# Volume Corrector EC 24


## OPERATING INSTRUCTIONS

Reliable Measurement of Gas

RMG

STATUS September 19th, 2019 Version: 07

**Manufacturer** Our customer service is available for technical queries

| | |
|---|---|
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**Original Document** The **EC24_manual_en_07** from September 19th, 2019 for the volume corrector EC 24 is the document translated first from the German original version. Anyhow, this document may serve as reference for translations into other languages. Please use in case of any uncertainties the German version as main reference.

**Note** Unfortunately, paper is not updated automatically, whereas technical development continuously advances. Therefore, we reserve the right to make technical changes in regard to the representations and specifications of these operating instructions. The latest version of this manual (and other devices) can be downloaded at your convenience from our Internet home-page **www.rmg.com**.

| | | |
|---|---|---|
| **Date created** | July | 2009 |
| **1st revision date** | January | 2012 |
| **2nd revision date** | March | 2012 |
| **3rd revision date** | May | 2013 |
| **4th revision date** | February | 2015 |
| **5th revision date** | February | 2017 |
| **6th revision date** | September 19th, 2019 | |

**Document version and language**

| | |
|---|---|
| **Document version** | EC24_manual_en_07<br>September 19th, 2019 |
| **Language** | EN |

# Introduction

## General information

### Design variants

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 | EC 24 |
|---|---|---|
| Measuring element (meter) | electronic | electronic |
| Function | Vm totalizer | Vm totalizer and volume correction (p,T) |
| Case |  |  |
| Inputs | Wiegand (1 or 2 channels) | Wiegand (1 or 2 channels) |
| Pulse comparison | No | Optional |
| Pulse outputs | LF, HF | LF, HF |

There are various hardware configurations for the device types listed:

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

**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 -25°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 24 by switching off not only the battery but also a possibly available external power supply.

## Booting

In case of serious disturbances it may be necessary to reboot the device.

**With the booting all parameter settings and totalizer readings are lost! Therefore read out all parameters of the EC 24 before booting.**

To reboot the device proceed as follows:

- For mains supplied devices switch off the power supply.
- For battery powered devices disconnect the battery (see section "Changing the battery"). Also a possibly existing backup battery for mains supplied devices must be disconnected.
- Press the "P" key and keep it pressed.
- Connect the battery again and/or switch on the power supply again.
- Now the text "del all" appears in the display. Press the ⏎-key (Enter).
- As soon as the addresses are counted up in the display, you can release the "P" key.
- The booting procedure has finished, if the totalizer is displayed (now set to 0).

Now transfer all device parameters back to the EC 24 or enter the values from the calibration certificate.

# Operating Modes

### Battery-powered device

The EC 24 is fitted with two exchangeable batteries. Both devices have been designed for a continuous operation over approx. 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 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.

### 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 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 -25°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  Ex ib[ib] IIC T3/T4 Gb**

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 24 may be used in areas subject to explosion hazards. Connect the pulse outputs of these devices only to intrinsically safe circuits.
- The battery must be changed in an area without explosion hazards.
- The specifications on cable type and cable length in this manual and in the ex-approval must be observed.
- Modifications to the device make the Ex approval invalid and are therefore prohibited.

**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 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!

# Operating instructions for the installer

**Identification:**

Type: EC 24*
II 2 G Ex ib[ib] IIC T3/T4 Gb
TÜV 02 ATEX 1970
Temp.= -25°C....+40°C and/or +60°C
Data see EC type approval certificate
Year of construction: 2004
Serial number: xxxx xx

CE 0032



**Manufacturer:** RMG Messtechnik GmbH
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**Application:**

The device 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:**

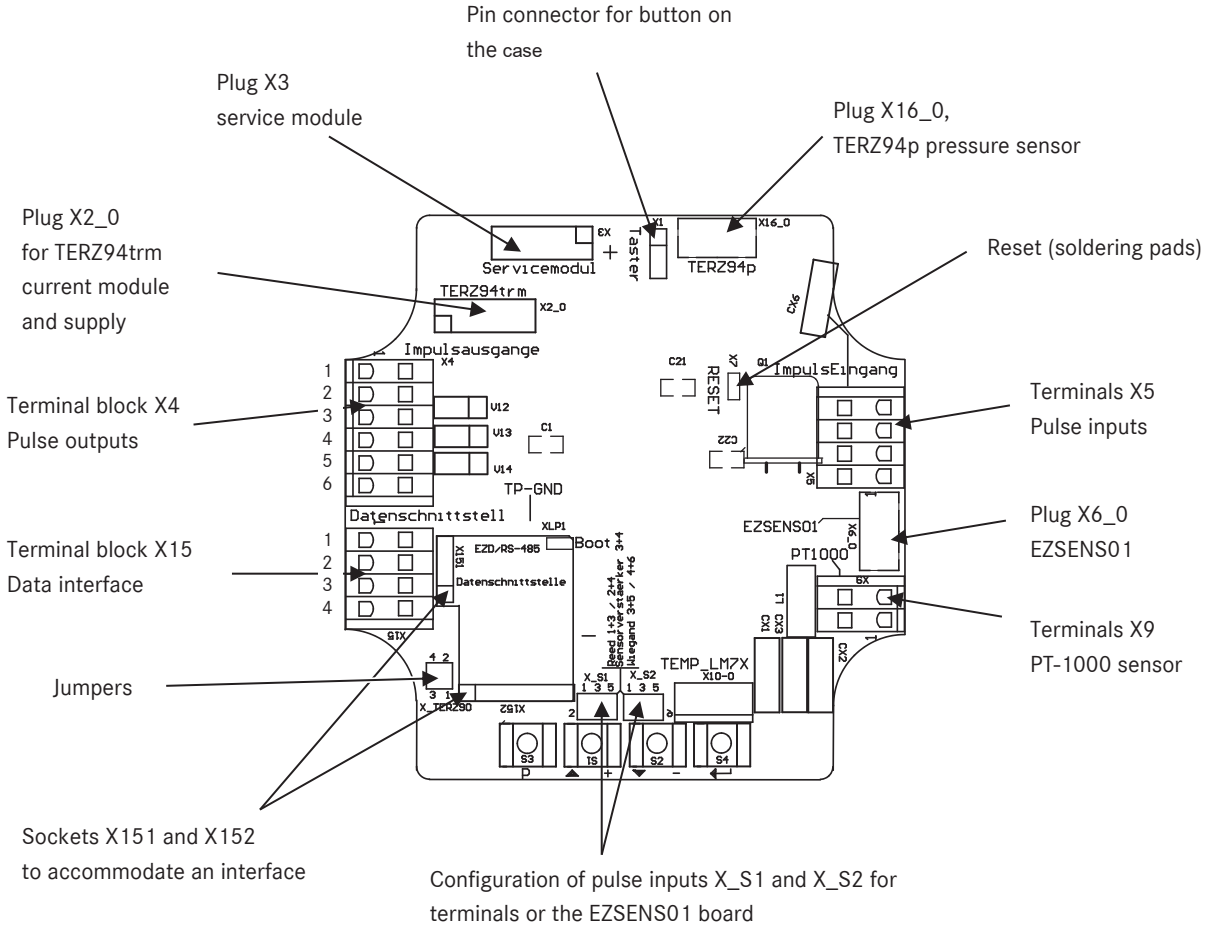
The manual must be accessible to all persons, who are authorized with the operation of the device.
No arbitrary changes may be made at the device, since otherwise the [ATEX] approval becomes invalid.
The device may be never opened by force.
The warning references in this manual and the generally accepted safety rules must be observed.

# 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 for input X5 by the X_S1 (for sensor 1), X_S2 (for sensor 2) and X_TERZ90 (additional for remote totalizer) jumpers as follows:

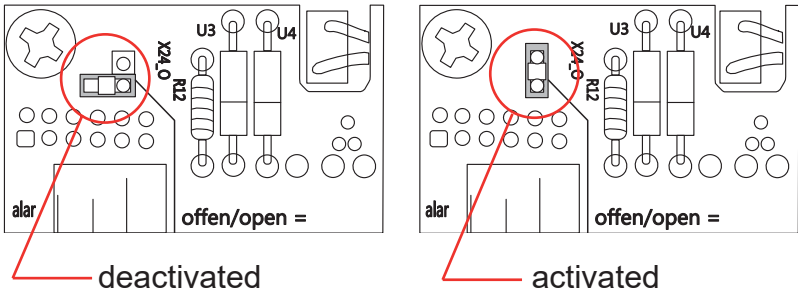
| Reed contact | Wiegand | Remote totalizer | |
|---|---|---|---|
| X_S1, X_S2 | X_S1, X_S2 | X_S1, X_S2 | X_TERZ90 |
| Jumpers 1-3 and 2-4 | Jumpers 3-5 and 4-6 | Jumper 3-4 | Jumpers 1-2 and 3-4 |

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.



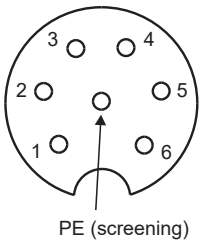
**For devices with current output:** Before commissioning, the device must be activated.
The jumper must be plugged as shown in the drawing.




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

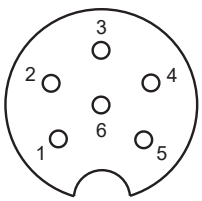
To connect cables to the spring terminals, you need a screwdriver with a blade width of a maximum of 2.5 mm. Introduce the blade into the intended slot and press down the screwdriver to open the spring terminal.

**Standard connection pulse outputs: 7-pin connector (Binder series 692)**




1 - / 4 + LF signal (Vm or Vb)
2 - / 5 + Fault
3 - / 6 + HF signal
(view on device)

**Standard connection interface: 6-pin connector (Binder series 423)**




1 - / 4 + RS485 supply
3 - / 5 + RS485 data line
2, 6 Spare
(view on device)

In areas subject to explosion hazards, the 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.

The maximum voltage which may be connected to the RS 485 interface is 10.5 V. A higher voltage causes damage of the device.



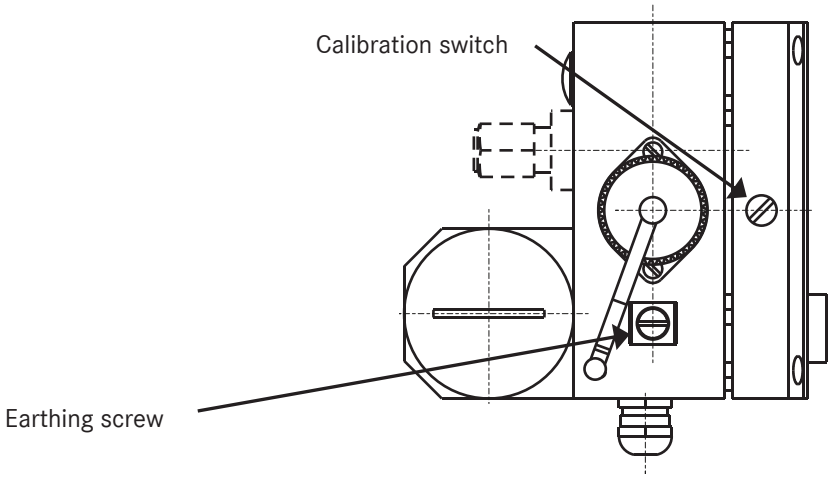
If one or more than one circuit is used, make sure that the permissible limit values in accordance with the EC type approval certificate are not exceeded. Each intrinsically safe signal circuit must be installed in a separate cable which is to be taken through an appropriate high-strength cable gland. It is absolutely imperative 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 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.

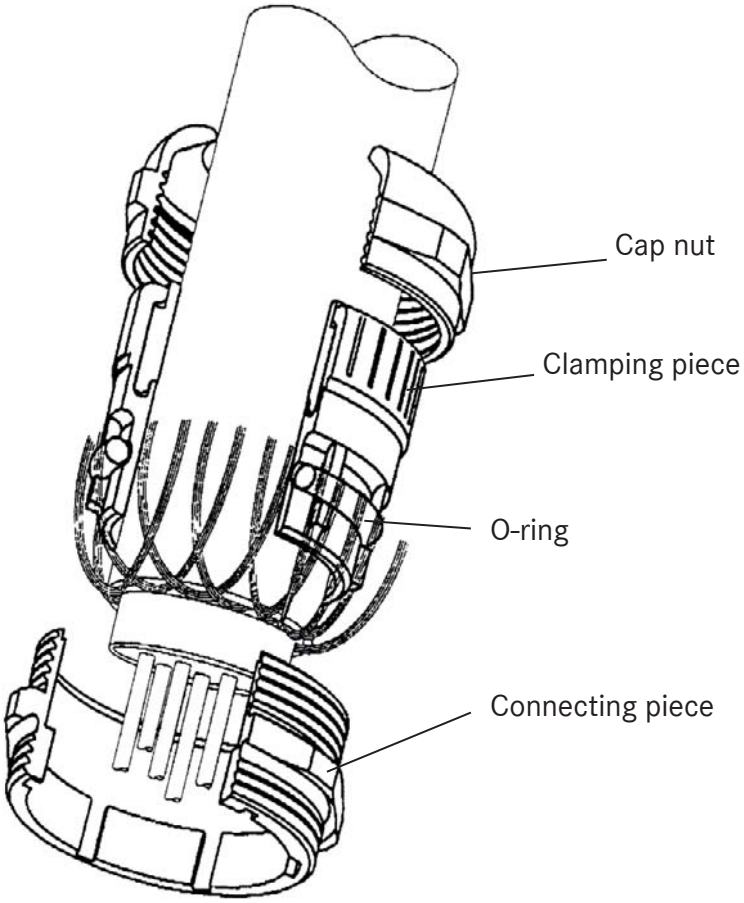
If the device is used in areas subject to explosion hazards, the maximum cable length is limited by the limit values for intrinsically safe circuits and depends on the inductance and capacitance of the cable!



**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.



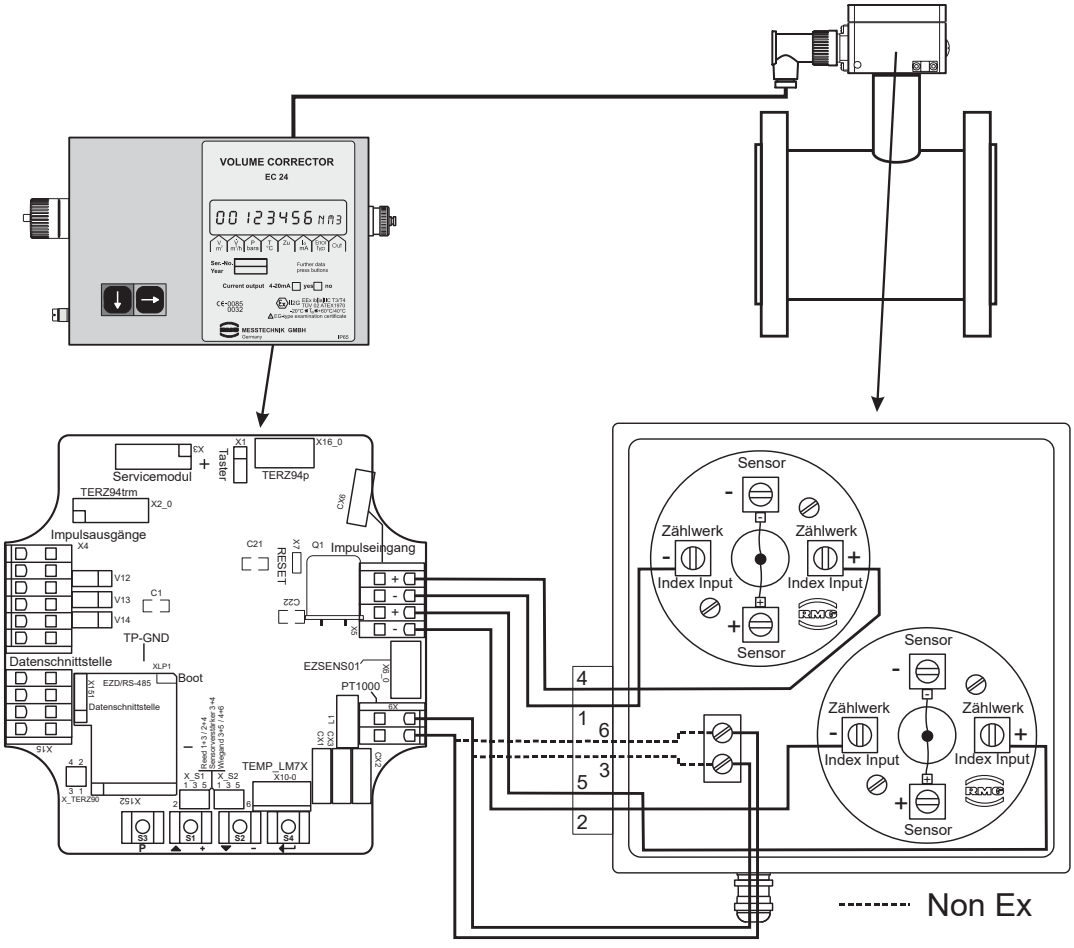
### Permissible temperature ranges

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: -25°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 (installation with longer cable only on request)


**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!**



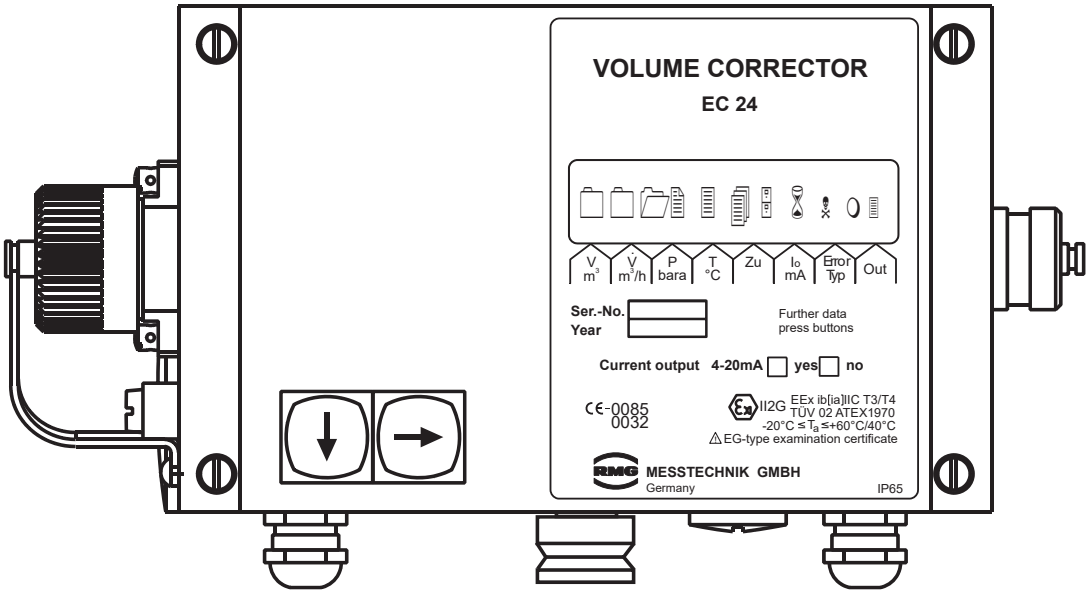
In addition, check the plug-in jumpers XS1 / XS2 and XTERZ90 on the board (see inputs and outputs in the annex).

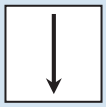
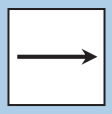
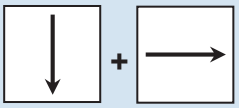
**Make your settings of XS1 and XS2 as follows: jumpers 3-4.**

# Operation

## Front panel and keyboard of the EC 24






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

If the EC 24 is operated together with the measuring element of an electronic turbine meter, the 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 24 will return to displaying the main totalizer. If the display of the 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 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 Io |
| → |  | |
| Pointer position 7 | 1 -- | Error / ID |
| → |  | |
| Pointer position 8 | 1 -- | Mode / Memory |

# Programming

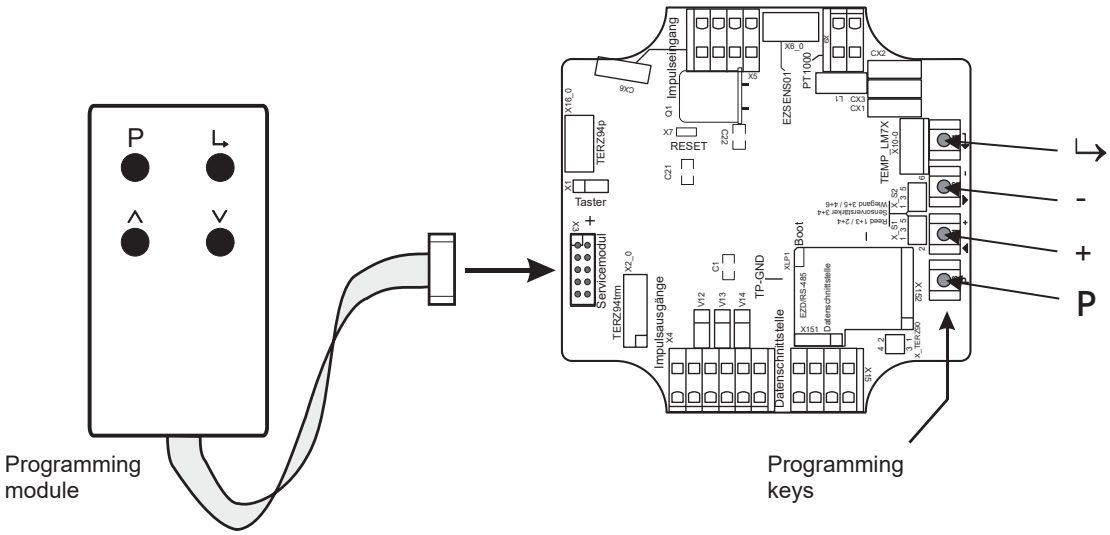
### Via the programming keys

For programming the EC 24, there are four buttons on the rear side of the board. The official parameters are protected by a calibration switch and a password.



### Via the programming module

Instead of using to the programming keys, you can program the device using the programming module. 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.

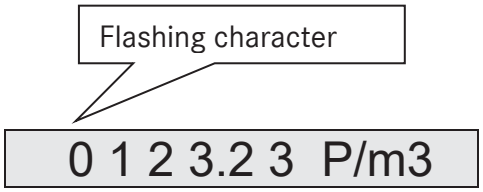
The external and internal buttons correspond to each other in the following way:

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



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

$f$: Signal frequency [Hz]
$K_V$: Meter factor (pulse value) [pulses/m³]
$Q_B$: Flow rate at measurement conditions [m³/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:

$$f_{min} = \frac{Q_{B\,min}}{3600} \cdot K_V \qquad f_{max} = \frac{Q_{B\,max}}{3600} \cdot K_V$$

$Q_{B\,min}$: Minimum flow rate at measurement conditions
$Q_{B\,max}$: Maximum flow rate at measurement conditions
$K_V$: Meter factor

Example:

$Q_{B\,min}$ = 16 m³/h $Q_{B\,max}$ = 250 m³/h $K_V$ = 2362 Pulses/m³

$$f_{min} = \frac{16}{3600} \frac{m^3}{s} \cdot 2362 \frac{\text{Pulses}}{m^3} = 10{,}5\ Hz \qquad f_{max} = \frac{250}{3600} \frac{m^3}{s} \cdot 2362 \frac{\text{Pulses}}{m^3} = 164\ Hz$$

### 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 A 05 from 0.01 to 100 as required.

# Coordinate system

## Coordinates from A – E

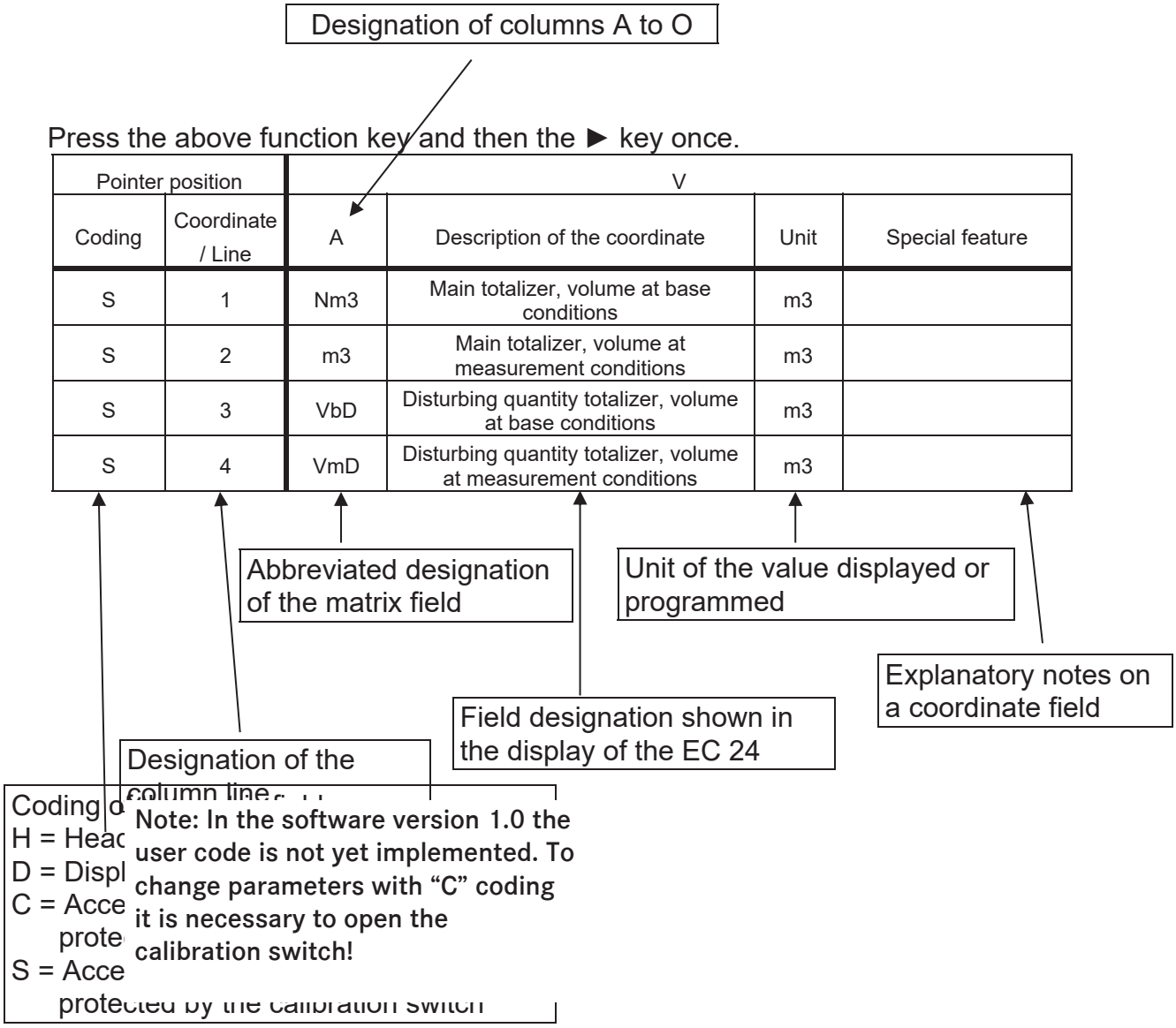
| Pointer position | V | V· | P | T |
|---|---|---|---|---|
| Designation | Totalizers | Flow Rate | Pressure | Temperature |
| Coordinate / Line | A | B | C | D |
| 1 | Volume at base conditions | Qb | bara | °C |
| 2 | Volume at measurement conditions | Qm | p min | t min |
| 3 | Disturbing quantity totalizer Vb | Frequency | p max | t max |
| 4 | Disturbing quantity totalizer Vm | 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 | | Switch-off Qm | Binary value at 0.5 V | Offset adjustment value |
| 8 | | Time limit for Q < Qm.min | Binary value at 4.5 V | AD binary value |
| 9 | Monthly data memory | | 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 ... 22 | Monthly data memory | | | |

## Coordinates from F – Z

| 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 | N2 | | T max | Wake-up pulse |
| 11 | rd | | Ser. no. meter | Code number |
| 12 | | | Meter size | Beginning of gas day |
| 13 | | | Battery change | EcMode2 |
| 14 | | | | Charge no. |
| 15 | | | | K factor formula |
| 16 | | | | Change of code number |

# Description of individual columns

## Column structure




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

The **calibration switch** is realized by a screw on the left (EC 24) side of the device (see fig. on page 10). For opening the calibration switch just unscrew the screw by some turns until the text “Input” is blinking in the display. 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 | m3 | |
| S | 2 | m3 | Main totalizer, volume at measurement conditions | m3 | |
| S | 3 | VbD | Disturbing quantity totalizer, volume at base conditions | m3 | |
| S | 4 | VmD | Disturbing quantity totalizer, volume at measurement conditions | m3 | |
| S | 5 | l/m3 | Pulse scaling factor | l/m3 | |
| S | 6 | l/m3 | Meter factor | l/m3 | |
| D | 9 ... 22 | | 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 | m3/h | |
| D | 2 | m3/h | Calculated flow rate at measurement conditions | m3/h | |
| D | 3 | F | Frequency (measurement) | Hz | |
| S | 4 | Qm< | Lower fault limit | m3/h | |
| S | 5 | Qm> | Upper fault limit | m3/h | |
| D | 6 | Qmx | Maximum value of the flow rate at measurement conditions | m3/h | |
| S | 7 | qug | Creeping limit | m3/h | |
| S | 8 | qmt | Time limit for operation below Qm< | s | |

## 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/m3 | |
| C | 5 | rhn | Rhon | Kg/m3 | |
| 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 | |
| C | 10 | N2 | Nitrogen content (for AGA-NX-19) | % | |
| C | 11 | dv | Relative density (for AGA-NX-19) | 1 | |

## 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 | | |
| - | 11 | COD | Code number | | Presetting: 1234 |
| C | 12 | h | Beginning of day for data logger | | full hour (0-23) |
| S | 13 | MOD | EcMode2 | | See operating modes |
| D | 14 | CNO | Charge number | | |
| D | 15 | ZG | 10=GERG, 11=AGA-NX-19, 12=AGA-8 | | fixed value |
| C | 16 | C-V | Input for change of the code number | | |

TerzMode, EcMode and EcMode2 are 8-digit strings where each digit stands for one mode. These modes are listed in the following tables.

## 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 | **0** |
| **1** | service | cf | 250 ms | 5 min. | Modbus ASCII | 0.1 | Iout without error | 1 channel Vm Stop | **1** |
| **2** | | | | 10 min. | Modbus RTU | 1 | Iout 3.5 mA with error | 1 channel Vm Run | **2** |
| **3** | | | | 15 min. | | 10 | Iout 21.8 mA with error | 2 channels // X:Y act. (SW) $V_m$ Stop | **3** |
| **4** | | | | test mode | | 100 | | 2 channels // X:Y act. (SW) $V_m$ Run | **4** |
| **5** | | | | | | | | 2 channels // X:Y act. (HW) $V_m$ Stop | **5** |
| **6** | | | | | | | | 2 channels // X:Y act. (HW) $V_m$ Run | **6** |
| **7** | clear data | | | | | | | 2 channels // X:Y deactivated | **7** |
| **8** | clear Qm | | | | | | | | **8** |
| **9** | all coord. on | | | | | | | | **9** |

## 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 | **0** |
| **1** | on | PT 1000 | default | Vb | 10 ms | GERG | $V_b$, $V_m$, $dV_b$, $dV_m$, p, T | pos. edge | **1** |
| **2** | default | default | Qm | | 20 ms | AGA | | neg. edge | **2** |
| **3** | | | Qb | | 50 ms | | | | **3** |
| **4** | | | temp | | 75 ms | | | | **4** |
| **5** | | | pressure | | 100 ms | | | | **5** |
| **6** | | | | | 125 ms | | | | **6** |
| **7** | | | | | 250 ms | | | | **7** |
| **8** | | | | | | | | | **8** |
| **9** | | | | | | | | | **9** |

## EcMode2 (coordinate Z13)

| | EcMode2[0] | EcMode2[1] | EcMode2[2] | EcMode2[3] | EcMode2[4] | EcMode2[5] | EcMode2[6] | EcMode2[7] | |
|---|---|---|---|---|---|---|---|---|---|
| | GERG-TN mode | GERG-TB mode | Protection mode | Spare mode | Spare mode | Device type-mode | Spare mode | Tamper contact mode | |
| 0 | 0.00°C | 0 | fiscal metering | | | meter | | OFF | 0 |
| 1 | 15.00°C | 15 | secondary metering | | | meter + T | | tamper contact closed | 1 |
| 2 | 15.56°C | 20 | | | | meter + p + T | | tamper contact open | 2 |
| 3 | 20.00°C | 25 | | | | corrector + T | | | 3 |
| 4 | | | | | | corrector + p + T | | | 4 |
| 5 | | | | | | | | | 5 |
| 6 | | | | | | | | | 6 |
| 7 | | | | | | | | | 7 |
| 8 | | | | | | | | | 8 |
| 9 | | | | | | | | | 9 |

The connection of a tamper contact is only possible with the one-channel version via the sensor input 2.

## 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 cannot be written (parameters are lost) |
| 3 | 0x0004 | Analog digital converter for temperature measurement |
| 4 | 0x0008 | Analog digital converter for pressure measurement |
| 5 | 0x0010 | Sensor failure |
| 6 | 0x0020 | Measured temperature outside limits |
| 7 | 0x0040 | Measured pressure outside limits |
| 8 | 0x0080 | Hardware and software configuration do not fit |
| 9 | 0x0100 | Tamper contact |
| 10 | 0x0200 | Error during GERG calculation |
| 11 | 0x0400 | Error in flow rate measurement |
| 12 | 0x0800 | Error in monthly data logger |
| 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)

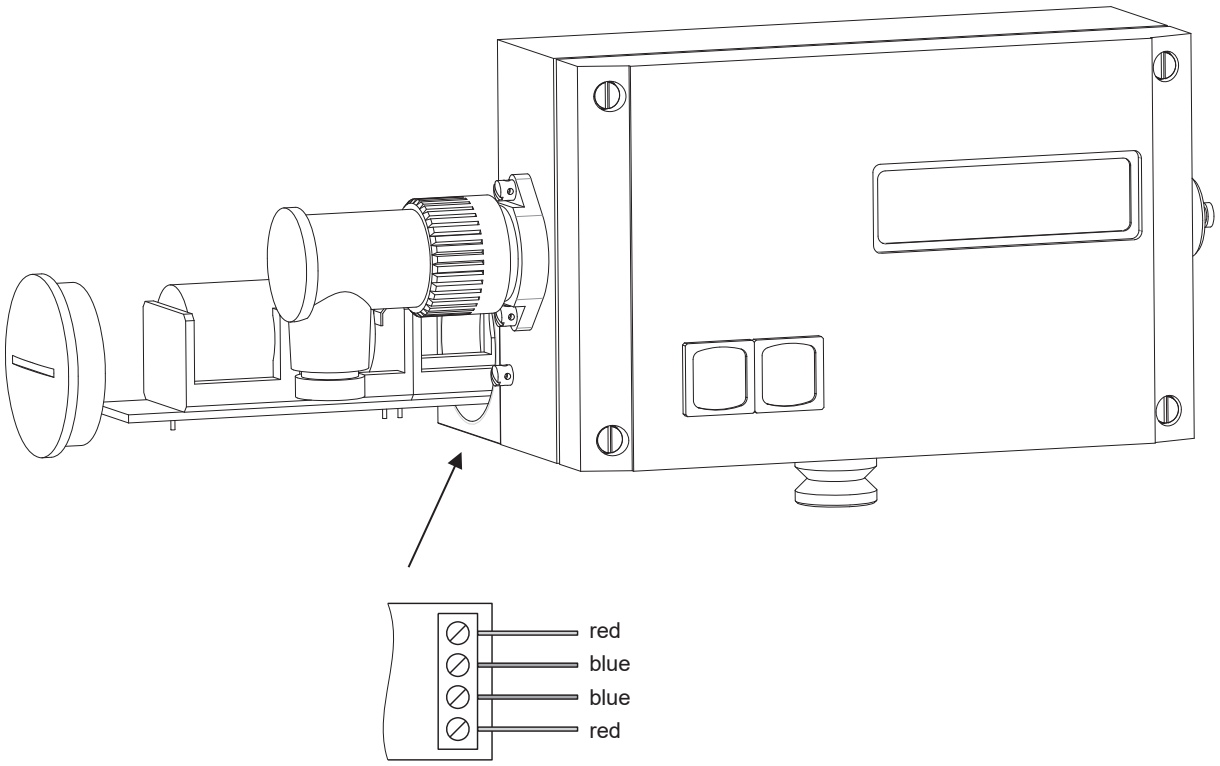
The two batteries of the EC 24 can easily be changed without opening the corrector. On the left side of the casing, there is a round slotted cover which can be screwed out. Behind this cover, there is the battery holder. In hazardous areas disconnect the battery holder and change the batteries in a safe 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.

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 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 |
| $P_V$ | = | 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<br>$Z / Z_b$ 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

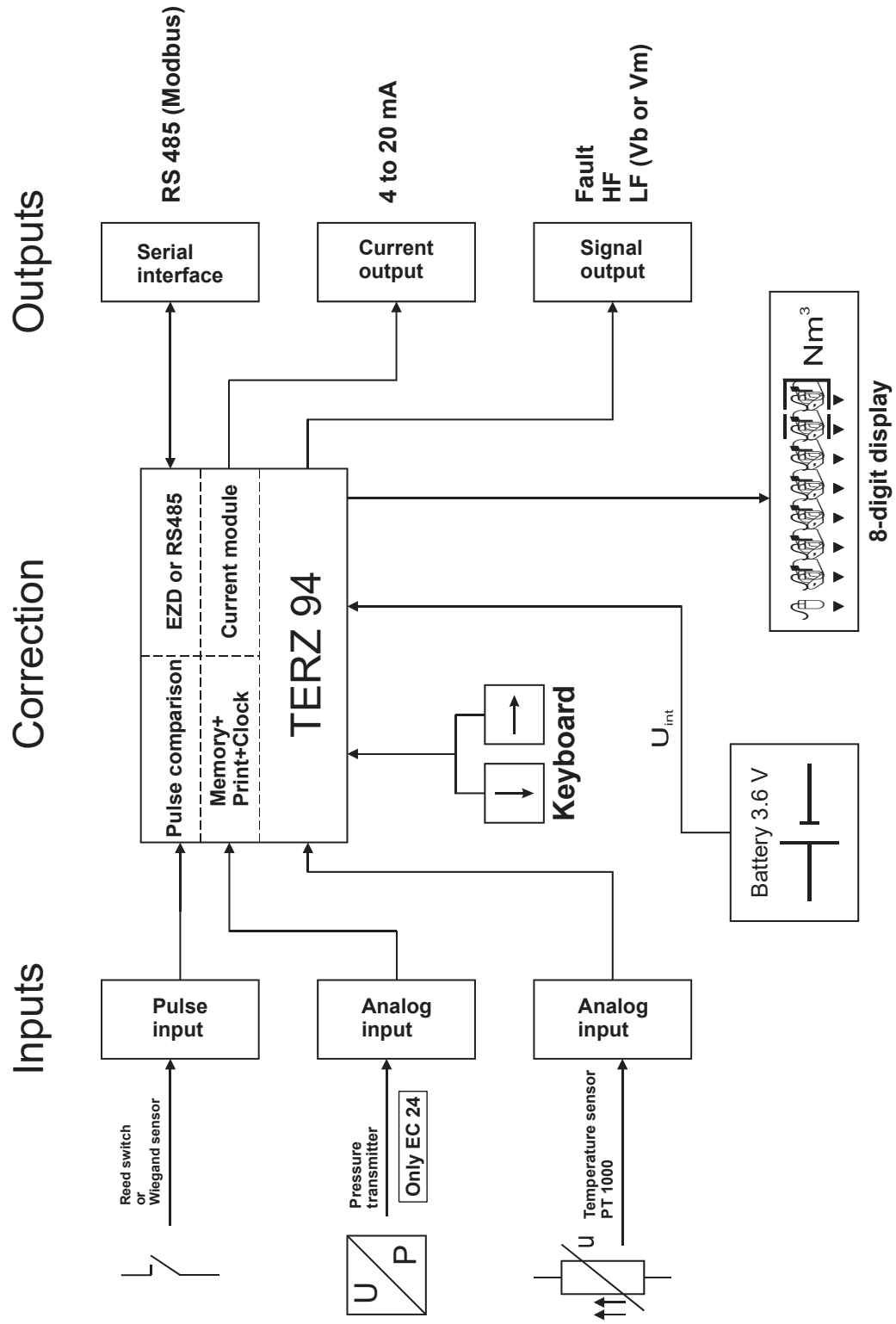
$$q_b = \frac{f_V}{K_V} \cdot 3600 \cdot C(p,T)$$

### 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/cm2 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 24



# C Specifications

## Temperature ranges

| | | | |
|---|---|---|---|
| Type: EC 24 | II2 G Ex ib IIC T4 Gb | from | -25°C to +40°C |
| | II2 G Ex ib IIC T3 Gb | from | -25°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),<br>or<br>external 24 V supply via current-loop connection by means of an intrinsically safe power supply unit, e.g. 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 94 meter instead of the meter head. |
| Supply | Internal battery (Ex),<br>or<br>external 24 V supply via current-loop connection by means of an intrinsically safe power supply unit, e.g. 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 4 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 400 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 | Jumpers X_S1 / 3-5 and 4-6 |
| Wiegand sensor, remote totalizer | Length of line < 50 m[1)] |
| | Jumpers: X_S1 / 3-4 |
| | Jumpers: X_TERZ90 / 1-2 |
| Reed contact | Jumpers: X_S1 / 1-3 and 2-4 |

# Sensor – S2 input (Reference input)

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

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

[1)] Attention: In case of use of an external pressure transmitter the maximum cable length reduces to 3m!

## Temperature input: (hardware and software option)

For Ex connected loads, see the approval certificate.

| | |
|---|---|
| Signal: | Resistor (Pt1000), 2-wire |
| Terminals: | X9,1 (+)<br>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.

Connector: 3 (-) internally: X4,3
6 (+) internally: X4,4
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 |
| Internal inductivity | neglectable | |
| Internal capacity | 3.3 nF | |

## 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.)

Connector: 1 (-) internally: X4,1
4 (+) internally: X4,2
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 |
| Internal inductivity | neglectable | |
| Internal capacity | 3.3 nF | |

### 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.)

| | | |
|---|---|---|
| Connector: | 2 (-) | internally: X4,5 |
| | 5 (+) | internally: X4,6 |
| 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 |
| Internal inductivity | neglectable | |
| Internal capacity | 3.3 nF | |

### 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.)

| | | |
|---|---|---|
| Connector: | 4 (+supply) | internally: X15,4 |
| | 1 (-supply) | internally: X15,3 |
| | 5 (line A) | internally: X15,2 |
| | 3 (line B) | internally: X15,1 |

| | |
|---|---|
| $U_{min}$: | 6.0 V |
| $U_{max}$ ($U_i$) | 10.5 V |
| $I_i$: | 428 mA |
| $P_i$: | 900 mW |
| Internal inductivity: | 1320 nF |
| Internal capacity: | 600 µH |

**Note: If the RS-485 interface is used, the device is supplied via the data interface.**

## Current-loop connection

| | | |
|---|---|---|
| Terminals: | X22,1 (+) | with cable: white conductor |
| | X22,2 (-) | with cable: brown conductor |
| $U_{ext}$ (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:

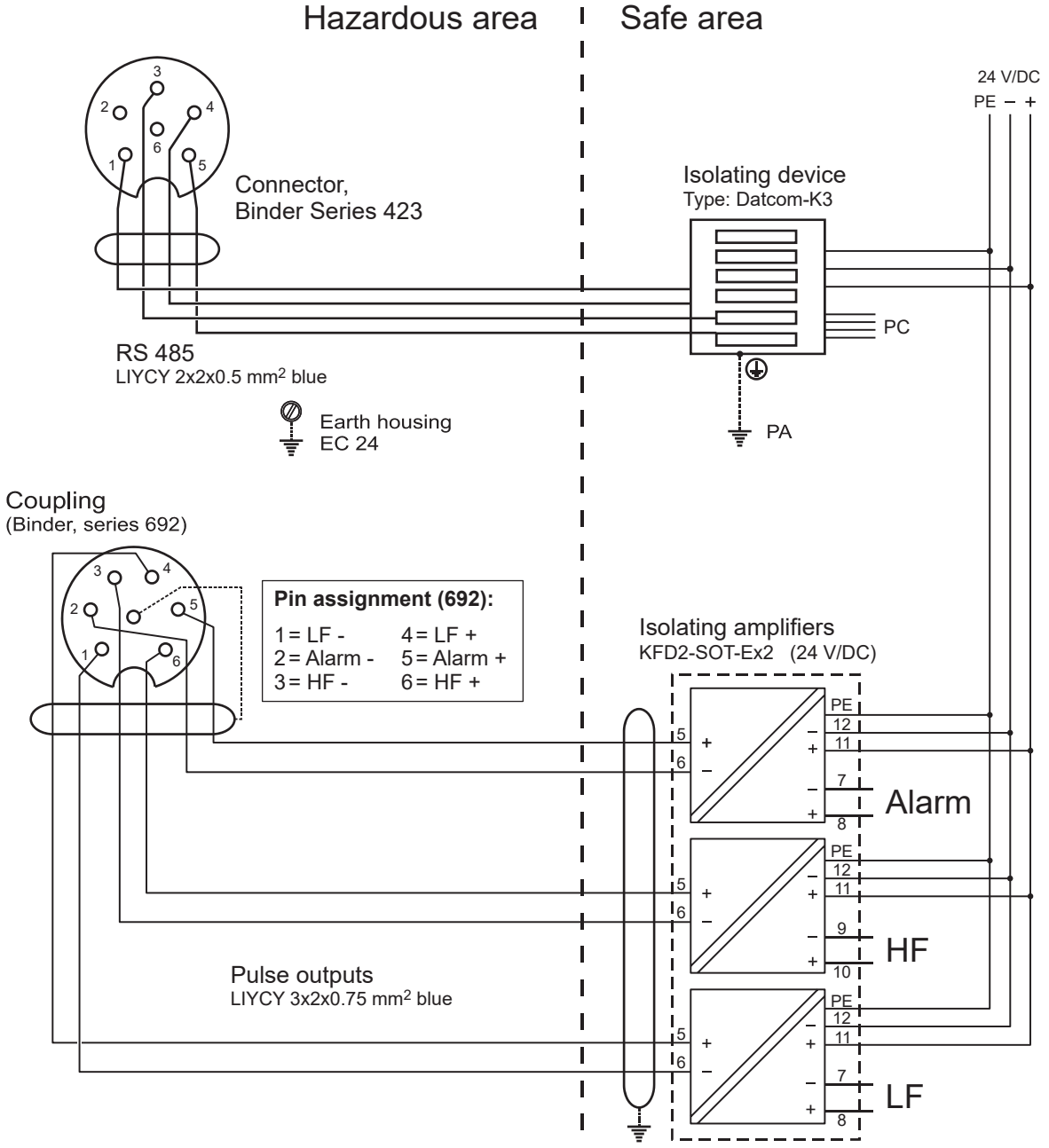
| | | |
|---|---|---|
| $U_i$ | = | 28 V |
| $I_i$ | = | 110 mA |
| $P_i$ | = | 770 mW |
| $C_i$ | = | 2.2 nF |
| $L_i$ | = | 110 µH |

## 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 24)

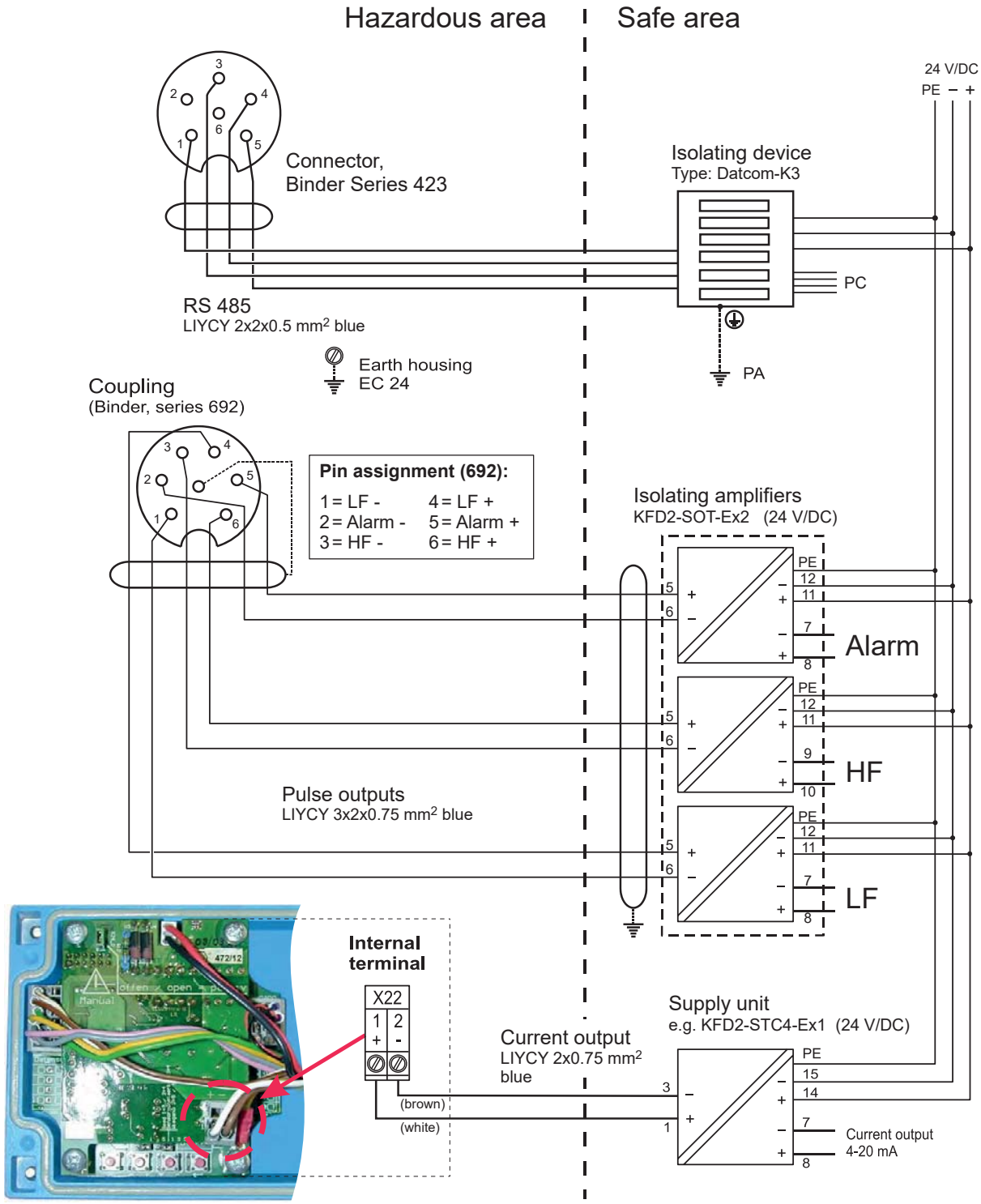
## Battery-powered device




* If 2-channel isolating amplifiers are used, the two inputs must be separated!

# Mains-powered device

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

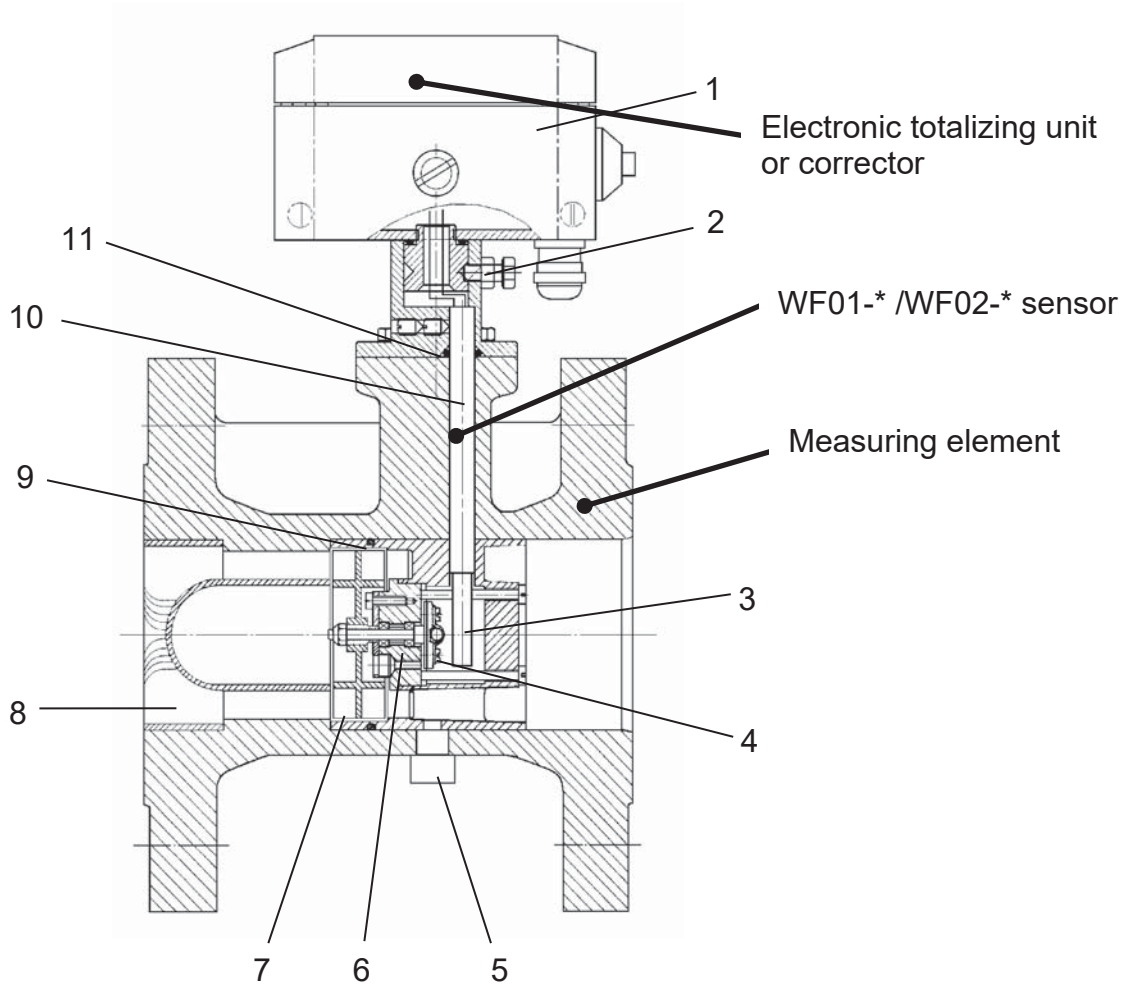



* If 2-channel isolating amplifiers are used, the two inputs must be separated!

# 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 / aluminum |
| 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 34.



## 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 | $\Delta p$ | is the pressure loss | [mbar] |
| | $Z_P$ | is the pressure loss coefficient | |
| | $\rho$ | is the density | [kg/m³] |
| | $Q_M$ | is the flow rate at measurement conditions | [m³/h] |
| | DN | is the nominal diameter of the meter | [mm] |

The pressure loss coefficient ZP 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 m³/h; DN 150; $\rho$ = 1.3 kg/m³ [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 $\Delta p$ 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.

Downstream of the meter a straight pipe or a bend in the diameter of the meter and with a total length of at least 2 DN has to be built in as outlet pipe.
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 Qmax 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.

# F Modbus

## Modbus settings

- The EC 24 Modbus has to be activated via coordinate Z01
- The Modbus - ID has to be set via coordinate Z07 (default is 1)
- The Modbus - register - Offset (MRO) has to be set via coordinate Z08 (default is 0)
  The MRO has to be used during reading and writing operations.



## EC 24 interface parameters

*The EC 24 only operates with the following interface parameters*:

2400 baud
no Parity
8 Data bit
1 Stop bit
Modbus – ASCII or RTU

The EC 24 has a passive RS485 interface, means, the interface needs to be powered externally.
(see Page 37, RS 485 interface)

## EC 24 Modbus – commands

The EC 24 knows the following Modbus commands:

(03 Hex) Read Holding Registers
(06 Hex) Read Single Register
(10 Hex) Preset Multiple Regs
(08 Hex) Diagnostic
(00 Hex) Return Query Data

## EC 24 Exception Codes

| | |
|---|---|
| 01 | Illegal Function |
| 02 | Illegal Data Address (Register not available) |
| 03 | Illegal Data Value (Register not addressable or wrong value) |

## Example (Modbus Question /Answer):

| **Question:** | **Sent character** | |
|---|---|---|
| Start Char | **:** | |
| Slave Address | **01** | |
| Function | **03** | |
| Starting Address Hi | **07** | |
| Starting Address Lo | **CF** | 2000-1 |
| No. of Points Hi | **00** | |
| No. of Points Lo | **02** | |
| LRC | **24** | |
| carriage return | **cr** | |
| line feed | **lf** | |
| | | |
| **Answer:** | **Received character** | |
| Start Char | **:** | |
| Slave Address | **01** | |
| Function | **03** | |
| Byte Count | **04** | |
| Data Hi (Reg 2000) | **3F** | s.u. |
| Data Lo (Reg 2000) | **80** | s.u. |
| Data Hi (Reg 2001) | **00** | s.u. |
| Data Lo (Reg 2001) | **00** | s.u. |
| LRC | **39** | |
| carriage return | **cr** | |
| line feed | **lf** | |



## Example (Modbus – format of numbers):

| **Data type** | **Register** | **Value** | **Byte 1** | **Byte 2** | **Byte 3** | **Byte 4** | **Byte 5** | **Byte 6** | **Byte 7** | **Byte 8** | **Byte 9** | **Byte 10** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| float | 2 | 1.0 | 0x3f | 0x80 | 0x00 | 0x00 | | | | | | |
| Text | 5 | "90111200" | 0x39 | 0x30 | 0x31 | 0x31 | 0x31 | 0x32 | 0x30 | 0x30 | 0x00 | 0x00 |
| int | 1 | 1357 | 0x05 | 0x4d | | | | | | | | |
| long | 2 | 698614 | 0x00 | 0x0a | 0xa8 | 0xf6 | | | | | | |

*Further information you may get from the Modbus specifications.*

## Specifics of the EC 24 – Modbus:

- Data types (float, text ...) may only be read or written completely

| | | |
|---|---|---|
| float | : | 2 Register |
| long integer | : | 2 Register |
| integer | : | 1 Register |
| text | : | 5 Register |
| Month-archive | : | 15 Register |



- Maximal 100 register (with one command) can be read or written.

- Text fields have to have minimal one final zero (0x00).

- The writing of certain parameters causes an internal initiating of the hardware, for example, to delete intermediate results (pulse output, …)
  Therefore parameters should only be overwritten if required (for example counter factor).

- Totalizer factors will be given as long – value (without point), the priority of the totalizing unit the be read via the TerzMode (Register 2310).

## Modbus - register (November 2009)

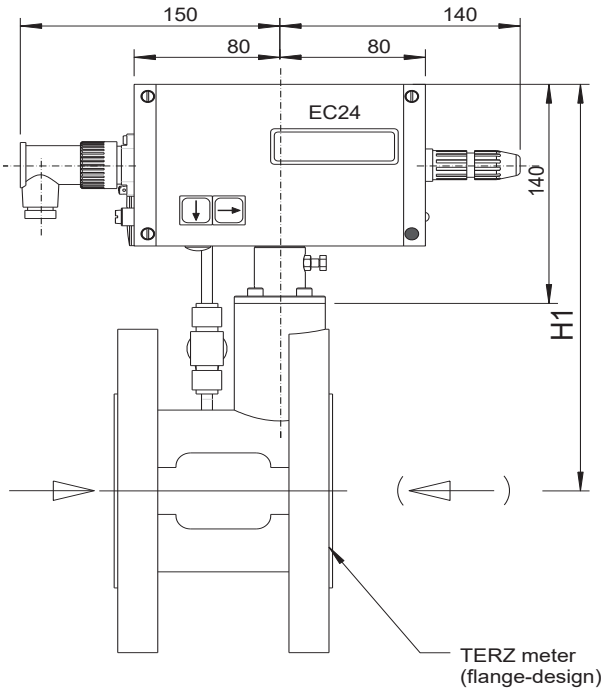
| Koordinate | Kurzbezeichnung | Beschreibung | Modbus Reg. | Zugriff | Type |
|---|---|---|---|---|---|
| **A01** | ZlwVN | Totaliser base condition | **1000 (2)** | **W-E** | **long** |
| **A02** | ZlwVB | Totaliser measurement condition | **1002 (2)** | **W-E** | **long** |
| **A03** | ZlwVNErr | Totalisator meas. cond. disturbing quantity | **1004 (2)** | **W-E** | **long** |
| **A04** | ZlwVBErr | Totalisator base. cond. disturbing quantity | **1006 (2)** | **W-E** | **long** |
| **B01** | Qn | Base cond. volume flow rate | **1008 (2)** | **R-O** | **float** |
| **B02** | Qb | Meas. cond.  volume flow rate | **1010 (2)** | **R-O** | **float** |
| **B03** | Freq | Frequency | **1012 (2)** | **R-O** | **float** |
| **B06** | QbMaxwert | | **1014 (2)** | **R-O** | **float** |
| **C01** | Druck | Pressure | **1016 (2)** | **R-O** | **float** |
| **D01** | Temp | Temperature | **1018 (2)** | **R-O** | **float** |
| **E01** | ZustandsZahl | | **1020 (2)** | **R-O** | **float** |
| **E02** | K_Zahl | K-number at Gerg or Aga | **1022 (2)** | **R-O** | **float** |
| **E07** | Zn | | **1024 (2)** | **R-O** | **float** |
| **E08** | Z | | **1026 (2)** | **R-O** | **float** |
| **F01** | StromOut | Current output in mA | **1028 (2)** | **R-O** | **float** |
| **G02** | SwVersion | | **1030 (2)** | **R-O** | **float** |
| **C06** | DruckBin | Pressure Binary | **1100 (1)** | **R-O** | **int** |
| **D08** | PT1000Bin | Binary value AD converter | **1101 (1)** | **R-O** | **int** |
| **G01** | Error | | **1102 (1)** | **R-O** | **int** |
| **G04** | Checksumme | | **1103 (1)** | **R-O** | **int** |
| **Z09** | ErrorStatus | (Hexadezimal) | **1104 (1)** | **R-O** | **int** |
| **A05** | PulsUntersetzer | | **2000 (2)** | **W-E** | **float** |
| **B04** | QbMin | Min. limit | **2002 (2)** | **W-E** | **float** |
| **B05** | QbMax | Max. limit | **2004 (2)** | **W-E** | **float** |
| **C02** | PMin | Min. limit | **2006 (2)** | **W-E** | **float** |
| **C03** | PMax | Max. limit | **2008 (2)** | **W-E** | **float** |
| **C04** | Pn | Start pressure base cond. | **2010 (2)** | **W-E** | **float** |
| **C05** | PVorgabe | Start pressure meas. cond. | **2012 (2)** | **W-C** | **float** |
| **C09** | DruckUmin | Voltage at Pmin | **2014 (2)** | **W-E** | **float** |
| **C10** | DruckPmin | Pmin | **2016 (2)** | **W-E** | **float** |
| **C11** | DruckSteigung | Pressure gradient | **2018 (2)** | **W-E** | **float** |
| **C12** | DruckA0 | Factor corr. Equation | **2020 (2)** | **W-E** | **float** |
| **C13** | DruckA1 | Offset corr. Equation | **2022 (2)** | **W-E** | **float** |
| **D02** | TempMin | Min. limit | **2024 (2)** | **W-E** | **float** |
| **D03** | TempMax | Max. limit | **2026 (2)** | **W-E** | **float** |
| **D04** | Tn | Start temperature base cond. | **2028 (2)** | **W-E** | **float** |
| **D05** | TempVorgabe | Start temperature meas. cond. | **2030 (2)** | **W-C** | **float** |
| **D06** | TempFaktor | | **2032 (2)** | **W-E** | **float** |
| **D07** | TempOffset | | **2034 (2)** | **W-E** | **float** |
| **E03** | KZahlVorgabe | Start value for K-number at K=const. | **2036 (2)** | **W-C** | **float** |
| **E04** | Ho | Calorific value | **2038 (2)** | **W-C** | **float** |

| | | | | | |
|---|---|---|---|---|---|
| **E05** | Rhon | Base density | **2040 (2)** | **W-C** | **float** |
| **E06** | CO2 | Concentration | **2042 (2)** | **W-C** | **float** |
| **E09** | Tb | | **2044 (2)** | **W-E** | **float** |
| **F02** | StromMin | Value at 4 mA | **2046 (2)** | **W-C** | **float** |
| **F03** | StromMax | Value at 20 mA | **2048 (2)** | **W-C** | **float** |
| **F04** | StromVorgabe | | **2050 (2)** | **W-C** | **float** |
| **F05** | StromOffset | | **2052 (2)** | **W-C** | **float** |
| **F06** | StromSteigung | | **2054 (2)** | **W-C** | **float** |
| **F07** | StromDaempfung | Damping | **2056 (2)** | **W-C** | **float** |
| **G06** | DruckBereichMin | | **2058 (2)** | **W-E** | **float** |
| **G07** | DruckBereichMax | | **2060 (2)** | **W-E** | **float** |
| **G09** | TempBereichMin | | **2062 (2)** | **W-E** | **float** |
| **G10** | TempBereichMax | | **2064 (2)** | **W-E** | **float** |
| **E10** | N2 | for AGA | **2066(2)** | **W-C** | **float** |
| **E11** | dv | for AGA | **2068(2)** | **W-C** | **float** |
| **G03** | SerialNo | | **2200 (2)** | **W-E** | **long** |
| **G05** | DruckNo | Serien Nr. pressure transmitter | **2202 (2)** | **W-E** | **long** |
| **G08** | TempNo | | **2204 (2)** | **W-E** | **long** |
| **G11** | ZaehlerNo | | **2206 (2)** | **W-E** | **long** |
| **G13** | BattWechsel | (z.B. 10032008) 10.03.2008 | **2208 (2)** | **W-C** | **long** |
| **A06** | Zaehlerfaktor | | **2300 (5)** | **W-E** | **Text** |
| **G12** | ZaehlerGroesse | | **2305 (5)** | **W-E** | **Text** |
| **Z01** | TerzMode | | **2310 (5)** | **W-E** | **Text** |
| **Z02** | EcMode | | **2315 (5)** | **W-E** | **Text** |
| **Z05** | TimeStr | | **2320 (5)** | **W-C** | **Text** |
| **Z06** | DateStr | | **2325 (5)** | **W-C** | **Text** |
| **Z13** | EcMode-2 | | **2330 (5)** | W-E | **Text** |
| **C07** | DruckBin05 | Binary value at 0.5 V | **2400 (1)** | **W-E** | **int** |
| **C08** | DruckBin45 | Binary value at 4.5 V | **2401 (1)** | **W-E** | **int** |
| **Z03** | Imp_X | | **2402 (1)** | **W-E** | **int** |
| **Z04** | Imp_Y | | **2403 (1)** | **W-E** | **int** |
| **Z07** | ModbusID | Modbus Bus address | **2404 (1)** | **W-C** | **int** |
| **Z08** | ModbusRegOffset | | **2405 (1)** | **W-C** | **int** |
| **Z10** | WakeUpPuls | | **2406 (1)** | **W-E** | **int** |
| **Z11** | CodeWort | | **2407 (1)** | **W-E** | **int** |
| **Z12** | Tagesbeginn | | **2408 (1)** | **W-C** | **int** |
| | Gerätetyp | | **5000(1)** | **R-O** | |
| | CRC | | **5001(1)** | **R-O** | |
| | EcStatus | | **5002(1)** | **R-O** | |
| | Bit 0 | Current Modul available | **5002.0** | | |
| | Bit 1 | EZD- or 485 HW | **5002.1** | | |
| | Bit 2 | Sealing switch | **5002.2** | | |
| | Bit 3 | Code word | **5002.3** | | |

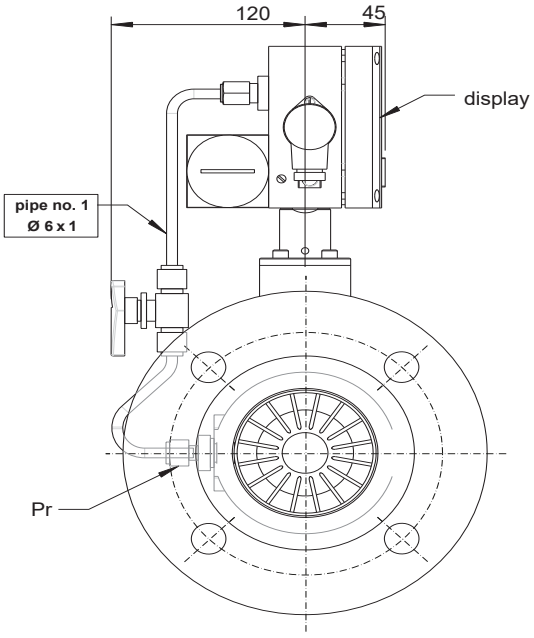
| | | | | | |
|---|---|---|---|---|---|
| | Bit 4 | Reserve | **5002.4** | | |
| | Bit 5 | IG04 | **5002.5** | | |
| | Bit 6 | Error | **5002.6** | | |
| | Bit 7 | Notstrom | **5002.7** | | |
| | Bit 8 ... Bit 15 | Reserve | **5002.8 - .15** | | |
| **A09** | Mon. Speicher 1 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6000 (15) | **R-O** | **Struct** |
| **A10** | Mon. Speicher 2 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6015 (15) | **R-O** | **Struct** |
| **A11** | Mon. Speicher 3 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6030 (15) | **R-O** | **Struct** |
| **A12** | Mon. Speicher 4 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6045 (15) | **R-O** | **Struct** |
| **A13** | Mon. Speicher 5 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6060 (15) | **R-O** | **Struct** |
| **A14** | Mon. Speicher 6 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6075 (15) | **R-O** | **Struct** |
| **A15** | Mon. Speicher 7 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6090 (15) | **R-O** | **Struct** |
| **A16** | Mon. Speicher 8 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6105 (15) | **R-O** | **Struct** |
| **A17** | Mon. Speicher 9 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6120 (15) | **R-O** | **Struct** |
| **A18** | Mon. Speicher 10 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6135 (15) | **R-O** | **Struct** |
| **A19** | Mon. Speicher 11 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6150 (15) | **R-O** | **Struct** |
| **A20** | Mon. Speicher 12 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6165 (15) | **R-O** | **Struct** |
| **A21** | Mon. Speicher 13 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6180 (15) | **R-O** | **Struct** |
| **A22** | Mon. Speicher 14 | Tag ; Vn ; Vb ; dVn ; dVb ; P ; T; S | 6195 (15) | **R-O** | **Struct** |

| | |
|---|---|
| **W-E** | Gaige switch |
| **W-C** | Code word |
| **R-O** | No protection |

# G Dimensions



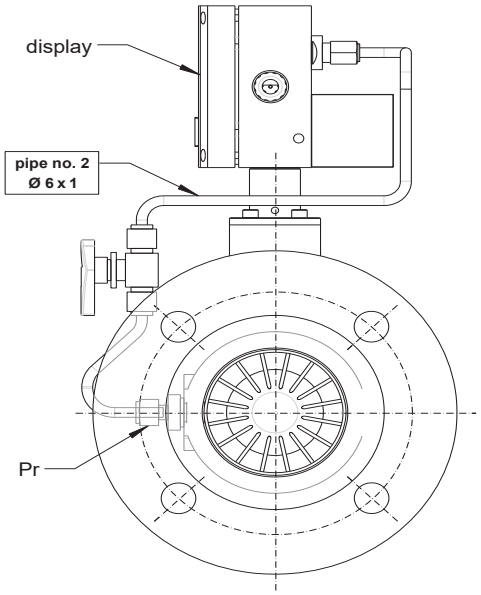

**Flow direction from left to right***




***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** |

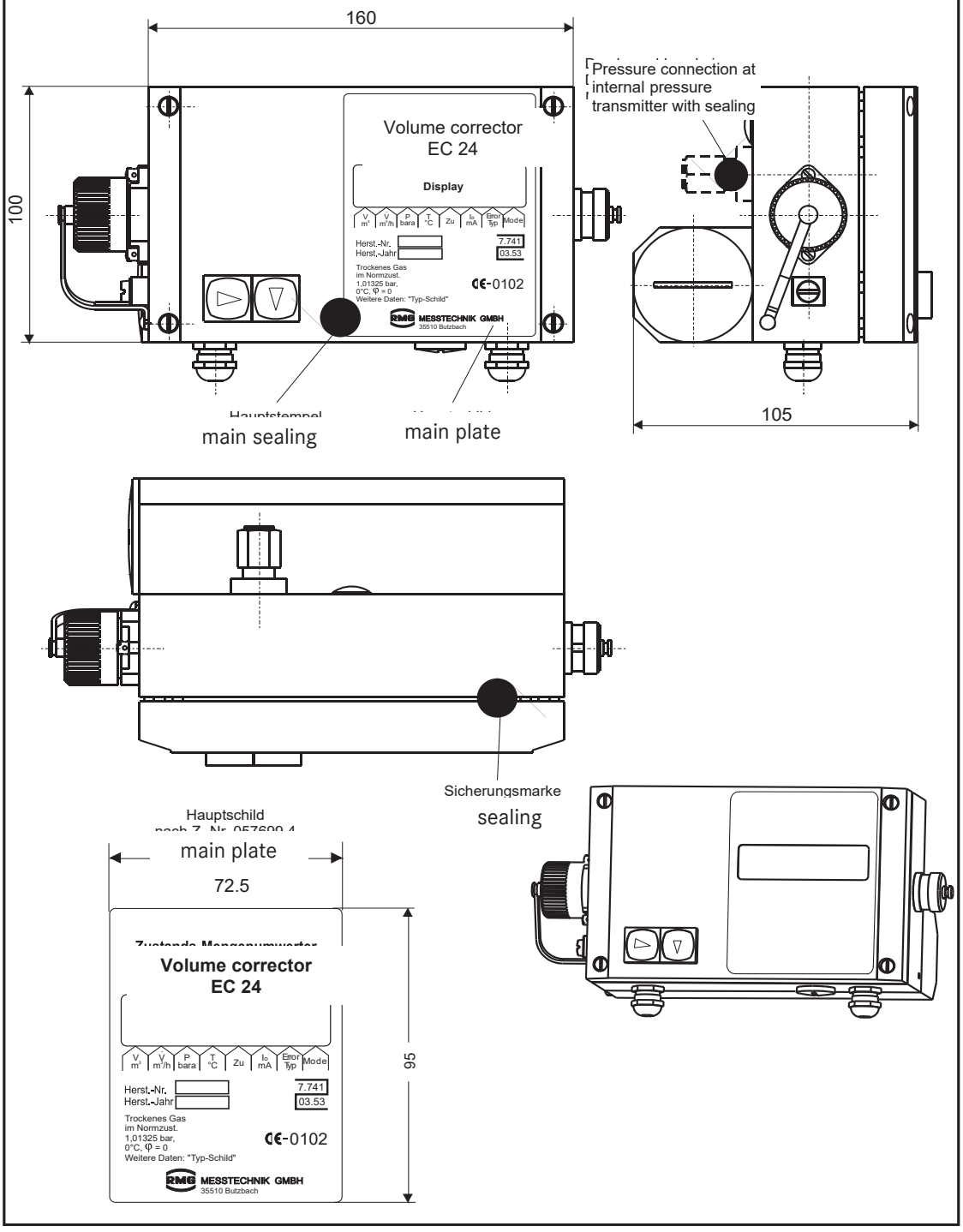
# H Sealing plan

RMG MESSTECHNIK GMBH
Pintsch-Gerätetechnik

Z Volume corrector EC 24

Sealing plan with main plate

Z.-Nr.: 057 699.4
Datum: 14.07.03
Gez.: Eckert
Gepr.
Stand: 04.08.03



*Subject to technical modification*

**For further information**
please visit our website:

www.rmg.com

or contact your local sales support office
to learn more about the RMG products.

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