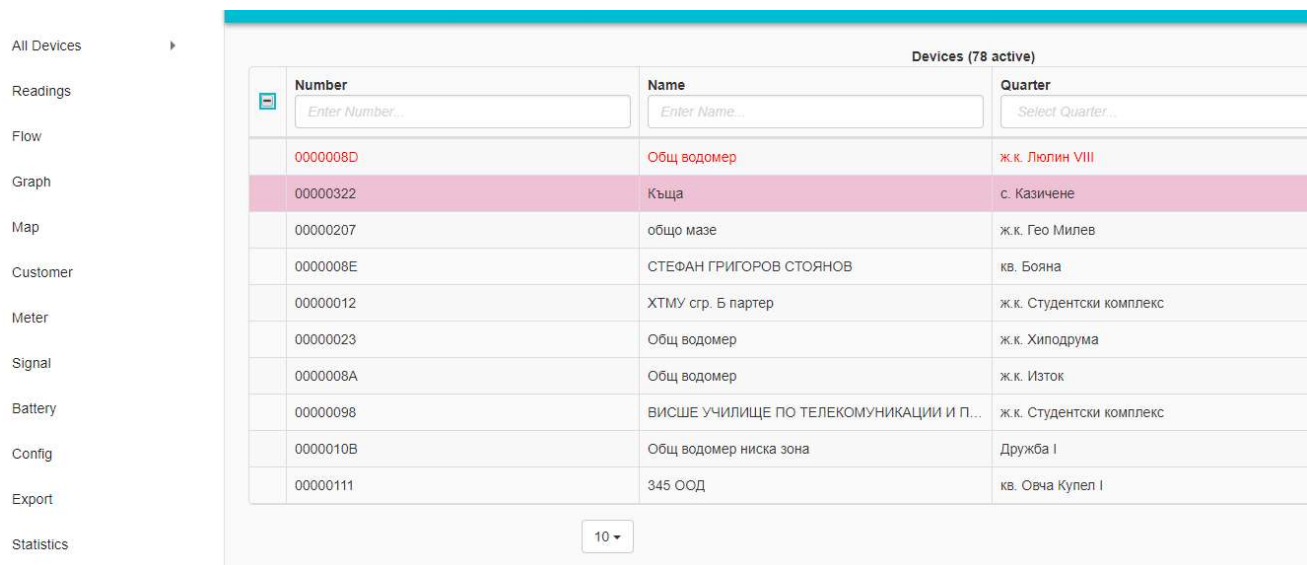
   b. Circuit
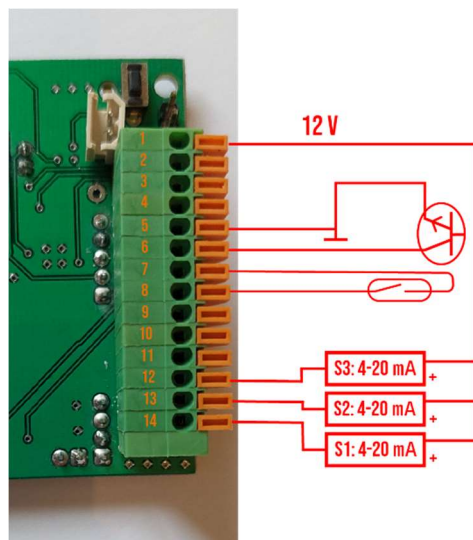
3. Connect 2 analog 4-20 mA and 2 analog 0-3V inputs. The analog sensors 4-20 mA are power by external power supply (non-low power case). The logger is powered by external power supply.

   a. You need following logger models: LPMDL-110-XX-YYYY-2V2C-LLLL-L0/L1-000

   b. Circuit

4. Connect 4 analog 0-3V inputs. The analog sensors are powered by the logger power supply but only for the time of reading analog value.

   a. You need following logger models: LPMDL-110-XX-YYYY-4V0C-LLLL-00-LAS

   b. Circuit
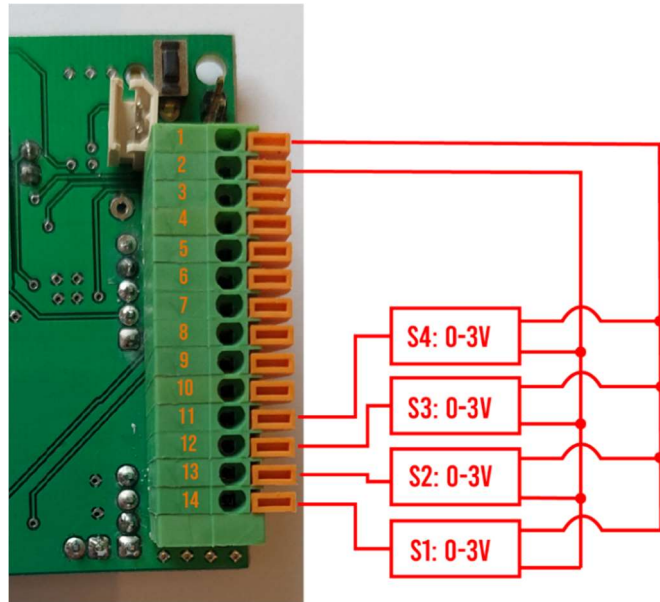
5. Connect 4 analog 4-20 mA. The analog sensors are power by 12 V supply, generated by the logger.

    a. You need following logger models: LPMDL-110-XX-YYYY-0V4C-LLLL-00-S12

    b. Circuit
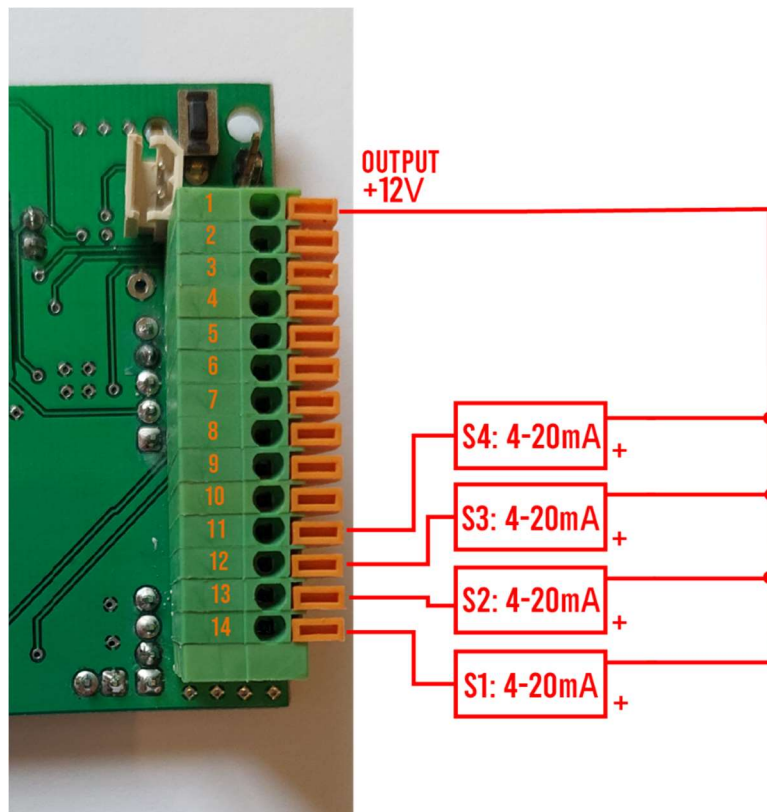
8   User guide

8.1   Login to ThingsLog platform

1. In order to perform the initial configuration you should have an account for ThingsLog IoT platform. If you don't have an account please contact us at support@thingslog.com.

2. Once you have the account navigate to https://iot.thingslog.com

3. You should be able to see a device list with the devices associated to your profile.

8.2   Initial configuration ThingsLog LPMDL-110X

1. Connect your logger to your meters and sensors as described in section physical installation.

2. Navigate to menu "All Devices" - and pick your newly added logger.

Figure 6 Menu "Devices"

3. From the menu choose "Config" then a similar configuration dialog will appear.

Figure 7 Configuration dialog

On the top you can see the logger id, date when it was configured for a last time and current configuration status.

Then follows the common section for all inputs/outputs.

- *Transmission period* - Number of minutes/hours/days between the logger scheduled transmissions

- *Record period* - Could be Minutes or Hours. This is the period on which the logger will log in memory the reading values from the pulse inputs or the period on which it will perform low power reading of its analog current inputs.

4. Pulse sensors

Pulse sensors are typically meters connected to a pulse input port or buttons. To enable the port please slide the slider to the right and enter. Once the port is enabled you have to set the following.
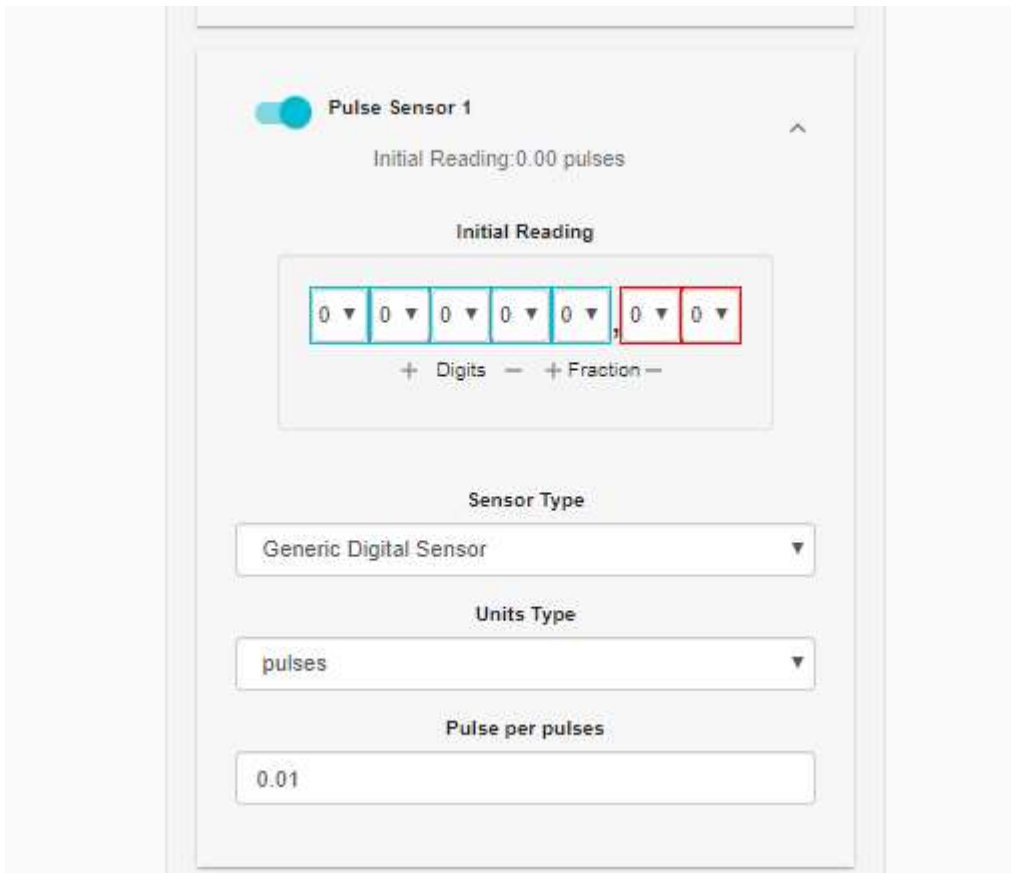

Figure 7 Pulse input port configuration dialog

- *Digits* - Number of digits - equals to the number of digits on the display of the meter

- *Fraction* - Number of digits after the decimal pointer on the display of the meter

- *Initial reading* - Initial value of the counter of the meter

- *Sensor type* – the type of the sensor could be water, gas, power etc meter.

- *Units type* – the dimension of the metered values – m3, kw etc.

- *Pulse per unit* – how much of the measured value is equal to one pulse
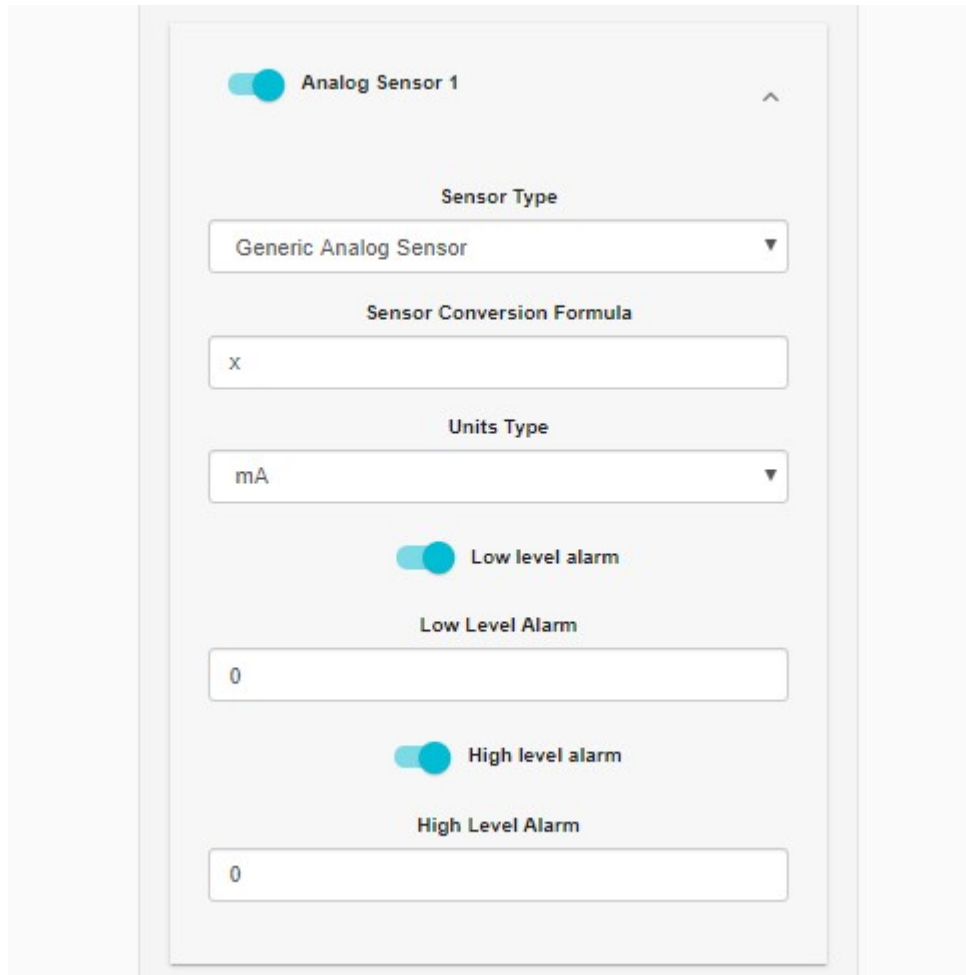
5. Analog sensors

Figure 7 Analog input port configuration dialog

To enable analog sensor readings (connected to the analog inputs) just slide the slider to the right and configure:

- Sensor type – the type of an analog 4-20mA sensor we are measuring
- Sensor conversion formula – convert the "x" into bars or something else based on the formula for conversation of mA to the required dimension of your sensor. If you leave it as x you will get values in mA.
- Units type – the type of the unit – mA, bar, etc.

- Low Level Alarm – Instant alarm for reaching certain low level analog sensor value
- High Level Alarm - Instant alarm for reaching certain high level analog sensor value

6. ON/OFF sensors

    To enable the ON/OFF sensors slide the slider to the right. The sensors has to be normally open ON/OFF sensors. If the port is enabled and the sensor goes from OFF to ON the logger will wake and will transmit an instant alarm.

7. *Delete old counters* - once you are ready with the inputs configuration decide do you want to keep the old values or not. If not choose "NO" else chose "YES".

8. Once you are ready press "**Start Setup**" button.

This will start a 1000 seconds counter. You will have to touch the logger with a magnet prior the counter expiry. This will put the logger into configuration mode and it will try to obtain its configuration from the server.

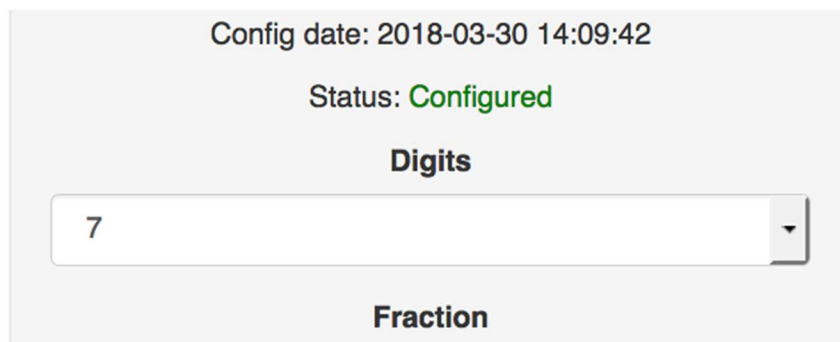9. If the logger get configured successfully you will be able to see the following message on your screen.

Figure 8 Confirmation of successful configuration

If the configuration process is unsuccessful and the device stays in "Not configured" mode please ensure that the device has been placed in an area with proper GSM coverage. If you are not sure that such is available in your area please let us know at support@thingslog.com.

8.3   Reconfiguration over the air

Once the logger has been initially configured with the magnet a user with company administrator privileges could attempt to reconfigure the logger over the air.

Reconfiguration over the air allows the user to change:

- Record period
- Transmission period
- Enable/disable ports

- Set high/low level alarms
- Change K factors (pulse per m3)
- Set on/off alarms

What could be changed but loggers will ignore the changes is:

- Initial readings for pulse input ports.

If you need to change those you have be physically close to the meter and the logger and attempt normal configuration with a magnet.

To reconfigure the logger over the air use the same "Config" menu as we for normal setup.
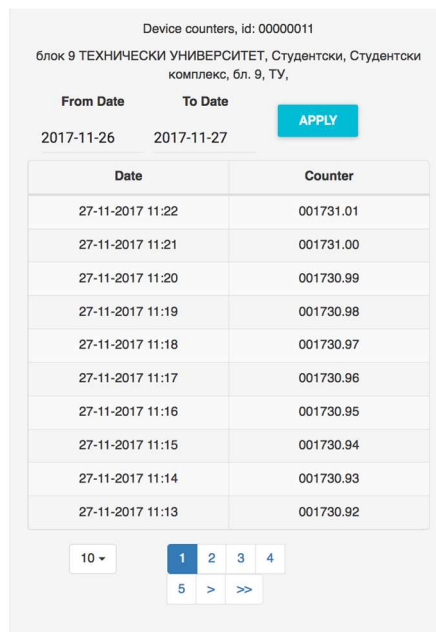
Once the new config is set press start Config.

The logger will obtain its new configuration on next successful transmission.

8.4 Normal operation mode & short functional description

Once configured the logger will start to collect and transmit readings from the attached sensors. The logger supports the following main functionalities:

8.4.1 Readings

From the readings menu the user has access to the readings gathered by the logger. The user can select a time interval and export the readings to a file in csv file format.

Device counters, id: 00000011

блок 9 ТЕХНИЧЕСКИ УНИВЕРСИТЕТ, Студентски, Студентски комплекс, бл. 9, ТУ,

From Date	To Date	APPLY
2017-11-26	2017-11-27	

Date	Counter
27-11-2017 11:22	001731.01
27-11-2017 11:21	001731.00
27-11-2017 11:20	001730.99
27-11-2017 11:19	001730.98
27-11-2017 11:18	001730.97
27-11-2017 11:17	001730.96
27-11-2017 11:16	001730.95
27-11-2017 11:15	001730.94
27-11-2017 11:14	001730.93
27-11-2017 11:13	001730.92

10 ▾   1 2 3 4
        5 > >>

Figure 9 Readings

8.4.2 Flow graph

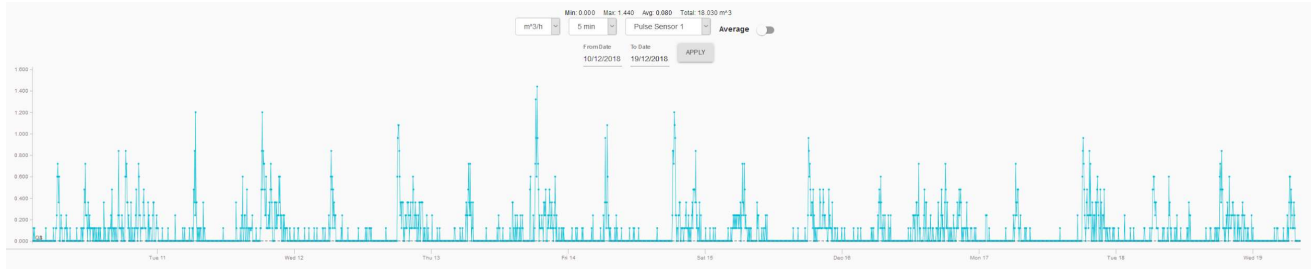Flow menu allows the user to visualize the consumption flow of the meter captured by the logger.

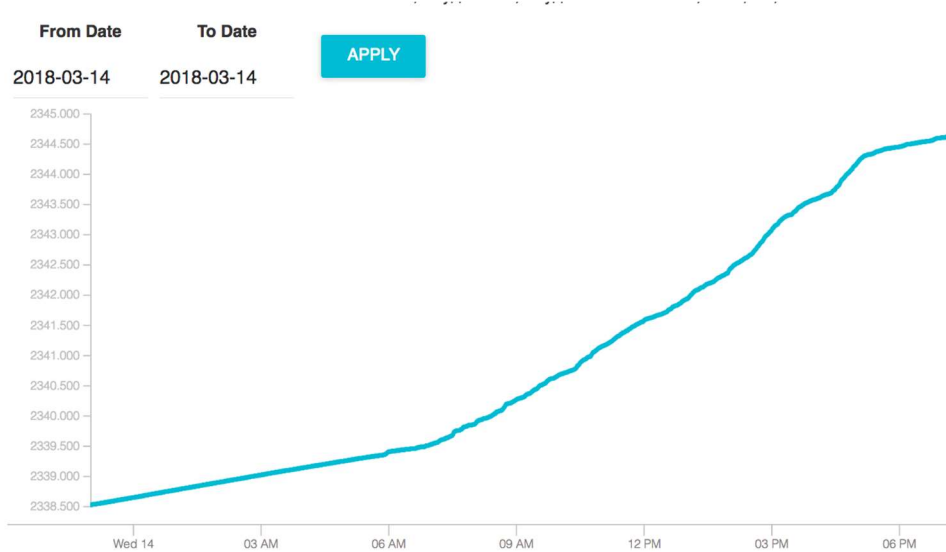**Figure 10 Flow consumption graph**

8.4.3 Cumulative graph

Figure 11 Cumulative consumption graph

8.4.4 Data export

The system supports readings data export from certain time range in CSV file format.

Figure 12 Data export in CSV file format

8.5 Operational considerations

8.5.1 Dashboard

Navigate from the menu to the "Dashboard" where you can verify the operational status of your loggers.
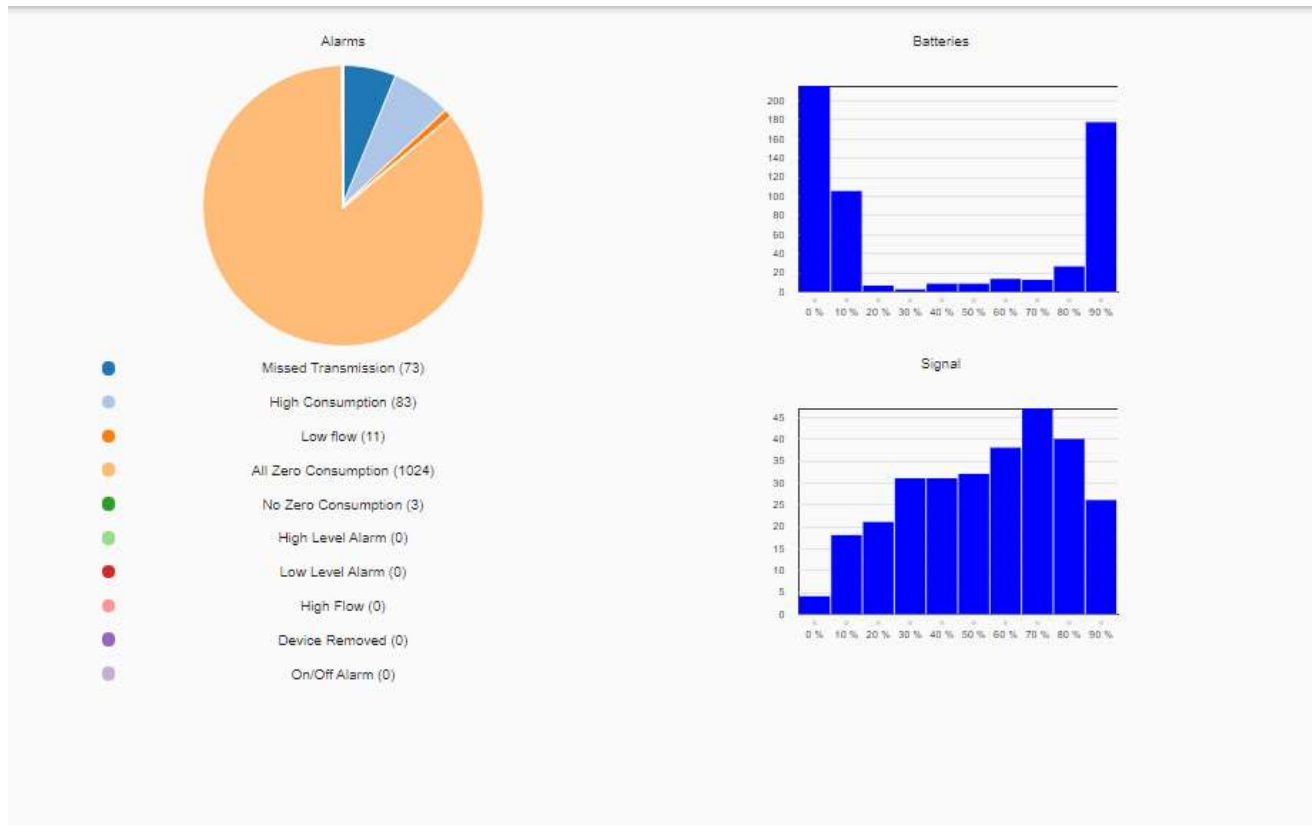

Figure 13 operational status dashboards

ThingsLog™ supports the following kinds of alarms:

- **NO_ZERO_CONSUMPTION** - alarm for non-zero consumption. The non-zero consumption is defined as condition in which the logger is detecting constant consumption over a period equal to the transmission period.

- **HIGH_CONSUMPTION** - alarm indicating consumption higher than a certain preconfigured level over certain period. For example $1m^3$ over 1 hour.

- **MISSED_TRANSMISSION** - alarm indicating that the transmission from the logger did not happen.

- **LOW_FLOW** - alarm indicating that the flow time interval is lower than the expected value per second.

- **HIGH_FLOW**- alarm indicating that the flow time interval is lower than the expected value per second.

- **HIGH_CONSUMPTION** - alarm indicating that the consumption time interval is lower than the expected one.

- **ALL_ZERO_CONSUMPTION** - alarm signaling zero consumption through certain time-period. For there is no consumption for 24 hours. Could potentially indicate a fault meter.

- **DEVICE_REMOVED** - alarm indicating that the meter has been disconnected from the logger.

- **LOW_BATTERY** - alarm indicating that the battery of the logger is under 20%.

- **ON/OF alarm** – on/off sensor is enabled and an instant alarm is triggered

8.5.2 Battery status

Battery status in % of your logger. The same could be reviewed in more details if you navigate to "Battery" section of the product.
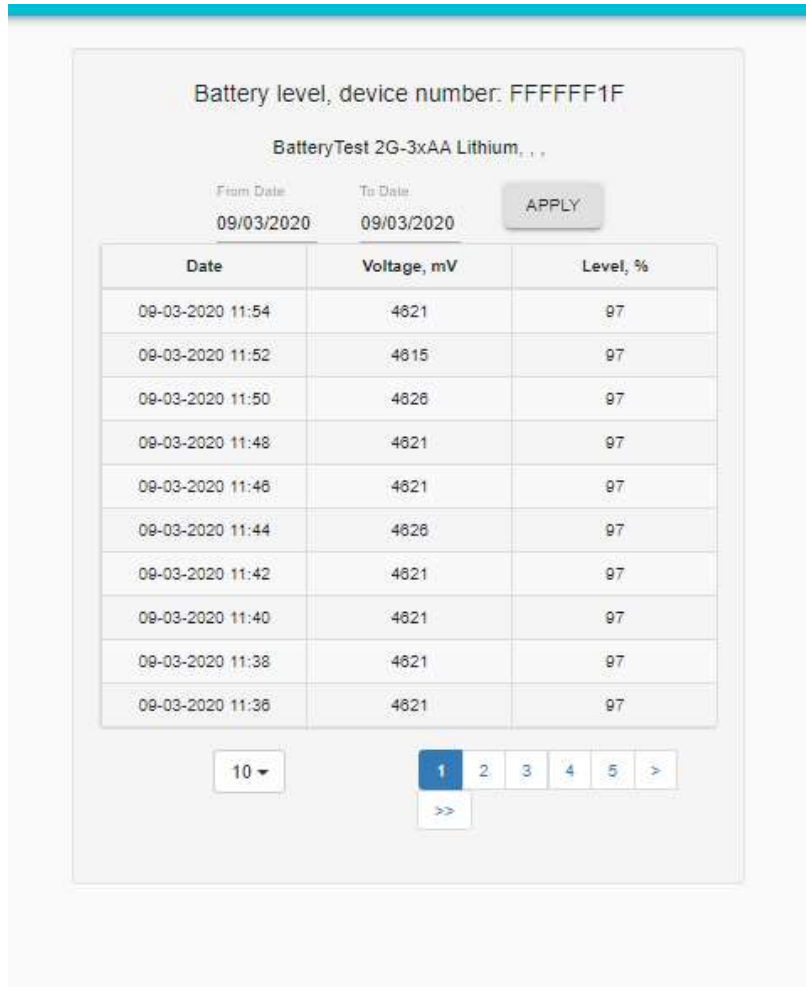
Figure 13 Battery status

Since our loggers are with battery holders we sometimes don't exactly know what kind of a battery is inside the logger. Therefore the more important value is the voltage in mV. The level in % might be incorrect depending of the type of the logger and the battery you have placed in.

8.5.3 Signal status

On each transmission, the loggers are sending their current measured RSSI (Received Signal Strength Indication) and BER (Bit Error Ratio) if there is an error.
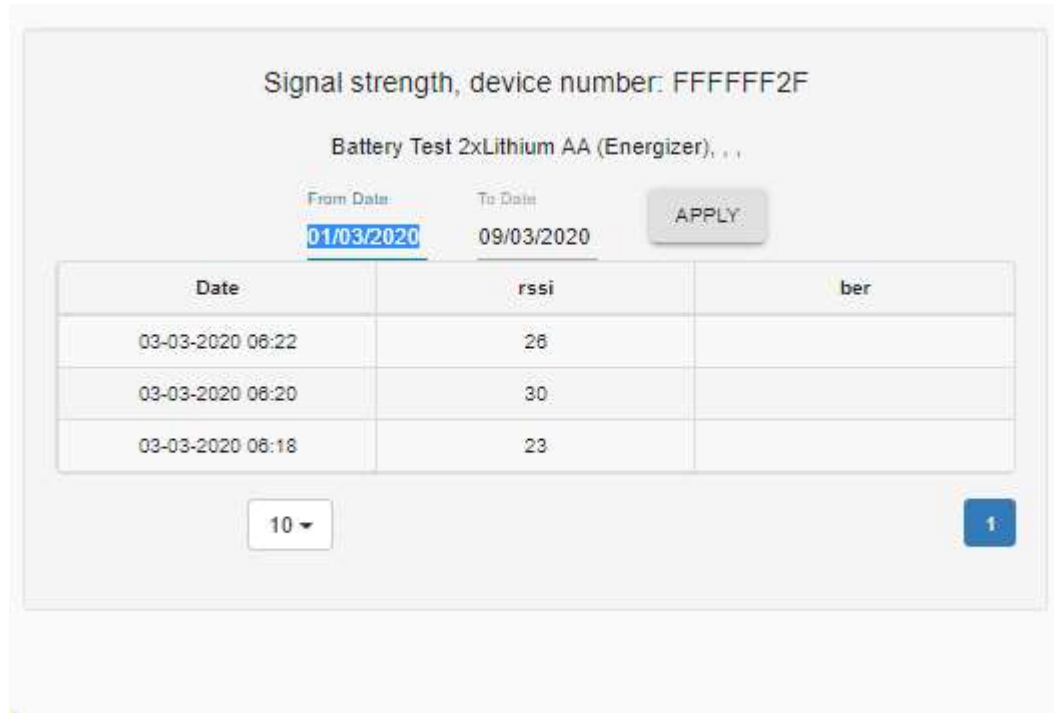
Figure 13 Signal status

9   API guide & 3th party application integration

9.1   REST API

ThingsLog platform supports rich REST API layer. The REST API layer allows to 3th party systems to integrate with thingslog platform and to:

- Perform remote configuration of ThingsLog devices
- Obtain data from data loggers and other 3th party devices
- Obtain statistical analysis data.

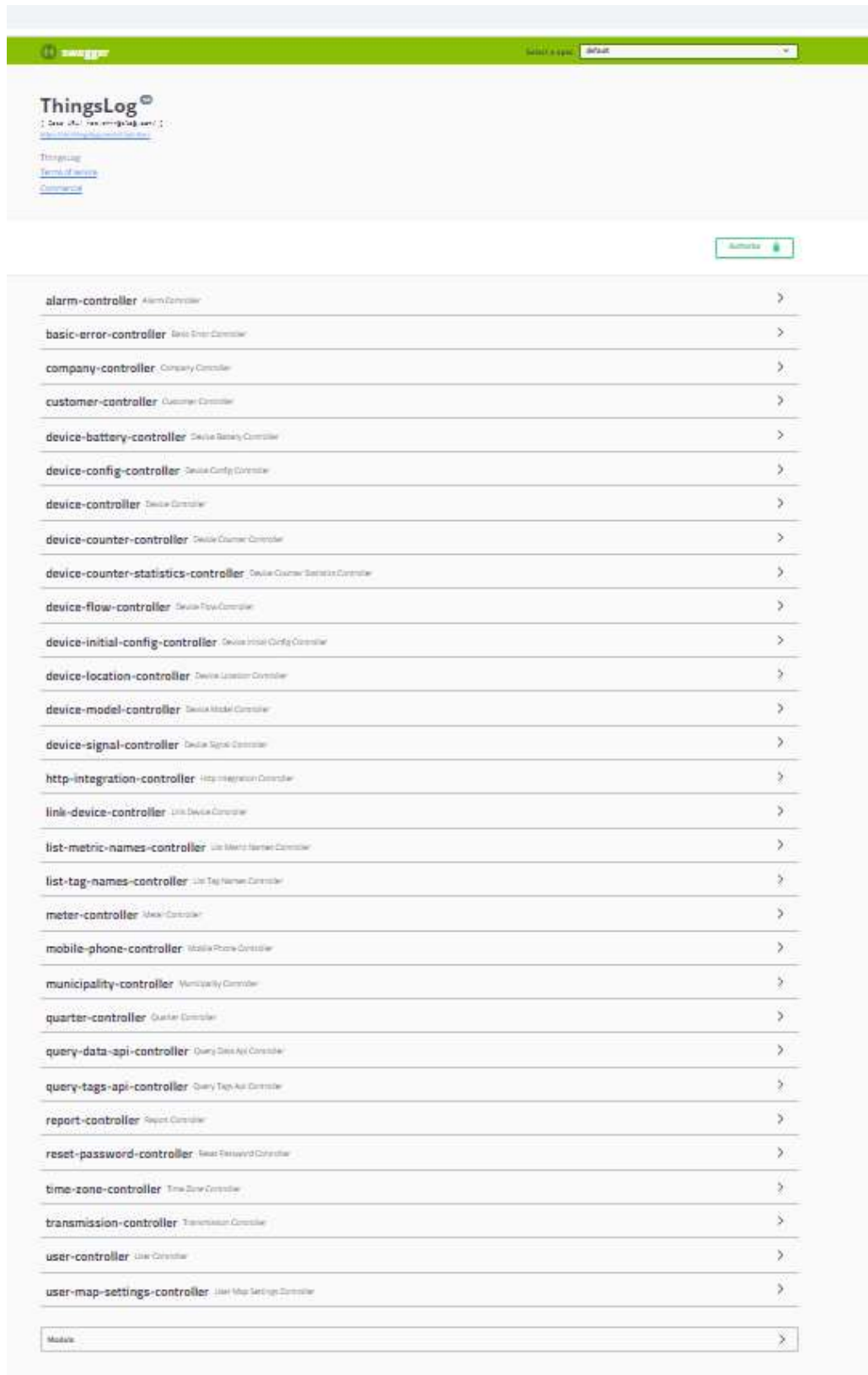A high level overview of ThingsLog REST API controllers is presented bellow:

Figure 14 REST API

Visit us at www.thingslog.com; (+359) 875 32 80 70; sales@thingslog.com

9.2 DATA PUSH REST API

In addition to the REST API ThingsLog is offering a REST DATA PUSH API, which allows the 3th party system to obtain the data directly once it is received by the ThingsLog platform.

The PUSH API provides data in json format similar to the one bellow:

```
[
{"name":"thingslog","value":17,"timestamp":1568548140000,"tags":{"general":"rssi","device_number":"01008213"}},
{"name":"thingslog","value":0,"timestamp":1568548140000,"tags":{"general":"ber","device_number":"01008213"}},
{"name":"thingslog","value":4392,"timestamp":1568548140000,"tags":{"general":"battery","device_number":"01008213"}},
{"name":"thingslog","value":84304,"timestamp":1568548140000,"tags":{"device_number":"01008213","sensor_index":"0"}},
{"name":"thingslog","value":7398,"timestamp":1568548140000,"tags":{"device_number":"01008213","sensor_index":"1"}},
{"name":"thingslog","value":84309,"timestamp":1568548440000,"tags":{"device_number":"01008213","sensor_index":"0"}},
{"name":"thingslog","value":7398,"timestamp":1568548440000,"tags":{"device_number":"01008213","sensor_index":"1"}},
{"name":"thingslog","value":84311,"timestamp":1568548740000,"tags":{"device_number":"01008213","sensor_index":"0"}},
{"name":"thingslog","value":7398,"timestamp":1568548740000,"tags":{"device_number":"01008213","sensor_index":"1"}},
]
```

The fields that will be received by the third party system are:

- rssi - The received signal strength indicator.
- ber - The bit error ratio.
- battery - the voltage of the battery in mV.
- sensor_index - the index of the sensor from which the data are collected (0,1 are pulse input ports, 2,3 are analog
- device_number - the unique number of ThingsLog data logger or 3th party smart meter.

9.3 GRAFANA integration

ThingsLog provides a GRAFA data source plugin for integration with Grafana. ThingsLog data source provides data about the device raw data values, signal & battery status.

Based on this powerful dashbords could be created where the data is compared and aggregated between customer devices.
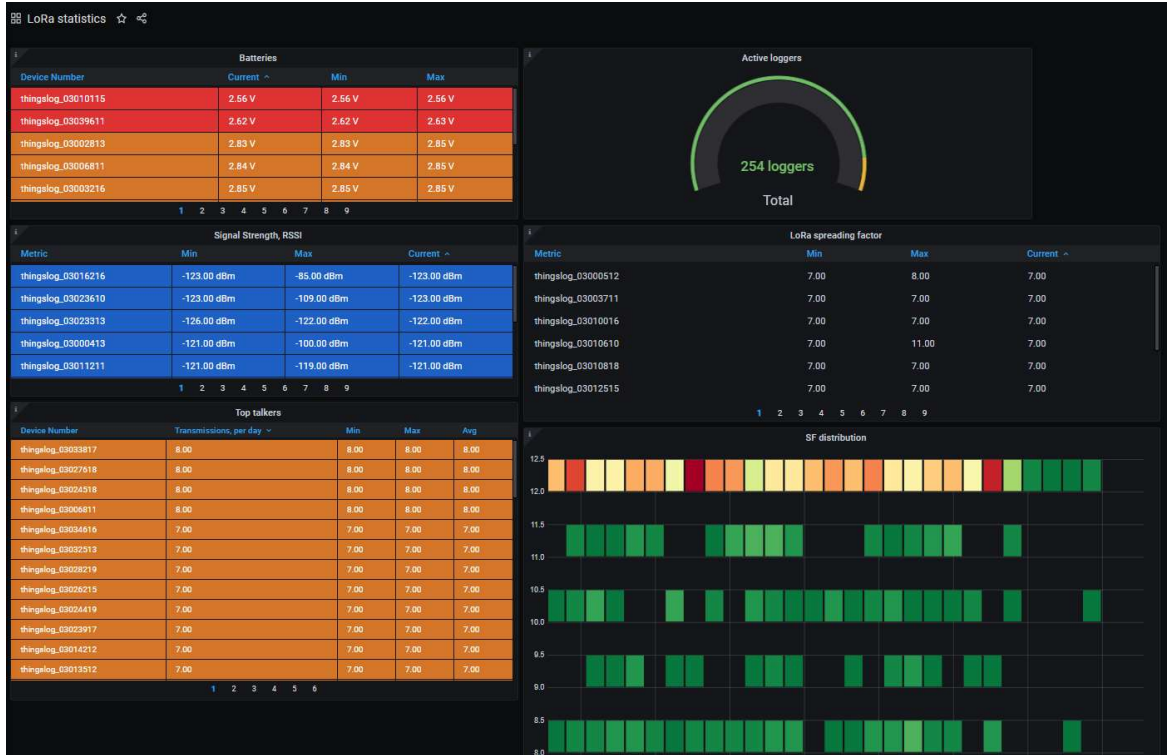
By default ThingsLog provides the following dashboards:

Figure 15 Network statistics

Network statistics – provides aggregated information about the status of all the devices linked to certain customer account.

Figure 16 Device status

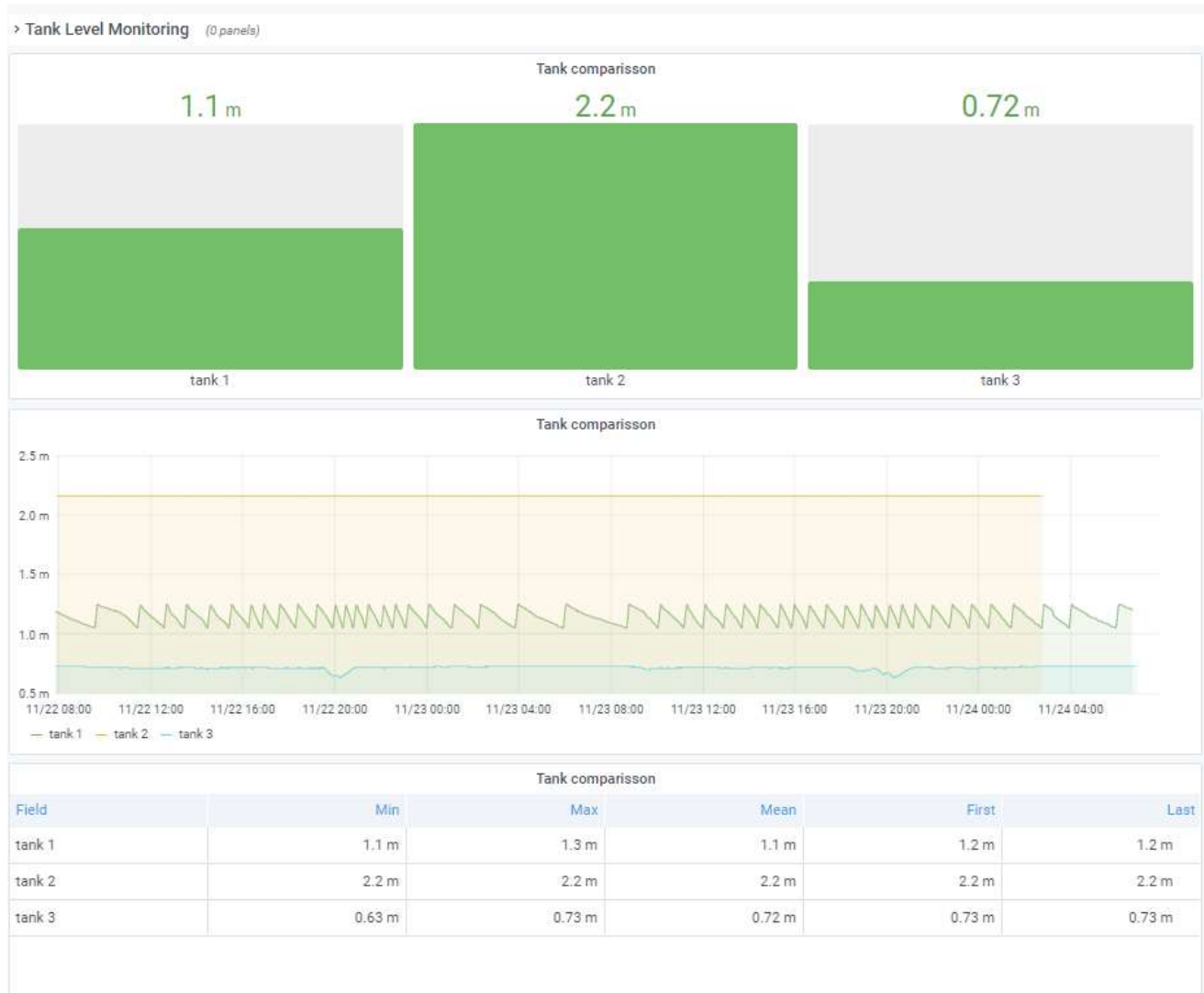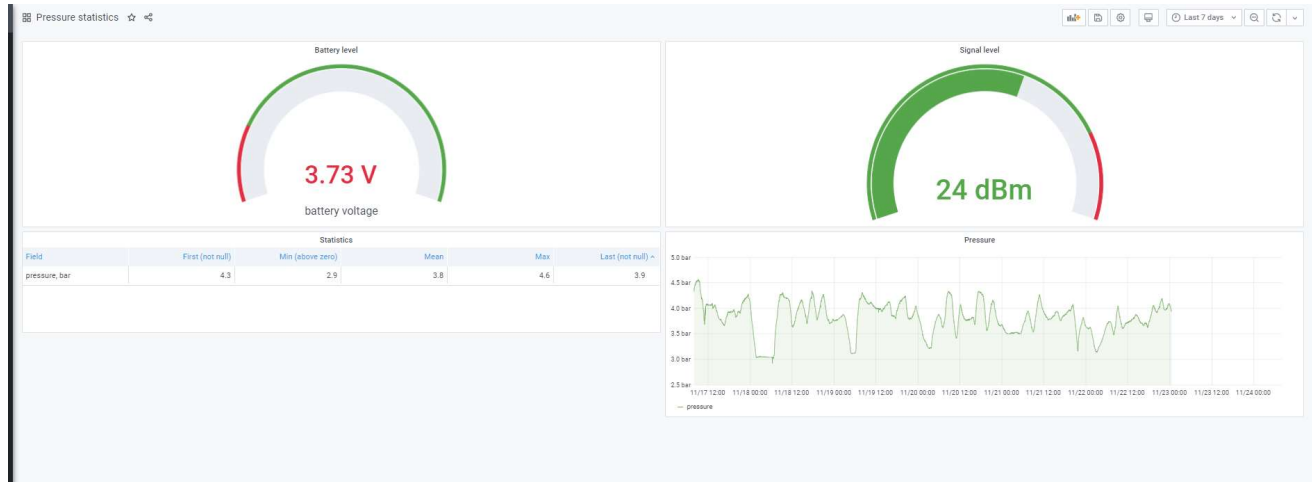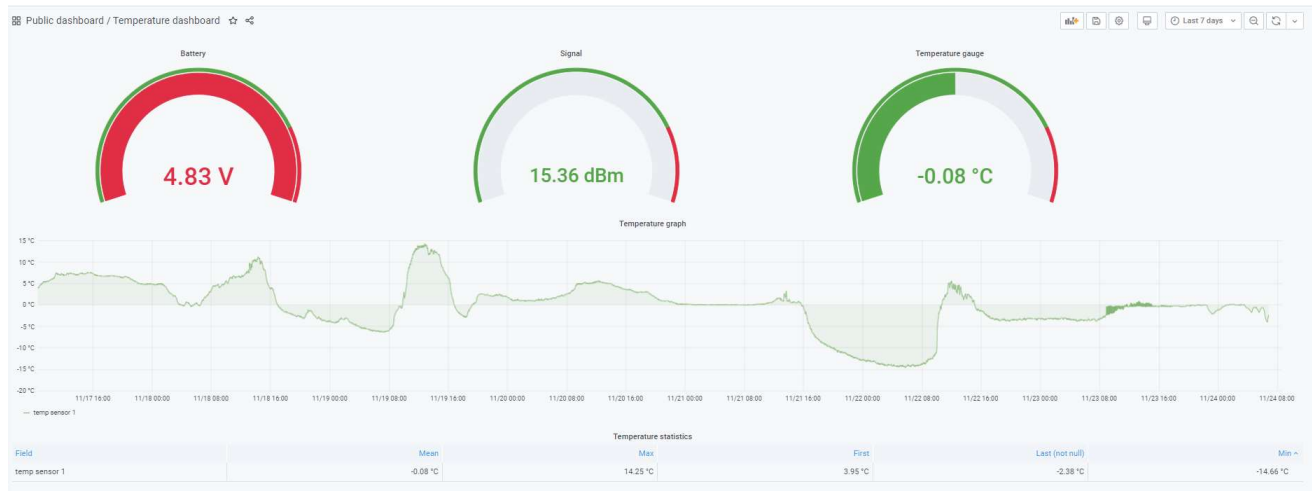**Device status – provides aggregated information about the status of a particular device.**

Figure 17 Level dashboard

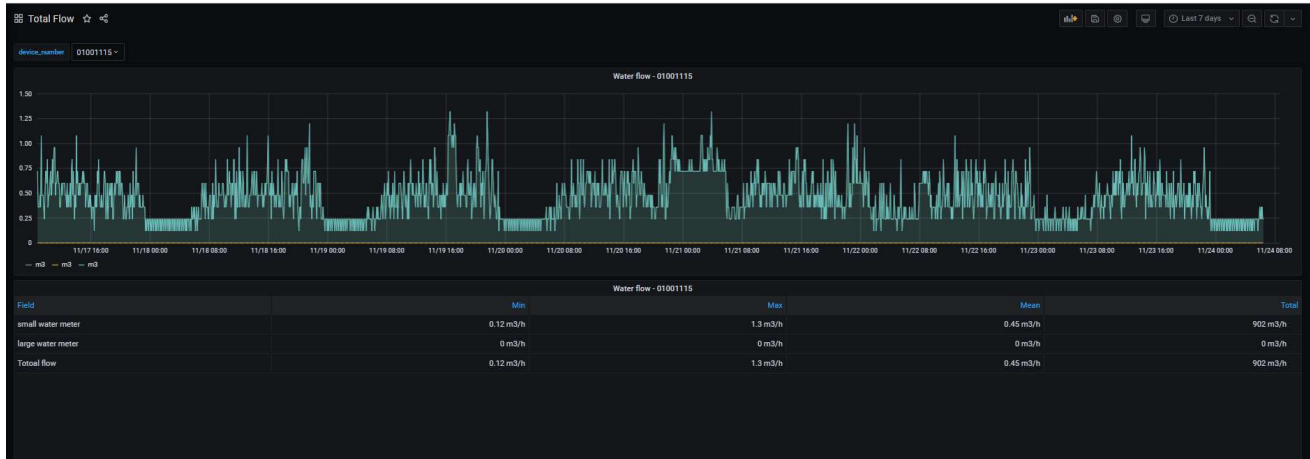Level dashboards are available with ThingsLog level monitoring solution

Pressure dashboard

Level dashboards are available with [ThingsLog pressure monitoring solution](#)

Temperature dashboard

Temperature dashboards are available with [ThingsLog temperature & cold chain monitoring solution](#)

Total flow

Flow dashboards are available with [ThingsLog smart water monitoring solution](#).

Total energy
Energy dashboards are available with [ThingsLog energy consumption monitoring solution](#).