Smart diaphragm gas meter with a volume conversion device

picoELCOR G10/16/25

(version V.2)

Description of the device
Operating instructions
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Installation instructions

Approved for installation in potentially explosive atmospheres.

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Content

Symbols

Symbol		Meaning	Unit
AGA8-G1	...	method for calculation of gas compressibility ratio	
AGA8-G2	...	method for calculation of gas compressibility ratio	
AGA8-92DC	...	method for calculation of gas compressibility ratio	
AGA NX-19 mod	...	method for calculation of gas compressibility ratio	
ASC	...	Authorized service centre	
BTS	...	Base Transceiver Station	
CL 1	...	module allowing 4-20mA flow output	
CRC	...	control sum - used for data protection	
CTR	...	communication protocol	
DATCOM-Kx	...	a product from DATCOM-K series (DATCOM-K1, DATCOM-K2, DATCOM-K3, DATCOM-K3/A, DATCOM-K4, DATCOM-K4/A)	
DC	...	DC voltage	
dE	...	energy gain (difference)	MJ
dV, dVm	...	volume gain (difference) at measurement conditions V_m	m^3
dV_b	...	volume gain (difference) at base conditions	m^3
E	...	energy	MJ
Es	...	error energy value	MJ
EMC	...	electromagnetic compatibility and resistance	
EMI	...	electromagnetic interference	
EO	...	Ermeto Original, type of pressure tube fittings	
firmware, FW	...	software embedded in the device	
GOST NX-19	...	method for calculation of gas compressibility ratio (similar to AGA NX-19 mod) according to VNIIMS directive (valid in the temperature range -23°C to +60°C)	
H_s	...	combustion heat	MJ/m^3
JB	...	intrinsically safe, intrinsic safety	
Modbus, Modbus-RTU	...	communication protocol designed by Modicon	
M900	...	communication protocol designed by RMG	
RSSI	...	Received signal strength indication. Identifies the unit that determines the quality of signal for wireless devices.	
SGERG-88	...	method for calculation of gas compressibility ratio	
SW	...	software - PC programs	
C	...	compressibility factor	-
K	...	compressibility ratio (Z/Z_b)	-
k_p	...	gas meter constant (number of pulses per $1m^3$)	p/m^3
N	...	number of input impulses from the gas meter	imp
p	...	absolute pressure at measurement conditions	kPa

Symbol		Meaning	Unit
p_b	...	absolute pressure at base conditions	kPa
Q	...	flow rate at measurement conditions (also referred to as primary flow rate)	m^3/h
Q_b	...	flow rate at base conditions (also referred to as standard flow rate)	m^3/h
T	...	absolute temperature at measurement conditions (T = t + 273.15)	K
t	...	gas temperature at measurement conditions	°C
T_b	...	absolute temperature at base conditions	K
V	...	volume V_m	
V_m	...	volume at measurement conditions (also referred to as primary volume)	m^3
V_b	...	volume at base conditions (also referred to as standard volume)	m^3
V_{bs}	...	error volume at base conditions (also referred to as error standard volume)	m^3
V_s	...	error volume at measurement conditions (also referred to as error primary volume)	m^3
V_d	...	primary volume difference	m^3
V_{bd}	...	volume difference at base conditions	m^3
V_f	...	primary volume tariff counter	m^3
V_{bf}	...	tariff counter of primary volume at base conditions	m^3
Z	...	gas compressibility factor at measurement conditions	
Z_b	...	gas compressibility factor at base conditions	

ATEX symbols

Symbol		Meaning
⟨Ex⟩	...	Explosion-proofing identification
II	...	A class of electrical equipment designed for use in environment with potentially explosive atmospheres (other than mines where methane builds up)
-/2	...	Category: indoor use: none outdoor use: category 2 (Zone 1)
3	...	Category: indoor use: none outdoor use: category 3 (Zone 2)
1		Category 1 (Zone 0)
G	...	Atmosphere type (gases and vapours)
c	...	Explosion protection method “construction safety”
Ex	...	The electrical device corresponds with one or more protection types that are subject to specific standards (see CSN EN 60079-0 ed.3, Ch. 1)
IIA	...	Groups of electrical devices according to the gas type for which they are designed (typically propane)

IIB	...	Groups of electrical devices according to the gas type for which they are designed (typically ethylene)
IIC	...	Groups of electrical devices according to the gas type for which they are designed (typically hydrogen)
ia	...	Intrinsic safety method
TX	...	No actual heating
T1	...	temperature class marking (T1 - maximum allowed surface temperature 450°C)
T3	...	temperature class marking (T3 - maximum allowed surface temperature 200°C)
Ga	...	Equipment protection level. Equipment for potentially explosive atmospheres, with “very high” level of protection and which is not a source of ignition in normal operation, in expected malfunctions or at the occurrence of unexpected malfunctions.

1 Introduction

1.1 Basic description of the device

Smart diaphragm gas meter with a volume converter picoELCOR G10/16/25 (hereinafter referred to as Device) is a compact device for measurement of gas consumption in smaller objects (e.g. administration and small business objects). It is designed for measuring the consumption of natural gas and for transmission of data by a built-in GSM/GPRS modem.

Diaphragm gas meter Elster BK-Gxx is the basic part of the machine that facilitates the measurement of primary volume of gas. The device is supplied in diaphragm gas meter sizes G10, G16 or G25.

The conversion of the measured gas volume to standard conditions, assessment and display of primary amount and converted gas volume are provided by a built-in electronic conversion device picoELCOR with a display. Built-in gas pressure and temperature sensors are also part of the electronics of the smart gas meter. Remote gas meter data reading is made possible by a built-in GSM/GPRS modem, or by other communication interfaces.

The device is designed and approved of in compliance with the standard CSN EN 12405-1+A2, as a conversion device type 1 (compact system) and is supplied with a PTZ conversion, possibly a PT conversion.

In terms of safety the electronic conversion device picoELCOR is designed in compliance with CSN EN 60079-11 as intrinsically safe and is approved for use in potentially explosive atmosphere.

Smart diaphragm gas meter with a volume converter is manufactured and delivered in compliance with following European parliament directives:

- 1994/9/EC Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres (GO No. 23/2003 Coll.)
- 2004/108/EC Electromagnetic Compatibility (GO No. 616/2006 Coll.)
- 2004/22/EC Directive on measuring instruments (GO No. 464/2005 Coll.)
- 99/5/EC Radio and telecommunications terminal equipment (GO No. 426/2000 Coll.)

The device is released on the market and for use in accordance with directives mentioned above and it is CE marked.

The device with a built-in GSM/GPRS modem can be operated as a radio device on the basis of a general authorisation No. VO-R/1/04.2014-2.

The body of the diaphragm gas meter is made of steel plate with a surface finish; the electronic counter is located in a housing made of durable plastic with IP65 protection. The counter is equipped with a display and six control buttons. The buttons are covered with a machine cover. There is one digital (pulse) output.

The device is powered from a B-02 battery pack with a lithium battery. The battery life is 15 years in a defined nominal range of use. The built-in GSM/GPRS is powered by a special HB-02 battery pack.

The device stores measured values in data archive with adjustable structure and adjustable storing cycle. The binary archive captures changes at binary inputs and occurrence of observed events (limits, etc.). Error conditions are stored in a status archive. Storing of important quantities, calculation and storing of some statistical values can be programmed in daily and monthly archives. For service and metrology purposes the settings archive stores actions influencing device parameters. There are other available archives as well and they will be described later.

For the communication with a superior system the device is equipped with an optical interface and a built-in modem. It can automatically initiate connection in the event of emergency.

The device was manufactured using modern technologies that provide high security and safety of the device and protection against damage or tampering. The resistance is increased by:

- optical sensor of rotations in the gas meter, resistant to exposure to magnetic field
- internal combined pressure and temperature sensor, built into the body of the gas meter and inaccessible for any handling
- device opening indication with the option of sending an alarm message by a remote transmission
- hidden GSM/GPRS antenna inside the device
- data and settings are protected by passwords
- possibility of encryption of transmitted data
- possibility of locking the device against opening, by a padlock
- option of sealing the checking outlet for Pm pressure measurement

Device configuration can be executed by the service SW [26] software provided for PCs. This software also allows listing, displaying and storing both the momentary values and the contents of internal archives in the device.

1.2 Principle of operation

1.2.1 Conversion based on the gas law

The device receives the indication of quantity of gas that flew through at primary conditions (V) by means of a rotation-detecting sensor.

The built-in combination temperature and pressure transducer provides the device with other information about the gas that flew through - gas temperature (t) and absolute pressure at measurement conditions (p). The data is also used for calculation of the conversion factor (C), influenced by other factors: absolute temperature at base conditions, (T_b), absolute pressure at base conditions (p_b) and gas compressibility ratio at base conditions (Z_b).

Compressibility ratio:

$$K = \frac{Z}{Z_b}$$

Conversion factor:

$$C = \frac{p}{p_b} * \frac{T_b}{(t + 273.15)} * \frac{1}{K}$$

Volume at base conditions (standard volume):

$$V_b = V * C$$

The gas compressibility ratio stands for the difference between natural gas properties and ideal gas properties. By setting parameters, you can select a specific method for the calculation of the compressibility factor according to the standard (AGA NX-19 mod, AGA8-G1, AGA8-G2, SGERG-88 or AGA8-92DC). For gases other than natural gas a constant compressibility value can be used. If the pressure or temperature exceeds the range set by the standard selected for the calculation of compressibility, the device uses an error compressibility value.

Based on the frequency of the input signal, the device calculates the gas flow in real time by mathematical filtration on the signal received.

Primary flow rate:

$$Q = \Delta V / \Delta t \ [m^3/h]$$

where: ΔV ..... *primary volume increment*

Δt ..... *the time between impulses within an accuracy of one hundredth of a second*

The value of actual flow rate on the display of the conversion device updates every 10 seconds.

Standard flow rate:

$$Q_b = C * \Delta V / \Delta t \ [m^3/h]$$

1.2.2 Error volume values at base or measurement conditions

For calculation at error conditions (i.e. caused by a conversion device error, deviation from the operating range or a fault on the device) the device is equipped with a conversion device that calculates error volume at measurement conditions (V_s) and error volume at base conditions (V_{bs}). These conversion devices are coupled with relevant devices that convert volume at normal conditions.

A detailed description of device operation at normal and error conditions is described in the section4.4.

1.2.3 Volume to energy conversion

The device can calculate the amount of consumed gas as the consumed energy. The volume to energy conversion uses the value of combustion heat H_s. The calculation is carried out by adding increments to the volume dV_b (and dV_{bs}) multiplied by the actual value of the combustion heat H_s.

$$dE=H_s \times dV_b, \quad dE_s=H_s \times dV_{bs}$$

The measurements in energy units are provided by two additional counters installed in the device, one of them being the energy E counter and the other being the energy counter of error values E_s.

When configuring the device, you can select the unit of energy measurement from the following list: MJ, kWh, Btu.

Caution:

When the unit is changed, the absolute value E (Es) of the counter is not converted. Subsequent increments are counted with regards to the new unit of measurement.

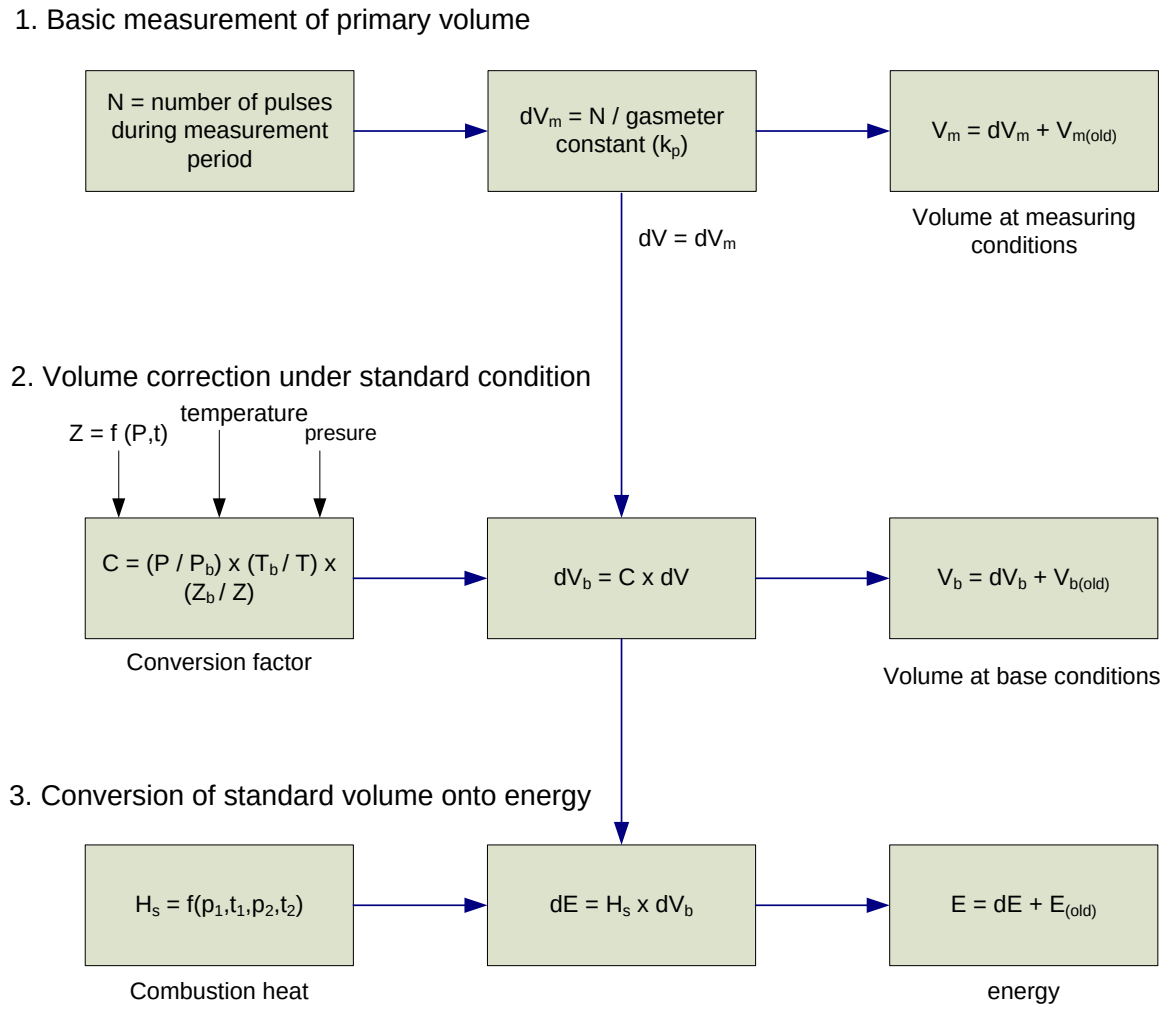
The principle scheme of energy calculation is shown in Fig. 1.

Combustion heat H_s

To ensure proper conversion, you have to use the combustion heat value Hs at properly selected conditions. It is therefore necessary to specify the combustion heat value and base conditions. The device then performs the conversion of base heat for specified base conditions and then uses the resulting value to calculate energy.

In the case of AGA8-92DC method the combustion heat is not specified; the device calculates it from specified gas composition according to EN ISO 6976. It is necessary to specify the value H_s in other methods. The value H_s (MJ/m3) always has to be specified for following base conditions:

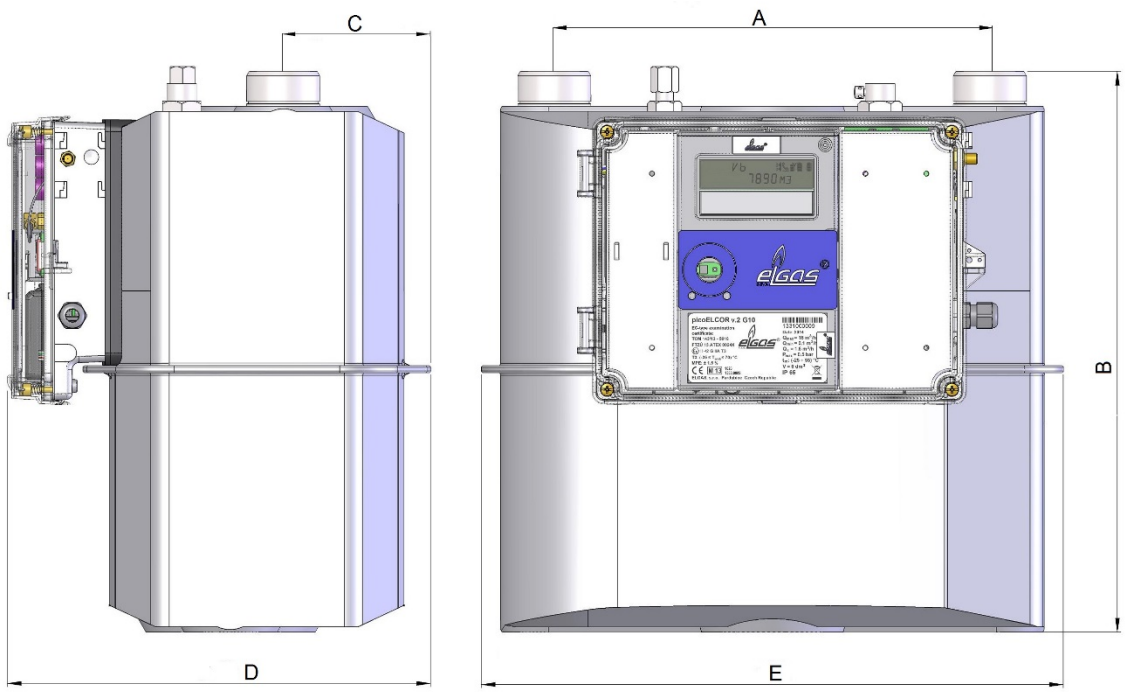
combustion temperature/gas temperature = 25°C / 0 °C



LEGEND:			
C	conversion factor	T	absolute temperature at measurement conditions
dE	energy addition	T_b	absolute temperature at base conditions
dV	adition dV_m	V	volume V_m
dVb	adition base volume	V_b	volume at base condition (standardized volume)
dVm	adition primary volume	$V_{b(old)}$	standard volume at the end of previous measurement period
E	energy	V_m	volume at measurement conditions (primary volume)
Eold	energy at the end of previous measurement period	$V_{m(old)}$	primary volume at the end of previous measurement period
Hs	combustion heat	Z	Gas compressibility factor at measurement conditions
P	absolute pressure of gas	Z_b	Gas compressibility factor at base conditions
Pb	absolute pressure at base conditions		
p1	air pressure in which is defined burning of gas	P2	presure in which is dedfined volume of burned gas
t1	air temperature in which is defined burning of gas	t2	temperature in which is defined volume of burned gas

Fig. 1 Volume and energy calculation - calculation diagram

1.3 Dimensions of the device



Type		Dimensions [mm]					
	A	B	C	D	E	DN	Thread*
picoELCOR G10	250	320	85	243	334	25	1 ¼”
	250	320	85	243	334	32	1 ¾”
	280	330	108	259	405	40	2“
picoELCOR G16	280	330	108	259	405	40	2“
picoELCOR G25	335	398	138	313	465	50	2 ½“

* ISO 228-1

Fig. 2 Dimensions of the Smart gas meter picoELCOR G10/16/25

2 Safety instructions

2.1 General

Smart diaphragm gas meter with a volume converter picoELCOR G10/16/25 is designed for metering of natural gas consumption or propane-butane consumption (group IIA gases) according to EN 437.

The conformity of the device was assessed in compliance with EC Directive 94/9/EC (Government Order No. 23/2003 Coll.). Declaration of conformity (TUV) was issued for the body of the diaphragm gas meter and EC type examination certificate (FTZU) was issued for the electronic counter for use in potentially explosive environment. Complying with this guideline is included in the CE mark of compliance.

device part	Declaration of Conformity/ EC certificate	type identification
the body of diaphragm gas meter	TUV 11 ATEX 090370 X	Ex II -/2 G c IIB TX
electronic counter	FTZÚ 13 ATEX 0024X	Ex II 1G Ex ia IIA T3 Ga

Operation of the gas meter is guaranteed only within the range of specified operating conditions, see [Technical data]. Any other use is considered improper.

2.2 Use in potentially explosive atmospheres

Smart diaphragm gas meter picoELCOR G10/16/25 with CE a Ex marks (see the data plate) is suitable for use in potentially explosive atmospheres classified as ZONE 1 or ZONE 2.

Explosion-proofing mark:

Ex **II -/2 G IIA T3**	**picoELCOR G10/16/25**	**Zone 1**

Ambient temperature -25°C to +55°C

Intrinsically safe parameters of the device are specified in the section 14.

2.3 Hazards

The gas meter casing is made of sheet metal and the electronics casing is made of polycarbonate. In certain extreme cases an electrostatic charge may build up on the surface of the casing; its energy could cause ignition of the ambient explosive atmosphere.

To avoid the danger of ignition due to electrostatic charge it is necessary to comply with the Special conditions of use.

Only battery blocks approved by the manufacturer can be used as the power supply unit.

CAUTION!

IF YOU REPLACE A BATTERY WITH AN INAPPROPRIATE TYPE OF BATTERY, YOU RISK EXPLOSION. DISPOSE OF USED BATTERIES ACCORDING TO MANUFACTURER'S INSTRUCTIONS.

2.4 Special conditions of use

Under certain extreme circumstances an electrostatic charge may build up on the plastic casing which may lead to ignition. The device must not be installed in places where external conditions could lead to an occurrence of electrostatic charge. The device can be wiped only with a damp cloth.

2.5 Use of the device for different gas groups

PicoELCOR G10/16/25 can be used with different gas groups in accordance with the following table:

gas group / device version	IIC	IIB	IIA
picoELCOR G10/16/25	no	no	yes

3 Technical description of the device

The device performs these basic functions:

- gas volume measurement,
- volume conversion to base conditions,
- periodic measurement of actual values of pressure, temperature and flow rate,
- calculation and archiving of values,
- communication and data transfer to PC or other system

3.1 Main parts of the device

Fig. 3 Main parts of the device

1 – The body of the diaphragm gas meter

2 – Electronic counter with a display and a built-in GSM/GPRS modem

3 – Connecting sockets

4 – Protective covers

5 – Thermometric well (tm)

6 – Outlet (testing point) for pressure measurement with a sealing sleeve (Pm)

The body of the gas meter is placed in a metal casing. The size of fittings for tube connection is shown in Fig. 2. The electronic counter is built into a cabinet made of durable plastic with IP65 protection and it is inseparably connected to the body of the diaphragm gas meter. The device is fitted with an LCD display and two control buttons (hereinafter referred to as keyboard) located under the hinged cover of the machine. The control of the machine through the keyboard is therefore possibly only after opening the cover of the electronic counter. Rotations of the diaphragm gas meter are monitored by and optical sensor.

The device is powered from a built-in lithium battery. The battery life is 15 years in a defined nominal range of use. Battery power supply also makes the use of impulse outputs possible.

If the B-02 battery pack discharges or disconnects, the device continuously evaluates the rotations of the gas meter (i.e. you will not lose any data on the quantity of gas passed), stores the data and generates real time. This is ensured using long-life backup battery.

The device stores measured values in data archive with adjustable structure and adjustable storing cycle. Error conditions are stored in a status archive. Storing of important quantities, calculation and storing of some statistical values can be programmed in daily and monthly archives. For service and metrology purposes the settings archive stores actions influencing device parameters. It is possible to configure the binary archive too, for recording of occurrence of observed events (limits, etc.). There are other available archives as well, see section 7.3.

The device can be set up through the supplied service software (setting up using a keyboard is not possible). Service SW is designed for PCs with Windows OS. The device is connected to PC by an optical head (HIE-03 or HIE-04 type). The optical head is attached to an optical visor on the front cover, on the left below the display.

The device is equipped with a built-in GSM/GPRS modem that facilitates remote reading of the device. The built-in modem is powered from a separate battery. Various communication protocols installed in the device allow easier connection to SCADA systems. Modem connection allows setting of device parameters, possibly upgrading of the control software as well. In the event of alarm the device can automatically initiate a connection through the GSM/GPRS modem.

The device is equipped with following inputs and outputs:

- combined digital temperature and pressure sensor (built in the gas meter)
- input for evaluation of gas meter rotations (optical monitoring)
- 1x digital (pulse) output DO1
- communication channel connected to GSM/GPRS that facilitates the communication with a superior system
- communication channel of optical infrared interface that facilitates the communication with PC through an infrared head

The service SW for device settings (for PC) also allows reading, displaying and storing both the actual values measured and the contents of internal archives in the device.

3.2 Electronic counter

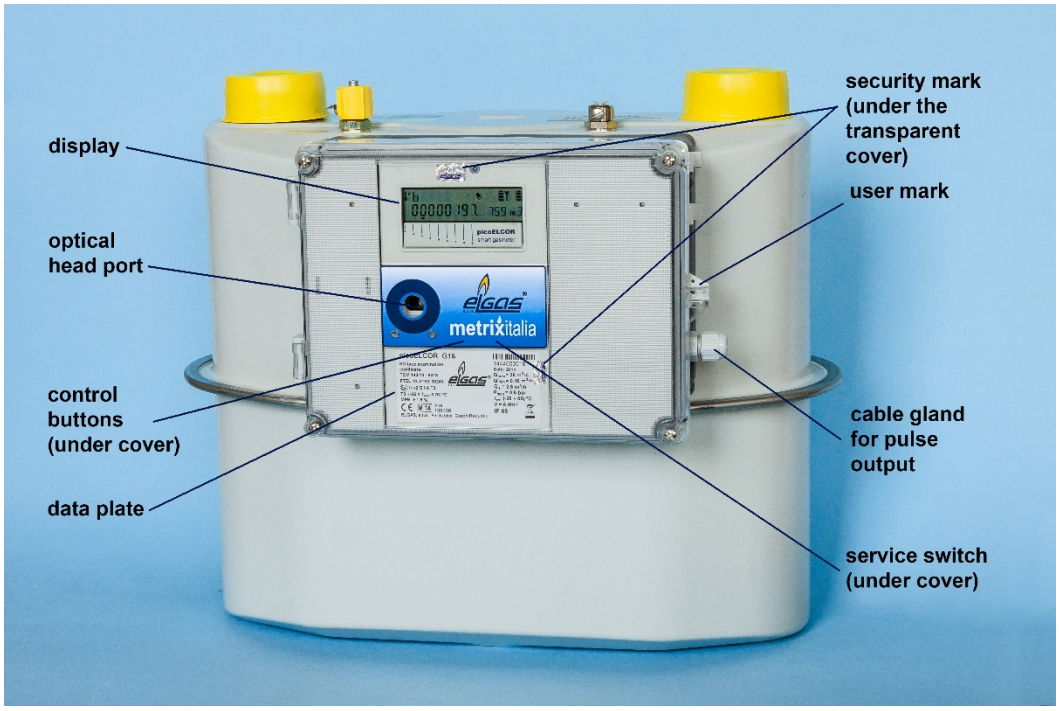


Fig. 4 Arrangement of elements on the electronic counter

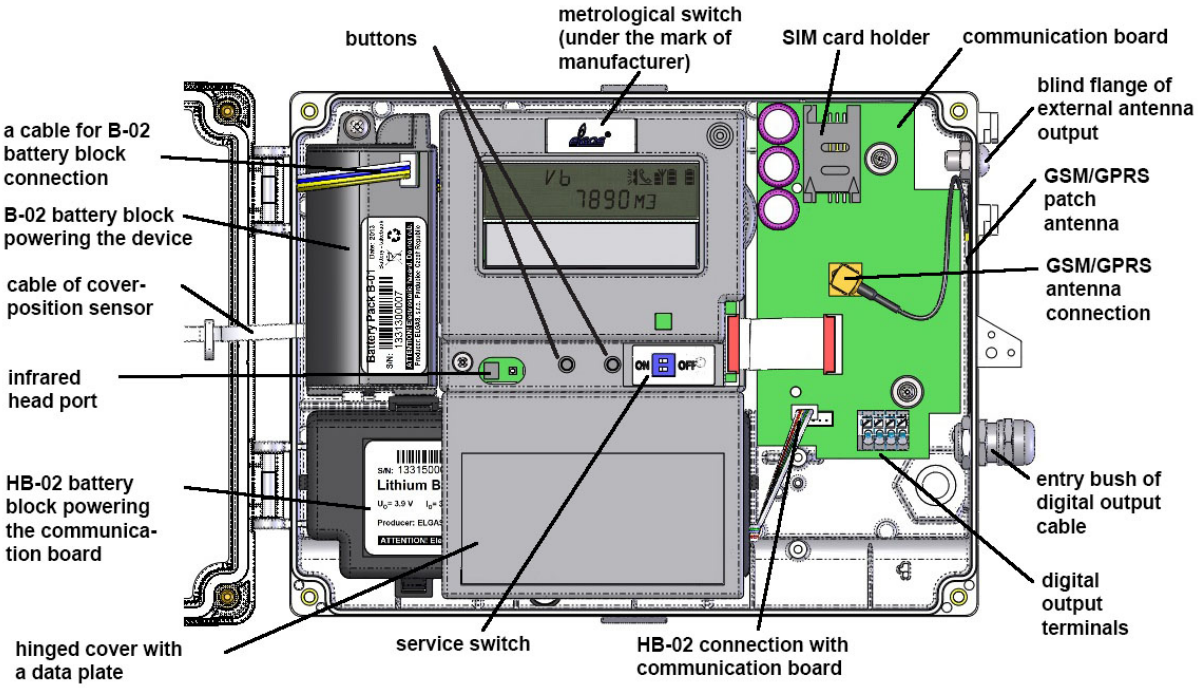


Fig. 5 Arrangement of components under the cover of the electronic counter

The electronic counter consists of two main parts - the measuring part and the communication part. Both are powered from separate battery blocks.

The electronic counter performs the conversion of the measured gas volume to base conditions. Calculated consumption is shown on LCD display. The electronic counter contains a combined built-in gas pressure and temperature sensor.

Remote gas meter data reading is made possible by a built-in GSM/GPRS modem. Before you start using the built-in modem, you have to configure it according to the SIM card used (no included in the supply), mobile operator and type of the desired communication. The modem uses an antenna installed in the electronic counter by default. If necessary, you can connect an external antenna. For purposes of operative reading or setting of the device in the place of installation the electronic counter is fitted with optical communication interface for communication through an infrared head. The possibility of setting up parameters of the machine is affected by the service switch.

3.3 Power supply

The device contains two independent battery blocks. Both of them power separate parts of the electronic counter.

3.3.1 B-02 Battery Block

B-02 battery block powers the metrological part of the electronic counter. It contains a lithium battery, surge suppressor (for intrinsic safety) and a memory that maintains the current state of capacity. The supply voltage of the battery lies within the range from 2.8 - 3.6V. Battery life is 15 years. The battery block is sealed by the manufacturer and must not be disassembled due to safety reasons.

If the battery capacity drops to 10% before expected discharge the device will notify you about the need to replace the battery (error message E9, see Table 11).

B-02 battery block can be replaced in potentially explosive atmospheres. Data on the replacement of B-02 battery are stored in the factory diagnostics of the device. The procedure of replacement of B-02 battery block is described in 3.3.3.

When the B-02 battery pack is disconnected, the device continuously evaluates the rotations of the gas meter (i.e. you will not lose any data on the quantity of gas passed), stores the data and generates real time. This is ensured using long-life backup battery. The backup battery life is at least 16 years. It is located under the metrological seal.

-During the replacement of B-02 the data from volume counters and other data are stored in FRAM memory (memory that stores data for several years after shut-down of the power supply). Archive data are stored into this memory every time a record is archived.

3.3.2 HB-02 Battery Block

HB-02 battery block (HB-01D) powers the communication part (GSM/GPRS) of the gas meter. It contains a lithium battery, surge suppressor (for intrinsic safety) and a memory that maintains the current state of capacity. The battery delivers voltage between 2.0 and 3.0V. The battery life is 5 to 15 years, depending on the selected communication mode. The battery block is sealed by the manufacturer and must not be disassembled due to safety reasons.

HB-02 battery block can be replaced in potentially explosive atmospheres. The procedure of replacement of the battery block is described in 3.3.3.

Defined nominal range of use of HB-02 battery, life over 5 years:

- 1 x per day - GSM/GPRS data transmission (modem operation time around two minutes per day)
- 1 x per day - GSM/GPRS service window (switched on for 10 minutes, in average 1-minute communication every week)
- 1 x per year remote reading of the firmware

The battery life depends mainly on the mode of use, signal strength at the place of operation and on the ambient temperature:

battery life: typically 5 years (HB-02, 12Ah), -25°C to +25°C, signal strength 80%

The battery life decreases with higher ambient temperature.

The battery life decreases with the drop in signal strength.

3.3.3 Replacement of batteries

It is recommended to disconnect the discharged battery (battery block) as soon as possible. During the replacement of B-02 battery the device does not measure pressure or temperature but it measures the volume passed (however, it does not carry out the conversion, that is carried out after the connection of the battery). The real time clock is maintained at any time. Data in archives of the device and setting of parameters remain unchanged.

Battery blocks for the device and the modem can be replaced in potentially explosive atmospheres. Only trained operator can replace battery blocks. Only specific types of battery blocks B-02 and HB-02 (HB-01D) are allowed to use.

To replace the battery blocks, unscrew the 4 screws in the cover (cross recessed screws) of the electronic counter (you need to break the user tag) and open the door of the electronic counter.

B-02 battery

The battery must be disconnected from the four-wire supply cable ended by a connector. The block is attached to the bottom of the casing by a single screw with a Phillips head. The screw is located in the upper part of the battery block. The lower part of the battery block is fastened to the casing by clamping to plastic fittings on the bottom of the casing.

During the replacement of B-02 battery the device does not measure pressure or temperature, but it constantly evaluates the rotations of the gas meter and measures the gas volume passed. Conversion is carried out after the connection of the battery. Error values of pressure and gas temperature will be used for the conversion.

System time of the device is running even when B-02 battery is disconnected.

Data in archives of the device and setting of parameters remain unchanged.

After you connect the battery block of the device (B-02), the device will automatically read the data stored in its internal memory (current capacity and battery identification). The data are loaded from the battery to the device regularly, every day at 11 p.m. Furthermore it carries out the conversion of the volume passed during the time for which the battery was disconnected.

HB-02 battery

The battery block is partially covered by a lid with a data plate on it. The lid has to be lifted upwards. Battery outlet is connected by a cable with a connector to the communication board. After disconnecting the battery it is necessary to loosen the cross recessed screw. After you insert a new battery and fasten it with a screw, close the cover lid (closed lid is held by two fittings in the bottom of the casing). Plug the battery block cable into the communication board connector.

Status of modem battery block HB-02 (voltage, remaining capacity) is checked automatically by the device every 2 minutes.

Disposal of used batteries

Used batteries are classified as hazardous waste. According to the WEEE directive (2002/96/EC) and according to national legislation, batteries must not be disposed of along with normal household waste. The take-back system obligation applies to used batteries. It is therefore necessary to return the batteries at the place of take-back or at places authorized for recycling of waste electrical and electronic equipment.

3.4 Security marks of the device

Security marks placed on the device indicate the technical condition of the device in terms of tampering.

Security marks of the manufacturer (metrological mark, security mark)

- its location is described in the EC type examination certificate in accordance with Annex 2, route B, Government Order No. 464/2005 Coll. issued by the notified body No. 1383. This security mark is of the same importance as the so-called official mark pursuant to Act. No. 505/1990 Coll. Section 9, paragraph 3 on metrology.

In the event of a breach of this mark the manufacturer does not guarantee that the properties of the device are in conformity with the EC type examination certificate.

User mark

- control user marks (seals), applied according to user's needs

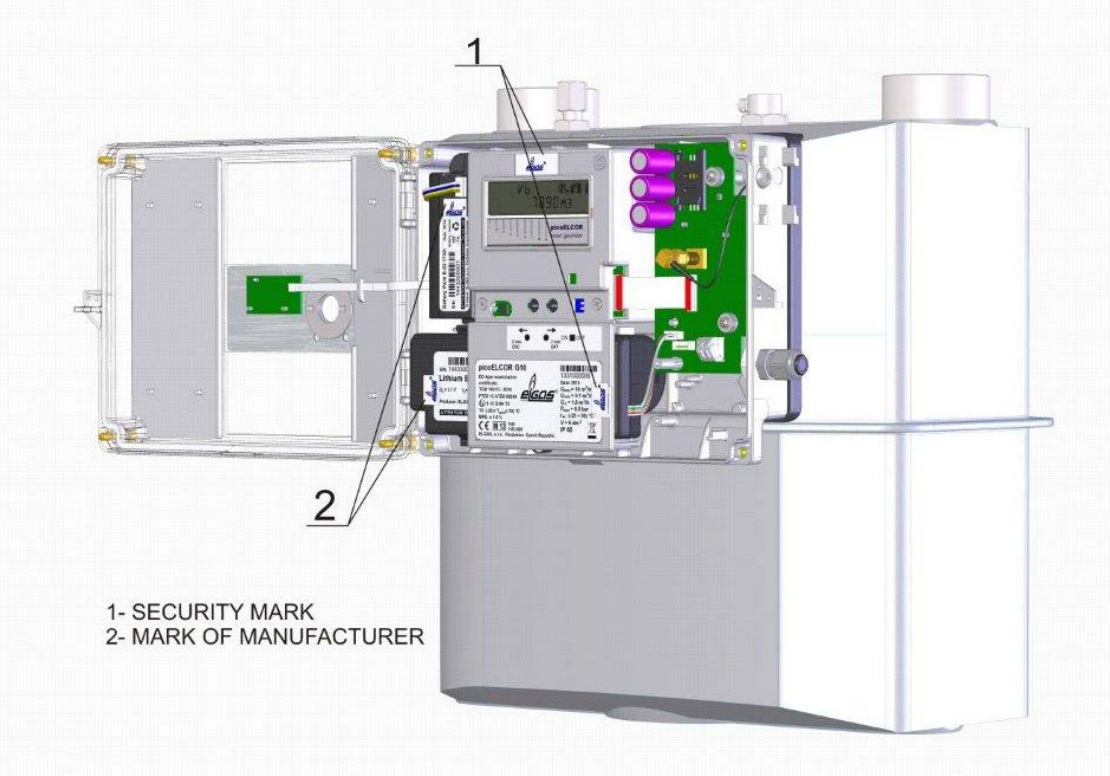
Mark of manufacturer

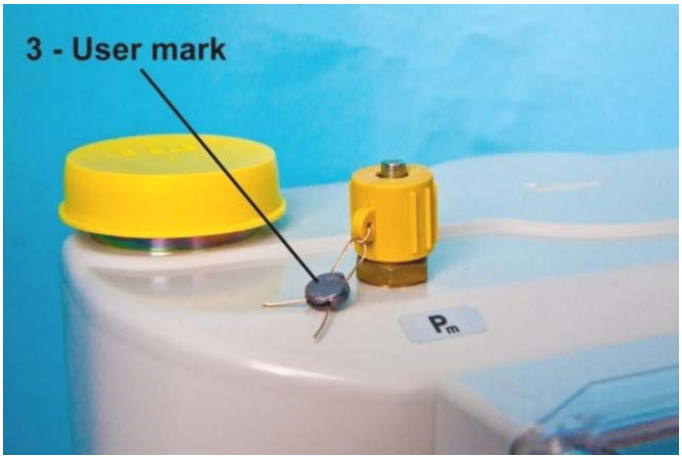
- control marks of the manufacturer, applied according to manufacturer's needs

In the event of a breach of security mark of the manufacturer or the mark of manufacturer, the warranty is breached.

Note:

The gas meter doors are adapted for securing against opening by a padlock with shackle diameter up to 5 mm.





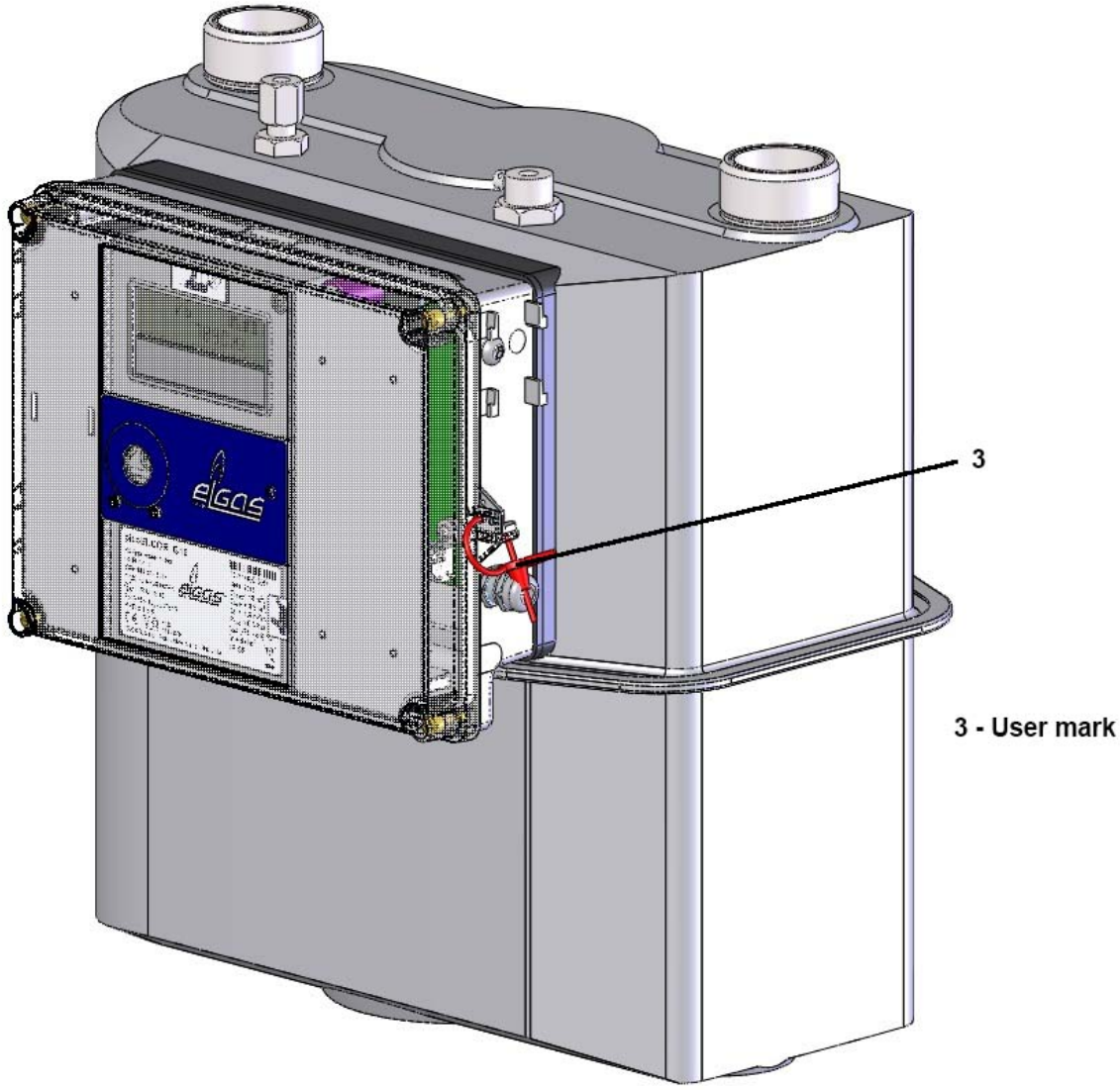


Fig. 6 Security marks of the manufacturer

3.5 Type identification and marking plates

Type identification	Qmax [m3/hod]	Qmin [m3/hod]	cyclic volume V [dm3]
picoELCOR G10	16	0.1	6
picoELCOR G16	25	0.16	6
picoELCOR G25	40	0.25	12

Table 1 Type identification and flow rate range

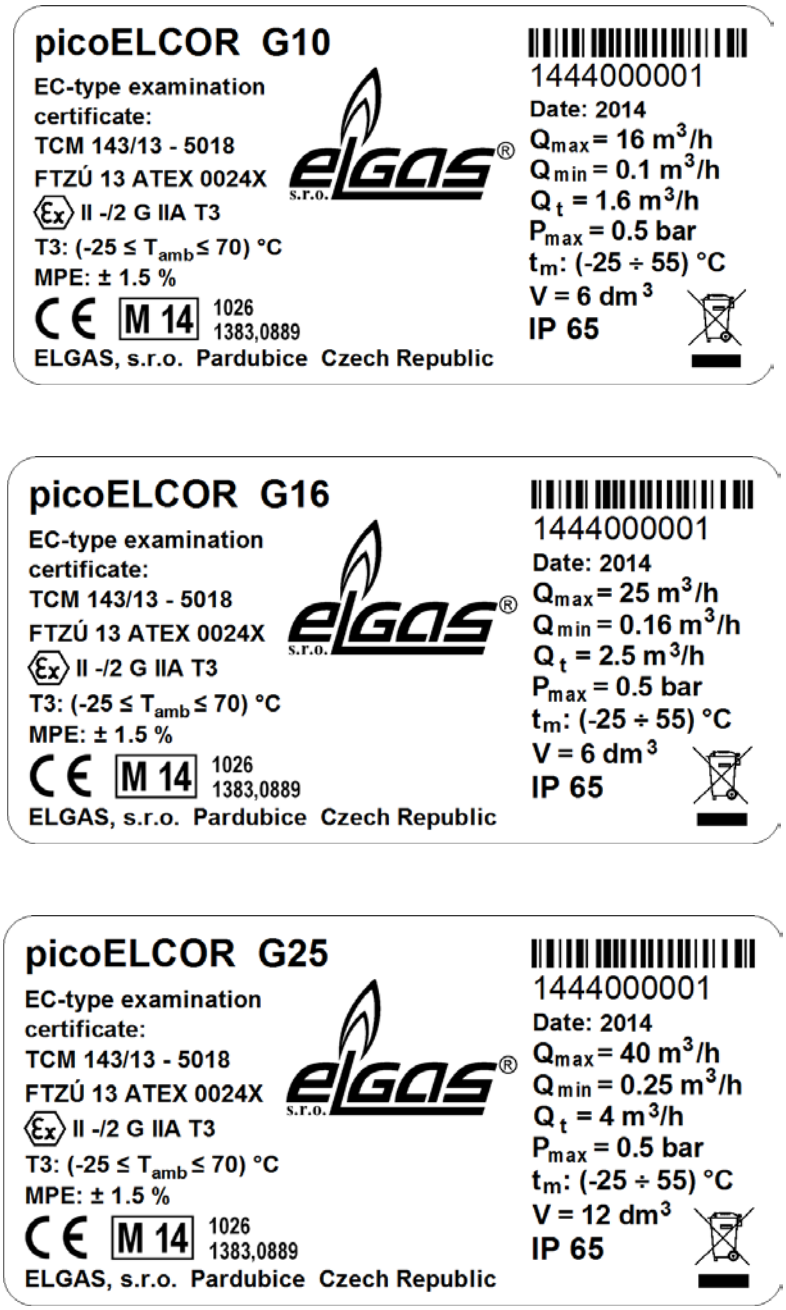


Fig. 7 Data plate examples

4 Metrological properties

The device uses a combined digital pressure and temperature converter marked KP 089 for the measurement of gas temperature and pressure. It is located inside the gas meter and it is connected to the electronic counter through a flat four-wire cable.

4.1 Temperature measuring

The temperature measuring range is from -25°C to +55°C. The measurement period is common both for temperature measuring and pressure measuring and it is firmly set at 30s. The units of temperature measuring are adjustable.

When configuring the device the user has to input the constant parameter **Error temperature value** in the device. This value is used in calculation of compressibility instead of the measured temperature value in following cases:

- the value of measured temperature does not fall within the measuring range
- an error occurred during the measurement of temperature

4.2 Pressure measuring

On the basis of calibration data stored in the memory of the device, the electronics of the combined sensor provides correction of non-linearity and dependence of the pressure sensor on the temperature. The measuring range of pressure converter is 80 - 160 kPa abs.

The measurement period is common both for temperature measuring and pressure measuring and it is firmly set at 30s. The units of temperature measuring are adjustable.

When configuring the device the user has to input the constant parameter **Error pressure value** in the device. This value is used in calculation of compressibility instead of the measured pressure value in following cases:

- the value of measured pressure does not fall within the measuring range
- an error occurred during the measurement of pressure

4.3 Calculation of compressibility

4.3.1 PTZ conversion

The compressibility ratio is calculated from the composition of the gas specified in parameters using one of the following methods in the device: AGA NX-19-mod, SGERG-88, AGA8-G1, AGA8-G2 or AGA8-92DC.

Compressibility factor is calculated in every measuring interval. In SGERG-88 and AGA8-G1 the value of combustion heat has to be set for gas combustion temperature 25°C, while gas combustion volume has to be defined for 0°C (abbreviated as 25/0). The service SW also contains a built-in calculator for conversion of the combustion heat specified at other temperatures.

pressure measuring range	*Method*			
	AGA NX-19 mod	SGERG-88	AGA8-G1 AGA8-G2	AGA8-92DC
80 ÷ 160 kPa	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C

2Table 2 Applicability of standards for calculating compressibility for pressure range and gas temperature

Note:

GOST NX-19 method of compressibility calculation is also implemented in the device. This method is not approved by Czech Metrological Institute.

Compressibility calculation for GOST NX-19 method is limited to the measuring temperature range -23°C to +60°C.

Error compressibility

Error compressibility is used instead of the calculated compressibility if the compressibility calculation couldn't be carried out because of limit concentration of the gas composition. The value of error compressibility has to be set by the manufacturer during configuration of the device.

4.3.2 PTZ conversion

It is also possible to set the compressibility ratio K as a constant. The range of the constant is not limited.

4.4 Measurement and calculation of volume

Following counters are used for measurement and calculation of volume:

V_m	-	counter of volume at measurement conditions (primary volume)
Vs	-	counter of operating volume at error conditions (error primary volume)
Vb	-	counter of volume at base conditions (standard volume)
Vbs	-	counter of standard volume at error conditions

4.4.1 Activity in the case of occurrence of error conditions

If error conditions occur the device keeps calculating volumes in the counter of volume at measurement conditions (V_m) and begins to calculate volumes in the counter of error volume at measurement conditions (V_s) at the same time. The values of volume at base conditions (V_b) stop being calculated in the counter of volume at base conditions (V_b) and start being calculated from error values of pressure or temperature and the values are stored in the counter of error volume at base conditions (V_{bs}). In this state values are not stored in the counter of volume at base conditions (V_b).

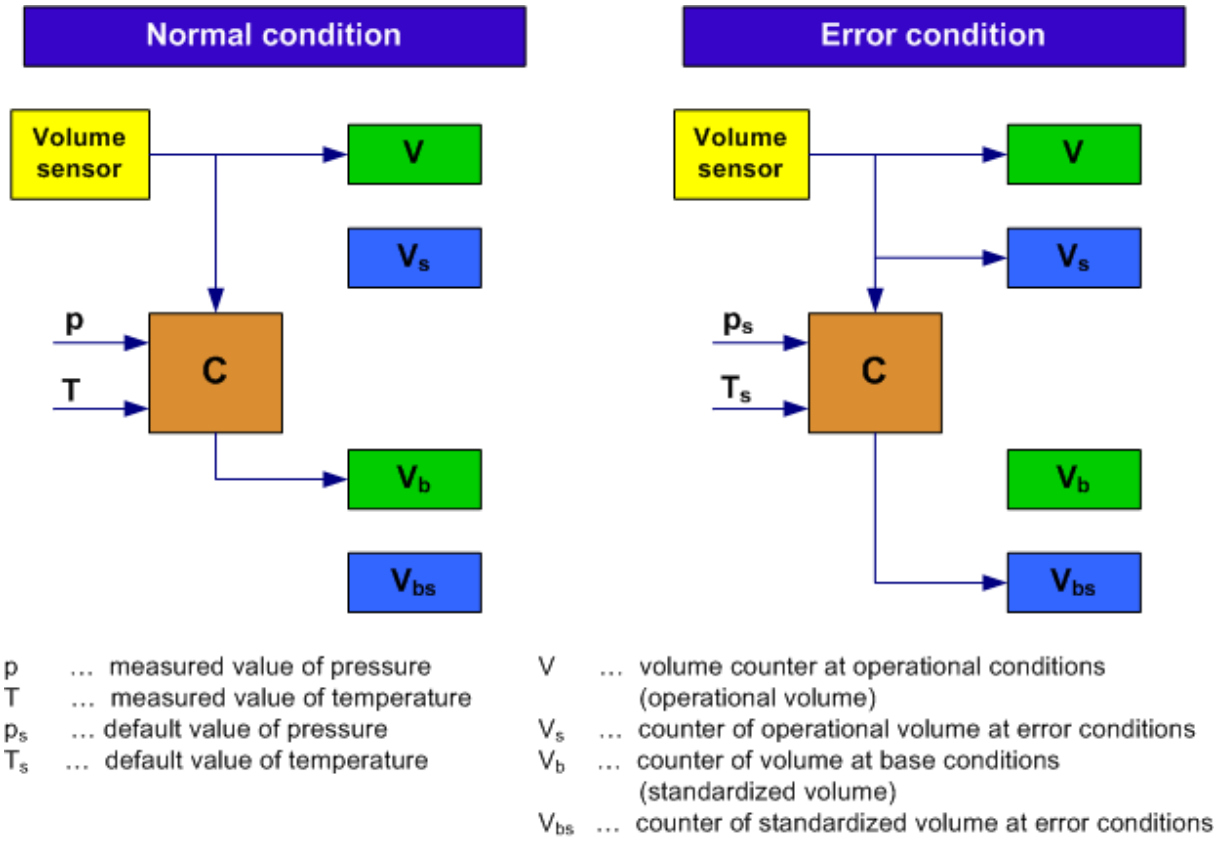


Fig. 8 Storing volume values in counters

If error compressibility is used in the calculation due to an unsuccessful attempt at compressibility calculation (see 4.3.1), while p and t lie within the measuring range, the converted volume is stored in the error counter (Vbs).

5 Digital output

5.1 Digital output characteristics

The device is fitted with a DO1 digital output which is designed to generate output pulses. The output can be controlled using calculation equations input by the operator into the device's parameters.

Pulse output (DO1)

The output is of an "open collector" type and galvanically isolated from other circuits of the electronic counter. Output pulses are calculated and sent to the output within the measuring interval. The time for which the pulse output is switched on (pulse length) and the interval between pulses can be adjusted in parameters of the device.

The outputs are galvanically isolated, therefore their use has a significant influence on the battery life. For this reason the parameter setting options in service SW Telves are limited so that the batter life is always guaranteed, regardless of the application or non-application of the output and regardless of the number of pulses generated. The limit is set for a short duration of the pulse within the range 4–50ms and the intervals of generated pulses have to be at least 1s. If you need to use different settings, contact the manufacturer.

The output is intrinsically safe. Therefore standard equipment has to be connected through a safety barrier (e.g. DATCOM-K3, see Fig.9).

If parameters for output pulses are set incorrectly, so-called output pulses debt can occur in the device. The debt of output pulses (i.e. number of pulses that did not manage to transfer to the output) can reach the maximum of 65535 pulses. Accumulated pulse debt keeps transmitting to the output at a time where no input pulses are coming from the gas meter. In the equation setting the output variables the output constant can be implemented as well.

5.2 Connection of the digital output

The output is intrinsically safe and galvanically isolated from other circuits of the electronic counter. It is implemented as a **galvanically isolated transistor with an open collector.** The digital output is connected to the terminals located on the communications board.

signal	*description*
DO1	Digital output
GND	negative pole

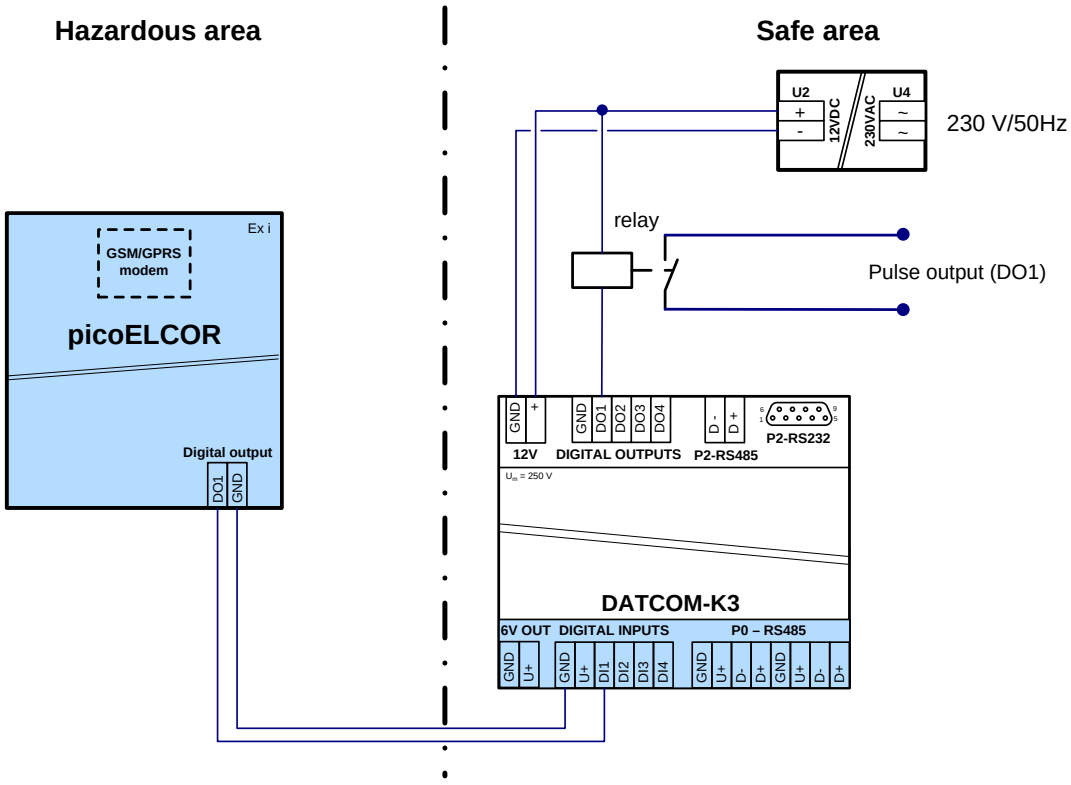


Fig. 99 An example of pulse output connection

Pulse output cable in picoELCOR does not have to be shielded. If you use a shielded cable you do not connect the shielding on the side of the gas meter.

6 Communication with the device

The device is equipped with two communication interfaces that facilitate communication with other devices.

- Optical interface for local reading or setting of the device
- Communication interface to which the built-in GSM/GPRS modem is connected

Firmware in the device is currently equipped with several communication protocols. The device is ready for addition of optional protocols desired by the customer. Standard implemented protocols:

- ELGAS ver. 2 protocol,
- CTR protocol,
- MODBUS RTU protocol.

If you want to use MODBUS-RTU protocol, it is necessary to load MODBUS register map in the device.

Selected communication protocol applies to all communication interfaces. Communication speed is to be set for the optical interface for the infrared head.

ELGAS ver. 2 protocol is the “parent protocol” of the device. The complete set of functions implemented in the device is available. Service SW[26] uses solely this protocol - if switching to a different link layer is necessary, ELGAS ver. 2 only gets packed in a different link layer (so-called tunnel). ELGAS ver. 2 and CTR protocols are the only protocols that can be used for firmware uploading (protected by a metrological mark).

6.1 Simultaneous communication through multiple communication interfaces

It is possible to communicate with the device through the optical interface and through the built-in GSM/GPRS modem at the same time. These types of communication are independent from each other and do not restrain operation of each other in any way.

6.2 Optical interface EN 62056-21 (IEC-1107)

There is an optical port for communication using the optical head on the front wall of the casing. Optical head is applied to the port. It is fastened by a magnet. Any of the HIE-03 and HIE-04 head types can be used as the optical head. Upon applying the optical head the device switches from standby mode to a mode in which it can receive data. Depending on the settings, it will remain in this mode either until the optical head is detached from the communication interface or after expiration of the set period (timeout within 1–255s) from last communication. The length of timeout can be adjusted by the service SW [26] (parameter “Deactivate IR head after [s]:” in Service parameters card).

Communication speed of the optical interface can be changed in parameter settings. Settings for communication protocol applies to all interfaces.

6.3 Built-in GSM/GPRS modem

There is a built-in GSM/GPRS modem facilitating remote data transmission. The modem is quad band (QUAD), i.e. it can be operated in bands 850/900/1800/1900 MHz. Built-in

modem antenna is located inside the device. If the signal in the place of installation is weak, you can use an external antenna. However, in such case it is necessary to contact the manufacturer and order special HF cable reduction that allows the connection of the external antenna. The installation of HF cable reduction is described in 6.3.1.

You can set the modem in following modes using the service SW [26]:

- GSM modem
- GPRS modem
- GSM & SMS modem
- GPRS & SMS modem

(Note: SMS modes can be used only when using CTR protocol)

Basic information on modem connection and signal strength is displayed on the display of device through icons (see Table 10). Some other additional information on the current status of the modem can be displayed on the display of the device. This indication can be activated on the keyboard by selecting SYSTEM->MODEM. You can view following data (for details see 8.4):

- numeric code of the last modem error and the time it occurred numeric code of the error and its meaning is shown in Table 3
- currently assigned IP address in GPRS mode
- signal strength (%) on the place where the device is installed

In addition, you can use the keyboard to (in particular for service purposes, see section 8.4):

- turn the GSM/GPRS modem on,
- initialize GSM/GPRS call from the device to a superior system (if an option of such call is set in device parameters).
- call SMS sending

code	error description
general errors	
0	modem without error indication
1	modem does not respond
20	modem responds “ERROR”
SIM card related errors	
2	PIN code required, but it is not stored in configuration data
3	PIN code required, an incorrect code stored in configuration data
4	PIN blocked, PUK required
5	SIM card not inserted
GSM network registration related errors	

6	registration into GSM network takes longer than usual (>~20s after switching off)
7	not registered into GSM network, does not search network at the moment
8	registration into GSM network denied (e.g. roaming is not active and domestic operator is not available)
9	unable to register into the GSM network for an unknown reason
10	low GSM signal <= -85dBm (error is stored only when the modem is registered in GSM network)
initialization related errors	
11	incorrect initialization command specified in configuration data (in service software [22] Initialization or Special initialization)
dialling related errors	
12	unable to dial GPRS or GSM/CSD, or already established connection fails for error reasons (modem responds “NO CARRIER”, “BUSY” or “NO DIALTONE”)
PPP protocol related errors - GPRS connection	
13	LCP protocol error
14	PAP protocol error (incorrect user name and password, in practice even with incorrect settings this stage passes and ends in IPCP stage)
15	CHAP protocol error (incorrect user name and password, in practice even with incorrect settings this stage passes and ends in IPCP stage)
16	IP address allocation error (can be caused by incorrect user name and password)
TCP protocol related errors	
17	TCP session error - RST packet sent
18	18 error while opening a TCP session in Client mode - unable to connect remote Server
SMS related errors	
19	unable to send SMS

Table 3 GSM/GPRS modem, error codes

Signal strength

The minimum recommended RSSI value for GPRS communication is -85 dBm (i.e. 45% - indicated by one scale interval at the signal strength icon - see Table 10). By this value the

device displays error no. 10 (see Table 3). Low strength of GSM/GPRS signal very significantly decreases the specified modem battery life.

RSSI [dBm]	-51	-61	-71	-81	-91	-101	-113
RSSI [%]	100.00	83.87	67.74	51.61	35.48	19.35	0.00
RSSI [rel]	31	26	21	16	11	6	0

4Table 4 RSSI signal strength conversion chart, among dBm, % and relative units

6.3.1 Adjustment of the device for connection of the external antenna of the GSM/GPRS modem

By default the built-in GSM/GPRS modem uses an antenna located inside the device. If it is necessary to use a more powerful external antenna instead of the internal antenna, you have to make a small adjustment to the device (can be carried out by the operator). This adjustment is an installation of an HF cable reduction that will facilitate the extension of the antenna output outside the casing of the device. The necessary component, HF cable reduction (see Fig. 10), has to be ordered separately, it is not included in the standard delivery of the device.

The installation of HF cable reduction:

- open the cover of the device and disconnect (unscrew) the internal antenna cable on the right side of the communication board,
- remove the metal seal of the opening for external antenna connector output on the upper right side of the electronic counter casing,
- plug the panel connector of the HF cable reduction (not included in the standard accessories to the device) in the opening with a rubber O-ring on and fasten it on the outside of the casing by a nut with a washer (Fig. 12),
- connect the other end of the HF cable reduction to the communication board,
- set the internal antenna by pushing it under the lower part of the communication board (Fig. 11).

Connect the external antenna (not included in the standard accessories) to the installed panel SMA connector (f) in the side of the casing of the electronic counter.

Fig. 10 HF cable reduction, 9cm long

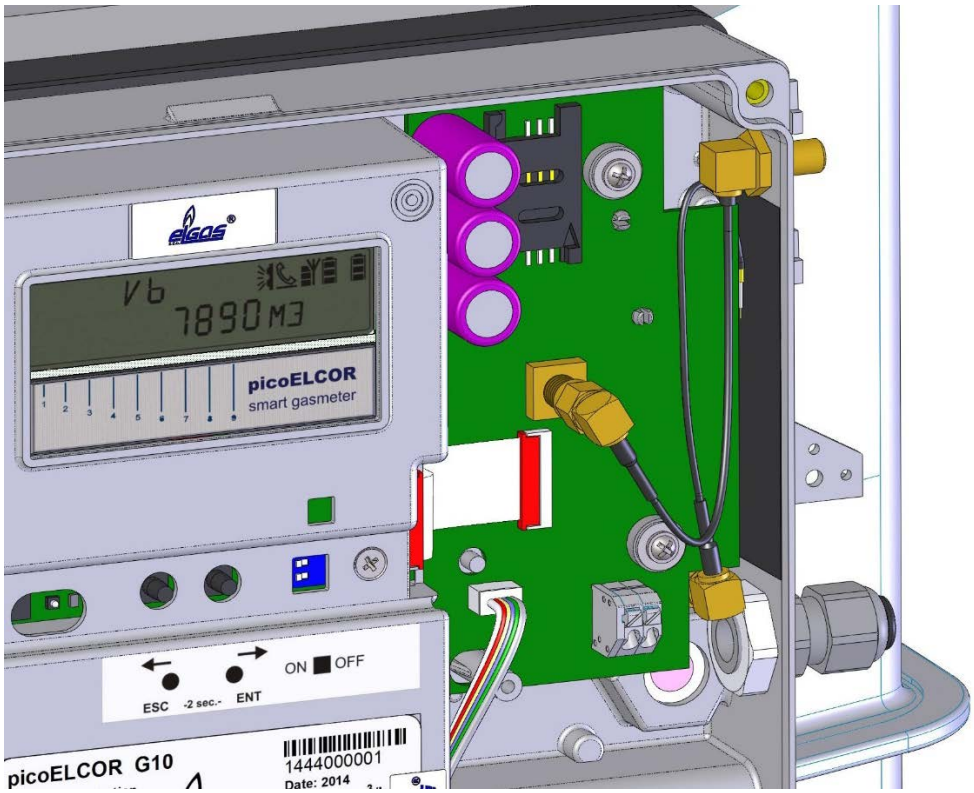


Fig. 11 Device with the HF reduction for connection of the external antenna

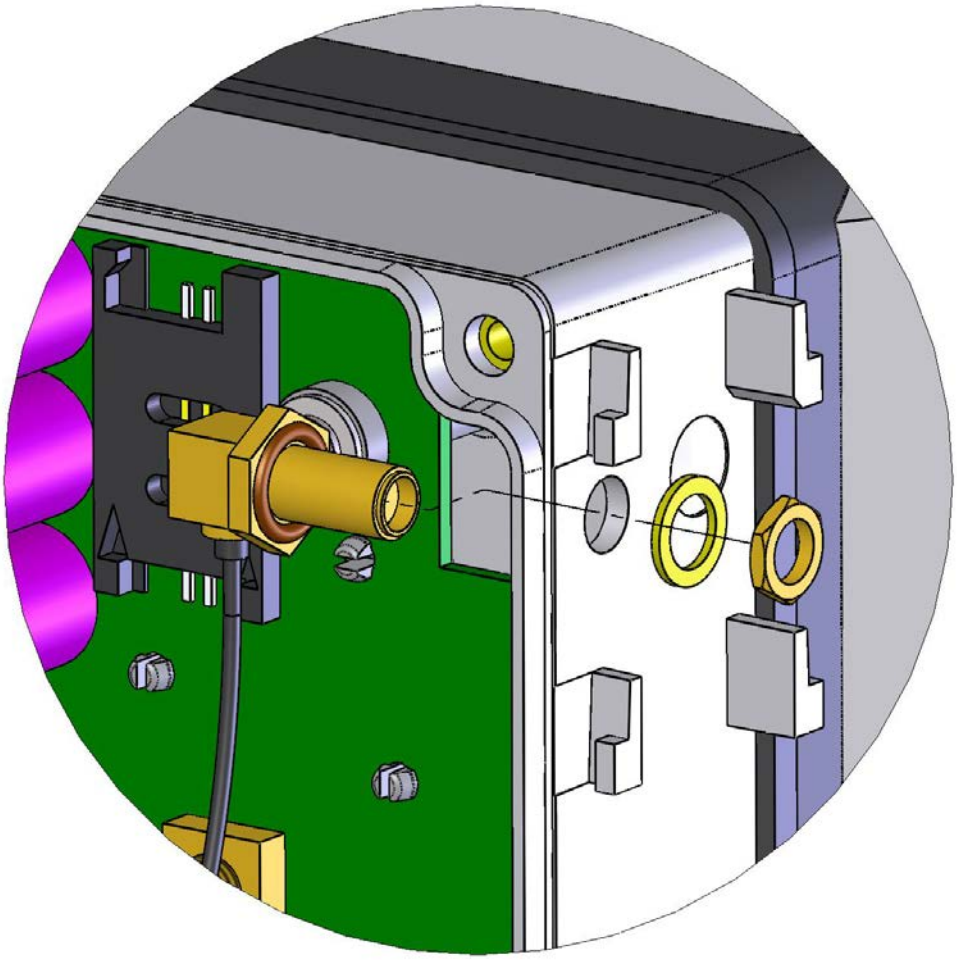


Fig. 12Panel connector installation

7 Functions

The options of the device regarding displaying data and storing quantities are variable and customizable. User can fully control which quantities are displayed at actual values and which quantities are stored in individual archives.

7.1 Marking of quantities:

Symbols specified in the table “Terms and symbols used” (see the beginning of this document) are used for marking of quantities.

Marking of quantities

- in marking of metrological quantities no index is used
- in marking other quantities (non-metrological) index can be used to distinguish between quantities of the same type.

User marking of quantities

Device allows the user to define their own marking of quantities. Default marking of quantities in the service program [26] is displayed in blue. Marking has to be selected so as to maintain uniqueness of marks. The uniqueness (unambiguity) is checked by the service program.

Marking of metrological quantities can be changed only on ASC level and the marking has to comply with metrological approval.

User-defined marking of quantities is used when showing data on the display and it can be exported for use in SW by third parties.

7.2 Actual values

The user can set the number of displayed locations, format of units and the name of displayed quantities. If the measured quantity is in error condition, this condition is indicated on the display by a sign  (see 8.1).

Examples of quantities that can be displayed as actual values:

- pressure p
- temperature t
- primary volume Vm
- error primary volume Vs
- standard volume Vb
- error standard volume Vbs
- primary flow rate Q
- standard flow rate Qb
- conversion factor C
- compressibility ratio K
- device error
- battery capacity
- internal temperature

7.3 Archives

The values in archives are organized into time sections; a time section contains the time data of the section and the individual values of quantities selected for archiving.

Measured and calculated values of quantities can be stored in following archives:

- Monthly archive
- Daily archive
- Data archive
- Binary archive
- Limit archive

In addition to these data archives the device also contains:

- Status archive
- Invoicing archive
- Settings archive
- Gas composition archive

	Data archive	Daily archive	Monthly archive	Limit archive	Binary archive
Analogue quantities					
Input analogue - mean value	yes	yes	yes		
Internal analogue - mean value	yes	yes	yes		
Output analogue - mean value	yes	yes	yes		
Minimum/maximum	yes	yes		yes[2)]	
Pulse quantities, flow rate measurement					
Primary volume - absolute mode	yes	yes	yes		
Standard volume - absolute mode	yes	yes	yes		
Error primary volume - absolute mode	yes	yes	yes		
Error standard volume - absolute mode	yes	yes	yes		
Maximum daily consumption - primary volume			yes[1)]		
Maximum daily consumption - standard volume			yes[1)]		
Maximum hour consumption - primary volume		yes[1)]	yes[1)]		
Maximum hourly consumption - standard volume		yes[1)]	yes[1)]		
Internal counter - absolute mode	yes	yes	yes		
Output pulses - pulses debt condition	yes	yes	yes		
Primary flow rate - mean value	yes	yes	yes		
Standard flow rate - mean value	yes	yes	yes		
Minimum/maximum flow rate	yes	yes		yes[2)]	
Conversion, compressibility ratio					
Compressibility factor	yes	yes	yes		
Compressibility ratio - mean value	yes	yes	yes		
Minimum/maximum conversion, compressibility ratio	yes	yes		yes 2)	
binary quantities					
binary input - status	yes				yes
binary output - status	yes				yes
Setpoints - status	yes				yes

Device errors and communication with converters - status	yes				yes
Internal binary	yes				yes
Other quantities					
Counter/timer - absolute mode	yes				
Device status (24bit compact format)	yes	yes	yes		

Notes:
1) Day or hour (or combination, depending on what is more suitable) is stored along with the value.
2) Date and time of reaching the maximum or minimum is stored along with the value.

Table 5 Options for archiving individual quantities

7.3.1 Monthly archive

Archive capacity: 25 records

The values are recorded in the archive once a month at a set "gasworks" hour (usually at 6 a.m.). The time data of the record is stored in the archive along with values. If the archive is full, new data starts to overwrite the oldest data. It is possible to store statistics for consumption of gas and analogue quantities (see Table 5).

Record with the date 01.06. then means statistics for quantities within the interval between 01.05. 6 a.m. and 01.06. 6 a.m.

7.3.2 Daily archive

Archive capacity: adjustable (preset 400 records)

Has similar properties as the monthly archive (for list of options see Tab. 5); it is also possible to store statistics for consumption of gas and analogue quantities. The values are recorded in the archive once a day at a set "gasworks" hour (usually at 6 a.m.).

Record with the date 13.06. then means statistics for quantities within the interval between 12.06. 6 a.m. and 13.06. 6 a.m.

7.3.3 Data archive

Archive capacity: Varies according to configuration of stored quantities. Capacity is operatively displayed when configuring the archive in service SW. Typical size is: ???

Archiving interval: adjustable within "measurement period", up to 1h

The quantities in this archive are stored in a set interval, the length of the interval can be adjusted by the user. The preset value is 1h. In regard to functions of state the archive stores the occurrence of active status within the respective archiving period. The active status for binary inputs can be set according to actual status of parametrizations; for setpoints and errors the active status is log.1.

7.3.4 Binary archive

Archive capacity: 2000 records

The archive stores statuses of binary inputs, state bits calculated and stored in the system and errors of individual devices. The values store in this archive only if status of a stored binary changes. The time data specified to seconds is also a part of the record.

7.3.5 Limit archive

Archive capacity: 1 record for every monitored quantity

Reaching maximum/minimum extremes is stored with archived values. Value and time data are stored. When initializing this archive the actual measured values of specific quantities are set in the maximum/minimum registers.

7.3.6 Status archive

Archive capacity: 500 records

The archive stores date and time of the event, status word (64 bits) describing statuses of all monitored events in the device and the status of the counter of primary volume V and the counter of standard volume Vb. The list of monitored events is specified in Table 11 and Table 12. The contents of the archive cannot be shown directly on the display, it can be displayed through service SW on a PC.

7.3.7 Settings archive

Archive capacity: an average of 500 records (depends on the length/type of records)

Settings archive stores information on changes in device parameters, especially when it has an influence on metrological properties of the device. The archive also stores the identification of the employee who made the change. The record contains the time data, employee identification, task description, possibly new and old values of parameters that have been set.

This archive, unlike other archives, does not overwrite the data, i.e. after the archive is full, it is not possible to store in it and further modification of parameters is disabled. This archive cannot be shown on the display, contents can be viewed only by a PC.

7.3.8 Invoicing archive

Archive capacity: 15 records

The device contains an invoicing archive. This archive stores data with invoicing period specified in parameters of the device. Storing in the archive can be executed in following ways - single storing according to preset time or regular storing in intervals of 1, 2, 3, 4, 5, 6 and 12 months. At this time all actual statuses of counters of primary volume and converted volume are stored, including the overall counter and the counters of individual tariff zones.

The device allows to set the invoicing period interval and the time when next invoicing period starts.

7.3.9 Gas composition archive

Archive capacity: 150 records

If gas composition changes or the standard for gas compressibility changes, a record is stored in this archive. This archive stores the time data, information on the method used for compressibility calculation and the size of individual components of the measured gas. If the archive is full, new data starts to overwrite the oldest data.

7.4 Device parametrization

7.4.1 Parametrization using service SW

The device provides a very wide range of possibilities in terms of settings. Given the wide scope, the parametrization is carried out to full extent by using the supplied service SW [26] for PCs. In addition to setting the device, this software also allows listing, displaying, storing and printing both the actual values and the contents of archives.

The device does not allow setting of parameters directly using the keyboard, i.e. without using a computer.

7.5 Other properties of the device

7.5.1 Summer/winter time (DST)

The function changing the time format (summer/winter time) is implemented in the device. This function can be activated/deactivated using the service SW. When this function is activated, the device automatically changes the time based on the settings of the region where the device is used (Europe or USA). At the same time it is necessary to maintain correct operation by setting the deviation from the GMT. The archives in the device then show if the record was stored in summer or winter time.

7.5.2 Tariff counters

There are up to four tariff counters in the device that allow volume calculation according to preset schedule. There are two separate schedules (Tariff schedule 1 and Tariff schedule 2) which can be configured independently of each other; only one of them is active at a time. These schedules allow you to assign individual tariffs to individual time periods in individual days; it is also possible to define if the selected day is a workday, Saturday on Sunday (holiday).

Every schedule has its own identification number and you can adjust the time of activation for every individual schedule.

7.5.3 Remote download

Remote download of the firmware according to WELMEC 7.2 allows you to update the software in your device. For this case the firmware has a unique digital signature that can be used to overcome hardware block on the device. Firmware uploading can be done either locally by the optical head or remotely by the modem.

7.6 Securing the device against a change in metrological parameters

The device is equipped with metrological and service switch that protect the device from tampering, especially with the data influencing metrological properties of the device. It also utilizes password security system. Changes in device settings and other activities are stored in

in the settings archive. These means facilitate securing of the device in compliance, in fact even beyond the scope of the standard EN 12405-1.

7.6.1 Protection switch

There are two switches inside the device - metrological switch and service switch.

7.6.1.1 Metrological switch

- protects metrological settings of the device. It is located above the display, under the cover, on the motherboard inside the device (Fig. 5) and it is protected by a label that is secured by a security mark of the manufacturer (official metrological mark, see Fig. 6). It is a twin switch and therefore it is necessary to switch both parts.

7.6.1.2 Service switch

- is located on the right side, below the display (Fig. 5). The switch is twin as well, it is therefore necessary to switch both parts. You can use the user's mark to prevent opening of the device and thereby access to this switch, see Fig. 6.

Operation of the ***service switch*** depends on settings in device parameters that specify its function. The setting is done by a service program (Parameters -> Service switch function). The user can select what influence switching the switch will have on individual groups of parameters of the device.

This variability provides settings of various approaches to work with the device (e.g. remote setting of parameters via modem...).

Service switch - function

The user can use service SW to assign one of the three functions to the service switch.

switch function	*location*	*description*
full [1)]	OFF	Writing parameters in the device disabled.
	ON	You can write parameters in the device.
none	OFF	The position of the switch does not matter, you can write in the device. Protection by switch is disabled.
	ON	
partial	OFF	Writing in the device is blocked with the exception of writing of non-metrological parameters (e.g. archiving interval, communication parameters, station identification, system time setting, etc.). This kind of setting is adequate when transmitting the data remotely from the device. It is recommended to protect the use of the switch by passwords.

[1)] Means preset by the manufacturer (default settings)

	ON	You can write parameters in the device (the same as in the full function).

Table 6 Service switch setting

7.6.2 Passwords

The device uses password security system. Use of passwords can be limited depending on the selected communication protocol. Maximum number of passwords that you can enter into the device is 52. If the passwords in the device are on (see below), they must be used both during communication through the optical interface and through modem.

7.6.2.1 Password groups (valid for protocols ELGAS ver. 2 and CTR)

The passwords are divided into 5 groups. Users in the "Administrators" group have the most extensive rights, the users in "User 3" group have the most restricted rights. Higher group users have all the rights of subordinate groups and several additional ones. Every group can use up to 10 passwords (i.e. 50 passwords in total). Individual passwords are identified by three-digit numeric indication. The length of any password is limited to 6 characters maximum. User of any group can change his/her password. The group administrator (the user with the lowest ID in the respective group) can change passwords of all other members of that group. Administrator of "Administrators" group (ID=801) can change passwords of administrators of all other groups. Depending on the communication protocol used, following characters can be used for a password:

communication protocol	*available characters*	*Note*
ELGAS ver.2	letters a-z, A-Z, numbers 0-9	password length 1-6 characters distinction between small and capital letters (the password is case-sensitive)
CTR	digits 0 to 9 (the device allows you to write letters, but they are not accepted by the opposite station)	the password has to be 6 characters long (the device allows you to write a shorter password, but a shorter password is not accepted by the opposite station)

Password group	*Password ID identifiers*	*Description*
Administrators Administrators	801 to 810	When the metrological switch is in ON position, you can change metrological properties of the device: - upload new firmware using the "Loader" method - upload new firmware of MSP processor - reset metrological archives (settings archive, status archive, gas composition archive) - replace or calibrate the converter - create or discard metrological quantities

		- change the name or prefix of metrological quantities - set Tb and Pb - change the device status - change restrictions - set values for Vb, Vbs - set the schedule for the active tariff If the metrological switch is in OFF position, you can: - upload new firmware using the "Remote download" method - set the system time of the device, if it is used with CTR protocol (in other cases it is possible to adjust the settings for subordinate users)
Servicing Maintenance	811 to 820	- transition from "Maintenance" to "Normal" and vice versa
User 1 User1	821 to 830	Depending on the service switch function, the parameters are divided into groups. Service switch function described in 7.6.1.2 Parameters influencing metrological properties: - setting error values for compression ratio calculation - setting units for system quantities (Tb, Pb, combustion heat), base conditions for combustion heat calculation - selecting the DST mode (summer/winter time) - setting parameters for storing in the invoicing archive - the unit and constant of quantities, configuration of the pulse input of metrological quantities - setting the values of volume counters other than Vb or Vbs - assigning the service switch function influencing the writing of parameters - changing the method of compressibility calculation Other parameters: - adding or removing quantities other than metrological - setting parameters of non-metrological quantities - name, identification, unit, constant - storing in the related data archive - setting the connection of input quantity to the output by user equation - setting communication parameters - setting descriptive data - station name - setting the measuring interval and archiving interval
User 2	831 to 840	enables:

User2		- setting the system time (if using CTR protocol this setting is possible only for "Administrators" group)
User 3 User3	841 to 850	enables reading the data in the device (does not enable writing in the device) Setting the password (see above)

Table 7. Password groups and their meaning

Notes:
Administrator with password ID 801 is entitled to:

- set passwords for other administrators (ID 801 to 810)
- set passwords with IDs 811, 821, 831 and 841

The first user in every group (ID 801, 811, 821, 831 and 841) is entitled to assign passwords to other users of the respective group.

Enabling passwords

- by writing the password with ID 801

Disabling passwords

- by deleting the password with ID 801
  By deleting the password by ID 801 other passwords in individual group are disabled, but their settings are not lost. They become active again after switching passwords on.

7.6.2.2 Password for writing and for reading (for ELGAS ver.2, CTR and MODBUS-RTU protocols)

In addition to password groups (801 to 850) you can use two following passwords:

Password type	*Password ID identifier*	*description*	*note*
The password for reading	999	enables reading the data in the device	not used in MODBUS protocol, reading always enabled
Password for full access	1000	allows reading and writing of data in the device	MODBUS protocol: - digits 0 to 9 have to be used - this is the only password that can be used in MODBUS protocol

If you want to delete the password for full access (ID 1000), you must first disable password groups (by deleting ID 801 password) and delete the password for reading (ID 999).

7.6.3 Access levels

With regards to options of parameters modification and other operations with the device, the users of the device can be divided into various levels of access.

User level

- regular user of the device. It is allowed to read all the data in the device and set a large number of parameters on this level. You cannot change parameters that directly influence metrological properties of the device. Detailed description in Table 8. You can use the protection by a service switch together with user's mark and password security system in order to prevent tampering.

Authorized service centre (ASC)

- intended for the personnel of the service centre authorized by the manufacturer. The centre is entitled to carry out operations with the device that are related to its metrological properties. These activities are subject to breach of the official mark and switching of the metrological switch. Description in Table 9.

User level			
activity		***service switch position***	***authorization to use passwords in activities***
data reading	- reading of actual values of quantities - reading archives - reading parameters	OFF, ON	• enabled with disabled passwords • enabled with enabled passwords upon entering the "password for reading"[2]
non-metrological changes in parameters	- enabling/disabling archiving of individual quantities in individual archives - setting the measuring interval - setting the archiving interval for the data archive - change of passwords - resetting the archives - setting the internal time of the device - setting communication parameters - setting the station identification - setting the hour at which the gasworks day begin - enabling/disabling the display of actual values of non-metrological values on the display - configuration of digital inputs - configuration of digital outputs - option of user defined quantities indication	ON	• enabled with disabled passwords • enabled with enabled passwords upon entering the "full access"[2)]
metrological changes	- assigning the service switch function influencing the writing of parameters - setting counters of V and Vs - changing the method of compressibility ratio calculation - setting the gas composition - setting the measuring units and constants - setting error values of temperature and pressure for the conversion	ON	

[2]) the effect of activated codes can be cancelled by HW key WGQOI, ("Service" version)

Table 8 User level of access - for the "full" function of the service switch

The level of authorized service centre (ASC)			
activity		***metrological switch position***	***activity allowed when***
	- all activities described in the user level - setting the status bit mask (quantity Diagnostics)	OFF, ON	*Note:* If you use the HW key, the function of passwords is suppressed (if they are used in the device).
metrological changes	- firmware upgrade - changing the type of metrological approval (NMi, ČMI, MID,...) - setting the base temperature - setting the base pressure - setting counters of Vb and Vs - configuration of metrological quantities (C, K, Vm, Vb, Vs, Vbs) - converter replacement - one-point or two-point converter adjustment - resetting the settings archive and status archive - option of user defined quantities indication	ON	

Table 9 ASS level of access

8 Operating the device

The device is fitted with a two-line user LCD display that displays various data.

The device is not equipped with a power switch; if there is a battery inside the device (B-02), it is automatically switched on and the display is permanently lit. If the B-02 battery is disconnected or discharged, the display turns off.

The device is also fitted with a two-key keyboard that is accessible upon the opening of the lid of the device. Use of these keys significantly extends options for displaying additional information about device settings, status and diagnostics.

Standard view

During standard operation with the lid of the device closed and the keys are idle (none of them has been pressed), the display automatically displays actual values of measured and calculated variables. These values are displayed consecutively and regularly. They appear in the second line of the display, while the values of desired variables can be set by the user.

Standard view characteristics

- standard view - regular displaying of actual values of user-selected measured or calculated variables
- the length of display of each variable is 5s, in the case of standard volume Vb the length is 15s
- displaying without diacritical signs

Displaying using keyboard buttons

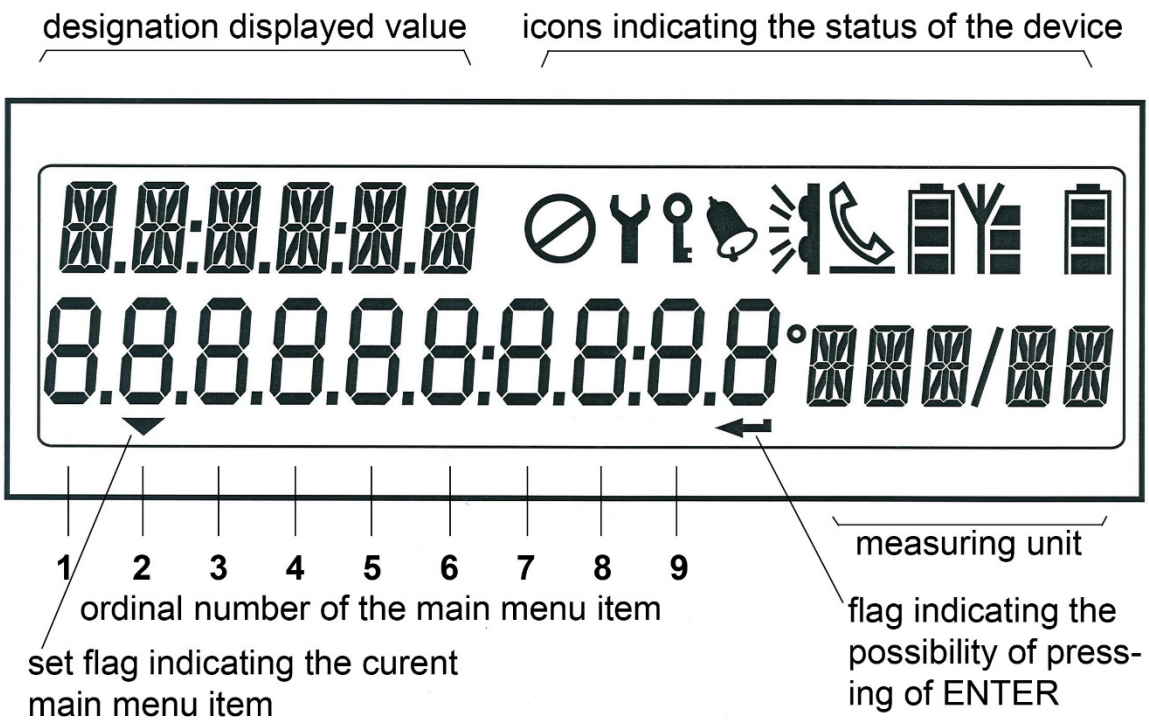
Using the keyboard buttons (with the lid open) you can display apart from actual values and calculated data various device parameters, system data and diagnostics including the information about the status of the built-in GSM/GPRS modem. Selection of displayed data is carried out in the menu of the device (see 8.4). Displaying of menu items depends on parameter settings. The contents of some items in the menu can be configured by user.

Display properties

- in accordance with the standard EN 12405-1+A2 section 6.3.1.5 the display changes to the basic display. Parameters allow you to change the interval, after which the device should change to the basic display.
- The service is made easier for untrained users by the possibility of displaying gradually actual values by pressing RIGHT (for description of keys, see Section 8.2). Prior to that it is necessary to return to the highest menu level (Vb) by pressing ESC key multiple times.

Displaying the data stored in archives and performance of changes in settings of the device cannot be facilitated through the keyboard; these actions can be carried out only using service SW [26] running on a PC connected to the device.

8.1 Display



	indication of the operating status “Not Configured”
	indication of the operating status “Maintenance”
	indication of the status of the metrological and service switch light is on: - metrological or service switch is ON
	Indication of the cumulative status of the device. no display: - status is OK light is on: - Warning or Error
	Communication channel of the device switches to the optical interface. light is on: - the infrared head is attached
	Communication channel of the device is controlling the GSM/GPRS modem. Communication is facilitated by dialled connection in the GSM network. light is flashing: - establishing a connection light is on: - connected

	Communication channel of the device is controlling the GSM/GPRS modem. Communication is facilitated in GPRS mode. lower dash is flashing: - establishing a connection lower dash is not flashing: - logged in GPRS
	Status of the battery of the GSM/GPRS modem. The indicated battery capacity according to number of black boxes displayed: number of boxes: 3 2 1 0 capacity: ≥75% 50÷74% 25÷49% <25%
	Indication of GSM signal strength on the site. The indicated signal strength according to number of black boxes displayed: number of boxes: 3 2 1 0 signal strength: ≥75% 50÷74% 25÷49% <25%
	Status of the battery of the device. The indicated battery capacity according to number of black boxes displayed: number of boxes: 3 2 1 0 capacity: ≥75% 50÷74% 25÷49% <25%

Table 10 Meaning of Display Icons

8.2 Keyboard

There is a keyboard to control the device on the front side under the cover of the device. The keyboard constitutes of two buttons. Depending on the length of pressing each button has two meanings.

`Left key`	***Short pressing:*** At the current level of display movement to the left, i.e. move to the previous entry. Hereinafter to referred to as **LEFT key**. ***Long pressing (2s):*** Move from the current menu level to a higher level. Hereinafter to referred to as **ESC key**.
`Right key`	***Short pressing:*** At the current level of display movement to the right, i.e. move to the next entry. Hereinafter to referred to as **RIGHT key**. ***Long pressing (2s):*** Move from the current menu level to a lower level (submenu). Hereinafter to referred to as **ENTER key**. ENTER key is used for transition to lower level and for selection of functions or variant view (e.g. to display the decimal part when displaying volume). The user is informed by the arrow on the lower line on the display if it is possible to press ENTER key.

Fig. 13 Function of keys

8.3 System menu

Data to be displayed on the display are structured using a menu. For the purposes of further descriptions we call the basic items in the main menu the highest; by going into these menus you can reach the lower levels of menu (submenu).

8.4 Main menu

The menu depends on the parameters set in the device, the set of following items may change according to the settings of the device.

The main menu consists of seven items. The main menu can be displayed from the homescreen (Vb) by long press of the bottom key (ENTER). You can browse through items by short press of some of the keys (LEFT, RIGHT). If any of the items in the main menu contains a submenu (e.g. PARAM or SYSTEM item), the menu will go to the submenu upon pressing ENTER.

serial number	main menu	1st submenu	2nd submenu	3rd submenu	note
1	**VB**				the actual value of the volume counter Vb
2	**ACTUAL**				displaying the actual values

		VB			status of the converted volume Vb Press ENTER to display the decimal part of the value of Vb.
		VM			status of the operating volume counter Vm Press ENTER to display the decimal part of the value of Vm.
		P			actual value of gas pressure
		T			actual value of gas temperature
		Q			actual value of the operating flow Q
		QB			actual value of the standard flow Qb
		C			compressibility factor
		Z/ZB			
		VBS			status of the error counter of converted volume Press ENTER to display the decimal part of the value of Vbs.
		VMS			status of the error counter of operating volume Press ENTER once more to display the decimal part of the value of Vs
		... etc.			further items depend on the configuration of the device.
3	**USER1**				user-defined view
4	**USER2**				user-defined view
5	**PARAM**				displaying the parameters of the device
		COMMUN			communication parameters
			SPEED		communication speed (optical interface)
			ADDR		device address (Address 1, Address 2)
			PROT		set communication protocol of the device
		SERV			service parameters
			S.N.		serial number of the device
			FW VER		firmware version
			STNAME		station identification
		CONV			gas conversion parameters
			STAND		method of compressibility calculation
			PB		base pressure value
			TB		base temperature value
			ZB		gas compressibility factor at base conditions
			GAS		gas composition parameters
				CO2	$CO_{2\ volume}$
				H2	$H_{2\ volume}$
				N2	$N_{2\ volume}$

				DENS	relative density
				CALOR	Combustion heat (calorific value)
			PSPARE		error pressure value
			TSPARE		error temperature value
			ZSPARE		error gas compressibility factor value at measurement conditions
			PRANGE		pressure range
			TRANGE		temperature range
		INPUTS			
			PRANGE	PS.N.	pressure range Press ENTER once more to display the serial number of the conversion device (PS.N).
			TRANGE	TS.N.	temperature range Press ENTER once more to display the serial number of the conversion device (TS.N).
			GASKP	GASSN	gas meter constant [pulse/m3] Press ENTER once more to display the serial number of the conversion device.
6	**SYSTEM**				system parameters
		TIME			system time Press ENTER to display the system date.
		TEST			- runs the internal test of the device (upon pressing ENTER) - runs the display test (upon pressing ENTER once more)
		RESET			device reset (upon pressing ENTER)
		MODEM			modem parameters
			GPRSIP		current IP address of the GPRS modem
			MODERR		code of the last modem error and the time of occurrence (format Err.xx hh:mm DD.MM.YY) “xx” - modem error message code (see Section 6.3, Table 3)
			SIGNAL		GSM signal strength measurement initiated using the keyboard. Displays the status of measurement: BTS:test BTS:roam BTS:connect BTS:search BTS:no

					BTS:denied After a successful measurement of signal strength the value will appear in % (SIG:xx [%], conversion to dBm – see Table 4). Automatic termination after two minutes or by the user.
			MOD ON		when turning the GSM/GPRS on using the keyboard - depending on the mode it will turn on, or turn on and connect to GPRS - displays the time in seconds remaining until the automatic termination and shut-down of the modem - automatic termination after five minutes or by the user
			CALL		manual initialization of GSM/GPRS call from the device to a superior system - must be enabled in parameter settings - after activating the command, “working” message will appear - then you can leave the mode and the device will carry out the action
			PACKET		Displays the number of sent packets during active or last communication.
		BAT			the remaining battery capacity [%]
		BATMOD			the remaining battery capacity [%]
		LATCH			Displays and freezes actual values on the display. This function is used in the device functionality tests in the field (so-called short test).
7	**DIAG**				device diagnostics
		ACT			the current status of the device will appear (browse using the ENTER key)
		SUM			the calculation status of the device will appear (browse using the ENTER key)
		RESSUM			resets the calculation status

Note:

The number of displayed characters (digits) is limited by the display to 10. If you need to display a piece of information of more characters (e.g. STNAME item - station identification), the displayed information will scroll.

8.4.1 ACTUAL menu item - displays actual values

(serial number 2 in the main menu)

Actual values of metrological quantities and set non-metrological quantities (you can set the view of non-metrological quantities in the device parameters using the service software [26]).

Fig. 14 Example of V_b (197.759 m^3) actual value display

Limit exceeded indication

If the device measures a value outside the measuring range of the device for a certain quantity, "**E**" symbol will appear before the figure.

8.4.2 SYSTEM menu item - system data

(serial number 6 in the main menu)

TEST - test of the device

Upon selecting this menu item the device runs a test of its internal condition (indicated by displaying "WORKING") and it lists all detected errors and warnings on the display. The test takes about several seconds and it does not have any influence on the measuring and archiving operation of the device. The command is executed regardless of service switch position.

During the test warnings are being shown on the display. Indicated errors are marked with a prefix "E" and an identification number; similarly, for warning messages the prefix "W" is used.[3] Complete list of errors and warning messages - see Table 11 and Table 12.

Display test

After the end of test you can run the display test by pressing ENTER. All displayable segments of the display will light up (Fig. 14).

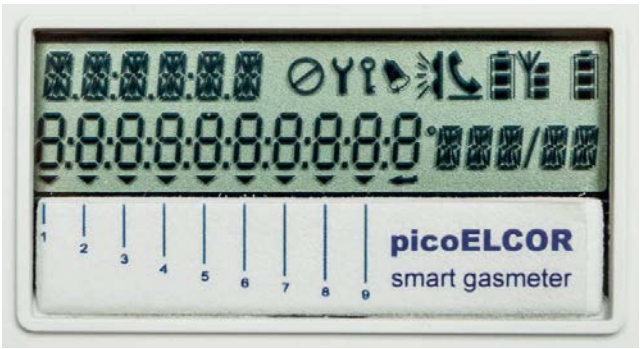


Fig. 15Device Test

[3] In order to limit displaying of characters on the customer display "W" character is displayed as "U".

RESET - device reset

After selecting the reset option the program will jump to a starting address and it will reinitialize complete measuring system. Contents of all archives and statuses of all gas volume converters (Vm, Vs, Vb, Vbs) do not change during this operation. Neither do the other specified parameters change. The command is executed regardless of service switch position.

LATCH – freezing the actual values

The measured values freeze on the display of the device upon the press of the button. You can display frozen values of individual quantities (VB, VM, P, T, etc.) in the standard way as if displaying actual values. If you want to terminate displaying of frozen quantities, press ESC key.

LATCH function is advisable e.g. when writing down the values of actual measured quantities when checking the device accuracy.

8.4.3 DIAG item menu - device diagnostics

(serial number 7 in the main menu)

DIAG menu contains information on gas meter status.

ACT.ST - actual status

In this menu the actual status of the device is displayed. By pressing RIGHT key all actual errors and warning messages will be displayed.

SUM.ST - summary status

Summary status is used to monitor occurrence of active error conditions (individual device status bits) since the last initialization of the summary status. That means that this function stores statuses which have already ceased to exist.

Basic information on the state of summary status is displayed in the form of a “bell” icon on the display.

RESSUM - summary status initialization

If you carry out this option using the keyboard or by selecting “Clear summ. status” in the “Setup ->Status (diagnostics) of device” menu from the PC with service SW, the summary status will be initialized, i.e. the current state will be set according to the actual status. To allow the initialization the service switch must be in ON position. If switched OFF, a message “Not possible” will appear saying that initialization cannot be done.

8.5 Display device errors

Error messages are displayed in “ACT” and “SUM” menu. Autodiagnostics runs regularly; complete test of the device runs once a day; test of sensors confusion runs once per hour or irregularly at the startup of the device.

The resulting status of summary diagnostics appears on the display in the form of “bell” icon. You can display diagnostic information in more detail using the service SW [26].

8.5.1 Device status word

The actual status of the device is stored in the status word of the device. The status word has 64 bits. If the monitored bit changes the complete word is saved in the Status archive.

8.5.2 Device status word stored in data archives

A compact status word for storing in data, daily or monthly archive is defined in the device. The information about whether the specific bit was set in the active state in the archiving interval, is stored in archives. Individual bits are calculated as the sum of relevant bits of the Device status word. Meaning of individual bits is described in Table 13.

Display	***Description***
E0 CRC program	Error in the firmware checksum.
E1 CRC loader	Error in the loader checksum.
E2 CRC parameter	Error in the checksum of device parameters.
E3 memory error	Device memory error.
E4	*- not used -*
E5 setup full	Settings archive full.
E6 sensor change	Sensor was replaced for a wrong one or its parameters were changed.
E7 sensor commun.	Error in communication with the sensor.
E8 sensor failure	Sensor error.
E9 bat. volt. low	The battery is flat (remaining capacity is approx. 10%).
E10 compres.tab.	Error in compressibility table calculation due to input parameters.
E11 compres.fail.	The compressibility calculation cannot be carried out because the range specified by the applicable standard for compressibility calculation was exceeded
E12	*- not used -*
E13	*- not used -*
E14 P1 min limit	the measuring range exceeded
E15 P1 max limit	
E16 P1 failure	
E17 T1 min limit	
E18 T1 max limit	
E19 T1 failure	
E26 time synchronization (RTC)	RTC synchronization error, shift > 2 hours was requested
E27 modem battery capacity	Modem battery error - low capacity.
E28 encoder error	Encoder (optical speed sensor) error
E29 CRC metrology	Error in the check sum in the metrological part of the firmware
E30 CRC tab.	Error of the table check sum (gas meter, bar. pressure, etc.)
E31 FRAM error	FRAM memory error
E32 FASH error	FLASH memory error

Table 11List of Events - Error Messages (Err indications)

Display [4]	***Description***
W0 sensor warn.	One of the connected converters has an active warning message. Details can be found by listing the converter parameters.
W1	*- not used -*
W2	EPROM error in the battery of the device
W3 overcur.term.	There is a current overload.
W4	*- not used -*
W5	*- not used -*
W6 setup archive crowded	Settings archive is 80% full.
W7 tamper1 fault	Contact 1 disruption active.
W8 tamper2 fault	Contact 2 disruption active.
W9 P1 min threshold	user ranges exceeded
W10 P1 max threshold	
W11 T1 min threshold	
W12 T1 max threshold	
W13 Q1 min threshold	
W14 Q1 max threshold	
W15 Qb1 min threshold	
W16 Qb1 max threshold	
W17 C1 min threshold	
W18 C1 max threshold	
W29 EEPROM modem battery	EPROM error of the modem battery.
W30 modem battery voltage	Modem battery voltage error.
W31 communication error	Communication error
W32	The lid is open
M0	without configuration (maintenance mode)
M1 maintenance	maintenance mode (maintenance)

Table 12 List of Events - Warning Messages (Wrn indication)

bit	***Display***	***Description***
0	General error	General error of the device.
1	General warning	General warning of the device.
2	-----	*- not used -*
3	TAMPER active	Contact disruption active.
4	Calculation error	Conversion error occurred, conversion carried out by error counters.
5	Transducer error	Converter error occurred.
6	Value out of range	The value of temperature or pressure lies outside the converter range.
7	Value out of limits	The value of temperature or pressure lies outside user-defined range.
8		Temperature t outside the allowed range
9		Pressure p outside the allowed range
10		Maximum flow exceeded

[4] In order to limit displaying of characters on the customer display “W” character is displayed as “U”.

11		Battery voltage low
12		Settings archive is 90% full
13		Settings archive full
14		Time synchronization error
15		MAINTENANCE work mode

Table 13 Compact Device Status Word

8.6 Short test

After the installation of the device the device checks functionality and accuracy of the conversion, so-called short test. This test runs both periodically and during the operation. During this exam it is necessary to subtract the actual values measured at the same time. The device has a built-in support for such request. The SYSTEM menu contains LATCH command that ensures subtraction of actual values and it “freezes” the subtracted values in order to display them continuously on the display for purposes of the check of device accuracy calculation.

9 Device assembly

9.1 Installation

Gas meter is among designated electrical and gas equipment. Only a worker with ITI authorization can perform installation of a gas meter. Assembly of electrical equipment may only be performed by a worker fulfilling the conditions specified in the Regulation No. 50/78 Coll., section 6 (or higher) for class B electrical equipment.

Follow the following instructions to prevent injuries to persons or damage to the gas meter during installation and operation:

- Observe the maximum allowed primary pressure p_{max} and measuring range Q_{max}, see Section 13.
- Observe the maximum allowed ambient temperature t_m and gas temperature t_g, see [Marking plate] or Section 13
- The gas meter is suitable for mechanical conditions specified for M1 class according to Directive 2004/22/EU.
- Outlet for pressure measurement is secured by a yellow seal sleeve. The sleeve may be opened only in order to connect a pressure measuring device.
- Use sealing made of approved materials. Seal made from elastomer or flat asbestos-free seal manufactured by Elster are recommended.
- For high-heat-resistant gas meters you can use only seals tested for resistance to high temperatures.
- Use the seals only once.
- During installation and operation observe the national legislation and directives of gas companies. In Germany a worksheet DVGW G600 (DVGW-TRGI) is valid.
- Gas meters marked with Ex can be installed in potentially explosive atmospheres only by a person with appropriate qualifications.
- It is necessary to take into account equipotential bonding of gas meters with Ex indication; e.g. by connecting them to grounded piping. Installation has to be carried out according to EN 60079-14.
- Ex marked gas meter must be protected from falling objects.

If the gas meter is stored or installed in the open air, it is necessary to protect the site from rain.

The gas meter (or its magnetic coupling) fitted with an electronic index is protected against the ingress of moisture and it is therefore suitable for outdoor installation.

A. Remove the protective covers

- Vertical installation position: connecting ports face upwards.
- Observe the direction of gas flow (arrow).
- The gas meter must not touch a wall or other objects.
- Make sure there is enough space for installation.
- Ensure free view on the counter.
- Sealing surfaces on screwed connections must be clean and must not be damaged.

- Follow seal manufacturer's information regarding compression of the seal and related tightening torques.
  http://www.docuthek.com/For recommended flat seals in connection with the screwing use torques according to DIN 3376-1 and 3376-2, see www.docuthek.com — Elster-Instromet — Produkte — Gasmessgeräte — Balgengaszähler — Ergänzung für Betriebsanleitung BK, Verschraubungen und Anzugsmomente für BK-G1,6 bis BK-G25 (Additional information to BK gas meter operating instructions, Screwed connection and torques for BK-G1,6 to BK-G25) (D).

B. Install the gas meter without tension.

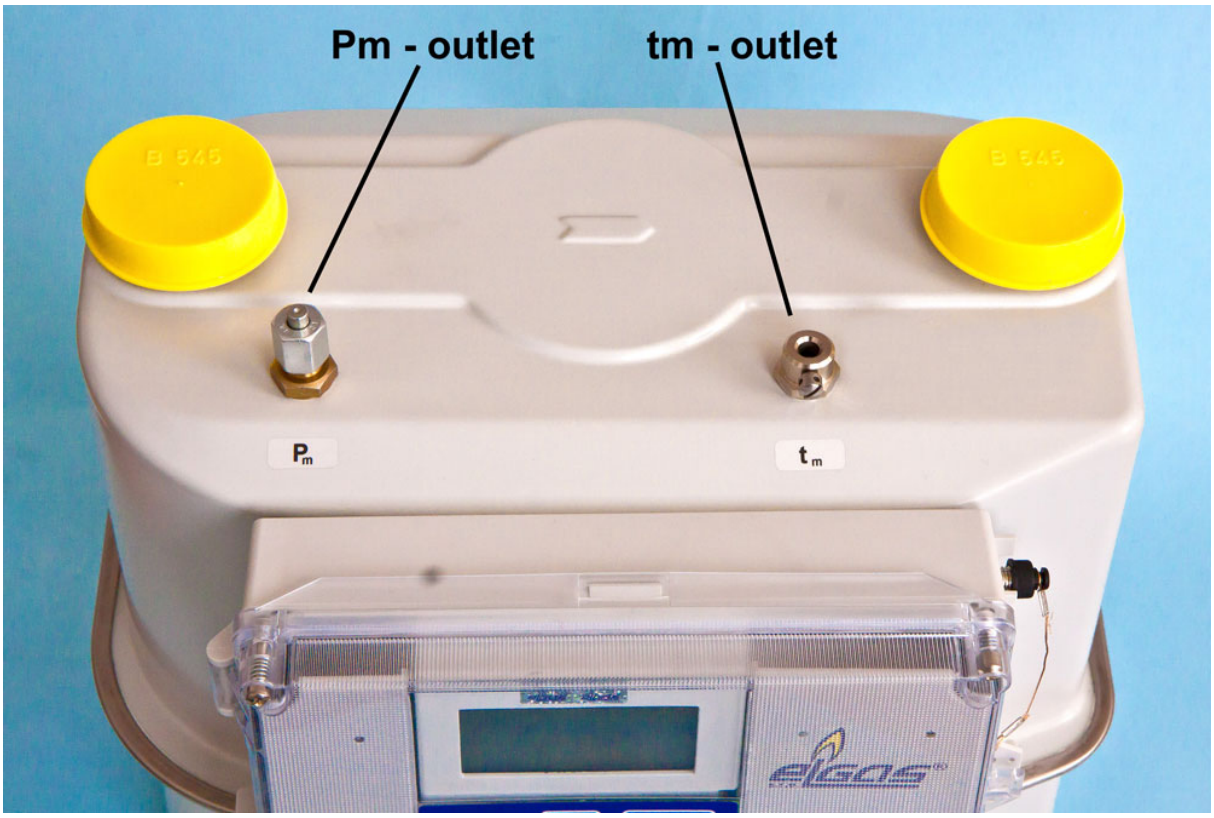
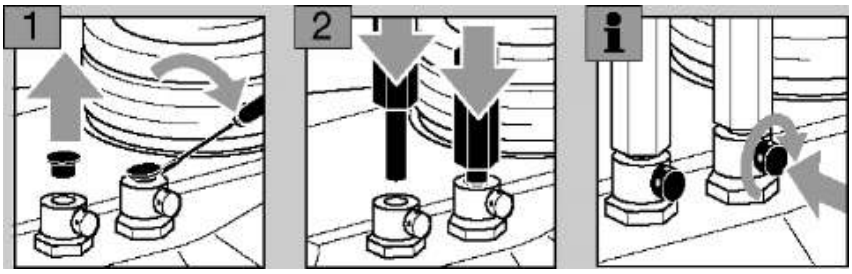


Fig. 16 Pm and Tm gas meter outputs for check measurement

9.2 Outlet for check measurement of temperature (tm outlet)

If you want to measure gas temperature in the gas meter casing for check purposes (so-called Shortened test), insert a temperature sensor in the temperature well on the top of the gas meter.



C. Temperature sensors are fastened by cross-recessed hollow screw bolt.

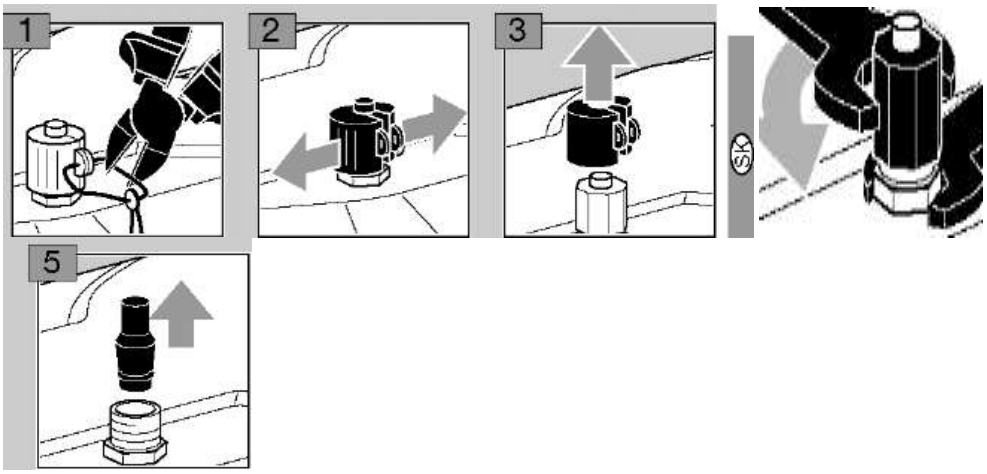
9.3 Connecting the outlet to check pressure (Pm outlet)

CAUTION

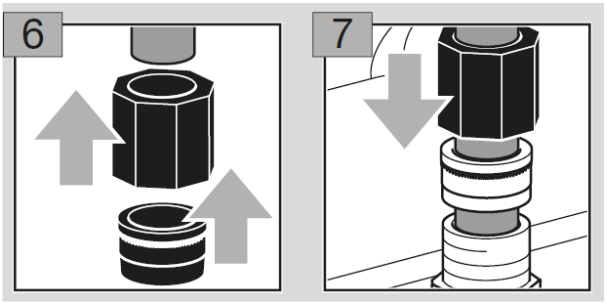
To ensure tightness of the gas meter:

- Pressure measurement outlet must not be twisted, bent or deformed in any other way.
- Always hold the outlet in place by a corresponding screw wrench during the installation.

- Safety operation will only be guaranteed if the materials of screw connection correspond to the outlet for pressure measurement.
- Use only the supplied shaping ring and cap nut. Shaping ring is mounted on the seal sleeve.
- In additional ordering use the original screwed connection Parker EO.



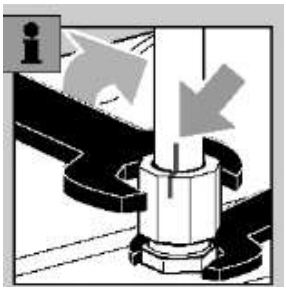
- Use corrosion-resistant, seamless drawn steel pipe according to DIN EN 10305-4 (external diameter 6mm, material E235 = 1.0308). With other materials use a suitable adapter and consider the recommended Parker/EO.
- Connect the conduction without tension.



8 Tighten the cap nut by hand until it stops.

While doing that, strongly press the end of the tube towards the end stop.

9 Mark the position of the cap nut and tighten it by 1 and a half turn.



If you repeat the installation, the cap nut will return in its original position and then it will tighten of about 30°.

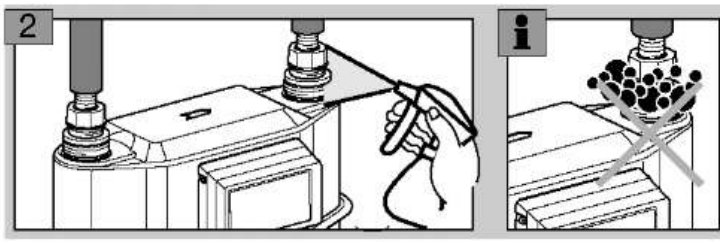
10 After you finish the installation and sealing test [Tightness test], secure the pressure measurement outlet by a seal sleeve and by a seal protecting against outside interference.

9.4 Tightness test

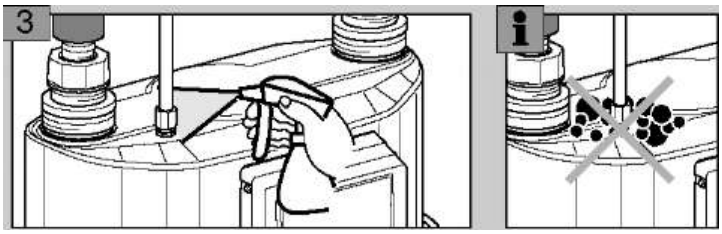
If the piping is tested by a greater trial pressure than the maximum allowed primary pressure p_{max} of the gas meter, you need to check the piping for tightness first. Otherwise the gas meter can be damaged.

Customer gas installation must be closed.

1 Slowly increase the pressure in the gas meter up to the required test value.



If the gas meter was additionally equipped with a coupling for pressure measurement, this connection has to be tested for tightness.



4 After finishing the test slowly decrease the pressure in the gas meter.

5 If the diaphragm gas meter is sufficiently provided with a pressure measurement connection, the outlet for pressure measurement has to be sealed by a seal sleeve and a seal protecting from outside interference.

10 Commissioning

After a successful tightness test the gas meter is ready for operation. However, you have to set certain parameters of the gas meter before you put it into operation. Slowly open the ball valve.

10.1 Device configuration

The device is supplied with pre-set configuration parameters. However, you have to set certain parameters after the mechanical installation of the device in order to ensure proper operation of the gas meter. The sequence of activities before commissioning is as following:

- Connecting batteries
- Inspection (or setting) the system time of the device
- Setting the consumption site identification
- Setting error values of temperature and pressure
- Setting the gas compressibility calculation method
- Setting the gas composition
- Diagnostics check, correction of potential errors, summary status initialization
- Device archive reset

These activities can be carried out using a PC with the service program [26]. If you use a PC, you need to connect the gas meter with the computer by an infrared head (HIE-04 or HIE-03). If necessary, other gas meter parameters can be set (Pulse output settings, etc.).

Caution

During the communication with the device through an infrared head the lid must be closed.

10.1.1 Connecting batteries

The device is supplied with disconnected batteries. First you have to connect the battery powering the electronics of the counter (B-02) and the battery powering the communication modem (HB-02). Both batteries can be connected/disconnected in potentially explosive atmospheres.

10.1.2 System time and gasworks hour setting.

After you insert the B-02 battery the display activates. The initial display with rotating data according to device settings will light up. The device status is indicated by icons in the upper right corner of the display (see section 8.1).

Note

The device can be set up by the manufacturer to accept summer time. It is therefore necessary to specify the current summer time according to these settings. Otherwise the time in the device is set as CET.

Check the so-called gasworks hour data as well. This value defines the initial hour of the so-called gasworks day. For gas consumption billing purposes the gas consumption

assessment is not based on the standard initial hour of the day (0 h), but on the beginning of the gasworks day (e.g. 6 h). Setting the gasworks hour influences the data on gas consumption that are being stored in the daily and monthly archives.

10.1.3 Setting the consumption site identification

Character string of maximum length of 16 characters can be used for the identification of the consumption site (station name).

10.1.4 Setting error values of temperature and pressure

Error pressure or temperature value is used if the measured value of temperature or pressure cannot be used for the calculation of the conversion number C and compressibility, e.g. due to exceeding the measuring range or sensor error (see Section 4.4.1).

10.1.5 Setting the gas compressibility calculation method

One of the following methods can be selected:

AGA NX-19 mod, AGA 8-92DC, SGERG-88, AGA 8-G1, AGA 8-G2.

10.1.6 Setting the gas composition

You can set the values [%] for individual gas components; or you can set the relative gas density at the pressure of 101.35 kPa and temperature 0°C and the combustion heat at (25/0) °C. The individual components of the gas can be viewed on the display. The number of components depends on the set method of compressibility calculation.

10.1.7 Diagnostics check, correction of potential errors, summary status initialization

Check the device for any potential errors and correct them (if there are any) before you finish setting the device and resetting archives. The actual status and summary status are checked (for further reference see 8.4.3).

Viewing diagnostics and summary status initiation can be done using the keyboard or using the PC with service software.

After pressing the DIAG->ACT.ST. the actual status of the device is displayed. If there is an error indication in the device, its numeric code with prefix E (possibly W) is displayed; (see Table 11 and Table 12). These errors have to be corrected.

Similarly, you can display the summary status of the device by pressing DIAG->SUM.ST. If you correct the current errors and the summary status indicates errors, you have to reset the status. If the summary status is reset (i.e. is OK) then the icon on the display is not lit.

10.1.8 Device archive reset

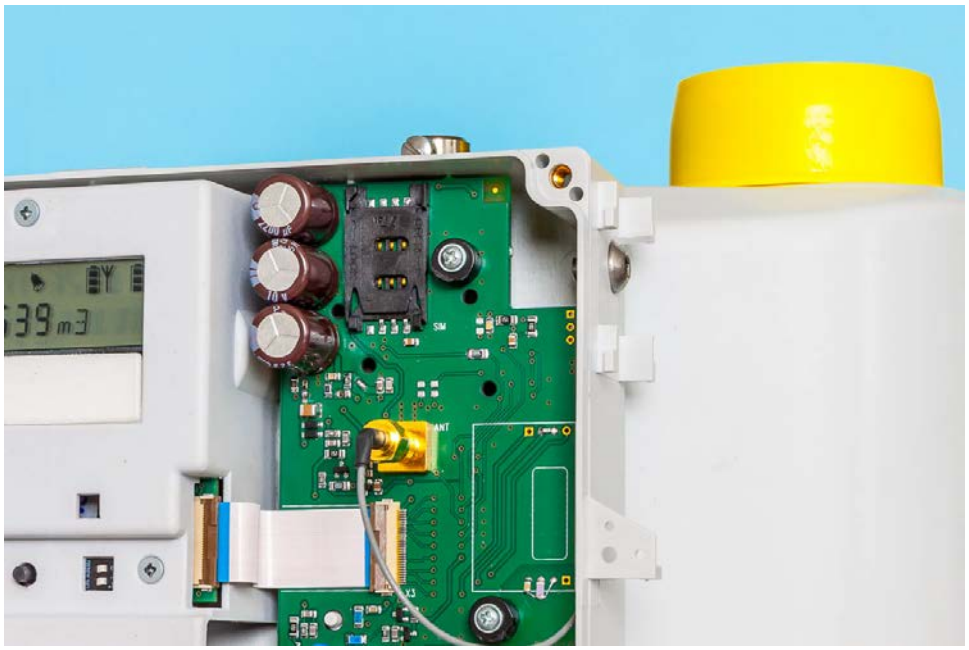
At the end of the installation the archives are reset. Every archive can be reset individually.

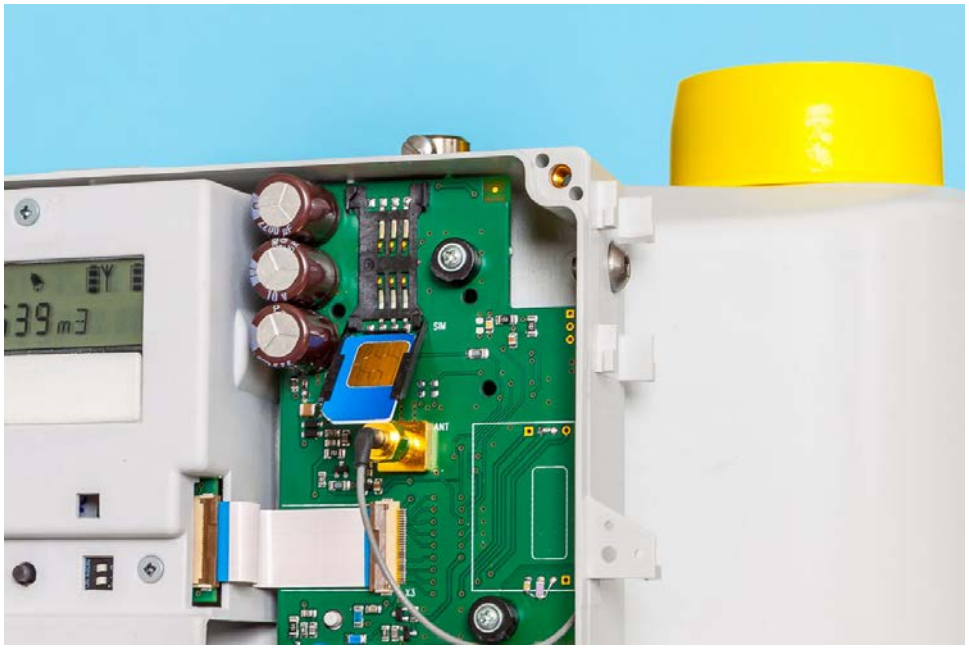
10.2 Modem communication check

If you want to check the communication via the built-in GSM/GPRS modem, you have to input certain settings using the PC with SW [26] connected through an infrared head.

SIM card installation

If you need to check GSM/GPRS modem communication, the modem in the gas meter has to be equipped with a SIM card. Open the cover of the gas meter. Open the SIM card holder (move the movable part of the holder to the left and open it). Insert the SIM card, push it to the board and secure it by sliding the holder up.





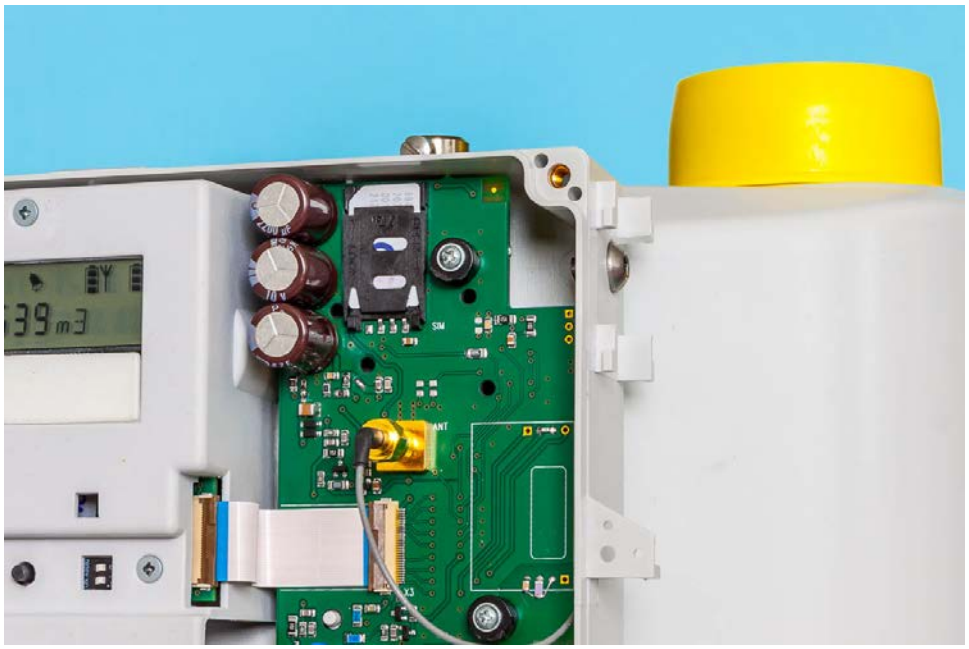


Fig. 17 Inserting the SIM card into the holder

The settings of the device have to allow modem communication. i.e. using the service program [26], go to Basic parameters on „Communication“ card. Choose other option than “None” in Modem box.

10.2.1 BTS connection check, signal strength measuring

The initialization string for modem has to be set correctly to ensure proper operation of this utility. It is recommended to set the string “AT” in **INITIALIZATION** box (without inverted commas).

Now you can check the connection to mobile network from the device menu SYSTEM->MODEM->SIGNAL.

Then the modem switches on and initializes. After a successful connection to BTS the signal strength on the place of installation and basic information on BTS connection will display. In the case of error you can display the error code by selecting SYSTEM->MODEM->MODERR (see Section 6.3 for further info).

10.2.2 Communication check by calling the device

Leave the “AT” settings in **INITIALIZATION** box.

If you use GPRS communication, two additional communication parameters have to be set in the device. These are “Dial number” and “Special initialization”. Their specific settings depend on the mobile operator and the specific network.

Example of settings for the public network (T-mobile):

DIAL NUMBER: ATD99***1#

SPECIAL INITIALIZATION: AT+CGDCONT=1,“1P“,internet.t-mobile.cz“

If you want to check by calling from a dispatching to the device, the modem has to be switched off. You can switch the built-in GSM/GPRS modem on by selecting SYSTEM->MODEM->MOD ON. The modem will be switched on for 5 minutes (default). The time remaining until the shutdown of the modem [s] is counted down on the second line of the display. You can initiate connection with the device in this interval by calling from the dispatching.

10.2.3 Communication check by calling the device from the dispatching

The parameters for initiation of connection with a dispatching station have to be set in parameter settings of the device. The form varies depending on the type of connection (GSM or GPRS).

GSM connection: Enter ATDxxxxxxxxx into the “Dial number” box (x stands for the phone number of the dispatching).

GPRS connection: Leave the contents in boxes “Dial number” and “Special initialization” according to the settings in 10.2.2. Add the IP address settings and port number of the remote dispatching in the device.

Check if the option “Enable call to dispatching” is enabled in communication parameters.

You can connect to the dispatching using the device menu SYSTEM->MODEM->CALL. Ask the dispatcher if the connection was fine.

11 Maintenance and disassembly of the device

Gas meters picoELCOR G10/16/25 do not require maintenance.

- When deployed in calibrated facility, recalibration has to be carried out in compliance with national regulations.
- If the screwed connection loosens during the maintenance or revision, the seal must be replaced for a new one.
- After disassembling the gas meter, put protective caps on the pipes immediately to prevent ingress of dirt.

Caution

The gas meter can contain residual quantity of gas. It is necessary to carry out safety measures regarding the risk of explosion:

- After disconnecting the gas meter has to be thoroughly purged by inert gas.
- If you need to transport the gas meter with residual quantity of gas, use a car with open or ventilated storage space.
- It is allowed to open the service cover of the electronic counter, e.g. when replacing a battery.

12 Accessories

12.1 Accessories not included in the price of the device

- HF cable reduction to the modem (see Fig. 10)
  - length 9cm, SMA(m) connectors angular cable – SMA(f) panel angular
- GSM Stick 90° Antenna, Dual-band, 2dB
- GSM Magnetic Antenna, Dual-band, 3dB, cable length 3m
- GSM Magnetic Antenna, Dual-band, 5dB, cable length 3m

13 Technical parameters

13.1 Smart diaphragm gas meter picoELCOR G10/16/25

Flow rate, dimensions, weight

Type	Qmax	Qmin	Qt	V	Connection	
	[m3/h]	[m3/h]	[m3/h]	[dm3]	DN	Thread*
picoELCOR G10	16	0.1	1.6	6	25	1 1/4“
					32	1 3/4“
					40	2“
picoELCOR G16	25	0.16	2.5	6	40	2“
picoELCOR G25	40	0.25	4.0	12	50	2 1/2 “

Type	Dimensions [mm]					Weight
	A	B	C	D	E	[kg]
picoELCOR G10	250	320	85	243	334	5.3
	280	330	108	259	405	6.9
	280	330	108	259	405	6.9
picoELCOR G16	280	330	108	405	259	6.9
picoELCOR G25	335	398	138	465	313	11.2

* ISO 228-1

Environment		
- protection	…	IP65 (under CSN EN 60529)
- environment class	…	M1 / E2
- range of operating temperatures	…	-25 °C - +55 °C
- storage temperature	…	-25 °C to +60 °C
- operating position	…	vertical, screwing facing upwards
Metrological parameters		
- type approval mark	…	TCM 143/13 – 5018 (according to MID)
Operating conditions		
Medium	…	natural gas
Maximum primary pressure	…	0.5 bar
Resistance to contamination	…	RPF = 0.8
Explosion-proof execution		
- type identification	…	Ex II -/2 G IIA T3
- environment class	…	Zone 1, Zone 2
Electronic counter:		

Power supply		B-02 battery
- battery type	...	lithium 3.6V/17Ah
- battery life	...	15 years
- battery voltage	...	2.8 ÷ 3.6 V
- measurement of battery life	...	yes, warning when the capacity drops to 10%
Power supply of the communication part (GSM/GPRS)		HB-02 battery
- battery type	...	lithium 3.0V/12Ah
- battery life	...	5-15 years [5)]
- battery voltage	...	2.0 ÷ 3.0 V
- measurement of battery life	...	yes, warning when the capacity drops to 10%
Conversion parameters		
- principle	...	PTZ
- maximum total conversion error	...	< 0.5% of the measured value
- typical total conversion error	...	0.15% of the measured value
- compressibility factor calculation error	...	< 0.05 %
- compressibility factor calculation	...	AGA-8 92DC, AGA NX-19 mod, AGA 8-G1, AGA 8-G2, SGERG-88, constant [6)]
Pressure measuring		
- sensor	...	silicon piezoresistive sensor
- measuring ranges	...	80 ÷ 160 kPa abs
- accuracy	...	± 0.25% of the measured value
- long-term stability	...	± 0.1% of the measured value per year
- maximum overload capacity	...	200 kPa abs without changes to metrological parameters
Temperature measuring		
- sensor	...	semiconductor sensor
- measuring range	...	-25 ÷ +55 °C
- measurement error	...	±0.25°C
- long-term stability	...	±0.02 % per year (relative error in K)
Internal temperature measurement		
- measurement error	...	±2°C
Real time circuit		
- long-term stability	...	±5 min / year at 25°C
Digital outputs		
- number	...	1

[5)] Battery life depends on the current mode selected.

[6)] Selected method for calculation of compressibility can lead to a restriction of the range of measured temperature of gas.

- connection	…	terminals
- maximum cable length	…	30 m
- output options (sw configuration)	…	pulse
- galvanic isolation		
- output type	…	open collector
- voltage	…	3.6 V – 30 V (28 V in Zones 0,1,2)
- current	…	1uA - 100 mA
- maximum resistance in ON state	…	10 Ω
- safety parameters (intrinsic safety)	…	Ui = 28 V, Ii = 120 mA, Pi = 0.67 W
	…	Li = 0, Ci = 0
Pulse output	…	DO1
- actuation time	…	4-50ms
- disconnection time	…	min 1 sec
Communication with a superior system		
Optical interface (IEC 62056-21)		
- baud rate	…	9600 Bd to 38400 Bd
GSM/GPRS modem		
- frequency band	…	850/900/1800/1900 MHz (Dual, Quad)

14 Intrinsic safety parameters

Digital output: DO1:

U_i = 28 V, I_i = 120mA, $\sum Pi$ = 0.67 W, C_i = 0, L_i = 0

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[23] GO 464/05 Coll., Technical requirements for meters

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Software

[26] TELVES.exe, Elgas, s. r. o., software supplied with the device

[27] TELGUIDE.exe, Elgas, s. r. o., software supplied with the device

Trademarks used

{1} IrDA® - trademark of Infrared Data Association

{2} ModBus® - trademark of Modicon

Smart diaphragm gas meter with a volume conversion device picoELCOR G10/16/25 Device description, Operating instructions, Technical data, Installation instructions		
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