GAS VOLUME CORRECTOR
ELCOR and ELCOR*plus*

ELECTRONIC DATALOGGER
DATCOM and DATCOM*plus*

Device Description
Operating Instructions
Technical Description
Installation Instructions

Gas flow volume corrector at base conditions.
Approved for installation in potentially explosive atmospheres.

CE M 18 1026
1383,0678

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Rev.4

Safety Measures

Only a person trained in accordance with the specification, safety regulations and CSN (EN) standards may operate the metering device. In addition, other legal and safety regulations for special cases of use in potentially explosive atmospheres must be taken into account. A similar measure applies to the use of the accessories. Training for the operators must be in accordance with Decree 50/1978Sb. or national equivalent standard as amended.

The information in these instructions do not establish legal commitment by the manufacturer. The manufacturer reserves the right to change them. Changes in the instructions or of the product itself may be made at any time without prior notice in order to improve the device or to correct typographical or technical errors.

CONTENTS

Symbols and Terms

Symbol		Meaning	Unit
AGA8-G1	...	method to calculate gas compressibility factor	
AGA8-G2	...	method to calculate gas compressibility factor	
AGA8-DETAIL	...	method to calculate gas compressibility factor (Note: The earlier designation of this method was AGA8-92DC)	
AGA NX-19 mod	...	method to calculate gas compressibility factor	
ASC	...	Authorized Service Centre	
BTS	…	Base Transceiver Station	
CLO	...	4-20mA current output module	
CRC	...	checksum - for data protection purposes	
CTR	...	communication protocol	
DC, dc	...	DC voltage	
dE	…	energy addition (difference)	MJ
dE_s	…	energy difference (difference) in error conditions	MJ
dV	…	addition primary volume V_m or V (difference)	m^3
dV_b	…	addition converted volume V_b (difference)	m^3
dV_{bs}	…	increment (difference) of the recalculated volume Vb under the error conditions	m^3
dV_c	…	addition corrected primary volume V_c (difference)	m^3
dV_m	…	addition primary volume (difference)	m^3
E	…	energy	MJ
Es	…	substitute energy value	MJ
EDTxx	…	digital transducer of pressure EDT 96 or of temperature EDT 101	
ELGAS ver. 2	…	Communication protocol developed by ELGAS, s.r.o.	
EMC	...	electromagnetic compatibility and resistivity	
EMI	...	electromagnetic radiation	
EVC		Electronic gas volume corrector	
firmware, FW	...	software in the device	
GOST 30319.2	…	method to calculate gas compressibility factor	
GOST 30319.3	…	method to calculate gas compressibility factor	
HF	…	high frequency	
H_s	...	combustion heat	MJ/m^3
JB	...	intrinsically safe, intrinsic safety	
LF	…	low frequency	
MID	…	Measuring Instrument Directive, 2014/32/EU Directive about measuring instruments supply to the market (NV 120/2016 Sb.)	
Modbus	...	Modicon communication protocol [15]	
MPE	…	maximum permissible error	
M900	...	RMG communication protocol	
RTD sensor	...	Resistance Temperature Detector	
SGERG-88	...	method to calculate gas compressibility factor, for more details refer to [18]	
SW	...	software – PC program	
C	...	conversion factor	-
K	...	gas compressibility factor (Z/Z_b)	-
k_p	...	gas meter constant (number of pulses per $1m^3$)	imp/m^3
N	...	number of input pulses from the gas meter	imp

p	...	absolute pressure at metering conditions	kPa
p_b	...	absolute pressure at base conditions	kPa
Q	...	flow rate at measurement conditions (primary flow rate)	m^3/h
Q_b	...	flow rate at base conditions (converted flow rate)	m^3/h
T	...	absolute temperature at measurement conditions (T = t + 273,15)	K
t	...	gas temperature	°C
T_b	...	absolute temperature at base conditions	K
V	...	volume V_m or V_c	
V_m	...	volume at measurement conditions (primary volume)	m^3
V_c	...	corrected volume at measurement conditions (volume corrected based on correction profile of the gas meter)	m^3
V_b	...	volume at base conditions (converted volume)	m^3
V_{bs}	...	substitute volume at base conditions (substitute converted volume)	m^3
V_s	...	substitute volume at measurement conditions (substitute primary volume)	m^3
V_f	...	primary volume for the set tariff (tariff counter of primary volume)	m^3
V_{bf}	...	volume at base conditions for the set tariff (converted volume counter)	m^3
Z	...	gas compressibility factor at measurement conditions	-
Z_b	...	gas compressibility factor at base conditions	-

1 Introduction

1.1 Basic Description of the Device

The ELCOR and ELCORplus gas volume correctors (hereinafter referred to as the device) are measuring devices designed to convert the volume of gas measured under operating conditions to the volume under base conditions.

The gas volume information is scanned through the gas meter's pulse outputs or through the encoder data output. Gas temperature and gas pressure are measured with integrated transducers. The gas compressibility degree the instrument calculates according to common methods or a constant value is used.

The corrector has been designed and approved according to CSN EN 12405-1+A2/EN 12405-1 as a Type 1 corrector (compact system) and can be supplied as a T, TZ, PT or PTZ corrector.

From a safety point of view, the device has been designed to be intrinsically safe according to applicable standards and approved for potentially explosive atmospheres.

The device is manufactured and delivered in accordance with the following directives of the European Parliament and of the Council:

2014/34/EU	(ATEX) Equipment and protective systems intended for use in potentially explosive atmospheres (NV 116/2016 Coll.)
2014/30/EU	Electromagnetic Compatibility (NV 117/2016 Coll.)
2014/32/EU	(MID) Measuring Instruments (NV 120/2016 Coll.)
2014/53/EU	(RED) Radio Equipment and Telecommunication Broadcasting Equipment (NV 426/2016 Coll.)
2011/65/EU	(RoHS) NV 481/2012

The device is placed on the market and put into service according to the above-mentioned directives with the CE mark affixed.

The device is built in a housing made of durable plastic with IP66 rating. It is equipped with a graphic display or segment display and 6-key keypad.

The device is powered by a battery. In the defined operating mode, the battery life is 18 years. ELCORplus and DATCOMplus devices can be powered from an external power supply. For gas pressure measurement, the device is equipped with a digital pressure sensor positioned as standard in the bottom of the device housing. A digital temperature transducer located on the cable is used to measure the gas temperature. The gas meter information on gas consumption can be transferred to the corrector from the pulse output of the meter or from the gas meter encoder data output.

In addition to the pulse inputs, the device also has binary inputs that can work for example as control inputs to check the connection to a gas meter or perform other functions such as monitoring the state of the safety quick closing valves, condition of the door etc. The device has also digital outputs that can be configured as pulse, binary, or data outputs for the CLO module. Analogue current output can be implemented using this module.

To store the values, the device uses several types of internal archives. The data archive stores the measured and calculated values has an adjustable structure with an adjustable storing frequency. In the daily and monthly archives, it is possible to program the storing of important quantities and the calculation and storage of some statistical values. The binary archive captures changes on binary inputs and the occurrence of supervised events (limits, ...). Error states and

> # Trade Name of the Device
>
> These instructions specify the features and parameters of **ELCOR** and **ELCOR***plus* correctors. The device is also marketed as **DATCOM** and **DATCOM***plus* electronic data logger. To some foreign markets, the device can also be supplied with a mechanical indexer under the name **ELCOR***plus Indexer*. These instructions apply to devices marketed under any of the trade names mentioned above.
>
> **All the mentioned devices (both correctors and data loggers) are identical devices from the technical point of view (technical parameters, features) as well as from the safety point of view (ATEX). However, the DATCOM and DATCOM***plus* **data loggers have not approved gauges and cannot be used for billing purposes.**
>
> As concerns **DATCOM** and **DATCOM***plus* loggers, the metrological parameters stated in this document are not assessed under the 2014/32/EU (MID) Measuring Instruments Directive about putting measuring instruments on the market (NV 120/2016 Coll.). No additional metrology marking is attached to the CE conformity marking.

diagnostics are stored in the status archive. In the settings archive, operations that affect the device parameters are recorded for service and metrology purposes when changing the settings. In addition, other archives are available; for more details, refer to Section 11.3.

The device is equipped with serial interface RS232/RS485 for communication with superior system. The various communication protocols installed in the device allow easier connection to SCADA systems. The device can be supplied with built-in modems of both modern fast communication networks and older 2G networks. In the event of an alarm condition, the device can initiate the connection itself. The device also works with standard telephone, radio, GSM and GPRS modems via the RS232/RS485 line.

The device allows wide-range user parametrization. The device can be configured using the keypad of the device or the supplied PC software (see [42] or [43]). This software also allows reading, displaying and archiving both actual measured values and the internal archives contents.

Main features

- the latest technology used to ensure the high performance of the device and its high resistance to use and handling
- robust cabinet designed for outdoor use, the cover is equipped with a closing mechanism that keeps the lid closed without securing the screws
- high immunity to electromagnetic interference (EMC), withstand up to twice the interference values required by the industry standard
- modular architecture for easy customization
- digital inputs and outputs widely configurable by the end user
- resistant capacitive keyboard for easy operation of the device
- display of actual and archival values - a graphic display option
- device variant suitable for temperatures up to -40°C with always ON multisegment display
- new generation of pressure and temperature digital transducers with high precision and long-term stability
- high capacity FLASH memory for internal archives for storing measured and calculated data for several years
- communication with the device via several independent communication channels. It can

run locally or remotely via an internal modem in the latest generation networks with different communication protocols
- each communication channel can communicate with different protocol
- communication is completely independent and does not affect the measurement, computation and data archiving system
- possibility of remote download of the FW according to Welmec 7-2 Extension D
- several degrees of protection against device abuse have been implemented
- changing the device settings locally or remotely
- ELCOR, ELCORplus and ELCORplus indexer as an electronic volume corrector for billing purposes
- the same technical solution for DATCOM and DATCOMplus electronic data loggers for station monitoring and control
- open architecture to satisfy new requirements and projects

ELCORplus device

- is the most powerful full-modular model covering all known end-user requirements
- allows battery operation up to 18 years without battery replacement
- connecting gas meters with LF (reed, Wiegand), HF (NAMUR) pulse outputs, or various types of encoders (NAMUR, SCR +)
- use as a single-channel or two-channel gas volume corrector with the possibility of adding a non-metrological channel
- modular architecture allows to create different configurations (up to 6 pressure or temperature transducers, 12 digital inputs, 4 digital outputs, 6 analog inputs and 4 analog outputs)
- battery power supplied devices with an option of external power supply for ELCORplus / DATCOMplus
- Reading of NAMUR or SCR encoder in battery mode (without external power supply)
- 4 independent communication channels with high communication speed (up to 115kBd)
- possibility to connect two modems (internal / external + external)

ELCOR

- simplified variant of the device
- single channel variant, battery power supply
- connection of the meter to the LF (reed, Wiegand) with a pulse output or an encoder output (NAMUR or SCR +)
- 2 x binary input, 2x digital output, 1 RS232 / 485 communication line, 1x internal modem or 2nd RS232 communication line
- 3 independent communication channels with high communication speed (up to 115kBd)

1.2 Securing the Device

The device is equipped with the following mechanisms against abuse:

Sealing the device

- sealing of the closed device with the seal of the user and the possibility of locking the device by a lock (par. 5.2 and 5.6.1.2)
- sealing of the internal pressure transducer nut
- sealing of mechanical indexer screws for connection to the gas meter flange
- sealing the screws of the mechanical indexer setting cover
- sealing the connection of the pressure transducer to the pipeline (par. 5.4.4)
- sealing the connection of the temperature transducer to the pipeline (par. 5.4.5)

Sealing of the internal parts (par. 5.2)

- protection of metrological parts by an official MID seal
- protection of selected non-metrological parts by the manufacturer's identification seal or by the user's identification seal

Tampering device detection

- detection of the opening of the device with the possibility of sending an alarm (**Fig. 54**, **Fig. 55**)
- detection of removing metrological covers with the possibility of sending an alarm
- detection of an attempt to disturb the function of a mechanical indexer by an external magnetic field

Device configuration and data protection (11.6)

- metrological switch - secured by the official MID seal, blocks the execution of operations that directly modify the metrological characteristics of the instrument (eg measuring accuracy, calibration of transducers, exchange of transducers, setting of converted volume counters, etc.)
- service switch - is used to block parameter settings that do not directly affect the device's metrological properties
- password security - optionally, you can use 50 passwords in 5 groups with different hierarchy of authority to modify the device settings
- encryption - protection of transmitted data by encryption (symmetric AES encryption with 128-bit encryption key length) This option is optional and can be used for data transmission by ELGAS protocol, ver.2 or CTR protocol. (par. 10.4)

All changes to device parameter settings, along with the worker's identification mark, are stored in an indelible setting archive.

1.3 Versions of the Device

The gas volume corrector is manufactured and supplied in two types designated as ELCOR and ELCOR*plus*, which differ in features, internal extension options and dimensions. The ELCOR and ELCOR*plus* correctors are certified for commercial measurement according to 2014/32/EU.

The ELCOR*plus* corrector is also manufactured with an integrated mechanical indexer under the name ELCOR*plus Indexer.*

In terms of design and most of the technical parameters, DATCOM and DATCOM*plus* are identical with ELCOR and ELCOR*plus;* however, from the measurement point of view, they are not approved gauges and are primarily intended as electronic data loggers. They cannot be used for commercial measurement purposes.

1.3.1 ELCOR, DATCOM

The ELCOR (DATCOM) device is a single-channel battery-powered device with an optional internal communication modem and with an interface for connecting a gas meter equipped with an encoder. The device does not have an external power supply option.

Depending on the equipment, it may exist in the following versions:

a) Basic version:
 - Single channel battery-powered corrector
 - Six-key keypad
 - Graphic or segment display
 - 1 x digital pressure transducer EDT 96
 - 1 x digital temperature transducer EDT 101
 - 1 x pulse input for connecting a gas meter with LF pulse output

- 2 x digital input
- 2 x digital output (binary, pulse or analogue)
- Optical head communication
- 1 x RS232/RS485 communication interface
- 1 x battery to power supply the corrector

b) Optional extension:

- 1 x internal modem module (including the battery to power supply the internal modem):
   - 2G modem (i.e. GSM, dial-up CSD and GPRS connections); or
   - LTE modem
- 1 x interface module for gas meter with encoder (SLOT 0 position):
   - NAMUR interface module for NAMUR encoder; or
   - SCR interface module for SCR encoder

1.3.2 ELCOR*plus*, DATCOM*plus*

ELCORplus, DATCOMplus can be supplied in a single channel or dual channel design. Its features can be largely customized by additional modules. The device can be operated either as battery-powered or with external power supply. In devices equipped with an internal modem, the modem is powered by a separate battery; alternately, it can be powered from an independent external power supply. Extension modules are inserted into slots (SLOT 0 to SLOT 5) on the input board.

a) Basic (minimum) configuration of the device:

- Single channel (dual channel) battery corrector
- Six-key keypad
- Graphic or multisegment display
- 1 x (2 pcs) digital pressure transducer EDT 96
- 1 x (2 pcs) digital temperature transducer EDT 101
- 1 x (2 x) pulse input for connecting the gas meter with the LF pulse output
- 3 x (2 x) digital input
- 4 x digital output (binary, or pulse, or analogue)
- Optical head communication
- 1 x corrector battery

b) The basic version can be extended by one of the following modules:

- 1 x interface module for gas meter with encoder (SLOT 0 position):
   - NAMUR interface module for NAMUR encoder; or
   - SCR interface module for SCR encoder; or
   - Module for connection of HF pulse output of gas meter (module EXT1, EXT1/HF)
   - module for connection of HF pulse output of gas meter and extension of digital
     and analogue inputs (EXT1 module with auxiliary terminal board EXT1-T)
- 1 x communication interface or analogue input/output module (SLOT 1 position):
   - Communication module RS232/RS485 for communication with the master system; or
   - Analogue input module 4 - 20 mA (2 inputs); or
   - Analogue output module 4 - 20 mA (2 outputs)
- 1 x communication interface or analogue input/output module (SLOT 2 position):
   - Communication module RS232/RS485 for communication with the master system; or
   - Analogue input module 4 - 20 mA (2 inputs); or
   - Analogue output module 4 - 20 mA (2 outputs)
- 1 x PWR1 module for connecting an external IS power supply for the device (SLOT 3)
- 1 x modem external power supply module or communication interface for external modem
     (SLOT 4 position):

- PWR2 module to connect an external IS power supply to the modem, or
- RS232 communication module for connecting an external modem

- 1 x internal modem module (SLOT 5**¹** position) /including battery for internal modem/:

- 2G modem (i.e. GSM, dial-up CSD and GPRS connection); or
- LTE modem

The designations and features of the modules are specified in Section 3.11.

1.3.3 ELCOR*plus Indexer*

Unlike the ELCOR*plus* device, the ELCORplus indexer is equipped with an additional mechanical indexer for connection to the gas meter. The mechanical indexer makes it possible to determine the direction of rotation of the gas meter. The signals from the mechanical indexer are processed by the interface module, which is permanently fitted in the SLOT 0 position of the I/O board. For design reasons, the number of cable glands in the device is reduced. With the exception of the SLOT 0 position, the device options are the identical to ELCOR*plus*.

a) Basic (minimum) equipment of the device:

- Single channel battery corrector
- Six-key keypad
- Graphic or segment display
- Indexer interface module for connecting a mechanical gas meter indexer (in SLOT 0)
- 1 x digital pressure transducer EDT 96
- 1 x digital temperature transducer EDT 101
- 4 x digital input
- 4 x digital output (binary, or pulse, or analogue)
- Optical head communication
- 1 x corrector battery

b) The basic version can be extended by one of the following modules:

- 1 x communication interface or analogue input/output module (SLOT 1 position):

- Communication module RS232/RS485 for communication with the master system; or
- Analogue input module 4 - 20 mA (2 inputs); or
- Analogue output module 4 - 20 mA (2 outputs)

- 1 x communication interface or analogue input/output module (SLOT 2 position):

- Communication module RS232/RS485 for communication with the master system; or
- Analogue input module 4 - 20 mA (2 inputs); or
- Analogue output module 4 - 20 mA (2 outputs)

- 1 x PWR1 module for connecting an external JB power supply for the device (SLOT 3)
- 1 x PWR2 module for connecting an external JB power supply for the modem (SLOT 4)
- 1 x internal modem module (SLOT 51 position) /including battery for internal modem/:

- 2G modem (i.e. GSM, dial-up CSD and GPRS connection); or
- LTE modem

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¹) If the modem is not powered externally, the internal modem must be installed in SLOT 4 position.

2 Safety

> ⚠️ **EX**
>
> ## Different versions of the devices in terms of safety
>
> **The devices are supplied in terms of explosion safety in the following versions:**
>
> - **intrinsically safe design** - the whole device is intrinsically safe and is intended for Zone 0 or Zone 1 environments (see below)
> - **combined safety version** – only ELCOR*plus* (DATCOM*plus*), used „ic" and „nA" protections. <u>The device may only be used in zone 2 (see Appendix 2).</u>
>   The device is also referred to as ELCOR*plus* for Zone 2.
>
> **Each design has a separate ATEX approval for hazardous areas.**

This chapter and the following chapters describing the intrinsically safe design of a device designed for Zone 1 or Zone 0.

> ⚠️ **EX**
>
> ## <u>ELCOR*plus* for Zone 2</u>
>
> **- has its own ATEX approval, different from intrinsically safe design,**
>
> **- is described, including safety data, in Annex 2 to this document,**
>
> **- may not be installed in Zone 0 or Zone 1 environments.**

> ℹ️
>
> ## ELCOR*plus* for Zone 2 (DATCOM*plus* for Zone 2)
>
> **- the device is described in the Annex:**
>
> - **Appendix 2 Design of ELCOR*plus* for Zone 2**
>
> **The appendix describes:**
>
> - Safety device in terms of the risk of explosion
> - Different properties against intrinsically safe design
> - Differences in technical parameters
> - Differences in the use of plug-in modules
> - Differences in the options of connections with other devices

2.1 General

The device has been approved according to Directive 2014/34/EU (NV 116/2016 Coll.) and the following certificates has been issued for it:

FTZÚ 17 ATEX 0143X	EU type-examination certificate (ATEX) for use in potentially explosive atmospheres.
IECEx FTZU 17.0023X	IECEx Certificate of Conformity

Important Notices:

ATTENTION!

The device has been designed in accordance with safety rules for use in potentially explosive atmospheres. It has been approved as an intrinsically safe device in accordance with CSN EN 60079-11.

DANGER!

The device must be installed and used in accordance with this documentation and the conditions stated in the ATEX certificate.

WARNING!

Only batteries listed in the technical parameters table (see Sections 3.4 and 3.11.2) may be used to power the device.

The battery replacement procedure should be performed in accordance with this documentation (see Sections 7.5.2 and 7.5.4).

WARNING!

The IP66 rating is valid only if correctly tightened cables of the appropriate diameter are used in the cable glands of the device. Unused cable glands must be blinded.

2.2 Using the Device in Potentially Explosive Atmospheres

Based on the EU type-examination certificate 17 ATEX 0143X, the device in the basic battery-powered version may be operated in potentially explosive atmospheres designated as ZONE 0 (environment, where explosive atmosphere may occur under normal operation). If the internal modem is powered externally, or when using an SCR encoder, the device is designed for ZONE1 environment.

The marking of the device in terms of explosion safety depends on the extension modules fitted:

1/ ELCOR (DATCOM)

European Union marking (ATEX)

Designation of explosion safety	Device and its internal equipment	Environment
II 1G Ex ia IIB T4 Ga	Basic design including module extensions: - S0-NAM Interface for NAMUR gas meter encoder - S4-COM0 – RS232 communication module	**ZONE 0**

II 1G Ex ia IIB T3 Ga	**- when installed by the module:/***
	    M2G internal 2G modem, or
	    M4G internal LTE-Cat1 modem
	        Internal LTE-Cat M1 modem
		ZONE 0

II 1G Ex ia IIA T4 Ga	**Powered by an alkaline battery B-03A /***	**ZONE 0**
II 2G Ex ib IIB T4 Gb	**- when installed by the module:** S0-SCR interface for SCR gas meter encoder	**ZONE 1**

/* You cannot use an internal modem when using a B-03A alkaline battery

2/ ELCORplus (DATCOMplus)

European Union marking (ATEX)

Designation of explosion safety	Device and its internal equipment	Environment
II 1G Ex ia IIB T4 Ga	Basic design including module extensions: - S0-NAM interface for NAMUR gas meter encoder - S0-EXT1 extension module - S0-EXT1/HF extension module - S1-COM1 RS232/RS485 communication module - S1-2AI Analog inputs module - S1-2AO Analog outputs module - S3-PWR1 EVC external power supply module - S4-COM0 – RS232 communication module	**ZONE 0**

II 1G Ex ia IIB T3 Ga	**- when installed by the module:/***
	    M2G internal 2G modem, or
	    M4G internal LTE-Cat1 modem
	        internal LTE-Cat M1 modem
		ZONE 0

II 1G Ex ia IIA T4 Ga	**Powered by an alkaline battery B-03A /***	**ZONE 0**
II 2G Ex ib IIA T3 Gb	**- when installed by the module:/*** S4-PWR2 external power supply of the internal modem module	**ZONE 1**
II 2G Ex ib IIB T4 Gb	**- when installed by the module:** S0-SCR interface for SCR gas meter encoder	**ZONE 1**

/* You can not use an internal modem when using a B-03A alkaline battery

3/ ELCORplus Indexer

European Union marking (ATEX)

Designation of explosion safety	Device and its internal equipment	Environment
II 1G Ex ia IIB T4 Ga	Basic design including module extensions: - S0-MIE mechanical indexer interface - S1-COM1 RS232/RS485 communication module - S1-2AI analog inputs module - S1-2AO analog outputs module - S3-PWR1 EVC external power supply module - S4-COM0 RS232 communication module	**ZONE 0**
II 1G Ex ia IIB T3 Ga	**- when installed by the module:/*** M2G internal 2G modem, or M4G internal LTE-Cat1 modem internal LTE-Cat M1 modem	**ZONE 0**
II 1G Ex ia IIA T4 Ga	**Powered by an alkaline battery B-03A /***	**ZONE 0**
II 2G Ex ib IIA T3 Gb	**- when installed by the module:** S4-PWR2 external power supply of the internal modem module	**ZONE 1**

/* You can not use an internal modem when using a B-03A alkaline battery

ATTENTION!

The device has been designed and approved as intrinsically safe. This means that only approved devices (intrinsically safe devices, connection devices) or "Simple Devices" meeting the EN 60079-11 standard and complying with intrinsically safe parameters listed in the EU type-examination certificate [20] may be connected to all terminals of the device.

When connecting the device, the relevant safety standards must be observed.

When connecting the device, the electrical characteristics of the connecting cables must be considered and the requirements of the relevant safety standards met. Additionally, the Special conditions for Use must be observed, if listed in these Certificates. The explosion safety parameters of the device are specified in Section 4.

2.3 Special Conditions for Use

ATTENTION!

Under certain extreme circumstances, an electrostatic charge capable of explosion initiation can form on the plastic box. The device must not be installed in places where external conditions could result in electrostatic charge. The device may be wiped only with a damp cloth.

2.4 Risks of Use

The enclosure of the device is made of polycarbonate. A polyester foil keypad is located on the top cover. In some extreme cases, an electrostatic charge may accumulate on the surface of the enclosure, whose energy can cause initiation of the surrounding explosive atmosphere.

To avoid the risk of ignition due to electrostatic charge, we recommend observing the following procedure:

- If the device is used in potentially explosive atmospheres, it must not be installed in a location where external conditions can cause electrostatic charge generation.
- The device may be cleaned only with a damp cloth.

2.5 Connecting External Devices

Intrinsically safe signals run to all the connection terminals of the device. When connecting external devices to these terminals, the intrinsic safety principles must be followed. The equipment must be connected in accordance with applicable standards, in particular:

EN 60079-25 ed.2, Explosive atmospheres - Part 25: Intrinsically safe electrical systems;

EN 60079-14 ed.4, Explosive atmospheres- Part 14: electrical installations design, selection and erection;

EN 60079-0 ed.4, Explosive gas atmospheres, Part 0: Equipment - General requirements;

EN 60079-11 ed.2 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i".

The intrinsic safety parameters of the connection terminals are specified in Section 4. The recommended cable types are listed in Section 5.6.

3 Technical Parameters

3.1 Mechanical Parameters

	ELCOR	ELCOR*plus*
Mechanical dimensions (W x H x D) More in paragraphs 5.1	210 x 190 x 93 mm	263 x 201 x 111mm
Weight	1.5 kg	2.2 kg
Cabinet material	PC+GF (polycarbonate + fibreglass)	
Connecting Terminals - Conductor cross section	0.5 mm^2÷2.0 mm^2	
Mechanical Environment Class	M2	
Electromagnetic Environment Class	E2	

3.2 Environment

IP Rating	IP66, according to EN 60529
Operating temperature	-25 °C ÷ +70 °C -40 °C ÷ +70 °C [2]) -30 °C ÷ +65 °C [3])
Storage temperature	-40 °C ÷ +85 °C
Recommended working position	vertical
Working environment	according to EN 60721-3-4, class 4K3
Measurement of the device internal temperature	
- Location	integrated sensor in CPU module
- Measurement error	±3 °C
System time of the device	
- Long-term stability	± 5 min/year at 25 °C
Keypad	Capacitive, 6-key
Displaying	LCD graphic display, 128 x 64 pixels, backlit, or segment customer display

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[2]) Device design with segment display. Extended temperature range at extra charge.

[3]) When the alkaline battery B-03A is used.

3.3 Safety, Explosion Protection

	ELCOR	ELCORplus
Explosion Safety Level [4]		
- Basic version	⟨Ex⟩ II 1G Ex ia IIB T4 Ga	
- With internal modem (battery-powered)	⟨Ex⟩ II 1G Ex ia IIB T3 Ga	
- With internal modem powered from external source S4-PWR2	N/A	⟨Ex⟩ II 2G Ex ib IIA T3 Gb
- With SCR encoder interface	⟨Ex⟩ II 2G Ex ib IIB T4 Gb	
Ambient temperature Tamb	-40°C ≤ Ta ≤ +70°C	
Type of explosion protection	"I" – intrinsic safety	
ES Type-Examination Certificate	FTZÚ 17 ATEX 0143X	
IECEx Certificate of Conformity	IECEx FTZU 17.0023X	
Protection against dangerous contact of live and dead parts	by low voltage SELV	

3.4 Corrector Power Supply

	ELCOR	ELCORplus
- Type of battery	Lithium battery B-03 (17Ah)	Lithium battery B-03 (17Ah) or B-03D (30Ah) battery or B-03A alk. batt.
- Battery life - B-03 B-03D	11 years [5] 18 years [5]	
- Battery voltage	3.6 V	
- Battery life indication	Yes, alert when the capacity drops to 10%	
- Battery voltage limit for switching on the backup battery	2,7 V	
- Battery voltage for switch from backup to battery power supply	3,1 V	
- Optional external power supply of the corrector	No	Yes
- Module for the connection of EVC external power supply from IS source	-------------	S3-PWR1

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[4]) Depending on the configuration of the device, see Section 2

[5]) The lifetime of the battery depends on the mode set, the lifetime of the back-up battery depends on the way the device is used without the battery (see Section 7.5.1).

- External power supply parameters	-------------	See the technical parameters of the S3-PWR1 module
Back-up Battery of the Corrector		
- Back-up battery	yes (part of the CPU module)	
- Back-up battery life	16 years (ELCORplus indexer – 15 years) 5)	

3.5 Device Accuracy

Relative error (in operational temperature range)	
- Max. total error of the corrector	< 0.5 % of the measured value < 0.3 % of the range [6] - for version without MID certification
- Typical total error of the corrector	0.15 % of the measured value 0.10 % of the range [6] - for version without MID certification
- Operating volume measurement error	No error
- Compressibility factor calculation error	< 0.05 %

3.6 Measurement Parameters

3.6.1 General

Measurement principle	PTZ corrector [7]
Type-approval marking	TCM 143/18 – 5562, EU-Type Examination Certificate (MID certification)
Measurement Period	30 s (adjustable, range 1s ÷ 1h)
Reference conditions	
- Reference temperature Tb	15° C, or 0 °C, 15.55555 °C, 20 °C, 25 °C, 27 °C (other units available)
- Reference pressure pb	101.325 kPa, or 100.000 kPa, 101.592 kPa, 101.560 kPa, 101.0085 kPa, 102.3872 kPa, 103.5937 kPa (other units available)
Compressibility calculation	SGERG-88, AGA NX-19 mod, AGA 8-G1, AGA 8-G2, AGA 8-DETAIL, GOST 30319,2-2015, GOST 30319.3-2015

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[6]) For the device version without MID certification, measurement errors are specified in % of the range according to US common practice.

[7]) Simpler conversion options can also be configured. Supported variants are PTZ, PT, TZ, and T.

Period of official metrology check	5 years - valid for the Czech Republic (based on Decree No. 345/2002 Coll. of the Ministry of Industry and Trade) - vary from country to country. In general, the validation period of a specified meter is determined by a country's decree.

3.6.2 Pressure Measurement

	ELCOR	ELCOR*plus*
Number of pressure transducers, single channel	1	1
Number of pressure transducers, dual channel	--------------	2
Designation of the pressure transducer	EDT 96 pressure transducer	
Transducer version	internal - built-in in the device, or external - cable length 2.5 m as a standard (max. 100m in total for the connected EDTxx transducers)	
Sensor	silicon piezoresistive sensor	
Pressure connection	$\varnothing$ 6 mm tube, ERMETO M12 x 1.5 threaded joint	
Measurement of gas pressure within temperature range of	-25 ÷ +70 °C -40 ÷ +70 °C [2]	
Measurement ranges - MID certified		
(absolute pressure values)	80 ÷ 520 kPa	
	200 ÷ 1000 kPa	
	400 ÷ 2000 kPa	
	700 ÷ 3500 kPa	
	1400 ÷ 7000 kPa	
	2500 ÷ 13000 kPa	
	80 ÷ 1000 kPa [8]	
	80 ÷ 2000 kPa [8]	
	400 ÷ 7000 kPa [8]	
- Measurement error	< 0.25 % of the measured value	
- Long-term stability	< 0.1 % per year of the measured value	
Overload capacity without changing metrological parameters	standardly: 1.25 x upper limit (UL) on request: 1,5 x UL for the range 80 ÷ 2000 kPa 3 x UL for the range 80 ÷ 1000 kPa	

[8]) Extended pressure range at extra charge.

	5 x UL for the range 80 ÷ 520 kPa
Mechanical resistance (without leakage)	2 times upper limit of the measurement range or 17MPa [9]) (whichever is lower)

Measurement ranges - without MID certification

(absolute pressure values)	
	80 ÷ 1000 kPa
	80 ÷ 2000 kPa
	80 ÷ 3500 kPa
	80 ÷ 7000 kPa
	80 ÷ 13000 kPa
- Measurement error	< 0.20 % of the range [10])
- Long-term stability	standardly: < 0.2 % per year of the range [10] on request: < 0.1 % per year of the scale [10]

Overload capacity without changing metrological parameters	standardly: 1.25 x upper limit (UL)
	on request: 1,5 x UL for the range 80 ÷ 2000 kPa
	                    3 x UL for the range 80 ÷ 1000 kPa
	                    5 x UL for the range 80 ÷ 520 kPa

Mechanical resistance (without leakage)	2 x upper limit of the measurement range or 17MPa [11]) (whichever is lower)

Measurement ranges - without MID certification

(relative pressure values)	0 ÷ 20 kPa
	0 ÷ 100 kPa
	0 ÷ 160 kPa
	0 ÷ 400 kPa
	0 ÷ 600 kPa
	0 ÷ 1000 kPa
	0 ÷ 2500 kPa
	0 ÷ 4000 kPa
	0 ÷ 7000 kPa

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[9]) Pressure transducer is destroyed, gas-tightness remains.

[10]) For the device version without MID certification, measurement errors are specified in % of the range according to US common practice.

[11]) Pressure transducer is destroyed, gas-tightness remains.

- Measurement error	< 0,20 % of the range (ranges 100 kPa and higher) [12] < 0,40 % of the range (ranges lower than 100 kPa) [12]
- Long-term stability	< 0,20 % of the range (ranges 100 kPa and higher) [12] < 0,40 % of the range (ranges lower than 100 kPa) [12]
Overload capacity without changing metrological parameters	2 x upper limit (UL)
Mechanical resistance (without leakage)	2 x upper limit of the measurement range or 17 MPa [11] (whichever is lower)

3.6.3 Temperature measurement

	ELCOR	**ELCORplus**
Number of temperature transducers, single channel	1	1
Number of temperature transducers, dual channel	------------	2
Designation of the pressure transducer	EDT 101 temperature transducer	
Temperature sensor	Pt 1000 RTD sensor, platinum resistance sensor	
Transducer measurement range	-25 ÷ +70 °C -40 ÷ +70 °C 2)	
- Measurement error	±0.2 °C (i.e. ± 0.09 % of the measured value in K)	
- Long-term stability	< 0.02 % per year (relative error in K)	
Sensor design	∅ 5.7 mm tube, measuring shank 50 mm long, integrated cable with electronics	
Length of the sensor cable	2.5 m as a standard, (max. 100 m in total for the connected EDTxx transducers)	

3.7 Digital inputs

	ELCOR	**ELCORplus**
A. Metrology		
- Number	2	
- Terminals marking (DIN terminal blocks)	DI1, DI3	DI1, DI4
- Input options (SW configuration)	1 LF pulse input, 1 binary input/intrusion contact/LF pulse input to determine the direction of rotation of the meter	
- Backup function in case of power supply failure	Yes, the signal monitoring function at the specified DI inputs is backed up by the backup battery of the	

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[12]) For the device version without MID certification, measurement errors are specified in % of the range according to US common practice.

	device	
- Cable length for each input	max. 30 m	
- LF pulse input	Terminals DI1, DI3 (DI3 – for gas meters with the option of detecting the rotation direction)	Terminals DI1, DI4 (DI4 – for gas meters with the option of detecting the rotation direction)
- Maximum frequency - Maximum operating flow rate Qm	10 Hz 36 000 m^3/h	
- Input type	Reed contact or potential-free output connection, WIEGAND	
- Min. pulse/delay time	40 ms	
- No-load voltage	2.5 V ÷ 3.6 V	
- Short-circuit current	approx. 3 µA	
- "ON"	R < 100 kΩ or U < 0.2 V	
- "OFF"	R > 2 MΩ or U > 2.5 V	
- Binary input, tamper contact	Terminals DI3 (Terminals DI1 [13])	Terminals DI4 (Terminals DI1 [13])
- Input type	Low-power input, reed contact or potential-free output connection	
- Min. duration of the condition	100 ms	
- No-load voltage	2.5 V ÷ 3.6 V	
- Short-circuit current	approx. 3 µA	
- "ON" level	R < 100 kΩ or U < 0.2 V	
- "OFF" level	R > 2 MΩ or U > 2.5 V	

B. Non-Metrology

- Number	1	2
- Marking of the terminals (DIN terminal block)	DI2	DI2, DI3
- Input options (SW configuration)	1 LF pulse input, or 1 binary input	2 LF pulse inputs, or 2 binary inputs, or 1 LF pulse input + 1 binary input
- Backup function in case of power supply failure	No	
- Cable length for each input	30 m max.	

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[13]) Only when input DI1 is not used for gas meter connection (e.g. with the datalogger).

- LF pulse input

- Maximum frequency	10 Hz
- Input type	Reed contact or potential-free output connection, WIEGAND
- Min. pulse/delay time	40 ms
- No-load voltage	2.5 V ÷ 3.6 V
- Short-circuit current	approx. 3 μA
- "ON"	R < 100 kΩ or U < 0.2 V
- "OFF"	R > 2 MΩ or U > 2,5 V

- Binary input

- Input type	Low-power input, reed contact or potential-free output connection
- Min. duration of the condition	100 ms
- No-load voltage	2.5 V ÷ 3.6 V
- Short-circuit current	approx. 3 μA
- "ON"	R < 100 kΩ or U < 0.2 V
- "OFF"	R > 2 MΩ or U > 2.5 V

3.8 Digital Outputs

	ELCOR	ELCOR*plus*
- Number	2	4
- Marking of the terminals (DOUT terminal block)	DO1, DO2	DO1, DO2, DO3, DO4
- Output options (SW configuration)	Pulse output, binary output, analogue output (via CLO)	
- Output type	Open collector	
- Cable length for each output	30 m max.	
- Galvanic separation	Yes (output circuit requires power to U0 +) *)	
- Supply voltage range (terminal U0 +)	3.6 V – 15 V	
- Max. output voltage (DO1-4)	15 V**)	
- Max. output current	10 mA	
- Max. resistance in closed state	5 Ω	
- Pulse output		
- On time	Programmable 5 ms ÷ 25 s	
- Off time	Programmable 0.1 s ÷ 25 s or adaptive	
- Analogue output		
- Output realization	via external module CLO	

- Type of output	4-20 mA current output, passive transmitter
- supply voltage range of current loop	5 V ÷ 40 V
- accuracy	0.25 % of the range (at 25 °C)

*) DO1 and DO2 outputs can be operated in pulse output mode even without power supply at U0+ terminal with defined limitation: it requires a shorting jumper JP1 (the operating values drop - for more details refer to Section 7.6)

**) JP1shorting jumper must not be fitted, otherwise reduced voltage values apply for DO1, DO2 (see Section 7.6)

3.9 Communication Inputs/Outputs

Communication interface for optical head	
- Interface type	Interface IEC-1107
- Communication speed	9600 Bd to 115200 Bd, adjustable
- Communication protocol	Selectable, depending on the firmware version (see Section 10)

Communication interface RS485/RS232 (integrated on IO board)		
	ELCOR	**ELCOR*plus* **
- Number of integrated interfaces	1	0[14])
- Galvanic separation	Yes	----------
- Serial communication interface	RS485 or RS232 (cannot be used simultaneously)	----------
- Communication protocol	Selectable, depending on the firmware version (see Section 10)	----------
- Communication speed	2 400 Bd to 115 200 Bd, adjustable	----------
- Byte format	8 bits, 1 stop, no parity	----------
RS-232 line		
- Marking of the terminals	(GND1, CTS, RxD, TxD)	----------
- Connection via IS separator	B-RS module or MTL5051	----------
- Cable length	30 m max	----------
RS-485 line		
- Marking of the terminals	GND1, U1+, D1+, D1-	----------
- Connection via IS separator	B-RS	----------
- Max. cable length	100 m max.	----------

3.10 Quantities Archiving

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[14]) RS232/RS485 communication interface solution uses plug-in modules in SLOT 1, SLOT 2 or SLOT 4 (see par.0).

	ELCOR	ELCOR*plus*
Data archive		
- Archiving frequency t_{arch}	1 hour as standard (adjustable from 1 s to 1 h)	
- Capacity	approx. 112 000 records (i.e. approx. 12 years at t_{arch}=1 h), (changes dynamically depending on the configuration)	
- Stored quantities	Vm, Vb, Vs, Vbs, E, Es, Status, t, p, Q, Qb, C, K, Hs + adjustable depending on the configuration	
Daily archive		
- Capacity	approx. 4 200 records (approx. 11.5 years)	
- Stored quantities	Vm, Vb, Vs, Vbs, E, Es, Status, t, p, Q, C + adjustable depending on the configuration	
Monthly archive		
- Capacity	approx. 960 records (approx. 80 years)	
- Stored quantities	Vm, Vb, Vs, Vbs, E, Es, Status + adjustable depending on the configuration	
Other archives (capacities)		
- Binary archive	approx. 4 600 records	
- Status archive	approx. 5 000 records	
- Gas composition archive	approx. 1 870 records (approx. 5 years at 1 change per day)	
- Settings archive	More than 1000 records (depending on the type of setting)	
- Limit archive	1 record for each monitored quantity	
- Billing archive	approx. 1 260 records	

3.11 Optional Extension

3.11.1 Interface modules for connecting the gas meter encoders

S0-NAM Interface module for ENCODER – NAMUR		
	ELCOR	ELCOR*plus*
- Max. number of modules in the device	1	1
- Installation in the device	SLOT 0	SLOT 0
- Number of inputs	1	
- Connection	Two-conductor	
- Type	NAMUR (DIN 19234)	
- terminals marking	SLOT0 Terminals NAM- (1), NAM+ (2)	
- Cable length	30 m max.	
Note: The module installation is protected by a MID security mark.		

S0-SCR Interface module for ENCODER – SCR		
	ELCOR	**ELCORplus**
- Max. number of modules in the device	1	1
- Installation in the device	SLOT 0	SLOT 0
- Number of inputs	1	
- Connection	Two-wire	
- Type	SCR+	
- Communication protocol supported	OBIS 2005 (IEC 62056-21 Mode A) (EDIS (IEC1107 Mode A))	
- Terminals marking	SLOT0 Terminals A (1), B (2)	
- Cable length	30 m max.	
Note: The module installation is protected by a MID security mark.		

3.11.2 Communication Modules

S1-COM1 Communication module RS232/RS485		
	ELCOR	**ELCORplus**
- Max. number of modules in the device	0	2
- Installation in the device	-------	SLOT1, SLOT2
- Galvanic separation	Yes	
- Serial communication interface	RS485 or RS232 (cannot be used simultaneously)	
- Communication protocol	Selectable, depending on the firmware version (see Section 10)	
- Communication speed	2 400 Bd to 115 200 Bd, adjustable	
- Byte format	8 bits, 1 stop, no parity	
- RS232 communication output		
- Marking of the terminals	SLOT1,2 terminals GND (3), CTS (4), RxD (5), TxD (6)	
- Connection via IS separator	B-RS module, or MTL5051	
- Cable length	30 m max.	
- RS485 communication output		
- Marking of the terminals	SLOT1,2 terminals D+ (1), D- (2), GND (3), U+ (4)	
- Connection via JB separator	B-RS module	
- Max. cable length	100 m max.	

S4-COM0 RS232 communication module		
	ELCOR	ELCORplus
- Max. number of modules in the device	1	1

- Installation in the device	independent position	SLOT 4
- Galvanic separation	yes	
- Serial communication interface	RS232	
- Communication protocol	Selectable, depending on the firmware version (see Section 10)	
- Communication speed	2 400 Bd to 115 200 Bd, adjustable	
- Byte format	8 bits, 1 stop, no parity	
- RS232 communication output		
- Marking of the terminals	RS232 terminals (GND, CTS, TxD, RxD)	
- Connection via IS separator	B-RS module, or MTL5051	
- Cable length	30 m max.	

M2G internal 2G modem		
	ELCOR	**ELCORplus**
- Max. number of modules in the device	1	1
- Device installation	Separately	SLOT 4 (battery powered) SLOT 5 (external power supply)
- Type of connection	2G modem, GSM/GPRS	
- Frequency	Quad band 850/900/1800/1900 MHz	
- Output power	Class 4 (2 W) for GSM 850 MHz, 900 MHz Class 1 (1 W) for GSM 1800 MHz, 1900 MHz	
- Communication protocol	Selectable, depending on the firmware version (see Section 10)	
- Required SIM card size	miniSIM	
Power supply of the modem module:		
- Battery type	HB-03 (12 Ah) or HB-03D (20 Ah) battery	
- Battery life - HB-03 HB-03D	6 years [15] 11 years [15]	
- Battery voltage	3,0 V	
- External power supply option	Yes	
- Type of module for external power supply connection	S4-PWR2	

M4G internal modem LTE		
	ELCOR	**ELCORplus**
- Max. number of modules in the device	1	1

[15]) The life of the battery depends on the set mode of the modem connection

- Device installation	Separately	SLOT 4 (battery powered) SLOT 5 (external power supply)
- Required SIM card size	miniSIM	
Versions of LTE modem		
Designation	**M4G, LTE-Cat1E**	
- Type of connection	LTE cat. 1, European design	
- Frequency	800/900/1800/2100 MHz	
- Output power	Class 4 (2 W) for GSM 900 MHz Class 1 (1 W) for GSM 1800 MHz Class 3 (23 dBm) for LTE 800, 900, 1800, 2100 MHz	
Designation	**M4G, LTE-Cat1US**	
- Type of connection	LTE cat. 1, American design	
- Frequency	700/850/1700/1900 MHz	
- Output power	Class 3 (+24 dBm) for UMTS 850, 1700, 1900 MHz Class 3 (+23 dBm) for LTE 700, 850, 1700, 1900 MHz	
Designation	**M4G, LTE-CatM1US**	
- Type of connection	LTE-M1, American design	
- Frequency	700/1700/1900 MHz	
- Output power	Class 3 (+23 dBm) for LTE 700, 1700, 1900 MHz	
- Communication protocol	Selectable, depending on the firmware version (see Section 10)	
Power supply of the modem module:		
- Battery type	HB-04 (12Ah) battery	
- Battery life	6 years [15])	
- Battery voltage	6V	
- External power supply option	Yes	
- Type of module for external power supply connection	S4-PWR2	

3.11.3 Modules for Connecting External Power Supply

S3-PWR1 module of EVC power supply		
	ELCOR	**ELCOR*plus***
Max. number of modules in the device	0	1
- Installation in the device	-------	SLOT3
- Module function	External power supply of the corrector circuits from an intrinsically safe PS-E source (does not power to M2G, M4G modems)	

Galvanic separation	yes
Supply voltage	4,5 V ÷ 6,5 V
Max. consumption	70 mA
Terminals marking	PWR1+, PWR1-
Cable length	30 m max. (min. conductor cross section 0.75 mm^2 see paragraph 5.6.6)

S4-PWR2 module of external power supply of the internal modem		
	ELCOR	**ELCOR*plus***
Max. number of modules in the device	0	1
- Installation in the device	-------	SLOT4
- Module function	External power supply of the of the M2G or M4G internal modem module from an intrinsically safe PS-M source	
Galvanic separation	yes	
Supply voltage	4,5 V ÷ 6,2 V	
Max. consumption	1 A	
Terminals marking	PWR2+, PWR2-	
Cable length	see chapter 5.6.6 (depends on used cable cross section)	

3.11.4 Analogue Inputs/Outputs Modules

S1-2AI Module of 4 – 20mA analogue inputs		
	ELCOR	**ELCOR*plus***
- Max. number of modules in the device	0	2
- Installation in the device	-------	SLOT 1, SLOT 2
- Number of module inputs	2	
- Marking of the terminals	SLOT1,2 terminals GND (2), AI1 (3), GND (5), AI2 (6)	
- Input options	4 ÷ 20 mA current input	
- Galvanic separation	No	
- Cable length for each output	30 m max.	

S1-2AO Module of 4 – 20mA analogue output		
	ELCOR	**ELCOR*plus***
- Max. number of modules in the device	0	2
- Installation in the device	-------	SLOT 1, SLOT 2
- Number of module inputs	2	
- Marking of the terminals	SLOT1,2 terminals AO1- (2), AO1+ (3), AO2- (5), AO2+ (6)	
- Output options	4 ÷ 20 mA current output	

	Yes (separation from the instrument and mutual separation both outputs apart)
- Galvanic separation	Yes (separation from the instrument and mutual separation both outputs apart)
- Power supply voltage	5 V ÷ 28 V
- Cable length for each output	30 m max.

3.11.5 Other Modules

S0-EXT1 extension module		
	ELCOR	**ELCOR*plus***
- Max. number of modules in the device	0	1
- Installation in the device	----------	SLOT 0
DIN-NAMUR digital inputs		
- Number of digital inputs	2	

- Input options DI1, DI2	HF NAMUR:
	    2 HF pulse inputs, or
	    1 HF pulse input of the gas meter with the option of detecting the rotation direction, or
	    2 binary inputs (NAMUR), or
	    2 NAMUR encoders	

- Terminals marking	SLOT0 terminals DI1- (1), DI1+ (2), DI2- (5), DI2+ (6)	
DIN digital inputs		
- Number of digital inputs	6	

- Input options DI3 to DI8	LF inputs:
	    6 LF pulse inputs, or
	    3 LF pulse input of the gas meter with the option of detecting the rotation direction), or
	    6 binary inputs	

- Terminals marking (DIN terminals)	GND, DI3 ,DI4 ,DI5 ,DI6 ,DI7 ,DI8 [16])	
- Cable length for each input	30 m max.	
AIN analogue inputs		
- Number of analogue inputs	2	
- Terminals marking (AIN terminal blocks)	AI1, AI2, GND [16])	
- Input options AI1, AI2	4 ÷ 20 mA current input	
- Cable length for each input	30 m max.	

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[16]) The terminals are mounted on a special EXT1-T terminal board (KP100 160), which is connected

with an extension module S0-EXT1 via cable (see Section 9, Fig. 75).

Inputs for digital transducers	
- Number of inputs	2
- Terminals marking (IB1 terminal blocks)	GND, U+, D-, D+ [16])
- Type of transducer	EDT 96, EDT 101
- Max. cable length (total length of both transducers)	100 m max.

S0-EXT1/HF extension module		
	ELCOR	**ELCOR*plus***
- Max. number of modules in the device	0	1
- Installation in the device	----------	SLOT 0
DIN-NAMUR digital inputs		
- Number of digital inputs	2	

- Input options DI1, DI2	HF NAMUR:
	    2 HF pulse inputs, or
	    1 HF pulse input of the gas meter with the option of detecting the rotation direction, or
	    2 binary inputs (NAMUR), or
	    2 NAMUR encoders	

- Terminals marking	SLOT0 terminals DI1- (1), DI1+ (2), DI2- (5), DI2+ (6)	

BARP barometric pressure measurement module		
	ELCOR	**ELCOR*plus***
- Maximum number of modules in the device	0	1
- installation	optional *) – during production	

*) Warning:
The requirement to install the BARP module must be specified when ordering the device. The module will be installed during manufacturing of the device. The module cannot be installed by end user.

- Barometric pressure measurement ranges	30 ÷110 kPa
- accuracy	± 0,25 kPa

Remark:
The barometric pressure measurement module BARP is connected directly to the device's internal bus and does not reduce the number of connectable EDT xxx transducers to the device.

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4 Explosion Safety Parameters

DIN digital inputs: *(terminals DI1, GND, DI2, GND, DI3, GND, DI4, GND)* [1/]

U_o = 6.5V

I_o = 2mA

P_o = 3mW

	IIB	IIA
Co	20μF	100μF
Lo	10mH	100mH

U_i = 5,5 V

I_i = 1 mA

P_i = 1 mW

C_i = 0, L_i = 0

[1/] *ELCOR - 3 inputs only: DI1, GND, DI2, GND, DI3, GND*

DOUT digital outputs: *(terminals U0+, GND0, DO1, DO2, DO3, DO4)* [2/]

U_i = 15V

I_i = 0.3A

ΣP_i = 0.5W

C_i = 3.3uF

L_i = 0

[2/] *ELCOR - 2 inputs only: U0+, GND0, DO1, DO2*

IB0 and IB1 internal buses: *(terminals GND, U+, D-, D+)* [3/]

U_o = 6.5V

I_o = 2.2A

P_o = 1.1W

	IIB	IIA
ΣCo	24μF	50μF
ΣLo [4/]	1uH	1uH

[3/] *ELCOR - IB0 only*

[4/] *inductive concentration, max. 100m cable can be connected*

KP 100 060 - Indexer interface: *(SLOT 0 TERMINALS: GND, U+, TXD, RXD, UB)* [5/]

U_o = 6.5V

I_o = 2.2A

P_o = 1.1W

	IIB	IIA
ΣCo	24µF	50µF
ΣLo	1uH	1uH

[5] *ELCORplus version only*

KP 100 061 - SCR interface: *(SLOT 0 TERMINALS: A, B)* [6]

Uo = 8.0V

Io = 20mA

Po = 160mW

	IIB	IIA
Co	14uF	100uF
Lo [4]	8uH	10uH

[4] *Inductive concentration, max. 30m cable can be connected.*

[6] *The module has an impact on the basic type of protection - see the instructions.*

KP 100 062 - NAMUR interface: *(SLOT 0 TERMINALS: NAMUR+, NAMUR-)*

Uo = 10.0V

Io = 11mA

Po = 27mW

	IIB	IIA
Co	20uF	100uF
Lo	1mH	1mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

KP 100 110 - RS485 interface: *(SLOT 1,2 TERMINALS: D+, D-, GND, U+)* [7]

Ui = 10V

Ii = 0.15A

ΣPi = 0.33W

Ci = 4uF

Li = 0

[7] *ELCOR includes the interface as a standard; not SLOT 1,2 TERMINALS.*

KP 100 110 - RS232 interface: *(SLOT 1,2 TERMINALS: GND, CTS, RXD, TXD)* [7]

Ui = 20V

Ii = 0.15A

ΣPi = 0.46W

C_i = 1uF

L_i = 0

[7] *ELCOR includes the interface as a standard; these are not SLOT 1,2 TERMINALS.*

RS232 interface (KP 100 170): *(TERMINALS COM0: GND, CTS, RXD, TXD)*

U_i = 20 V

I_i = 150 mA

ΣP_i = 0,46 W

C_i = 1 uF

L_i = 0

KP 100 121 - PWR1 external power supply:*(SLOT 3, terminals PWR1+, PWR1 -)* [8]

U_i = 6.5V

I_i = 0.2A

P_i = 0.41W

C_i = 40uF

L_i = 1.1mH

[8] *ELCORplus version only*

KP 100 140 – PWR2 external power supply: *(SLOT 4, terminals PWR2+, PWR2 -)* [6][8]

U_i = 6.2V

I_i = 1A

P_i = 6.2W

C_i = 13.5mF

L_i = 55uH

[6] *The module has an impact on the basic type of protection - see the instructions.*

[8] *ELCORplus version only*

KP 100 112 - AIN analogue inputs: *(SLOT 1,2 TERMINALS: GND, AI1, GND, AI2)* [8]

U_i = 28V

I_i = 93mA

P_i = 0,66W

C_i = 40nF

L_i = 0

[8] *ELCORplus version only*

KP 100 113 - AO analogue outputs: *(SLOT 1,2 TERMINALS: AO1+, AO1-, AO2+, AO2-)*[8]

U_i = 28V

I_i = 0.1A

P_i = 0.66W

Ci = 0.46uF

Li = 0

8/ ELCORplus version only

EXT1, EXT1/HF board (KP 100 130) – Digital Iputs: DI1, DI2 (NAMUR): *(SLOT 0 TERMINALS: DI1-,DI1+,DI2-,DI2+)8/*

Uo = 10,0V

Io = 11mA

Po = 27mW

	IIB	IIA
Co	20uF	100uF
Lo	1mH	1mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

8/ ELCORplus version only

EXT1 board (KP 100 130) – Digital Iputs: DI3 to DI8: *(terminals EXT-1T: GND, DI3,DI4, DI5, DI6, DI7, DI8) 8/*

Uo = 6.5V

Io = 2mA

Po = 3mW

	IIB	IIA
Co	20μF	100μF
Lo	10mH	100mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

8/ ELCORplus version only

EXT1 board (KP 100 130) - AIN analogue inputs: *(terminals EXT1-T: GND, AI1, GND, AI2) 8/*

Ui = 28V

Ii = 93mA

Pi = 0.66W

Ci = 40nF

Li = 0

8/ ELCORplus version only

EXT1 board (KP 100 130) – Internal Bus IB1: (terminals EXT1-T: *GND, U+, D+, D-*) [8]

Same as Internal Bus IB0 and IB1.

[8] *ELCORplus version only*

5 Installation and Commissioning

The corrector (logger) is a compact device built into a tough plastic enclosure with IP66 protection rating. The device is intended for installation in potentially explosive atmospheres. It has been approved for either ZONE 0 or ZONE 1 environment, depending on the specific modules installed in the device, as specified in Section 2.

In addition to completely enclosed electronics, the enclosure contains power supply batteries and a digital pressure transducer with M12x1.5 threaded joint according to DIN W 3861 for connecting a pressure pipe.

At the bottom of the cabinet are metal cable glands for connecting the input and output signal cables with the possibility to connect the cable shielding conductively.

5.1 Dimensions of the Device

5.1.1 ELCOR corrector
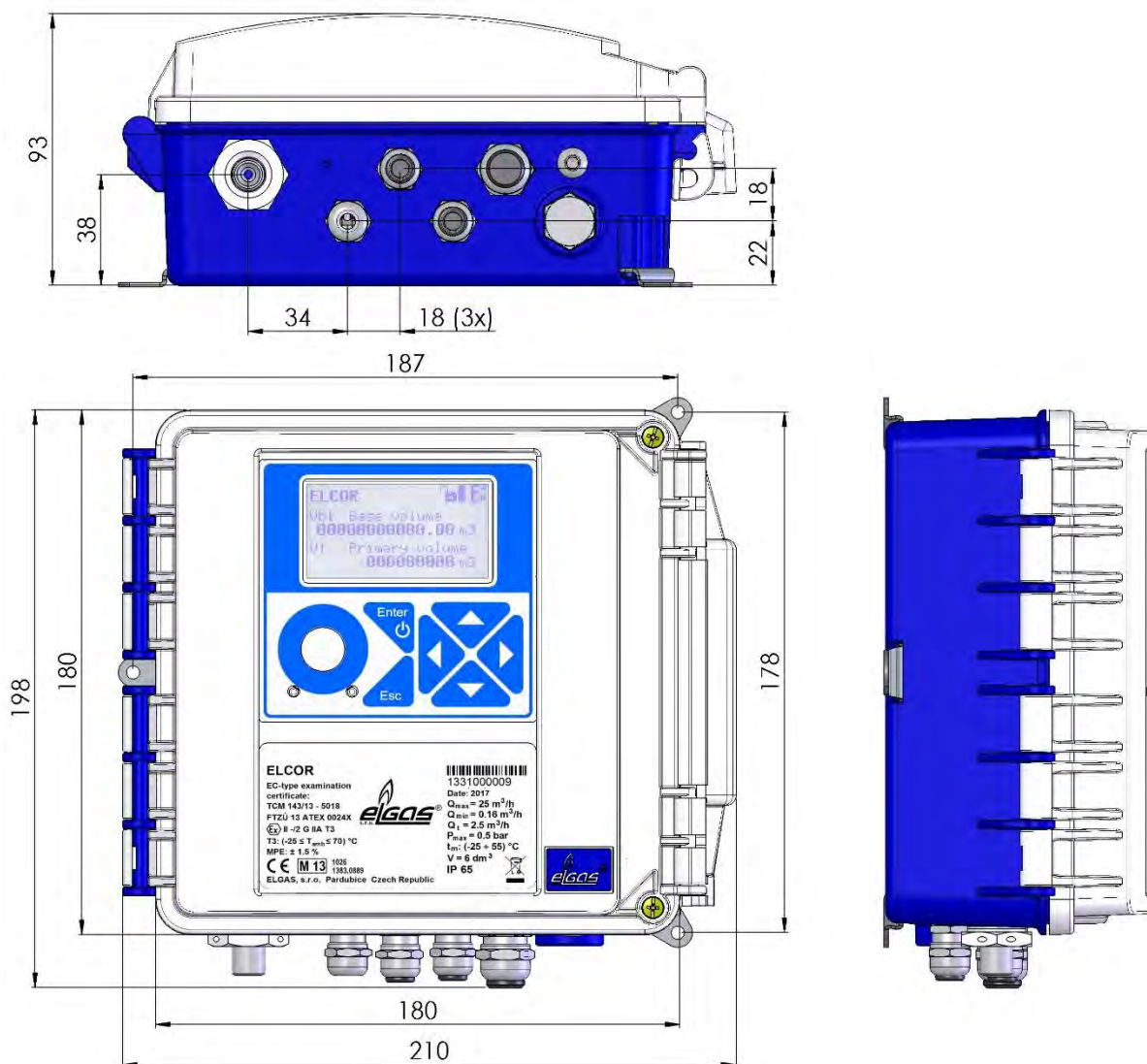
Fig. 1 ELCOR device dimensions

5.1.2 ELCOR*plus* corrector
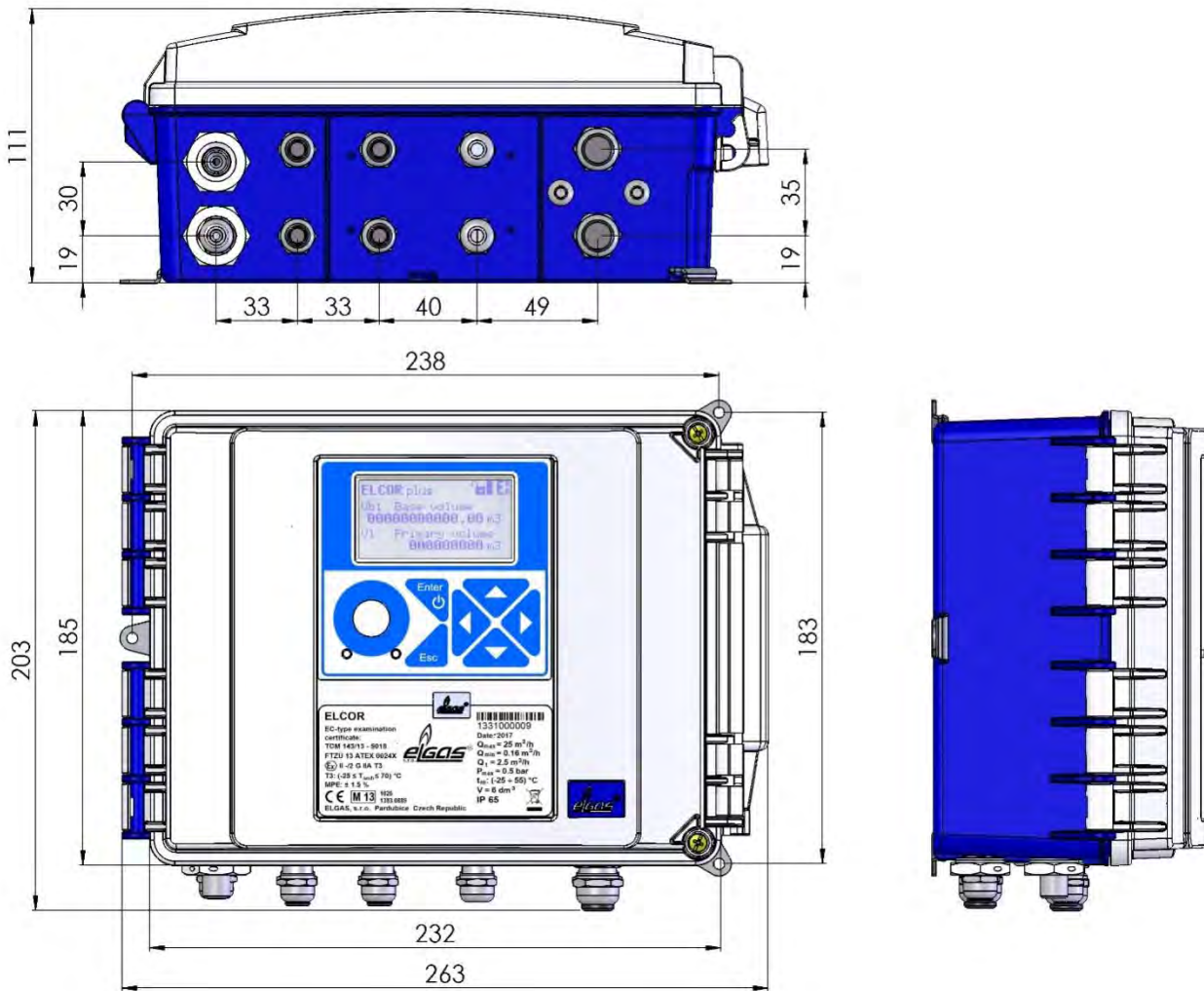
Fig. 2 ELCORplus device dimensions

5.1.3 ELCOR*plus Indexer* corrector
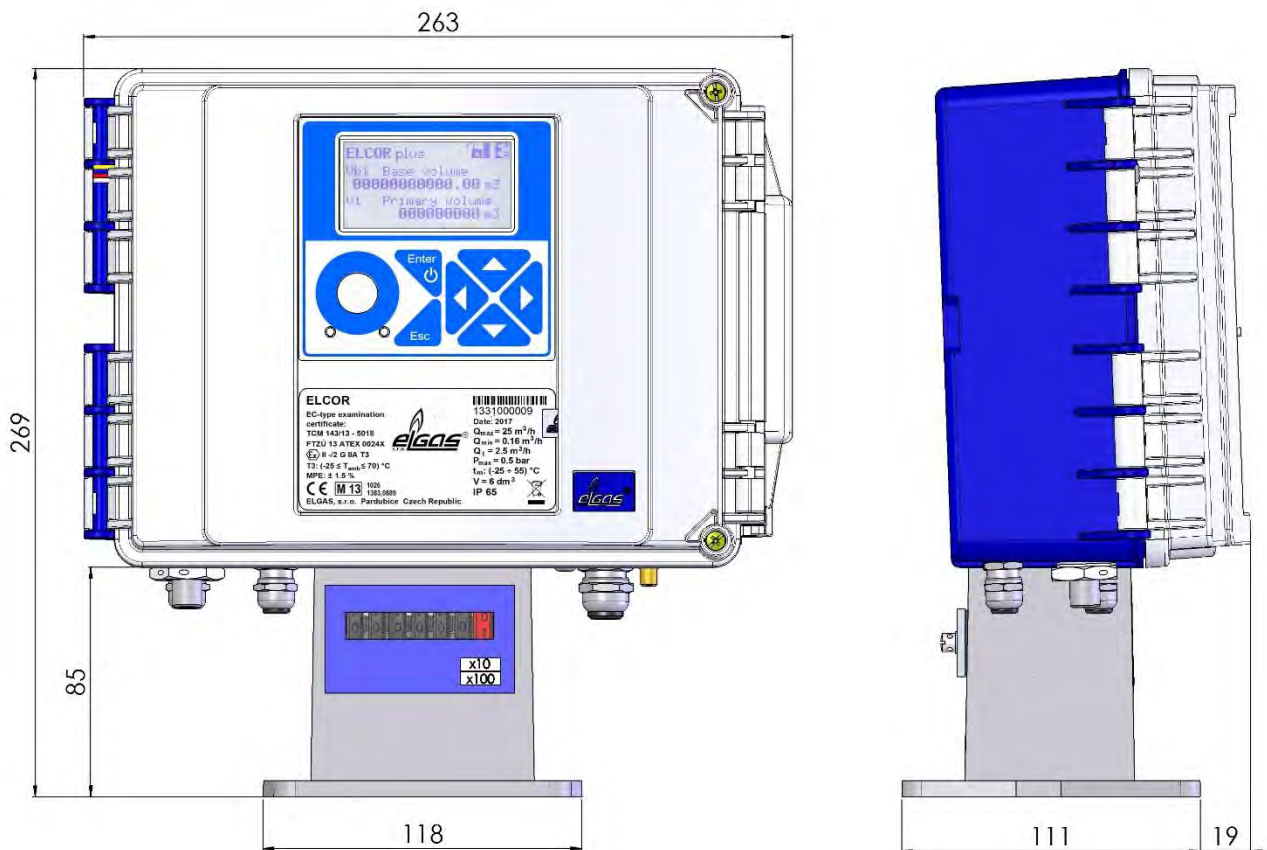
Fig. 3 ELCORplus Indexer device dimensions

5.2 Security Marks of the Device

Security marks on the device indicate the technical condition of the device from the point of view of unauthorized manipulation.

Security Mark MID (Metrological Seal, not applicable to the logger)

- Its form is prescribed by the certificate for Quality Management System for Production, Output Control and Testing according to Annex No 2, Procedure D, NV 120/2016 Coll., issued by Notified Body No 1383. This security mark together with the CE conformity marking and the supplementary metrology marking, e.g. M19 , have of the same significance for the user in the Czech Republic as the Official Mark of initial verification according to the Metrology Act (§9 Par. 3).

According to Decree 345/2002 Coll. there is a validation period of 5 years in the Czech Republic (valid on the assumption that the gas volume correctors are subject to a regular short verification test with a validity of 1 year).

When this mark is breached, the manufacturer cannot guarantee that the device features are in compliance with the EU type-examination certificate.

Manufacturer's Seal

- Inspection mark of the manufacturer according to the manufacturer's needs.

User Mark

- Inspection mark (seal) of the user according to the user's needs.
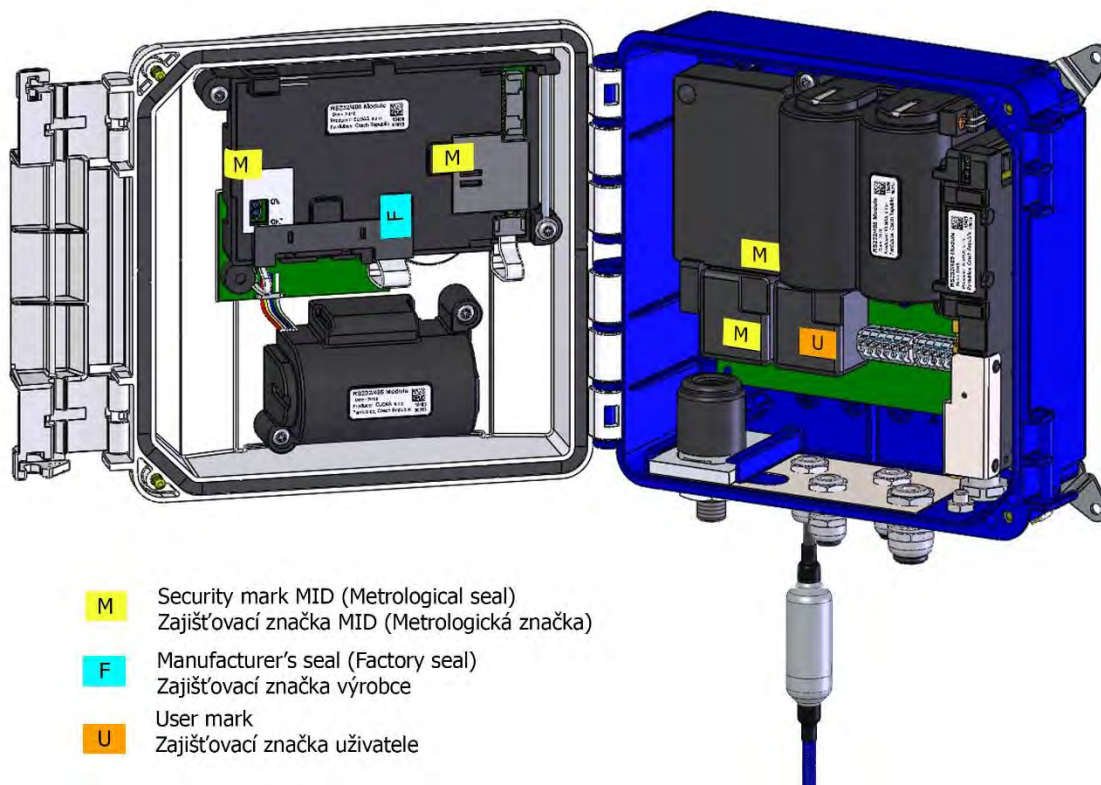
Fig. 4 Internal security marks of ELCOR
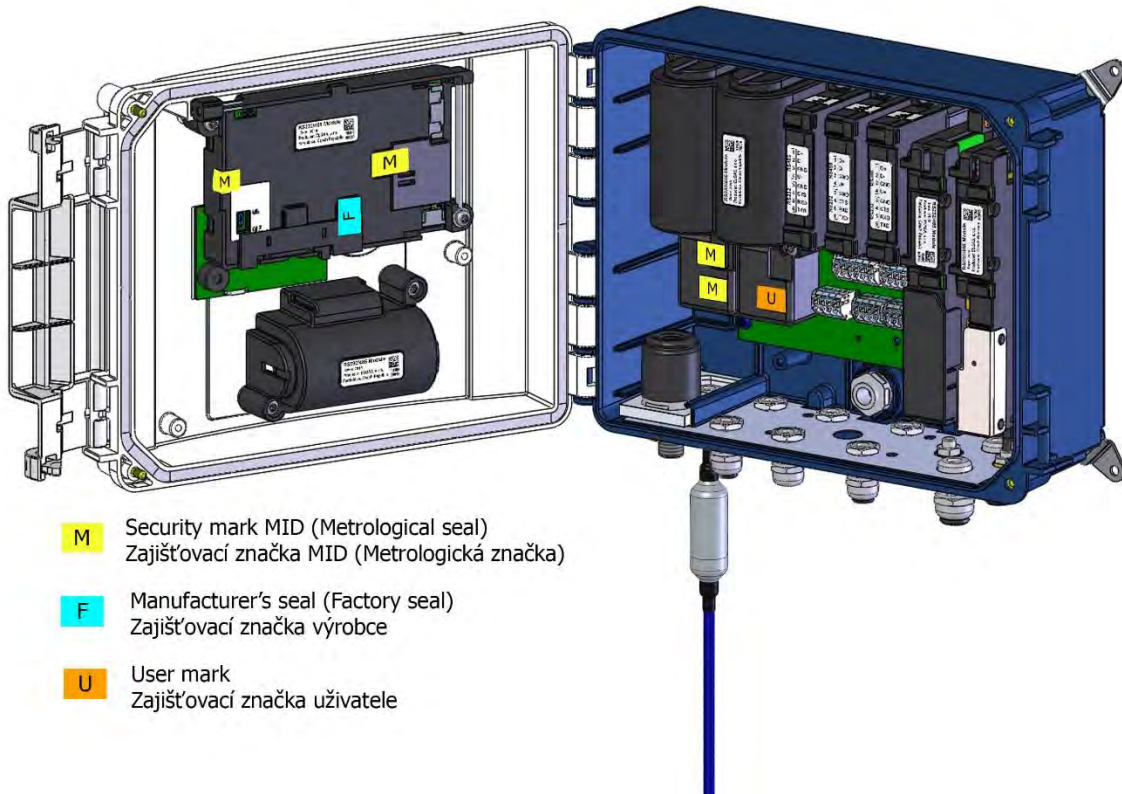
| M | Security mark MID (Metrological seal) |
| | Zajišťovací značka MID (Metrologická značka) |

| F | Manufacturer's seal (Factory seal) |
| | Zajišťovací značka výrobce |

| U | User mark |
| | Zajišťovací značka uživatele |

Fig. 5 Internal security marks of ELCORplus

User mark
Zajišťovací značka uživatele

| M | Security mark MID (Metrological seal) |
| | Zajišťovací značka MID (Metrologická značka) |

Fig. 6 External security marks of the device

5.3 Data Plates
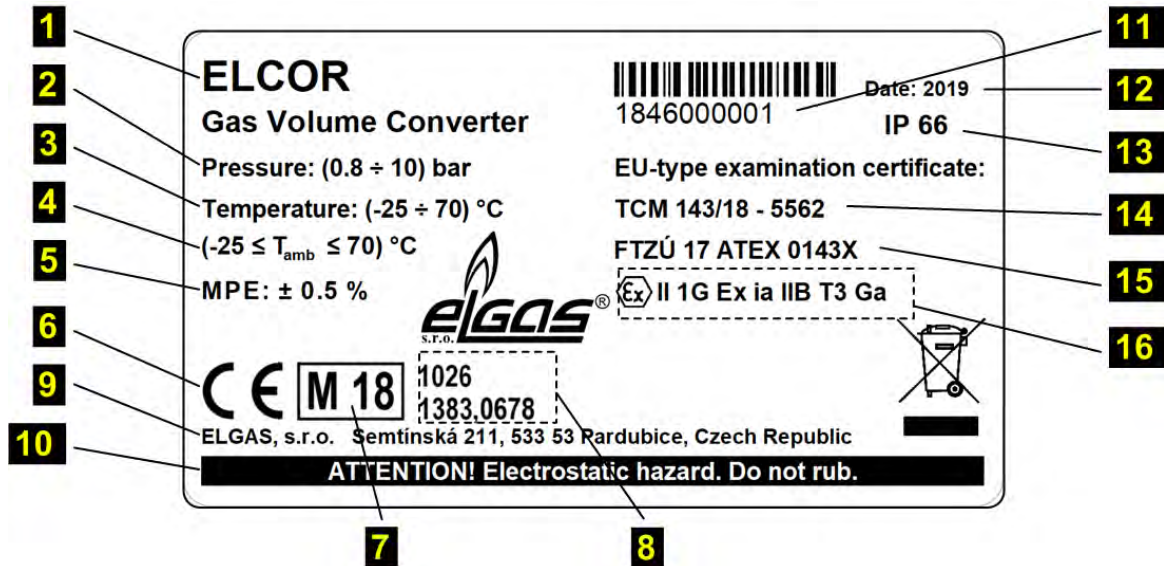
Legend:

1	Device designation	**9**	Manufacturer's address
2	Pressure measurement range	**10**	Warning to operators
3	Temperature measurement range	**11**	Serial number of the device
4	Ambient temperature range	**12**	Year of manufacture
5	Max. permitted error of the device	**13**	IP rating
6	CE conformity mark	**14**	EU Type examination certificate (metrological)
7	Year of conformity assessment	**15**	EU Type examination certificate (ATEX)
8	Notified body designation	**16**	Explosion protection designation

ELCOR *plus*
Gas Volume Converter

1846100001   Date: 2019

IP 66

Pressure: (0.8 ÷ 10) bar
Temperature: (-25 ÷ 70) °C
(-25 ≤ T$_{amb}$ ≤ 70) °C
MPE: ± 0.5 %

EU-type examination certificate:
TCM 143/18 - 5562
FTZÚ 17 ATEX 0143X
⟨Ex⟩ II 1G Ex ia IIB T3 Ga
With the PWR2, SCR module:
⟨Ex⟩ II 2G Ex ib IIA T3 Gb

CE M 18   1026
1383,0678

ELGAS, s.r.o.   Semtínská 211, 533 53 Pardubice, Czech Republic

ATTENTION! Electrostatic hazard. Do not rub.

ELCOR *plus indexer*
Gas Volume Converter

1846200021   Date: 2019

IP 66

Pressure: (0,8 ÷ 10) bar
Temperature: (-25 ÷ 70) °C
(-25 ≤ T$_{amb}$ ≤ 70) °C
MPE: ± 0.5 %

EU-type examination certificate:
TCM 143/18 - 5562
FTZÚ 17 ATEX 0143X
⟨Ex⟩ II 1G Ex ia IIB T3 Ga
With the PWR2 module:
⟨Ex⟩ II 2G Ex ib IIA T3 Gb

CE M 18   1026
1383,0678

ELGAS, s.r.o.   Semtínská 211, 533 53 Pardubice, Czech Republic

ATTENTION! Electrostatic hazard. Do not rub.

Fig. 7 Examples of data plates

5.4 Mechanical Installation

The device is intended for mounting on a wall or on a pipe by means of a mounting plate. In the case of pipe mounting, special holders can also be used instead of the standard mounting plate.

The device is mounted on the mounting plate first. If a device pressure transducer is required to be connected via a 3-way ball valve, the 3-way ball valve can also be placed on this mounting plate. The mounting plate has been designed to be fitted with three-way valves supplied by ELGAS. The equipped mounting plate can be attached by means of screws and dowels to the wall, or by means of two clamps with locking devices on horizontal or vertical piping.

ATTENTION!

The gas volume corrector is a legally controlled technical equipment that is subject to government professional supervision.

The device may be installed by only a qualified person holding a certificate of professional competence issued by a government body of labour safety supervision.

A person meeting the above conditions must also hold a "Certificate of completion of professional training" for the installation and operation of the given type of equipment. Such certificate is usually issued by the device manufacturer or an authorized partner on the basis of the training provided.

Failure to comply with these requirements gives rise to a risk of breach of warranty conditions.

ATTENTION!

The ELCOR, ELCORplus gas volume corrector is classified under the Metrology Act as being in the category of approved measuring instruments. Entities intending to carry out the installation of approved measuring instruments in the Czech Republic are obliged to submit an application for registration to the Czech Metrology Institute; see § 19 of the Metrology Act.

ATTENTION!

The device is available in various models to be used in ZONE 1 or ZONE 0 environment. The model designated for ZONE 1 must not be used in ZONE 0 environment.

The device may be operated in ZONE 0 only on condition that the "II 1G" category is indicated on data plate of the device in the ATEX label.

Before installing the device to ZONE 0, make sure that the "II 1G" category is indicated in the ATEX label.

> **i** The device display and the visor for the optical head are protected from scratching by a transparent protective foil. Remove the protective foils after installation (they may impair the readability of the display and the functionality of the optical head).

5.4.1 Mounting the Device on the Plate

Procedure:

1. Before attaching the device to the mounting plate, first fit 3 pcs of brackets **1** using 3.5x12 self-tapping screws for plastic **2** supplied with the device (see Figure 8) onto the bottom side of the device (see Fig. 8).
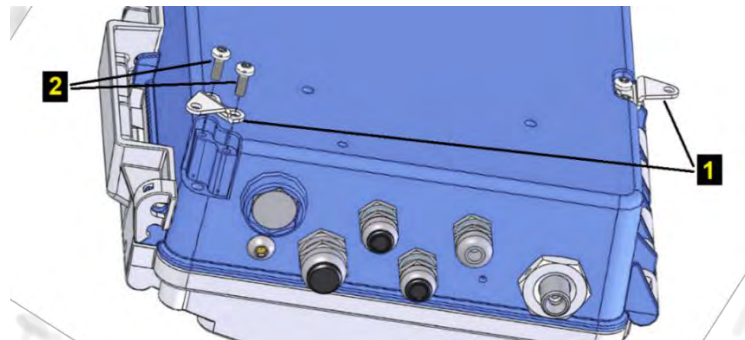
Fig. 8 Mounting the brackets on the device

2. Attach the device fitted with brackets **3** to the mounting plate using 3 screws M4x10 ISO 7045 **4** (Fig. 9, Fig. 10). The M4 rivet nuts are pre-fitted on the mounting plate.
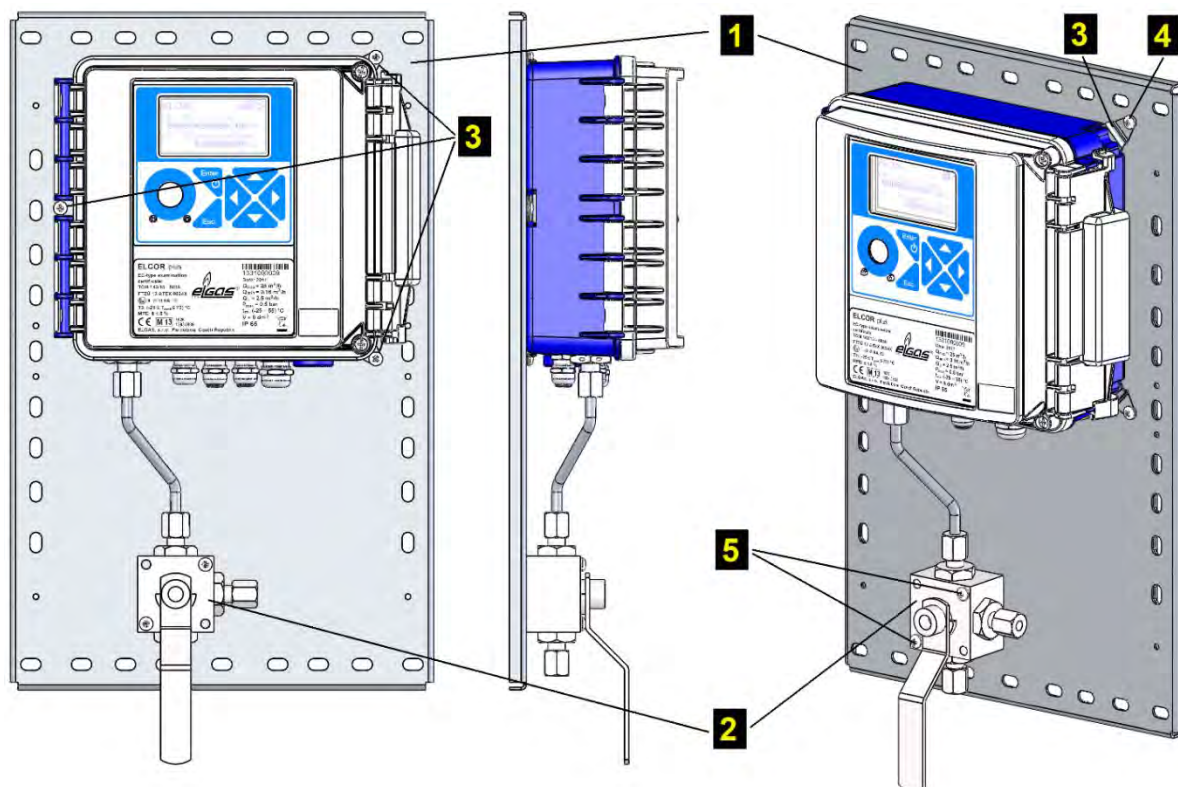
Fig. 9 Mounting of the ELCOR convertor on the mounting plate

3. Attach a 6 mm connection pressure tube to the pressure sensor in the bottom of the cabinet to connect the 3-way valve. To attach the tube to the pressure sensor, use a cutting ring with M12x1.5 ERMETO nut.

4. Screw the holder under the three-way tap **9** onto the mounting plate **4** into the prepared position with two M4x10 **8** screws. Attach a three-way tap **5** to this metal holder using 2 screws M4x40 ISO 7045 **7** Check that the pins and the position of the three-way tap control lever are correctly oriented before installation. Connect the free end of the connection tube to the three-way valve outlet (for more details, refer to Section 5.4.4).

5. Check the tightness of the connections.

Mounting plate designation	Designed for device	Size [mm]	Note
KP 107 85	ELCOR	250 x 250	For mounting without 3-way valve
KP 107 86	ELCOR	250 x 350	Allows for mounting 1 pc of 3-way valve
KP 107 87	ELCOR		For mounting on turbine gas meter ELGAS (see Fig. 13)
KP 107 88	ELCOR		For pipe flange mounting with 3-way valve mounting option (see Fig. 12)
KP 108 85	ELCOR*plus*	300 x 250	For mounting without 3-way valve
KP 108 88	ELCOR*plus*	300 x 400	Allows for mounting up to 2 pcs of 3-way valve (for dual channel corrector)

Table 1 Mounting plates supplied
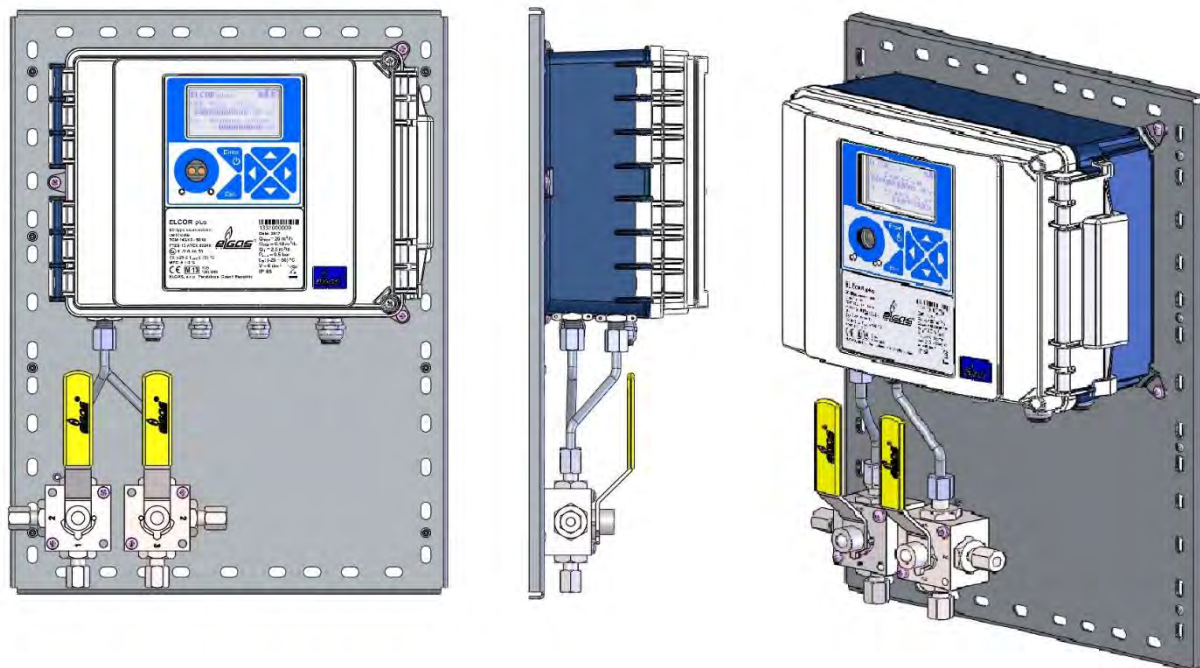
Fig. 10 Mounting dual channel ELCORplus on a mounting plate

5.4.2 Mounting the Device on a Pipe

Clamps **10** (see Fig. 11) with spacings corresponding to the pipe diameters are reeved through the openings in the mounting plate **4** and inserted over the pipe. Fasteners **11** are fixed onto the free ends of the clamps by means of nuts M6 **14** and washers **12** and **13** to secure the mounting plate in the desired position on the pipe. The mounting plate can be used for fixing to a pipe of diameter:

- DN80 - DN200 for horizontal piping, or
- DN80 - DN150 for vertical piping.
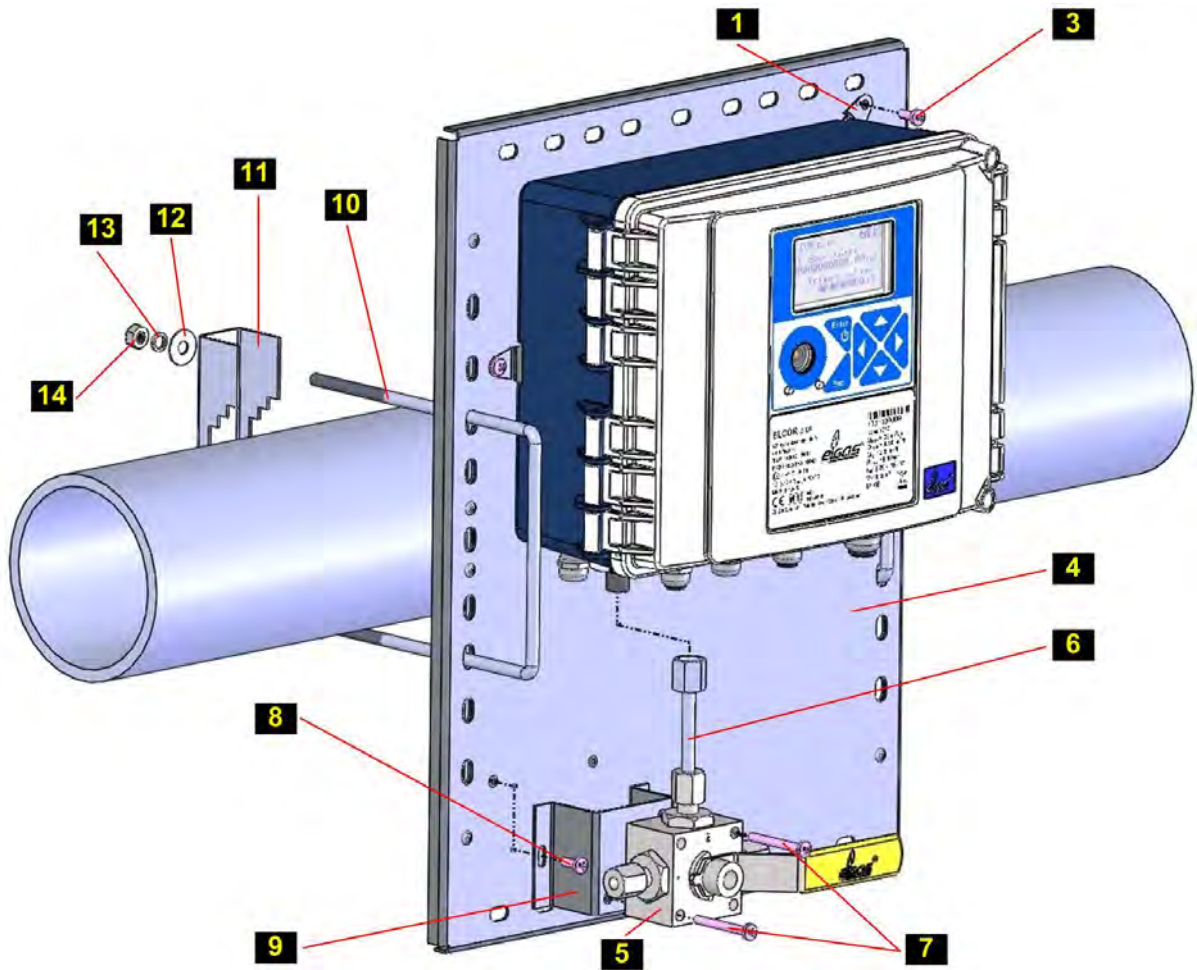
Fig. 11 Mounting the device on a pipe (ELCORplus)

For installation on piping or on ELGAS gas meters special holders shown on Fig. 12, Fig. 13 can also be used.
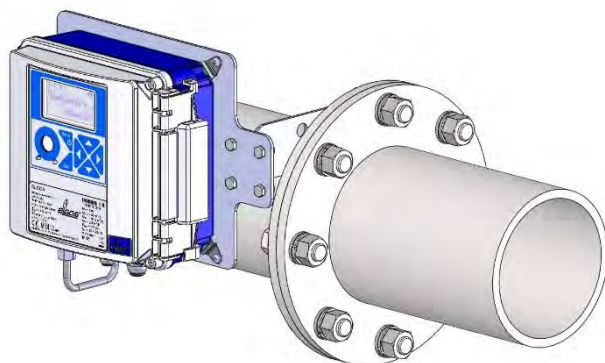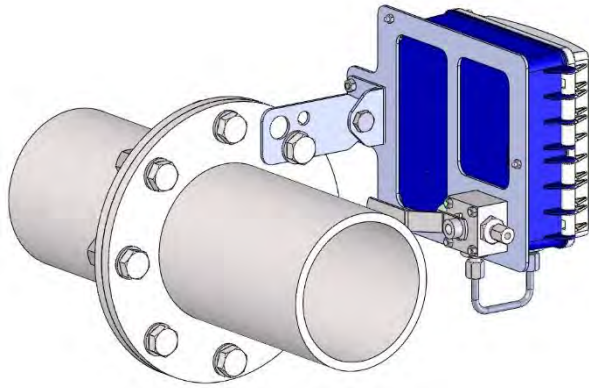
Fig. 12 Installation of ELCOR on piping using a special holder
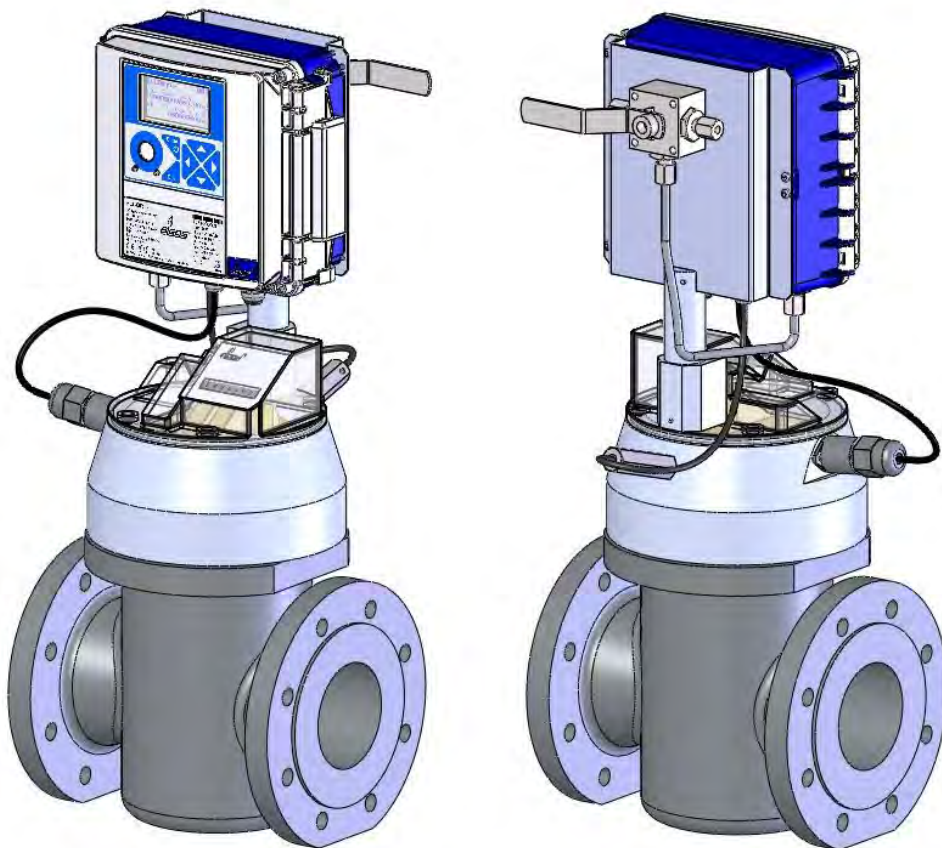
Fig. 13 Installation of ELCOR on ELGAS radial turbine gas meter

5.4.3 Installation of ELCOR*plus indexer on gas meter*

Place the gasket **1** on the gas meter flange and then the ELCORplus indexer, which is supplied as a complete set including the attached mechanical indexer. Screw it down to the meter. The necessary mounting parts (see Fig. 14 are supplied with the device as a mounting kit.
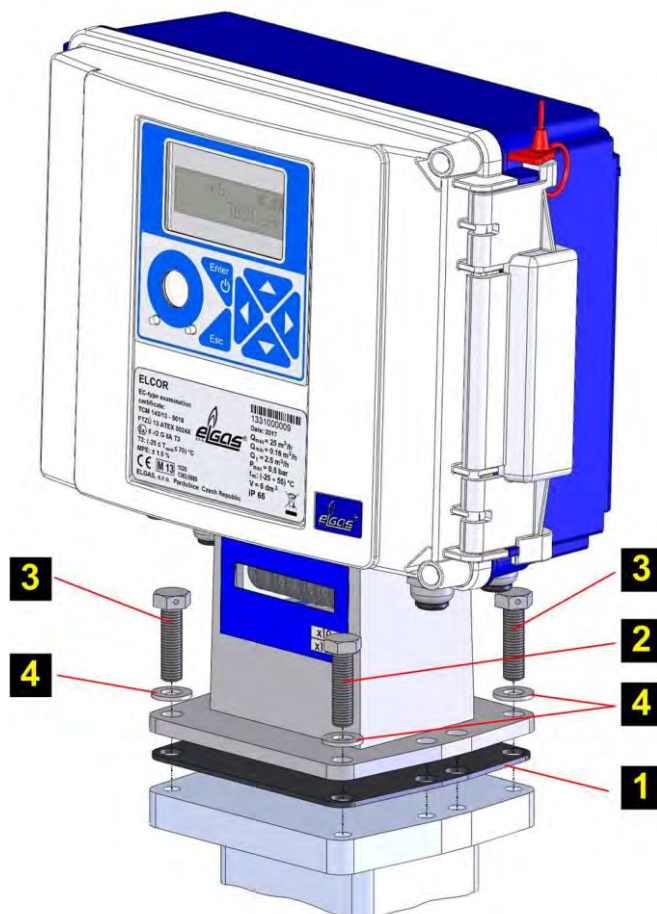
Fig. 14 Installation of ELCORplus indexer device on the gas meter

1	Indexer gasket KP067 06	**3**	Sealing screw KP 067 07
2	5/16 x ¾ hexagon screw ST.5 Zn	**4**	M8 washer DIN125-ISO7089 Zn

Make sure the indexer counter rotates in the right direction. If not, loosen the bolts **1** , remove the cover **2** at the back of the indexer (see Fig. 15), perform the following indexer adjustment.

Indexer adjustment

- Use Allen key size 1.5mm (it is not included) for removing the bracket, loosen the screw in the hub of the bevel gear **3** , move the wheel out of engagement and tighten the screw. Push the second wheel **4** into the engagement, press the teeth together very lightly and tighten the screw.
- Switch the switch **6** . The position of the switch lever must always correspond to the position of the gear that is engaged (i.e. to the right if the right wheel is engaged or to the left when the left wheel is engaged).
- fasten back the cover **2** with screws **1** and seal the screws.

55

> ℹ️ **After the indexer adjustment is finished it is imperative to carry out a RESET of the device!**
>
> You can reset the device either from the keypad of the device - menu System data (see section 6.8.2), or via the service software [42], [43].
>
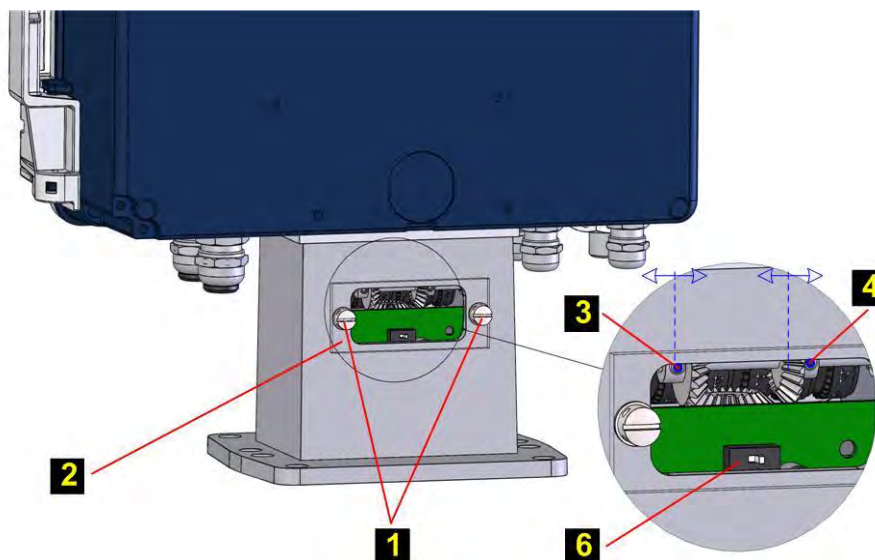> Changing the indexer settings will not be accepted without resetting the device.

Fig. 15 Indexer rotation direction adjustment (ELCORplus indexer)

5.4.4 Connecting the Pressure Transducer

To apply pressure to the pressure transducer, or the 3-way valve, we recommend using precision seamless 6x1mm stainless steel pipes or approved plastic hoses fitted with suitable end caps. The measured pressure comes from the gas pipe from the Pm outlet (former Pr) on the gas meter body or directly from the pipe (e.g. by means of a welded-on pressure fitting to connect the pressure pipe of the required size). The pipeline pressure outlet is positioned in accordance with the manufacturer's instructions for the gas meter used, usually in front of the gas meter, while the recommended distance depends on the type of the gas meter (rotary, turbine, etc.).

The corrector connected via the 3-way valve is shown in Fig. 11. Pressure tube 6x1 **6** with cutting ring pre-pressed on both sides is first thoroughly inserted into the pressure inlet of the device and secured with M12x1,5 ERMETO nut. The other end of the tube is attached to the 3-way valve working outlet fitted on the mounting plate and the nut is gently tightened. The last operation is tightening the nuts on both sides of the connecting pressure pipe. Excessive force must not be applied when tightening the key, otherwise the thread will be damaged.

5.4.5 Connecting the Temperature Transducer

Connecting the temperature transducer by means of a thermowell fitted on the gas meter is the preferred method of connection. If no thermowell is fitted on the gas meter, a weld-on fitting for mounting the thermowell is welded according to the gas meter manufacturer's instructions, typically at a distance of 1x DN to 2x DN after the gas meter in the media flow direction.

The weld-on fitting must be welded in such a way that the thermowell is in the vertical position, or inclined under 45° angle from the vertical axis with the cavity up (Fig. 16). Into the weld-on fitting, a thermowell of the appropriate length for the used pipe diameter is screwed over a copper gasket (see Table 2). The metal shank of the temperature transducer is inserted thoroughly into the thermowell and secured by a locknut. The maximum axial load of the temperature transducer cable is 50N.

Before inserting the sensor shank into the thermowell, it is recommended that the space around the shank inside the thermowell is filled with silicone oil or that the shank is lubricated with silicone grease for better heat transfer to the temperature sensor.

DN (mm)	L – Thermowell (mm)	Weld-on fitting
40	55	inclined
50	55	straight
80	100	inclined
100	100	straight
150	160	inclined
>200	160	straight

Table 2 Weld-on fittings and thermowells appropriate for the pipe diameters
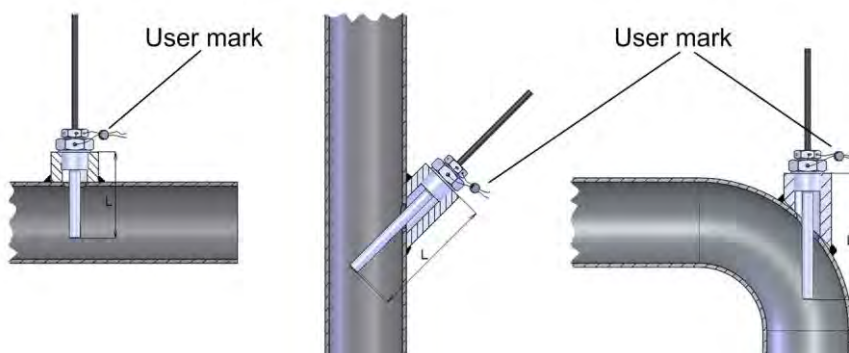
Fig. 16 Mounting the temperature sensor on the pipe

1 Temperature transducer
2 Locknut
3 Thermowell
4 Straight weld-on fitting
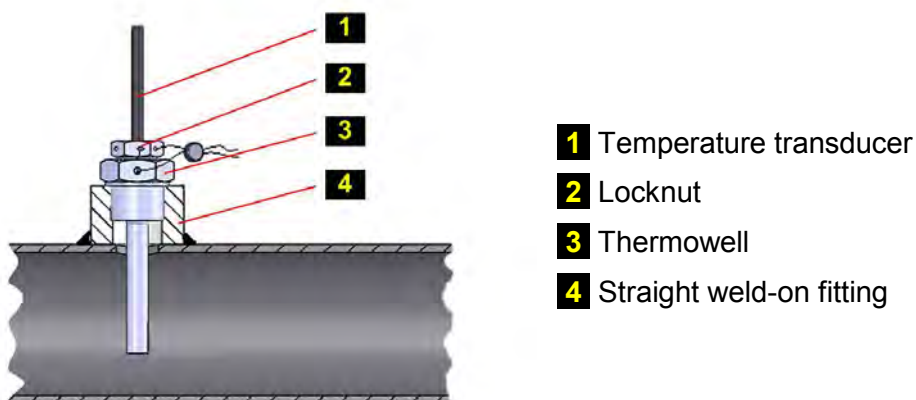
Fig. 17 Mounting the temperature sensor using a straight weld-on fitting

5.5 Electric installation

5.5.1 Basic installation requirements in terms of interference and EMC

Electronic devices must work correctly at the place of use. This must be applied even if the device is affected by electromagnetic interference (up to a certain size). The most important effects of electromagnetic interference, which may affect the device are:

- overvoltage - mainly impulse overvoltage and HF interference induced by atmospheric disturbances (storms, discharges) and interference from industrial equipment (frequency converters, compressors, pumps, etc.)

- transients during switching of inductive loads in the network (motors, valves, pumps, elevators, etc.)

- the difference in voltage potentials between the individual parts of the equipment, the flow of unwanted balancing currents

- electrostatic discharge

Limitation of the effect of these effects can be achieved by suitable installation, shielding of electrical and magnetic induction, use of filters in the supply wires to the device, and interconnection and grounding of metal parts of the installation.

Devices manufactured by ELGAS are designed to have very high immunity to interference. They are tested according to valid standards (set of standards ČSN EN 61000 4) for radiation (EMI) and resistance (EMC) to electromagnetic interference in an industrial environment (see [29], [30], [31]). However, improper installation of the device may reduce the resistance, especially if the device is connected to other devices (communication, external power supply, etc.). Therefore, certain principles must be observed when installing the unit in order not to reduce the immunity to interference.

5.5.2 EMC connection principles

The following principles are a prerequisite for the correct operation of the device (corrector, recorder).

An example of the correct installation of a converter/recorder in a gas control station according to the following principles is shown in Fig. 19. The Corrector is connected here with a telemetry and power supply box (TENAS-01) and is externally powered from the 230Vac electrical distribution network.

> **NOTICE**
> **When installing the device and connected devices, it is necessary to follow the standard [10] EN 60079-14.**

5.5.2.1 Surge protection

If an electrical network is used to supply the devices, the TN-S network must be used (i.e. with a separate middle conductor N and a separate protective conductor PE). When designing the electrical installation, measures must be taken to reduce the effects of lightning strikes to a safe level (viz [32] IEC 62305-3, Annex D). The power supply must be protected against overvoltage in accordance with the set of standards ČSN EN 60099. For the distribution network, three-stage overvoltage protection is recommended and used as standard [33] ČSN 332000-5-534 (HD60364-5-534):

The **first level** is protection against the effects of lightning. The protection is realized by overvoltage protection SPD type 1, which is placed in the low-voltage part of the substation or in the main switchboard of the building. It serves mainly to limit atmospheric overvoltage.

The **second level** of protection is usually realized by overvoltage protection SPD type 2, which is usually located in the secondary switchboard and further reduces the magnitude of the overvoltage value for the next third stage. It serves mainly to eliminate industrial interference (switching overvoltage, etc.).

The **third level** uses **SPD type 3 overvoltage protection with built-in HF filter**, which must be placed in close proximity to the protected equipment (see [33]) to protect individual devices, in our case in box TENAS-01 (e.g. protection PI-k8, HSAF10, DA-275, etc.).

A certain minimum line distance must be observed between the individual levels of overvoltage protections (so-called coordination of overvoltage protections) so that the switching of protections in the event of a pulse overvoltage takes place in the correct order.

NOTICE

In the case of external power supply to the corrector/recorder, overvoltage protection must always be applied to the power supply using a type 3 SPD surge arrester with an integrated RF filter.

Therefore, the TENAS-01 power supply and telemetry cabinets supplied by the manufacturer are always equipped with an SPD type 3 surge arrester together with the power supply, more precisely SPD type 3 with a built-in HF filter, which also suppresses HF interference. The SPD type 3 version with HF filter is used to protect devices with a built-in processor (i.e. converter or recorder).

If the supply from the power supply network is not treated against overvoltage by a 2nd stage arrester or even 1st stage arrester, these arresters must be applied additionally, e.g. in a separate box connected in front of the TENAS-01 cabinet.

When using all types of arresters, it is necessary to follow the correct principles of connection of used arresters and especially to observe:

- recommended minimum conductor cross-sections for individual SPDs,
- minimum distances between arresters SPD type 1 and SPD type 2, and
- minimum distances between arresters SPD type 2 and SPD type 3.

If the prescribed minimum distance between SPD type 1 and SPD type 2 and the distance between SPD type 2 and SPD type 3 cannot be observed, a surge arrester must be connected between the surge arresters.

The shortest possible distance between the SPD type 3 and the protected device is recommended. It is generally recommended that the third level protection should not be followed by a connecting cable longer than 1.5 m. In the extreme case, 5 m can be accepted if the building is not in a stormy area.

> ⚠️ **NOTICE**
>
> If the main supply is the absence of surge protectors or their incorrect connection, the manufacturer of the corrector/recorder cannot guarantee its correct function.

If remote communication with the corrector via a cable line (RS485 interface, Ethernet, etc.) is used it is advisable to use overvoltage protection also for this connection.

As an integral part of overvoltage protection, a protective connection must be made in the control station (generally at the installation site), which is connected to the main protective terminal block, to which the PE protective conductor of the supply cable and the grounding of the building (and possibly other conductive technical wiring are connected) inside the building - gas, water, heating, air conditioning, etc.).

Note – ELCORplus for Zone 2

If the device is powered from the S4N-PWR3 module, it is powered directly from 230Vac. In this case, SPD type 3 in a design designed for mains sockets can be used or a mains socket with an integrated SPD type 3 can be used.

5.5.2.2 Grounding and bonding

The inlet and outlet of the gas pipe to/from the control station must be galvanically separated from the pipe located inside the control station in order to prevent the flow of balancing currents through the pipes, which can be a source of interference.

Insulated pipe inside the control station must be perfectly grounded and its individual components including the gas meter must be perfectly concatenated. In between the individual parts have not arisen voltage potential which would cause flow disturbance compensating currents (Fig. 18).

Fig. 18 interconnection pipelines

5.5.2.3 Device grounding

The device (corrector ELCOR, ELCORplus, ELCORplus corrector for zone 2 and the DATCOM, DATCOMplus, DATCOMplus recorder for Zone 2) does not have to be grounded from a functional point of view.

In the case of a device with an internal pressure sensor, the device is grounded (connected to the pipeline) via a pressure sensor housing and a Ø 6mm gas supply pipe from the pipeline (so-called impulse tube) screwed to it – see Fig. 19.

In the case of devices with an external pressure sensor, the cable shield on the sensor side is conductively connected to the sensor housing (provided by the manufacturer) - see paragraph 5.6.1 In this case, the device is galvanically connected to the piping (grounded) via the cable shield of the external pressure sensor.

Note:

If you do not want to ground the device, the pressure supply to the pressure sensor (internal or external) of the device must be electrically insulated with a suitable insulating connector. However, it is always necessary to ensure that no electrostatic charge is generated on the surface of the device.

5.5.2.4 Grounding of overvoltage protection

The condition perfect grounding must be respected and used for surge protection devices on all three levels. For individual levels of SPD, min. cross-sections of live conductors and PE conductors (see [33]). For SPD type 3, a PE conductor with a min. cross-section 1 mm^2 (for SPD type 2 a minimum cross-section of PE conductor 6 mm^2 is prescribed).

5.5.2.5 Using of shielded cables

The connection of the corrector with other devices must be made with shielded cables. Recommended types of shielded cables and their cross-sections and maximum lengths are given in sections 3 and 5.6 and in the accessory's manual [41]. In general, the requirements for cables with intrinsically safe signals complying with the standard [10] for use in potentially explosive atmospheres must be complied with. Cables must have good shielding. Unused conductors of multicore cables with intrinsically safe signals must be treated in accordance with [10].

5.5.2.6 Preventing the formation of unwanted current loops

When connecting the device to other devices, there must be no closed conductive loops for the flow of any balancing currents. The balancing currents are caused by the difference between the potentials in remote parts of the installation. In conductive loops (mostly grounded), interfering currents are induced from RF interfering fields, which weakens the efficiency of cable shielding.

The cable shield must be connected only on one side, in our case on the side of the corrector or electronic recorder (see Fig. 19).

For cables connected to the internal terminals of the converter/recorder passing through a metal gland, the shield must be conductively connected to the metal part of the cable gland (see Fig. 20), i.e. essentially connected to the converter box - see paragraph 5.6.1. The shield at the other end of the cables must not be connected.

The connected shield of all cables inside the converter via cable glands is conductively connected to the metal body of the pressure sensor. Grounding is realized on the gas pipeline by means of a 6 mm impulse tube of the gas supply to the pressure sensor.

Note – External pressure range

If the device uses an external pressure sensor instead of an internal pressure sensor, the sensor cable shield must be connected to the converter in the cable gland. The shield on the sensor side is conductively connected to the sensor body (provided by the manufacturer) - see paragraph 5.6.1.

5.5.2.7 Concurrence of cables

Requirements for the distance of metallic cabling of data and information lines and cabling of power distribution (a combination of shielded and unshielded cables) are given in the set of

standards ČSN EN 50 174. It is generally recommended:

- Store power cables (230/400 V) separately from signal cables (24 V, analog/digital signals) preferably at a distance of 20 cm or more or use closed metal cable trays with a shielding partition.

- Use of cables with sufficient insulation and shielding.
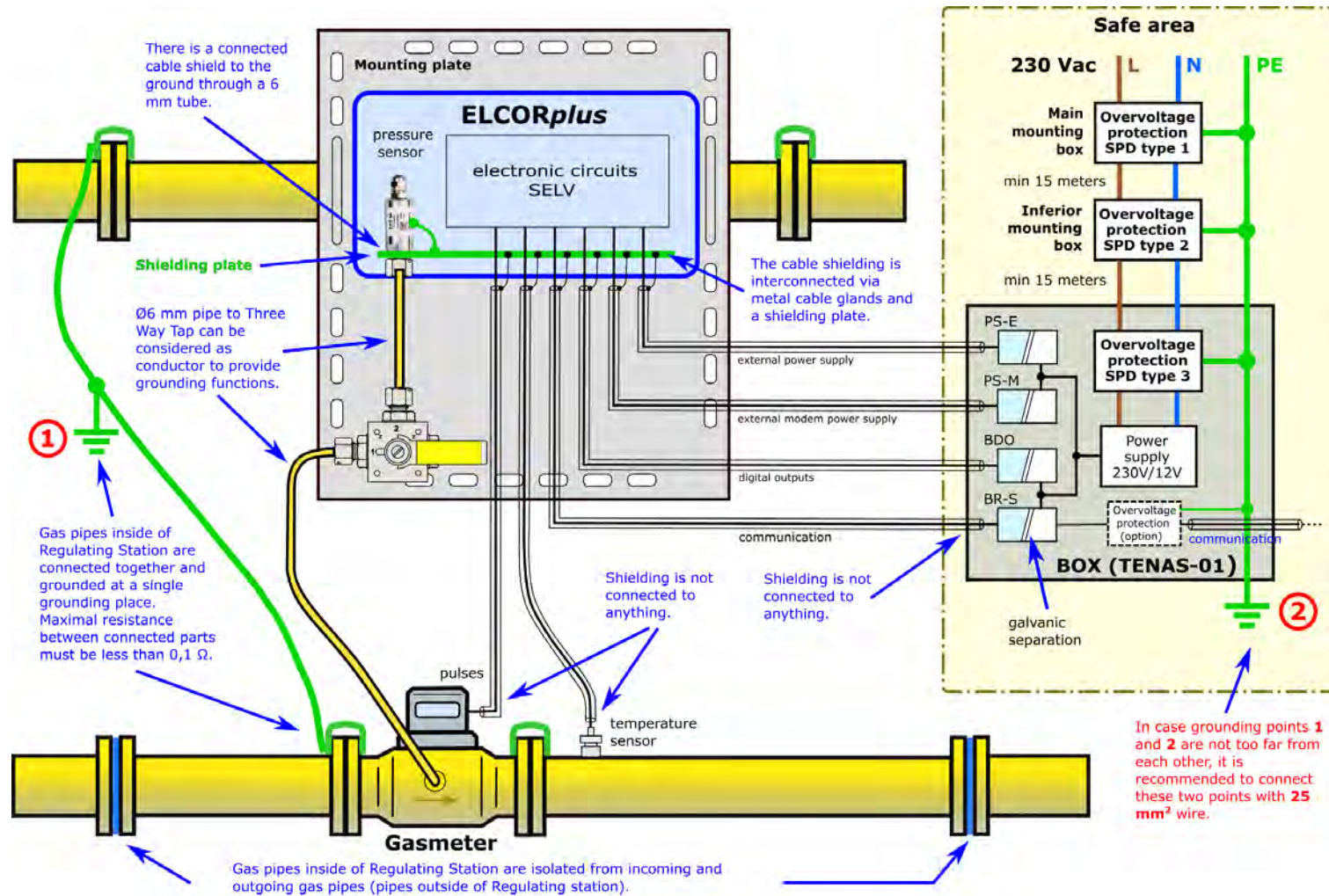
- Use of cables with sufficient cross-section.

Fig. 19 Installation of a converter with pressure and temperature transducer, external power supply and remote communication with an emphasis on EMC

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5.6 Electrical Connection

The text below describes electrical connection of the corrector with other devices. For the described connections to work properly, the device should also be set correctly up. The device can be set up either using the service software [42], [43] or from the device keypad (see Section 6.7).

5.6.1 Connecting Cables

> **Always use shielded cables complying with the standard [10] to connect the device to other devices.**
>
> **On the device side, the shields of all the connected cables must be connected to the metal body of the cable gland according to** Fig. 20**.**
>
> **When installing the device and connecting the cable shields, make sure that ground loops are not created.**
>
> All the cable glands in the device are electrically interconnected, the shields of all the cables entering the device are therefore connected at this point. This ensures high resistance to electromagnetic interference.

The following applies:

- **For the digital pressure transducer (i.e. built into body of the device housing), the metal housing of the transducer is conductively connected with the metal cable glands of the device, i.e. with the shielding of the cables fixed in the cable glands of the device.**

- **The temperature transducer and the external digital pressure transducer (if installed) are connected to the device with a shielded cable whose shield is connected to the metal body of the cable gland.**

- **The metal shank of the temperature transducer is insulated from the shield of the cable and all other parts of the device.**

- **The metal body of the external pressure transducer is connected to the cable shield.**
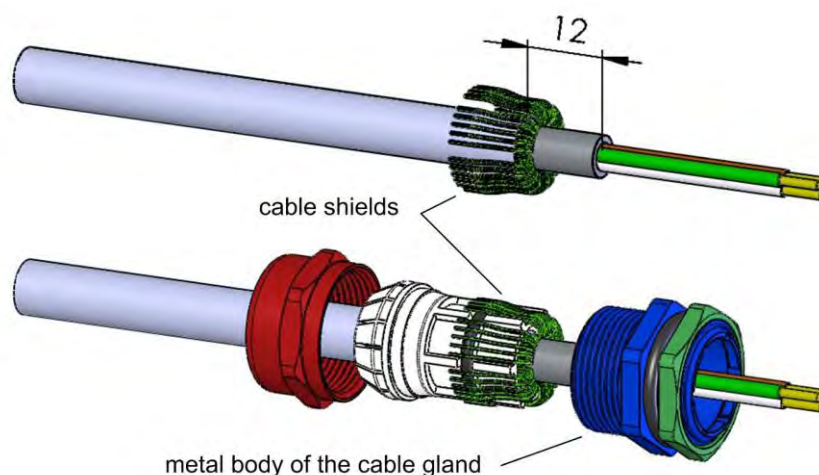
Fig. 20 Connecting the cable shields in the cable glands

The device is equipped with metal cable glands size PG7 and PG9. These glands are designed for cables of the following diameters:

PG7	3.0 ÷ 6.5 mm
PG9	4.0 ÷ 8.0 mm

The cable glands are arranged as shown in Fig. 21.

The minimum cross section is specified for the recommended shielded cables listed below. When using larger cross sections, it is necessary to check that the cable diameter matches the used cable gland.

ATTENTION!
Unused cable glands must be sealed with a stopper plug.

When supplied, stopper plugs are mounted in all unused cable entries.

Terminals for connecting cables allow to connect conductors with a cross section of 0.5 mm2 ÷ 2.0 mm2 (20 AWG ÷ 14 AWG).

Before connecting the cables, it is necessary to attach a cable sleeve to each insulated end of a cable and press the sleeves with pliers recommended by the sleeve manufacturer.

Cables terminated with sleeves can be inserted into the terminals without any tool, while taking the cable out requires a slight push on the clamp pin and slightly pulling the cable out.

Temperature ranges for recommended UNITRONIC LiYCY cables according to the manufacturer:

- Fixed mounting: -40°C ÷ + 80°C
- Occasional mobile use: -5°C - + 70°C
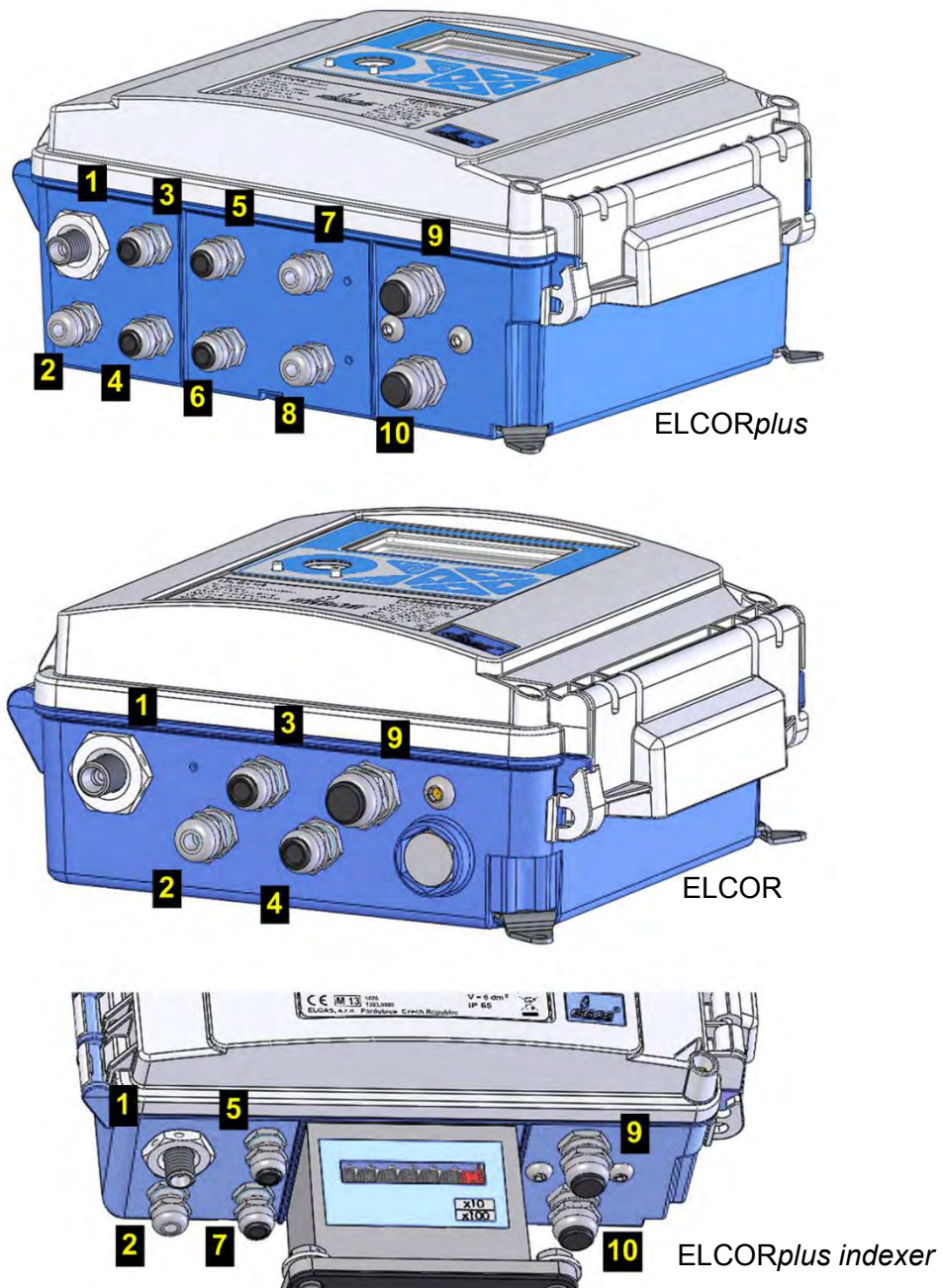
Fig. 21 Cable glands arrangement

No.	Cable	Size	No.	Cable	Size
1	Pressure (1st channel)	PG7	**6**	Temperature (2nd channel)	PG7
2	Temperature (1st channel)	PG7	**7**	Communication	PG7
3	Gas meter (1st channel)	PG7	**8**	External pressure (2nd channel)	PG7
4	HF gas meter, encoder	PG7	**9**	Digital output (DOUT), communication	PG9
5	Gas meter (2nd channel), digital inputs (DIN)	PG7	**10**	External power supply for the device and the modem	PG9

Table 3 Cable entries - recommended use

5.6.1.1 Opening   and   Closing   the   Device

To open the device:

- Loosen the screws **1**
- Open the catch **2**
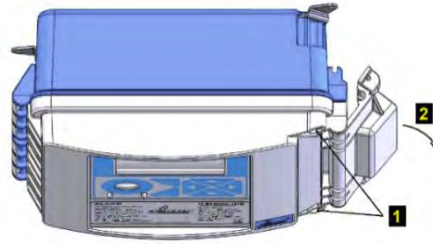
To close the device:

- Close the catch **1**
- Tighten the screws **2**
Specified tightening torque
the cover bolts is 0.5 to 0.7 Nm.

5.6.1.2 Locking and Sealing the Device

The clamp of the device cover can be secured with plastic or wire seal **1** and locked with a padlock **2** with the shackle diameter of up to 5mm.
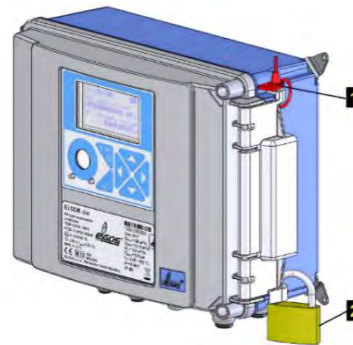
5.6.2 Connecting Gas Meters

Gas meters with LF pulse output

DIN terminal block is the standard for a LF gas meter connection. Only one [17]) LF gas meter can be connected to the ELCOR device. The ELCORplus device can be either single channel or dual channel. The DIN terminal block is hidden under a plastic cap that the users can secure with their mark.

ELCOR – LF gas meter	
Terminal	Connection
DI1	Pulse output of the gas meter
DI3	- Contact for the gas meter connection monitoring (tamper contact), or - Pulse output of the gas meter for detecting the rotation direction

---

[17]) DI2 terminal of the ELCOR corrector can also be configured to connect the LF pulse output of another meter. However, it cannot be used as a metrological quantity.

ELCORplus – LF gas meter	
1st channel	
Terminal	Connection
DI1	Pulse output of the gas meter
DI4	- Contact for the gas meter connection monitoring (tamper contact), or - Pulse output of the gas meter for detecting the rotation direction
2nd channel	
Terminal	Connection
DI2	Pulse output of the gas meter
DI3	- Contact for the gas meter connection monitoring (tamper contact), or - Pulse output of the gas meter for detecting the rotation direction

ELCORplus indexer –The integrated mechanical indexer is equipped with optical sensors with the detection of the direction of rotation of the meter. The terminals of these sensors are connected to the SLOT 0 terminals by the manufacturer. The module of the mechanical indexer interface is fitted in the SLOT 0 position.

Gas Meters with HF Pulse Output

ELCOR – HF gas meter cannot be used.

ELCOR*plus* – To connect the device, the EXT1 or EXT1/HF module must be installed in the SLOT 0 position. The EXT1 (EXT1/HF) module allows for connecting either one HF gas meter with the detection of rotation direction or two HF gas meters. The meter is connected by means of terminals 1 and 2; to terminals 5 and 6, either auxiliary gas meter sensor with the detection of rotation direction or another HF gas meter can be connected.

⚠️ **WARNING**

When using a HF meter, the corrector must be powered from an external intrinsically safe power supply (e.g. PS-E, PS-E/A).

Gas Meter with NAMUR or SCR Encoder

ELCOR, ELCOR*plus* – The module of the interface of the encoder must be fitted in the SLOT 0 position. The gas meter is connected to terminals 1 and 2. The external power supply of the corrector is not necessary.

Connection	Cable	Entry	Recommended type of cable	Cable Ø
Pulse input (both LF and HF gas meter), encoder	2-wire shielded	PG7	Unitronic LiYCY 2 x 0.25 Lappkabel	4.5 mm
Pulse input with tamper contact	4-wire shielded	PG7	Unitronic LiYCY 4 x 0.25 Lappkabel	5.0 mm
Pulse input with the detection of rotation detection	4-wire shielded	PG7	Unitronic LiYCY 4 x 0.25 Lappkabel	5.0 mm

Table 4 Cables recommended to connect the gas meter

5.6.2.1 LF Gas Meter, Single Channel corrector
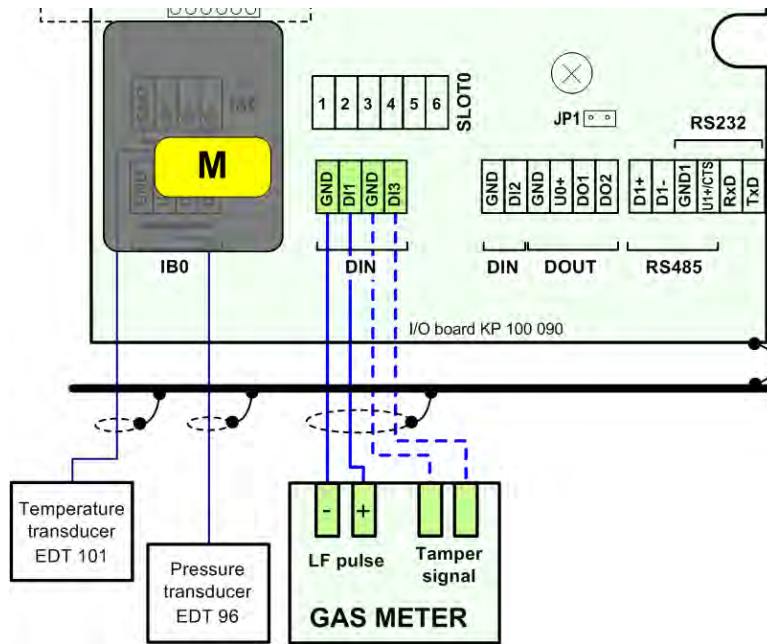
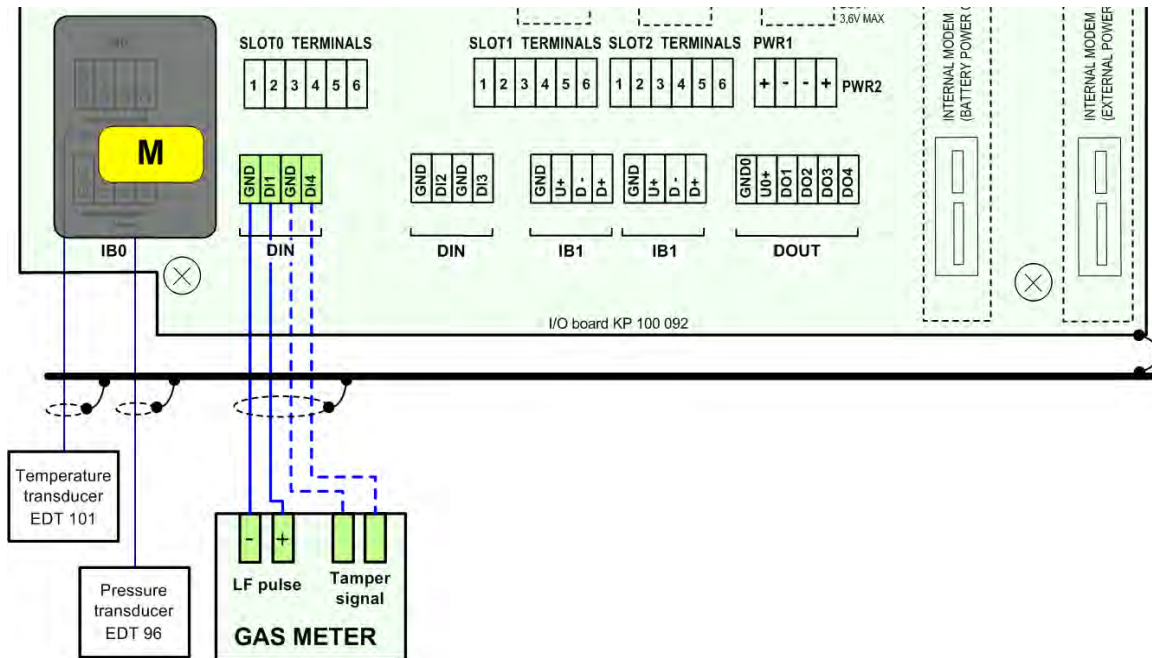*Fig. 22 Connecting LF gas meter to ELCOR*

Fig. 23 Connecting LF gas meter to ELCORplus (single channel)

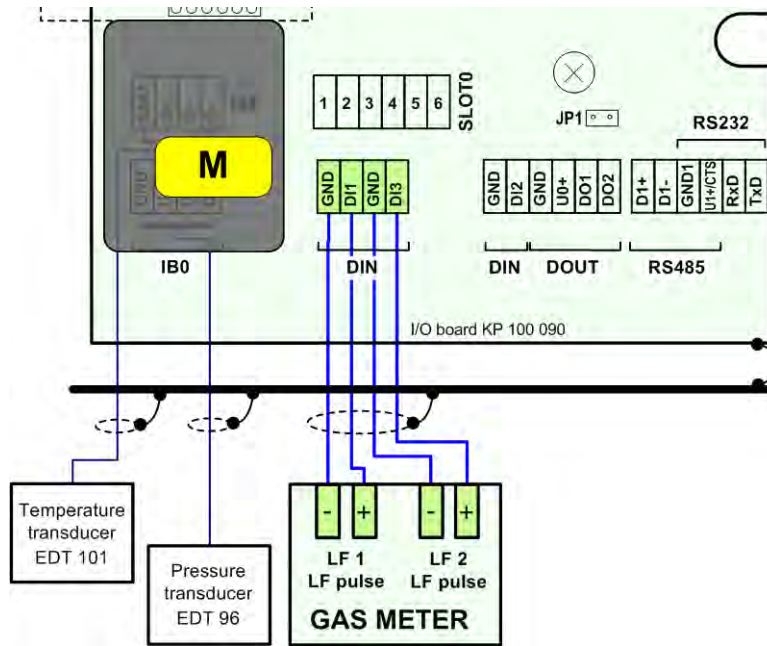### 5.6.2.2 LF Gas Meter with the Detection of Rotation Direction

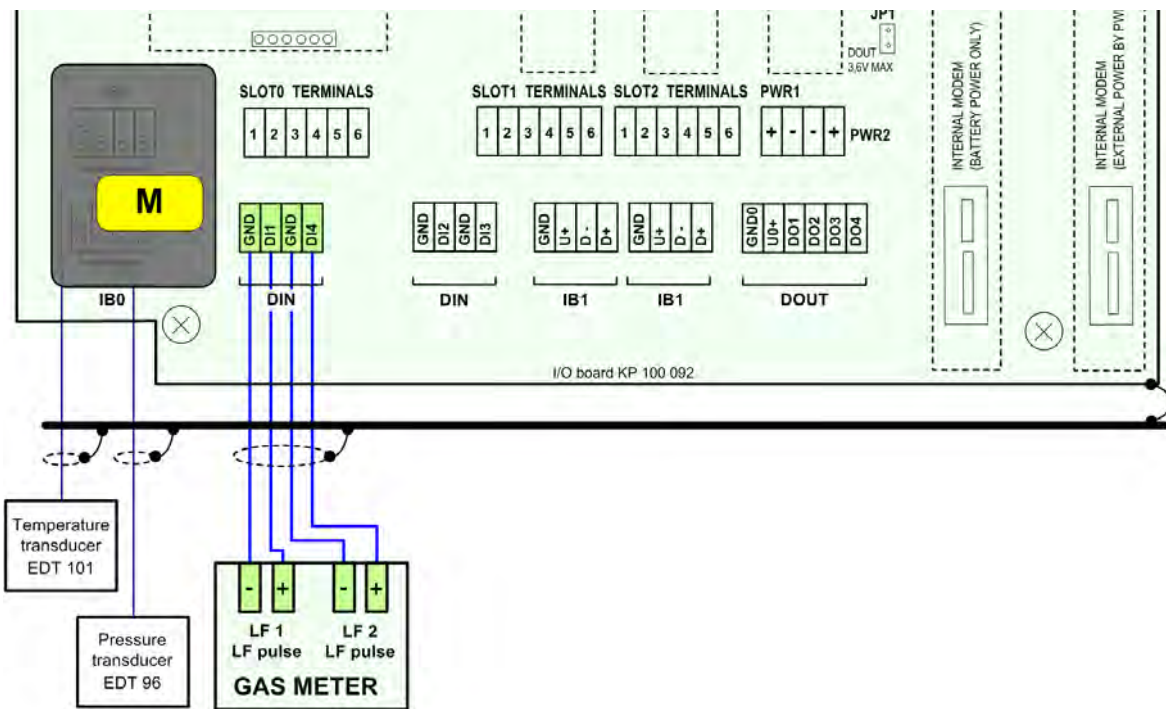*Fig. 24 Connecting LF gas meter with the detection of rotation direction to ELCOR*

Fig. 25 Connecting LF gas meter with the detection of rotation direction to ELCORplus
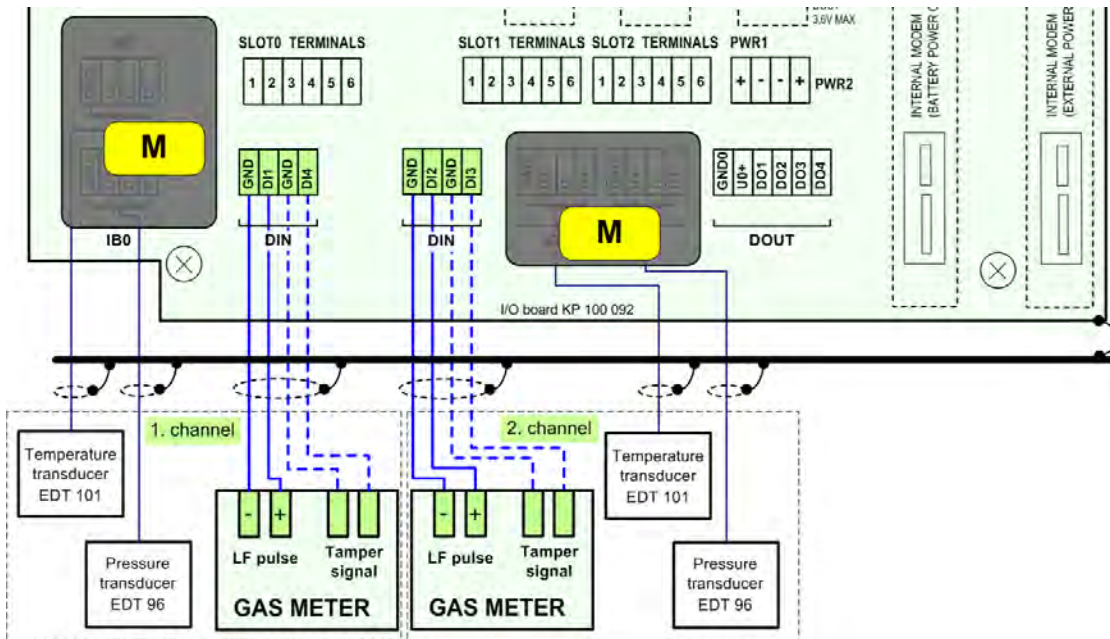
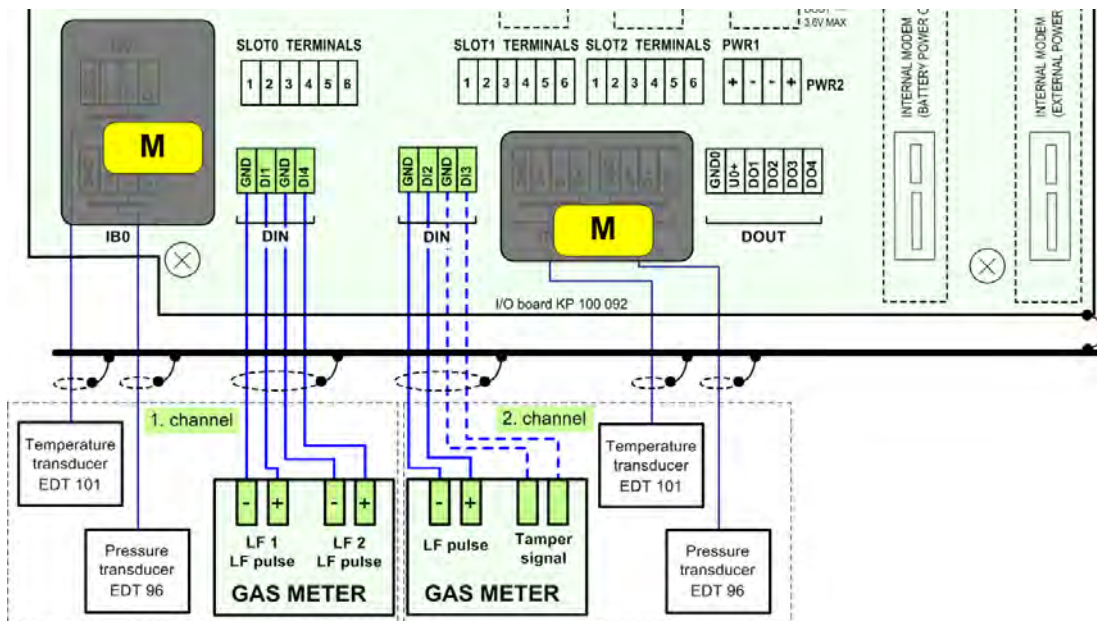### 5.6.2.3 LF Gas Meter, Dual Channel

Fig. 26 Connecting LF gas meters to ELCORplus (dual channel)

Fig. 27 Connecting LF gas meters to ELCORplus (dual channel, gas meter with the detection of rotation direction)

5.6.2.4 HF Gas Meter
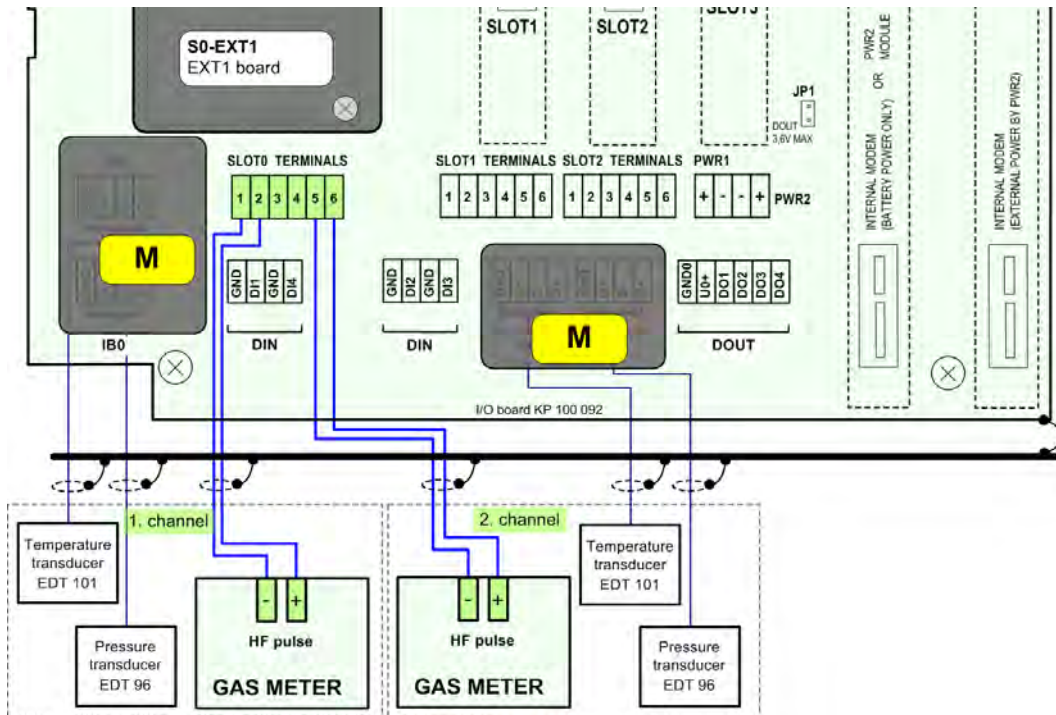
Fig. 28 Connecting HF gas meters to ELCORplus (dual channel)

5.6.2.5 Gas Meter with Encoder
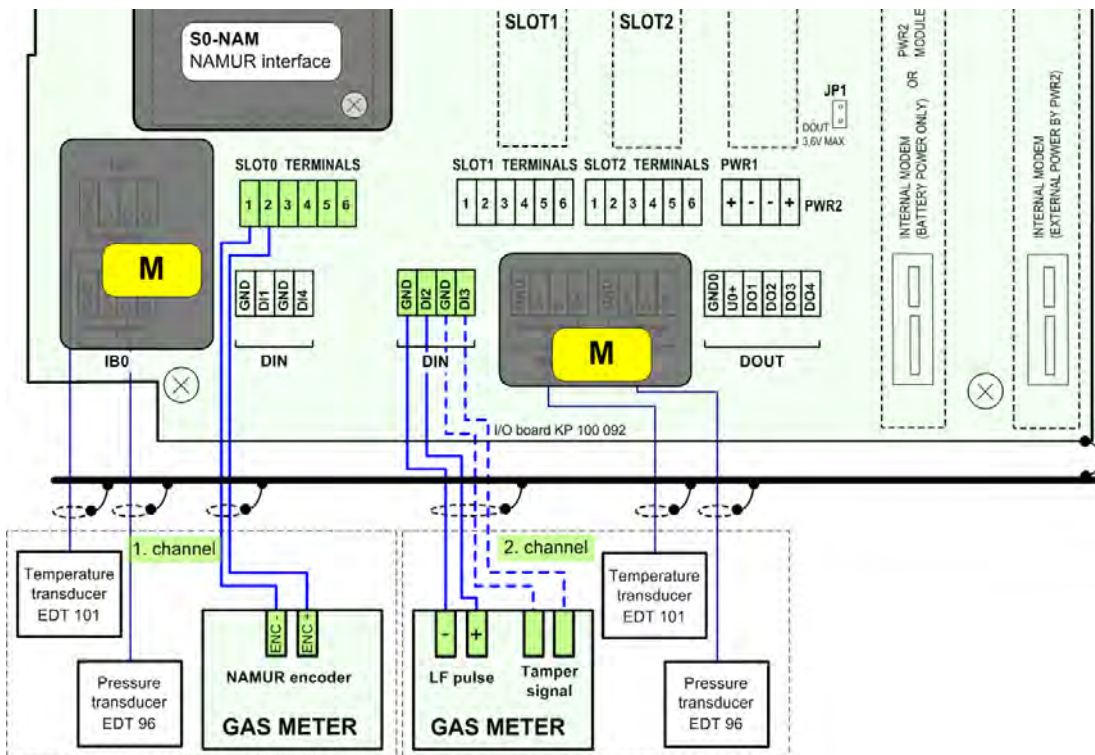
Fig. 29 Connecting gas meter with NAMUR encoder to ELCORplus
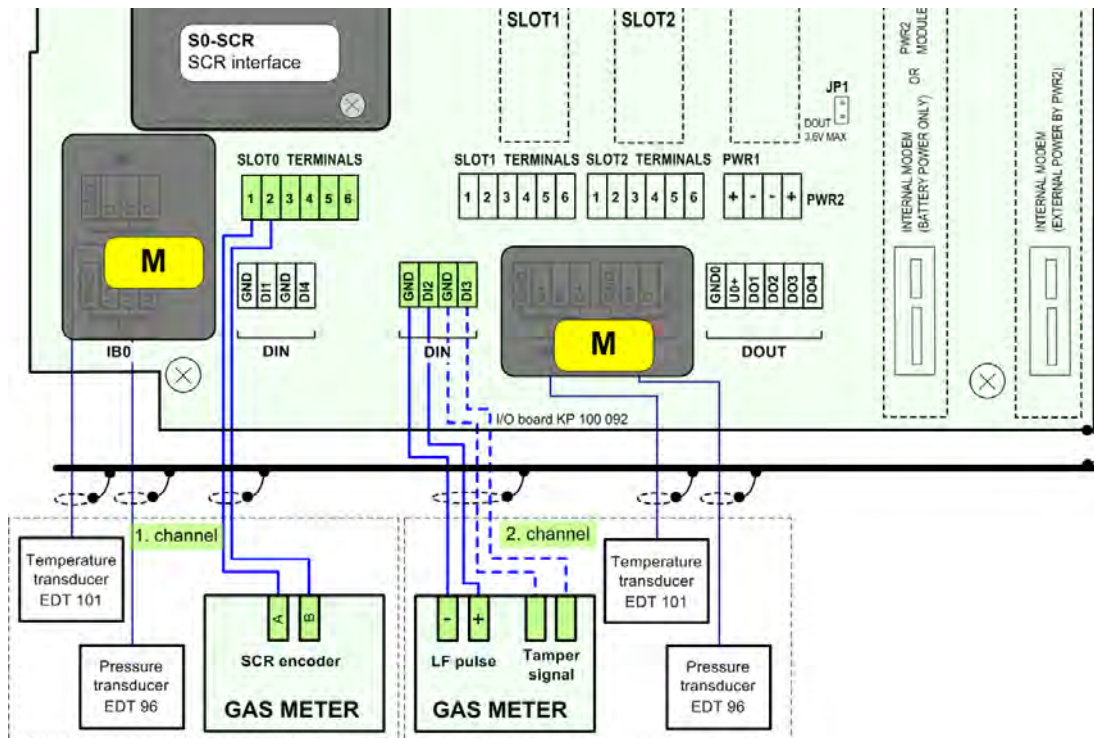
Fig. 30 Connecting gas meter with SCR encoder to ELCORplus

5.6.3 Connecting Binary Inputs

ELCOR - Terminal DI2 is the standard for binary input connection. If the DI3 terminal or DI1 has not been used to connect the gas meter, these terminals also can be used.

ELCOR*plus* – One of the fee terminals DI1 to DI4 can be used to connect binary inputs, if they have not been used to connect the gas meter.

ATTENTION!

Signals on all digital inputs (DIN terminals) are intrinsically safe. The sensors connected to these terminals must be:

- **Either intrinsically safe with the corresponding IS parameters,**
- **Or they must fall under the "Simple Device" category according to [4],**
- **Or they must be connected via a safety barrier.**

Connection	Cable	Entry	Recommended type of cable	Cable Ø
Binary input (single)	2-wire shielded	PG7	Unitronic LiYCY 2 x 0.25 Lappkabel	4.5 mm
Binary input (double)	3-wire shielded	PG7	Unitronic LiYCY 3 x 0.25 Lappkabel	4.7 mm
Binary input (triple)	4-wire shielded	PG7	Unitronic LiYCY 4 x 0.25 Lappkabel	5.0 mm
Binary input (four times)	5-wire shielded	PG 7	Unitronic LiYCY 5 x 0.25 Lappkabel	5.6 mm

Table 5 Cables recommended to connect binary inputs

5.6.4 Connecting Binary Outputs

ELCOR – with 2 digital outputs available, DO1 and DO2 terminals on the DOUT terminal block.

ELCOR*plus* – with 4 digital outputs available, DO1 to DO4 terminals on the DOUT terminal block.

> ⚠️ **EX**
>
> **ATTENTION!**
>
> **The signals of the DOUT terminal block are intrinsically safe, which is why common devices must be connected via a separation safety barrier (B-DO module).**

Connection	Cable	Entry	Recommended type of cable	Cable Ø
Digital output (single)	3-wire shielded	PG7	Unitronic LiYCY 3 x 0.25 Lappkabel	4.7 mm
Digital output (four times)	6-wire shielded	PG7	Unitronic LiYCY 6 x 0.25 Lappkabel	6.0 mm

Table 6 Cables recommended to connect binary outputs to the B-DO module
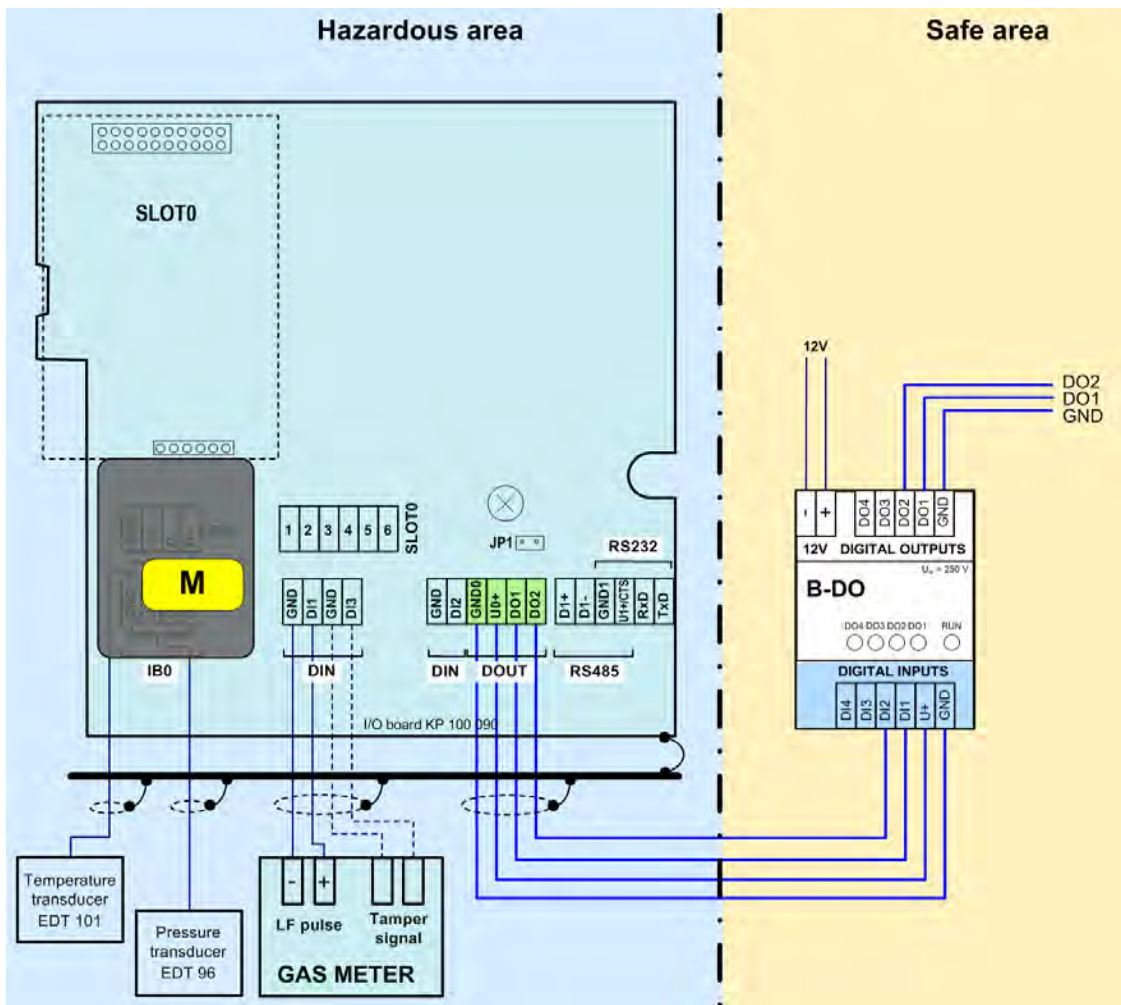
Fig. 31 Connecting digital outputs via B-DO separation barrier (ELCOR)

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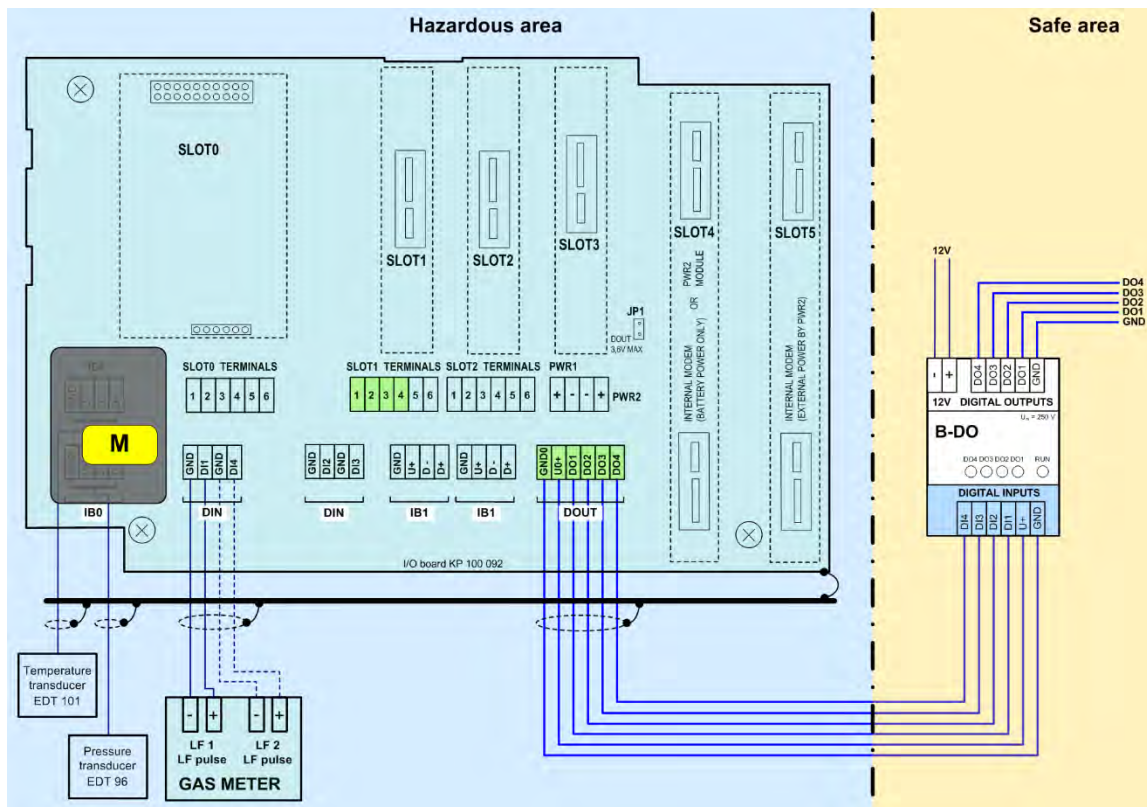
Fig. 32 Connecting digital outputs via B-DO separation barrier (ELCORplus)

5.6.5 Connection of pressure and temperature transducers

These transducers are connected to the I / O board in the IB0 terminal block, respectively terminal block IB1 (ELCORplus only). Furthermore, they can be connected to the IB1 terminal block of the EXT1-T terminal board of the EXT1 module. In the case of the metrology channel, the connection is covered and secured with the MID security mark.

⚠️ **ATTENTION!**
The intrinsically safe internal communication bus is connected to terminals IB0 and IB1. In case of any manipulation on terminals IB0 and IB1 it is necessary to disconnect the device power supply (ie external power supply and battery).

IB0, IB1	EDT 96 EDT 101	EDT 101 Temperature transducer	EDT 96 Pressure transducer	
			internal (var. A)	external (var. C)
terminal	signal	wire	wire	wire
GND	GND	green	green	green
U+	PWR	brown	brown	brown
D-	DATA-	yellow	yellow	yellow
D+	DATA+	white	white	white

Table 7 EDT 96 and EDT 101 transducers wire colors

75
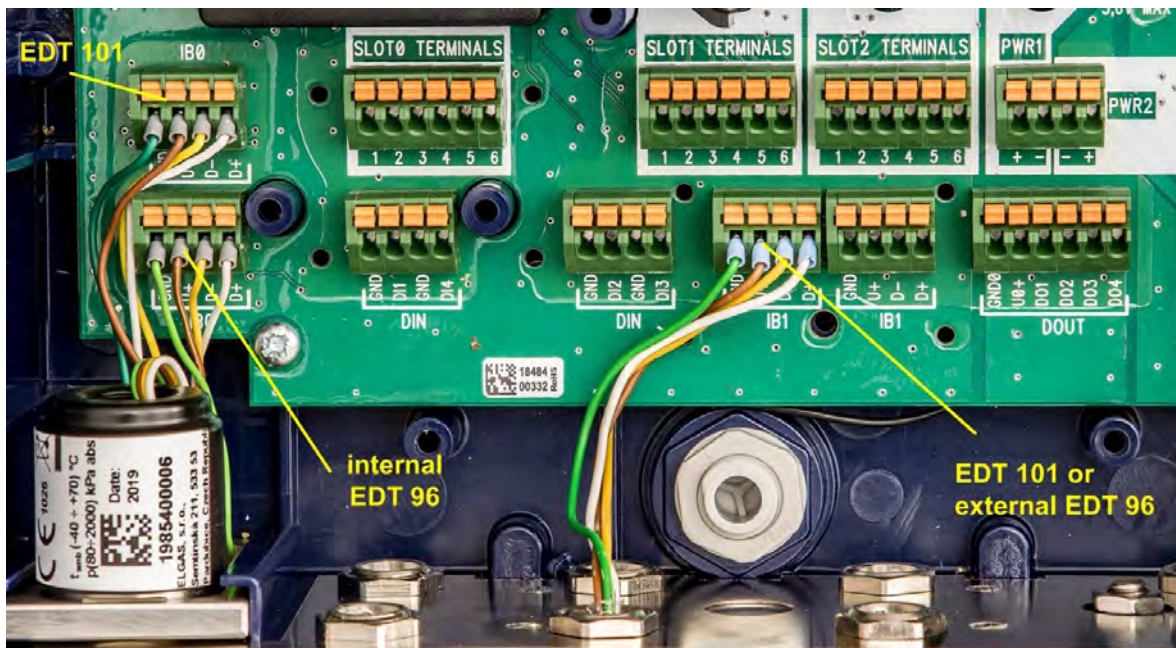
Fig. 33 EDT 96 and EDT 101 transducers connection

The EDT 96 pressure transmitter and the EDT 101 temperature transmitter are supplied by the manufacturer calibrated in whole measurement range. The calibration and correction data are stored in the transducer´s internal memory when the transmitter is calibrated and the resulting measured data already included with the corrections is passed to the instrument control unit.

Nevertheless, the device is equipped with the option of **one-point or two-point adjustment** of the transducer using the supplied SW [42], [43]. This option is protected by the metrology switch provided by the metrology mark. In the case of a corrector without MID metrological verification or an electronic data logger, the adjustment is accessible to the user. A description of the corrector settings via user SW is given in [38].

For more information on EDT 101 and EDT 96 transducers, see [39] and [40].

5.6.6 Connecting External Power Supply

A cable with a minimum cross section of 0.75 mm^2 is required for the external power supply from the PS-E (PS-E/A) intrinsically safe power supply.

To connect the external power supply to internal modem from the PS-M (PS-M/A) intrinsically safe power supply, cable with the conductor cross section of at least 1 mm^2 is required. The table below shows the maximum length of this cable. The PG9 cable gland is designed for the cable. If both the corrector and the internal modem are powered from external power supply, the only one 4-core cable can be used for the power supply.

Connection	Cable	Cable gland	Recommended type of cable	Max. lenght	Cable Ø
External power supply of the corrector (separate)	2-wire shielded	PG9 (PG7)	Unitronic LiYCY 2 x 0.75 Lappkabel	30 m	6.0 mm
External power supply of the modem (separate)	2-wire shielded	PG9	Unitronic LiYCY 2 x 1.5 Lappkabel, or	20 m	7.1 mm

			Unitronic LiYCY 2 x 1.0 Lappkabel	13 m	6.3 mm
External power supply of the convertor and the modem	4-wire shielded	PG9	Unitronic LiYCY 4 x 1,0 Lappkabel	13 m	7.3 mm

Table 8   Cables recommended for external power supply for the corrector and the modem

5.6.6.1 External Power Supply for the Corrector (Measurement Part)

External power supply can be used with ELCOR*plus* or ELCOR*plus Indexer*. If external power supply is used for the corrector (i.e. its measurement part), the S3-PWR1 module must be installed in SLOT 3. Power from an external intrinsically safe PS-E source is fed to the PWR1 terminals. In the event of a power failure, the corrector battery (B-03) performs the power backup function.

> **WARNING**
>
> If the corrector is powered from an external power supply, it is necessary for the device to operate correctly that the batteries (B-03) of the corrector are inserted and connected in the device.
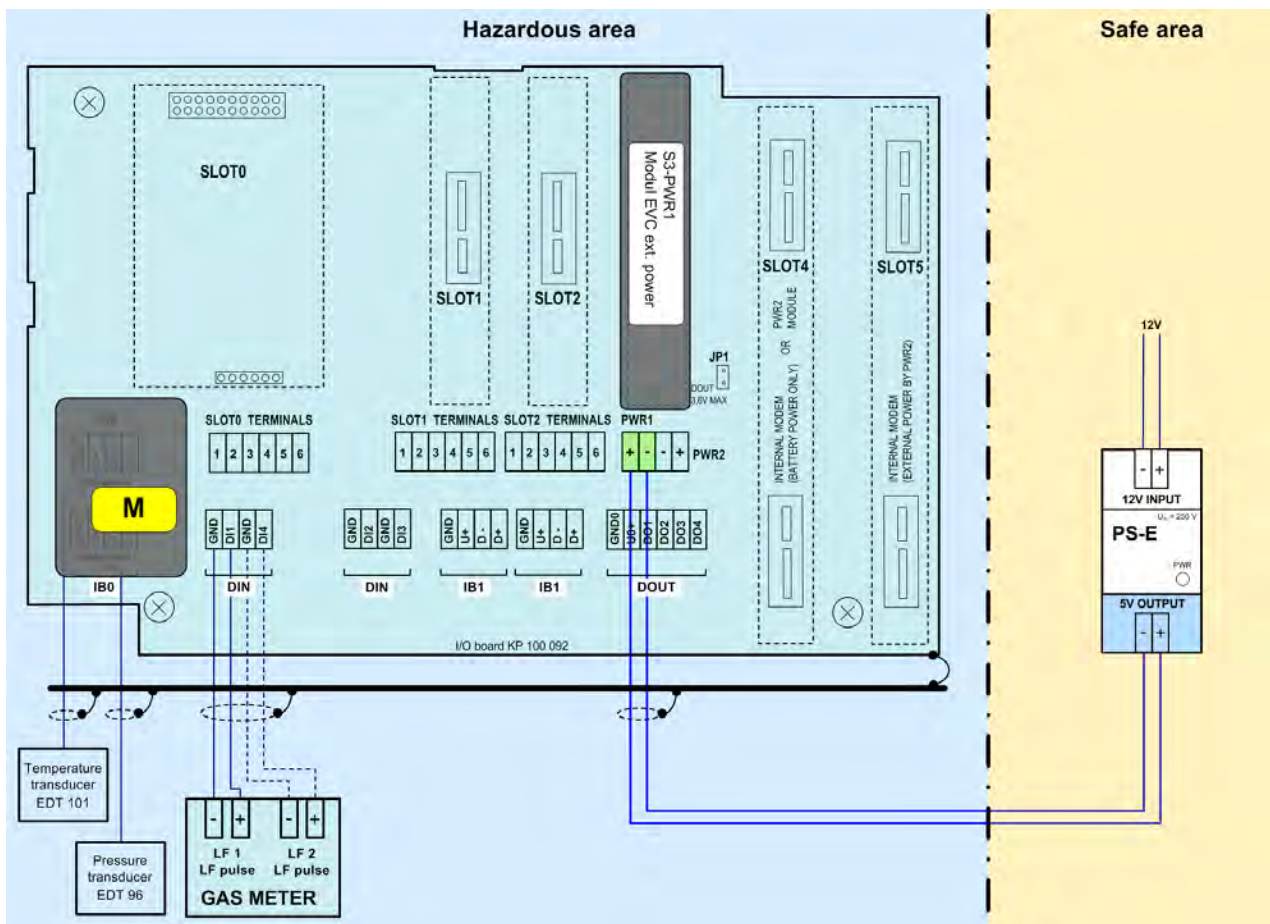
Fig. 34 Connecting the external power supply of the corrector

5.6.6.2 External Power Supply for the Internal Modem

The external power supply for the modem is ensured by the S4-PWR2 module in conjunction with

the PS-M external intrinsically safe source. The S4-PWR2 module must be installed in SLOT 4. Power from an external intrinsically safe PS-M source is fed to the PWR2 terminals.

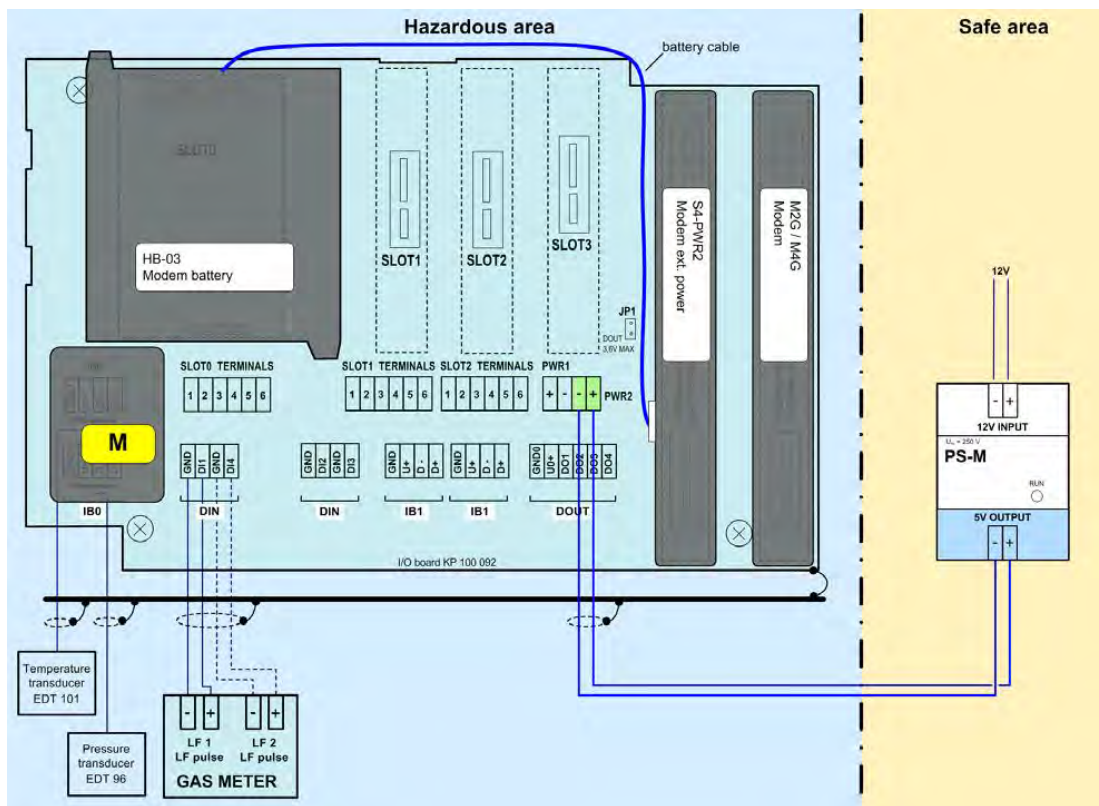In the event of a power failure, the modem battery (HB-03, HB-04, etc.) performs the power backup function.

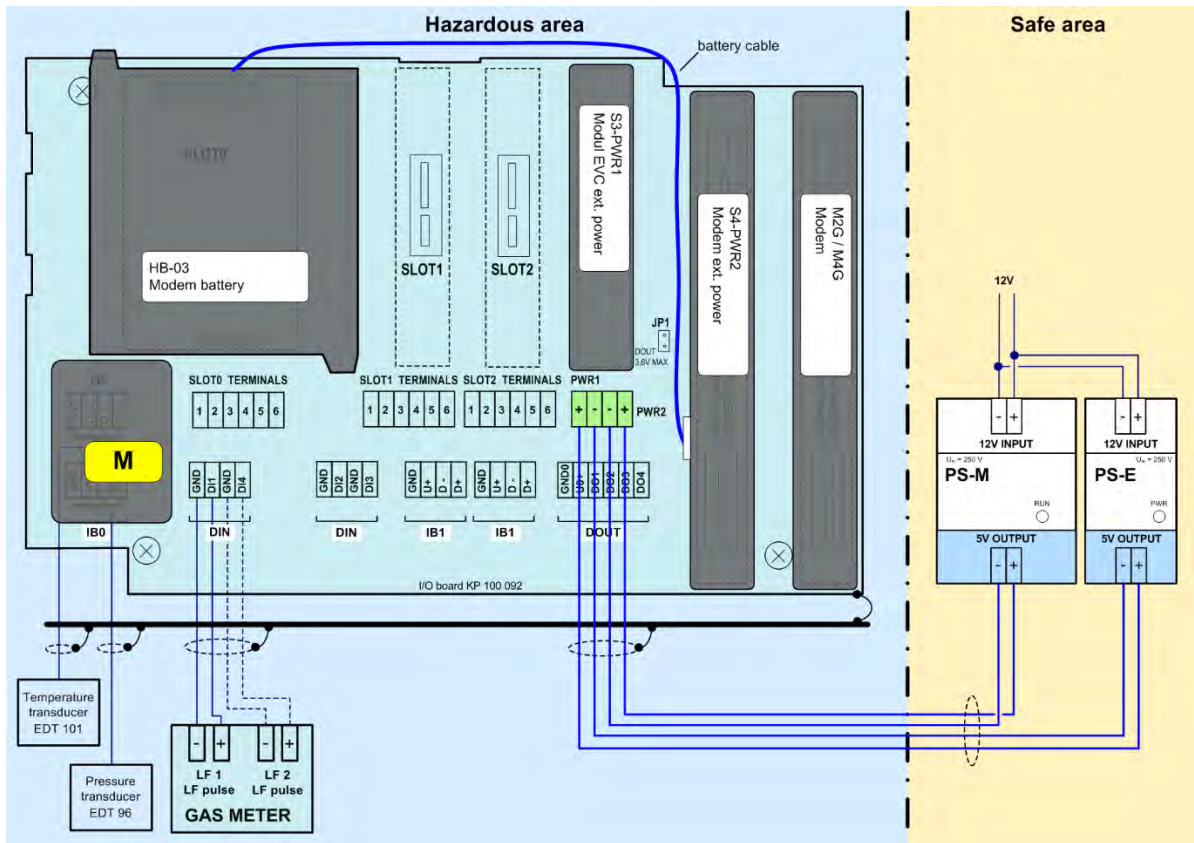*Fig. 35 PS-M External power supply for the internal modem from PS-M source*

Fig. 36 External power supply to the corrector and the internal modem

5.6.7 Connection of RS232/RS485 Communication

ELCOR - one RS232/RS485 communication interface is built in the device. For communication, either RS232 or RS485 is used. The cable is connected to the RS232/RS485 terminal block. If there is no internal modem in the device, the communication can be extended by another independent RS232 communication interface using the S4-COM0 module. Two independent communication lines are available in such case.

ELCOR*plus*, ELCOR*plus Indexer* - The device must be fitted with the S1-COM1 communication module. The module must be fitted in SLOT 1 or SLOT 2. The module offers RS232 or RS485 communication interface. Two S1-COM communication modules can be installed in the device. In this case, communication on two completely independent communication lines is possible. The cable is connected to SLOT 1 or SLOT2 terminal.

SLOT 1, SLOT 2	RS232	RS485
Terminal	Signal	Signal
1	---	D1+
2	---	D1-
3	GND	GND
4	CTS	U1+
5	RxD	---
6	TxD	---

Table 9 Assigning the terminals of the terminal block SLOT 1 and SLOT 2 when S1-COM module is installed

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Communication interface	Cable	Cable gland	Recommended type of cable	Max. lenght	Cable Ø
RS232	4-wire shielded	PG7	Unitronic LiYCY 4 x 0,34 Lappkabel	30 m	5,7 mm
RS485	4-wire shielded	PG7	Unitronic LiYCY 4 x 0,34 Lappkabel	100 m *)	5,7 mm

Table 10 Recommended cables for RS232 and RS485 of the corrector

*) cable length may be reduced at higher communication speeds

If there is no internal modem in the device, the communication can be extended by one additional independent RS232 communication interface using the S4-COM0 module in SLOT 4. Up to three independent communication lines are available.

EX	**ATTENTION!** **The signals of the DOUT terminal block are intrinsically safe. Common devices must be connected via a suitable communication barrier (B-RS).**

Recommendation:

If an external communication modem is connected to the device, an RS232 communication interface is required to connect the device with the B-RS barrier to ensure full duplex communication.
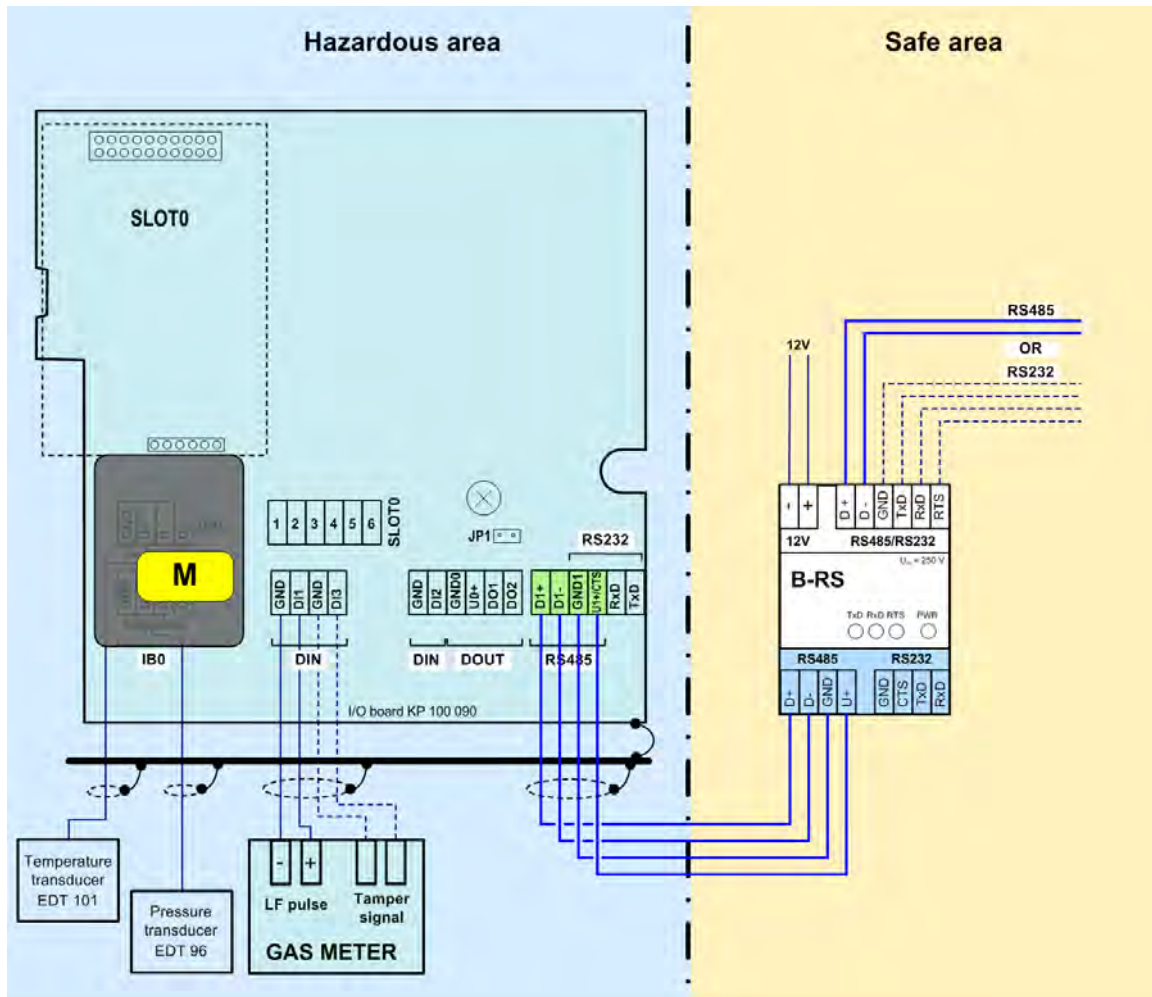
Fig. 37 Communication via RS232/RS485 using B-RS module
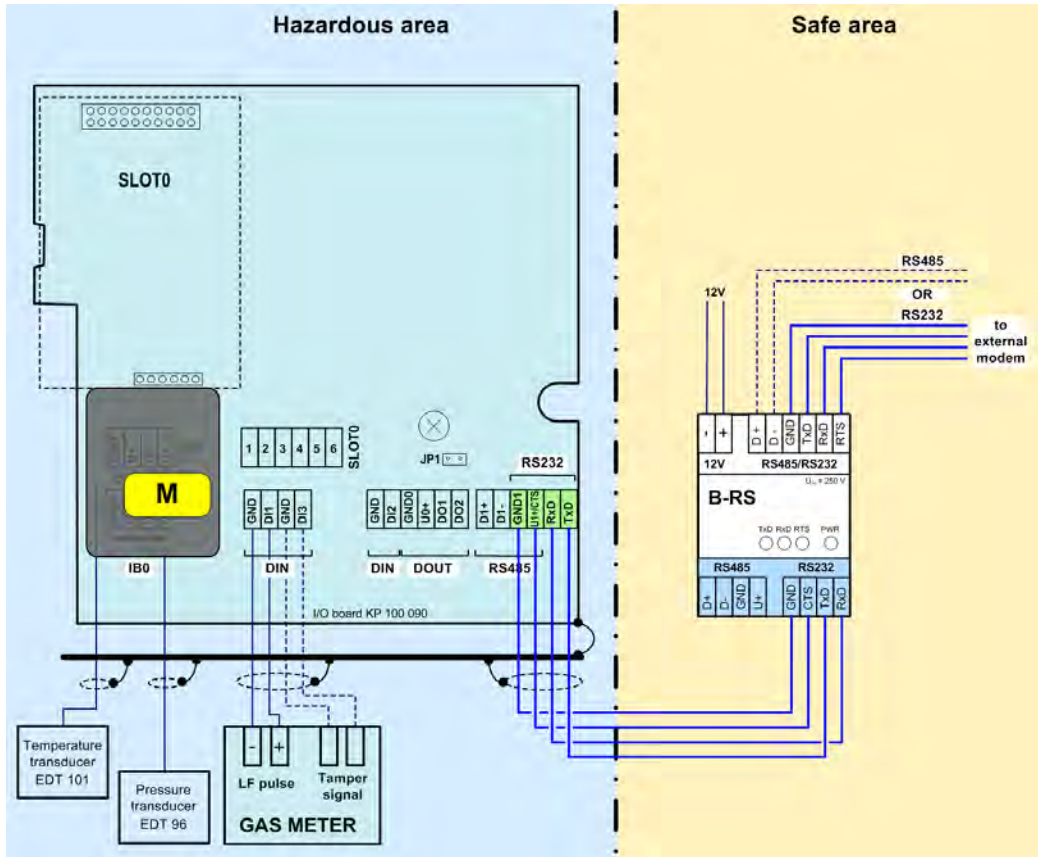
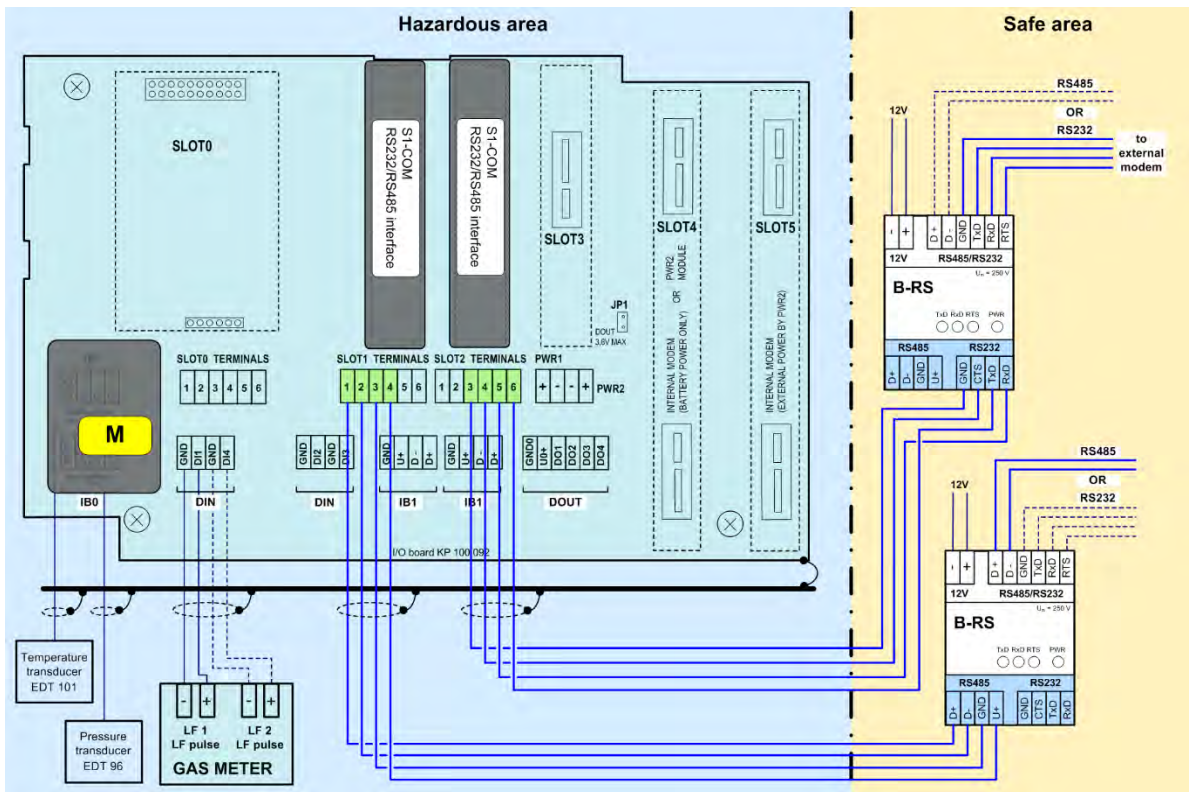Fig. 38 Connecting B-RS when external modem is connected

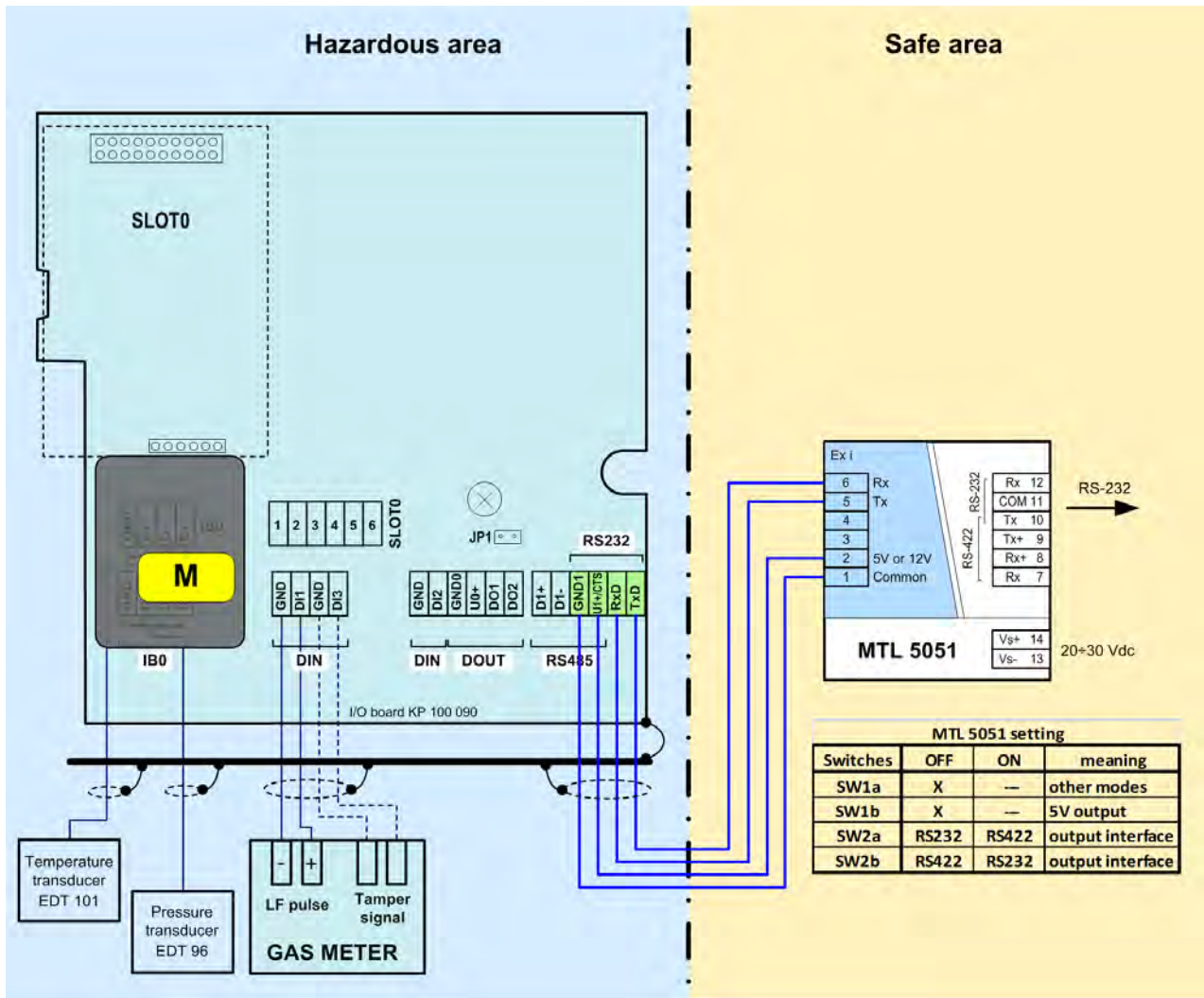*Fig. 39 ELCORplus, communication via two independent interfaces RS232/RS485*

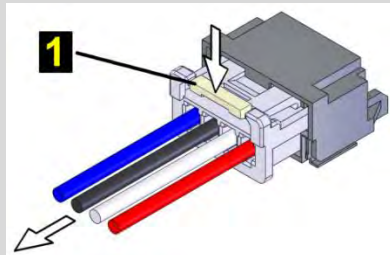*Fig. 40 Communication using the barrier MTL 5051*

5.7 Commissioning

The device is delivered either in the operating state with the battery connected or in the off mode with the battery disconnected. Both the battery of the device (B-03 etc.) and the modem battery (HB-03, HB-04, etc.) are equipped with a cable with a connector by which they are connected to the device.

> ⚠️ **WARNING!**
>
> **All the connectors in the device contain a mechanical safety lock 1 against accidental disconnection.**
>
> **To disconnect the connector, first press the lock to release the connector, then pull the connector gently out of the socket. Never apply force grasping and pulling the cable, it can be damaged.**
>
>
>
> **To re-connect the cable to the device, plug the connector slightly so that the lock snaps into place, then check for the proper connection by a slight pull on the cable.**

The device comes with pre-set configuration parameters. After the mechanical assembly of the device, however, some parameters have to be set to ensure proper operation of the gas meter.

The basic operations to put the device in operation are as follows:
- **Connecting the batteries**
- **Checking (or adjusting) the system time of the device**
- **Setting the offtake point identification**
- **Setting the temperature and pressure substitute values**
- **Setting the method to calculate the gas compressibility**
- **Setting the gas composition**
- **Checking the diagnostics, removing device errors, if any, initiating cumulative status**
- **Resetting the device archive**

These basic operations can be performed either from the device keypad (Section 6.7) or from the PC with a utility program [42] or [43]. When using a PC, you must connect the device to a computer, preferably using HIE 04 infrared head. If necessary, additional parameters can be set using the utility program (setting the pulse outputs, setpoints, etc.).

5.7.1 Connecting the Battery

The device display is off in the basic settings. The display light comes on when the Enter key is pressed for at least 2 seconds.

If the device is delivered in the off mode (nothing is displayed after pressing Enter for more than 2 seconds), the B-03 battery pack is disconnected from the unit. The battery cable with connector 1 must be plugged into connector 2 of the processor board (CPU module) to put the device into operation. This operation is also possible in potentially explosive environments.

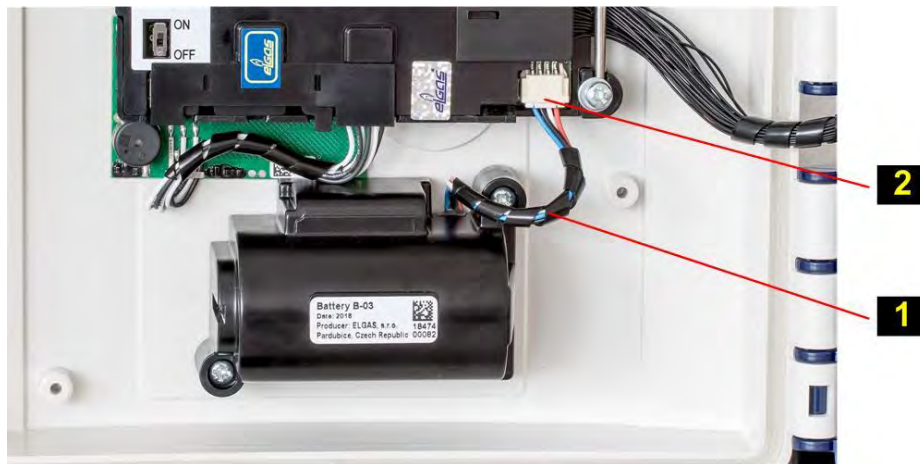When the battery is connected, the device is automatically in the operating mode.

*Fig. 41 Connecting the device battery*

Fig. 42 ELCORplus indexer with alkaline battery B-03A located above slot 0

5.7.2 Connecting the Modem Battery

The version of the device with internal GSM/GPRS modem can be delivered with a disconnected modem battery.

5.7.2.1 ELCOR

When commissioning the device, the battery outlet (HB-03, HB-04, etc.) with the connector must be plugged into the modem module connector.
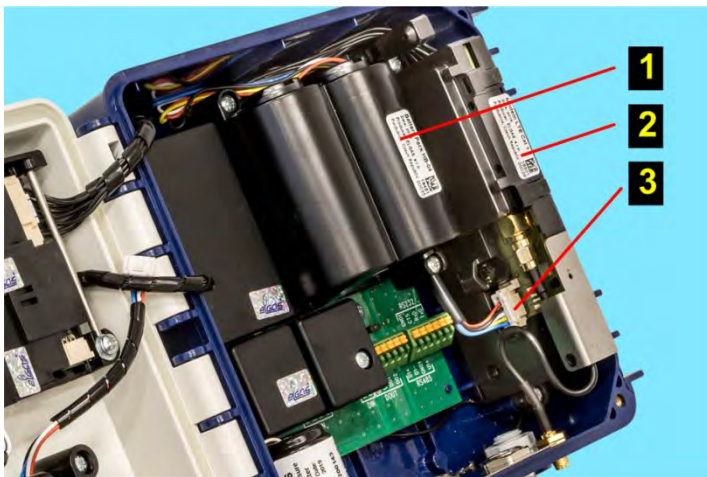
1 Modem battery

2 Modem module

3 Connector of the modem battery

Fig. 43 Connecting the modem battery for ELCOR

5.7.2.2 ELCORplus, ELCORplus Indexer

When commissioning, the modem power supply battery pack (HB-03, HB-04, etc.) with the connector must be plugged into the connector of the module that is installed in the SLOT 4 position.

> ⚠ **ATTENTION!**
>
> **The internal modem battery must always be connected to the module in SLOT 4:**
>
> - **If the external power supply of the modem is not used, the modem module is installed in SLOT 4. In this case, the modem battery is connected directly to the modem.**
> - If the external power supply of the modem is used, the modem is installed in SLOT 5, while the module of the external power supply of the modem S4-PWR2 is in SLOT 4. The battery is then connected to the S4-PWR2 connector.
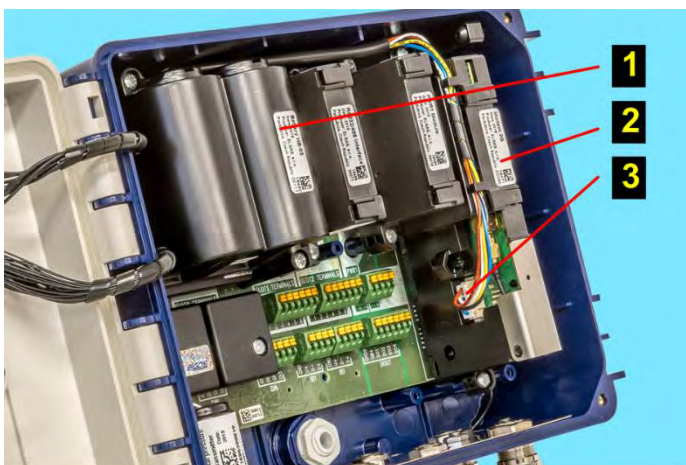
1 Modem battery

2 PWR2 in SLOT 4 position

3 Connector of the modem battery

Fig. 44 Connecting the modem battery for ELCORplus

Note:

For longer time storing, it is recommended to remove the batteries from the device or, if necessary, at least disconnect them by pulling out the battery connector.

5.7.3 Installing SIM Card in the Modem

5.6.3 Install the SIM card into the modem

The device is delivered without the modem SIM card. Before using the modem, the SIM card received from the operator must be inserted into the modem. The SIM card holder is designed for miniSIM size of the SIM card.

To insert/remove the SIM card:

- If the external power supply of the modem is used, disconnect the power supply from the PWR2 terminals.
- Press lock **1** and pull gently the cable out to disconnect the connector of the battery modem.
- Push slightly in the direction of arrow **3** on the SIM card cover **4** and tip it to the vertical position.
- Insert SIM card **5** into the holder and push it until you hear a click.
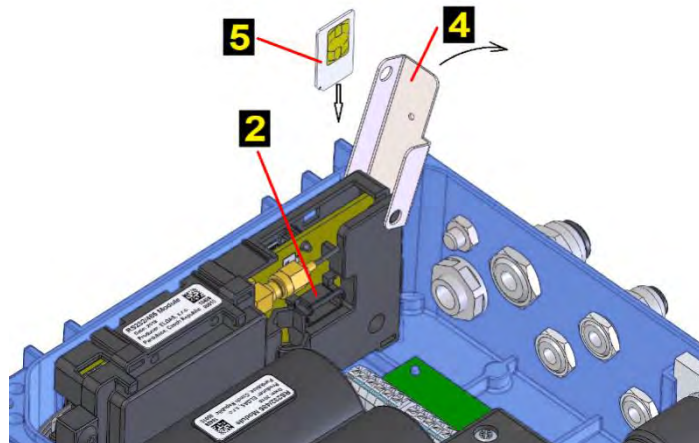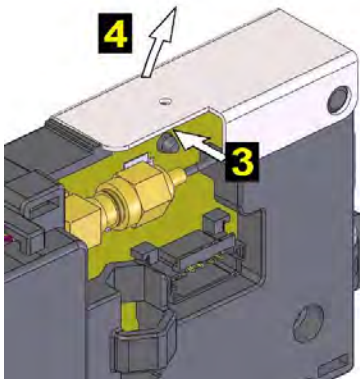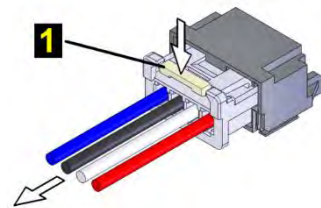
- To remove the SIM card, press the card until you hear a click, release the pressure, and the card moves several millimetres out. Grasp the card and remove it from the holder.
- After inserting the SIM card, close cover **4** and push it slightly in the direction of arrow 3 for easier insertion.
- Connect the connector of the battery of modem **2**. For a device without external power supply of the modem, connect the connector to the modem. For a device with the external power supply of the modem, connect the connector to the S4-PWR2 module and then connect the wires to the PWR2 terminals of the external power supply of the modem.

6 Operating the Device

The device is not equipped with a power switch. The device turns automatically into the operation mode when the battery is inserted in the device. The device registers the LF pulses even with the main battery removed.

A 6-button keypad is used to operate the device and to display the measured and other values. The values are displayed on a 128 x 64 pixel graphic display, or on a segment display.

For battery operation, the graphical display is switched off after 30 seconds since the last press

of any key. **The display lights up when the enter key** **has been pressed for 2 seconds**. If the device is powered by an external power supply source, the display is permanently on.

> **i**
>
> With the segment display, the display is permanently on and backlit even when the device is battery operated.
>
> The keypad is the same for the version of the device with the graphical display and with the segment display.
>
> **The display and operating features of the device with the segment display are described in the "Segment Display Version" appendix.**

The data to be displayed are selected in the device menu. The menu items are displayed depending on set parameters of the device. The contents of some menu items is user-configurable.

Display Features (Graphical Display)

- Automatic display update for changing data with 1 sec period
- Autorepeat - when holding a key, the keystroke is automatically generated; this feature can be useful for example when viewing archives
- Display without diacritic
- In compliance with the standard CSN EN 12405-1+A2, Section 6.3.1.5, the display switches to the basic settings after a certain idle time. The time after which the display switches to basic can be set in the parameters.
- In order to simplify the operation by a untrained user, the option to display actual values one after another by pressing the **Enter** key is included. Before this, it is necessary to exit by pressing the **Esc** key several times to the top menu level.
- For energy saving purposes, the device's graphic display goes out after 30 seconds when in battery operation mode, and lights up only when any key is pressed. .
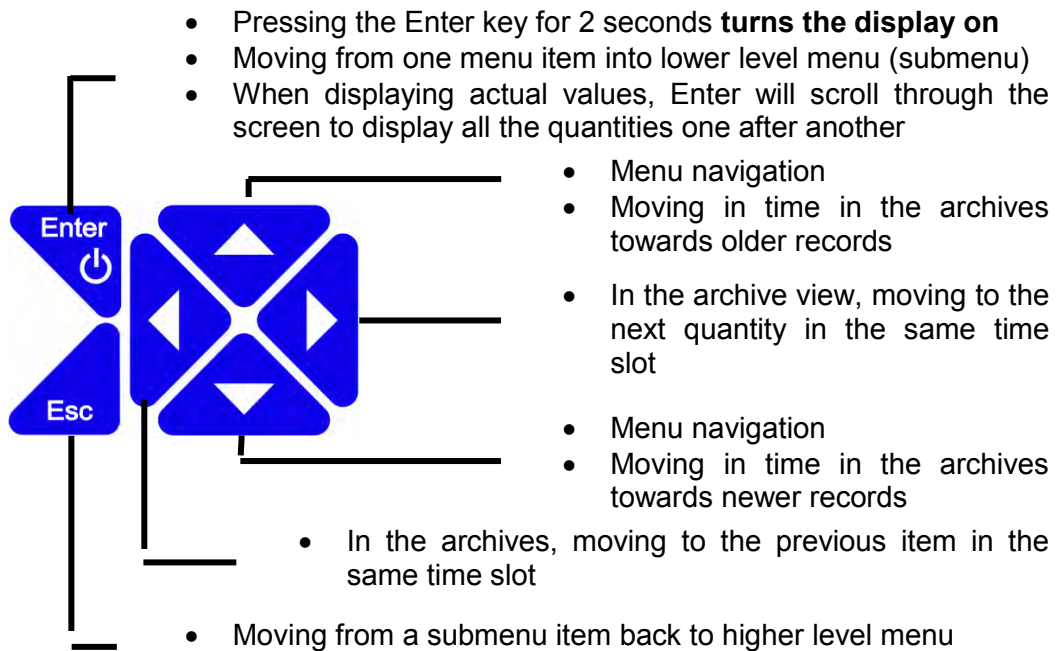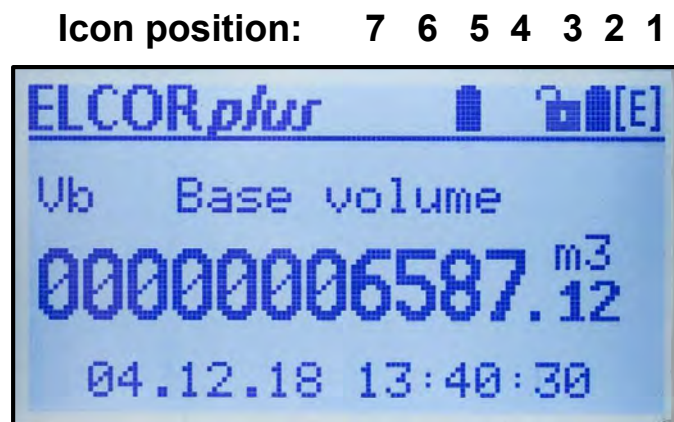
6.1 Keypad

- Pressing the Enter key for 2 seconds **turns the display on**
- Moving from one menu item into lower level menu (submenu)
- When displaying actual values, Enter will scroll through the screen to display all the quantities one after another

- Menu navigation
- Moving in time in the archives towards older records

- In the archive view, moving to the next quantity in the same time slot

- Menu navigation
- Moving in time in the archives towards newer records

- In the archives, moving to the previous item in the same time slot

- Moving from a submenu item back to higher level menu

Fig. 45 Function of the keys

6.2 System Menu

The device is operated based on selecting items from the menu. For the purposes of further interpretation, we call the basic menu items the highest items. By entering those items, navigate to the lower menu levels (submenus).

If the display has been off for a longer time, the home screen with a volume Vb value is displayed.

Home Screen (Initial Display)

Icon position: 7 6 5 4 3 2 1

ELCOR*plus*   [E]

Vb   Base volume

00000006587.12 m3

04.12.18 13:40:30

The first line in the top right corner displays icons indicating the basic status of the device.

Pos.	Meaning	Symbol	Description
1	Device status (sum status)		The compressibility is being calculated or the firmware is verified after the remote download update
		OK	The device works flawlessly
		[E]	An error has occurred in the device
		[W]	The device has generated a warning message
2	Power state of the device		The external power supply of the device is connected
			Battery charge status 100 %
			Battery charge status 75 ÷ 91%
			Battery charge status 58 ÷ 75 %
			Battery charge status 42 ÷ 58 %
			Battery charge status 25 ÷ 42 %
			Battery charge status 8 ÷ 25 %
			Battery charge status 0 ÷ 8 %
3	Status of the service and metrological switch		Writing to the device disabled (both the service and metrological switches are in the OFF position)
			Writing to the service area enabled (service switch is ON)
			Blinking - Writing to the metrological area enabled (metrological switch is ON)
4	Status of the modem, signal strength		The modem is off or not set in the parameters
			The modem is registering (connecting) in (to) the network
		—	Modem connected, signal strength 0 ÷ 25 %
			Modem connected, signal strength 25 ÷ 50 %
			Modem connected, signal strength 50 ÷ 75 %
			Modem connected, signal strength 75 ÷ 90 %
			Modem connected, signal strength 90 ÷ 100 %
5	Power state of the internal modem		External power supply of the modem connected
			Battery charge status 100 %
			Battery charge status 75 ÷ 91 %
			Battery charge status 58 ÷ 75 %

			Battery charge status 42 ÷ 58 %
			Battery charge status 25 ÷ 42 %
			Battery charge status 8 ÷ 25 %
			Battery charge status 0 ÷ 8 %
6	Communication status		Communication via internal modem or via optical head
			Communication via the modem or the head disabled
7	Operating mode		Not configured
			Maintenance
			Normal

Table 11 Status icons of the display
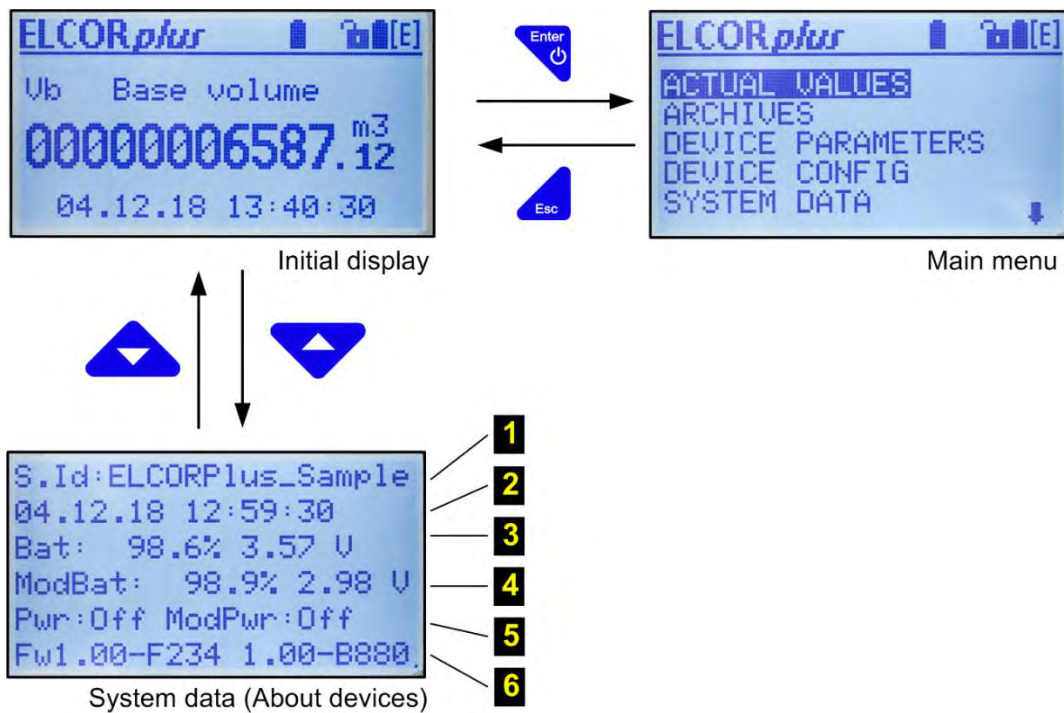
Fig. 46 Basic navigation from the home screen

Legend:

1 Station identification
2 System time
3 State of the device battery (level of charging, voltage)
4 State of the modem battery (level of charging, voltage)
5 Status of the external power supply of the device and modem (on/off)
6 The versions of the metrological firmware and its checksum (CRC) and version of the application firmware and its checksum (CRC)

6.3 Main Menu

The selected menu item is highlighted inversely on the display.
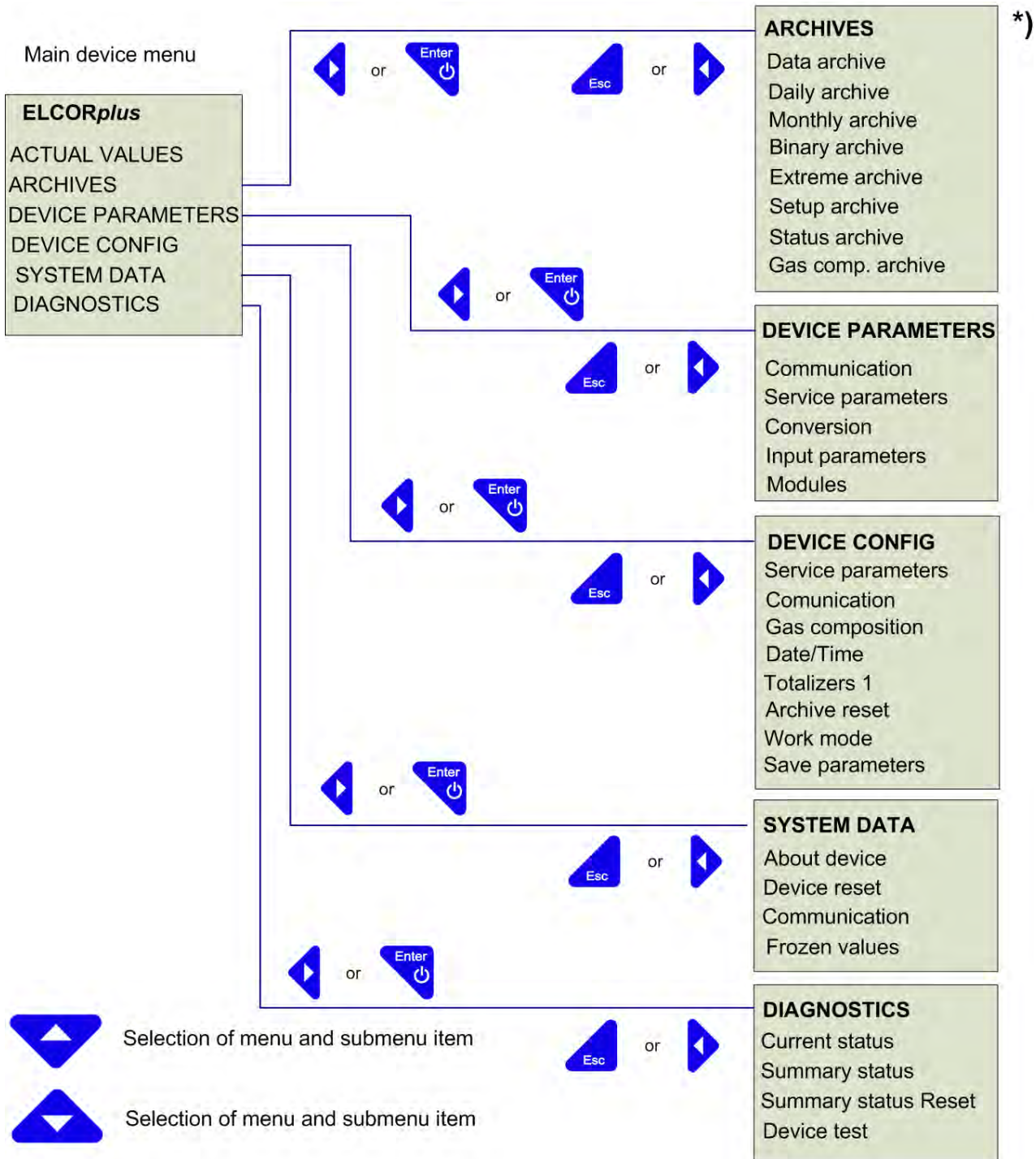
*) The menu items can vary from the listed ones depending on the specific device configuration.
If one of the archives is missing in the menu, it means that none of the quantities in the device has archiving set up in such archive.

Fig. 47 Main menu of the device and the first-level submenu

6.4 Actual Values Menu

By pressing the key [Enter] the actual values are displayed. To scroll through the displayed data, use the arrow up ▲ and down keys ▼.

1	Scrolling through the displayed values
2	The asterisk flag indicating exceeding the measuring range of the analogue quantity
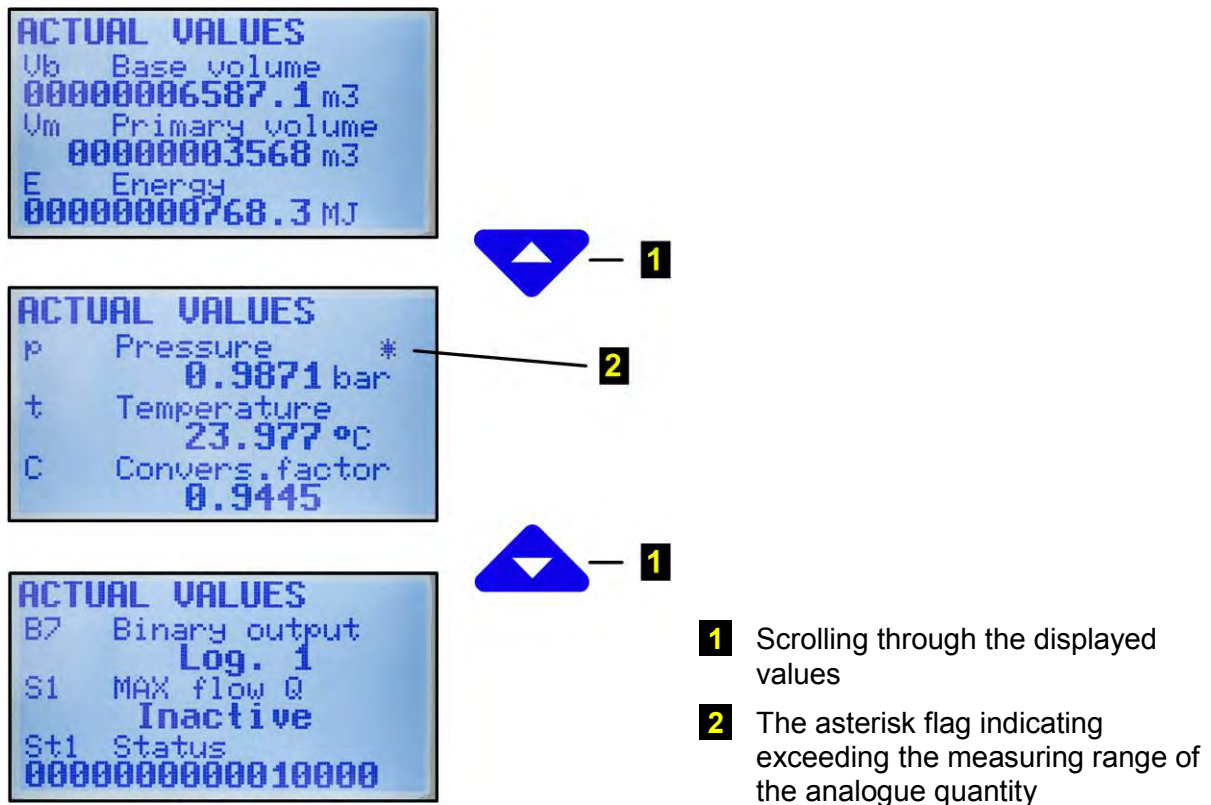
Fig. 48 Example of actual values display

6.5 Archives Menu

For data, daily, monthly, and binary archives, the way the data is displayed is identical and can be seen in the figure below.

1	Moving to the previous quantity
2	Moving to the next quantity
3	Moving forward in time
4	Moving backward in time (to the history)
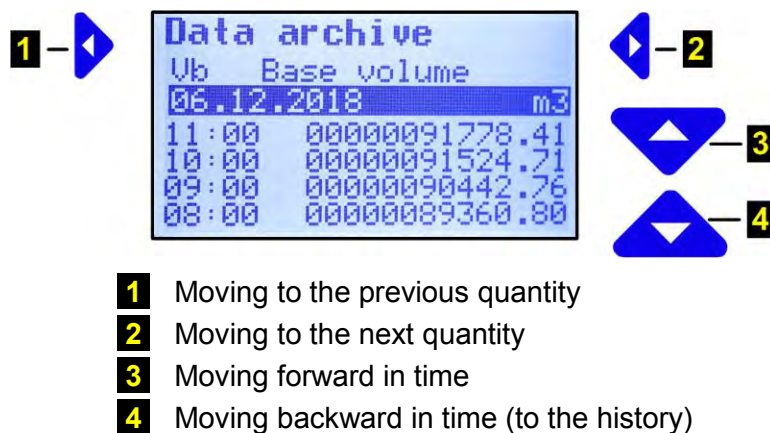
Fig. 49 Navigation in the archives (in this case, with archiving frequency 1 h)

The binary archive is displayed in the same way, only the records are not stored in the archive with the archiving frequency, but at times when the status of some of the stored quantities has

changed.

To end archive viewing, press the key **Esc**.
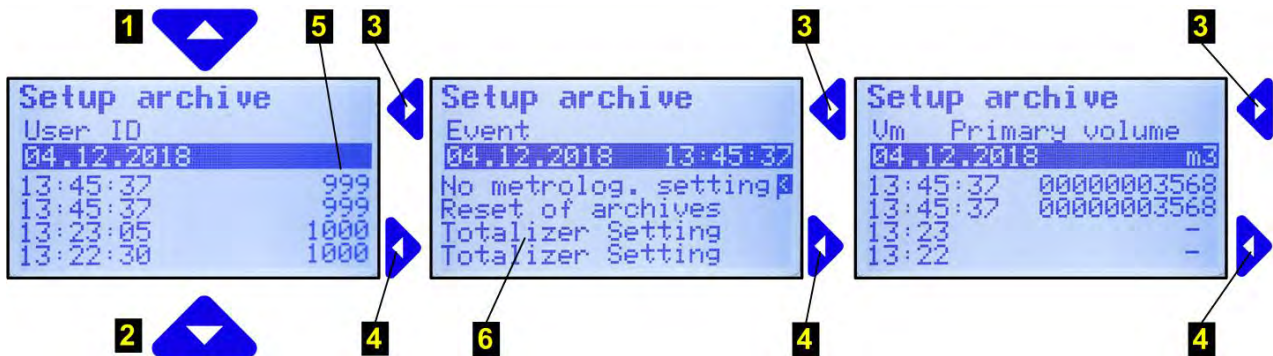
1	Moving forward in time
2	Moving backward in time (to the history)
3	Moving to the next information at the selected time
4	Moving to the previous information at the selected time
5	ID of the user that made the setting
6	Settings made at the selected time (4.12.2018, 13:45:37)

Fig. 50 Display of the settings archive
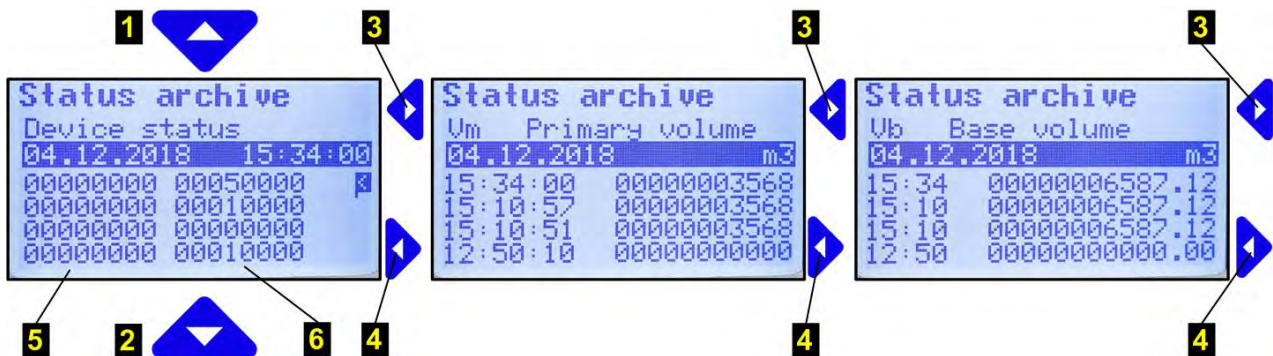
1	Moving forward in time
2	Moving backward in time (to the history)
3	Moving to the next information at the selected time
4	Moving to the previous information at the selected time
5	Device status (1st part of the status word)
6	Device status (2nd part of the status word)

Fig. 51 Display of the status archive

6.6 Device Parameters Menu

The following parameters are displayed in the **Communication** menu:

- General parameters (network address1, network address2)
- IR head (baud rate, communication protocol)
- Internal modem (baud rate, communication protocol, communication device)
- Serial COM1 (baud rate, communication protocol, communication device)
- Serial COM2 (baud rate, communication protocol, communication device)

The following are displayed in the **Service Parameters** menu:
- Serial number of the device
- Application FW, version and checksum (CRC)
- Metrological FW, version and Checksum (CRC)
- FW Loader, version and checksum (CRC)
- Memory size [byte]
- Station Identification

Scroll through the display using the ▼ and ▲ keys. The end of the data is marked with "<" on the display.

In the **Conversion** menu, the following data is displayed:
- **Conversion**
  - Conversion according to the standard
  - Reference pressure p_b
  - Reference temperature t_b
  - Compressibility Z_b
  - Gas composition items (displayed depending on the selected conversion standard)
- **C Conversion Factor**
  - Recalculation type
  - Substitute temperature
  - Substitute pressure
  - Compressibility
  - Standard
  - Pressure range
  - Temperature range

In the **Input Parameters** menu, the following data are displayed:

Vm (gas meter)	- Marking of input terminals - Gas meter constant kp [imp/m3] - Serial number of the meter
t EDT 101 (temperature measurement)	- Transducer communication address - Measuring range - Serial number of the temperature sensor
p EDT 96 (pressure measurement)	- Transducer communication address - Pressure range - Serial number of the pressure transducer

plus e.g. parameters of the 2nd channel and additional transducers (non-metrological)

In the **Modules** menu, you can view the basic data of the modules, transducers, batteries, and other system components. Use the ▲ and ▼ keys to scroll through the data.

```
Modules
SLOT1
ModuleID: 8800
RS Interface
SN: 1848600015
```

```
Modules
SLOT3
ModuleID: 9800
PWR1 Module
SN: 1849000205
```

```
Modules
SLOT5
ModuleID: 9000
Modem 2G
SN: 1847100036
```

```
Modules
IB0 adr(1)
ModuleID: F000
PSensor EDT-096
SN: 1886200036
```

1 Module identification number
2 Module designation
3 Serial number of the module
4 Number of the slot in which the module is installed or the identification of the internal communication bus to which the module (transducer) is connected

Fig. 52 Example of the displayed information on device components

6.7 Device Configuration Menu

In this menu, the device parameters can be set directly from the device keypad.

> **i** Setting device parameters from the keypad can be protected:
>
> - By the service switch (the switch must be set to ON)
>
> - By a password (for more details, refer to Section 11.6.2)
>
> If the service switch is set to OFF, the message "Parameters cannot be set" appears in the display.
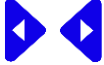
The following parameters can be set:

Service parameters	- Station Identification - Gas hour
Communication	- General parameters - IR head - Communication protocol - Internal modem - Serial COM1 - Serial COM2 ... (the baud rate and communication protocol are set separately for each communication)
Gas composition	- N2 concentration - CO2 concentration - Combustion heat - Relative density ... (the parameters depend on the calculation method selected)
Date/Time	HH:MM/DD:MM:YYYY
Volume parameters (Totalizers 1,2)	- kp1, kp2 Gas meter constant [imp/m3] - Vm1, Vm2 Primary volume (-Vb1, Vb2 Volume at base conditions) - Vs1, Vs2 Substitute primary volume (- Vbs1, Vbs2 Substitute volume at base conditions) (- E Energy) (- Es Substitute Energy) - Serial numbers of the gas meters - Qmax1, Qmax2 Max. gas flow rate
Archive reset	Data archive Daily archive Monthly archive Billing archive Binary archive Limit archive (Settings Archive) (Status Archive) (Gas composition archive)
Work mode	normal (standard)
Saving parameters	Entering the changed parameters in the device

To edit a parameter, press the ▼ or ▲ keys to move the parameter to the first row on the display (the parameter is displayed inversely). Start the editing by pressing the Enter key.

The edited position in the row is indicated with the symbol ⬆. The keys for parameter editing have the following functions:

▶ ◀	Selecting the edited position in the row
▼ ▲	Selecting and entering an alphanumeric character (space, 0 to 9, A to Z, a to z)
Enter ⏻	End of editing the parameter

Saving the Parameters

After you finish editing the parameters, you need to enter the changes in your device. To do this, choose "Save Parameters". Successful saving the parameters in the device is confirmed by the message "Valid Data".

Totalizer values and Current time are saved immediately after entering the value. A confirmation dialog is displayed before the value is saved, and on confirmation, the value is stored in the appropriate register.

6.8 System data Menu

- About Device
- Device Reset
- Communication
- Frozen Values

6.8.1 About Device

The basic system parameters are displayed here, see Fig. 46. In addition, you can use the ▲ and ▼ keys to display additional data (digital inputs and outputs, etc.).

6.8.2 Device Reset

The command is non-destructive. After selecting the device reset, the program jumps to the start address and re-initializes the entire metering system. Neither the contents of all archives, nor the values of all V and V_b gas volumes change during this operation. The same applies to all the other set parameters. The command execution is independent of the position of the service switch.

6.8.3 Communication

> **i**
>
> This option makes it possible to:
>
> - **View important information about the modems** connected to the device (the modem must be set in the device parameters),
>
> - **Verify that the modem settings are correct by simple testing the connection** to the master communication point (modem) of the dispatch centre (regardless of the timer setting and calls of the internal timers of the device).
>
> For modem communication, also some diagnostic data is displayed.

In the first step, the modem is selected (the device allows for connecting no more than 2 modems, one internal and one external). The following options can be selected for each of selected modems.

6.8.3.1 Modem Status

The current status of the modem is displayed on the 2nd row of the display. The following rows contain additional information.
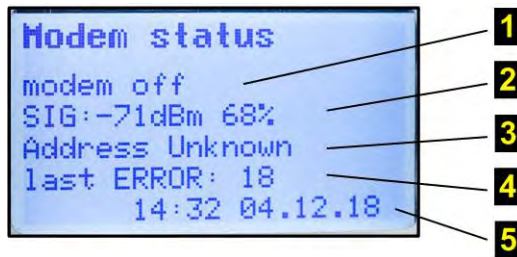
1 Modem status	
modem not present	the modem is not enabled in the device parameters
modem off	the modem power is off
modem connecting	the modem was connected to power (by software- the internal control signal connected the modem power supply)
modem init	the device is sending initialization commands to the modem
modem on	the modem is on and initialized
modem connected; 2G connected	the modem is logged on the network
modem disconnecting	the modem is logging off of the network and turning off [18])

2 Signal strength[19])

---

[18]) If modem communication is in progress, the modem is turned off only after the communication has been completed.

[19]) After resetting the device (see Section 6.8.2), or after changing some important modem parameters, this value is reset.

Information about signal strength at the location of the device. The Modem Status command does not measure the signal strength. If this information appears on the display, it is the data ascertained at the time when the modem last logged on to the network. The strength is stated in dBm and in %. Comparison table - see Table 12

3 **IP Address**

For GPRS communication, the IP address of the device is displayed.

4 **Modem Error**[19)]

The code of the last modem error is displayed if an error occurred. The meaning of the error according to its numeric code is specified in Table 13.

5 **Error Date and Time**[19)]

For modem error, the date and time of the last error is displayed.

6.8.3.2 Signal Testing

After selecting this option (the modem must be set in the device parameters, it can be turned off), the device turns on the modem power supply, initializes the modem and measures the signal strength after connecting to the mobile network. (The sequence **2** modem off, modem on, modem init, modem connected is run). The time limit for measuring the signal **3** is 120 seconds.

The minimum recommended RSSI value for GPRS communication is -85 dBm (i.e. 45%). Under this value, the device displays error number 10 (see Table 13). In addition, low GSM/GPRS signal levels significantly reduce the reported battery life of the modem.

Note:

The number **1** in the top right corner of the display shows the time in seconds to the end of measurement.

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

Table 12 RSSI signal strength conversion table between dBm, %, and relative units

Code	Error description
	General Errors
0	modem without error indication
1	modem does not respond

20	modem returns "ERROR"
SIM card errors	
2	PIN code requested, but not stored in the configuration data
3	PIN code requested, incorrect PIN code stored in the configuration data
4	PIN blocked, PUK code requested
5	SIM card is not inserted
GSM network registration errors	
6	registration in the GSM network takes longer than usual (> ~ 20s after the modem is turned on)
7	not registered in the GSM network, not searching for the network currently
8	registration in the GSM network disabled (eg no active roaming and no home operator available)
9	registration in the GSM network impossible for unknown reasons
10	low GSM signal level <= -85 dBm (the error is saved only if the modem is registered in the GSM network)
Initialization errors	
11	incorrect initialization command entered in the configuration data (Initialization or Special Initialization field in the service software [42], [43])
Dial-up errors	
12	GPRS or GSM/CSD cannot be dialled, or the connection that has already been established fails due to error reasons (the modem returns "NO CARRIER", "BUSY" or "NO DIALTONE")
PPP protocol errors - errors in connecting to GPRS	
13	LCP protocol error
14	PAP protocol error (the user name and password may be incorrectly set, but in practice and in the wrong setting this phase is performed and ends up in the IPCP phase)
15	CHAP protocol error (the username and password may be incorrectly set, but in practice and in the wrong setting this phase is performed and ends up in the IPCP phase)
16	IP address allocation error (may also be caused by a wrong username and password)
TCP protocol errors	
17	TCP session error - RST packet sent
18	error opening TCP session in Client mode - failed connection to remote server
SMS errors	
19	SMS could not be sent

Table 13 Error Codes of the Modem

6.8.3.3 Power on Modem

This option will turn the modem on for 5 minutes (i.e. 300 seconds; the remaining time in seconds to turning off the modem **1** shows in the top right corner of the display). This command is useful, for example, to test the communication when setting up the device (basically simulates the function of the internal parameter "Timer - Service Window" described in the TELVES program parameterization).
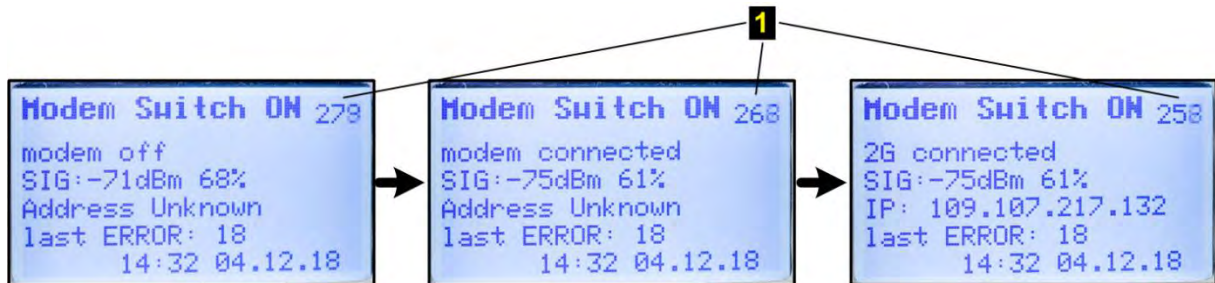
6.8.3.4 Call to Dispatch

If the device is configured to call the dispatch centre, this command can verify that the device call to the master system is correct (applies to both dial-up connection and GPRS mode). This option basically simulates the function of the internal parameter "Timer - Call Window". On the first row of the display, the modem states (switching on, initializing, connections ...) are displayed sequentially through which the modem goes through when the connection is terminated. When the connection is established, the device sends the calling data frame to the master station, which must accept it when the settings are correct. After that, the modem terminates the connection and is turned off.
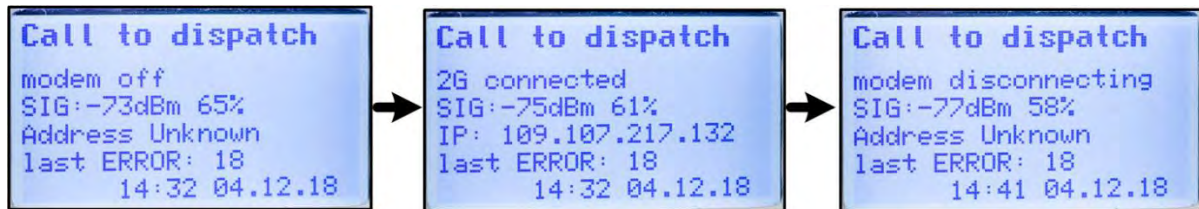
6.8.3.5 Modem Battery

It displays the battery charge status of the modem in % and the current battery voltage. If the battery is disconnected, the message "Communication Error"/"Comm.error" appears.

6.8.4 Frozen Values

This option freezes the actual values. Use this option if the measured data have to be copied manually.

6.9 Diagnostics

In the "Diagnostics" menu, the status of the corrector is displayed. The errors are indicated by the prefix "E" and the identification number; similarly, the prefix "W" is used for warnings. For a complete list of error and warning messages see paragraph 6.9.5.

> ### Technical assistance in troubleshooting
>
> **If there are any problems with the operation of the device for any reason, technical support personnel may be contacted. Contacts are available at http://www.elgas.cz/kontakty.**
>
> **To help you find a solution to the problem, we recommend providing as much as possible information about your device and connections to related devices nearby. Diagnostic and solving the problem would be easier, if you send us a * .dt_all diagnostic file obtained from the device via a service SW [42] or [43].**

6.9.1 Current Status

This menu displays the current status of the device. Press the "*right arrow*" key to display all current errors and warnings of the corrector one after another.

6.9.2 Summary Status

The summary status is used to monitor the occurrence of active error states (individual device status bits) **since the last summary status reset**. This means also the statuses of the device that have been removed by the operator, or have disappeared over time (typically, for example, exceeding the pressure limit, etc.) are recorded in memory.
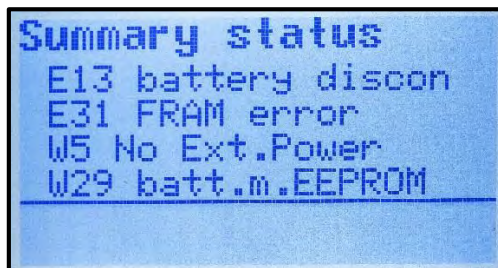
Fig. 53 Example of a summary status display

Basic status information is also displayed in the form of an icon (see Section 6.2) of the home screen.

6.9.3 Summary Status Reset

After this option has been selected using the device keypad or via the "Summary Status Reset" option from the "Setup-Diagnostics" menu of the PC utility SW, the summary status is initialized, i.e. the current status is set according to the actual status. To enable initialization, the service

switch must be ON. If switched to OFF, a message is displayed that the initialization cannot be performed.

6.9.4 Device Test

After selecting this menu item, the device tests its internal state and displays a list of detected errors and warnings. The test of the device runs for several seconds and does not affect the measuring and archiving operation of the device. The execution of the command is independent of the position of the service switch.

The notification is displayed during the test.

6.9.5 Device Errors Display

Error messages are displayed in the "Actual Status", "Summary Status" and "Device Test" menus. Autodiagnostics runs regularly, a full test of the device once a day, a sensor swap test every hour or irregularly when the device is switched on. The test can be also triggered by selecting the "Device Test" function from the keypad.

The shortened form of summary diagnostics is displayed in the right corner of the top level menu in the form of OK, Err or Wrn (see Section 6.2). This shortened form is the sum of the individual states, and in each case, the abbreviation with the highest priority is displayed. The priority order is Err, Wrn, OK, starting with the highest one. More detailed diagnostic information can be displayed using the utility SW [42], [43]. An overview of the indicated Err messages is included in Table 14, *and the Wrn report is provided in* Table 15.

Displayed Message	bit	Description
E0 program CRC	0	Firmware checksum error.
E1 loader CRC	1	Checker loader error.
E2 parameter CRC	2	Device parameter checksum error.
E3 memory error	3	Device memory error.
E4		- not used -
E5 setting archive full	5	The number of changes made to the device configuration has filled the archive capacity. The device is still working, only the parameter changing is blocked. It can be unblocked in ASC only.
E6 transd. replacement	6	Unauthorized replacement of the sensor or modification of its parameters has been made.
E7 trans. communication	7	Error in communication with the sensor.
E8 transd. error	8	Transducer error.
E9 battery discharged	9	The EVC battery is discharged (the remaining battery capacity is about 10%).
E10 compress. table	10	Error in compressibility table calculation due to input parameters.
E11 compressibility error	17	The compressibility cannot be calculated due to the limitation of the scope of the standard used for the compressibility calculating in the measured gas temperature and pressure.

E12		- not used -
E13 battery disconnected	19	Battery is disconnected
E14 P1 under limit	32	Pressure range exceeded (1st channel)
E15 P1 above limit	33	
E16 P1 error	36	Pressure transducer error
E17 T1 under limit	37	Temperature range exceeded (1st channel)
E18 T1 T1 above limit	38	
E19 T1 error	41	Temperature transducer error
E20 P2 under limit	48	Pressure range exceeded (2nd channel)
E21 P2 above limit	49	
E22 P2 error	52	Pressure transducer error
E23 T2 under limit	53	Temperature range exceeded (2st channel)
E24 T2 T2 above limit	54	
E25 T2 error	57	Temperature transducer error
E26 time synch	4	RTC synchronization error, adjustment by > 2 h was required.
E27 mod.bat.capacity	15	The modem battery is discharged
E28 encoder error	20	Encoder error (SCR or NAMUR)
E29 CRC metrolog.	22	CRC error of metrological part of the FW
E30 CRC tables	23	CRC error in password or encryption key table
E31 FRAM error	26	FRAM memory error
E32 FLASH error	27	FLASH memory error
E33 bar sensor error	46	Integrated barometric transducer error

Table 14 List of events - error messages (Err indication)

Displayed Message	bit	Description
W0 transd. warning	11	Warning alert on one of connected transducers (internal modules SCR, NAMUR, EXT1, SRM or other). Details can be found by reading the parameters of the corrector.
W1		- not used -
W2 battery	13	Memory error in battery pack.
W3 overcurrent	14	Current overload occurred
W4		- not used -
W5 network failure	16	Mains power supply failure
W6	21	- not used -
W7 tamper contact 1	24	Tamper contact 1 active.
W8 tamper contact 2	25	Tamper contact 2 active.
W9 P1 min. limit	34	Pressure user limits exceeded (1st channel)
W10 P1 max. limit	35	
W11 T1 T1 min. limit	39	Temperature user limits exceeded (1st channel)
W12 T1 T1 max. limit	40	
W13 Q1 Q1 min. limit	42	Flow rate at measurement conditions user limits exceeded

W14 Q1 Q1 max. limit	43	(1st channel)
W15 Qb1 Qb1 min. limit	44	Flow rate at base conditions user limits exceeded (1st channel)
W16 Qb1 Qb1 max. limit	45	
W17		- not used -
W18		- not used -
W19 P2 P2 min. limit	50	Pressure user limits exceeded (2nd channel)
W20 P2 P2 max. limit	51	
W21 T2 T2 min. limit	55	Temperature user limits exceeded (2nd channel)
W22 T2 T2 max. limit	56	
W23		- not used -
W24		- not used -
W25		- not used -
W26		- not used -
W27		- not used -
W28		- not used -
W29 EEPROM m.bat	18	Memory error of the modem battery
W30 m.battery voltage	12	Modem battery voltage low
W31 communication error	28	Communication error
W32 user cover	29	Housing cover opened
W33 ext.power supply of modem	61	External power supply to the modem has failed
W34 metrol.switch	62	Metrological switch is ON
W35 user switch	63	Service switch is ON
W36 volume dif.	47	Volume limit has been exceeded when comparing volume counters
W37 metrolog. cover	60	Cover of metrological part of the device was opened
W38 RTC setting	58	The system time has been set
W39 Primary volume setting	59	The primary volume has been set
M0 no configuration	30	The device is in Not configured state
M1 maintanance	31	The device is switched to Maintenance state

Table 15 List of events - error messages (Wrnr indication)

6.9.6 Status Word of the Device

The current status of the device is stored in the 64-bit status word of the device. Each of the monitored status (eg temperature error, pressure error, battery status, etc.) is assigned a fixed bit in the status word. The state of each bit indicates whether the status occurred or not.

> **i** If any monitored bit changed, the entire status word is stored in the status archive with a time stamp.

The status word of the device is also stored in the data, daily and monthly archives. These records store information about whether the bit has reached the active state during the archiving

interval. Assignment of a specific status word bit to each monitored event is shown in Table 14 and Table 15. When viewing the status in the device archives by the utility SW [42], [43] the status word is already displayed in decoded readable form.

7 Technical Description of the Device
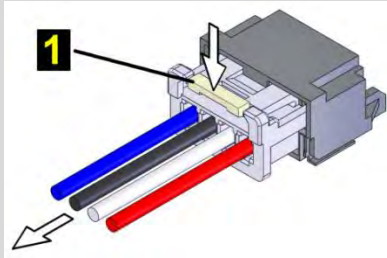
> **WARNING!**
>
> **All the connectors in the device contain a mechanical safety lock 1 against accidental disconnection.**
>
> **To disconnect the connector, first press the lock to release the connector, then pull the connector gently out of the socket. Never apply force grasping and pulling the cable, it can be damaged.**
>
>
>
> **To re-connect the cable to the device, plug the connector slightly so that the lock snaps into place, then check for the proper connection by a slight pulling on the cable.**

7.1 Architecture of the Device

The device is of compact design with a temperature and pressure transducers solidly attached. In the standard version of the corrector, the pressure transducer is built into the bottom wall of the enclosure. The device architecture is based on interchangeable modules that are mounted in the slots of the I/O board (see below) located on the bottom of the enclosure.

The CPU Module (processor board) with the display, keypad, and battery for the device (powering the device except the modem) is located in the top cover of the device. The CPU module is protected by the cover and marked with an official mark. In the cover of the board is an opening to access the service switch. Use the service switch to enable/disable the device parameter settings.

At the bottom of the cabinet there is the I/O board of inputs and outputs with terminal blocks for connecting external devices and with slot connectors for connecting of exchange modules used to extend the features of the device.

Connections related to the metrological function of the corrector are protected by covers that are marked with the official mark.

> **i**
>
> The device is equipped with autodetection of the installed modules.
>
> Modules located in SLOT 0, SLOT 1, SLOT 2 and SLOT 3 are always detected (without any other conditions).
>
> To the detection of SLOT 4 and SLOT 5 modules, the following applies:
>
> - Modems requiring a modem battery (S4-PWR2 module or M2G, M4G modem) can only be detected in these slots with the modem battery connected.
> - Other modules are always detected.

7.2 Main parts of the device

Fig. 54 shows the main parts of the ELCOR device, Fig. 55 of the ELCORplus device. The internal layout of the ELCOR*plus Indexer* is identical with ELCOR*plus*.

ELCOR has only SLOT 0 available to extend its features. The basic design can be extended by a modem module installed to the right in the device enclosure outside of the I/O board.

ELCORplus and ELCOR*plus Indexer* are equipped with SLOT 0 to SLOT 5 extension connectors.

In ELCOR*plus Indexer*, SLOT 0 is permanently fitted with the mechanical indexer interface module. Compared to the ELCOR device, ELCOR*plus Indexer* is equipped with smaller number of cable glands.
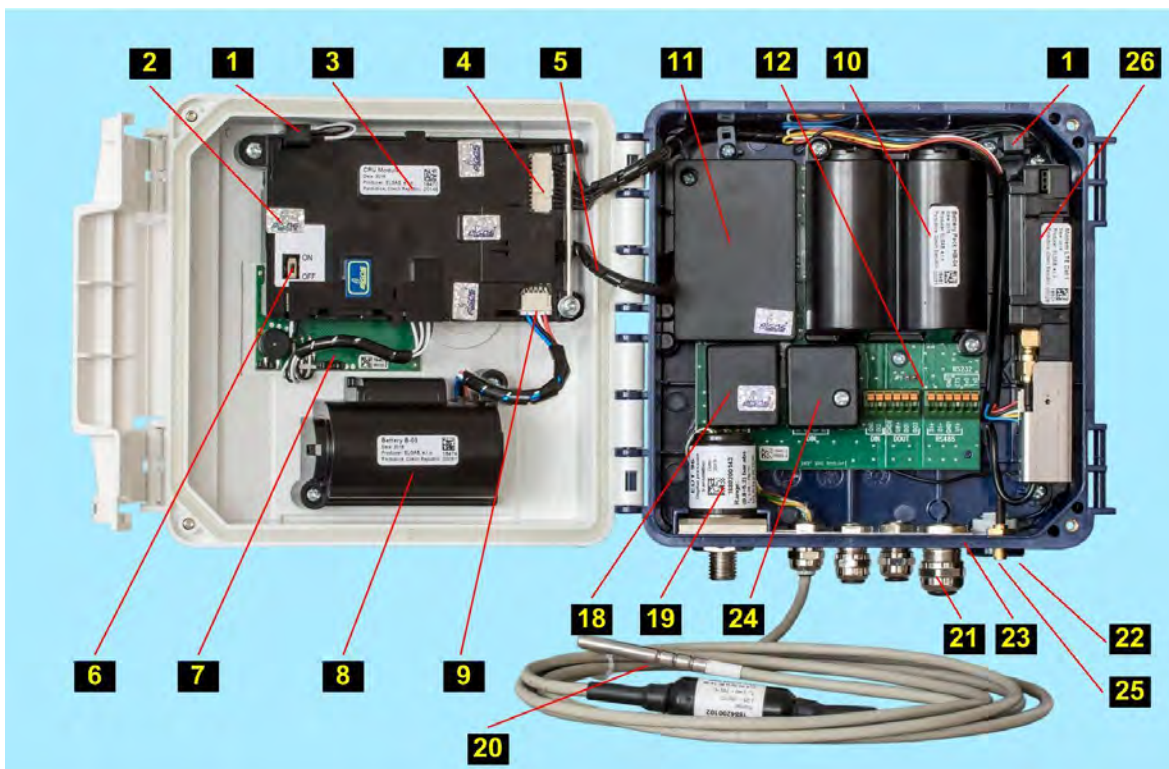
Fig. 54 Main parts of the ELCOR device
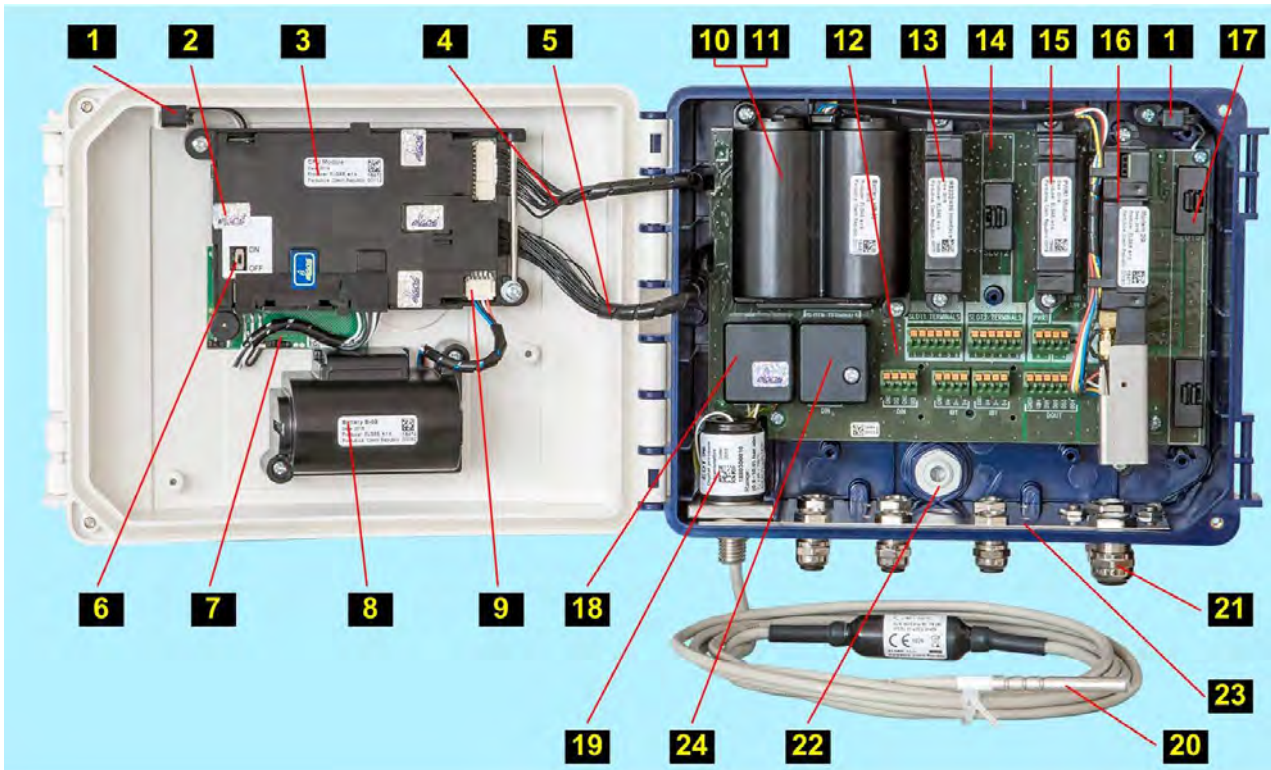
Fig. 55 Main parts of the ELCORplus device

Legend:

1	device opening sensor	**14**	empty SLOT 2
2	metrological seal of metrological switch cover	**15**	module installed in SLOT 3
3	CPU mode	**16**	module installed in SLOT 4
4	modem cable	**17**	module installed in SLOT 5
5	I/O board cable	**18**	cover or temperature and pressure transducer
6	service switch	**19**	EDT 96 pressure transmitter
7	keypad board	**20**	EDT 101 temperature transmitter cable
8	device battery	**21**	cable glands
9	device battery connector	**22**	ventilation grommet with IP68 rating
10	modem battery	**23**	conductive strip connecting the metal cable glands, cable shields
11	module fitted in SLOT 0 (placed under modem battery in ELCOR*plus*)	**24**	terminal cover for gas meter connection
12	I/O board	**25**	cable adapter for external modem antenna connection
13	module installed in SLOT 1	**26**	Internal modem (ELCOR)

7.3 ELCORplus indexer – Description of mechanical indexer

The mechanical indexer ensures the mechanical transmission of the gas meter rotation to the shaft with the orifice located in the mechanical indexer. Based on the sensing of the rotation of this diaphragm, the generation of pulses for the converter is ensured. Shaft rotation, resp. the aperture is scanned optically by means of light emitting diodes.

The generated pulses are processed and stored in the internal memory of the electronics of the mechanical indexer and from there they are transmitted by a communication protocol to the S0-MIE module of the converter for further processing. The setting of the correct direction of rotation of the indexer counter in accordance with the gas meter is performed during the installation of the device and is described in paragraph 5.4.3. The mechanical indexer also includes sensitive external magnetic field sensors that detect an attempt to disrupt its function.

The information transmitted from the mechanical indexer is:
- pulses carrying information on gas consumption and gas flow
- direction of rotation of the gas meter
- signal of an attempt to disturb the function of the indexer by an external magnetic field

The evaluation of the disturbance signal depends on the setting of the device parameters (parameter TAMPER in the device parameters, see Fig. 56) and can be included in the alarm signal, resp. cause a call to the dispatcher. Furthermore, this signal can be stored in archives together with a time stamp, and it can also be included in the status of the device, the resulting total status of which is shown on the device display (see Tab. Table 11 and section 6.9). It can be stored in the status archive as an intrusion contact (W7 or W8, see Table 15).

The mechanical indexer is electrically connected to the SLOT 0 terminal block on the I/O board of the device. The device must have the S0-MIE module in the SLOT 0 position.

SLOT 0 terminal	signal	color of wire
1	GND	white
2	U+	green
3	RxD	brown
4	TxD	yellow
5	Ub	gray
6	TxD	---

Table 16 Connection of mechanical indexer to SLOT 0 terminals

The electrical connection of the mechanical indexer to the SLOT 0 terminals is secured with a seal. (Elgas security marks).

Fig. 56 Mechanical indexer – settings of TAMPER parameters in the Corrector via Compass software (signal of an attempt to disturb the function of the indexer by an external magnetic field)
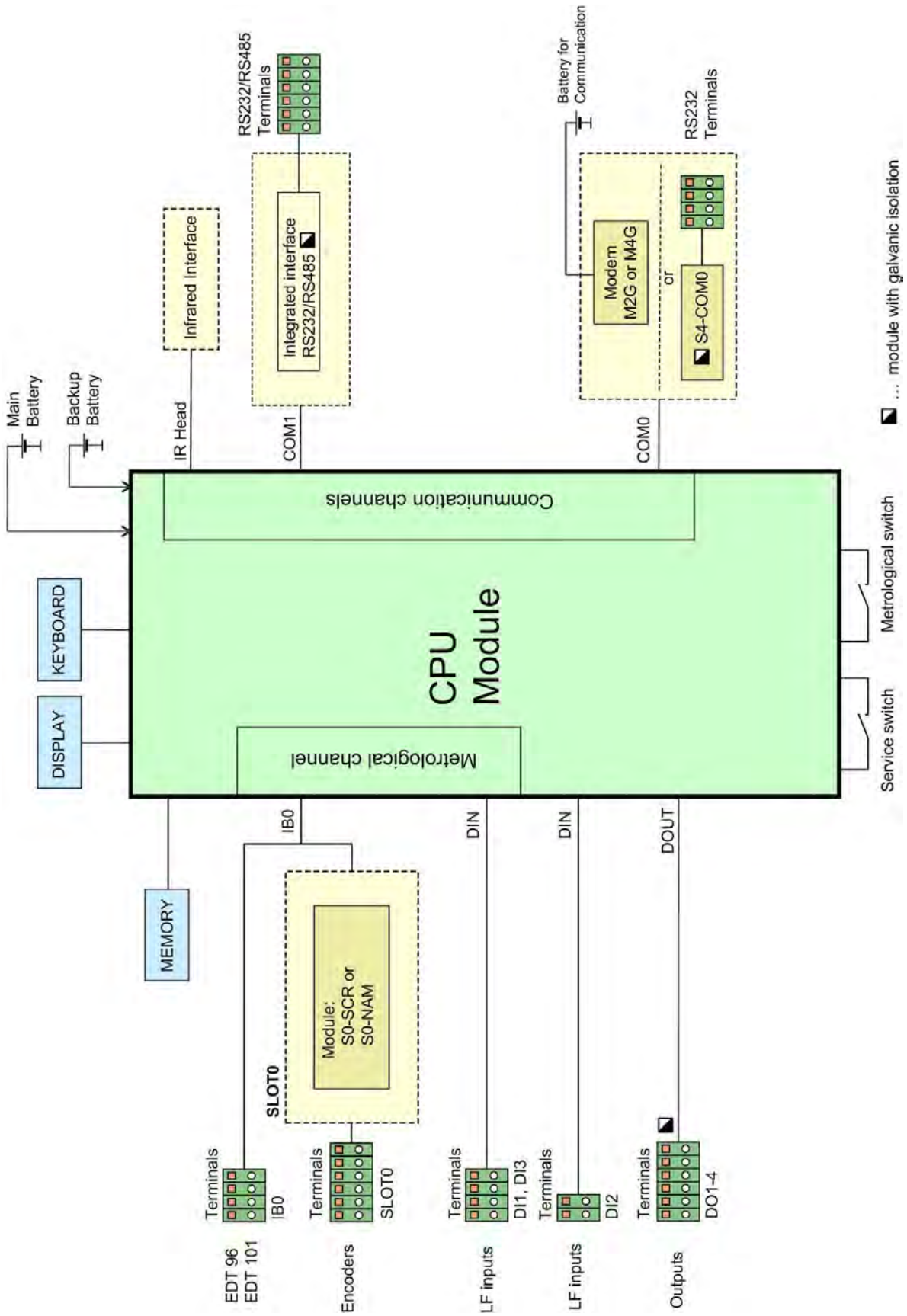
Fig. 57 Functional diagram of ELCOR
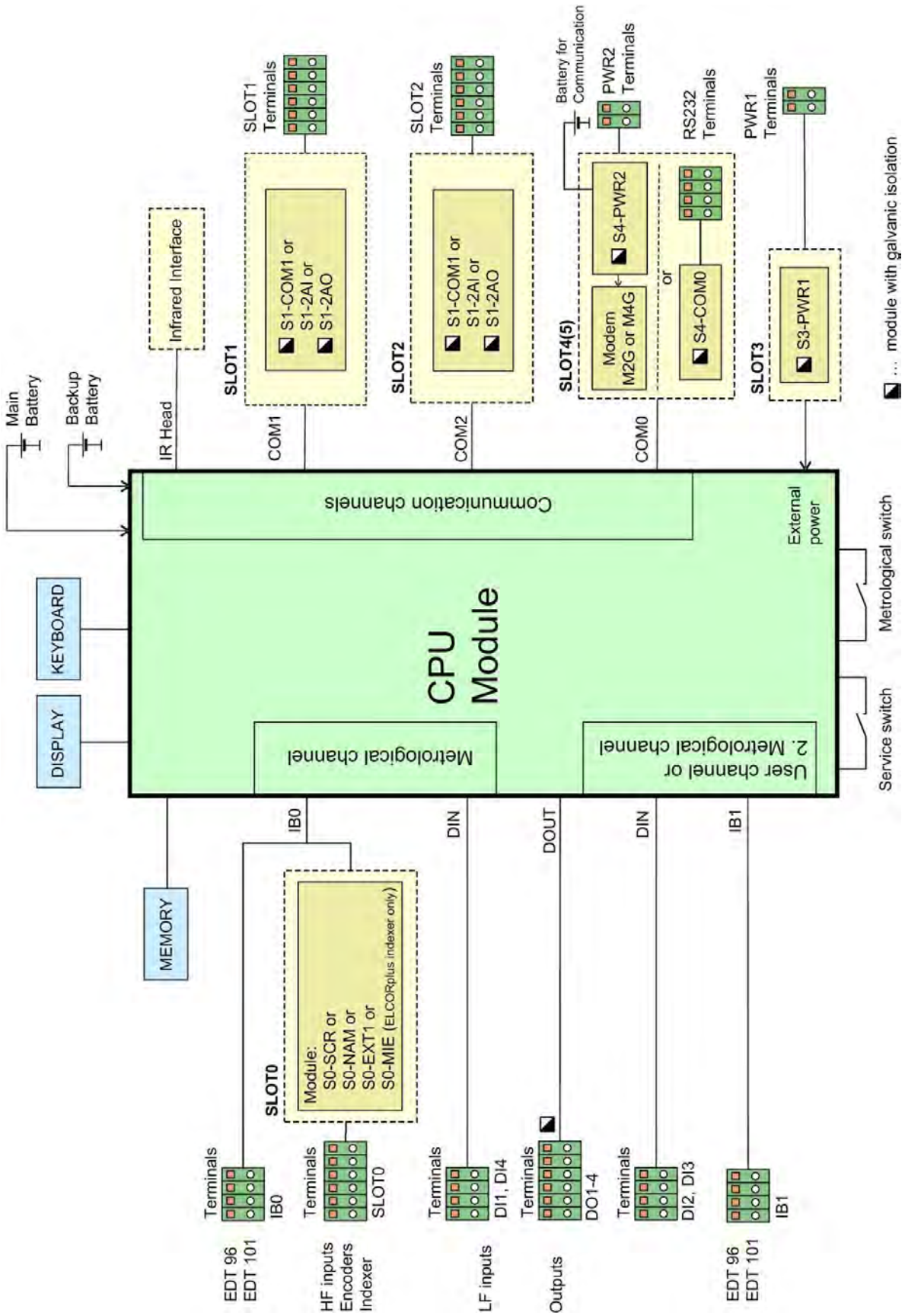
Fig. 58 Functional diagram of ELCORplus

7.4 Modules, Principles of Use

The supplied expansion modules are designed for installation into the slots located on the I/O board. ELCOR device is equipped with SLOT 0 only, ELCOR*plus* and ELCOR*plus Indexer* with SLOT 0 to SLOT 5. For each module, the manufacturer determines into which slot it can be fitted. Each slot is fitted with a connector into which the module is inserted. The inserted module is fixed in the device by two secure screws.
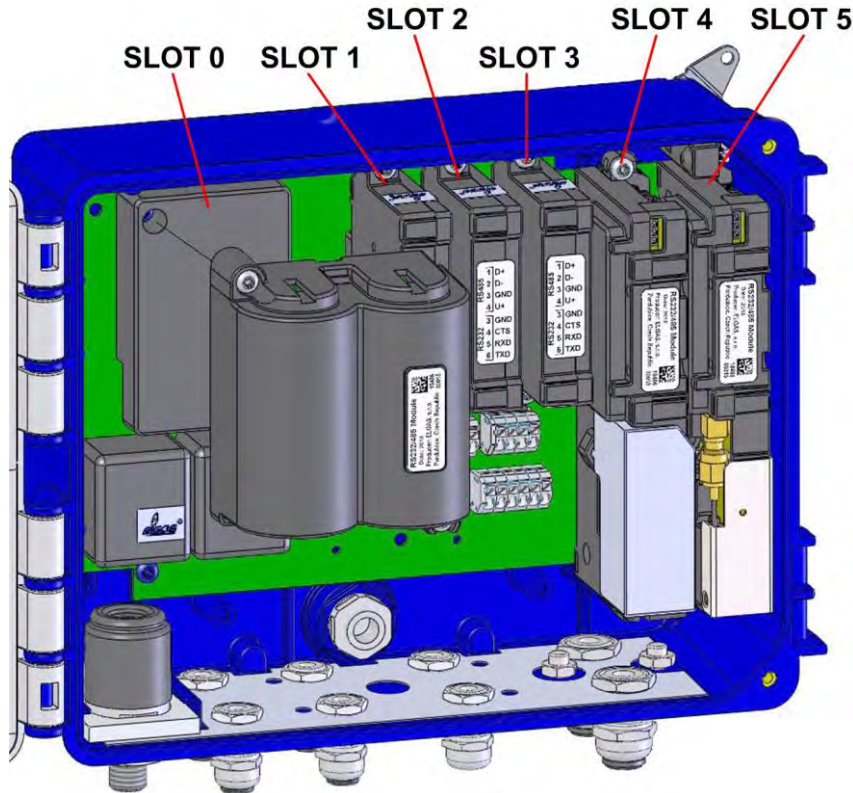
Fig. 59 Arrangement of ELCORplus slots

ATTENTION!

A trained person may install or replace modules that are not protected by a metrological seal (i.e. outside of SLOT 0) even in potentially explosive environments, provided that the warnings and procedures described in this document are observed and that all safety standards applicable to products and explosive environments are complied with.

ATTENTION!

When handling the modules in the device, first disconnect the device and modem power supply. If external power supply is used, disconnect it first, then disconnect the battery.

Following this procedure, the module replacements may be carried out even in potentially explosive environments. When handling removed modules, be careful so as not to damage them. Put plastic protective caps to the connectors to the empty slots of the I/O board.

> **ATTENTION!**
>
> **The device and modules are equipped with CMOS components that are sensitive to static charges. Do not touch the outlets of the components and connectors.**
>
> **When working, do not use synthetic fabrics (including clothing) from which a static electricity spark could arc to the circuit.**

7.4.1 Marking of modules

Each plug-in module has a product label on the upper side with its designation and serial number, or with the indication of signals on the terminals. Another label on the side of the module contains additional information, e.g. electrical intrinsically safe explosion-proof parameters, information for which slot it is intended, etc.
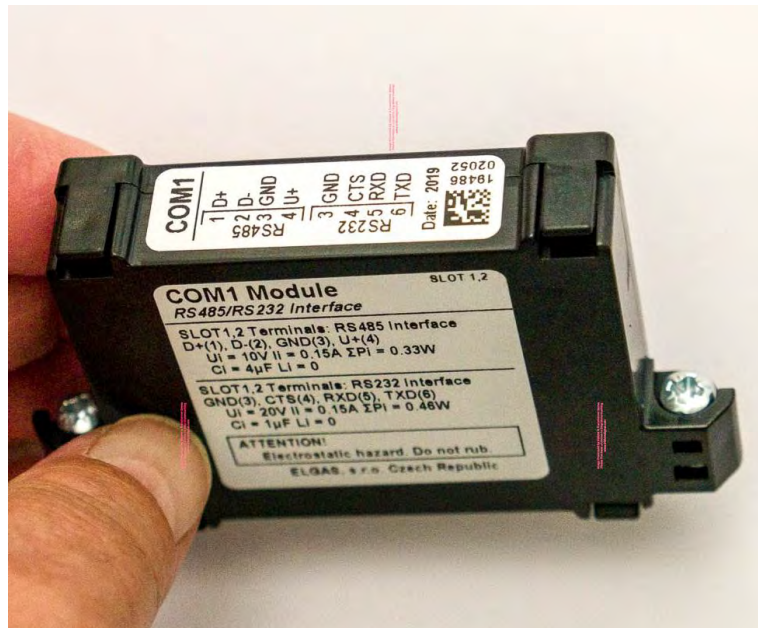
Fig. 60 Plug-in, identification labels

> ℹ️ For easier orientation in this document are uses the trademarking of the modules which are slightly different from the marking on the nameplate. For most modules, the commercial designation of the plug-in module begins with a prefix indicating the slot number "**Sx-**" for which the module is intended.
>
> For modules that can be installed in multiple slots, only the primary slot number is listed.

trade name of the module	module designation on the label	name	installation
S0-MIE	Indexer Module	Interface for mechanical indexer ELGAS (only ELCORplus indexer)	SLOT 0
S0-SCR	SCR Module	Interface for SCR encoder of gas meter	
S0-NAM	NAMUR Module	Interface for NAMUR encoder of gas meter	
S0-EXT1	EXT1 Module	extension module - 2x HF NAMUR impulse inputs, - 6x digit. inputs - 2x analog. inputs - 2x connection of digital converter	
S0-EXT1/HF	EXT1/HF Module	extension module - 2x HF NAMUR impulse inputs,	
S1-COM1	COM1 Module	Communication module RS232/RS485	SLOT 1, SLOT 2
S1-2AI	AI Module	Analog inputs module 4-20 mA (2 inputs)	
S1-2AO	AO Module	Analog outputs module 4-20 mA (2 inputs)	
S3-PWR1	PWR1 Module	External power supply module of EVC	SLOT 3
S4-PWR2	PWR2 Module	External power supply module for internal modem	SLOT 4
S4-COM0	COM0 Module	Communication module RS232	
M2G	Modem 2G	Internal modem 2G	*(according to the design of the device)*
M4G, LTE-Cat1E	Modem LTE-Cat 1 Mod E	Internal modem LTE, cat. 1-E	
M4G, LTE-Cat1U	Modem LTE-Cat 1 Mod U	Internal modem LTE, cat. 1-US	
M4G, LTE-CatM1U	Modem LTE-Cat M1 Mod U	Internal modem LTE, cat. M1-US	
BARP	Barometric Sensor	Module for measuring of barometric pressure(only for ELCORplus)	

Table 17 Labeling of internal modules

A list of all plug-ins modules for the individual versions of the device and their designations with information on the location in the slots is given in section 12.

For device **ELCORplus for Zone 2** is this information in appendix numb. 2, paragraph 6.3.

7.4.2 Installing the Modules

The device design allows additional extension or alteration of the input/output modules (SLOT 1, SLOT 2) and external power supply of the whole device (SLOT 3) and the communication module (SLOT 4).

ATTENTION!

If the device classification from the point of view of explosion safety has been changed after retrofitting of certain modules (see paragraph 2), the classification must be corrected on the device data plate.

The prescribed tightening torque of the module mounting screws to the I / O board is 0.7 Nm.

Procedure:

Always disconnect the power supply from the measurement part (processor board) before handling the modules.

- If external power supply is used, disconnect the power supply from the PWR1 terminals.

- Disconnect the battery. Press the lock and gently pull the wires to disconnect the connector.

- Unused connectors on the system board are protected by caps. To retrofit a module, first remove the cap. Push the levers gently with pliers to release the latch and remove the cap easily.

- Attach the module to the posts and press it gently into the connector on the system board. Tighten the screws. The module is impossible to be installed in a wrong slot. If the module is difficult to plug in, do not use greater force, but check the correct position and orientation of the module.

- Connect the battery or external source terminals.
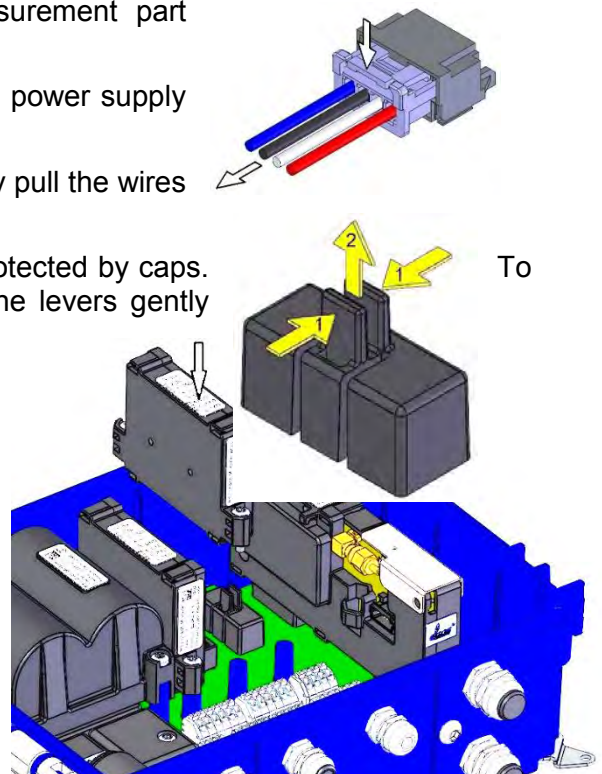
7.4.3 Installing the External Power Supply of the Modem

- Press the lock and gently pull the cables to disconnect the connector of the modem battery (1).

118
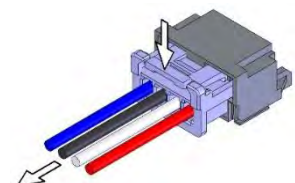
- The battery-powered modem is located in SLOT 4. To connect an external power supply source, you need to move the modem to SLOT 5 and place the external power module in SLOT 4.

- Remove the caps of the connector (2) in SLOT 5. Using pliers, press gently the levers to loosen the catch and release the cap.

- Loosen the battery cables from the bracket (3)

- Loosen the fixing screws (4).

- Remove the modem by pulling it perpendicular to the base plate, do NOT tilt the module to the side! An antenna is installed inside the module, which moves together with the module.

- Place the module on the posts of Slot 5 and press it gently into the connector on the system board. Tighten the screws (4).

- Install the external power supply module to SLOT 4 in the same way.

- Connect the external source cables to the PWR2 terminals.

- Insert the battery into the PWR2 external power module.
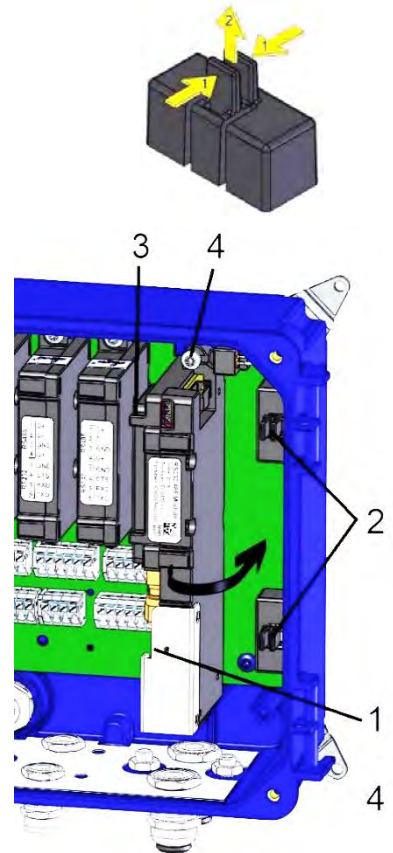
7.4.4 Replacement of the Internal modem

- If external power supply sources are used, unplug the power supply from the PWR1 and PWR2 terminals.

- Press the lock and gently pull the cables to disconnect the connectors of both batteries.

- Loosen the battery cables from the bracket (3)

- Loosen the fixing screws (4).

- Remove the modem (1) by pulling it perpendicular to the base plate, do NOT tilt the module to the side! An antenna is installed inside the module, which moves together with the module. If external antenna is used, disconnect its connector from the communication module before removing the module.

- Place the module on the posts and press it gently into the connector on the system board. Tighten the screws (4). Pay attention to the correct orientation and position of the module, see Section 0

- Connect the battery connectors (2) and (3).

- Connect the cables to the PWR1 and PWR2 terminals of the external power supply.

- Make sure that the battery is connected to the correct connector, see Section 0.
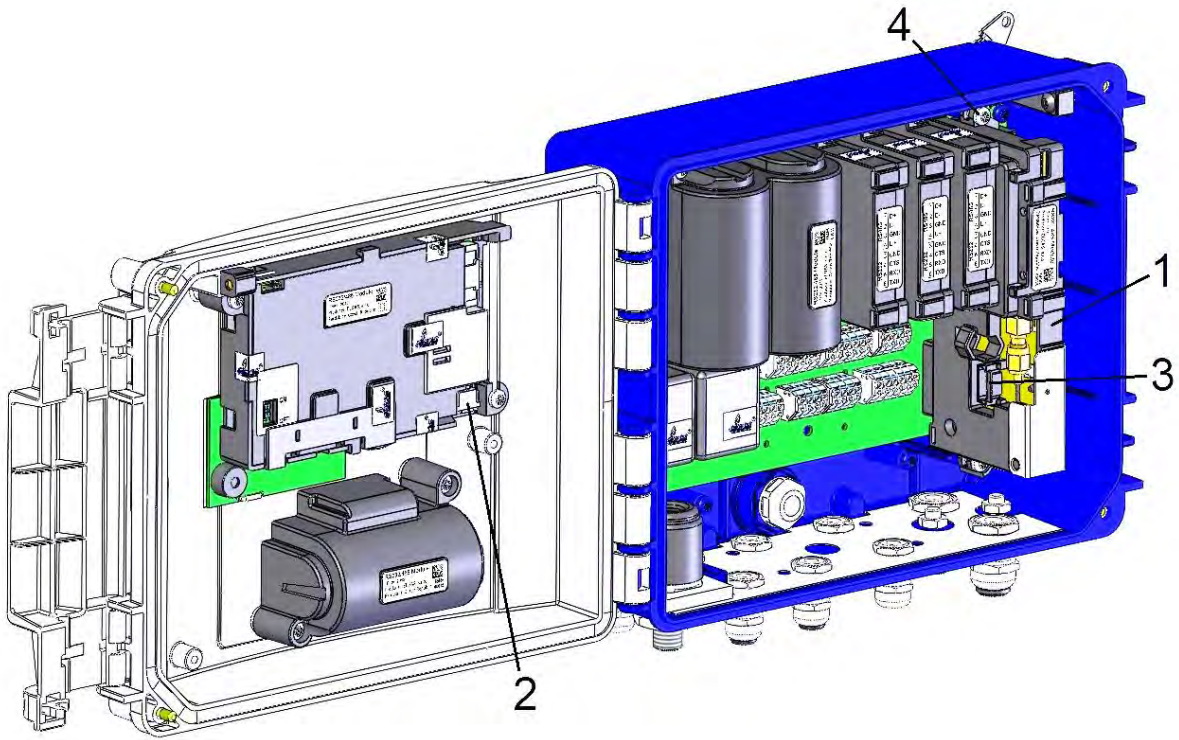
Fig. 61 Modem replacement

7.5 Power Supply of the Device

	ATTENTION!
EX	**! The danger of explosion if the battery is incorrectly replaced for a different type !**
	Only <u>batteries prescribed by the manufacturer</u> (see paragraphs 3.4 and 3.11.2), approved by the laboratory for this device and complying with the parameters for explosive environment may be used in the device.
	Batteries are sealed by the manufacturer and must not be disassembled for safety reasons.

	Both the device battery and the modem battery can be replaced in a potentially explosive environment.
⚠	**The battery may only be replaced by trained personnel.**
	Only the prescribed type of battery may be used.

	WARNING!
⚠	**All used connectors in the device contain a fuse against accidental disconnection. When disconnecting, it is necessary to press down first to release the pull-out catch, then pull it slightly.**
	Never pull by force on the cable, it can be damaged. When reinserting, simply insert it slightly so that the lock is visible. Then, make sure to pull it lightly by the cable.
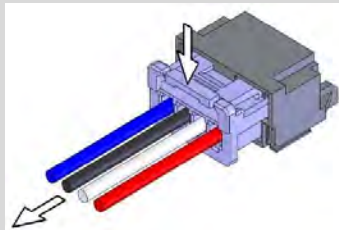
	Discharged batteries fall under hazardous waste category. According to the WEEE Directive (2002/96/EC) and under national regulations, batteries may not be disposed of together with household waste. Discharged batteries are subject to a take-back obligation. Therefore, it is necessary to dispose of the discharged batteries at the point of take-back or at authorized points for the recycling of electrical and electronic waste.
i	

7.5.1 Batteries to Power the Device

The device is powered by a **B-03** battery with a nominal voltage of 3.6 V and a capacity of 17 Ah. Instead of this battery, the device ELCOR*plus* can be equipped with a **B-03D** battery that has a higher capacity (30 Ah).

> **i** In special cases, the **B-03A** alkaline battery can be used to power the ELCOR*plus* and ELCOR*plus indexer*. When using this battery, an internal modem cannot be used in the device.

The modem module is not powered from this battery in the device variant with the modem. Its power supply is provided by its own battery.

During operation, the consumed capacity is measured and calculated. The remaining battery capacity is stored directly in the internal battery memory.

> **i** If the battery capacity drops to 10% before the expected discharge, the device will alert you of the need to replace the battery (error message **E9**, see Table 14).

The battery life depends mainly on the device configuration, the frequency of communication, the time of display illumination and weather conditions.

Defined conditions for declared battery life:

- 30 s measurement period (not applicable to encoders)
- archive period of data archive 1 hour
- period of input pulses from the gas meter ≤10 Hz
- generating output pulses with frequency f ≤ 1 Hz
- operating communication (local or remote) with the device for 2 min per day
- service communication (local or remote) with the device for 5 min per week
- firmware update (locally or remotely) once a year
- ambient temperature [20]): -25 °C to +70 °C or -40 °C to +70 °C
- ambient temperature [21]): -30 °C to +65 °C

Under these conditions, the lifetime of the batteries supplied for typical ELCOR and ELCOR*plus* configurations is shown below:

7.5.1.1 ELCOR/ELCOR*plus* Volume Corrector Basic Variant

a) Basic configuration

Battery life	With the display OFF (graphic or segment)	Display ON all the time (segment only)
Lithium battery B-03	11 years	9 years

---

[20]) Temperature range when lithium battery power supply B-03, B-03D is used.

[21]) Temperature range when alkaline battery power supply B-03A is used.

Lithium battery B-03D [22])	18 years	16 years

Backup battery lifetime: *16 years backup time (including use without main battery for 3 years)*

b) Basic configuration with online communication

Communication via RS232 or RS485 interface, transfer rate 115 kBd:

Battery life	With the display OFF (graphic or segment)	
Actual values reading period	5 s	15 s
Lithium battery B-03	---	5 let
Lithium battery B-03D [22])	5 let	10 let

Declared battery life applies to the HW device configurations:

ELCOR HW Configuration:

    - IB0: 1x EDT 96, 1x EDT 101 (metrological transducers)

    - SLOT0: not fitted

    - Modem

ELCORplus HW Configuration:

    - IB0: 1x EDT 96, 1x EDT 101 (metrological transducers)

    - IB1: not fitted

    - SLOT0: not fitted

    - SLOT1: S1-COM1 - RS232/RS485 interface

    - SLOT2: not fitted

    - SLOT3: S3-PWR1

    - SLOT4: S4-PWR2 or modem

    - SLOT5: Modem or not fitted

7.5.1.2 ELCOR/ELCOR*plus* volume corrector variant with connected NAMUR or SCR+ encoder

a) Encoder reading period 1 hour

Battery life	With the display OFF (grafic or segment)	Display ON all the time (segment only)
Lithium battery B-03	10 years	8 years
Lithium battery B-03D [22])	17 years	15 years

Backup battery lifetime: *16 years backup time (including use without main battery for 3 years)*

---

[22]) ELCORplus only.

b) Encoder reading period 30 s

Battery life	With the display OFF (graphic or segment)	
Encoder type	NAMUR	SCR+
Lithium battery B-03	---	5 years
Lithium battery B-03D [22]	5 years	9 years

Comment:

1) *In this mode, the battery life depends mainly on the power consumption of the connected encoder. The consumption of the encoder of different manufacturers may be different. The above lifetimes apply to encoders manufactured by Elster, RMG and FMG.*

2) *The encoder reading period is limited, see section 9.4.*

ELCOR HW Configuration:

- IB0: 1x EDT 96, 1x EDT 101 (metrological transducers)

- SLOT0: S0-NAM or S0-SCR module with encoder connected

- Modem

ELCORplus HW Configuration:

- IB0: 1x EDT 96, 1x EDT 101 (metrological transducers)

- IB1: not fitted

- SLOT0: S0-NAM or S0-SCR module with encoder connected

- SLOT1: S1-COM1 - RS232 / RS485 interface

- SLOT2: not fitted

- SLOT3: S3-PWR1

- SLOT4: S4-PWR2 or modem

- SLOT5: Modem or not mounted

7.5.1.3 ELCOR*plus* volume corrector dual channel variant

Battery life	With the display OFF (graphic or segment)	Display ON all the time (segment only)
Lithium battery B-03	9 years	7 years
Lithium battery B-03D	15 years	13 years

Backup battery lifetime: *16 years backup time (including use without main battery for 2 years)*

ELCORplus HW Configuration:

- IB0: 1x EDT 96, 1x EDT 101 (metrological transducers - 1st channel)

- IB1: 1x EDT 96, 1x EDT 101 (metrological transducers - 2nd channel)

- SLOT0: not fitted

- SLOT1: S1-COM1 - RS232/RS485 interface

- SLOT2: not fitted

- SLOT3: S3-PWR1

- SLOT4: S4-PWR2 or modem

- SLOT5: Modem or not fitted

7.5.1.4 ELCOR*plus* indexer volume corrector with mechanical counter

Battery life	With the display OFF (graphic or segment))	Display ON all the time (segment only)
Lithium battery B-03	10 years	8 years
Lithium battery B-03D	16 years	14 years
Alkaline battery B-03A [23])	6 years	5 years

Backup battery lifetime: 15 years backup time (including use without main battery for 2 years)

ELCOR*plus* indexer HW configuration:

- IB0: 1x EDT 96, 1x EDT 101 (metrological transducers)

- IB1: not fitted

- SLOT0: S0-MIE with mechanical counter encoder connected

- SLOT1: S1-COM1 - RS232/RS485 interface

- SLOT2: not fitted

- SLOT3: S3-PWR1 [23])

- SLOT4: S4-PWR2 or modem [23])

- SLOT5: Modem or Not Mounted [23])

7.5.1.5 ELCOR/ELCOR*plus* other variants

Contact the manufacturer to determine the battery life of a different HW/SW configuration of the device that is not stated here (see section 6.9).

Note:

If the device needs to be operated with a higher consumption than in the defined mode, it is necessary to take into account the more frequent replacement of the battery or, in the case of ELCOR*plus*, to use the external power supply.

7.5.2 Replacing the Battery

It is advisable to disconnect the discharged battery as soon as possible.

---

[23]) Modules S3-PWR1, S4-PWR2 and the modem cannot be used with alkaline battery power supply.

> ⚠ **The device indicates discharged battery by E9 error message in the device diagnostics (see Section 6.9.5).**

> **i** **All data in the device, archives and parameter settings are stored in <u>non-volatile</u> (energetically independent) memory and will remain intact even if the device is disconnected from the power supply, including the disconnection of the backup battery.**

> **i** **During the battery replacement, the device does not measure pressure or temperature, but counts incoming LF pulses (however, the pulse conversion is not carried out before the battery is connected), and the real-time clocks operation is ensured.**

> **i** **The prescribed tightening torque of the batteries mounting screws to the device is 0.7 Nm.**

To replace the battery:

- Press the mechanical connector lock and pull the cables gently to disconnect the battery connector **2** from the CPU module.

- Loosen the battery fixing screws.

- Remove the battery and replace it with a new one. Fix the battery in position by the screws.

- The battery cable with connector **1** must be plugged into connector **2** on the processor board.

- When the battery has been connected, the device is automatically turned on.
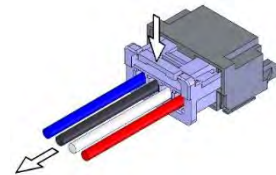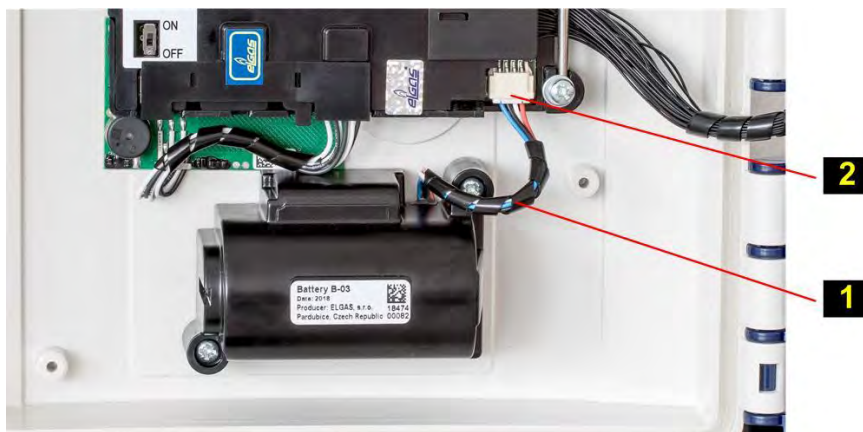
Fig. 62 Main battery

7.5.3 Battery to Power the Modem

> **i** **Discharged battery of the modem is indicated by the E27 error message in the device diagnostics; low voltage of the modem battery is indicated by the W30 warning message.**

The status of the modem battery is automatically checked by the machine every 2 minutes. Replacing the battery of the modem is therefore automatically registered within 2 minutes or after resetting the device.

During modem operation, the consumed capacity is measured and calculated. The remaining battery capacity is stored in the internal memory of the battery.

Each type of applied modem requires the appropriate battery type.

Type of the modem	Battery designation	Battery life *)	Battery voltage	Battery capacity
M2G internal 2G modem	HB-03	6 years	3.0 V	12 Ah
	HB-03D	11 years	3.0 V	20 Ah
M4G internal LTE modem	HB-04	6 years	6.0 V	12 Ah

*) The specified battery life applies to the following mode of operation:

- GSM/GPRS data transmission once a day (modem ON for 2 minutes per day on average)
- GSM/GPRS service window once a week (10 minutes ON, average 1 minute of communication each week)
- remote download once a year
- Ambient temperature -25°C to + 25°C
- Signal strength 80%

Battery life depends mainly on the mode of use, the signal strength at the point of deployment and the ambient temperature:

• Battery life decreases with higher ambient temperatures (to approx. 90% at 50°C, to 80% at 70°C).

• Battery life decreases with decreasing signal strength (to approx. 60% at 15% signal strength).

7.5.4 Replacing the Modem Battery

- Press the lock and gently pull the cables to disconnect the connector of the modem battery.

- Loosen the battery cables from the bracket (2)

- Loosen the fixing screws (3).

- Remove the battery and replace it with a new one. Tighten the screws.

- Hitch the cables under the bracket (2) and connect the connector.

- Connect the cables into PWR2 terminals of the modem external power supply.

- Make sure that the battery is connected to the correct connector, see Section 0.
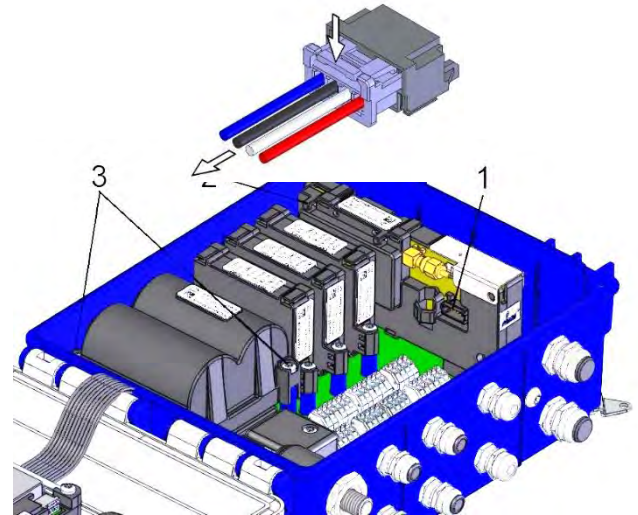
7.5.5 Back-up Battery

The battery serves to backup important functions when the main battery is discharged or being replaced. The back-up battery is located in a holder on the processor board (CPU module) under the cover. The back-up battery can be replaced by an authorized service centre after disrupting the official and manufacturing marks (the replacement must not be performed in potentially explosive atmospheres). Only approved battery types may be used.

The battery life of the back-up battery is specified in Section 7.5.1.

7.5.6 External Power Supply

> **i**
>
> **External power supply can be used for ELCORplus and ELCORplus Indexer.**
>
> **For ELCOR, external power supply cannot be used.**
>
> **The external power supply to the device does not provide power to the internal modem. For an internal modem, separate external power supply must be used.**

The ELCORplus and ELCORplus indexer can be powered from an external intrinsically safe source. If the device is equipped with an internal modem, the device can also be equipped with an external power supply for the modem.

External power is recommended where the operating mode of the device or modem is set to have an increased current consumption from the batteries, thus shortening the batteries life.

Using external power supply for the device (its measuring part) is necessary:

- When using S0-EXT1 module with NAMUR HF pulse input

- When using a NAMUR (S0-NAM) encoder with the measurement frequency of less than 1 min

Using external power supply for the device is recommended:

- For frequent communication (more than once a day),
- When longer time ON of the modem than specified in paragraph 7.5.3 is requested

In order for the device or modem to be powered externally, it must be fitted with an appropriate plug-in module to which an external intrinsically safe source is connected. The supplied intrinsically safe sources must be powered from a 12 Vdc source.

> **i**
>
> **The device batteries and modem batteries must be inserted and connected in the device even when external power supply is used.**
>
> **In the event of the external power supply failure, the device and the modem are switched automatically to battery operation. In this case, the batteries serve as backup power supply.**

External power supply	External power supply module		IS source	
	Module	**Installation**	**Type of source**	**Installation**
Device	S3-PWR1	SLOT 3	PS-E, PS-E/A	Out of potentially explosive atmosphere
Internal modem	S4-PWR2	SLOT 4	PS-M, PS-M/A	Out of potentially explosive atmosphere

Table 18 External power supply, components required

The wiring diagram for the external supply of the device is specified in Section 5.6.6.1.

The wiring diagram for the external supply of the modem is specified in Section 5.6.6.2.

7.6 Digital Outputs, Modified Use

ELCOR has 2 digital outputs DO1 and DO2 in basic design, ELCOR*plus* and ELCOR*plus Indexer* have 4 digital outputs DO1 to DO4. These outputs run to the DOUT terminal block of the input/output board (I/O board). All outputs are galvanically isolated and are of the open collector type.

The basic use of these outputs required feeding these outputs externally by supplying voltage to the U0 + terminal of the DOUT terminal block. In this case, the shorting jumper JP1 must not be fitted to the I/O board.

For pulse outputs, however, it is possible to set a special mode of use for DO1 and DO2 outputs where these outputs can be operated as pulse outputs without power supply at terminal U0 +. This method of use requires a shorting jumper JP1 on the I/O board (see Fig. 63).

> ⚠ **Notice**
>
> **Special mode (with fitted jumper JP1) is intended only for special cases of connection of the device with another device when it is not possible to use the supply terminal U+.**
>
> **The condition for its use is that the voltage from the connected device, which is connected to the output DO1 (DO2), must not have a voltage greater than**

3.6V.

An example of use is, for example, the connection of DO1 (DO2) to the digital input of another converter (miniELCOR, maxiDATCOM, etc.), which meets this condition.

⚠️ **Notice**

If jumper JP1 is fitted and terminal DO1 (DO2) is connected to a device that provides a DC voltage greater than 3.6 V on the wire connected to terminal DO1 (DO2), the device will be damaged!

Attention: this mode reduces the operating ranges of the DO1 and DO2 outputs
(see Table 19)

Parameter	Without shorting jumper JP1	With shorting jumper JP1
DO1 and DO2 output option	Pulse, binary, data	Pulse output
Supply voltage (terminal U0+)	3.6 V ÷ 15 V	-----------------
Output voltage	2.7 V ÷ 15 V	3.0 V ÷ 3.6 V !!!
Output current	3 µA ÷ 100 mA	3 µA ÷ 1 mA
Max. frequency	1 Hz	1 Hz
Pulse width (closed output)	5 ms ÷ 25 s	5 ms ÷ 50 ms

Table 19 Operating parameters of DO1 and DO2 outputs depending on shorting jumper JP1

Note

If the supply voltage is not applied to the U0 + terminal, the DO3 and DO4 outputs are disabled in the case of ELCOR*plus*.
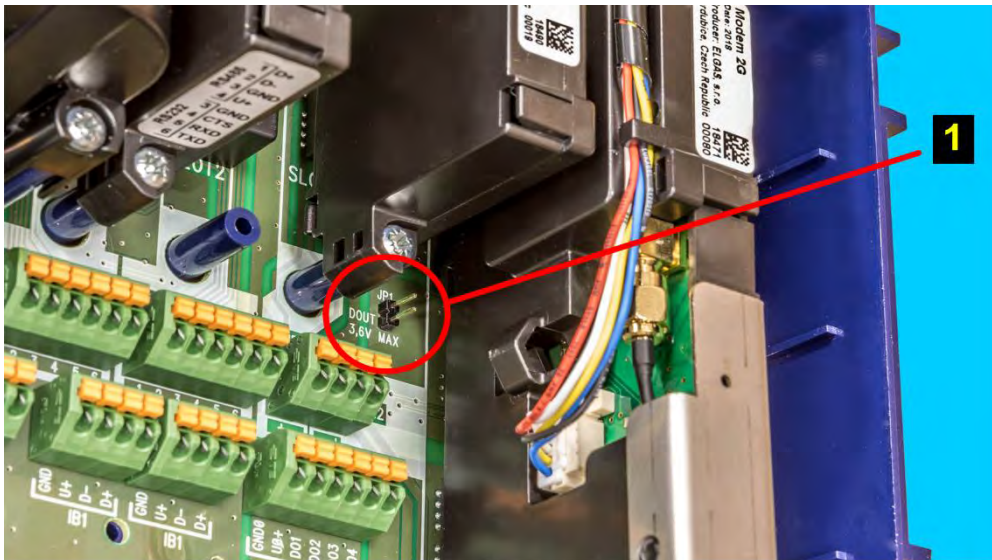
Fig. 63 Placing JP1 Jumper on I/O Board

7.7 Internal Modem, Using External Antenna

The internal M2G, M4G modem is powered by a stand-alone HB-03/HB-03D battery. The modem is fully controlled by the device parameters. Due to the current consumption of the modem, it is necessary to choose the mode and timing of the transmitted data and to control the switching ON and OFF of the modem with respect to the modem battery. For the ELCORplus and ELCORplus Indexer, the internal modem can also be powered from an external power supply (PS-M, PS-M/A) using the S4-PWR2 module.

7.7.1 Using the Device with an External Antenna

The internal M2G and M4G modems are equipped with an integrated antenna that is part of the M2G or M4G modem. The antenna is located under the modem module cover and is connected to the modem board via a standard SMA connector.

In locations with poor signal quality, the internal antenna can be disconnected and an external, more powerful antenna, attached to the coaxial cable outside the device, can be connected. This modification is based on the installation of a HF cable adapter that interconnects modem antenna outlet with outer antenna plug. The required part - HF cable adapter - see Fig. 64 must be ordered separately, it is not included in the standard delivery.

An external antenna (not included in the standard accessory) is connected to the SMA (f) panel connector at the bottom of the device enclosure.

The external antenna may be located in a potentially explosive zone or in a safe environment.

WARNING:

When designing the installation and use of an antenna other than the supplied standard one, especially when located outside a potentially explosive zone, measures must be taken to reduce the impact of the lightning strike (see CSN EN 60079-14 and CSN EN 62305 3).

The maximum cable length for the external antenna is 10 m.

7.7.2 Modifying the Device for Connecting an External Antenna to the Modem

Procedure:

- If external power supply of the modem is used, first disconnect power source from PWR2 terminals.

- Press mechanical lock of the connector on the modem battery cable and pull the cables gently to disconnect the modem battery.

- Put SIM card cover (1) to the vertical position, open it slightly, and remove the modem plastic cover.

- Hold the fixed part of the connector (2) with a flat key size 7 to prevent the part from slipping out of the printed circuit board, and release the nut of the inner antenna connector (3) nut with a key size 8.
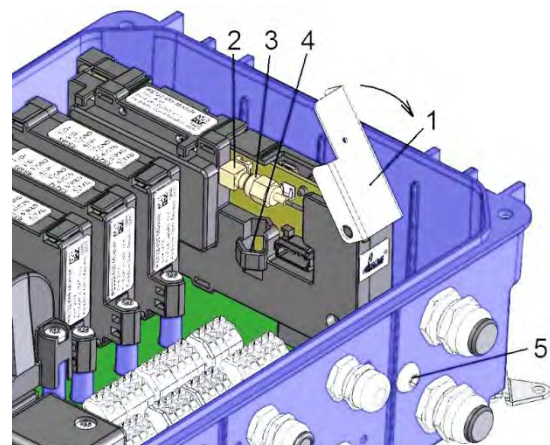
- Unscrew the connector nut (3) and insert it into the holder in the cover (4).

- Remove the blind cap (5) at the bottom of the enclosure.

- Install the HF cable reducer. Insert the panel connector of the HF cable reducer with the rubber O-ring into the blind cap opening (5) and fasten it outside the enclosure using a nut and a washer. Tighten the nut gently (0.7 Nm), remember to hold the fixed part of the connector with the key. Then connect the other end of the HF cable reducer to the connector on the modem board.

- Put the SIM card cover (1) back and close it.

- Reconnect the modem battery connector.

- Connect the external power supply to the PWR2 terminals of the external power supply of the modem.

Fig. 64 External antenna cable adapter

7.8 Software

The device software (firmware, FW) is divided into 3 parts. The first part ("Loader") is used to ensure that the firmware is uploaded when it is updated.

The second part of the firmware ("Metrolog") includes software for the metrological functionality of the device, display control and keypad control, metrological data security routines and control mechanisms for error statuses detection.

The third part of the firmware ("App") contains the rest of the firmware - communication protocols, communication channel management, superstructure functionality, etc.

Each part of the FW is identified by the version number and the checksum. The version designation is stored in the form of a string; it is a decimal number with two decimal places. The version and checksum "Loader" and "Metrolog" are specified in the certificate, versions can only be modified by the notified body with official approval. Changing in version unit number means a major change, changing the decimals indicates a version with minor changes or bug fixes.

7.8.1 Downloading Application Firmware Using "Remote Download" Method

Using this method, you can load new firmware to your device in accordance with the **Welmec 7-2 Extension D** recommendation. The loaded firmware is secured with a **digital signature**, separately in each section. This is to check the integrity of data, the authenticity and also the specificity of the device. The upgrade process is divided into several phases, delayed start of the firmware activation can be set. Information on processing of each individual phase of loading is recorded in the settings archive.

Downloading the FW is not bound to a specific communication protocol or specific PC software, and can be performed via any communication channel. For recording, the firmware is divided into two parts; either the "App" part or the "App" part together with the "Metrolog" can be downloaded.

The digital signature contained in the application firmware file (* .srec) confirms that standard testing has been performed at ELGAS, s.r.o. and that the "Metrolog" module complies with the valid certificate of the relevant notified body.

7.8.2 Storing Data in the Device

Various memories (internal processor RAM, internal FLASH processor, SPI FRAM and SPI dataFLASH) are used to store data in the device.

All the archives and counters are stored in 16MB **non-volatile** SPI dataFLASH memory. Important archives, counters and parameters are additionally backed up in other memories. All data is properly secured. Irregular errors are indicated in the internal diagnostics of the device. The backup battery in the device is used to back up the RAM and the RTC circuit remains in operation. The pulses are counted at the LF inputs.

7.9 Principle of the Function

7.9.1 Conversion Using State Equation

The gas flow data is obtained by means of pulses (N) from the LF or HF sensor located in the meter. From the number of pulses (N) and from the gas meter constant (kp), the volume is calculated at the measurement conditions (V).

From the temperature and pressure transducers, the device receives additional gas flow data - gas temperature (t) and absolute pressure under the measurement conditions (p). From this data, the conversion number (C) is calculated, which is influenced by other factors: absolute temperature under basic conditions (Tb), absolute pressure under basic conditions (pb) and gas compressibility factors under basic conditions (Zb) and measurement conditions (Z) .

Volume under measurement conditions:

$$V = \frac{N}{k_p}$$

Gas compressibility factor:

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

Conversion factor:

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

Volume at the basic conditions:

$$V_b = V * C$$

The compressibility factor of the gas expresses the variation of the natural gas properties from the properties of the ideal gas. By setting the parameters, a specific method according to a specific standard (AGA NX-19 mod, AGA8-G1, AGA8-G2, SGERG-88, AGA8-92DETAIL, GOST 13390.2, or GOST 13390.3) can be selected for compressibility factor calculation. For gases other than natural gas, a constant compressibility value can be used. If the value of pressure or temperature exceeds the limit of the standard selected to calculate the compressibility, the device calculates the compressibility using a substitute compressibility value.

From the input pulse frequency, the device calculates the flow of gas in real-time by mathematical filtration from the incoming signal.

Primary flow:

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

Where: ΔV .... *increase in operating volume*

Δt .... time between pulses with the accuracy of one hundredth of a second

The instantaneous flow rate displayed on the corrector screen is updated every 10 seconds.

Flow rate at base conditions:

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

Base conditions remark

The base conditions are the conditions on which the gas quantity measurement is recalculated. These conditions are different in different countries.

E.g. for the Czech Republic:

absolute temperature Tb = 288.15 K (i.e. tb = 15 ° C)

absolute pressure pb = 101.325 kPa

7.9.2 Substitute volume values

For calculation under error conditions (i.e. because of a transmitter error, a value deviation from the operating range or a device error), the substitute volume counters at measurement conditions (V_s) and at basic conditions (V_{bs}) are installed in the device.

These counters are coupled with appropriate volume counters under normal (correct) conditions.

A detailed description of the behaviour of the device under normal (correct) and error conditions is described in Section 8.4.1

7.9.3 Volume Correction under the Measurement Conditions

The device is equipped with the option of compensating the gas meter errors according to the correction profile data specified in the gas meter test report. This possibility to use the corrected volume V_c is in accordance with CSN EN 12405-1 + A2. The function and the V_c parameter can be added by the manufacturer or at the ASC level. If this function is used, it must be ensured that the error rate profile of the gas meter in relation to the flow rate Q corresponds to the actual operating conditions.

The meter error is corrected using the f (Q) function. For the corrected volume, the following applies:

$$V_c = V_m \ x \ f(Q)$$

where:

V_c	...	Corrected volume at the measurement conditions (volume corrected based on the correction profile of the gas meter)
V_m	...	Volume at the measurement conditions (primary volume)
Q	...	Flow rate at the measurement conditions (primary flow rate)

The linear interpolation method is used as the implicit interpolation method to determine the values between the calibration points.

> **i** The gas meter correction data file is uploaded to the device using the utility program [42], [43].
>
> Gas meter correction values are stored in a file as a table. The table can contain up to 10 flow-dependent correction values.
>
> Information on entering the correction profile of the gas meter in the device is stored in the settings archive.

The principal scheme of volume calculations is shown in Fig. 65.

Conditions for using Volume Correction

The conditions are in accordance with the requirements of CSN EN 12405-1 + A2:

- The correction is used if only the gas meter measures at least 10 pulses per second at Qmin.
- Below Qmin, the correction is not applied, and the value of the correction factor specified for Qmax is used above Qmax.

It follows from these conditions that the correction can only be applied to gas meters with a HF pulse sensor and in the connection with ELCOR*plus* type.

7.9.4 Conversion of Volume to Energy

The device allows to recalculate the amount of consumed gas in the amount of energy E and it is therefore possible to use the device as an Energy conversion device according to EN 12405-2. The conversion of the volume to energy uses the value of combustion heat H_s. Only when the AGA8-DETAIL method is used, the gross calorific value Hs is calculated according to EN ISO 6976:2016 by the device. In the case of other methodologies, the fixed value of the gross calorific value Hs is used (the user can change this value). It is thus possible to define reference conditions (t1 / tb, pb) for the heat of combustion Hs in the device. The calculation is made by adding increments of volumes dV_b (and dV_{bs})) multiplied by the actual value of combustion heat H_s:

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

For measuring in energy units, the device contains two additional counters, the energy counter E and the energy substitute values counter Es.

When configuring, the energy measurement unit can be selected from the following list: MJ, kWh, Btu.

WARNING:

When changing the unit, the absolute value of the counter E (Es) is not recalculated. The addition volume is then read observing the new measurement unit.

If the instrument performs energy calculations (Hs is activated in the device parameters), the reference conditions must be consistent, i.e.:

- pb, tb to convert the volume V to volume Vb

- p2, t2 for combustion heat to calculate E

Here the rule p2 = pb and t2 = tb is applied. This setting is checked by the service program and does not allow the saving of parameters if the conditions do not match.

The main scheme of energy calculation is shown in Fig. 65.

Combustion Heat H_s (for energy calculation purposes)

The heat conditions t_1 / t_b under which natural gas is sold are prescribed by the Energy Act of each state; t_1 is the reference ambient temperature of combustion, t_b is the reference temperature of V_b of the burned gas.

Note:

E.g. in the Czech Republic according to Energy Act No. 458/2000 Coll. § 98a art.1 letter A and Decree of the Ministry of Industry and Trade No. 108/2011 Coll. (amended 2017) §1 art.3 that the heat of combustion in kWh/m^3 is stated at the reference combustion temperature of 15 ° C.

In order to ensure the correct conversion of the consumed amount of V_b (t_b, p_b) to the energy units it is necessary:

- enter the value of the gross calorific value H_s in the respective units into the device

{the value H_s is usually easily obtained as an output from chromatograph analysis under conditions (t_1, p_1; t_b, p_b) enacted in a particular state (e.g. H_s 15/15 is used in the Czech Republic}

- select the appropriate t_1/t_b conditions from the device menu.

In case of selected methodology AGA8-DETAIL:

- the t_1/t_b conditions are selected.

- the calorific value is not entered (the device calculates it according to ISO 6976 from the specified gas composition). The value of H_s (t_1/t_b) is published after reading "instantaneous values".

For other methodologies, the H_s value must be entered manually.

1. Basic measurement of primary volume

N = number of pulses during measurement period $\rightarrow$ $dV_m = N$ / gasmeter constant (k_p) $\rightarrow$ $V_m = dV_m + V_{m(old)}$

Volume at measuring conditions
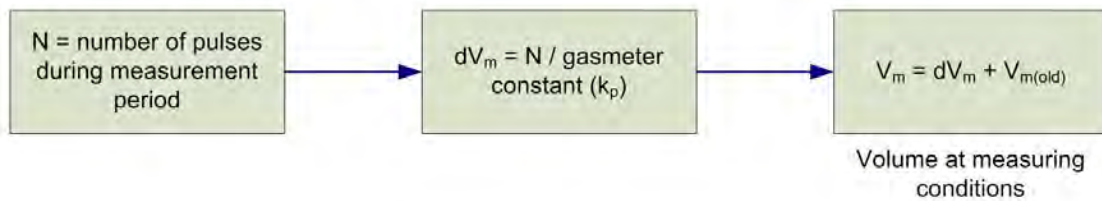
2. Application of gasmeter correction

$Cf = f(Q)$ $\rightarrow$ $dV_c = Cf \times dV_m$ $\rightarrow$ $V_c = dV_c + V_{c(old)}$

Gasmeter correction curve

$dV = dV_c$
or
$dV = dV_m$

Base volume corrected
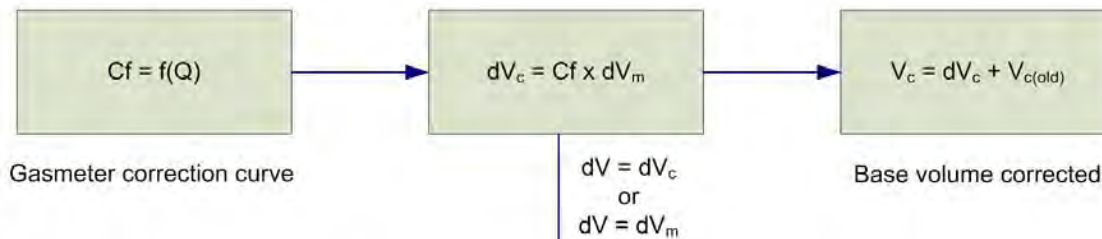
3. Volume correction under standard condition

$Z = f(P,t)$

temperature   presure

$C = (P / P_b) \times (T_b / T) \times (Z_b / Z)$ $\rightarrow$ $dV_b = C \times dV$ $\rightarrow$ $V_b = dV_b + V_{b(old)}$

Conversion factor

Volume at base conditions
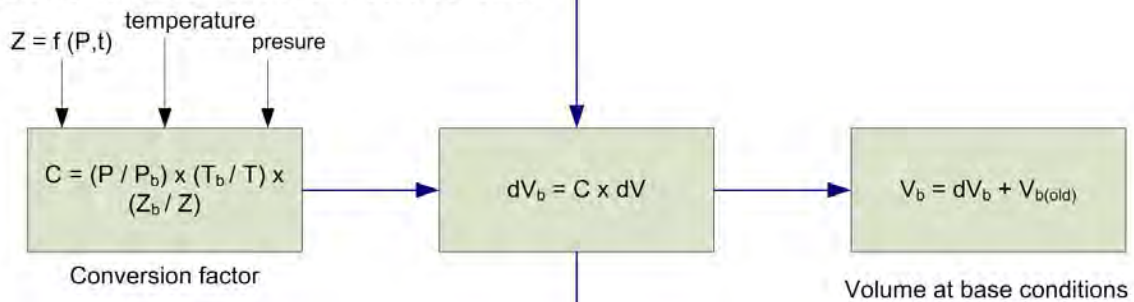
4. Conversion of standard volume onto energy

$H_s = f(p_1,t_1,p_b,t_b)$ $\rightarrow$ $dE = H_s \times dV_b$ $\rightarrow$ $E = dE + E_{(old)}$

Gross calorific value
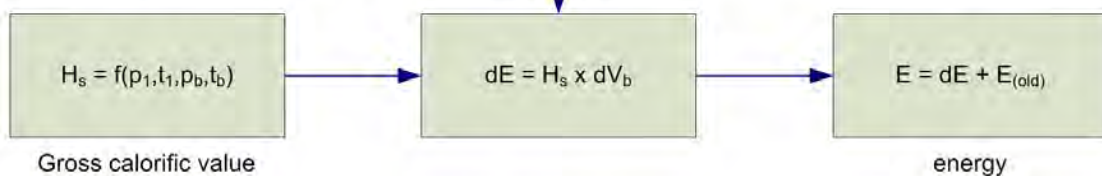
energy

LEGEND:			
C	conversion factor	T	absolute temperature at metering conditions
Cf	correction factor	T_b	absolute temperature at base conditions
dE	incremented energy	V	volume V_m or V_c
dV	adition dV_m or dV_c	V_b	volume at base condition (standardized volume)
dV_b	adition base volume	$V_{b(old)}$	standard volume at the end of previous measurement period
dV_c	adition corrected primary volume	V_c	corrected volume at metering conditions
dV_m	adition primary volume	$V_{c(old)}$	corrected volume at the end of previous measurement period
E	energy	V_m	volume at metering conditions (primary volume)
$E_{(old)}$	energy at the end of previous measurement period	$V_{m(old)}$	primary volume at the end of previous measurement period
Hs	gross calorific value	Z	Gas compressibility factor at metering conditions
P	absolute pressure of gas	Z_b	Gas compressibility factor at base conditions
P_b	absolute pressure at base conditions		
p_1	air pressure in which is defined burning of gas	t_1	air temperature in which is defined burning of gas

Fig. 65 Volume and energy calculations - calculation scheme

8 Metrological Features

8.1 Temperature Measurement

To measure temperature, the device uses the EDT 101 digital transmitter with the PT1000 temperature sensor.

Mechanically, the transducer consists of a sensor in a 5.7 mm stainless steel shank with a length of 50 mm from which the cable is routed. A part of the cable is a plastic cylindrical case with electronics.
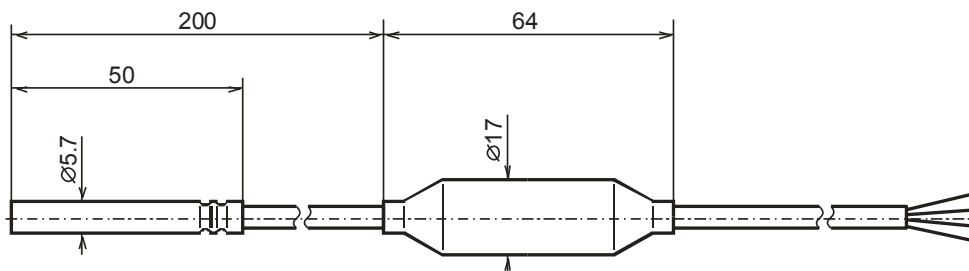
Fig. 66 Transducer dimensions

The temperature is measured using a platinum resistance sensor whose output signal is fed to an analogue-to-digital high-resolution corrector input. After converting to digital, the data is processed by a microprocessor that corrects nonlinearity based on calibration data. The calibration data is stored to EEPROM memory when the transducer is manufactured. The transmitter communicates with the device via the RS485 communication interface.

The temperature measurement range is -25°C to +70°C or -40°C to +70°C. The measurement period is common to both temperature and pressure measurements and can be set by the user from 1s to 30s. The temperature measurement units are selectable by end user.

The temperature sensor replacement is protected by the manufacturer's seal (metrological seal) and can only be performed by an Authorized Service Centre (ASC).

8.2 Pressure Measurement

The pressure is measured using the digital EDT 96 transducer. The transducer includes a piezo-resistive silicon sensor with a durable stainless-steel diaphragm. The device electronics corrects the non-linearity and temperature dependences of the pressure transducer based on the calibration data stored in the transducer memory. The measuring range of the pressure transducer must be specified by the customer when ordering the device. The supplied pressure ranges are specified in Section 3.6.2.

The measurement period is common for both temperature and pressure measurements and can be set by the user within the range from 1s to 30s. The pressure measurement units are adjustable.

The temperature transducer replacement is protected by the manufacturer's seal (metrological seal) and can only be performed by an Authorized Service Centre (ASC).

8.3 Compressibility Calculation

8.3.1 PTZ, TZ Conversion

The compressibility factor K is calculated from the gas composition specified in the parameters

using one of the following methods implemented in the device: AGA NX-19-mod, SGERG-88, AGA8-G1, AGA8-G2, GOST 13390.2, GOST 13390.3 or AGA8-DETAIL. Other quantities also enter into the calculation, especially the reference values of pressure Pb and temperature Tb and the current values of pressure p and temperature t of the gas.

The analysis of the chemical composition of the gas is carried out by chromatographs whose output is also the physical properties of the gas calculated according to ISO 6976 but with the conditions preferred for billing purposes:

- relative density d at temperature t_b and pressure p_b = 101.325 kPa,

- the heat of combustion H_s at t_1/t_b and pressures $p_1 = p_b$ = 101.325 kPa.

That is why a calculator is built into the service SW to calculate the physical properties of gas to the condition required by the methods for calculating the compressibility factor:

- relative density d at temperature t_b = 0°C and pressure p_b = 101.325 kPa,

- the heat of combustion H_s (applied to methods SGERG-88 and AGA8-G1) at a burning temperature of t_1 = 25°C and a pressure p_1 = 101.325 kPa / gas temperature t_b = 0°C and a gas pressure p_b = 101.325 kPa.

Note: in literatures is abbreviated as H_s (25/0)

Calculation of the compressibility factor $K = Z/Z_b$ is performed by each measuring period.

Due to the required accuracy of the device, the use of compressibility calculation methods is limited in terms of pressure and temperature ranges as shown in the following tables Table 20 and Table 21:

Pressure Measurement Range	Method			
	AGA NX-19 mod	SGERG-88	AGA8-G1 AGA8-G2	AGA8-DETAIL
80 ÷ 520 kPa	-25 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
80 ÷ 1000 kPa	N/A	-25 ÷ +70°C	-25 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
80 ÷ 2000 kPa	N/A	-25 ÷ +70°C	-25 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
200 ÷ 1000 kPa	N/A	-25 ÷ +70°C	-25 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
400 ÷ 2000 kPa	N/A	-25 ÷ +70°C	-25 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
400 ÷ 7000 kPa	N/A	-10÷ +70°C	-10÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
700 ÷ 3500 kPa	N/A	-10 ÷ +70°C	-10 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
1400 ÷ 7000 kPa	N/A	-10 ÷ +70°C	-10 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C
2500 ÷ 13000 kPa	N/A	-10 ÷ +70°C	-10 ÷ +70°C	-25 ÷ +70°C, optional -40 ÷ +70°C

Table 20 Limitation of standard applicability given by limitation in compressibility calculation (AGA, SGERG)

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Pressure Measurement Range	Method	
	GOST 13390.2	GOST 13390.3
100 ÷ 520 kPa	-23,15 ÷ +70 °C	-23,15 ÷ +70 °C
100 ÷ 1000 kPa	-23,15 ÷ +70 °C	-23,15 ÷ +70 °C
100 ÷ 2000 kPa	-23,15 ÷ +70 °C	-23,15 ÷ +70 °C
200 ÷ 1000 kPa	-23,15 ÷ +70 °C	-23,15 ÷ +70 °C
400 ÷ 2000 kPa	-23,15 ÷ +70 °C	-23,15 ÷ +70 °C
400 ÷ 7000 kPa	-10 ÷ +70 °C	-23,15 ÷ +70 °C
700 ÷ 3500 kPa	-10 ÷ +70 °C	-23,15 ÷ +70 °C
1400 ÷ 7000 kPa	-10 ÷ +70 °C	-23,15 ÷ +70 °C
2500 ÷ 13000 kPa	Not applicable	-23,15 ÷ +70 °C

Table 21 Limitation of ranges applicability given by limitation in compressibility calculation (GOST)

8.3.1.1 **Substitute Compressibility**

For the selected method, it is checked at every calculation whether the measured value of pressure and temperature is within the range of the method validity. If a value is outside of this range, substitute compressibility K is used for the conversion. The substitute compressibility value must be entered by the user when configuring the device Fig. 67.
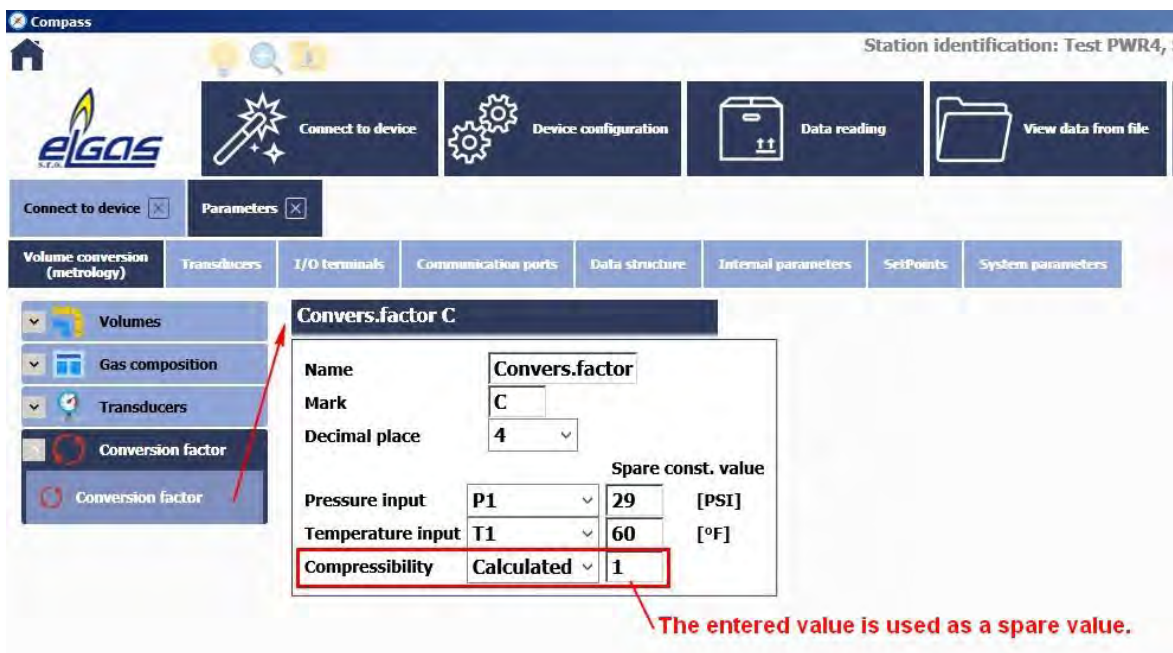
Fig. 67 Setting the substitute compressibility value K for calculating C (SW Compass)

8.3.2 PT, T Conversion

If it is required to set the device as PT or T corrector, then the device does not calculate gas compressibility, but a fixed constant value is used as the degree of compressibility K to calculate the conversion number K. The constant value of the degree of compressibility K is set in the device parameters for parameter C (Fig. 67). For the value "Compressibility" it is necessary to set

instead of "calculated" to "Constant value". The range of the constant entered is not limited.
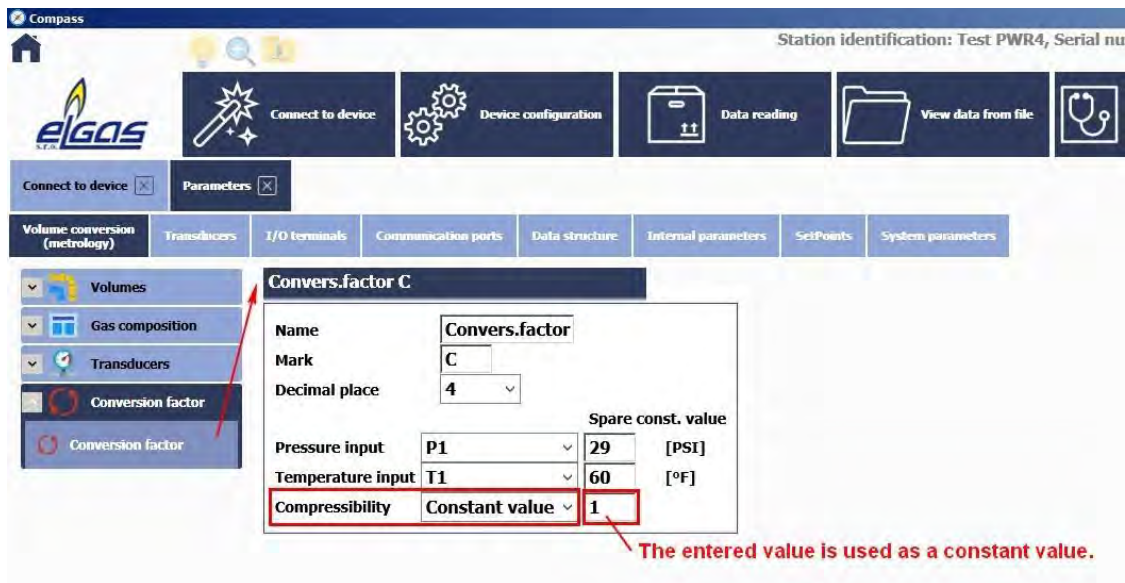
Fig. 68 Setting the constant compressibility value for calculating C (SW Compass)

8.4 Volumes Measurement and Calculation

To measure and calculate volumes, the following counters are used for each channel in the device:

V_m	-	Volume counter under the measurement conditions (primary volume)
V_c	-	Corrected volume under the measurement conditions (volume corrected based on the correction profile of the meter)
V	-	Volume V_m or V_c
Vs	-	Operating volume counter at error conditions (substitute primary volume)
Vb	-	Volume counter at base conditions
Vbs	-	Base volume counter at error conditions

8.4.1 Calculation of conversion number C for volume conversion

As stated in paragraph 7.9.1, the following relation applies to the calculation of volume under basic conditions:

$$V_b = V * C$$

The following applies to the conversion number:

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

The conversion number C depends on the degree of compressibility of the gas K, the reference conditions (pb, Tb), the gas pressure p and the gas temperature t.

8.4.1.1 Gas pressure - measured or fixed value

By default, the measured value of the gas pressure p in the pipeline by the pressure sensor is used to calculate C. In some special cases, instead of the measured pressure value, the value entered into the device as a constant when configuring the device can be used for the calculation. Then we talk about a substitute or constant value of pressure.

Substitute pressure value ps

This value is used automatically instead of the measured value of gas pressure if the so-called error conditions occur, i.e. in the following cases:

- the measured gas pressure is outside the measuring range, or
- an error has occurred and the measured gas pressure value is not available:

Constant pressure value p

The constant pressure value is used if the device is not equipped with a gas pressure transducer. The use of a constant value must be set manually in the device parameters.

Setting of substitute and constant pressure value

The substitute pressure value ps and the constant pressure value p are in fact the only common value entered in the instrument parameters. If it is to be used as a constant value, it is necessary to select a constant value for the pressure parameter on the parameter card C instead of the measured value P. The size of the spare, resp. constant pressure is entered in the field "Spare const.value". The set value should be as close as possible to the real value of the gas pressure in the pipeline.

Fig. 69 Setting the replacement pressure value (Compass SW)

Fig. 70 Constant pressure value setting (SW Compass)

The size of the substitute value can be changed by the user after turning the service switch to the ON position. Switching measured value p / constant value is protected by a metrological switch.

8.4.1.2 Gas temperature - measured or fixed value

By default, the measured value of the gas temperature t in the pipeline by the temperature sensor is used to calculate C. In some special cases, instead of the measured temperature value, the value that is entered into the device as a constant when configuring the device can be used for the calculation. Then we talk about a substitute or constant value of temperature.

Substitute temperature value ts (Ts)

This value is used instead of the measured value of the gas temperature automatically if the so-called error conditions occur, i.e. in the following cases:

- the measured gas temperature is outside the measuring range, or
- an error has occurred and the measured gas temperature value is not available

Constant temperature value t (T)

The constant temperature value is used if the instrument is not equipped with a transmitter for measuring the gas temperature. The use of a constant value must be set manually in the device parameters.

Note:

This option is not allowed if the instrument is delivered as a specified meter according to MID approval (certificate TCM143 / 18-5562).

Setting of substitute and constant temperature value

The substitute temperature value ts (Ts) and the constant temperature value t (T) are in fact one single common value entered in the instrument parameters. If it is to be used as a constant value, it is necessary to select a constant value for the temperature parameter on the parameter card C instead of the measured value p. Spare size, resp. constant temperature is entered in the field

"Spare const.value". The set value should be as close as possible to the real value of the gas temperature in the pipeline.
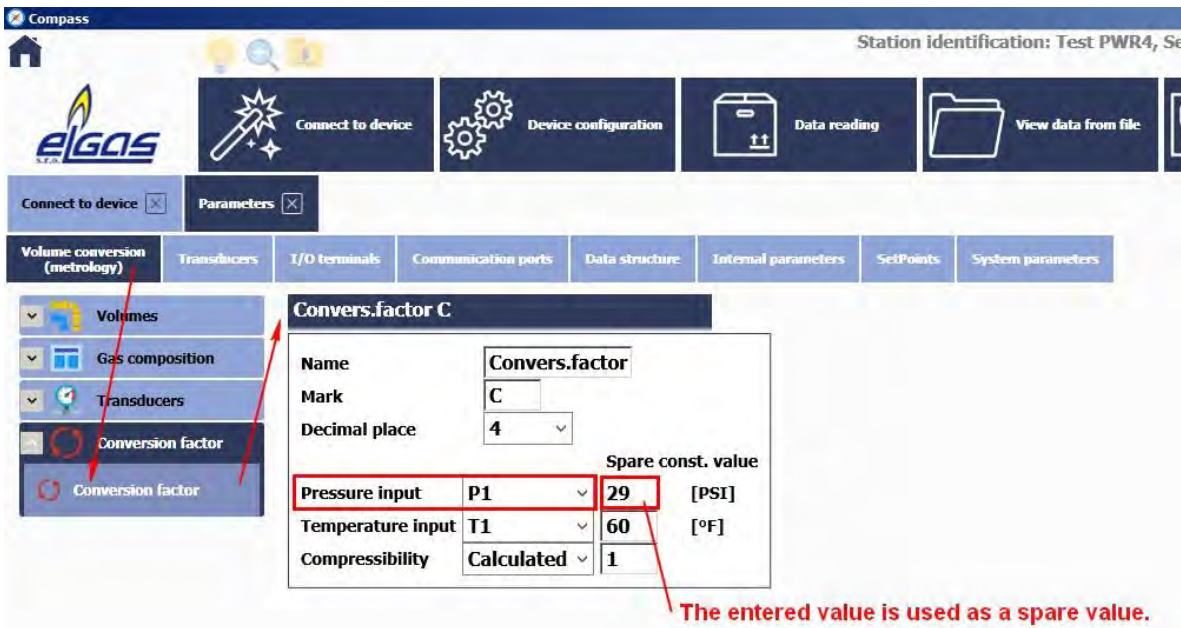

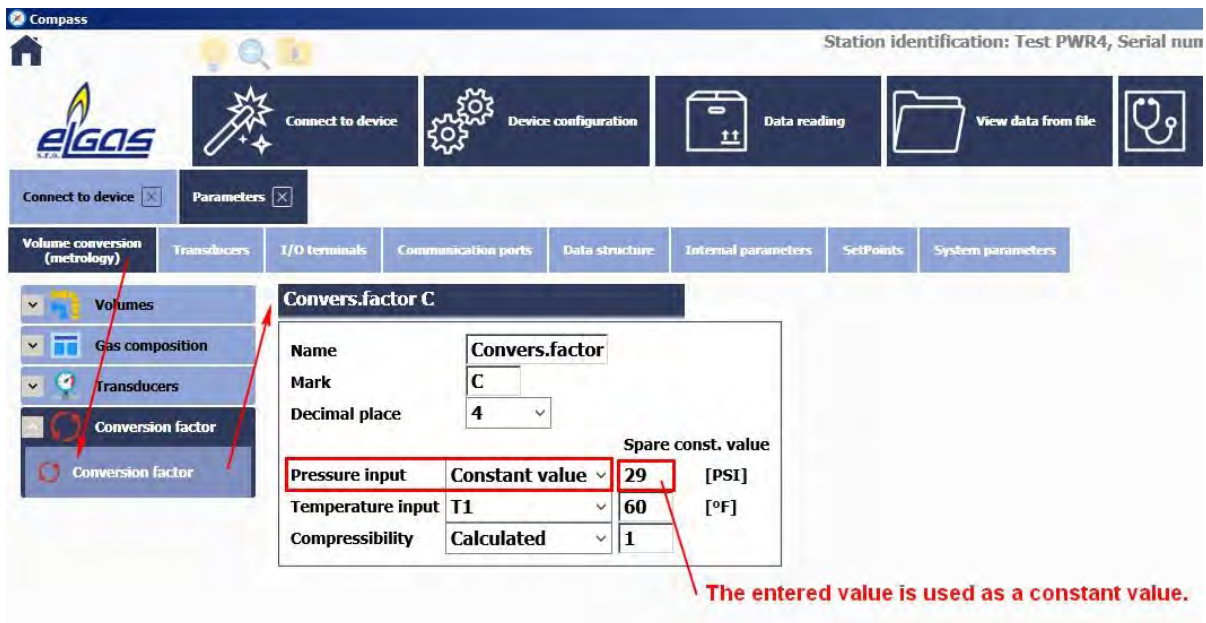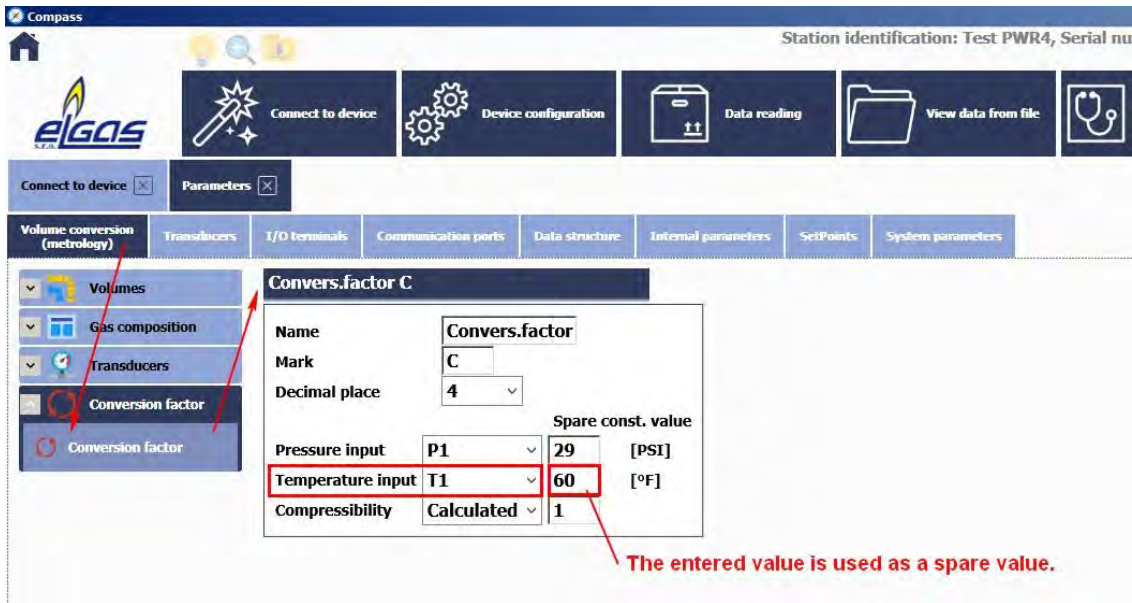*Fig. 71 Setting the replacement temperature value (SW Compass)*
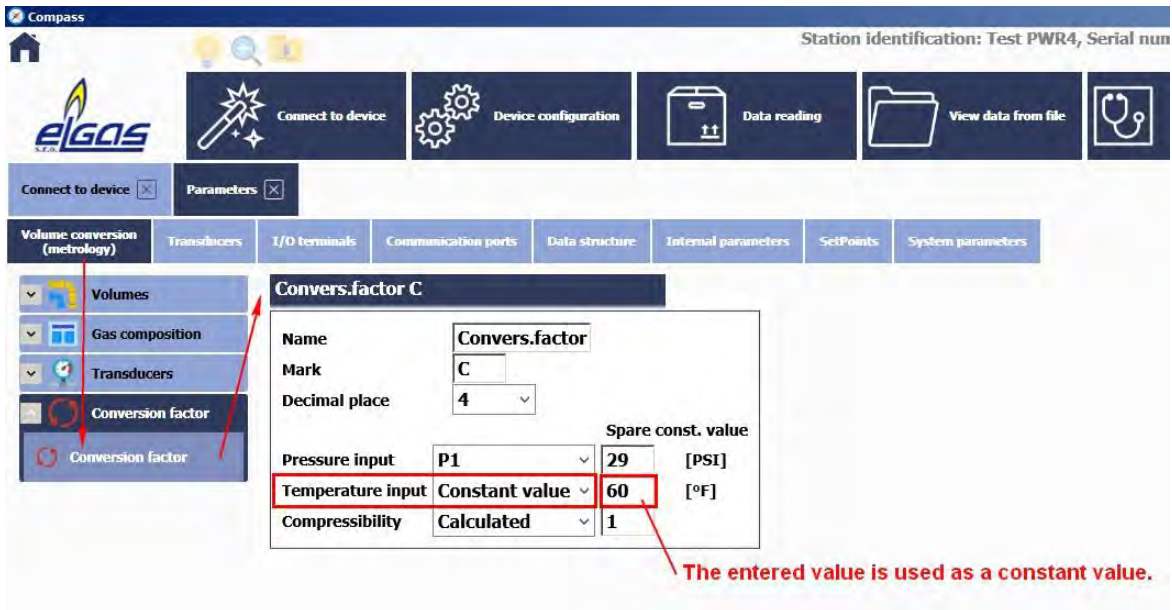
Fig. 72 Setting a constant temperature value (SW Compass)

The size of the substitute value can be changed by the user after turning the service switch to the ON position. Switching measured value t / constant value is protected by a metrological switch.

8.4.2 Activities at Error Conditions Occurrence

In the event of error conditions, along counting the pulses into the volume counter at the measurement conditions (V), the device starts to count the pulses into the volume counter at the base conditions (V_b). The volume values at the basic conditions (V_b) cease to be counted in the

volume counter at the basic conditions (V_b) and start to be calculated from substitute pressure or temperature values and stored in the substitute volume counter at basic conditions (V_{bs}). Under this condition, the values are not stored in the volume counter at the basic conditions (V_b).

The device error condition occurs in these cases:

1. the measured gas pressure is outside the measuring range - a substitute pressure value ps is used to calculate the conversion number C, or

2. the value of the measured gas pressure is not available - an alternative pressure value ps is used to calculate the conversion number C (e.g. in case of a sensor error), or

3. the measured gas temperature is outside the measuring range - a substitute temperature value ts is used to calculate the conversion number C, or

4. the value of the measured gas temperature is not available - an alternative temperature value ts is used to calculate the conversion number C (e.g. in case of a sensor error), or

5. If, during the calculation of the volume under the basic conditions, the measured value "p" or "t" deviates from the scope for the set calculation standard outside the permitted value (see paragraph 8.3.1 and Table 20, Table 21), and at the same time "p" or "t" are not outside the measuring range, so the substitute compressibility "C" will be used for the calculation.
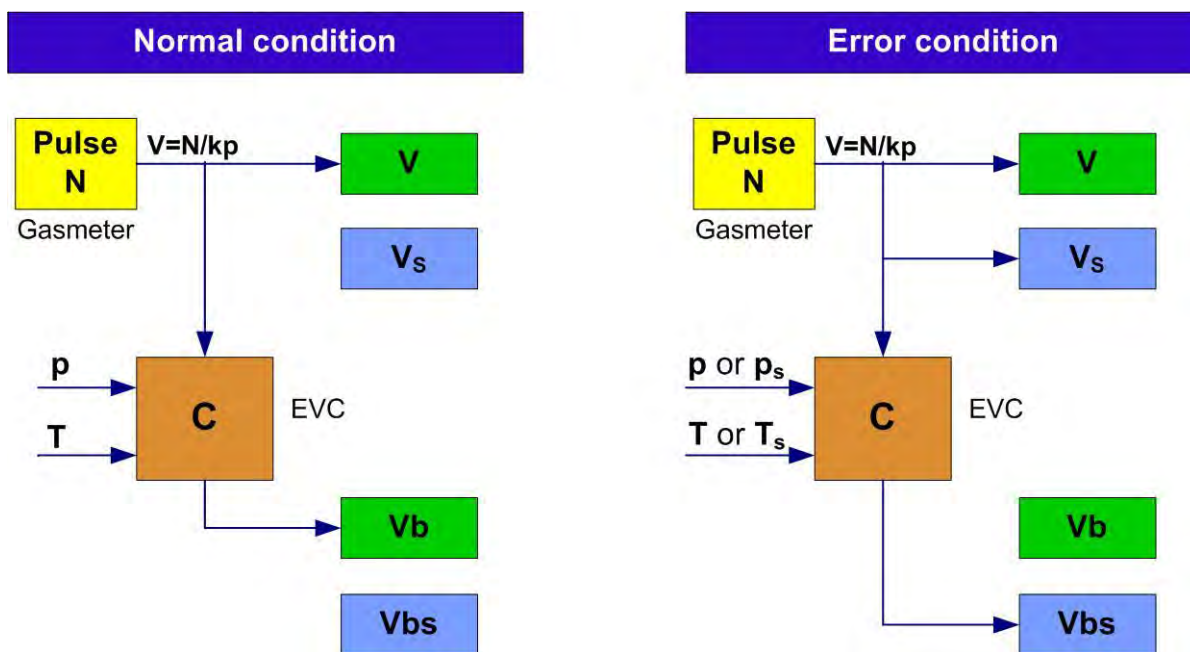
Symbol		Meaning
N	-	Pulses from the meter
kp	-	Gas meter constant [pulse/m3]
p	-	Measured gas pressure
T	-	Measured gas temperature
ps	-	Substitute gas pressure
Ts	-	Substitute gas temperature
V	-	Volume counter at measurement conditions (primary volume)

Vs	-	Primary volume counter at error conditions (substitute primary volume)
Vb	-	Volume counter at base conditions (corrected volume)
Vbs	-	Base volume counter at error conditions (substitute corrected volume)

Fig. 73 Storing volumes in the counters in error-free and error-free condition

If the substitute compressibility is used in the calculation because of accuracy deviation outside the value permitted under the selected calculation standard, while neither p and t are outside the measuring range, the converted volume is stored in the spare counter.

If the corrected volume V_c is used, the primary volume counter at error conditions V_c can be related to V_m or V_c.

8.4.3 Respecting the Change of the Gas Flow Direction in the Gas Meter

A gas meter equipped with two phase-shifted LF rotary sensors allows detecting the flow direction of the gas, which is the case of e.g. the ELCOR*plus Indexer*.

When detecting the gas flow directing while respecting the change of direction, the corrector processes data from the meter in the following way (Fig. 74):

- If the primary volume V_m addition is positive, the volume is processed following the standard procedure (i.e. the increasing the values of counters V_m and V_b, or V_{ms} and V_{bs})

- If the direction of rotation of the meter is changed, the device remembers the reading of the primary volume counter V_m (gas meter reading) at which the gas flow direction has been reversed. If gas flows back, only the value of the primary counter V_m (and $V_{ms,}$ if applicable) is updated. All the other counters do not change the reading.

- After changing the direction, the related counters (V_b, V_{bs}) start to count the additions again (only after the state at which the flow was reversed has been restored). The primary volume counter constantly copies the status of the meter.

Volume counter

V_b (V_{bs})

V_m (V_{ms})

V_m status when reverse flow occurs

time

Reverse flow of gasmeter
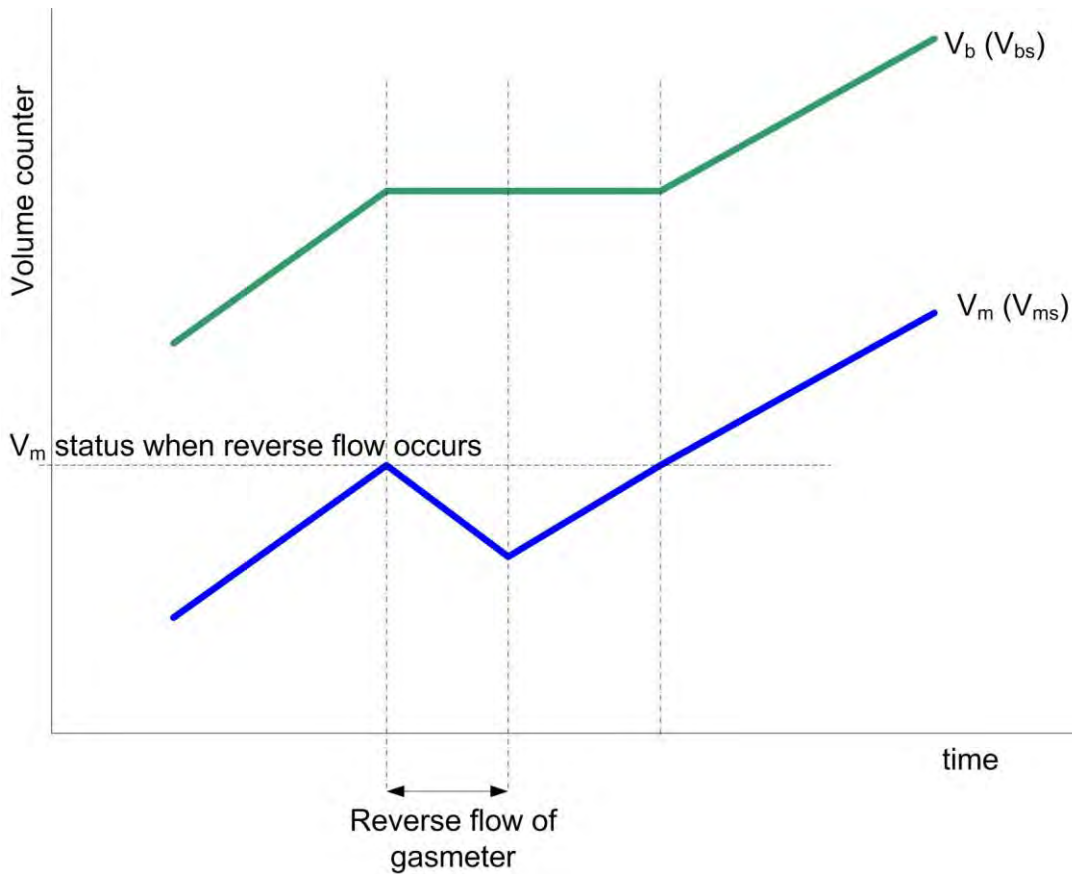
Fig. 74 Processing the volumes at the gas meter revers rotation

Note:

If the instrument is set to respect the change of gas flow direction through the gas meter, it is possible to switch on the counter in the instrument parameters, in which the amount of gas flow is stored during the gas meter return.

9 Connecting Inputs

Three digital inputs can be connected to the **ELCOR** device, marked as DI1 to DI3. The **ELCOR*plus*** has 4 digital inputs in the basic version, marked DI1 to DI4. Other inputs can be added to the device via plug-in modules.

Digital inputs can be set by the utility SW as binary or LF pulse. The electrical connection of the meters is described in Section 5.6.2.

ELCOR

Inputs	Module	Terminals	Pulses	Indication of the gas meter rotation direction	Binary	Encoder
Digital inputs	Basic design	DI1	LF	LF direction	✓	---
		DI3	---		✓	---
		DI2	LF	---	✓	---
	S0-NAM		---	---	---	NAMUR
	S0-SCR		---	---	---	SCR

Table 22 Options of digital inputs for the ELCOR device

Notes:

1) S0-EXT1 extension module cannot be used for the ELCOR device
2) Without 4-20 mA analogue input option

ELCOR*plus*

Inputs	Module	Terminals	Pulses	Indication of the gas meter rotation direction	Binary	Encoder
Digital input	Basic design	DI1	LF	LF direction	✓	---
		DI4	---		✓	---
		DI2	LF	---	✓	---
		DI3	LF	---	✓	---
	S0-EXT1	DI1	HF (NAMUR)	HF direction	✓ NAMUR	NAMUR
		DI2	HF (NAMUR)		✓ NAMUR	NAMUR
		DI3	LF	LF direction	✓	---
		DI6	LF		✓	---
		DI4	LF	LF direction	✓	---
		DI7	LF		✓	---
		DI5	LF	LF direction	✓	---
		DI8	LF		✓	---
	S0-EXT1/HF	DI1	HF (NAMUR)	HF direction	✓ NAMUR	NAMUR
		DI2	HF (NAMUR)		✓ NAMUR	NAMUR
	S0-NAM		---	---	---	NAMUR
	S0-SCR		---	---	---	SCR

Table 23 Options of digital inputs for the ELCORplus device

> ⚠️ **NOTICE!**
>
> If the **S0-EXT1 module** is installed in the device, while no HF input of this module is used and the device is powered only by the battery (no external power supply is used), it is necessary to **deactivate the HF inputs of this module** (service SW [42], [43]). Otherwise, the power supply will be quickly discharged due to the higher current consumption of the module.

Input	Module	Terminals	Mounting options
4-20 mA analogue	S0-EXT1	AI1	SLOT 0
		AI2	
4-20 mA analogue	S1-2AI	AI1	SLOT 1
		AI2	SLOT 2

Table 24 Options of analogue inputs for the ELCORplus device
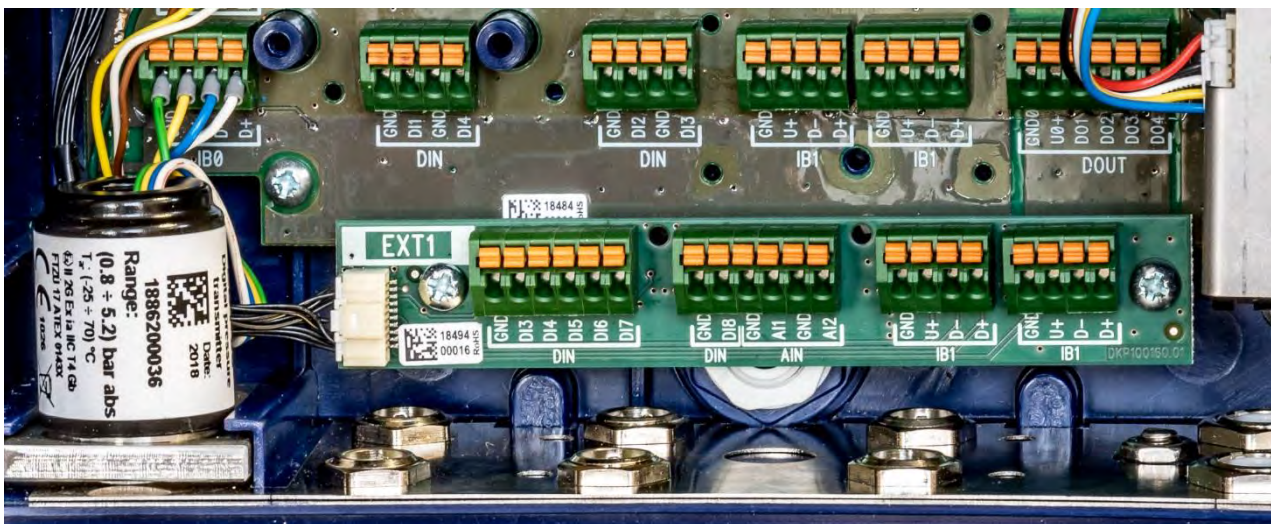
Fig. 75 EXT1-T add-on terminal board for S0-EXT1 module

ELCOR*plus indexer*

In the ELCORplus Indexer, the module of S0-MIE mechanical indexer interface is permanently fitted in the SLOT 0 position.

Inputs	Module	Terminals	Pulses	Indication of the gas meter rotation direction	Binary	Encoder
Digital input	(Basic design)	DI1	LF	LF direction	✓	---
		DI4	---		✓	---
		DI2	LF	---	✓	---
		DI3	LF	---	✓	---

Table 25 Options of digital inputs for the ELCORplus Indexer device

Input	Module	Terminals	Mounting options
4-20 mA analogue	S1-2AI	AI1	SLOT 1
		AI2	SLOT 2

Table 26 Options of analogue inputs for the ELCORplus Indexer device

9.1 LF Pulse Inputs

There are used to count pulses from the gas meter. For these inputs, flow measurement function can be selected. The backup battery ensures that the counter readings and the LF input pulses count are maintained even when the battery is discharged or replaced. After the power supply connecting, the impulses read during the voltage outage of the supply battery are added to the spare counters.

Changing the Measurement Units, Setting the Gas Meter Constant

Pulse input measurement units can be changed by the utility SW [42], [43]. The gas meter conversion constant and the gas meter serial number can be set using both the utility SW and the device keypad. When setting the gas meter constant value, only decimal multiples or fractions within the range of 0.001 to 1000 should be used.

9.2 Binary Inputs

These inputs are used to scan the input signals with the possibility to detect the state "closed" (i.e. log 0) or "open" (log 1). The device allows to evaluate binary inputs from potential-free outputs (reed contact or open collector).

By setting the parameters, the user can select the displayed actual values, save changes to these entries in the archive, the displayed message for log. 0 and log. 1 statuses and the active signal level.

9.3 HF Pulse Inputs (NAMUR)

These inputs are available on ELCOR*plus* with S0-EXT1 module. For these inputs, flow measurement function can be selected. The backup battery ensures that the counter readings are maintained when the external power supply fails even when the main battery is discharged or replaced, but it does not provide for pulse counting in this case.

Changing the Measurement Units, Setting the Gas Meter Constant

Pulse input and gas meter measurement units can be changed by the utility SW. The gas meter constant and gas meter serial number can also be set from the device keypad.

9.4 Connecting a Gas Meter with an Encoder

A gas meter equipped with an encoder can be connected to the corrector. The meter counter reading is transferred to the corrector in digital form. To connect an encoder, it is necessary to install the module into SLOT 0 according to the type of encoder. Two types of encoders, a NAMUR encoder and an SCR encoder, are supported.

The use of both types of encoders is metrologically approved by EC Type Certificate TCM 143/18-5562.

The corrector is connected with the encoder by a shielded two-wire cable. The electrical connection of the encoders with the device is described in Section 5.6.2.5. When making the connection, the signal polarity must be respected.

The encoder data is transmitted to the corrector in the measurement frequency. Setting a short measurement frequency shortens the battery life. Section 7.5.1 shows the battery life when using encoders.

The period of reading the data from the gas meter encoder connected to the instrument by means of an add-on module located in the SLOT 0 position is limited according to the type of encoder and the type of module used:

encoder type	module (SLOT 0)	reading period
SCR+	S0-SCR	10 s ÷ 1 hour
NAMUR	S0-NAM	1 min ÷ 1 hour
	S0-EXT1, S0-EXT1/HF	10 s ÷ 1 hour

Table 27 Encoders – limitation of reading period

9.4.1 Device Specifics when using the Encoders

When the encoder is connected, the data communication with the corrector takes place on a two-wire cable. In addition to transferring the absolute value of the gas meter counter reading, additional information from the meter can be transmitted (serial number, gas meter constant, number of nines to reverse the counters, etc.). This additional information is downloaded by the control firmware of *the corrector and used to parameterize the device.*

If there is a communication error between the corrector and the encoder, then:

- The "*" flag (asterisk) shows on the display of the corrector at the actual primary volume value.
- If the communication error lasts for more than 10 minutes, the volume difference is added to the counter after the communication has been restored.

The manual setting of the primary volume V_m value is blocked for inputs connected to an encoder.

9.4.2 Gas Meter Installing and Replacing

When the gas meter is connected to the corrector, the current reading of the meter is transferred to the corrector, i.e. the state Vm may change abruptly. In order that this abrupt change is not falsely reflected in the converted volume Vb (Vbs), the following procedure should be followed:

- In the utility SW [42], [43] running on the PC, display the device parameters, select the "SCR Encoder" object and press the "Encoder Replacement" button. During the exchange of the encoder, the processing of volume from the meter will be stopped. (You also need to follow the instructions displayed on the PC screen).
- Connect the encoder physically to the corrector.
- After connecting the encoder, complete the installation/replacement with the OK button.

During the installation/replacement (i.e. from point 1), no increments are added to the related counters, and the corresponding counter is marked with an exclamation mark on the display. If point 3 of this procedure is not performed within one hour of the start of the replacement, the replacement mode will automatically be terminated in the utility program.

10 Communication with the Device

In order to communicate with other instruments, the device is equipped with several communication devices:

	ELCOR DATCOM	ELCORplus DATCOMplus	ELCORplus Indexer
Optical interface for IR head	1	1	1
RS232/RS485 integrated communication line	1	-----	-----
RS232/RS485 communication line, module S1-COM1	-----	2	2
RS232 communication line, module S4-COM0	1	1	1
Internal modem	1 **)	1 **)	1 **)

**) Using plug-in internal M2G or M4G modem

Table 28 Communication options of the devices (max. possibilities)

The table specifies the maximum numbers of communication interfaces for the plug-in modules. An external modem can be connected to RS232 communication lines (for details see 10.3.1)

---

i The devices can operate up to two modems.

A combination of 1 internal modem and 1 external modem is allowed, or 2 external modems connected to RS232 communication lines can be used.

---

i All listed communication interfaces work independently and communication on them can take place simultaneously and with the same priority.

Different communication speeds and different communication protocols can be set for each interface.

EX **ATTENTION!**

Signals on all RS232/RS485 communication terminals of the device are intrinsically safe. Common communication devices connected to the device must be connected via a suitable communication barrier (B-RS).

The recommended wiring diagram is shown in Section 5.6.7.

The speed settings and communication protocol type for each interface can show on the device

display. It is also possible to change the setting from the device keypad (see 6.7).

The internal modems are supplied in the following versions:

Designation	Description	Battery type	Note
1. Modems for 2nd generation networks (2G)			
M2G	Data transfer in GSM or GPRS mode	HB-03, HB-03D	
2. Modems for 4th generation networks (4G)			
M4G, LTE-Cat1E	LTE cat. 1, European design	HB-04	
M4G, LTE-Cat1US	LTE cat. 1, European design	HB-04	
M4G, LTE-CatM1US	LTE-M1, European design	HB-04	
M4G, LTE-CatNB	LTE-NB, European design	HB-04	in progress

Baud rate setting ranges

	Baud rate
Optical interface for IR head	2 400 Bd ÷ 115 200 Bd
Internal modem (Baud rate between the device and the modem)	2 400 Bd ÷ 115 200 Bd
RS232/RS485 communication line	2 400 Bd ÷ 115 200 Bd

In the current firmware version, the device is equipped with several communication protocols. The device is extendable by additional protocols according to customer requirements. By default, the following protocols are implemented:

- ELGAS ver. 2,
- MODBUS RTU
- MODBUS TCP
- MODBUS IGD
- M900
- GAZ MODEM

(other communication protocols are being prepared)

When using MODBUS protocols, a map of the MODBUS registers must be loaded to the device. The map assigns the numeric addresses to the measured and calculated quantities stored in the internal memory of the device. The Modbus map can be uploaded to the device by user-operated SW [43].

The ELGAS protocol ver. 2 is the native protocol of the device. A complete set of features implemented in the device is available. The utility SW [43], [42] uses this protocol only; to switch to another data link layer, the ELGAS version 2 protocol is just nested in another data link layer (the tunnel). Only the ELGAS version 2 and CTR protocols can be used to download the firmware (protected by a metrological seal).

If **MODBUS protocol**s are used, the MODBUS register map must be uploaded to the device. The map assigns numerical addresses to an individual measured and calculated quantities stored in the internal memory of the device. The Modbus map can be loaded into the device by the user service SW [43].

Device addressing

The communication protocols used to use so-called addresses for communication with the

device, which must be set in each device. The address of each device must be set in the device parameters. The device address can be set either from the device keyboard (section 6.7), or using the service SW [42], [43].

The device address consists of two parts, in the parameters labeled Network address1 and Network address2. If more than one device is connected to the communication line, the addresses must be set so that no collision occurs.

The ELGAS communication protocol uses both parts of the address, the MODBUS communication protocol uses only Address1.

Setting the range of the communication address (network address) of the device		
	Address1	Address2
Communication protocol ELGAS	0 – 65 535	0 – 255
Communication protocol MODBUS *)	10 - 247	not used

*) communication addresses 1 to 9 are reserved for the internal parts of the device

Table 29 Setting range of device communication addresses

10.1   EN 62056-21 (IEC-1107) Optical Interface

In the front cover of the enclosure there is a port for communication via the optical head. The optical head is placed to the port and secured with a magnet. An HIE-04 with USB connection to the PC (or HIE 03 with RS232 interface) can be used as an optical head. When the optical head is attached, the machine switches from the standby mode into a mode that allows for data receiving. Depending on the device setting, the device remains in this state either until the attached optical head is removed from the communication interface or until the set time limit since the last communication expires (timeout within 1 to 255 seconds) since the last communication expires. The size of the set timeout can be read and changed using the parameter "Deactivate IR head after[s]" (in SW TELVES [43] on the Service parameters tab, in SW COMPASS [42] in Pro settings, menu Parameters-> General-> Other).

10.2   Modules of the Internal Modems

The device contains a build-in antenna of the integrated M2G, M4G modem. If the signal is weak at the installation site, an external antenna may be used. In this case, however, it is necessary to order a special HF cable adapter from the manufacturer to connect the external antenna. The HF cable reducer is installed as described in v Section 7.7.2.

Using the utility SW [43], [42], the M2G modem can be set to one of the following modes:

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

Data transfer can be initiated either by the dispatcher station calling the device (PULL) or by the device calling the dispatcher station (PUSH).

The minimum recommended RSSI value for GPRS communication is -85 dBm (i.e. 45%). Below

this value, the device displays error number 10 (see Section 6.8.3, Table 13).

Note on the SIM Card

The modem requires a SIM card in order it can be operated. The SIM card is not supplied with the device. The internal modem allows data transfer both in dial-up (CSD) mode - i.e. data transfer to GSM, and in GPRS or LTE mode. The SIM card for the given data transfer mode must be provided to the user with his mobile operator.

For dial-up connection (CSD), the mobile operator must be required to activate the data transfer on the SIM card. Data transfer activation is, of course, required even for GPRS data transfer.

Basic information about the modem connection and signal strength is shown on the device display with icons (see Table 11). In addition, some additional information on the modem current status can be displayed. This screen can be accessed from the device keypad by selecting SYSTEM DATA-> Communication. The following information can be displayed (for details, refer to Section 6.8.3):

- The numerical code of the last error of the modem and the time of its occurrence. The numerical codes of errors and their meanings are shown in Table 13 .
- For the GPRS mode, the assigned current IP address
- Signal strength (in%) at the installation site

In addition, the keypad can be used, when needed, (especially for service purposes) to:
- Turn on the power of the GSM/GPRS modem,
- Initialize GSM/GPRS calls from the device to the master system (if this call option is set in the device parameters),
- Send SMS

10.3 Connecting communication devices via RS232 interface

In terms of data transmission, we distinguish two types of devices, DTE - Data Terminal Equipment and DCE - Data Communication Equipment.

Both ELCOR and ELCOR*plus* are DTE devices.

Depending on whether a device of the same type (i.e. DTE) or a DCE-type device is used, either a crossover or a direct link cable is used. For example, a PC is a DTE device, a modem is a DCE device.

Generally (RS232):
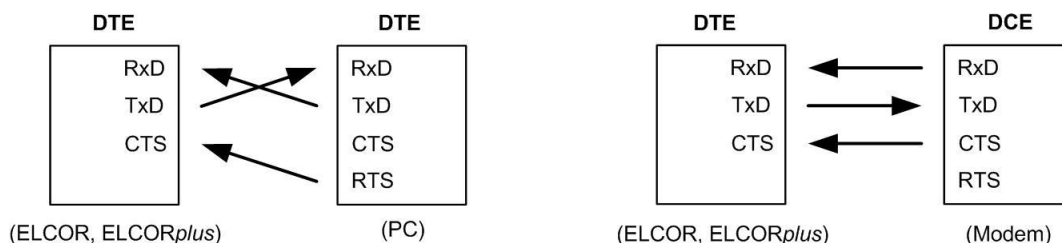
In case of ELCOR, ELCOR*plus* is connected via external module B-RS, B-RS/A. This communication module includes an internal signal crossing. Therefore, connecting to a PC and modem will look like this:
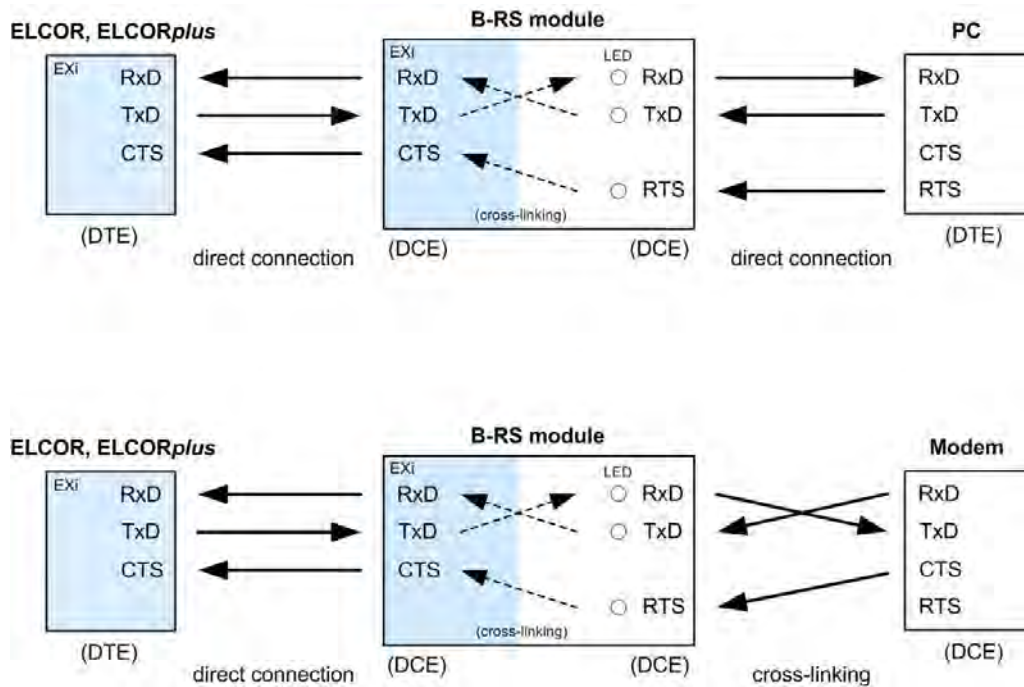
Fig. 76 Principle of connection with PC and external modem via module B-RS

10.3.1 Connecting an external modem

An external modem with RS232 communication interface can be connected to the device.

For the ELCOR, the external modem is connected either to the terminals of the RS232 communication interface on the I/O board or to the S4-COM0 module. In this case, the S4-COM0 module is installed in the device in a position where the M2G or M4G internal modem is normally fitted.

For the ELCOR*plus* and ELCOR*plus* indexer, the external modem can be connected either to the S1-COM1 module, which must be located in the SLOT1 position, or to the S4-COM0 module, which must be installed in the SLOT 4 position.

Note: If S4-COM0 (SLOT 4) is used, the internal modem in SLOT 5 cannot be used.

In any case, the external modem must be connected to the device via an intrinsically safe barrier (module B-RS, or MTL5051).

If the connected modem allows it, you can use the service SW [42], [43] to set the parameters of the external modem communication similarly to the internal modem (see par. 0).

10.4 Encrypting Data when Communicating with the Master System

This optional feature is implemented in the ELGAS version 2 and CTR protocols. For this purpose, the device contains cryptographic keys. Symmetric AES encryption with a key length of 128 bits is used. In addition, the packet of transmitted data includes the type of encryption key and the control signature. Thanks to this signature, the authenticity of the key can be confirmed, and consequently, the use of the decrypted data permitted. In case of incorrect decryption, the counterpart is informed by means of a standard error response. Modifying keys is only possible with highest security level. The keys from an unencrypted packet cannot be accepted.

The implemented protocols include the option to block the device response if an unencrypted packet has been queried. In the case of such a query, the device responds with a standard error

packet.

11 Function Description

The device offers highly variable and user-configurable options for displaying of values and storing the quantities. The user can decide which quantities to display as actual values and which quantities should be stored in the archives.

11.1 Quantities Designation

The quantities are designated using the symbols shown in the table "Symbols and Terms" (see page 1).

Quantities Designation

- The designations of the metrological quantities in the single channel device do not include an index (Index 1 or 2 is used with dual channel devices.)

- For other quantities (non-metrological), index can be used to distinguish the quantities of the same type.

User Designation of Quantities

- This new feature allows the user to define customized designations of quantities. The original quantities designation then serves as the default designation (shown in blue in the utility program [43]). The quantities designation must be chosen in such a way as to preserve the uniqueness of the designation. The uniqueness of the designation is checked by the utility program.

- The designation of metrological quantities can only be changed at ASC level.

- The user-defined quantities designation is used for display purposes both in the device and in the utility program and can be exported to be used in third-party software.

11.2 Actual Values

For the displayed quantities, the number of displayed digits, the units, and the displayed name are user-customizable. If the measured quantity is in an error state, this state is indicated by the asterisk at the last position in the quantity designation row.

Example of quantities that can be displayed as actual values:

- Pressure p1, p2
- Temperature t1, t2
- Primary volume Vm1, Vm2
- Substitute primary volume Vs1, Vs2
- Corrected volume Vb1, Vb2
- Substitute corrected volume Vbs1, Vbs2
- Energy E1, E2
- Primary flow rate Q1, Q2
- Corrected flow rate Qb1, Qb2
- Conversion factor C1, C2
- Compressibility factor K1, K2
- Device error
- External power supply
- Battery capacity
- Internal temperature

11.3 Archives

The values in the archives are ordered in time slots. Each time slot includes the time data of the slot and the values of the quantities selected for archiving.

The measured and computed quantity values can be stored in the following archives:

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

Besides these data archives, the device contains the following additional archives:

- Status archive
- Billing archive
- Settings archive
- Gas composition archive

The archives with a fixed number of records (monthly, daily, binary, and limit) are stored at the beginning of the available memory of the device, and in the remaining memory, data archive is stored in (with the length depending on the size of the remaining memory).

	Data archive	Daily archive	Monthly archive	Limit archive	Binary archive
Analogue quantities					
Analogue input - mean value	yes	yes	yes		
Analogue internal - mean value	yes	yes	yes		
Analogue output - mean value	yes	yes	yes		
Minimum/maximum	yes	yes		yes [2]	
Pulse quantities, flow rate measurement					
Primary volume - absolute state	yes	yes	yes		
Corrected volume - absolute state	yes	yes	yes		
Substitute primary volume – absolute state	yes	yes	yes		
Substitute corrected volume - absolute state	yes	yes	yes		
Max. daily consumption - primary volume			yes [1]		
Max. daily consumption - corrected volume			yes [1]		
Max. hourly consumption - primary volume		yes [1]	yes [1]		
Max. hourly consumption - corrected volume		yes [1]	yes [1]		
Internal counter - absolute state	yes	yes	yes		
Output pulses - pulse deficiency	yes	yes	yes		
Primary flow rate - mean value	yes	yes	yes		
Corrected flow rate - mean value	yes	yes	yes		
Minimum/maximum flow rate	yes	yes		yes [2]	
Conversion, gas convertibility factor					
Conversion factor - mean value	yes	yes	yes		

Gas compressibility factor - mean value	yes	yes	yes		
Minimum/maximum conversion, gas compressibility factor	yes	yes		yes [2]	
Binary quantities					
Binary input - state	yes				yes
Binary output - state	yes				yes
Setpoints - state	yes				yes
Device and transducer communication errors - state	yes				yes
Binary internal	yes				yes
Other quantities					
Counter/ timer - absolute	yes				
Device status	yes	yes	yes		
Notes:					
1) The day or hour is stored together with the value (or in combination, where suitable)					
2) The date and time of reaching the minimum/maximum is stored together with the value					

Table 30 Quantities archiving options

11.3.1 Monthly Archive

The values are recorded in the archive once a month at the set "gas" hour (usually 6:00 am). The record time is stored in the archive along with the values. When the archive is filled, the new data starts to overwrite the oldest. There is an option to store statistical values for gas consumption and analogue quantities (see Table 30).

Therefore, a record dated 01.06. means statistical values of quantities in the interval 1.05. 6:00 to 1.06. 6:00.

11.3.2 Daily Archive

The features are similar to the monthly archive (for the list of options see Table 30). Also in this archive, the statistical values of gas consumption and analogue quantities can be stored. The values are recorded in the archive once a day at the scheduled "gas" hour (usually 6:00 am).

Therefore, a record dated 13.06. means statistical values of quantities in the interval 1.05. 6:00 to 1.06. 6:00.

11.3.3 Data Archive

Archiving period: adjustable from 1s to 1h

In this archive, the quantities are stored in the defined period, which can be set by the user. The default value is 1 h. For status variables, the occurrence of the active state in the archive period is stored in the archive. For binary inputs, the active status can be set according to the actual parameter setting. Log1 is the active status for setpoints and errors.

11.3.4 Binary Archive

The archive stores the states of binary inputs together with status bits calculated and stored in the system, and the errors of each device. The values can only be stored in this archive if the status of any stored binary is changed. The record includes a time with a resolution of seconds.

11.3.5 Limit Archive

For the archived quantities, limit (minimum or maximum) reaching is stored. A value and a time are stored. When this archive is initialized, the current measured values of the specific quantities are set in both maximums and minimums registers.

11.3.6 Status Archive

The archive stores the date and time of an event change, the status word (64 bits) describing the statuses of all the monitored events in the device and the state of the primary volume counter Vm1 and the volume counter Vb1 at base conditions. The list of monitored events in the device is listed in Table 14 and in Table 15.

The content of the archive cannot be displayed directly, but it has to be viewed via the service PC software.

11.3.7 Settings Archive

The settings archive stores the parameter changes, especially if they affect the metrological properties of the device, except for changes in gas composition and the standard for gas compressibility calculation. The ID of the person who made the change is stored in the archive, as well. The record contains the time, person ID, activity description, and new and old parameter values that have been set.

This archive is different from the other archives, as it is not rewritable, i.e. when filled, no records can be stored, and further modification of the parameters is impossible. This archive cannot be displayed directly, the contents can only be viewed on a PC.

11.3.8 Billing Archive

The device contains a billing archive. This archive is used to record data of the billing period set in the device parameters. The records can be made in the archive in the following ways: first, as one-off record and according to a preset time or periodically at intervals of 1,2,3,4,6 and 12 months. At this time, all current readings of the primary volume and the recalculated volume of both the total counter and the counters of the individual tariff bands are recorded.

The device allows for setting the billing period and the time when the next billing period is due.

11.3.9 Gas Composition Archive

Changes in the gas composition or in the standard for the gas compressibility calculation are recorded in this archive. A time stamp, information on the compressibility used and the size of gas composition items are stored. When the archive is filled, the new data starts to overwrite the oldest.

11.4 Device Parametrization

11.4.1 SW Parameterization Using the Service SW

The device allows for setting the parameters needed for the device to be put into operation after installation directly from the device keypad, i.e. without the need to use a computer. The description of the procedure is provided in paragraph 6.7

The device can be fully parametrized using the supplied utility SW [42], [43] for PC. In addition to setting up the device, the software also allows reading, viewing, archiving and printing of both actual values and the archives contents. The parameterization procedure using the utility SW is described in [38].

11.5 Other Features of the Device

11.5.1 Summer/Winter Time (DST)

The time change function (summer/winter time) is implemented in the device. This function can be activated/deactivated with the utility SW. When this function is activated, the device automatically changes the time based on the region where the device is used (Europe or USA). At the same time, it is necessary to set a deviation from the central time (GMT) for correct operation. The archives of the device then distinguish whether the record was taken in summer or winter time.

11.5.2 Time Synchronization

The device is equipped with a time synchronization function that allows only the administrator to correct the time within a time deviation of +/- 10 minutes without recording the adjustment in the setup archive and without generating the warning message W38 in the device status [24]).

Remark for CTR communication protocol:

> *If the time deviation is greater than 60 s and less than 2 hours, then the time correction is enabled, but it is recorded in the status archive. If an attempt is made to change the time by more than 2 hours, then this correction is not enabled and an alert is generated.*

In the device parameterization, if the device is equipped with a modem, it is possible to set automatic time synchronization using NTP protocol via the GPRS network or using the ETTC protocol via GSM CSD call. The time is synchronized automatically with a 20-day period, or with a 24-hour in the case of failure. If the synchronization is not successfully completed by 25th day, an E26 error is triggered and recorded in the status archive (Table 14). The amount of the time deviation detected during synchronization is always evaluated with respect to the data storage frequency so that the archives are not corrupted during synchronization.

11.5.3 Tariff Counters

Up to four tariff counters are available in the device that allow for volume calculating according to a pre-set time schedule. There are two separate schedules (Tariff Schedule 1 and Tariff Schedule 2) that can be configured independently and only one can be active at a given time. In these schedules, the tariffs can be assigned to specific time slots in the days, and it is also possible to define whether the selected day is a working day, Saturday or Sunday (holiday).

Each schedule has its own identification number and the time of activation can be set separately for each schedule.

11.6 Protection against change of Metrological Parameters

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[24]) This data is valid for the OEM ELGAS s.r.o. device version.

The device is protected against unauthorized manipulation (especially with data that affect the metrological characteristics of the device) with a metrological and service switch and uses password system security. Changes to the device settings and other operations are stored in the settings archive. These measures make it possible to protect the device both in accordance with and beyond standard CSN EN 12405-1.

11.6.1 Protection Switches

The device contains two switches, a metrological switch and a service switch.

11.6.1.1 Metrological Switch

- Protects the metrological setting of the device. It is located on the inside of the enclosure cover (see Fig. 54 and Fig. 55) and is protected by plate secured with the manufacturer's seal (official metrological mark).

11.6.1.2 Service Switch

- The service switch is located beneath the metrological switch (Fig. 54 and Fig. 55). Opening the device and the switch accessibility can be protected with the user mark, see Fig. 4, Fig. 5.

The *service switch* function depends on the settings in the device parameters. The settings are done via the utility program (Parameters Menu -> Service Switch Function). Here, the user can choose what effect the switch settings will have on each device parameter group.

This variability resolves the setting of various access options to work with the device (e.g. remote setting of the parameters via the modem ...).

Using the utility SW, the user can select one of the following functions for the service switch:

Switch function	Position	Description
Full [25]	OFF	Writing parameters into the device is blocked.
	ON	Parameters can be entered into the device.
Non	OFF	The position of the switch is of no significance, writing to the device is possible. The switch protection has been overridden.
	ON	
Partial	OFF	Writing to the device is blocked with the exception of non-metrological parameters (such as archiving frequency, system time etc.) This setting is suitable for remote data transfers from the device. Protecting the setting with a password is recommended.
	ON	Parameters can be entered in the device (in the same way as in the case of full function).

Table 31 Service Switch Settings

11.6.2 Passwords

The device has password protection implemented. The use of passwords may be restricted depending on the communication protocol set. Maximum number of passwords that can be entered in the device is 50. When the password protection in the device is turned on (see below), the passwords must be used both for serial line or modem communication and for setting device

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[25] This function has been pre-set by the manufacturer (default setting).

parameters using the device keypad. When setting parameters from the keypad, the list of items to be edited is limited by the access level permitted.

11.6.2.1 Password Groups (Valid for ELGAS version 2, MODBUS, and CTR)

The passwords are divided into 5 groups. Users of the "Administrators" group have the highest rights, the users of the "User 3" group have the lowest rights. Higher-level users have lower-level users rights, plus some others. Up to 10 passwords can be used in each group (i.e., a total of 50 passwords are available). The passwords are identified by a three-digit numeric designation. The length of each password is limited to a maximum of 6 characters. Users in all the groups can change their own passwords. The group administrator (the user with the lowest ID in each group) can change the passwords of other users in that group. The administrator of the "Administrators" (ID = 801) group can change the passwords of the administrators of the other groups. According to the communication protocol used, the following characters can be used in a password:

Communication Protocol	Permitted characters	Note
ELGAS ver.2	letters a-z, A-Z, digits 0 to 9	password length 1 to 6 characters case-sensitive
CTR	digits 0 to 9 (the device allows for entering letters, which however are rejected by the counterpart station)	password length must be 6 characters (the device allows for entering shorter password, which however is rejected by the counterpart station)
MODBUS	digits 0 to 9	password length 1 to 6 characters

Table 32 Password Format

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i

Turning on password protection

- by entering a password with ID 801

Turning password protection off

- **by deleting the password with ID 801.**
  By deleting the ID 801 password, the other passwords set in each group are deactivated, but their settings are not lost. Once the password protection is enabled, they become active again.

Password Group	Password IDs	Description
Administrators	801 to 810	When the metrology switch is set to ON, the metrological properties of the device can be changed: • Loading a new firmware using the "Loader" • Loading new MSP processor firmware • Resetting metrological archives (settings archive, status archive, gas composition archive) • Transducer replacement, calibration of the corrector • Creating or removing metrological quantities • Changing the name or prefix of metrological quantities

| | | • Setting Tb and Pb
• Changing the device status
• Changing a restriction
• Setting Vb, Vbs
• Setting the schedule of the tariff currently active

When the metrology switch is set to ON, it is possible to:
• Load a new firmware using the "Remote Download"
• Setting the system time of the device if the device is used with CTR protocol (in other cases, the settings can be made for lower-lever users) |
| **Service Maintenance** | 811 to 820 | Switching to the "Maintenance" mode and back to "Normal" |

User 1	821 to 830	Depending on the service switch, the parameters are divided into groups. For the effect of the service switch, see Table 31. Parameters influencing metrological properties: • Setting the substitute values to calculate the conversion factor • Setting the units for the system quantities (Tb, Pb, combustion heat), of reference conditions for combustion heat calculation • DST mode setting (summer / winter time) • Setting the parameters for storing the billing archive • Unit and constants of the quantity, configuration of the pulse input of metrological variables • Setting the values for counters of volumes other than Vb, Vbs • Assigning the influence of the service switch to parameter entering • Changing the compressibility calculation method Other parameters: • Adding to or reducing non-metrological quantities • Setting the parameters of non-metrological quantities - name, marking, unit, constants • Saving to the appropriate data archive • • setting the input quantity connection with the output in the form of the user equation • Setting the communication parameters • Setting the descriptive data - station name • Setting the measurement frequency and the archiving frequency
User 2	831 to 840	permits: • Setting the gas composition (via keypad only) • Setting the system time (when using CTR, this setting is only possible for the "Administrators" group)
User 3	841 to 850	• Permits reading data from the device • (does not permit writing to the device) • Setting the access password

Table 33: Password Groups and their Specification

Notes:

Administrator with password identifier 801 is authorized to:

- Set passwords for the other administrators (ID 801 to 810)

- Set passwords with IDs 811, 821, 831 and 841

The first user in each group (ID 801, 811, 821, 831 and 841) is allowed to assign passwords to other users in the same group.

11.6.3 Levels of Access

From the point of view of modifying parameters and other operations with the device, it is possible to divide the users of devices according to different levels of access.

User Level

- Common user of the device. At this level, reading all the data from the device and setting a large number of parameters is allowed. It is not possible to change the parameters directly affecting the metrological properties of the device. For more details, see Table 34. As a protection against misuse, protection switch together with user mark and password system can be used.

Accredited Service Centre (ASC)

- Designed for the workers of the centre authorized by the manufacturer. The Centre is authorized to carry out operations relating to the device metrological properties. These activities require the breaking the official mark, switching the metrological switch and using a **special HW key** for the utility program [42], [43]. For the description, see Table 35

User Level			
	Activities	**Service switch**	**Activities permitted with password protection**
Reading data	• Reading actual values of quantities • Reading archives • Reading parameters	OFF, ON	• Permitted with password protection off
Non-metrological parameters changes	• Turning archiving of the quantities into the archives on / off • Setting the measurement frequency • Setting archiving frequency of data archive • Changing passwords • Resetting archives • Setting the internal time of the corrector • Setting communication parameters • Setting station identification • Setting the start time of the gas day • Switching displaying the actual values of non-metrological variables on / off • Configuring digital inputs • Configuring digital outputs • User designation of the quantities	ON	• Permitted with password protection off

| Metrological changes | • Assigning the influence of the service switch on parameter writing
• Setting the V and Vs counters
• Changing the method of calculating the compressibility factor
• Setting the gas composition
• Setting units and constants
• Setting of temperature and pressure substitute values for conversion | ON | |

Table 34 User access level - for the "full" function of the service switch

Authorized Service Centre (ASC) Level		
Activities	**Service switch**	**Activities permitted with password protection**
• All the activities described in the user level • Setting the status bit mask (Diagnostics quantity)	OFF, ON	Note: When using the HW key, the effect of passwords is suppressed, if used with the device.
Metrological changes • Firmware upgrade • Changing metrological approval variant (NMi, CMI, MID, ...) • Setting the reference temperature • Setting the reference pressure • Setting Vb, Vbs • Configuring metrological quantities (C, K, V, Vb, Vs, Vbs) • Replacing the transducers • One-point or two-point transducer assembly • Reset the archive settings and status archive • User designation of the quantities	ON	Using the HW key designated WGQOI, "Accredited Service" version

Table 35 ASC Access Level

12 Accessories

12.1   Plug-in Modules for ELCOR corrector

Module	Designation	Slot
S0-SCR	Interface for SCR gas meter encoder	SLOT 0[26])
S0-NAM	Interface for NAMUR gas meter encoder	
M2G	Internal modem 2G	
M4G, LTE-Cat1E	Internal modem LTE cat.1-E	
M4G, LTE-Cat1US	Internal modem LTE cat.1-US	
M4G, LTE-CatM1	Internal modem LTE cat.M1-US	

12.2   Plug-in Modules for ELCOR*plus* corrector

Module	Designation	Slot
S0-SCR	Interface for SCR gas meter encoder [26])	SLOT 0
S0-NAM	Interface for NAMUR gas meter encoder [26])	
S0-MIE	Interface of ELGAS mechanical indexer) [26])	
S0-EXT1	Extension module - 2 HF NAMUR pulse inputs, 6 digital inputs, 2 analogue inputs, 2 transducer connection [26]) [27])	
S0-EXT1/HF	Extension module - 2 HF NAMUR pulse inputs	
S1-COM	RS232/RS485 communication module	SLOT 1, SLOT 2
S1-2AI	4-20 mA analogue inputs module (2 inputs)	
S1-2AO	4-20 mA analogue outputs module 4-20 mA (2 outputs)	
S3-PWR1	EVC external power supply module	SLOT 3
S4-PWR2	Module of external power supply of internal module	SLOT 4
S4-COM0	RS232 communication module	
M2G	Internal modem 2G	SLOT 5 [28])

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[26]) The module has a direct effect on the metrological features of the device. For this reason, it cannot be installed by the user and must be installed during the device manufacture. The installed module is secured with a metrological seal.

Modules in positions SLOT 1 to SLOT 5 can be installed by user.

[27]) External power supply from S3-PWR1 is required

[28]) If external power supply to the modem is not used, the internal modem module is mounted in SLOT 4 instead of in slot SLOT 5

M4G, LTE-Cat1E	Internal modem LTE cat.1-E
M4G, LTE-Cat1US	Internal modem LTE cat.1-US
M4G, LTE-CatM1	Internal modem LTE cat.M1-US

Extension Internal Module

| BARP | Module for barometric pressure measurement (ELCORplus only) (must be specified in the order, cannot be installed by user) |

12.3 External Modules

The main function of these modules is to ensure external power supply of the device and external power supply of internal modems and to ensure correct connection of other cooperating devices, which extend the utility features of the device. Since the device is intrinsically safe, the following modules act as a safety barrier (except for the CLO module) to connect conventional devices.

Dual module design

Most of the modules are available in two versions - the basic version and the designation "/A" (e.g. PS-E and PS-E / A). Both designs are functionally identical, the difference is only in its resistance in terms of intrinsic safety, current consumption and the possibility of galvanic separation.

basic design - for common use, the module is powered with a 12V power supply connected to the 230Vac power supply (intrinsically safe parameter Um = 250V). The intrinsically safe module terminals are galvanically isolated from the other terminals.

"/ A" version - the module has reduced its own current consumption, therefore it is suitable for installations where the 230Vac power supply is not available and which are powered from the battery (intrinsically safe parameter Um = 60V). In this case, the power supply battery <u>must not</u> be charged from a power supply connected to the 230Vac power supply. The module does not have galvanic isolation of terminals.

The external modules are designed for DIN rail mounting into the switchboard. There are separate manuals for the modules. The use of external modules illustrates Fig. 77, Fig. 78, Fig. 79 and Fig. 80.

12.3.1 Intrinsically Safe Sources for External Power Supply (ELCOR*plus* only)

| PS-E PS-E/A | External intrinsically safe power supply for the corrector (powered from 12Vdc mains) |
| PS-M PS-M/A | External intrinsically safe power supply for internal 2G or 4G modem (powered from 12Vdc mains) |

12.3.2 Separation and Communication Modules

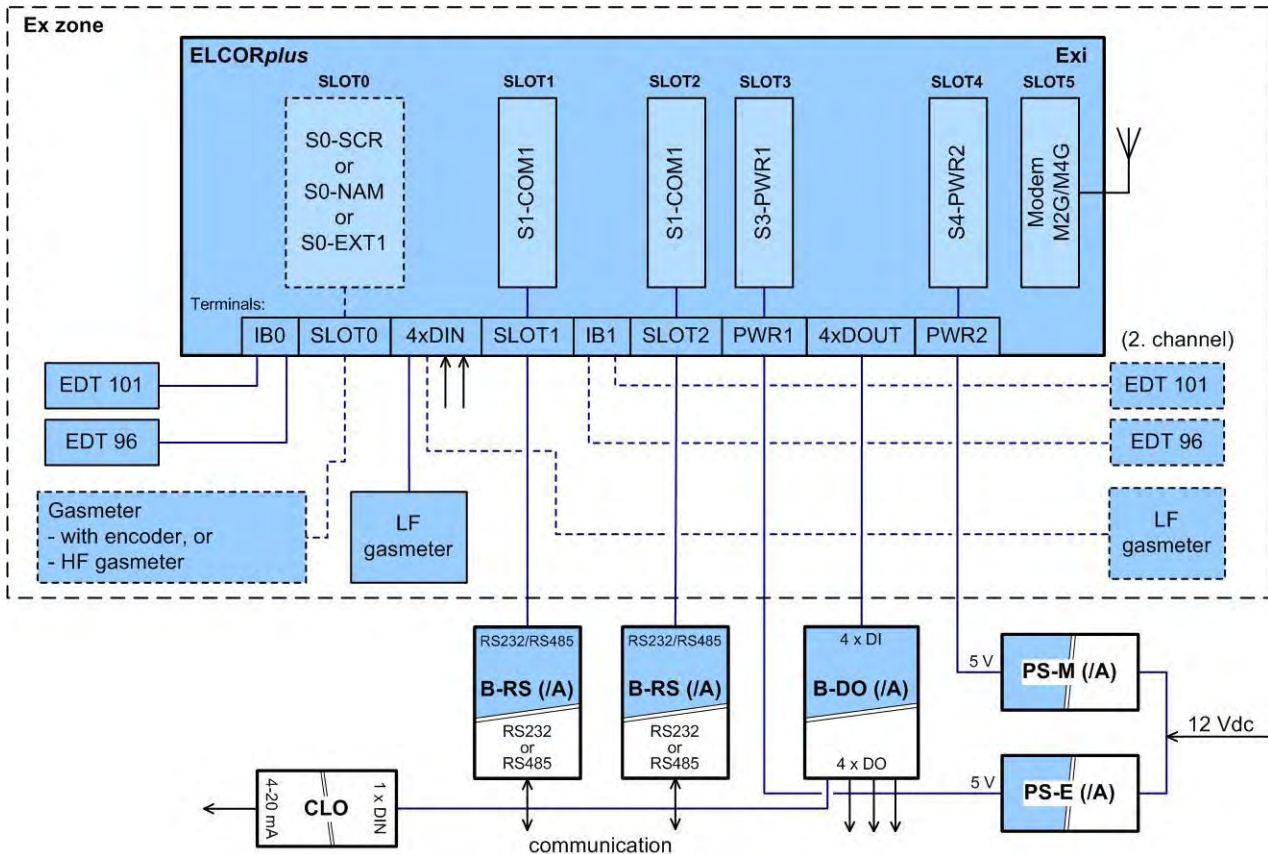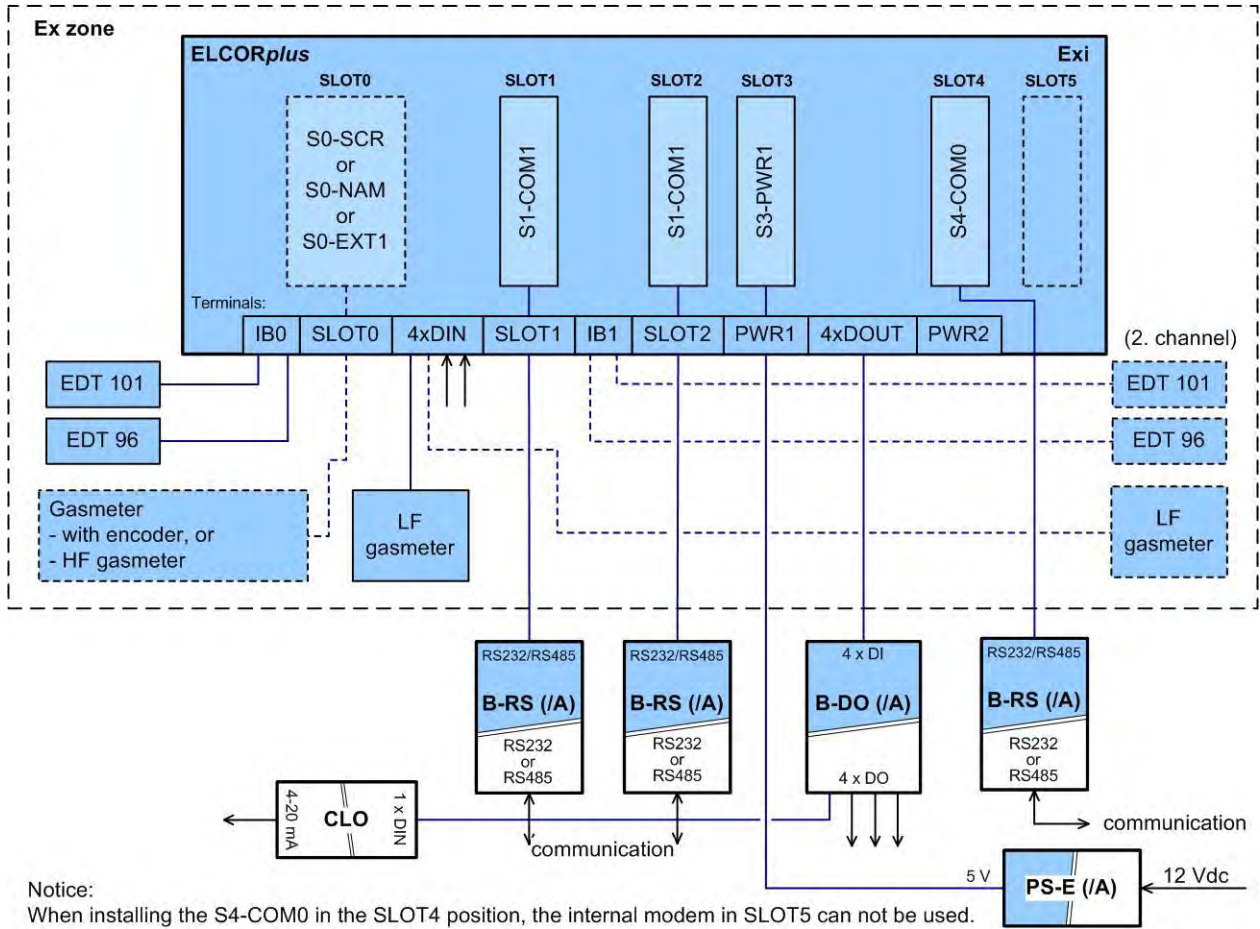| B-RS B-RS/A	Separation barrier for RS485	
B-DI	Separation barrier for digital inputs (2 pcs)	
B-DO B-DO/A	Separation barrier for digital outputs (4 pcs)	
B-IB	Separation barrier for internal bus	

Fig. 77 ELCORplus, example of use of external modules

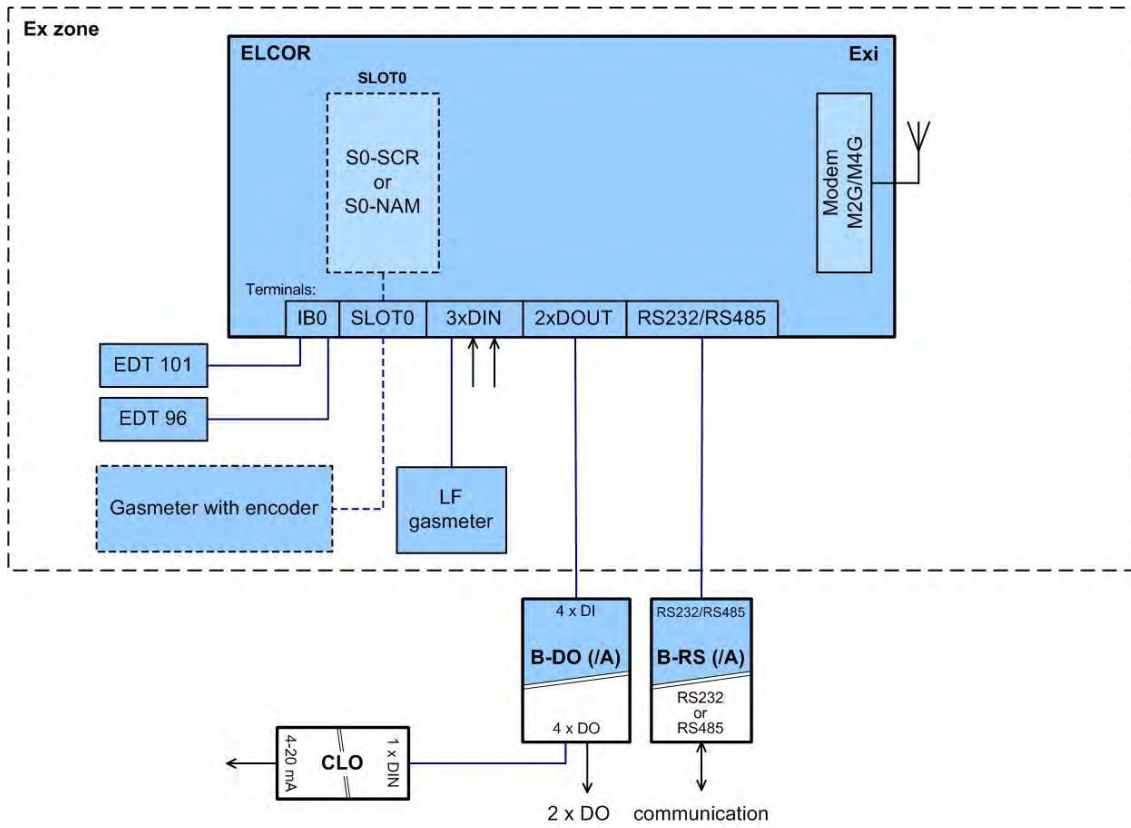*Fig. 78 ELCORplus, example of use of external modules*
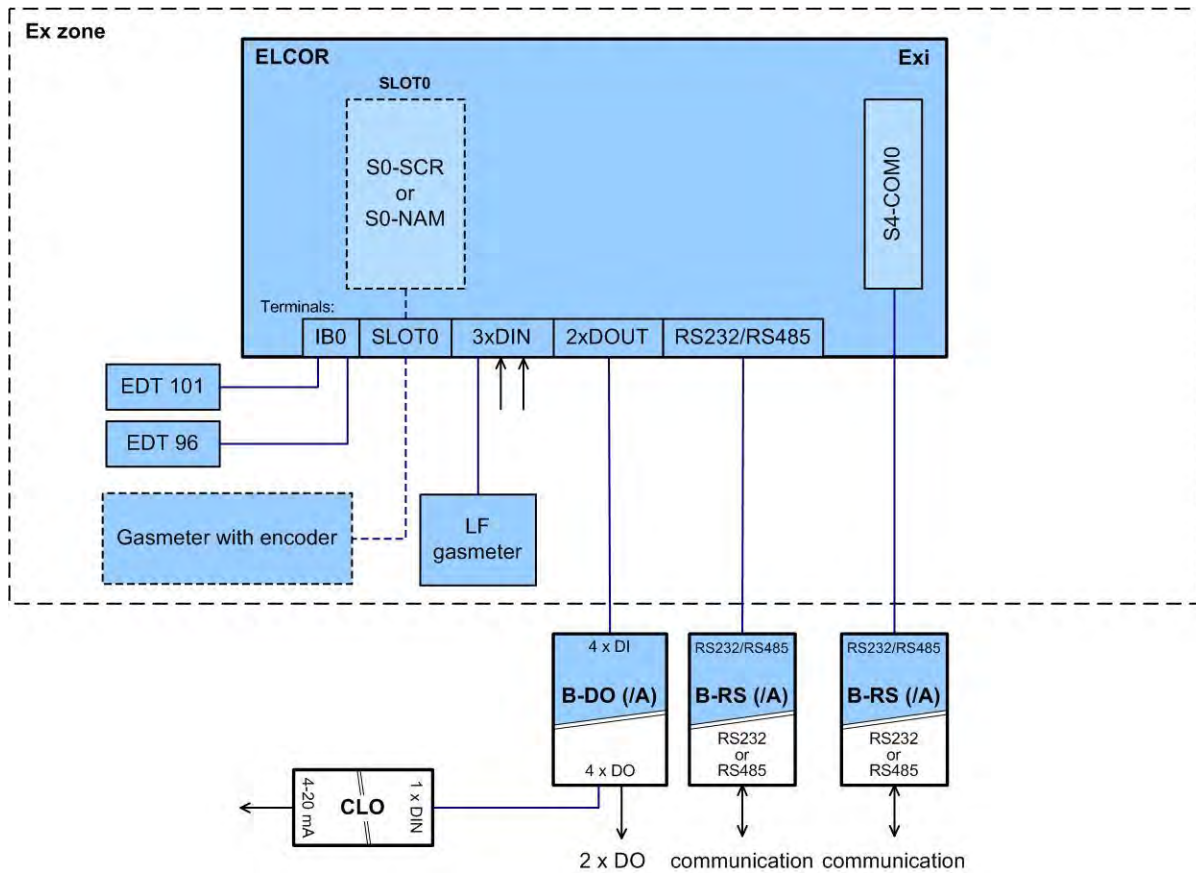
Fig. 79 ELCOR, example of use of external modules

Fig. 80 ELCOR, example of use of external modules

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12.4 Other Accessories

CLO	4-20 mA analogue output module	
HIE-04 B	IR head with USB communication interface (max.115 200 Bd)	
HIE-04	IR head with USB communication interface (max. 38 400 Bd) (production ceased)	
HIE-03	IR head with RS232 communication interface (max. 38400 Bd) (production ceased)	
EDT 101	Temperature transducer	
EDT 96	Pressure transducer, internal or external	

Appendix 1: Device variant with the segment display

1 Device operation

For viewing data, the device is equipped with a two-line segment LCD display with icons. Using this display brings these changes in the display features when compared with a standard graphic display:

- Permanent display of data (display does not switch off) while maintaining the specified battery life of the device
- Displaying data even in frosty weather below -20 ° C (i.e. at ambient temperature within the range -40°C ÷ +70°C)
- Limitations of some data, worse readability of text data

The device is not equipped with a power switch. If the battery (B-03) is inserted and connected to the device, the device is automatically in the operation mode and the device's display is permanently lit. If the B-O3 battery is disconnected or discharged, the device display goes off.

The device is equipped with a six-key keypad, the same as in the graphic display version.

The keypad is activated by pressing Enter for more than 2 seconds. The keypad activates the backlight of the display.

1.1 Standard Display

In the standard operation of the device, actual values of the measured and calculated quantities designation of the displayed quantity is displayed in the first line of the display, the value is displayed in the second line of the display. The quantities whose values we want to display can be set by the user.

Features of the Standard Display

- Standard display - periodic display of the actual values of the measured values or calculated quantities selected by the user
- The length of the display of each quantity is 5 seconds, 15 seconds in the case of the volume at base conditions Vb
- The text is displayed without diacritics

By means of parameterization of the device by the utility [43], individualized display of the selected quantities can be set by the user, except for the standard display of the actual values.

1.2 Display Using Keypad Keys

Using the keypad keys, the various device parameters, system data, and device diagnostics, including the status of the internal modem, can be displayed along with the values of the actual and calculated data. The data to be displayed are selected using the device menu (see 2.1). The display of menu items depends on the set parameters of the device. The contents of some menu items can be user-configured.
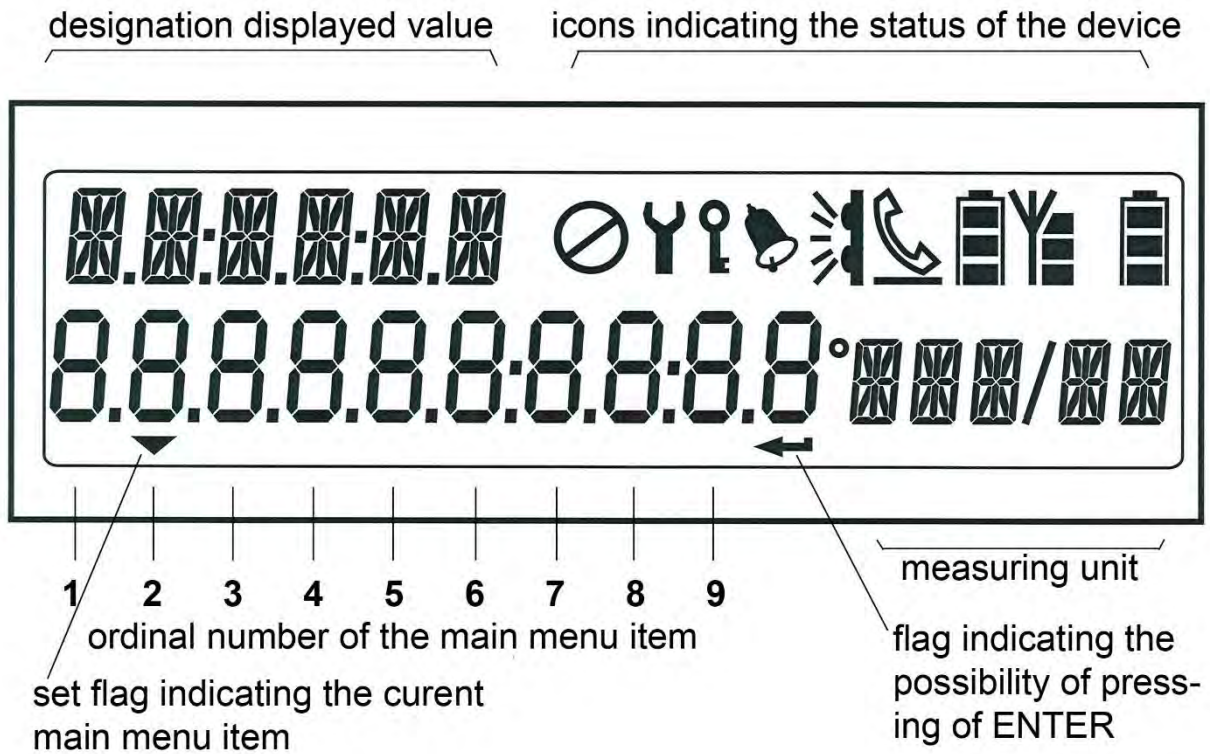
Display Features

- In compliance with standard CSN EN 12405-1+A2, section 6.3.1.5, the display switches to the basic display. In the parameters, the time after which the device switches to the basic display can be selected.
- In order to simplify the operation by a non-trained user, the option to display incremental values instantly by pressing the RIGHT key. Before you first have to press the ESC key several times to the top menu level (Vb).

- In order to simplify the operation by a non-trained user, the option to display actual values one after another by pressing the RIGHT key is included. Before this, it is necessary to exit by pressing the Esc key several times to the top menu level (Vb).

> **i** **The device does not display the contents of the data stored in the archives.**
>
> **This can only be done with the utility SW [42] running on a PC connected to the device.**

1.3 Display of the Device

⊘	Indication of the operating state "Unconfigured"
Y	Indication of the operating state "Maintenance"

	Indication of the status of the metrological and service switch lighted: - The metrology or service switch is ON
	Indication of the status checksum not shown: - status OK lighted: - Warning or Error
	The communication channel of the device is switched to the optical interface. lighted: - infrared head is attached
	The communication channel of the device is handled by a GSM / GPRS modem. Communication is established via dial-up connection in the GSM network. flashing: - connecting lighted: - connected
	The communication channel of the device is handled by a GSM / GPRS modem. Communication is established in the GPRS mode. the bottom line flashing: - establishing a connection the bottom line not flashing: - logged in to GPRS
	Battery status of the GSM / GPRS modem. The number of black displayed rectangles indicates the battery capacity: number of rectangles: 3 2 1 0 capacity: >50% 25÷50% 10÷25% <10%
	Indicates the signal strength of the GSM network at the device location. The number of black displayed rectangles indicates the signal strength: number of rectangles: 3 2 1 0 signal strength: ≥75% 50÷74% 25÷49% <25%
	Device battery charge condition. The number of black displayed rectangles indicates the state of the battery. number of rectangles: 3 2 1 0 capacity: >50% 25÷50% 10÷25% <10%

Table 36 Meaning of the display icons

2 System Menu

Data that can be displayed on the device display are structured based on the menu. For the purposes of further interpretation, we call the basic menu items the highest items. By entering those items, navigate to the lower menu levels (submenus).

2.1 Main Menu

The menu depends on the parameters set in the device. The set of items below can be changed according to the device settings.

The main menu consists of eight items. The main menu can be displayed from the home screen (Vb) by pressing the (ENTER) key. You can scroll through one of the keys (LEFT, RIGHT). If any of the main menu items contains a submenu (e.g. PARAM, CONFIG or SYSTEM), the submenu is entered by the ENTER key.

	main menu	1st submenu	2nd submenu	3rd submenu	note
1	**Vb**				actual value of the volume counter at basic conditions
2	**ACTUAL**				actual values display
		Vb			actual value of the volume counter at basic conditions
		Vm			actual value of the primary volume counter at basic conditions
		E			actual value of energy
		P			actual value of gas pressure
		T			actual value of gas temperature
		Q			actual value of primary flow rate
		Qb			actual value of flow rate at base conditions
		C			conversion factor
		K			gas compressibility factor
		Z			gas compressibility factor at measurement conditions
		Zb			gas compressibility factor at basic conditions
		Vbs			actual value of the substitute value at basic conditions
		Vs			actual value of the substitute value at measurement conditions
		... etc.			other items depending on the device configuration
3	**MENU1**				user-defined display of actual values
4	*(reserve)*				*reserved*
5	**PARAM**				displaying the device parameters
		COMMUN			communication address
			COM.GEN.		general
				ADR1	communication address 1
				ADR2	communication address 2
			IR.HEAD		optical head
				SPEED	baud rate
				PROT.	communication protocol
			COM0		ELCOR: internal modem ELCORplus: communication device connected via SLOT 4,5
				SPEED	baud rate
				PROT.	communication protocol

				COM.DEV.	communication device
			COM1		ELCOR: interface RS232/RS485 ELCORplus: communication device connected via SLOT1
				SPEED	baud rate
				PROT.	communication protocol
				COM.DEV.	communication device
			COM2		ELCORplus: communication device connected via SLOT2
				SPEED	baud rate
				PROT.	communication protocol
				COM.DEV.	communication device
		SERV			service parameters
			S.N.DEV		device serial number
			VER.APP		application SW, version no., CRC
			VER.MTR		metrological firmware, version no., CRC
			VER.LDR		loader – version no., CRC
			ST.NAME		Station Identification
		CONV			gas volume conversion parameters
			STAND.C		method of compressibility calculation
			PB		pressure reference value
			TB		temperature reference value
			ZB		gas compressibility factor under reference conditions
			GAS		gas composition parameters
				CO2	CO_2 content
				H2	H_2 content
				N2	N_2 content
				DENS	relative density
				CALOR	Combustion heat (calorific value)
			P.SPARE		pressure substitute value
			T.SPARE		temperature substitute value
			K.SPARE		error gas compressibility factor value at measurement conditions
			P.RANGE		pressure measurement range
			T.RANGE		temperature measurement range
		INPUTS			input parameters
			Vm		primary volume
				GAS KP	gas meter constant [imp/m3]

				S.N.GAS	gas meter serial number
			P		pressure measurement
				P.RANGE	pressure range
				S.N. P	serial number of the transducer
			T		temperature measurement
				T.RANGE	temperature range
				S.N. T	serial number of the transducer
6	CONFIG				setting the device parameters from the keyboard
		SERV			setting service parameters
			ST.NAME		Station Identification
			GAS.H		hour of the start of the gas day
		COMMUN			setting communication parameters
			COM.GEN.		general parameters
				ADR1	communication address 1
				ADR2	communication address 2
			IR.HEAD		optical head
				SPEED	baud rate
				PROT.	communication protocol
			INT.MOD		communication device
				SPEED	baud rate
				PROT.	communication protocol
			COM1		RS232/RS485 interface
				SPEED	baud rate
				PROT.	communication protocol
			COM2		RS232/RS485 interface
				SPEED	baud rate
				PROT.	communication protocol
		GAS.COM.			gas composition setting
			CO2		CO_2 content
			H2		H_2 content
			N2		gas composition parameters
			CALOR		Combustion heat (calorific value)
			DENS		relative density
		DAT:TIM			
			TIME		system time of the device setting
			DATE		the date setting
		VOL1			volume setting
			GAS KP		the gas meter constant setting

			Vm		primary volume setting
			Vb		converted volume setting
			Vs		substitute primary volume setting
			Vbs		substitute converted volume setting
			E		energy setting
			Es		substitute energy setting
			S.N.GAS		gas meter serial number setting
			QMAX		maximum gas meter flow rate setting
		CLEAR.A			deleting archives contents
			DATA.AR.		deleting the data archive
			DAY.AR.		deleting the daily archive
			MONTH.A.		deleting the monthly archive
			TARIFF		deleting the tariff archive
			BINARY		deleting the binary archive
			LIMIT.A.		deleting the boundary archive
			SETUP.A.		deleting the settings archive
			STATUS		delete the status archive
			GAS.AR.		deleting the gas composition archive
		WORK.M.			working regime setting
		SAVE.PA			entering the set parameters into the device
7	**SYSTEM**				system parameters display
		TIME			system time display
		DATE			system date display
		RESET			device reset
		MODEM			modem parameters
			MODEM1		modem no.1 parameters
				GPRS.IP	up-to-date GPRS modem IP address
				MODERR	last modem error code and time of occurrence (Err.xx format hh: mm DD.MM.YY) "Xx" - modem error code (see Table 13)
				SIGNAL	Measuring the signal strength triggered by a keyboard command. Showing measurement status: BTS: test BTS: roam BTS: connect BTS: search BTS: no BTS: denied

					After the signal strength is successfully measured, the value in percent (SIG: xx [%], converted to dBm - see Table 12) is displayed. Automatic shutdown after 2 min or by shutdown by the user.
				MOD ON	Turning the modem power supply on manually from the keypad - switches on, or switches on and connects to GPRS according to the set mode - the time in seconds to automatic exit and shut down the of modem is displayed - automatic shutdown after 5 minutes or shutdown by the user
				CALL	Manual initialization of GSM / GPRS calling from the device to the master system - must be enabled in parameters - after activating the command, it displays "Working" - then you can exit the mode and the device performs the action
				PACKET	displays the number of packets sent during the active or last communication
		BAT.EVC			remaining battery capacity [%]
		Vcc			battery voltage
		LATCH			Displays and freezes the actual values on the display. This function is used to check the field operation of the device (abbreviated test). For Vb, Vbs, E, Es, the decimal part of the value is displayed when Enter is pressed.
8	DIAG				Device Diagnostics
		ACT.ST.			The current device status is displayed (browse by pressing ENTER)
		SUM.ST.			The device checksum is displayed (browse by pressing ENTER)
		SUM.CLR			resetting total status
		TEST			triggering the device test
9	TARIFF				
		ID.CURR			
		ID.PREV			
		PREV.D			

Note:

The number of display characters (digits) on the display at a time is limited to 10. If you need to display longer information (such as ST.NAME - Station Identification), the displayed information will be scrolled.

2.1.1 ACTUAL Menu – Actual Values Display
(serial number 2 of the main menu)

Immediate values of metrological quantities and the set non-metrological quantities are displayed (the non-metrological quantities are set in the parameters of the instrument using the utility program [42]). In the basic view (device idle), these data are displayed periodically on the display (except as in 2.1.2).

Indication of Exceeding the Limit

If the value of the measured quantity is outside the measuring range of the instrument, the "**E**" flag appears before the displayed numeral.

2.1.2 USER 1, USER 2 Menu
(serial number 3 and 4 of the main menu)

These items are displayed only if they are set in the device. Settings can only be performed by the utility SW [43].

With these settings, actual values can be displayed, in the order defined by the user.

> **i** **If the USER 1 menu is set in the device, the display of the actual values defined in the ACTUAL menu item is suppressed in the device and the actual values defined in the USER 1 item are displayed.**

2.1.3 PARAM Menu
(serial number 5 of the main menu)

Select this menu to display the set parameters of the device.

2.1.4 CONFIG Menu
(serial number 6 of the main menu)

Use this menu to set the device parameters from the keypad. Service parameters, communication parameters, gas composition, system date and time, gas meter parameters and volume measurement parameters can be set. After changing the parameters, you must save the changed values to the device memory using the last submenu option SAVE.PA.

Select CLEAR.A to delete the contents of the device archives.

2.1.5 SYSTEM Menu - system data
(serial number 7 of the main menu)

RESET - Device Reset

After selecting the device reset, the program jumps to the initial address and re-initializes the entire measurement system. The contents of all the archives and the states of all gas volume counters (Vm, Vs, Vb, Vbs) do not change during this operation, nor any other configured parameters. Execution of the command is independent of the position of the service switch.

MODEM

In this option you can find the assigned IP address of the device for the configured GPRS modem and the mobile signal strength of the device at the device location. In addition, you can turn on the modem and, if necessary, initiate connection with the dispatch centre if the device is configured to send alarms. These operations are especially useful when configuring the modem and putting the device into operation.

LATCH – Freezing the Actual Values

The actual values measured are frozen at the display on pressing the key. The frozen values of the quantities (Vb, Vm, P, T etc.) can be displayed in the standard way when displaying the actual values. Press ESC to stop displaying frozen quantities.

The LATCH function should be used, for example, when manually copying the values of the measured actual values when checking the accuracy of the device.

2.1.6 DIAG Menu Item – the Device Diagnostics
(serial number 8 of the main menu)

V menu DIAG Information on the device condition are stored in the DIAG menu.

ACT.ST. - Actual Status

This menu displays the actual state of the device. Pressing the RIGHT key shows all the current errors and warnings of the device one after another.

SUM.ST. - Checksum

The checksum is used to monitor the occurrence of active error states (individual device status bits) since the last checksum initialization. This means that also statuses of the device that may have been already extinct are stored in the memory.

The basic status information is also displayed as a "bell" icon on the device display.

SUM.CLR. - Checksum Trigger

On selecting this option on the device keypad or via the "Clear Checksum" option from the "Setup-Diagnostics" menu from the utility SW on the PC, the checksum is triggered, i.e. the current status is set according to the actual status. To enable the triggering, the service switch must be ON. If it is switched to OFF, a message ("Not Possible") is displayed, warning that the function cannot be triggered.

TEST - Device Test

After selecting this menu item, the device tests its internal state and displays a list of detected errors and warnings. The test runs for several seconds (the message "Working" appears on the display) and does not affect the actual measuring and archiving operation of the device. The command execution is independent of the position of the service switch.

During the test, WARNING is displayed on the display. The indicated errors are identified with the prefix "E" and the identification number; similarly, the prefix "W" is used for the warnings [29]). Refer to Table 14 and Table 15 for a complete list of error messages and warnings.

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[29]) Due to the limitation of character display on the customer display, the "W" is displayed as "U"

Appendix 2: ELCOR*plus* version for Zone 2

1 Introduction

This appendix describes a version of the ELCOR*plus* that has a different type of explosion protection than the one described in the previous section of the manual and is intended for use in a hazardous area Zone 2.

In the following, this embodiment of the device is designated ELCOR*plus* for Zone 2.

ELCOR*plus* for Zone 2 is implemented with "nA" type protection in combination with "ic" protection and <u>cannot be used in Zone 0/1 environments</u>.

This version of the device can be also supplied under the trade name **DATCOM*plus*** for Zone 2 as an electronic data logger.

The appendix describes the differences between the ELCOR*plus* for Zone 2 and the intrinsically safe version of the device described in the main body of this document.

ATTENTION!

The ELCOR*plus* for Zone 2 (DATCOM*plus* for Zone 2) with explosion-proof category "II 3 (3) G" and combined explosion protection "ic nA" <u>must not be used in Zone 0/1 environments</u>, otherwise, there is a risk of explosion.

The whole device with transducers and etc. must be located in the <u>Zone 2</u> environment (i.e. including pressure and temperature transducers).

The production label with ATEX is located on the top of the housing.

The device ELCOR*plus* for Zone 2 (DATCOMplus for Zone 2) has a working temperature limited to range of :

Operating temperature scope: -25 °C ÷ +60 °C

2 Safety

2.1 General

The device **ELCOR*plus* for Zone 2** is approved according to Directive 2014/34/EU (NV No. 116/2016 Coll.) and has been released with the following certificate:

FTZÚ 19 ATEX 0002X	Certificate of examination certificate (ATEX) for use in potentially explosive atmospheres.

Important Notice:

EX	**ATTENTION!** **The device is designed according to safety principles for use in potentially explosive atmospheres of type Zone 2.** **It is approved as a safe device with combined protection of the type "intrinsic safety" ic and a type of non-sparking device "nA" according to the standards EN 60079-0, EN 60079-11 and EN 60079-15.** **The version for Zone 2 must not be used in Zone 0/1, otherwise, there is a risk of explosion.**

EX	**DANGER!** The device must be installed and used in accordance with this documentation and the conditions specified in the ATEX certificate.

⚠	**Warning!** The specified protection IP66 is only valid if cables of suitable diameter and proper tightening are used in the cable glands of the device. Unused cable glands must be blinded. Unused cable glands must be blinded.

2.2 Use in potentially explosive atmospheres zones

Based on Certificate of Examination type 19 ATEX 0002X, the device can be operated in a potentially explosive atmosphere designated Zone 2 (space in which an explosive gaseous atmosphere is not likely to occur during normal operation, but will remain for a short period of time if this atmosphere occurs) – EN 60079-10-1).

ELCOR*plus* (DATCOM*plus*)

Explosion proof	Device and internal equipment	Environment
II 3G Ex ic nA IIB T4 Gc	- basic design, including module extensions: S0-NAM Interface for NAMUR gas meter encoder S0-SCR Interface for SCR gas meter encoder S0-EXT1 Expansion module S0-EXT1/HF Expansion module S1N-COM1 RS232/RS485 communication module S1N-2AI Analogue inputs module S1N-2AO Analogue outputs module S4N-PWR3 Module of EVC and modem external power supply S4N-PWR4/24V Module of EVC and modem external power supply S4N-PWR4/12V Module of EVC and modem external power supply M2G Internal modem 2G M4G Internal modem LTE-Cat1 Internal modem LTE-Cat M1	Zone 2

> **If the ATEX marking is marked with the category "II 3G", the device must not be operated in Zone 0/1, but only in Zone 2!**
>
> The ATEX label is located on the top of the housing.

When connecting the device, it is to be expected with the electrical properties of connecting cables and comply with the requirements of the relevant safety standards. Furthermore, it is necessary to respect the Special Conditions of Use, if mentioned in these certificates.

2.3 Special conditions of use

> **ATTENTION!**
> 1. **In certain extreme situations, an electrostatic charge capable of initiation may be formed on the plastic housing. The device must not be installed in places where external conditions could lead to electrostatic charging. The device may only be wiped with a damp cloth.**
> 2. **The product has been tested with a low risk of mechanical damage. This must be taken into account when installing the product.**

> **ATTENTION!**
> **Do not open the device if there is an explosive atmosphere!**

2.4 Risks of Use

The housing is made of polycarbonate. On the top lid is placed foil keyboard made of polyester. In some extreme cases, electrostatic charges may build up on the cabinet surface. Its energy could cause the initial explosive atmosphere to initialize.

Here are recommendations to avoid the risk of ignition due to electrostatic charges:

- If the device is used in a potentially explosive atmosphere, it must not be installed in a place where external conditions may cause electrostatic charges.
- The device may only be cleaned with a damp cloth.

It is also necessary to observe:

- the cables must be tightly tightened in the cable glands against pulling out
- the device must not be opened if there is an explosive atmosphere
- the enclosure must not be damaged

2.5 Connecting of external devices

ATTENTION!

In terms of safety, the device is equipped with connection terminals with two types of signals:

- terminals with intrinsically safe signals

- terminals with signals with protection "nA"

The terminals of intrinsically safe device can be connected only approved devices (intrinsically safe device associated apparatus) or so. Simple devices complying with the standard EN 60079-11 and complying with the intrinsically safe parameters mentioned in paragraph in the EU Examination Certificate Type[16].

Terminals with "nA" protected signals can be connected to standard equipment that meets operating parameters. When connecting wires to these terminals, it must be non-energized conductor.

The relevant safety standards must be observed when wiring.

The electrical connection of external devices to the ELCOR*plus* for Zone 2 is described in paragraph 8 of this Annex.

The designation of intrinsically safe and "nA" terminals is described in paragraph 8.1 of this Annex.

The connection of the device must be carried out in accordance with the applicable norms and standards, in particular:

EN 60079-14 - Explosive atmospheres - Part 14: Design, selection and installation of electrical installations,

EN 60079-25 - Explosive atmospheres - Part 25: Intrinsically safe electrical systems,

EN 60079-0 - Electrical apparatus for explosive gas atmospheres - Part 0: General requirements,

EN 60079-11 - Explosive atmospheres - Part 11: Protection of equipment by intrinsic safety "i",

EN 60079-15 - Explosive atmospheres - Part 15: Equipment protected by type of protection 'n'

3 Safety parameters of signals on terminals

3.1 Intrinsically safe terminals

Digital inputs DIN: *(terminals DI1, GND, DI2, GND, DI3, GND, DI4, GND)*

Uo = 6,5 V

Io = 2 mA

Po = 3 mW

	IIB	IIA
Co	20 μF	100 μF
Lo	10 mH	100 mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

Internal bus IB0 and IB1: *(terminals GND, U+, D-, D+)*

Uo = 6,5 V

Io = 2,2 A

Po = 1,1 W

	IIB	IIA
ΣCo	24 μF	50 μF
ΣLo [4]	1 uH	1 uH

[4] *concentrated inductance, max. 100 m cable can be connected*

SCR interface - KP 100 061: *(terminals SLOT0 TERMINALS: A, B)*

Uo = 8,0 V

Io = 20 mA

Po = 160 mW

	IIB	IIA
Co	14 uF	100 uF
Lo [4]	8 uH	10 uH

[4] *concentrated inductance, max. 30 m cable can be connected*

NAMUR interface - KP 100 062: *(terminals SLOT0 TERMINALS: NAMUR+, NAMUR-)*

Uo = 10,0 V

Io = 11 mA

Po = 27 mW

	IIB	IIA
Co	20 uF	100 uF
Lo	1 mH	1 mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

Module EXT1, EXT1/HF (KP 100 130) – Digital Inputs DI1, DI2 (NAMUR): *(terminals SLOT0 TERMINALS: DI1-, DI1+ ,DI2-, DI2+)*

Uo = 10,0 V

Io = 11 mA

Po = 27 mW

	IIB	IIA
Co	20 uF	100 uF
Lo	1 mH	1 mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

Module EXT1 (KP 100 130) – Digital Inputs DI3 to DI8: *(terminals EXT1-T: GND, DI3, DI4, DI5, DI6, DI7, DI8)⁄*

Uo = 6,5 V

Io = 2 mA

Po = 3 mW

	IIB	IIA
Co	20 μF	100 μF
Lo	10 mH	100 mH

Ui = 5,5 V

Ii = 1 mA

Pi = 1 mW

Ci = 0, Li = 0

Module EXT1 (KP 100 130) – analog inputs AIN: *(terminals EXT1-T: GND, AI1, GND, AI)*

Ui = 28 V

Ii = 93 mA

Pi = 0,66 W

Ci = 40 nF

Li = 0

Module EXT1 (KP 100 130) - Internal Bus IB1: *(terminals EXT1-T: GND, U+, D+, D-)* [8]

Same parameters as Internal Bus IB0 and IB1

[8] *only for ELCORplus*

3.2 Terminals with protections „nA"

Digital outputs DOUT: *(terminals U0+, GND0, DO1, DO2, DO3, DO4)*

U = 15 V

RS485 interface - KP 100 110: *(terminals SLOT1,2 TERMINALS: D+, D-, GND, U+)*

U = 5 ÷ 15 V

RS232 interface - KP 100 110: *(terminals SLOT1,2 TERMINALS: GND, CTS, RXD, TXD)*

U = ± 15 V

Analog inputs AIN - KP 100 112: *(terminals SLOT1,2 TERMINALS: GND, AI1, GND, AI2)*

I = 0 ÷ 25 mA

Analog outputs AO - KP 100 113: *(terminals SLOT1,2 TERMINALS: AO1+, AO1-, AO2+, AO2-)*

U = 5 ÷ 28 V

Power voltage 230 VAC (module PWR3, TERMINALS: N,L)

Un = 100 ÷ 240 VAC, 50/60 Hz

Power voltage 24 VDC (*module PWR4/24, TERMINALS: +U, -U*)

Un = 20 ÷ 32 VDC

Power voltage 12 VDC (*module PWR4/12, TERMINALS: +U, -U*)

Un = 10 ÷ 16 VDC

Degree of cover protection: IP66

Ambient temperature: -25 °C ≤ Ta ≤ +60 °C

4 Device identification of ELCORplus for Zone 2

There are two labels on the front of the device:

- a **production label** (corrector or recorder), and
- an **additional label** with a warning about opening the device in a potentially explosive atmosphere.

4.1 Production label for corrector

Legend:

1	device designation	**10**	operating instructions
2	pressure measuring range	**11**	device serial number
3	temperature measuring range	**12**	Year of manufacture
4	ambient temperature range	**13**	Protection degree
5	max. permitted device error	**14**	EU-Type examination certificate (metrological)
6	CE conformity marking	**15**	EU Type Examination Certificate (ATEX)
7	year of conformity assessment	**16**	Ex designation
8	designation notified body	**17**	Emphasizing the use of the device only in Zone 2 environments for explosion hazard
9	manufacturer's address		

4.2 Production label for recorder

DATCOM_plus_

Elektronický záznamník dat
pro ZONU 2

1946400001   r.v.: 2020   IP 66

FTZÚ 19 ATEX 0002X
Ⓔx II 3G Ex ic nA IIB T4 Gc

(-25 ≤ T_{amb} ≤ 60) °C

CE 1026
0678

elGAS ®

ELGAS, s.r.o.   Semtínská 211, 533 53 Pardubice, Czech Republic
POZOR! Nebezpečí elektrostatického nabití - netřít!

4.3 Additional label

**ATTENTION - DO NOT OPEN WHEN AN EXPLOSIVE
ATMPOSPHERE MAY BE PRESENT**

Both labels are situated on the front part of device.

5   Product features

5.1   Metrological characteristics and parameters

Metrological characteristics and parameters of device ELCOR*plus* for Zone 2 are identical to the standard version of the intrinsically safe ELCOR*plus* device.

5.2   Technical design and characteristics

Technical design and characteristics of the device ELCOR*plus* for zone 2 are almost no different from intrinsically safe but a modified version of the I/O board and the associated changes in plug-in modules are used.

Some terminals for connecting external devices are not intrinsically safe on this unit and have a "nA" type of protection. This changes the way of connecting some additional devices (communication devices, digital outputs and possibly analog inputs / outputs).

These changes are described in the following chapters.

6 Technical design

6.1 I/O board differences

I/O board (position 12 in Fig. 55 of manual), The board contains terminal blocks for connecting external devices and slot connectors for plug-in modules, in the version for Zone 2 the following differences:

- does not contain SLOT 3 (S3-PWR1 cannot be used). The EVC's external power supply is via the S4N-PWR3 or S4N-PWR4 module. These new modules provide both external power to the EVC and an internal modem at the same time.

- Change with SLOT 4 – SLOT change 4 - slot is designed exclusively for external power module S4N-PWR3 or S4N-PWR4 (S4-PWR2 and S4-COM0 cannot be used).

- does not contain PWR1 and PWR2 terminals. The external power supply for the EVC and the internal modem is common, and is connected to the terminals directly on the S4N-PWR3 or S4N-PWR4 module.

- non-intrinsically safe terminals with 'nA' protection, i.e. SLOT1, SLOT2 and DOUT terminals, are color coded in black from intrinsically safe terminals, and are further separated from them by a safety partition.

- Plug-in modules for which the protection type "nA" is applied to the output terminals (i.e. modules intended for SLOT0, SLOT 1 and SLOT4) have the prefix "SxN-" used in the trade name.

6.2 External power supply

The EVC part of the converter can be powered from the internal battery B-03, B-03D or B-03A. In this version, the internal modem cannot be powered from the internal battery.

Only the S4N-PWR3 module or the S4N-PWR4 module is intended for external power supply of the ELCOR*plus* in the version for Zone 2. Both modules are designed for SLOT 4.

Note:

The S3-PWR1 and S4-PWR2 modules cannot be used for the external power supply of the ELCORplus in Zone 2. In addition, these modules are mechanically incompatible with slot 4 connectors on the I/O board.

> **External power supply of EVC and internal modem is provided by a single module S4N-PWR3 or S4N-PWR4 simultaneously.**
>
> **The internal modem cannot be powered from the battery.**

The **module S4N-PWR3** provides external power supply of EVC and internal modem from 230 Vac electric network, S4-PWR4 module from DC power supply.

The **module S4N-PWR4** is available in two versions depending on the DC supply voltage:

- The module **S4N-PWR4/24V**, powered by DC 24V,
- The module **S4N-PWR4/12V**, powered by DC 12V.

The technical parameters of the S4N-PWR3, S4N-PWR4/12V and S4N-PWR4/24V modules are

given in paragraph 7 of this Annex.

The connection of the external power supply is described in section 8.3.

6.3 Plug-in modules - changes in use

The device has not place for SLOT 3. The change occurs in modules installed in SLOT 1, SLOT 2 and SLOT 4.

New modules S1N-COM1, S1N-2AI and S1N-2AO are intended for SLOT1 and SLOT 2, which are functionally identical to similar intrinsically safe modules but their signals are output to the SLOT 1 terminal block, resp. SLOT 2 are not intrinsically safe and can be connected to common devices whose electrical parameters are in accordance with the parameters of these modules.

Other types of power supply modules are intended for SLOT 4.

trade name of the module	module designation on the label	name	instalation
S0-MIE	Indexer Module	Interface for mechanical indexer ELGAS (only for ELCORplus indexer for Zone 2)	SLOT 0
S0-SCR	SCR Module	Interface for SCR encoder of gas meters	
S0-NAM	NAMUR Module	Interface for NAMUR encoder of gas meters	
S0-EXT1	EXT1 Module	Expansion modules (with board EXT1-T): - 2x VF impulse inputs NAMUR, - 6x digital inputs - 2x analog inputs - 2x connection of digital transducer	
S0-EXT1/HF	EXT1/HF Module	Expansion module: - 2x VF impulse inputs NAMUR,	
S1N-COM1 *)	COM1 Module	Communication module RS232/RS485	SLOT 1, SLOT 2
S1N-2AI *)	AI Module	Analog inputs modules 4-20 mA (2 inputs)	
S1N-2AO *)	AO Module	Analog outputs modules 4-20 mA (2 inputs)	
S4N-PWR3	PWR3 Module	External power supply module of EVC and internal modem	SLOT 4
S4N-PWR4/24V	PWR4 Module	External power supply module of EVC and internal modem	
S4N-PWR4/12V	PWR4 Module	External power supply module of EVC and internal modem	
M2G	Modem 2G	Internal modem 2G	*(according to the design of the device)*
M4G, LTE-Cat1E	Modem LTE-Cat 1 Mod E	Internal modem LTE, cat. 1-E	
M4G, LTE-Cat1U	Modem LTE-Cat 1 Mod U	Internal modem LTE, cat. 1-US	

| M4G, LTE-CatM1U | Modem LTE-Cat M1 Mod U | Internal modem LTE, cat. M1-US | |
| BARP | Barometric Sensor | Module for barometric pressure (only ELCOR*plus*) | |

*) These modules are functionally identical to intrinsically safe modules but they have terminals for connection of external devices protected by the type of protection "nA".

Table 37 Plug-in modules, ELCORplus for Zone 2

Internal modules for positions SLOT 1 and SLOT 2, it means modules:

**S1N-COM1,
S1N-2AI,
S1N-2AO,**

they are functionally identical to intrinsically safe modules, but they have **terminals for connection of external devices protected by the type of protection "nA" and are only intended for zone 2** (check the module's side rating plate).

Devices connected to these modules are connected to the terminals of these modules directly without using a safety barrier.

Marking and using modules for positions SLOT 1 a SLOT 2

**Modules with marking:
S1N-xxxx   ... not suitable for intrinsically safe device design,
S1-xxxx   ... not applicable with ELCOR*plus* for Zone 2.**

Marking and using modules for positions SLOT 4

**Modules with marking:
S4N-xxxx   ... not suitable for intrinsically safe device design,
S4-xxxx   ... not applicable with ELCOR*plus* for Zone 2.**

6.4 Sealing of the 2nd channel

M	Security mark MID (Metrological seal) Zajišťovací značka MID (Metrologická značka)
F	Manufacturer's seal (Factory seal) Zajišťovací značka výrobce
U	User mark Zajišťovací značka uživatele
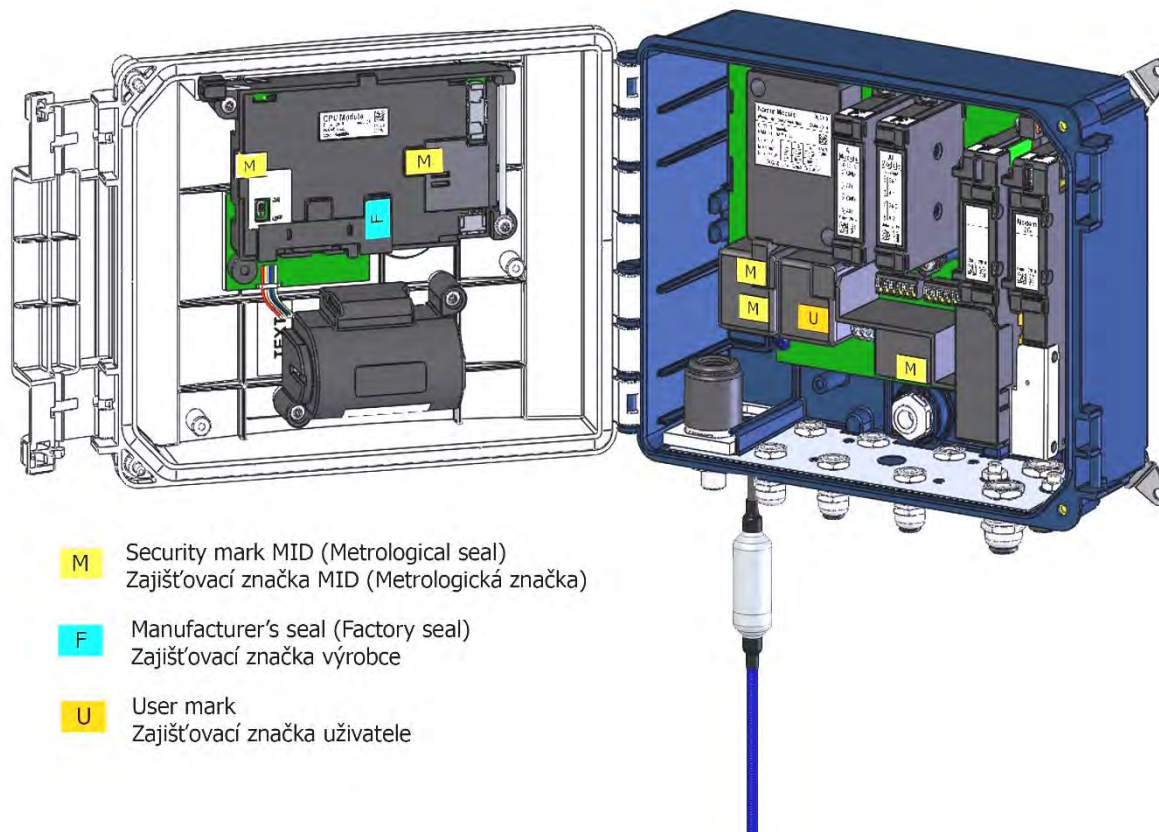
Fig. 81 Sealing of the 2nd channel on ELCORplus for zone 2

7 Technical parameters – modules for external power supply

S4N-PWR3 Module of external power supply EVC and internal modem	
	ELCORplus for Zone 2
max. count of modules in device	1
installation in EVC device	SLOT 4
module identification	providing external power to the converter (EVC) circuits and internal modem from the 230 Vac, 50 Hz power supply network
galvanic separation	Yes
the nominal supply voltage	230 Vac, 50/60 Hz
range of power supply voltage	100 V ÷ 240 Vac, 50/60 Hz
max. power input	25 W
max. input current	0,25 A
design in terms of protection against electric shock	protection class equipment II (ČSN EN 61140)
overvoltage protection	by varistor
identification of terminals for power supply connection	N, L
terminals allow to connect conductor with cross-section	0,2 ÷ 3,3 mm^2

S4N-PWR4/24V Module of external power supply EVC and internal modem	
	ELCORplus for Zone 2
max. count of modules in device	1
installation in EVC device	SLOT 4
module identification	providing external power to the converter (EVC) circuits and internal modem from the 24Vdc power supply network
galvanic separation	yes
the nominal supply voltage	24 Vdc
range of power supply voltage	20 V ÷ 32 Vdc
max. input current	0,5 A
overvoltage protection	yes
identification of terminals for power supply connection	+U, -U
terminals allow to connect conductor with cross-section	0,2 ÷ 3,3 mm^2

S4N-PWR4/12V Module of external power supply EVC and internal modem	
	ELCORplus for Zone 2
max. count of modules in device	1
installation in EVC device	SLOT 4
module identification	providing external power to the converter (EVC) circuits and internal modem from the 12Vdc power supply network
galvanic separation	yes
the nominal supply voltage	12 Vdc
range of power supply voltage	10 V ÷ 16 Vdc
max. input current	0,5 A
overvoltage protection	Yes
identification of terminals for power supply connection	+U, -U
terminals allow to connect conductor with cross-section	0,2 ÷ 3,3 mm^2

8 Connection of inputs and outputs

Connecting the equipment to the intrinsically safe terminals is described in the main section of the manual and also applies to the ELCOR*plus* for Zone 2.

A different connection method applies to terminals that are not intrinsically safe but have "nA" type protection applied, i.e. terminals:

- SLOT 1,
- SLOT 2,
- DOUT
- external power connection.

It is the connection of communication, digital outputs, analog inputs/outputs and external power supply (common for EVC part and internal modem).

8.1 Safety marking of terminals

The device ELCORplus for Zone 2 has on terminals I/O board shown as intrinsically safe signals and so signals with "nA" protection. These two types of signals are distinguished by the type and color of the terminal:

type of signal	terminal blocks on the I/O board	color terminals
signal with protection "nA"	DOUT, SLOT 1, SLOT 2	black
intrinsically safe signal	all others	green (or blue)

Non-intrinsically safe terminals are separated from intrinsically safe terminals on the I / O board by a safety barrier to maintain safety distances according to ČSN EN 60079-11 (see Fig. 82).

> **WARNING!**
>
> **Do not open the device if it is located in a potentially explosive area!**
>
> **Cable leads from external power supply and cable leads to DOUT, SLOT 1 and SLOT 2 terminals must not be connected/disconnected while they are under voltage!**

SLOT 2

SLOT 5

SLOT 0   SLOT 1   SLOT 4

terminals with protection „nA"   **barrier**   **external power**
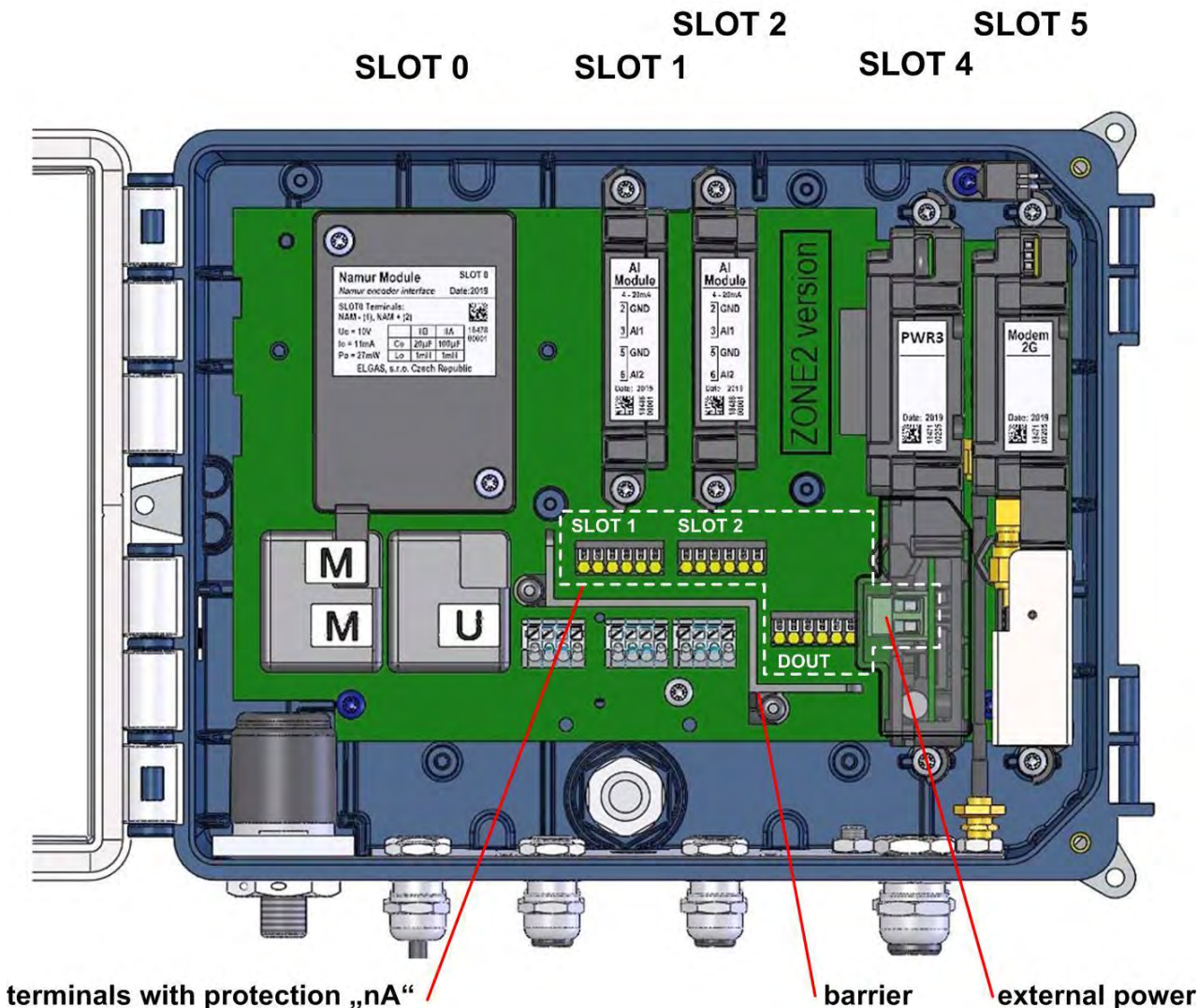
Fig. 82 Terminals with protection „nA"

8.2 Identification of cable glands

> ⚠️ **EX**
>
> The cable glands for intrinsically safe cables are marked with a blue gland nut cover on the device ELCOR*plus* for zone 2.

For cables with standard signals (i.e. non-intrinsically safe signals) - external power supply, communication, digital outputs and analog inputs/outputs, two PG9 cable glands, gland no. 9 and 10 are intended – see Fig. 83 .

For external power supply it is necessary to use separate two-core cable. When using all signals from the SLOT 1 (4-wire), SLOT 2 (4-wire) and DOUT (6-wire) terminal blocks, a 14-core cable must be used.
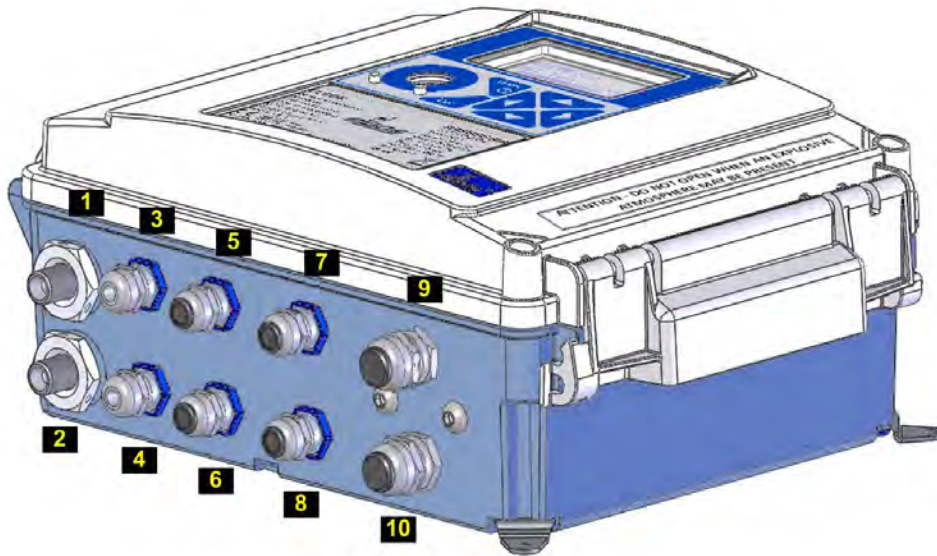
Fig. 83 The deployment of the cable gland

des.	cable	Type of signal	gland
1	pressure (1. channel)	intrinsically safe	PG7
2	temperature (1. channel)	intrinsically safe	PG7
3	gas meter (1. channel)	intrinsically safe	PG7
4	gas meter HF, encoder	intrinsically safe	PG7
5	gas meter (2. channel), digital inputs (DIN)	intrinsically safe	PG7
6	temperature (2. channel)	intrinsically safe	PG7
7	communication	intrinsically safe	PG7
8	external pressure (2. channel)	intrinsically safe	PG7
9	external power supply (for device and modem)	standard	PG9
10	digital outputs (DOUT), communication, event. analog input/output	standard	PG9

Table 38 Cable glands - recommended use for ELCORplus for Zone2

8.3 External power connection

The instrument must have the S4N-PWR3 or S4N-PWR4 module in the SLOT4 position, depending on the type and size of the supply voltage. The device is delivered with a fitted power supply module according to the customer's requirements and without a power supply.

> ⚠️ **NOTICE**
>
> **In the case of a corrector powered from the 230 V mains, there is a risk of death if the conductive parts are touched!**
>
> For this reason:
>
> - Work on the electrical components of the device and connection of the mains supply of the device must be carried out by a worker with the

> appropriate electrical qualification.
>
> - During all activities with electrical equipment, switch off the power supply and check that the device is not live.
> - Keep the inside of the device free of moisture to prevent possible short circuits.

Requirements for the electrical connection of mains-operated equipment
(i.e. with the S4-PWR3 module mounted):

- If the device is installed as a plug-in device, the power outlet must be located near the device and must be easily accessible.

- Hazardous voltage supply lines with operator-accessible insulation must meet the requirements for double insulation or reinforced insulation (this also applies to the connections to the input terminals inside the device, as they are accessible to the operator).

- When the device is installed as a permanently connected device, an easily accessible disconnecting device must work with it. Such a device that disconnects both poles of the power supply. To ensure overcurrent and short-circuit protection, a circuit breaker with a rated current of 4 to 16A must be connected in both poles of the power supply. A two-pole circuit breaker can be used as the disconnecting means.

NOTICE

To ensure proper operation of the device, the applied supply voltage to the device must be treated for interference and overvoltage.

A surge arrester type 3 with HF filter must be used in the power supply near the device.

NOTICE

The wires of external power supply cables must by connecting without under voltage to EVC device!
There is also a risk of electric shock if the power supply is connected!

The power supply cable of the external power supply is connected to the device via cable gland No. 9 (see. Fig. 83). Remove a cover of connector from a module S4N-PWR3/S4N-PWR4 **5** for power supply connecting. The connector-plug **2** is pulled out and the power supply wires **4** are fastened to the terminals of connector **2**. Make sure the polarity of the S4N-PWR4 is correct. Check the cable clamp for tightness for moving. Insert the plug with the power cord plugged into the connector socket **3** on the module fitted in the instrument. Finally, replace the connector cover **5**.

Fix the cable against being pulled out by tightening the nut cable glands.
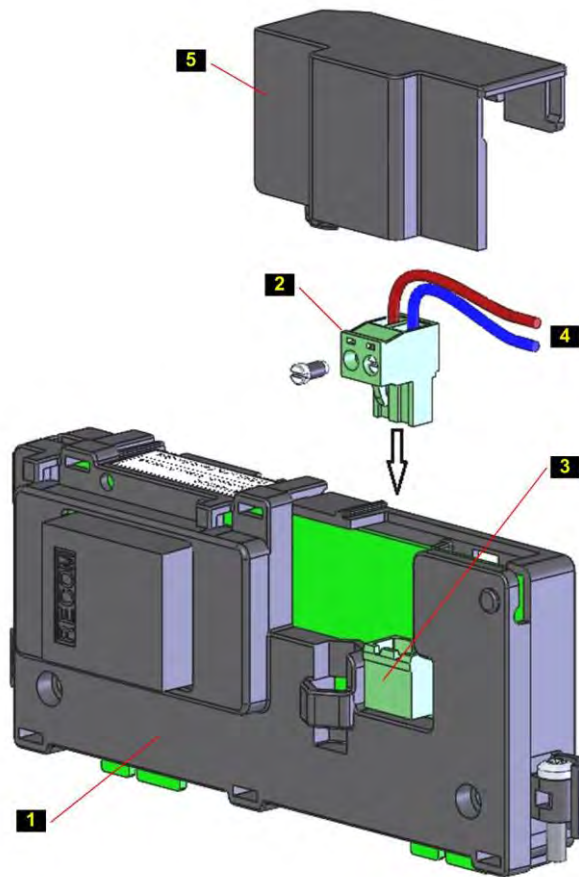
des.	Part
1	pug-in module S4N-PWR3 (S4N-PWR4)
2	connector-plug with terminals for external power supply
3	connector-plug for external power supply to board of module
4	external power supply
5	cover of external power supply

Fig. 84 connecting of external power supply

Note:

Do not connect the external power supply to the terminals when the connector plug **2** *is inserted into module board . The reason is mechanical stress on the connector on the board!*

Choose the power cord diameter with regard to the PG9 cable gland, which is designed for cables with a diameter of 4 to 8 mm.

In the case of **DC power supply**, we recommend using a 2-core shielded cable type UNITRONIC LiYCY with min. wire cross-section 0.25 mm2, and connect its shielding to the cable gland body of the device. Do not connect the shield at the opposite end of the cable.

In case of **mains power supply**, select a cable (power cord) with min. 0,75 mm^2 cross-section.

When the external power supply failure occurs, the conversion battery (B-03) performs a backup function for EVC. The modem power is not backed up by the battery.

> **Notice**
>
> If the converter is powered by an external power supply, it is necessary for the conversion battery power supply (B-03) of the converter to be inserted and connected in the device.

8.4 Connection of communication devices via RS232 / RS485 interface

For communication, ELCOR*plus* for Zone 2 must have at least one S1N-COM1 communication module. The module must be installed in SLOT 1 and/or SLOT 2. The module offers RS232 or RS485 communication interface. A maximum of two S1N-COM1 communication modules can be installed in the device. In this case, it is possible to communicate on two completely independent communication lines. The cable is connected to terminal block SLOT 1 and / or SLOT 2.

Note:

Module S4-COM0 is not possible to use in device.

SLOT 1, SLOT 2	RS232	RS485
terminal	signal	signal
1	---	D1+
2	---	D1-
3	GND	GND
4	CTS	U1+
5	RxD	---
6	TxD	---

Table 39 Terminal block assignment of SLOT 1 and SLOT 2 when fitted with S1N-COM1 module

Communication device (PC, modem, PLC automat etc.) is connecting directly with module S1N-COM1 (resp. to terminals SLOT 1 and SLOT 2) without safety isolation barrier.

We recommend using a shielded cable of the UNITRONIC LiYCY type as the connecting cable. The number of cores and the conductor cross-section depend on the required outputs and parameters of the PG9 cable gland (cable gland No. 10, see Fig. 83). The cable is common to signals from SLOT 1, SLOT 2 DOUT terminals. The PG9 cable gland is designed for cable diameters of 4 to 8 mm.

Recommended cables:

signal	number of cores	Recommended types of cables with max. cross section of cores	cable diameter
only SLOT 1 or SLOT 2	4	Unitronic LiYCY 4 x 0,34 Lappkabel	5,7
from SLOT 1 and SLOT 2	8	Unitronic LiYCY 8 x 0,34 Lappkabel	7,8
only digital outputs DOUT (4x)	6	Unitronic LiYCY 6 x 0,5	7,6

		Lappkabel	
from SLOT 1 (or SLOT 2) and DOUT (4x)	10	Unitronic LiYCY 10 x 0,25 Lappkabel	7,5
from SLOT 1, SLOT 2 and DOUT (4x)	14	Unitronic LiYCY 14 x 0,14 Lappkabel	6,7

Table 40 Recommended cables for RS232 and RS485 converters

Recommendation:

When you connect an external modem to the device, we recommend using the RS232 communication interface to ensure full duplex communication.

In terms of data transmission, the ELCOR*plus* for Zone 2 is a DTE device, i.e. for the RS232 interface:
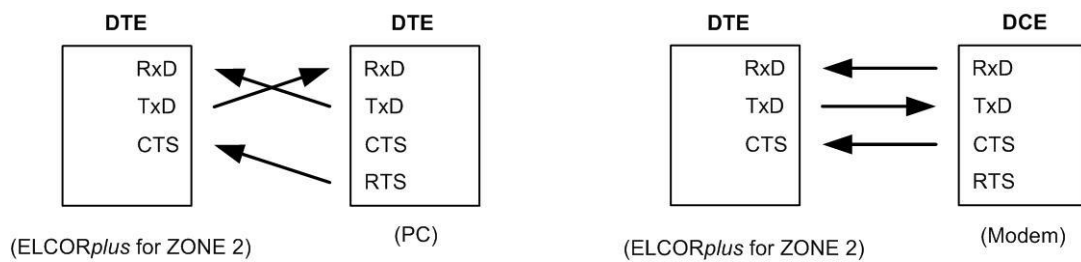
In the case of ELCOR*plus* for Zone 2, there is no need to use the B-RS (B-RS / A) safety barrier that included signal crossing. For this reason, it is necessary to check the correct wiring of the cables used:

9 Examples - block diagram of connection
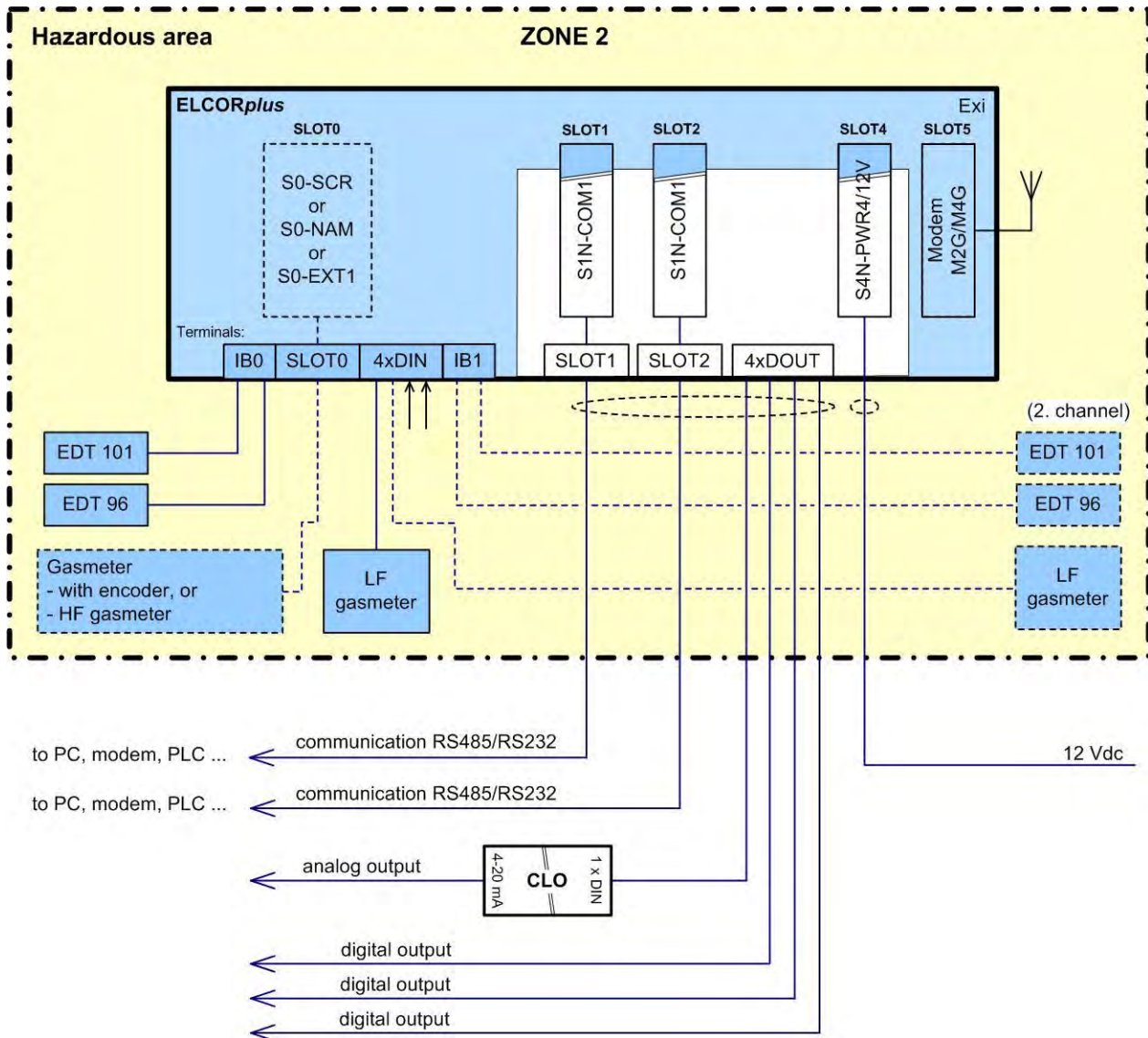
Fig. 85 Block diagram, ELCORplus for Zone 2 with ext. 12V power supply
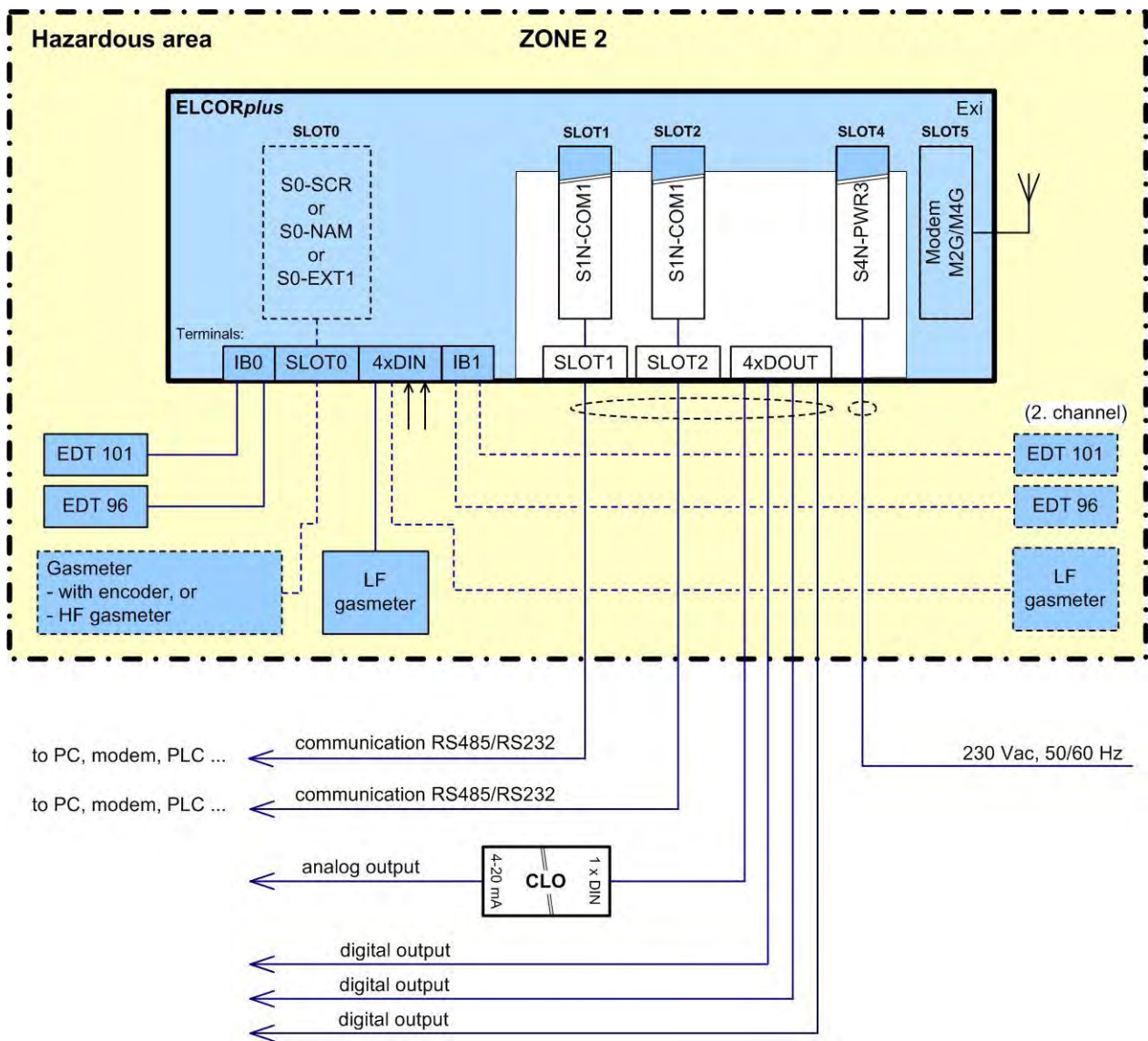
Fig. 86 Block diagram, ELCORplus for zone 2 with ext. 230V power supply

Appendix 3: Compass – Data Export

1. Export parameters to PDF
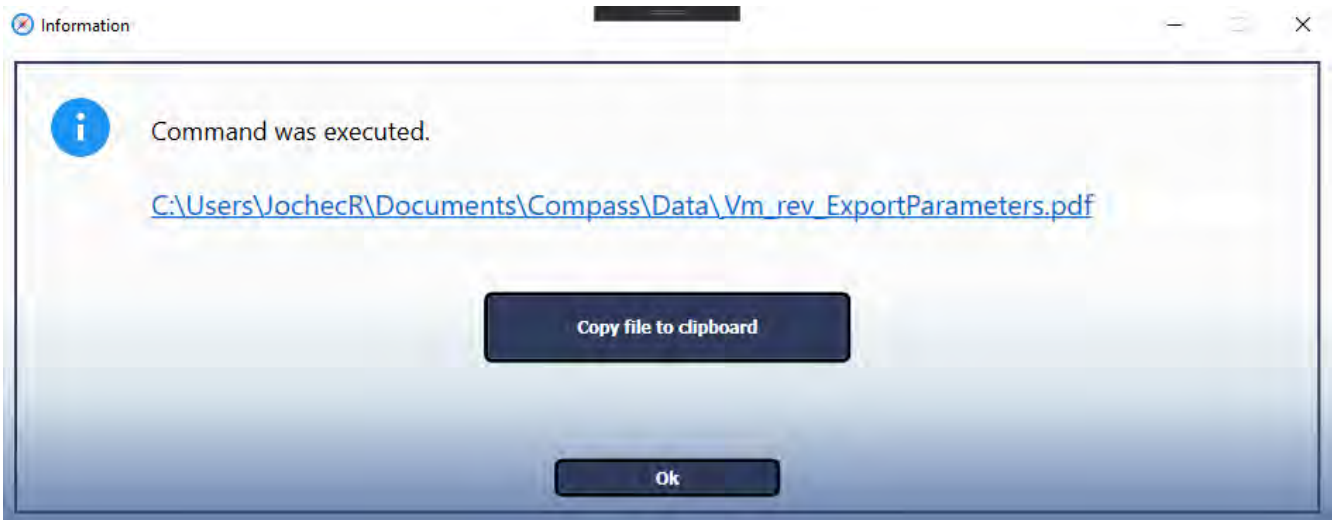
At the end of the generating process is opened this window:

System

General

Station identification:	0000000000000001
Serial number:	0
Device:	Not found: Variant
Time Export:	06.08.2020 09:45:26
Construction year:	20Not found

Firmware

Version: application:	ver.1.16
CRC:	0000
Version: loader:	ver.1.02
CRC:	0000
Version: metrological:	ver.1.16
CRC:	0000

Compressibility

Compressibility method:	AGA 8-G2
Relative density by 101.325 kPa/0°C:	0.587 [kg/m3]
Calorific value for temperature combustion/gas:	1091.283 [Btu/ft3]

Base values

Pressure:	14.65 [PSI]
Temperature:	60 [°F]

Default units

Pressure (Base, bar. and const.):	PSI
Temperature (Base and const.):	°F

Preview of generated document:

2. Read the archive from the device

Click on the export button after reading any archive from the device. Use the arrows to select which columns you want to export. The resulting PDF file contains the export of parameters (as in paragraph 1) and plus the last 30 records from the selected archive. This option cannot be performed if we are opening data from a DB or DT file.
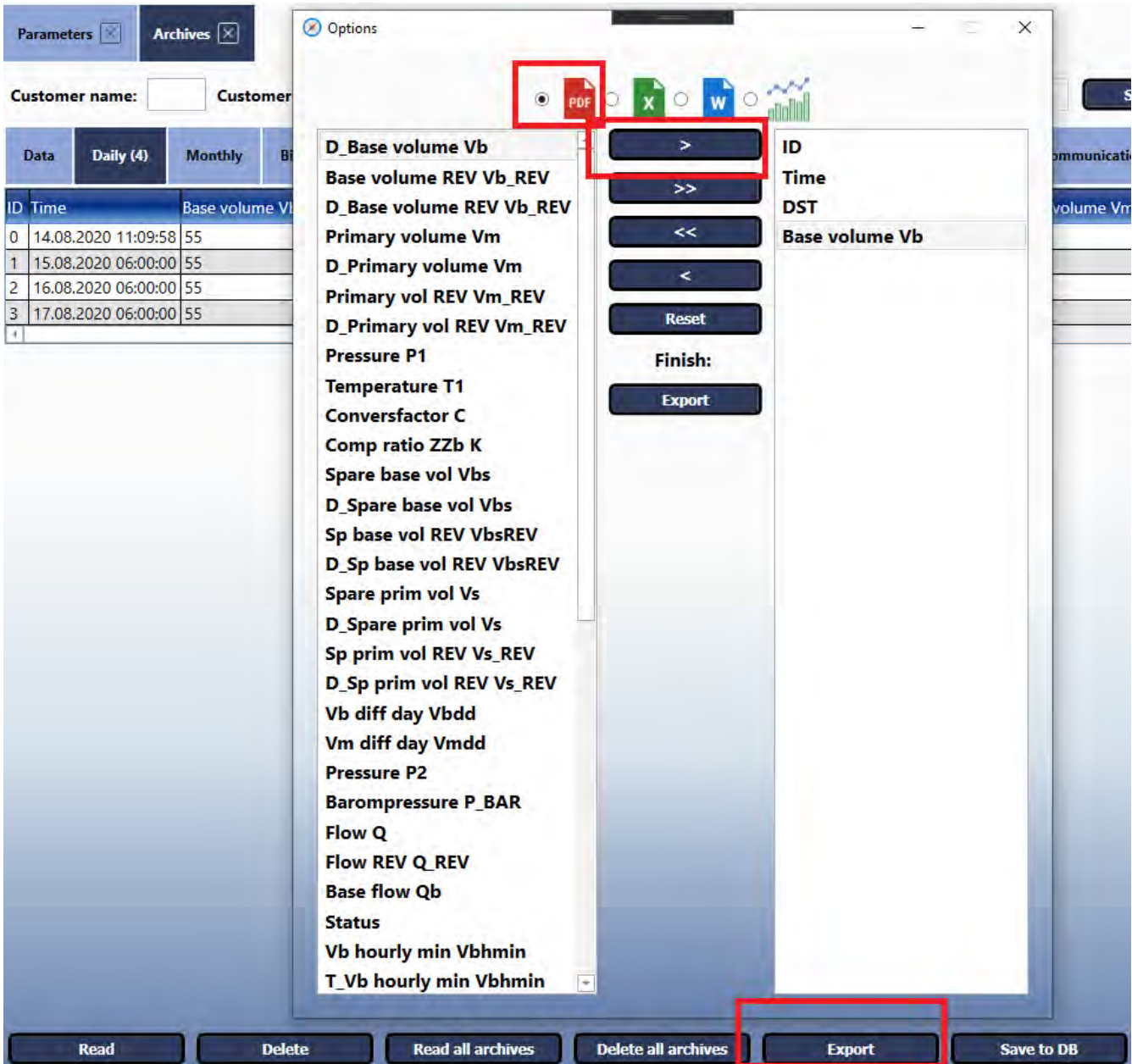
Archive Daily (4)

Record: 1
ID	0
Time	8/14/2020 11:09:58 AM
DST	False
Base volume Vb	55

Record: 2
ID	1

Compass   www.elgas.cz

Station identification: SNGPL_new_Vm_rev   Serial number: 1746100018

Time	8/15/2020 6:00:00 AM
DST	False
Base volume Vb	55

Record: 3
ID	2
Time	8/16/2020 6:00:00 AM
DST	False
Base volume Vb	55

3. Export to   XLS

	A	B	C	D
1	ID	Time	DST	Base volume Vb
2	0	8/14/2020 11:09:58 AM	0	55
3	1	8/15/2020 6:00:00 AM	0	55
4	2	8/16/2020 6:00:00 AM	0	55
5	3	8/17/2020 6:00:00 AM	0	55

4. Export to TXT (DOC)

DailyArchiveExport.txt – Poznámkový blok

Soubor Úpravy Formát Zobrazení Nápověda

```
ID Time                     DST   Base volume Vb
 0 8/14/2020 11:09:58 AM False              55.00
 1 8/15/2020 6:00:00 AM  False              55.00
 2 8/16/2020 6:00:00 AM  False              55.00
 3 8/17/2020 6:00:00 AM  False              55.00
```
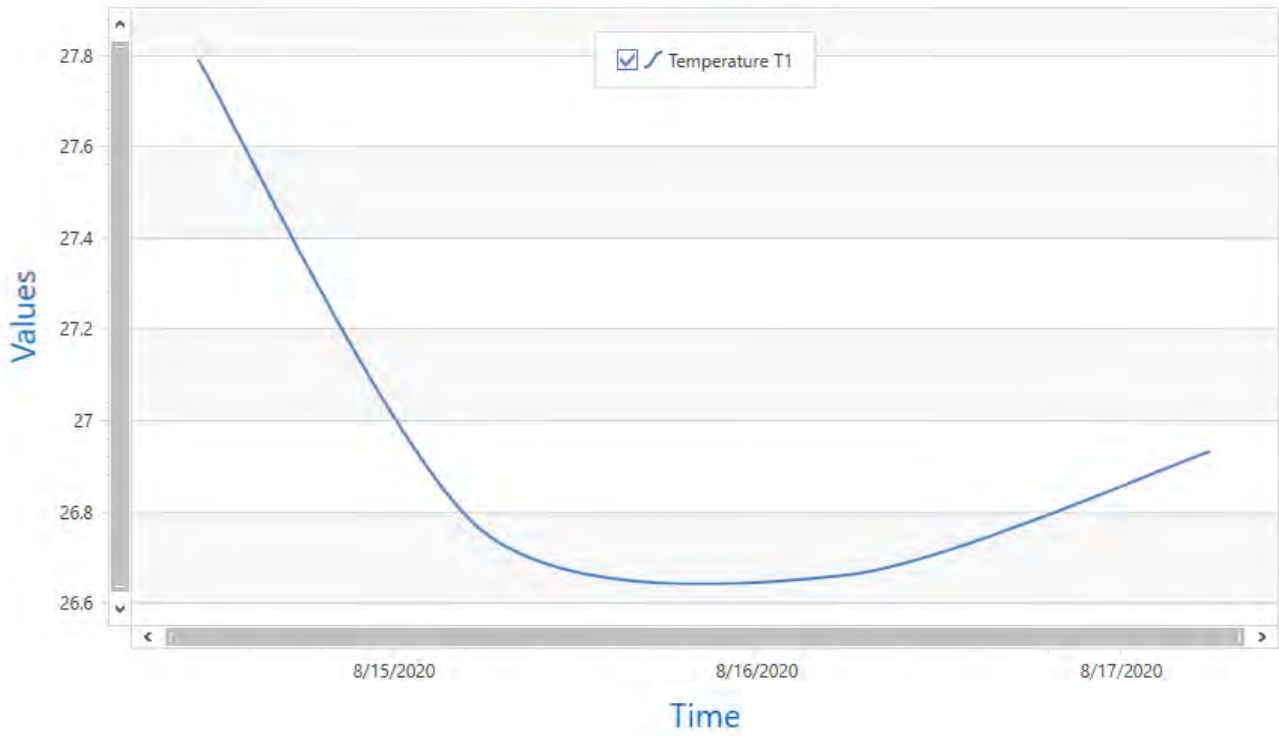
5. Export of graph

13 References

[1]   Act no. 22/1997 Sb. Zákon o technických požadavcích na výrobky a o změně a doplnění některých zákonů (Act no. 22/1997 Coll. on the Technical Requirements for Products, and on a change and addition to certain laws

[2]   ČSN EN 60079-0 ed.4 (33 2320): III.2013–Elektrická zařízení pro výbušnou plynnou atmosféru–Část 0: Všeobecné požadavky. (Electrical apparatus for explosive gas atmospheres — Part 0: General requirements

[3]   ČSN EN IEC 60079-0 ed.5 (33 2320): XXII.2018 – Výbušné atmosféry – Část 0: Zařízení - Všeobecné požadavky. (Explosive atmospheres - Part 0: Equipment - General requirements)

[4]   ČSN EN 60079-11 ed.2 (33 2320):VI.2012–Výbušné atmosféry –Část 11: Ochrana zařízení jiskrovou bezpečností „i" (Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i".)

[5]   ČSN EN 60079-15 ed.3 (33 2320):XXII.2010 – Výbušné atmosféry –Část 15: Zařízení chráněné typem ochrany „n" (Explosive atmospheres - Part 15: Equipment protected by protection type "n")

[6]   ČSN EN 60079-26 ed.3 (33 2320):VII.2015 – Výbušné atmosféry – Část 26: Zařízení s úrovní ochrany (EPL) Ga (Explosive atmospheres - Part 26: Equipment with level of protection (EPL) Ga)

[7]   ČSN EN 12405-1 (25 7865): I.2006, +A1: II.2007 – Plynoměry – Přepočítávače množství plynu – Část 1: Přepočítávání objemu. (GAS METERS - CONVERSION DEVICES - PART 1: VOLUME CONVERSION Gas Meters - Conversion Devices - Part 1: Volume Conversion)

[8]   EN 12405-1: X.2018 – Gas meters - Conversion devices - Part 1: Volume conversion

[9]   OIML R 140 Edition 2007 (E), Measuring systems for gaseous fuel/ Měřicí systémy pro plynné palivo, INTERNATIONAL RECOMMENDATION

[10] EN 60079-14:2014 Explosive atmospheres – Part 14: Electrical installations design, selection and erection

[11] ČSN EN 61000-4-2 (33 3432): VII.1997 + A1: VII.1999 + Z1: XI.2001 - Elektromagnetická kompatibilita (EMC) - Část 4-2: Zkušební a měřicí technika - Elektrostatický výboj - zkouška (Electromagnetic compatibility (EMC) - Part 4-2: Testing and measuring technology - Electrostatic discharge - resistance test)

[12] ČSN EN 61000-4-3 (33 3432) ed.3:2006 + A1:2008+ Z1: 2010 - Elektromagnetická kompatibilita (EMC) - Část 4-3: Zkušební a měřicí technika - Vyzařované vysokofrekvenční elektromagnetické pole - zkouška odolnosti. (Electromagnetic compatibility (EMC) - Part 4-3: Testing and measuring technology - Radiated electromagnetic field - resistance test)

[13] ČSN EN 61000-4-4 (33 3432) ed.2:2005 - Elektromagnetická kompatibilita (EMC) - Část 4-4: Zkušební a měřicí technika - Rychlé elektrické přechodové jevy/skupiny impulzů - zkouška odolnosti. (Electromagnetic compatibility (EMC) - Part 4-4: Testing and measuring technology - Fast electrical transient phenomena/pulse groups - resistance test)

[14] ČSN EN 61000-4-6 (33 3432) ed.2:2008 - Elektromagnetická kompatibilita (EMC) - Část 4: Zkušební a měřicí technika - Oddíl 6: Odolnost proti rušením šířeným vedením indukovaným vysokofrekvenčními poli. (Electromagnetic compatibility (EMC) - Part 4: Testing and measuring technology - Section 6 Resistance to conducted disturbances

induced by radio-frequency fields)

[15] ČSN EN 61000-6-2 (33 3432) ed. 3:2006 – Elektromagnetická kompatibilita (EMC) – Část 6-2: Kmenové normy – Odolnost pro průmyslové prostředí. (Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Resistance to the industrial environment)199/828

[16] ČSN EN 61000-6-4 ed.2:2007

[17] ČSN EN 62056-21 (35 6131): IV.2004 – Měření elektrické energie - Výměna dat pro odečet elektroměru, řízení tarifu a regulaci zátěže – Část 21: Přímá místní výměna dat. (Measurement of electric energy - Data exchange for meter reading, tariff control and load control - Part 21: Direct local data exchange)

[18] ČSN 33 2000-4-41 ed.2: VII.2007 - Elektrotechnické instalace nízkého napětí – Část 4-41: Ochranná opatření pro zajištění bezpečnosti - Ochrana před úrazem elektrickým proudem. (Low voltage electrical installations - Part 4-41: Safety precautions - Protection against electric shock)

[19] Modicon Modbus Protocol Reference Guide, Modicon Inc., Industrial Automation Systems, 1996

[20] FTZÚ 17 ATEX 0143X – EU-Type Examination Certificate, Gas-Volume Conversion Device ELCOR, ELCORplus, ELCORplus indexer, Datalogger DATCOM, DATCOMplus, FTZÚ Ostrava-Radvanice

[21] FTZÚ 19 ATEX 0002X – Type Examination Certificate, Gas-Volume Conversion Device type ELCORplus for Zone 2, Datalogger type DATCOMplus for Zone 2, FTZÚ Ostrava-Radvanice

[22] IECEx FTZU 17.0023X Certificate of Conformity

[23] CZ/FTZU/ExTR17.0023/00 IECEx Test Report IEC 60079-11

[24] FTZÚ 19 ATEX 0046 – EU – Type Examination Certificate, Accessories, FTZÚ Ostrava-Radvanice

[25] TCM 143/18-5562 EU-Type Examination Certificate, Czech Metrology Institute, Notified body No. 1383

[26] TPG 902.01

[27] ČSN EN ISO 12213-3:2010 Zemní plyn-výpočet kompresibilitního faktoru-Část 3: Výpočet pomocí fyzikálních vlastností (Natural gas - calculation of compressibility factor - Part 3: Calculation using physical properties)

[28] Zákon č. 185/2001 Sb., o odpadech (Act No. 185/2001 Coll., on Waste)

[29] 194300-238/2019 Test Report Electromagnetic Compatibility - Immunity, VTÚPV Vyškov

[30] 194300-278/2019 Test Report Electromagnetic Compatibility - Immunity, VTÚPV Vyškov

[31] 194300-277/2019 Test Report Electromagnetic Compatibility - Emission, VTÚPV Vyškov

[32] EN 62305-3:2011 Protection against lightning – Part 3: Physical damage to structures and life hazard

[33] HD 60364-5-534:2016, Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control – Clause 534: Devices for protection against transient overvoltages

[34] EN 50174-1:2018 Information technology – Cabling installation – Part 1: Installation specification and quality assurance

[35] EN 50174-2:2018 Information technology – Cabling installation – Part 2: Installation planning and practices inside buildings

[36] EN 50174-3:2013 Information technology – Cabling installation – Part 3: Installation planning and practices outside buildings

[37] LR1502 Certificate of Compliance, QPS Evaluation Services Inc., September 2019

14 Related Documents

[38]   COMPASS – Software description. User Manual. Elgas, s.r.o.

[39]   EDT 96 Pressure transducer. User Manual. Elgas, s.r.o.

[40]   EDT 101 Temperature transducer. User Manual. Elgas, s.r.o.

[41]   Accessories for ELCOR and ELCORplus correctors and DATCOM and DATCOMplus data loggers, ELGAS, s.r.o.

15 Software

[42]   COMPASS.exe, Elgas, s. r. o., supplied with the device

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

[44]   Reliance, GEOVAP Pardubice

16 Trade Marks Used

{1}   IrDA$^®$ - trade mark of Infrared Data Association company

{2}   ModBus$^®$ - trade mark of Modicon company

17 List of Figures

18 List of Tables

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