PTZ-BOX

ELECTRONIC VOLUME CONVERTER

Technical description
Operating instructions
Assembly instructions

Battery-powered conversion device for gas volumes; with a record of monthly, daily and hourly values. Intended for use in potentially explosive atmospheres.

Thank you for deciding to use the PTZ-BOX Gas Volume Converter. This is a reliable, accurate and stable device for the volume conversion of gas volumes to standard pressure and temperature. With its small dimensions it is practical and compact. The design of the volume converter was developed with a view to the requirements of low power consumption at a wide range of operational temperatures. The basic operation is very simple and software utilities have been prepared for more demanding work.

The device is constantly being improved according to the latest findings and customer requirements. The producer reserves the right to change certain functions without notice.

Contents

List of illustrations

List of abbreviations and symbols used

Symbol	*Meaning*	*Unit*
EMC	Electromagnetic compatibility, radiation and immunity	
EEPROM	Non-volatile memory (independent from power-supply)	
CRC	Checksum	
HW	Hardware, or component equipment of the device	
SW	Software, or program equipment of the device	
PC	Personal computer	
K	Compressibility factor (Z/Z_b)	[-]
k_p	Gas meter factor	[m^3/imp]
N	Number of pulses	[imp]
eV	Actual volume counted under error conditions	[m^3]
eV_b	Base volume counted under error conditions	[m^3]
eC	Conversion factor for error base volume	[-]
P	Absolute pressure at operating conditions	[bar]
p_b	Base pressure (absolute)	[bar]
Q	Flow at operating conditions	[m^3/h]
Q_b	Flow at base conditions	[m^3/h]
T	Temperature at operating conditions	[°C]
T	Absolute temperature at operating conditions	[K]
T_k	Constant of absolute temperature = 273.15	[K]
T_b	Absolute base temperature	[K]
V	Volume at operating conditions (primary volume)	[m^3]
V_b	Volume at base conditions	[m^3]
C	Conversion factor	[-]
Δt	Time between pulses	[h]
ΔV	Increment of primary volume under operating conditions	[m^3]

For description of communication parameters further symbols are used in section 2.1.8.

1 Technical description

1.1 Basic characteristics

PTZ-BOX is a battery-powered volume conversion device. It converts the volume of gas measured by the gas meter at operating (primary) conditions to volumes of gas at standard (base) conditions of pressure and temperature. Typically the converted volume under base conditions is the measure for the legal custody transfer of the gas measured. The PTZ-BOX is part of the legal chain of measurement values, and must therefore typically be approved by a national body for such application. In many cases it must be legally activated by a local verification officer. The PTZ-BOX has legal metrology approvals in the European Community and several other countries. The PTZ-BOX offers reliability, accuracy, small dimensions, compactness and long-term stability.

Measured values of primary volume and calculated values of base volume are stored in the memory of the device. It is possible to view actual values on the display of the device. All measured and stored values can be transferred to the memory of a PC and there further processed using the appropriate SW programs. Communication with a PC is made possible through an infrared interface via a reading head or a standard serial link of the RS 232 and RS 485 types.

The period of measurement is selectable as: 10; 15; 20 and 30 sec.. The updating period of stored values is 1 hour. Capacity of the memory allows the storage of 21 monthly recordings, 720 daily recordings (equal to 23 months) and up to 8000 hourly recordings (more than 10 months). The device has been developed for battery power and its hardware and software equipment ensure a minimum of 6 years correct functioning without having to change the battery.

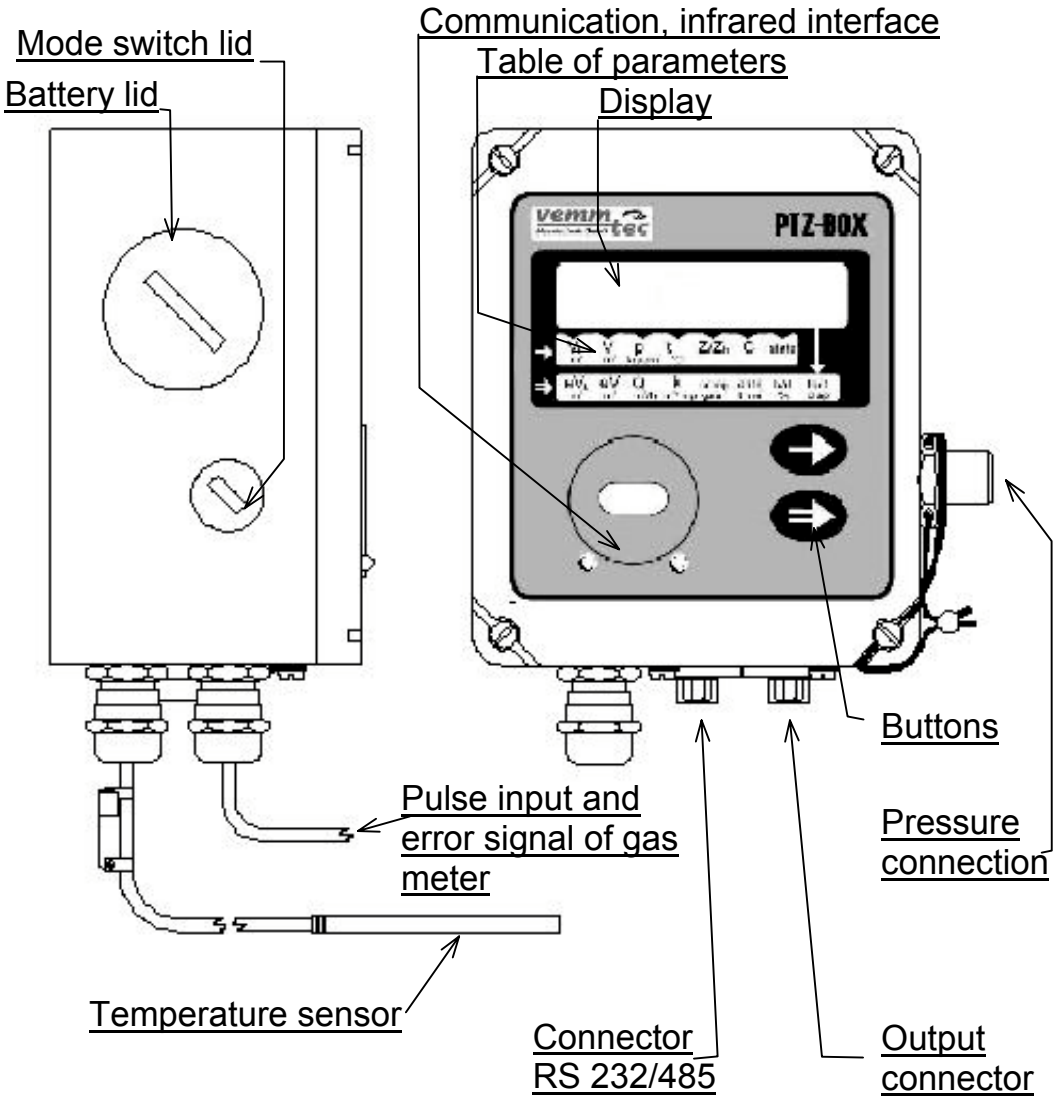
The device meets the standard EN 61000-6-2:1999 (EMC: immunity for industrial environment). It is tested for compliance with the EN 12405 and the Dutch regulations on gas meters. The PTZ-BOX is approved by the Nederlands Meetinstituut; other approvals pending. It is intended for use in Potentially Explosive Atmospheres (ZONE 1) in accordance with Article 9 of the Council Directive 94/9/EC. It is approved by the notified body no. 1026, FTZÚ. It is approved to carry the CE-marking and the ATEX-marking.

PTZ-BOX is constructed as a compact robust device in a protective aluminium alloy casing (Illustration 1). Access to the internal parts is prohibited by the metrological seals. The eight-position LCD display is situated on the front of the device. Under the display is the yellow two-row table of displayable parameters. Under the display on the right are the two buttons for operating the device. On the left beneath the table is the aperture for the communication optical head.

The pressure transmitter is installed on the inside of the device casing. The connection of the pressure transmitter is accomplished at the fitting situated on the right side. The two cable bushing entries and two nine pole connectors Cannon (D-Sub) are used for the electrical connection of linked equipment and are found on the bottom of the device (connectors are non-standard supplied equipment). In the first bushing a cable for the gas meter pulse output is connected and also if ordered a cable for tamper contact, activated at opening of the gas meter. The second cable ends in the temperature sensor and can be found in the second bushing. Both cables are an integral part of the device. The first connector is equipped for the use of RS 232/485 links, the second connector is used for pulse outputs of primary and base volume and error signal.

In the left side of the casing two lids can be found. These lids are protected by user markings or metrological seals (stickers). A sealing with use of a sealing line and metallic seals is also possible. The smaller lid covers the mode switch (description in 2.1.1). This switch controls setting the parameters via communication interface (in SET mode) (see 2.1.8), setting into operation (see. 3.4. Start up) and changing the battery (see 3.5). The larger lid is for access to the battery.

Illustration 1 General view of device



1.2 Description of functionality

The device counts low-frequency volume pulses from turbine, rotary or diaphragm gas meters. From the number of pulses (N) and the constant (gas meter factor) (k_p) it calculates the actual volume passed (V). From the measured values of absolute pressure (p) and temperature (T) the value of the gas compressibility factor is calculated as needed ($K = Z/Z_b$). Then the conversion factor (C) is calculated and the base volume (V_b) is calculated from the primary volume. The device can operate without pressure transmitter and/or temperature sensor. In this case the formulas are calculated with default (fixed) (pressure, temperature) values.

From the increments of primary and base volume and the time interval between incoming pulses, it is possible to calculate the flow rate under

primary and base conditions(Q, Q_b), and their maximum values can be evaluated and stored.

The following applies for increments of primary volume:

$$\Delta V = \Delta N \cdot k_p \quad [m^3]$$

where ΔV increment of primary volume [m^3]
ΔN number of pulses [imp]
k_p gas meter factor [m^3/imp]

The following applies for increments of base volume:

$$\Delta V_b = C \cdot \Delta V \quad [m^3]$$

where ΔV_b increment of base volume [m^3]
ΔV increment of primary volume [m^3]
C conversion factor [-]

The following applies for the conversion factor:

$C = T_b/T \cdot p/p_b \cdot 1/K$ [-] where T_b base absolute temperature, [K] (e.g. 273.15 K ~ 0 °C)
T primary absolute temperature [K]
$T = t + 273.15$ [K]
t primary temperature (actual temp.) [°C]
p primary absolute pressure [bar]
p_b base absolute pressure, [bar] (e.g. 1.01325 bar)
K compressibility factor [-]

The following applies for primary and base flow:

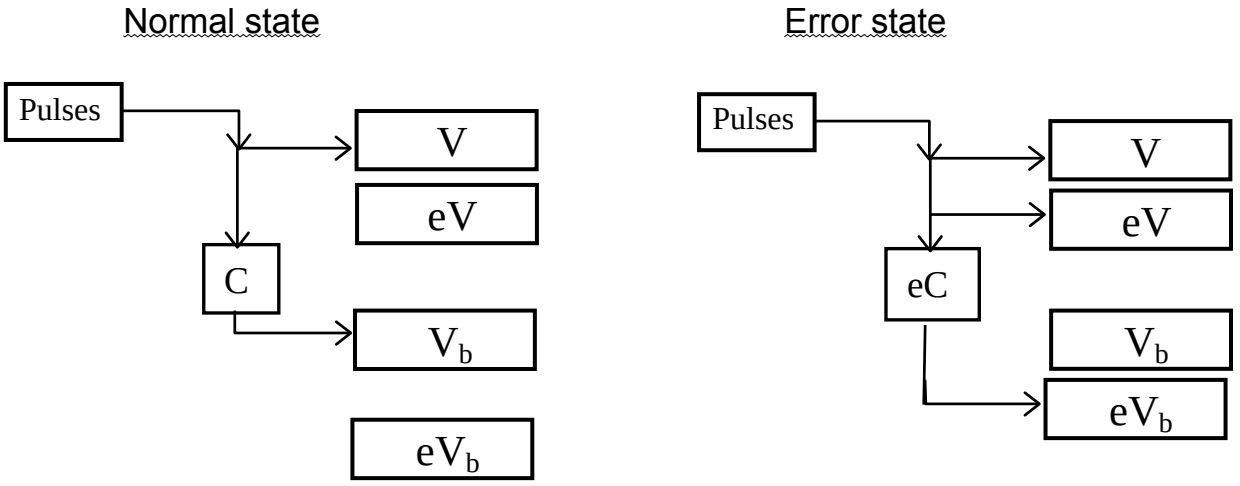
$$Q = \Delta V / \Delta t \quad [m^3/h]$$

$$Q_b = C \cdot Q \quad [m^3/h]$$

where ΔV increment of primary volume [m^3]
Δt time between pulses [h]

In case the pressure or the temperature is outside of the pre-set valid measurement ranges (extended by 1%) the PTZ-BOX goes into the error status. The increments of base volume are than calculated from the default (fixed pre-set values) for pressure or/and temperature. The calculation results are now stored in the **error base volume** (eV_b) counter, instead of the base volume counter. Values of actual volume are still accumulated and in the event of error they are now stored also in the **error primary volume** (eV).

Illustration 2 Pulse processing



Calculation of flow rate is carried out on the basis of precisely measured intervals between pulses. The value is updated on the display with the same frequency as the measurement period. If the pulse does not come at the expected time (corresponding to the previous one), this results in the calculation of flow values as if the pulse had arrived at the measurement period.

When more than around $2^1/_4$ hours have passed without receiving a pulse the flow is evaluated as zero.

1.3 Calculation of compressibility factor

The compressibility factor can be set as fixed or can be calculated based on the gas composition using the SGERG-88 or AGA NX-19 or AGA NX-19-mod method. The type of calculation method is fixed during production and cannot be changed on site by the user.
After entry of the required parameters the device calculates the internal constants. The validity range of parameters is shown in Tab. 1, page 21.
In every measurement period a calculation of compressibility is performed based on pressure and temperature measured in the whole range of values. For SGERG-88 is the range (-10°C ÷ 60°C).

1.4 Technical data

Mechanical parameters

Dimensions of box (w x h x d):	100 x 120 x 70 mm
Box material:	Aluminium alloy
Weight of device:	1.2 kg

Environment

Protection:	IP65 - according to EN 60529
Intrinsic safety:	II 2G EEx ia IIC T4 / T3 T4 for temp. around –25°C ÷ 40°C T3 for temp. around –25°C ÷ 60°C - according to EN 50014, EN 50020
Certificate number:	FTZÚ 01 ATEX 0044X
Classification of environment:	Zone 1, Zone 2 – according to EN 60079-10
Electromagnetic compatibility:	EN 61000-6-2 Immunity for industrial environments
Storage temperature:	-40 ÷ 80 °C
Operating temperature:	-25 ÷ 60 °C
Classification of environmental conditions:	Groups IE36 – according to EN 60721-3-3
Protection against dangerous touch	Small voltage

Power supply

Battery type:	LP-03, 3.6 V / 16 Ah *(lithium, intelligent)*
Battery life:	min. 6 years *(depending on use)*
Measurement of battery life:	Yes *(warning message at 10% remaining capacity)*

Accuracy of device

Relative error (at ambient temperature)	
Base volume:	< 0.50 %
Primary volume:	errorless
Mathematical element:	< 0.10 %
Annual additional error of volume:	< 0.10 %
Indicative values	
Base flow:	< 1.00 %
Primary flow:	< 1.00 %

INPUTS – OUTPUTS

Measurement of pressure

Transmitter:	Measurement of absolute pressure, integrated in casing
Pressure range: (For custody transfer: not all transmitters mentioned are approved in all countries, please enquire)	0.9 - 3.0 bar (abs) 2.0 - 5.2 bar (abs) 3.0 - 10 bar (abs) 0.8 - 5.2 bar (abs) 2.0 - 10 bar (abs) 4.0 - 20 bar (abs) 7.0 - 35 bar (abs) 14 - 70 bar (abs)
Accuracy of measurement:	≤ 0.25 % of measured value
Annual additional error:	< 0.10 %
Maximum overload capacity:	125 % of measurement range
Measurement period:	10, 15, 20 and 30 sec.
Pressure connection:	tube ∅6 mm, connection: ERMETO M12 x 1.5

Measurement of temperature

Sensor:	Pt1000, permanently connected with the device
Temperature range:	-25 ÷ 60 °C (AGA-NX 19, AGA-NX 19 mod) -10 ÷ 60 °C (SGERG-88)
Accuracy of measurement:	≤ 0.10 % of measured value in K
Annual additional error:	< 0.02 %
Measurement period:	10, 15, 20 and 30 sec.
Length of sensor:	max. 160 mm (also 60 mm and 120 mm in total)
Length of cable, standard:	2.5 m
Max.:	12 m

Pulse input

Type of signal:	non-potential input (reed contact, or other suitable pulser)
No-load voltage:	around 3.6 V
Short circuit current:	max. 4 µA
Max. frequency:	4 Hz
Time constant of filter:	20 ms
Pulse width:	≥ 100 ms
Gas meter constant (input):	100, 10, 1.0, 0.1, 0.01 m^3/impuls
Length of cable, max.:	12 m

Input for tamper contact of gas meter (optional)

Type of signal:	non-potential input (contact)
No-load voltage:	around 3.6 V
Short circuit current:	max. 4 µA
Activation:	closed or open *(tampering must last longer than one measurement period)*

Pulse outputs and error state signal

Operating voltage:	3.6 ÷ 30 V (max. 28V in hazardous area see 3.3
Operating current:	1 µA ÷ 100 mA
Pulse width (contact on):	100 ms for pulse outputs around 300 ms for output of error state
Output factor	
Pulse of primary volume:	1 pulse / 1 m^3
Pulse of base volume:	1 pulse / 10 m^3

Optical head communication

Used standard:	EN 61107

RS 232 communication

Connection, connector:	Cannon (D-Sub) 9F (IP 65, type FWDF09S-K413)
cable:	max. 15 m
Input voltage:	max. ± 20 V (cannot be used in hazardous area)

RS 485 communication

Connection, connector:	Cannon (D-Sub) 9F (IP 65, type FWDF09S-K413)
Cable:	max. 100 m
Input voltage:	max. 15 V (max. 5.5 V in hazardous area see 3.3)

Communication speed: 9600 Bd

ARCHIVES

Monthly archive

Number of records:	21 *(depends on manipulation with the mode switch 2.1.7.1)*
Up-dating:	1 hour
Stored values:	Gas meter factor, values V, V_b, eV, eV_b, day and time and value of max. actual flow, day and value of max. base volume per day, day and hour and value of max. base volume per hour, accumulated status
Mode when full:	cyclic overwriting

Daily archive

Number of records:	720 (23 months)
Stored values:	like the extended format (see below)
Mode when full:	cyclic overwriting

Hourly archive

Number of records:	5300 extended format (7 months)
Or	8000 standard format ($10^1/_2$ months)
Mode when full:	cyclic overwriting
Standard format:	date and time, values V, V_b, eV, eV_b, average temperature, average pressure, status
Extended format:	in addition to the standard format also: min. and max. temperature, min. and max. pressure, maximal primary and base flow

Limits archive

Number of records:	10 for pressure + 10 for temperature
Up-dating:	measurement period
Stored values:	date and time and value exceeding the measuring range
Mode when full:	cyclic overwriting

Min., max. values

Stored values:	date, time and value of the maximal, minimal pressure
(can be erased)	date, time and value of the maximal, minimal temperature
	date, time and value of the maximal, primary flow

Archive of setting

Number of records:	more than 100 *(according to type of setting)*
Stored values:	operator code, date and time, values V, V_b, eV, eV_b, state before and after change
Mode when full:	stop + indication of error

Status archive

Number of records:	around 500
Stored values:	change of error states
Mode when full:	cyclic overwriting

2 Operating instructions

2.1 Functional description of the device

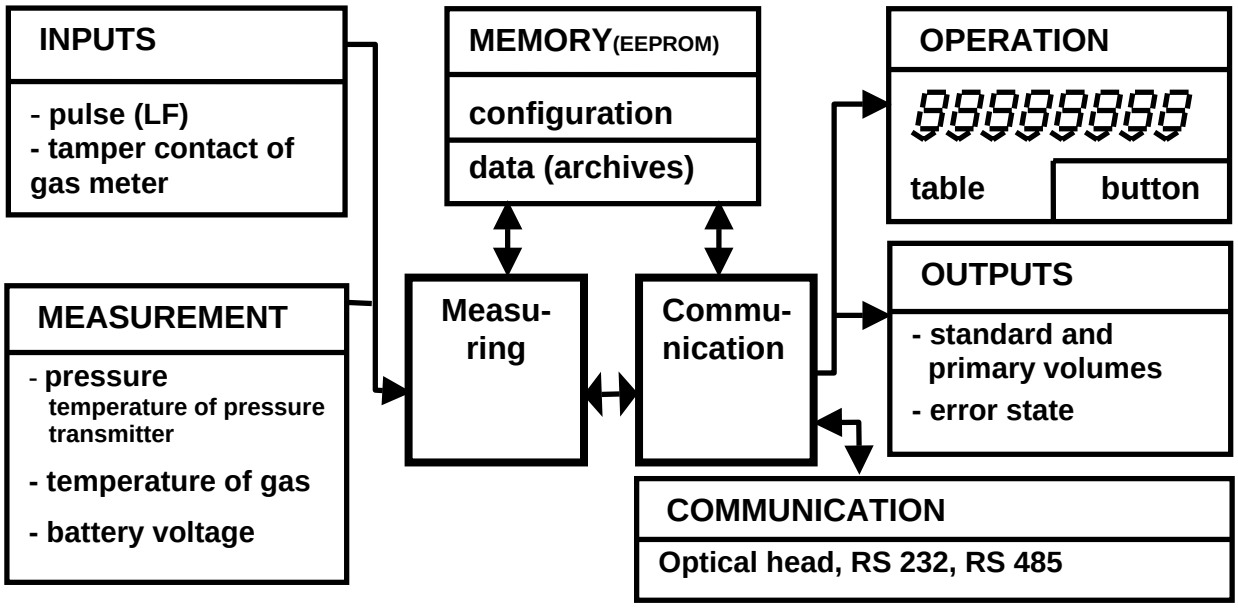
The device ensures the following basic functions:

- periodical measurement of actual values of pressure, temperature, number of pulses, time;
- volume counting at actual conditions and base conditions;
- calculation and archiving of values;
- communication and data transfer to computer or other systems.

Activity of the device is controlled by a microprocessor core with internal program by means of parameters stored in the memory. The core and program are split into two parts. The first part deals with measurement, processing and calculation of basic data. The second part deals with archiving, communication and display. Versions of these parts and versions of the hardware can be read using a PC. It is shown for example in the form: 1.0-1.0-1.0. The first number shows the number of the measurement parts, the second number the version of the communication part and the third shows the version of hardware. The integer part of the number shows the approved version, the decimal part shows the insignificant changes.

Parameters for controlling the activities of the device are pre-set by the manufacturer; the user has the possibility to change some of these. Change in parameters is possible only by connection to a PC type computer using the programming equipment (see 2.2.8.). The keyboard is for operation of the display of data and cannot be used to change the set-up of the device.

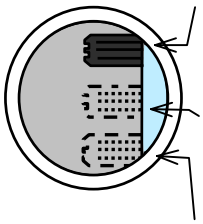
Illustration 3 Block diagram



2.1.1 The mode switch

The mode switch is located under the smaller lid on the left side of the device. The lid is protected against unauthorised opening by a (possibly legal) seal. Description of the possible modes is in Illustration 4. A switching over causes the current mode to be shown on the display for about 8 sec..

Illustration 4 Description of the mode switch.



RUN: normal mode – the device measures, up-dates the archives, the clock is running, it is possible to read data by communication;

SET: setting mode – the device does not measure, archived values are maintained, the clock is running, it is possible to set the device by communication using a PC;

OFF: inactive mode – the device does not measure, keeps the archives, the clock is running, it is not possible to communicate with the device.

2.1.2 Operation and display

The display is made up of an eight-position seven-segment display. The variable displayed is indicated with the arrows on the display and on the yellow two-line table underneath the display. Displayed values with description and their units:

V_b	volume at base conditions	[m^3]
V	volume at operating conditions	[m^3]
p	absolute pressure	[bar]
T	actual temperature	[°C]
Z/Z_b	compressibility factor ratio of gas	[-]
C	conversion factor	[-]
state	indicating of error status	

upper button

eV_b	error base volume	[m^3]
eV	error primary volume	[m^3]
Q	primary flow	[m^3/h]
k_p	gas meter factor	[m^3/imp.]
comp. of gas	parameters for calc. of Z/Z_b	
Date	internal date	[dd.MM.yyyy]
Time	internal time	[hh-mm-ss]
Bat	remaining battery capacity	[%]
test disp.	test of display function	

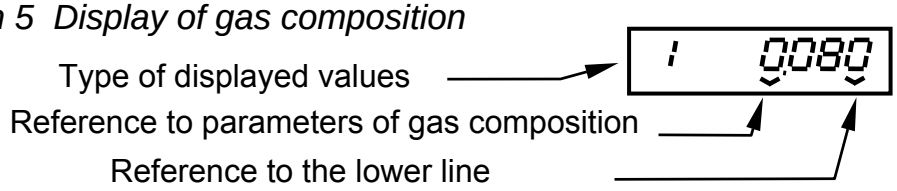
lower button

The upper button is used to change the displaying of parameters for each line. To read out the lower parameters use the lower button, which is indicated by the right outer arrow according to illustration 5.

In normal operation the display will switch off automatically, if not activated by a touch. At the first pressing of the button it displays the first parameter of the corresponding line. Position of the pointer '**V**' refers to the shown parameter. For V_b and eV_b the remaining decimal places of the figure are displayed on the second pressing of the button. Each further pressing of the button moves the pointer along the line. Values of base volume and error base volume are displayed including the leading zero. If the pressure or temperature measurement range is exceeded, the indicated values are not of maximum accuracy and can only be used for indication. This state is indicated by the symbol '***E***' in the first position of the display. In this case the default pre-set (fixed) values are used for calculation. If the device is not equipped with pressure and/or temperature sensor, symbol '***П***' is displayed in the first display position together with the corresponding applicable value. In this case the calculations are made with the default (pressure / temperature) fixed values.

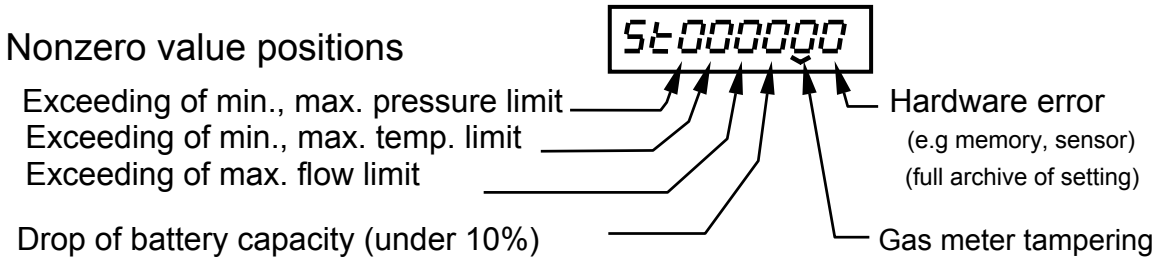
Composition of gas shows hyphens in case of a fixed compressibility factor. When using an actual calculation of the compressibility factor, according to one of the selected methods (methods cannot be changed additionally by the user), the values used in the calculation are displayed. The kind of variables is determined by the number in the first position on the display. A description of calculation method and variable together with their units is printed on the main label of the device (see Illustration 11).

Illustration 5 Display of gas composition



If an error state has occurred and it is still present, than during the switched off display after the first pushing of a button an indication ''**Er ...**'' together with the error specification will appear. If the error state has already disappeared, than after the first button pushing an indication ''**St...**'' will appear. The error specification is still maintained in the entry ''**state**'' (see illustration 6). A further button pushing gives a standard response. The error indication and error state can be reset after its prior removal, see below.

Illustration 6 Display of "state" entries



Pressing of both buttons performs the following functions according to order of pressing.

Resetting the indication of error state is carried out by pressing the upper and then at the same time lower button (for ca 2 s). After releasing them (in reverse order) '***CSt*' appears on the display as confirmation. If the device is in RUN mode, the indicators ''**Er...**'' and ''**St...**'' will be reset. However, the position **state** will not be influenced. If the device is in SET mode, the indicators ''**Er...**'' and ''**St...**'' together with **"state"** will be reset. The indicator **"state"** can be also reset via a PC, after the password entry.

Pressing of the lower and than at the same time the upper button causes „**freezing**", of displaying the actual values of pressure, temperature, compressibility factor and conversion factor.

'***Frn***' is shown on the display. Internally, the measurement goes on as normally. By pressing the upper button the successive viewing of frozen values is possible. Back to up-dating of values: when the lower button is pressed or if the display switches off automatically and than an activation by button pressing is performed.
The display switches off after about $1^1/_2$ min to save the battery.

2.1.3 Measurement of pressure and temperature

Measurement of pressure and temperature is carried out simultaneously. At the same time the calculation and up-dating of the volume counters is carried out. The value of these measurement periods can be set to: 10, 15, 20 and 30 sec.

Exceeding of the measurement range (limit) is evaluated and recorded in the status archive. The value is recorded in the limits archive and if necessary even as a minimum or maximum value. If the device is not equipped with pressure and/or temperature sensor the calculation is performed with the default fixed value.

2.1.4 Pulse input

A low-frequency non-potential contact of the gas meter should be connected to the pulse input (connected in 3.1.5 and 3.2). The device evaluates the number of pulses at this input, together with the gas meter factor, as the increment of

the counter at primary volume. This state is up-dated after measurement of the pressure, temperature and the calculation is carried out. Primary flow is evaluated by accurate time measurement. If the upper flow limit is exceeded a record entry in the status archive and if selected it records the maximum value too.

2.1.5 Input for tamper contact of gas meter

This option is not included in the basic version. A non-potential gas meter contact can be connected to the tamper input (connection see 3.1.5 and 3.2). The required active level can be set. The device checks and evaluates the input at every measurement period. Tampering is detected, if this contact is in the pre-set level for a minimum of two measurement periods, this state is recorded in the status archive and the error output is activated.

2.1.6 Outputs

Outputs are provided if specified and ordered by the customer. Outputs are galvanically isolated transistors with open collector, reverse polarity protected by an antiparallel diode (connection in 3.1.5; Tab. 2 and 3.2).

Generating of the output pulses is delayed for one measurement period (the time necessary for calculation).

Pulse output of primary volume is generated after each increment. The pulse output of base volume is generated after every tenth increment (output divided by ten).

The error output is activated if events occur as described in section 2.1.7.4.

2.1.7 Data logging

For evaluation of measured and calculated data and other operational matters for a longer period of time, the device has a built-in archiving (logging) system. Because these archives cannot be shown on the display, interpretation and processing of data is performed by using the relevant software which enables communication through PC (optional accessories are required, serial communication interface or optical reading head HIE-01).

Size of the archives can be found in 1.4. All archives start to overwrite the oldest values once they become full, except for the archive of setting.

If you need to change the device time or date, you should readout daily and hourly archives first.

2.1.7.1 Monthly archive

The following values are stored in the record:

Gas meter factor, base volume, primary volume, error base volume, error primary volume, day and time and value of maximum primary flow, day and value of maximum daily consumption of base volume, day and hour and value of maximum hourly consumption of base volume, accumulated status.

The current values of the volume counters are recorded and consumption calculations are carried out by the SW on a PC. All values are calculated with the measurement period and actual values are stored in the temporary memory. Every hour these values are compared and saved or added to the values of the month already stored. On the first day of the new month, at the pre-set hour (gas month) for the store time, the current record is closed and a record for the new month is opened.

If the mode switch is switched to the “SET” position, a premature closing of the month is performed. Switching to the “RUN” position saves the actual state at the time of switching and begins a new record as at the start of the month.

Accumulated status makes it possible to find out immediately if the period of relevant records was affected by any errors. In this case it would be not zero. Types of recorded errors are described in section 2.1.7.4.

2.1.7.2 Daily archive

Is not included in the basic version. It serves to store the value of the volume counter, average pressure and temperature per day, minimum and maximum pressure and temperature per day, maximum primary and maximum base flow per day, status.

Values are calculated with the measurement period and the current values are recorded in the temporary memory. From these values the new record is created and saved at the set hour for the store time.

2.1.7.3 Hourly archive

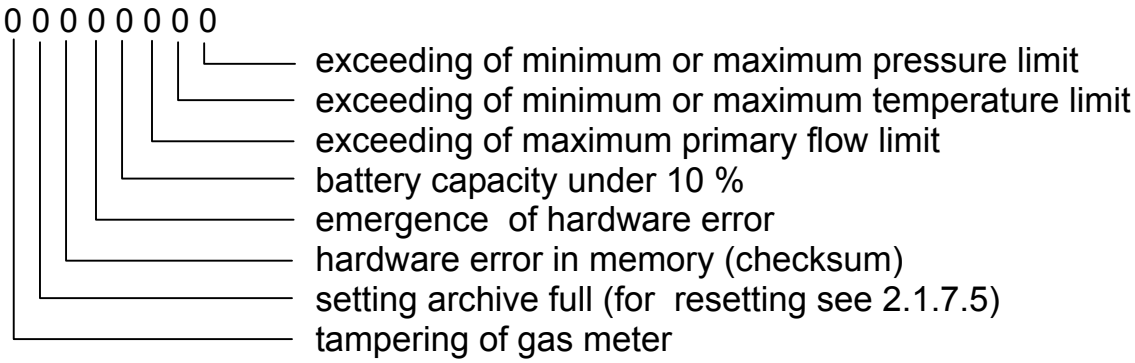
Is not included in the basic version. For recording the standard format can be selected: volumes of counters, average pressure and temperature per hour. The format can be extended by minimum and maximum pressure and temperature per hour and maximum of primary and maximum of base flow per hour.

All values are calculated with the measurement period and the current values are recorded in the temporary memory. Data is taken from here every hour and stored.

2.1.7.4 Status archive

Information about important error states of the device is stored in the status archive. This concerns the following states (expressed binary):

Illustration 7 Meaning of status word



On emergence or disappearance of one of these states a record of events with date and time stamp is created in the archive. If another event occurs a new record is created. This record contains information about all events, again.

If any event occurs the error output will be activated by standard. Cancellation of this activation is performed only after all reasons for alarm status have been removed.

2.1.7.5 Archive of settings

This archive contains changes of the device parameters. The values archived are: erasing of this archive (only by the producer possible); start of measurement of data archives; changes in the values of the volume counter; gas meter factor; customer number and serial number of gas meter; configuration of: default values of temperature and pressure; parameters of compressibility factor; network addresses; interval of measurement; store time (start of the gas day); changes of date and time.

Every record is made up of sequential number, the operator code who made the changes (see 2.1.8), time and state before and after the change. Further to this the values of the volume counters are always stored (primary, base and both error volumes) and gas meter factor.

When the archive of settings is full, the error notification is generated. This error can only be cancelled by erasing the archive and breaking the official marking.

2.1.7.6 Limits archive

This archive serves to record the values of pressure and temperature, that exceeded the measurement range (limits). Values are recorded together with the date and time. Because the values in this archive are on the edges of the measurement range they are not extremely accurate but help to discover problems.

2.1.7.7 Minimal and maximal values

This record contains informative values of min. pressure, min. temperature and maximum pressure, max. temperature and actual primary flow since the last reset. Individual records only contain the most extreme value, which exceeded the limit, with data and time given.

2.1.7.8 Communication, data protection

The device is equipped for communication with standard infrared interface, and (if ordered) with RS 232/485. The optical reading head (HIE-01- optional equipment) serves for connecting with a PC through the infrared interface. For connection by RS 232/485 four wire shielded cable with connectors is sufficient.

Communication software on the PC makes it possible to only read or alternatively change the device parameters. The mode (reading/change of parameters) is determined when starting the program by entering the password. This password is operator specific and is stored together with time of access and record of the changes made in the archive of setting. In this way, it is possible to see exactly who and when carried out the change.

For data protection and security the position of the mode switch (on the device) is important. In the “RUN” mode it is **only** possible to read the data.

For modification of parameters it is necessary to switch to the “SET” mode. When this mode is selected the monthly values are stored in the monthly archive. After the changes it is necessary to switch back into the “RUN” mode. A new, current record will be made in the monthly archive. The device will continue measuring according to the new parameters.

Tab. 1 Parameters and instructions made available by PC software

Allocation	Marking	Sorted description -content	Range		P.
OPERATION	Adr	net address	000 ÷ 999		r/w
	Dat	date and time			r/w
	Bat	battery capacity	0 ÷ 100 %		r
	eVb	error base volume	0÷99999999.9999 m^3		r/w
	eV	error primary volume	0 ÷ 99999999 m^3		r/w
	Vb	base volume	0÷99999999.9999 m^3		r/w
	Qb	base flow	0 ÷ 99999.999 m^3/h		r
	I_m	measuring period	10; 15; 20; 30 s		r/w
	V	primary volume	0 ÷ 99999999 m^3		r/w
	Q	primary flow	0 ÷ 99999.999 m^3/h		r
	t	primary temperature	-99.99 ÷ 99.99 °C		r
	p	primary pressure	0 ÷ 99.9999 bar		r
	C	conversion factor	0 ÷ 99.99999		r
	St	Status	00000000 ÷ 11111111		r, c
	Z/Z_b	compressibility ratio	0 ÷ 1.99999		r
	Tpr	temperature of device	-50.00 ÷ 99.99 °C		r
		Composition of gas	SGERG-88	AGA NX-19	r/w
	kCO2	content of CO_2	0.001÷ 30.000	0.001÷ 15.000	r/w
	kN2	content of N_2		0.001÷ 15.000	r/w
	kH2	content of H_2	0.001÷ 10.000		r/w
	kd	relative density	0.55 ÷ 0.9000	0.55 ÷ 0.7500	r/w
	kHon	calorific value	5.5 ÷ 13.3300		r/w
CUSTOMER	CD	store time in hours (gas day)	0 ÷ 23		r/w
	CZ	Customer number	12 positions		r/w
	k_p	gas meter factor	10;1;0.1;0.01 m^3/imp.		r/w
	Q_{max}	max. limit of primary flow	0 ÷ 99999 m^3/h		r/w
	t_{est}	default (fixed) temperature	-40.00 ÷ 60.00 °C		r/w
	p_{est}	default (fixed) pressure	Converted to bar		r/w
	K	fixed compressibility factor	0.9 ÷ 1.1		r/w
	Pvc	serial number of gas meter	12 digits		r/w

S Y S T E M	C1 to C5	CRC of device memory	0000 ÷ FFFF	r
	t_b	base temperature	0; (15) °C	r
	p_b	base pressure	1.01325 bar	r
	TYP	type of device	C1A ÷ U4D	r
	Version	$SW_{MEASURING}$ – $SW_{COMMUNICATION}$ – HW	x.x - y.y - z.z	r
	VCmE	serial number of device	8 digits	r
	VCP	serial number of pressure transmitter	8 digits	r
	VCT	serial number of temperature sensor	8 digits	r
A R C H I V E S	DV_{nMDEN}	max. base daily volume– day		r
	V_{nMDEN}	max. base daily volume – value	0 ÷ 99999999 m^3	r
	DV_{nMHOD}	max. base hourly volume – day, hour		r
	V_{nMHOD}	max. base hourly volume – value	0 ÷ 99999999 m^3	r
	DQ_{MMES}	max. prim. monthly flow – day, hour		r
	Q_{MMES}	max. prim. monthly flow – value	0 ÷ 99999.999 m^3/h	r
	Q_{Dmax}	max. primary flow – value	0 ÷ 99999.999 m^3/h	r
	Dq_{Dmax}	max. primary flow – date time		r
	Q_{Dmax}	max. base flow– value	0 ÷ 99999.99 m^3/h	r
	V_{Dnest}	Error base volume	0 ÷ 99999999.99 m^3	r
	V_{Dest}	Error primary volume	0 ÷ 99999999 m^3	r
	V_{Dn}	Base volume	0 ÷ 99999999.99 m^3	r
	V_D	primary volume	0 ÷ 99999999 m^3	r
	t_{ap}	average temperature	-99.99 ÷ 99.99 °C	r
	P_{ap}	average pressure	0 ÷ 99.99999 bar	r
	$t_{amax/min}$	max./min. temperature	-99.99 ÷ 99.99 °C	r
	$P_{amax/min}$	max./min. pressure	0 ÷ 99.99999 bar	r
	Ch	user password	00 ÷ 99	r
	Dnul	time of erasing of min. and max. values		r/w
	DatS	date of record		r
	DQ_{Mmax}	flow above limit – date, time		r, c
	Q_{Mmax}	flow above limit – value	0 ÷ 99999.999 m^3/h	r, c
	$Dt_{max\ n/p}$	temp. above/under limit – date, time		r, c
	$t_{max\ n/p}$	temperature above/under limit – value	-99.99 ÷ 99.99 °C	r, c
	$Dp_{max\ n/p}$	pressure above/under limit – date, time		r, c
	$P_{max\ n/p}$	pressure above/under limit – value	0 ÷ 99.9999 bar	r, c
	$AS_{Dak/A}$	status accumulated/archived	00000000 ÷ 11111111	r, c

* – the decimal part of the number is not stored in the daily and hourly archive

P.– access: *„r“ read only*

„c“ possible to be cleared

„w“ write, entries also possible

3 Assembly instructions

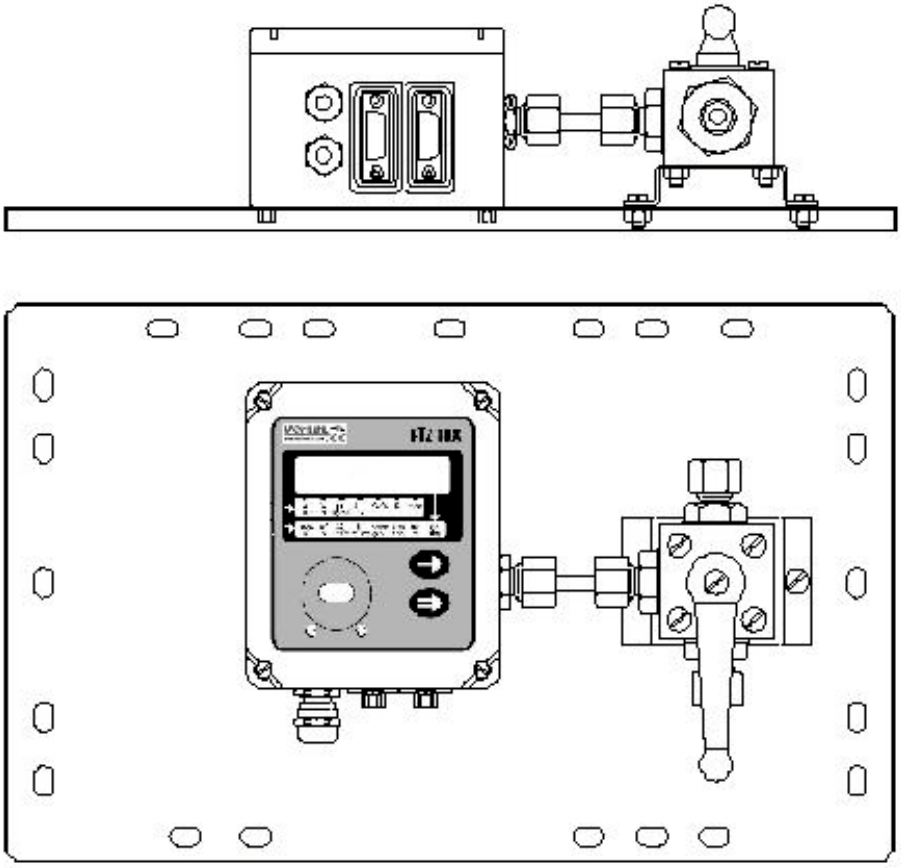
If the device is installed in the environment ZONE 1, a grounding is required (see further on). For installations in ZONE 2 the grounding is not required in case that no accumulation of electrostatic charging occurs (see further on).

3.1 Basic configuration

As standard, a mounting plate is delivered with the PTZ-BOX. The PTZ-BOX can be fixed to this plate using the two M4x8 screws. These screws are fixed into the thread in the holes on the back side of the casing. It is also possible to fix a three-way valve PN 100 to he mounting plate using a support bracket. Connection of the three-way valve and pressure inlet of the device is accomplished by the pressure tube ∅6, 60 mm long (included as accessories). This is connected to the pressure inlet of the device and at the other end, to the working output of the three-way valve. The valve is mounted on the support bracket using M5x40 screws.

Optionally, for open air installations and for protection against direct sun rays combined with rain, there is a little screening roof with a frontal cover to be used.

Illustration 8 Basic assembly on the mounting plate



This Assembly can be mounted in various ways

In hazardous areas (Zone 1) where a ground connection is required, the terminal screw on the side of the casing is used with a washer. The washer should be applied in such a way that it is in contact with the head of the screw. This connection prevents electrostatic discharging.

3.1.1 Mounting onto pipeline

At a straight section of the pipeline the PTZ-BOX assembly can be mounted directly onto the pipeline using 2 lugs. Lugs of relevant size are led through the slots on the mounting plate and placed on the pipeline. On the free ends of the lugs are fishplates inserted and screwed with M6 nuts. Supplied lugs permit electrical connection to the pipeline. It is possible to mount the assembly to a horizontal pipeline DN 80 ÷ DN 150 or to a vertical pipeline DN 80 ÷ DN 200.

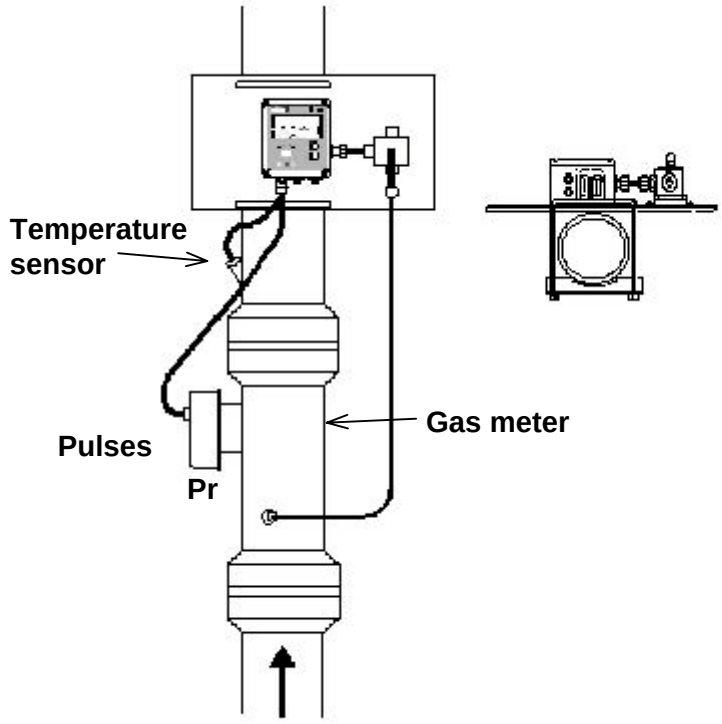


Illustration 9 Mounting assembly onto vertical pipeline

3.1.2 Mounting on the wall

The assembly can also be mounted a wall by means of the corner slots in the mounting plate using four 5x40 screws and ∅8 dowels.

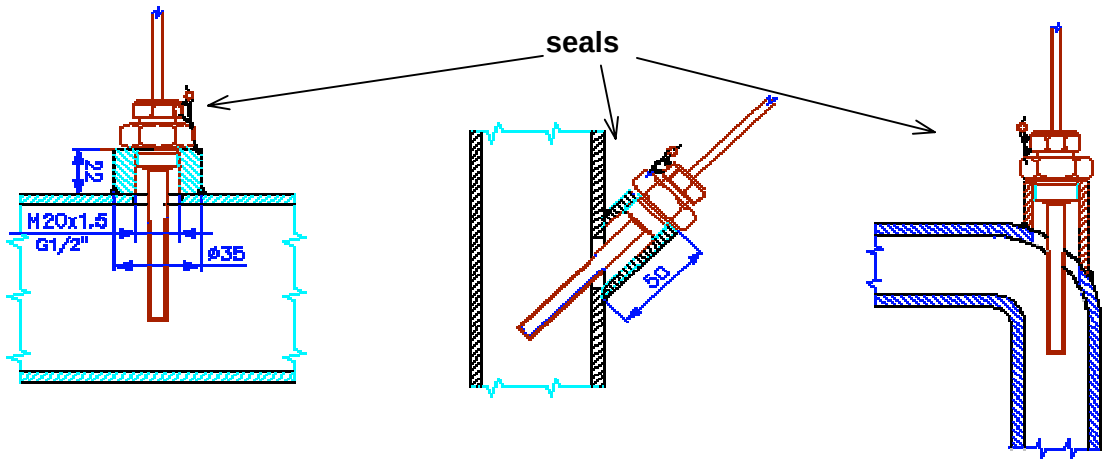
3.1.3 Pressure connection

Connection of the pressure input to the three-way valve with the *Pr* output of the gas meter is accomplished by stainless steel tube. The tube should be inserted into the operation input of the valve sealed with sealing ring ∅6 mm and M12x1,5 lock nut, to form a tight seal. **For mounting of the cutting ring, is the pre-mounting set to be used!**

3.1.4 Connection of temperature sensor

A weldolet must be placed on the pipeline at a distance of 1 to 2 times DN downstream the gas meter in case of a turbine meter. For rotary meters the temperature sensor can be mounted upstream the gas meter. The weldolet must be welded in such a way, that the thermowell, which is to be mounted in the weldolet, is positioned vertically or in other cases tilted 45° from the vertical axis after mounting with the opening facing up (see illustration 10). Consult the factory for special mounting rings or combined pressure/temperature thermowells.
Pt1000 temperature sensor should be inserted into the thermowell through the nut, it must touch the bottom and must be secured against pulling out of the fastening nut. For a better thermal transmission the area around the sensor inside the thermowell can be filled with silicon oil. The insulation of the supply cable to the sensor must be protected from contact with this oil.
Insertion depth of the thermowell should be to the middle third of the pipeline.

Illustration 10 Mounting of temperature sensor



The temperature sensor can be protected from unauthorised manipulation by the user marking or a legal seal on the nut and thermowell or weldolet.

3.1.5 Connection of external circuits (inputs/outputs)

Connection of the gas meter is made by the cable through the bushing situated near the front panel of the device (see illustration 11).

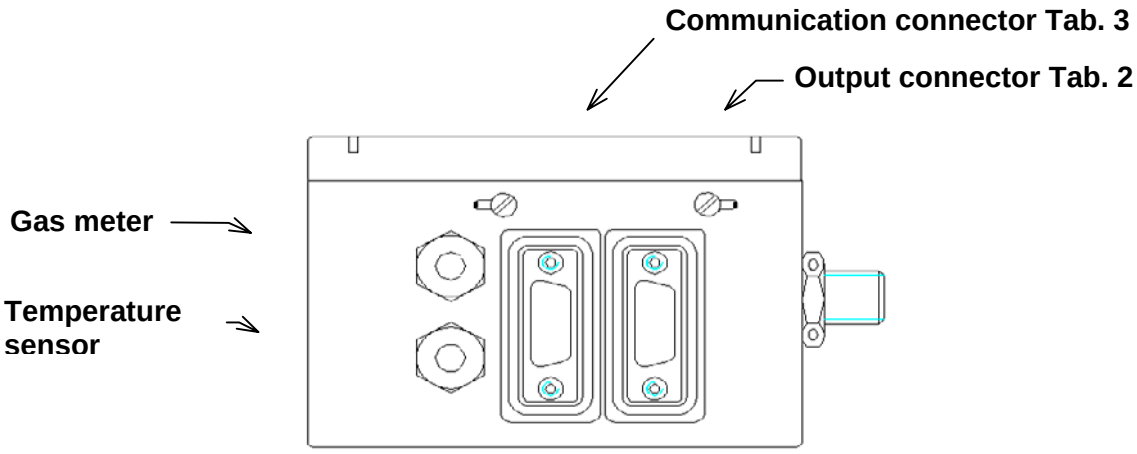
The white wire is the common **ground**.
The brown or **red** wire is used for connection of **input pulses**.
The green or **blue** wire is optionally used for connection of the gas meter tamper contact.

If desired, the device can be equipped with one or two connectors situated on the bottom of the casing to enable connection to external devices. Wiring diagram of the connectors is shown in Tab. 2 and 3.

If shielded/armoured cables are used, we recommend to **connect the screening** to the casing of the PTZ-BOX and do not connect it at the other end.

Recommended connection is in the paragraph 3.2.

Illustration 11 Connection description



Tab. 2 Wiring of the output connector

PIN no.	Description
1	not connected
2	not connected
3	positive pole of output primary volume pulses
4	positive pole of output base volume pulses
5	positive pole of error output pulses
6	not connected
7	Negative pole of output primary volume pulses
8	Negative pole of output base volume pulses
9	Negative pole of error output pulses

Tab. 3 Wiring of the communication connector

PIN no.	RS 485 connection	RS 232 connection (marked according to PC connectors)
1	connect with PIN no. 5	do not connect !
2	————	RxD – data output
3	————	TxD – data input
4	————	————
5	power supply – pole	GND – ground
6	————	————
7	power supply + pole	RTS – control voltage
8	B data wire –	————
9	A data wire +	————

3.2 Connection of external devices

Illustration 12 Recommended connection in hazardous areas

- outputs with Zener barriers and RS 485 with DATCOM-S2 unit

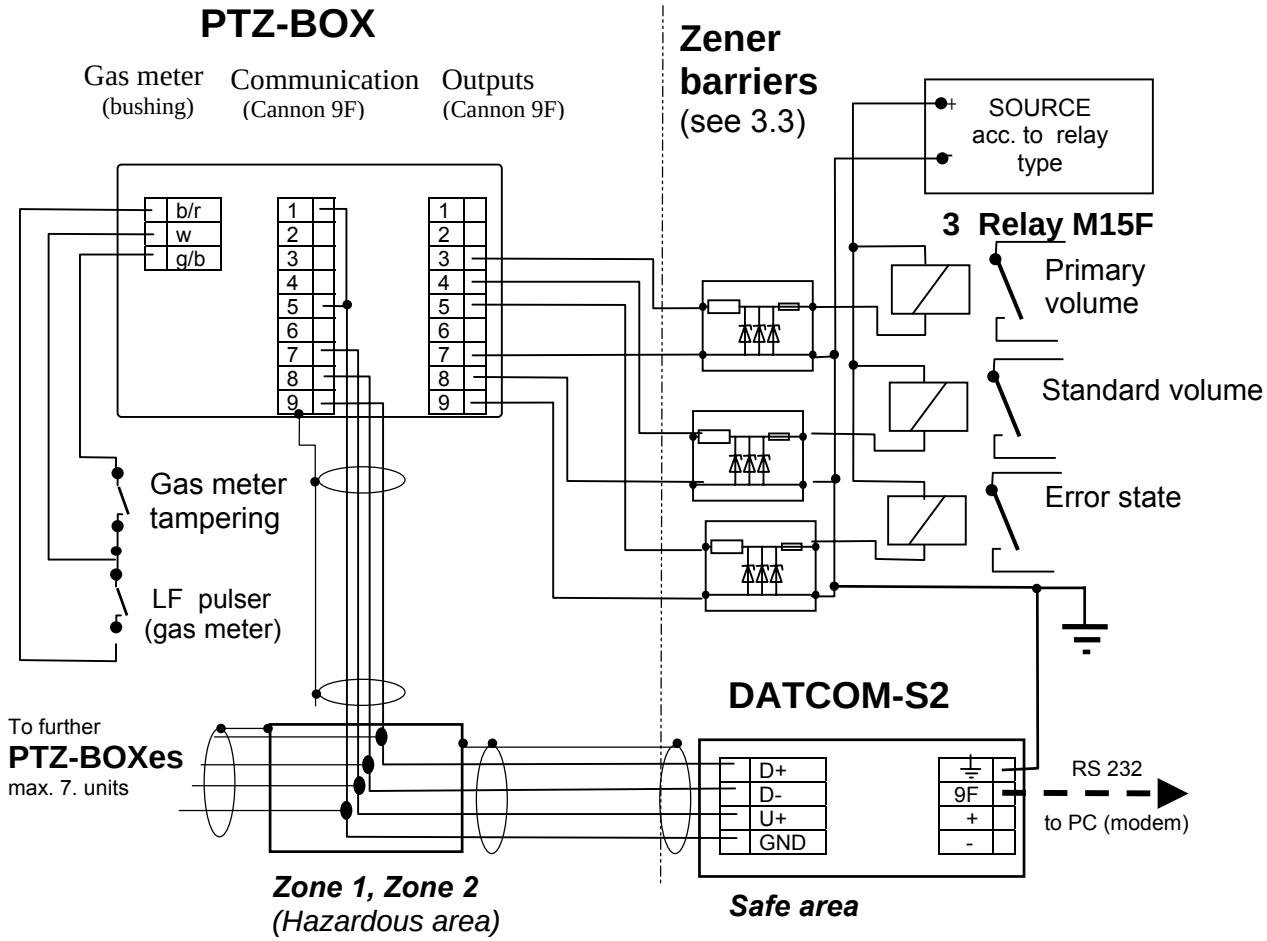
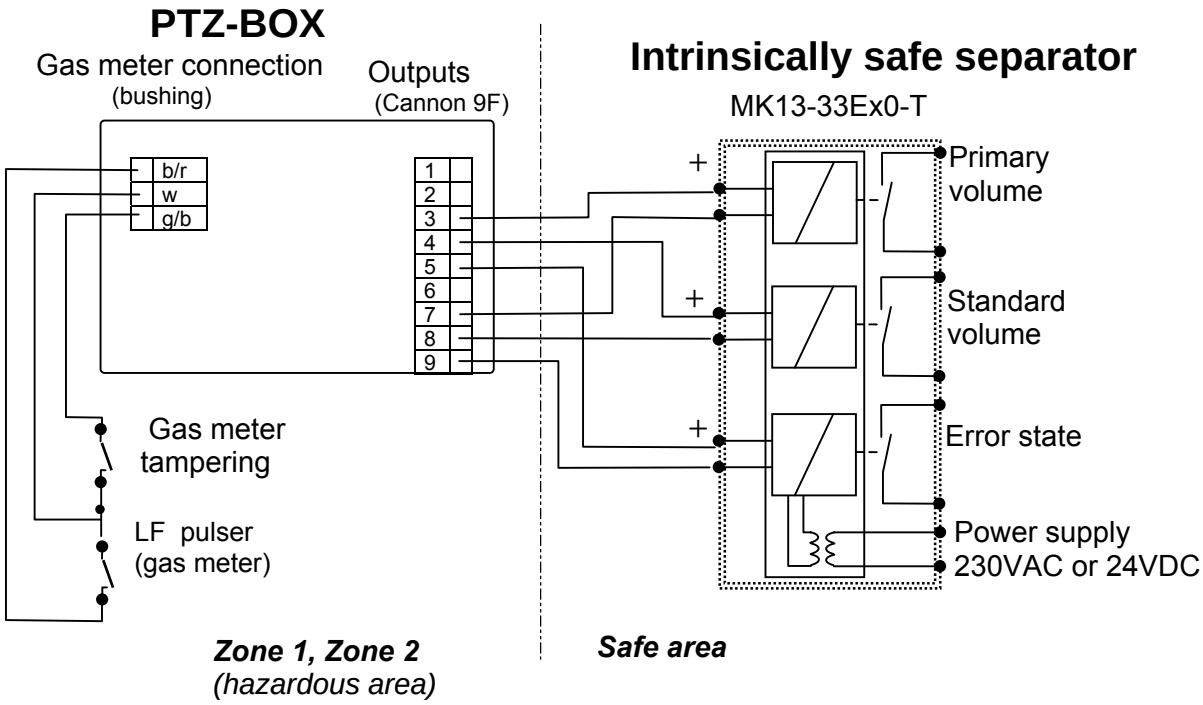
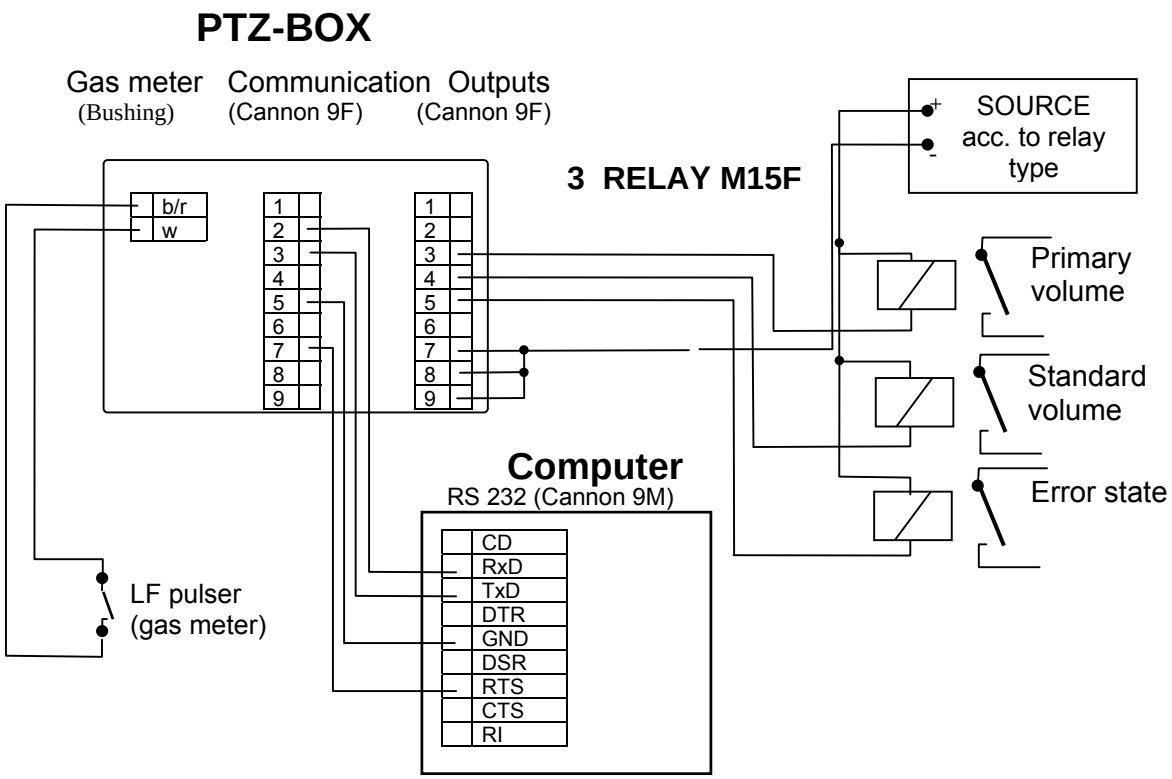


Illustration 13 Recommended connection using a separator



Insulating voltage of the separately connected output is 500V AC. When using the safe separator (illustration 13) we must take into account the transfer of 100 ms pulses (Turck intrinsically safe separator with transistor outputs). For use outside of hazardous areas a connection according to illustration 14 (without Zener barrier/safe separator) can be used.

Illustration 14 Recommended connection for use outside of hazardous areas -outputs and RS 232



3.3 Explosion protection

For using the device in a potentially explosive atmospheres specific conditions must be fulfilled which are mandatory by the certificate of FTZÚ Ostrava-Radvanice, (notified body No. 1026). Only the LP-03 battery block may be used as the power supply. When changing the battery, it is necessary to avoid the possibility of electrostatic discharging. For battery change proceed in accordance with paragraph 3.5.

For assembly the following conditions must be respected:

1. Only approved passive contact elements or non-contact intrinsically safe transducers may be connected to the device pulse input and gas meter tamper contact (so called. „simple apparatus“ according to EN 50020 [3]). The device does not accept any energy coming into these inputs.
2. Connection of pulse outputs powered by an external source in hazardous areas must be carried out through a Zener barrier or a certified safe separator.

Limit values of Zener barriers:

Max. output voltage U_0 :	28 V
Max. short circuit current I_0 :	93 mA
Max. output power P_0 :	0,65 W
Recommended type (manufacturer) :	MTL 787 (MTL), Z788 (Pepperl+Fuchs)

3. In hazardous areas, the serial communication must be performed via an extending intrinsically safe communication module DATCOM-S1 or DATCOM-S2 or via an approved infrared reading head (HIE-01).
4. For installation, it is necessary to use cables which comply with EN 60079-14 [5]. They must resist the test voltage of 500V AC for a period of 1 minute. For example the UNITRONIC ® shielded cable- LiYCY is produced with various numbers of wires. Temperature range is –30 °C to +80°C for permanent use.
5. Protection against fraying of stranded cable ends must be performed by an end piece (e.g. crimping tube, connector), the end must not be protected by a tin solder only.
6. If a grounding of the screening cable is required it should be connected to one point according to paragraph 3.1.5. Unused ends of the screening must be protected from accidental dangerous contact.
7. If the device requires an grounding, this is to be performed according to paragraph 3.1.5. Connection must be effectively protected against corrosion.
8. Installation of cables must be performed in such a way that the intrinsic safety is not affected by neighbouring wires.
9. The design and testing of intrinsically safe electric systems with the explosion protection of “i” type must comply with EN 500 93 [3].

3.4 Start up

The device is supplied by the manufacturer ready for transportation. The mode switch is set in the “OFF” position. The user should switch the mode switch to the “SET” position and configure the device using the relevant SW for PC (see. 2.1.8), according to his requirements. For example if required, the generation of output pulses can be activated. Switch the mode switch to the “RUN” position after configuration. The device is now in normal operation mode (RUN) and carries out all measurements and recordings of values. For monitoring of manipulation (device tampering) we recommend to stick user marks (in some countries legal marks) on the battery lid and the mode switch lid as in the illustration. In certain countries metrological seals using a steel-wire rope need to be applied at these two lids.

Illustration 15 Position of verification and user markings (seals)

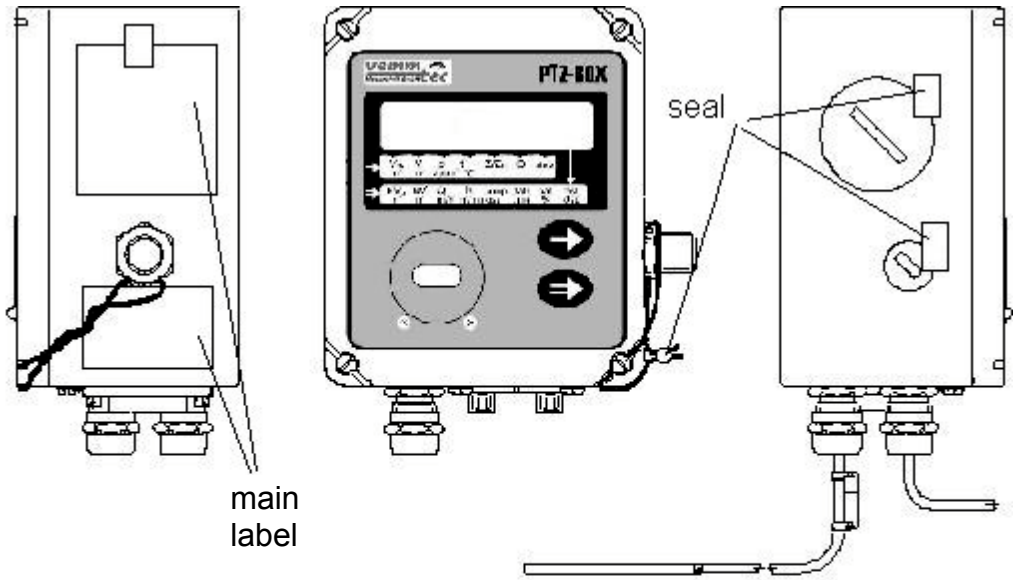


Illustration 16 Example of main label

Vemm tec Messtechnik GmbH	**PTZ-BOX**	Date 2002 Ser.No. **02680424**
Gas-volume conversion device		
T_b = 273,15 K p_b = 1,01325 bar Φ= 0 %		
Type approval: T6038	Testcertificate: TC 3486	
-25 °C ≤ T_{amb} ≤ 60 °C		
Compresibility factor : SGERG – 88 Comp. gas: **1** – CO_2 [%] **2** – N_2 [%] **3** – H_2 [%] **4** – d [—] **5** – $H_{o,n}$ [kWh / m^3]		
Pressure (0,9 ÷ 3) bar abs Pt 1000 (-25 ÷ 60) °C	$V_b = V \cdot \frac{p}{p_b} \cdot \frac{T_b}{T} \cdot \frac{Z_b}{Z}$	

IP 65	**FTZÚ 01 ATEX 0044X**
CE 1026 Ex	**II 2G EEx ia IIC T4 / T3**
T4: (-25 ≤ T_{amb} ≤ 40)°C	**T3: (-25 ≤ T_{amb} ≤ 60)°C**

3.5 Changing the battery

The device uses an intelligent lithium LP-03 type battery block with long life span and integrated system for monitoring battery capacity. If the conditions of FTZÚ Certificate are met, it is possible to change the battery block in a potential explosive area. Special conditions of use:

1. Only the original Battery Block as supplied by *Vemm tec Messtechnik GmbH* must be used.
2. During the replacing of battery in hazardous areas avoid the electrostatic charging by rubbing etc.
3. The enclosure of the PTZ-BOX must be electrostatically grounded.

Procedure for changing the battery:

It is recommended to read out all data since last reading before changing the battery.

First the mode switch must be switched to the “OFF” position. The device will store the current measurements and calculated values into the EEPROM memory, it will not carry out measuring. Wait until the display has switched off.

Change the battery block. After connection of the new battery, switch the mode switch back to the “SET” position and then “RUN”. The device will collect the values from the EEPROM memory and continue measurement and archiving according to the previously set parameters. Data stored in all archives of the device remain stored. If the change takes longer than about 20 sec., only the date and time settings will be lost. This data can be re-entered using the appropriate software (see 2.1.8).

3.6 Battery life

The battery capacity is sufficient for operation up to six years under the following conditions.

- Measurement period is longer or equal 15 sec. (Settable values).
- Generation of output pulses is allowed.
- Display max. five minutes daily.
- Communication with device 30 sec. once a day. (Reading of data stored during one day).

3.7 Content of delivery

Delivery of every unit of the PTZ-BOX set contains:

PTZ-BOX device,

with pressure transmitter
with temperature sensor on a cable
with a cable for connection to the gas-meter

user manual;

Weldolet and thermowell for temperature sensor (to be specified)

Mounting plate and specified mounting equipment (to be specified)
Software for configuration, read out and data collection.

In case a PTZ-BOX is delivered already mounted at a gas meter no separate mounting equipment is delivered.

Optional accessories :

Communication modules, barriers or intrinsic safe separators
infrared head HIE-01 (with 2.5 or 12 meter cable)
GSM or line modem assemblies
Special mounting equipment

3.8 Ordering

When ordering it is necessary to specify:

pressure range;
compressibility method (AGA NX-19, AGA NX-19 mod, SGERG 88)
base temperature and base pressure
requirements for pulse outputs;
requirements for communication RS 232/485 interfaces;
required data archive (monthly, daily, hourly entries) ;
requirements for monitoring of the gas meter tampering;
length of temperature sensor cable – standard 2.5 m;
length of pulse input cable from gas meter – standard 2.5 m;
wall or pipeline mounting (mounting plates are the same, only different mounting lugs according to pipe DN will be used);
weldolet (straight or sideways, thread M20x1.5; NPT or G $^1/_2$);
optional accessories (see 3.7).

In case of further requirements, please consult our internal sales department.

4 Bibliography

[1] EN 50014:1992 Electrical apparatus for potentially explosive atmospheres. General requirements.

[2] EN 50020:1994 Electrical apparatus for potentially explosive atmospheres. Intrinsic safety „i”.

[3] EN 50039:1980 Electrical apparatus for potentially explosive atmospheres. Intrinsically safe electrical system „i”.

[4] EN 60079-10:1996 Electrical apparatus for explosive gas atmospheres Part 10: Classification of hazardous areas.

[5] EN 60079-14:1997 Electrical apparatus for explosive gas atmospheres Part 14: Electrical installation in hazardous areas (other than mines).

[6] EN 60529:1991 Degrees of protection provided by enclosures (IP Code).

[7] EN 60721-3-3: 1995 Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations.

[8] EN 61000-6-2: 1999 Electromagnetic compatibility (EMC) Part 6-2: Generic standards – Immunity for industrial environments.

[9] EN 61107: 1996 Data exchange for meter reading, tariff and load control - Direct local data exchange.

[10] EMC Test report 730-811,769/2001

[11] EC-Type Examination Certificate N° FTZÚ 01 ATEX 0044X

[12] EN 12405 – 2002 -Gas meters - Gas-volume electronic conversion devices

GAS-VOLUME CONVERSION DEVICE PTZ-BOX

published: ***vemm tec* Messtechnik GmbH**
Gartenstrasse 20
14482 Potsdam
GERMANY

www.vemmtec.com
info@vemmtec.com
tel.: +49 331 7096 274
fax.: +49 331 7096 270

date: March 2003
edition: First