plum GAS

MacSM G4

Diaphragm gas meter with digital totalizer module integrated with IoT telemetry module

User manual

Document version: 1.6
Program series: S010.xx
Hardware version: H2.0

1. Introduction and safety rules

Compliance with all safety information and instructions for use contained in this operating manual is a prerequisite for safe working processes and proper use of the device. Furthermore, the valid guidelines, standards, local accident prevention regulations, and general safety regulations must be complied with for the respective area of application of the device.

This manual forms a constituent part of the product and must be stored within the immediate vicinity of the device and always be accessible to installation, service, maintenance, and cleaning personnel. The graphic illustrations used in this manual serve as a visual representation of the described processes and are therefore not necessarily to scale and may deviate from the actual design of the device.

Main used marks:

This mark is related to the significant security or safety information*.

This mark means the information related to product usage or the important technical matter*.

* The used marks does not determine finally the type of information.

Customer service:

For the customer technical support regarding installation or usage of this product please contact Manufacturer Technical Support Channel.

PLUM Technical Department
Phone: +48 (85) 749-71-63
E-mail: support@plum.pl

Safety measures

This measurement device can be operated only by an operator trained in compliance with the technical terms, safety regulations, and standards. It is necessary to consider any other legal and safety regulations stipulated for special applications. Similar measures also apply for special applications. Similar measures also apply for using the accessories.

The information in this manual does not have the power of a legal obligation from the manufacturer's side. The manufacturer reserves the right to implement changes. Any changes in the manual or in the product itself can be performed at any time without any previous alert, with the goal of improving the device or fixing any typographical or technical mistakes.

ATEX safety and health

This device is an equipment protected by intrinsic safety "i" intended for use in potentially explosive atmospheres according to the ATEX Certificate. Carefully read the whole documentation.

Radio equipment safety and health

Directives:

MID - Directive 2014/32/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to the making available on the market of measuring instruments

ATEX - DIRECTIVE 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres

RED - Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC

According to Directive WEEE 2012/19/UE:

Purchased product is designed and made of materials of highest quality. The product meets the requirements of the Directive 2012/19/EU of 4 July 2012 on waste electrical and electronic equipment (WEEE), according to which it is marked by the symbol of crossed-out wheeled bin (like below), meaning that product is subjected to separate collection.

Responsibilities after finishing a period of using product:

- dispose of the packaging and product at the end of their period of use in an appropriate recycling facility,
- do not dispose of the product with other unsorted waste,
- do not burn the product.

By adhering obligations of waste electrical and electronic equipment controlled disposal mentioned above, you avoid harmful effects on the environment and human health.

1.1. Device description

Diaphragm gas meter with digital totalizer module integrated with IoT telemetry module MacSM G4 (later called as smart meter) is an intelligent gas meter designed to measure the volume of the natural gas. Device contains the integrated telemetry module to send the measurement data, archives and events caused by intrusions or maintenance failures to the data acquisition system.

MacSM according to standard EN 16314:2013 is a device type AFD1 – telemetry module integrated with diaphragm gas meter constituting one single device

Device can be equipped with (not all the features may be present – some are optional):

- 1 or 2 internal lithium-thionyl chloride D-size batteries to supply the smart meter
- Internal valve on the inlet side to cut off the gas flow
- Temperature sensor for the temperature compensation
- Optical interface, IEC 62056-21 standard
- Remote communication modem, standards GSM or LTE-M or NB-IoT

1.2. Function principle – general characteristics

- Gas meter contains magnetic counter driver which rotates with equal gas amount flow through the measurement chambers. One revolution is the 1,2 dm3 of the gas. Outside of the gas meter chamber there is a plastic disc that is a base for the volume counting by the electronic counter.
- Optical circuit inside the electronic counter recognizes the revolutions of the plastic disc and basing on the information received from it, programmable logic of the device increases the main device counter which is showed constantly on the integrated display and it is refreshed in real time.
- Device is supplied from internal non rechargeable battery which can supply the device for the time mostly dependable on the frequency of data transmission
- Measurements are stored in non-volatile memory of the device and can be accessed on demand using dedicated interfaces and tools locally or remotely.
- Device transmits the measurement data to the data acquisition platform in programmed period with most frequent ratio of every hour. Frequency of data transmission is configurable and most common and efficient is one transmission per day
- Internal modem of the device requires to be used with SIM card size micro-SIM or Embedded SIM MFF2 installed during device production. MFF2 cards must be delivered to manufacturer prior to the production process.

The device consists of following equipment:

- Diaphragm gas meter size G4 with mechanical chambers of capacity 1,2 liters of the medium, remotely controlled valve, flat cable to connect to the electronic counter, two connectors of size 1 1/4 inch or 7/8 inch on inlet and outlet side.
- Electronic board with display, SIM card slot, internal antenna, communication module, optical port, keyboard with multifunctional button.
- Enclosure sealable by the plastic caps to prevent from unauthorized access to the counter interior.

1.3. Definitions

The following definitions apply to certain terms used in this document.:

- **Smart meter, meter, counter** – MacSM Diaphragm gas meter with digital totalizer module integrated with IoT telemetry module
- **Firmware** – program which is uploaded to the device
- **Software** – ConfIT! application, installed on PC with Windows® system, for reading and configuring of smart meter
- **Optical head / Opto** – Optical Interface according to IEC 62056-21 to read the smart meter through infrared
- **Valve** – internal valve that can be remotely controlled in case of i.e. lack of payment or intrusion attempt
- **DP Table** – table of parameters stored in the smart meter. It contains whole configuration of the device listed in the table with names, descriptions, units, and values.
- **ZD Table** – table of events appearing in the device during its lifetime. It contains whole device history listed in the table with names and dates of beginning and end.
- **Modem** – unit integrated in the smart meter used for remote data transmission
- **MID** – compliance with the MID directive and the harmonized EN 1359:2017 standard, corresponding to the quality of the device in the measurement range

1.4. Subsidiary documentation

For full acknowledgement and understanding of the gas meter work and maintenance it is necessary to make use of the following documents in some certain steps, which are mentioned in further part of this document. All the mentioned documents can be obtained from the manufacturer upon request.

- **ConfIT! User manual** – manual for the ConfIT! software, which is configuration program for smart meter and other products which enables configuration and readout
- **OptoBTEx user manual** – optical interface for readout and communication

Documents not related to the usage of the product:

- **EU Declaration of Conformity** – document confirming approvals for the device

2. Safety

2.1. General safety

The manufacturer's declaration of the IP65 housing tightness class will be valid only ensuring proper placement of gasket and tightening of the housing cover to the device casing.

Smart meter is intrinsically safe device. It should be used in accordance with the requirements of this documentation and the conditions specified in the ATEX certificate.

The person installing the device is responsible for checking the continuity of protective connections.

The unit should not be installed in the vicinity of strong electromagnetic fields.

Unauthorized opening of the device, installation inconsistent with this documentation or any changes in the device design may lead to the loss of intrinsically safe features and / or metrological characteristics and / or characteristics of radio devices. Damage to any seal means loss of confirmation of: metrological features, intrinsic safety, compliance with the requirements for radio devices.
Under no circumstances the construction of the device must not be modified.
Any of the above events excludes the manufacturer's liability, including warranty liability.

The smart meter can be ordered with cellular network modem, such device becomes a radio equipment and fulfills the requirements of the Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC (RED).

Use of the device is only allowed where the working radio does not interfere with the operation of other equipment (e.g., medical).
This equipment because of a Radio Frequency radiation exposure should be installed and operated with minimum 20cm distance between the antenna and your body.

Only devices with the same serial number on the name plate on the housing cover and electronic name plate (displayed on LCD) are allowed.

The smart meter can be ordered to be complied of the requirements of the Measuring Instruments Directive 2014/32/EC of European Parliament and Council (MID) which apply to volume conversion devices intended for residential, commercial, and light industrial use.

The smart meter compliant with MID, on the name plate, next to the “CE” sign has the supplementary metrology marking consists of capital letter “M” followed by last two digits of the year of its affixing, surrounded by a rectangle.

2.2. Ex markings and parameters

Device is approved for usage in potentially explosive atmospheres.

Marking: **II 3G Ex ic IIB T3 Gc**

Certificate: **OBAC 25 ATEX 0047X**

Operating environment:

Device is approved to be used at the Zone 2 threatened with explosion of mixture of: vapors, gases and explosive vapors with air which are placed in IIB or IIA explosive group and temperature class T1, T2, T3.

Lack of any external connections and additional circuits occurs in not present Ex parameters such as induction, capacity, permissible powers, currents and voltages.

3. Technical data

3.1. General data

Nominal meter size	G4, capacity of the chamber 1,2dm3
Connection	Inch connection 1 1/4" or 7/8” according to ISO 228-1 110, 130, 160mm spacing between connectors
Nominal flowrate	4
Maximum flowrate	6
Minimum flowrate	0,04
Basic error	± 1.5% - 0.1 Qmax ≤ Q ≤ Q max ± 3% - Qmin ≤ Q < 0.1 Qmax
Maximum pressure	50 kPa
Maximum pressure drop	≤ 0.2
Weight	up to 2.4 kg
Ambient temperature range	-25 ÷ 55 °C
Ingress protection class	IP 65
Ex marking	II 3G Ex ic IIA T3 Gc
Design type	design of the AFD1 gas meter with a communication module built into the gas meter in accordance with EN 16314:2013
Keypad	1 monostable button, performing the following functions: short press: navigation, long press: selection of an option
Display	backlit alphanumeric, 2 lines, 12 characters, function and unit icons
Built-in sensors	opening of the housing cover, metrological lock
Application approval	permissible for installation in zone Z2 of explosion hazard for gases classified as group IIA
Resistance to high temperatures	T (according to EN1359)
Electromagnetic environmental class	E2 (the instrument may be installed in areas exposed to disturbances in industrial buildings)
Mechanical class	M1
SIM standard	3FF or MFF2
Communication protocol	DLMS (for both local and remote transmission) GAZ-MODEM (can be enabled/disabled - used only in local transmission)
Local communication	IEC 62056-21 compliant optical interface in the physical layer
Power supply	One D-size lithium batteries (standard) or one double D-size battery (optional)
Battery lifetime (standard)	technology - daily report + 20 additional (emergency) reports per year NB-IoT – 18 years (without PSM mode) / 20 years (active PSM mode)

Parameters of alternative types of cellular technology modems (see the list of types in the point Radio equipment identification)	Legend: Class no. / (maximum power) / additional info **(1) model 01, standard NB-IoT** (radio protocols supported by 3GPP Rel.13 and Rel.14) • **Class 5** (+23 dBm ±2,7 dB) for LTE HD-FDD bands: **LTE-NB2:** B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/B25/B28/B66/B70/B85 **(2) model 02, standards LTE-M, NB-IoT, GSM** • **Class 5** (+21 dBm +1,7/-3 dB) for LTE HD-FDD bands: **LTE-M1:** B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B26/B27/B28/B66/B85 **LTE-NB2:** B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B28/B66/B71/B85 • **Class 4** (33 dBm ±2 dB) for GSM850 • **Class 4** (33 dBm ±2 dB) for EGSM900 • **Class 1** (30 dBm ±2 dB) for DCS1800 • **Class 1** (30 dBm ±2 dB) for PCS1900 • **Class E2** (27 dBm ±3 dB) for GSM850 8-PSK • **Class E2** (27 dBm ±3 dB) for EGSM900 8-PSK • **Class E2** (26 dBm ±3 dB) for DCS1800 8-PSK • **Class E2** (26 dBm ±3 dB) for PCS1900 8-PSK
Modem, external antenna	Antenna with connector type FME. Formally, the length of the antenna cable is unlimited, but the usable length of the antenna cable is still determined by cable loss and signal strength at the installation site. From the MID and EMC side, the permissible length of the antenna cable is over 10 m.

3.2. Radio equipment identification

Each device with radio emission unit – in case of smart meter it is integrated modem – is marked with special label describing the radio equipment type.

Principle of marking is: Mx.y where capitals are constant and lower cases are positions with variable digits depending on the equipment type, according to the presented table.

Position	Description
Mx	X - symbolic marking of the main modem's technology. Available values: 1 – NB-IoT 2 – NB-IoT / LTE-M / 2G
.y	Y – symbolic marking of the antenna type. Available values: 1 – internal antenna type 1 2 – external antenna type1

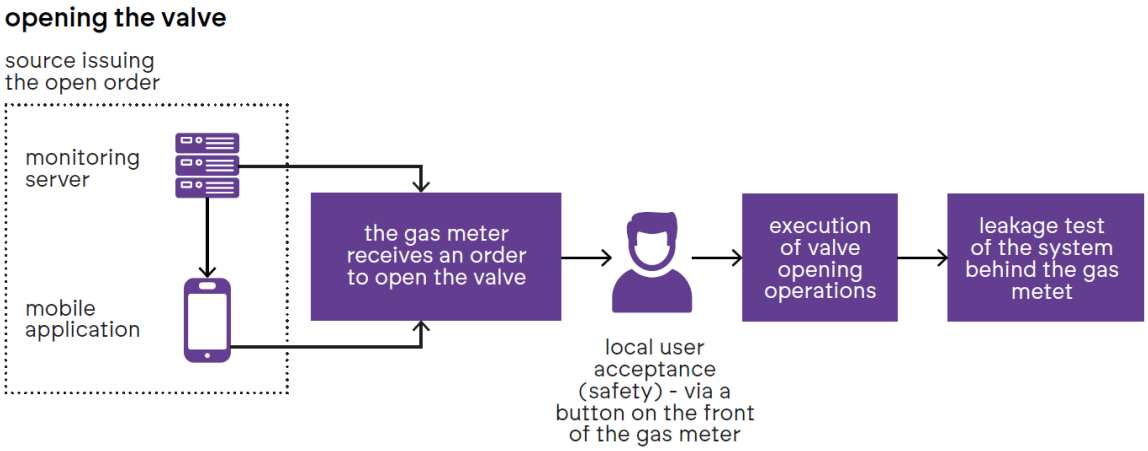
Output example code: M1.1

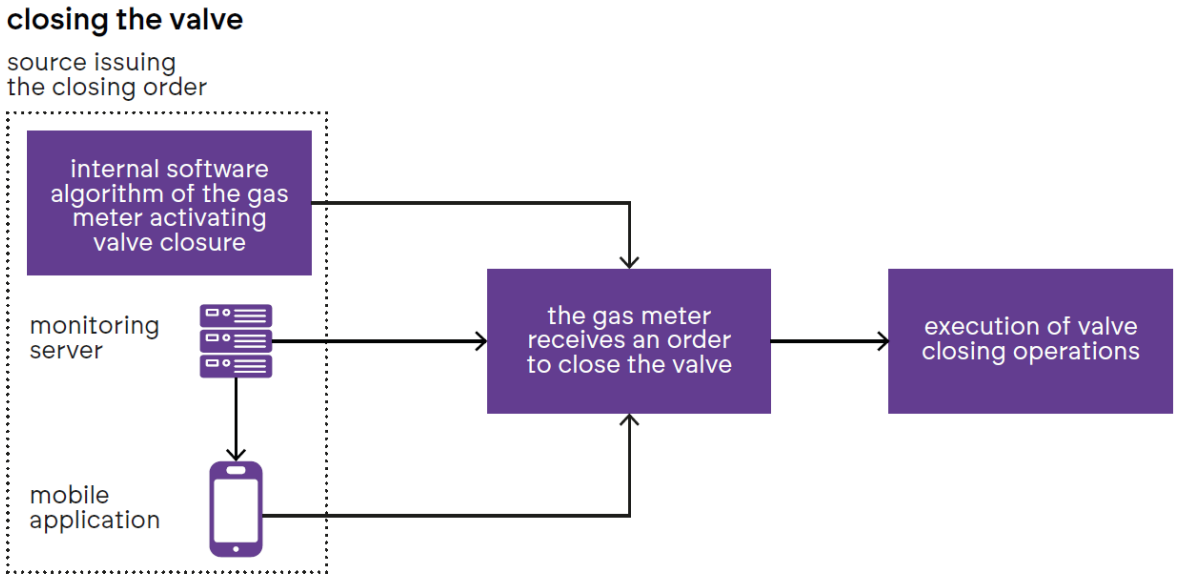
Detailed description: Internal modem allowing for connection in NB-IoT technology with internal antenna type 1.

3.3. Internal valve

The device contains an internal valve that is controlled locally or remotely. The internal valve is used to cut off the gas supply to the consumer in the event, for example, that the gas supply to the consumer is discontinued in the event of non-payment.

Opening the valve remotely is not a direct order to open the valve. It is the request requiring confirmation from the local user by the keypad. Closing of the valve does not require confirmation, this is operation done instantly.





3.4. Communication with MacSM gas meter

3.4.1. Serial communication

Local communication with the smart meter using serial connection is realized by using optical port on the device front area. Optical port is compliant with standard IEC 62056-21. Normal state of the optical port is turned off. To turn on the port it is necessary to use the correct menu operation described in details in paragraph **Menu OPTO**

Baudrate of the optical port is 9600b/s and cannot be changed.

To establish the communication with the device through serial interface it is necessary to have compliant interface i.e. PLUM OptoBTEx which is an interface communicating through USB with PC or Bluetooth Low Energy through PC or Android phones.

Optical port is automatically turned off after a set time of lack of activeness (5 minutes by default).

3.4.2. Mobile transmission network

Remote communication with the smart meter is realized by using internal modem transmission. For uninterrupted and correct work SIM card with data transfer is required. This way of communication is realized in form of a schedules executed at programmed time, which is a real time device internal clock. When the device crosses the programmed time, internal modem begins realizing programmed task. There are other ways to enable the modem: while some of the alarms appear or during device installation. For correct device operation, proper settings must be programmed in the device. These settings are PIN to the SIM card and APN, so the Access Point Name to the Network. These values must be known and provider along with the SIM to ensure that data transmission can be realized. Principle says that this transmission mode is a simplex type of the communication, where only smart meter is sending the data to the platform as a master, however it is possible to turn on the half duplex communication, where after successful data transmission, device switches to slave mode and awaits for the requests from the server. This mode results in higher energy consumption due to prolonged modem activity.

Device will transmit the data in DLMS protocol.

Device can work in both transmission standards, TCP and UDP and this is configurable by a user.

3.4.3. Transmission protocols

MacSM firmware contains two types of transmission protocols.

- DLMS (compliance with **UNI/TS 11291-12-2** standard) – transmission protocol used for the remote communication, billing data transmission to the platform, allowing also for basic configuration and limited current parameters. Transmission in DLMS protocol can be encrypted.

- GAZ-MODEM – device transmission service protocol. Allows for access to all the data that are stored in the device, such as settings and event logs. The protocol is also used in the process of downloading new software (this can be done locally or remotely). The role of the protocol can be limited to the option of downloading new software only.

3.5. Device's firmware upgrade

Smart meter is equipped with function of the firmware updating.
There are following options for firmware upgrade:

- Local upgrade using application ContIT desktop – upgrade using PC with Windows system – necessary equipment is optical interface to connect by the optical port

- Remote upgrade using update server UpIT and the update management application UpdateManager – necessary equipment is active SIM card allowing for the data transmission over the GSM network.

Remote firmware upgrade is available after correct configuration of the UpIT server and UpdateManager. UpIT can be installed in the local environment complete system can be managed by final customer. UpIT as a standard service is available at PLUM and devices can communicate with this server to receive updates. UpIT works in standards TCP. It requires installation of a database to store the logs and other information about the devices that

were supported.

UpdateManager is graphic user interface used to upload the upgrade files to the server, ordering devices to upgrade by their serial numbers, to review the logs from the devices and monitor the efficiency of upgrade process. Communication between UpIT and UpdateManager is established through REST API. To secure the connection, TLS encryption is used.

Details about UpIT are available in its documentation.

4. Archives and device memory description

4.1. General presentation of data stored in the device

Below are presented all the data types that are stored in the device.

Data type	Transmission method		Transmission protocol	
	Local	Remote	GAZ-MODEM	DLMS
Current data	YES	YES	YES	YES
Archives*	YES	YES	NO	YES
Events and alarms	YES	YES	YES	YES

The GAZ-MODEM protocol is a service protocol, which means it can access all parameters but does not have access to data archives. The DLMS protocol a user protocol (access to all archived data) but does not allow changes to manufacturer's parameters/objects specific to this gas meter.

4.2. Archives

The device can save counter readings to archives. Data is saved at a set time (end of the gas day). The structure of data saved in memory is described in the UNI/TS 11291-12-2 standard.

4.3. Events and alarms

Two separate event logs are stored in the device memory. The first log records all events, while the second log records events related to the operation of the metrology module.
The structure of events is described in document UNI/TS 11291-12-2.

5. Device labelling and marking

5.1. Device front and information on it

Some important information is imprinted directly on the solid elements of the device housing. The specific, additional information are placed on the stickers unique for each device.

Device front contains following information:

- Full manufacturer data and device name
- Window showing the manufacturer seal proving device legal and metrology status confirmation
- ATEX certificate number
- ATEX marking
- Permissible temperature range
- Base temperature (possible values are 0°C, 15°C or 20°C)(data visible in the window) (option only for temperature-corrected gas meters)
- Central temperature (data visible in the window) (option only for temperature-corrected gas meters)
- Specials conditions of use
- Notification body number
- CE marking
- MID marking year with year of issuing conformity
- Nominal flowrate (data visible in the window)
- Cyclic volume (data visible in the window)
- Compliance with standards numbers
- Other environmental and metrology markings
- Device SN (data visible in the window)

5.2. Meter sealing

Smart meter as a device for billing should be protected against unauthorized access. For this purpose, the housing of the device is protected by screw-head caps, as well as by internal seals (physical seal for legal metrology and technical control).
In addition, the device has a device opening detection (service operation) and a metrology cover removal detection (electronic legal metrology seal). Damage to the physical legal metrology seal and/or activation of the electronic legal metrology seal results in the loss of confirmation of the metrological characteristics and certificates of the device. Avoid damaging the seals during installation and operation of the instrument.

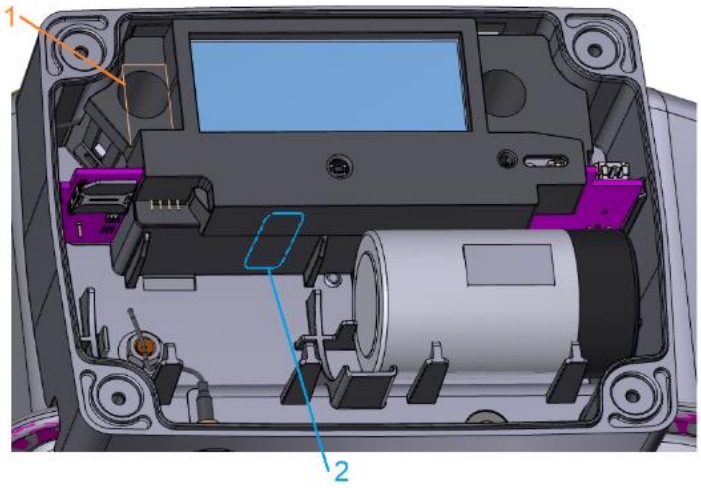
Unauthorized opening of the device, mounting inconsistent with this documentation or any changes to construction of the device can lead to loss of intrinsically safe features and/or metrological characteristics and/or radio equipment characteristics. Damage of any sealing marks causes loss of confirmation of: metrological, intrinsically safe, radio equipment features of the device.

In accordance with the directive RoHS 2011/65/UE, where applicable, it is unacceptable to use lead seals.

Properly sealed device provides certainty of device integrity, warranty, and quality. Each damaged seal can cause the device to be called into questions due to plausible integrity violation.

There are two types of seals inside the smart meter.

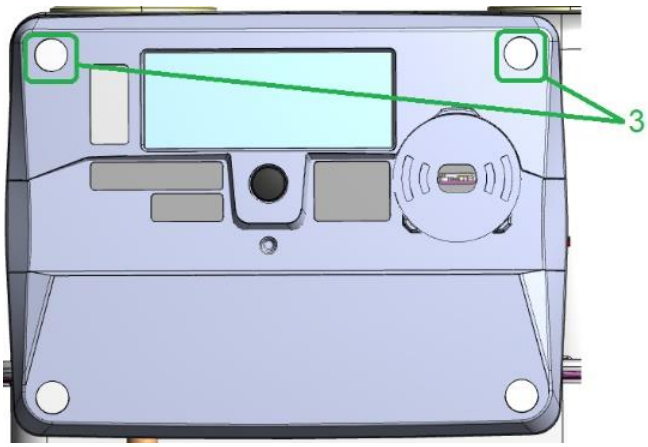
	MID protective seal. Damaged or missing one of these seals is the factor causing loss of MID conformity check.
	Manufacturer protective seal. This seal ensures device was not manipulated. Warranty is void when this sticker is removed.



1 – MID protective seal that can be visible through the transparent window in the front cover.

2 – Manufacturer protecting seal

Installation staff is obligated to verify condition of seals before mounting of device. If the seals are damaged, the proper functioning of device must be checked by the manufacturer's authorized service.



3 – place for the caps covering the screws heads. This is also potential place for adding the installer seal instead of attached plastic caps added by manufacturer.

There are also electronic hardware seals which are the components:

- Cover opening sensor – it detects that the front cover has been removed
- Sarcophagus removing sensor – it detects that the sarcophagus has been removed – access to the device electronics with bare hands, what is a severe violation of the MID conformity.

When the device is not assembled and certified with the MID conformity check all seals from above are replaced by manufacturer seals.

6. Device installation

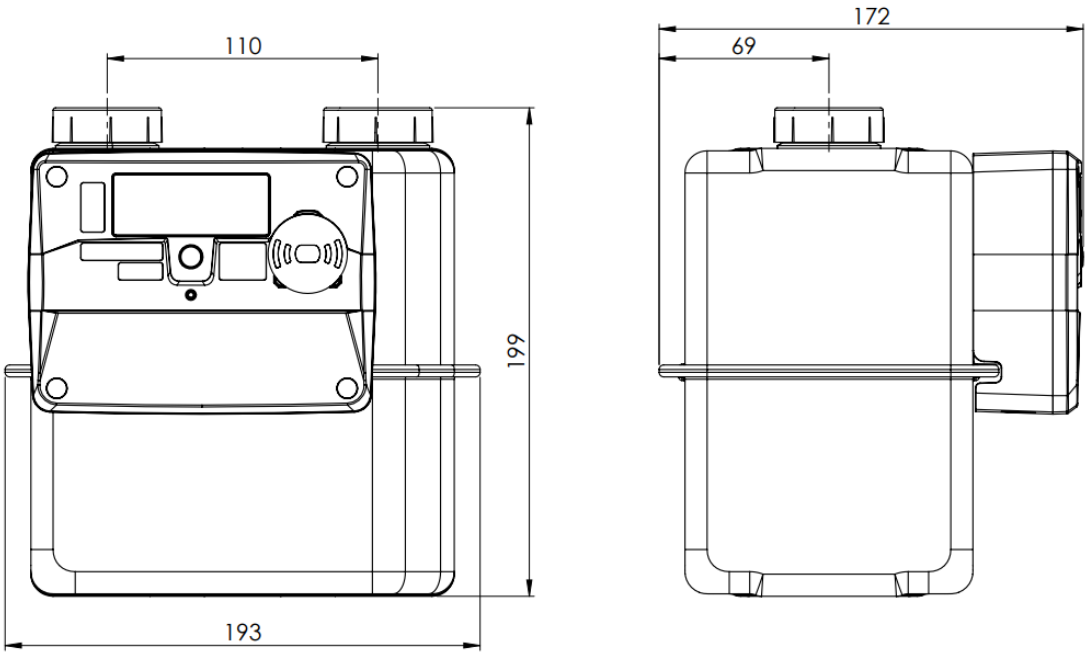
6.1. Tools list

Installation of the device may require some tools to perform the process correctly. Below it is listed what tools are required and what is their purpose in the process of installation

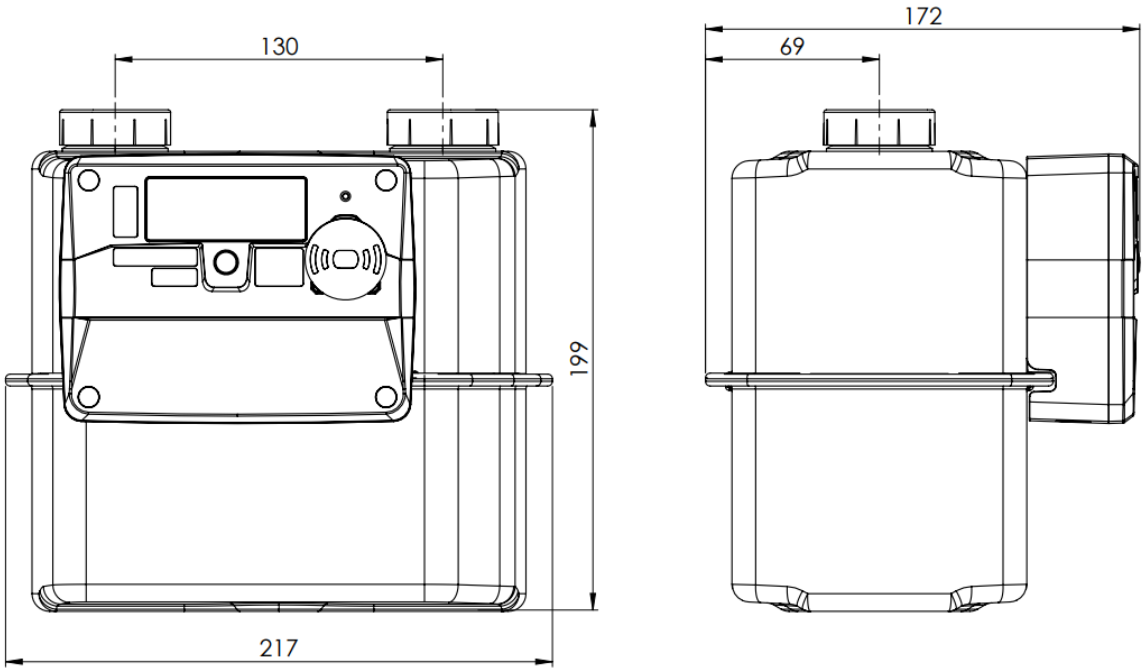
Fork spanners	Tightening the nuts for the gas pipelines connection. Adjustable spanner is suggested because of different dimensions of the nuts despite the threads are the same.
Torx T10 screwdriver	Removing and tightening the front cover – applicable only for the physical SIM placement

6.2. Device dimensions

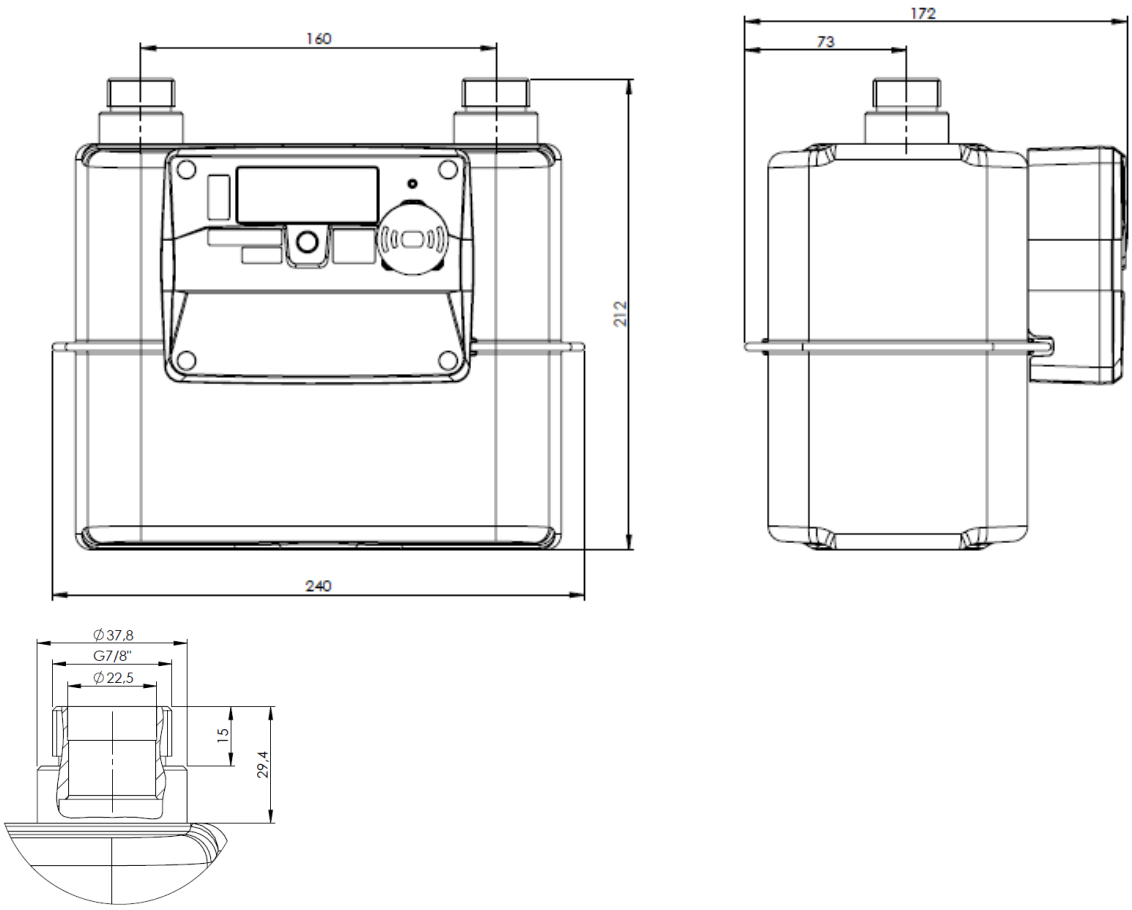
Body with 110mm distance between inlet and outlet



Body with 130mm distance between inlet and outlet



Body with 160mm distance between inlet and outlet

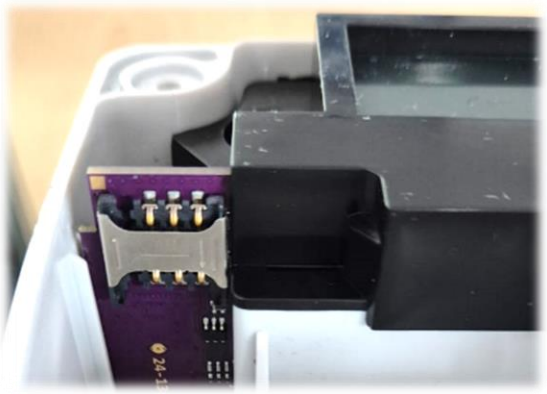


6.3. Preparation for the installation

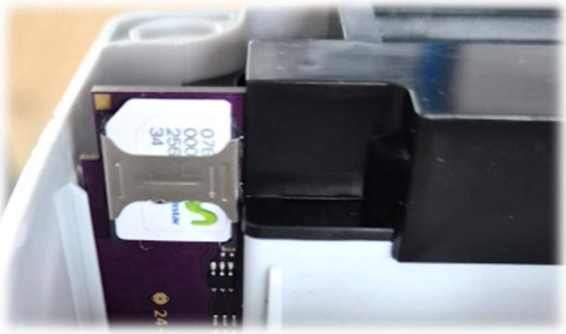
This chapter is applicable only for the devices with regular Micro SIM card slot. For the devices with installed MFF2 SIM card this chapter is not valid.

This step can be done in any moment; however, it is recommended to do this in the beginning of the works, before device is mounted.

1. Reach the device interior and find the SIM slot in marked place

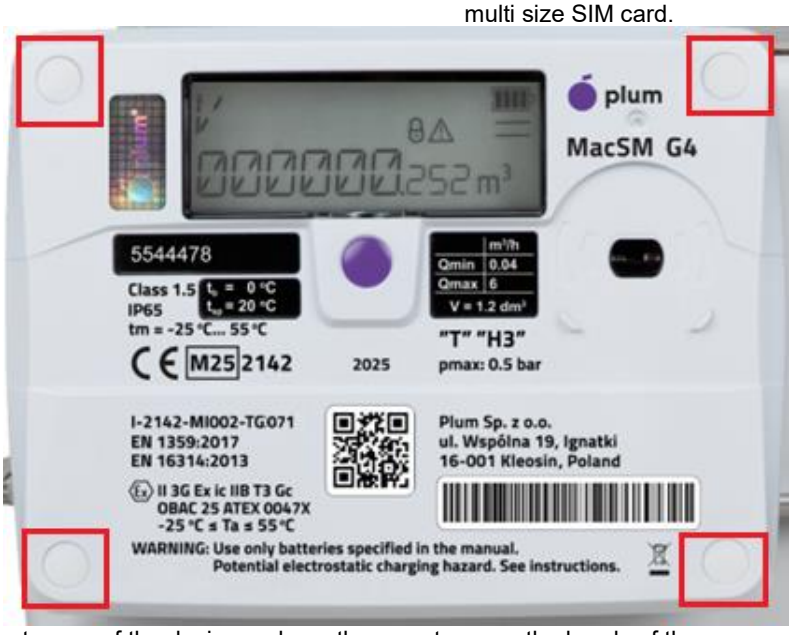


2. SIM slot is located on the bottom side of the board



3. Slide the SIM inside the slot as presented above

4. Ensure the SIM did not split if used as the multi size SIM card.



5. Tighten the front cover of the device and use the caps to cover the heads of the screws.

6.4. Installation of the meter

Mechanical installation of the device must follow below requirements:

- Smart meter must be installed in vertical position with the pipe connectors aimed to the top.
- Smart meter must be installed in dry place, protected from freezing and allowing for easy access to the indication on the display.
- Always take into account the direction of the gas flow permanently marked on the top of the meter between the inlet and outlet connectors.
- Do not install the meter on the object that flow characteristics exceeds Qmax of the meter. Violation of this rule will result in higher than allowed measurement uncertainty.
- Do not install the meter on the object that pressure exceeds maximum permissible. Violation of this rule may damage the inlet valve and the volume diaphragm inside the meter body.
- Device is sensitive to the tension of the installation. Do not use the device on the station with excessively pressed pipes, or in places where pipeline had to be bend in order to fit the meter – for example pulling the pipe to fit the 110mm fittings wherein the nominal distance between them is designed for meter with 130mm.
- Gap between the meter and wall must be at least 2cm.
- Pipeline from the inlet side must be cleaned by blowing the air inside prior to the installation of the meter to avoid pushing the dirt into the meter.
- When there is a risk of humidity condensation, a catch basin should be installed before the meter.
- Before the gas inlet a mechanical valve should be installed to cut off the gas flow for a safe installation and no leakage of the gas to the area.
- Connections should be secured with rubber gaskets. Always keep the gaskets clean. Connection must be

tight and clean.

- Tighten the meter with 110Nm momentum maximum.

Example installation of MacSM device:

- Pressure regulator before the inlet
- Mechanical valve before it
- Whole device placed in the yellow gas equipment cabinet

7. Device usage

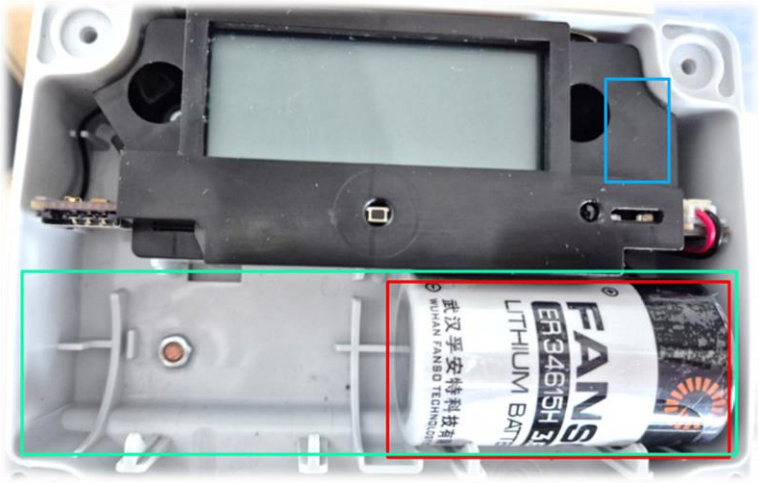
7.1. Internal battery

The device contains a set of up to internal battery types:

- Main battery (standard configuration) D-size 3.6V FANSO ER34615H with 70mm wire ended with plug PHR-2P
- Hidden under metrological cover supporting HPC cell, 3,6V 40mAh to enhance the main battery performance and sustain internal memory and real time clock

In an optional configuration, the main D-size battery can be replaced with a double D-size battery.

Do not keep the device with disconnected main battery. This brings to premature discharging of the HPC battery, what in later stage can cause unexpected behaviors such as wrong device clock. Permissible period of keeping device with only HPC cell connected is 4 weeks.



Placement of the batteries:

1. Red – standard D-size battery
2. Green – optional double D size battery instead of single D size
3. Blue – placement of the HPC cell under metrological cover

7.2. Device startup

When the functional battery is inserted, device will startup automatically. To check if the device is operational, press shortly the purple button in the middle of the housing.

7.3. Device navigation, entering data

For the local data configuration the program GuruX can be used. Link for the program pooling: https://www.gurux.fi/Download.
MacSM firmware lets to read available DLMS objects during establishing the connection. This way the full list of available objects (OBIS codes) is ready to be used.

Alternatively configuration data can be entered into the smart meter using software ConfIT for Windows. This application enables configuration of Plum products through a clear graphical interface that can be customized if needed. basic functionality of graphical device profiles allows configuration in both basic and advanced modes. Table based configuration is also available. Each modified and unsaved value is highlighted with a distinct color, ensuring the user is aware of every change made. Firmware can be upgraded on Plum devices without the need for additional interfaces or software. ConfIT! PC remembers the list of recently used devices, eliminating the need to search for a new device each time.

Device also allows for basic navigation and diagnostics using display and pushbutton. This is described in details in paragraph **Device navigation through keyboard**

7.4. Clients and keys

From the DLMS protocol perspective, the gas meter is always the “server” and users are “clients.” Each client has specific permissions and therefore access to device resources.
Supported clients are listed in table below:

DLMS Client	Client ID	Security
Public	16	none
Management	1	KeyC
Guarantor Authority	48	KeyS
Installer/Maintainer	3	KeyT
Broadcasting	32	KeyM

Except for one client (named Public), the rest have their communications secured using encryption and authorization. Each of them has their own unique key.

7.5. Device clock

Device is equipped with real time clock. Synchronization of clock is possible via:

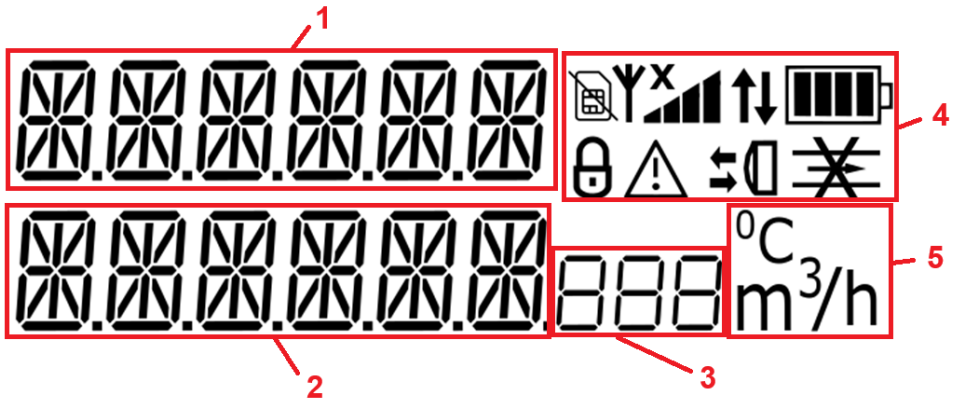
- Automatically during the remote data transmission. It is automated process that device will be connecting periodically to the NTP server. User must program the NTP server in the device memory and ensure that this server is available in the network infrastructure.
- Manually during the configuration. It is possible to set the time manually through any configuration tool and synchronize the time with the phone, PC or to type the time manually.

Information about clock modification is saved into device's events memory (time before and after modification).

An option is available for automatic change to summer/winter time. Change of time can perform automatically, according to built-in calendar or manually, by setting new time by user.

7.6. Display

Device display is divided into few sections which are described below:

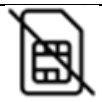


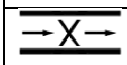
1. Top value/information row
2. Bottom value/information row
3. Decimal value part
4. Diagnostic and status icons
5. Units part

Top value/information row is majorly used for displaying menu which in the user currently is or the name of the value that is presented. Bottom row is used to display the sub-menu or the option that is currently chosen, or the value of some quantity – for example cumulative volume.

Decimal part is used to present the amount of the value after coma or in minor cases, to extend the length of the main field – for example to display device serial number.

Icons on the diagnostics part are explained in details below:

Icon	Icon behavior	Icon description
	Active	SIM card not detected, damaged or locked requiring PUK code
	Inactive	SIM card is detected. When this icon is inactive, antenna icon should be active as an indication that the connection is established.
	Active	Modem is active
	Inactive	Modem is inactive
	Flashing	Modem is currently working – transmission ongoing
	Active	SIM card not registered to the network

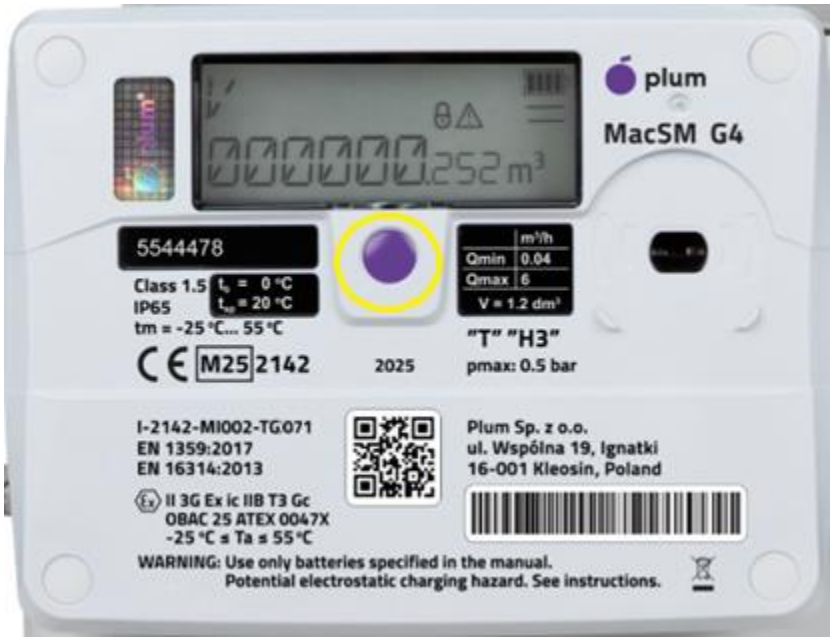
Icon	Icon behavior	Icon description			
	Inactive	SIM card registered to the network. When this icon appears, next icon representing the GSM range bars cannot be presented.			
	Active	Information about the GSM signal level during last transmission:			
		1 bar; CSQ: 2-9	2 bars; CSQ 10-14	3 bars; CSQ 15-19	All bars; CSQ: 20-33
	Active	Data transmission finished with success			
	Inactive	Data transmission failed or not even started			
	Flashing	Data transmission ongoing			
	Active	Device received at least one successful request			
	Inactive	Device did not receive any request – does not have to. This icon works only when some requests are transmitted to the device.			
	Flashing	Device currently receives data.			
	Active	1 bar: battery level 10-20%	2 bars: battery level 21-40%	3 bars: Battery level 61-80%	4 bars Battery level 81-100%
	Flashing	Battery level below 10% - only battery icon, no bars			
	Active	Metrology lock is active			
	Inactive	Metrology lock is inactive – device is opened, sarcophagus is removed			
	Flashing	Metrology lock is ready but inactive			
	Active	SETUP LOG memory is full – metrology events			
	Inactive	SETUP LOG memory is below 90% or removal of metrology lock was authorized			
	Flashing	SETUP LOG memory is above 90% or removal of metrology lock was unauthorized			
	Active	Last 30 seconds there was active transmission on local communication port			
	Inactive	Last 30 seconds there was not active transmission on local communication port			
	Flashing	There is currently active transmission on local communication port			
	Active	Optical interface is active			
	Inactive	Optical interface is inactive			
	Flashing (arrows)	Gas flow present			
	Inactive (arrows)	Gas flow not present			
	Active	Gas flow blocked – valve is closed			
	Inactive	Valve is opened			
	Flashing	Valve position change in progress			

7.7. Device navigation through keyboard

Device enables limited interaction with user through monostable button and display. Display is mostly used for the observation and diagnostics of current device state rather than configuration. Device contains single pushbutton which works in two modes:

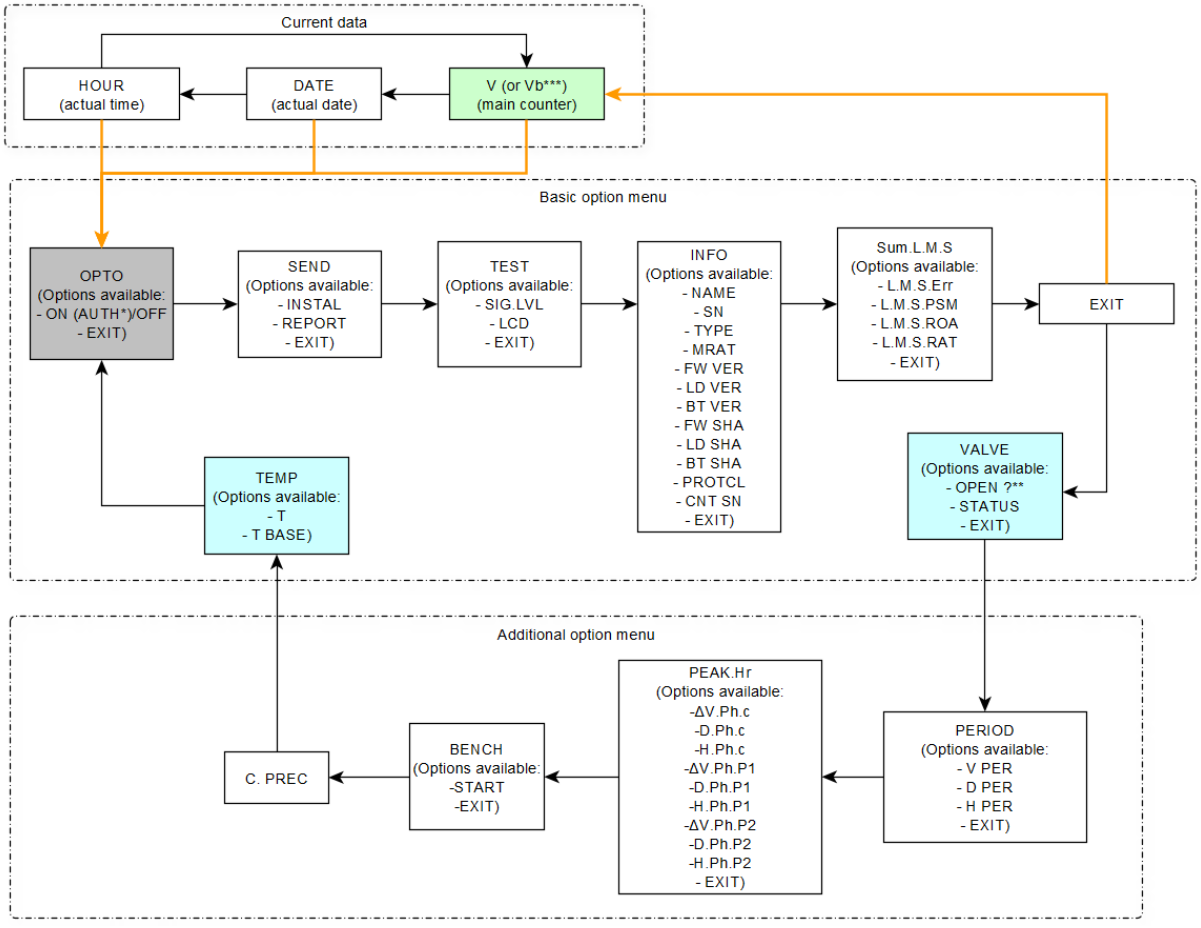
- Press – navigate on the parallel level of the menu, scroll through the menu options
- Press and hold (2 seconds) – move to the higher level of the menu or confirm choice to accept some change, i.e. confirm opening the valve, turn on optical port, exit to previous menu

Purple circle in the middle of the device front is the button.



7.7.1. Main menu structure

Below it is presented a structure of the main menu accessed by pressing and holding the button for 2 seconds. First available menu is marked in gray and it appears first after entering the menu. As described previously, navigation through the same level of the menu is done by short pressing of the buttons.



Green color - this is the option that is active after turning on the LCD display (pressing the button)

Gray color - first item in the menu (after leaving the MAIN option)
Blue colour - options available when the appliance has an additional module active (VALVE - valve added, TEMP - gas temperature sensor added)
Orange arrow - move from the display of current data (long press of the button) to the options menu or return from the options menu to the display of current data
* - this option only appears if the authorisation requirement for activating the optical interface is active.
** - This option only appears if there is a need for manual confirmation of opening by the user.
***- If there is a measurement of gas temperature, instead of the counter V (volume value under measurement conditions) there is a counter Vb (volume value converted to base conditions)

Access to additional menu options

The options assigned to the secondary menu are hidden by default (inaccessible from the LCD). Access to these options is performed programmatically by changing the value of the "LcdConfig" parameter. Access to this parameter is only possible via local communication (OPTO interface) using the GAZ-MODEM protocol.
In the " LcdConfig " parameter, each of the options from the additional menu is assigned a separate bit which means that any configuration can be set. The bit numbers and the corresponding options are shown in the table below

Bit number	Decimal value	Additional menu option name
Bit0	1	PERIOD
Bit1	2	PEAK.Hr
Bit2	4	BENCH
Bit3	8	C. PREC
Bit4..Bit7	-	Not used (for future use)

Example:
A value of 6 in the "LcdConfig" parameter causes the LCD display to show the options: "PEAK.Hr" and "BENCH".
The new options only appear on the first activation of the display after changing the value of the "LCD Config" parameter.

7.7.2. Menu OPTO

First menu available for the user after pressing and holding button. This is done purposely that to start the optical channel it is needed only to press and hold button three times.

OPTO
(Options available:
- ON/OFF
- EXIT)

Available options in this menu:

ON/OFF – turn on or turn off optical port
EXIT – back to previous menu

7.7.3. Menu SEND

Next menu available is the one used for the data transmission to the platform on demand.

SEND
(Options available:
- INSTAL
- REPORT
- EXIT)

Available options in this menu:

INSTAL – sending installation report to the system. Should be done immediately after the device is installed
REPORT – sending data on demand
EXIT – back to previous menu

7.7.4. Menu TEST

This menu allows you to test the device in scope of the internal modem, GSM range and the LCD test, to check if all the segments are working in case that there is a risk that some icons do not show.

TEST
(Options available:
- SIG.LVL
- LCD
- EXIT)

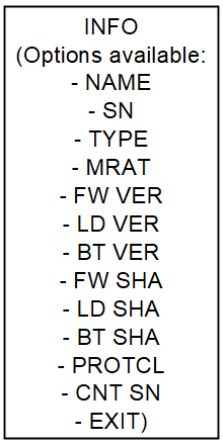
Available options in this menu:

SIG.LVL – test of the signal level. Test begins and on the display there is a signal level presented for 1 minute.

Example LCD behavior when LCD test is executed.

7.7.5. Menu INFO

Informative menu showing mostly the device consistency and resources. This menu is unique as there is no entering to submenus by long press. Short presses switch together submenu type + value in this menu.

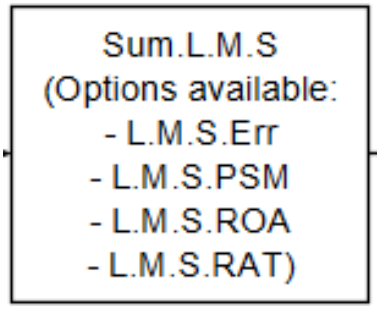


Available options in this menu:

NAME – device name according to nameplate is presented
SN – presentation of device serial number, divided to few segments, to obtain complete SN it is needed to join where parts of the SN showed separately after three presses
TYPE – gas meter type
MRAT – information about the selected radio technology
FW VER – information about the main software version
LD VER – information about the loader software version
BT VER – information about the boot software version
FW SHA – SHA value for the main program
LD SHA – SHA value for the loader program
BT SHA – SHA value for the boot program.
PROTCL – information about the transmission protocol
CNT SN - counter module serial number

7.7.6. Menu SUM L.M.S.

Menu Sum L.M.S. in extension means Summary of Last Modem Session. In this menu we can see how the modem behaved during last transmission. We can easily check if the last data transmission was ended successfully or not.



Available options in this menu:

L.M.S.Err – last session error, which can show following information:
- Modem – general modem error > device could not communicate with modem, what may be the reason of modem malfunction
- SIM – SIM card not detected. Inserted wrong or damaged, if physical SIM. If MIM, damaged.
-PIN.PUK – SIM card locked due to 3 wrong attempts of PIN. Necessity to insert the SIM to the phone and unlock it by PUK code.
- REG.GSM – card rejected from GSM network
- REG.APN – card rejected from GPRS network, possible reason, wrong APN, wrong credentials to APN, attempt to connect to private network with unsupported card.
- SERV – data transmission unavailable, possible reason; incorrect data server address, attempt to connect to private network with unsupported card
- NONE – there were no errors during last transmission

L.M.S. PSM – information if the Power Saving Mode was active during last transmission. Information about PSM is active only when Err. Is SERV or NONE. In other cases, this field is blank.
L.M.S. ROA – information if the Roaming was active during last transmission. Information about roaming is active only when Err. is REG.APN, SERV or NONE
-L.M.S.RAT – information about transmission technology that was used for the last transmission. Information about technology is active only when Err is SERV or NONE

7.7.7. Menu VALVE

Menu valve is present only if the device is equipped with internal valve. It is simple menu which exceptionally can be active without manual entering to it. This exception is when there is a remote order to open the valve and to actually open the valve, confirmation must be done from the device display. Once the request to open the valve enters the device, proper menu will be present on the main screen.

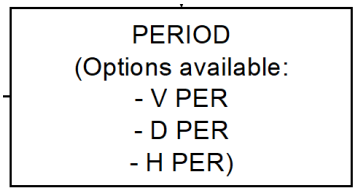
Available options in this menu:

-OPEN? – this is a request for confirmation to open the valve when the remote request has been transmitted do the device. When valve is opened, this position does not appear in the menu
- STATUS – current status of the valve, can have only two positions which are OPEN and CLOSE
- EXIT – back to previous menu

7.7.8. Menu PERIOD

Menu PERIOD is additional menu which is by default hidden. To turn it on along with the others menus marked as an additional ones it is necessary to make a configuration change using mobile app or desktop app. Refer to the paragraph 7.7.1 (in section “Access to additional menu options”) to obtain the information how to enable this menu.

This menu contains information about the gas consumption in the last billing period



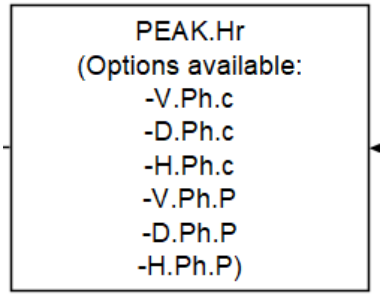
Options available in this menu:

-V PER – value of the main counter on the last billing period
-D PER – day of the last finished billing period
-H PER – hour of last finished billing period
-EXIT – back to previous menu

7.7.9. Menu PEAK Hr

Menu PEAK Hr is additional menu which is by default hidden. To turn it on along with the others menus marked as an additional ones it is necessary to make a configuration change using mobile app or desktop app. Refer to the paragraph 7.7.1 (in section “Access to additional menu options”) to obtain the information how to enable this menu.

This menu contains information about the peak hours consumption registered by the meter



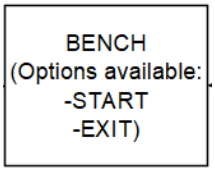
Options available in this menu:

-V.Ph.c – value of the peak hour in current month
-D.Ph.c – day of the peak hour in current month
-H.Ph.c – hour when the peak value was registered in current month
-V.Ph.P – value of the peak hour in previous month
-D.Ph.P – day of the peak hour in previous month
-H.Ph.P – hour when the peak value was registered in previous month
-V.Ph.P2 – value of the peak hour 2 months before
-D.Ph.P2 – day of the peak hour 2 months before
-H.Ph.P2 – hour when the peak value was registered 2 months before

7.7.10. Menu BENCH

Menu BENCH is additional menu which is by default hidden. To turn it on along with the others menus marked as an additional ones it is necessary to make a configuration change using mobile app or desktop app. Refer to the paragraph 7.7.1 (in section “Access to additional menu options”) to obtain the information how to enable this menu

This menu enables the special mode in the meter that during the accuracy test of the device, measurements are not stored in the main memory



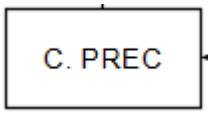
Options available in this menu:

-START – start accuracy test procedure
-EXIT – exit to previous menu

7.7.11. Menu C.PREC

Menu C.PREC is additional menu which is by default hidden. To turn it on along with the others menus marked as an additional ones it is necessary to make a configuration change using mobile app or desktop app. Refer to the paragraph 7.7.1 (in section “Access to additional menu options”) to obtain the information how to enable this menu

This menu does not contain any options. After entering the menu, main volume counter is presented with increased accuracy.

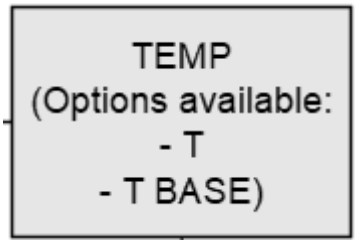


Options available in this menu:

-By default – main counter with increased precision displayed
-EXIT – back to previous menu

7.7.12. Menu TEMP

This menu contains information about the temperature of the gas and the base temperature used for compensation. This functionality is available only for the devices with temperature compensation functionality. For other types, this menu is unavailable.



Options available in this menu:

-T – currently measured temperature
-T BASE – base temperature Tb stored in the device memory.

8. Configuration and data readout using PC

8.1. Device configuration - introduction

Configuration of the smart meter using PC is possible by using ConfIT! Software available on website http://plum.pl

ConfIT! deskop software enables configuration of Plum products through a clear graphical interface that can be customized as needed.

The basic functionality of graphical device profiles allows configuration in both basic and advanced modes. Table based configuration is also available. Each modified and unsaved value is highlighted with a distinct color, ensuring the user is aware of every change made. Firmware can be upgraded on Plum devices without the need for additional interfaces or softwares. ConfIT! desktop remembers the list of recently used devices, eliminating the need to search for a new device each time.

This paragraph presents the software designed for configuration and diagnostic of devices. The user-friendly graphic interface allows basic and extended configuration. Software supports local firmware upgrade in the devices without additional interfaces. It also stores a list of previously connected devices and allows for quick navigation between them.

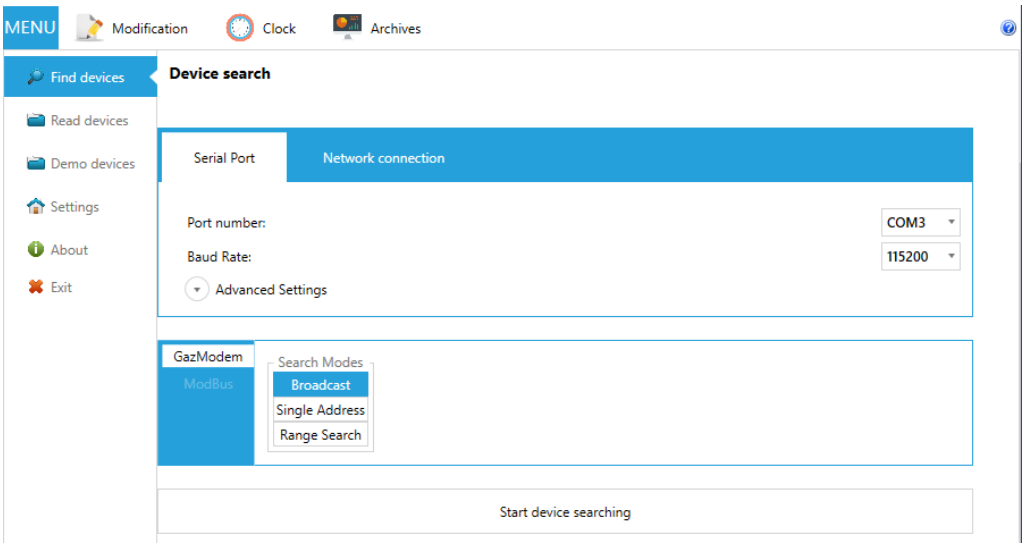
To connect with the device use serial communication on RS485 ports or Optical interface using Optical Head – e.g., OptoBTEx

Full manual explaining Software work and principles is available as the auxiliary document. Read the manual before starting device configuration.

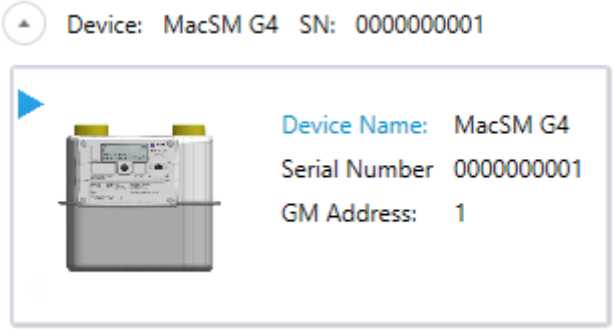
It is suggested to provide all the configuration data to manufacturer before delivery of the devices. Correctly configured meters on stage of the production can simplify the installation process that only required operation will be physical installation on the meter and forcing the report to be transmitted to the head-end system. Application would not be used in any step.

8.2. Device searching and main program view

- Choose proper COM port in computer corresponding to connected interface.
- Adjust the baud rate to 9600
- Click on the button Start device searching



Correctly recognized device will be indicated by its simplified nameplate visible with serial number

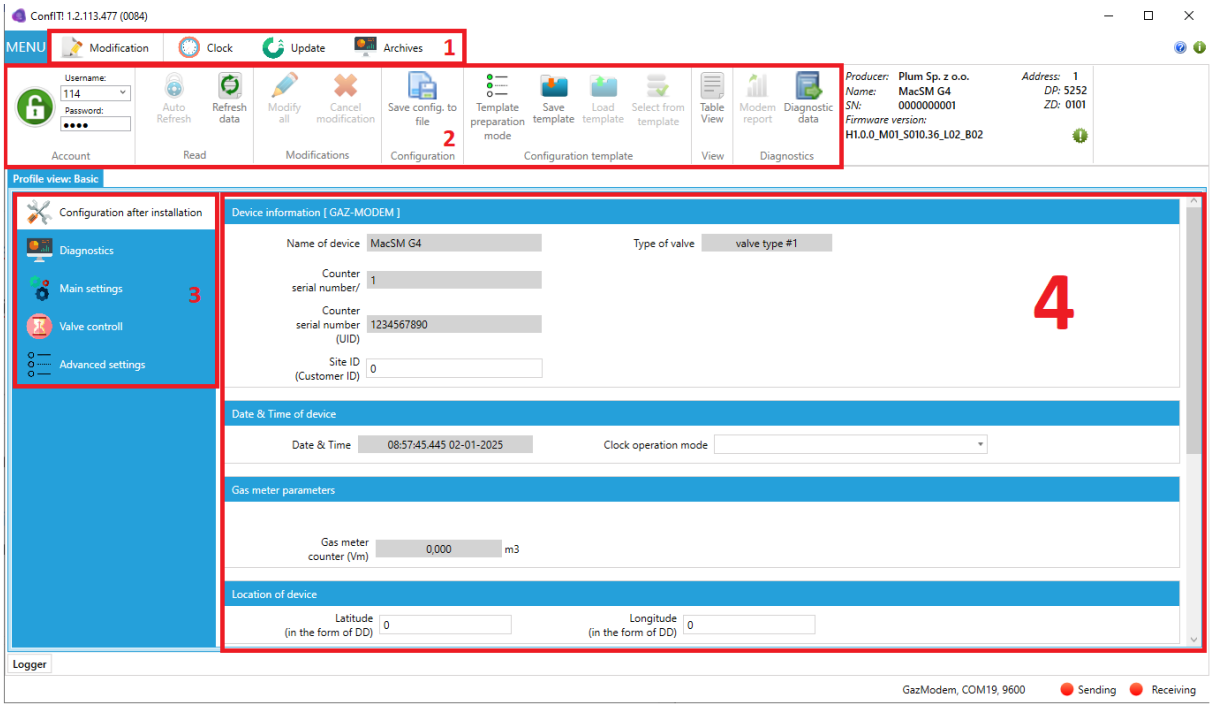


Remember to turn on optical port.

Serial communication

Menu OPTO

Basic view over the software interface:



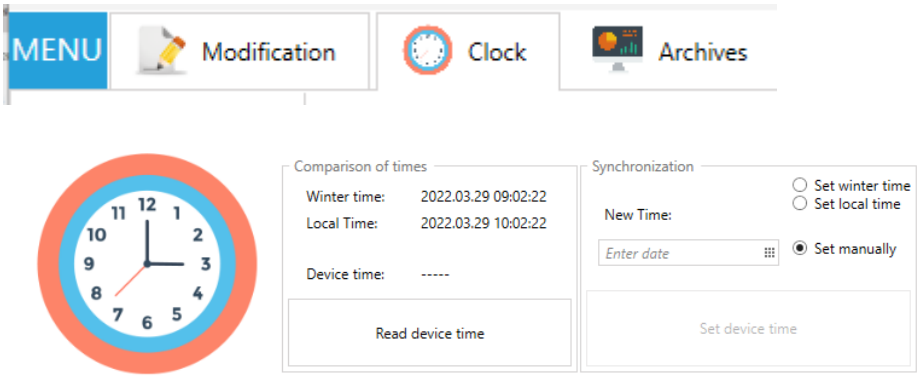
1. Main tabs panel – switching between software functions
2. Function buttons
3. Categories with thematically grouped parameters
4. View of parameters inside the category

View consisting of 3 & 4 is called later PROFILE

When software does not show the profile for the device, only list of parameters, please inform Technical Staff of Manufacturer.

8.3. Clock adjustment

First setting which is worth mentioning and important from the point of view of device configuration is clock setting done in Clock tab:



Clock can be set according to following assumptions:

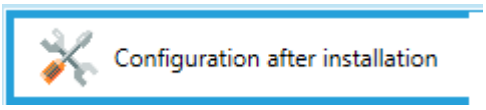
1. Setting local time – downloaded from PC which is used for device configuration.

2. Setting winter time – downloaded from PC which is used for device configuration. Device uses also programmed time shift between winter and daylight saving time to show winter time.
3. Manual time – type the time manually.

Wrong date and time will cause in improper timestamping of registered data and making the modem to execute the schedule in wrong time (correct for the meter, not real time).

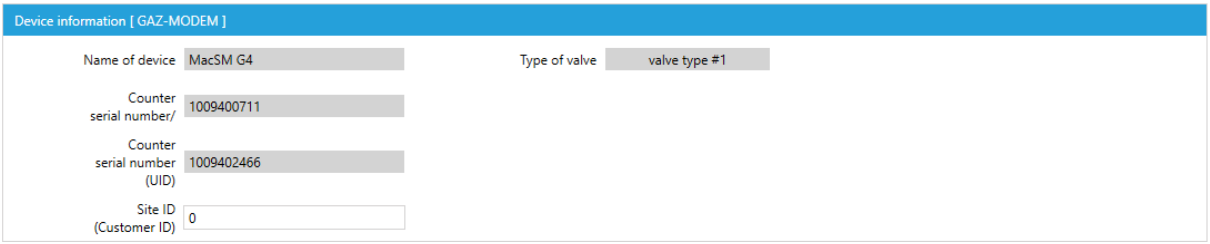
8.1. Configuration after installation

As suggested before, most optimal and correct way of handling the smart meter would be to preconfigure the device during production process. However, if this is not possible, local configuration can be done easily by using graphic interface of ConfIT.



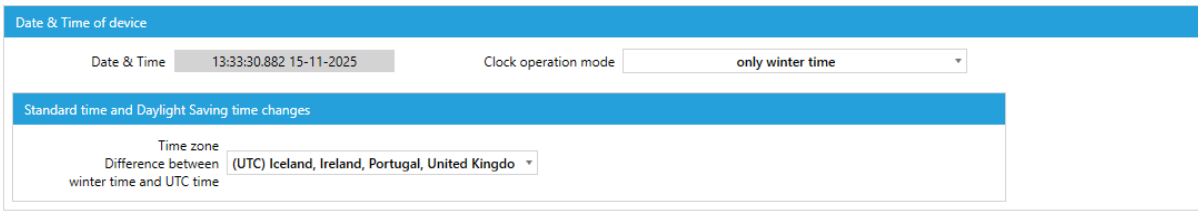
Parameters and fields may repeat between various categories, such as registration period, time zone setting. Reason of that is “Configuration after installation” category is the one where most crucial settings are included and when speaking of simplified device setting, it is set of parameters necessary for just an initial device startup. Rest of the categories may include repeated sections but in extended way.

Values possible to set in this category:



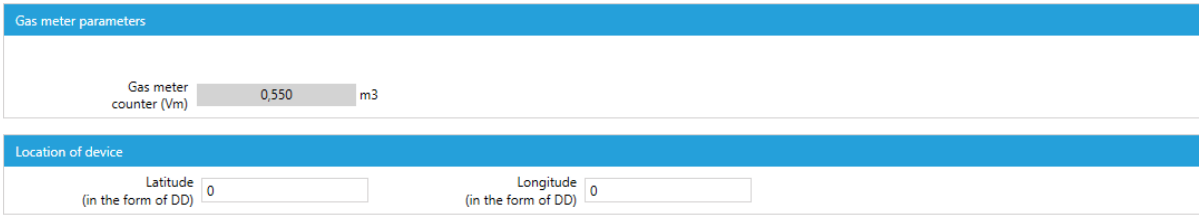
Basic devices information:

- Name of Device – read only
- Counter serial number/ – read only (information about the device's serial number)
- Type – whether device contains VALVE and / or TEMP modules
- Site ID – information to be filled by final user, name of the station



Time settings:

- Choice of clock operation mode, should the device work in winter and summer time, depending on the settings of the time zone below, only winter time, only summer time, only UTC time
- Settings related to the time zone – when mode of automatic winter summer change is chosen, fields about the time switching are enabled. These fields contain most common settings used worldwide. Also there is a choice of the time zone from range UTC -12 to UTC +14. When mode “only UTC time” of clock operation mode is chosen, this setting does not appear.

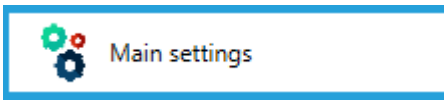


Gas meter totalizer: in this device the main volume counter is read only, as the device itself is the measurement unit and counter must not be manipulated.

GPS settings – location of the device. May be necessary when some map functionality is used in head end system, i.e. PLUM eWebtel. Then these settings allow to display a pin on the map in the web platform.

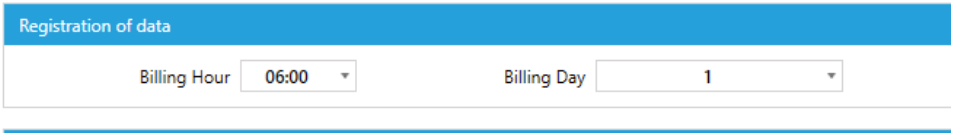
8.2. Main settings – extension of configuration after installation

In this paragraph there will be an extension of the information given in previous paragraphs. This paragraph is mostly aimed on the full device configuration, when they are delivered without SIM cards, so all the settings are default and require config step by step.



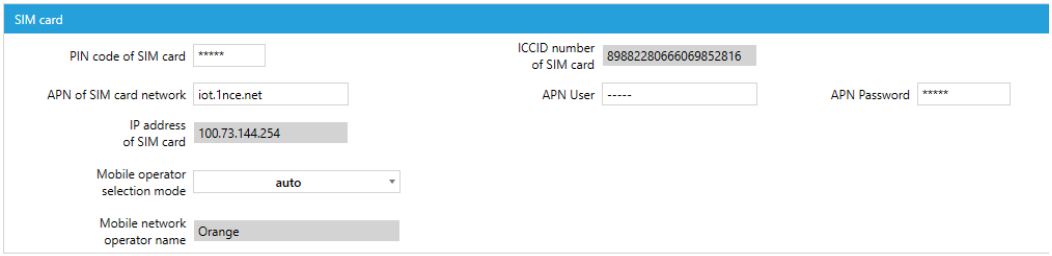
In the category Main settings there are also same fields as in configuration after installation, therefore their purpose will not be explained again and repeated. Only fields that do not repeated are explained below.

Values possible to set in this category:



Settings of the billing hour and billing day:

- Billing hour – hour when the gas day starts
- Billing day – day when the gas month starts

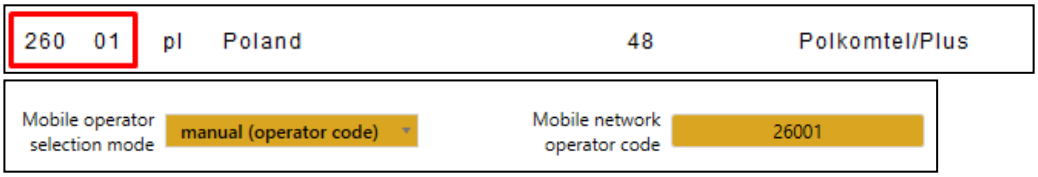


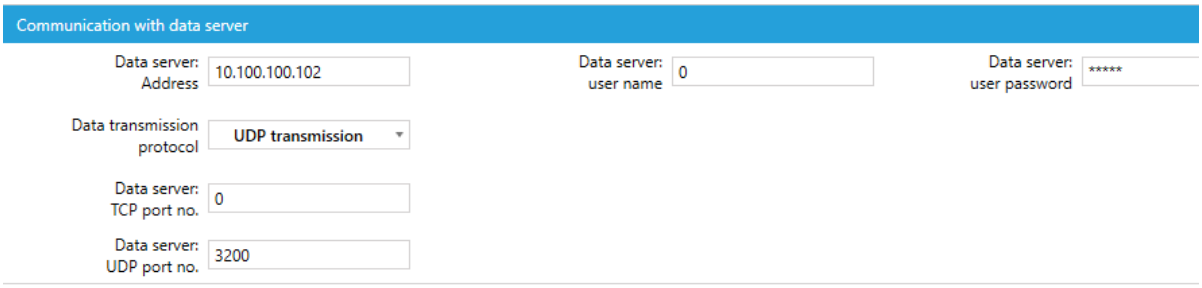
SIM cards settings:

- PIN to SIM card: if not used, leave field unchanged. Even if some value is stored there it is not used when card has PIN turned off.
- APN: access point name for the SIM. APN is usually given with the SIM.
- Username / Password for APN: Especially important for the private type APNs, where access is protected additionally by credentials.
- Mobile operator selection mode – parameter important when using roaming SIM and it is intended to use single operator.
    - Auto – modem connects to a bast available network and transmission technology. Network and technology may be changed automatically during active reporting (even many times) - prolonging reporting time and consumed energy;
    - Manual – modem connects to only one defined network (and transmission technology);

- Preferred – modem tries to connect to preferred network (and transmission technology) on first priority, but if it fails - continue reporting in Auto mode (**recommended option** because of energy saving);

- Choice of priority mobile network provider is done by typing string called MCC/MNC code. List of these codes can be found on website: https://www.mcc-mnc.com/
  We put code as MCC+MNC without space between them. Example below.





Data server address settings – where the device will be reporting data to, destination of the head end system:

- Data server address – IP or domain address of the server that data will be delivered
- Data server port – port of the server
- Data server username and password – if the server requires authentication data this is used.

8.3. Valve control menu

Valve control menu is mostly used to test the valve locally. More information about this is in the paragraph **Device diagnostics**

8.4. Table view

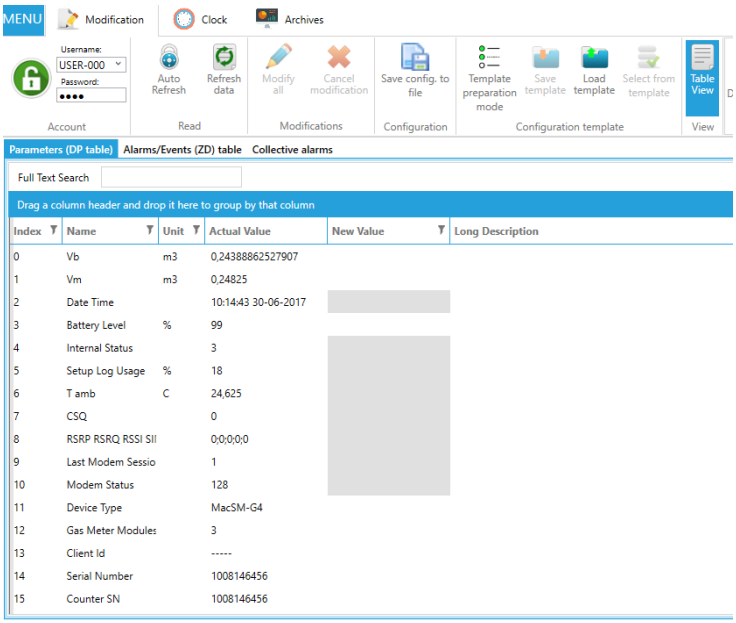
PC software allows also for the full configuration over the raw device parameters table.

Modification of parameters through the raw table is burdened with risk of adverse effect. This mode is aimed for advanced users knowing the data structure and meaning of each parameter.

There are no hints or text descriptions of each value. Each modification is done by editing the numeric values representing functions. In some cases, wrong modification can lock the device.

Modification is being done similarly to the one in graphic profile mode. New value must be put in the “New Value” column and left there for modification. Field with changed but not accepted value will be highlighted in orange.

Gray boxes in the New Value column mean this parameter is not modifiable.



9. Device maintenance

9.1. Battery replacement

The battery replacement procedure must be carried out in accordance with the instructions given in this chapter.

Smart meter is the intrinsically safe equipment. The housing of the device should be sealed – replacement of the battery can only be carried out by an authorized person, i.e., a factory or authorized service representative or other persons authorized by the manufacturer.

It is permissible to replace the batteries in the explosion hazard zone.

For power supply of smart meter only batteries of the types accepted in ATEX certificate may be used. Please find the list of accepted types of batteries in point Technical data, section Internal supply of this document.

Opening of device’s housing is forbidden under conditions that allow ingress of water (for example rain, snow) or dirt inside the unit.

Always replace the battery with a new, full charge battery.

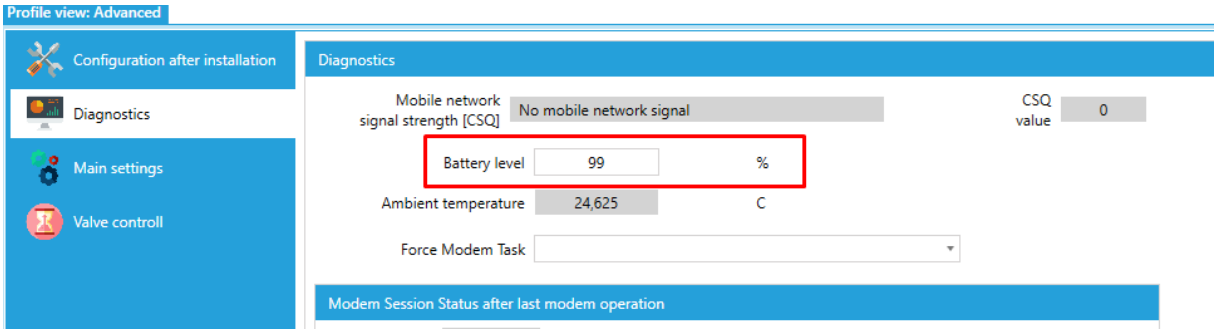
Battery replacement causes break in measurements but allows working of real time clock. Settings and registered data are not affected.

Inserting of „old”, partly discharged batteries will cause incorrect readouts of charge level and may lead to unexpected device operation (such as restarting, errors in counting, errors in archives and in current values).

Discharged batteries are in the hazardous waste category, therefore they must not be disposed together with common waste.

1. Open the device front cover
2. Remove the battery by disconnecting the connector visible on the right side

3. Connect the new battery. Connector cannot be connected opposite so there is only one correct placement.
4. Using the PC software go to the category Diagnostics and set the battery level to 100



9.2. HPC cell access

During a standard device work access to the HPC cell is not required and it is protected by the sarcophagus and the metrology seals. Access to this cell is motivated only by the device serious malfunction or request from the manufacturer technical team. This cell does not require replacement in any moment during the device lifetime.

Accessing this cell requires complete teardown of the device – to remove the electronic counter unit from the gas meter body. This results in loss of warranty and metrology features of the device as the counting coupling driver is disassembled.

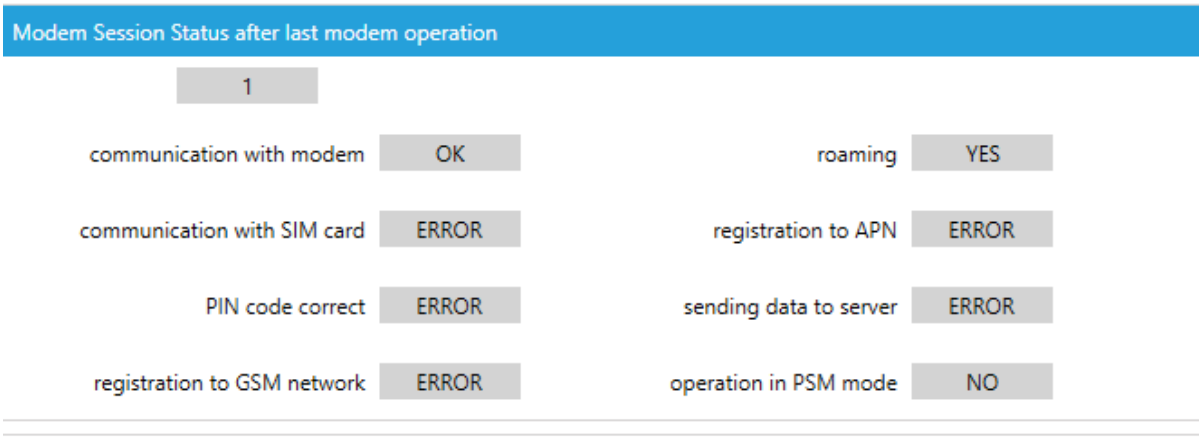
9.3. Device diagnostics

Smart meter is an electronic device which may affect damage or malfunction. There are several ways to perform self-diagnostics by the installer or the qualified person to check and diagnose potential issues with the device.

Below are presented some most common scenarios that installers may encounter during the installation or commissioning of the smart meter.

9.3.1. Device does send the data

This scenario can happen because of several reasons. Most common can be found in the tab Diagnostics of the PC Software:



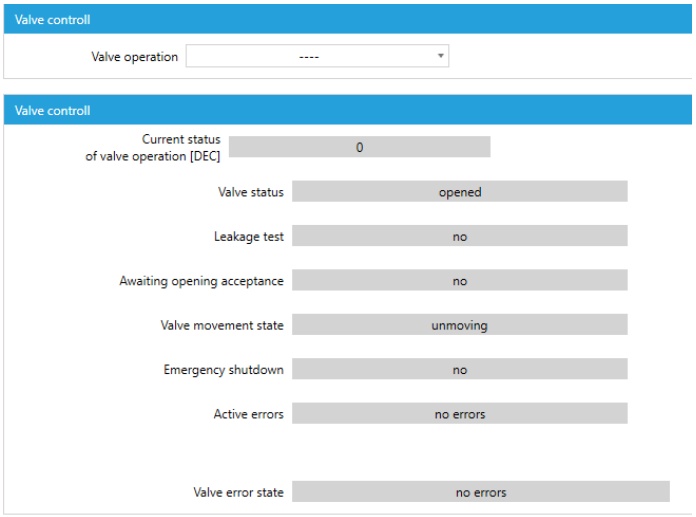
Above steps are the ones that normally appear in the device while device connects to the network. It is a logical order of the operations that come one after another.

- Communication with the modem – first device must check if the modem is operational. If no, then we can suspect malfunction of the modem or power supply issue. If yes, next step is:
- SIM card communication – when modem is recognized correctly, it starts detecting the SIM card. If the SIM is not detected it can mean
    - SIM not present in the slot
    - SIM damaged
    - SIM inserted incorrectly
    - MIM soldered incorrectly
- PIN code check – if the SIM is correctly detected, PIN code is checked. This step is optional if the SIM does not have a PIN. When PIN is incorrectly recognized 3 times, proper icon will be displayed on the screen of the device. Then mobile phone must be used to unlock the SIM by putting the PUK code.
- GSM registration - when PIN is correct, or it does not exist, SIM attaches to the GSM network, so general mobile provider area. This is not yet layer of data transmission. If the SIM cannot enter the GSM network it means it can be damaged or inactive, or it does not have support in current country for instance.
- Roaming – this is only an indication if the SIM is using roaming or not. When the SIM should have roaming and it does not have it enabled, this means that provider did not enable roaming service for this particular SIM.
- APN registration – when card logs in to the GSM it goes to the next step which is logging to GPRS / NB-IoT / LTE-M. Correct APN is the key to pass this step. If the APN data are incorrect, device will not continue logging in and error is present here. Typical mistake: wrong APN, typo, additional space in the end of the APN
- Sending data to server – last step of the transmission – data sending. Device is correctly logged in to the network, to the APN, so the last step should be to transmit the data. If this step fails, means that the data server address is incorrect; can be a typo, or it is not available.
- PSM mode – only indication for the user that Power Saving Mode is active.

9.3.2. There is no gas flow

Gas flow can be stopped for several reasons:

- Damage of the coupling motor, which transfers the revolutions to the interior of the digital meter. When the sound of movement of the internal chambers in the meter is heard and flow is not transmitted to the device, make an attempt to replace the meter in order to check the performance of problematic meter.
- Valve stuck – in order to check if the valve is stuck, a PC app can be used to check if the valve is opened, closed, does it react on the order to open the valve and if the confirmation on the display is done, is the sound of valve opening noticeable.



1. Check if the vale status is OPENED
2. If valve is not opened, use the Valve operation dropdown and force valve opening
3. If valve is opening, monitor the sound of its opening and check if the valve status changes to opened. During opening the valve the movement state should also take status – opening.
4. If the valve still does not open, observe the status of error. If there is some collision or valve cannot open fully, or it does not react on the forcing opening, this may be risk that valve is faulty and replacement shall be considered.

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