GAS-VOLUME CONVERSION DEVICE

PTZ-BOX 3.0

Manual
Specifications
Technical Description
Mounting instructions
Configuration

Single-channel gas conversion device
Approved for installation in potentially explosive atmospheres.

February 2017

Safety Measures

This measurement device can be operated only by an operator trained in compliance with the technical terms, safety regulations, and standards. It is necessary to consider any other legal and safety regulations stipulated for special applications. Similar measures also apply for special applications. Similar measures also apply for using the accessories. The operator training must be in compliance with Decree no. 50.1978 Coll.

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

TABLE OF CONTENTS

Used symbols and definitions

Symbol	***Description***	***Unit***
AGA8-G1	Compressibility calculation method	
AGA8-G2	Compressibility calculation method	
AGA8-92DC	Compressibility calculation method	
AGA NX-19 mod	Compressibility calculation method	
ASC	Accredited Service Centre	
BTS	Base Transceiver Station	
CL-1 Module	Analogue output module (4-20mA)	
CRC	Checksum – used for data protection	
CTR	Communication protocol	
Kx MODULE	Some of the products of series Kx module (K1 MODULE, K2 MODULE, K3 MODULE, K3/A MODULE, K4 MODULE, K4/A MODULE)	
DLMS	Communication protocol	
DC	Direct Current voltage	
dE	Increment of energy	MJ
dV	Increment of primary volume V_m or V_c	m^3
dV_b	Increment of base volume	m^3
dV_c	Increment of corrected primary volume	m^3
dV_m	Increment of primary volume	m^3
E	Energy	MJ
Es	Estimated value of energy	MJ
PA1.1	Digital pressure sensor PA1.1 (RS485/Modbus connection)	
TA1.1	Digital temperature sensor TA1.1 (RS485/Modbus connection)	
EMC	Electromagnetic compatibility and resistance	
EMI	Electromagnetic radiation	
firmware, FW	Software equipment loaded in the device	
GOST NX-19	Compressibility calculation method (related with AGA NX-19 mod) according to VNIMS directive (valid at temperature range -23°C to +60°C)	
H_s	Combustion heat (Superior heating value)	MJ/m^3
IS	intrinsic safety, intrinsically safe	
JBZ-0x	Some of the JBZ-01, JBZ-02, JBZ-02/A products	
Modbus	Communication protocol designed by Modicon [15]	
M900	Specific communication protocol	
SGERG-88	Calculation method of gas compressibility factor, more details in [17]	
SNAM	Communication protocol	
SW	Software for PC	
C	Conversion factor	-
K	Ratio of compressibility factors (Z/Z_b)	-
k_p	Gas meter constant (number of impulses per 1 m^3)	imp/m^3

Symbol	***Description***	***Unit***
N	Number of input impulses from gas meter	imp
p	Absolute pressure at measurement conditions	kPa
p_b	Absolute pressure at base conditions	kPa
Q_m	Flowrate at measurement conditions (further primary flowrate)	m^3/h
Q_b	Flowrate at base conditions	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 (further primary volume)	m^3
V_c	Corrected volume at measurement conditions (volume corrected based on correction curve of gas meter)	m^3
V_b	Volume at base conditions (hereinafter also the standardized volume)	m^3
V_{bs}	Error volume at base conditions (hereinafter also the error standardized volume)	m^3
V_s	Error volume at measurement conditions (hereinafter also the error operational volume)	m^3
V_d	Difference of primary volume	m^3
V_{bd}	Difference of base volume	m^3
V_f	Tariff counter of primary volume	
V_{bf}	Tariff counter of base volume	
Z	Compressibility factor at measurement conditions	
Z_b	Compressibility factor at base conditions	

1 Introduction

1.1 Basic device description

The Electronic gas volume converter PTZ-BOX 3.0 (hereinafter called: “the device”) is a measuring instrument designed for the conversion of the gas volume measure at measurement conditions to volume at base conditions.

The information on the gas volume passing through is measured using the impulse outputs of the gas meter. The gas temperature and pressure are measured by integrated converters. The device calculates the ratio of compressibility factors of gas using standard methods or a constant value is used.

The device has been constructed and approved according to the EN 12405-1 standard as a conversion device type 1 (compact system) and can be supplied as a T, PT, or PTZ conversion device.

From safety point of view the device is constructed according to EN 60079-11 as intrinsic safe.

It is manufactured and supplied in compliance with the following European Parliament directives:

2014/34/EU	Equipment and protective systems for use in potentially explosive atmospheres
2014/30/EU	Electromagnetic compatibility
2014/32/EU	Directive on measuring instruments

Device is put on the market and into usage according to above mentioned standards and is marked with CE mark.

The device is built in a casing with sturdy plastic with IP65 protection. It is equipped with a graphic display and a 10-button keypad. Furthermore, it has impulse inputs for the connection of a gas meter with LF or HF impulse output and binary inputs. The device is also suitable for connection to encoder outputs of a gas meter. The binary inputs can work as check inputs to check the connection with a gas meter or can have a different function, e.g. monitoring the conditions of safety snap locks, doors, etc. The device has 4 available outputs. These can be configured as impulse or binary outputs, or as data outputs for the CL-1 module. When using this module, an analogue current output can be realized.

The device is powered by a lithium battery. The life cycle of the battery is 6 years in the standard work mode. An external power supply source can be used in applications with higher demands.

The device has a data archive of the measured values with an adjustable structure and storing period. The binary archive stores changes on the binary inputs and the occurrence of the monitored events (limits, etc.) Error conditions are stored in a status archive. It is possible to program the storing of important parameters and calculations and storage of some statistical values in the daily and monthly archive. The archive has settings for service and metrology; in case of changing the settings, these settings, as well as the counter values, date and time are recorded. Other available logs are mentioned in 7.3.

For communication with a superior system, the device has a serial interface (RS-232 and RS-485). Various communication protocols installed in the device allow easier connection to SCADA systems. The device cooperates with common phone, radio, GSM, and GPRS modems, and in case of an alarm condition, it can initiate the connection.

The device can be extended by one non-metrology sensor for measuring pressure or temperature. This extension can be performed without breaking the official mark on an already installed device.

Basic configuration of the PTZ-BOX 3.0 offers**:**

- analogue input (pressure P - metrological channel)
- analogue input (temperature T - metrological channel)
- 4x digital input DI1 to DI4 (binary, pulse); input DI1 can be used for connecting a NAMUR encoder
- 4x digital output DO1 to DO4 (binary, pulse, analogue)
- communication channel RS485/RS232 for communication with superior system
- input of external power supply
- option: connection of one digital pressure sensor PA1.1 or one digital temperature sensor TA1.1 (non-metrological) to the internal bus via the EDT expansion board. This extension can be accomplished by the end user on an already installed device without breaching metrological seals.

The device can be configured using the supplied SW [22] for PCs. This SW also allows the readout, display and archive of both the immediate measured values as well as the contents of the internal device archives.

1.2 Function principle

1.2.1 Conversion using the equations of state

The device obtains data on the gas volume via impulses (N) from an LF or HF sensor located in the gas meter. The volume at the measuring conditions (V) is calculated from the number of impulses (N) and gas meter constant (k_p).

The device obtains other data on the gas from the temperature and pressure sensors. This data is used to calculate the conversion factor (C) which is influenced also by: Absolute temperature at base conditions (T_b), absolute pressure at base conditions (p_b) and compressible factor of the gas at base conditions (Z_b).

Volume at measuring conditions (operational volume):

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

Ratio of 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 base conditions (standardized volume):

$$V_b = V * C$$

The gas compressibility factor expresses the deviation of properties of natural gas from the properties of an ideal gas. By setting the parameters, it is possible to choose a specific method for calculation of the compressibility factor according to the standard (AGA NX-19 mod, AGA8-G1, AGA8-G2, SGERG-88 or AGA8-92DC). A constant compressibility value can be used for other gases besides natural gas. If the pressure or temperature value gets out of the limits of the validity of the chosen standard, the device calculates using a default compressibility value.

The device calculates the gas flow from the impulse frequency on the input in real time using mathematical filtration from the input signal.

Operational flow:

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

Where: ΔV ..... *increment of operational volume*

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

The value of the flow displayed on the converter display is updated every 10 seconds.

Standardized flow:

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

1.2.2 Error values of volumes at measuring conditions and volumes at base conditions

For calculation during error conditions (i.e. in case of a sensor error, deviation of the parameter value from the working range, or device error), the device has counters of the error volume at measuring conditions (V_s) and error volume at base conditions (V_{bs}). These counters are interconnected with the pertinent counters of volume at normal conditions.

A detailed description of device behaviour during normal and error conditions is in paragraph 4.4.

1.2.3 Volume correction at measurement conditions

Device enables to compensate gas meter error according to predefined correction curve from gas meter test certificate. This function and parameters V_c can be activated only by the manufacturer or by an accredited service center to ensure that the used gas meter correction curve as a function of the flowrate Qm is valid within the working conditions.

The error of measurement is corrected by using the function $f(Q_m)$. The corrected volume is:

$$V_c = V_m \times f(Q_m)$$

where

V_c	Corrected volume at measurement conditions
V_m	Primary volume
Q_m	Primary flowrate

Linear interpolation method is used for getting values between calibration points. The file with correction values is to be inserted into the device by using the service software [21]. Information about the insertion of a correction curve into the device is logged in the setup archive.

The principle of the volume calculation is explained in Fig. 1

Condition for use of volume correction.

1. Correction is possible only in the case that the gas meter transmits at least 10 pulses per second which means the use of HF sensors is required.
2. Under Q_{min} the correction is not applied and over Q_{max} the value of the correction coefficient given for Q_{max} will be used.

1.2.4 Conversion of volume to energy

The device can calculate the energy content from the consumed quantity of gas. This conversion uses the value of the combustion heat H_s. The calculation is made with the differences dV_b (and dV_{bs}) multiplied by the actual value of the combustion heat H_s.

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

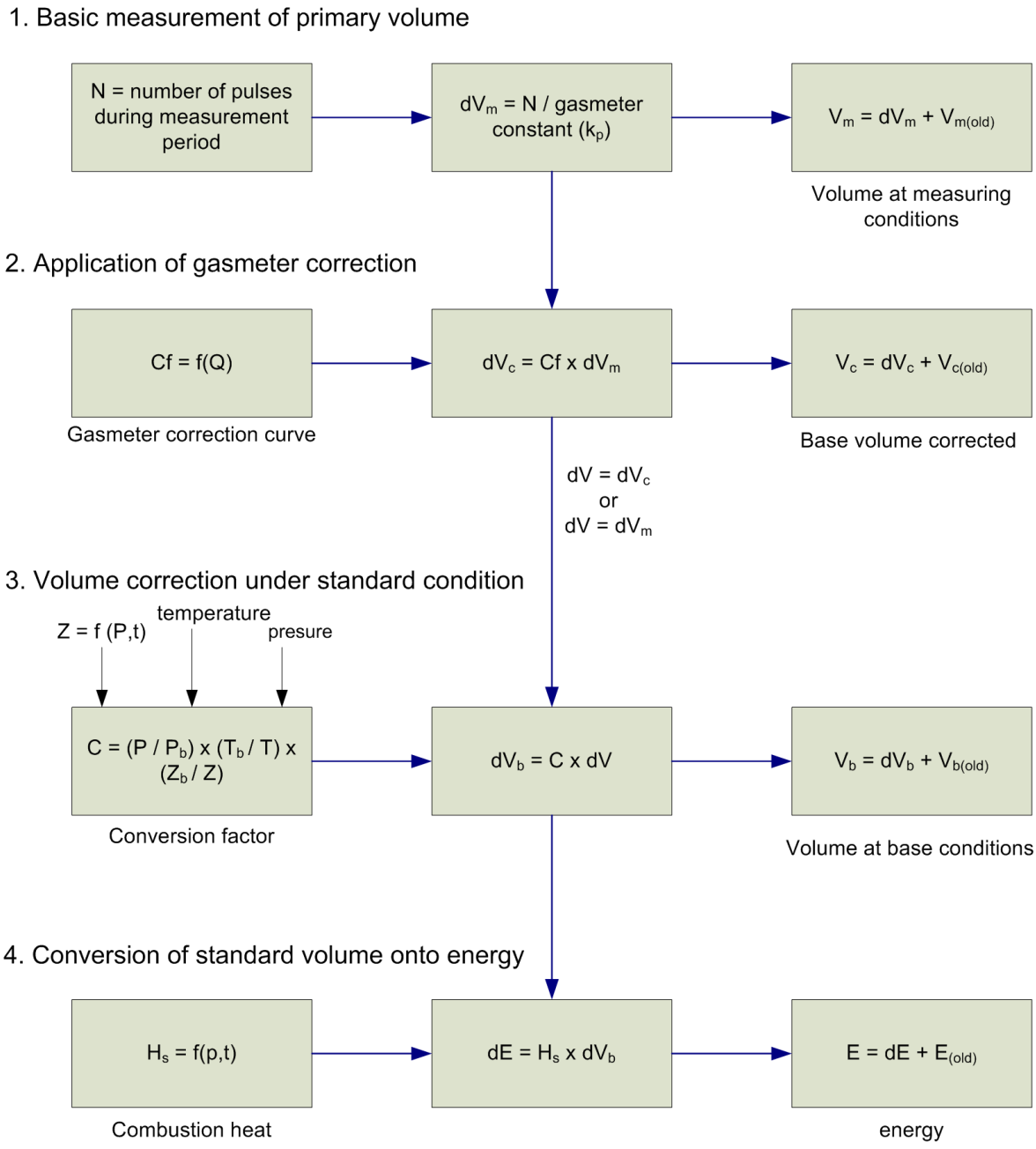
Two counters (energy counter E and error energy counter E_s) are dedicated for measurement in units that can be selected to present the value in MJ, kWh or Btu. No conversion of the absolute counter value (E or Es) is performed after the change of measurement units. Following increases are added in the new units.

Principle diagram of energy calculation is drawn at Fig. 1

Combustion heat Hs

To get a correct conversion it is necessary to enter the right value of the combustion heat and the related conditions. Then the device will make a new conversion of the relative temperature for the defined relative conditions and the final value will be used for the energy calculation. In case of the AGA8-92DC method the combustion heat is not entered as a fixed value but calculated from the gas composition according to EN ISO 6976. For the other methods the value of H_s (MJ/m3) must be entered manually and always under the conditions:

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



LEGEND:			
C	conversion factor	T	absolute temperature at measurement conditions
Cf	gasmeter volume correction	T_b	absolute temperature at base conditions
dE	energy addition	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 measurement conditions
dV_m	adition primary volume	$V_{c(old)}$	corrected volume at the end of previous measurement period
E	energy	V_m	volume at measurement 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	combustion heat	Z	Gas compressibility factor at measurement conditions
P	absolute pressure of gas	Z_b	Gas compressibility factor at base conditions
P_b	absolute pressure at base conditions		

Fig. 1 Volume and energy calculations - Scheme

1.3 Device dimensions

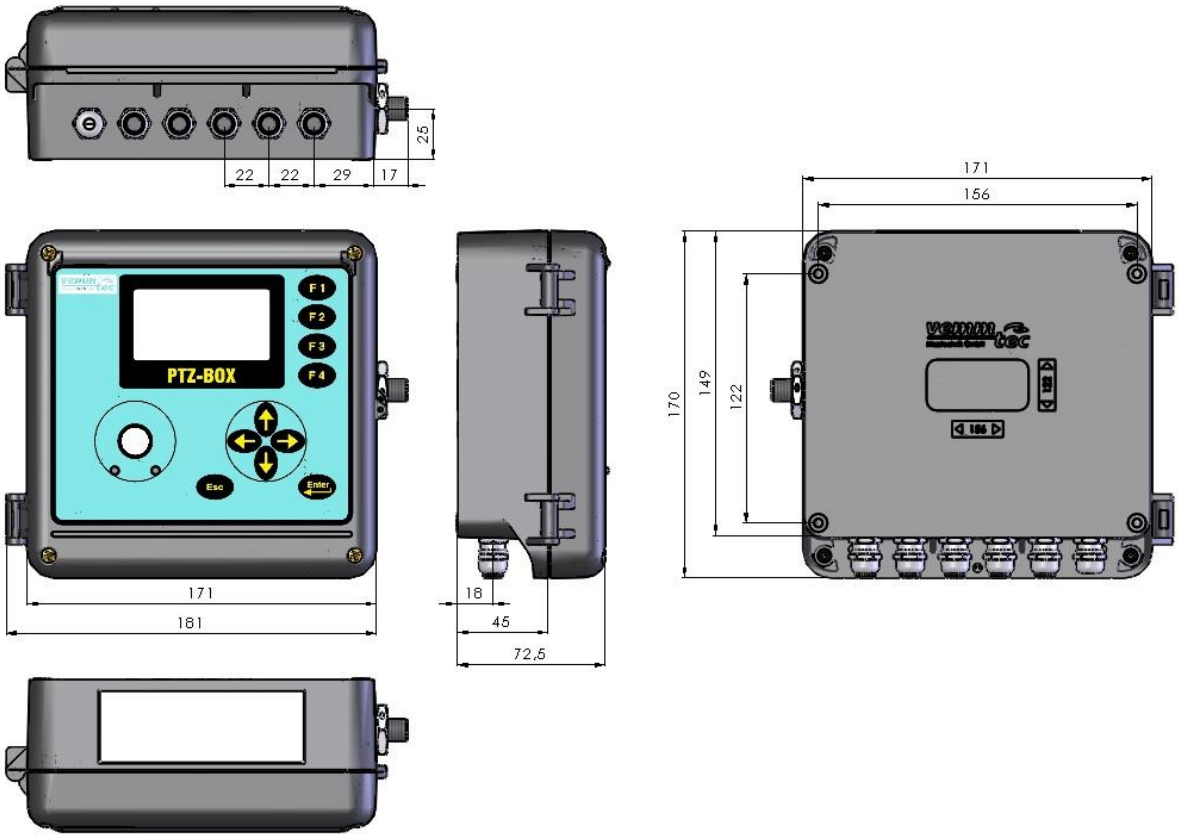


Fig. 2 Device dimensions

2 Device technical description

2.1 Device architecture

The device's electronics are laid out on three basic boards.

The bottom part of the casing contains the input/output board with the battery and back-up battery and terminals for connecting the pressure and temperature sensors and device inputs and outputs. The connections related to the metrological function of the converter are protected by covers which are secured with official seals.

Optionally, the input board can have an extension board (EDT port) for connecting an additional digital pressure sensor (PA1.1) or digital temperature sensor (TA1.1). This additional digital sensor communicates with the converter using the Modbus RTU protocol (via RS-485). More information can be found in chapter 17.

The lid of the housing contains a processor board that is protected by a cover and secured by an official seal. The board cover has an opening for access to the service switch. The service switch can be used to enable/disable the setting of the device parameters using a service SW.

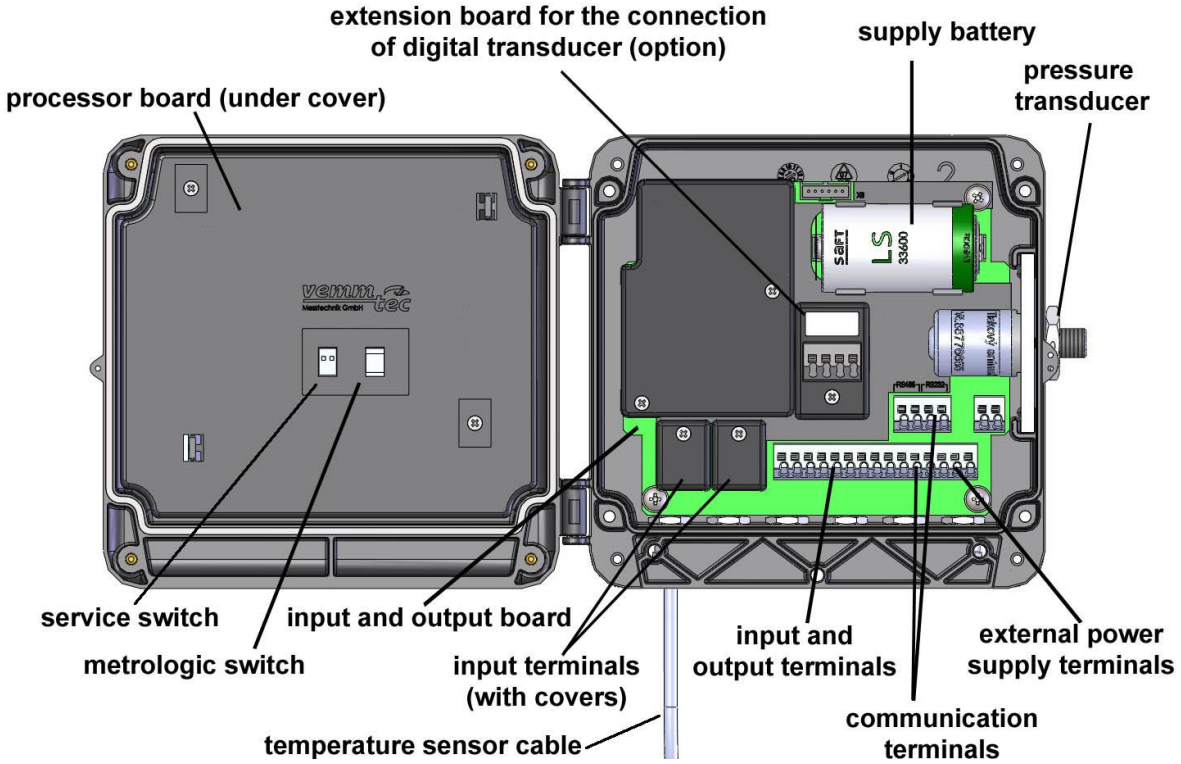


Fig. 3 Main parts of the device

2.2 Power supply

2.2.1 Main supply battery

The device is powered by a built-in (lithium) battery with a voltage of 3.6 V. The life cycle of the battery depends especially on the configuration of the device, the frequency of communication, and the time the display is on. The consumed capacity is calculated during the device's activity and the capacity decrement is recorded in its memory. The device will issue an alert to replace the battery 90 days before the expected discharge (error message **E9** – see paragraph 9.4.8.

Standard mode for a life cycle of the main supply battery of more than 5 years:

- Archiving period of the data archive 1x per hour
- Communication with device 2 min/day
- Activating the display 2 min/day
- Frequency of input impulses ≤10 Hz
- Measuring period 15 s
- Ambient temperature 25 °C

If the device is operated with higher consumption than in the defined mode, it is necessary to count on a more frequent replacement of the battery or use a network power source.

2.2.2 Replacement of main supply battery

Replacement of main supply battery is allowed in the hazardous area but only with recommended type of battery.

It is advised to disconnect a discharged battery as soon as possible. While the battery is being replaced, the device does not measure pressure or temperature, but counts the incoming LF impulses (but does not convert the number of pulses, this will be performed when the supply battery is connected again) and insures that the real time clock is running. The data stored in the device archives and parameter settings will remain.

To correct the calculation of the remaining battery capacity after replacement it is necessary to reset the battery calculation with service SW [22]. In the parameter file, select the hardware module and press the button „Change battery“.

Discharged batteries are in the hazardous waste category. According to European directives and other internal directives batteries must not be disposed together with household waste.

2.2.3 Back-up battery

The battery ensures the back-up of important functions in case of the discharge or replacement of the supply battery. The back-up battery can be replaced in an accredited service center after the official and security seal is broken (replacement cannot be performed in a potentially explosive atmosphere). It is necessary to use the same type of battery: **Only recommended battery type may be used.**

Standard mode for a life cycle of the back-up battery of 10 years

- Storage temperature 25 °C
- Backed-up inputs (DI1 – DI4) not connected or connected contacts disconnected
- Does not depend on the presence of the supply battery

Standard mode for a life cycle of the back-up battery of 4 years

- Backed-up inputs (DI1 – DI4) short-circuited
- Without powering battery

Self-discharging of batteries

The back-up and supply batteries are lithium type. Their capacity drops due to self-discharging. The recommended time frame for their replacement is 10 years, even if the battery was never connected.

2.2.4 External power supply

Use of an external power supply is **required** in case of:

- NAMUR HF pulse input
- Binary output
- NAMUR encoder.

External power supply is **recommended** in case of increased current consumption like:

- frequent communication (more than once a day),
- frequent LCD displaying

An approved intrinsically-safe power source must be used for the external power supply. The internal power sources of the communication modules Kx Modules can be used if no NAMUR sensors are connected.

If a NAMUR sensor is connected: always use an external power source JBZ-02 or JBZ-01.

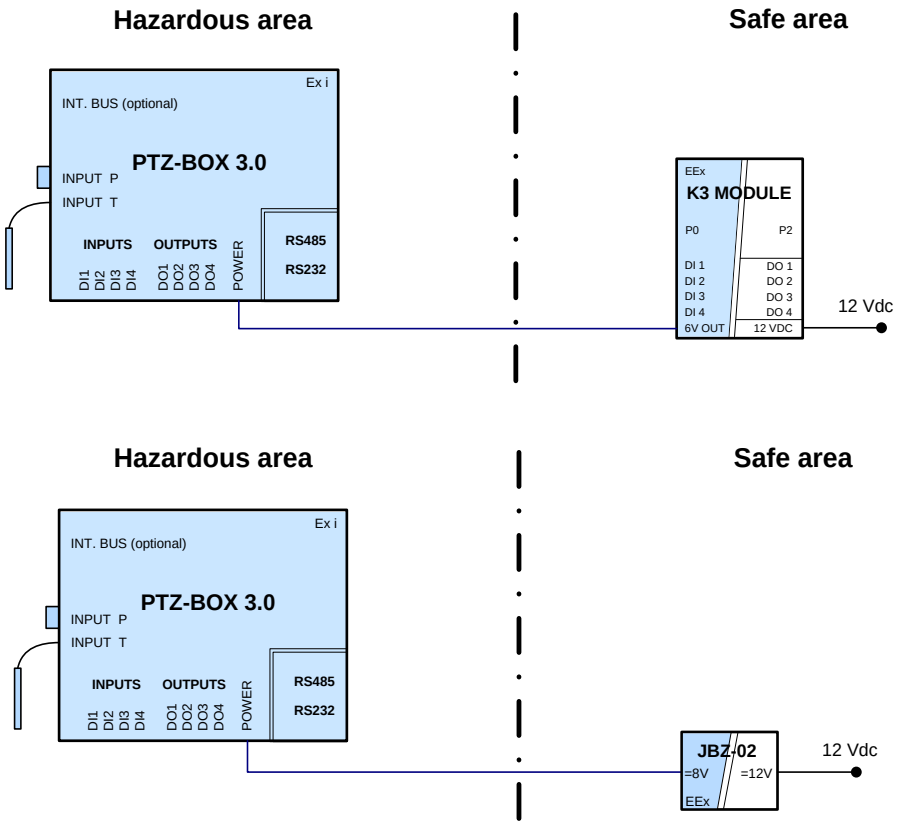


Fig. 4 Examples of external power supply

2.3 Security seals

Security seals located on the device indicate the technical condition of the device regarding unauthorized handling.

Security seal of the manufacturer (metrological seal)

- its design is stipulated by the Approval certificate on the quality management system for production, output control, and testing pursuant to Enclosure no. 2, procedure D, ND no. 464/2005 Coll., issued by the Notified Body no. 1383. Such security mark has the same importance for the user as the so called official seal according to the Act on Metrology.

In case such a seal is broken, the manufacturer does not guarantee that the properties of the device are in compliance with the EC Certificate on type verification.

User seal

- control seal of the user (seals) as needed

Seal of the manufacturer

- control seal of manufacturer as needed

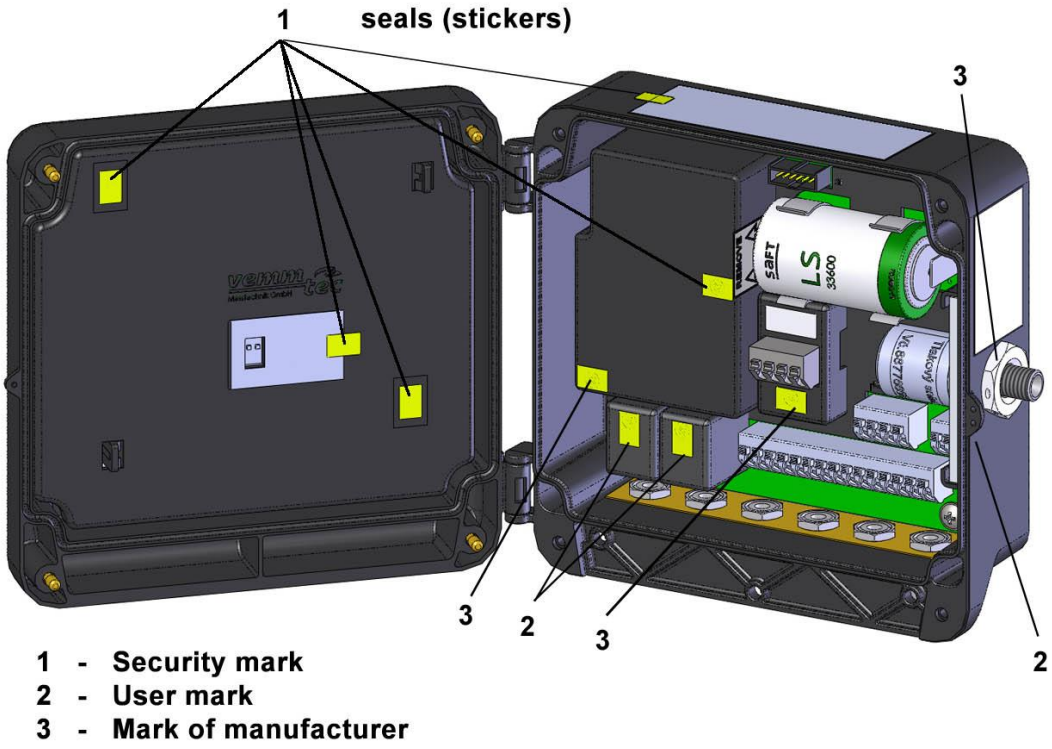
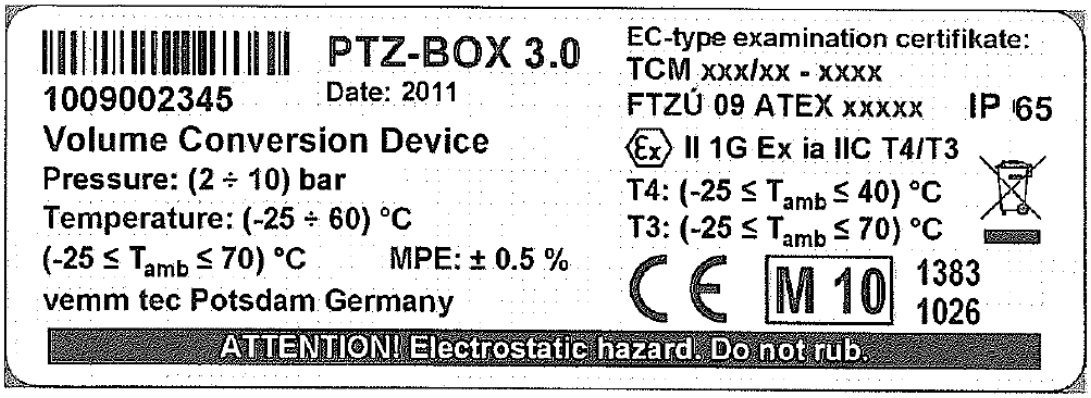


Fig. 5 Security marks

2.4 Product label



3 Safety instructions

3.1 General

The device has been approved according to the guideline 94/9/CE (2014/34/EU) and an EC certificate on type approval (ATEX) has been issued for its use in potentially explosive atmospheres. Respecting this guideline is mentioned in the CE compliance notation.

3.2 Use in potentially explosive atmosphere

Device is fully in compliance with EN 60079-26 ed.2 (see [4]).

Based on the EC certificate in the verification 11 ATEX 0015X, the device can be operated in potentially explosive atmospheres with a classification of ZONE0.

Indication of the device regarding safety against explosion:

II 1G Ex ia IIC T4/T3	**PTZ-BOX 3.0**	**Zone 0**

Environment temperature for temperature class T4: -25 °C to +40 °C
Environment temperature for temperature class T3: -25 °C to +70 °C

The device has been constructed and approved as intrinsically safe. That means that only approved devices (intrinsically safe devices, consecutive devices) or so called simple devices complying with the EN 60079-11 standard and complying with the intrinsically safe parameters listed in the EC Certificate on type verification [16] can be connected to the device connectors.

The applicable safety standards must be met when connecting.

When connecting a device, it is necessary to consider the electrical characteristics of the connecting cables and respect the requirements of the applicable safety standards. Furthermore, it is necessary respect the Special conditions of use provided these certificates contain them. The parameters of non-explosiveness of the device are listed in chapter 13.

3.3 Risks of use

Device cabinet is made of polycarbonate. A keypad foil of polystyrene is placed on the top cover. In some extreme cases electrostatic charge accumulated on surface of cabinet could cause explosion. To avoid explosion it is strictly recommended to keep the following rules:

- At hazardous the zones device must not be installed at places where ambient conditions could create an electrostatic charge.
- Device may only be cleaned by humid wiper.

3.4 Special conditions of use

1. **The device must not be installed or located in an environment with a potential danger of electrostatic charge of the device casing (e.g. by flowing air, etc.) Only a damp cloth must be used if the device is being cleaned, to prevent the creation of electrostatic charge.**
2. **Only the following types of batteries are allowed to be used in the device: Main supply battery: Saft LS33600, Backup battery: Saft LS14250.**

3.5 Using different groups of gas

Individual variants of device can be used only with certain groups of gas according to this table.

Group of gas / Device variant	**IIC**	**IIB**	**IIA**
PTZ-BOX 3.0	yes	yes	yes

4 Metrological characteristics

4.1 Temperature measurement

This device uses the PT1000 temperature sensor to measure temperature. The temperature sensor's connection is two-wired. The influence of the length and the characteristics of the cable used are considered during calibration and therefore do not influence the accuracy of the temperature measuring.

The temperature measuring range is -25 °C to +60 °C. The measuring period is equal for both the temperature and pressure sensor and it can be custom set at a range from 1 s to 30 s. The temperature measurement units can be adjusted.

Replacement of the temperature sensor is protected by the security seal of the manufacturer (metrological seal) and can be performed solely at an Accredited Service center (ASC).

During device configuration, the user must enter the **Default temperature value**. This value will be used for the calculation of compressibility instead of the measured temperature value in the following cases:

- The value of the measured temperature are out of the measuring range
- An error occurred when measuring the temperature

4.2 Pressure measurement

Pressure measurement is performed by an analogue converter. The converter contains a piezoresistive silicon sensor with a resistant stainless steel membrane. The device electronics ensures the correction of non-linearity and the temperature dependency of the pressure sensor based on the calibration data saved in the device memory. The measuring range of the pressure converter must be requested by the customer when ordering the device. The available pressure ranges are listed in chapter 12.

The measuring period is equal for both the measuring of temperature and pressure, and can be custom set at a range from 1 to 30 s. The pressure measuring units can be set.

Replacement of the pressure converter is protected by a security seal of the manufacturer (metrology mark) and can be performed solely at an Accredited Service center (ASC).

During device configuration, the user must enter the constant parameter **Default pressure value**. This value will be used for the calculation of compressibility instead of the measured pressure value in the following cases:

- The value of the measured pressure are out of the measuring range
- The device is manufactured without the pressure converter (so called TZ or T corrector)
- An error occurred when measuring the pressure

4.3 Compressibility calculation

4.3.1 PTZ, TZ conversion

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

Calculation of the compressible factor is performed in each measuring period. In the SGERG-88 and AGA8-G1 methods the value of the heating value is entered for the combustion temperature 25°C / gas temperature 0°C. The service SW contains a built-in calculator for the conversion of the heat of combustion at different temperatures.

Due to the required accuracy of the device, the use of the individual methods of calculation of compressibility is limited by the pressure and temperature ranges according to the following table:

Pressure measuring range	Method			
	AGA NX-19 mod	SGERG-88	AGA8-G1 AGA8-G2	AGA8-92DC
80 ÷ 520 kPa	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C
200 ÷ 1000 kPa	N/A	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C
400 ÷ 2000 kPa	N/A	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C
700 ÷ 3500 kPa	N/A	-10 ÷ +60 °C	-10 ÷ +60 °C	-25 ÷ +60 °C
1400 ÷ 7000 kPa	N/A	-10 ÷ +60 °C	-10 ÷ +60 °C	-25 ÷ +60 °C
80 ÷ 1000 kPa	N/A	-25 ÷ +60 °C	-25 ÷ +60 °C	-25 ÷ +60 °C
400 ÷ 7000 kPa	N/A	-10 ÷ +60 °C	-10 ÷ +60 °C	-25 ÷ +60 °C

Table 1 Limitation of standard validity range of compressibility calculation

Note:

Additionally the GOST NX-19 method is applied which is not approved in the MID certificate. The use of the GOST NX-19 method is limited to a temperature range from -23°C to +60°C.

Default compressibility

For the set method during each calculation, it is checked whether the measured pressure and temperature value are in the valid range of the selected method. If values are outside the valid range, the so called default compressibility is used for the conversion. The value of the default compressibility must be entered by the user during device configuration.

4.3.2 PT, T conversion

The device also allows the setting of the ratio of compressibility factors (K) as a fixed constant. The range of the entered constant is not limited.

4.4 Volume measurement and calculation

For measurement and volume calculation the following counters are used for each channel.

V_m	Primary volume counter (Actual volume)
V_c	Corrected volume counter (volume corrected based on gas meter correction curve)
V	Volume V_m or V_c
V_s	Counter of the actual volume under error conditions (error actual volume)
V_b	Counter of volume at base conditions (standardized volume)
V_{bs}	Counter of standardized volume under error conditions

4.4.1 Operation at error conditions

In case of error conditions, the device will count the actual value as well in the counter of the actual volume (V) and in the counter of the error volume at measuring conditions (V_s). The values of the volumes at base condition (V_b) will stop being counted in the counter of the volume at base conditions (V_b), and will calculate from the default values of pressure or temperature and will be stored in the counter of the error volume at base conditions (V_{bs}). During this condition, the values are not stored in the counter of volume at base conditions (V_b).

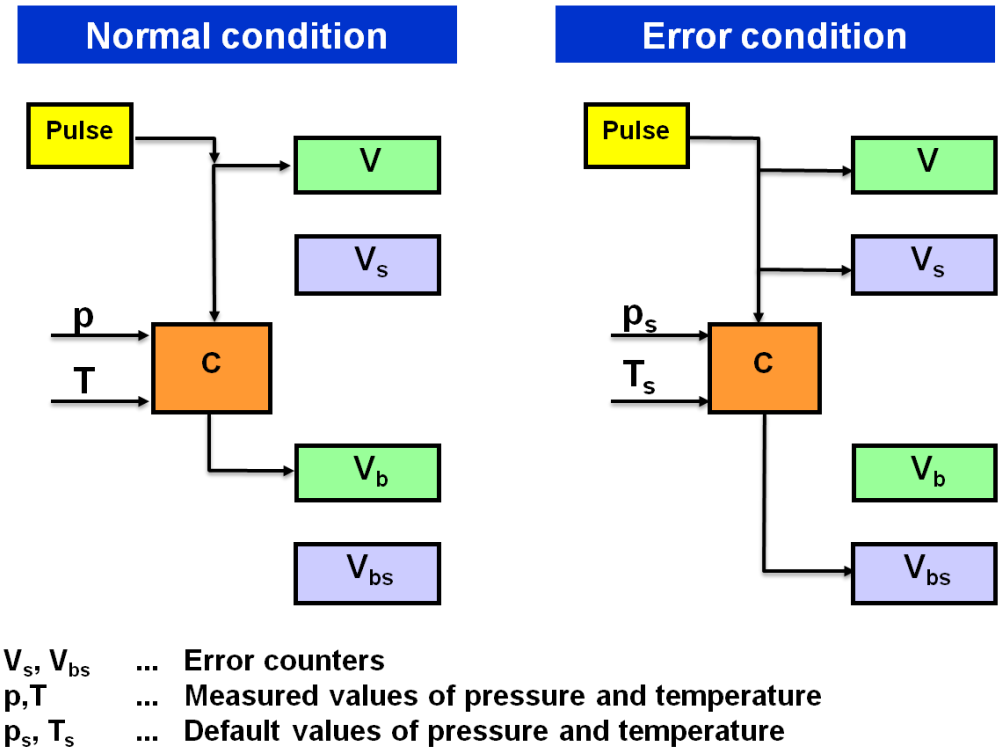


Fig. 6 Storing impulses in counters

If a default compressibility is used during the calculation (when temperature or pressure are out of the valid range of the compressibility calculation formula) (see article 4.3.1), whereas pressure or temperature are not outside the measuring range; the converted volume is stored in the error counter.

4.4.2 Recognition of a changing gas flow direction

Flow direction detection is enabled for gas meters equipped with two phases shifted LF sensors or encoders. Corrector evaluates gas flowrate respecting direction changes (Pic. 7) under following terms:

- If primary volume additions are positive: volume processing is made by standard procedure (for example increasing of V_m and V_b, or V_{ms} and V_{bs}).
- If gas flow direction is changed device will fix the value of primary volume counter at the moment of turn. When gas flows back only primary volume V_m (or V_{ms}) is updated. The other counters are frozen.
- After returning back to the correct direction counting will get blocked out into appropriate counters (V_b, V_{bs}) only after reaching level of primary volume where reversed flow was started up. Primary volume counter is equivalent to gas meter counter all the time.

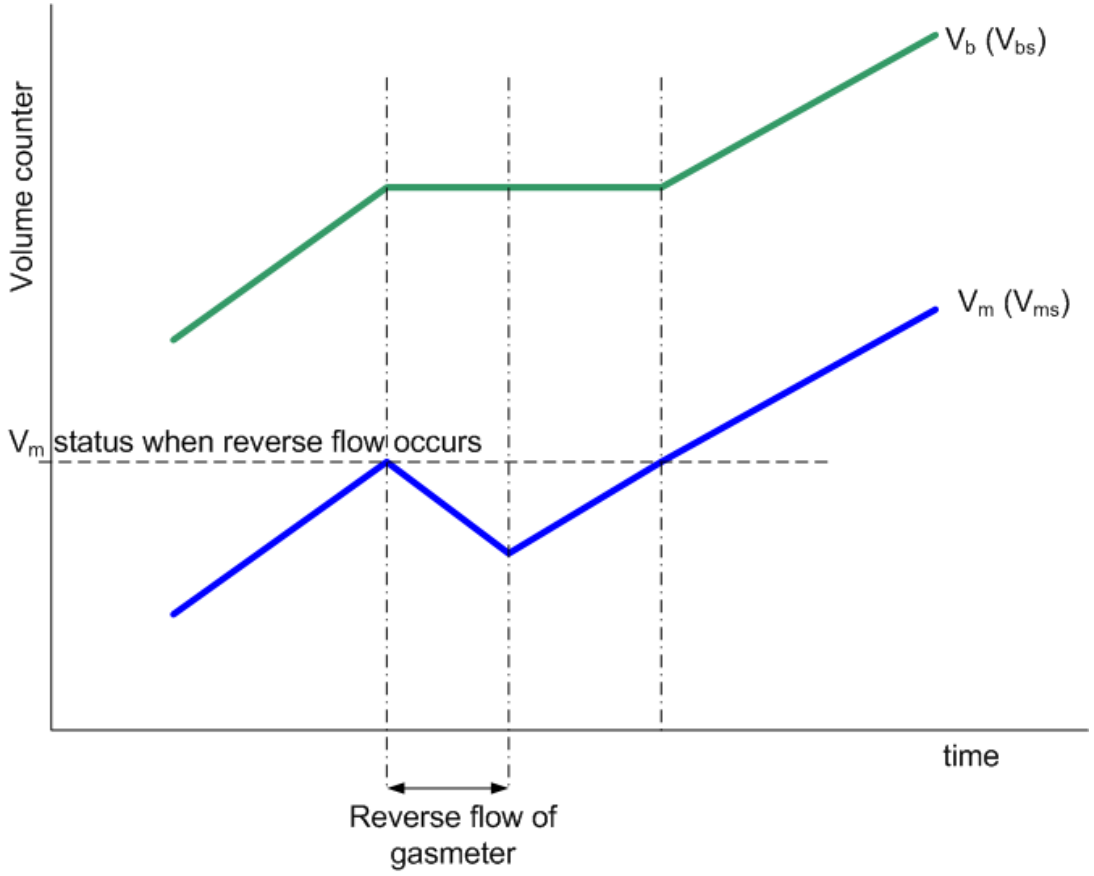


Fig. 7 Processing of volumes during reversed flow

5 Inputs and outputs

5.1 Inputs

A total of 4 digital inputs marked as DI1 to DI4 can be connected to the device. The inputs are provided at the terminal board inside the device. The digital inputs can be adjusted as a binary or as a LF impulse by using the service SW. The DI1 and DI2 can also be set as HF NAMUR impulse or as a binary NAMUR type. In devices with FW ver. 4.xx input DI1 may be setup also for connection with NAMUR encoder.

Input	Binary contact	Binary NAMUR	LF impulse	HF impulse	NAMUR encoder
DI1	√	√	√	√	√
DI2	√	√	√	√	-
DI3	√	-	√	-	-
DI4	√	-	√	-	-

Table 2 Digital inputs setting options

5.1.1 LF impulse inputs

Serves to read impulses from a gas meter. The flow measuring function can be chosen for these inputs. The back-up battery ensures preservation of counters' conditions and reading the impulses of the LF inputs also in case of the discharge or replacement of the supply battery. After connection of the supply battery, the impulses read during missing voltage of the supply battery are added to the error counters. The LF impulse input is, on the DI1 and DI2 inputs, connected between the terminals LF+ and LF- (see Fig. 8).

Changing measuring units, setting the gas meter constant

The measuring units of the impulse inputs can be changed using the service SW [22]. The conversion constants of the gas meter and S/N of gas meter can be set using the service SW as well, as also directly from the device keyboard. When setting the value of the gas meter constant, only decimal folds or fractions in range from 0.01 to 100 are expected.

Number of places of counters of LF impulse inputs

In the case of LF impulse inputs, the counter works with 9 valid digits, the gas meter constant influences the size of the maximum number from 9 999 999.99 (for constant = 0.01) to 99 999 999 900 (for constant = 100).

5.1.2 HF impulse inputs (NAMUR)

The inputs DI1 and DI2 can be configured for processing HF NAMUR impulses. Due to the fact that these sensors require a supply voltage higher than the voltage of the supply battery of the device, the converter must have an external supply voltage higher than 7 Vdc (e.g. from JBZ-02) for the registration and processing of HF impulses.

The flow measuring function can be chosen for these inputs. The back-up battery ensures the preservation of counters' conditions in case of a failing external power supply even in the case of discharge or replacement of the supply battery, but

it does in this case not count the impulses. The terminals for the HF NAMUR inputs are marked HF+ and HF- (see Fig. 8).

Changing measuring units, setting the gas meter constant

The impulse inputs measuring units and the gas meter constant can be adjusted using the service SW. The gas meter constant and S/N of gas meter can be also set from the device keyboard.

Number of places of counters of the HF impulse inputs

In the case of HF impulse inputs, the counter works with 9 digit places.

5.1.3 Connection with gas meter via encoder

Gasmeter can be connected with corrector via an NAMUR encoder. In this case the digital value of the gas meter counter is transferred into EVC. The use of an encoder is approved for metrological use by the EC- MID type approval.

NAMUR Encoder

No special HW is required for the use of a NAMUR encoder. The only condition for NAMUR encoder data processing is the use of an IS external power supply (JBZ-02 or JBZ-01).

NAMUR Encoder input

Connection between EVC and encoder is made with a shielded two wire cable. The NAMUR encoder can only be connected via the digital input DI1. Terminals for the encoder are the same as for HF pulse inputs marked HF+ and HF- (correct signal polarity is important.). NAMUR encoder connection must be setup in the EVC parameters with service SW [22].

5.1.3.1 Device specification with encoder

Data from an encoder are transferred into EVC via shielded two wires cable. Together with the absolute value of gas meter counter there are transferred other additional data like S/N, gas meter constant, nine positions for counter overturning). These additional data are read out with service SW [22] usable at device configuration.

In case of an error in the communication between EVC and encoder then an asterisk symbol " * " after the actual primary volume. Manual setup of primary volume counter V_m is not allowed at encoder input.

Installation and replacement of gas meter

When the actual counter value of the gas meter is transferred into the EVC after connection of the encoder and the EVC a big difference might occur at the primary volume Vm. To prevent against affection of base volume Vb (Vbs) it is necessary to keep following instruction:

1. In service SW [22]: display device parameters; select subject „Hardware" and the push button „Change gas meter". During encoder exchange the processing of the primary volume from the gas meter will be stopped. (Follow further follow instructions on the PC display).
2. Physically connect the encoder to the EVC.

3. After connection of the encoder finish installation/exchange with OK button.

During installation/exchange (point 1) no differences are added to the applicable counters which are marked on display with exclamation mark. If point 3 is not finished by one hour exchange procedure will be closed automatically at service SW.

5.1.4 Binary inputs

These inputs monitor the input signals with the option of an evaluation of the condition “connected” (i.e. log. 0) or “disconnected” (log. 1). The device allows evaluation of binary inputs from no-potential outputs (reed contact or open collector – these signals are on DI1 and DI2 inputs connected to terminals LF+, LF-) or from NAMUR sensors (DI1 and DI2 inputs, terminals HF+, HF-). NAMUR sensors require an external power supply of the converter higher than 7 V (JBZ-01 or JBZ-02).

By setting the parameter, the user can choose the display of the actual values on the display, storing the changes of these inputs in the archive; display the headline for condition log. 0 and log. 1, and active signal level.

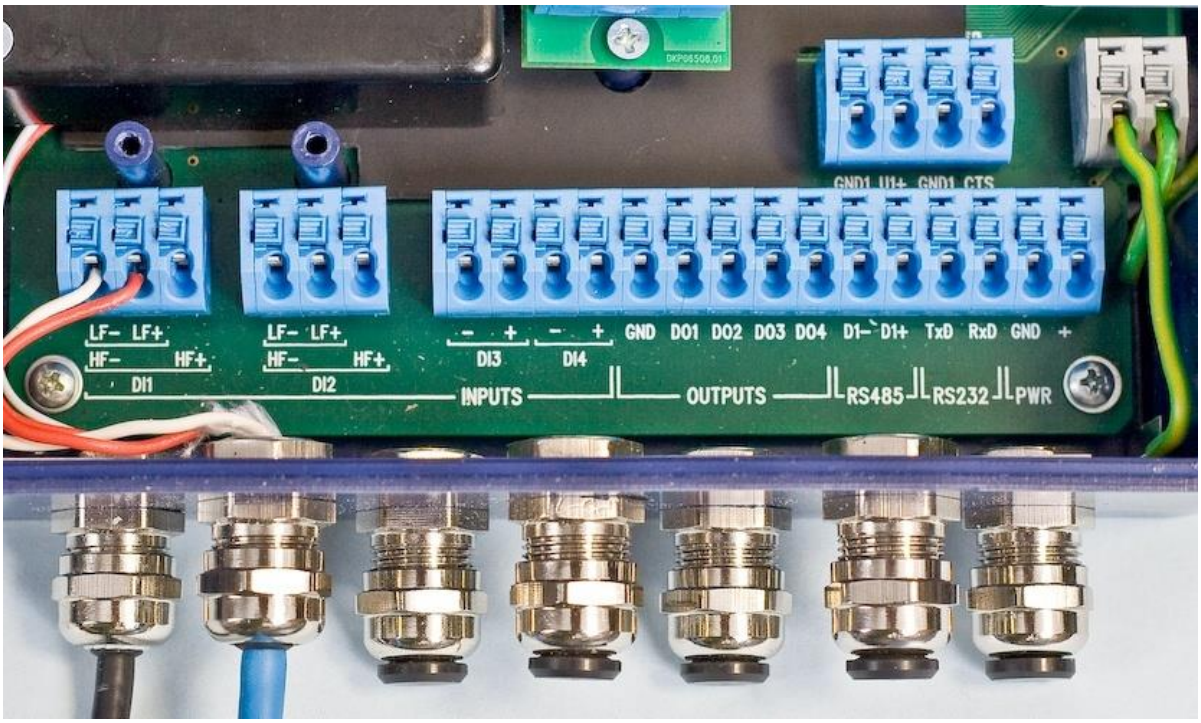


Fig. 8 Inputs and outputs terminals

5.2 Outputs

The device has 4 digital outputs DO1 to DO4 which can be configured as binary, impulse, or data. A data output serves the CL1 analogue output module (4-20 mA) which should be connected to this output.

The outputs can be controlled by the device using calculation equations entered by the user in the device parameters (for example, it is possible to generate outputs according to the gas flow, indication of alarm condition, exceeding the set limits of pressure or temperature, etc.).

The device structure allows the generation of outputs even when the device is powered solely by the battery with no effect on the battery life cycle. The outputs are “open collector” type and are not galvanic separated. All four outputs have a joint GND conductor.

The outputs are intrinsically safe, thus when connecting standard devices, the devices must be connected via a safety barrier (e.g. K3 Module, see Fig. 9).

Impulse outputs

The impulse outputs have adjustable width and impulse periods in folds of 0.1 s. Collection of impulses for these outputs can reach max. 65535 pulses. An output constant can also be configured in the setting equation of the output parameter.

Binary outputs

Output terminals are according to the setting and status in the connected or disconnected state. In the resting state, the output terminals are disconnected (condition log.1).

Data output

The digital output configured as a data output serves for communication with the CL-1 module. An analogue output 4-20 mA can be realized using this module. Using the calculation equations, the value of the output can be parameterized as proportional to pressure, flow, daily consumption, etc. The CL-1 module must be connected to the converter via a safety barrier (K3 module).

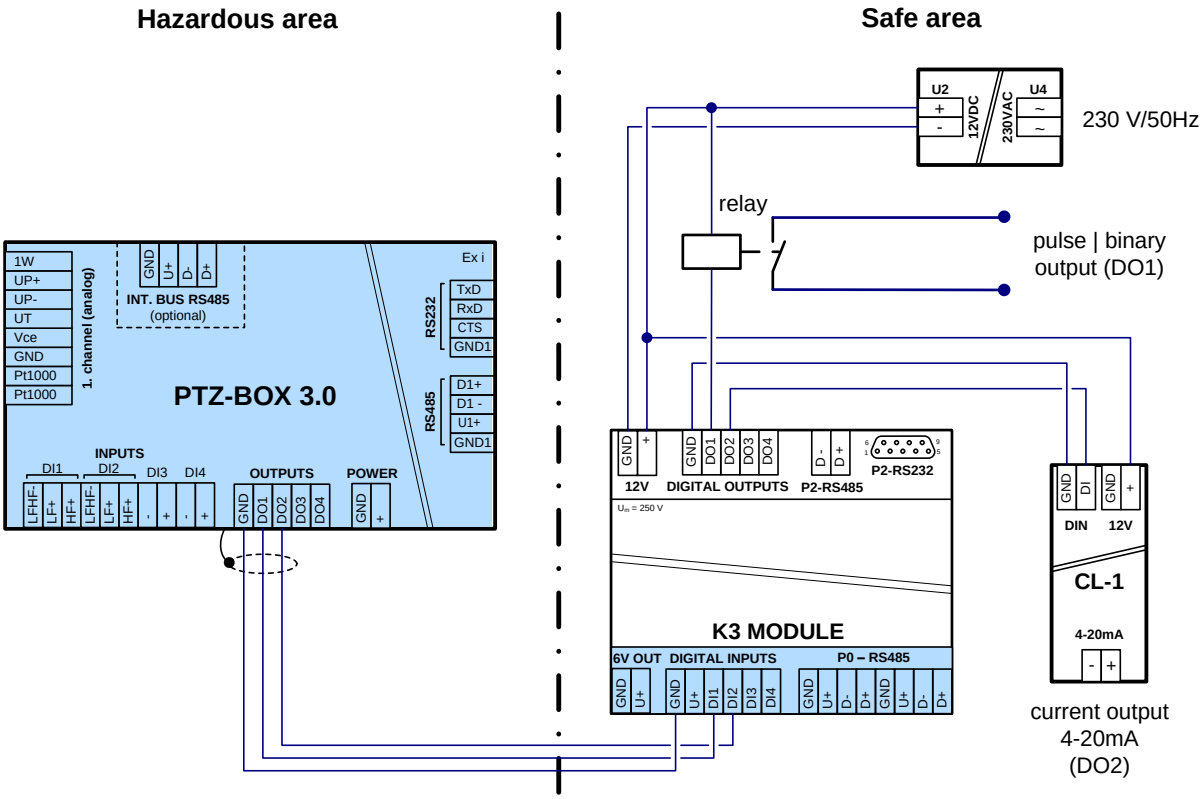


Fig. 9 Example of an impulse (binary) output and current output scheme

6 Communication with the PTZ-BOX 3.0

For communication with other devices, the PTZ-BOX 3.0 is equipped with one communication channel with three possible communication interfaces. Either the communication interface RS-232 or the RS-485 can be used for connection with a superior system. The optical interface is designed as temporarily connection for readout or device configuration.

In the current firmware version, the device is equipped with several communication protocols. The device is prepared for extension by other protocols as required by the customer. The standardly implemented protocols are VTC and MODBUS RTU. Pre-set communication protocol is the same for all communication interfaces. It is possible to change communication speed for fixed connections and for optical interface independently.

The VTC protocol is the native protocol of the device. A complete set of functions realized in the device is available. The service SW [22] solely uses this protocol – in case it is necessary to switch to other link level, the VTC protocol is only wrapped in one other link level (a so called “a tunnel”). The VTC protocol is used as the only one for loading firmware (protected by the metrology seal).

The communication circuits are galvanic separated from other device circuits. Because of the galvanic separation, the communication circuits must be powered from outside, from a connected device (CTS signal in case of the RS-232 interface and U1+ in case of the RS-485 interface).

6.1 RS-232 and RS-485 interfaces

Both interfaces are brought out to the internal terminal board and, although they are simultaneously functioning, only one of these interfaces can be used (connected) for communication at a time. Because both of the interfaces are intrinsically safe, it is necessary during installation to separate the device in a potentially explosive environment from the connected common device (computer, modem, etc.) by a consecutive device (Sx Module, Kx Module, MTL 5051 etc.), or use a device with an intrinsically safe design.

The communication speed of the interface (the speed is joint for both interfaces) and the communication protocol can be set in the device parameters.

Communication via modem controlled by AT commands

Basic setting features of a modem for the correct cooperation with the device:

- Sending answer (ATQ0)
- Long format of the sent answers (ATV1)
- Echo disabled (ATE0)
- Automatic pickup (ATS0=1)
- Set firmly serial port communication speed of the modem (e.g. for speed 38400 Bd is command AT+IPR=38400)
- Ensure presence of power feeding on clamp DSR of the modem (by command AT&S0). Clamp DSR is connected with CTS clamp of device.

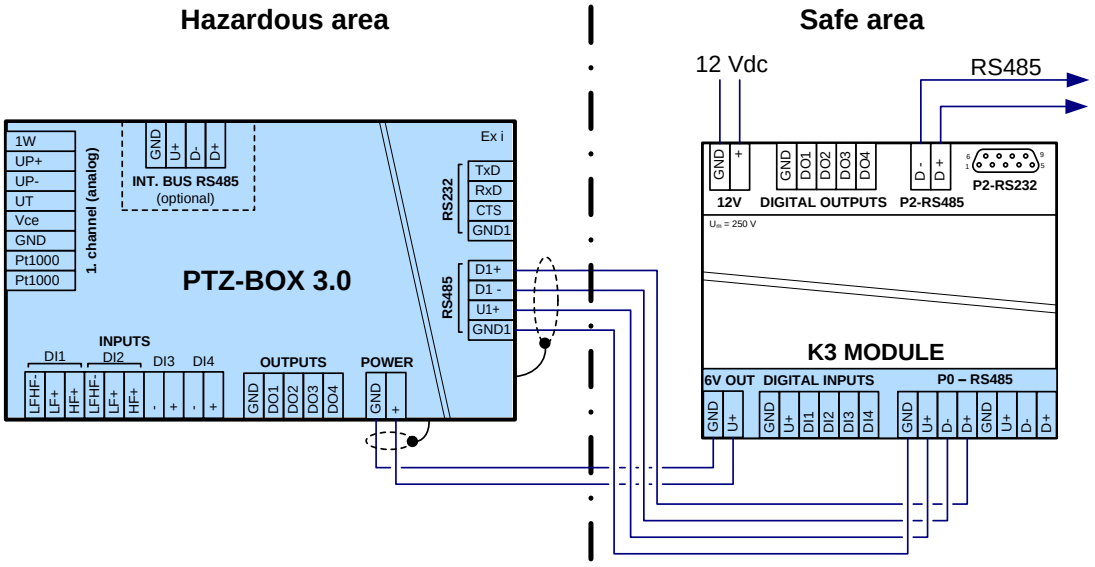
More detailed information must be found in the manual of the used modem.

Communication with GSM and GPRS modems

For the purpose of diagnostics during the modem installation, the device has the option of displaying the information from the modem on the presence and connection to a GSM network, and further information on the signal strength measured by the modem. In the case of a GPRS connection, it is possible to display the IP address.

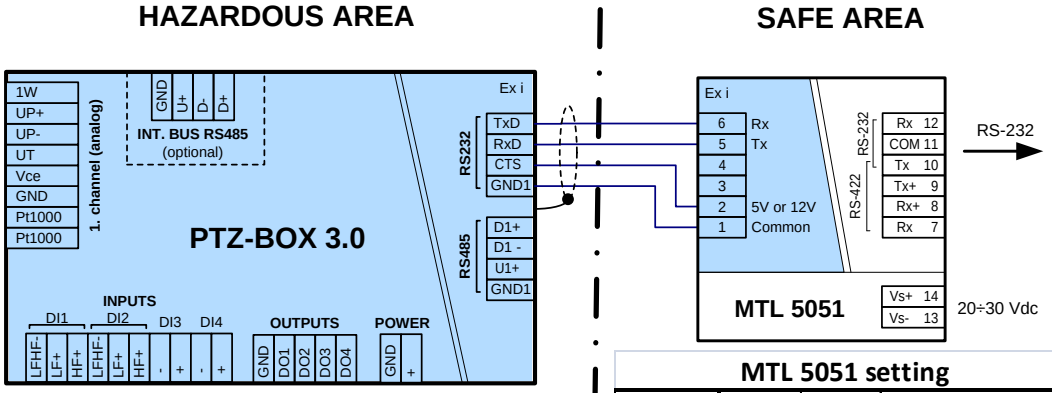
Compatibility with the Siemens MC35, MC39 modem is necessary for correct function in AT commands:

AT+CREG?, AT+CSQ?, AT+CGDCONT and AT^SGAUTH+CGDCONT.



Note: Communication output from K3 Module can be RS-485 or RS-232

Fig. 10 Safety separation of communication using module K3 Module for RS-485

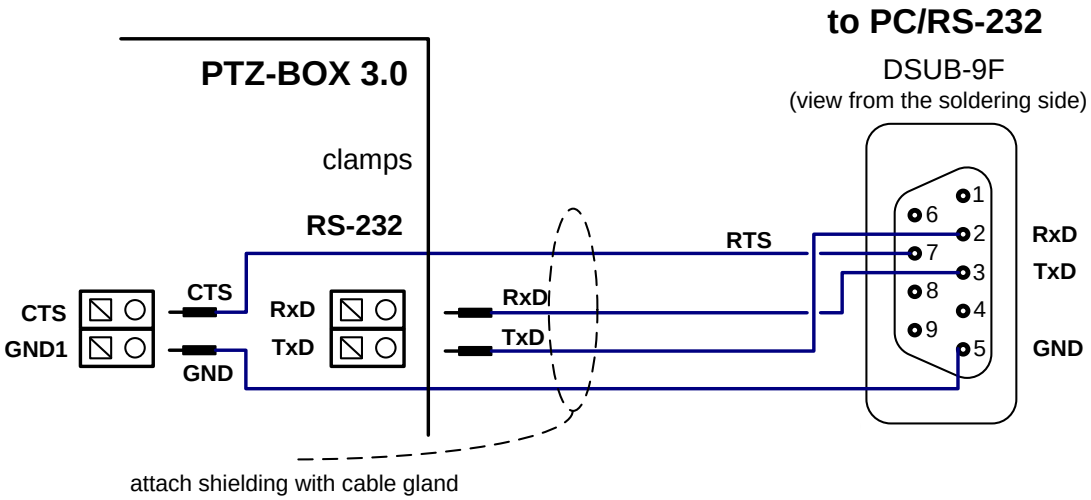


MTL 5051 setting

Switches	OFF	ON	meaning
SW1a	X	---	other modes
SW1b	X	---	5V output
SW2a	RS232	RS422	output interface
SW2b	RS422	RS232	output interface

Note: Communication output from MTL5051 can be RS-232 or RS-422

Fig. 11 Safety separation of RS-232 communication via separator MTL 5051



Note: Described connection of EVC with the PC without safety barrier must not be used if the EVC is placed in hazardous area.

Fig. 12 Communication cable wiring

6.2 Optical interface IEC-1107

On the front face of the casing, next to the keyboard, is an optical window for communication using an optical head. The optical head is to be put to the window. It is fixed in place using a magnet. One of the HIE-01, HIE-03, and HIE-04 types can be used as the optical head. After applying the optical head, the device switches over from the economy mode to the mode in which data can be transferred. It remains in this mode for 180 s from the last communication (timeout) or until the user takes the optical head of the communication interface.

Remark:

The HIE-04 is an optical head with an USB connector. Before use the driver for this Infra-red head need to be installed at the applicable computer.

The communication speed of the optical interface can be set in the device parameters independently of the speed of the RS-232/RS-485 interface. The setting of the communication protocol is the same for all three interfaces.

Warning:

After applying the head, the communication channel switches from the RS-232/RS-485 device to the optical interface. That means that the communication via the RS-232 or RS-485 is discontinued until the moment the optical head is removed, or until the mentioned timeout from the last communication expires.

.

7 Functions

The options of the device regarding displaying the data on the display and storing the data are extremely variable and customizable. The user has full control over which parameters will be displayed in the actual values and also which parameters will be stored in the individual archives.

7.1 Parameter indication

For parameter indication symbols are used that are defined in the table „Used symbols and definitions“ (see page 1).

Definitions

- For a single channel device no any index is used (Index number 1 or 2 is used only for two channel configuration)
- For other types of parameters (non-metrological) indexes can be used for differentiation between the same types of parameters.

User parameter indication

A new SW feature enables the user to define a user specific parameter indication. Original marking is considered as default (blue marked at service SW [22]). Marking must comply with marking limitations. These limitations are checked by the service SW.
Metrological parameters may be renamed only on ASC level.
User defined parameter indication is used for showing on the display and also for the service SW and exported to 3rd party SW.

7.2 Actual values

For the displayed parameters, the number of the displayed places, units, and the displayed name can be custom set. If the measured parameter is in an error condition, such a condition is indicated by displaying an asterisk at the last position in the line with the parameter name.

Example of parameters which can be displayed as instantaneous values:

- Pressure p
- Temperature t
- Actual volume Vm
- Actual volume under error conditions Vms
- Base volume Vb
- Base volume under error conditions Vbs
- Flow Qm
- Base flow Qb
- Conversion factor C
- Compressibility ratio K
- Device error
- Presence of external power supply

- Battery capacity
- Internal temperature

7.3 Archives

The values are arranged in the archives in time sections. The combination of date and time and the values of the parameters selected for archiving form a part of each time section.

The measured and calculated parameter values can be stored in the following archives:

- Monthly archive
- Daily archive
- Data archive
- Binary archive
- Limits archive

Besides the listed data archives, the device also contains the following archives:

- Event archive
- Billing archive
- Settings archive
- Gas composition archive

First the archives with a fixed number of records (monthly, daily, binary, and limits) are stored in the available memory. The data archive is placed in the remaining memory (its length depends on the size of the remaining memory).

	Data archive	**Daily archive**	**Monthly archive**	**Limits archive**	**Binary archive**
Analogue values					
Input analogue – average value	yes	yes	yes		
Internal analogue – average value	yes	yes	yes		
Output analogue – average value	yes	yes	yes		
Minimum/maximum	yes	yes		yes[2)]	
Impulse values, flow measurement					
Actual volume – absolute condition	yes	yes	yes		
Base volume – absolute condition	yes	yes	yes		
Error actual volume – absolute condition	yes	yes	yes		
Error base volume – absolute condition	yes	yes	yes		
Max. daily consumption – actual volume			Yes[1)]		
Max. daily consumption – base volume			Yes[1)]		
Max. hourly consumption – actual volume		Yes[1)]	Yes[1)]		
Max. hourly consumption – base volume		Yes[1)]	Yes[1)]		
Internal counter – absolute condition	yes	yes	yes		
Output impulses – impulse debt condition	yes	yes	yes		

	Data archive	Daily archive	Monthly archive	Limits archive	Binary archive
Actual flow – average value	yes	yes	yes		
Base flow – average value	yes	yes	yes		
Minimum/maximum flow	yes	yes		yes[2)]	
Conversion, ratio of compressibility factors					
Base factor – average value	yes	yes	yes		
Ratio of compressibility factors – average value	yes	yes	yes		
Minimum/maximum of conversion, of ratio of compressibility factors	yes	yes		yes[2)]	
Binary values					
Binary input - condition	yes				yes
Binary output - condition	yes				yes
Set points - condition	yes				yes
Device errors and communication with converters	yes				yes
Internal binary	yes				yes
Other parameters					
Counter/timer – absolute condition	yes				
Input code					yes

Notes:

1) Date or time is stored with the value (or combination, whichever suitable).

2) Date and time of achieving the minimum/maximum is stored along with the value.

Table 3 Options of archiving the individual values

7.3.1 Monthly archive

Archive capacity: 25 records

The values are saved in the archive once a month at the set “Start hour of the day“ that each gas company can define (often 6:00 am). The time data of the record is stored in the archive along with the values. If the archive is full, new data will start to overwrite the oldest ones. There is an option to store also the statistical values of gas consumptions and analogue values (see. Table 3).

The record with date 01.06 thus means statistical values of parameters in interval 1 May 6:00 to 1 June 6:00.

7.3.2 Daily archive

Archive capacity: 400 records (adjustable)

Has similar features to the monthly archive (for the list of options see Table 3); even here statistical values of gas consumptions and analogue parameters can be stored. The values are stored in the archive once a day at the set “Start hour of the day“ (often 6:00 a.m.).

The record with date 13.06 thus means statistical values of parameters in interval 12 June 6:00 to 13 June 6:00.

7.3.3 Data archive

Archive capacity: variable depending on the configuration of the stored values. The capacity is displayed during the configuration of the archive in the service SW.

Archiving period: Adjustable within 1 s to 1 hr.

The parameters in this archive are saved with the set time interval, and the interval can be set by the user. The pre-set value is 1 hr. In the case of status values, the archive stores the occurrence of the active state in the applicable archiving period. For binary inputs, the active state can be set according to the actual status of the parameterization; log.1 is the active state for set points and errors.

7.3.4 Binary archive

Archive capacity: 2000 records

The archive stores the binary input status, status bites calculated and stored in the system, and errors of the individual devices. The values are stored in the archive only if the status of one of the stored binaries is changes. A time/date with a resolution in seconds is a part of the record.

7.3.5 Limits archive

Archive capacity: 1 record for each monitored parameter

Reaching an extreme (minimum or maximum) value is recorded for the archived values. The archive saves the value and a time mark. When initiating this archive, the actual measured values of the specific parameters are set in the registers of minimums and maximums.

7.3.6 Event archive

Archive capacity: 500 records

The archive stores the date and time of the event change, a status word (64 bits) describes the status of all the monitored events in the device and the status of the counter of actual volume V and counters of the standardized volume Vb.

This archive, unlike the previous archives, will not overwrite after it has been filled. The archive content cannot be displayed directly on the display, but it can be displayed using the service SW on a PC.

7.3.7 Settings archive

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

The settings archive stores changes of parameters, especially if they have effect on metrological features of the device. The archive also stores the identification of the employee who performed the change. The record contains a time mark, employee identification, description of his/her activity, and eventually the new and old values of the parameters which were changed.

This archive, similarly as the event archive and unlike the other archives, does not overwrite, i.e. after filling the archive up, you cannot add to it and then changing of parameters is disabled. This archive cannot be displayed on the display, and the content can only be displayed using a PC.

7.3.8 Billing archive

Archive capacity: 15 records

The device can contain a billing archive. This archive serves as data recorder with a billing period set at device parameters. There are two possible ways how to write into this archive: writing according to a pre-set time or periodically at intervals 1, 2, 3, 4, 6 or 12 months. At this time a new record is created of all actual counters, The billing period is configurable.

7.3.9 Gas composition archive

Archive capacity: 150 records

When gas composition or compressibility calculation method is changed a new record is stored into this archive. The record contains time and date stamp, previous used compressibility method and value of gas composition items. If this archive is full the oldest data records are overwritten. Notice: in the older FW versions changes of the gas composition are recorded in the setup archive.

7.4 Device configuration

7.4.1 Configuration using the GASCcomm service SW

The device provides a wide range of options regarding its settings. Due to the wide range, the full configuration can be performed using the supplied GASCcomm service SW [22] designed for PCs. Besides the device settings, this SW also allows the read out, display, archiving, and printing of the actual values as well as the archive contents. Description of the parameterization using the SW is described in chapter 14 and 15.

7.4.2 Configuration from the device keypad

The device allows the setting of some of the selected parameters directly from the device keypad, i.e. without using a computer. These parameters are:

- Service parameters: station name, gas hour
- Communication settings: Name of station, communication protocol, transfer speed, network address, network address 2
- Gas composition (individual components of the gas according to the set calculation method)
- Date and time in the device
- volume parameters like setup of gas meter constant, Vm, Vms, Vb, Vbs, S/N of gas meter

7.5 Other device functions

7.5.1 Summer/winter time (DST)

In the device the summer/winter time exchange is implemented and this can be activated (or deactivated) with the service SW. If activated the device makes time changes automatically based on selected region (Europe or USA). At the same time

it is necessary to setup the deviation from GMT. In device archives it is indicated whether record was made in summer or in winter time.

7.5.2 Tariff counters

In the device it is possible to configure up to four tariff counters enabling volume calculation based on a time schedule. Two independent schedules (Tariff schedule 1 and Tariff schedule 2), are changed mutually in active respectively non-active mode. Single tariffs are assigned to time slots in single days and parallel days can be defined like working days, Saturdays or Sundays (or holiday)

Each schedule has own ID number and activation time of each schedule is adjustable separately.

7.5.3 Remote download

Remote download according to WELMEC 7.2 specifications enables the remote upgrade of FW. For such purpose the FW is equipped with a unique digital signature overcoming security system at device.

7.6 Securing the device against a change of metrological values

The device is equipped with a metrology and a service switch and uses a password system of protection against an unauthorized manipulation especially with the data that affects the metrological features of the device. Changes in the device settings and other acts are stored in the settings archive. This way the device is in compliance and even above the requirements of the EN 12405-1 standard.

7.6.1 Switch protection

There are two switches located inside the door of the device; the metrology switch and the service switch. The User switch is located left; the metrology switch is located right. Both are double dip switches; and both the parts need to be switched.

7.6.1.1 Metrology switch

The metrology switch protects the metrology settings of the device. It is located on the inside of the casing cover (see Fig. 3) and protected by a label which is secured by a manufacturer’s security seal (official metrological seal) – see Fig. 5.

7.6.1.2 Service switch

The service switch is located next to the metrology switch (See Fig. 3). Opening of the device and thus the access to this switch can be protected by a user mark, see Fig. 5.

The function of the ***service switch*** depends on the setting of its functionality in the parameters in the device. This setting is done via the service SW (menu Parameters > Meaning of service switch). Here, the user can choose what influence the switch setting will have on the individual groups of device parameters.

Service switch - Functionality

The user has the option of setting one of the three functionalities of the service switches in the service SW:

Switch functionality	Position	Description
Complete [1)]	OFF	The writing of parameters in the device is disabled.
	ON	Parameters can be written in the device
none	OFF	The position of the switch does not matter; it is possible to write in the device. Protection using the switch is disabled.
	ON	
partial	OFF	Writing in the device is blocked, except writing the non-metrology parameters (e.g. archiving period, communication parameters, station identification, setting system time, etc.). This method of settings is convenient in the case of remote transfers of data from the device. It is suitable to secure it use using a password.
	ON	It is possible to write parameters in the device (i.e. the same as in case of a complete functionality).

Table 4 Service switch settings

7.7 Access passwords

The device works with two passwords: “Password for a complete access” and “Password for reading”. In the case of a blank password, the password function is turned off. It is necessary to enter a password with a max. of 6 alphanumeric characters to make the password system work. Some implemented protocols do not support using the password system during communication even if the system is turned on.

7.7.1 Access levels

Regarding the possibility of parameter modification and other operations with the device, users can have different levels of access.

User level

- Common device user. Users of this level can read out all the data from the device and set a large amount of parameters. It is not possible to change the parameters directly influencing the metrology features of the device. For a more detailed description see Table 5. The protection by the service switch

[1)] This meaning is preset by the manufacturer (default setting)

along with the user mark and password system can be used as a protection against misuse.

Accredited Service Centre (ASC)

- Designed for employees of a center accredited by the manufacturer. The center is accredited to perform operations on the device regarding its metrology features. These activities are conditioned by breaking the official mark, switching the metrology switch and using a **special HW key** for the service SW [22] . For description see Table 6.

Configuration of password access is described in paragraph 14.4.

User level			
	Activity	***Position of the service switch***	***Allowing activity when using passwords***
Data readout	- Reading the actual values of parameters - Reading archives - Reading parameters	OFF, ON	• Allowed when passwords turned off, • With passwords turned on allowed after entering the "password for reading" [2])
Non-metrology changes of parameters	- Turning on/off archiving of the individual parameters in the individual archives - Setting the measuring period - Setting the period of archiving the data archive - Passwords changes - Zeroing the archives - Setting the internal time converter - Setting the communication parameters - Setting the station identification - Setting the start hour of the gas day - Turning on/off the displaying of the actual values of the non-metrology parameters on display - Configuration of digital inputs - Configuration of digital outputs - Parameter indication change by the user	ON	• Allowed when passwords are turned off, • With passwords turned on allowed after entering the password for "complete access" [2)]
Metrological changes	- Changing the functionality of the service switch on entry of parameters - Setting the V and Vs counters - Change of calculation method of compressibility factor - Gas composition setting - Setting measurement units and constants - Setting default values of temperature and pressure for conversion	ON	

Table 5 User access level (for "complete" functionality of the service switch)

[2]) The effect of the turned-on passwords can be suppressed by using the HW key WGQOI, „service" version.

Accredited Service Centre level			
Activity		***Position of metrology switch***	***Allowing activities when***
	- Activities described in the user level	OFF, ON	*Note:* When using HW key, the effect of passwords is disabled (when applicable)
Metrology changes	- Upgrade firmware - Change of the metrology approval option (NMi, ČMI, MID, etc.) - Setting a reference temperature - Setting a reference pressure - Setting the Vb, Vbs counters - Configuration of metrology parameters (C, K, V, Vb, Vs, Vbs) - Replacement of the converter - One-point or two-point calibration of the sensors - Zeroing settings archive and status archive - Parameter indication change by the user	ON	Using HW key marked WGQOI, “Accredited service“ option.

Table 6 ASC access level

8 Starting the device

Device is delivered either in operation condition with connected battery or switched out with disconnected battery.

Device is delivered in switched-out position (no displayed information after pushing of any button) and battery is placed at battery holder. A blocking foil strip is placed between battery and holder contact. Putting in operation is performed by removing this foil strip. This operation is also allowed in the hazardous zone.

Fig. 13 Removable foil strip in the battery holder

In case of a disconnected battery: before inserting the battery into the holder align up battery polarity with the marked signs on holder. Only the approved type of lithium battery (see technical device parameters in Chapter 12.) must be used.

When a battery is connected the device is automatically put in operation.

In the basic configuration the device display is switched off when the device is not manually operated. Pushing any button causes the display to switch on.

Note:

In case of longer storage it is recommended to take out the battery from the battery holder or at least disconnect battery by inserting foil strip between the battery and the contact of the battery holder.

9 Operation

The device is not equipped with a power switch; if a supply battery is inserted in the device, the device is automatically switched on (the device also registers LF pulses if the battery is taken out).

A 10-button keypad serves for the operation of the device and displaying the measured and other values. The values are displayed on a graphic display with a resolution of 128 x 64 points. During battery operation, the display shuts down after 20 s from the last time you pressed any key. The display lights automatically once you press any key. In case the device is powered by an external source, the display is permanently on.

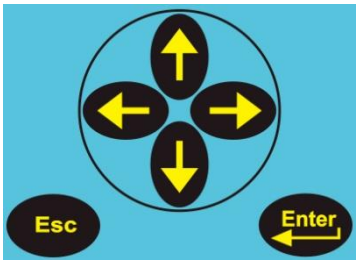
You can select the displayed data using the device menu. Displaying the menu items depends on the set parameters of the device. Content of some menu items can be custom configured.

Display features

- Automatic update of data changing with period 1 s; depending on the selected scanning time of the sensors.
- Auto repeat – when holding a key, the key pressing is automatically generated, can be used for e.g. viewing archives
- Displaying without diacritical marks
- In compliance with the EN 12405-1 standard par. 6.3.1.5, the display starts in the basic display setup. By configuration you can choose a time period after which the device should go back to the basic display
- To simplify the operation for an untrained user, it is possible to display the actual values by pressing the Enter key. If you are in some menu; you can go to the highest menu level by pressing the Esc key for several times.
- To conserve energy, the device display shuts down after 20 s during battery operation; It lights up again once you press a key.

9.1 Keypad

9.1.1 Main keypad



	In archive display, transition to another item in the set time cross-section.
	In archives, transition to the previous item in the same time cross section
	Movement in time in archives, movement in a menu
	Movement in time in archives, movement in a menu

	• Select a deeper level • When displaying the actual values, Enter causes scrolling through the screen to display all parameters
	• Transition from a submenu item to a menu of higher level

9.1.2 Quick Access Buttons

F 1	QA button 1
F 2	QA button 2
F 3	QA button 3
F 4	QA button 4

Quick Access Buttons are used as a shortcut to lists of important values or often used menus. These lists or shortcuts can be pre-configured according to your wishes and can be reconfigured by the user by using the GASCcomm service SW. The configuration of these buttons is described in Paragraph

9.2 Menu system

The operation of the device is based on selecting from the menu. For the purpose of further explanation, we will call the basic items the main menu; by immersion in these items, we get to the lower menu levels (submenu).

If the display was off for a while, pressing any key will light on the initial display with volume values Vb and V.

9.3 Initial display

If the display was off for a while, pressing any key will bring back the initial display with Vb and V volume values. (Vb, V, p, t, date and time)

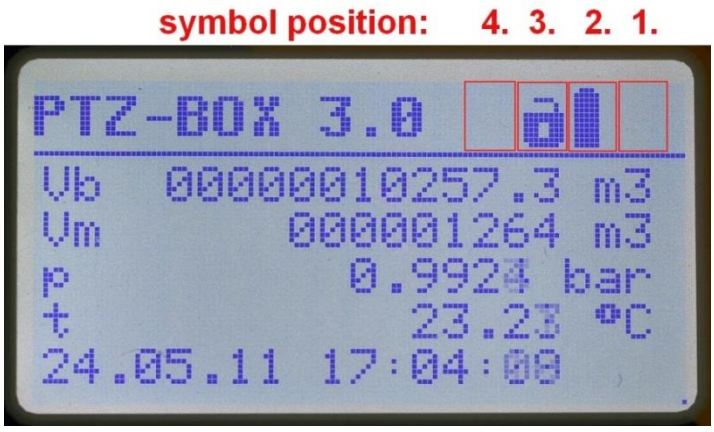


Fig. 14 Initial display

The information about the device basic status is provided through the icons displayed on the first line in the upper right corner.

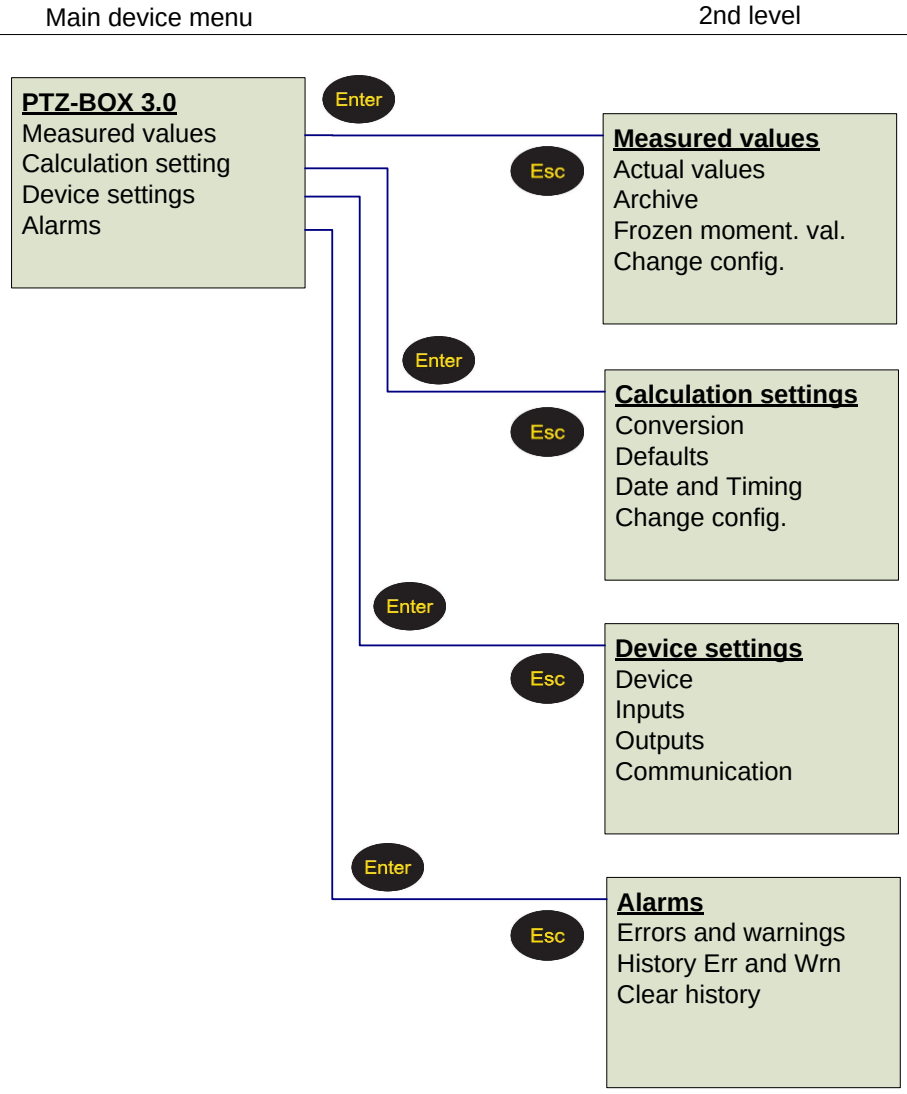
Position	Meaning	Symbol	Description
4	Communication condition		Communication via infrared head
			Communication via GPRS
			Communication via GSM
			Communication via modem
3	Service switch (user switch) position		Service switch is in OFF position
			Service switch is in ON position
2	Battery condition		Battery is charged 100 %
			Battery is charged 50 %
			Battery is charged 25 %
1	Device condition	(no symbol)	Device works flawlessly
			There is an error in the device
			The device generated a warning message

Additional symbols:  Indicating External power supply;  confirmation and  for navigation in the menus.

9.4 Menu structure

The device operation is based on items selected from the menu. To avoid confusion, we will from here call the main menu the highest menu; by selecting these items, the user can go to lower menu levels (submenus).

9.4.1 Main menu

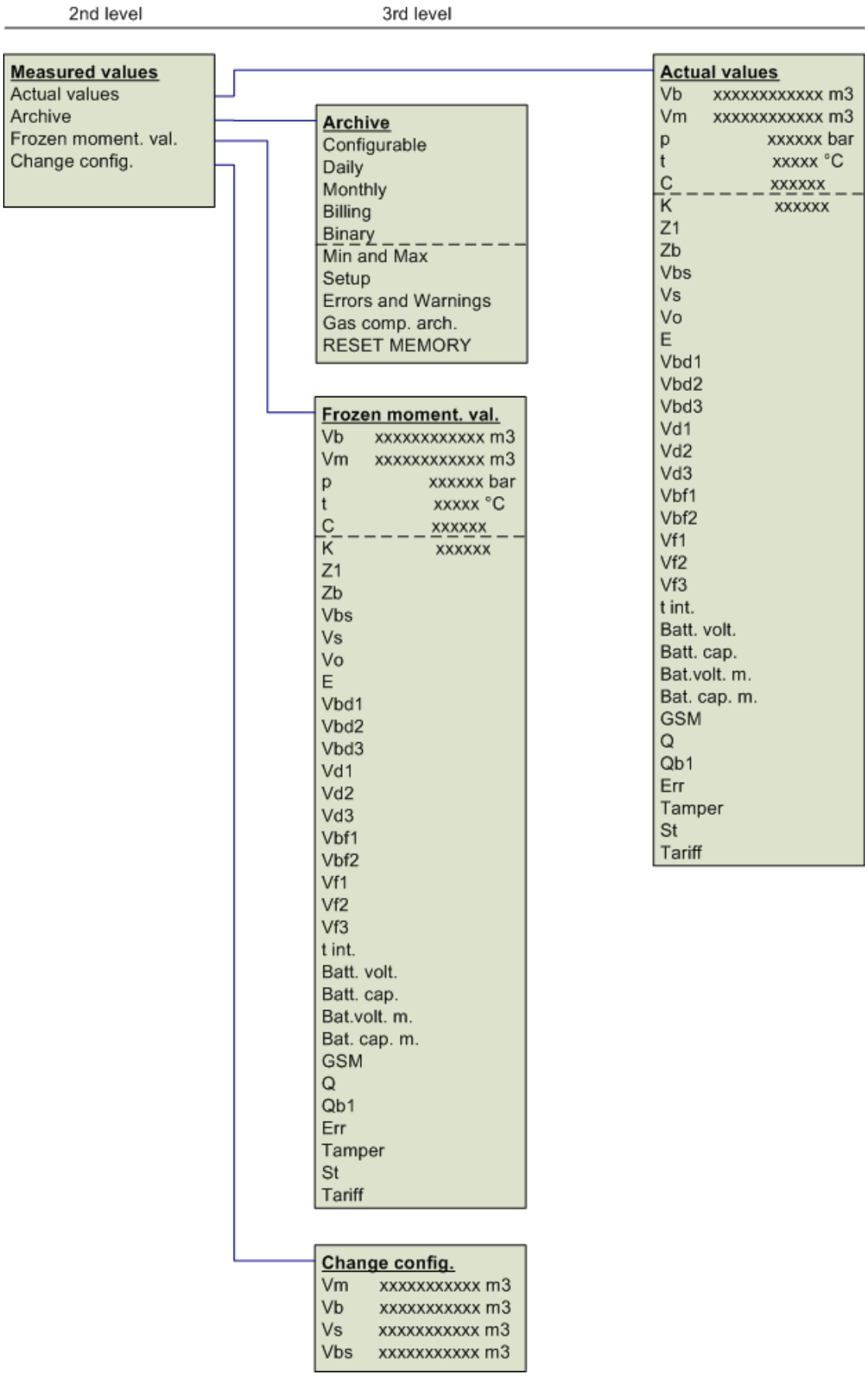


selection of menu and submenu item

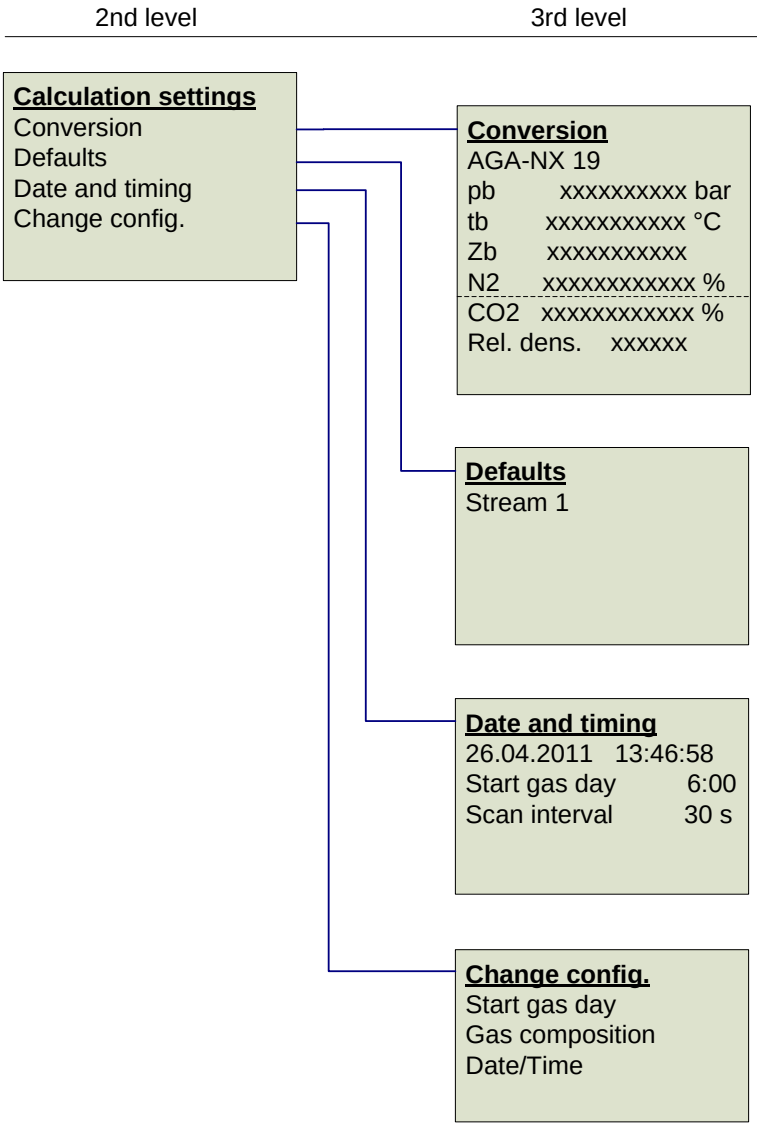
selection of menu and submenu item

***)** 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.

9.4.2 Measured values menu



9.4.3 Calculation settings menu



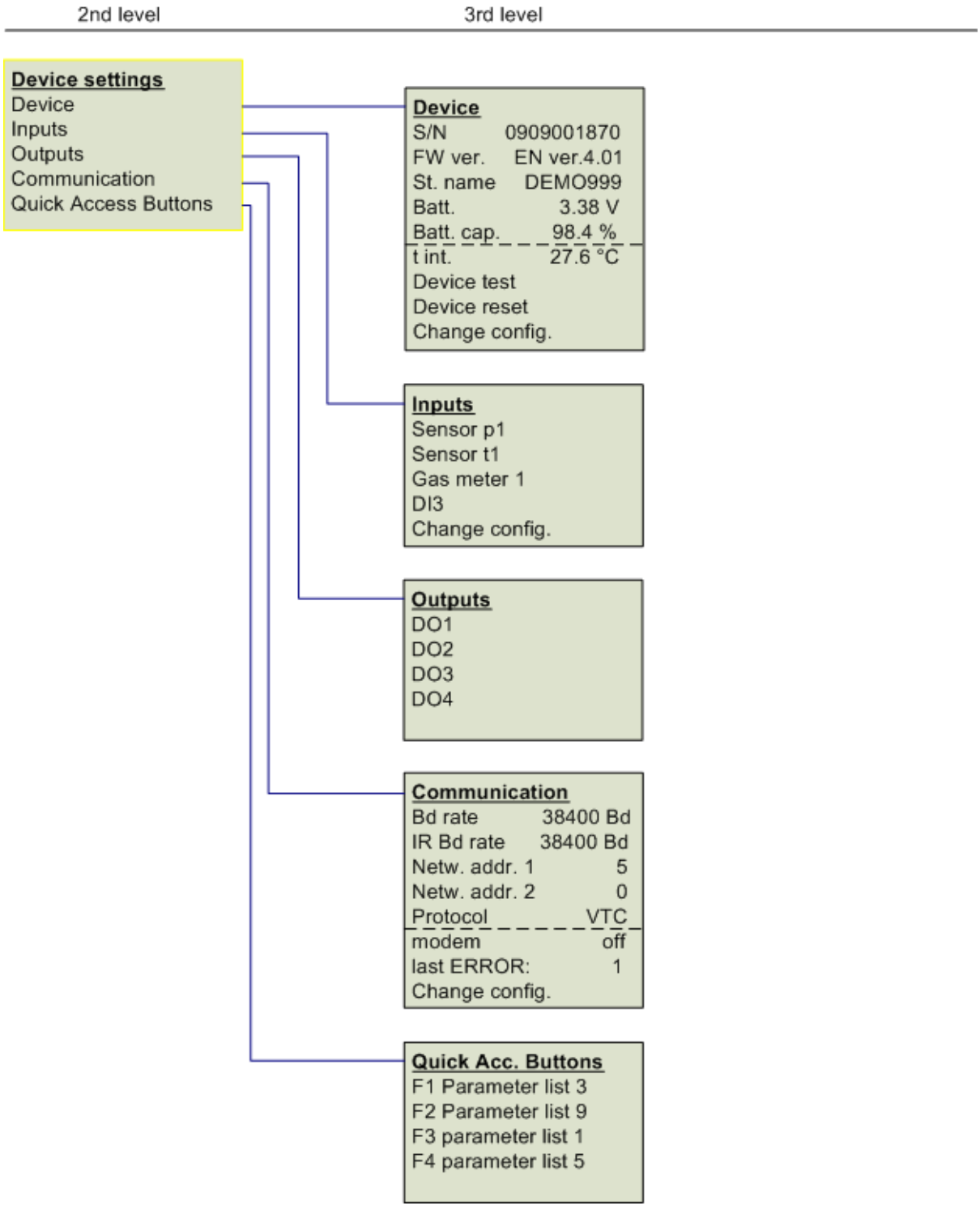
The **Conversion** menu displays the following data:

- Conversion factor calculation method
- Base (reference) pressure p_b
- Base (reference) temperature t_b
- Compressibility Z_b
- *Individual gas components (depending on the selected conversion method)*

The **Stream (defaults)** menu displays the following data:

- Conversion type
- Default temperature
- Default pressure
- Default compressibility
- Calculation method
- Pressure range
- Temperature range

9.4.4 Device settings menu



The **Device** menu displays the following data:

- Device serial number
- FW version
- Station name
- Battery capacity

- Internal temperature
- Device test

  After selecting this menu item, the device will test its internal status and list the errors and warning messages on the display. The initiated test of the device takes a few seconds and has no effect on the measuring and archiving operations of the device. The order will be carried out regardless of the service switch position.

  A warning is shown on the display during the test. The indicated errors are marked with prefix “E” and identification number; similarly, warning messages are marked with prefix “W”. For a complete list of errors and warning messages see par. 9.4.8.
- Device reset

  When the device reset is selected, the software jumps to the starting address and performs a repeated initialization of the entire measuring system. The contents of all archives and the statuses of all the V and Vb gas volume counters remain the same during this operation. All the other set parameters remain the same as well. The order will be carried out regardless of the service switch position. After the device reset, the initial display will be shown.

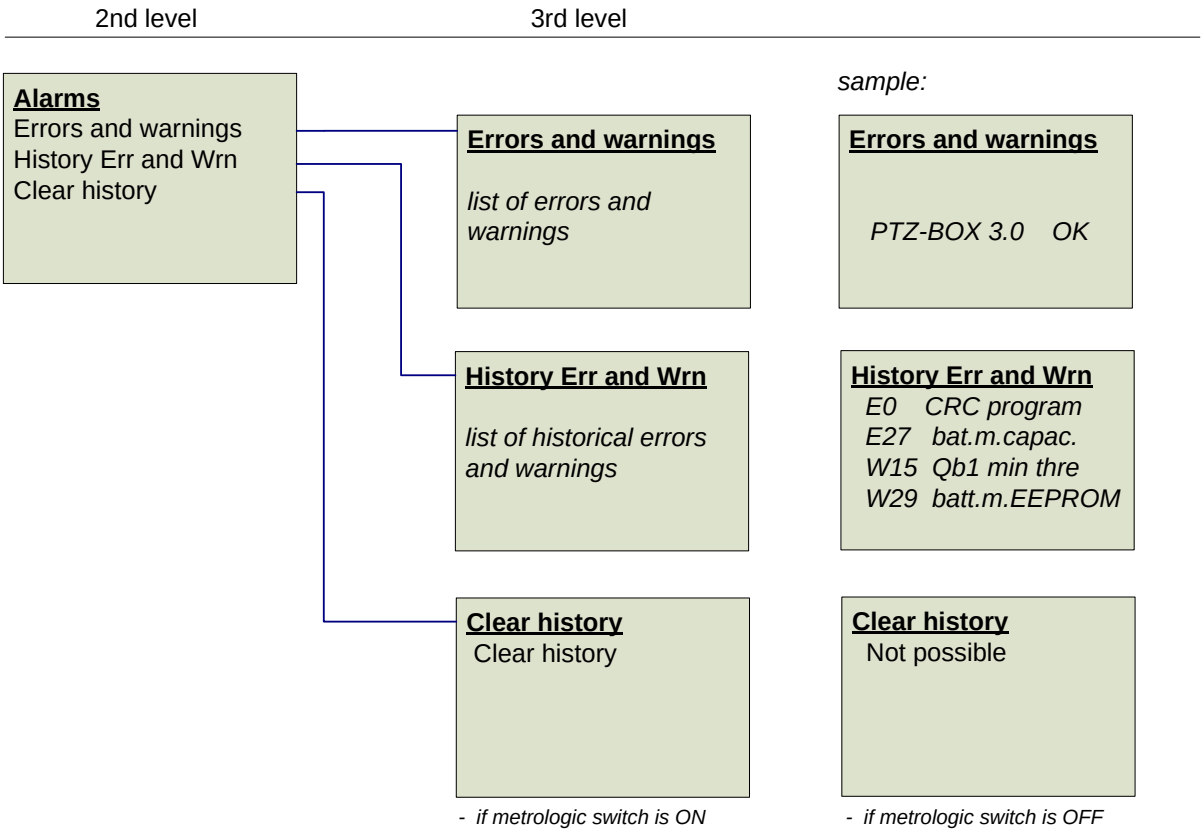
The **Inputs** menu displays the following data:

- Measuring pressure (p)
  - pressure range
  - pressure converter serial number
- Measuring temperature (t)
  - measuring range
  - temperature sensor serial number
- Impulse input (V)
  - input clamps identification
  - gas meter constant (kp) [imp/m3]
  - gas meter serial number
- Digital inputs

The **Communication** menu displays the values of the following parameters:

- Cable transfer speed (RS232, RS485) [Bd]
- Infrared head transfer speed [Bd]
- Network addresses
- Communication protocol
- Modem communication information (if applicable)

9.4.5 Alarms menu



Errors and warnings

This menu displays the instantaneous status of the device. Pressing the “right arrow” button will display all the existing errors and warning messages of the converter one after the other.

History errors and warnings

The history status monitors the occurrence of active errors (of the device status individual bits) from the last reset. Therefore, even errors and warnings that have already expired are recorded.

The basic information about the state of the summary status is also indicated as an icon Err or Wrn on the device initial display.

Clear history

After selecting this option via the device keypad or the “Summary status reset” option from the “Settings – Diagnostics” menu from the PC service software, the Alarm status will be reset. To allow the initialization, the service switch must be ON. Should it be OFF, the message “The initialization is not possible” will appear.

9.4.6 Displaying device errors

Error messages are displayed in the “Actual values”, “Alarms” and “Device test” menus. A diagnostic self-test is launched regularly, a complete device test daily, a sensors displacement test hourly, or irregularly when the device is turned on. The test can also be launched by selecting the “Device test” function via the keypad.

The short form of the summary diagnostics is displayed in the right corner of the highest menu level in the form of abbreviations OK, Err or Wrn. This short form is the sum of the individual statuses; the highest priority abbreviation is displayed. The order of the priorities from the highest to the lowest is as follows: Err, Wrn, OK. More detailed display of the diagnostic information can be obtained via the GASCcomm service software.

9.4.7 Device status word

The device status word has 64 bits. In case of the monitored bit variation (changing error or warning status), the whole status word is stored in the Status archive. The significance of individual bits is described in Tables 1 and 2.

9.4.8 Device status word stored in data archives

To allow saving to the data, daily or monthly archive, a compact status word of 24 bits is defined in the device. This information is stating whether or not the bit (error or alarm) became active during the applicable interval and it is stored in the archives. The individual bits are calculated as the sum of bits of the device status word. The significance of individual bits is described in Table 3.

On the display	***Description***
E0 CRC program	Firmware check sum error.
E1 CRC loader	Loader check sum error.
E2 CRC parameter	Device parameters check sum error.
E3 memory error	Device memory error. (FW 2.xx:E3 RAM error)
E4	*- not used -* (FW 2.xx: E4 FLASH error)
E5 settings archive full	Settings archive full.
E6 sensor change	A sensor was displaced or its parameters were modified.
E7 sensor communication	Sensor communication error.
E8 sensor error	Sensor error.
E9 battery discharged	Battery is empty (remaining battery capacity is approximately 10%).
E10 compressibility table	Compressibility table calculation error due to the input parameters (failure).
E11 compressibility error	Compressibility cannot be calculated due to the range limitation of the applied standard for compressibility calculation in measured temperature and gas pressure.
E12	*- not used*
E13	*- not used*
E14 P1 below the limit	Measuring range exceeded (not indicated in case of FW 2.xx)
E15 P1 above the limit	
E16 P1 error	
E17 T1 below the limit	

E18 T1 above the limit	
E19 T1 error	
E26 RTC synchronization	RTC synchronization error, feed > 2 hours was required.
E27	*- not used*
E28 encoder error	Encoder error (SCR or NAMUR)

Table 7 List of events – error messages (Err indication)

On the display	***Description***
W0 sensor warning	One of the connected converters has sent out a warning message. More details can be obtained by reading the converter parameters.
W1	*- not used* (FW 2.xx:W1 battery capacity)
W2	*- not used*.
W3 overload	Overload occurred.
W4	*- not used*
W5 out of power	Network power supply failure occurred.
W6 Settings archive full	Settings archive 80% full. (FW 2.xx: W6 device overload)
W7 tamper 1	Tamper contact 1 active.
W8 tamper 2	Tamper contact 2 active.
W9 P1 below the limit	User limits exceeded (not indicated in case of FW 2.xx)
W10 P1 above the limit	
W11 T1 below the limit	
W12 T1 above the limit	
W13 Q1 below the limit	
W14 Q1 above the limit	
W15 Qb1 below the limit	
W16 Qb1 above the limit	
W17 C1 below the limit	
W18 C1 above the limit	
W29	*- not used*
W30	*- not used*

Table 8 List of events – warning messages (Wrn indication)

Bit	***Display***	***Description***
0	general error	General device error.
1	general warning	General device warning.
2	ext. power supply error	Network power supply outage occurred.
3	tamper active	Tamper active.
4	conversion error	Conversion error occurred, conversion executed into reserve counters.
5	converter error	Converter error occurred.
6	range exceeded	Temperature or pressure range of the converter exceeded.
7	limits exceeded	Temperature or pressure user limits exceeded.

Table 9 Compact device status word

9.5 Quick Access Buttons

In some cases, it is useful to display a user defined set of variables or specific often required menu quickly. This can be performed by the 4 QA Buttons.

9.5.1 Changing the display with the QA buttons

The device allows up to four user screens to be displayed. The F1 to F4 QA buttons can be used for quick display of these user screens.

9.5.2 User screens settings

The individual user screens contents are defined in a data file. This data file, so-called “Quick button map” (*.DB), must be loaded in the device parameters. The quick screens calls will not work unless this data file is incorporated into the device parameters.

9.6 Change settings via the keypad

Selected device parameters can be set directly from the device keyboard. Setting the device parameters from the keyboard can be protected by:

- Service switch (to allow writing, the switch must be ON)
- Password

If the service switch is OFF, the message stating “Parameters setting could not be completed” will appear on the display.

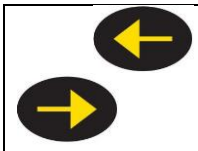
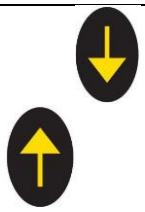
A maximum of 10 passwords protecting this setting (including the employee code) can be entered into the device. The passwords must be entered via the service software. These passwords are valid only for setting parameters from the keyboard and are not related to the passwords described in chapter. If an empty password list is entered into the device, the password protection is turned off.

The following parameters can be set:

Menu	**Parameters that can be changed**
Measured values	Actual volume (V) Actual volume under error conditions (Vs) Base volume (Vb) Base volume under error conditions (Vbs)
Calculation settings	Start hour of the gas day Gas composition Date and time
Device settings/ Device	Station name
Device settings/ Inputs	Serial number of the gas meter Impulse factor of the gas meter
Device settings/ Communication	Baud rate of the fixed lines Baud rate of the infra-red connection Address 1 Address 2 Communication protocol
Save parameters	Saving new parameters in the device

By the buttons  and  , you must set the parameter that you want to edit on the first line of the display (the parameter is displayed with a dark background). Initiate the editing by pressing the Enter key.

The edited position on a line is marked by the symbol:  . The functions of the parameter editing buttons are:

	Selection of the edited position on a line
	Selection and insertion of alphanumeric character (space, 0 to 9, A to Z, a to z)
	End of parameter editing

Saving parameters

Once the parameter editing is finished, the changes must be written in the device. The recording in the device is executed by selecting this option “Save into device”. Successful parameters recording in the device is confirmed by the message “Data valid”.

The totalizers values and current time are recorded immediately after insertion of the value. Before the value is recorded, the confirmation dialog box will appear; after confirmation, the value is saved into applicable register.

10 Mounting instructions

The gas volume converter PTZ-BOX 3.0 is a compact device built in sturdy poly carbonate housing and with IP65 protection. The device is designed for mounting in hazardous area Zone 1 and Zone 2.

Inside the housing there is next to the covered electronics a battery and if applied; the internal analogue pressure sensor with input thread M12x1.5 according to DIN W 3861 for attachment of pressure piping. (The pressure sensor can also be mounted outside the housing).

On the bottom side of the housing there are 6 metal glands PG7 (IP68 protection) and they are used for the connection of input and output signals with a conductive connection of the cable shielding.

On the front of the device there is a foil label with display, optical interface for infrared head communication (HIE-01, 03, 04) and the keypad.

10.1 Mechanical mounting of the device

The device can be easily mounted either directly to the gas meter by using single-purpose holder for given gas meter type, directly on the wall of the control station or on the gas pipeline using mounting plate.

Mounting on the wall:

The device is mounted by using 4 screws M4x30 and mounting holes which are out of IP protected area. Screws are placed in the corners on the bottom of the housing. Mounting holes for the screws are accessible after opening the housing cover.

Mounting on the pipeline:

Mechanical mounting of PTZ-BOX 3.0 on the pipeline is made easier by using an optional mounting plate which can be fitted on a straight pipeline section via a pair of mounting lugs with hold-down straps.

Lugs with the spacing corresponding to pipeline diameter will be pulled-through the holes on the mounting plate and all will be pulled on the pipe. On the free ends of the lugs the M6 nuts with spacers are mounted to hold-down the straps. The mounting plate can be installed on a horizontal pipe with diameter from DN80 to DN150 or on a vertical pipe with diameter from DN80 to DN200.

Fastening of the PTZ-BOX 3.0 to the mounting plate is to be performed by 4 screws M4x10 via mounting holes which are accessible after opening the housing cover. The mounting plate also makes it possible to attach a three way valve necessary to perform a short verification.

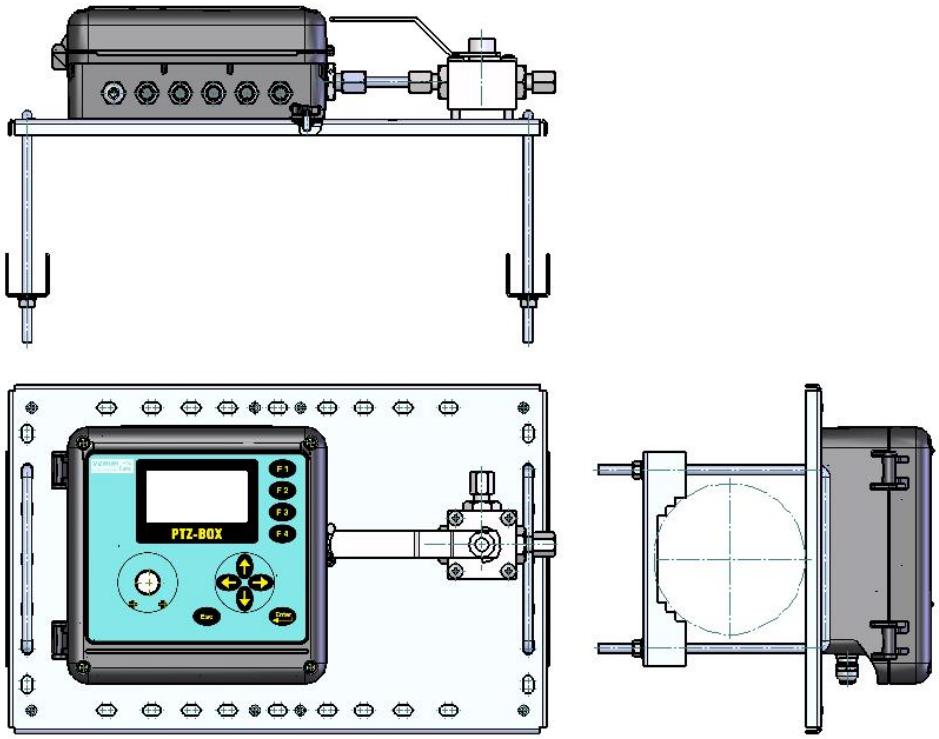


Fig. 15 Mounting of the PTZ-BOX 3.0 to the mounting plate

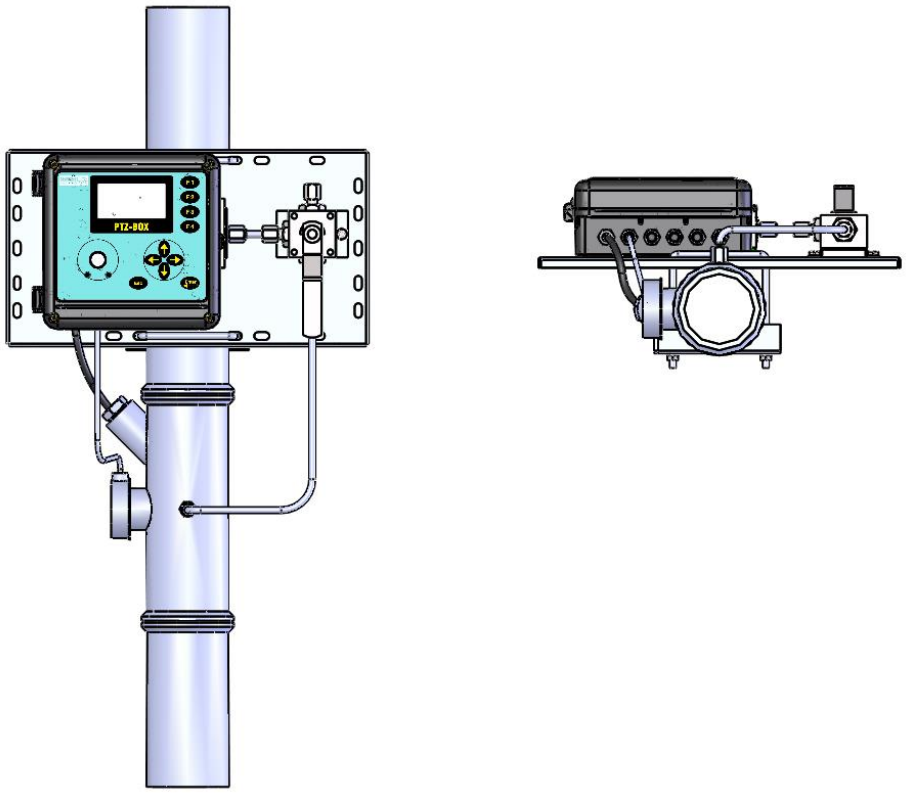


Fig. 16 Mounting the PTZ-BOX 3.0 to a pipeline

Connection of the pressure sensor

For connection of the pressure sensor we recommend to use weld less stainless steel pipe 6x1 mm. Connect the sensor to the gas meter output Pm (previous Pr) eventually it is necessary to use a dedicated weldolet.

The use of a three way valve is shown on Fig. 16. Stainless steel pressure pipe

Connection of the temperature sensor

For connection of the temperature sensor please use the thermowell mounted on the gas meter. If the gas meter is not provided with a thermowell, please fit a weldolet and thermowell according to gas meter manufacturer‘s instructions. This depends on the meter type.

DN (mm)	L – thermowell Including thread (mm)
50	51.5
80	61.5
100	71.5
150	86.5
200	116.5
250, 300	158.5
400	205.3

Table 10 Assigning of weldolets and thermowells according to pipeline diameter

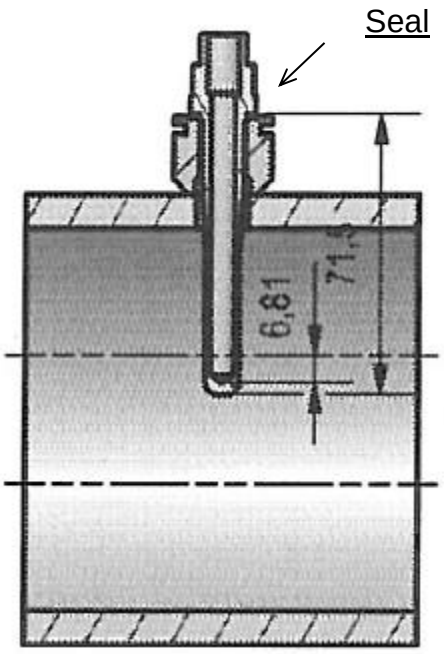


Fig. 17 Temperature sensor mounting

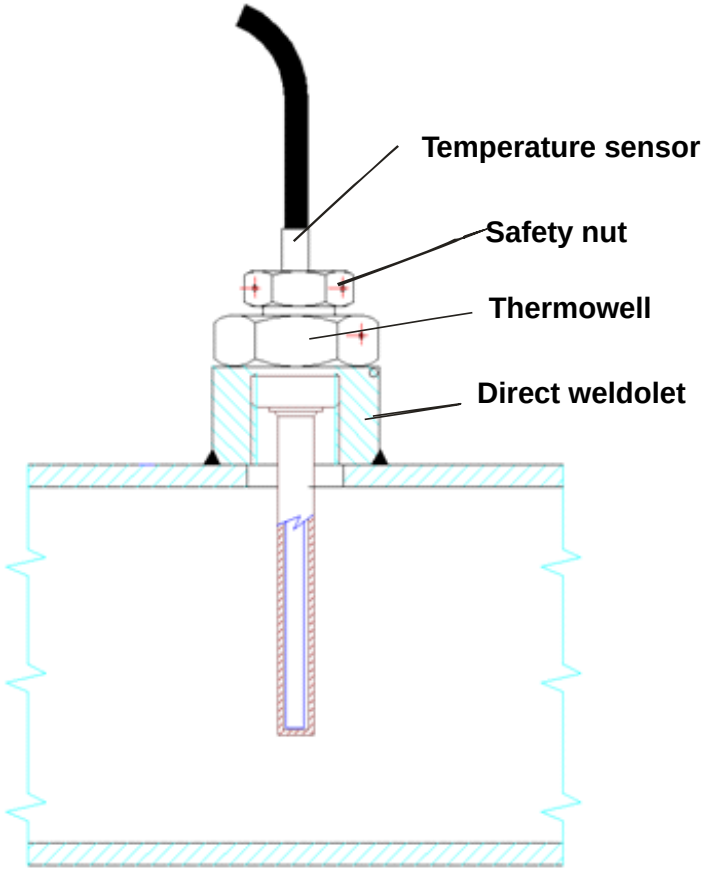


Fig. 18 Temperature sensor mounting by a weldolet

10.2 Cable connection, grounding

For connecting with another device it is necessary to use only shielded cables. On the device side the shielding of the cable must be connected with the metal body of the cable gland (according to Fig. 19). All cable glands of the device are connected. Thereby is a high resistance against electromagnetic disturbance ensured.

The temperature sensor and the external pressure sensor (if included) are also equipped with cable whose shielding is attached to the metal body of the cable gland. The metal part of temperature sensor is insulated. Metal body of pressure sensor is connected with cable shielding.

During the installation of the device and connecting of the shielding it is important to avoid the creating of a ground loop.

It is not necessary to ground the device.

For cable connection (size of the conductors: 0,5 – 1,5 mm^2) clamps are mounted in the device. On the board a description of the signal to be connected is printed. (see Fig. 8). Before connecting the cables it is necessary first to a apply wire-

end ferrule on the stripped end of the wire. Wires with ferrules can be plugged in the clamps without the need of a special tool. During removing it is necessary to slightly push the nose of the clamp and carefully take out the wire.

	cable type	cable diameter	Recommended cable type
Pulse input	Shielded 2 wire cable	4 – 6,5 mm	Unitronic LiYCY 2 x 0.25 Lappkabel Stuttgart
External power feeding	Shielded 2 wire cable	4 – 6,5 mm	Unitronic LiYCY 2 x 0.75 Lappkabel Stuttgart
Pulse outputs	Shielded 6 wire cable	4 – 6,5 mm	Unitronic LiYCY 6 x 0.25 Lappkabel Stuttgart
RS-232 connection	Shielded 4 wire cable	4 – 6,5 mm	Unitronic LiYCY 4 x 0.25 Lappkabel Stuttgart
RS-485 connection	Shielded 4 wire cable	4 – 6,5 mm	Unitronic LiYCY 4 x 0.34 Lappkabel Stuttgart

Table 11 Recommended cable types

The manufacturer of Lappkabel Stuttgart guarantees the resistance on their product Unitronik LiYCY for moving lead-wires in a range -5°C - +70°C and for immovable lead-wires in range -30°C - +80°C.

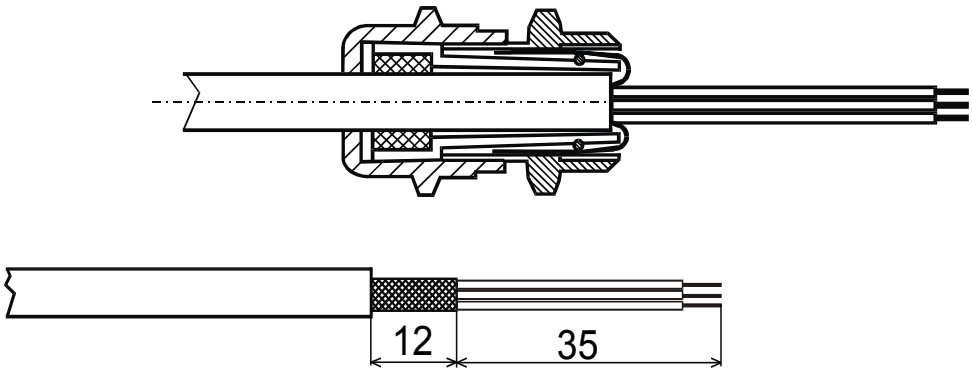


Fig. 19 Shielded connection in the gland

11 Accessories (options)

11.1 Assembly accessories

1 pc mounting plate (metal)

2 pcs mounting legs with straps
for assembly on pipes (for pipes Ø 50 mm, Ø 100 mm, Ø 150 mm. Specified when ordering!)

1 pc thermowell (length according to the pipe diameter. Specify when ordering)

1 pc of weldolet for the thermo well

1 pc three-way valve or 2 way valve

11.2 Intrinsically safe power supply

JBZ-01 Module	(power supply from 230 Vac)
JBZ-02 Module	(power supply from 12 Vdc)

11.3 Barrier and communication modules

S1 Module, S2 Module

K1 Module, K2 module

K3 Module, K4 Module

11.4 GPRS communicators

AMR1 Module	(battery supply of the communicator)
AMR-BOX	(battery supply of the communicator)
AMR3/S Module	(accumulator power supply of the communicator with solar charging)
AMR3/E Module	(accumulator power supply of the communicator with charging from network 230 Vac)

11.5 Other accessories

CL -1 Module	4-20 mA analogue output module
HIE-03	Infra-red head with RS232 communication interface
HIE-04	Infra-red head with USB communication interface
PA1.1	Digital pressure transmitter, type of protection ”i” - intrinsically safe
TA1.1	Digital temperature transmitter, type of protection ”i” - intrinsically safe
EDT-port	expansion module for digital sensors
SCR-port	SCR Encoder Input Port for Reed encoders

12 Specifications

Mechanical parameters

- mechanical dimensions (w x h x d)	…	170(185) x 170 x 73
- weight	…	1.2 kg
- casing material	…	polycarbonate
- terminals – conductor cross section	…	0.5 mm^2 – 1.5 mm^2
- mechanical class	...	M2
- electromagnetic environment	...	E2

Environment

- protection	…	IP65, According to EN 60529
- working temperature	…	-25 °C - +70 °C Readability of display in ambient temperature below -20 °C is not guaranteed.
- storing temperature	…	-40 °C - +85 °C
- working position	…	vertical [3)]
- humidity	…	max. 95%, non-concentrating vapours
- protection against dangerous touch of live and non-live parts	…	Small voltage

Non-explosive design – *intrinsically safety*

- indication	…	Ex II 1G Ex ia IIC T4/T3 - ZONE 0
- certificate no.	…	FTZÚ 11 ATEX 0015X

Power supply

- supply battery type	…	Lithium 3.6V/17Ah (size D) Use strictly: SAFT LS 33600
- supply battery life time	…	6 years [4)]
- supply battery voltage	…	2.8 ÷ 3.6 V
- measuring the supply battery life time	…	Yes, alert 90 days before discharge
- back-up battery type	…	Lithium 3.6V/1Ah (size ½ AA) Use strictly: SAFT LS14250
- back-up battery life time	…	10 years

Power supply from external source

PWR (GND,+) terminals

- External source type	…	JBZ-02, JBZ-01, Kx Module (IS)
- supply voltage of the external source U_{PWR}	…	4.5 – 10V (Not using NAMUR sensors)
	…	7 – 10V (Using NAMUR sensors) Note: real value depends on type of connected sensor NAMUR
- cable length	…	30 m

[3]) Recommended working position. In case of a guaranteed dry working environment, the device can also be installed in horizontal position.

[4]) The life time of the supply battery depends on the set mode, and the life time of the back-up battery depends on the method of using the device without the main battery

Device accuracy, metrology parameters

- measuring principle	…	PTZ converter, 1 channel [5)]
- type approval mark	…	(in accordance with certification type)

Relative error (within scope of working temperatures)

- max. total error of the converter	…	< 0,5 % of the measured value (MID)
		< 0,3 % of the range [6)]
	…	(version without MID certification)
- typical total error of the converter	…	0.15 % of the measured value (MID)
		0.10 % of the range [7)]
	…	(version without MID certification))
- Operational volume measuring error	…	No error
- Compressibility factor calculation error	…	< 0,05 %
- Compressibility factor calculation	…	AGA-8 92DC, AGA NX-19 mod, AGA 8-G1, AGA 8-G2, SGERG-88, constant [7)])

Measuring pressure

- Number of inputs	…	1
- Sensor	…	Silicon piezoresistant sensor

- certification under MID

- measuring ranges	…	80 ÷ 520 kPa
	…	200 ÷ 1000 kPa
	…	400 ÷ 2000 kPa
	…	700 ÷ 3500 kPa
	…	1400 ÷ 7000 kPa (8000 kPa)[8)]
	…	80 ÷ 1000 kPa [9)]
	…	400 ÷ 7000 kPa [9)] (8000 kPa) [10)]
- measuring error	…	< 0.25 % of the measured value
- long-term stability	…	< 0.1 % for each year of the measured value
	…	< 0.2 % for each year of the range

- without MID certification

- measuring ranges	…	80 ÷ 520 kPa
	…	80 ÷ 1000 kPa
	…	80 ÷ 2000 kPa
	…	80 ÷ 3500 kPa
	…	80 ÷ 7000 kPa
- measuring error	…	< 0.20 % of the range [7)]
- long-term stability	…	< 0.2 % for each year of the range [7)]

[5)] Even simpler options of conversion can be configured. Supported options are PTZ, PT, TZ and T.

[6)] In case of device version without MID certification the measurement error can be specified in a percentage from the range.

[7)] Selected calculation method of compressibility can involve temperature range. See Table 1.

[8)] Calibrated up to 7500 kPa

[9)] Enhanced range for extra charge. Cannot be combined with enhanced accuracy.

[10)] Calibrated up to 7500 kPa

- maximum overload rating	…	125 % of the upper limit of the measuring range
- mechanical resistance	…	10 MPa[11)]
- Connecting pressure	…	tube ∅ 6 mm, screwing ERMETO M12 x 1.5
- design	…	Internal or
	...	External, standard cable length 2.5 m max. 5 m

Measuring temperature

- Number of inputs	…	1
- Sensor	…	Pt 1000, platinum resistor detector
- measuring range	…	-25 ÷ +60 °C
- measuring error	…	±0.2 °C
- long-term stability	…	< 0.02 % for year (relative error in K)
- sensor design	…	tube ∅ 5.7 mm, length 120 mm with integrated cable
- length of external sensor cable	…	Standard 2.5 m, max. 10 m

Internal temperature measuring

- measuring error	…	±3 °C

Real time circuit

- long-term stability	…	±5 min / year at 25 °C

Digital inputs		INPUTS terminals
- number	…	4
- input options	…	LF impulse input, HF impulse NAMUR input, binary input low-input, binary NAMUR input
- length of cable for the individual inputs	…	30 m
Binary input - classic	…	Terminals DI1(LF+/-), DI2(LF+/-), DI3, DI4
- Max. number of inputs	…	4
- input type	…	Low-input input – connecting reed contact or no-potential output
- min. time of status duration	…	100 ms
- open circuit voltage	…	2.5 V - 3.6 V
- Shortcut current	…	Approx. 3 μA
- level “ON”	…	R < 100 kΩ or U < 0.2 V
- level “OFF”	…	R > 2 MΩ or U > 2.5 V
LF impulse input	…	Terminals DI1(LF+/-), DI2(LF+/-), DI3, DI4
- Max. number of inputs	…	4
- max. frequency	…	10 Hz
- input type	…	Connecting reed contact or no-potential output, WIEGAND
- min. length of pulse / pause	…	40 ms
- open circuit voltage	…	2.5 V - 3.6 V
- Shortcut current	…	Approx. 3 μA

[11)] Will damage pressure converter, the gas-tightness remains the same.

- level “ON”	…	R < 100 kΩ or U < 0.2 V
- level “OFF”	…	R > 2 MΩ or U > 2.5 V
Binary input - NAMUR [12]	…	Terminals DI1 (HF+/-), DI2 (HF+/-)
- Max. number of inputs	…	2
- input type	…	NAMUR (DIN 19234)
- min. length of pulse / pause	…	200 ms
- open circuit voltage	…	U_{PWR}
- Internal resistance	…	1 kΩ
HF impulse input – NAMUR [13]	…	Terminals DI1 (HF+/-), DI2 (HF+/-)
- Max. number of inputs	…	2
- max. frequency	…	5 kHz
- input type	…	NAMUR (DIN 19234)
- min. length of pulse / pause	…	100 µs
- open circuit voltage	…	U_{PWR}
- Internal resistance	…	1 kΩ
Input NAMUR ENCODER		Terminals DI1 (HF+/-)
- Max. number of inputs	…	1
- type	…	NAMUR (DIN 19234)
- type of input	…	Absolute ENCODER S1
- cable length	…	30 m
Digital outputs	…	OUTPUTS terminals
- number	…	4
- outputs options (SW configuration)	…	Impulse output, binary output, analogue output (via CL-1 Module)
- Output types	…	Open collector
- length of cable for the individual outputs	…	30 m
- without galvanic separation		
Binary output		DO1, DO2, DO3, DO4 terminals
- Max. number of outputs	…	4
- max. voltage	…	15 V
- max. current	…	100 mA
- max. resistance in connected status	…	10 Ω
Impulse output	…	DO1, DO2, DO3, DO4 terminals
- Max. number of outputs	…	4
- max. voltage	…	15 V
- max. current	…	100 mA
- max. resistance in connected status	…	10 Ω
- time of connection	…	Programmable 0.1 s – 25 s (step 0.1 s)
- time of disconnection	…	Programmable 0.1 s – 25 s (step 0.1 s)
Analogue output		DO1, DO2, DO3, DO4 *) terminals
- Max. number of outputs	…	4
- Output type	…	Current output 4-20 mA (using one CL-1 Module per output)

[12]) The device must be powered from an external JBZ-01 Module or JBZ-02 Module.

[13]) The device must be powered from an external JBZ-01 Module or JBZ-02 Module.

*) necessary to connect an external module CL-1 using the JB separator (e.g. K3 Module)

Connection of external sensor via EDT-port
– optional (communication line RS-485 internal bus)

- Expanding module marking	…	EDT-Port
- Communication interface for sensor	…	RS-485 (intrinsically safe)
- communication protocol	…	MODBUS RTU
- max.number of connected modules	…	1
- max. length of cable of sensor	…	100 m
- recommended type of pressure sensor	…	PA1.1 (intrinsically safe)
- recommended type of temp. sensor do	…	TA1.1 (intrinsically safe)

Interface for communication with superior system	…	All three interfaces share the same communication channel and cannot be operated simultaneously
Metallic interfaces		
- galvanic separation		yes
- Interface of serial communication	…	RS-485 or RS-232 (not possible simultaneously)
- Communication protocol	…	Optional, according to the firmware version
- Communication speed	…	9600 Bd – 57600 Bd, adjustable
- Byte format	…	8 bits, 1 stop, without parity
RS-232 line	…	RS232 terminals (GND1, CTS, TxD, RxD),
- connection via IS separator		E.g. MTL5051
- cable length	…	30 m
RS-485 line	…	RS485 terminals (GND1, U1+, D1+, D1-)
- connection via IS separator	…	K3 Module, K4 Module
- max. cable length	…	<100 m
IEC-1107 interface (Infra-red)		
- Communication speed	…	9600 Bd to 38400 Bd

Possible inputs / outputs configurations

	Binary input		Impulse input	
	Classic	NAMUR	LF	HF (NAMUR)
DI1	YES	YES	YES	YES
DI2	YES	YES	YES	YES
DI3	YES	-	YES	-
DI4	YES	-	YES	-

	Binary output	Impulse output	Data output*)
DO1	YES	YES	YES
DO2	YES	YES	YES
DO3	YES	YES	YES
DO4	YES	YES	YES

13 Intrinsically safe parameters

HF inputs NAMUR DI1, DI2: *HF+, HF- (INPUTS) Terminals*

Uo = 10V

Io = 11mA

Po = 27mW

	IIC	IIB
Co	2,8µF	18µF
Lo	200mH	700mH

LF inputs and binary inputs DI1, DI2, DI3, and DI4: *LF+/-, DI3+/-, DI4+/- (INPUTS) terminals*

Uo = 6.5V

Io = 8mA

Po = 15mW

	IIC	IIB
Co	2,8µF	18µF
Lo	200mH	700mH

RS485 communication line – internal bus (optional): *Terminals GND, U+, D-, D+*

Uo = 6.5V

Io = 1A

Po = 1.1W

	IIC	IIB
ΣCo	3,5µF	250µF
ΣLo	30µH	120µH

Digital outputs DO1 to DO4: *Terminals GND, DO1, DO2, DO3, DO4 (OUTPUTS)*

Ui = 15V

ΣPi = 1W

Ci = 500nF

Li = 0

External power supply: *PWR (GND,+) terminals*

Ui = 10V

Ii = 0.2A

Pi = 0.33W (Pi = 0.41W only for JBZ-02, JBZ-01)

Ci = 0

Li = 0

RS485 communication line – communication with superior system: *Terminals GND1, U1+, D1-, D1+*

Ui = 10V

ΣPi = 0.33W* (sum of outputs in RS485 and RS232)

Ci = 2.8µF

Li = 0

RS232 communication line – communication with superior system: *Terminals GND1,CTS, TXD, RXD*

Ui = 20V

ΣPi = 0.33W* (sum of outputs in RS485 and RS232)

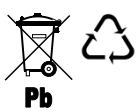
Ci = 200nF

Li = 0

or

MTL5051 (only terminals 1,2,5,6)

* Note: Sum of outputs is defined jointly for both interfaces, i.e. sum of outputs on RS485 and RS232 must not exceed 0.33W except MTL5051.



The battery used in the device are in the hazardous waste category. The used batteries can be returned to the manufacturer.

14 Configuration

After assembly and connection of the device in the measuring place it is necessary to set several device parameters (gas meter serial number, gas meter constant and station identification, etc.). Configuration of the device is performed with the GASCcomm service SW. The installation process is started with running the file SETUP.EXE

For parameters setting is necessary to have the service switch in the **"***On***"** *position***.**

14.1 Checking after installation

Recommended points for correct device function:

- check of system time in the device (see paragraph 14.3.3)
- check compressibility algorithm and gas composition setting (see Fig. 21)
- adjust gas meter constants and gas meter serial numbers setting (see paragraph 15.2.
- set default pressure and temperature values (see paragraph 14.3.5)
- adjust actual values of counters according to gas meter volume indication (see paragraph 14.3.6)
- check device diagnostics, solve possible problems, initialization of device summary status (see paragraph 14.3.7)
- clear device archives (see paragraph 14.3.8)

According to configuration, it is necessary to adjust other functions and controls (output settings, external power supply, etc.) during installation. Archives clearing and summary status clearing must be completed at the end of the adjustments. At the very end of configuration changes switch the service switch in ***„Off"*** position.

Notes:

1. Metrological device parameters are set by the manufacturer so that the device will work according to customer's requirements. Metrological values settings are protected by HW key and metrological switch. This switch is secured with an authorized seal.
2. The possibility to set other device parameters is protected with service switch, or with a password.
3. The device is delivered without active passwords.

14.2 Connecting the PTZ-BOX 3.0 with a PC

The device can be connected with a PC either by a serial interface (RS-232, or RS-485), infrared-head (HIE-01, 03, 04) or via a modem.

For device setting in the field the best is to use an infrared-head (with RS232 or USB connection) or a RS-232 cable (see 6.1). In case of communication through the infrared-head this communication has the highest priority and the device will automatically switch over to this communication when the IR head is attached.

Warning:

If is the PC used in the explosive area (ZONE 1 or ZONE 2), then all protecting norms and regulations must be followed.

Communication parameters (default setup)

In the device the following parameters for connection with PC (or modem) are pre-configured:

Communication speed, interface RS232/RS485	38 400 Bd
Communication speed, optical interface of infra-red head	9 600 Bd
Communication protocol	VTC
Communication address of device (see further)	Address1=0 Address2=0

14.3 Configuration with the GASCcomm software

When the device is connected with a PC, it is possible to start-up the GASCcomm service SW with double-click on the „exe file“. After the SW is starting already defined devices (gas stations) are displayed see Fig. 20. In this list for each device one line is configured. In each line all parameter for device identification and for communication are specified. User may edit parameters easily with double-click on each window. By some parameters symbol of arrow is displayed in the right corner. By clicking this arrow the user can choose from several possibilities. When the user cannot find the device in the list or the list is empty, it is necessary to make a new line with the definitions of the new device (station). A new line is created after a click on the „+“ icon. The parameter setting of a new station is the same as editing of an existing station.

14.3.1 Parameters setting of a station

At all stations columns arrange the identifying data and data that are necessary for communication.

- ***Station description*** – users description of the station
- ***Station identification*** – short station indication; this indication (name of the station) must be the exactly the same as the indication that is written in the device memory.
- ***Tel. no.*** – only fill in, when you will have communication via a modem. Fill in the telephone number of modem, which is connected with PTZ-BOX.
- ***IP address: port*** – complete only in case of LAN network or GPRS connection (IP address to be issued by the network administrator)
- ***PTZ-BOX*** - choose ***No!*** (Only applicable for communication with older models: PTZ-BOX V1 or V2).
- ***Name of comm. channel*** – after double-click choose communication channel (description – see paragraph 14.3.2)
- ***Addr.1, Addr.2*** – if you have only one connected device choose zeros – in a communication network choose the actual address of the device you communicate with.
- ***Protocol*** – Choose the same which is set in the device. For establishing the first communication, the device set communication protocol is VTC

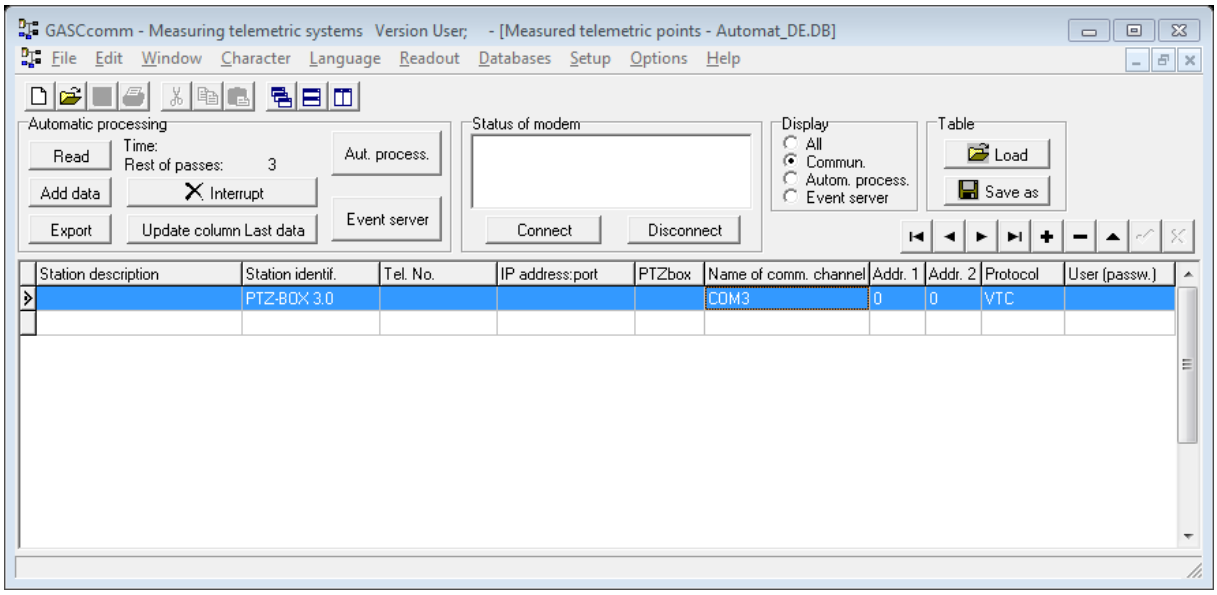


Fig. 20 Station setting

Note for parameters Addr.1, Addr.2:

Parameters Addr.1, Addr.2 are connected with the specific device that is connected to the PC in the given station. In case that this station includes more connected devices then is necessary to differentiate devices by these addresses. For connecting the PC with a conversion device the right addresses as configured in the PTZ-BOX must be mentioned (see 14.3.5). In case, that only one device is connected it is possible to leave these parameters zero.

WARNING (in case of working with MODBUS protocol):

In case of using **MODBUS** protocol (see 15.7) only address Addr.1 is used. In this case you cannot use zero as address; you have to use the (non-zero) address Addr.1 which is set in the device (in range from 1 to 247) or you may use universal address **Addr.1 = 248**. The device will answer on this address always.

If are all data in the line are set in the right way, then the station is set and communication between PC and device is ready for testing. This can be done by reading the actual values (menu ***Readout -> Actual values***).

14.3.2 Communication channel setting

For successful communication between the device and the PC the communication channel must be correctly set. For each communication channel the correct communication interface, communication speed, etc. must be chosen.

Setting progress

- Choose menu: ***Options –> Communication channels***
- In case of adding a new device into the GASCcomm service SW it is possible to choose an already defined communication channel or to define a new communication channel with the button „+“ see Fig. 21.

- Setting of a new communication channel starts with the choice of the connection between device and PC (program switch ***Communication medium***). For instance for communication via infrared-head choose **RS-232** or **USB** and relevant communication port. After this selection a new communication channel will be added in the table ***Configuration of communication channels***.

Configuration of communication channel:

- name of the communication channel – here assign your own indication (in case of more communication channels that is better for the identification)
- Speed of communication channel:
  - communication via infrared-head HIE-03,04 – communication speed up to 38 400 Bd (older model HIE-01 - communication speed 9600 Bd)
  - communication via serial port – Communication speed up to 38,400 Bd.
  - communication via modem – communication speed is set according to communication speed of modem.
- Other parameters are without changes.

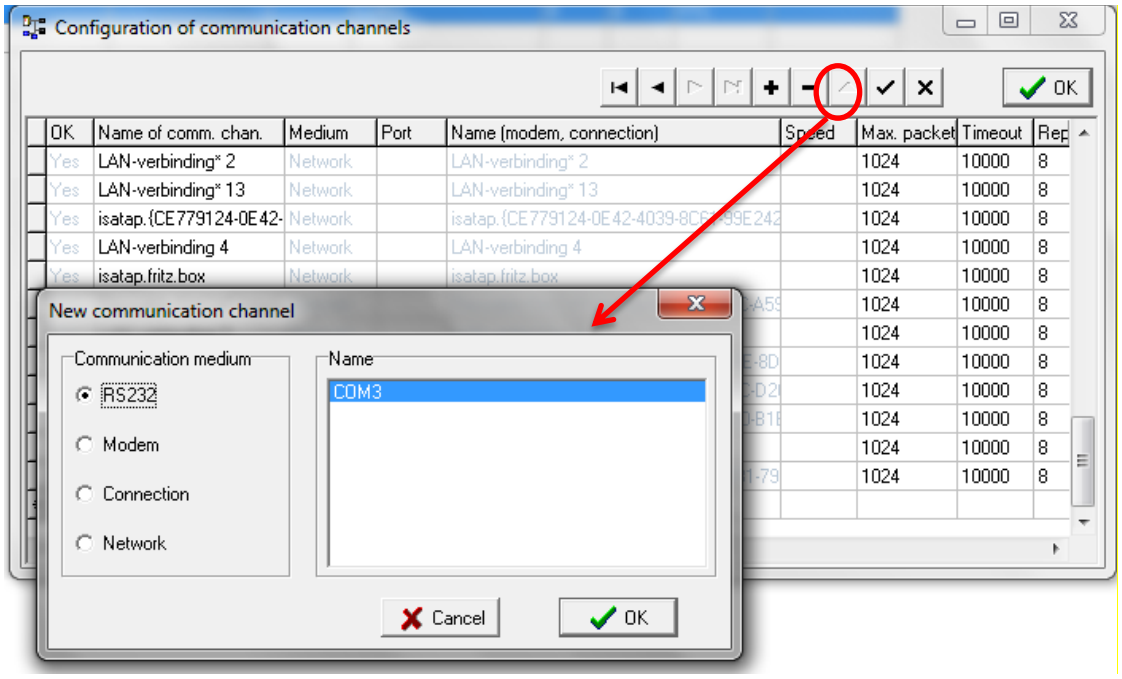


Fig. 21 Adding a new communication channel

After complete definition of the new communication channel a new setting is saved by pressing the button **OK.** The new defined channel may be chosen by setting of station settings (see paragraph 14.3.1).

14.3.3 Checking and setting of the system time

In the device is a real time clock with a calendar. It is possible to display actual date and time on device display via the menu ***Calculation settings -> Date and Timing*** or by reading out of the actual values with the GASCcomm service SW. The item ***Setup -> Date and time*** in SW menu allows changing these values.

14.3.4 Downloading and uploading parameters in the device

The user may readout parameters from the device via the menu ***Readout -> Parameters***.

After parameter readout the data from the device are displayed in a separate window. With the button with the  icon you can switch between two types of display modes:

a) **Simple mode display**

On the screen base device parameters are displayed and the settings can be changed (see Fig. 22 and Fig. 23).

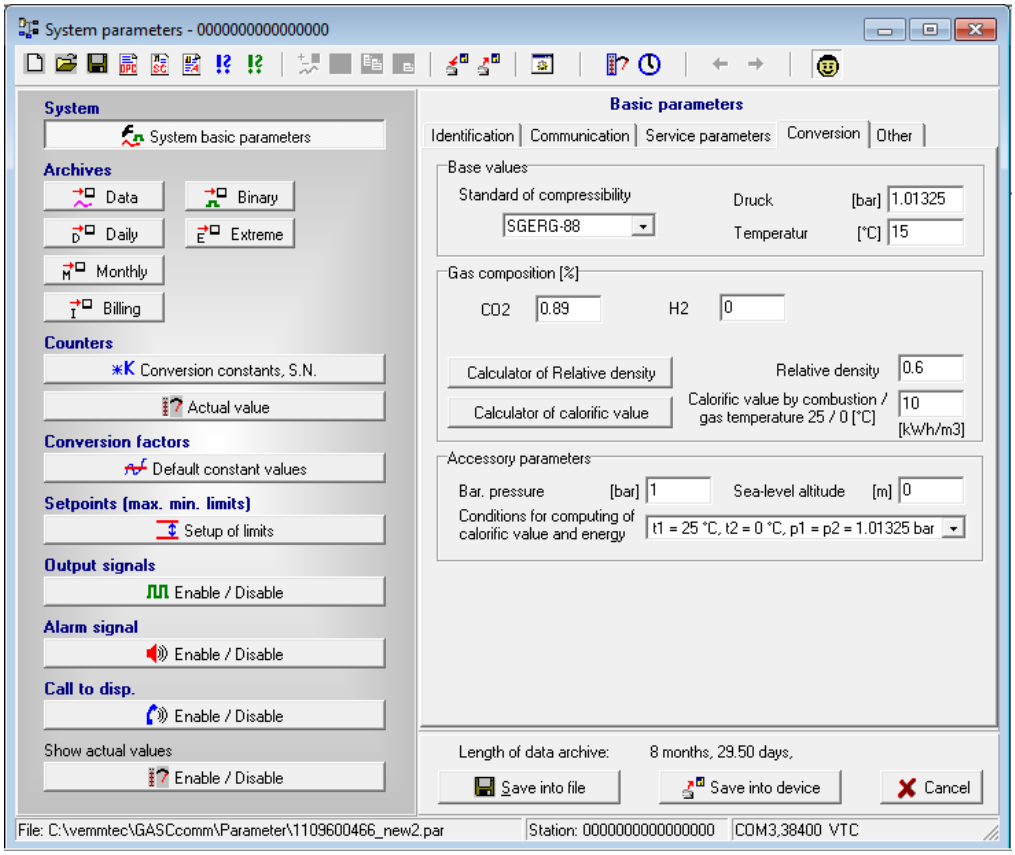


Fig. 22 Base device parameters

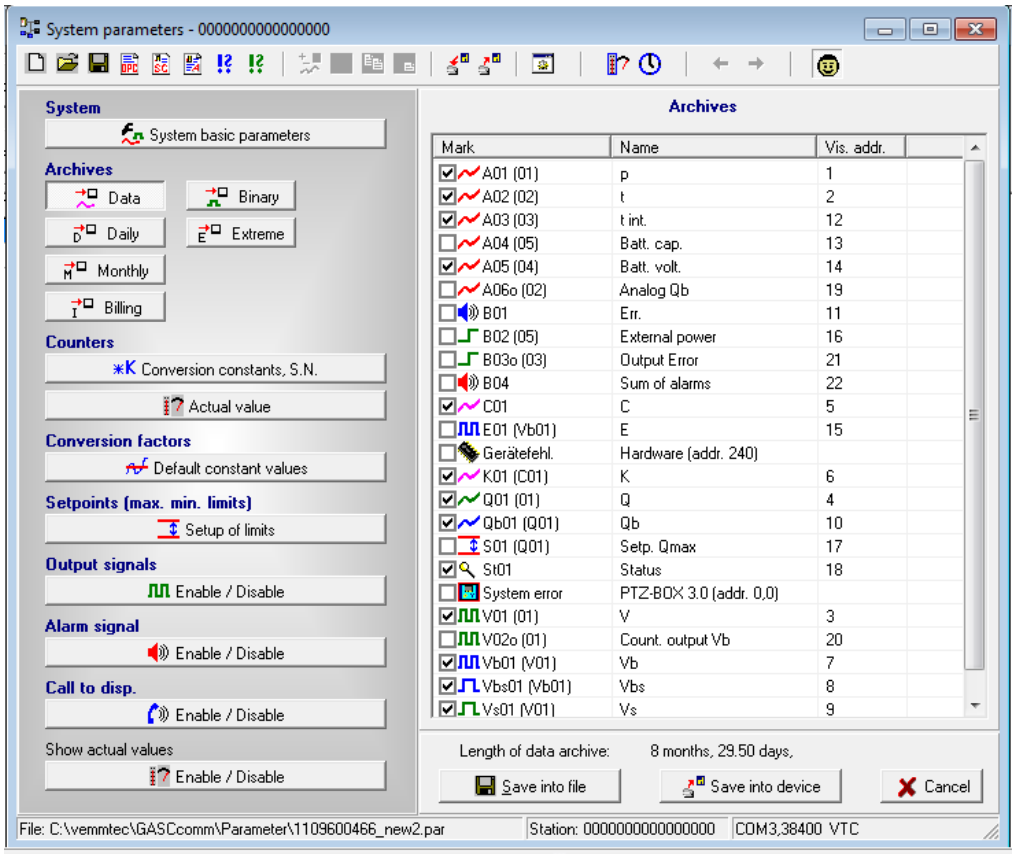


Fig. 23 Data archive

b) **Full mode display**

All parameters are displayed in a tree structure. This type of display is for advanced users.

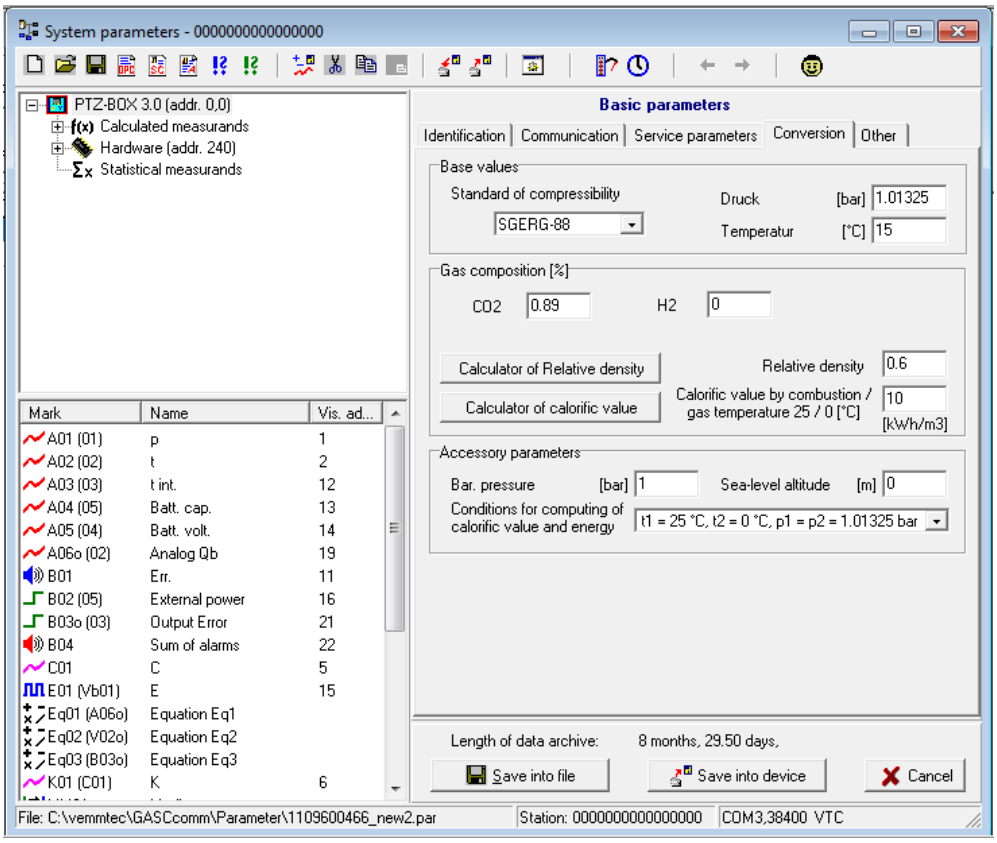


Fig. 24 Base parameters – Full mode display

In the simple mode it is possible to set followings:

a) System parameters – allows identification settings, communication settings, service parameters setting and setting of parameters for conversion.
b) Structure of individual archives. With a simply check-mark parameters are assigned for displaying or for the applicable archives.
c) Actual values of counter
d) Error values of temperature, pressure and constant value for a fixed conversion factor.
e) Set points or settings of limits, if these limits already exist.
f) Output pulses – permission or blocking of already defined output pulses generating

A changed configuration can be saved into the PC memory. Record into the device can be made after the configuration is finished by pressing the button ***„Save into device“***.

Warning:

In some cases (a, b) the change of the setting results in clearing of some archives.

14.3.5 Device configuration with the assistant

For easier device configuration the GASCcomm SW comes with a user-friendly and simple assistant. User can start up this assistant with click on the icon in the toolbar of the (system) parameter window (see Fig. 25). With the selection of ***Installation of telemetric system*** in the ***Wizard for editing of parameters*** the configuration starts.

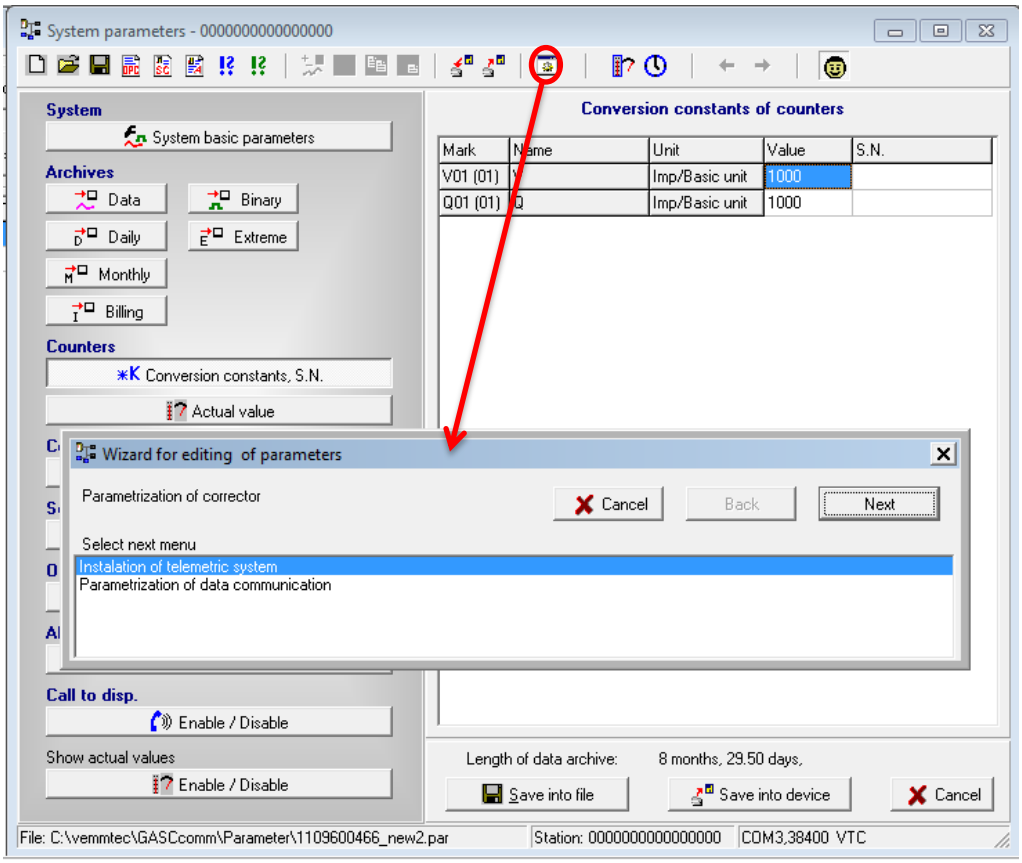


Fig. 25 Assistant for configuration

The configuration assistant guides the user through the setting of some parameters.

The meaning of all parameters is described on a lower window frame.

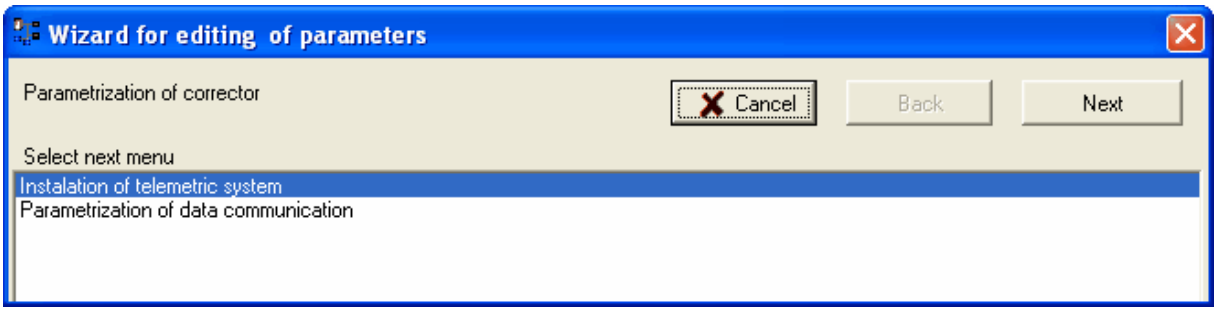


Fig. 26 Configuration of identification and communication

On the first screen it is possible to set the station identification, station address in the network (Address 1 and Address 2), communication protocol, communication speed, frequency of recording into the archives and the measuring period.

Address 1 is ranging from 0 to 65535; **Address 2** from 0 to 255. For the **MODBUS** protocol **Address 1** ranges from 1 to 247 and **Address 2** is not used.

After the button ***Next*** is pressed the following screen will be displayed, which is determined for the setting of the ***Gas*** composition***.*** First the ***compressibility method*** must be chosen. According to the chosen method a pre-set gas composition is indicated. The user can set gas composition according to actual values.

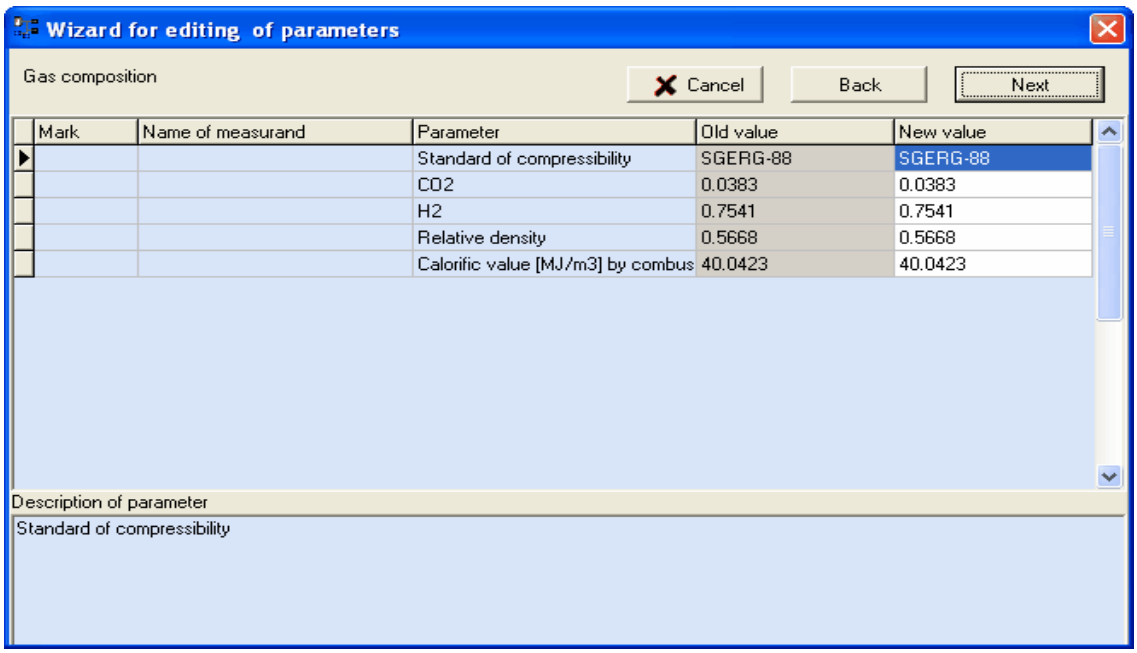


Fig. 27 Gas composition configuration

Note:

The parameters are changed according to the chosen compressibility method that is chosen in the first line. In the case of a fixed value of this parameter it is configured in following steps (see Fig. 28).

After pressing the button ***Next Setup of 1. channel (***or ***Setup 2. Channel***) follows.

On this screen it is possible to set following channel parameters:

- ***Gas meter*** values are set in the first line ***V01, Q01 Primary volume V1, Flow Q1*** it is indicated as ***Input pulse /Base unit.*** The set value is for volume V1 increment and for the Flow Q1. If gas meter has a HF output, then is the range limited only on decimal multiples and most of the time the impulse values need to be adjusted later.
- The **Gas meter serial number** is set in the line ***V01 Primary volume V1*** and is marked ***Serial number***
- The **default pressure value** (which is used when the device is in error status) is set in the line ***C01 Convers. factor C1*** and is marked as ***Default const. pressure***.

- **Default temperature value** (which is used when the device is in error status) is set in the line ***C01 Convers. factor C1*** and is marked as ***Default const. temperature.***
- **Setting of the default compressibility value** is set in the line ***C01 Convers. factor C1*** and is marked as ***Default const. compressibility***. This compressibility value is used in calculation only if there is no compressibility calculated according to mathematical methods.

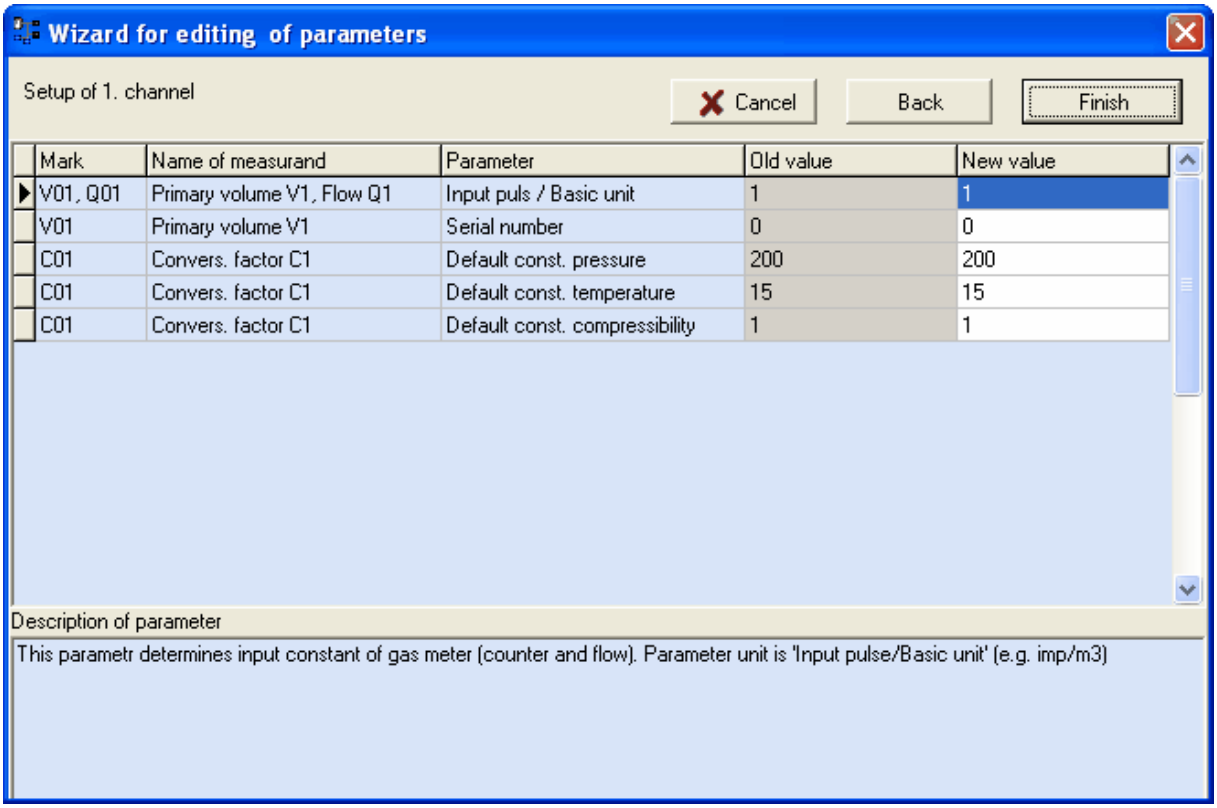


Fig. 28 Channel setting

With pressing the button ***Next*** follows analogous screen ***Setting 2. channel.*** (not applicable for the PTZ-BOX 3.0)

This is the last step of ***Assistant for configuration***. Other settings can be made in the normal configuration screens

Note:

After closing the wizard for configuration parameters are prepared in the software for writing into the device. Therefore do not forget to write these into the device using the button „Save into device“ before closing this page. For writing the parameters into the device is necessary to have the service switch (user switch) in the position „***On***“. After the parameters were saved switch over the service switch (user switch) in the „***Off***“ position.

14.3.6 Setting of Actual (primary) volume counter

It is useful to adjust the counter of the volume converter to the value that is indicated at the gas meter. In the screen that shows the device parameters (Fig. 29 – simple parameters display) choose ***Actual value*** and in the column "**Value**" write the applicable values.

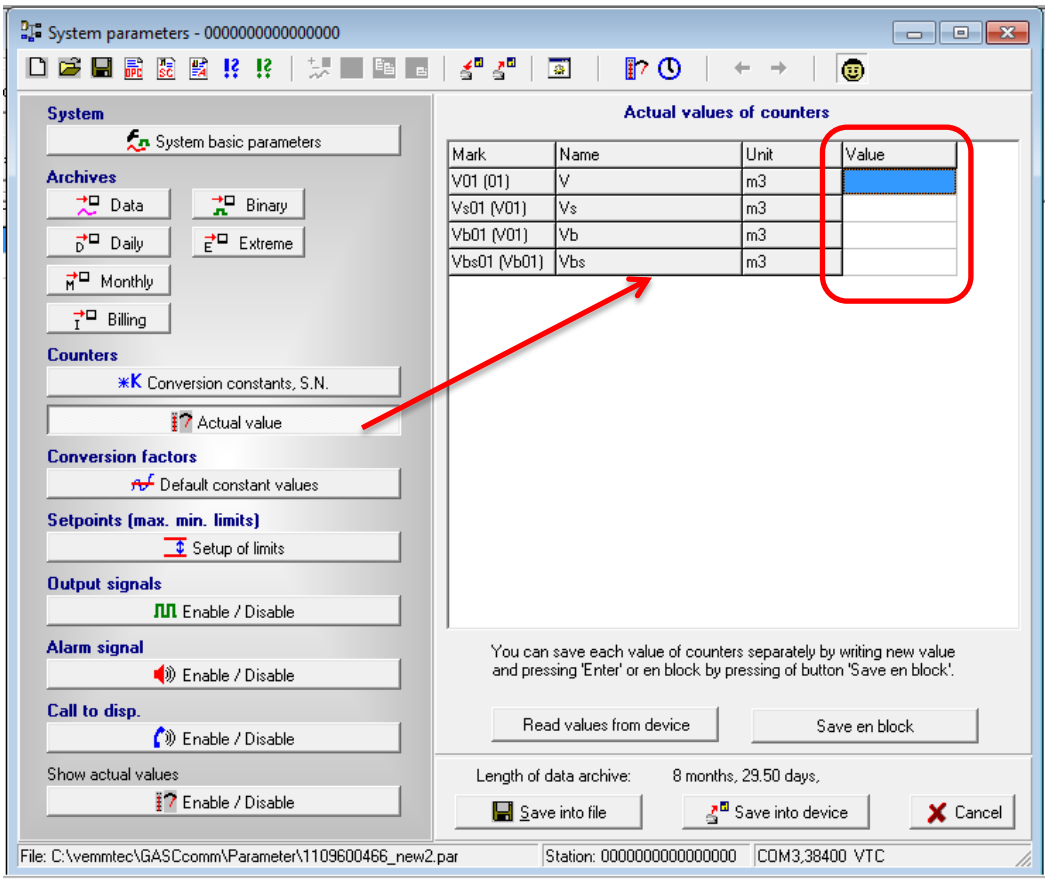


Fig. 29 Actual (primary) volume counter setting

14.3.7 Device diagnostics and clearing History

Device diagnostics may be done: a) by the device keyboard
b) by the GASCcomm service SW.

a) In menu „***Alarms***" are saved information about device condition:

- „***Errors and warnings***"– shows current device status. With pressing the button „***Right arrow***" there are displayed all actual errors of the device one by one.
- „**History errors and warnings** " – serves for instance for monitoring of active conditions of single device bit status from last summary status clearing.
- „***Clear history***" – clears the history.

b) In SW on PC (Fig. 30)

Menu choice „***Setup -> Diagnostics (status) of the device -> From device***“ will be read out the errors and warnings from the connected device. It is possible to find out current status of the device with pressing: ***Device settings -> Device ->Device test***.

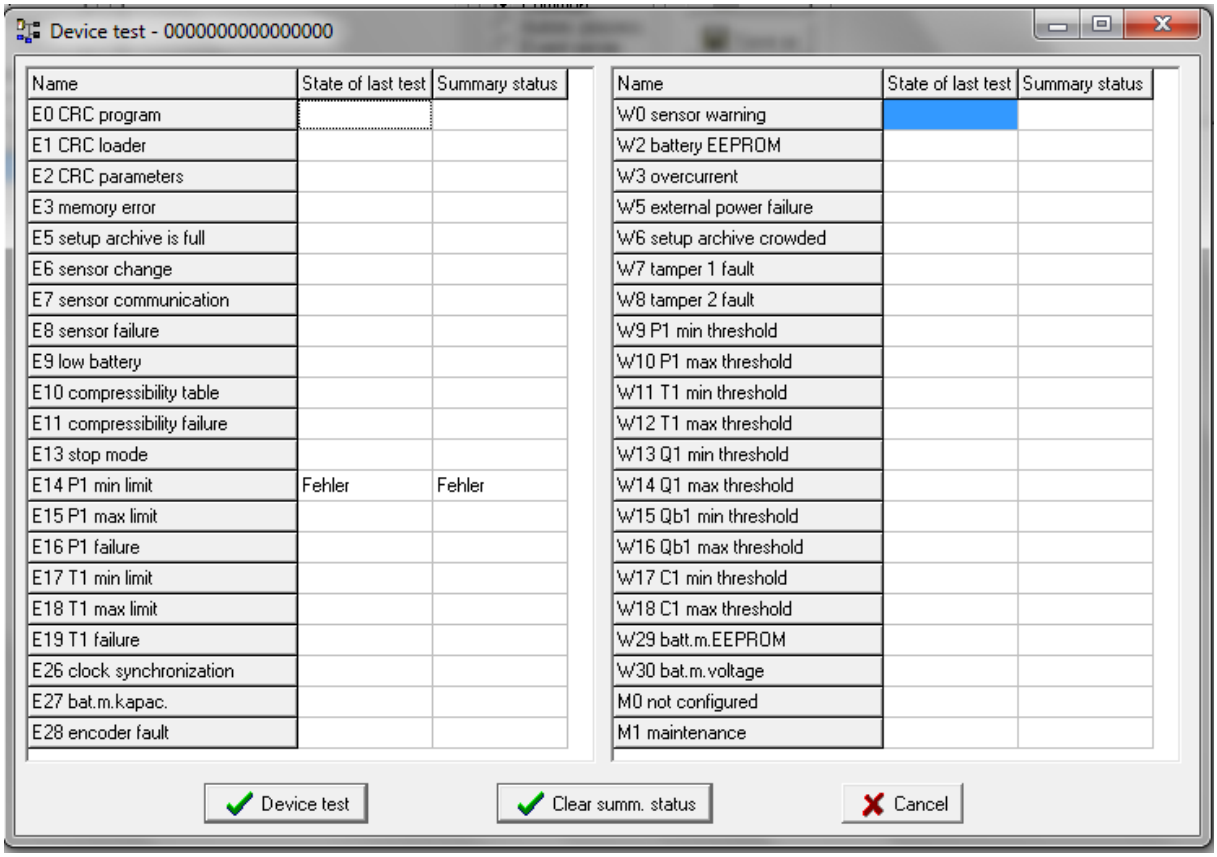


Fig. 30 Displaying of device diagnostics

In column „Summary status“ there are all errors from the last reset of summary status. The central button at bottom part of window can be used for reset.

A table with the description of errors and warning messages and procedures how to remove them are shown in chapter 9.4.8.

14.3.8 Clearing archives

This operation can be made only with the GASCcomm service SW. In the menu (see Fig. 31) it is possible to clear archives selectively or all archives at once (except Setup archive).

Warning:

Deleted data in archives cannot be recovered!

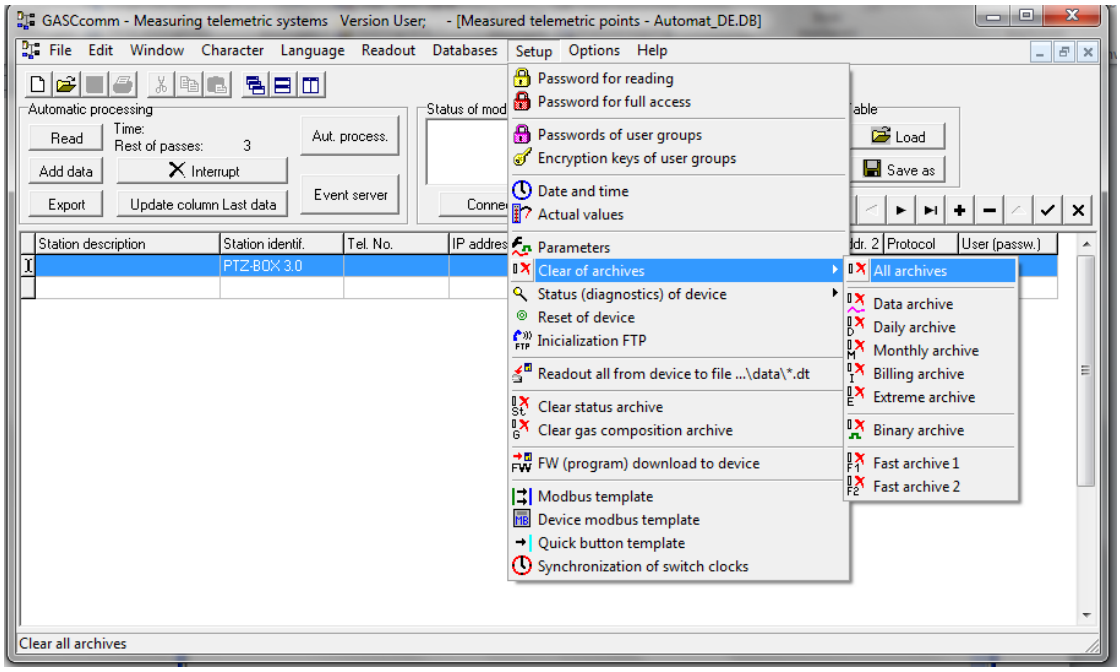


Fig. 31 Clearing of the archives

14.4 Password in the device

It is possible to use the device either without passwords or with password protection. Password can be set by the GASCcomm service SW. It is possible to set a password for reading and/or for full access. The device asks for providing the passwords only if passwords are activated.

- With the password for reading it is possible to readout data from the device.
- Password for full access allows to readout data and to write data into the device.

The GASCcomm service SW remembers the password until its restarted, so it is not necessary to enter the passwords again during reading or writing. Passwords may be set in the menu

Setup –> Password for reading; Password for full access.

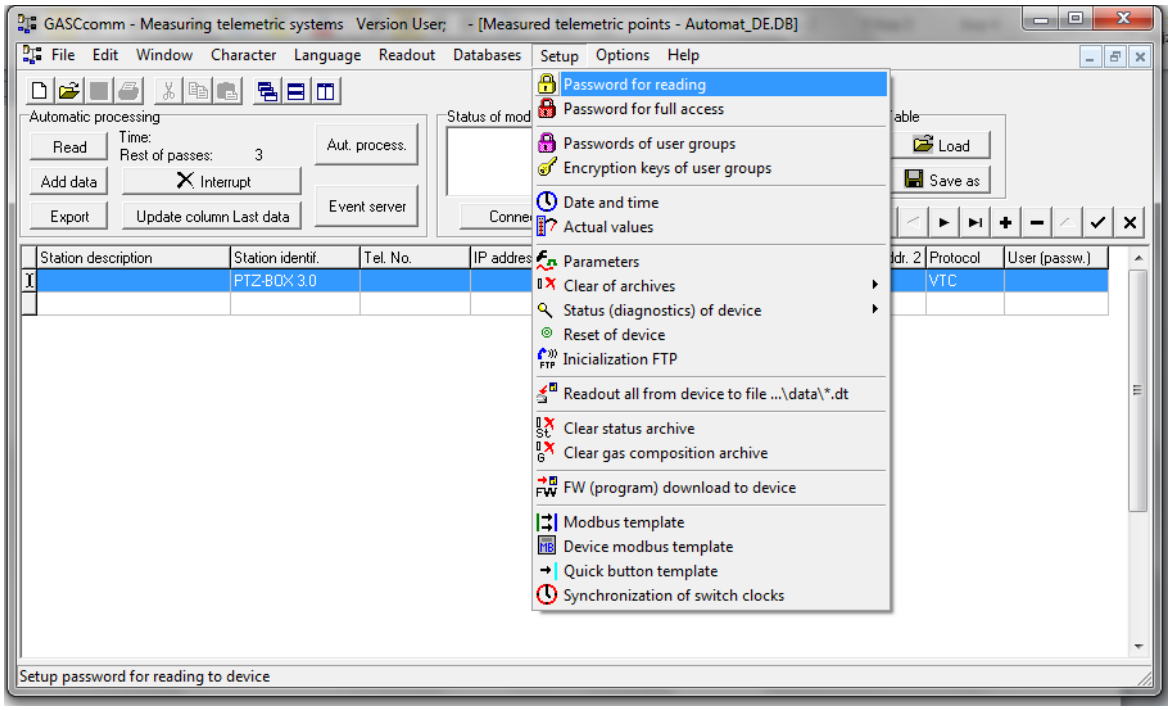


Fig. 32 Password setting

Note:

1. The password will not be activated (or de-activated) if you fill up an “empty” password during password setting.
2. Maximal length of password for reading and for full access is 6 characters.
3. Password system can be changed by the administrator

15 Configuration examples

In this chapter are examples of the most common device configurations. The device configuration is made by using the GASCcomm service SW.

First the file of device parameters must be displayed:

1) Parameters of the device connected to the PC:
   menu ***Readout -> Parameters***
2) Parameters readout form the device in the past:
   menu ***Setup -> Parameters*** (select a saved file with suffix *.par)

Notes:

1) Changes of the parameters are made in the PC memory. They are saved into the device after pressing the button **Save into device.**
2) Described examples of configuration may be performed by users without applying the hardware key (except indicated exceptions). For saving the parameter file into the device it is necessary to have the service switch (user switch) in the „***On***“ position. After finishing it is necessary to switch the service switch back to „***Off***“ position.

15.1 Parameters display modes

In the GASCcomm service SW it is possible to choose between two modes of displaying the device parameters:

a) Simple mode display

Base device parameters are displayed on the screen with the possibility of changing the settings.

b) Full mode display

All parameters are displayed in a tree structure. This type of display is determined for advanced users.

It is possible to switch between both modes by the  icon, at the toolbar (see Fig. 33). It is possible to set the default mode in the menu ***Options*** -> ***Programme parameters*** -> ***Other parameters***. Described types of parameters settings are for both types (if possible).

15.2 Setting the gas meter impulse factor

It is necessary to set gas meter factor (in the GASCcomm service SW marked as a relation pulse input/base unit) during installation or after gas meter replacement.

15.2.1 Simple mode display

In this paragraph the setting of gas meter constant in the simplified display is described. Enter the gas meter factor in the line “Primary volume V1” in imp/m³ or in other volume units if applicable. Into column S.N. in the line “primary volume” write gas meter serial number.

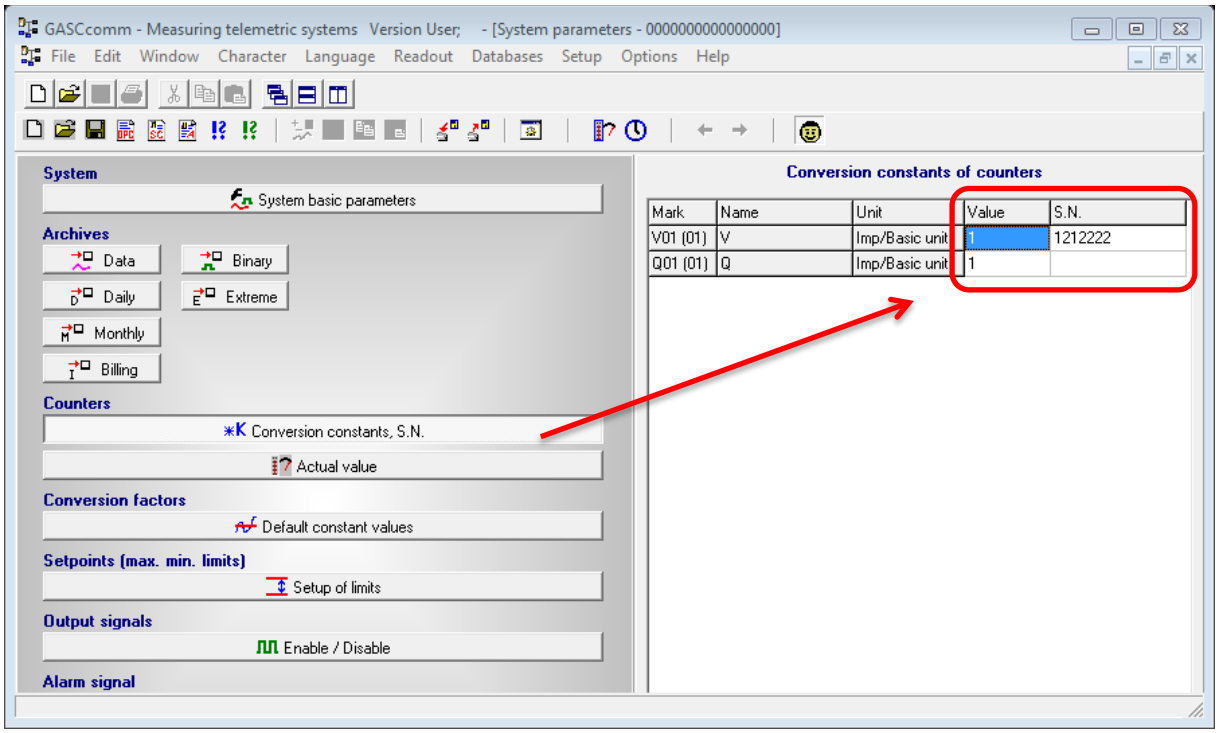


Fig. 33 Setting the gas meter factor in simple mode display

Values of constants from item V01 are automatically copied into item Q01. If applicable (not for PTZ-BOX 3.0) the same rule stands for V02 a Q02, because this constant is used for counting of both parameters.

15.2.2 Full mode display

It is necessary to make the setting separately for:

a) – counting of **Primary volume V1** (or V2)

b) – estimation of **Flow Q1** (or Q2).

In this display mode the constant chosen for one parameter (V) is not automatically copied for the second parameter (Q).

Warning:

Practically it means that we can have for V and Q two different constants; which most of the time is not what we want!

Example 1 – Gas meter with LF output:

The program allows setting the gas meter factor with LF output in the range of the followings values: 0.01, 0.1, 1, 10, 100 or 1000 pulses/m^3. The set value must be written into the field **Input pulse/Basic unit**. This progress for Primary volume V1 is displayed on Fig. 34. The same procedure is to be used for Flow Q1.

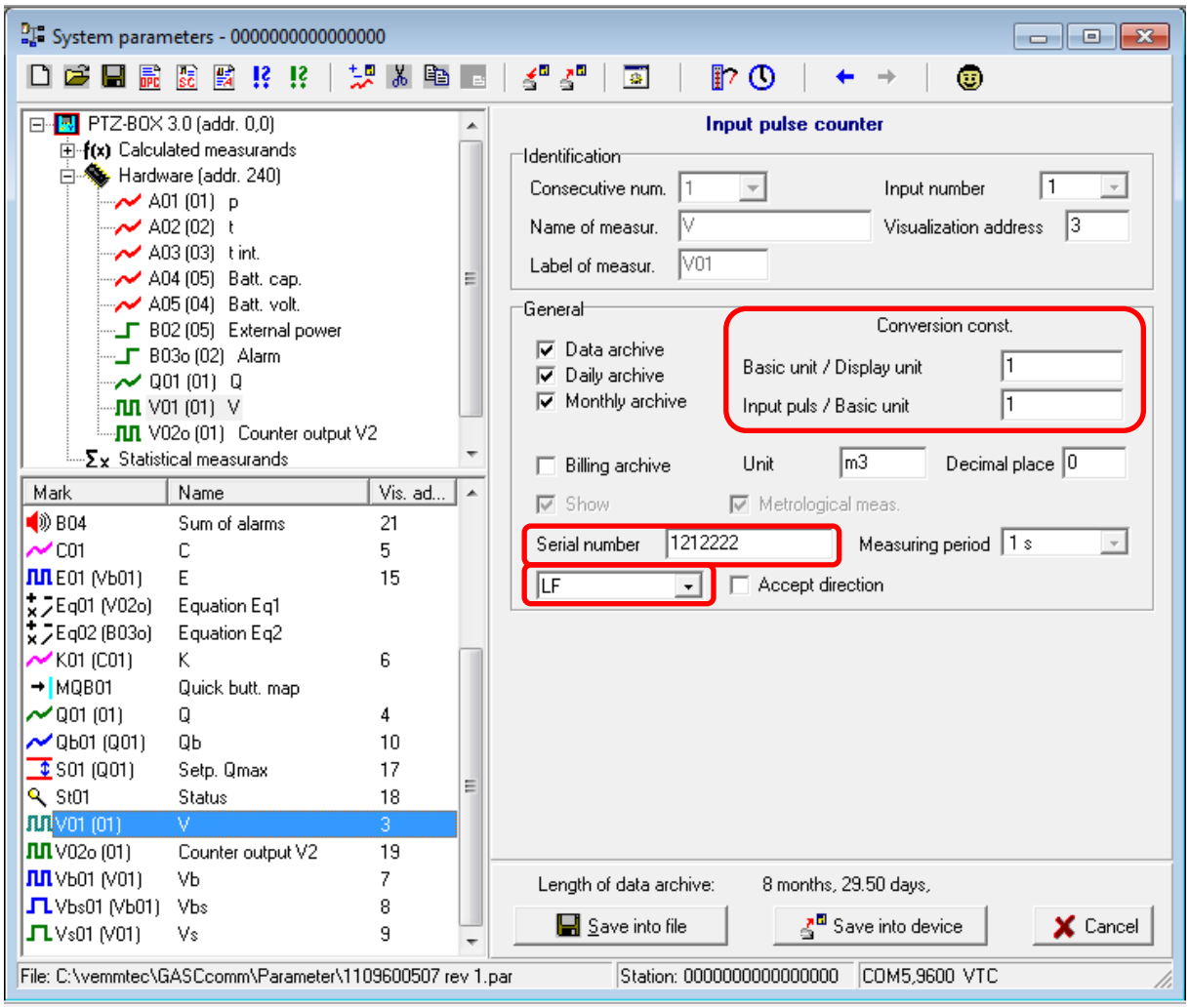


Fig. 34 Setting gas meter factor for LF pulses in full mode display

Example 2 – Gas meter with HF output

For gas meter with HF output **HF** must be selected. Fig. 35 shows setting of gas meter with the HF output factor on a value of 82.5564 pulse/m^3 and a serial number of the gas meter 1212222. Here it is also necessary to make the same setting for the Flow Q.

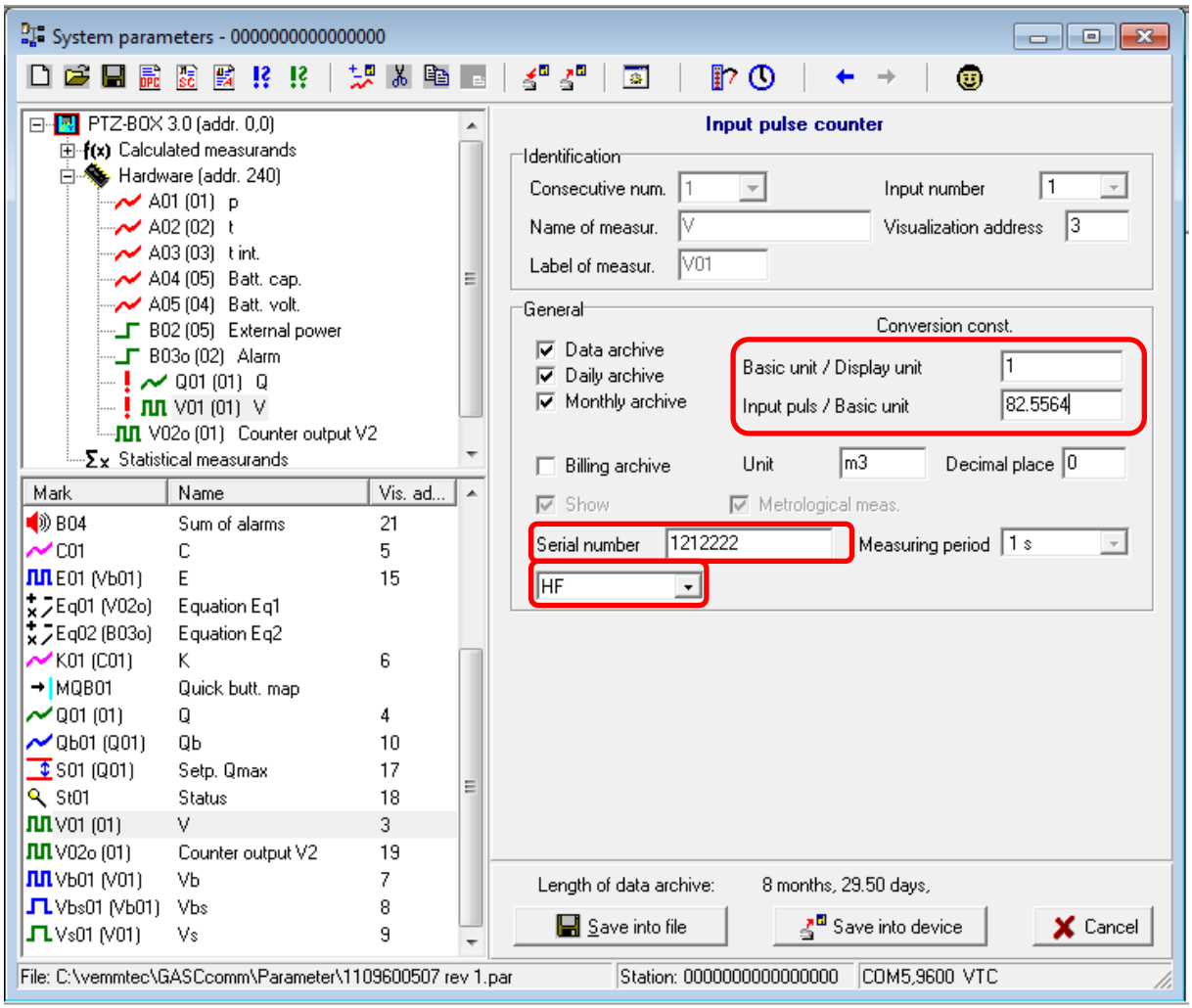


Fig. 35 Setting of gas meter factor for HF pulses in full mode display

15.3 Pulse outputs setting

Pulse output may be used for instance for controlling of odorization, preheating or as an output for management systems, dispatching, etc.

15.3.1 Simple mode display

Configuring this type of output it is possible only if this output was already created in full mode display. Then it is possible (in simple mode display) to switch this output on or off by using the button ***Output pulses, binary*** (see Fig. 36).

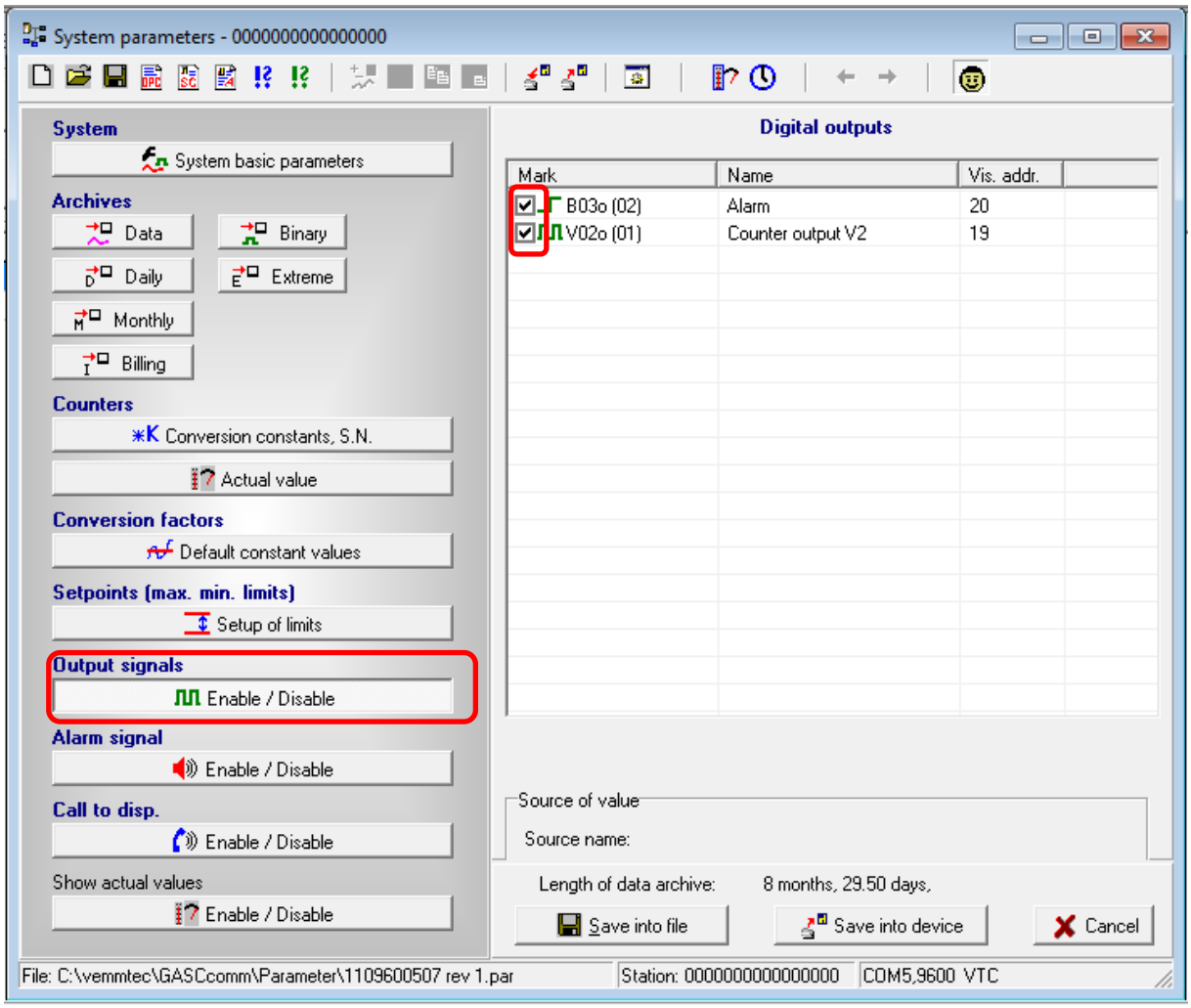


Fig. 36 Switching on and off output pulses

15.3.2 Full mode display

In case this output was not configured it is necessary to configure it and assign a parameter. It is necessary to set technical parameters of output pulses as well.

1. Inserting an output into parameters

In left upper window choose item ***Hardware***, press right mouse button -> ***Insert output measurand*** ->***Counter (pulses) output measurand*** (Fig. 37).

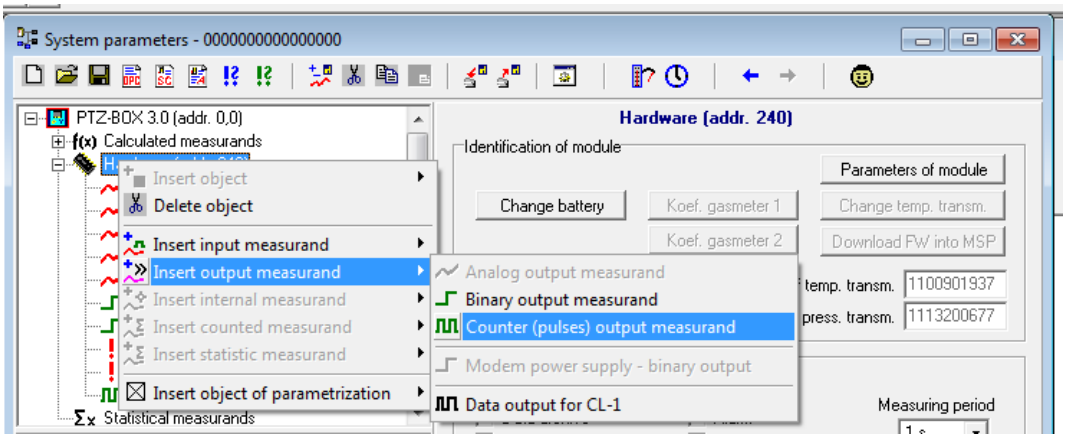


Fig. 37 Configuring a pulse output

Then a module of ***Pulse output counter*** will be created e.g. with indicated V03o (see Fig. 38).

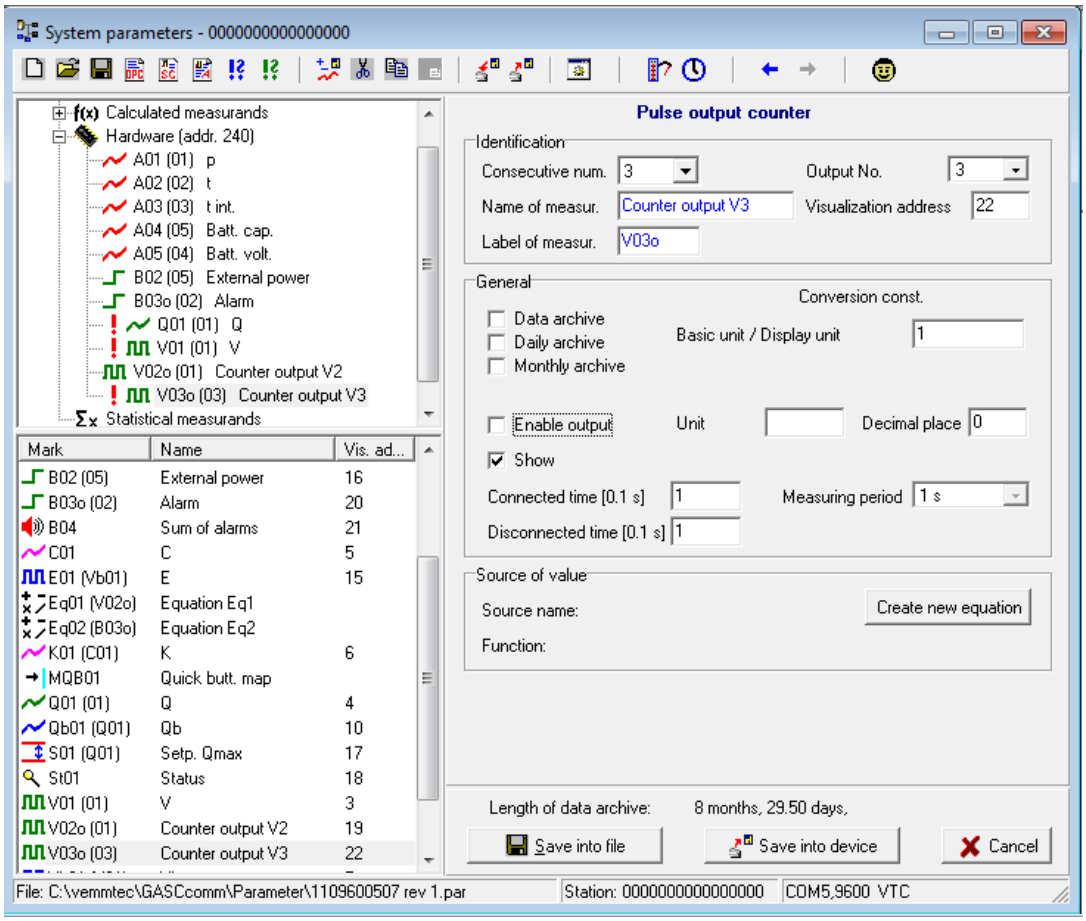


Fig. 38 Pulse output configuration

Now a hardware pulse output is configured. The device offers possibility of four digital outputs. These outputs are connected to clamps (DO1 to DO4). Item ***Output No.*** indicates on which clamps of OUTPUT terminal block is this output connected:
Output No. 1 – clamp DO1
Output No. 2 – clamp DO2

Output No. 3 – clamp DO3
Output No. 4 – clamp DO4
The programme assigns automatically free output clamp (in our example DO3). But it is possible to swap.

2. Setting output pulses properties

- ***Connected time*** – range of output pulse. Minimal range is 0.1 s. It is set in complete multiples of this value.
- ***Disconnected time*** – time between pulses. Setting of this is the same as for connected time.
- **Enable output** – with this choice is possible to enable/disable a configured output (is the same like in simple mode).
- ***Unit*** –the measure unit for output information (e.g. m^3)
- **Basic unit / Display unit** – leave value 1
- **Input pulse / Basic unit** – leave value 1

3. Output measurand and output constant

Till now it was not defined which measurand (e.g. actual volume or base volume etc.) should the measure for the pulses. In the next step it is necessary to connect this output counter (V03o) to the required parameter. Assignment of this parameter is performed by the equation tool. Press the button **Create new equation** in the frame **Source of value** with help of the *Wizard for mathematic expression* (see Fig. 39).

This example creates the *Equation module* (Fig. 40). In this case the equation Eq03 is to be used for output pulses of the base volume generated at the first channel (total of the base volume counter and of the error base volume counter). The equation is for the output V03o. The mathematical expression defines the input value. In this case the expression looks like:

V03o = dVb1+dVbs1

- it means that the output value V03o is the sum of:

dVb1 d (=difference) of base volume V1 of the first channel. In case of actual volume there would be dV1.

dVbs1 d (=difference) of base spare volume V1 of the first channel.

If necessary multiply this output with an **output constant**. E.g. if the constant should be 6.53, then it is necessary to adjust the mathematical expression to:

(dVb1+dVbs1)*6.53

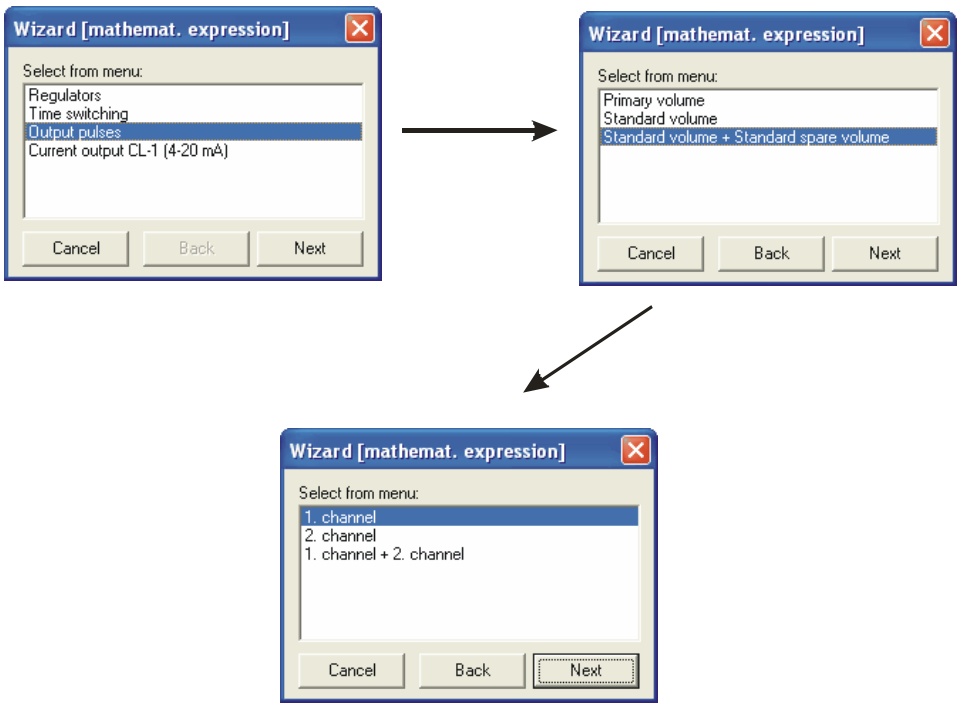


Fig. 39 Wizard for mathematical expressions

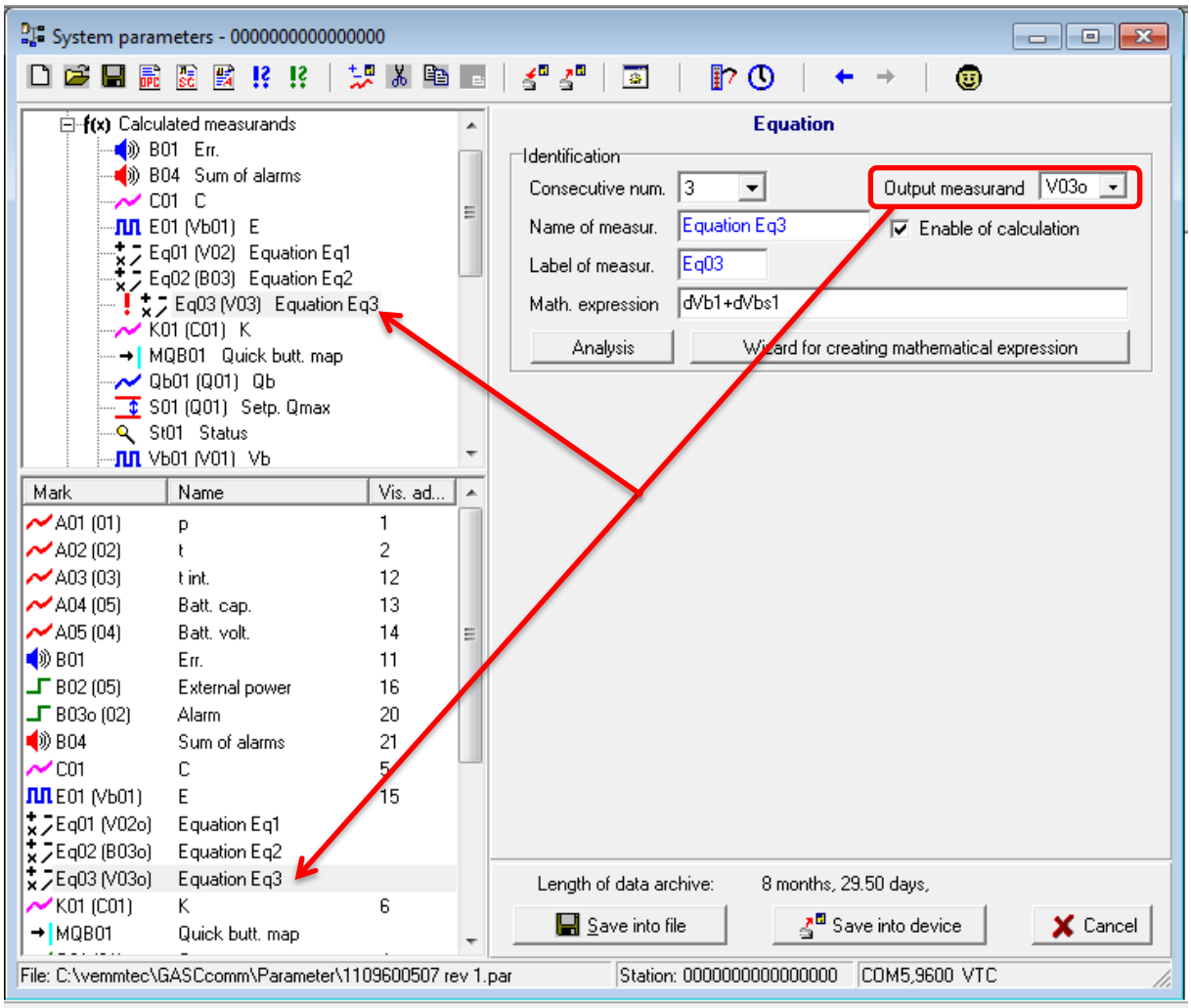


Fig. 40 Equation for base volume pulses and output connection

After this, the related equation is in the V03 module displayed in the frame ***Source of value.*** To make changes in equation press the button ***Skip on source*** (see Fig. 41).

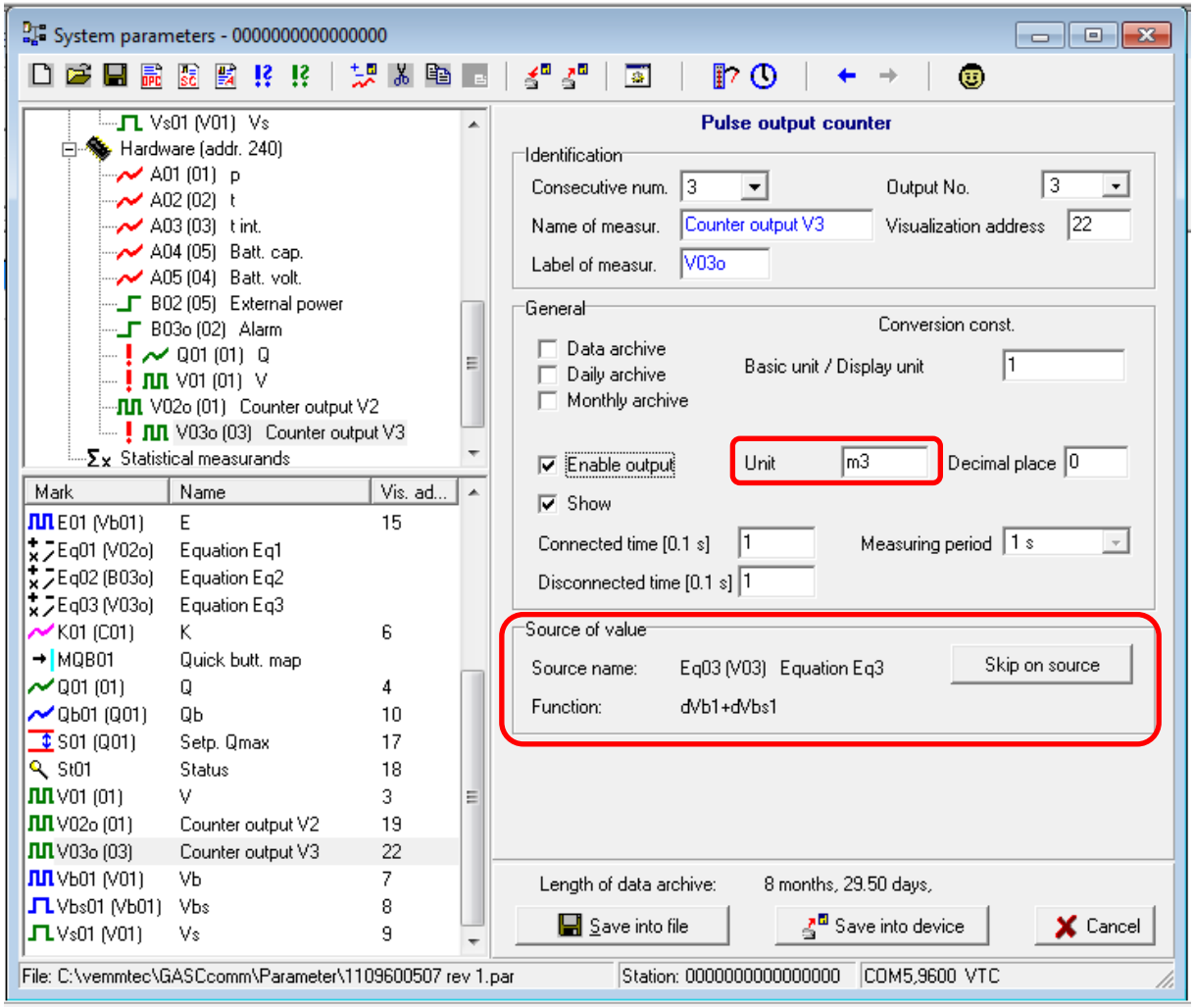


Fig. 41 Parameter V03 after equation assigment

15.4 Analogue output setting

Analogue output can be used for instance for the display of actual gas consumption or for pressure or temperature in a pipe line.

An analogue (current) output from the device (4-20 mA) is made by an additional hardware module (CL-1) connected to the clamp of digital device outputs (DO1 to DO4). The used digital output must be configured for connection with the CL-1 module. The CL-1 module itself cannot be configured since the analogue output parameters are in the PTZ-BOX. Up to 4 CL-1 units (for 4 analogue outputs) can be connected to the PTZ-BOX.

15.4.1 Simple mode display

In the simple mode this output cannot be configured. Only if this output was already configured in full mode it is possible to switch on or switch off this (see Fig. 36).

15.4.2 Full mode display

This procedure is similar with the procedure for pulse output. From the item **Hardware** (in the left upper window) **Insert output measurand** must be chosen and then **Data output for CL-1** (see Fig. 42).

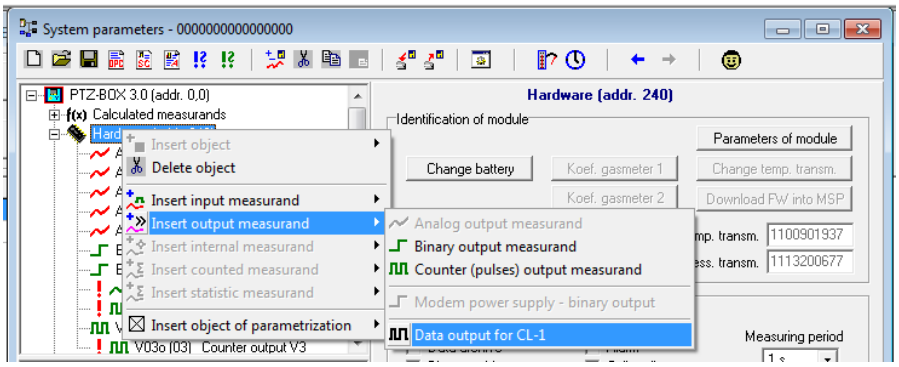


Fig. 42 Analogue output setting

On the ***Analogue output*** module (see Fig. 43, parameter A06o) the ***Output number*** gives appropriate hardware connection (DO1 to DO4) where the output signal will be sent to and where module CL-1 will be connected to.

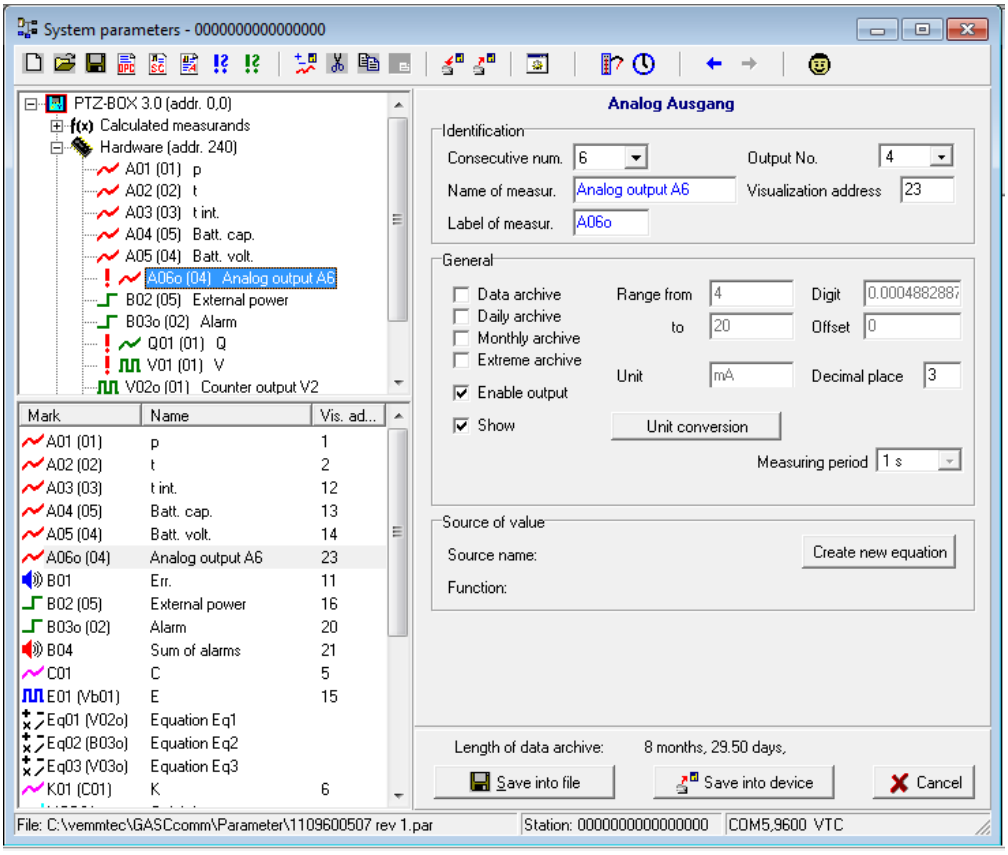


Fig. 43 Analogue output configuration

In the following step press the button ***Create new equation*** again.

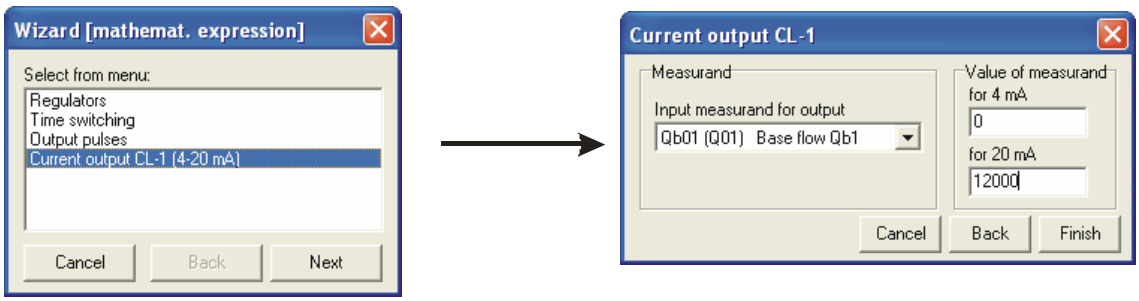


Fig. 44 Wizard for creating an analogue output equation

On the first screen choose ***Current output***, on the second screen choose the parameter for which you want an analogue output and then assign the values of minimum and maximum limits corresponding with a 4mA signal and a 20 mA signal. After the wizard is finished the equation for the analogue output is displayed (parameter A06 see Fig. 45).

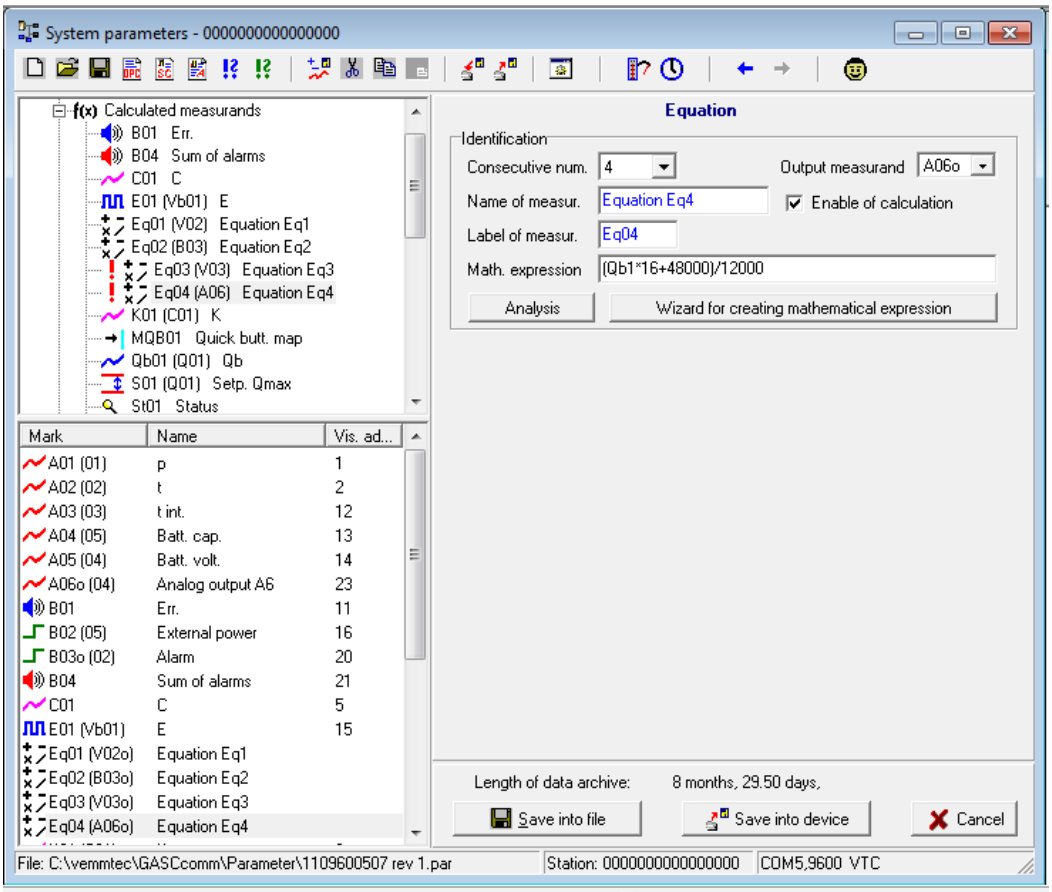


Fig. 45 Equation for analogue output

The resulting form of the generated equation is:

A06o = (Qb1*16+48000)/12000

From the equation it is possible to see that for Qb1=0 the equation result in A06o=4 mA and for flow Qb1=12000 the result is A06o=20 mA. See Fig. 46.

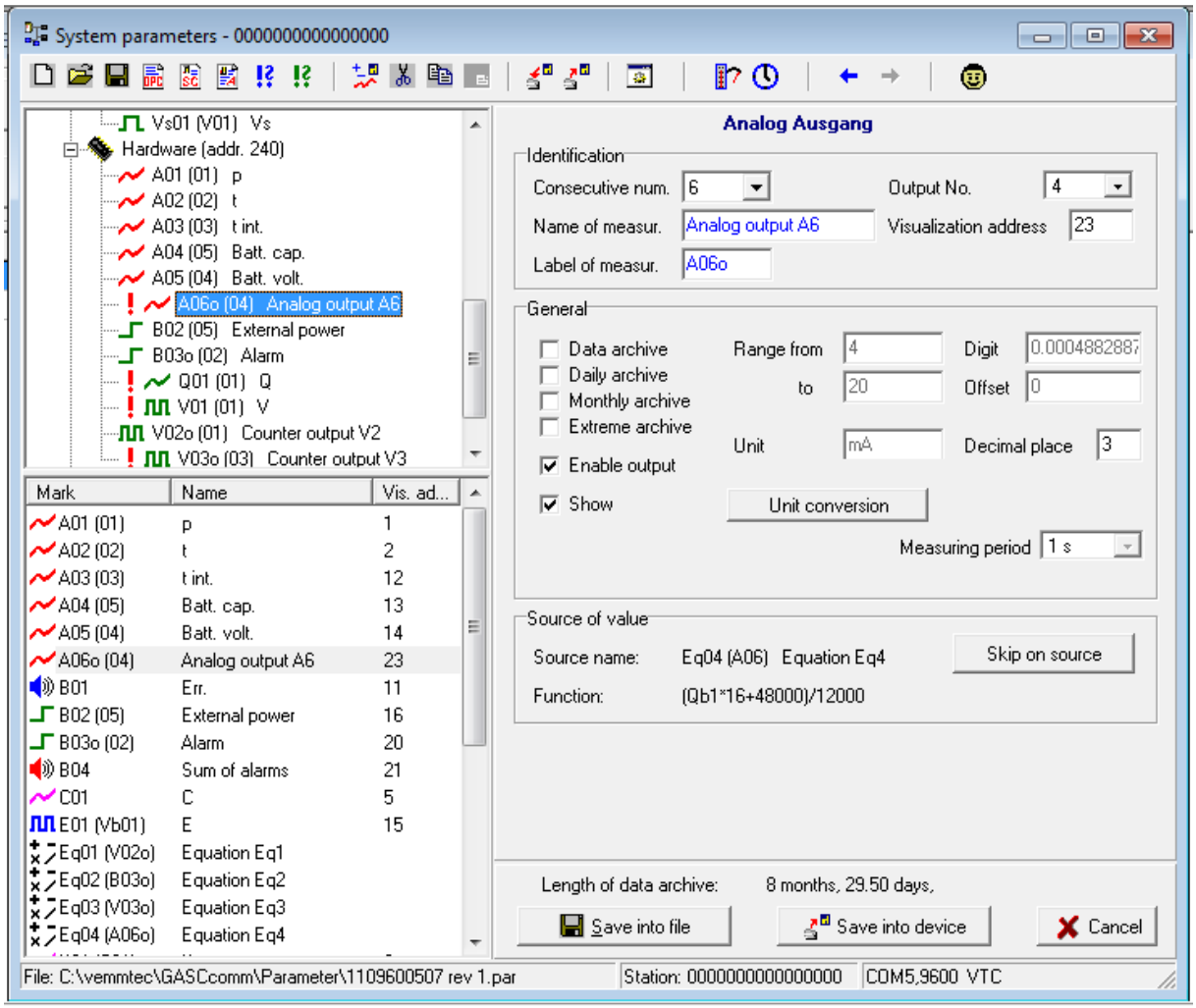


Fig. 46 Analogue output with equation on output clamp DO4

15.5 Limits of measured values

In many cases it is important to monitor limits of measured values. Because of that it is possible to configure so-called **Set points**. Set points may be defined either as a minimum or maximum value of a parameter. In case that a monitored parameter will be over the limit then a record will be written into the data or binary archive. Also the error status can be activated or the device may automatically call supervisory system.

15.5.1 Simple mode display

In this mode it is only possible to change already configured limits.

15.5.2 Full mode display

In the left upper window of the displayed parameters choose the item ***Calculated measurands.*** Press the right mouse button and choose ***Insert counted measurand*** –> ***Set point*** (see Fig. 47).

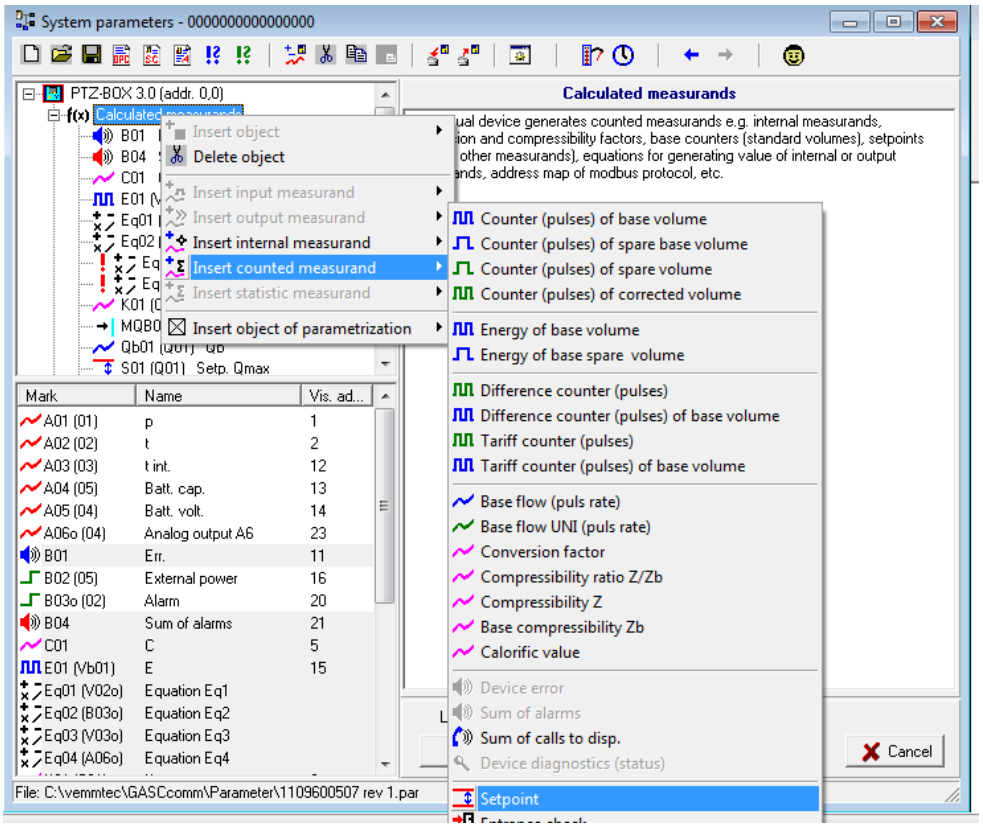


Fig. 47 Set point setting

Example:

If the measured pressure p1 will exceed the value 120 (kPa) and this is the case for more than 5s, the alarm will be generated (see Fig. 48).

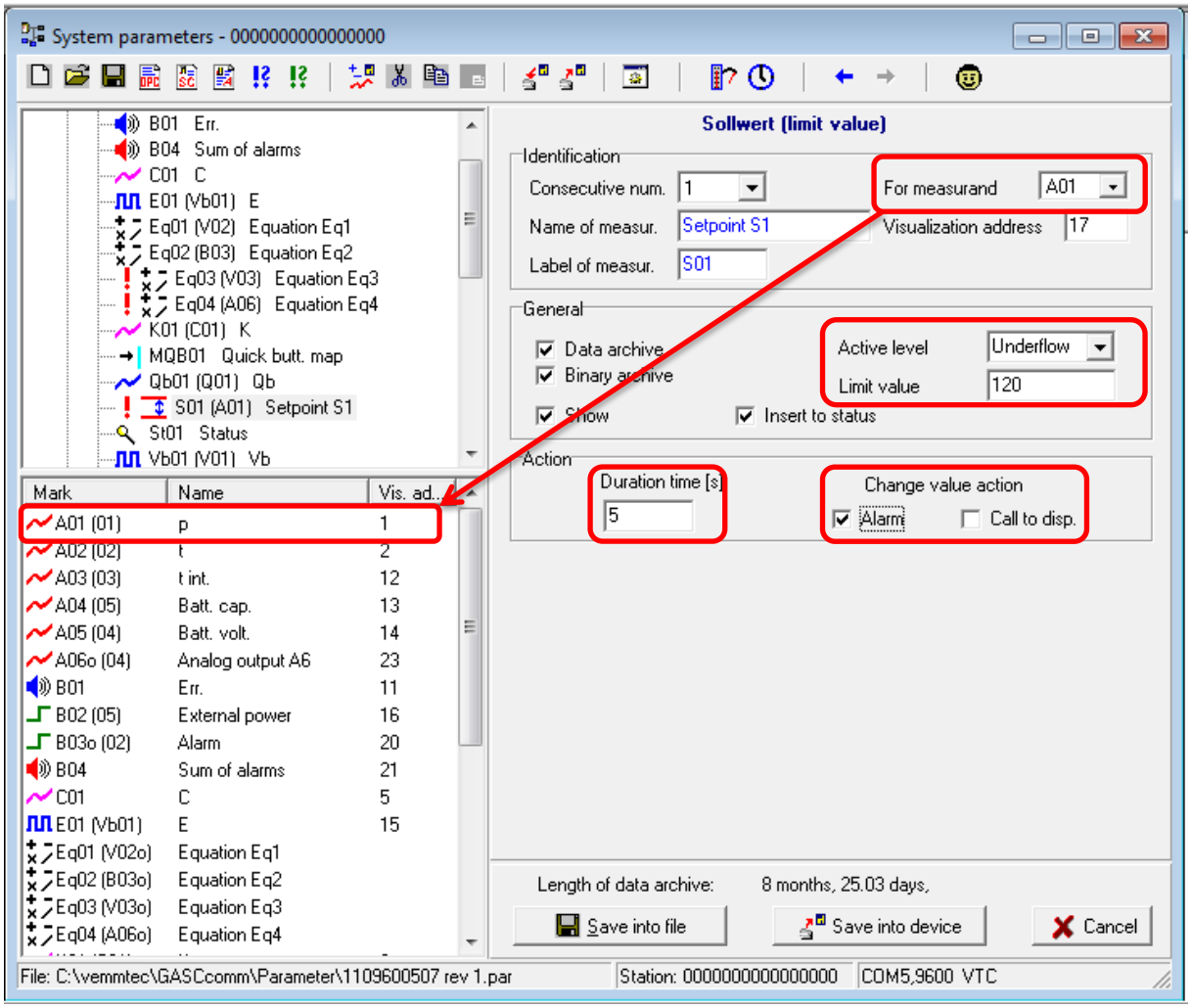


Fig. 48 Set point configuration

15.6 Monitoring the external power supply

With the following process it is possible to watch the external power supply. The information about the power supply condition can be saved into the data or the binary archive; it is possible to initiate an alarm signal or to make a call to dispatching. To configure choose the item **Hardware.** After pressing the right mouse button choose **Insert input measurand->External power** (see Fig. 49.)

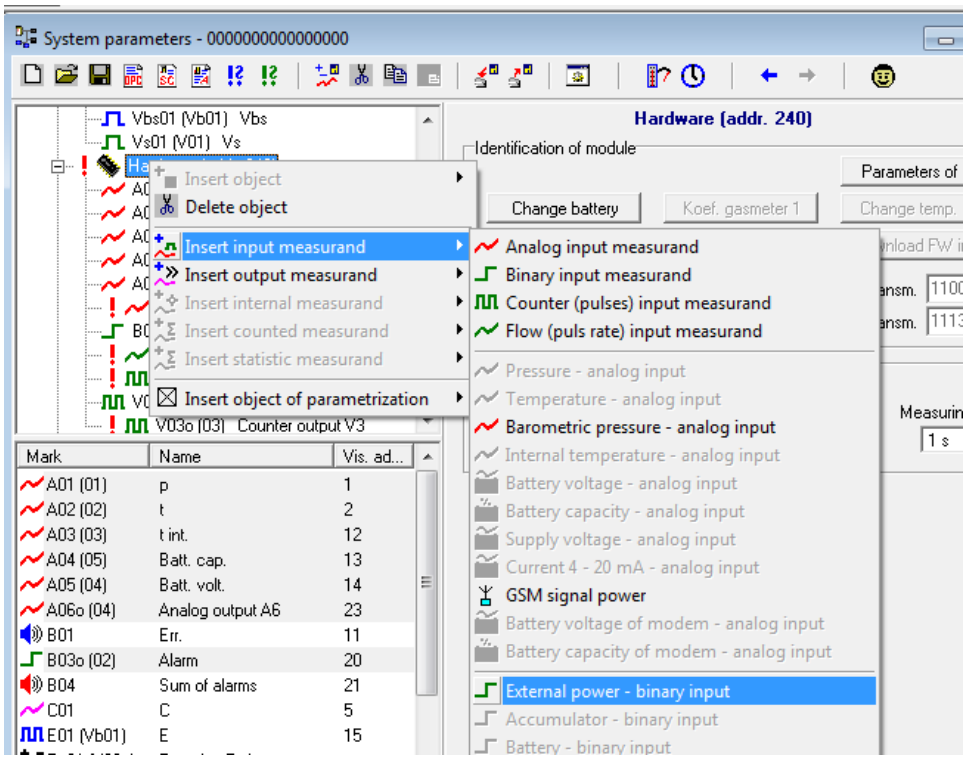


Fig. 49 Configuration the monitoring of the external power supply

When the external power supply fails for more than 3 seconds an alarm signal will be generated (see Fig. 50).

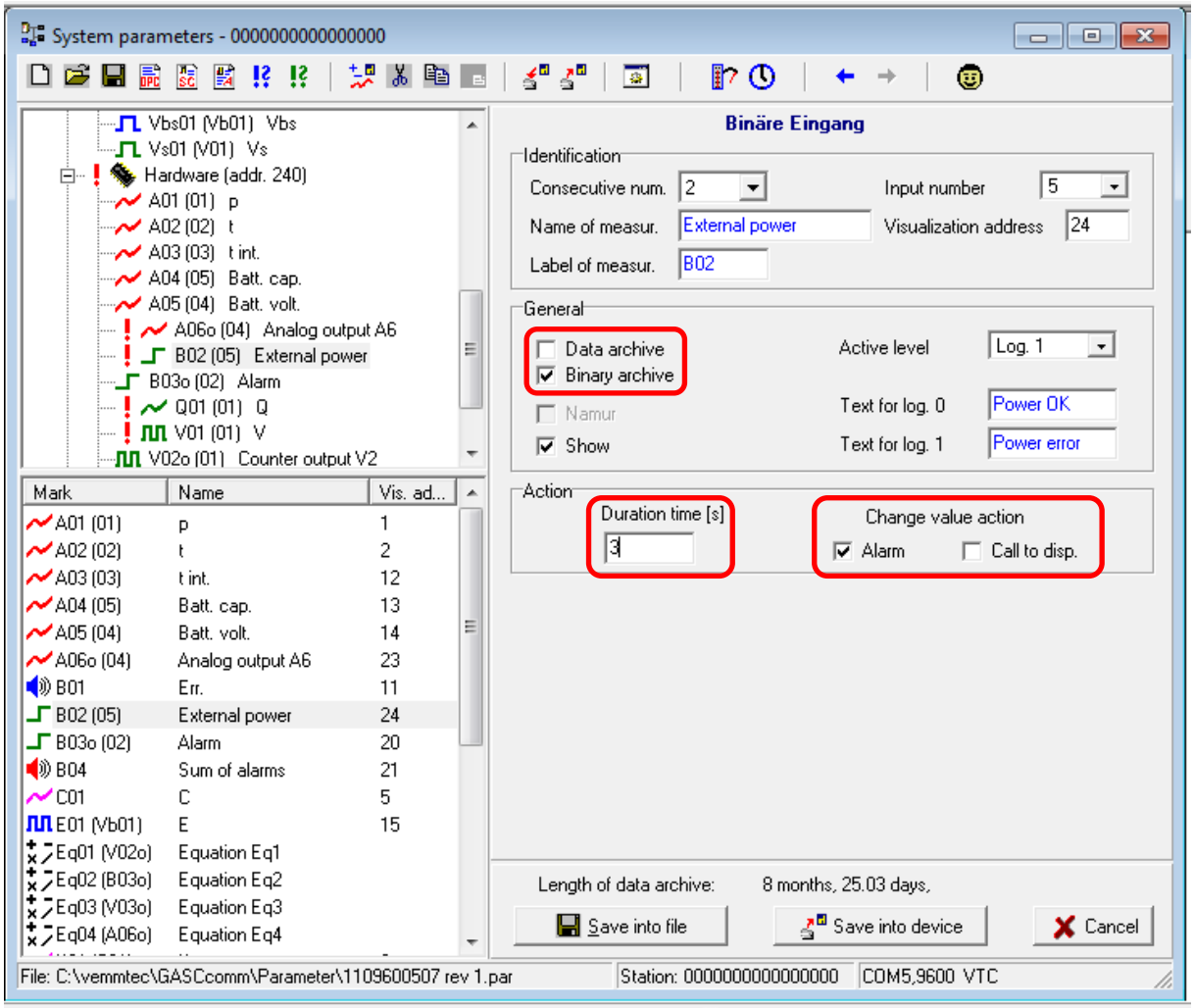


Fig. 50 Monitoring setting of external power supply failure

15.7 Setting of communication with MODBUS protocol

Standardly shipped devices are not configured for communication through a MODBUS protocol. The instruction for the configuration for MODBUS follows hereafter. Initial conditions:

- MODBUS protocol can be set only in devices with firmware version 1.12 and higher
- The MODBUS protocol for reading of archived values is adjustable only in FW version 1.16 and higher.
- for configuration of this communication it is necessary to have a prepared MODBUS template sometimes called MODBUS map (file with extension *.db, placed in subfolder Modbus).

MODBUS template:

– Is a pre-defined table of MODBUS addresses with device parameters. In the table is also information about the type of the parameter (reading or also for writing). Vemm tec offers a standard template for one-channel or two-channel devices. On demand vemm tec can adjust the template according to customer's wishes.

As a first step the ***Address map of MODBUS*** is added to device parameters. The progress is displayed on the Fig. 51: Right click the mouse button on the item ***Calculated measurands->Insert object of configuration***. Then a dialog window for file selection is displayed. Choose the required MODBUS template (file with extension *.db).

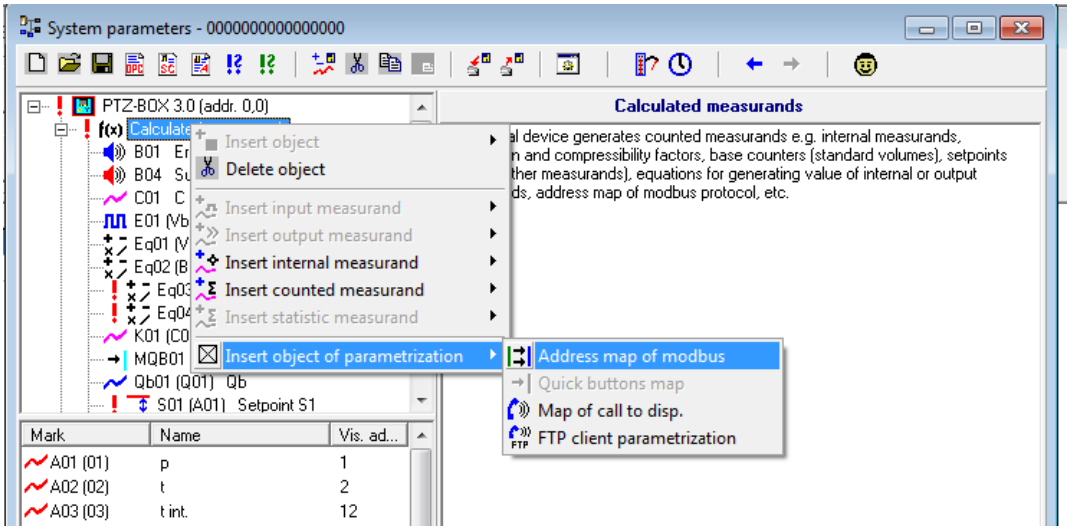


Fig. 51 Inserting a MODBUS map

After adding the MODBUS template file (MODBUS map) it will be displayed in the device parameters as a new parameter **MODBUS map** (MM01 - Fig. 52). The list of parameters readable or writable via the MODBUS protocol (from the category actual values or archives) is available at the right part of the screen. In case of any requirement for template changing it is necessary to change the original template file. After this, the template must be the loaded again into the MODBUS module with pressing the button ***Refresh from templ***.

Note:

Authorization of ASC (authorized service centre) is required to carry out the change of the MODBUS template (MODBUS map).

15.7.1 Switching to communication via MODBUS protocol

In case you need communication via MODBUS protocol it is necessary to set this type of communication protocol on ***System basic communication*** on the software module ***Communication*** (Fig. 53).

After this switch and writing the parameters into the device. The communication will be interrupted (communication protocols on device and PC are different). For communication with device it is now necessary to change parameters settings for the station in GASCcomm applicable for MODBUS protocol. It is also necessary to set parameter Address 1 either on a non-zero address (which is set in the device) or on universal address **Adr1 = 248** (see 14.3.1).

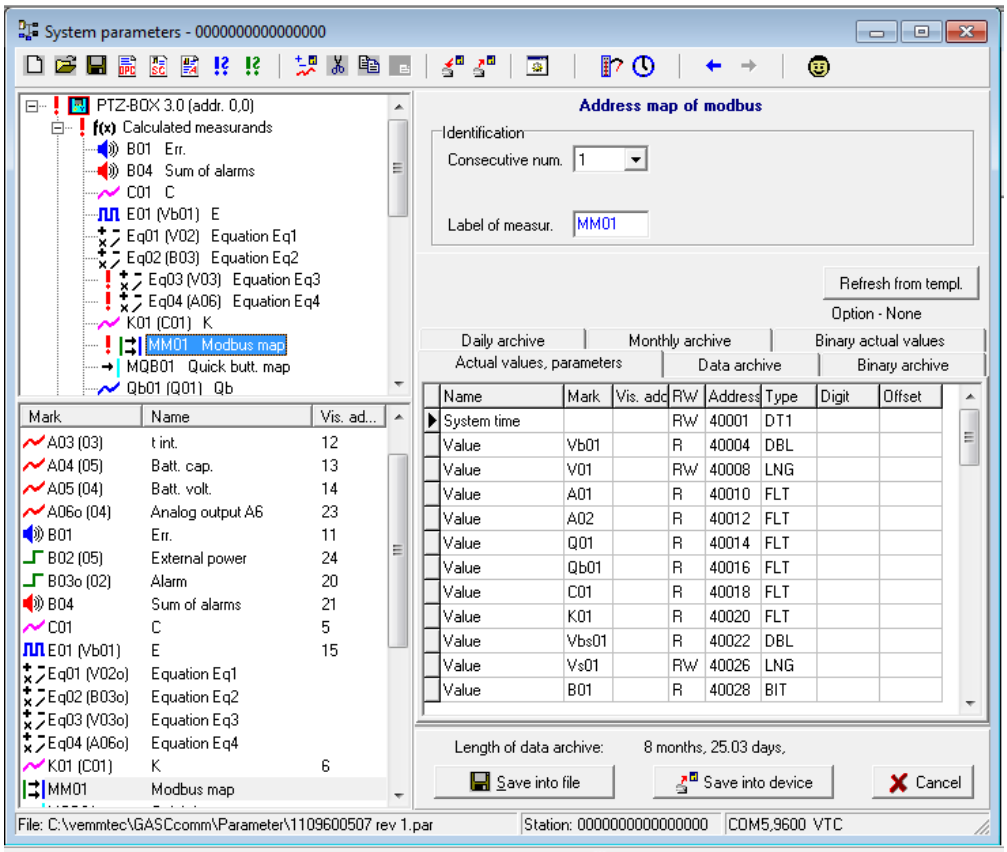


Fig. 52 Parameter of MODBUS map address

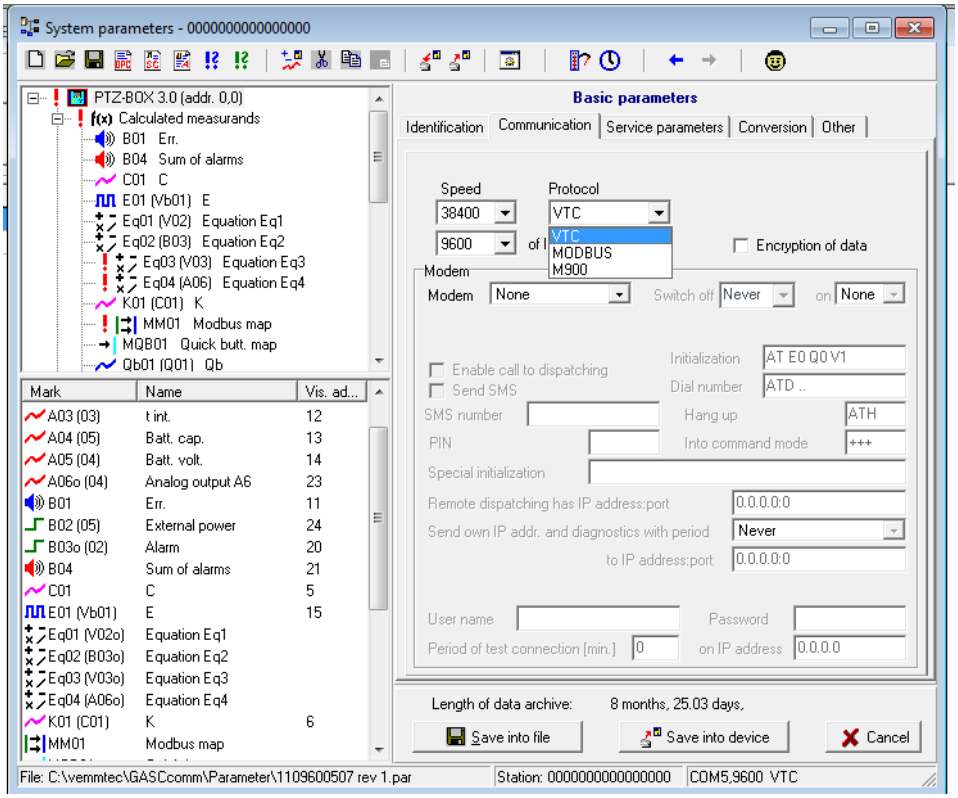


Fig. 53 Switch of communication protocol in the device

15.8 Configuration of Quick Access buttons

15.8.1 Adding the quick button map into the parameter file

Determine the device parameters via the GASCcomm service program. Choose the “Calculated measurands” item in the displayed parameters tree structure and click the right mouse button to display a submenu. From this submenu, select the “Insert object of configuration” item, and then “Quick buttons map”. A standard dialog box will appear; select the file that includes the required quick buttons template (usually the QuickButton directory in the service program directory is designated for these templates files).

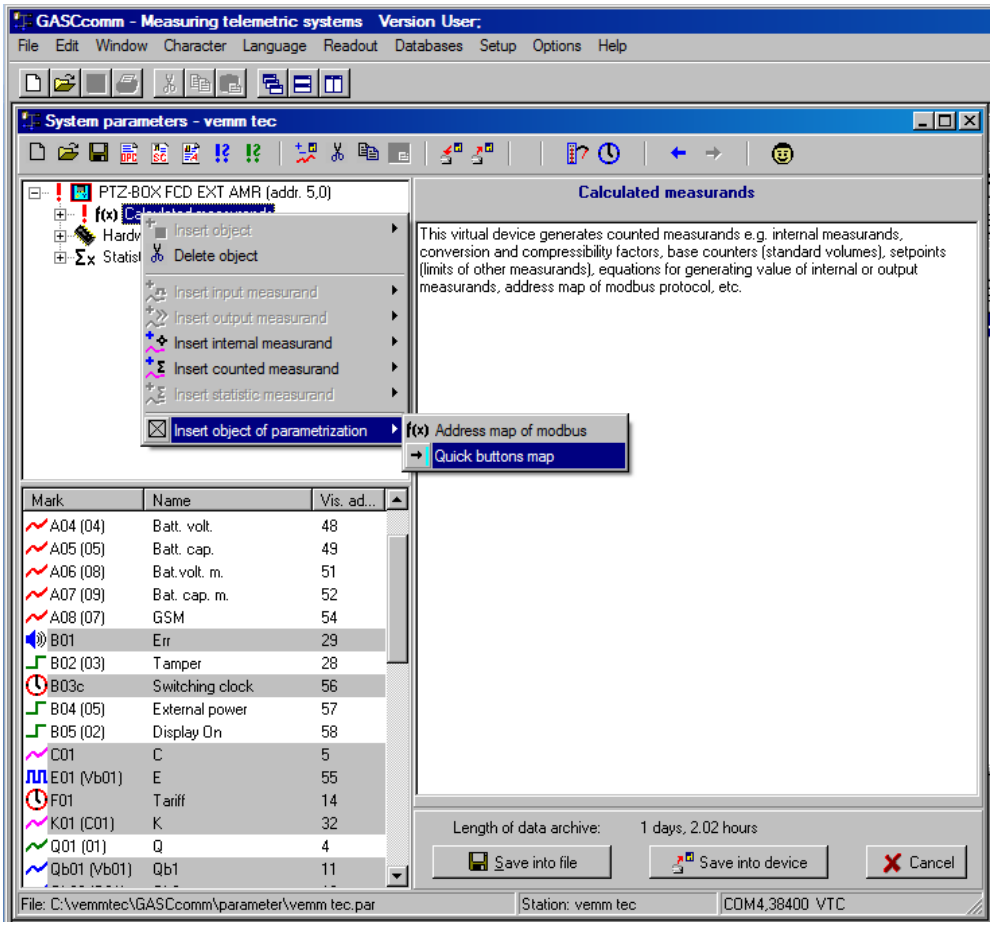


Fig. 54 Adding the QB map

When you click on the „Open“ button, the MQB01 Quick butt.map object will be added to the device parameter file. In the displayed details of this object (in the right part of the window), there are four tabs displaying contents definition of each of the four screens.

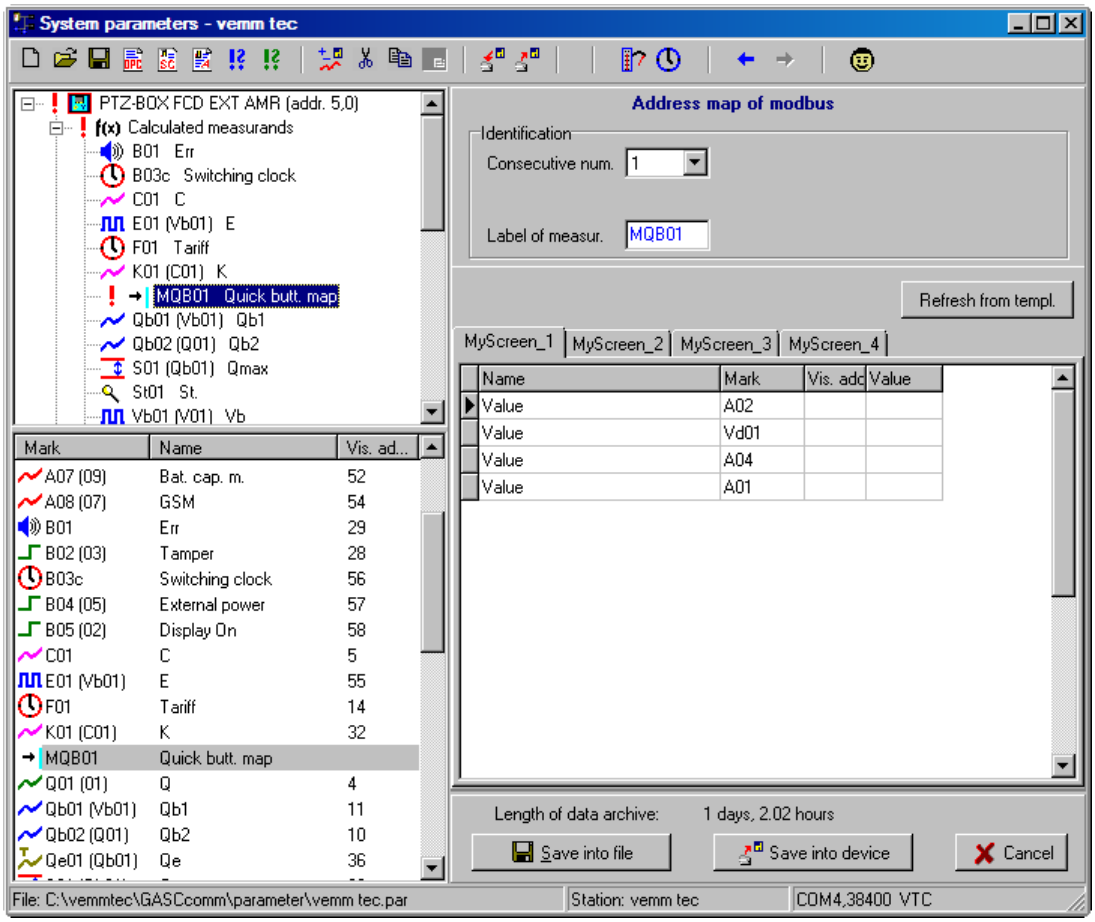


Fig. 55 Showing the QB map

The QA buttons are operational after saving the parameters into the device by clicking the “Save into device” button.

15.8.2 Creating a Quick Access Button map

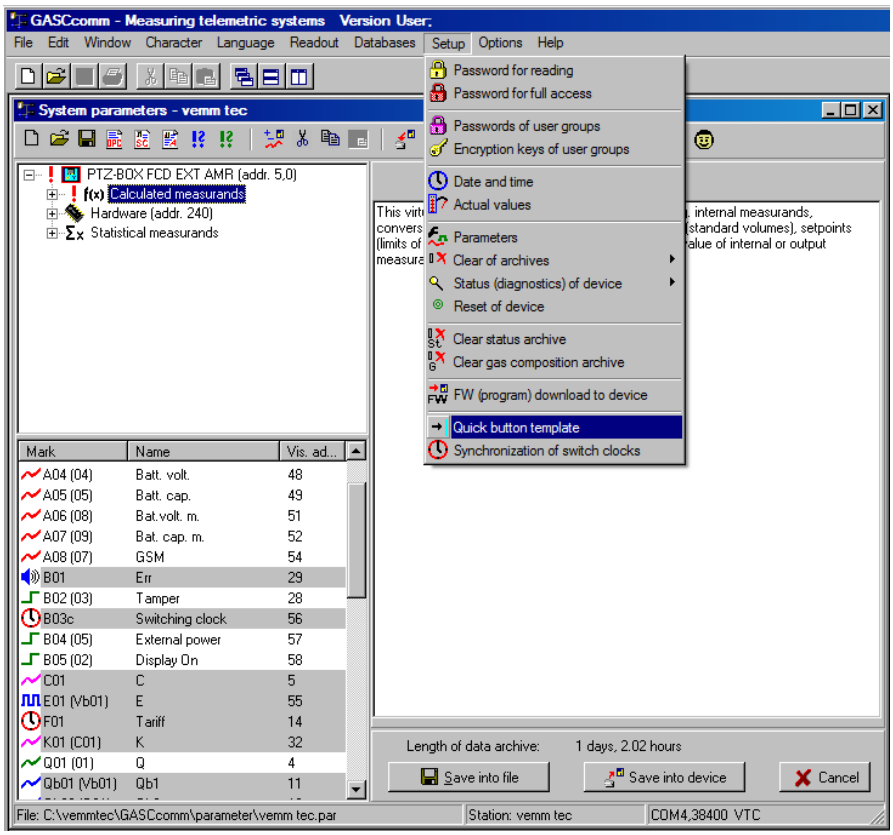


Fig. 56 Creating a QB map

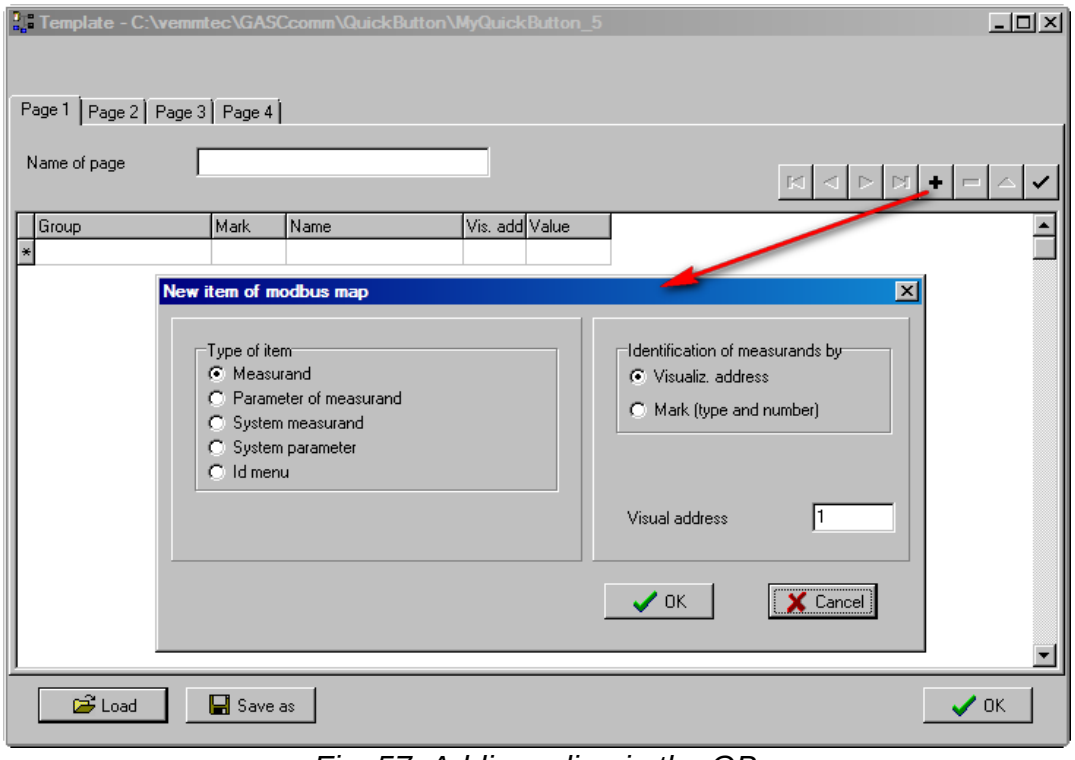


Fig. 57 Adding a line in the QB map

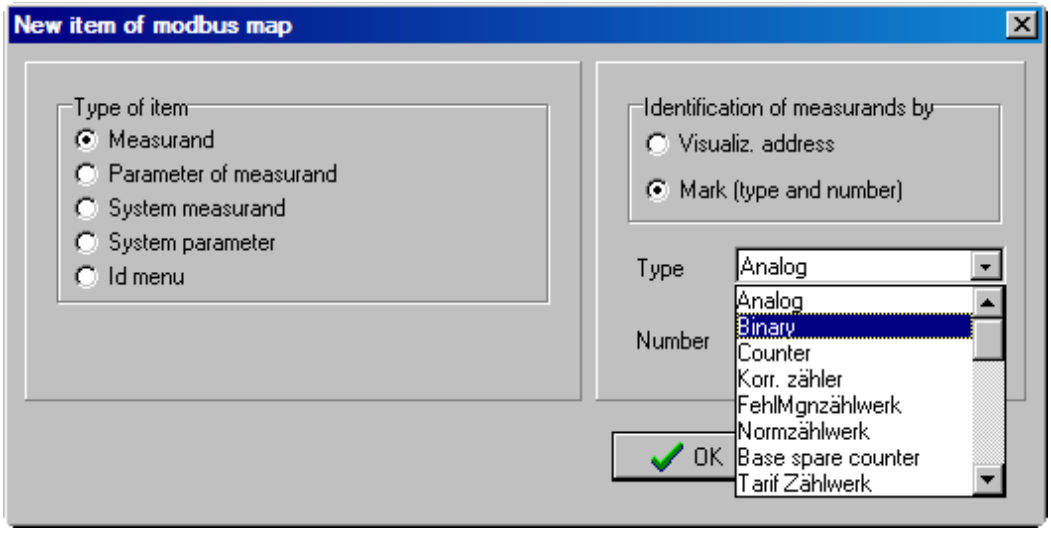


Fig. 58 Choose the type of measurant for the QB map

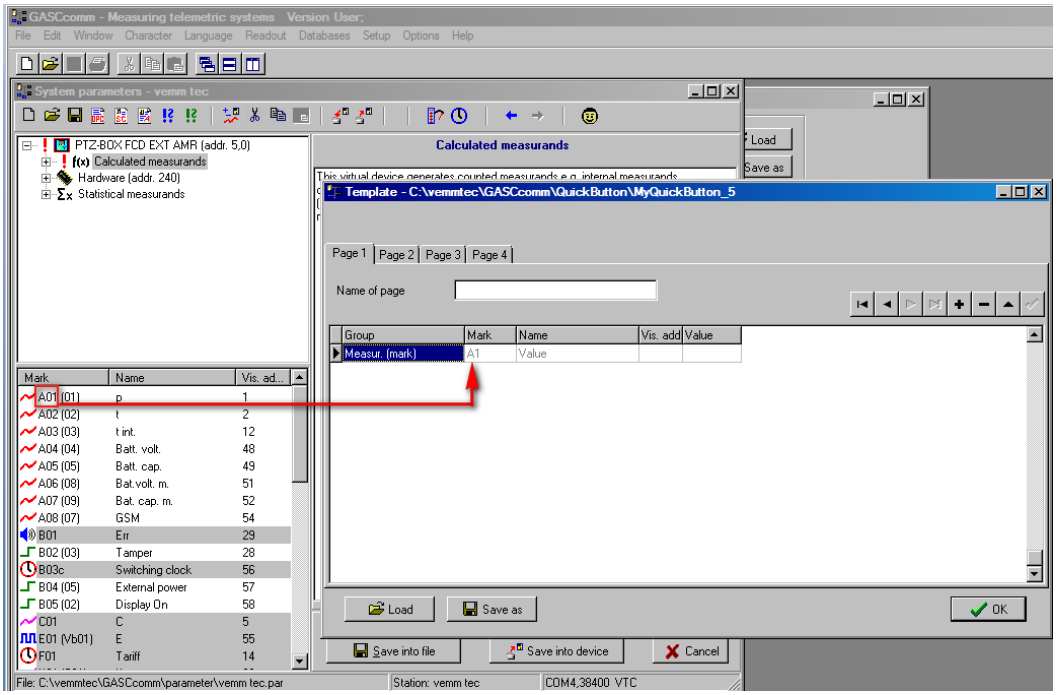


Fig. 59 Choose the parameter for the QB map

16 Exchange of pressure and temperature sensors

This chapter does not apply for the additional digital sensors that might be available. For these sensors see chapter 17.

Replacement of both sensors is relatively simple. The exchange consists of mechanical mounting of the sensor into the device followed by loading the file with calibration data by using the GASCcomm service software. In case of a temperature sensor the calibration data are delivered separately (on CD). The pressure sensor has the calibration data stored in its memory so it is not necessary to load the calibration file from a CD.

Warning:

In case of the replacement of a sensor that measures basic values, it affects the metrological part of the device. Before this operation it is necessary to breach the metrological seal and move metrological switch to the ON position.

Breaching of the metrological seal means, that the verification is not valid anylonger!

This operation can be proceeded only by an acreditted service center (ASC).

16.1 Pressure and temperature sensor replacement procedure in the PTZ-BOX 3.0

- Disconnect the device from the power supply – disconnect the external power supply (if applied) and remove the main battery (existing device settings and data in archives will not be lost)
- Disconnect required sensor from the device
- Apply new sensor into the device
- Reconnect power to device – battery first and external power supply (if applied) after that
- Switch metrological switch to the ON position (necessary to breach the metrological seal)
- By using the GASCcomm service software adjust the software settings of the device for proper communication with the new sensor (see chapter 16.2 and 16.3)
- Switch metrological switch to OFF position.
- Proceed new verification with new sensor

16.2 Software settings for a new temperature sensor

At this moment we have replaced a temperature sensor with the new one, the battery is inserted back into the device and now it is necessary to finish the installation by using the GASCcomm service software.

Readout the parameters from the device (menu **Readout-> parameters**). In the next step click in the parameters menu on „**Hardware**“ item (see Fig. 60).

In the right part of the opened window click on the item „**Change temperature transmitter**“. In the next window enter the path to the data file *.txt with stored calibration data, which was delivered together with temperature sensor (see Fig. 61). Select the required calibration file and confirm by clicking on the „**Open**“ button. The calibration data are stored in the parameter file now.

To finish this operation save the parameters into the device by clicking the „**Save into device**“ button. After saving the parameters, readout the parameters from the device in order to check if all changes were proceed successfully. Click on the „**Hardware**“ item (see description above) and check the serial number on sensor cable with serial number in parameters (see Fig. 62).

If serial numbers are complying, the change of the sensor is successfully finished. In the case that the serial numbers are not corresponding, check if the steps during changing of sensor were performed OK, step by step, or check if the correct calibration file was used.

Note: After the replacement of the temperature sensor it is possible (if legally required) to make a one or two point calibration of the sensor.

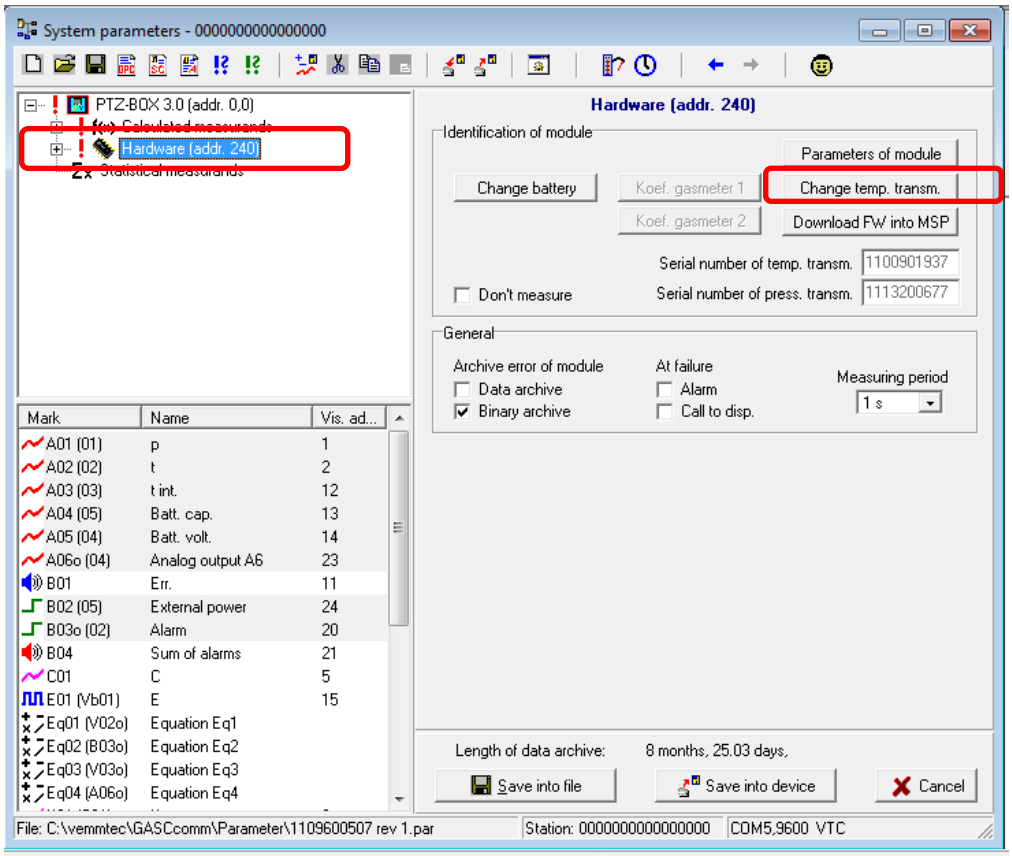


Fig. 60 Change the temperature sensor

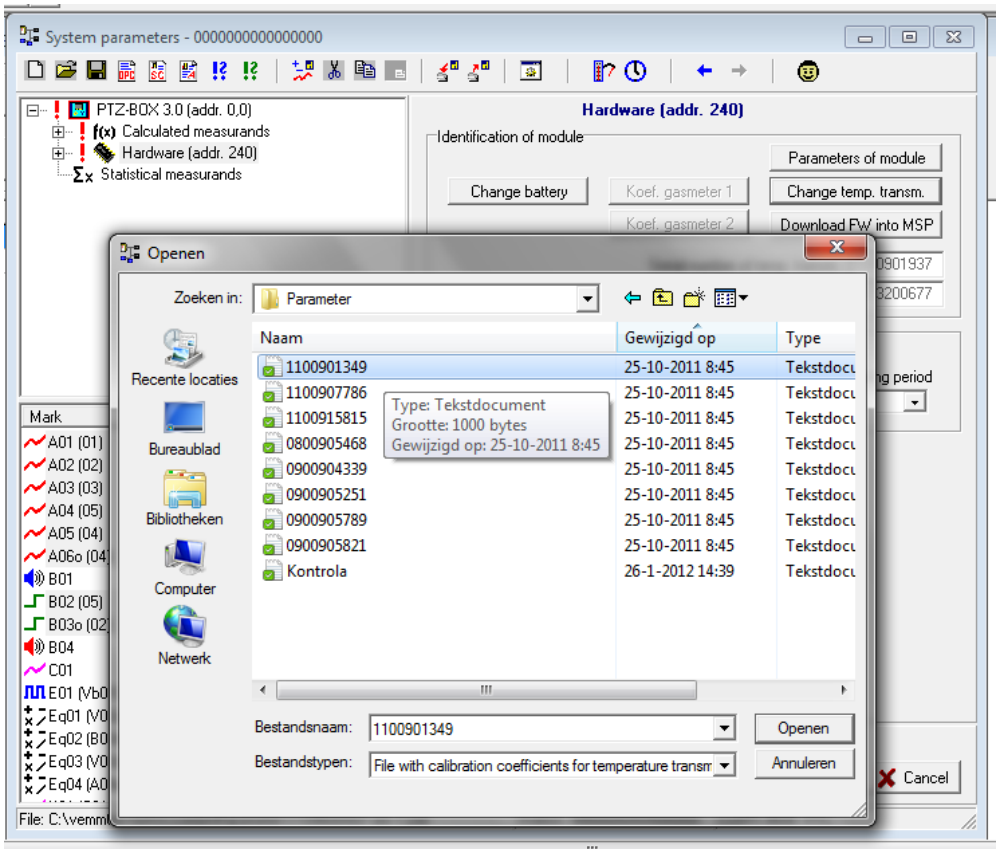


Fig. 61 Find the calibration file of the sensor

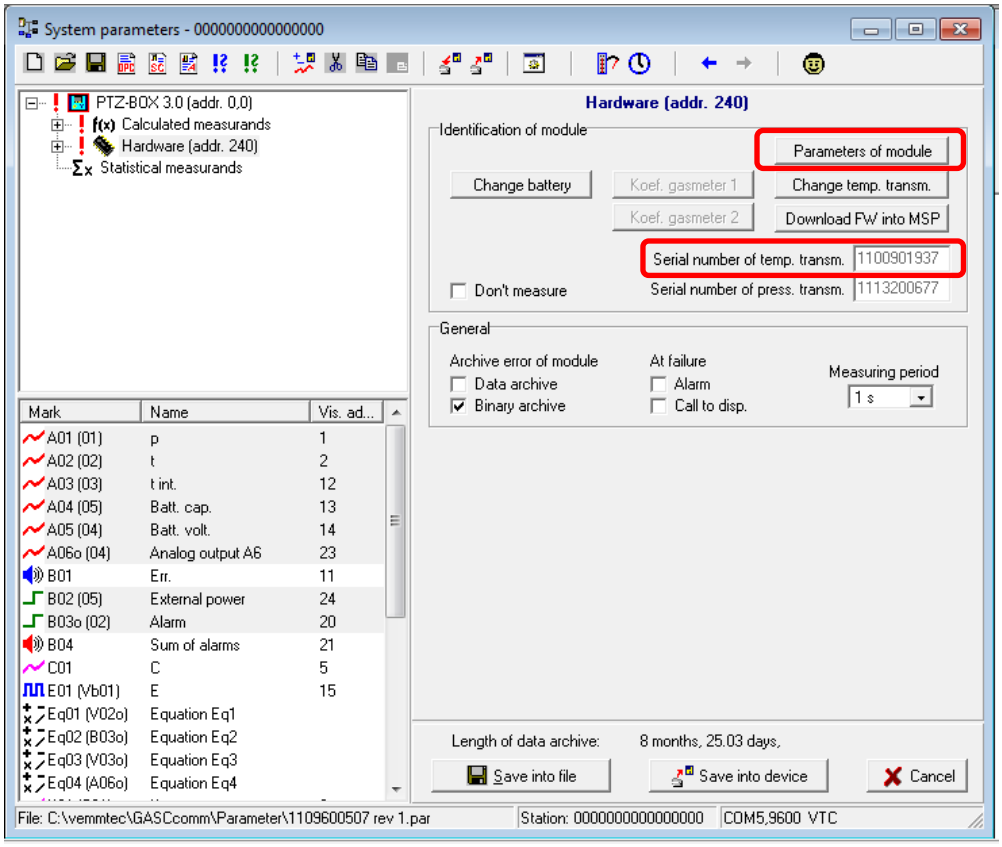


Fig. 62 Chek serial number of the sensor

16.3 Software settings for a new pressure sensor

At this moment we have replaced pressure sensor with the new one, the battery is inserted back into the device and it is necessary to finish the installation by using the GASCcomm service software.

Readout the parameters from the device (menu **Readout-> parameters**). In the next step click in the menu of parameters on the „**Hardware**“ item (see Fig. 60). In the right side of the window click on „**Parameters of module**“ (see Fig. 62). Now the service software will load the calibration data from the sensor’s memory into parameters of the device. At this time software setting is almost finished. Save parameters into the device by clicking on „**Save into device**“ button. After that check compliance of serial number placed on sensor and in parameters.

Now the sensor replacement is finished.

Note: After replacement of the pressure sensor it is possible (if legally required) to make a one or two point calibration of the pressure sensor.

17 Additional external digital temperature or pressure sensor

17.1 Fitting an additional digital pressure or temperature sensor

Additional to the standard mounted pressure and temperature sensors which are metrological approved according to the MID approval it is possible to add an additional pressure or temperature sensor.

The value measured by this additional pressure or temperature sensor is not a metrological value. It means that it is not included in the metrological part of the device. Measured values can be store in the archives and also the actual value can be showed at the display.

As additional sensor either the digital pressure sensor PA1.1 or the digital temperature sensor TA1.1 can be used. Digital sensors are using the internal intrinsically safe serial bus (RS-485) and MODBUS RTU protocol. For intrinsic safety, intrinsically safe “ia” sensors must be used.

For the connection of an additional digital sensor (PA1.1, TA1.1) the volume converter must be equipped with an RS-485expansion module (EDT-port) (see Fig. 64). The EDT-port and additional digital sensors are not part of standard accessories and it is necessary to order these separately.

The digital sensor is to be connected to the RS-485 clamps of the EDT-port. Only one digital sensor can be connected to this EDT-port.

Connecting/disconnecting a sensor and also of the EDT-port can only be performed when the power supply is disconnected.

Procedure of connecting EDT-port and digital sensor

1. Disconnect volume corrector from external power supply (if present)
2. Open the device and remove battery
3. Unscrew plastic cover located South of the plus pole of the battery. (factory seal will be broken)
4. Insert EDT-port in to the X4 board of inputs. After inserting of the module it is necessary to check if all pins are inserted into the connector properly
5. Apply cover delivered with the EDT-port and fix the expansion board on the input/output board with the screw
6. Connect digital sensor. Pull the cable of the sensor through the cable bushing. Attach the shielding of the cable with the body of the bushing. The electrical scheme of the connection is shown on Fig. 63.
7. Check the connection of the digital sensor
8. Connect device to the power. Insert the battery and connect the external power supply (if available)

After installation of a digital sensor it is necessary to adjust the parameters by using the service software.

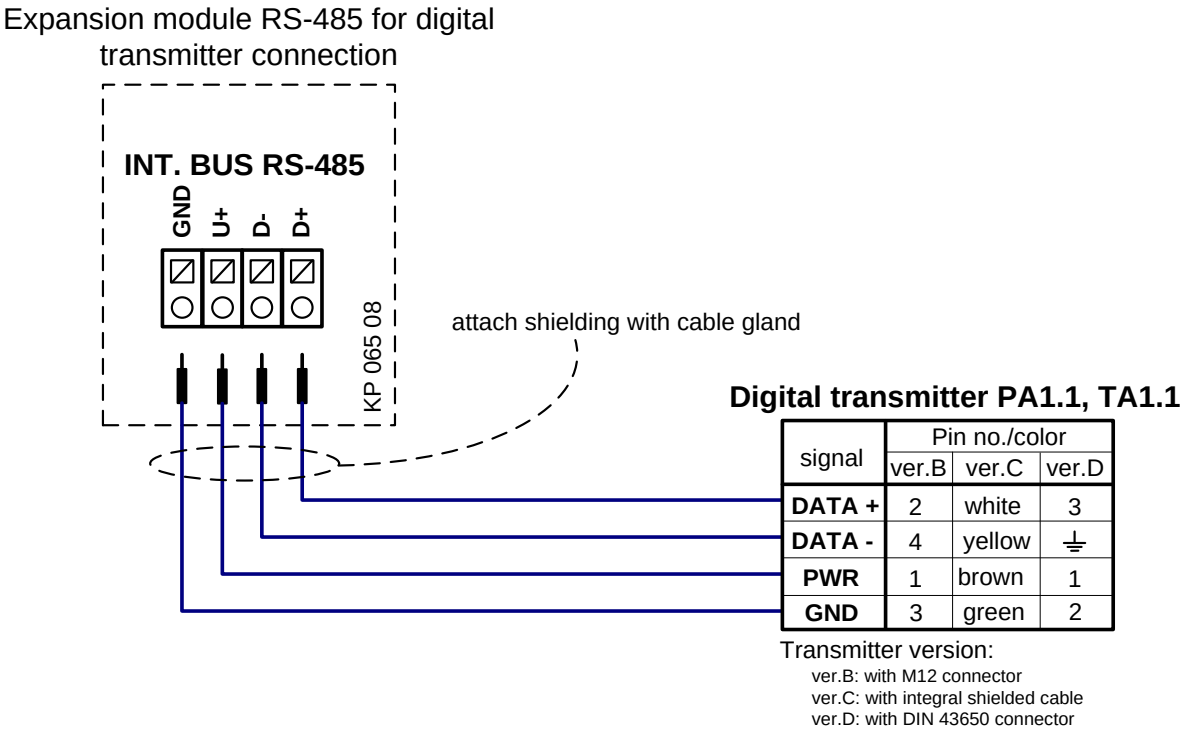


Fig. 63 Connecting of a digital sensor with the EDT expansion module (EDT port)

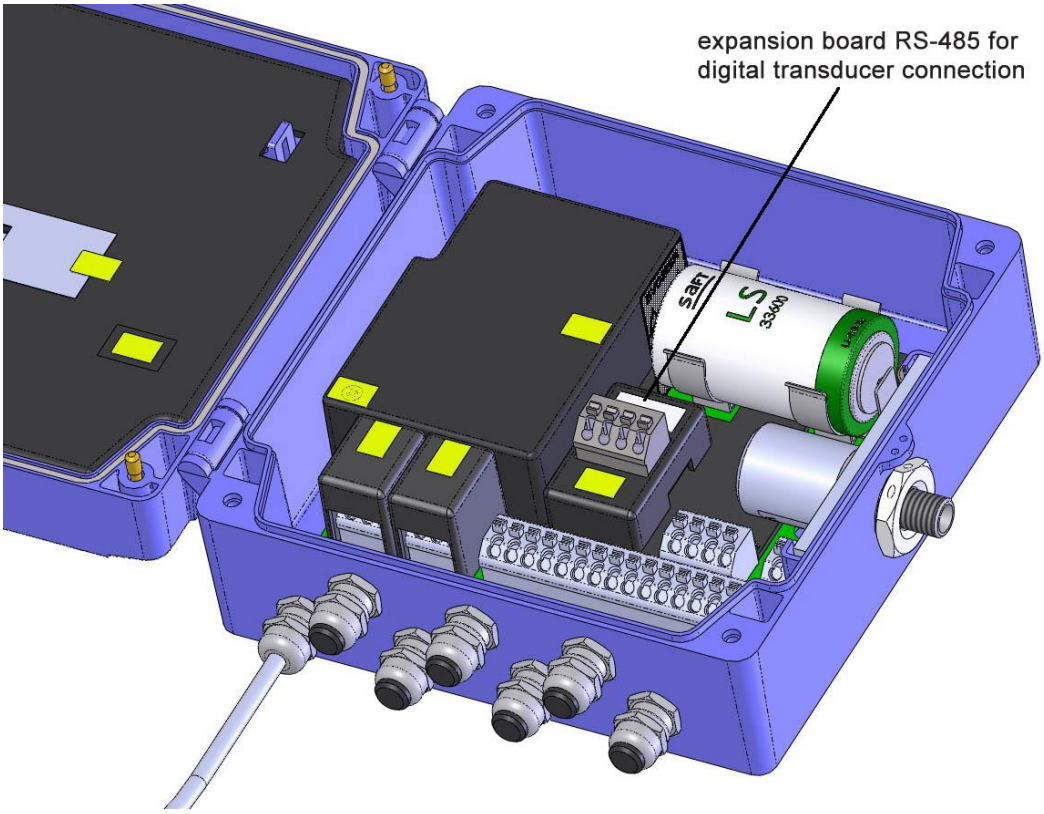


Fig. 64 Position of the EDT-port in the device

17.2 Configuring the digital sensor in the parameter file

As a first step it is necessary to readout the parameters from the PTZ-BOX (menu **Readout ->Parameters**).

Now click in parameters menu on the „**PTZ-BOX 3.0**“ item. Using the right mouse button will open a menu. In the opened menu select „**Insert object**“ and in next selection choose the required sensor (for instance temperature sensor TA1.1, see Fig. 65). Herewith we have added the digital sensor into the parameter file and now it is necessary to save the modified parameters into the device by clicking on „**Save into device**“ button.

Now click in parameters menu on just added digital sensor TA1.1 (see Fig. 66). Because it is a digital sensor connected to the intrinsically safe RS-485 serial interface it must have assigned communication address. There might be two possibilities with respect to the assigning of communication address:

a) The new digital sensor has the same address as is predefined in parameters – standard it is address no. 1 (see chapter 17.2.1.).
b) The new digital sensor has a different address than is stored in device’s parameters (see chapter 17.2.2).

17.2.1 The new installed digital sensor has the same address as is predefined in parameters (standard address no.1)

In this case it is not necessary to change communication address. By clicking on the „**Parameters of module**“ button. We will check if sensor is communicating with the device. If everything is correct, a window with the sensor parameters will appear. If the service software warns you, that „**Module doesn’t respond**“ this means that the address of the sensor is different from the address pre-set in parameters and it is required to set correct address. Setting of the right communication address will be described in chapter 17.2.2 .

If the sensor communicates without any problem (parameters of the module were read correctly), the installation is finished.

Note: After adding the digital sensor it is possible (if required) to make a one or two point calibration of sensor.

17.2.2 The new installed digital sensor has a different address than pre-set in parameters

If you find that the sensor is not communicating, it probably has a different communication address than is pre-set in device parameters. To correct the address click in the device parameters on the sensor item (in our case „**Temperature TA1.1**“ see Fig. 66). After that in in right part of the window click on „**New address**“ button. The GASCcomm service software will ask you to enter the serial number of the added sensor. Enter the serial number and click „**OK**“. After that the service software will ask you to enter the new communication address. Enter the same address that is stored in device parameters – standard it is the address no.1. New address is stored in the sensor now.

By clicking on the „**Parameters of module**“ button we will check if the sensor is communicating properly with the device. If everything is correct you will see a window with the sensor parameter. Herewith we finished the change of the address and also the installation of the sensor is finished.

Note: After adding of a digital sensor it is possible (if prescribed) to make a one or two point calibration of sensor. Adding the value measured by a digital sensor into archives

After adding a digital sensor into the device parameters it is also necessary to configure the parameter files so that the measured values are added to the archives. add parameter (temperature in our case) measured by this sensor into archives

In device parameters click on the digital sensor. In the right part of the window tick the archives where you want the values to be stored. After that save this change into device by clicking on „**Save into device**“ button.

17.3 Final verification after replacement of a sensor or adding a digital sensor

As a final step it is recommended to check the device by the self diagnostic function. Click on „**MENU- Setup / Status (diagnostics) of device / from Device**“. A new window will be opened that describes the actual status of device. In the column „**State of last test**“ there should not be any warning or error! If the device announces a warning or error, click on the „**Device test**“ button. In case that the problem continues, contact manufacturer’s technical support.

If everything is all right and still a warning or error message is displayed in „**Summary status**“ column, click on „**Clear summ. Status**“ thereby all historical warnings and errors that occurred before replacement or adding of a sensor will be cleared.

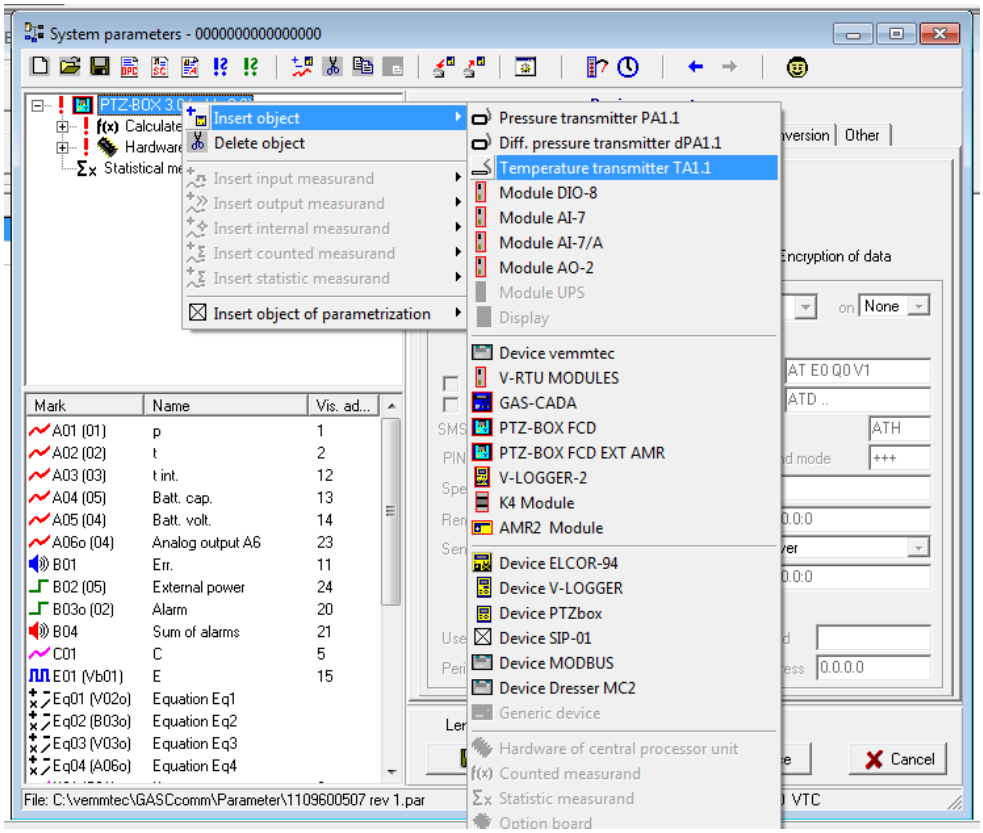


Fig. 65 Adding a digital temperature sensor

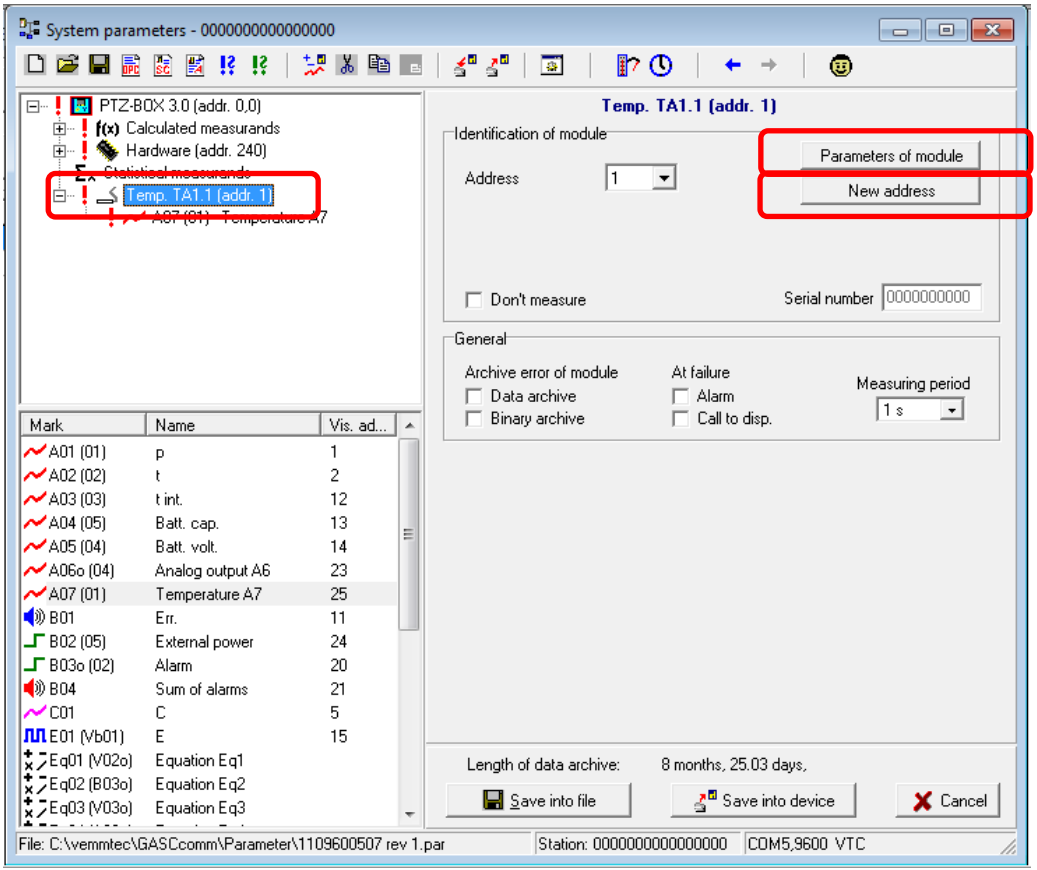


Fig. 66 Check the address

18 What if something does not work

problem	*Possible reason*
Readout does not working	Set wrong PC port. Set different address 1 or address 2 in the device and in the PC. Set different communication speed between PC and device. Set different communication protocol between PC and device.
Impossible to set parameters	Service switch in OFF position. Wrong password (only if the password is for full access). Full setting archive – send the device into authorized service centre.
Wrong value of primary volume	Check connection between device and gas meter (pulse input). Wrong set of gas meter constant. Wrong set of initial state of primary volume – set value of primary volume with momentary volume on gas meter.
Illogical value of base volume	The device saved the values into the error counters because of wrong measured values – start device diagnostics.
Impossible to switch on the display	Discharged battery. Exchange battery or connect external power supply.
Device communicates but it does not measure	STOP MOD – discharged battery. Exchange battery or connect external power supply.
Wrong number of output pulses	Wrong setting of output pulses constant or delay between pulses according to frequency of input pulses.
Battery discharges very quickly	Factors which affects battery consumption: ▪ Too frequent communication – Extend communication interval ▪ Short measuring period– Extend measuring period ▪ Output pulses generating – cancelled output pulses ▪ Switched on HF input– switch off with help of service SW.
On display is Err or Wrn	Start TEST from device keyboard.

If the corrector indicates errors and warning messages (on the initial display **Err** or **Wrn** is shown) it is necessary to start the internal device test either via keypad or via the GASCcomm software to identify the error. This procedure is described in chapter **Fout! Bladwijzer niet gedefinieerd.**

In the following table possible errors and warning messages as well as a possible solution is described

Visual display	Error description and solution	Abbrev.
E0 CRC of *program*	Error of check sum in FW - Necessary repair in ASC	Err
E1 CRC of loader	Error of checksum of loader. - Failure of memory FLASH, Necessary repair in ASC	Err
E2 CRC of parameter	Error of checksum of device parameters. - Accomplish changes of any parameters and write change into device.	Err
E3 memory error	Error of device memory. - Necessary repair in ASC.	Err

Visual display	Error description and solution	Abbrev.
E4 error of FLASH	Error of device FLASH memory. - Necessary repair in ASC	Err
E5 full setup archive	Full setup archive. - Device is fully operational but no parameters are changeable. Erase setup archive in ASC.	Err
E6 sensor replacement	Accomplished replacement of sensor or modification of parameters. - Set back device to original setup or arrange verification in ASC.	Err
E7 sensor communication	Error in communication with sensors. - Check connection of sensors for example setup of correct communication address.	Err
E8 sensor error	Error of sensor. - Measured value can be out of measured range, or sensor is defective – necessary replace sensor in ASC.	Err
E9 battery voltage	Battery voltage decreased under allowable level. - Replace battery.	Err
E10 compressibility table	Error of calculation in compressibility table due to input parameters. - Correct gas composition	Err
E11 compressib.	Infeasible calculation of compressibility table due to range restriction of used standard	Err

Visual display	Error description and pertinent solution	Abbrev.
W0 sensor warning	Warning message from sensor, no influence on metrological properties.	Wrn
W1 battery capacity	Capacity of battery decreased under allowable level (SW calculation) Warning message 90 days before discharged.	Wrn
W2	- unused -	Wrn
W3 surge current terminal	Current overload appears on internal bus terminals.	Wrn
W4	- unused -	Wrn
W5 external power shortage	External power failure. During external power shortage internal power is ensured by the main battery. But in case of HF Namur sensors no signals from the sensor is registered during external power failure.	Wrn
W6 surge current of device	Current overload in device appears.	Wrn

Note:

ASC – authorized service centre

19 Literature

[1] PTZ-BOX 3.0 Manual (this document)

[2] EN 60079-0:2006 – Electrical apparatus for explosive gas atmospheres – Part 0: General requirements.

[3] EN 60079-11:2007 – Explosive atmospheres –Part 11: Equipment protection by intrinsic safety “i”

[4] EN 60079-26 :2007 – Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga

[5] EN 12405-1:2006 – Gas meters – Conversion devices – Part 1: Volume conversion

[6] EN 60079-14:2004 – Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installation in hazardous areas (other than mines).

[7] EN 61000-4-2:1995+A1:1998+A2:2001 – Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test – Basic EMC Publication

[8] EN 61000-4-3:2006/A1:2008 Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency electromagnetic field immunity test.

[9] EN 61000-4-4:2004 - Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.

[10] EN 61000-4-6:2007+Cor.:2008 – Electromagnetic compatibility (EMC) - Part 4: Testing and measurements techniques – Section 6: Immunity to conducted disturbances, inducted by radio-frequency fields.

[11] EN 61000-6-2: 2005/Cor.:2005-09 - Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments.

[12] EN 61000-6-4: 2007

[13] EN 62056-21:2002 Electricity metering - Data exchange for meter reading, tariff and load control – Part 21: Direct local data exchange.

[14] IEC 60364-4-41: 2005 – Low voltage electrical installations – Part 4-41: Protection for safety - Protection against electric shock.

[15] Modicon Modbus Protocol Reference Guide, Modicon Inc., Industrial Automation Systems, 1996

[16] FTZÚ 11 ATEX 0015X – EC -Type Examination Certificate

[17] EN ISO 12213-3: 2009 - Natural gas – Calculation of compression factor – Part 3: Calculation using physical properties

[18] Directive 2006/66/EC and Amendment 2013/56/EU of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators

20 Documentation

[19] GASCCOMM – Software description. User manual (per 2012 integrated in this manual)

[20] PA1.1 – Pressure converter with Modus protocol. User manual.

[21] TA1.1 – Temperature converter with Modus protocol. User manual.

21 Software

[22] GASCCOMM.exe, software for configuration and read out supplied with device

22 Used trade marks

{1} IrDA® - is a trade mark of Infrared Data Association

{2} ModBus® - is a trade mark of Modicon

23 List of figures

24 List of Tables

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