USER MANUAL

ILA 1.0 RATMON LDS

1. Introduction

ILA 1.0 is designed to monitor, detect and locate faults in insulated pipes. Principle working of ILA is based on TDR technology and fully automated process of measurement and evaluation of results. ILA conducts 24/7 surveillance of insulated pipes. Utilising our MSC-1 sensor cable, ILA enables precise fault detection and location district cooling or other installations using insulated plastic or steel media pipe.

2. General principles of device

RATMON is the leak detection system, that carries out 24/7 remote supervision over the pre-insulated pipe network. Installed detectors send automatically to the server all measuring data, thanks to which the operator is kept informed about the state of the network and about the possible occurrence of an alarm. The operator has access to the system from any place with internet access. In the event of detecting the leak system sends automatically alarm notification to network supervisor.

3. Functional description

The leak detector at the bottom of the box has a description of all the sockets, it looks like the graphic below:

4. Basics of use and safety

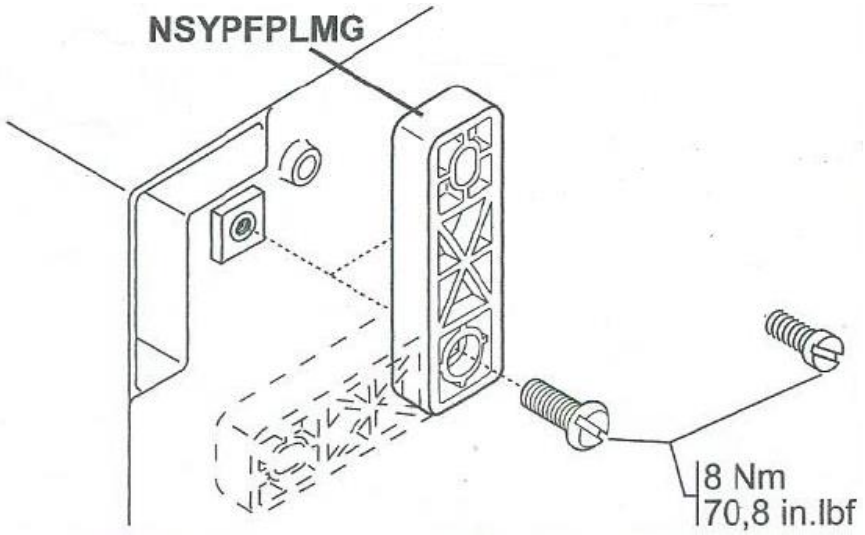
Below are a few rules for the safe use of ILA 1.0. By observing them, you will ensure the correct operation of the device.

4.1 Starting the device

To start the detector correctly, it must first be connected to the mains power supply. Once the detector is connected to the power supply, the POWER LED will light up green and our company logo will appear on the screen, as shown in the graphic below.

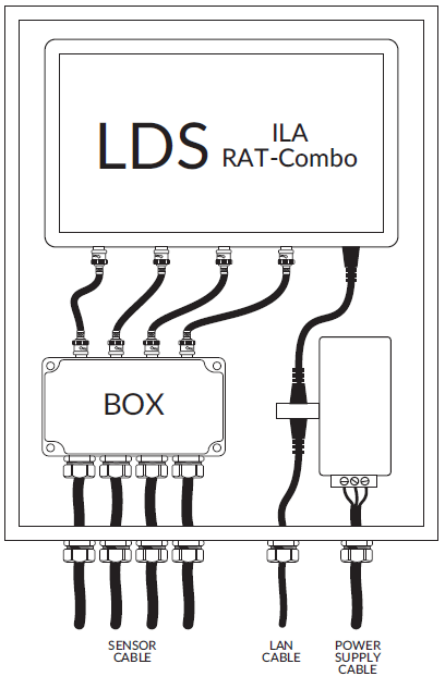
4.2 Mounting in a hermetic cabinet

The ILA 1.0 leak detector is supplied in a hermetic cabinet with NEMA: SK-1. Below is a description of how to properly mount the device in it. First, hang the SK-1 on the wall according to the graphic below.



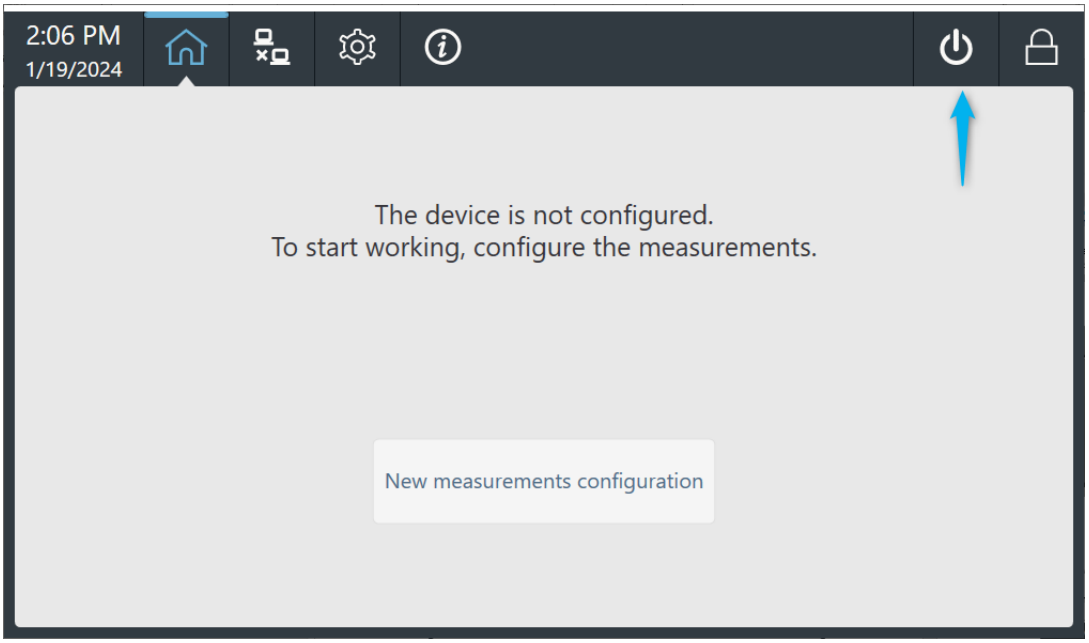
Then, following the steps below, place ILA 1.0 in the cabinet:

- Running the power cable through a suitable gland and connecting the power supply
- Running the LAN cable through a suitable gland and connecting to the device (option)
- Running the measurement cables through the choke according to the principle of one cable / one choke. Connecting to the cabinet.

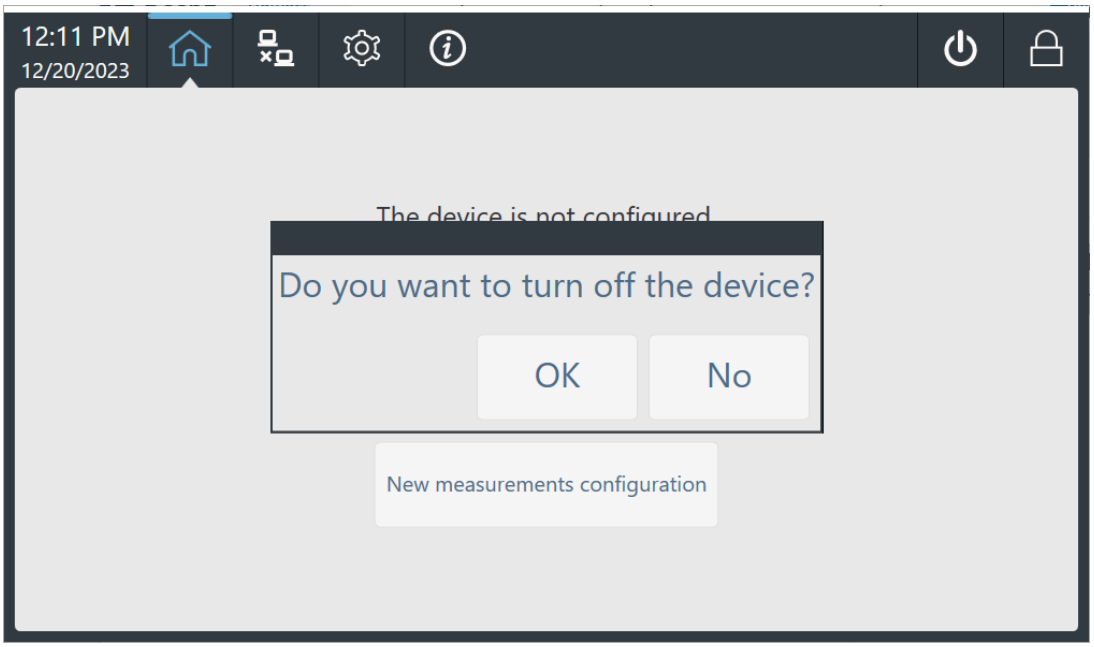


4.3 Safe shutdown of the device

To safely switch off the device, first press the button located in the top right corner of the device's touchscreen.



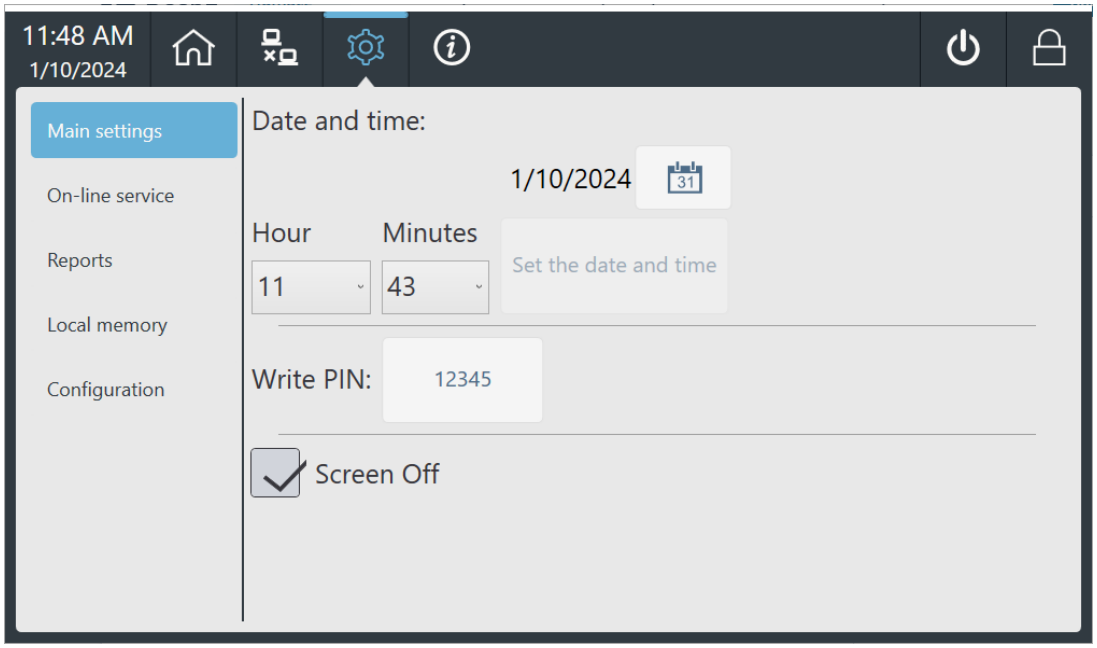
After pressing the button, the device will ask us to confirm the operation, if we confirm the operation, the device will switch off.



When the device switches off only then should it be disconnected from the mains supply.

5. Settings

This chapter provides information on basic meter settings such as date and time, pin settings or communication. To access the basic configuration of the device, press the settings button at the top of the touchscreen. When the button is pressed, the following tabs are visible on the left side of the screen: Main settings, On-line service, Reports, Local memory, Configuration.

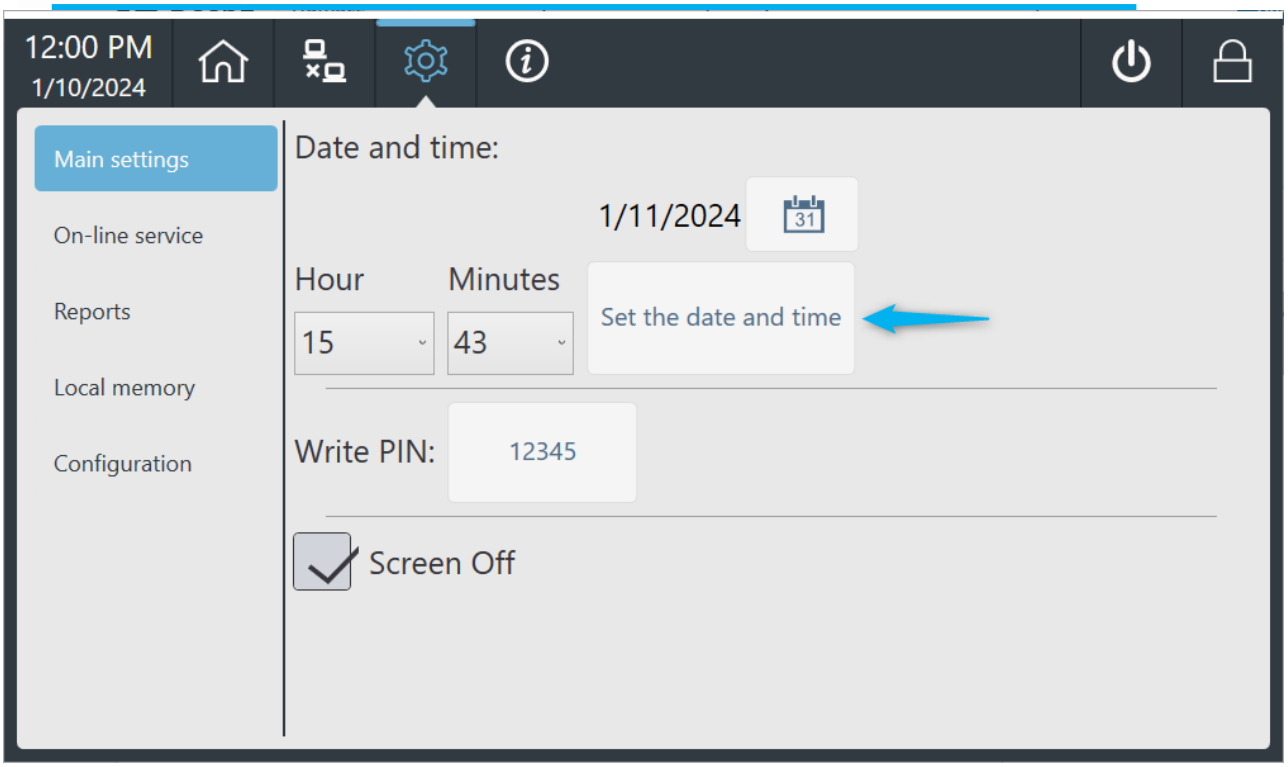


5.1 Main settings

In this tab, we make settings for the date and time, the PIN code that is required to unlock the touchscreen and we have the option to enable the screen to automatically switch off after 20 minutes of inactivity.

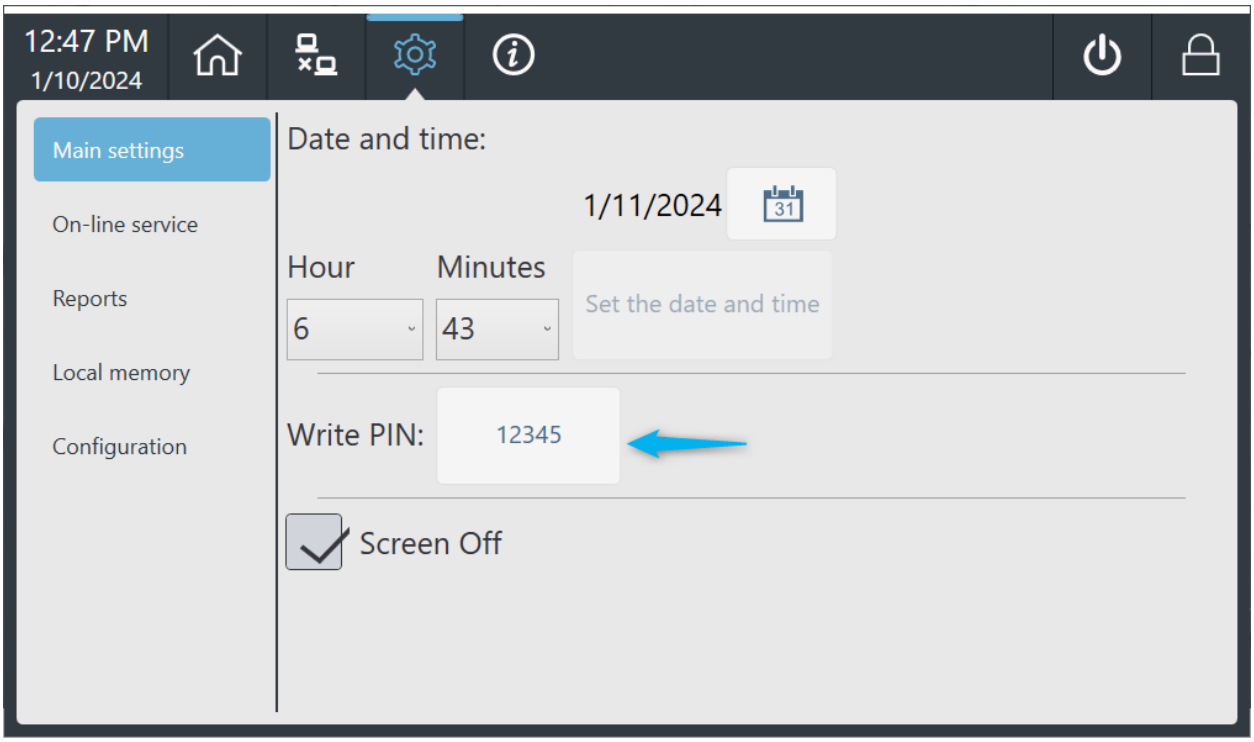
5.1.1 Date and time

To change the date and time settings, select the date and time respectively on the touchscreen. Save your settings by pressing the “Set the date and time” button.

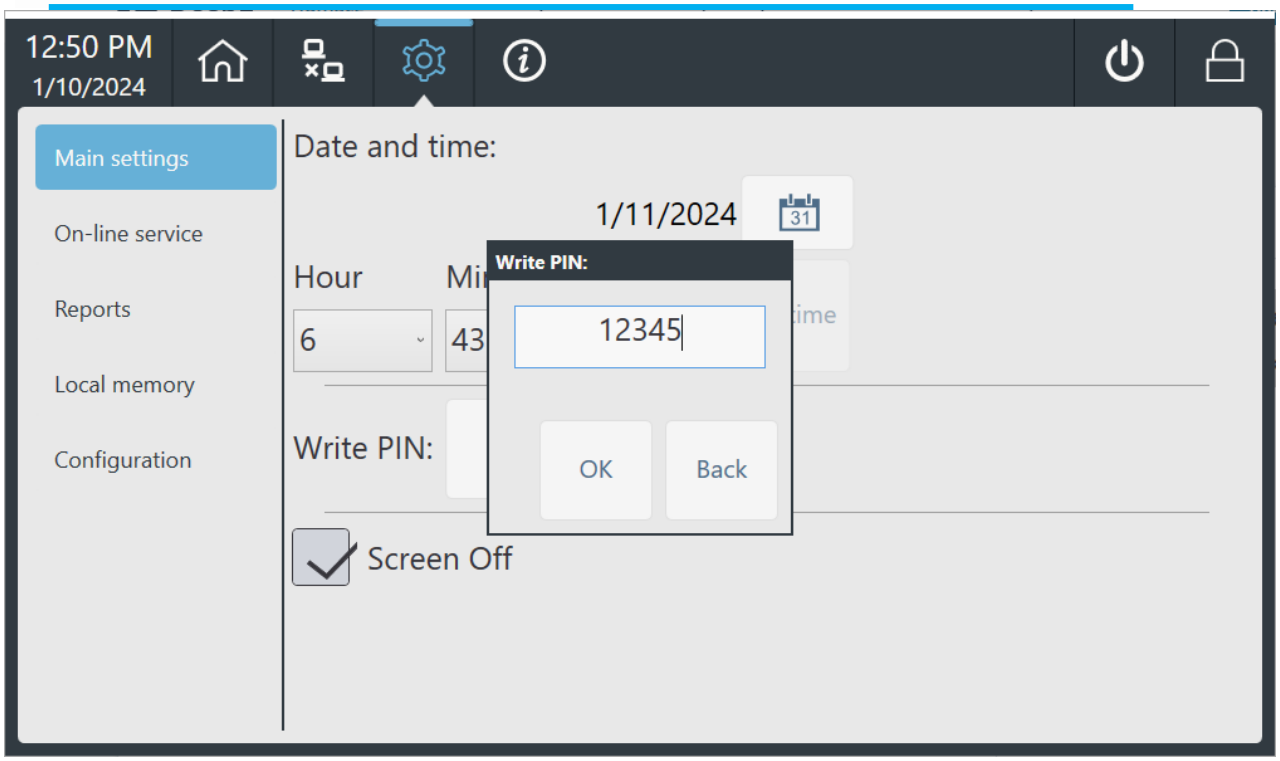


5.1.2 PIN

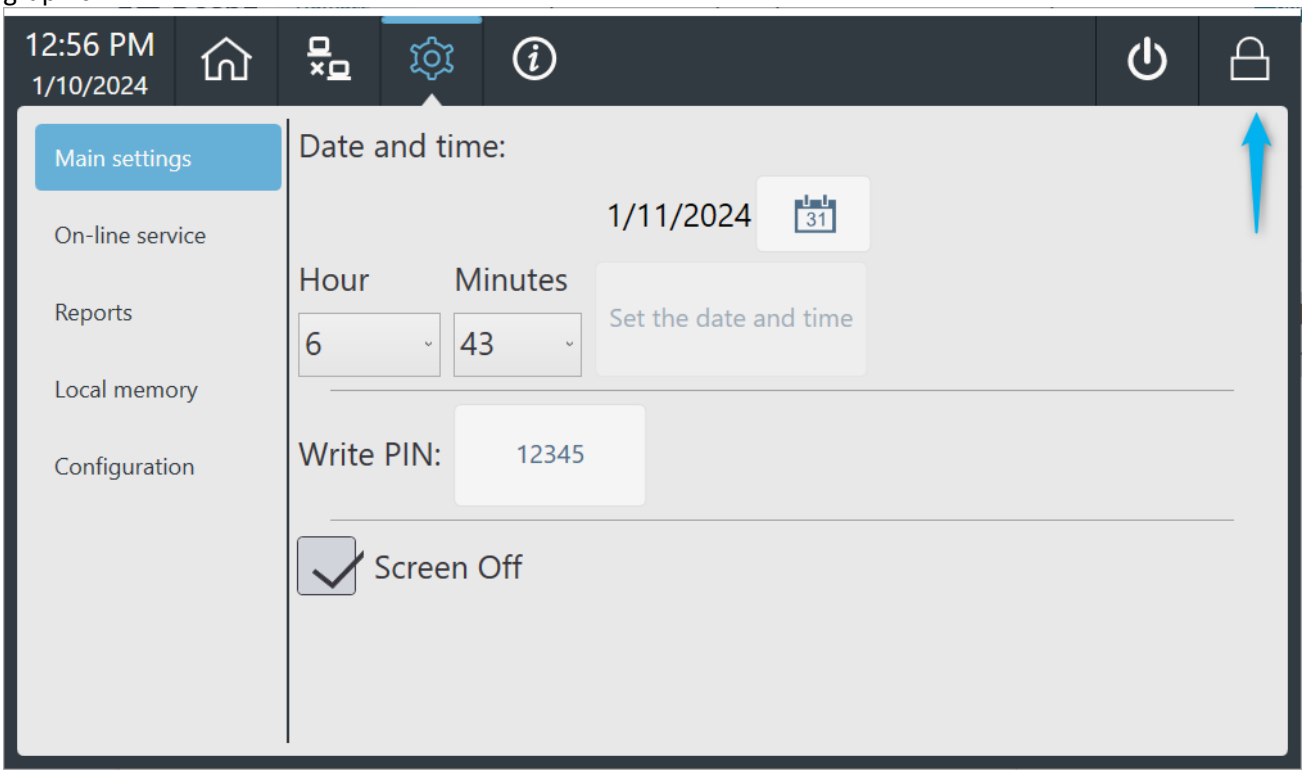
To set the PIN code required to unlock the screen press the button indicated in the following graphic:



Once the change has been made, confirm by pressing the "OK" button

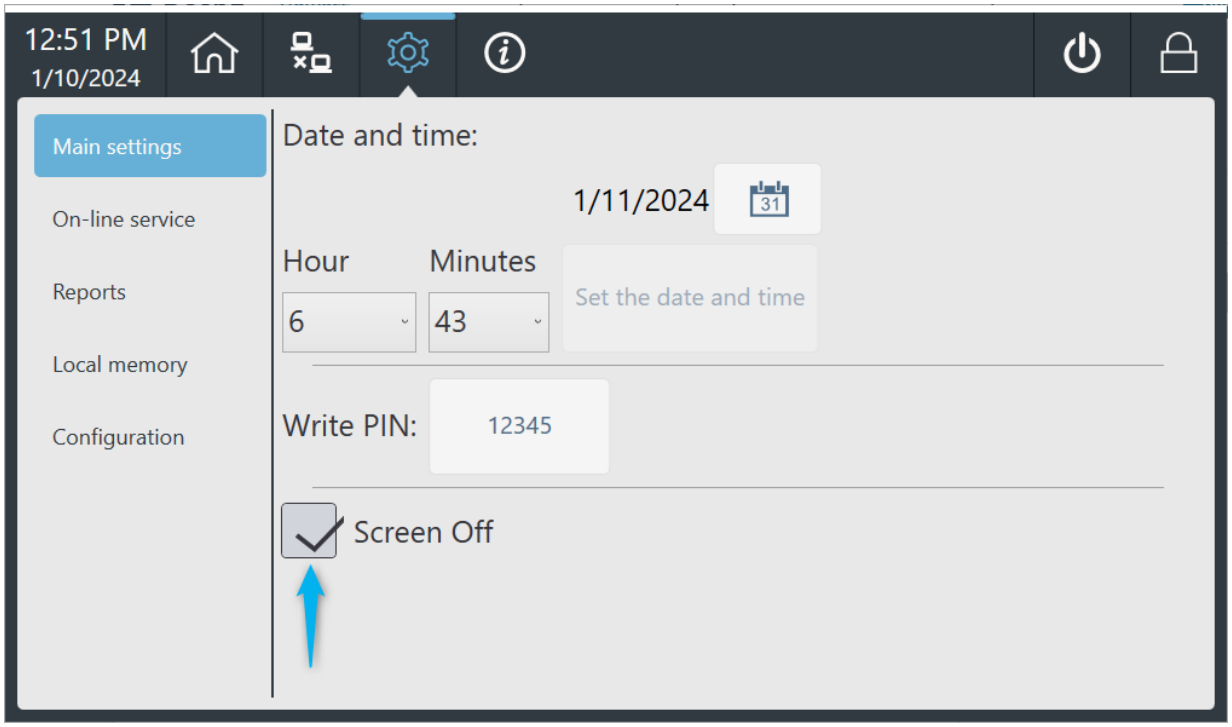


After setting the PIN, the screen can be locked at any time by pressing the button shown in the accompanying graphic:



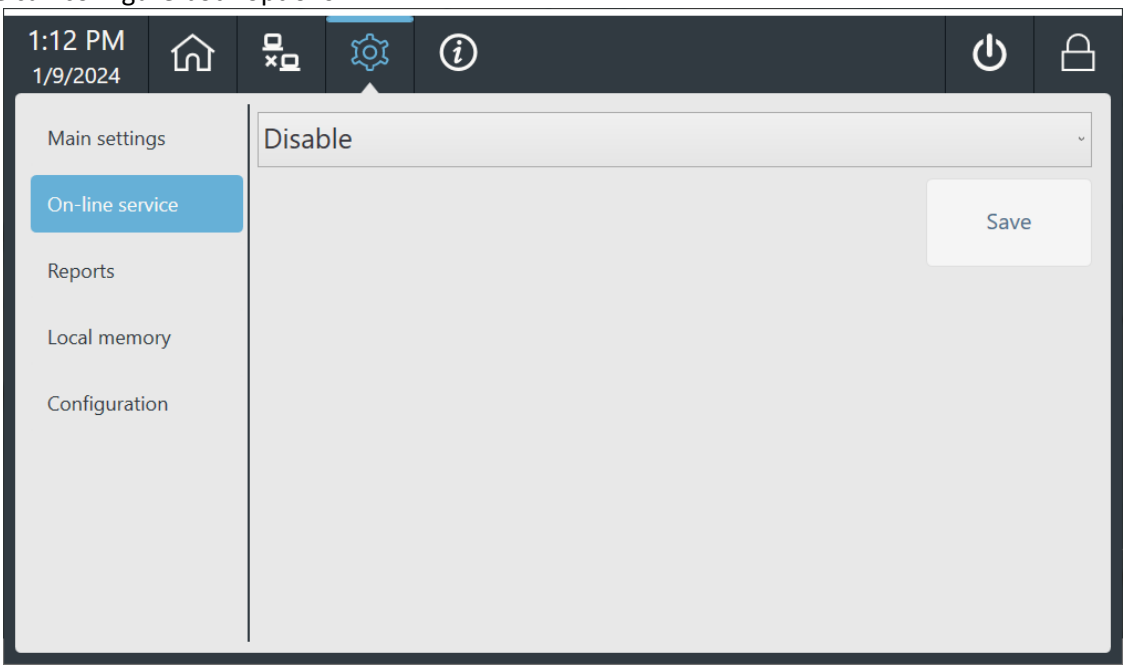
5.1.3 Screen Off

To disable the automatic screen off, uncheck the 'Screen Off' option. If the device is left idle for 20 minutes, the screen switches off.



5.2 On-line service

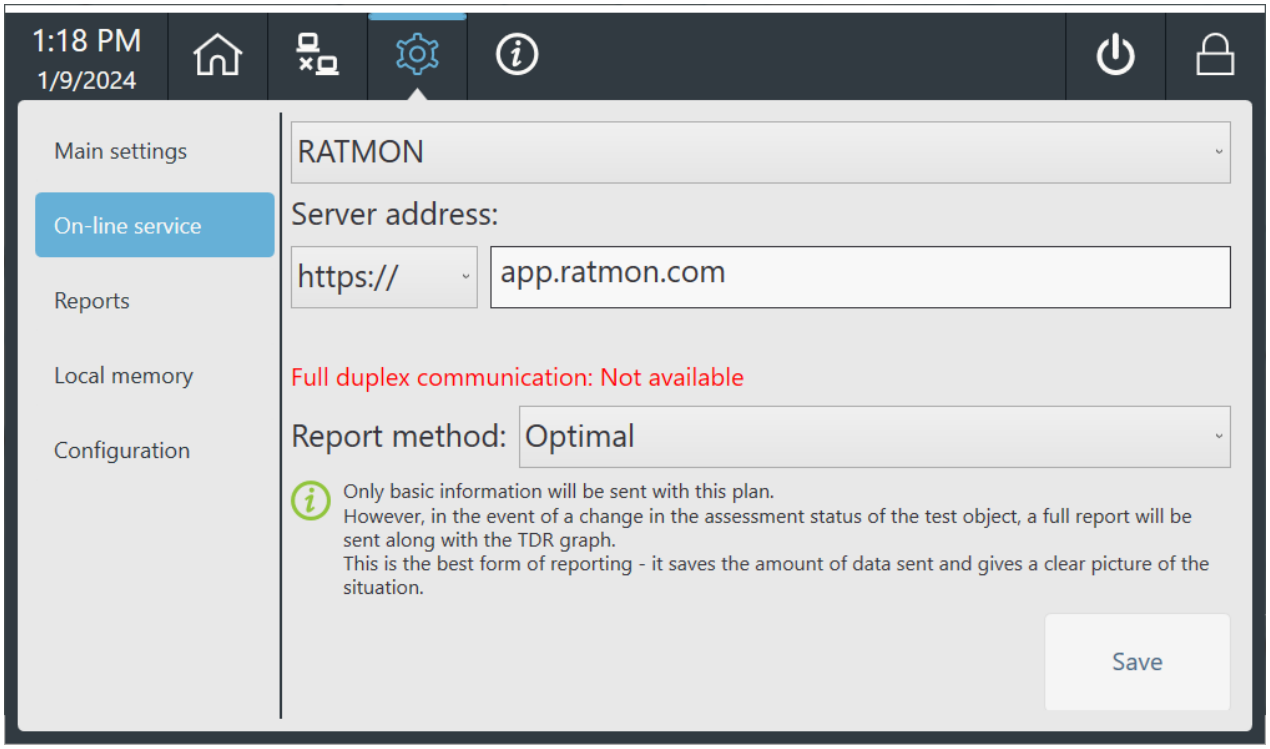
ILA 1.0 is compatible with RATMON leak detection system and also can send an e-mail notifications. In this tab we can configure both options.



5.2.1 Configure connection to RATMON system

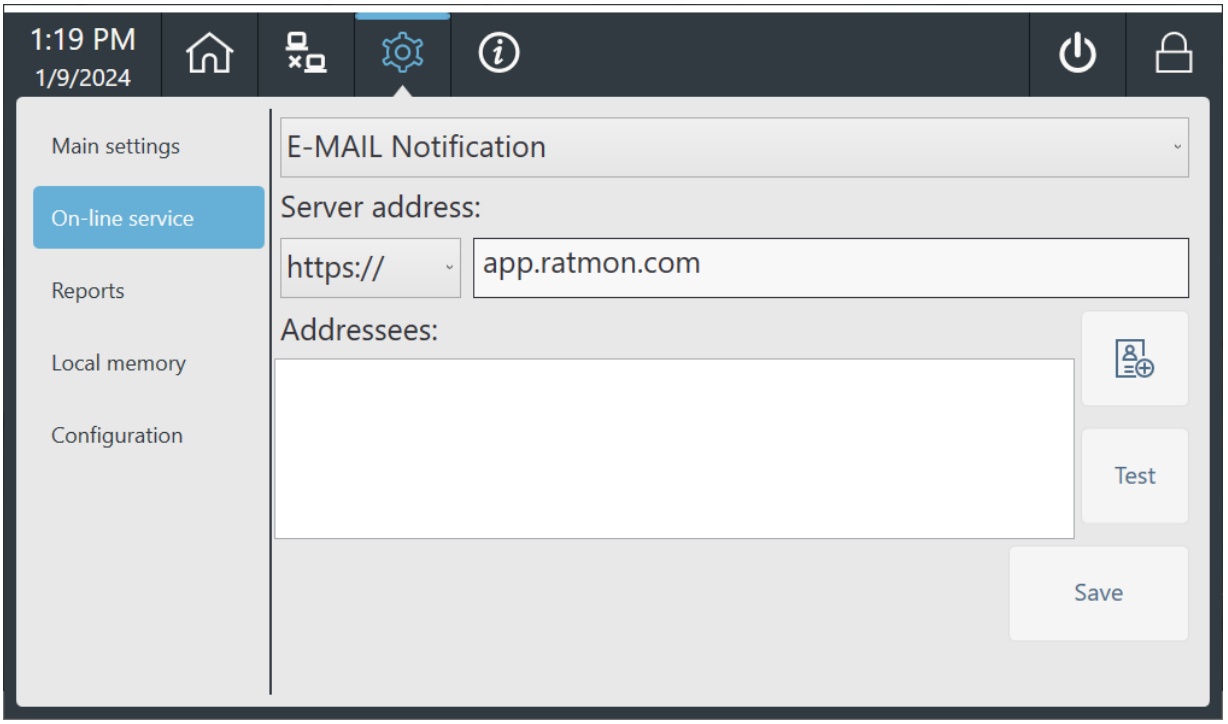
ILA 1.0 can work with RATMON automatic monitoring system. To set it up select RATMON in drop box menu. Then enter server address (app.ratmon.com for our server)
There are 3 report method:

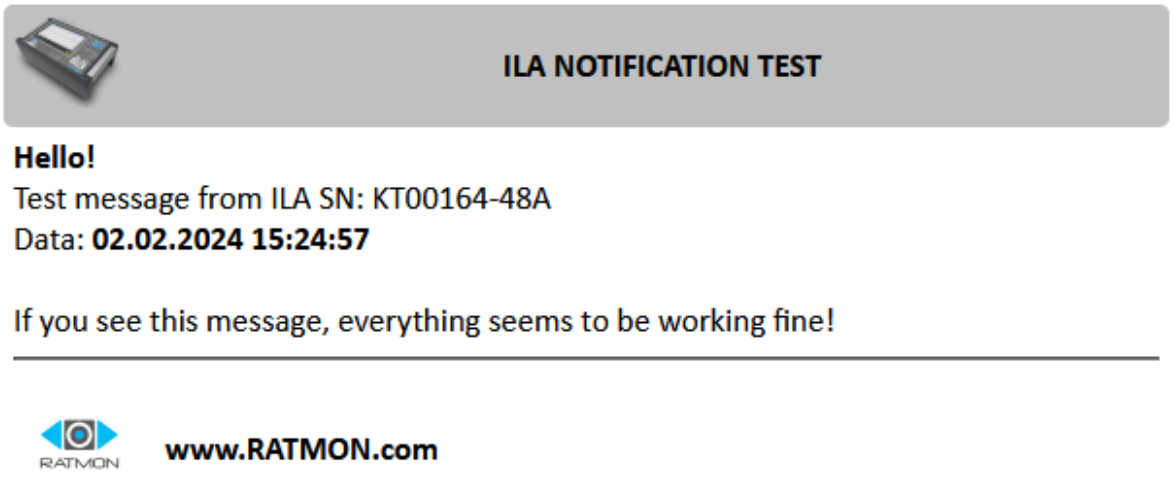
- Full – sends every measurement to server
- Optimal – sends every status to server and measurement only if status has changed
- Minimal – sends only status changes



5.2.2 E-mail notifications

ILA 1.0 can work as separated remote monitoring unit which sends e-mail notifications to supervisors when status changes. It is necessary for ILA 1.0 to have internet access for this function to work properly. ILA uses our mail service so there is no need to configure any e-mail account. To set it up select E-MAIL Notification in drop box menu. To add new supervisor click add icon and enter his e-mail. It should appear in the list. You can test if this function is working correctly by clicking “Test”. Test email will be send to listed e-mails.





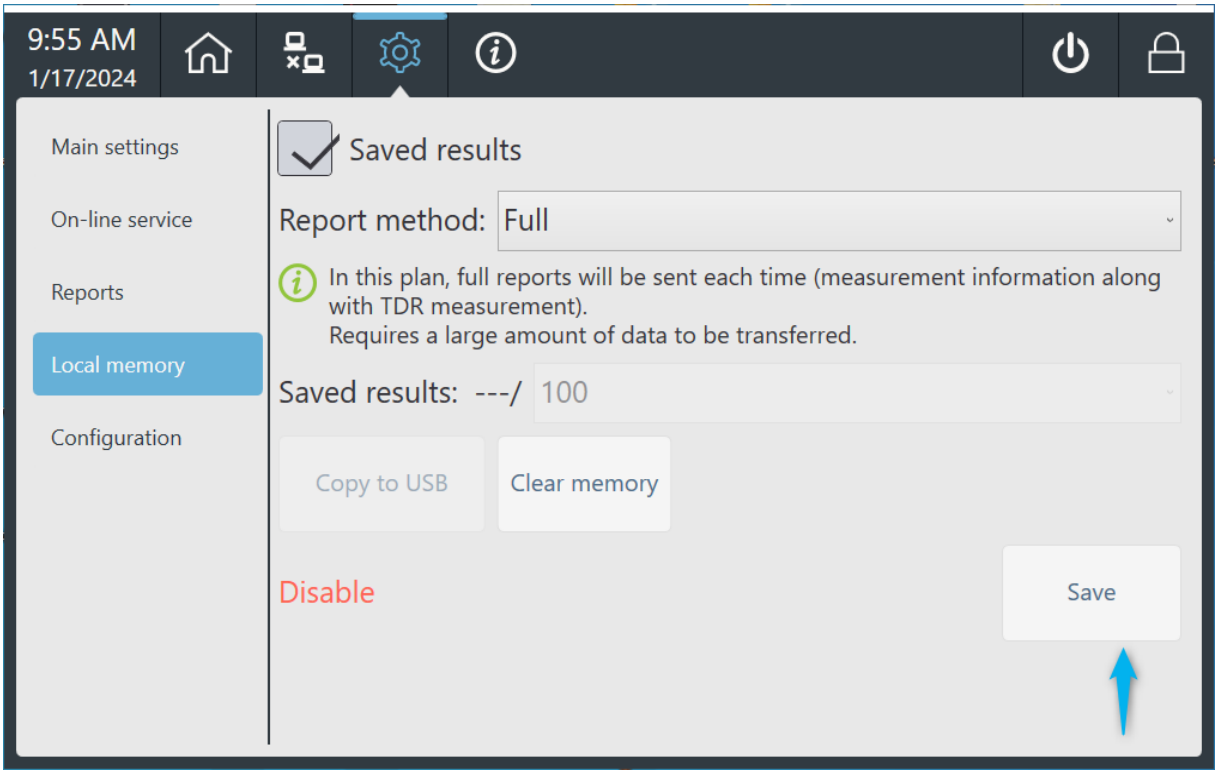
5.3 Local memory

ILA 1.0 has a built-in internal memory that can store up to 100 measurement results. We can transfer the results to an external USB memory stick by connecting it to the instrument.

There are three report method:

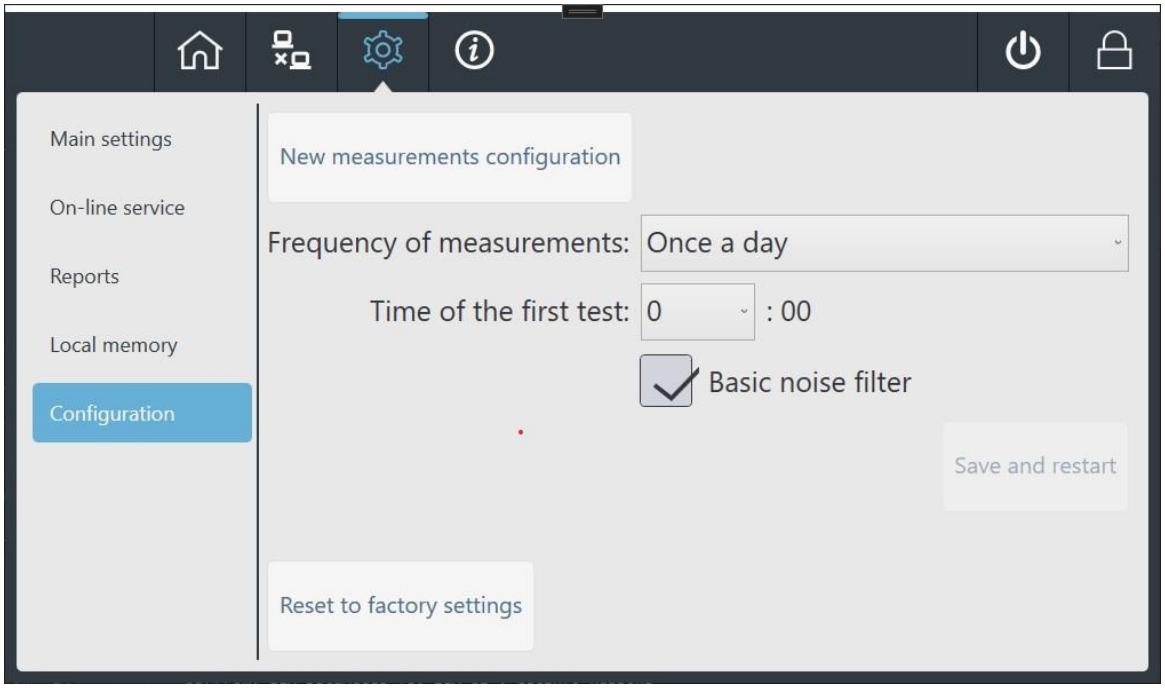
- Full – sends full reports to memory stick
- Optimal – sends every status and measurement only if status has changed to memory stick
- Minimal – sends only status changes

To enable the configuration of the report type, select the "Saved results" option as shown in the following graphic. The number of memory records filled is also visible here. To transfer data to a USB stick, connect it to the detector and then click the "Copy to USB" button. If you wish to clear the memory, you must use the "Clear memory" option. And if we want to save our settings, click on the "Save" button. We can transfer the stored data to RatManager 2, where we can read them and interpret the results.



5.4 Configuration

In this tab, we can make a new measurement configuration and reset it. A detailed description of the configuration can be found in chapter 7, while to reset the settings click on the "Reset to factory settings" button. In addition, in this tab we also have the option to set the frequency at which we take measurements and to switch on the noise filter.



6. Functional test and connection

Before connection and configuration of leak detector-locator it is required to perform functional test of pipe loop and issue test certificate as evidence of such approval.

6.1 Functional test

Functional test should include below procedure and measurements:

a) Insulation resistance test is done between:
Insulated wires (not looped)
Insulated wires (looped) and pipe

Insulation resistance value should be ∞ and not be lower than 1 MΩ.
(For copper sensor wires it should be 500 kΩ)

b) Loop resistance test is done between looped wires:
Loop resistance value should be lower than 50 Ω.

c) It is recommendable to make TDR measurement and compare TDR curve with pipe network layout (if TDR curve reflects e.g. loop ends, connections, T-joints, etc.). TDR curve is done between outer wires and middle wire. In case outer wires are looped the end of TDR curve should indicate double length of the pipe.

Final test certificate should include at least below information:

a) Date of test:
b) Pipe loop ID:
c) Insulation resistance value:
d) Loop resistance value:
e) TDR curve for both wires (L1, L2 outer wires):
f) Tested by:
g) Approved by:

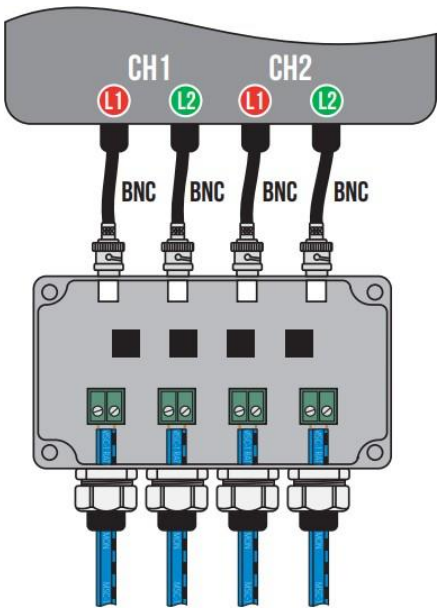
All above tests, including TDR can be done by our portable tester, MEGALOC-1. After conducting of test, all data can be sent directly to RATMON system or saved in internal memory. Data can be also copied to memory stick and moved to PC for printing.

6.2 Connection

After pipe loop approval test has been performed successfully, you can proceed with installation of leak detector-locator. Each leak detector-locator should be installed at any end of pipe loop, with most comfortable access to connection point. The number of devices on a given network also depends on its complexity.

6.2.1 MSC-1 sensor cable

Leak detector is connected to the pipe via connection BOX-9 and closed in hermetic outer cabinet (SK-1). Leak detector is connected with BOX-9 via BNC jumper cables. Max measuring section of leak detector is 3000 meter of pipe. However in order to make the system most effective by mean of accuracy and comfort of supervision, it is recommendable to install detectors around every 1000 meter of pipe.

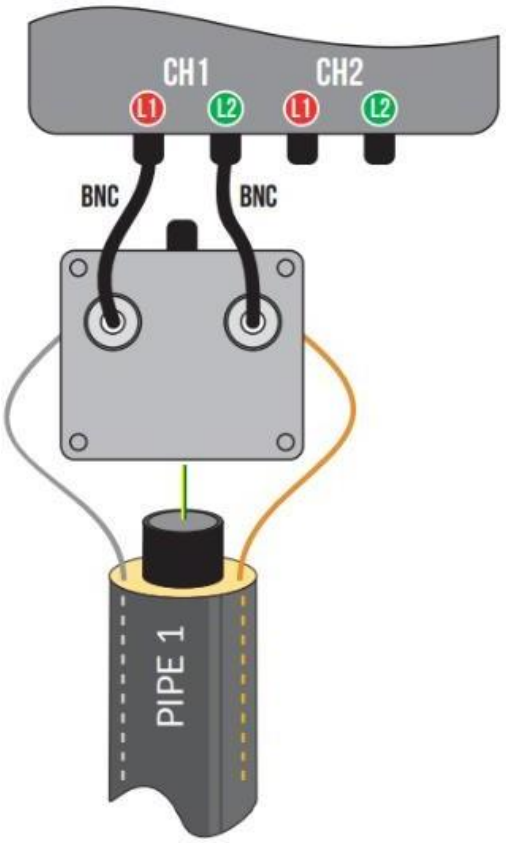


6.2.2 Copper sensor wires

Leak detector is connected to the pipe via connection BOX-3. BOX-3 is mounted directly to the pipe by steel grounding bar (GND-1). Insulated brown and blue wires, going out of BOX3 are connected with pipe copper alarm wires by crimp connectors (CON-1).

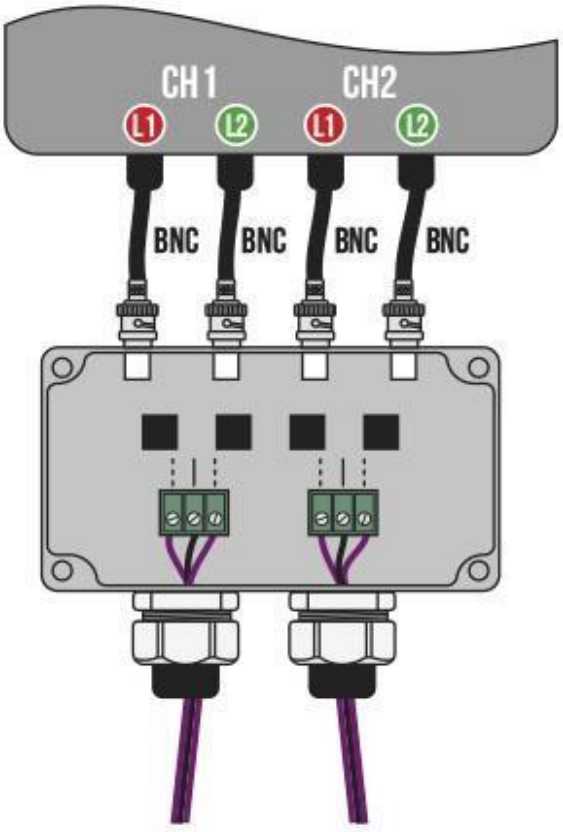
Leak detector can be installed in any place, in the distance of max 10 meters from the pipe. It is recommendable to mount and install leak detector in hermetic outer cabinet (SK-1).

Leak detector is connected with BOX-3 via BNC jumper cables, that maximum length is 10 meters. Max measuring section of leak detector is 3000 meter of pipe. However in order to make the system most effective by mean of accuracy and comfort of supervision, it is recommendable to install detectors around every 1000 meter of pipe.



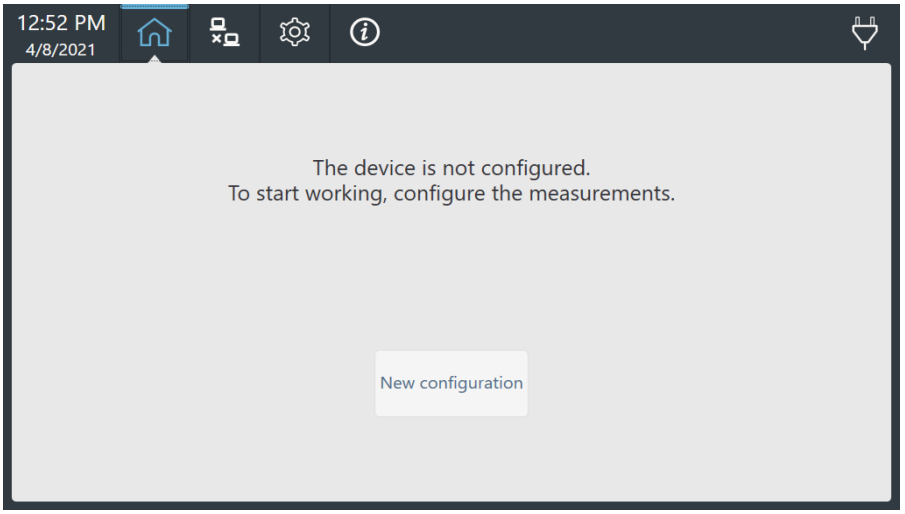
6.2.3 3-W sensor cable

Leak detector is connected to the pipe via connection BOX-7 and closed in hermetic outer cabinet (SK-1). Leak detector is connected with BOX-7 via BNC jumper cables. Max measuring section of leak detector is 3000 meter of pipe. However in order to make the system most effective by mean of accuracy and comfort of supervision, it is recommendable to install detectors around every 1000 meter of pipe.

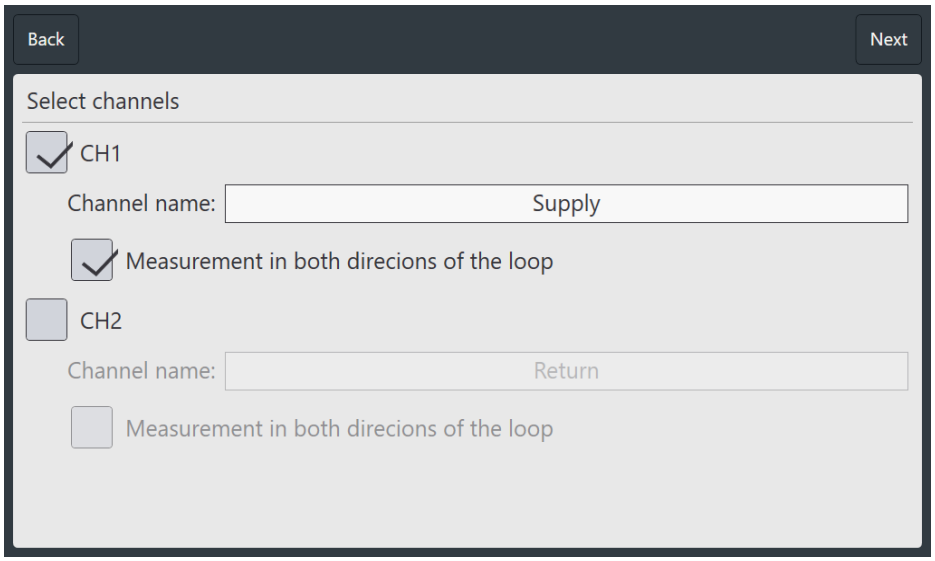


7. Commissioning and configuration

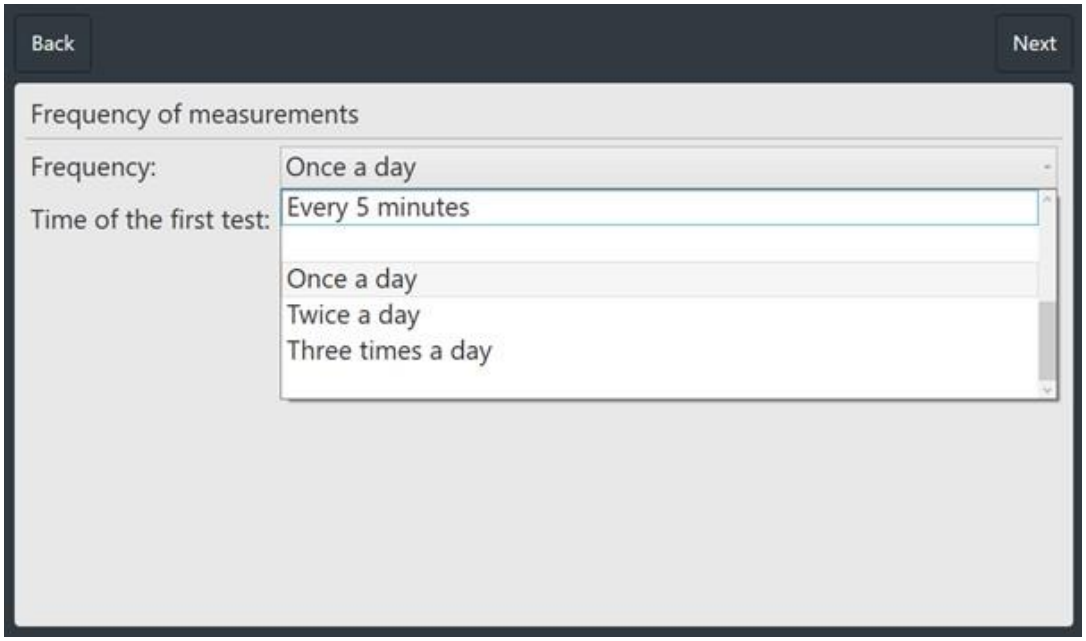
After connection of leak detector to the pipe it is required to go through configuration process, in order to set reference parameters. Principal of monitoring is done based on time domain reflectometer.
In order to start above process, please switch on the device and click button “New configuration”.



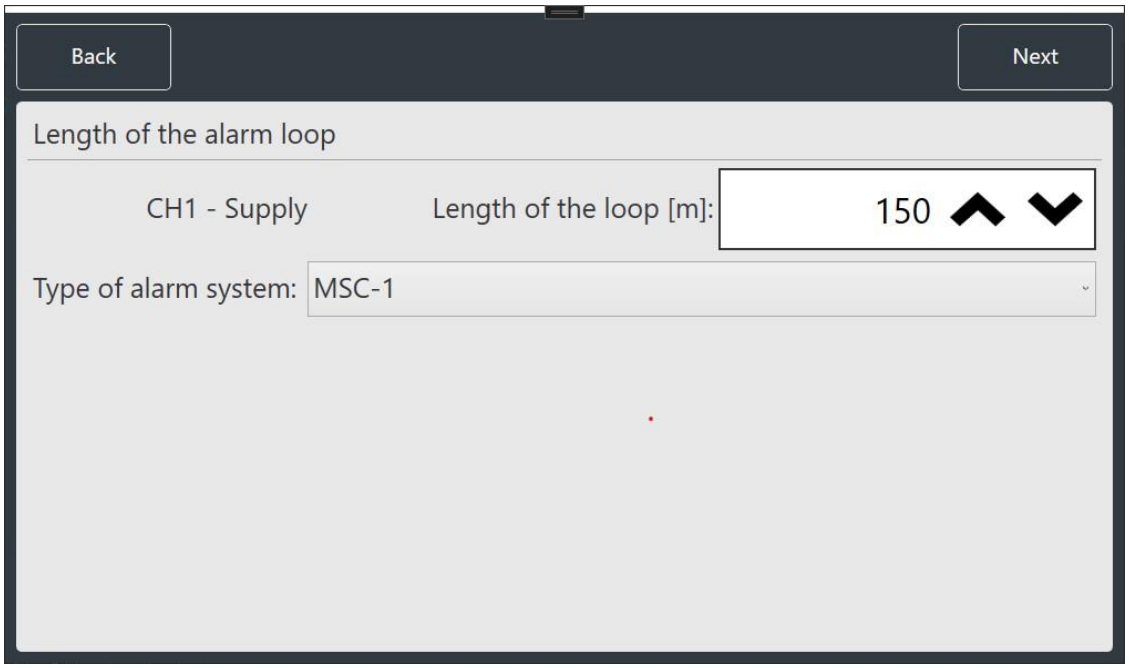
Select connected channels and provide name (e.g. Supply , Return). When you select tab of “Measurement in both direction…” detector will make automatically measurement in both directions of the alarm loop. It is recommendable in case of long pipe loops (over 1000 meter of pipe).



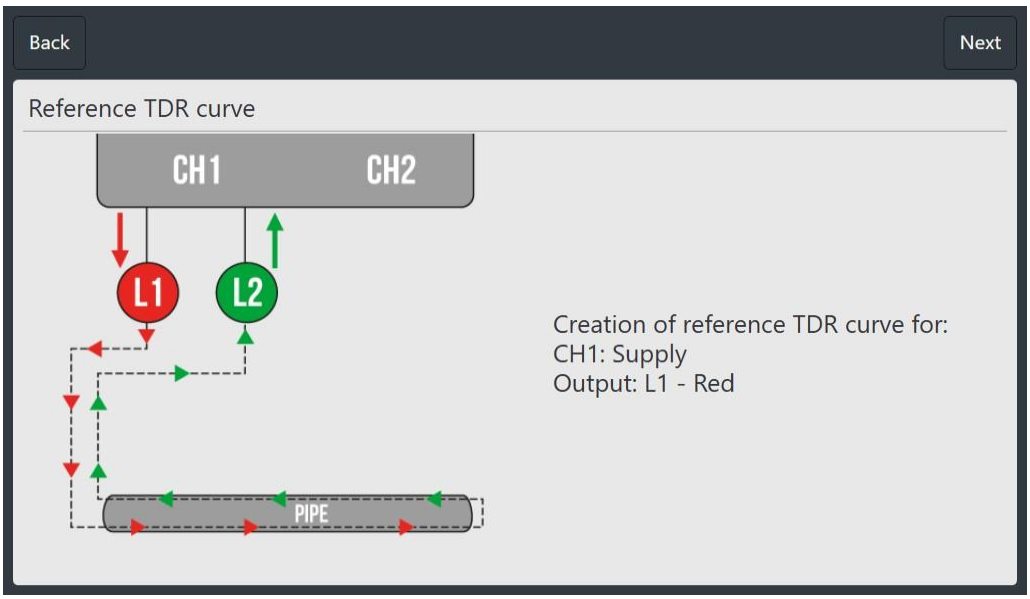
Select frequency of test.



Define length of pipe loop and click “Next”



Reference curve will be created after clicking “Next”.

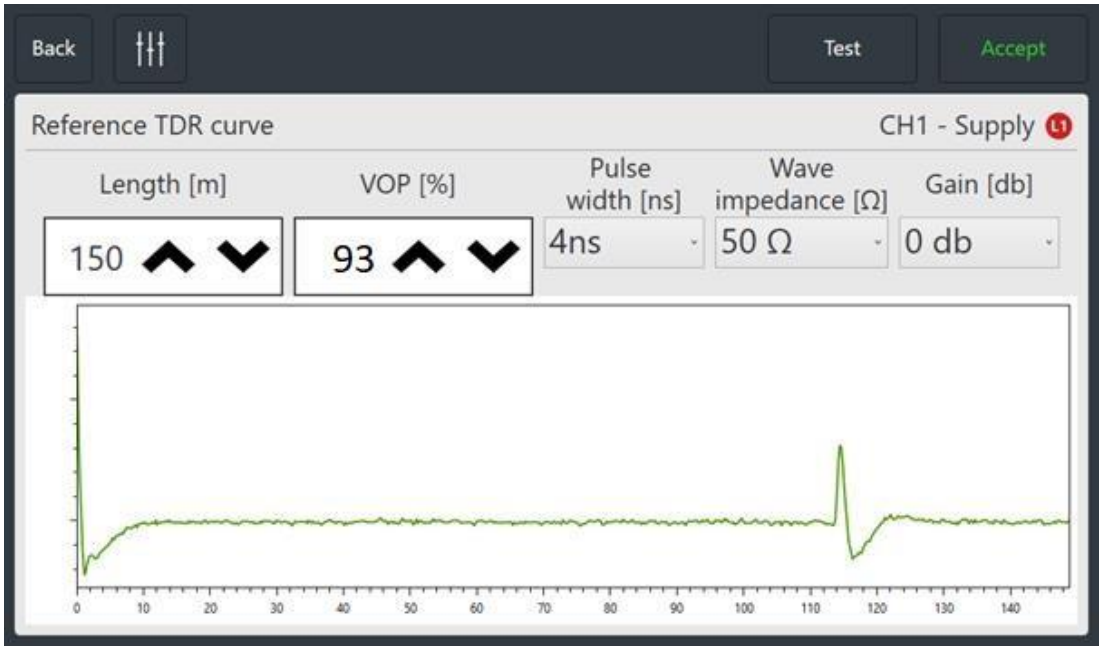


Set VOP parameter.

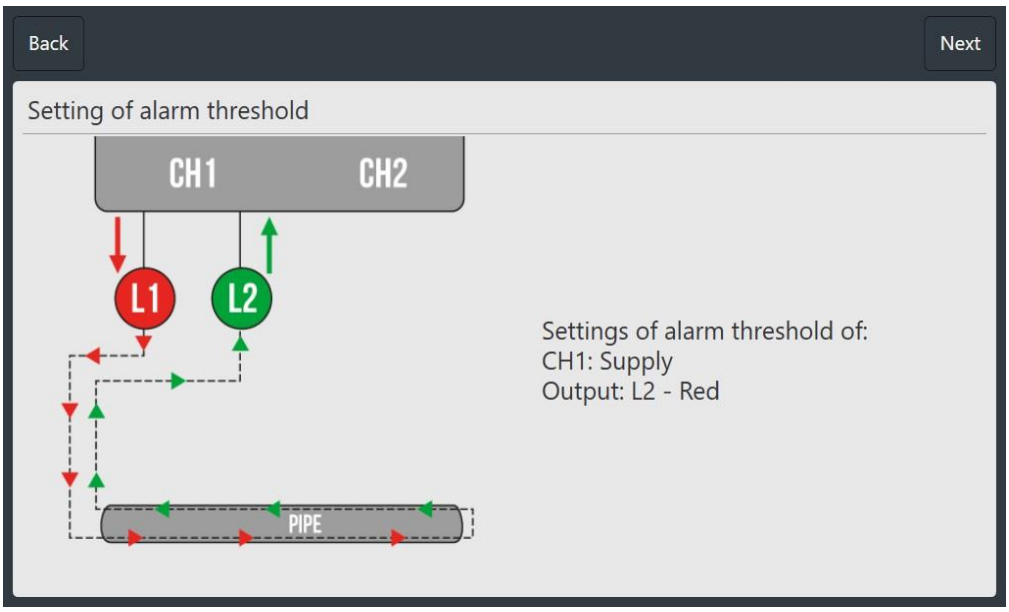
The VOP is different for each alarm system:

- **For pre-insulated pipes with MSC-1 cable, VOP is 80%**
- **For pre-insulated pipes with copper wires on is 93%.**
- **For pre-insulated pipes with 3 wire sensor cable is 70%.**
- **For pre-insulated pipes with twisted sensor wires is 78%.**

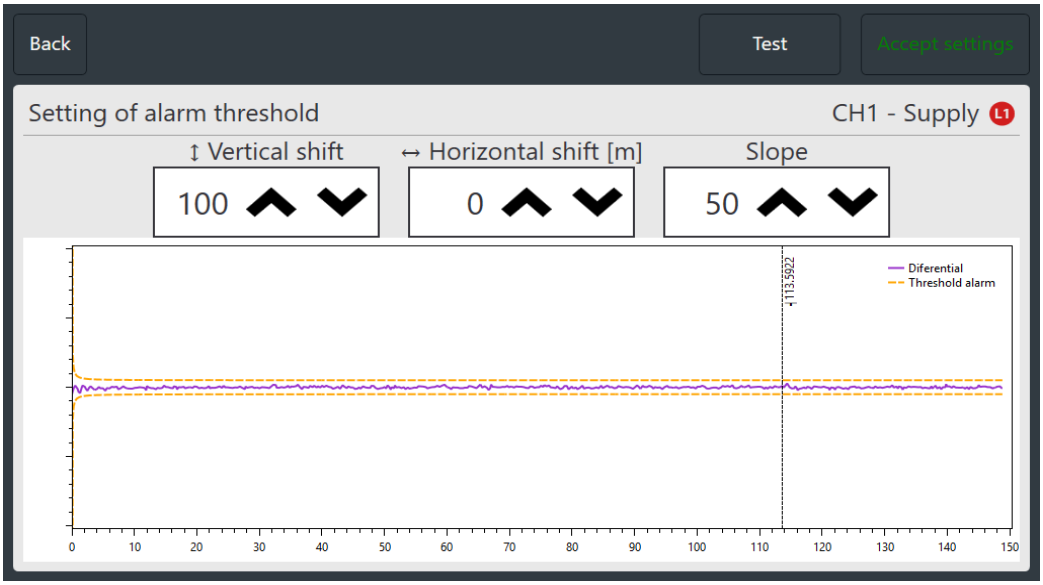
If you do not see the end of pipe loop, increase length and click “Test”. If all parameters are OK click on “Accept”. By default, both the gain and pulse parameters should be set to AUTO.

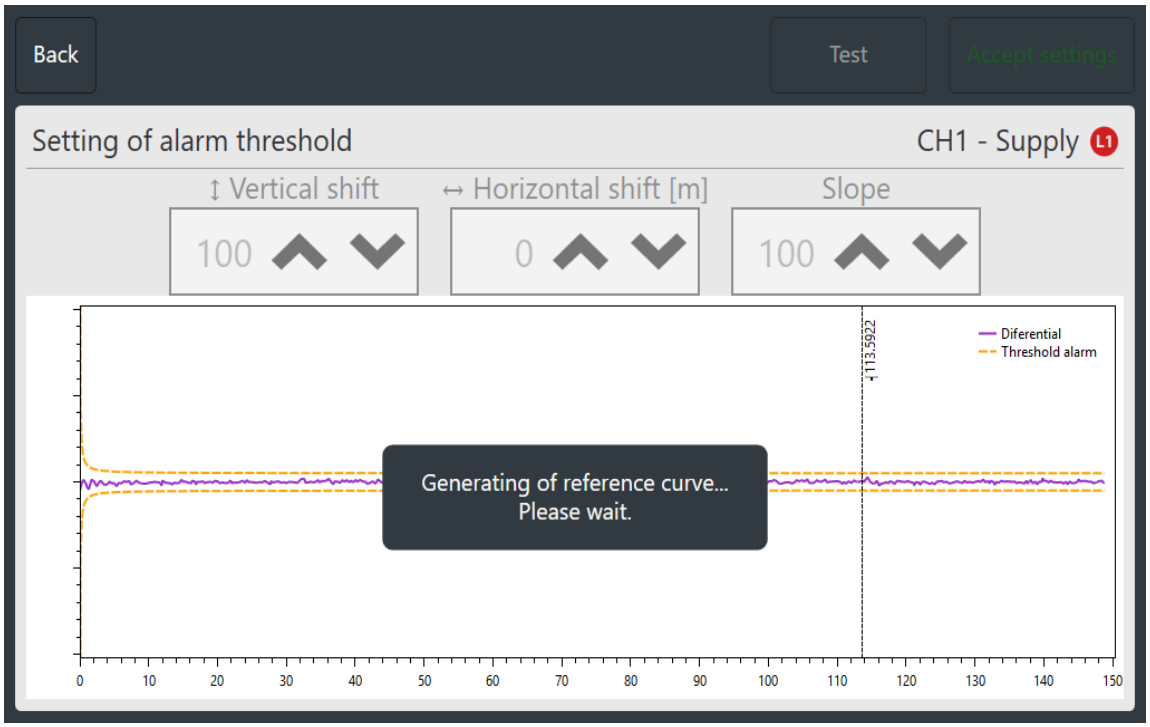


Setting of alarm thresholds. Click “Next” to move to settings.

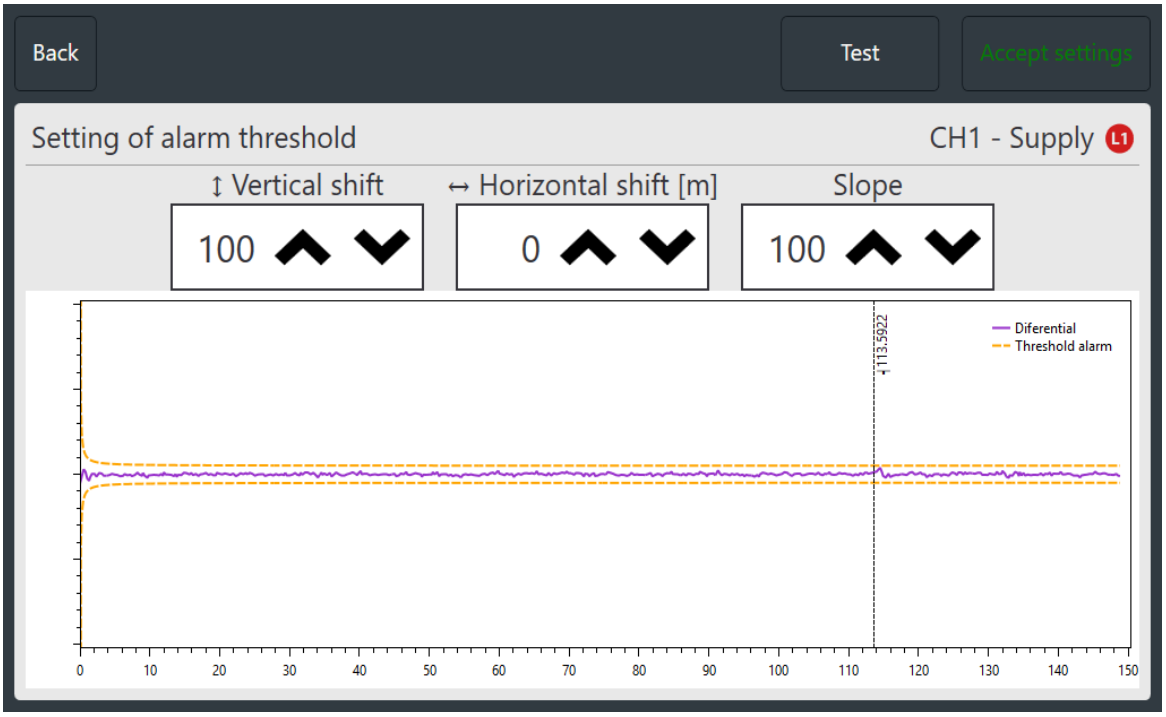


System automatically proposes alarm thresholds, based on differential curve. Differential curve is created as a difference between reference curve and current test curve. User can adjust alarm thresholds according to current pipe condition and sensitivity of reacting to faults. The best way for adjusting alarm thresholds is to simulate fault (leak/break/short) at endings of pipe loop, where there is an access to alarm wires and best if the simulating point is around middle of pipe loop. After simulating fault, click on “Test” to see how the system reacts to that change.



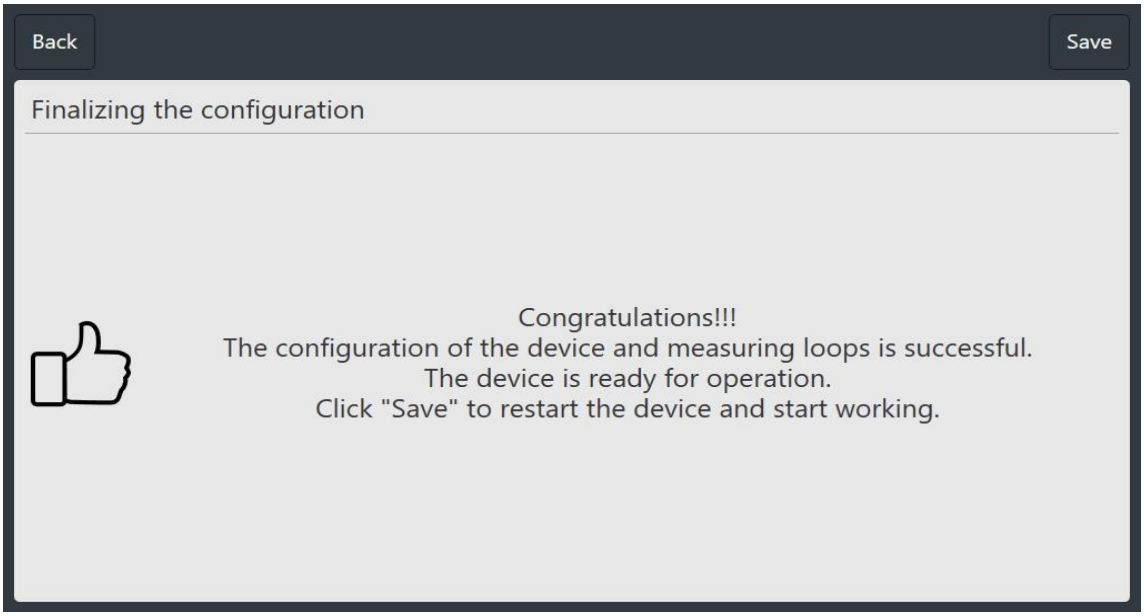


Click on „Accept” to close configuration for L1.

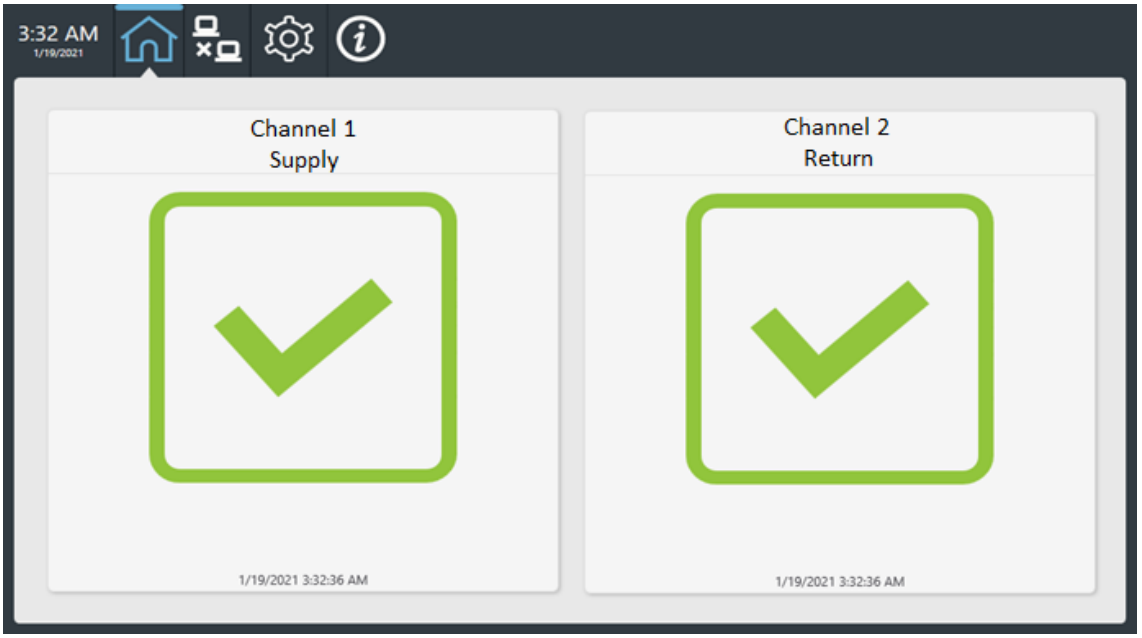


The same process repeat for L2 and channel 2.

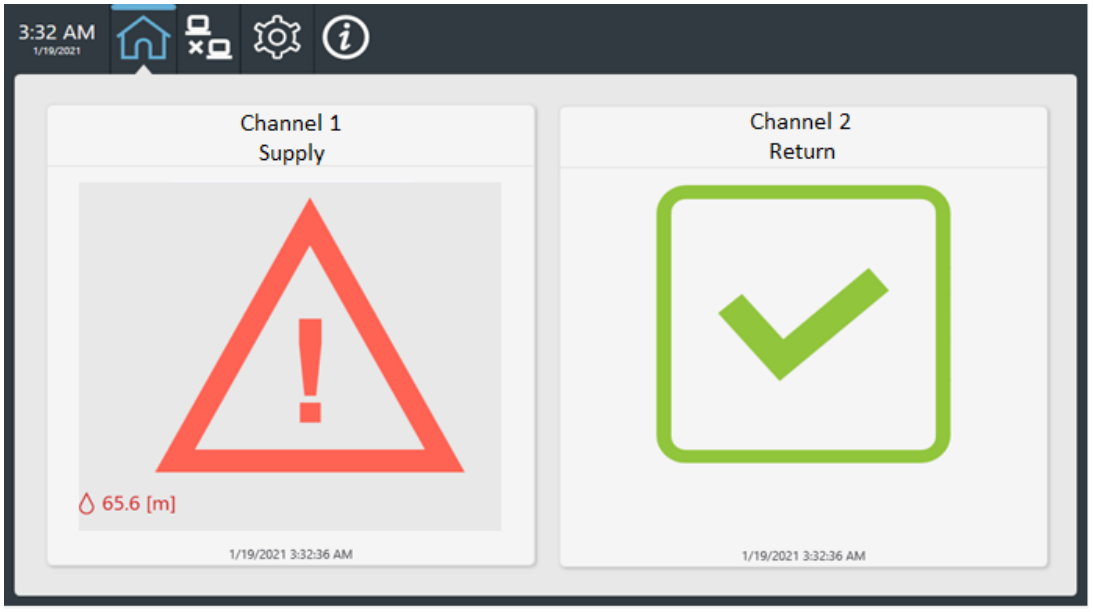
After completing configuration for selected channels (L1 and L2 each channel), below window will be displayed and click “Save” to restart ILA 1.0.

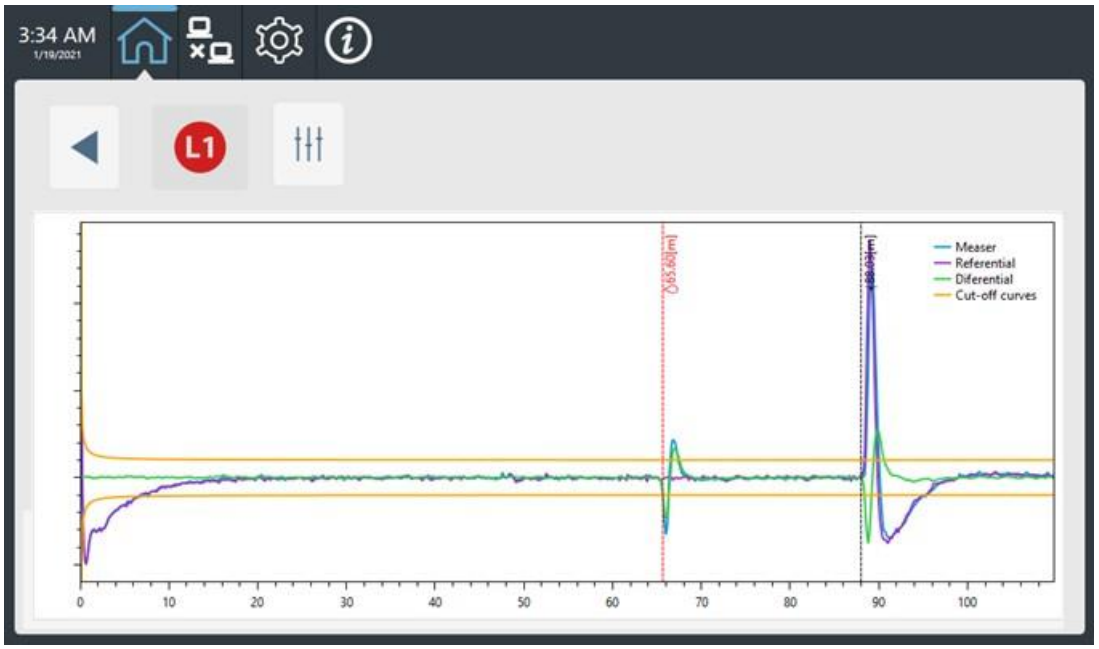


After restarting ILA 1.0 should display below window, showing “OK” state of the pipe.



Whenever faults occurs alarm notification will be sent automatically to supervisor (BMS/SCADA/RATMON) and above screen will be changed to the below, informing about type and place of fault. By clicking on touch screen of ILA 1.0 you can see the detailed TDR curve.





8. System with MSC-1 sensor cable

8.1 Main components and connection diagram with MSC-1 sensor cable

- ✓ Leak detectors (ILA)
- ✓ Connection box (BOX-9)
- ✓ Connection jamper cables (BNC)
- ✓ Hermetic cabinet (SK-1)
- ✓ Crimp connectors (type as per cable manufacture instruction)
- ✓ Heat shrink tubes (type as per cable manufacture instruction)

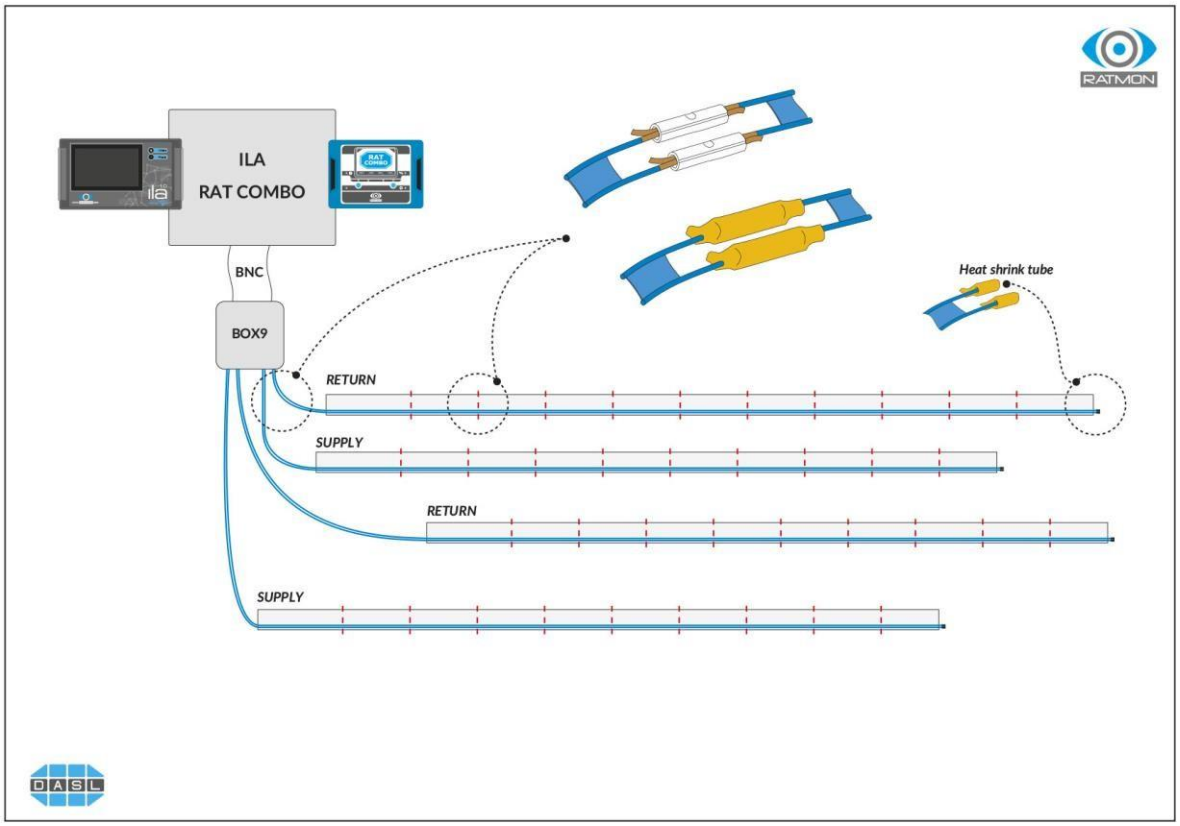
Deatiled technical data of each above component are available in product catalogue, available at www.ratmon.com

Leak detection system based on MSC-1 can be organized in 2 options:

Option 1. Straight pipe without any branches (T-Joints).

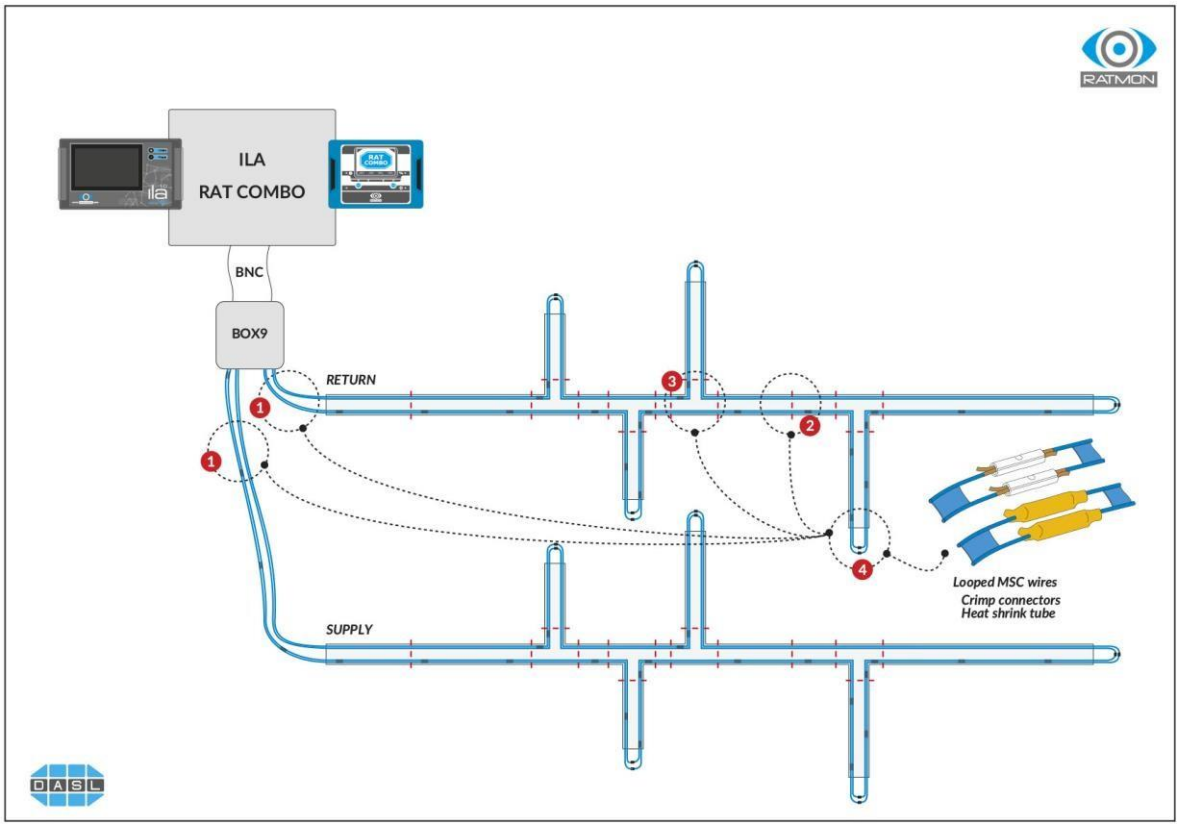
In this case ILA can monitor 4 pipes. Just one cable per pipe must be used. Individual wires of the cable MUST be left opened and insulated as show on the drawing.

Maximum measuring range of pipe/cable is 3 km.



Option 2. Pipe network with branches (T-Joints).

In this case surveillance of one pipe is based on 2 cables, looped at the end. Maximum measuring range of pipe is 3 km (6 km of MSC-1).



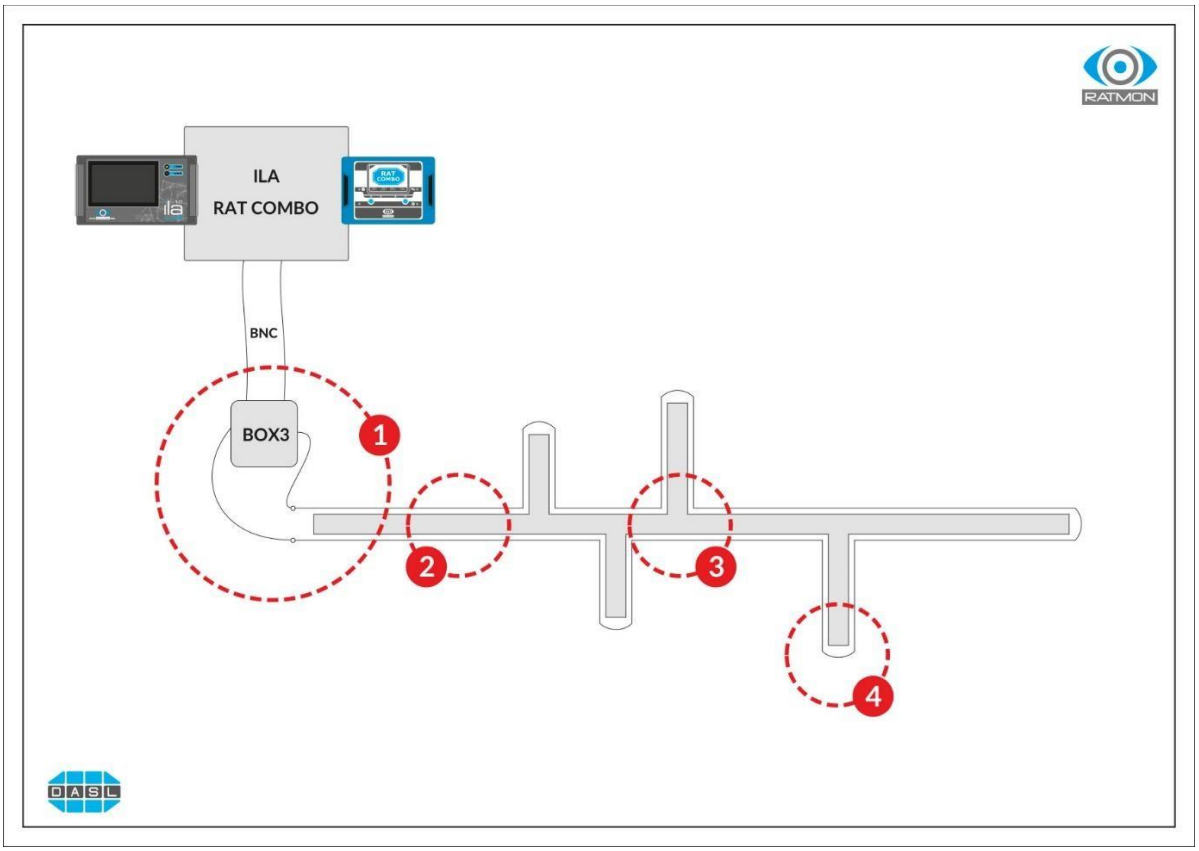
Instruction of installation and connection of cable in pipes, branches is described in appendix **MSC-1 – CABLE INSTALLATION**

9. System with copper sensor wires

9.1 Main components and connection scheme with copper sensor wires

- Leak detectors (ILA)
- Connection box (BOX-3) – 1 box per pipe
- Connection jamper cables (BNC)
- Crimp connectors (CON-1)
- Heat shrink tubes (HST-1)
- Hermetic cabinet (SK-1)

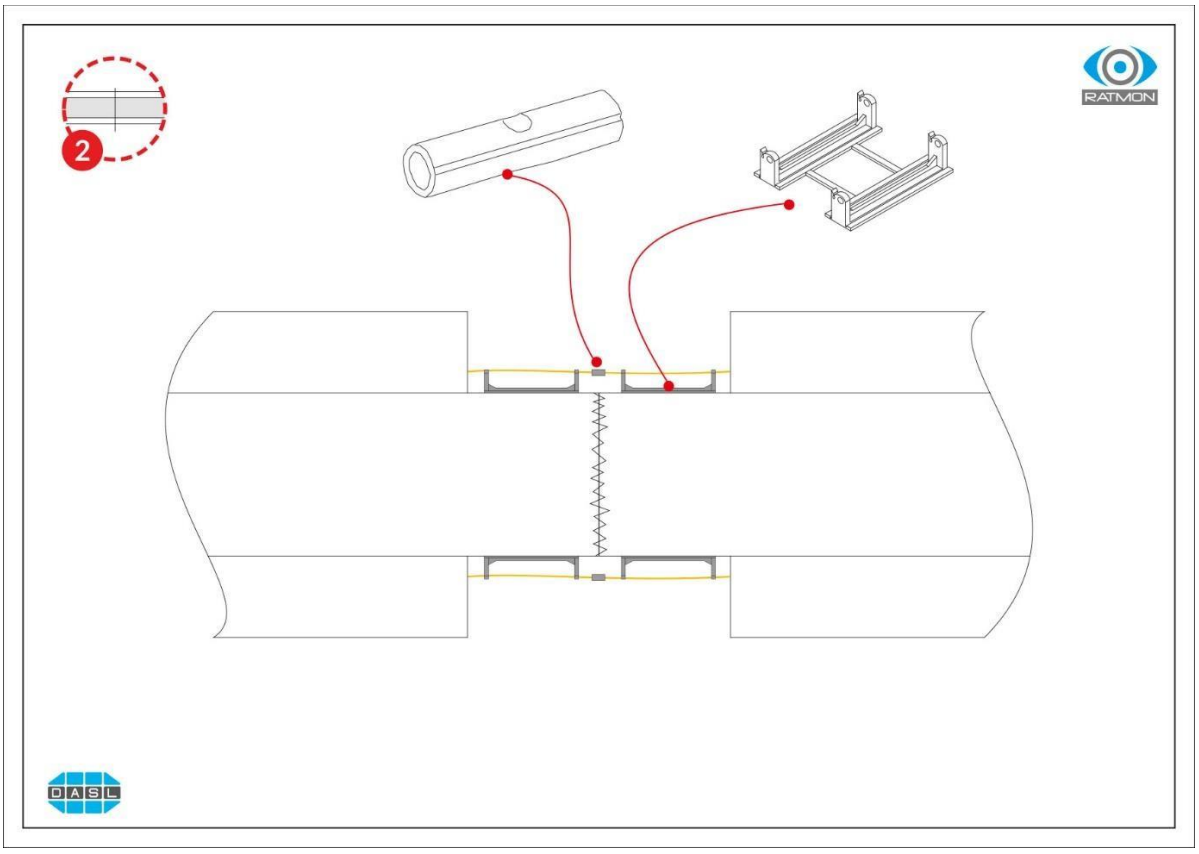
Deatiled technical data of each above component are available in product catalogue, available at www.ratmon.com



9.2 Connection of sensor wires between pipes

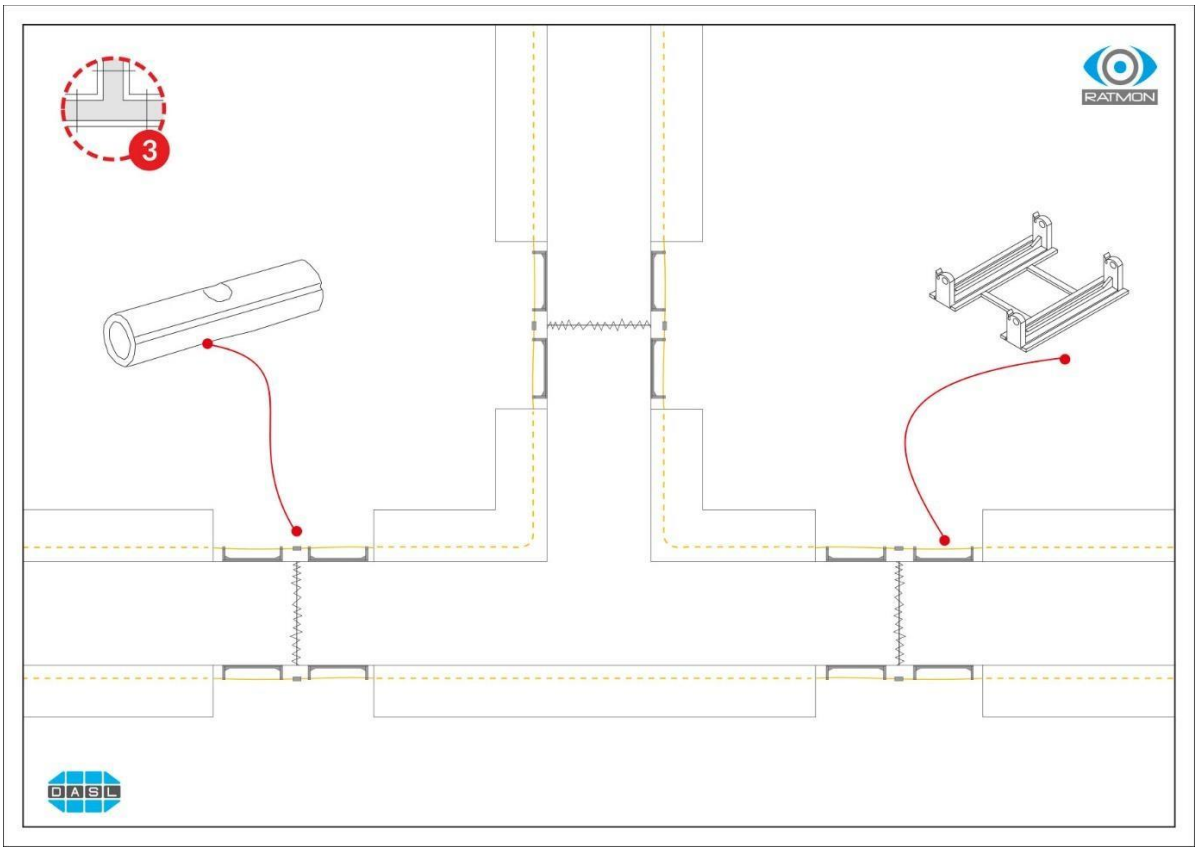
Basic rules to plan, position and connect alarm wires:

- Alarm wires always make the loop.
- Looping of wires requires keeping strictly wires in left and right orientation along the entire pipe loop.
- Wires can never be crossed each other.
- Wires can be connected each other by using crimp connector (CON-1) and such connection is next isolated by heat shrink tube (HST-1).
- In order to keep wires away from steel pipe it is required to use space legs (CLIP-1), as shown on below drawing.
- Positioning and fastening of wires inside pipe insulation depends on production method of each pipe manufacturer. Most popular positioning is 01:50 or 02:45.
- It is important that alarm wires are installed maximal parallel to the pipe. Quality of this factor has influence on quality of measurements and future surveillance comfort.



9.3 Connection of wires in t-joint

During connection of wires in T-joints it is important to avoid crossing of wires!!

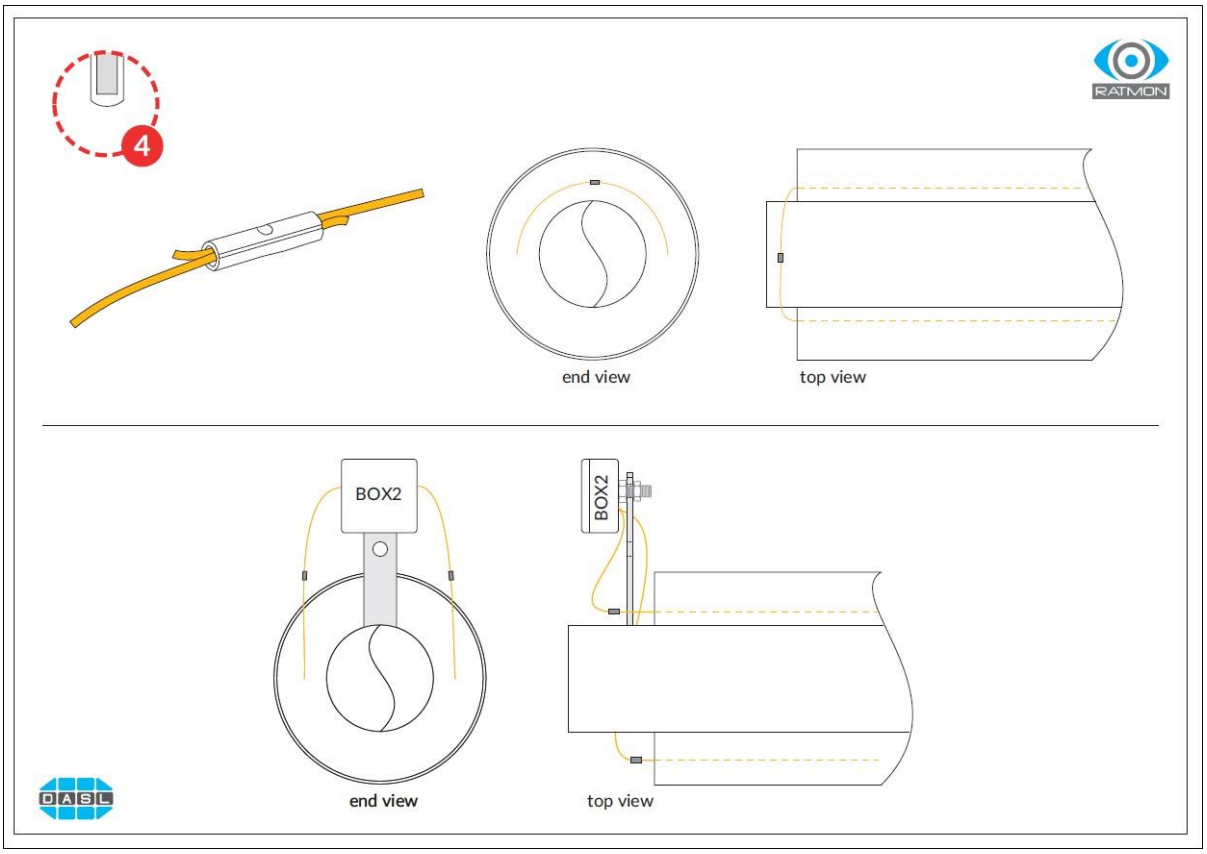


9.4 Looping of alarm wires

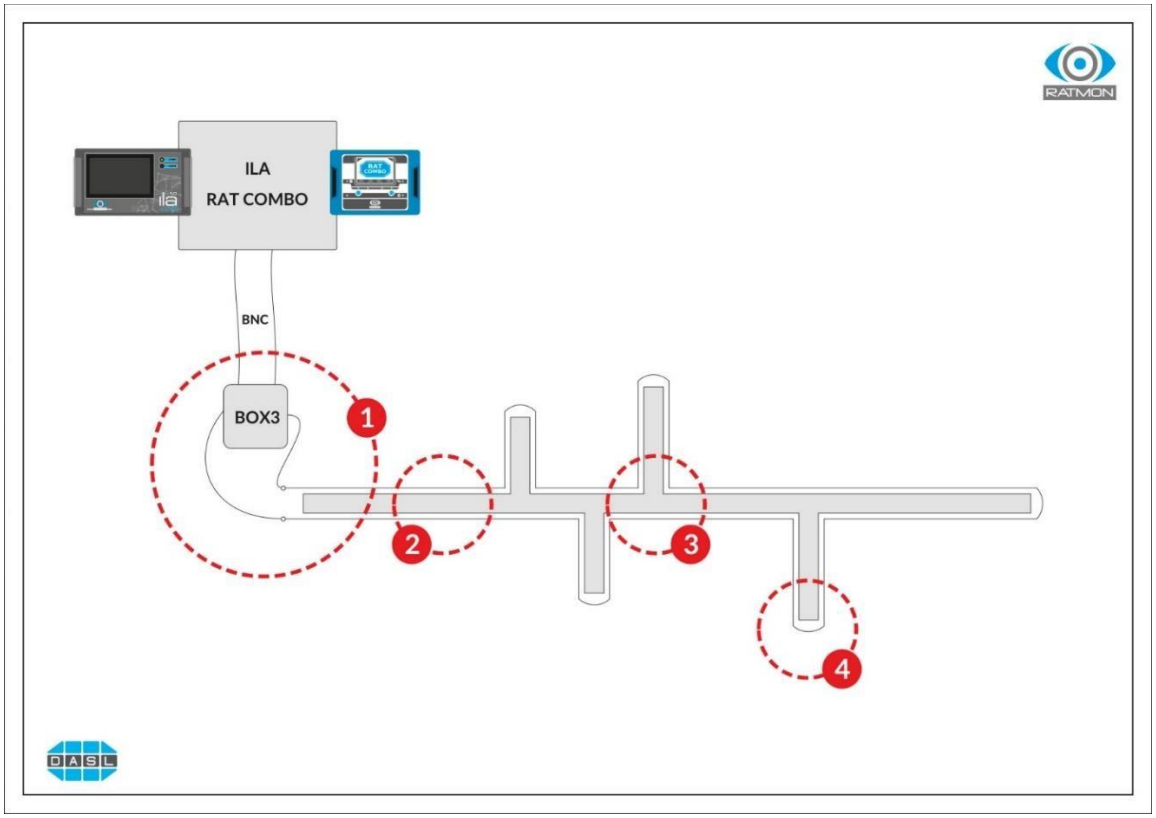
Left and right alarm wire must be lopped at each end, as shown on below drawing. There are two options of looping.

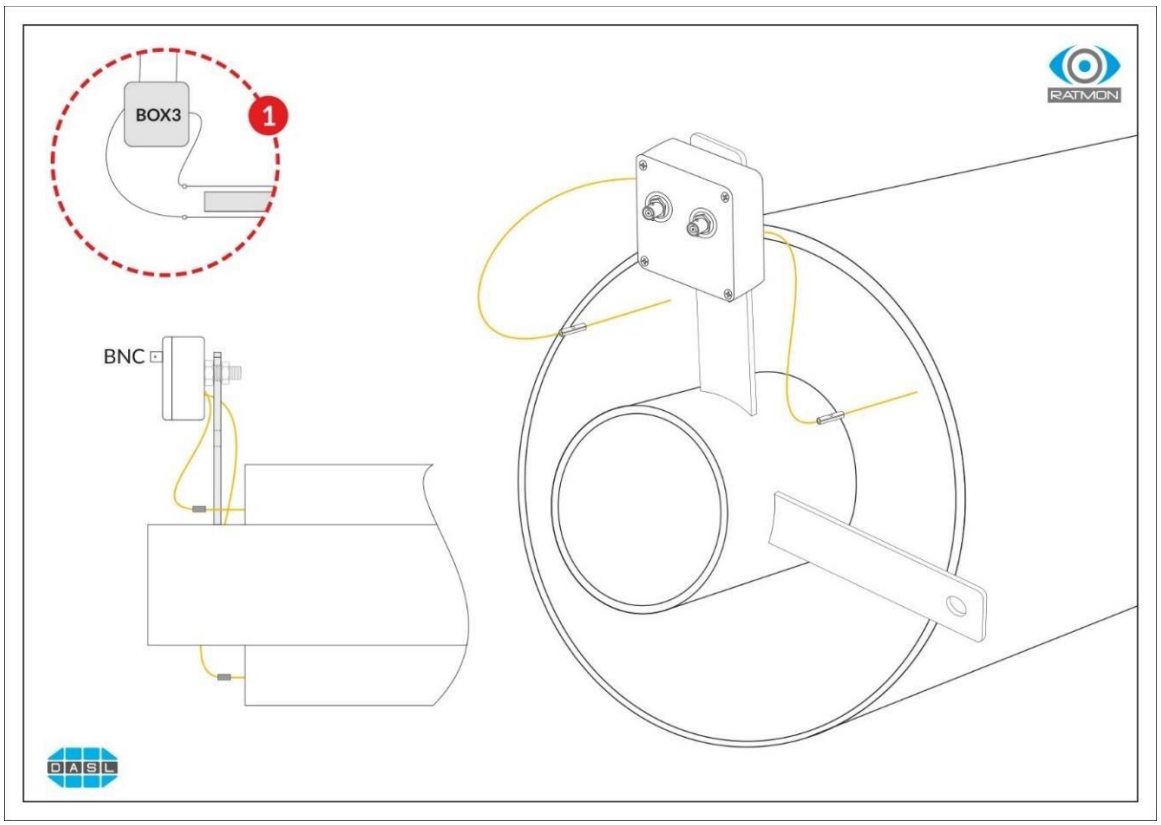
a) Option 1: looping of alarm wires by use of crimp connectors (CON-1).
b) Option 2: looping of alarm wires by use of BOX-2, that can be used as an access point in the event of future, manual measurements or fault location

In any above cases it is important to keep wires away from steel pipe!!



Example of connection of leak detector with 1 channel (e.g. Supply)



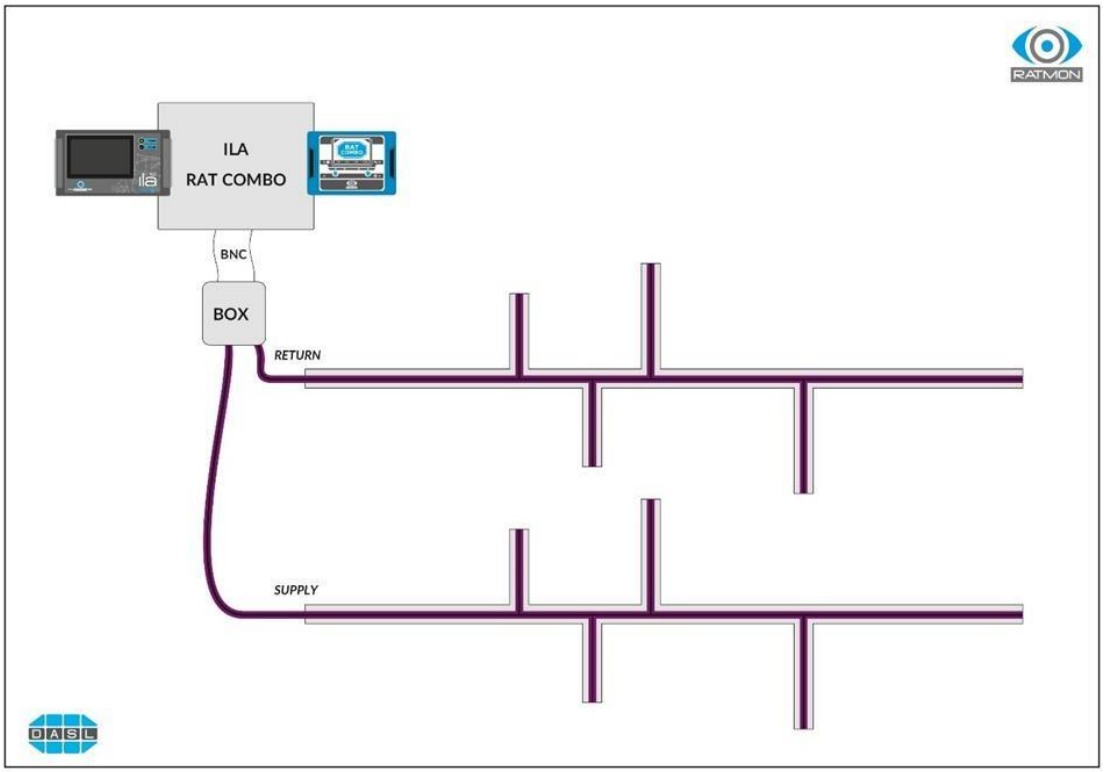


10. System with 3 wire sensor cable

10.1 Components and connection diagram with 3-wires sensor cable

1. Leak detector (ILA)
2. Connection box (BOX-7)
3. Connection jamper cables (BNC)
4. Hermetic cabinet (SK-1)
5. Crimp connectors (type as per cable manufacture instruction)
6. Heat shrink tubes (type as per cable manufacture instruction)

Deatiled technical data of each above component are available in product catalogue, available at www.ratmon.com



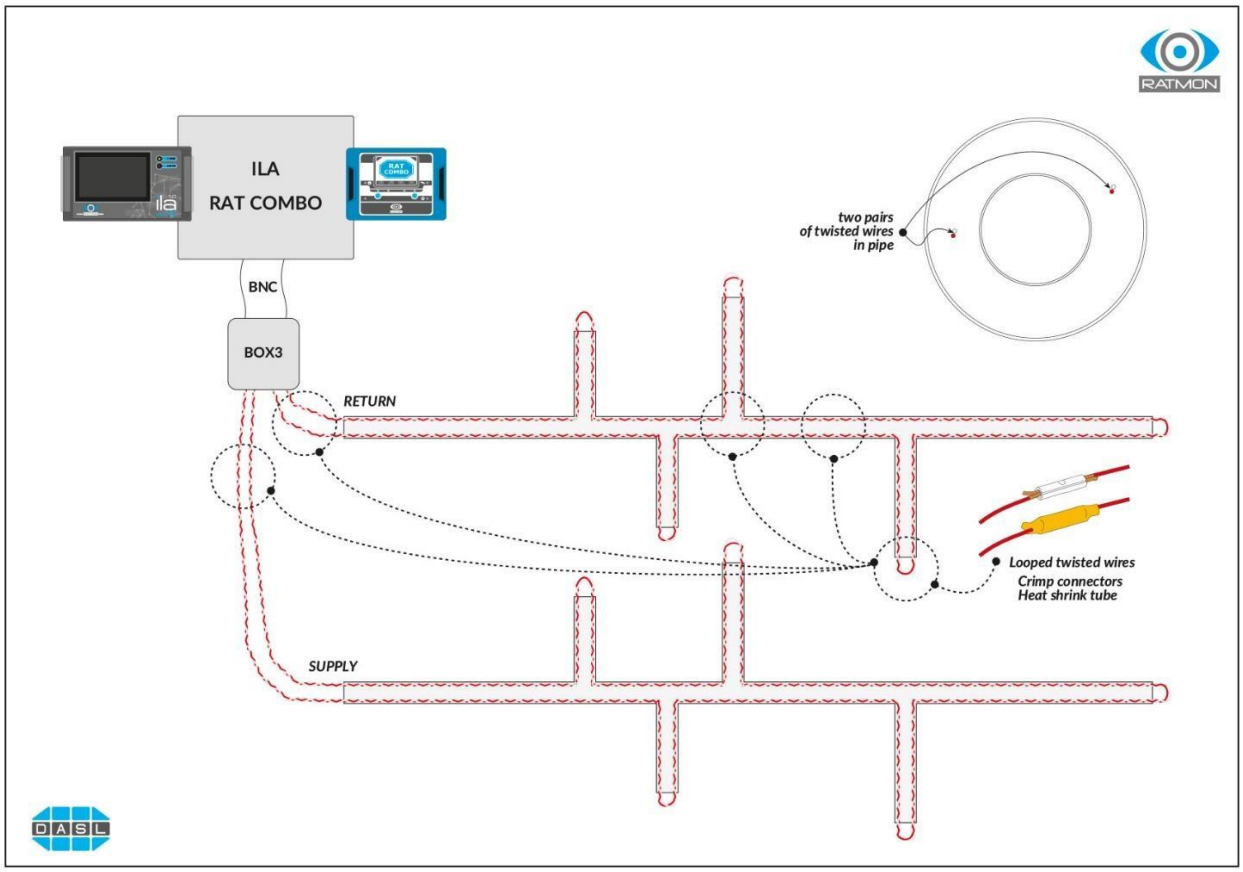
ILA enables surveillance of sensor wires that are looped or opened at the end of pipe. However it is recommendable to make the loop of outer wires. The middle wire must be insulated by heat shrink tube or insulation tape.

11. System with twisted sensor wires

11.1 Main components and connection scheme with twisted sensor wires

- Leak detectors (ILA)
- Connection box (BOX-3) – 1 box per pipe
- Connection jamper cables (BNC)
- Crimp connectors (CON-1)
- Heat shrink tubes (HST-1)
- Hermetic cabinet (SK-1)

Detailed technical data of each above component are available in product catalogue, available at www.ratmon.com



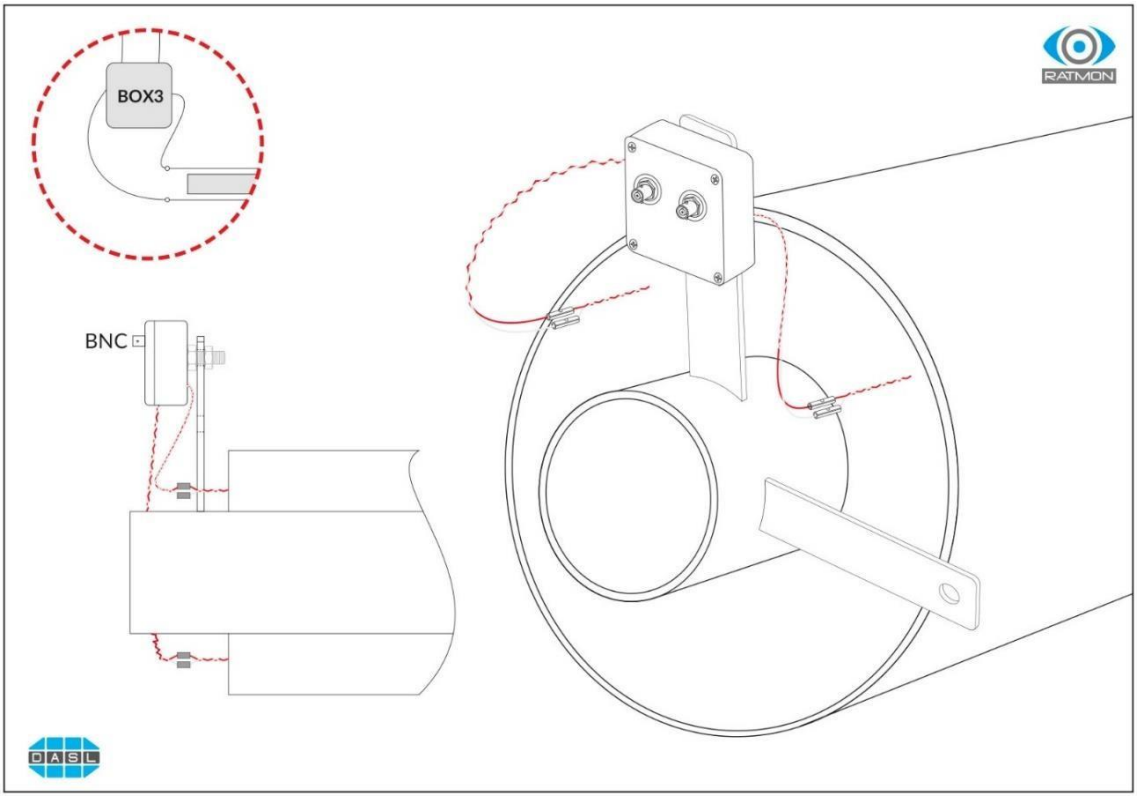
11.2 Connection of sensor wires between pipes

Basic rules to plan, position and connect alarm wires:

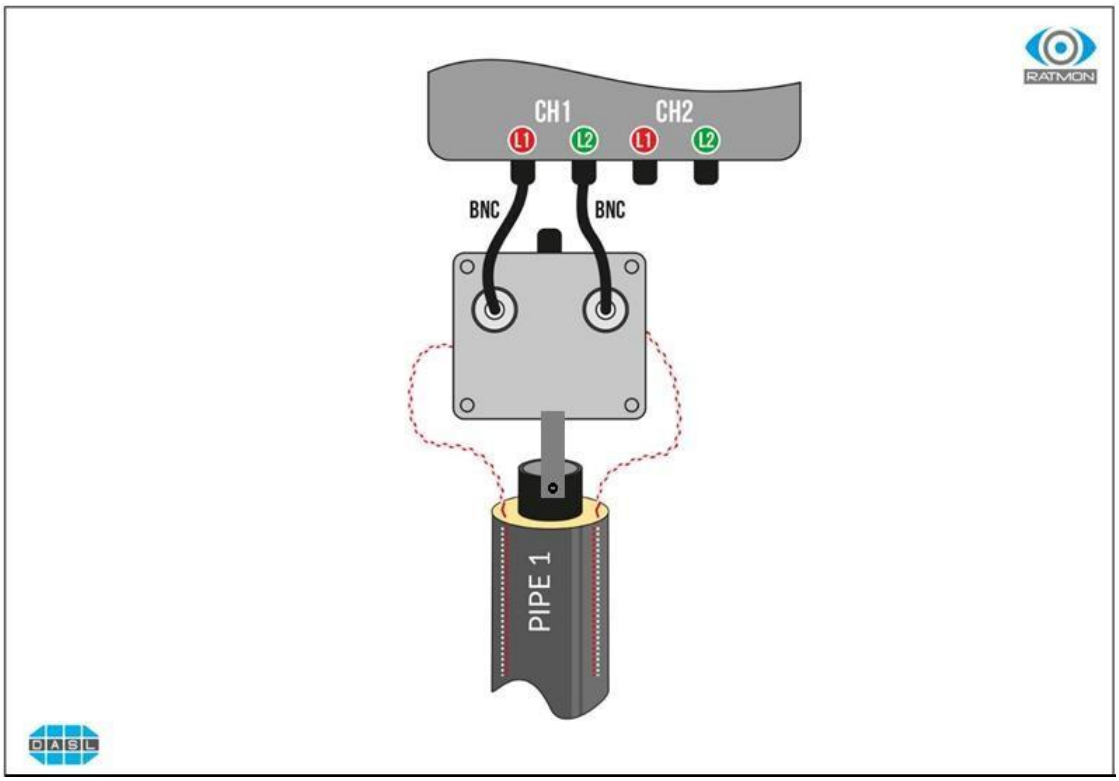
- Alarm wires always make the loop; white-white, red-red.
- Looping of wires requires keeping strictly wires in left and right orientation along the entire pipe loop.
- Twisted cables can never be crossed each other.
- Wires can be connected each other by using crimp connector (CON-1) and such connection is next isolated by heat shrink tube (HST-1).
- Positioning and fastening of wires inside pipe insulation depends on production method of each pipe manufacturer. Most popular positioning is 01:50 or 02:45.

11.3 Looping of alarm wires

Left and right alarm wire must be lopped at each end, as shown on above drawing. Looping of alarm wires by use of crimp connectors (CON-1).
Remark: in case of straight pipe it is possible to use just on twisted cable. In such case DO NOT loop wires (red and white). At the end wires must be insulated by HST-1.



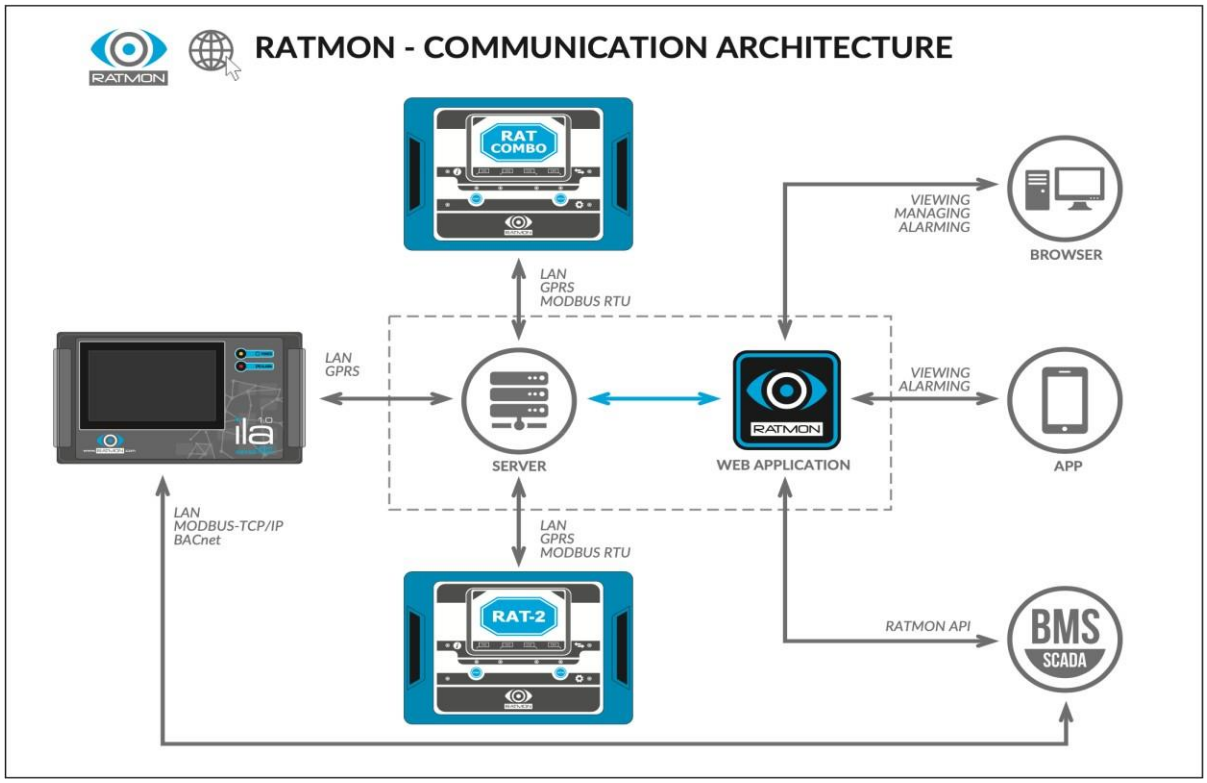
Example of connection of leak detector with 1 channel (e.g. Supply)



12. Communication of leak detectors with surveillance systems

Leak detectors send data to external systems like RATMON / BMS / SCADA, depending on the scope and functionalities of each detector. Before selecting leak detector it is important to understand how selected detector performs data analysis and what are the options of data transfer.

Structure of data analysis for ILA is shown on the below scheme.

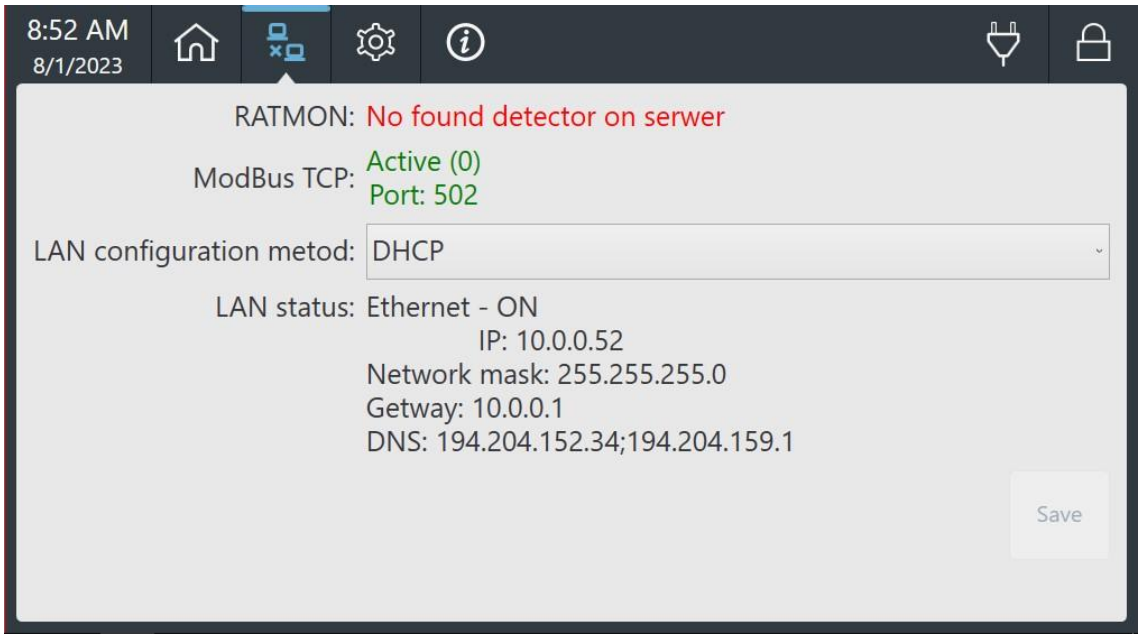


12.1 Communication via LAN

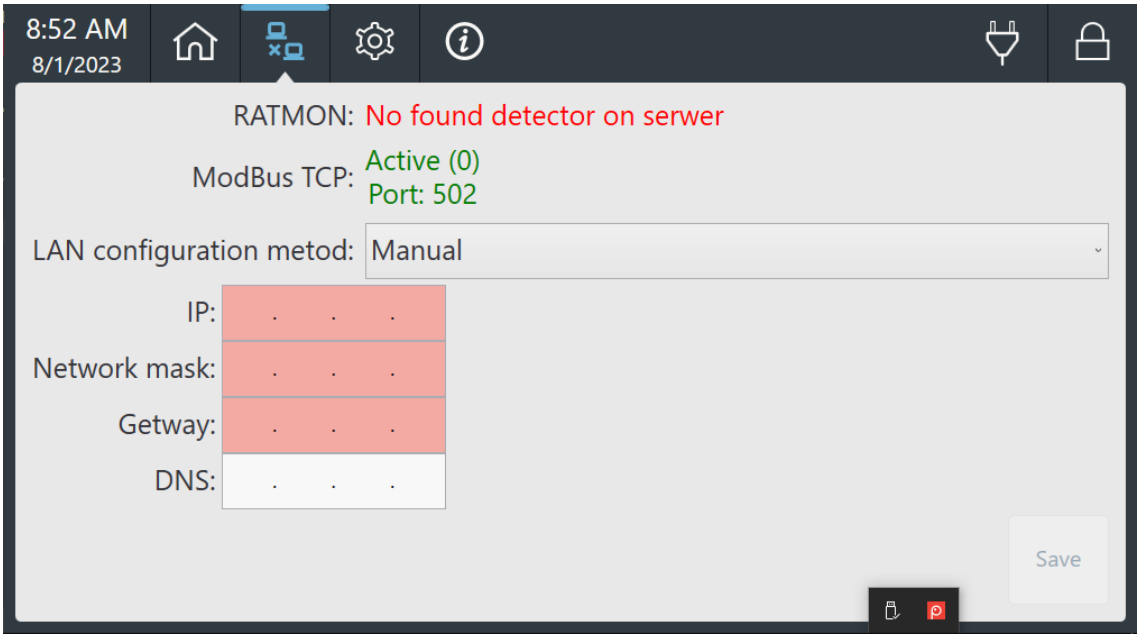
12.1.1 IP configuration

ILA 1.0 can connect to monitoring systems via LAN. It require IP address to work. ILA 1.0 supports manual IP configuration and automatic one (DHCP)

Automatic configuration:



Manual configuratio



12.2 Communication via MODBUS TCP/IP

ILA 1.0 uses MODBUS TCP/IP communication protocol over 502 communication port. The device is connected using UTP/STP cable and RJ 45 plug. IP address is available in ILA main application -> Information.

Communication protocol is described in appendix **COMMUNICATION PROTOCOL ILA – MODBUS TCP/IP.**

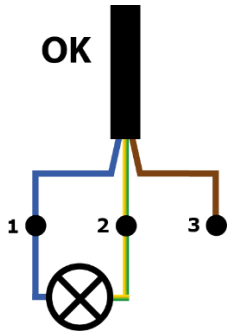
12.3 Communication via RATMON API

All RATMON devices can communicates with RATMON application (via LAN or GPRS). RATMON application can communicate with other systems via RATMON API. This communication can be done via local network or via internet.

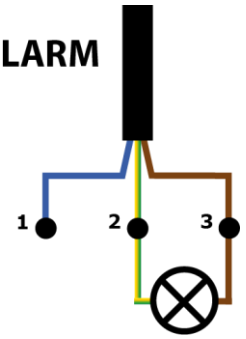
Communication protocol is described in appendix **RATMON API**

13. Relay operation

ILA 1.0 is equipped with potential-free NO NC relay. It changes state when alarm occurs and back to normal when alarm is discarded. It can be connected to other systems. Relay socket is located at bottom of the device and marked.



Normal operating condition – wires 1-2 shorted.



Alarm – wires 2-3 shorted.

14. Communication protocol ILA – MODBUS TCP/IP

14.1 Status

Read discrete inputs

CH1 - CHANNEL 1 - (SUPPLY)

FLAG	Description	Values
1	CH1 is switched-on/off	TRUE=on, FALSE=off
2	CH1 alarm notification	TRUE=alarm, FALSE=no alarms
3	CH1 L1 (RED) is switched on/off	TRUE=on, FALSE=off
4	CH1 L1 (RED) alarm notification	TRUE=alarm, FALSE=no alarms
5	CH1 L2 (GREEN) is switched on/off	TRUE=on, FALSE=off
6	CH1 L2 (GREEN) alarm notification	TRUE=alarm, FALSE=no alarms

CH2 - CHANNEL 2 - (RETURN)

FLAG	Description	Values
11	CH2 is switched-on/off	TRUE=on, FALSE=off
12	CH2 alarm notification	TRUE=alarm, FALSE=no alarms
13	CH2 L1 (RED) is switched on/off	TRUE=on, FALSE=off
14	CH2 L1 (RED) alarm notification	TRUE=alarm, FALSE=no alarms
15	CH2 L2 (GREEN) is switched on/off	TRUE=on, FALSE=off
16	CH2 L2 (GREEN) alarm notification	TRUE=alarm, FALSE=no alarms

14.2 Test date

Input register

All variables are converted using little-endian method.

TEST DATE – CH1 - CHANNEL 1 - (SUPPLY)

Register	Description	Values
1	0000-0000-0000-0000 there was no measurement	Uint16
2		
3		
4		

TEST DATE - CH2 - CHANNEL 2 - (RETURN)

Register	Description	Values
1	0000-0000-0000-0000 there was no measurement	Uint16
2		
3		
4		

14.3 Faults

Type of fault (first register), location of fault (4 registers), total 5 registers. Next faults are defined every 5 registers. In total could be 10 faults.

FAULTS - CH1 - CHANNEL 1 - (SUPPLY) - L1 RED

Register	Description	Values
FAULT 1		
100	Type of fault on L1/RED	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
101	Location of fault in meters	Uint16
102		
103		
104		
FAULT 2		
105	Type of fault on L1/RED	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
106	Location of fault in meters	Uint16
107		
108		
109		
FAULT 3 (110…114)		
FAULT 4 (115…119)		
FAULT 5 (120…124)		
FAULT 6 (125…129)		
FAULT 7 (130…134)		
FAULT 8 (135…139)		

FAULT 9 (140…144)		
FAULT 10 (145…149)		

FAULTS - CH1 - CHANNEL 1 - (SUPPLY) - L2 GREEN

Register	Description	Values
FAULT 1		
200	Type of fault on L2/GREEN	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
201	Location of fault in meters	Uint16
202		
203		
204		
FAULT 2		
205	Type of fault on L2/GREEN	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
206	Location of fault in meters	Uint16
207		
208		
209		
FAULT 3 (210…214)		
FAULT 4 (215…219)		
FAULT 5 (220…224)		
FAULT 6 (225…229)		
FAULT 7 (230…234)		
FAULT 8 (235…239)		
FAULT 9 (240…244)		

FAULT 10 (245…249)		

FAULTS - CH2 - CHANNEL 2 - (RETURN) - L1 RED

Register	Description	Values
FAULT 1		
1100	Type of fault on L1/RED	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
1101	Location of fault in meters	Uint16
1102		
1103		
1104		
FAULT 2		
1105	Type of fault on L1/RED	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
1106	Location of fault in meters	Uint16
1107		
1108		
1109		
FAULT 3 (1110…1114)		
FAULT 4 (1115…1119)		
FAULT 5 (1120…1124)		
FAULT 6 (1125…1129)		
FAULT 7 (1130…1134)		
FAULT 8 (1135…1139)		
FAULT 9 (1140…1144)		
FAULT 10 (1145…1149)		

FAULTS - CH2 - CHANNEL 2 - (RETURN) - L2 GREEN

Register	Description	Values
FAULT 1		
2100	Type of fault on L2/GREEN	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
2101	Location of fault in meters	Uint16
2102		
2103		
2104		
FAULT 2		
2105	Type of fault on L2/GREEN	0 - end 1 - leak 2 - break 3 - short FFFF- no faults
2106	Location of fault in meters	Uint16
2107		
2108		
2109		
FAULT 3 (2110…2114)		
FAULT 4 (2115…2119)		
FAULT 5 (2120…2124)		
FAULT 6 (2125…2129)		
FAULT 7 (2130…2134)		
FAULT 8 (2135…2139)		
FAULT 9 (2140…2144)		
FAULT 10 (2145…2149)		

15. Ratmon API

15.1 Authentication

15.1.1 User authorization in the API is done using Bearer Token.

This involves sending your login details (username and password) via **HTTP POST** method: **/Account/GetToken**:

```
{
  "username": "demonstration@ratmon.com",
  "password": "Yourpassword23#"
}
```

Received answer:


```
{
  "Token": "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJ1bmlxdWVfbmFtZSI6ImRlbW9uc3RyYXRpb25AcmF0bW9uLmNvbSIsIm5iZiI6MTYxOTY4NzczNiwiZXhwIjoxNjE5Njg4OTc2LCJpYXQiOjE2MTk2ODc3NzZ9.ewkp6bikfAjHCfUevM-po0qCJ9JDChhJUVhZ2uVf66Q",
  "Expiration": 20,
  "RefreshToken": "502b494d0f9e4e55b751edae9991e0fe"
}
```


Token – this is our token on the basis of which we will be able to authenticate our subsequent queries, so that you do not have to send your username and password every time.
Expiration – is the validity of our token in minutes, after this time the token will lose its validity.
RefreshToken – is a token thanks to which we can refresh our token when its validity period ends. In such a situation, when the token expires, we can use **RefreshToken** to refresh it (this will allow us to log in again without using a username and password), description below.

15.1.2 Downloading the token

Downloading the token using an incredulous token is done using the HTTP POST method - **/Account/GetRefreshToken**. In order not to re-enter your data (username and password) after the expiration of the token, receive naves based on the token refreshing the "**RefreshToken**" field point
In the **/Account/GetRefreshToken** method, we send **RefreshToken**:

```
{
  "refreshToken": "502b494d0f9e4e55b751edae9991e0fe"
}
```

in response we get data with new values.


```
{
  "Token": "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJ1bmlxdWVfbmFtZSI6ImRlbW9uc3RyYXRpb25AcmF0bW9uLmNvbSIsIm5iZiI6MTYxOTY4ODUxMiwiZXhwIjoxNjE5Njg5NzEyLCJpYXQiOjE2MTk2ODg1MTJ9.NBgpc1bGaGm9cIrKK9Dem6JqgniXB8svbKU-zIklKsc",
  "Expiration": 20,
  "RefreshToken": "c1f6a149a2294c3bb5d83e81eb706179"
}
```


15.2 Retrieve circuit information

Using the **HTTP GET** - **api/Circuit/Get** method, we can retrieve basic circuit information from the Ratmon system.

```
[
  {
    "Id": 1,
    "Localization": "Seweryna Udzieli 8, 33-332 Kraków,
      Polska",
    "Number": 1,
    "State": 2,
    "Description": null,
    "Channels": [
      {
        "Id": 1,
        "Name": "Supply",
        "State": 2,
        "AlarmType": 1
      },
      {
        "Id": 2,
        "Name": "Return",
        "State": 2,
        "AlarmType": 1
      }
    ],
    "Detector": {
      "Id": 3,
      "Battery_State": 1,
      "GSM_State": 1,
      "Comm_State": 0
    }
  },
```


The description of individual parameters can be checked on the https://editor.swagger.io/ page by loading the .json with documentation. Below is an example of a description:

Descriptions of enums:

State, Channels.State:
- 0: Ok
- 1: Accepted
- 2: Alarm
- 4: Alert
- 8: Undefined

Channels.AlarmType:
- 0: No alarms
- 1: Break
- 2: Leak
- 3: Break and leak

Detector.Battery_State, Detector.GSM_State, Comm_State:
- 0: Alarm
- 1: Ok
- 2: Undefined

From the above information (State: 2) we can read that circuit 1 is in the alarm state. In the detector, the parameters of the battery status and GSM network coverage are correct because they have a state of 1 (ok), while the communication status of the device with the Ratmon system indicates an alarm (state 0), which indicates a lack of communication.

15.2.1 Download the details of a specific channel.

If you want to download detailed information about a given channel, you can use the **HTTP GET** method - **/api/Channel/Get** by providing the channel identifier you are asking for (it can be read from the data downloaded in point 2 Channels → Id). For example, circuit 1 from point 2 has two channels, the first of which has ID 1. Using the **/api/Channel/Get** method, we will obtain individual values for the last resistance measurement (Insulation resistance, continuousness and voltage resistance, and the state of each of these measured values). The status of the measured values determines whether the result is within the norm or has exceeded the alarm threshold set in the application. In addition, ResTreshold are alarm thresholds for alarm and alert according to which the measured values are evaluated. Here's an example:


```
{
  "ChannelId": 1,
  "Resistance": {
    "Id": 13,
    "Date": "2021-03-11T12:00:09",
    "R1": ">200,00 [MΩ]",
    "R1_V": "-24,49 [mV]",
    "R1_State": 0,
    "R2": ">200,00 [MΩ]",
    "R2_V": "-0,89 [mV]",
    "R2_State": 0,
    "RLoop": ">200,00 [MΩ]",
    "RLoop_V": "---",
    "RLoop_State": 2
  },
  "ResThresholds": {
    "R1_Alarm": "500,00 [kΩ]",
    "R2_Alarm": "500,00 [kΩ]",
    "RLoop_Alarm": "100,00 [Ω]",
    "R1_Alert": "1,00 [MΩ]",
    "R2_Alert": "1,00 [MΩ]",
    "RLoop_Alert": "50,00 [Ω]"
  }
}
```


15.2.2 Download a list of reflectometric measurements

Using the **HTTP GET** - **/api/Tdr/Get** method, you can download a list of TDR measurements stored in the Ratmon system. When performing this query, you must provide data such as:
channelId -id of the channel whose TDR measurements we want to download
page – page number
pageSize – number of measurements per page

Providing the page number and the number of measurements on the page allows you to download the declared number of measurements. For example, you can ask for 10 measurements from page one, then another 10 from page 2, and so on.

Below is an example answer:


```
{
  "Page": 1,
  "PageSize": 10,
  "TotalCount": 17,
  "Data": [
    {
      "Id": 187,
      "ChannelId": 1,
      "WireType": 2,
      "Date": "2021-03-04T11:47:41",
      "TestState": 8,
      "AlarmType": 0,
      "Comment": null,
      "IsReference": false
    },
    {
      "Id": 184,
      "ChannelId": 1,
      "WireType": 0,
      "Date": "2021-03-04T11:23:55",
      "TestState": 8,
      "AlarmType": 0,
      "Comment": null,
      "IsReference": false
    },
    {
      "Id": 185,
      "ChannelId": 1,
      "WireType": 2,
```

15.3. Taking the details of the TDR measurement

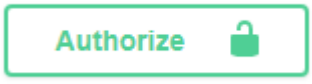
To retrieve detailed information about TDR measurement, use the **HTTP GET - /api/Tdr/Details** method. In the query parameter, specify the TDR reading in point 4. In response, you can find such data as the parameters with which this measurement was made (gain, pulse width, etc.), found failures (table "Failures") and a set of data to draw a reflectogram. The data to draw the reflectogram is Arguments (X-axis arguments) and Values (values on the Y axis) in the following example, this data is hidden because it would take up too much space.


```
{
  "Start": "0 [m]",
  "Stop": "150 [m]",
  "Width": "4 [ns]",
  "Amp": "0 [db]",
  "Imp": "50 [Ω]",
  "Vop": "87 [%]",
  "Values": [...],
  "Arguments": [...],
  "Failures": [],
  "Id": 1780,
  "ChannelId": 1,
  "WireType": 0,
  "Date": "2021-03-11T00:00:01",
  "TestState": 8,
  "AlarmType": 0,
  "Comment": null,
  "IsReference": false
}
```

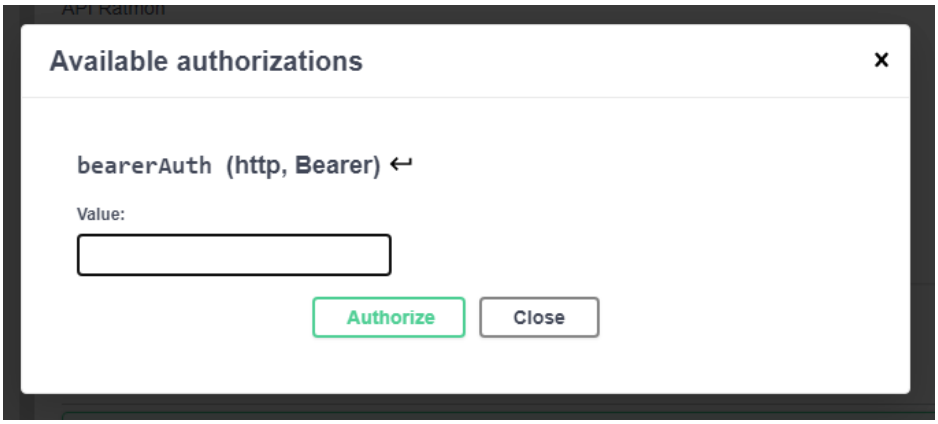

15.4 Conclusion

The above information shows the principle of using the Ratmon API, all the necessary explanations, descriptions of parameters can be found on the https://editor.swagger.io/ page by loading the file with the Ratmon API documentation. On the website using the https://editor.swagger.io/ button

you can test the above API queries and get acquainted with their operation, to do this in the first place we must use the **HTTP POST** method - **/Account/GetToken** to download our authenticator, after receiving the token copy it and then press the button



In the window that opens, paste the previously copied authenticator and confirm with the Authorize button.



After logging in in the above way, we can use the api methods (until the token expires) described in points 2, 3, 4, 5, because the https://editor.swagger.io/ page will automatically authenticate each query with the token that was provided during login.

16. Scope of delivery

- ILA device
- Power supply: 12 V DC / 120-240 V AC

16.1 Optional accessories

- External GSM antenna
- 3-wire sensor cable connection box, 2 alarm loops
- MSC-1 connection box, two loops
- Sensor cable
- Mounting bracket
- External cabinet

17. Troubleshooting

18. Manufacturer

The instrument manufacturer providing warranty and post-warranty service is:

RATMON sp. z. o. o.

ul. Wadowicka 8A
30-415 Krakow, Poland
Tel: +48 12 294 20 01
e-mail: ratmon@ratmon.com
www: ratmon.com