Volume Corrector EC 24
and
Temperature Corrector EC 21

Operating Instructions

EC 21
Volume Correction
via Temperature

EC 24
Volume Correction
via Pressure and
Temperature

Software version 1.0

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Introduction

General information

Design variants

The EC 21 temperature corrector (correction is made via the temperature measured and a fixed pressure value) or the EC 24 volume corrector (correction is performed using measured pressure and temperature values) can be used as a unit together with electronic turbine meters from RMG or separately with any mechanical turbine or rotary displacement meters.

The following device types are available:

Device type	**TERZ 94**	**TRZ 03 TE** **TRZ 03 TEL**	**EC 21**	**EC 24**	**EC 24** (pulse input)
Measuring element (meter)	electronic	electronic	electronic	electronic	mechanical
Function	Vm totalizer	Vm totalizer	Vm totalizer and volume correction (**T**)	Vm totalizer and volume correction (**p**,**T**)	Vm totalizer and volume correction (**p**,**T**)
Case					
Inputs	Wiegand (1 or 2 channels)	Wiegand (1 or 2 channels)	Wiegand (1 or 2 channels)	Wiegand (1 or 2 channels)	Reed (1 channel)
Pulse comparison	No	Yes	Optional	Optional	No
Pulse outputs	LF, HF	LF, HF	LF, HF	LF, HF	LF

There are various hardware configurations for the device types listed:

- without current output: Mother board
- with current output (4 to 20 mA): S board

and additional boards for:

- pulse comparison (not available for the TERZ 94)
- RS 485 interface (for Modbus)
- memory submodule with clock

If the corrector is used together with an electronic RMG turbine meter, please observe the instructions for the measuring element in the annex to this manual!

The operating concept

The operating concept has been chosen in such a way that the operator can easily use the device without wasting too much time reading a manual.

The coordinate system

A coordinate system makes it easy for the operator to access all configuration data as well as measured and calculated values by means of a table. The coordinate system is based on **8** columns. Every value in this coordinate system can be reached by pressing the appropriate cursor keys (arrows "►" "▼").

The display field

An alphanumeric single-line display with 12 characters enables data and measured values to be indicated together with their abbreviated designations and units. The LCD has been designed in such a manner that it is particularly suitable for battery-powered mode. At temperatures below -20°C or exceeding +60°C, the display may be impaired.

The system

A complete Flow Computer System has been developed on the surface of a few square centimetres using the most advanced SMD technology with large-scale integrated components. Several device functions, such as pulse counting, frequency measurement, keyboard controller and dispatcher output, have been incorporated into a controller. Thanks to large-scale integrated components, fewer chips are required and this also contributes to making the device reliable. The type of the individual device essentially depends on the software used.

Program memory

The program memory of the base device is located in a flash memory on the main board, whereas the data memory is located on an additional board.

Reset

In the case of a reset, the power supply is disrupted and the corrector is switched off during this period of time. In this way, the program and the operating parameters will not be lost and also the meter readings will be retained. A reset is made on the EC 21 / 24 by switching off not only the battery but also a possibly available external power supply.

Operating Modes

Battery-powered device

The EC 21 is fitted with an exchangeable battery and the EC 24 is fitted with two exchangeable batteries. Both devices have been designed for a continuous operation over six years. This, however, is conditional on the device being either read or “woken up” by pressing the external button once a week.

Battery-powered device with an external power supply

If an interface submodule is used for transmitting data, such as the externally supplied RS 485, the service life of the battery is more than 10 years.

Externally supplied device with built-in standard battery

In the case of an external power supply (current transmitter which serves as a power supply and 4 to 20 mA current output at the same time), the EC 21 / EC 24 is completely supplied via a current loop. For this purpose, a power supply unit is required which is to be connected to this output.

In the case of the EC 24 volume corrector, pulse processing is even ensured in the event of a power failure of the current loop.

If pulse processing is to be maintained with the EC 21 even in the case of a power failure of the current loop, a standby battery (available as an option) can be installed which will bridge the power supply during a period of up to six months.

Display of battery change

Lithium batteries retain their voltage until they are almost completely discharged so that the voltage cannot be monitored with an appropriate display until the next battery change is necessary.

Safety Instructions

The EC 21 and the EC 24 comply with currently applicable standards and regulations. However, failure to operate them properly may cause hazards.

Persons who install or operate a volume corrector in areas subject to explosion hazards, must be familiar with the currently applicable explosion protection standards and regulations.

Do not change anything of the volume corrector on your own, otherwise the approval will become invalid.

Operate the volume corrector only in the specified temperature range from -20°C to +60°C.

The electronic corrector system of the explosion-protected design has been approved for use in areas subject to explosion hazards and its code is:

II 2 G EEx ib[ia] IIC T4 or T3

You can find the EC type approval certificate in the annex and its reference number is:

TÜV 02 ATEX 1970

Please observe the following signs:

Danger of explosion
In the manual, this symbol warns you of an explosion hazard. Please observe the instructions given next to this symbol. As to the danger of explosion, please note the following in particular:

- Only the explosion-protected design of the EC 21 / EC 24 may be used in areas subject to explosion hazards.

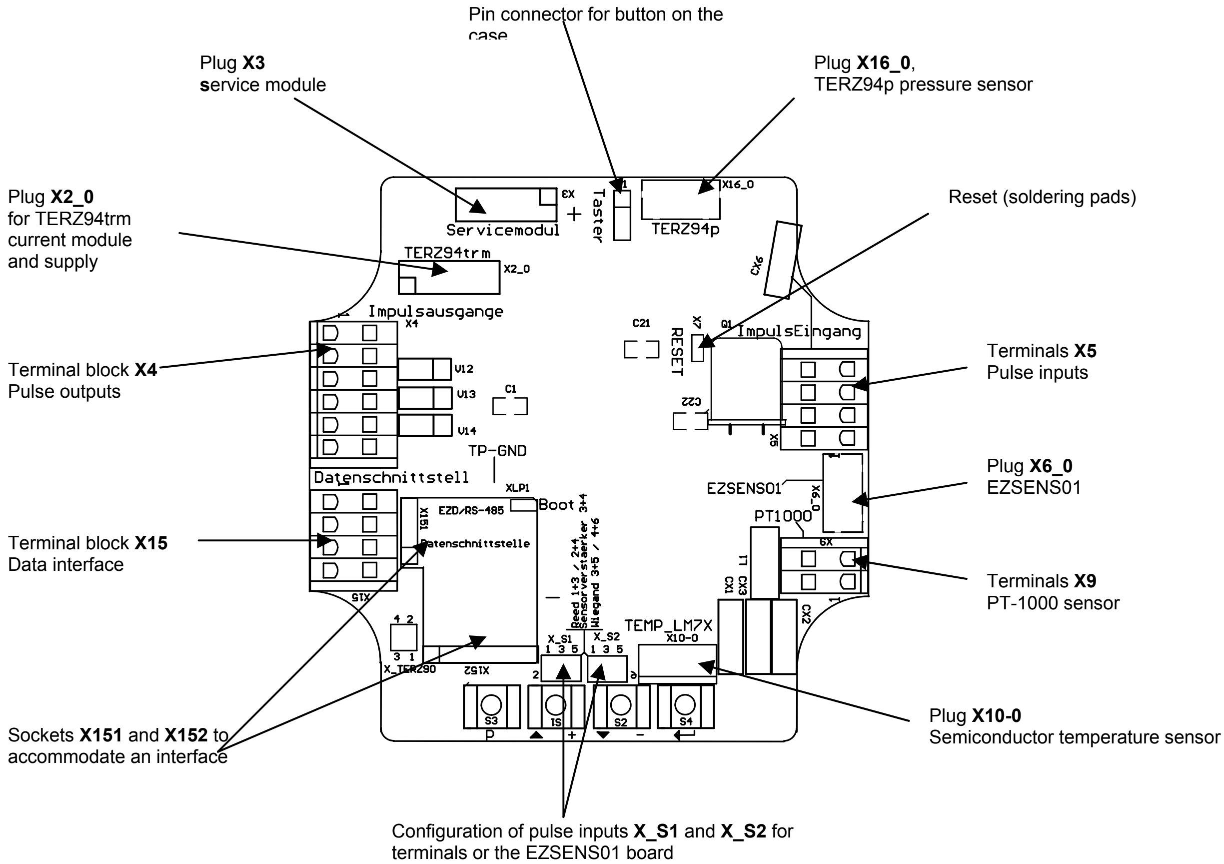
Damage to property
In the manual, this symbol warns you of possible damage to property. The instructions given next to this symbol inform you about what you can do to avoid damage to the EC 21 / EC 24 volume corrector.

It is essential to observe the warning information in these operating instructions and the generally applicable safety rules.
No warranty claims can be asserted if there is unauthorized interference with the device!

Installation

Electrical connections

To reach the electrical connections, you must first remove the cover of the corrector.



You must select the sensor inputs before you connect the cables. To do this, install the jumpers XS1 / XS2 and XTERZ90 on the board as indicated (see inputs and outputs in the annex).

Make your settings of X_S1 and X_S2 as follows:

Reed contact	Wiegand	TERZ90 Remote totalizer	EZSENS01 IG04
X5 effective	X5 effective	X5 effective	X6_0 effective
Jumpers 1-3 & 2-4	Jumpers 3-5 & 4-6	Jumpers 1-2 & 3-4	All open

Controlling the start-stop totalizer or resetting the resettable totalizer (depending on the programming of the electronic totalizing unit) is performed through input X5 terminals 1 and 2.

As soon as input X5 terminals 1 / 2 has been short-circuited through an external contact, interruption or resetting is performed.

⇒ For this purpose, set jumpers at the positions identified with X_S2 to the “reed contact” function.

In the case of the EC 21 / EC 24 , terminal X22 (on TERZ94trm current module) is used as current-loop connection to supply the device and as output current (4-20 mA).

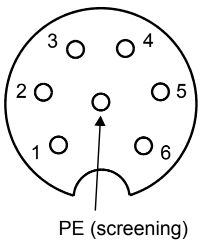
The output signals can be picked up at the following terminals:

HF signals: Output X4**,** terminals X4,4 (+) / X4,3(-)
LF signals: Output X4**,** terminals X4,2 (+) / X4,1(-)

Now connect the cables and then put the cover again on the lower part of the housing.

To connect the cables to the spring terminals, you need a screwdriver with a blade width of a maximum of 2.5 mm. Introduce the blade into the intended slot and press down the screwdriver to open the spring terminal.

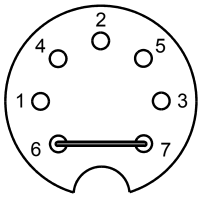
Standard connection pulse outputs: 7-pin connector (Binder)



1 - / 4 +	LF signal (Vm or Vb)
2 - / 5 +	Fault (for all battery devices and for Ex devices with external supply) or Current output 4 to 20 mA (for non-Ex devices with external supply only)
3 - / 6 +	HF signal

(view on device)

Standard connection interface: 7-pin connector (Lumberg)



1 - / 4 +	RS485 supply
3 - / 5 +	RS485 data line
2	Spare
6 / 7	Calibration switch

(view on device)

In areas subject to explosion hazards, the EC 21 / EC 24 must only be connected to certified intrinsically safe circuits.
Make sure that the limit values specified in the certificate of conformity (see annex) for the devices to be connected are not exceeded.

If one or more than one circuit is used, make sure that the permissible limit values in accordance with the EC type approval certificate are not exceeded.

Each intrinsically safe signal circuit must be installed in a separate cable which is to be taken through an appropriate high-strength cable gland.

It is absolutely imparative that the intrinsically safe cables are permanently installed.

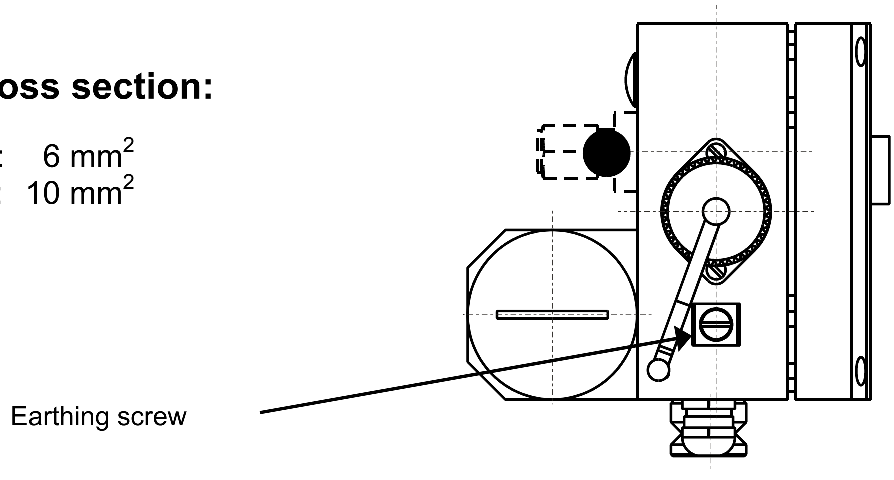
Make sure that the connecting cables are provided with core-end sleeves.

Earthing

To prevent measuring errors caused by electromagnetic interference, you **must not fail** to earth the case of the meter head via the earthing screw on the left side of the case.

Minimum cable cross section:

Up to a length of 10 m: 6 mm^2
From a length of 10 m: 10 mm^2



Cables

Use 2-core or multicore **shielded** cables which are twisted together in pairs (type LIYCY) for the signal lines (LF output, HF output, current-loop connection, control input).
Use 4-core **shielded** cables which are twisted together in pairs (type LIYCY) for the data lines (RS 485).
The shielding must always be connected to earth on both sides. In the case of the EC 21 / EC 24 , you must proceed as described under “Cable glands”.

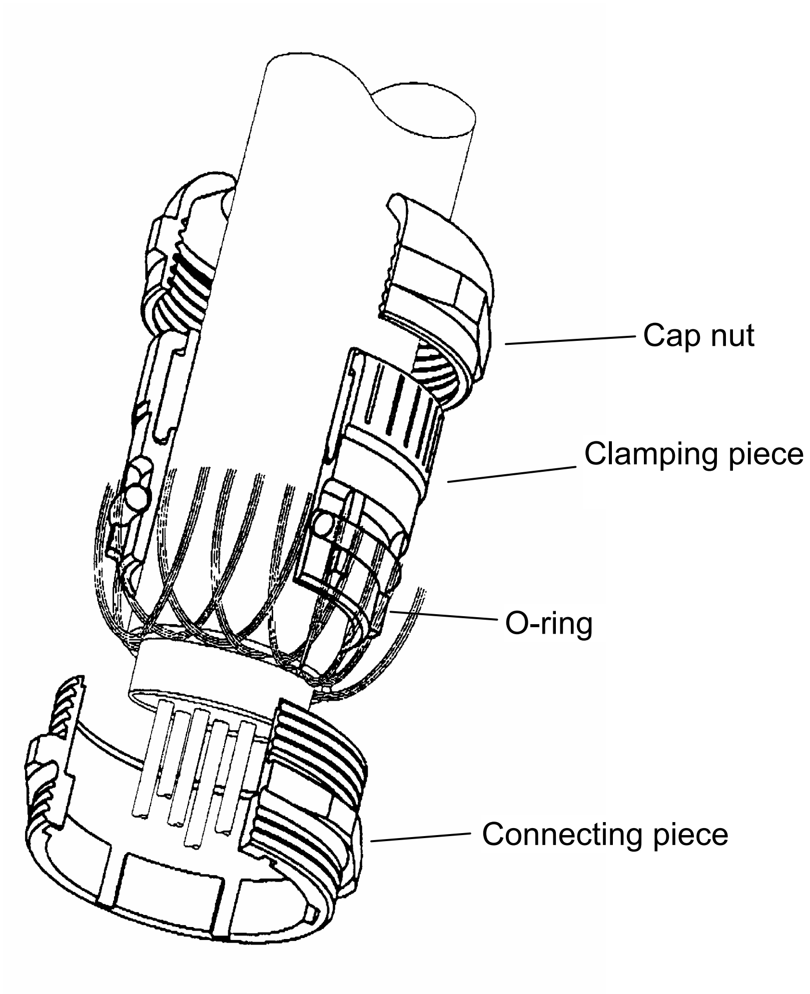
We recommend that cable cross sections of 0.5 mm^2 are used. Due to the cable gland, the outside diameter must be between 4.5 mm and 6.5 mm.

If the device is used in areas subject to explosion hazards, the maximum cable length is limited by the limit values for intrinsically safe circuits and depends on the inductance and capacitance of the cable!

Cable glands

Clamp the shielding **on both sides**, as shown in the picture below, into the cable glands located on the outside of the case:

- Unscrew the cap nut.
- Pull out the plastic clamping piece.
- Push the cable end through the cap nut and the clamping piece and bend the shielding backwards.
- Put the clamping piece back into the connecting piece.
- Screw on the cap nut again.

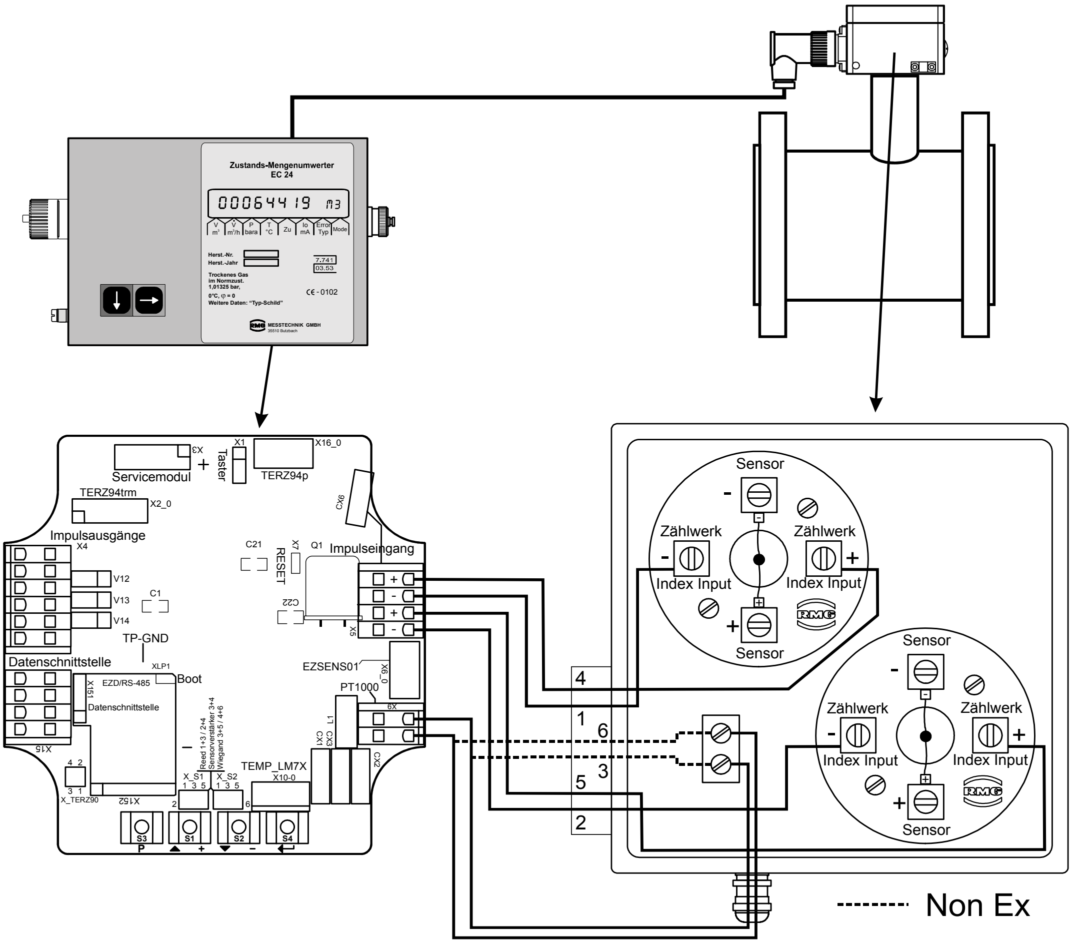


Permissible temperature ranges

For the standard design, the following fluid temperature and ambient temperature ranges are permitted:

Fluid temperature range: -20°C to +60°C
Ambient temperature range: -20°C to +60°C or 40°C

Installing the remote totalizer



If your model is designed for remote totalizing, you can install the totalizer at a distance of up to 3 m from the meter case. Usually, the cable has already been connected to the sensor and the totalizing unit when the device is delivered. Should this not be the case, you will have to connect the connecting cable to input X5, terminals S1+ and S1- of the board. If you have a 2-channel meter connect the second sensor to the clamps S2+ and S2-. Use only shielded cables of the type:

LIYCY - 2 x 0.75 blue (1-channel Ex)
LIYCY - 2 x 2 x 0.75 blue (2-channel Ex or 1-channel Non-Ex)
LIYCY - 3 x 2 x 0.75 blue (2-channel Non-Ex)
Maximum cable length: 3 m

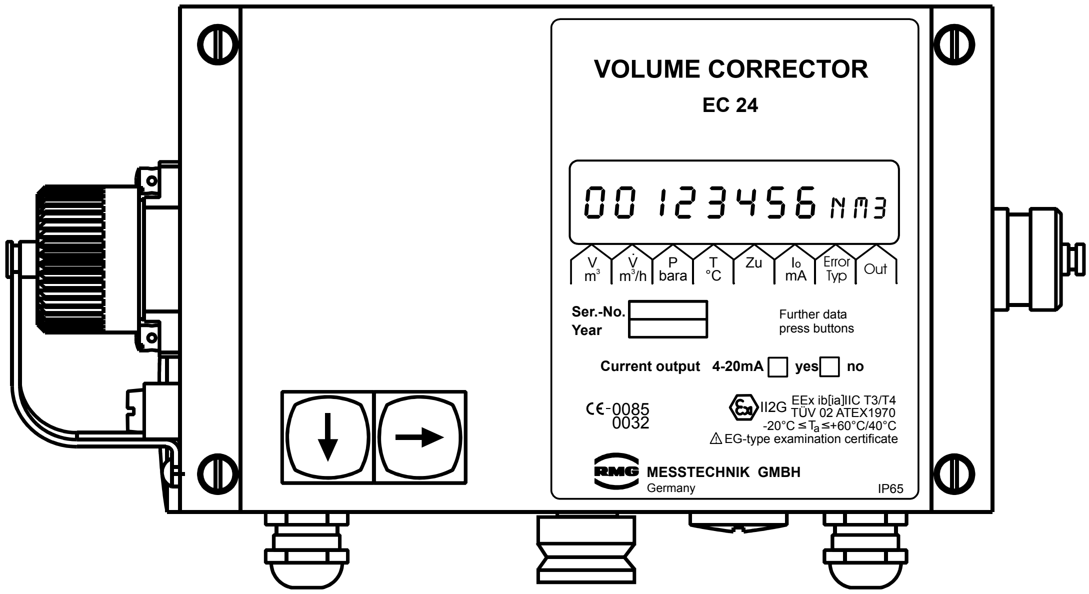
EX **In hazardous areas the temperature transmitter must not be connected via the socket on the meter case. In this case it is prescribed to lay a separate cable for the temperature transmitter!**

In addition, check the plug-in jumpers XS1 / XS2 and XTERZ90 on the board (see inputs and outputs in the annex).

Make your settings of XS1 and XS2 as follows: jumpers 3-4

Operation

Front panel and keyboard of the EC 24



Keyboard	Designation	Effect
↓	Arrow Down	• **Moves downwards** within a list: Moves from the first value of the list towards the last value.
→	Arrow Right	• **Moves to the right** towards another list: Moves from the first list towards the last list.
↓ + →	Function	Press both buttons at the same time to initiate the following functions: Hold down >2 sec.: Segment test Hold down < 2 sec.: The coordinate will be displayed.

If the EC 21 / EC 24 is operated together with the **measuring element of an electronic turbine meter**, the EC 21 / EC 24 contains the totalizing unit of the meter and the **data plate of the meter** is located on the left side of the front panel.

Display

In normal operating mode, the main totalizer is displayed.
If you press the external control buttons, you can select the other display values.
After an adjustable time has elapsed, the EC 21 / EC 24 will return to displaying the main totalizer.

If the display of the EC 21 / EC 24 does not show anything, the device is in energy-saving mode. In this mode, the display is completely switched off. However, incoming pulses are processed and the outputs are set. If you press one of the two control buttons, the display value will appear again.

Display
switched off:

Pointer position 1	0 0 0 0 5 8 3 1 m3	Main totalizer V
Pointer position 2	1 0. 0 0 0 m3/h	Flow rate $\dot{V}$
Pointer position 3	1. 0 0 0 0 0 0 0 bara	Pressure P
Pointer position 4	20. 0 0 0 0 0 0 °C	Temperature T
Pointer position 5	1 -- ...	Conversion factor C (Analysis)
Pointer position 6	16. 0 0 0 0 0 0 mA	Current I_o
Pointer position 7	1 -- ...	Error / ID
Pointer position 8	1 -- ...	Mode / Memory

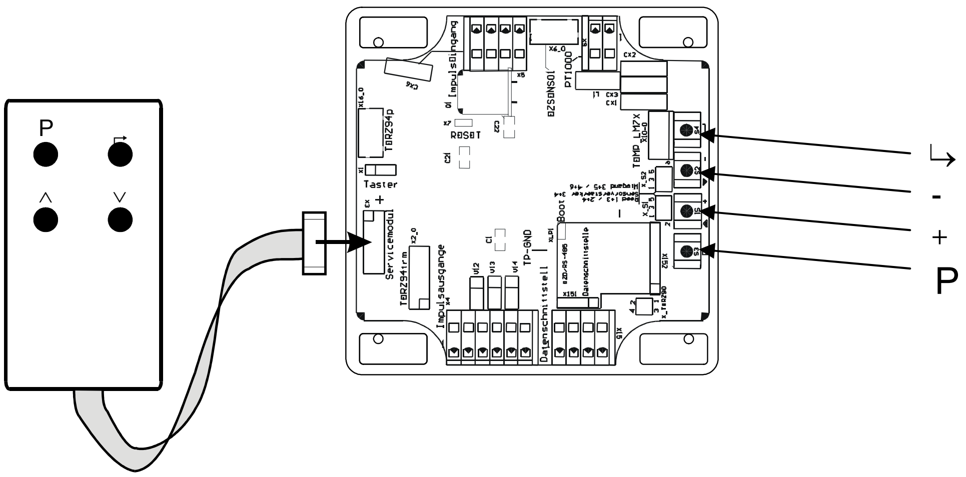
Programming

Via the parameterization and readout software

The parameters of the EC 21 / EC 24 can be changed using the parameterization and readout software. The official parameters are protected by a calibration switch and a password.
The link between the laptop computer and the corrector is established via the RS 485 interface of the EC 21 / 24.

Via the programming module

For programming the EC 21 / EC 24, there are four buttons on the bottom of the display board. Alternatively, you can program the device using the programming module (available as an accessory). The programming module is to be connected via a pin connector (see the picture below).



Programming with the programming module is to be performed in the same way as with the internal buttons.

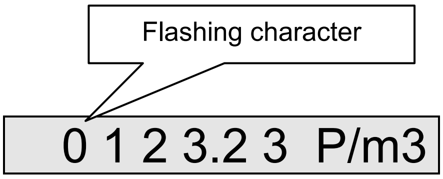
The external and internal buttons correspond to each other in the following way:

Int. button	Ext. button	Meaning
P	P	**Display mode:** Switch over to programming mode. (Press the button longer than 2 seconds.) **Programming mode:** Put the decimal point at the current position.
+	∧	**In display mode:** Move to the right within the matrix (change of column). **In programming mode:** - Increase the decimal by 1. - Scroll in the list. (Display value is identified by “L“.)
-	∨	**In display mode:** Move towards the bottom (change of line). **In programming mode:** - Decrease the decimal by 1. - Scroll in the list. (Display value is identified by “L“.)
↳	↳	**In display mode:** Short-term view of the coordinate (e.g. A01) **In programming mode:** Go to the right by one decimal place (if the last decimal has been reached: Quit programming mode).

Principle of programming

For programming, you must always proceed as follows:

- First change over to the display value to be modified.
  - To do this, press either the control button (only forwards)
  - or the internal buttons “**+**” and “-” or the external buttons “∧” and “∨” (forwards and backwards).
- Change to programming mode by pressing “**P**” for at least **2 seconds**. On the left side of the display, a flashing character or cursor will appear:



- You can now modify the flashing decimal by pressing either “**+**” or “∧” (+1) or “-” or “∨” (-1).
  Example: If you press the “∧“ button three times, the first decimal will be increased from 0 to 3. If an “L” appears on the far left side of the display, this value is a list. With a list, you can only scroll in the specified values.
- After you have completed your programming of the first decimal, press “↳” once and the next character will start to flash.
  Now proceed with your programming until you have reached the last decimal place.
- Then press “↳” once again to have the set value accepted and quit programming mode.
- Press the “P“ button to set the decimal point behind the flashing digit.
  With totalizers, modes and integers, no decimal point is permitted.
- Press the control button if you have made an error or if you want to discontinue inputting data.

Display values

Measured values, such as the flow rate, frequency, etc. are display values and cannot be directly modified. However, there are many parameters which influence the formation of these measured values. These parameters are described in the following section.

Display values include the flow rate, version number, year of construction, serial number, value of the current output in mA, for example.

Parameters and modes of the EC 21 / EC 24

The following sections describe the meaning of the individual parameters.

Meter factor (pulse value)

With the meter factor (pulse value), the relevant flow rate at measurement conditions is calculated from the signal frequency of the sensor element in the electronic totalizing unit:

$$Q_M = \frac{f}{K} \cdot 3600 \left[\frac{m^3}{h}\right]$$

f: Signal frequency (Hz)
K: Meter factor (pulses/m^3)
Q_M: Flow rate at measurement conditions (m^3/h)

The meter factor has been calibrated in the factory in such a way that working cubic metres are directly displayed.

Any modification of this adjustment is within the sphere of responsibility of the operating company.

NOTE!
The new value is immediately used for all calculations performed after each modification of the meter factor.

The uninfluenced signal frequency of the sensor element is available at the HF output.
The frequency range can be determined from the meter factor K and the minimum and maximum flow rates at measurement conditions of the meter in accordance with the following formulae:

$$f_{min} = \frac{Q_{Mmin}}{3600} \cdot K \qquad f_{max} = \frac{Q_{Mmax}}{3600} \cdot K$$

Q_{Mmin}: Minimum flow rate at measurement conditions
Q_{Mmax}: Maximum flow rate at measurement conditions
K: Meter factor (pulse value)

Example:

Q_{Mmin} = 16 m^3/h $\qquad$ Q_{Mmax} = 250 m^3/h $\qquad$ K = 2362 pulses/m^3

$$f_{min} = \frac{16}{3600} \cdot 2362 Hz = 10.5 Hz \qquad f_{max} = \frac{250}{3600} \cdot 2326 Hz = 164 Hz$$

Totalizer factor (decimal places)

You can set the totalizer factor in coordinate Z 01.

There are the following setting options:

Totalizer factor	Multiplier for value displayed	Decimal places
0.01		2
0.1		1
1		0
10	10	0
100	100	0

Example:
If the factor has been set to 0.1, the meter reading will be displayed with one decimal.

If the factor has been set to 10, the value displayed will be shown without decimals and you will obtain the actual meter reading by multiplying the value displayed by 10.

Output pulse value

The output pulse value indicates how many LF output pulses correspond to one cubic metre.
The output pulse value can be entered in coordinate Z 02 from 0.01 to 100 as required.

Coordinate system

Pointer position	V	$\dot{V}$	P	T
Designation	Totalizers	Flow Rate	Pressure	Temperature
Coordinate / Line	A	B	C	D
1	Volume at base conditions	Qb	bara	°C
2	Volume at measurement conditions	Qm	p min	t min
3	Disturbing quantity totalizer V_b	Frequency	p max	t max
4	Disturbing quantity totalizer V_m	Qm min	pb specified value	tb specified value
5	Pulse scaling factor	Qm max	p default	t default
6	Meter factor	Qm max val.	p binary display	Factor adjustment value
7			Binary value at 0.5 V	Offset adjustment value
8			Binary value at4.5 V	AD binary value
9			U min	
10	Monthly data memory		pu min	
11	Monthly data memory		Rise	
12	Monthly data memory		Factor correction value	
13	Monthly data memory		Offset correction value	
14 ... 23	Monthly data memory			

Pointer position	C	Io	Error / Type	Mode
Designation	Analysis	Outputs	Error / ID	Mode / Memory
Coordinate / Line	E	F	G	Z
1	Conversion factor	Current	Error text	TerzMode
2	K coefficient	Current min	Software version	EcMode
3	K specified value	Current max	Serial number	Puls_X
4	Hs	Current default	Checksum	Puls_Y
5	Rhon	Current rise	Ser. no. pressure transmitter	Time
6	CO2	Current offset	p min	Date
7	Zb	Current damping	p max	Modbus address
8	Z		Ser. no. temperature transmitter	ModbusRegOffset
9	Hs ref temp		T min	Error bit string
10			T max	Wake-up pulse
11			Ser. no. meter	
12			Meter size	
13			Battery change	

Description of individual columns

Column structure

Designation of columns A to O

Press the above function key and then the ▶ key once.

Pointer position		V			
Coding	Coordinate / Line	A	Description of the coordinate	Unit	Special feature
S	1	Nm3	Main totalizer, volume at base conditions	m^3	
S	2	m3	Main totalizer, volume at measurement conditions	m^3	
S	3	VbD	Disturbing quantity totalizer, volume at base conditions	m^3	
S	4	VmD	Disturbing quantity totalizer, volume at measurement conditions	m^3	

Abbreviated designation of the matrix field

Unit of the value displayed or programmed

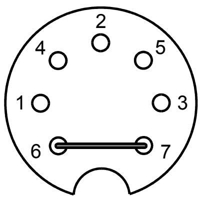
Field designation shown in the display of the EC 21 / EC 24

Explanatory notes on a coordinate field

Designation of the column line

Coding of the matrix fields
H = Header
D = Display value
C = Access to a data field which is protected by the user code
S = Access to a data field which is protected by the calibration switch

Note: In the software version 1.0 the user code is not yet implemented. To change parameters with "C" coding it is necessary to open the calibration switch!



The **calibration switch** is realized by a jumper in the (female) interface connector. For opening the calibration switch just remove the jumper. Then all parameters coded with "S" or "C" can be changed.

Totalizers

Pointer position		V			
Coding	Coordinate / Line	A	Description of the coordinate	Unit	Special feature
S	1	Nm3	Main totalizer, volume at base conditions	m^3	
S	2	m3	Main totalizer, volume at measurement conditions	m^3	
S	3	VbD	Disturbing quantity totalizer, volume at base conditions	m^3	
S	4	VmD	Disturbing quantity totalizer, volume at measurement conditions	m^3	
S	5	I/m3	Pulse scaling factor	I/m^3	
S	6	I/m3	Meter factor	I/m^3	
D	10 ... 23		Monthly data memory 1 ... 14 (Date, Vb, Vm, dVb, dVm, P, T)		

Flow rate

Pointer position		$\dot{V}$			
Coding	Coordinate / Line	B	Description of the coordinate	Unit	Special feature
D	1	N3H	Flow rate at base conditions	m^3/h	
D	2	m3/h	Calculated flow rate at measurement conditions	m^3/h	
D	3	F	Frequency (measurement)	Hz	
S	4	Qm<	Lower fault limit	m^3/h	
S	5	Qm>	Upper fault limit	m^3/h	
D	6	Qmx	Maximum value of the flow rate at measurement conditions	m^3/h	

Pressure

Pointer position		P			
Coding	Coordinate / Line	C	Description of the coordinate	Unit	Special feature
D	1	bar	Measured value for pressure (absolute pressure)	bara	
S	2	p<	Lower fault limit	bara	
S	3	p>	Upper fault limit	bara	
S	4	pb	Specified value, pressure at base conditions	bara	
C	5	p-def	Default value, pressure	bara	
D	6	Dig	Pressure, binary display		
D	7	Dig	Binary value at 0.5 V		
D	8	Dig	Binary value at 4.5 V		
S	9	Umi	Constant, pressure transmitter base calibration	V	
S	10	pmi	Constant, pressure transmitter base calibration	bara	
S	11	p-S	Constant, pressure transmitter base calibration		
S	12	pA0	Correction value, pressure transmitter (factor)		
S	13	pA1	Correction value, pressure transmitter (offset)		

Temperature

Pointer position		T			
Coding	Coordinate / Line	**D**	Description of the coordinate	Unit	Special feature
D	1	°C	Measured temperature value	°C	
S	2	T<	Lower fault limit	°C	
S	3	T>	Upper fault limit	°C	
S	4	Tb	Specified value, temperature at base conditions	°C	
C	5	T-def	Default value, temperature	°C	
S	6	T-F	Adjustment value (factor)		
S	7	T-O	Adjustment value (offset)		
D	8	Dig	Binary value of AD converter		

Analysis

Pointer position		C			
Coding	Coordinate / Line	**E**	Description of the coordinate	Unit	Special feature
D	1	C	Conversion factor	1	
D	2	K	K coefficient	1	
C	3	K-V	Specified value, K coefficient (if K=const)	1	
C	4	Hon	Superior calorific value	KWh/m^3	
C	5	rhn	Rhon	Kg/m^3	
C	6	CO2	Carbon dioxide content	%	
D	7	Zb	Compressibility factor at base conditions	1	
D	8	Z	Compressibility factor at measurement conditions	1	
S	9	TB	Reference temperature, superior calorific value	°C	

Outputs

Pointer position		Io			
Coding	Coordinate / Line	**F**	Description of the coordinate	Unit	Special feature
D	1	mA	Current out	mA	
C	2	I<	Value at 4 mA	mA	
C	3	I>	Value at 20 mA	mA	
C	4	I-def	Current default	mA	
C	5	I-F	Current rise		
C	6	I-O	Current offset		
C	7	I-D	Current damping		

Error / ID

Pointer position		Error / Type			
Coding	Coordinate / Line	**G**	Description of the coordinate	Unit	Special feature
D	1	ERR	Error text		
D	2	Ver	Software version		
S	3	SNo	Serial number		
D	4	CRC	Checksum		
S	5	PNo	Serial number pressure transmitter		
S	6	P <	Pressure range min	bar	
S	7	P >	Pressure range max	bar	
S	8	TNo	Serial number temperature transmitter		
S	9	T <	Temperature range min	°C	
S	10	T >	Temperature range max	°C	
S	11	ZNo	Serial number gas meter		
S	12	G	Meter size		
S	13	Bat	Date of next battery change		

Mode / Memory

Pointer position		Mode			
Coding	Coordinate / Line	**Z**	Description of the coordinate	Unit	Special feature
C	1	MOD	TerzMode		See operating modes
C	2	MOD	EcMode		See operating modes
C	3	X	Puls_ X		
C	4	Y	Puls_ Y		
C	5	T	Time		
C	6	D	Date		
C	7	Mid	Modbus address		
C	8	Mof	Modbus register offset		
C	9	Err	Error bit string (hexadecimal)		
D	10	Pul	Wake-up pulse		

TerzMode and EcMode are 8-digit strings where each digit stands for one mode. These modes are listed in the following tables.

Operating modes

TerzMode (coordinate Z1)

	TerzMode[0]	TerzMode[1]	TerzMode[2]	TerzMode[3]	TerzMode[4]	TerzMode[5]	TerzMode[6]	TerzMode[7]
	Internal	**Units**	**Pulse width LF output**	**Display cut-off time**	**Interface protocol**	**Pulse scaling factor**	**Current output**	**Operating mode**
0	customer	m3, bar, °C	125 ms	1 min.	off	0.01	off	1 channel
1	service	cf	250 ms	5 min.	Modbus	0.1	Iout without error	1 channel Vm Stop
2				10 min.		1	Iout 3.5 mA with error	1 channel Vm Run
3				15 min.		10	Iout 21.8 mA with error	2 channels // X:Y act. (SW) Vm Stop
4				test mode		100		2 channels // X:Y act. (SW) Vm Run
5								2 channels // X:Y act. (HW) Vm Stop
6								2 channels // X:Y act. (HW) Vm Run
7								2 channels // X:Y deactivated
8	clear Qm max.							
9	all coord. on							

EcMode (coordinate Z2)

	EcMode[0]	EcMode[1]	EcMode[2]	EcMode[3]	EcMode[4]	EcMode[5]	EcMode[6]	EcMode[7]
	Pressure mode	**Temperature mode**	**Current selection**	**LF selection**	**Pulse width LF-II**	**Analysis mode**	**Data logger mode**	**Frequency mode**
0	off	off	off	Vm	0.8 ms	K=const	Off	off
1	on	PT 1000	default	Vb	10 ms	GERG	V_b, V_m, dV_b, dV_m, p, T	pos. edge
2	default	default	Qm		20 ms	AGA		neg. edge
3			Qb		50 ms			
4			temp		75 ms			
5			pressure		100 ms			
6					125 ms			
7					250 ms			
8								
9								

Error messages

In coordinate G 01 error messages are displayed as error number followed by “Err”.

The messages no. 1 to 8 are fault messages. In this case the main totalizers stop and the disturbing quantity totalizers start to run. The messages no. 9 to 16 are warnings and have no effect on the totalizers.

Error no.	Hexadecimal	Description
1	0x0001	Parameters in EEPROM are wrong (may be wrong version)
2	0x0002	EEPROM can not be written (parameters are lost)
3	0x0004	Analog digital converter for temperature measurement
4	0x0008	Analog digital converter for pressure measurement
5	0x0010	-
6	0x0020	Measured temperature outside limits
7	0x0040	Measured pressure outside limits
8	0x0080	Hardware and software configuration do not fit
9	0x0100	-
10	0x0200	-
11	0x0400	-
12	0x0800	-
13	0x1000	Current output
14	0x2000	Too many output pulses in buffer (>500)
15	0x4000	Sensor defect (check hardware)
16	0x8000	Sensor defect (check hardware)

In the column “Hexadecimal” the error bit strings displayed in coordinate Z 09 are listed.

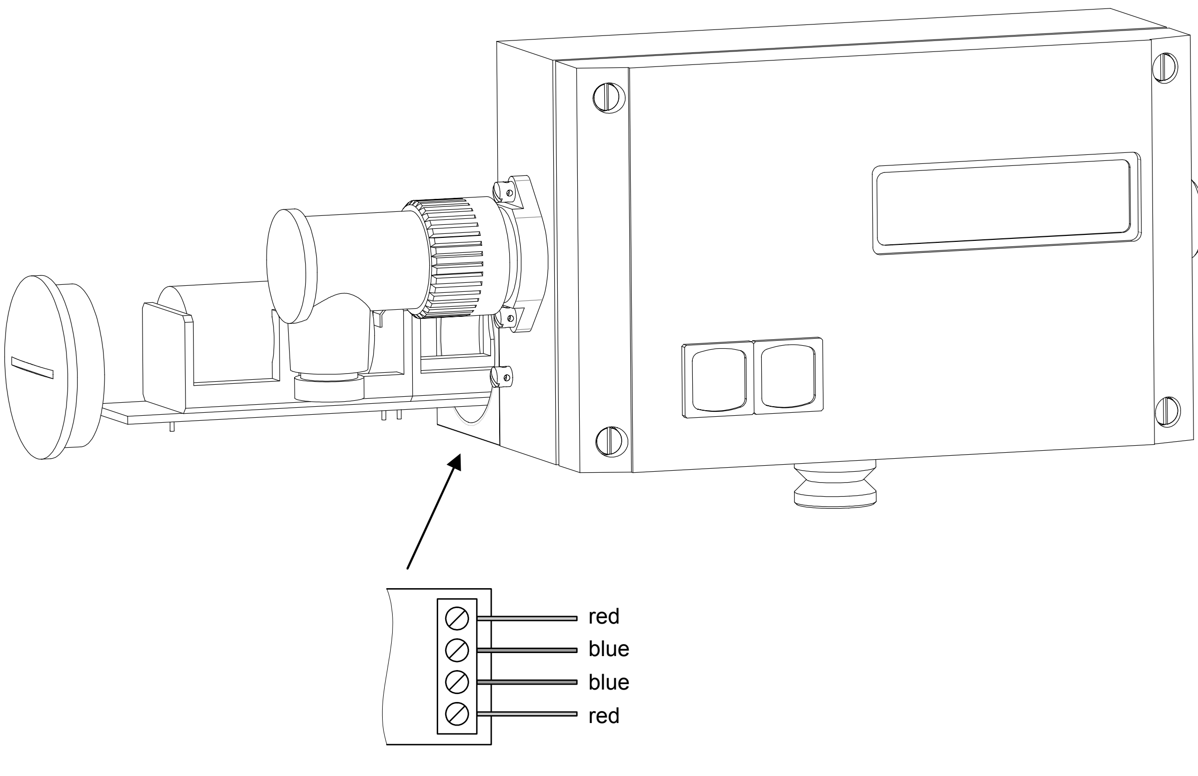
Changing the batteries (EC 24)

The two batteries of the EC 24 can easily be changed without opening the corrector. On the left side of the casing, there is a round slotted cover which can be screwed out. Behind this cover, there is the battery holder. In hazardous areas disconnect the battery holder and change the batteries in a safe area. Afterwards connect the battery holder again (see figure) and push it into the battery compartment. Now screw in the cover again and the battery change is terminated.
In safe areas the batteries can be changed directly without disconnecting the battery holder.

EX

If you use other batteries than the replacement batteries from RMG, you run the risk of the EC 24 not being approved for areas subject to explosion hazards any more.

In areas subject to explosion hazards, you must never insert or remove the batteries. Remove the battery holder from the case and change the batteries in an area without explosion hazards.



Annexes

A Equations used with the EC 21 temperature corrector and the EC 24 volume corrector

Symbol		Unit	Designation
q_m	=	m^3/h	Flow rate at measurement conditions
f_v	=	Hz	Frequency of the volume transducer
K_V	=	P/m^3	Meter factor
V_m	=	m^3	Volume at measurement conditions
Pv	=	1	Volume pulse
K_{Z1}	=	m^3/P	Totalizer factor (for output contacts only)
q_b	=	m^3/h	Flow rate at base conditions
V_b	=	m^3	Volume at base conditions
$C_{(p,t)}$	=	1	Conversion factor
K_{Z2}	=	m^3/P	Totalizer factor (for output contacts only)
p	=	bara, (barg, kg/cm^2)	(Absolute) pressure at measurement conditions
p_b	=	bara (barg, kg/cm^2)	Pressure at base conditions (= 1.01325 bar absolute)
T	=	°C	Temperature at measurement conditions
T_K	=	K	Temperature at measurement conditions in Kelvin
T_b	=	K	Temperature at base conditions (= 273.15 K)
K	=	1	K coefficient
Z	=	1	Compressibility factor at measurement conditions
Z_b	=	1	Compressibility factor at base conditions Z and Z_b are calculated in compliance with GERG-88 as per G9.

Flow rate at measurement conditions

$$q_m = \frac{f_V}{K_V} \cdot 3600$$

Volume at measurement conditions

$$V_m = \frac{P_V}{K_V} \cdot \frac{1}{K_{Z1}}$$

K coefficient

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

Conversion factor

$$C_{(p,t)} = \frac{p \cdot T_b}{p_b \cdot T_K \cdot K}$$

Flow rate at base conditions

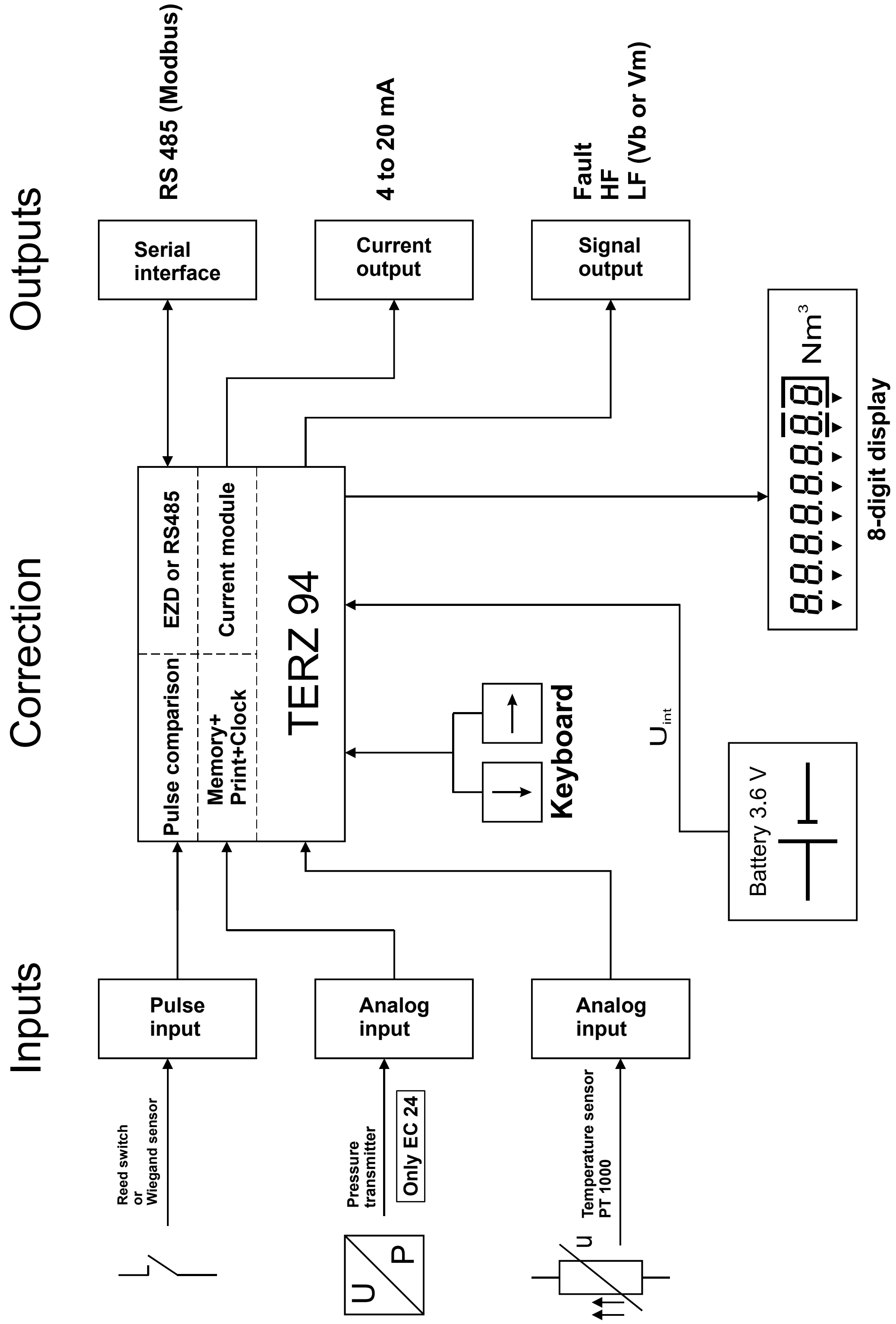
$$q_b = \frac{f_V}{K_V} \cdot C \cdot 3600$$

Volume at base conditions

$$V_b = V_m \cdot C_{(p,t)} \cdot \frac{1}{K_{Z2}}$$

The pressure at measurement or base conditions is processed as absolute pressure in the relevant equations. In selection mode 2 of column A, however, transmitters with gauge-pressure or kg/cm^2 scaling are also permitted. If these transmitters are used, the pressure at base conditions must also be indicated in the appropriate unit. Both the pressure at measurement conditions and the pressure at base conditions will then be converted automatically for the relevant equations.

B Block diagram for the EC 21 / EC 24



C Specifications

Temperature ranges

Type: EC 21 / 24	II2 G EEx ib IIC T4	from	-20°C to +40°C
	II2 G EEx ib IIC T3	from	-20°C to +60°C

In the case of special designs, even higher or lower fluid temperatures are possible with not explosion-protected (Non-Ex) versions.

Device types

Reed

Supply	Internal battery (Ex), or external 24 V supply via current-loop connection by means of a power supply unit of the type KFD2-STC3-Ex1 (Ex) plus battery pack.
Pulse input	Reed or transistor
Current output	Only possible via the current-loop connection.
Standby battery	Only in conjunction with the current-loop connection.

Wiegand

Use	Direct installation onto the TERZ 91 meter instead of the meter head.
Supply	Internal battery (Ex), or external 24 V supply via current-loop connection by means of a power supply unit of the type KFD2-STC3-Ex1 (Ex) plus battery pack.
Pulse input	Wiegand
Current output	Only possible via the current-loop connection.
Standby battery	Only in conjunction with the current-loop connection.

Inputs

Volume
– Reed

Pulse frequency	0 Hz to 20 Hz; in battery-powered mode, max. 1 Hz due to the service life	
Pulse width	≥ 20 ms	
Voltage	low: ≤ 0.9 V	high: ≥ 2.2 V

– Wiegand

Pulse frequency	0 Hz to 300 Hz; in battery-powered mode	
Pulse width	≥ 5 µs	
Voltage	min: 1 V	max: 5 V (depends on the sensor used)

Sensor – S1 input (Measurement input)

(For Ex connected loads, see the approval certificate.)

Terminals:	X5,1 (+) X5,2 (-)
Sensor type:	
Wiegand sensor, direct	Length of line < 50 cm Jumpers X_S1 / 3-5 and 4-6
Wiegand sensor, remote totalizer	Length of line < 50m Jumpers: X_S1 / 3-5 and 4-6 Jumpers: X_TERZ90 / 1-2
Reed contact	Jumpers X_S1 / 1-3 and 2-4

Sensor – S2 input (Reference input or start/stop/reset)

(For Ex connected loads, see the approval certificate.)

Terminals:	X5,3 (+) X5,4 (-)
Sensor type:	
Wiegand sensor, direct	Length of line < 50 cm Jumpers X_S1 / 3-5 and 4-6
Wiegand sensor, remote totalizer	Length of line < 50m Jumpers: X_S2 / 3-5 and 4-6 Jumpers: X_TERZ90 / 3-4
Reed contact	Jumpers X_S2 / 1-3 and 2-4

Temperature input: (hardware and software option)

For Ex connected loads, see the approval certificate.

Signal:	Resistor (Pt1000), 4-wire
Terminals:	X9,1 (+) X9,2 (-)
Measuring range:	-20°C to 60°C
Resolution:	± 0.2 °C

Pressure transmitter

For Ex connected loads, see the approval certificate.

Signal:	Voltage: 0.5 V to 4.5 V
Resolution:	16 bits
Terminals:	Plug X16_0

Outputs

HF output

In the case of the explosion-protected (Ex) design, the device can only be connected to a certified intrinsically safe circuit.

Terminals: X4,4 (+)
X4,3 (-)

Output: Open-drain transistor
T_{Pulse} 1 ms ± 10%
F_{max}: 300 Hz

	Ex	Non-Ex
U_{min}:	2.0 V	2.0 V
U_{max}:	28 V	30 V
I_{max}:	60 mA	400 mA
External inductance	1 H	
External capacitance	25 µF	

LF output

In the case of the explosion-protected (Ex) design, the device can only be connected to a certified intrinsically safe circuit. (For Ex connected loads, see the approval certificate.)

Terminals: X4,2 (+)
X4,1 (-)
Output: Open-drain transistor
T_{Pulse} 125 ms ± 10% (F_{max}: 4 Hz)
250 ms ± 10% (F_{max}: 2 Hz)

	Ex	Non-Ex
U_{min}:	2.0 V	2.0 V
U_{max}:	28 V	30 V
I_{max}:	60 mA	400 mA
External inductance	1 H	
External capacitance	25 µF	

Fault output

In the case of the explosion-protected (Ex) design, the device can only be connected to a certified intrinsically safe circuit. (For Ex connected loads, see the approval certificate.)

Terminals: X4,6 (+)
X4,5 (-)

Output: Open-drain transistor

	Ex	Non-Ex
U_{min}:	2.0 V	2.0 V
U_{max}:	28 V	30 V
I_{max}:	60 mA	400 mA
External inductance	1 H	
External capacitance	25 µF	

Vo or RS-485 data interface

In the case of the explosion-protected (Ex) design, the device can only be connected to a certified intrinsically safe circuit. (For Ex connected loads, see the approval certificate.)

Vo data interface:	*Internal*	*connector (from Binder)*
Parity:	Even	
Data bits:	7	
Stop bit:	1	
Baud rate:	2400	
Terminals:	X15,4 (+)	4
	X15,3 (-)	1
	X15,1 and X15,2 open	
U_{min}:	7.0 V	
U_i:	13.5 V	
I_i:	15 mA	
P_i:	210 mW	
External capacitance:	2.5 µF	
External inductance:	1 H	
Isolating device:	KFD2-ST2-Ex1.LB (from Pepperl+Fuchs)	

RS-485 data interface:

Terminals:	X15,4 (+ supply)
	X15,3 (- supply)
	X15,2 (line A)
	X15,1 (line B)
U_{min}:	7.0 V
U_i:	10.5 V
I_i:	428 mA
P_i:	900 mW
Inner capacitance:	1.32 µF
Inner self-inductance:	600 µH
External capacitance:	23.7 µF
External inductance:	1 H
Isolating device:	17-21S1-S111 / EExi (from Bartec)

Note: If the EZD protocol or the RS-485 bus is used, the device is supplied via the data interface.

Current-loop connection

Terminals:	X22,1 (+) X22,2 (-)
U_{ext} (min):	12 V
U_{ext} (max):	28 V
I_{min}:	3.5 mA
I_{max}:	23 mA
External load (max.):	$R_{Lmax} = (U_{ext} - 10\ V) / I_{max}$ (in Ω) e.g. $U_{ext} = 16\ V$ $\Rightarrow R_{Lmax} = (16\ V - 10\ V) / 23\ mA = 260\ \Omega$
Current output for	
- minimum flow rate:	4 mA
- maximum flow rate:	20 mA
- warning:	3.5 mA
- fault:	23 mA
Accuracy of current output:	Better than 1% of the upper-range value

Data for use in areas subject to explosion hazards:

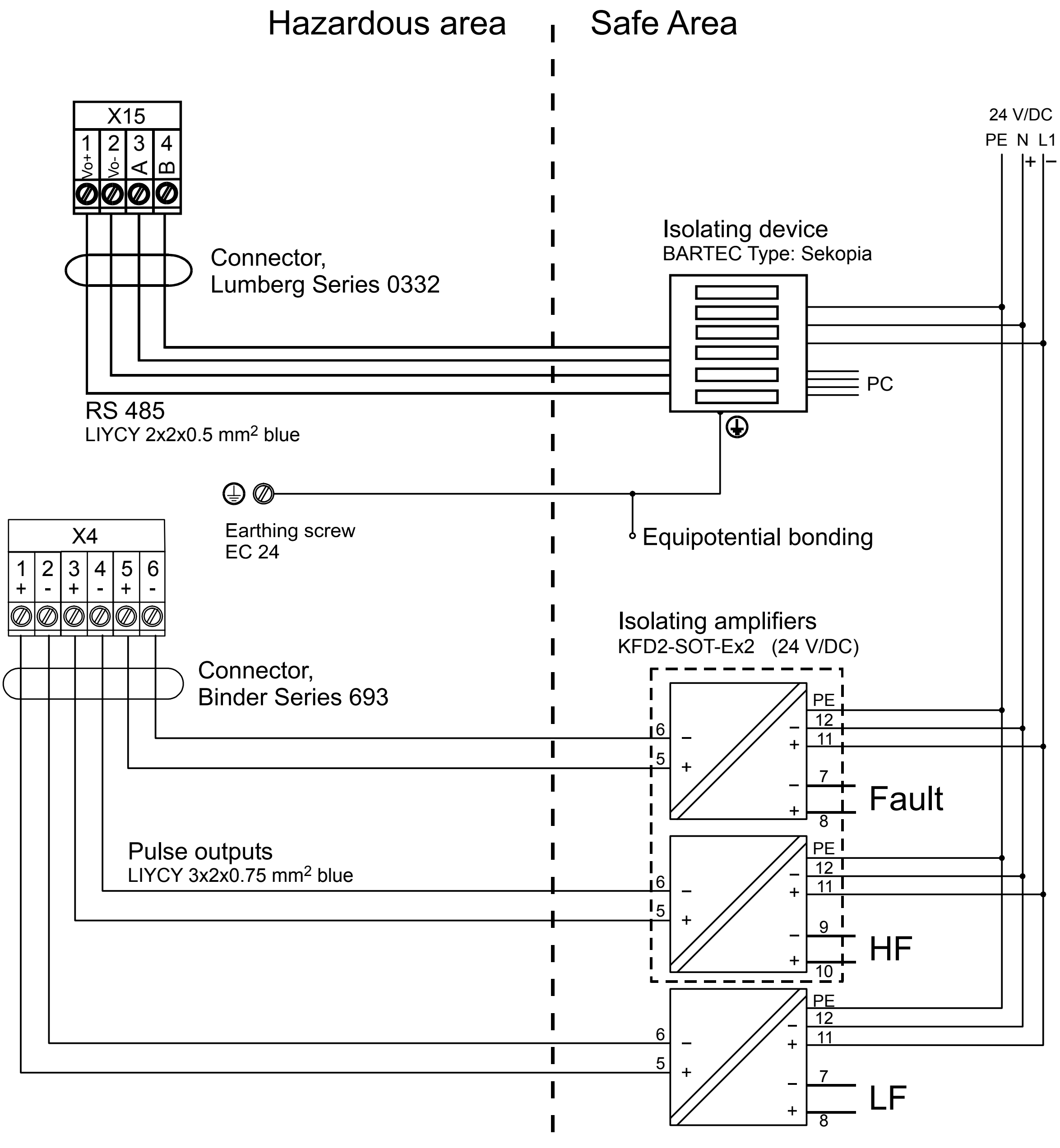
U_i	=	28 V
I_i	=	110 mA
P_i	=	770 mW
C_i	=	2.2 nF
L_i	=	110 µF

Supply

Battery supply	3.6 V lithium cell; inside the device (battery pack)
External 24 V supply	24 V DC; external; via current-loop connection plus battery pack

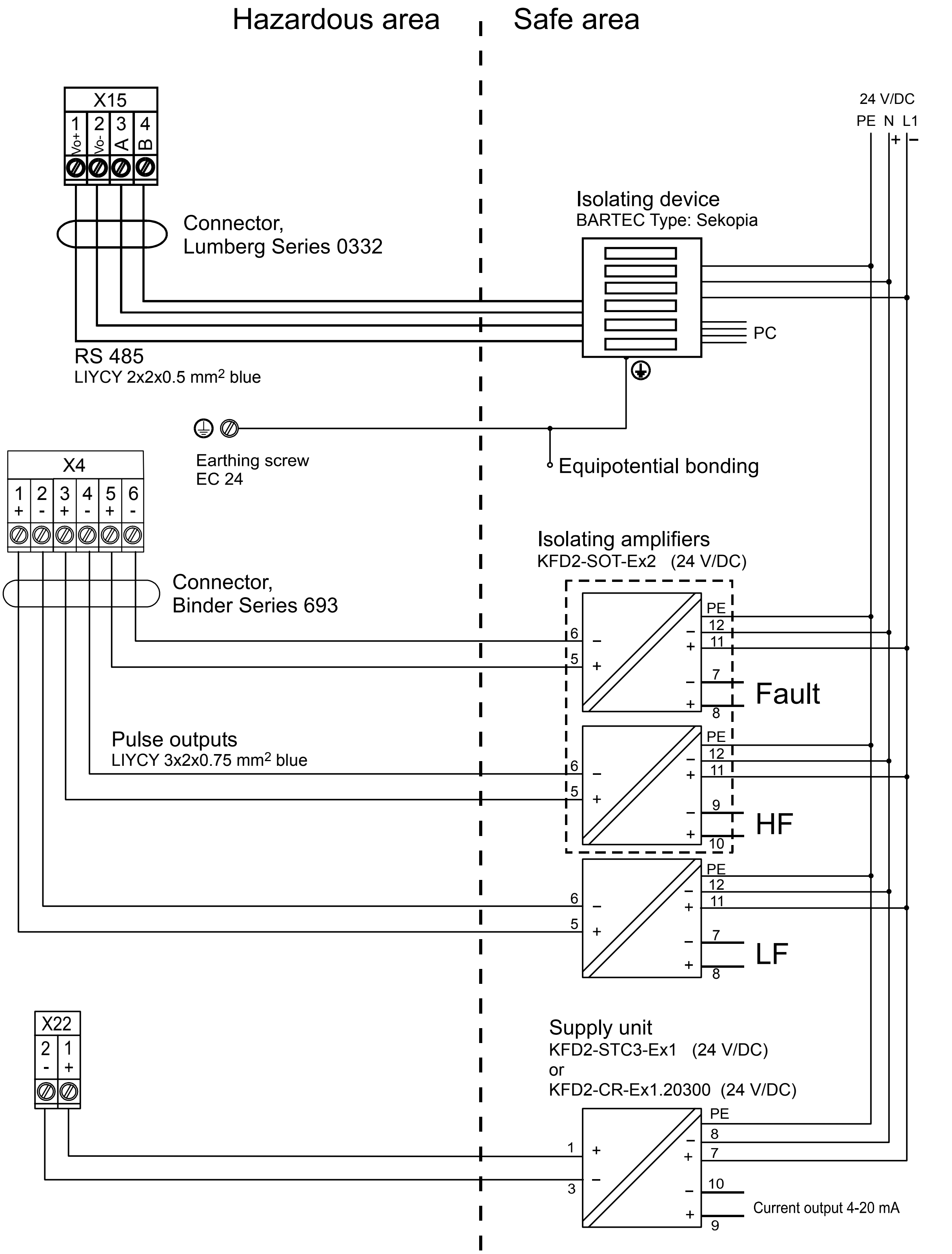
D Examples of connection
(EC 21 and EC 24)

Battery-powered device



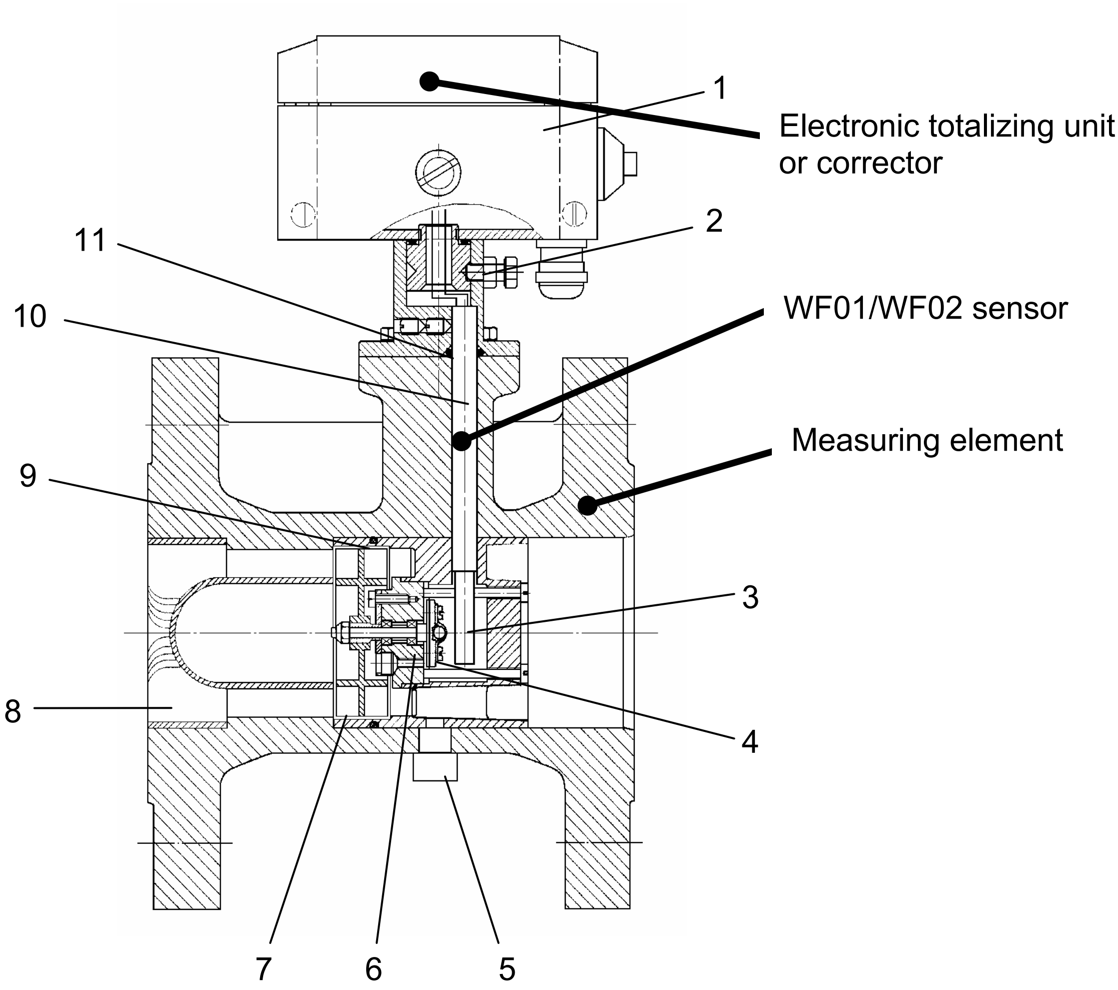
Mains-powered device

(Connection only via a current module with built-in back-up battery)



E Instructions for the measuring element of the turbine meter

Construction



Part	Designation	Material
1	Totalizing unit	
2	Clamping screw	Steel
3	WF01 or WF02 sensor	
4	Permanent magnet	Oerstit 500
5	Lubricator (with TERZ 94 from DN 200)	
6	Radial ball bearing	Nirosta steel
7	Turbine wheel	Delrin / aluminium
8	Flow straightener	Hostaform
9	O-ring	
10	Sensor sleeve with sensor	Nirosta steel
11	O-ring 8x2.5	83FKM592

Functional description

The measuring element directly measures the flow rate at measurement conditions and in the top-mounted meter head or corrector the measured values are integrated so that the result is the gas volume which flowed through the meter. The gas flow drives a turbine wheel whose speed is recorded through non-contact measurement by a sensor. Therefore, the meter is characterized by long-term stability and low wear.

An aerodynamic flow straightener (8) fitted into the meter case constricts the effective cross section of the pipe to form a ring-shaped cross-sectional area and substantially eliminates turbulence. The velocity of the flowing gas increases and the gas is directed to the turbine blades.

The turbine wheel (7) is dynamically balanced and mounted with dust-proof ball bearings (6). A permanent magnet (4) located at the end plate of the turbine shaft induces the sensor element (3) to give a voltage pulse with each rotation of the turbine wheel. This pulse is further processed by the electronic system of the meter head (1).

Inside the meter head or corrector, the number of pulses is divided by the meter factor (number of pulses per m^3) and the result is used to calculate the volume at measurement conditions. In the main totalizer, the sum of the volume at measurement conditions which flowed through the meter is formed and you can read the gas volume which flowed through the meter per time unit on the flow rate display.

At the HF output (only in the case of an electronic measuring element), the unchanged signal frequency of the sensor element is outputted, whereas, for the LF output, this HF frequency can be reduced by two programmable scaling factors.

Operating conditions

Permissible types of gases
The **standard design** of the TRZ 03 – TE / TEL turbine meters can be used for all non-aggressive gases, such as

Natural gas	Air
Town gas	Acetylene
Methane	Helium
Ethane	Carbon dioxide (dry)
Propane	Nitrogen
Butane	Hydrogen

Special designs (PTFE lining, special lubrication, special material, etc.) can be used for aggressive and humid gases, such as

Ethylene	Digester gas
Biogas	Sulphur dioxide
Acid gas	etc.

Permissible temperature ranges

For the standard design, the following fluid temperature and ambient temperature ranges are permitted:

Fluid temperature range: -20°C to +60°C
For the ambient temperature range, see the ID plate and Annex C on page 28.

Pressure loss

The pressure loss is calculated using the following formula:

$$\Delta p = Z_P \cdot \rho \cdot \frac{Q_M^2}{DN^4}$$

where	Δp	is the pressure loss	[mbar]
	Z_P	is the pressure loss coefficient	
	ρ	is the density	[kg/m^3]
	Q_M	is the flow rate at measurement conditions	[m^3/h]
	DN	is the nominal diameter of the meter	[mm]

The pressure loss coefficient Z_P is:

Z_P = 5040 (TERZ 94, TRZ 03-TE) Z_P = 6050 (TRZ 03-TEL)

This is an approximate mean value. The exact value is calculated from the pressure loss which is determined on testing the volumeter.

Example of calculation:

Q_M = 650 m^3/h; DN 150; ρ = 1.3 kg/m^3 [natural gas, 600 mbar]

$$\Delta p = Z_P \cdot \rho \cdot \frac{{Q_M}^2}{DN^4} = 5040 \cdot 1.3 \cdot \frac{650^2}{150^4} = 5.5\text{mbar}$$

Therefore, the pressure loss Δp with a TERZ 94 or TRZ 03-TE turbine meter is 5.5 mbar in this case.

Installation

The gas flow must be free of shocks and pulsations as well as free of foreign particles, dust and liquids. Any components affecting the gas flow must absolutely be avoided directly upstream of the TERZ 94 or TRZ 03-TE turbine meter.

To achieve the highest possible accuracy, the following inlet pipe is to be installed upstream of the meter:
TERZ 94: length of 2 DN, with one perforated-plate straightener
TRZ 03-TE: length of 2 DN (specified by Technical Guideline G 13)
TRZ 03-TEL: no inlet pipe required.

In the case of the TERZ 94, you can install the meters in any position (vertical or horizontal) up to and including the nominal diameter of DN 200. From the nominal diameter of DN 250 and in the case of the TRZ 03-TE / TEL, only the position stated in the purchase order is possible.

When you install the meter, please observe the direction of flow indicated on the case!

The meter head (1) can be turned after the clamping screw (2) has been loosened. Turn the meter head by max. 360°, otherwise the signal wires can become twisted and break.

Start-up

Connecting the gas flow

Do not fill any downstream pipelines or station sections through the TERZ 94 or TRZ 03 – TE / TEL turbine meters. This may speed up the turbine wheel and lead to excessively high flow rates with resultant damage.

Short-time overload operation of 20% above the maximum flow rate Q_{max} is permissible. No damage will occur in the case of a return flow without shocks.

Initializing the device

Set all totalizers to the meter reading of your choice. (See programming.)

Now check the settings of the pulse width, decade scalers, etc.

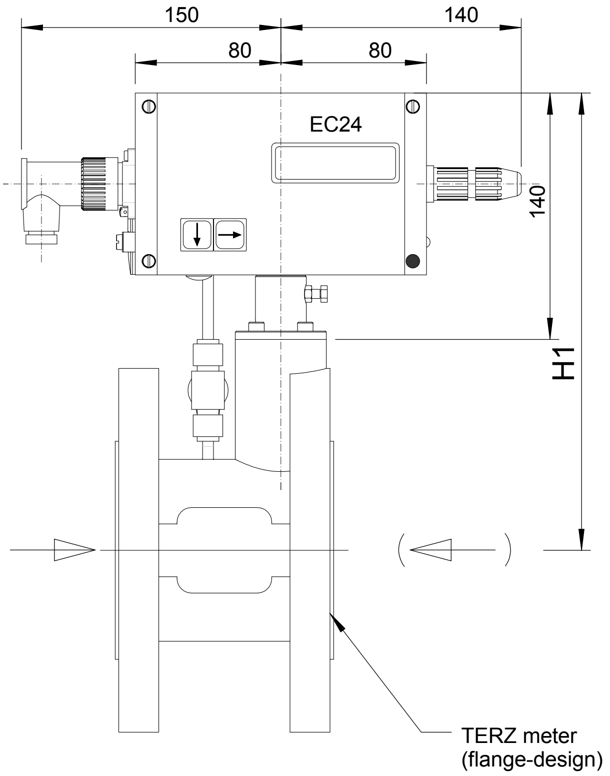
In the case of models with a current output:

Also check the settings of the current output.

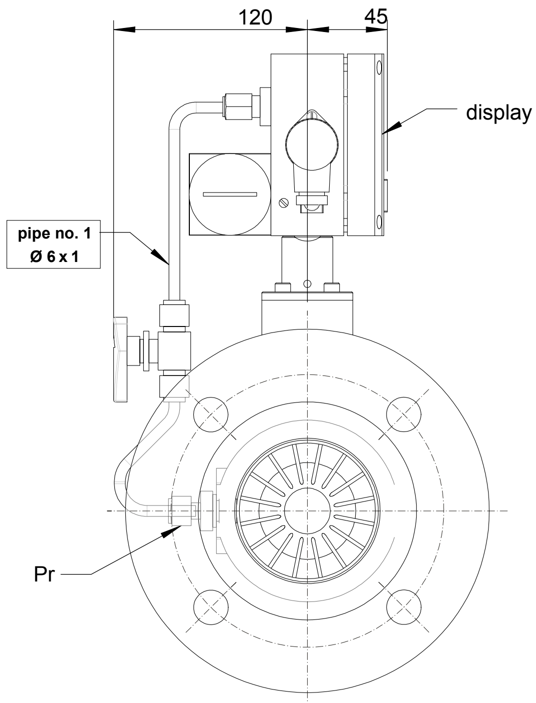
NOTE:

All parameters can only be changed if the device has been opened.

Annex F: Dimensions



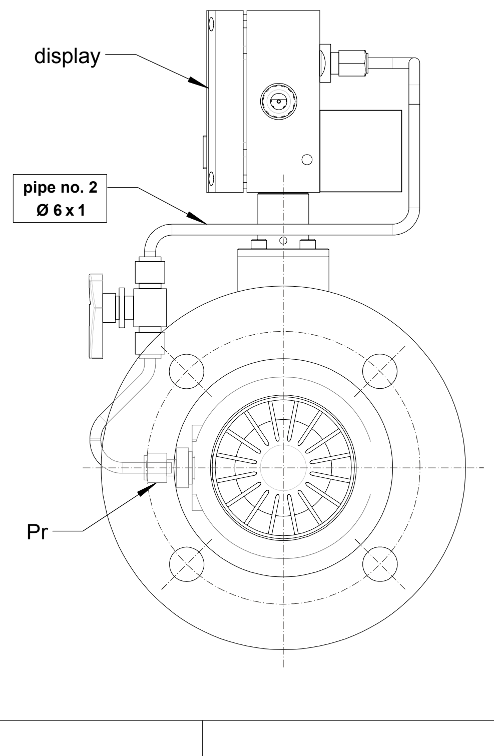
Flow direction from left to right*



***Standard installation**

DN	H1
25	190
40	190
50	225
80	260
100	265
150	295
200	325
250	370
300	385
400	375
500	395

Flow direction from right to left



RMG MESSTECHNIK GMBH 35510 Butzbach	**Dimensions** **volumeter/PT-corrector** **type EVC 24**	Drwg. no.	**058147.4**

Annex G: Operating instructions for the installer

Identification:

Type: EC 21* / EC 24*
II 2 G EEx ib IIC T4 and/or T3
TÜV 02 ATEX 1970
Temp.= -20°C....+40°C and/or +60°C
Data see EC type approval certificate
Year of construction: 2004
Serial number: xxxx xx
0032

Manufacturer: RMG Messtechnik GmbH
Otto – Hahn – Straße 5
D-35510 Butzbach

Application:

The device EC 21*/EC 24* is equipment for hazardous area.

Assembly/disassembly:

When assembling it is to be made sure that the degree of protection of the case is kept.

A direct exposure to sun must be avoided.
In case of disassembly the signal circuits are to be switched to zero potential and the corresponding cables are to be removed.

Installation:

If one or more circuits are used, it is to be made sure with the cable selection that the permissible limiting values according to the EC type approval certificate are not exceeded.

Each Ex signal circuit is to be run in its own cable, which has to be lead through the appropriate PG cable gland.

A fixed laying of the intrinsically safe cables is obligatory.

The connecting cables are to be provided with core-end sleeves.

Start-up:

With the start-up of this device it is to be made sure that all cables in the clamp area are correctly connected and run.

The case must be completely closed.

With the installation and start-up the standard EN60079-14 is to be observed.

The device may be started up only by persons after training.

Settings:

The basic setting of the device takes place by RMG Messtechnik.

Changes of the basic setting may only be carried out by persons after training and/or instruction.

Maintenance:

The battery changes may only take place in a safe area.

Repairs at this device may be carried out by RMG Messtechnik only.

Safety instructions:

The manual must be accessible to all persons, who are authorized with the operation of the device.

No arbitrary changes may be made at the device, since otherwise the approval becomes invalid.

The device may be never opened by force.

The warning references in this manual and the generally accepted safety rules must be observed.