OPERATING INSTRUCTIONS

Flow Computer

SYSTEM EC 694

VOLUME CORRECTOR

with

calculation of the volume at base conditions
and
calculation of the K coefficient in compliance with
GERG 88S or AGA-NX-19

10-key design

Status: July 2005

Contents

Introduction to the EC 694

General information

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. **If the EC 694 is not yet taken into operation, then read the chapter "start up instruction" (page 15) in any case.**

The function keys

The most important data for the operator can be directly selected via function keys. The following function keys are available:

– **Pressure**
– **Temperature**
– **C. Factor**
– **Totalizer**
– **ID**

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 **15** columns with **31** lines per column (including header line). The columns are marked **A** to **O**. The top line (header line) is not numbered, whereas the other lines below are numbered from 1 to 30. The operator can reach every value in this coordinate system using the cursor keys (arrows ◄ ▲ ▼ ►).

The display field

An alphanumeric 2-line display with 16 characters per line enables data and measured values to be indicated together with their abbreviated designations and units. The display has been designed as an LCD dot matrix so that it can be used especially in battery mode. Temperatures below -20°C or above +60°C may cause a disturbance of the display.

The system

A complete Flow Computer System has been developed on the surface of a few square centimeters 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.

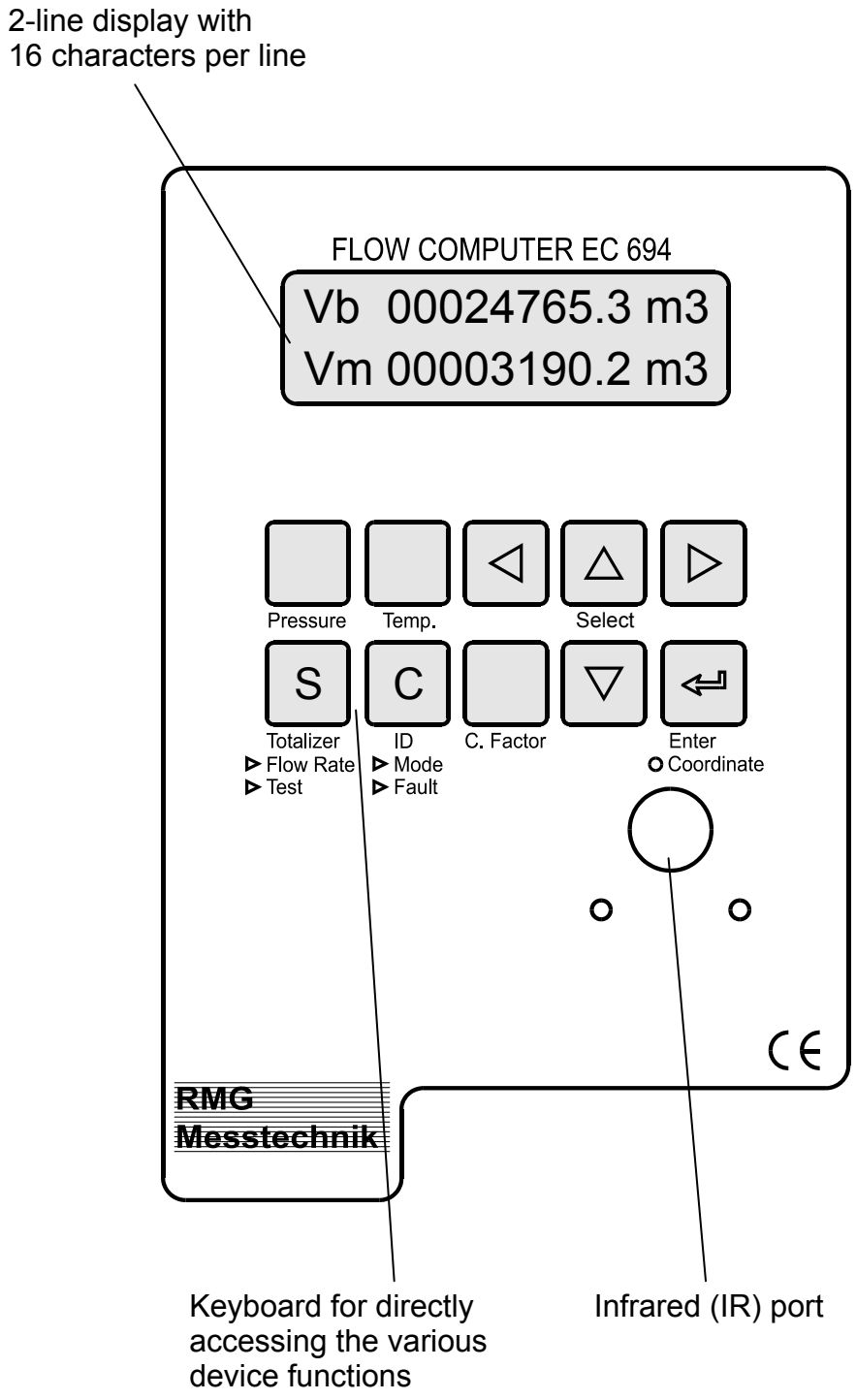
Program memory

The program memory of the basic unit has been incorporated into a flash memory located in the vicinity of the controller chip.

Reset

In case of a reset the power supply will be interrupted and the volume corrector will be switched off for this period of time. Program and operating parameters are not influenced by this means and also the totalizer readings are preserved. At the EC 694 a reset is done by disconnecting the battery as well as a possibly installed external power supply.

EC 694 front panel



Description of function keys

Pressure

Press this function key to display the **pressure** and use the ▲ ▼ keys to display all values related to the pressure. Press the ◄ key to display the **fault messages** and scroll up or down using the ▲ ▼ keys.

Temp.

Press this function key to display the **temperature** and use the ▲ ▼ keys to display all temperature-related values.

C. Factor

Press this function key to display the **conversion factor** and the **K coefficient** and use the ▲ ▼ keys to display all values related to the gas analysis.

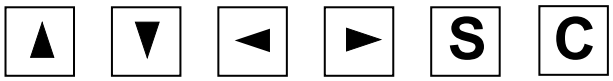
Totalizer
▷Flow Rate
▷Test

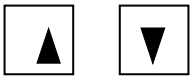
- Press this function key to display the **totalizer** and use the ▲ ▼ keys to display all values related to the totalizers.
- Press the ► key to display the **flow rate** and use the ▲ ▼ keys to display all values related to the flow rate.
- Press the ► key to display the **test** and use the ▲ ▼ keys to display all values related to the test totalizers.

ID
▷Mode
▷Fault

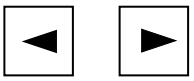
- Press the ► key to display the **ID data** and scroll up or down using the ▲ ▼ keys.
- Press the ► key to display the **operating modes** and scroll up or down using the ▲ ▼ keys.
- Press the ► key to display the **fault messages** and scroll up or down using the ▲ ▼ keys.

Description of special-function keys





Use the ▲ ▼ keys to scroll up or down by lines within a column. If you press the ▲ key in the first line of a column, you will jump to the last line of this column. In input mode, use these keys to increase or decrease current values or to scroll up or down in texts you are given for selection.



Use the ◄ ► keys to scroll either to the left or right by columns within a line. Press the ► key to jump via the last column to the first column or press the ◄ key to jump from the first column to the last column. In input mode, use these keys to select a digit within a number.

The following applies to cursor keys in general: Unoccupied columns and lines are automatically skipped. If the column you jumped to is occupied but the line field is empty, the first line is selected automatically.

- Press this key to display ID data directly.
- If the data logger has been activated, press the ► key twice to switch from the volume corrector to the data logger and vice versa.
- Press the ► key once to display operating modes (Mode).
- Press the ► key twice to display faults.
- Press this key to clear any changes entered into a field in input mode.

Enter
○ Coordinate

- Press this key to initiate a data input but make sure that the calibration switch is enabled or the user code was entered previously, depending on the type of the appropriate field.
- Press this key to complete a data input by transferring the input value or operating mode to the computer.
- Press this key to switch over from abbreviated designations to coordinates, if the computer is not in input mode.

Press this key to initiate various functions, such as resetting faults or starting on-the-fly calibration.

Displaying measured values and faults

Displaying measured values or computational results

- Press either the **Pressure** or **Temperature** function key. The measured value will be displayed in the top line of the display, whereas the physical value will be displayed in the bottom line.
- Press the **C. Factor** function key. The conversion factor will appear in the top line of the display, whereas the K coefficient will be displayed in the bottom line.
- Press the ▼ key to access subsequent values of the column selected. Press the ► key to access the next column or the ◄ key to access the previous column.

Displaying faults

The occurrence of a fault is indicated by the special character **#** in the top line of the display on the right and by an isolated contact at the terminal block. This character flashes, if there is a fault. If there are no more faults, the character turns to steady display.

Use the **C** key (ID, Mode, Fault) to display fault texts. Press the **C** key and then the ► key twice or the **Pressure** key and then the ◄ key once. Then you will be able to read in the top line of the display how you can reset the faults displayed. Faults that may have occurred will be displayed in the bottom line. If more than one fault has occurred, the text displayed changes approximately every two seconds.

The time and date of the first fault that occurred are displayed in the next two lines.

Enhanced function: event memory

Moreover, a detailed event memory is available which records not only fault messages but also other events like parameter changes, interface operation, resetting of faults, etc. A complete data record including totalizer readings, pressure, temperature, etc., is stored for each entry into the data memory.
You can select the event memory manually in the “Test” column. Press enter to jump to the last entry.

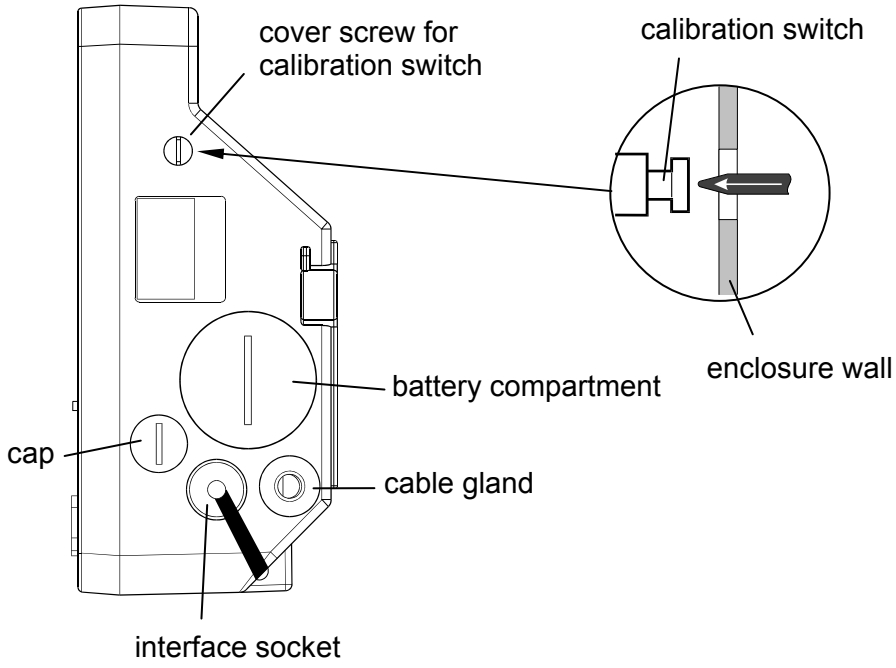
Special functions to be accessed using the S key

The **S** key comprises several special functions:
– Resetting faults
– In the data-logging memory: Displaying stored values (cf. page 31ff).
– Start, stop and reset in the on-the-fly calibration function (cf. page 13).

Resetting faults

First proceed in the same way as described under displaying faults. Then you will be given information about resetting fault messages in the top line of the display. Press the **S** key to reset the fault messages, provided these have been released by the computer for acknowledgement. The time and date of the last fault acknowledgement are displayed in the line O 4.

Operating the calibration switch



First remove the cover screw (for fiscal metering, this screw is covered by a seal) on the right side of the enclosure. Then press a pencil or a screw driver against the calibration switch until it snaps into place. Now the lock is removed, and the character **I** will be displayed in the first position of the top line. If you press the calibration switch again, the lock will be reactivated.

Inputting the user code

First press the **C** key and then the ► key to reach the “Mode” column. Then press the ▼ key twice. The following lines will be displayed:

MODE
Code * * * *-* * * *

Now press the ↵ key. The bottom line will change as follows:

MODE
Code 0???-????

Now select the first digit of your code number using the ▲ or ▼ key. Then press the ► key. The bottom line will change as follows:

MODE
Code ?0??-????

Now select the second digit and the subsequent ones in the same way as before. After you have selected the last digit and pressed the ► key, the special character **C** will be displayed in the first position of the top line of the display and the initial state will be displayed again in the bottom line of the display.

You can now change all fields disabled by means of the user-code lock. This user-code lock is automatically reactivated if you press no key for 30 minutes. You can immediately reactivate the user-code lock manually if you press the ► key prior to selecting the first digit of the user code as described above.

If you enable the calibration switch, all fields disabled by means of the user-code lock are also automatically enabled so that inputs can be made. It is now even possible to change the user code.

Inputting numeric values

Since the EC 694 provides no keys for numbers from 0 to 9, the decimal point or positive or negative signs, you must make your inputs by rolling the individual digits of a number up or down.

Example:
Changing the pressure default value.

- First enable the calibration switch or enter the user code.

- Search the input field for the pressure default value and press the ↵ key to reach input mode. You can see that you are in input mode if the special character **I** (input) or **C** (code number) is displayed in the first position of the top line of the display. The input control of the computer automatically accepts the value of the first digit inputted, which starts to flash. If the line only switches to displaying coordinates without displaying **I** or **C**, you cannot make any inputs.

p	**10.627 bara**
pdef	**11.250 bara**

- You can change the digit using the ▲ ▼ keys.
- Press the ► key to reach the next digit and proceed here in the same way as before. If you press the ► key beyond the last possible input position, the first input digit will be selected again.
- Press the ◄ key to return to one of the previous input positions in order to correct it and after the first input position to the last position.
- Press the ↵ key again to complete your inputs and store the new value.
- If you enable inputs by pressing the ↵ key and complete them by pressing this key again without having pressed another key, the previous value will remain stored. The value stored will not be overwritten unless it is recognized that the value displayed differs from the value stored or at least the ► key has been pressed.

If you happen to press the **C** key while making your inputs, the value inputted will be erased and the original value will be restored.

You can input a negative sign only with floating-point numbers in the first input position.

You can input a point only in one position of your input. If the computer identifies a point, this will be omitted from the selection of the next digit positions. If a large floating-point number is changed into a smaller number, it is possible that two points are visible in the display.

1. If you try to reach the next input position across the second point by pressing the ► key, the latter will be disabled until you have changed the point.

2. If you try to complete your inputs by pressing the ↵ key, the input positions after the first point will be set at zero.

After you have completed all your inputs, disable the calibration switch or disable user access. If user access remains enabled for more than 30 minutes and no key is pressed during this time, the computer will automatically disable access to the system.

Changing operating modes

If you want to change an operating mode, first proceed as if you were changing numeric values. As soon as you reach input mode, select the desired mode from the menu using the ▲ ▼ keys and press the ↵ key to accept the mode selected.

Programming the current output

The pressure, temperature, conversion factor or volume flow rate at either measurement or base conditions can be outputted as a current of 4-20 mA in the event of external power supply. First select the quantity to be outputted in coordinate N 12. Then enter the measured values for an output current of 4 mA into N 14 and for an output current of 20 mA into N 15. If you have selected “Calibration current” in N 12, a constant current is outputted which you can set in coordinate O 23.

On-the-fly calibration test function

Description of the function

The on-the-fly calibration function enables the totalizers for the volume at measurement conditions and the volume at base conditions to be operated in parallel with the normal totalizers during a limited period (1 hour). You can start or stop these totalizers through the keyboard. The running time is shown by a “stop-watch” which runs at the same time. To enhance resolution, the formats of the totalizers have been expanded to three decimal places for this operating mode. This function can be used for an operating point test.

Activating the test

Press the **S** key and then the ► key until the CVb totalizer appears. The top line will display either

“Start = S Key”	(on-the-fly calibration is ready to start and the totalizers can be started)
or	
“Stop = S Key”	(on-the-fly calibration is running and the totalizers and the stop-watch are running)
or	
“Reset = S Key”	(on-the-fly calibration has been stopped and the totalizers and the stop-watch can be read and then reset)

Consequences in the case of battery operation:

During the time on-the-fly calibration is running, the EC 694 will not switch to energy-saving mode. If the device is operated in the on-the-fly calibration test function, you must make sure that this function is stopped automatically after one hour and the device is switched to energy-saving mode. If this function is performed frequently over the full length of the running time of one hour, the battery life will be reduced.

Data-logging memory

The EC 694 has a data-logging memory which can store hourly, daily, monthly and yearly quantities. For a more detailed description, see the chapter “Data logger”.

Activating the data-logging memory:

1. Select the “Logger ON” storage mode in coordinate M 25.
2. To set the start date, press the **C** key twice and then the ▲ key until “LOG-D” appears. Here enter the start date.
3. To set the start time, press the ▼ key once so that “LOG-T” appears. Here enter the start time.

As soon as the start time has been reached, a “Logger ON” entry appears in the event memory. To check this, press the **S** key and then the ► key until “Start = S key” appears. Now press the ▲ key until you reach “Events” and then press the **S** key to display the event memory. Here you can scroll to check whether “Logger ON” has been entered.

From the time the data-logging memory has been started, a data record is stored after each complete hour which includes the following values: Vm, Vb, P, T, VmD, VbD, C and K. These values are entered into several archives and sorted logically. A maximum of 4,320 entries can be stored until the circular buffer starts to overwrite the oldest entries. If a To transducer operating mode has been selected as transducer type mode in field K 01, the reading of this totalizer is shown additionally.

Data can be read out manually or using the PVP program via the optical interface (IR port) on the front panel or the 3-wire interface on the right side of the device.

Data memory

Activating the data memory

1. Select the “Data M. ON” storage mode in coordinate M 25.
2. Enter the interval into coordinate L 11. Then the data memory will start immediately with the set interval (no start date).

Each time a time interval has elapsed, a data record is stored with the values: Vm, Vb, P, T, VmD, VbD, C and K.
A maximum of 720 entries can be stored, until the circular buffer starts to overwrite the oldest entries.
If data recording is made on a minute basis, the battery life will be reduced to a maximum of two years.

Data can be read out manually through the keyboard associated with the device or using the PVP program via the 3-wire interface or the optical interface (IR port).

Start-Up Instructions

Device variants

The following table shows the possible device variants which differ in power supply and pulse input. See the supplied documents to determine which device variant is concerned.

	Pulse input	Pulse output	Current output
Battery-powered device (Ex)	- Reed	Switch it on in K 25	Not possible!
9.2 V supply (Ex)	- Reed - Reed / Namur - Namur - Wiegand	Switched on on delivery	Only passive operation permissible (explosion protection)
24 V supply (non Ex)	- Reed - Reed / Namur - Namur - Wiegand	Switched on on delivery	Operation - active or - passive

Instructions for connection

1. If the EC 694 is operated with only one pulse input, the pulse transmitter is to be connected to terminals 21 and 22.
2. In the case of combined Reed / Namur operation, pulse counting (Vm) is performed via the Reed input (terminals 21 and 22). Namur pulses are used for the flow display and the current output; the Namur transmitter is to be connected via terminals 4 (+) and 5 (-).
3. Note the polarity of the output pulses. If necessary, use a polarity converter (available as accessory under the order number 50.36.763.00).
4. In the case of devices with battery backup, you must check after start-up whether the battery is connected and enabled.
5. The current output (4-20 mA) is to be connected differently for active and passive operation:
   - **- active:** Connection to terminals **13 (-)** and **14 (+)**.
     An external power supply must not be used in no event. If you connect an external voltage, this will result in the destruction of the current output!
     There is no electrical isolation towards the 24 V supply of the EC 694.
   - **- passive:** Power is supplied by an external supply unit, connection to terminals **13 (+)** and **14 (-)**.
6. To output a current (qVm or qVb), the input frequency must exceed 2 Hz!
7. The cable towards the temperature pick-up can be up to 25 m in length. It can be up to 3 m in length towards an external pressure transmitter!

Parameterization

During start-up, it is necessary to set or change several parameters. The most important ones are listed below. Please proceed in the same order, since some parameters are displayed or can be changed only after other parameters have been programmed. The coordinate of the parameter and the default value (DV) of common values are shown in parentheses.

Parameters which must always be programmed:

1. Define whether the EC 694 is to be operated by battery or an external power supply unit and whether the flow rate (O 22) is to be shown (for operation with HF pulses). If the mode is changed, you must disconnect the EC 694 from its power supply or battery for a short time.
2. Select the procedure for calculating the K coefficient (G 12, DV: GERG-88-S).
3. Select the physical unit for pressure (A 13, DV: bar a).
4. Replacement value for pressure which is used when a fault occurs in pressure measurement (A 6).
5. Standard pressure (A 8, DV: 1.01325 bar*****)
6. Replacement value for temperature which is used when a fault occurs in temperature measurement (F 6).
7. Standard temperature (F7 with AGA-NX-19 and K=const, F 8 with GERG-88-S and AGA-8; DV: 0°C*****).
8. Select the physical unit for the superior calorific value (G 21, DV: kWh/m^3).
9. Analytical values for calculating the K coefficient in accordance with GERG-88-S: superior calorific value (G 20), standard density (G 19) and CO_2 content (G 17). For calculations in accordance with AGA-NX-19: superior calorific value (G 20), relative density (G 19) and N_2 content (G 18).
10. Select the reference temperature for the superior calorific value (G 22, DV: 25°C*****)
11. Pulse value of the meter for volume measurement (K 2) and flow calculation (K 13, only with Reed / Namur version). The preset value is normally only a value for testing!
12. Set whether and how switching over to summer/winter time is to be made (N 28).

***** This value is mandatory in Germany.

Parameters which have to be programmed depending on the operating mode:

1. In the case that flow display is enabled: Measuring range of the gas meter with qmmin (I 4) and qmmax (I 5). In the case of ¼ qmmin, the input frequency should exceed 2 Hz.
2. Program the pulse outputs with select mode (K 25), mode for assignment to Vm or Vb (K 26), scaling factors (H 10 and H 12) and pulse period and interpulse period (K 27 to K 30).
3. Program the current output by selecting the quantity to be outputted (N 12) and the output limits I< (N 14, for 4 mA) and I> (N 15, for 20 mA).

Coordinate System of the EC 694

Coordinates from A to J

		Pressure	Temperature	Analysis	Totalizers	Flow rate 1	Flow rate 2
		A / 01	F / 06	G / 07	H / 08	I / 09	J / 10
0	Meas. val. 1	bara	°C	C	Vb	qm	qb
1	Meas. val. 2			K	To		
2	Input / Tot	Up	ohm	Zb	Vm	fqm	
3	Input / Tot			Z			
4	Min. range	p min.	t min.			qm min.	
5	Max. range	p max.	t max.		VbD	qm max.	
6	Default	p default	t default	K fixed val.			
7	Spare		tb AGA		VmD		
8	Reference	pb	tb GERG				
9	Correction factor			CA		qmA	qbA
10	Min. contact				O1 scaling factor		
11	Max. contact						
12	Mode 1	ON / Def	ON / Def	K calc.mode	O2 scaling factor		
13	Mode 2	p unit	t unit				
14	Mode 3				Totalizer mode		
15	Mode 4						
16	Calc. val.			rho calc.			
17	Calc. val.			CO2			
18	Calc. val.	Umin		H2 / N2			
19	Calc. val.	pumin		sd / rd			
20	Constant	pc	t corr.	Hs			
21	Constant	pA0		Hs unit		f<L	
22	Constant	pA1		Hs ref temp		t<qmmin	
23	Constant						
24	Output						
25	Special					>qm	>qb
26	Special				VmP	t>qm	t>qb
27	Spare						
28	Spare						
29	Spare						
30	Spare						

Display field

Input field locked via code number

Input field locked via calibration switch

Coordinates from K to O

		Flow parameters	Test	ID	Mode	Fault
		K / 11	L / 12	M / 13	N / 14	O / 15
0	Special	Heading	Heading	ID	MODE	FAULT
1	Special	Operating mode	CVb	p type	Time	Fault text
2	Special	Kv		p No.	Date	Fault time
3	Special	Unit	CVm	p min.	Code No.	Fault date
4	Special			p max.	Prog. date	Last reset
5	Special			t type	Operating hours	
6	Special	Set-Vb	C duration	t No.	RS-IR mode	
7	Special	Set-Vm	LOG-D	t min.	RS-IR baud rate	
8	Special	Pulse scal. factor	LOG-T	t max.	RS-4-wire mode	
9	Special	Set-To	LOG-I	M type	RS-4-wire bd rate	
10	Special			M No.	RS-service mode	
11	Special		DAT-I	M size	RS-service bd rate	
12	Special	Mant.	Data memory	M min	Imod	
13	Special	KTo	Cur. hourly qty	M max	Output current	Supply voltage
14	Special		Last hourly qty	Kv	I<	clk
15	Special		Max. hourly qty	Gas type	I>	
16	Special	To mode			IA	
17	Special	q mode		Bat. change	Emer. power	
18	Special					
19	Special	Pulse input				
20	Special					Test
21	Special					
22	Special				Lamp test	Hardw. type
23	Special			L-Source	Quartz frequency	Ical
24	Special			L-Pulses	Bit3D	Iout corr.
25	Special	Output pulse select	TD gas day	D.log./D.mem.		Iout corr.
26	Special	Output pulse assign	TM gas month	L-Test		
27	Special	Output1 pulse width	TAH hourly rec.	Computer No.		
28	Special	Output1 pause width	TAD daily rec.		Time zone	
29	Special	Output2 pulse width	TAM monthly rec.	Computer type	Summer time	
30	Special	Output2 pause width	E events	Software vers.	Winter time	

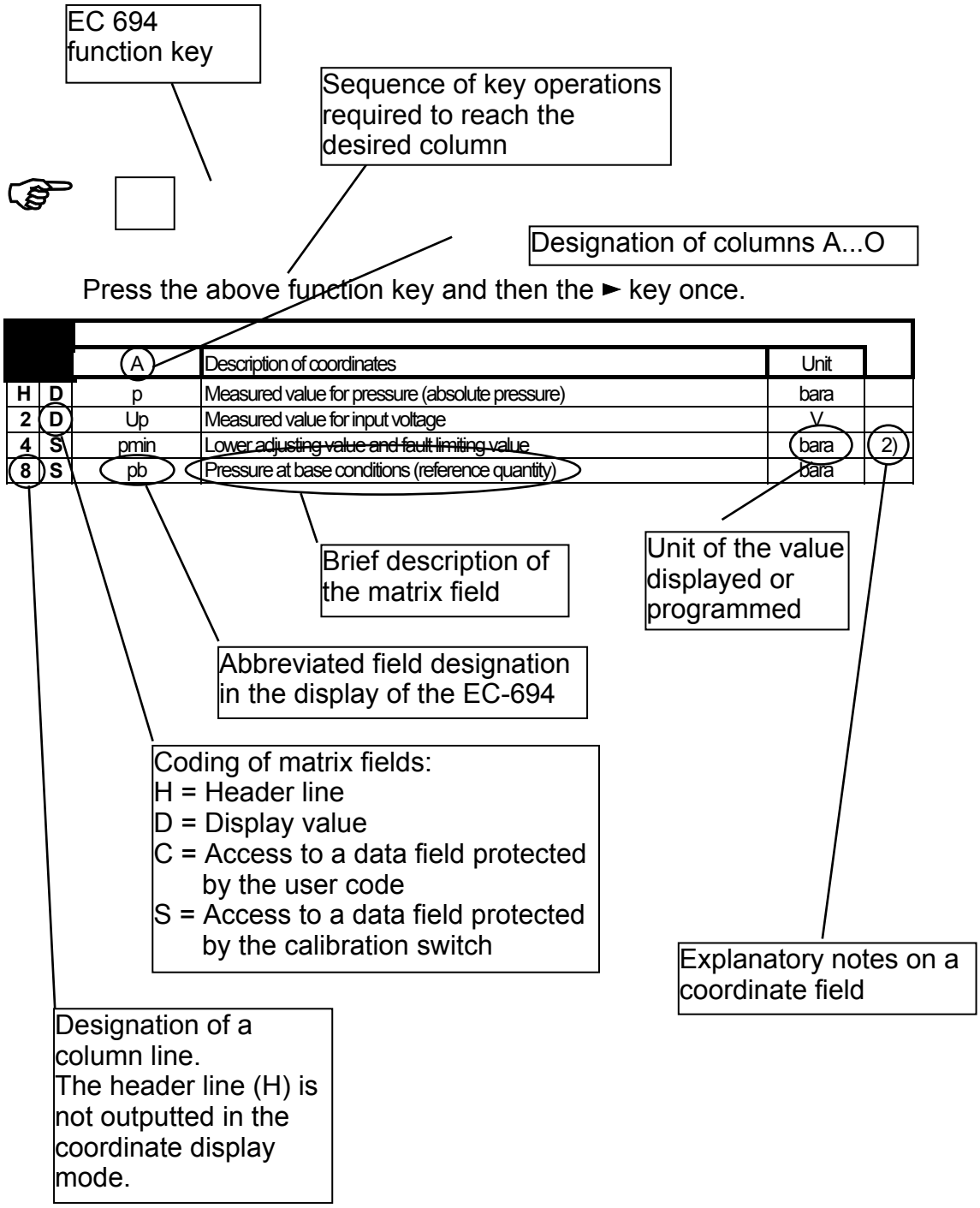
Display field

Input field locked via code number

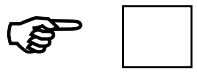
Input field locked via calibration switch

Description of Individual Columns

Column structure



Pressure at measurement conditions



Pressure

		A	Description of coordinates	Unit 2)	
H	**D**	p	Measured value for pressure (absolute pressure)	bara	
2	**D**	Up	Measured value for input voltage	V	
4	**S**	pmin	Lower adjusting value and fault limiting value	bara	
5	**S**	pmax	Upper adjusting value and fault limiting value	bara	
6	**C**	pdef	Default value (replacement value if a fault occurs)	bara	
8	**S**	pb	Pressure at base conditions (reference quantity)	bara	
12	**S**	pmod1	Current input mode p = ON / Default		1)
13	**S**	pmod2	Unit mode: switching units for display		1) 3)
18	**S**	Umin	Constant from basic calibration of the pressure transducer	V	4)
19	**S**	pumin	Constant from basic calibration of the pressure transducer	bara	4)
20	**S**	pc	Constant from basic calibration of the pressure transducer		4)
21	**S**	pA0	Correction value for pressure transducer		4)
22	**S**	pA1	Correction value for pressure transducer		4)

1) Rolling texts! Use the ▲ ▼ keys to make your changes.
2) The units displayed in the appropriate fields vary depending on the operating mode selected in field A 13 (option).
3) Options: bara kg/cm^{2}a
4) The values of A 18 through A 20 are determined during the initial pressure transducer test. Umin is the voltage supplied by the pressure transducer at the lowest test pressure pumin, whereas pc is the calibration factor. With the voltage U at the pressure transducer, the pressure can be calculated as follows:

$$p_{uncorr.} = pu\min + pc \cdot (U - U\min).$$

Using the values pA0 and pA1, it is possible to make a fine adjustment (during the volume corrector test), so that the pressure at measurement conditions p can be calculated as follows:

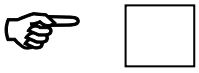
$$p = p_{uncorr.} \cdot pA0 + pA1$$

The two correction values can be calculated as follows:

$$pA0 = (p_{specified(max)} - p_{specified(min)}) / (p_{actual(max)} - p_{actual(min)})$$

$$pA1 = p_{specified(max)} - pA0 \cdot p_{actual(max)}$$

Temperature at measurement conditions (PT 1000)



Temp.

		F	Description of coordinates	Unit 2)	
H	**D**	t	Measured value for gas temperature	°C	
2	**D**	Rt	Input resistance	ohm	
4	**S**	tmin	Lower fault limiting value	°C	
5	**S**	tmax	Upper fault limiting value	°C	
6	**C**	tdef	Default value (replacement value if a fault occurs)	°C	
7	**S**	tb	Temperature at base conditions (AGA-NX-19, Beattie, K=const.)	°C	4)
8	**S**	tb	Temperature at base conditions (GERG, NX-19-corr, AGA-8)	°C	1) 4)
12	**S**	tmod1	Temperature input mode t = ON / Default		1)
13	**S**	tmod2	Unit mode: switching units for display		3)
20	**S**	tc	Correction factor: balancing A/D converter offset		

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) The units displayed in the appropriate fields vary depending on the operating mode selected in field F 13.

3) Options: °C / K / °F

4) If the AGA-NX-19, Beattie-Bridgeman or K=const. operating modes is selected in field G 12, use field G 7 to freely enter the temperature at base conditions. In GERG-88-S, AGA-8 or AGA-NX-19-corr operating modes, the temperature at base conditions can only be selected from among the options of field F 8 (0 / 15 / 15.56 / 20 and 25°C).

Analysis

C. Factor

		G	Description of coordinates	Unit	
H	**D**	C	Conversion factor		
1	**D**	K	Gas law deviation coefficient		
2	**D**	Zb	Compressibility factor at base conditions		
3	**D**	Z	Compressibility factor at measurement conditions		
6	**C**	Kdef	Fixed value for K coeffient		
9	**C**	CA	Conversion factor damping		
12	**S**	Kmod1	K coefficient calculation mode = K const / Beattie / GERG-88-S / AGA-NX-19 / NX-19-corr / AGA-8		1) 6)
16	**D**	ra	Calculated density	kg/m3	
17	**C**	CO2	Carbon dioxide content	%	5)
18	**C**	H2 or N2	Hydrogen content (GERG-88-S) or nitrogen content (AGA-NX-19)	%	5)
19	**C**	sd or rd	Standard density (GERG-88-S) or relative density (AGA-NX-19)	kg/m3	5)
20	**C**	Hs	Superior calorific value	kWh/m3	2) 5)
21	**C**	Kmod5	Unit mode: switching units for display		3)
22	**S**	Kmod6	Reference temperature mode: 25 / 20 / 15 / 0	°C	1) 4)

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) The unit displayed in field G 20 varies depending on the operating mode selected in field G 21.

3) Options: kWh/m^3
MJ/m^3
$kcal/m^3$
$Mcal/m^3$
BTU/ft^3

4) Combustion temperature to which the superior calorific value is related.

5) Not displayed with Beattie.

6) AGA-NX-19: without H-group gas correction
NX-19-corr: with H-group gas correction

Totalizers

S

Totalizer
▷ Flow Rate
▷ Test

		H	Description of coordinates	Unit	
H	**D**	Vb	Main totalizer for volume at base conditions	m3	3)
1	**D**	To	Reference totalizer for volume at measurement conditions	m3	3) 5)
2	**D**	Vm	Main totalizer for volume at measurement conditions	m3	3)
5	**D**	VbD	Disturbing quantity totalizer for volume at base conditions	m3	
7	**D**	VmD	Disturbing quantity totalizer for volume at measurement conditions	m3	
10	**S**	O1sf	Scaling factor for output contact 1 (0.1 – 100,000)	m3/I	4)
12	**C**	O2sf	Scaling factor for output contact 2 (0.1 – 100,000)	m3/I	4)
14	**S**	Tmod1	Totalizer mode = Fault stop / Fault cont		1) 2)
26	**C**	VmP	Settable totalizer for volume at measurement conditions (no fiscal metering)	m3	6)

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) Tmod1 = Fault stop: In the event of an alarm, the main totalizers stop and the disturbing quantity totalizers start to run.
Tmod1 = Fault cont: In the event of an alarm, the main totalizers continue to run, and in addition to this, the disturbing quantity totalizers start to run.

3) The totalizers can be set in column K (flow parameters).

4) The scaling factors can be selected freely, but you must note that the maximum pulse rate is 3 pulses per second. If the output is assigned to a totalizer for fiscal metering (see coordinate K 25), programming is only possible if the calibration switch was enabled previously. If the output is assigned as a dispatcher output, the user code is sufficient.

5) The To totalizer is used as a check totalizer in conjunction with a mechanical totalizer. It even continues to count if there is a fault. It has its own pulse values for both LF and HF transducers and can be adjusted to comply with the representation of the mechanical totalizer. It is settable and also available in emergency power supply mode and, if the data logger has been activated, its readings are stored in the hourly and daily data archives.

6) This additional totalizer is independent of Vm, Vb and To and is set directly, not in column K.

Volume flow rate at measurement conditions

This column is not available for battery/mains-powered devices without an activated display of the flow rate.

S

Totalizer
▷ Flow Rate
▷ Test

Press the above function key and the ► key once.

		I	Description of coordinates	Unit	
H	**D**	qm	Calculated volume flow rate at measurement conditions	m3/h	
2	**D**	fqm	Input frequency	Hz	1)
4	**S**	qmmin	Lower fault limiting value of the volumetric meter	m3/h	
5	**S**	qmmax	Upper fault limiting value of the volumetric meter	m3/h	
9	**C**	qmA	Damping of the volume flow rate at measurement conditions		
21	**S**	f<L	Minimum volumetric meter frequency	Hz	2)
22	**C**	t<qmmin	Maximum operating time for qm<qm-min	min	3)
25	**D**	>qm	Max. value of the volume flow rate at measurement conditions	m3/h	4)
26	**D**	t>qm	Time of max. value (date / time)		

1) Display of the frequency of the measuring channel. In the event of a failure of this channel, the frequency of the reference channel is displayed.
2) Lower frequency limit of the volumetric meter. If the frequency falls below this limit, flow calculation is no longer carried out (only pulse counting). We would recommend using a frequency corresponding to one fourth of Q_{min}. The frequency should not fall below 2 Hz, since the measured value for the current output is frozen for a period of at least 1/f<L. Therefore, you should deactivate the current output if there are low-frequency input pulses (J15: Set qmod4 to “OFF”).
3) Time in minutes during which the volumetric meter can be operated below Q_{min} before an alarm is generated.
4) Resetting the maximum value: – Unlock the user-code lock.
   – Select the maximum value.
   – Press enter.

Volume flow rate at base conditions

This column is not available for battery/mains-powered devices without an activated display of the flow rate.

S

Totalizer
▷ Flow Rate
▷ Test

Press the above function key and the ► key twice.

		J	Description of coordinates	Unit	
H	**D**	qb	Volume flow rate at base conditions	m3/h	
9	**C**	qbA	Damping of the volume flow rate at base conditions		
25	**D**	>qb	Maximum value of the volume flow rate at base conditions	m3/h	1)
26	**D**	t>qb	Time of maximum value (date / time)		

1) Resetting the maximum value: – Unlock the user-code lock.
– Select the maximum value.
– Press enter.

Flow parameters

Totalizer
▷ Flow Rate
▷ Test

Press the above function key and then the ► key once (battery-powered device).
Press the above function key and then the ► key three times (in the event of external power supply).

		K	Description of coordinates	Unit	
H	**D**	Header text	Flow parameters		
1	**S**	qmod1	Transducer type mode: 1*Reed-/Nam		1)
2	**S**	Kv	Volumetric meter pulse value	P/m3	
3	**S**	Emod1	Unit of flow rate		1)
6	**S**	Set-Vb	Setting the main totalizer for volume at base conditions		
7	**S**	Set-Vm	Setting the main totalizer for volume at measurement conditions		
8	**S**	Puls	Pulse scaling factor 1 / 2 / 5 / 10 / 20 / 50 / 100 / 300 / 600	P	1)
9	**S**	Set-To	Setting the To totalizer		
12	**S**	Mant.	Adjusting the representation of the check totalizer to comply with the mechanical totalizer: 6 Digits / 7 Digits / 8 Digits / 9 Digits		
13	**S**	KTo	Pulse value of the volume transducer's HF pick-off	P/m^3	
16	**S**	Tomod	Mode To totalizer: TO OFF / TO Softw. / TO Hardw.		
17	**S**	qmod	Mode flow rate display: qm ON / qm OFF		
19	**S**	Plnp	Selection of input pulses: Tot.-Reed / Tot.-Nam		
25	**C**	Dmod2	Pulse output mode : selection		1) 2)
26	**C**	Dmod3	Pulse output mode: assigning pulse outputs to the totalizers		1) 3)
27	**C**	Pwdth1	Pulse width of totalizer outputs 10 / 20 / 30 / 40 / 50 / 75 / 100 / 125 / 150 / 175 / 200	ms	1) 4)
28	**C**	Pper1	Pulse pause width of totalizer outputs 10 / 20 / 30 / 40 / 50 / 75 / 100 / 125 / 150 / 175 / 200	ms	1) 4)
29	**C**	Pwdth2	Pulse width of totalizer outputs 10 / 20 / 30 / 40 / 50 / 75 / 100 / 125 / 150 / 175 / 200	ms	1) 4)
30	**C**	Pper2	Pulse pause width of totalizer outputs 10 / 20 / 30 / 40 / 50 / 75 / 100 / 125 / 150 / 175 / 200	ms	1) 4)

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) The device has two volume pulse outputs (indicated in the display as OUT1 and OUT2) which can be selected as totalizer outputs for fiscal metering or as dispatcher outputs.
Battery-powered devices: If the pulse outputs are not needed, they should be deactivated to save battery power.

Options: TON: totalizer output ON (fiscal metering)
DON: dispatcher output ON (no fiscal metering)
OFF: pulse output deactivated

In the mode "TON" no pulses are outputted if the volume corrector is disturbed. In the mode "DON" the summed pulses are outputted both in the disturbed and in the undisturbed state.

3) Assigning the pulse outputs to V_m or V_b

Options:	OUT1	OUT2
	Vb	Vb
	Vm	Vm
	Vb	Vm
	Vm	Vb

(See coordinates H 10 and H 12 for scaling factors)

4) For battery-powered devices, we would recommend you to select the pulse width as small as possible, since higher values will reduce the service life of the battery.

5) The possible settings in field K-1 depend on the type of hardware. There are the following 3 variants:

   a) in the case of devices with the standard card (Reed/Namur) "1*Reed/Nam." is displayed. In field K-19 you can select whether the Reed pulses (always via the terminals 21/22) or the Namur pulses (terminals 4/5) are used for Vm counting. If both inputs are used, then the Reed pulses are counted into the totalizers Vb and To (Tomod in K-16 set to "TO Softw.") and the Namur pulses are used for the flow rate calculation (qMod in K-17 set to "qm ON") and for the current output.

   b) in the case of devices with Namur card "1*Nam" or "2*Nam" can be selected. The selection of "Tot.-Reed" in field K-19 is not possible.

   c) in the case of devices with Reed card "1*Reed" or "2*Reed" can be selected. The selection of "Tot.-Namur" in field K-19 is not possible, the field K-17 is not visible.

6) This field is displayed only if the mode in field K-17 is set to "qm ON". Here the meter pulse value of the Namur volume pulse transmitter must be entered.

7) This field is displayed only if the totalizer To is activated (settable in K-16).

Test

S

Totalizer
▷ Flow Rate
▷ Test

Press the above function key and then the ► twice (battery-powered device).
Press the above function key and then the ► key four times (in the event of external power supply).

		L	Description of coordinates	Unit	
H	**D**	Header text	(Text varies depending on the on-the-fly calibration status)		
1	**D**	CVb	On-the-fly calibration: totalizer for volume at base conditions		
3	**D**	CVm	On-the-fly calibration: totalizer for uncorrected volume at meas. conditions		
6	**D**	C-durat	Duration of the on-the-fly calibration	s	
30	**D**	E EVENTS	Event archive		1)

1) **Event memory**
If the heading “E EVENTS” appears in the display, press the **S** key to display the contents of the event memory. The time and date (time stamp) associated with the events will appear in the top line of the display. Press the **S** key again to return to the “Test” column.
Press enter to jump to the last (current) entry. If you press the **C. Factor** key, you can switch between the time stamp and the index (internal numbering) in the top line of the display.
Storage depth: 400 entries
Events stored: All operations carried out on the EC 694, such as changing values, fault messages, enabling or disabling the calibration switch, etc.

Structure of an entry in the event memory:

- Event in plain text (if there is a "+" before, then this means the occurrence of the event or the beginning of an action or a disturbance. In combination with a "-" the end of a disturbance or an action is marked.)
- Time of the entry
- The current values of: Vm, Vb, VmD, VbD, p, T, Zu, K
- With the mode "qm ON" (field K-17): Qm, Qb

List of the events recorded additionally to the fault and warning messages:

Message text	Description
Hour change	Entry into hourly archives (only in test operation)
Day change	Entry into daily archives (only in test operation)
Month change	Entry into monthly archives (only in test operation)
Field input x-xx	Change of a computer parameter with indication of column and line
+Input switch	Calibration switch has been opened
-Input switch	Calibration switch has been closed
+User code	Password has been entered
-User code	Locked again by password
Fault reset	Manual acknowledgement of the entries in the error display (field O-1)
+RS inquiry	Waking up the computer in battery operation via receipt of a character on one of the serial interfaces with the PVP protocol
-RS inquiry	Falling asleep of the computer after the transmission of the last character on one of the serial interfaces, if no new character has been received via one of the interfaces within 20 seconds
test mode on	Test mode has been switched on
test mode off	Test mode has been switched off. (this takes place automatically 60 minutes after last pressing a key)
Data memory on	Switching on the data logger
Data memory off	Switching off the data logger
Data log mem.on	Switching on the tariff memory
Data log mem.off	Switching off the tariff memory
Totalizer reset	Resetting of all totalizers and pulse outputs
TD-memory reset	maximum hourly quantity memory (hourly maximum of the last tariff day) reset *)
TM-memory reset	maximum daily quantity memory (daily maximum of the last tariff month) reset *)
TAH-memory reset	Hourly archives reset *)
TAD-memory reset	Daily archives reset *)
TAM-memory reset	Monthly archives reset *)
ET-memory reset	Event memory reset
Time = MEST	Change-over from winter to summer time
Time = MET	Change-over from summer to winter time
+backup battery	Switching to backup battery supply
-backup battery	Switching back to mains supply
store operation	Store operation switched on
battery oper.	Battery supply switched on
extern -FI	Mains supply without flow rate calculation switched on
extern +FI	Mains supply with flow rate calculation switched on

*) The events "TD -, TM -, TAH -, TAD and TAM-memory reset" are initiated together by only one command. Separate resetting of the individual memories is not possible.

Data logger

 **C** **(twice)**

ID
▷ Mode
▷ Fault

		L	Description of coordinates	Unit	
7	**S**	LOG-D	Start date of data logging		
8	**S**	LOG-T	Start time of data logging		
9	**D**	LOG-I	Recording interval of the data-logging memory	h	1)
11	**C**	DAT-I	Recording interval of the data memory		2)
12	**D**	DATA MEMORY	Heading		2)
13	**D**	CUR. HOURLY QUAN	Current hourly value		1)
14	**D**	LAST HOURLY QUAN	Last hourly data		1)
15	**D**	MAX. HOURLY QUAN	Maximum hourly data		1)
25	**D**	TD GAS DAY	Maximum hourly data of a gas day		1)
26	**D**	TM GAS MONTH	Maximum daily data of a calendar month		1)
27	**D**	TAH HOURLY REC.	Hourly data		1)
28	**D**	TAD DAILY REC.	Daily data (accumulated hourly quantities of a gas day)		1)
29	**D**	TAM MONTHLY REC.	Monthly data (accumulated hourly quantities of a calendar month)		1)

In field M 25, you can activate either the data memory or the data-logging memory. If the data-logging memory has been selected, only the fields identified by 1) are visible, whereas the fields identified by 2) are only visible if the data memory has been activated.

1) **Data-logging memory**
If the data-logging memory has been activated (field M 25), you can switch between the volume corrector and the data logger by pressing the **C** key twice. Use the arrow keys ▲ ▼ to select the desired data-logging memory from the menu and press the **S** key to display it. The time stamp of the measured values will appear in the top line of the display. Press the **S** key again to return to the selection menu.

To operate the data logger, use the following keys:

- **Pressure, Temp. and C. Factor keys**
  Without any function
- **C key**
  Press this key twice to return to the volume corrector.
- **S key**
  Switching between the selection menu and displaying memory contents (display mode) of the preselected menu item.
- **▲ key**
  Within the selection menu: Displaying the previous menu item.
  Within the memory: Scrolling forwards by hours and jumping from the last to the first entry if the end of the memory has been reached.
- **▼ key**
  Within the selection menu: Displaying the next menu item.
  Within the memory: Scrolling backwards by hours and jumping to the last entry if the beginning of the memory has been reached.
- **◄** or **► key**
  Displaying individual measured values (e.g. Vm, Vb, etc.) in display mode.
- **↵ key**
  Jumping to the current entry.

Retrievable memories
The following menu items can be retrieved within the data logger:

TD GAS DAY
Maximum hourly quantity of a gas day.
Storage depth: 370 days
Data stored: Vm and Vb.

TM GAS MONTH
Maximum daily quantity of a calendar month.
Storage depth: 14 months
Data stored: Vm and Vb.

TAH HOURLY REC.
Hourly data archive.
Storage depth: 4,320 hours (= 180 days)
Data stored: Vm, Vb, VmD, VbD, To, p and t.

TAD DAILY REC.
Accumulated hourly data of a gas day.
Storage depth: 370 days
Data stored: Vm, Vb, VmD, VbD, To, p and t.

TAM MONTHLY REC.
Accumulated hourly data of a calendar month.
Storage depth: 14 months
Data stored: Vm, Vb, VmD, VbD, To, p and t.

The To entries show the totalizer readings and not the quantities for the logging intervals.

The To totalizer in the TAH, TAD and TAM archives is only displayed if the appropriate mode has been selected in field K 1.

The hourly data for pressure, temperature, conversion factor and K coefficient are averaged!

2) Data memory

If the data memory has been activated, the heading “DATA MEMORY” will appear. Now you have the following options:

▲: Press this key to switch to the time interval (selectable, field L 11).
C: Press this key twice to return to the volume corrector.
S: Press this key to display the memory contents. The time stamp of the measured values will be displayed in the top line of the display. Now you can press the ▲ and ▼ keys to scroll in the entries, and if you press ► or ◄ you can display the individual measured values. Press enter to jump to the last (current) entry or press the **C** key twice to return to the volume corrector.

Storage depth: 720 entries
Data stored: Vm, Vb, VmD, VbD, p, t, C and K.

ID display

C

ID
▹ Mode
▹ Fault

		M	Description of coordinates	Unit 2)	
H	**D**	Header text	ID		
1	**S**	ptype	Pressure transducer select mode		1) 6)
2	**S**	pNo	Pressure transducer number		
3	**S**	pmin	Minimum range of the pressure transducer	bara	
4	**S**	pmax	Maximum range of the pressure transducer	bara	
5	**S**	ttype	Resistance thermometer select mode: PT 1000		1)
6	**S**	tNo	Number of the resistance thermometer		
7	**S**	tmin	Minimum range of the resistance thermometer	°C	2)
8	**S**	tmax	Maximum range of the resistance thermometer	°C	2)
9	**S**	Mtype	Gas meter type select mode: G4–G16000 / TM / Terz / RDM / VM / DGM		1)
10	**S**	MNo	Gas meter number		4)
11	**S**	Msize	Gas meter size		4)
12	**S**	Mmin	Minimum range of the gas meter	m3/h	4)
13	**S**	Mmax	Maximum range of the gas meter	m3/h	4)
14	**S**	Kv	Gas meter pulse value	P/m3	4)
15	**S**	Gas:	Gas type, e.g. natural gas		1) 5)
17	**C**	BC-in	Time until the next battery replacement	months	
23	**S**	LSour.	Origin of the test pulses for the data logging memory: Intern / Extern		
24	**S**	LPuls	Presetting of the number of pulses for the test of the data logging memory		
25	**S**	Lmod	Selection of data-logging memory / data memory		1) 3)
26	**S**	LTest	Start of the test programm for the data logging memory		1)
27	**S**	C-No	Serial number of the computer		
29	**S**	Cmod	Operating mode of the computer: pt-stand.		1)
30	**D**	Ver. pt	Version of the software installed		

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) The units displayed in the appropriate fields vary depending on the operating mode selected in columns A and F.

3) Options: OFF / Logger ON / Data M. ON

4) These fields are only displayed by mains-powered devices.

5) Natural gas, hydrogen, nitrogen, oxygen, air, ammonia, carbon dioxide, helium, neon, argon, methane, ethane, ethylene, propane, n-butane, krypton, xenon.

6) DA09/2, DA09/5, DA09/10, DA09/20, DA09/40, DA09/70

7) See the description of this test function on the next pages.

8) Only visible if LTest (M26) is set to “Log. test”.

Test of the data logging memory

Function:
By means of the tariff test the user is enabled to test the temporal, quantitative and contentwise sequence of the memory entries into the hourly, daily and monthly archives as well as the resulting entries in the maximum quantity memory, also during operation. The setting is possible only via opening the calibration switch. Maximally 20 tariff entries are possible, whereby a change of hour represents one entry. A change of day means two entries (1x change of hour plus 1x change of day) and the end of a month therefore causes three entries.
The tariff entries are caused by external or internally generated pulses (selection in field M-23).

NOTE:
The test uses the Unix time format for the temporal calculations. Here the seconds are counted by means of 1-second intervals since 1.1.1970. During normal operation "Unix time" and standard time are identical. If the time is changed, the Unix time is adapted automatically. This applies also to the change-over between summer and winter time.
During the tariff test the time read out from a clock chip is stopped, and only the "Unix time", fed from 1-second pulses is used. However if a change-over between summer and winter time should take place during the tariff test, this is not possible.
In addition the device, if it is battery-powered, does not go to sleep, so that in this time a permanent power consumption from the battery takes place. Furthermore the current output is switched off and the interfaces are blocked.

Conditions for the start of the tariff test:
The tariff memory must heve been started before and there must be at least one regular entry in the hourly archive. Furthermore the test is not started, if the time difference until the next full hour is less than 10 minutes or less than 1 minute has passed since completion of the full hour.

The test:
First an entry is generated in the event memory, which records the time of the test start with the current totalizer readings. With a test start all readings as well as a limited part of the archive memory is saved and the mean value memory of the archives for pressure and temperature is reset. Then all totalizers are set to 0. The second counter of the Unix time is set to 978328800, which corresponds to a time entry of 01.01.2000 06:00:00. Via the standard time the remaining time up to the next full hour will be calculated on minute basis and 2 minutes are subtracted in order to determine the maximum testing time. Afterwards the standard time is stopped.
Now the volume corrector counts all pulses coming into the volume input into the standard totalizers.

Performance:
- With external pulses: set the test mode in field M-26 to "Log. test" and LPuls in field M-24 to "1". Subsequently make changes of hours, days and months (see below).
- With internal pulses: set the test mode in field M-26 to "Log. test" and LPuls in field M-24 to the desired pulse number for the first entry. Subsequently make changes of hours, days and months (see below). For each further entry **increase** the value in field M-24 by the appropriate pulse number and make the changes again.

Note: With the test mode "Log. reset" the tariff memory is cleared!

Change of hour:
A change of the hour is initiated by pressing the "Pressure" key. Here the Unix time is automatically set to the next full hour in order to get a time-correct entry.

Change of day:
A change of the day is initiated by pressing the "Temp." key. Here the Unix time is automatically set to the full hour of the next change of tariff day in order to get a time-correct entry.

Change of month:
A change of the month is initiated by pressing of the "C.Factor" key. Here the Unix time is automatically set to the full hour of the next change of tariff month in order to get a time-correct entry.

After each pressing of one of these keys no further entries are accepted for the next 10 seconds, in order to avoid the generation of too many entries by accidentally pressing a key for a too long time. After 20 entries no further entries are possible.

The end of testing:
Manually by switching off the test via field M-26. Automatically, if the maximum test duration calculated with beginning of test has expired, whereby 1 minute before the end of testing the still remaining time is displayed in 10 second intervals. Afterwards the test is switched off automatically. At the end of testing all totalizers and the necessary tariff memory are restored, the mean value memory is cleared, the standard time is activated again and the Unix time is synchronized with the standard time. At last another entry in the event memory is generated which indicates that the test has been finished.

Mode

C

ID
▷ Mode
▷ Fault

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

		N	Description of coordinates	Unit	
H	**D**	Header text	(Text varies depending on the position in the column)		
1	**CD**	Time	Display and entry of the current time		
2	**CD**	Date	Display and entry of the current date		
3	**CS**	Code	User code (can only be changed if the calibration switch is enabled)		
4	**S**	Prog.	Date of the test		
5	**D**	Op-hour	Operating hours	h	
6	**S**	RS-m1	Mode: operating mode of the optical interface		
7	**C**	bd-IR	Baud rate of the optical interface		1)
8	**C**	RS-m2	Mode: operating mode of the internal interface (4 wires)		1)
9	**C**	bd-4w	Baud rate of the internal interface (4 wires)		1)
10	**C**	RS-m3	Mode: operating mode of the internal RS interface (3 wires)		
11	**C**	bd-RS	Baud rate of the internal interface (3 wires)		
12	**C**	Imod	Current output mode: Calibration current / Pressure / Temperature / Conversion factor / Volume flow rate at meas. cond. / Volume flow rate at base cond. / OFF		2)
13	**D**	Iout	Display of the output current	mA	2)
14	**C**	I<	Output current: assigning 4 mA		2)
15	**C**	I>	Output current: assigning 20 mA		2)
16	**C**	IA	Current output damping		2)
17	**C**	Mains	Emergency power supply: Standard (without backup battery) / +Battery (with backup battery)		1) 3)
22	**D**	Lamp test	Lamp test		
23	**S**	Quartz	Quartz frequency		
24	**C**	Bit3D	Parity internal interface (3 wires)		
28	**S**	TZone	Switching to summer/winter time: Su/Wi OFF / Su/Wi aut. / Su/Wi man.		
29	**C**	ST	Start of summer time		
30	**C**	WT	Start of winter time		

1) Rolling texts! Use the ▲ ▼ keys to make your changes.

2) Not applicable to battery-powered devices.

3) Note!
If “+Battery” has been selected under “Mains” (only from software version 1.08), the device will switch to battery mode in the event of a failure of the external power supply and continue to operate in this mode. If appropriate, the activated flow display and the current output (if there is one) will be switched off.

4) Possible parity settings:
8 E 1: Even
8 O 1: Odd
8 N 1: Without parity (none)

Fault

C

ID
▹ Mode
▹ Fault

Press the above function key and then the ► key twice.

		O	Description of coordinates	Unit	
H	**D**	Header text	(Text varies depending on the fault status)		
1	**D**	Fault text	Fault text or "NO FAULT" for undisturbed operation		
2	**D**	Time	Time of the first fault message		
3	**D**	Date	Date of the first fault message		
4	**D**	L-t	Indication of the time when the last faults were reset		
13	**D**	v_inp	Supply voltage for mains powered devices	V	3)
14	**D**	clk	Service status display		
20	**S**	Test	For servicing only		
22	**S**	Htype	Device type: Battery / Extern / Extern + FI		1) 2)
23	**C**	Ical	Fixed value for outputting the calibration current	mA	4)
24	**C**	Iout-A0	Output current correction value		4)
25	**C**	Iout-A1	Output current correction value		4)

1) Rolling text! Use the ▲ ▼ keys to make your changes.

2) Note!
- If you change the device type, the totalizers will be cleared!
- For the device types “Battery” and “Extern”, columns I and J are not available.

3) In this field the supply voltage, measured by the EC 694, is displayed. For this it is necessary to set the mode in fild N-17 to “+Battery”.

4) Not applicable for battery-powered devices.

Instructions for Battery Operation

Interrelation between the flow rate and the battery life

The following text is based on a battery-powered device with a reed input used in combination with an RMG Messtechnik TRZ 03 turbine meter. The table refers to a constant ambient temperature of 25°C under relatively steady pressure conditions and shows the possible battery life if a new battery is used. The service life is indicated in **years at 50% Q_{max}** and in **years at Q_{max}**.

1st example
Parameterization of the device:
without data-logging memory, dispatcher pulse width 40 ms, for each wakeup phase max. 1 pulse from the V_m dispatcher and 1 pulse from the V_b dispatcher. If the dispatcher factor of the V_b output is chosen in such a way that more than 1 pulse is to be outputted for each wakeup phase, the indicated service life will be reduced.

TRZ 03 DN	Size	Measuring range	SF_{out} m^3	Years at 50% Q_{max}	Years at Q_{max}
50	G 40	13 – 65	0.1	> 8	> 7
	G 65	10 – 100	0.1	> 8	> 7
80	G 100	16 – 160	1	> 8	> 7
	G 160	13 – 250	1	> 8	> 7
	G 250	20 – 400	1	> 8	> 7
100	G 160	13 – 250	1	> 8	> 7
	G 250	20 – 400	1	> 8	> 7
	G 400	32 – 650	1	> 8	> 7
150	G 400	32 – 650	1	> 8	> 7
	G 650	50 – 1000	1	> 8	> 7
	G 1000	80 – 1600	10	> 8	> 7
200	G 1000	80 – 1600	10	> 8	> 7
	G 1600	130 – 2500	10	> 8	> 7
250	G 1000	80 – 1600	10	> 8	> 7
	G 1600	130 – 2500	10	> 8	> 7
	G 2500	200 – 4000	10	> 8	> 7
300	G 2500	200 – 4000	10	> 8	> 7
	G 4000	320 – 6500	10	> 8	> 7
400	G 4000	320 – 6500	10	> 8	> 7
	G 6500	500 – 10000	10	> 8	> 7
500	G 6500	500 – 10000	10	> 8	> 7
	G 10000	800 – 16000	100	> 8	> 7
600	G 10000	800 – 16000	100	> 8	> 7
	G 16000	1300 – 25000	100	> 8	> 7

Table 1

The effect of the ambient temperature must be taken into account when calculating the actual service life.

Effect of the ambient temperature on the battery life:
$L_{act} = L_{table} * F_{amb}$

where
L_{act} is the effective service life of the battery with the specified parameterization;
F_{amb} is the correction factor for the average annual temperature (see graph);
L_{table} is the value from the above table.

2nd example
Parameterization of the device:
with data-logging memory, dispatcher pulse width: 40 ms, for each wakeup phase max. 1 pulse from the V_m dispatcher and 1 pulse from the V_b dispatcher. If the dispatcher factor of the V_b output is chosen in such a way that more than 1 pulse is to be outputted for each wakeup phase, the indicated service life will be reduced.

TRZ 03 DN	Size	Measuring range	SF_{out} m^3	Years at 50% Q_{max}	Years at Q_{max}
50	G 40	13 – 65	0.1	>6	>6
	G 65	10 – 100	0.1	>6	>5
80	G 100	16 – 160	1	>7	>7
	G 160	13 – 250	1	>7	>6
	G 250	20 – 400	1	>7	>6
100	G 160	13 – 250	1	>7	>7
	G 250	20 – 400	1	>7	>6
	G 400	32 – 650	1	>6	>6
150	G 400	32 – 650	1	>6	>6
	G 650	50 – 1000	1	>6	>5
	G 1000	80 – 1600	10	>7	>7
200	G 1000	80 – 1600	10	>7	>7
	G 1600	130 – 2500	10	>7	>6
250	G 1000	80 – 1600	10	>7	>7
	G 1600	130 – 2500	10	>7	>6
	G 2500	200 – 4000	10	>7	>6
300	G 2500	200 – 4000	10	>7	>6
	G 4000	320 – 6500	10	>6	>6
400	G 4000	320 – 6500	10	>6	>6
	G 6500	500 – 10000	10	>6	>5
500	G 6500	500 – 10000	10	>6	>5
	G 10000	800 – 16000	100	>7	>7
600	G 10000	800 – 16000	100	>7	>7
	G 16000	1300 – 25000	100	>7	>6

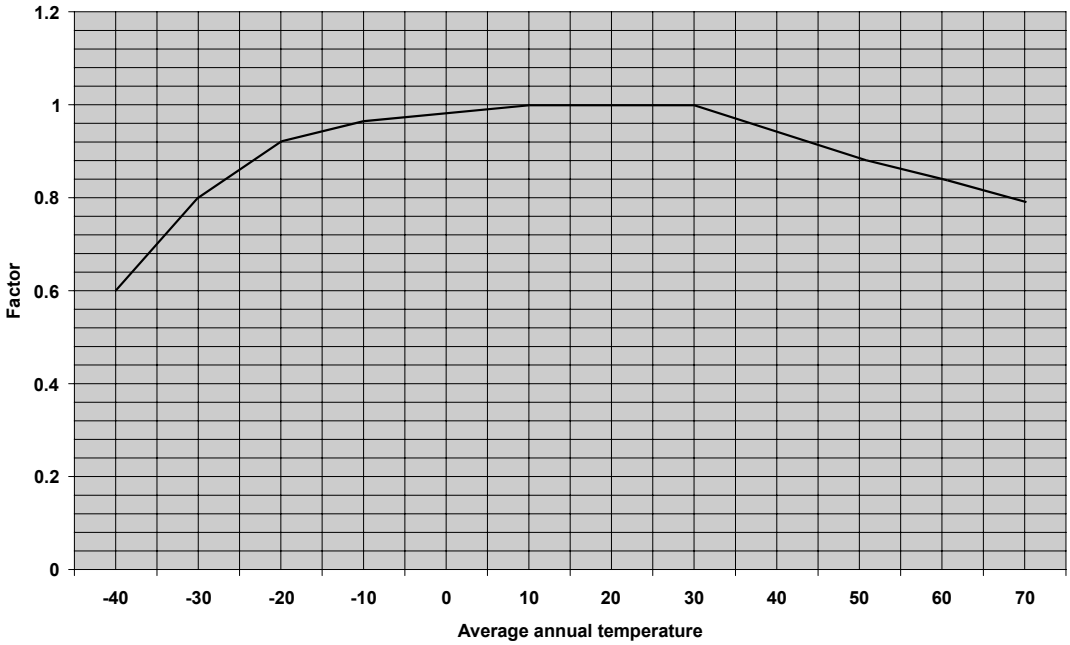
Table 2

The effect of the ambient temperature must be taken into account when calculating the actual service life.

Effect of the ambient temperature on the battery life:
$L_{act} = L_{table} * F_{amb}$

where
L_{act} is the effective service life of the battery with the specified parameterization;
F_{amb} is the correction factor for the average annual temperature (see graph);
L_{table} is the value from the above table.

Graph of the temperature correction factor



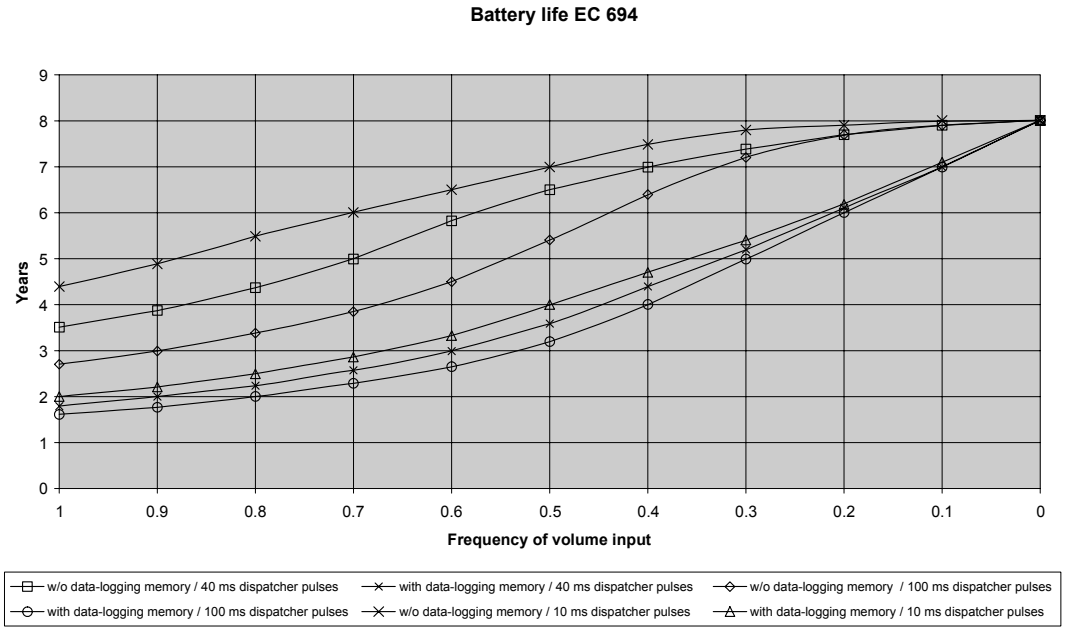
Example:
The EC 694 runs with the data-logging memory in conjunction with a turbine meter DN 100, G 250. The above table shows that the service life is 7 years at an average load of 50% Q_{max}. The average annual temperature is -10°C.
$L_{act} = L_{table} * F_{amb}$
$L_{act} = 7 * 0.95 = 6.65$

Therefore, the actual service life to be expected is approx. 6.6 years in the case of a battery which is 100% full at the initial startup. If the device has already been stored for a certain period of time, an appropriate reduction in the service life must be taken into account.

Further effects on the battery life

- Frequently reading out data manually, either by using the PVP program or remote data transmission.
- Higher variations of pressure or temperature for each wakeup phase initiate a repeated calculation of the K coefficient (GERG 88S).
- Activating the data memory function. Unlike the data-logging memory which stores data for events only, the device in data-memory mode collects all measured values at a settable interval (every n minutes) and stores the data records. Therefore, normal load is increased by an additional activity which results in a premature depletion of the battery. If the interval is set at 1 minute, for example, the battery can already be discharged after **2 years**.
- Frequently activating the on-the-fly calibration function by using the maximum running time of 1 hour. The device will remain active during this period of time and will not switch to energy-saving mode (sleep mode).
- Setting the pulse width of the dispatcher outputs V_m and V_b. The pulse width should be chosen as short as possible. The effect of the pulse width on the battery life can also be seen from the following graph.

For applications in conjunction with turbine meters of other manufacturers with other frequencies at Qmax, the following graph should be used to assess the service life of the battery. The same boundary conditions apply as with tables 1 and 2. Here, too, it should be noted that the ambient temperature must be taken into account subsequently.



Operating modes of the EC 694

Battery-powered device
Here the appropriate parameters for this operating mode must be set in order to achieve a long battery life. Please see the graphs, tables and examples on pp. 39-42.

Standard settings for battery operation

- Coordinate O 20 “Gener. Test” must be switched off.
- Coordinate O 22 must be set to “Battery”.
- The input frequency must not exceed 1 Hz at Q_{max} without pulse scaling.
  If the input frequency at Q_{max} exceeds 1 Hz, the pulse scaler must be programmed >1.
  You can set the pulse scaler in relation to the maximum input frequency in coordinate K 08.
- If the calculation of the K coefficient has been enabled (GERG 88 S), you must take care that the parameters in coordinates G 16 through G 20 are correct.
- You must parameterize the pulse outputs correctly.
  Coordinate K 25 switches the pulse output on or off.
  Coordinate K 26 selects either V_m or V_b.
  Coordinate K 27 determines the pulse width. The pulses calculated by the device are outputted at the end of the program cycle. As a result, they extend the active computer time and prevent the device from switching to energy-saving mode. Therefore, the pulse width should be chosen as short as possible. (Note the battery life.)
  The scaling factors (coordinates H 10 and H 12) are to be chosen in such way that no more than 1 or 2 pulses are to be outputted at Q_{max} per second (the fewer the better due to the battery life).
  Max. output pulses = (Q_{max} / 3600 x Kv) / scaling factor.

Externally supplied device with built-in standard battery
The following options can be chosen: 24 VDC or 9.2 VDC. When connecting 24 VDC, the internal DC/DC converter must be inserted.
The battery is used as a standby battery in the event of a failure of the external power supply. For standby power supply, the details about the service life are stated under Example 1.
Note: If the volume pulses are picked off through NAMUR transducers, no emergency power can be supplied by the battery in the event of a failure of the external power supply, since the required NAMUR voltage for the transducers cannot be generated. In the same way, possibly existing current outputs will be deactivated during the time emergency power is supplied.
In mains operation, emergency power supply mode will be activated if an input voltage of less than 8 V is measured for more than 10 seconds. Emergency power supply mode is deactivated again if an input voltage of more than 8.5 V is measured and **afterwards at least two processing**

pulses are supplied to the totalizer (one processing pulse is reached if the number of input pulses set in the pulse scaler has been reached). This also means that the pulse scaler must be set in such a way that a frequency of approx. 0.5 Hz of processing pulses per second is not exceeded in order to avoid excessive depletion of the battery.

Externally supplied device without battery
There are the following options: 24 VDC or 9.2 VDC. When connecting 24 VDC, the internal DC/DC converter must be inserted.

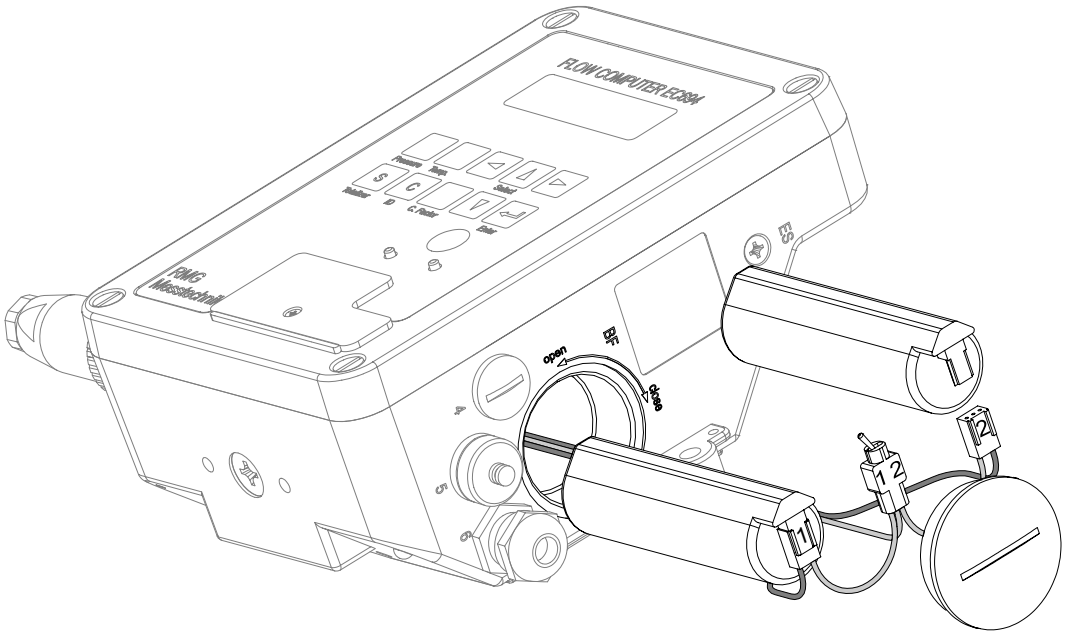
Storage mode
This is a particular mode which ensures that a battery-powered device kept in store remains as inactive as possible in order to conserve the capacity of the battery.
Important parameter: O 22 hardware type must be set to **"OFF"**.
This parameter must be changed manually if the device is to be used in the normal way or if it is stored.

Lithium batteries
The EC 694 is fitted with a replaceable battery pack and a permanently fixed battery (order No.: 86.77.560.00). The battery pack powers the whole device, whereas the permanently soldered battery is used as a backup battery for the static RAM. The capacity of this backup battery has been designed in such way that it must only be replaced during repair in the event of a defect. In normal operation, this backup battery is not active. It is decoupled via diodes and is kept "in store" so to speak. In this operating mode, its capacity will be sufficient for more than 10 years. The backup battery will only become active in the event of a failure of the supply battery or the external power supply.

Indication of a necessary battery change
Lithium batteries retain their voltage until they are almost discharged so that it is not possible to monitor their voltage with an appropriate means that indicates a necessary battery change. To estimate the time of a possible battery change, please use the table 1 or 2 and the appropriate graphs. In coordinate M 17 of the ID column, you can enter the months until the next battery change calculated from the tables. This coordinate is locked by the user code and the information must be entered by the user when changing the battery. The user will be responsible for entering appropriate information.
In the state the device is delivered, 60 months are programmed here. The indication of the battery change has been designed as a down counter. When there are only six months left, a warning will be generated which is used as an indication to change the battery. After the battery has been replaced, you must reprogram coordinate M 17. The warning will be cancelled and can be cleared.

Replacement of the supply battery

The battery pack can be changed easily without opening the volume corrector. On the right side of the enclosure, there is a circular cover with a slot which can be unscrewed. Behind this cover, there is the battery pack with a split connecting cable, a second connector and a changeover switch. If the battery is to be changed, such a change can be carried out without interruption. To do this, connect the new battery to the free connector and switch over to the other switch position. After the switch has been operated, the new battery is in use and the old battery can be removed. Put the new battery together with the cable and the switch into the battery compartment and take care that you do not operate the switch. Screw in the cover again.



Communication between the EC 694 and the PC

There are two programs which can be used for communication with the EC 694:

The first program (PVP) is used for reading out measured values and data from the data-logging memory, changing parameters and exporting data for further processing. With the PVP program, all measured values and parameters can be read and represented in the form of a table or graph.

The second program (Hex Load) is used for loading the program memory or installing a program update. Due to this function, it is no longer necessary to replace EPROMs, since the operating program of the EC 694 is stored in a flash memory which is firmly soldered in place.

The EC 694 provides interfaces for both programs. With regard to these interfaces, make sure in each case that the correct connecting cable is used and the relevant parameters are correctly set, otherwise no communication is possible with the EC 694.

There are two interfaces which can be optionally used for the PVP program. The optical read head and what is called the 3-wire interface. The optical read head is plugged on at the front of the device, whereas the 3-wire interface is connected on the right side of the EC 694 using a circular connector. In order to ensure proper functioning of the 3-wire interface in connection with the RS 232 interface of a laptop computer or PC, the connecting cable must be fitted with a coupling element (see page 48). This coupling element converts the voltage levels of the 3-wire interface to those of the RS 232 interface of the PC. The coupling element is supplied through the handshake lines of the PC interface. For this purpose, it must be ensured that at least 8 V are applied to pins 7 or 8 of the 9-pin subminiature Cannon connector. The coupling element should be located on that side of the cable which is connected to the PC.

Interface parameters: baud rate 9600 baud; other parameters are permanently set and cannot be modified.

Note:
The frequency of accessing the data affects the battery life. The standard access time assumed is a maximum of 15 minutes per week. Please note that the PVP program calls the EC 694 cyclically and automatically to ascertain whether there is still a connection to the EC 694. Therefore, the EC 694 cannot switch to power-saving mode. This means that after a reading operation has been performed, the PVP program should always be switched off or the read head removed.

For the Hex Load program, **only** the connecting cable can be used in conjunction with the coupling element. Several conditions must be met before a program update can be installed. These conditions are intended to protect the program code against unintentional overwriting and include enabling the calibration switch, entering the password, and starting the bootstrap loader (BTL) of the EC 694 by means of voltage OFF / ON. The BTL will load and then start the new program version within the EC 694. Interface parameters: baud rate 19200 baud, other parameters are permanently set and cannot be modified.

Program update

In the course of the further development of the EC 694, there will be not only new hardware variants, but also software modifications, functional enhancements, etc. If necessary, new software can be loaded into the program memory of the EC 694 using an external PC (laptop or notebook computer). The external PC which is to be used for installing the program update must meet the following requirements: RS 232 port, at least one of the CTS or RTS handshake lines must be activated, since they are required for supplying the coupling element on the connecting cable.

Flash memory

The program code of the EC 694 is stored in a flash memory which can be programmed more than 10,000 times. The flash memory is divided into two segments: one segment contains the actual program code and the other segment, which is called BTL core. The BTL segment has a size of 4 kilobytes and is protected against manipulation through external programs. The segment of the operating program is controlled by the BTL.

There are two designs:

Revision 4 = 250 kilobytes and Revision 5 = 506 kilobytes.

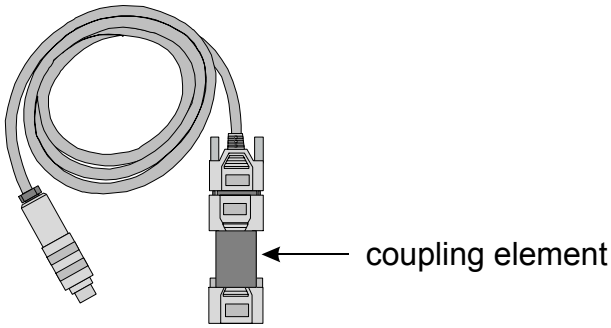
As soon as the operating voltage of the device is switched on, the BTL decides whether data are to be loaded into the memory or whether the operating program of the EC 694 is to be started.

From which hardware version is it possible to install a program update by loading the flash memory?

It is possible to install a program update by external programming of the flash memory only from the hardware version of Revision 4. Revision 3 correctors are fitted with a socket with an exchangeable memory chip which is located on the bottom of the printed circuit board.

Connecting cable between the external PC and the EC 694 (3-wire interface)

A specific coupling element is required to adjust the 3 V level of the wires of the volume corrector interface to the PC level and enable communication. This coupling element is fitted in a connector housing with two 9-pin subminiature Cannon connectors. It is plugged onto the connecting cable between the external PC and the EC 694.



Data saving

It is always recommended that data be stored prior to the installation of a software update. This applies to the data representing the coordinate system of the EC 694. These include all parameters, default values, limiting values, etc., but no measured data.

Which aids can be used for saving data?

The PVP program can be used for saving data. PVP has been developed to conveniently perform all operating functions from a PC (laptop computer).

Among other options, there are the following functions:

Reading parameters
All parameters can be read out from the coordinate system of the volume corrector. The data are sorted by function and displayed on the screen.

Writing parameters
All writable parameters can be sent to the volume corrector by entering a command. Provided that the calibration switch has been enabled, these values are written into the memory. First the data can be edited conveniently and then sent off by entering a write command.

Reading the data-logging memory
The data of the data-logging memory integrated into the volume corrector can be read out and exported or further processed.

Visualizing data
The measured data and totalizer readings can be presented in the form of a table or graph.

Software requirements
The program runs under Windows 95, 98 or NT.

Interface parameters
9600 baud; other parameters are permanently set and cannot be modified.

For further details, see the separate description of the PVP program.

Installing a software update using the Hex Load program

The Hex Load program which must be installed on an external PC (laptop computer) is used for loading the flash memory.
A program update can only be performed if three conditions are met:
1. The calibration switch of the volume corrector has been enabled.
2. The password has been entered into the PC.
3. The Hex Load program in the volume corrector has been started by voltage OFF / ON.

Short description of the Hex Load program functions

FILE Opens files, loads or quits the program.

EDIT Relocate
Shifts the program code! This function must not be used! It is only intended for test purposes when locating faults!

TARGET Check blank
Checks the contents of the flash memory (blank).

Get checksum
Checks CRC 16 (16 bit test number) in the target device (volume corrector). The correctness of the program version is checked.

Verify
Compares the file on the PC with the contents of the flash memory of the volume corrector.

Verify Checksum
Compares the file CRC on the PC with the volume corrector CRC.

Clear
Erases the program code. (The flash memory is erased.)

Program
Download / Overwrite
This command is used to load the new operating program into the flash memory. NOTE: The program is not yet operational.

Make Valid
Makes the program which has been newly loaded into the flash memory after a download operational (valid)! This function is important, otherwise the volume corrector **cannot** run. The program will not exist if the “make valid” function is not performed.

Auto
This command is used for automatically performing the functions: clear/program/verify/get checksum. It simplifies operation. **(Do not forget to activate the “make valid” function!)**

Start Program
Starts the newly loaded operating program from the PC. If all functions perform without any trouble, remove the connector from the interface again. The volume corrector will continue to run on its own.

OPTIONS

Communication
Make your interface settings on the PC. Only two parameters must be set:
Baud rate = 19200 baud. This baud rate is permanently programmed in the BTL (bootstrap loader) of the EC 694. Set the interface of the PC at this value.
COM ....? Enter the interface selected on the PC (COM 1, COM 2) here.

Password
Enter the password to release the BTL program. The code is contained in the flash memory and cannot be changed. The password reads as follows: *Australien*

Hardware requirements for the PC or laptop computer
An RS 232 interface is required.
Voltage levels of approx. 8 V are required at pins 7 or 8 (the CTS, RTS signals) of the 9-pin subminiature Cannon connector to supply the coupling element on the connecting cable. If both levels are missing, the coupling element can also be operated without this voltage if the lines are short.
The connecting cable is only to be used for the 3-wire interface.

Software requirements
The program runs under Windows 95 or 98 and NT.

Interface parameters
19200 baud, other parameters are permanently programmed and cannot be modified.

Newly creating the coordinate structure (booting)

In the event of a software change, the structure of the coordinate system must be newly created if data structures were changed or new functions were added with new coordinates. The device verifies automatically after a software update whether this routine must be executed. If this must be done, the operating program writes default values in the coordinate system in order to ensure a normal program flow. Afterwards, these default values must be overwritten with the correct system data (see the PVP program).

When must a boot be performed?

Comparison of version numbers.
This will be necessary each time the version number changes.
Examples:
No boot required => Version 1.24 D is changed to 1.24 E
A boot is required => Version 1.24 D is changed to 1.25 A

Retransferring data

If the device operates normally again after the software update and the subsequent boot routine have been completed, the data record previously saved can be retransferred through the same interface by means of the PVP program. If new coordinates have been added which were not known in the old data record, they still contain default values which must be changed manually. Please refer to the documentation accompanying the diskette with the software update in order to see which data and coordinates are affected.

Safety

Several safety conditions must be met before a program update can be installed. These conditions are intended to protect the program code against unintentional overwriting. They include the following activities: opening the seal and operating the calibration switch of the EC 694, entering the password into the PC, and starting the bootstrap loader (BTL) of the EC 694 by voltage OFF / ON.

Interface parameters

It is only necessary to set the baud rate at 19200 baud.

Scope of delivery for installing a program update

- Hex Load program for the PC
- Update diskette with the new software
- PVP program for saving and retransferring the data
- Documentation
- Interface cable with level adaptation

Example of installing a program update:

- Save your data (using the PVP program).
- Start the Hex Load program on the PC.
- Connect the connecting cable at COM 1 or COM 2 to the 3-wire interface of the volume corrector.
- Load the update file.
- Enter the password under **Options**.
- Briefly disconnect the volume corrector from the voltage supply and then switch it on again.
- The Hex Load program will automatically start communicating with the driver of the operating system of the volume corrector. If the connection is OK, **Target** in the upper right-hand corner of the screen will show the following information:
  Range Storage area from ... to ...
  Application: EC 694
  CPU M77
  BTL SW Version: Current version No. .....
- Enable the calibration switch. (If the calibration switch is not enabled, the message "**Target memory not blank"** will appear in the next step.)
- Load the program update either in individual steps ***clear/program/verify/get checksum*** or activate the ***Auto*** function.
- Make the program valid (***make valid*** function).
- Start the program.
- Remove the connecting cable again.
- Disable the calibration switch.
- If necessary, re-enter data (data saved can be retransferred using the PVP program).

Special features to be noted when installing a program update:

In the event of a program change which requires a boot to be executed, you must re-enter not only the normal parameters but also the transducer and device constants after the program update has been installed. If this is done using the PVP program, make sure that the “Gener. Test” mode is set in coordinate O 20 before you start reading out data. Only then will the PVP program be able to read and write all parameters. You must also take care that an already filled memory is read out before the program update is installed and that a reset is executed afterwards.
The rest is performed through coordinate O 5 with an activated “Gener. Test” mode in O 20. Resetting can be executed selectively:

“Tot.-reset”	clears the totalizers.
“Dat.-reset”	clears the data memory.
“Log.-reset”	clears the data-logging memory.
“Events”	clears the event memory including all “clk” information in O 14.
“Basic val.”	clears all parameters and writes default values to coordinates.

After the program update has been installed, you must activate the desired memory mode (data-logging memory or data memory) again.

Annexes

A Equations Used With the EC 694

Symbol		Unit	Designation
q_m	=	m^3/h	Volume flow rate at measurement conditions
f_V	=	Hz	Volume transducer frequency
K_V	=	P/m^3	Gas 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	Volume 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 measuring 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	Gas law deviation 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 or AGA-NX-19.

Volume flow rate at measurement conditions

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

Volume at measurement conditions

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

Gas law deviation coefficient

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

Conversion factor

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

Volume flow rate at base conditions

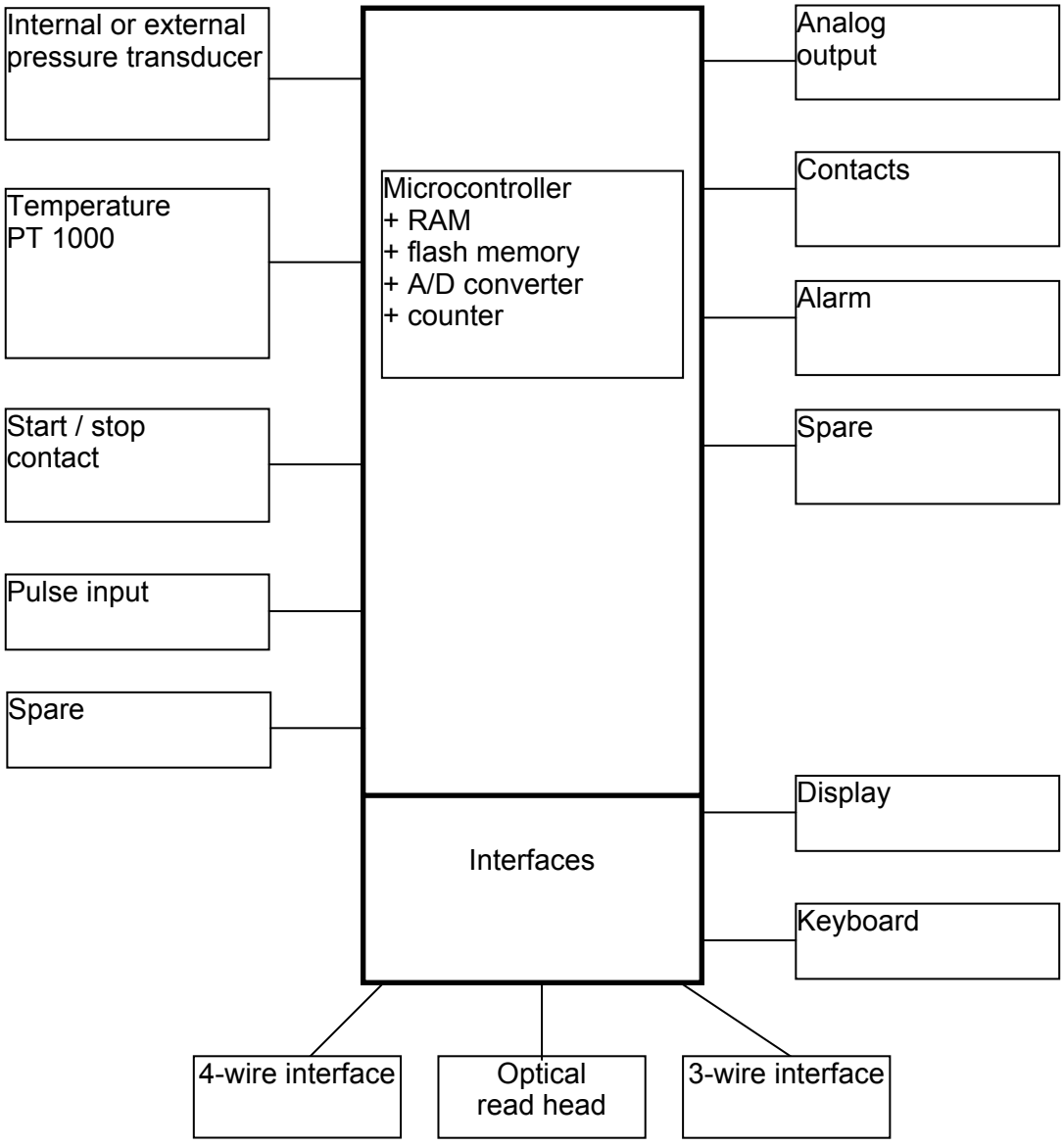
$$q_b = \frac{f_V}{K_V} \cdot C \cdot 3600$$

Volume at base conditions

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

The pressure at measurement conditions and the pressure at base conditions are processed as absolute pressures in the relevant equations. In selection mode 2 of column A, however, transducers with gauge-pressure or kg/cm^2 scaling are also permitted. If such transducers are used, the pressure at base conditions must also be indicated in the appropriate unit. 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 694



C Specifications

Device types

Reed

Supply	internal battery (Ex), external 9.2 V (Ex) or external 24 V (non Ex) if a DC/DC converter is retrofitted to the device
Pulse input	Reed or transistor
Current output	not possible
Battery backup	for externally supplied devices through the internal battery (from hardware Rev. 5)
Explosion protection	II2 G EEx ia IIC T3/T4 (not with external 24 V)

Namur

Supply	external 9.2 V (Ex) or external 24 V (non Ex) if a DC/DC converter is retrofitted to the device
Pulse input	Namur, reed or transistor
Current output	1 current output
Battery backup	not possible
Explosion protection	II2 G EEx ia IIC T3/T4 (not with external 24 V)

Wiegand

Use	direct mounting on the gas meter Type TERZ 91 instead of the meter head
Supply	internal battery (Ex), external 9.2 V (Ex) or external 24 V (non Ex) if a DC/DC converter is retrofitted to the device
Pulse input	Wiegand
Current output	1 current output (not possible with battery operation)
Battery backup	for externally supplied devices through the internal battery (from hardware Rev. 5)
Explosion protection	II2 G EEx ia IIC T3/T4 (not with external 24 V)

Inputs

Pressure

Signal	voltage: 0.5 V to 4.5 V
Resolution	12 bits

Temperature

Signal	resistance (Pt1000); 4 wires

Volume

– Reed

Pulse frequency	0 Hz to 20 Hz; in the case of battery operation max. 1 Hz due to battery life	
Pulse width	≥ 20 ms	
Voltage	low: ≤ 0.9 V	high: ≥ 2.2 V

– Namur

Pulse frequency	0 Hz to 600 Hz	
Pulse width	1.5 ms	
Voltage	low: 1.2 mA	high: 2.1 mA

– Wiegand

Pulse frequency	0 Hz to 300 Hz; in the case of battery operation with pulse scaler (field K 08)	
Pulse width	≥ 5 µs	
Voltage	min: 1 V	max: 5 V (determined by sensor)

Digital

Type	relay contact for start-stop
Overvoltage protection	from 6.8 V

Outputs

Pulse

Type	pulse outputs 1 and 2 (Vm, Vb), alarm output
Frequency	max. 3 Hz (note chapter “Battery life“)
Pulse duration	10 ms to 200 ms (adjustable)
Interpulse period	equal to pulse duration

In the case of “External 24 V“ supply

Switching voltage	max. 30 V
Current	max. 100 mA
Internal resistance	RDSon = 20 Ω (12 Ω with PK01)
Voltage drop in switched condition	$U = R_{Dson} * I$

In the case of “Battery” or “External 9.2 V” supply
Connection to certified intrinsically safe circuits. Specifications: see attached EU type approval certificate. If no explosion protection requirements must be fulfilled, the specifications apply as for the “External 24 V” version.

Current

Signal	4 mA to 20 mA
Resolution	12 bits
Load	max. 700 Ω
Overvoltage protection	from 33 V

“Battery“ supply

Current output	not possible

“External 9.2 V“ supply

Current output	passive, electrically isolated, supply through transducer supply unit

“External 24 V“ supply

Current output	passive, electrically isolated, external 24 V supply or active, no electrical isolation for supply

Interfaces

Parity	even
Data bits	8
Stop bit	1

3-wire

Baud rate	2400, 4800, 9600; when working with “Hex Load“ automatically 19200
Max. line length	50 m with a wire cross section of 0.75 mm^2

4-wire

Baud rate	1200
Max. line length	50 m with a wire cross section of 0.75 mm^2

Optical

Baud rate	4800, 9600
Standard	EN 61107 (IEC 61107)

Supply

Battery

Supply	lithium cell 3.6 V; inside the device

External 9.2 V

Supply	DC 9.2 V; external

External 24 V

Supply	DC 24 V; external; electrically isolated inside the device

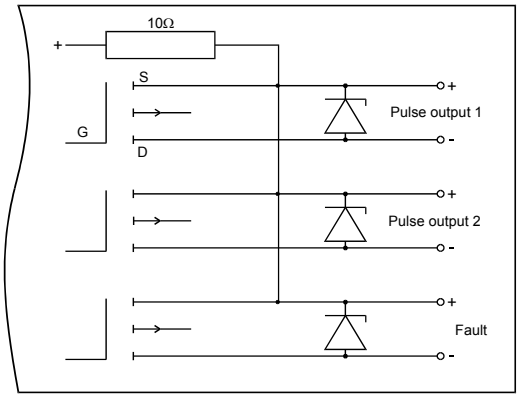
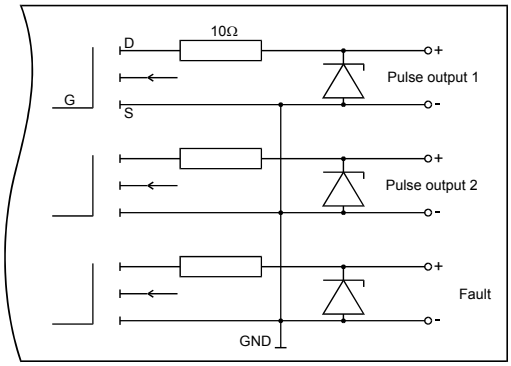
Enclosure

Enclosure	aluminium with 4 heavy-gauge conduit glands
Degree of protection	IP 65 (dust-tight and jet-proof)
Connections	via screw terminals
Pressure transmitter	screw connection M12 x 1.5 for ERMETO 6L (6 mm tube)
Dimensions	220 mm x 195 mm x 90 mm
Weight	approx. 2.5 kg

Environment

Temperature	-20°C to 60°C, LCD ready for use
EMC	see Declaration of Conformity in the annex

Description of signal outputs

EC 694	EC 694 with PK 01
	
The three signal outputs are P-channel MOSFET outputs. They are not electrically isolated and have a common positive.	If an N-channel MOSFET output is required for a downstream device, the PK 01 polarity converter can be slipped on inside the device.

Notes:

The signal outputs 1 and 2 are not frequency outputs!
Each advance of the totalizer (1 m^3) produces one pulse at the output. In the event of pulses following each other directly, the interpulse period is equal to the pulse length set.

The specifications are maximum values for operation in non-hazardous areas.

D Fault List

F A U L T M E S S A G E S

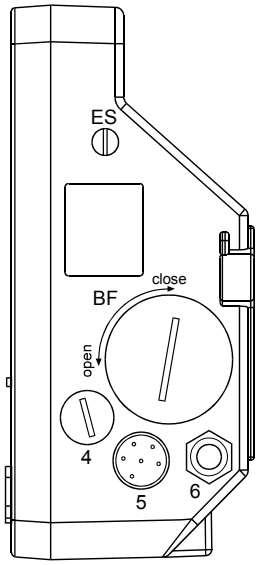
No.	Text displayed	Explanation
01	Power failure	Power failure
02	Defective clock	Clock component in the EC 694 is defective
03	RAM fault	Fault detected when checking the RAM or EEPROM
04	F 04	Spare
05	F 05	Spare
06	Watchdog	Program runtime exceeded; restart of the program
07	F 07	Spare
08	F 08	Spare
09	F 09	Spare
10	Pulse comp. 1:1	Error with 2-channel measurement 1:1
11	F 11	Spare
12	Miss.pulse meas	Failure of measuring channel with 2-channel measurement
13	Miss.pulse ref.	Failure of reference channel with 2-channel measurement
14	qm min range	Min. qm range violated downwards
15	qm max range	Max. qm range exceeded
16	F 16	Spare
17	F 17	Spare
18	F 18	Spare
19	F 19	Spare
20	p hardware	Pressure hardware, e.g. open circuit
21	p min range	Min. pressure range violated downwards
22	p max range	Max. pressure range exceeded
23	F 23	Spare
24	F 24	Spare
25	F 25	Spare
26	F 26	Spare
27	F 27	Spare
28	F 28	Spare
29	F 29	Spare
30	F 30	Spare
31	F 31	Spare
32	F 32	Spare
33	F 33	Spare
34	F 34	Spare
35	t hardware	Gas temperature hardware, e.g. open circuit
36	t min range	Min. gas temperature range violated downwards
37	t max range	Max. gas temperature range exceeded
38	F 38	Spare
39	F 39	Spare
40	F 40	Spare
41	F 41	Spare
42	F 42	Spare
43	F 43	Spare
44	F 44	Spare
45	F 45	Spare
46	F 46	Spare
47	F 47	Spare
48	F 48	Spare
49	F 49	Spare

No.	Text displayed	Explanation
50	1 out of 3 Vm	1-out-of-3 comp. def., totalizer for volume at meas. cond.
51	1 out of 3 Vb	1-out-of-3 comp. def., totalizer for volume at base cond.
52	F 52	Spare
53	F 53	Spare
54	F 54	Spare
55	1 out of 3 VmD	1-out-of-3 comp. def., dist.quant.tot. for vol. at meas. cond.
56	1 out of 3 VbD	1-out-of-3 comp. def., dist.quant.tot. for vol. at base cond.
57	F 57	Spare
58	F 58	Spare
59	F 59	Spare
60	F 60	Spare
61	F 61	Spare
62	F 62	Spare
63	F 63	Spare
64	F 64	Spare
65	F 65	Spare
66	F 66	Spare
67	F 67	Spare
68	F 68	Spare
69	F 69	Spare
70	Dispatcher 1	Overflow of dispatcher buffer
71	Disp. parameter	Too many pulses on dispatcher output (scaling factor)
72	Totalizer 1	Overflow of totalizer buffer
73	Tot. parameter	Too many pulses on totalizer output (scaling factor)
74	F 74	Spare
75	F 75	Spare
76	I1-out min.	Current out.1 current hardw. min.range violated downwards
77	I1-out max.	Current output 1 current hardw. max. range exceeded
78	F 78	Spare
79	F 79	Spare
80	Change battery	Residual capacity of battery < 3%
81	F 81	Spare
82	F 82	Spare
83	F 83	Spare
84	F 84	Spare
85	F 85	Spare
86	F 86	Spare
87	F 87	Spare
88	F 88	Spare
89	F 89	Spare
90	F 90	Spare
91	F 91	Spare
92	F 92	Spare
93	F 93	Spare
94	F 94	Spare
95	F 95	Spare
96	F 96	Spare
97	F 97	Spare
98	F 98	Spare
99	F 99	Spare

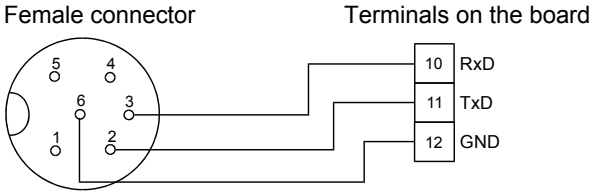
E Electrical Connections of the EC 694

Terminal assignments of the connectors

On the right side of the EC 694:

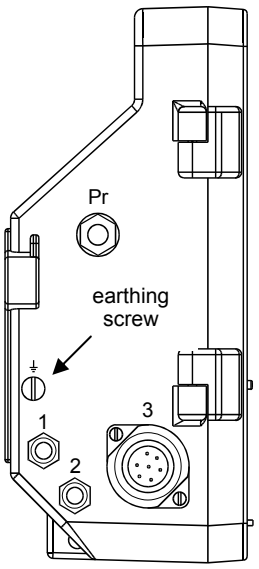


Interface connection (5)
(Binder, Series 423, 6 poles)

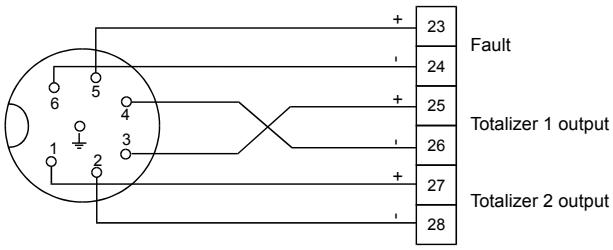


Moreover:
Feed-throughs without (4) and with (6) cable gland M16 x 1.5 for cable diameters 5 to 10 mm.

On the left side of the EC 694:



Connection of the signal outputs (3)
(Binder, Series 693, 6 poles & PE)



Moreover:
Feed-throughs with cable glands M12 x 1.5 for the cables of the resistance thermometer (1) and the gas meter (2) for cable diameters 3 to 6.5 mm.

Inside the EC 694, both female connectors are connected to the terminals on the board (see the following pages).

Make sure that the earthing screw (left side) is connected to the equipotential bonding.

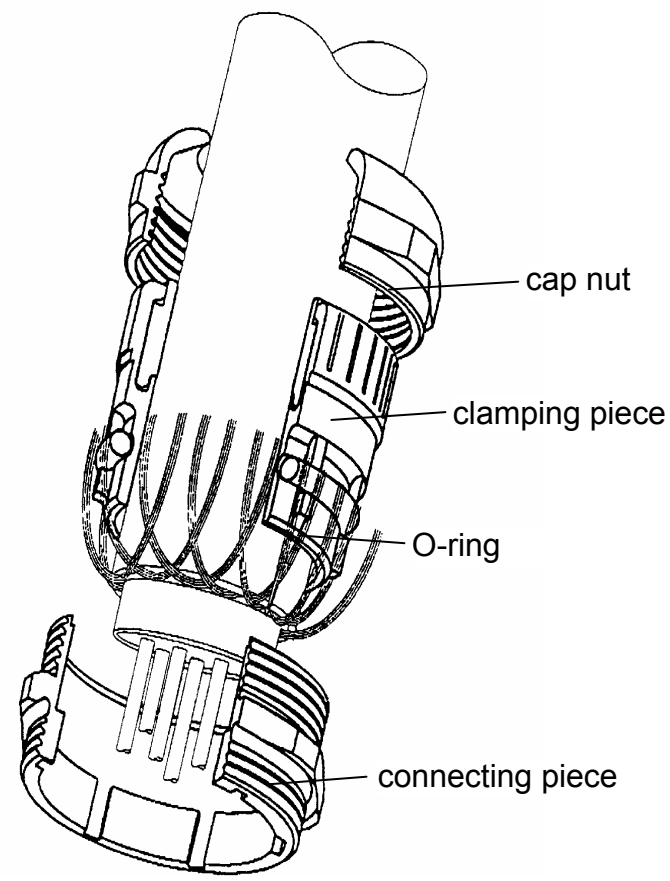
Explosion protection

The specifications stated in Annex C are maximum values for operation in non-hazardous areas.
If the EC 694 is operated in hazardous areas, the signal outputs must be connected to certified intrinsically safe circuits only. In such cases, the maximum values specified in the type approval certificate (see the last page of this manual) will apply. Please note that the specified maximum values apply to all the three signal outputs together, i.e. the currents and power drains of downstream devices must be added accordingly.

Cable glands

Clamp the screen as shown in the picture below into the cable glands located on the outside of the enclosure:

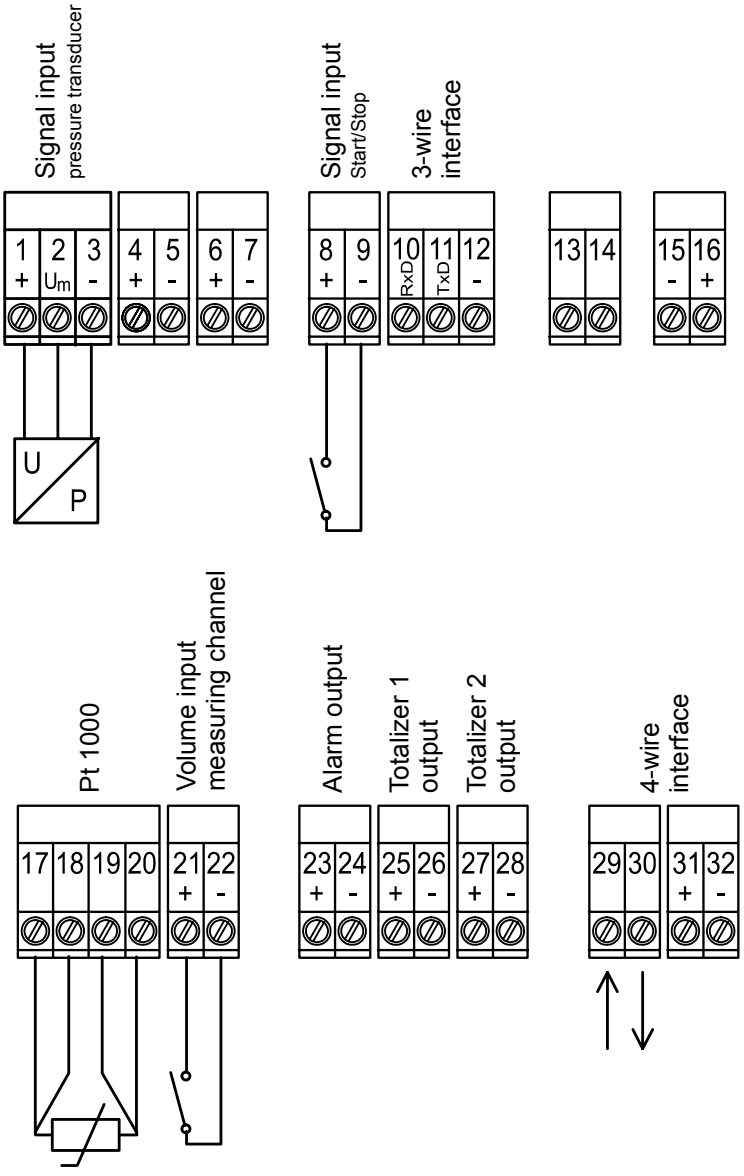
- Remove the cap nut.
- Pull out the plastic clamping piece.
- Push the cable end through the cap nut and the clamping piece and bend the screen backwards.
- Put the clamping piece back into the connecting piece.
- Fasten the cap nut.



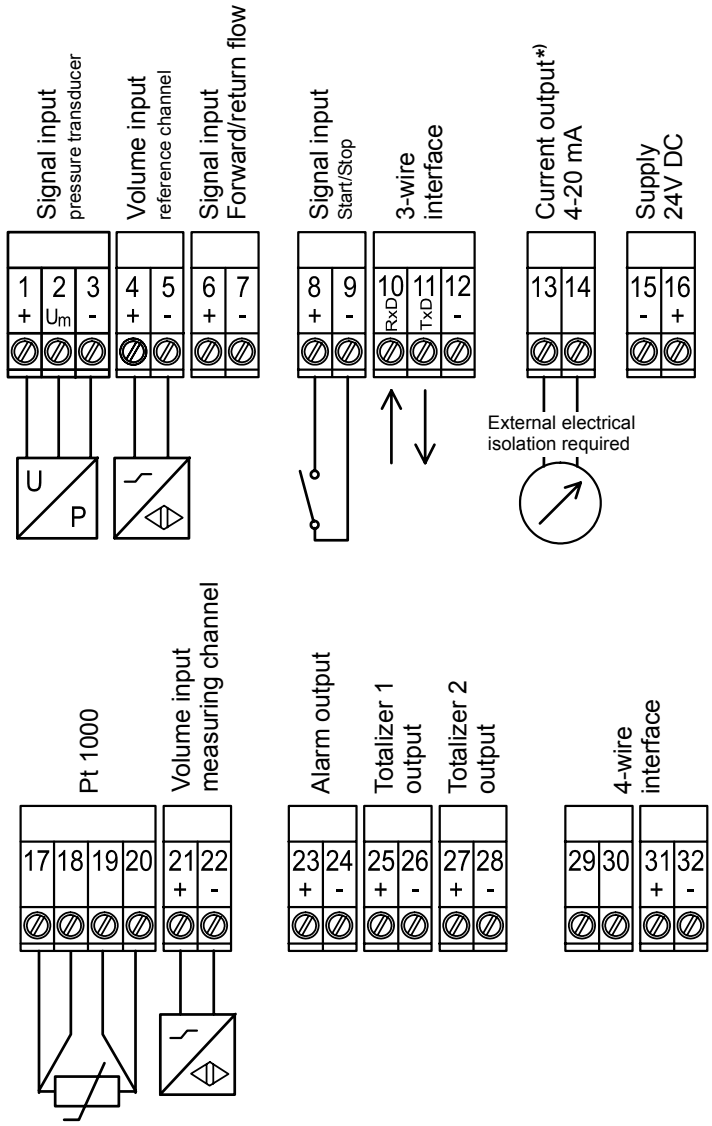
Terminals

The screw terminals 1 to 32 on the bottom of the enclosure are designed as plug-in/screw terminals and can be removed for easy handling.
The totalizer outputs have a common positive as standard. Depending on the input wiring of the downstream device, it may be necessary to have the outputs on a common frame potential. For this purpose, there is the PK 01 converter board available which must be installed in the terminal compartment (see page 67 for installation).

Terminals of the battery-powered version (Ex)



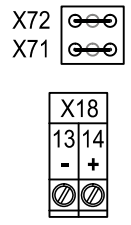
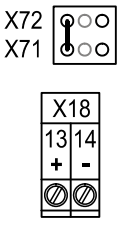
Terminals of the 24 V version (non Ex)



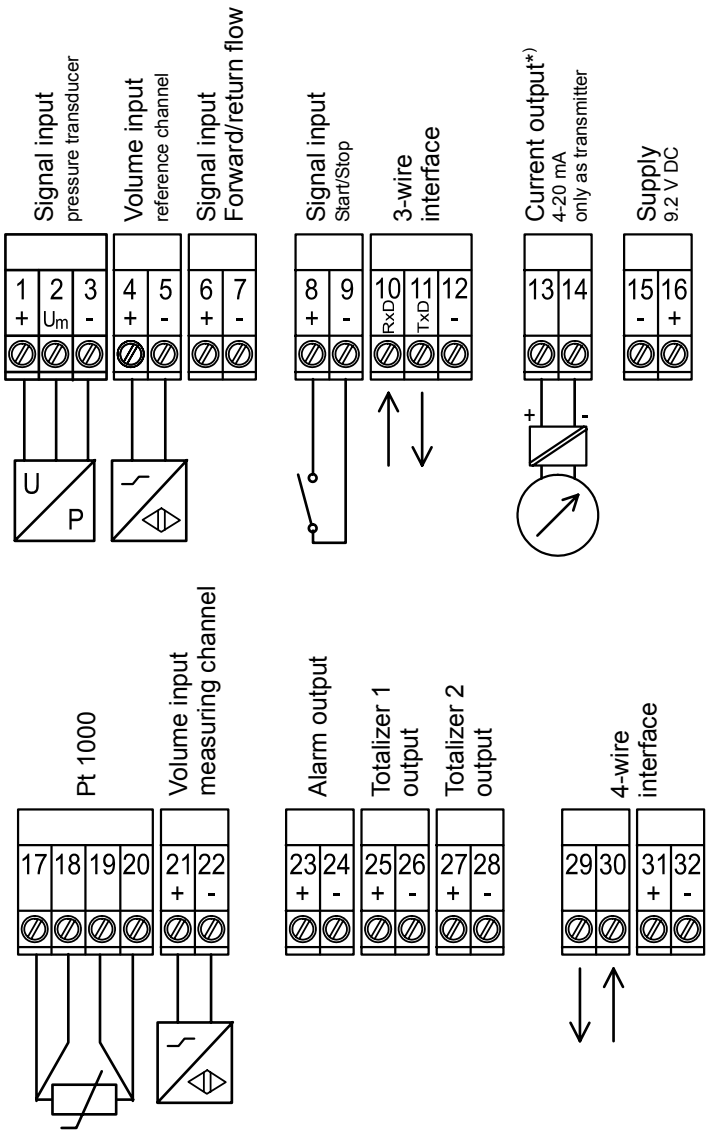
*) The jumpers X71 and X72, which are used to define whether the current output is operated actively (**not** electrically isolated) or passively (electrically isolated), are located above the terminals 13/14.

Attention!

- If the the current output is set active, **no** external supply unit may be used! **In this case the connection of an external supply unit causes damage to the EC 694!**
- The polarity is different for active and passive current output!

Current output **active**	Current output **passive**
	
Connection **without supply unit!**	Example of connection see page 71

Terminals of the 9.2 V version (Ex)



*) The jumpers X71 and X72, which are used to define whether the current output is operated actively or passively, are located above the terminals 13/14.

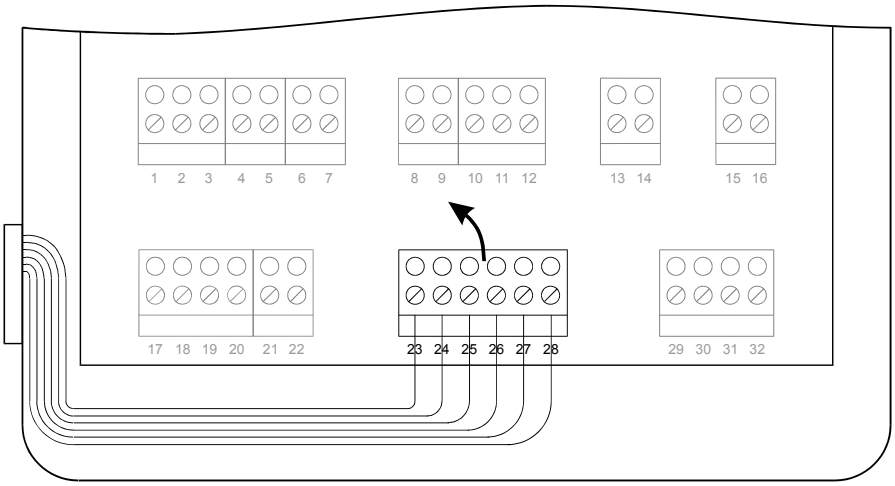
Attention!

- **In areas subject to explosion hazards, only the passive operating mode is permissible!**
  (an external supply unit is required)
- If the the current output is set active, **no** external supply unit may be used! **In this case the connection of an external supply unit causes damage to the EC 694!**

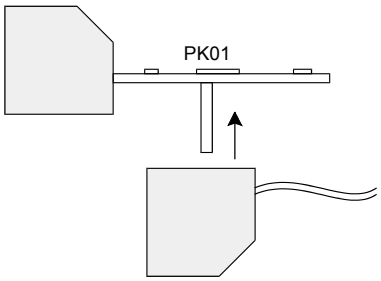
Current output **active**	Current output **passive**
Not permissible in hazardous area Connection without supply unit (see 24 V version)	X72 X71 X18 13 14 + - Example of connection see page 71

Installing the PK 01 polarity converter

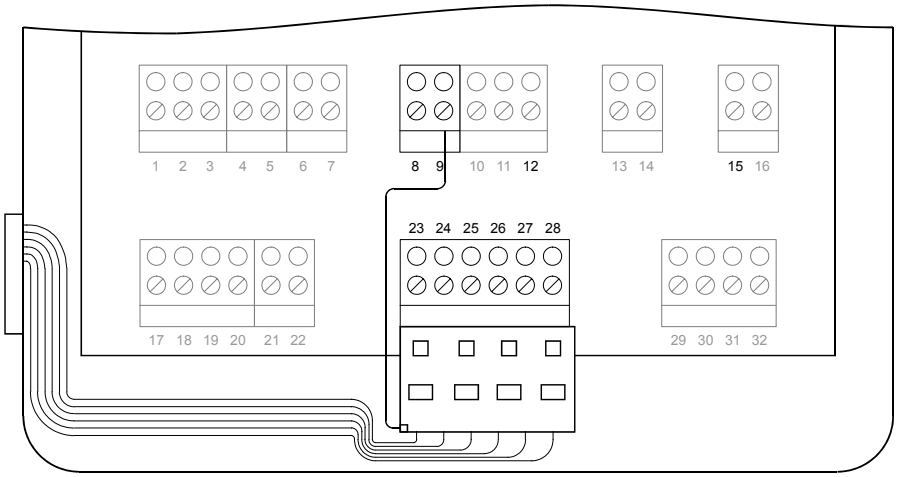
1. Open the cover and remove the connector with the terminals 23-28.



2. Plug the connector into the bottom of the PK 01.

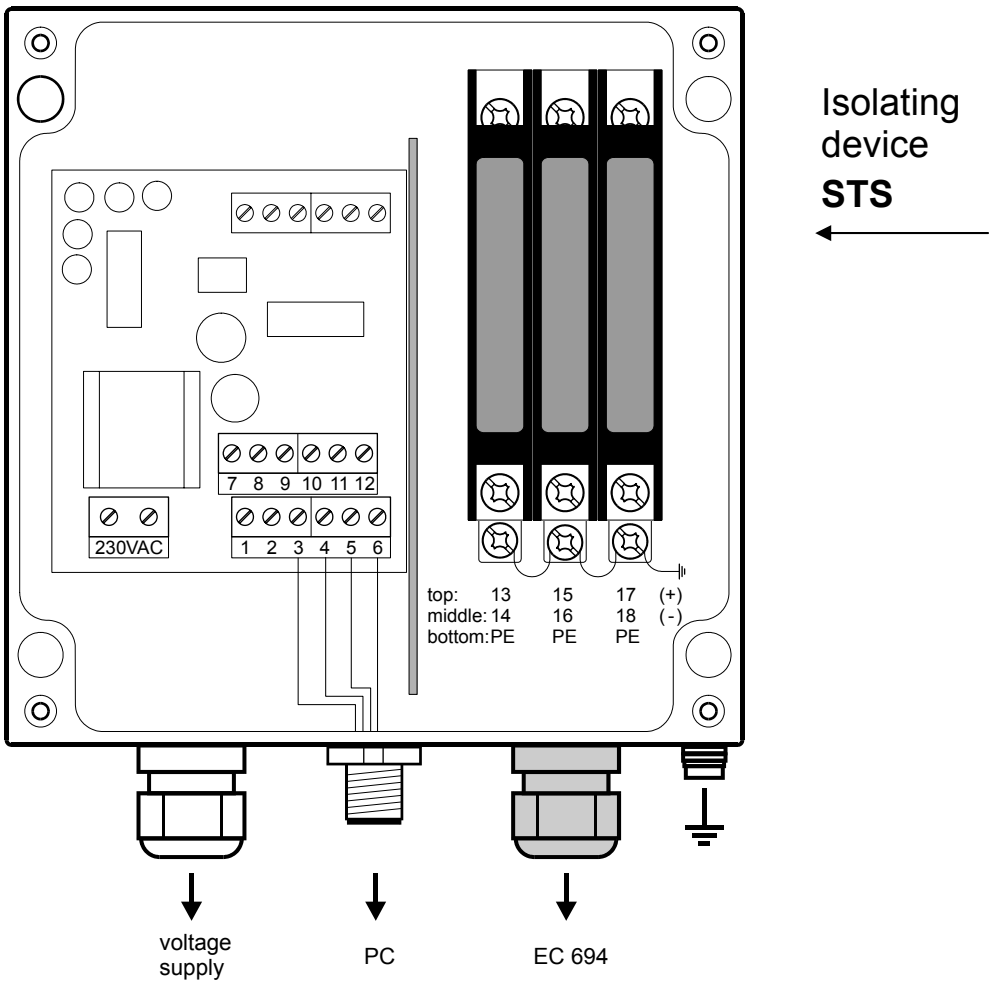


3. First connect the negative (black) wire to the terminal 9 (if terminal 9 is already used: 12 or 15) and then plug the PK 01 onto the pin connector 23-28.



Connecting a PC to the electric interfaces

In the case of a battery-operated volume corrector or a corrector installed in an area subject to explosion hazards, an interface isolating device is required for connecting a PC to the electric 4-wire or 3-wire interface.



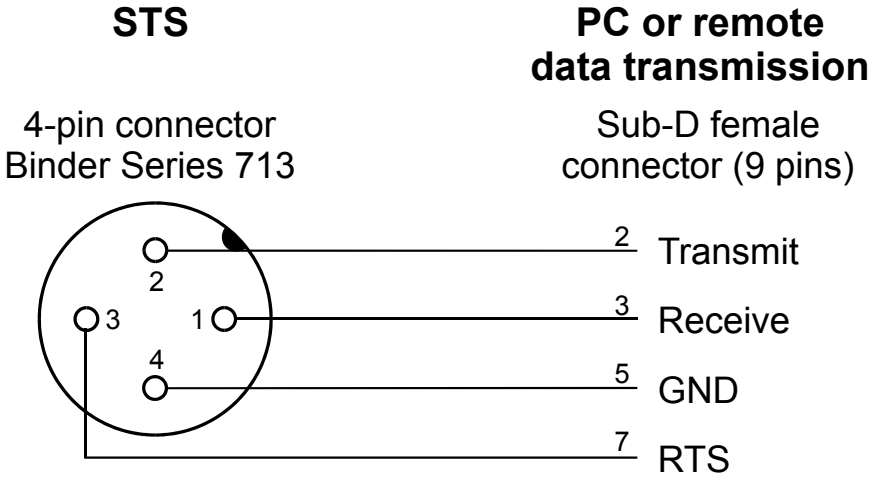
Terminal assignments for the isolating device Type STS (connection to the EC 694):

EC 694 → 4-wire interface		**Isolating device**		**← EC 694** 3-wire interface	
Terminal				Connector (5)	Terminal
29		15		2	11
30		17		3	10
31		13		-	-
32		14		6	12

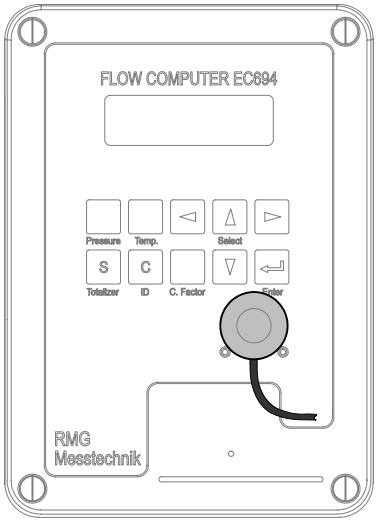
The terminals of the isolating device are **not** numbered (for assignment, see drawing).

The **supply voltage** is either 230 VAC (connection to the terminals “230 VAC”) or 12 VDC (terminal 1: GND, terminal 7: +12 V).

The **PC is connected** to the EC 694 using a Binder plug (included in the scope of delivery). The following illustration shows the terminal assignments with a view from the outside onto the female connector:



Connecting a PC to the optical interface



Remove the magnetic protective cover from the IR read head and plug it on the optical port as shown in the drawing. Make sure that the read head comes into contact with the two positioning points below the port and turn it in such a way that the cable is directed downwards.

Connection of temperature and external pressure transmitter

The required cable type for both transmitters is: LIYCY - 2 x 0.75 blue

The maximum cable length is:
- Temperature transmitter: 20 m
- Pressure transmitter: 3 m

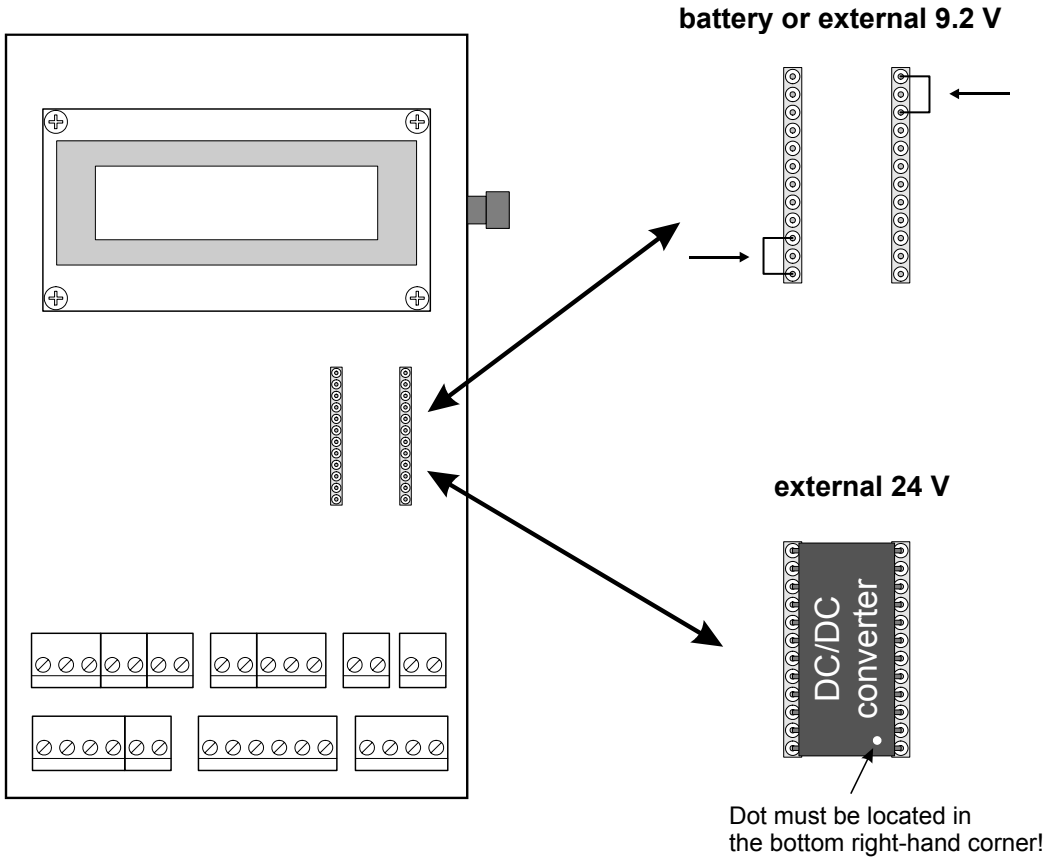
Converting the EC 694 to external 24 V supply

All EC 694 types can be converted to 24 VDC supply at any time. For this purpose, a DC/DC converter must be retrofitted on the board.

Prior to the installation of the DC/DC converter in the socket, the two jumpers must be removed.

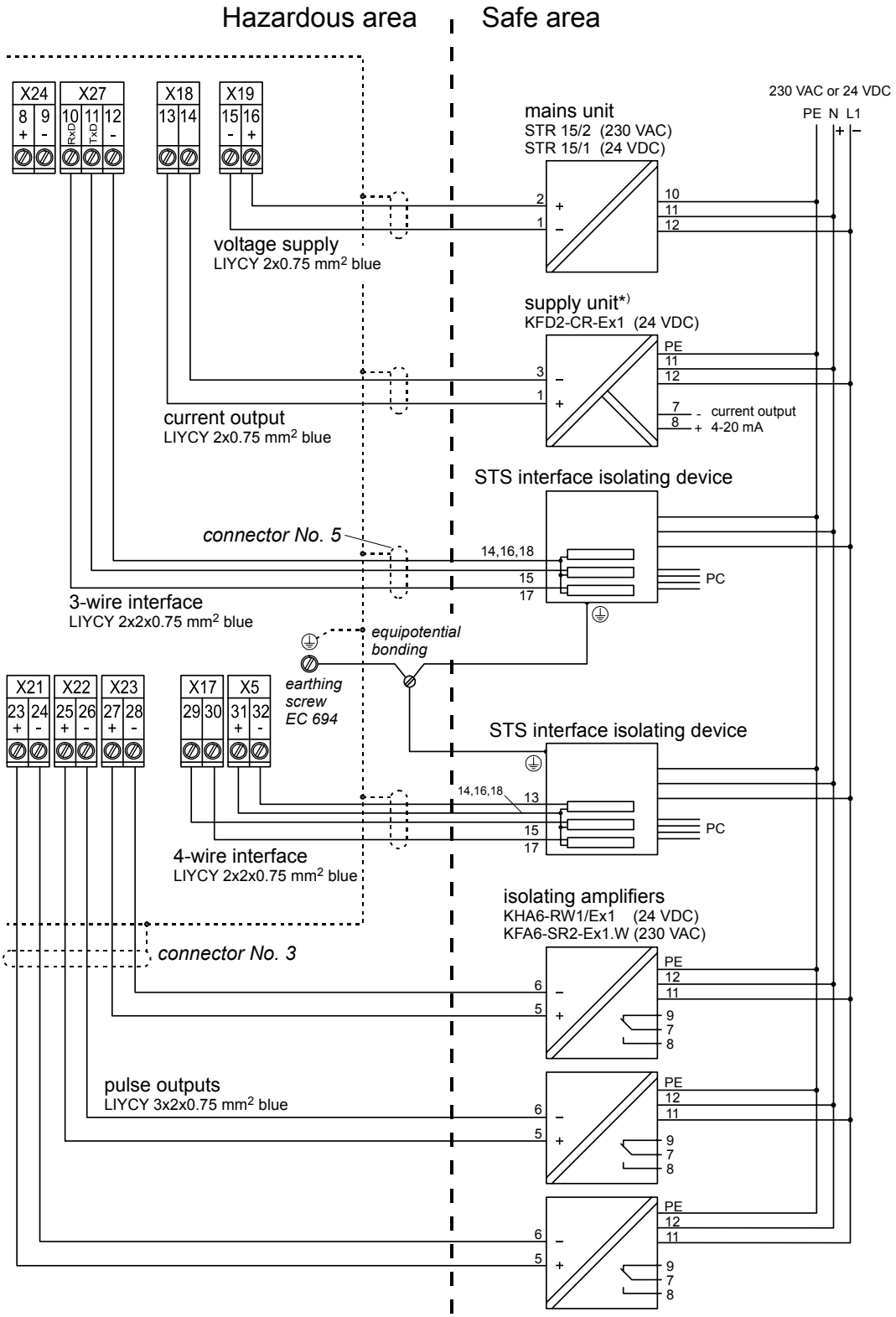
Note! After conversion, the device is no longer approved for areas subject to explosion hazards!

Battery-powered devices have no current output, also not after conversion! For devices with external 9.2 V supply the current output has to be adjusted again after conversion!



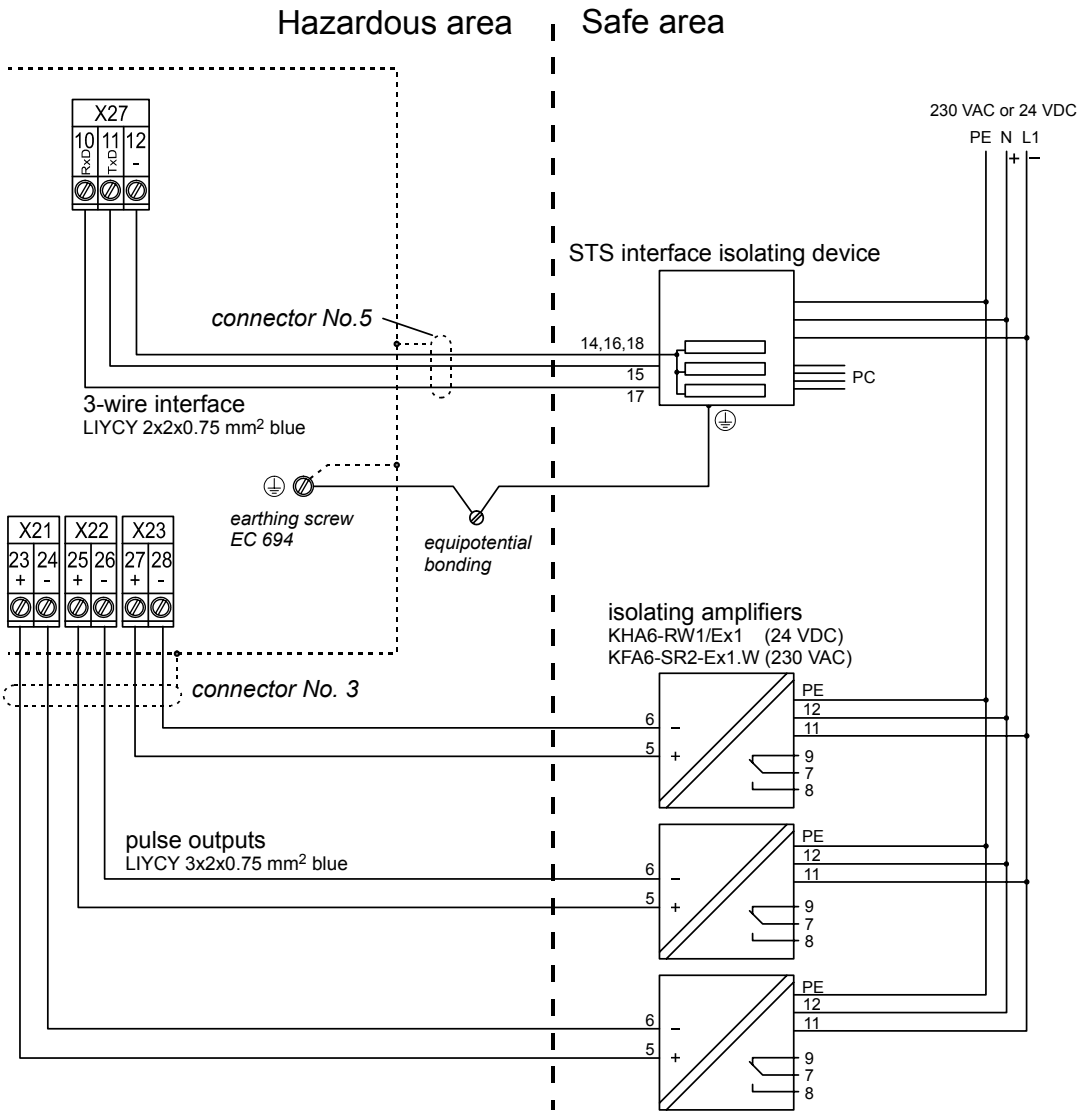
Examples of connection

Mains-powered device (all connections used)



*) for passive current output only!

Battery-operated device

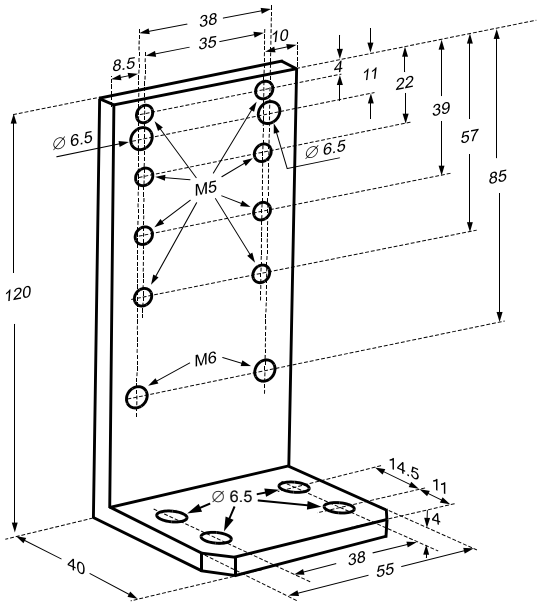
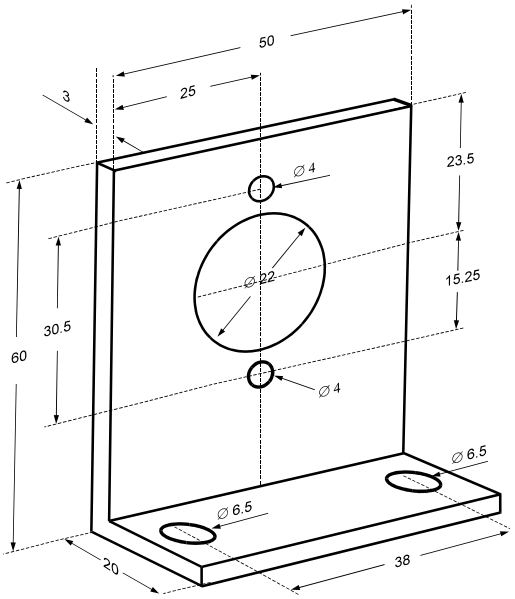


Please note the following:

1) For use in hazardous areas, isolating amplifiers, the interface isolating device and an intrinsically safe (EEx i) supply unit must **always** be used.
2) **Always** (EMC) connect the earthing screws of the EC 694 and the interface isolating device (cross section $\geq 4mm^2$) separately to the equipotential bonding. Also without additional devices the earthing screw of the EC 694 has always to be connected to the equipotential bonding!
3) In the event of pulse outputs (connector 5), connect the shield to the earthing screw of the EC 694.
4) If the power supply unit is intended to be installed in the hazardous area, the device type EST 15/1 (24 VDC) or EST 15/2 (230 VDC) is to be used.

F Mounting Instructions

The EC 694 volume corrector provides a number of mounting variants (with or without 3-way check valve) as there are **wall mounting**, **pipe mounting** and **gas meter mounting**.
For wall or pipe mounting or for mounting the corrector on an RMG turbine meter with a Type "**F**" meter head, you need the assembly kit **1**, and for mounting the corrector on an RMG turbine meter with a Type "**A**" meter head, you need the assembly kit **2**. The assembly kits contain the following parts:

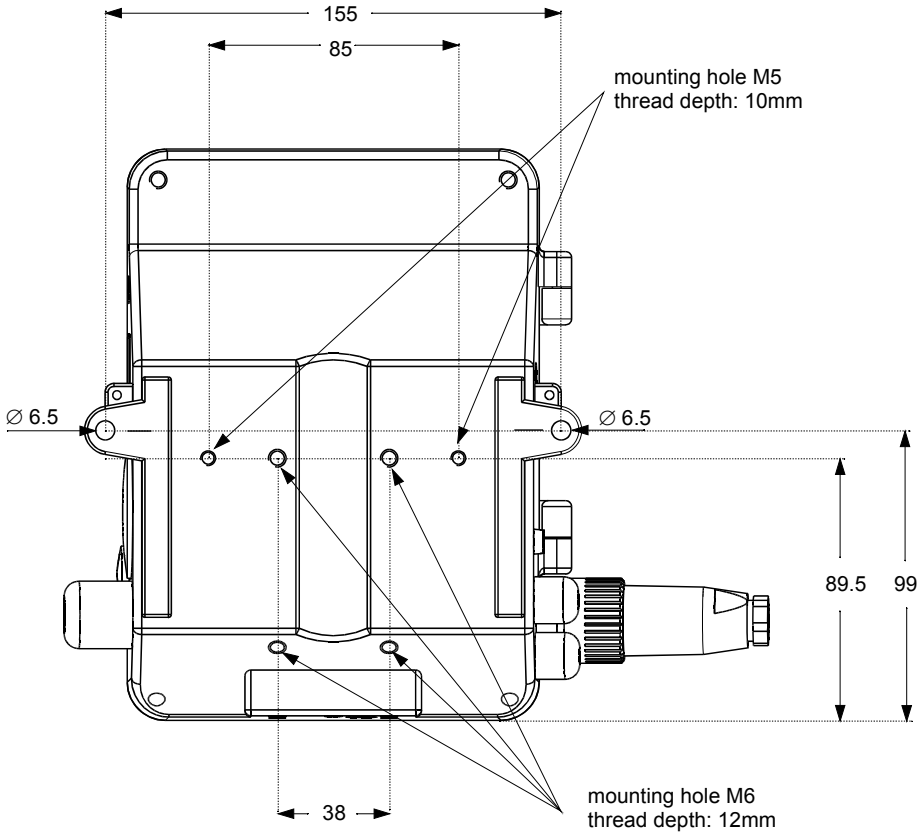
Assembly kit 1 Order No.: 50.36.756.00	**Assembly kit 2** Order No.: 50.36.761.00
2 mounting brackets, large 1 pipe clamp Pg 48 4 cylinder head screws M 6x12 4 cylinder head screws M 5x40 2 cylinder head screws M 5x10	1 mounting bracket, small 2 seals 2 cylinder head screws M 6x12
 Large mounting bracket	 Small mounting bracket

Please note that for each of the following mounting variants there has to be a free space of a minimum of 10 cm to the left and a minimum of 15 cm to the right of the EC 694. This is necessary to plug in connectors and replace the battery pack!

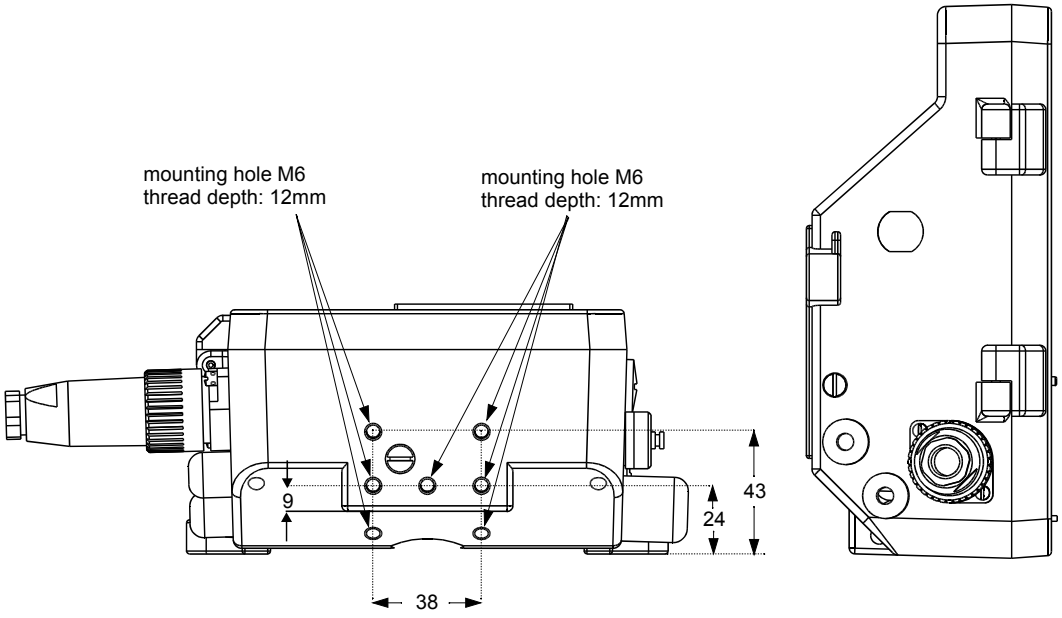
The specification of the connector of the built in **pressure transmitter** is: Screw connection M12 x 1.5 for ERMETO 6L (6 mm tube).

Threads and holes in the enclosure

Threaded holes on the back of the enclosure:

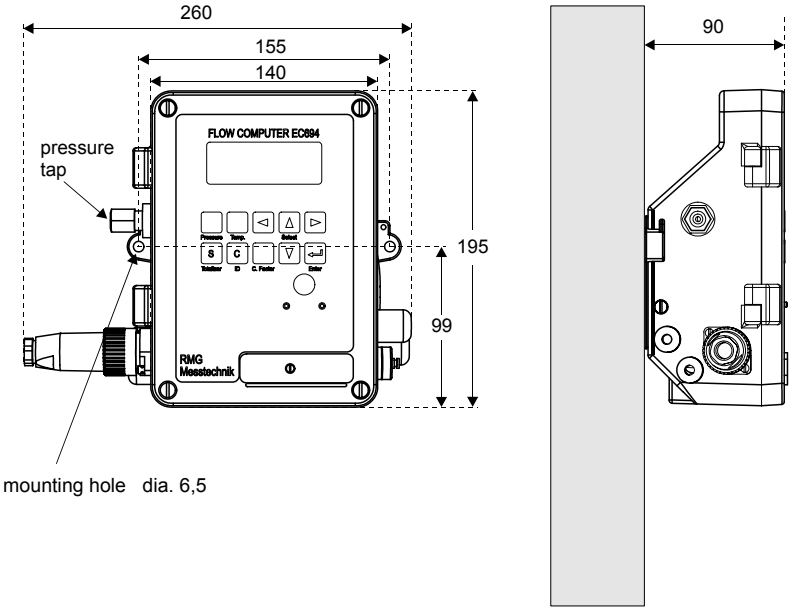


Threaded holes on the bottom of the enclosure:



Direct wall mounting without 3-way check valve

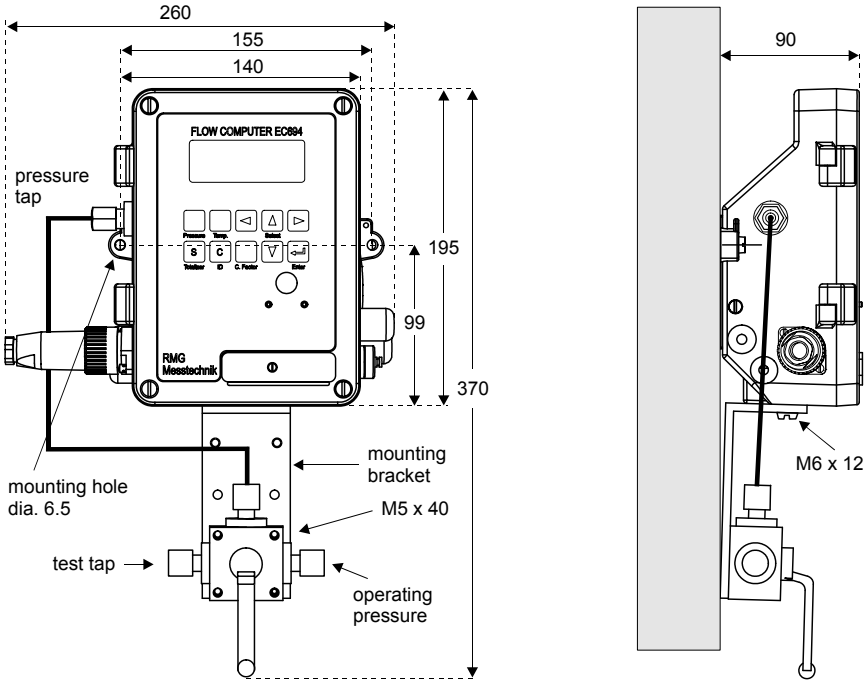
Required parts: 2 screws M 6



Direct wall mounting with a 3-way check valve

Assembly kit 1

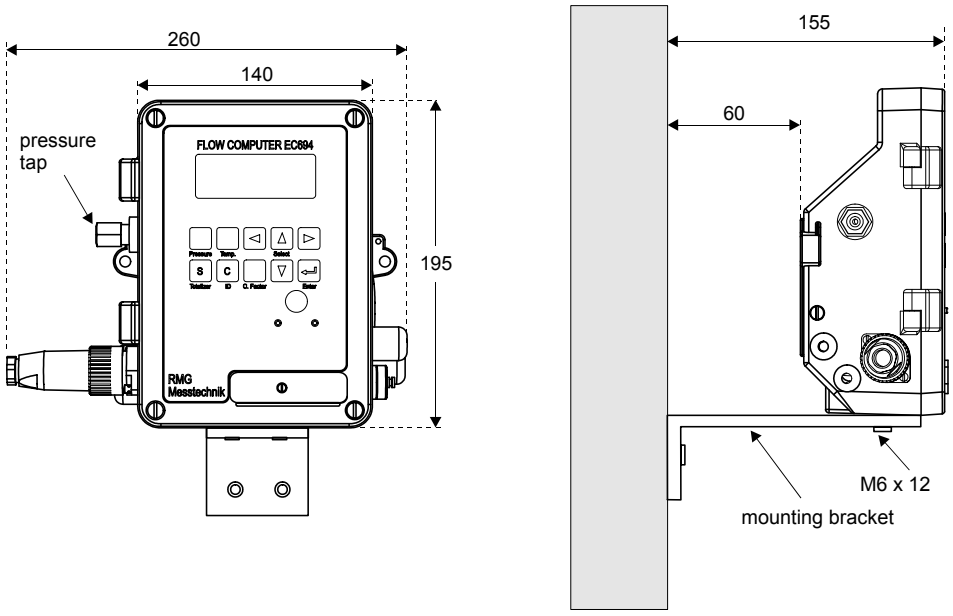
Required parts: 1 mounting bracket, 2 cylinder head screws M 6x12,
4 cylinder head screws M 5x40



Instructions to the 3-way check valve see page 83

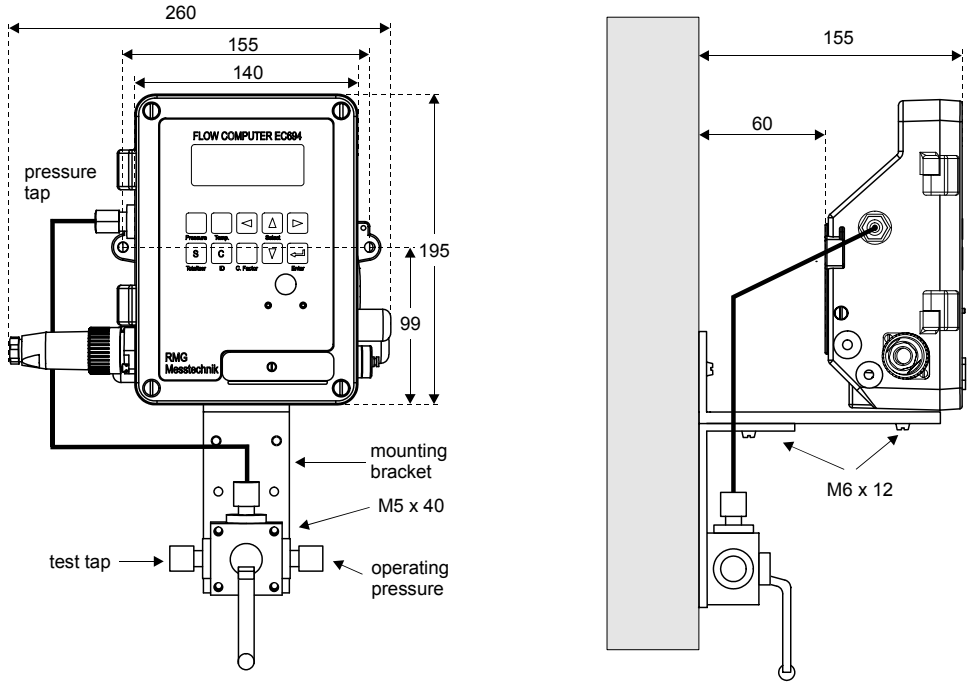
Perpendicular wall mounting without 3-way check valve

Assembly kit 1
Required parts: 1 mounting bracket, 2 cylinder head screws M 6x12



Perpendicular wall mounting with a 3-way check valve

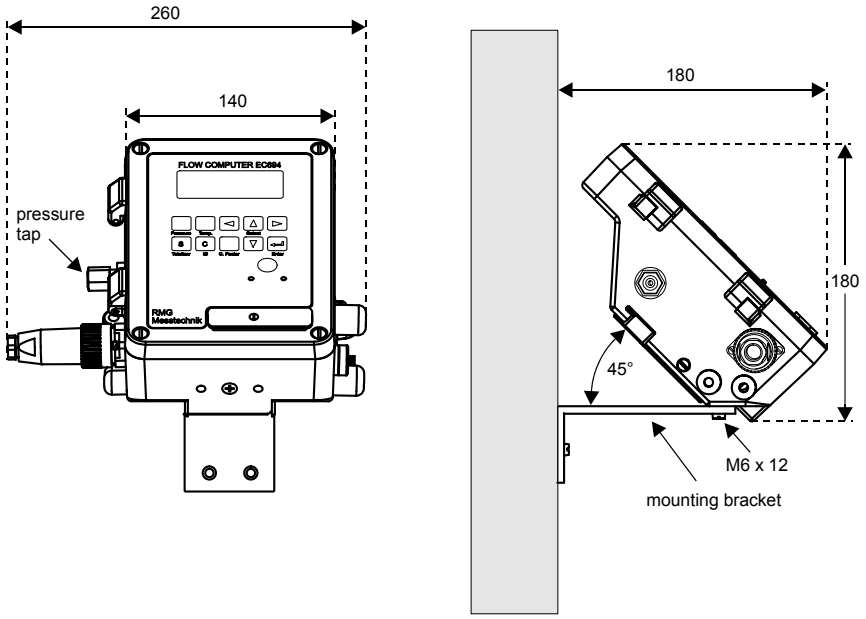
Assembly kit 1
Required parts: 2 mounting brackets, 4 cylinder head screws M 6x12,
4 cylinder head screws M 5x40



Instructions to the 3-way check valve see page 83

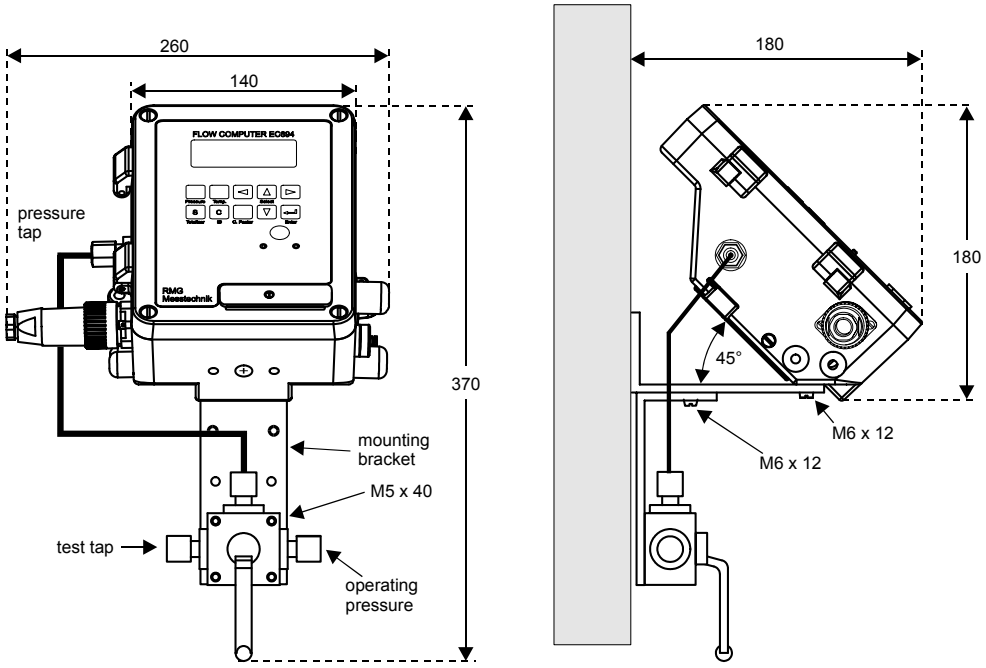
Inclined wall mounting without 3-way check valve

Assembly kit 1
Required parts: 1 mounting bracket, 2 cylinder head screws M6x12



Inclined wall mounting with a 3-way check valve

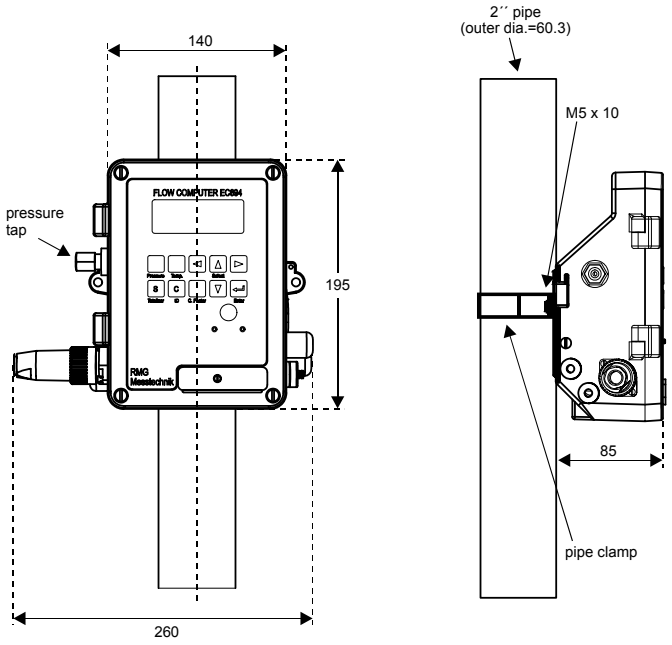
Assembly kit 1
Required parts: 2 mounting brackets, 4 cylinder head screws M6x12,
4 cylinder head screws M5x40



Instructions to the 3-way check valve see page 83

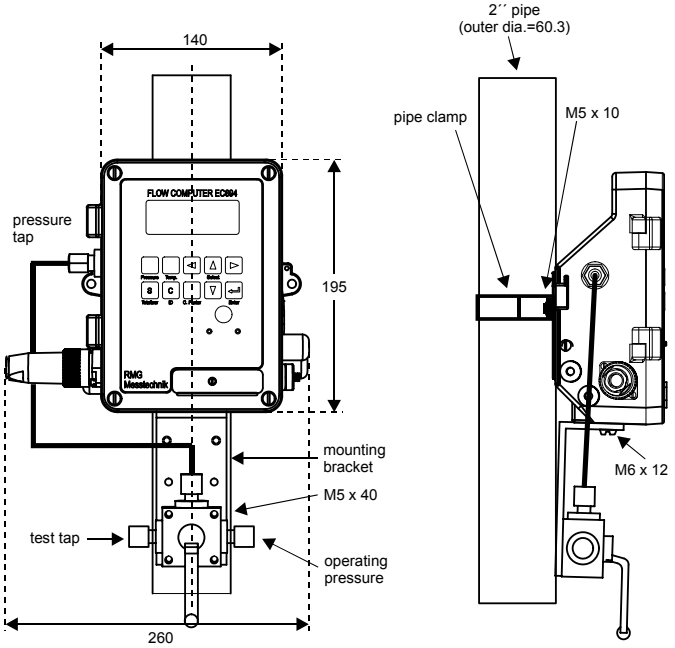
Pipe mounting on a 2" pipe (Ø 60.3 mm) without 3-way check valve

Assembly kit 1
Required parts: 1 pipe clamp, 2 cylinder head screws M 5x10



Pipe mounting on a 2" pipe (Ø 60.3 mm) with a 3-way check valve

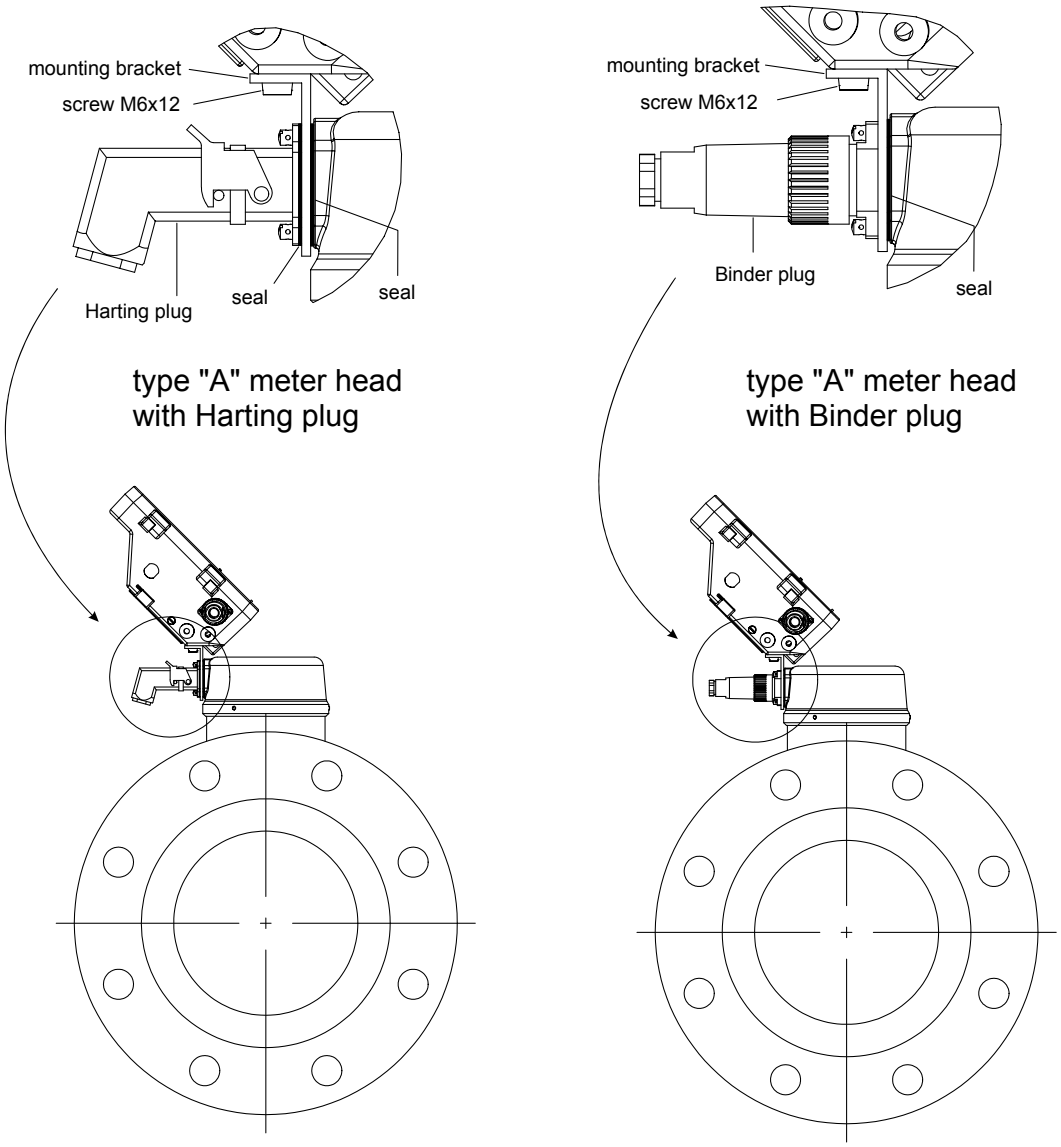
Assembly kit 1
Required parts: 1 pipe clamp, 2 cylinder head screws M 5x10,
1 mounting bracket, 4 cylinder head screws M 5x40



Instructions to the 3-way check valve see page 83

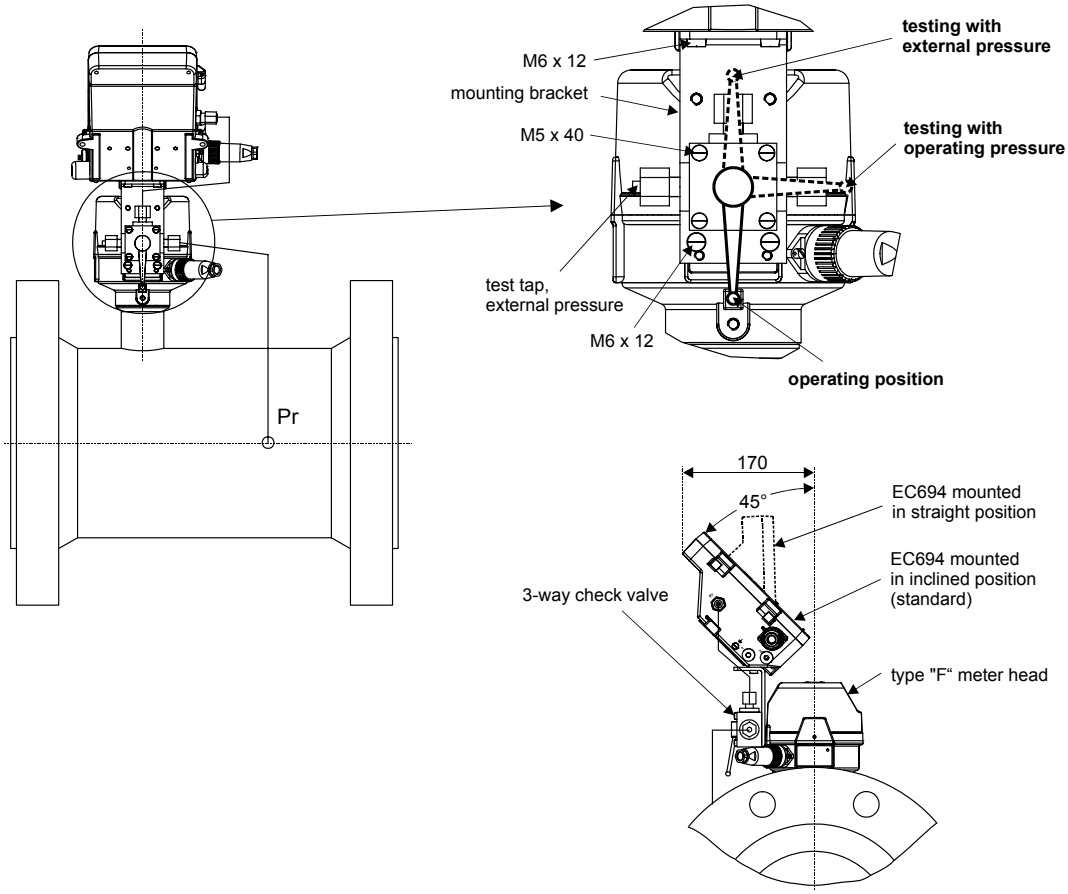
Gas meter mounting on an RMG Type “A” meter head

Assembly kit 2
Required parts: 1 mounting bracket, 2 cylinder head screws M6x12, seals (2 seals for Harting plug; 1 seal for Binder plug)



Gas meter mounting on an RMG Type “F” meter head

Assembly kit 1
Required parts: 1 mounting bracket, 4 cylinder head screws M 6x12, (with 3-way check valve: additional 2 cylinder screws M 5x40)

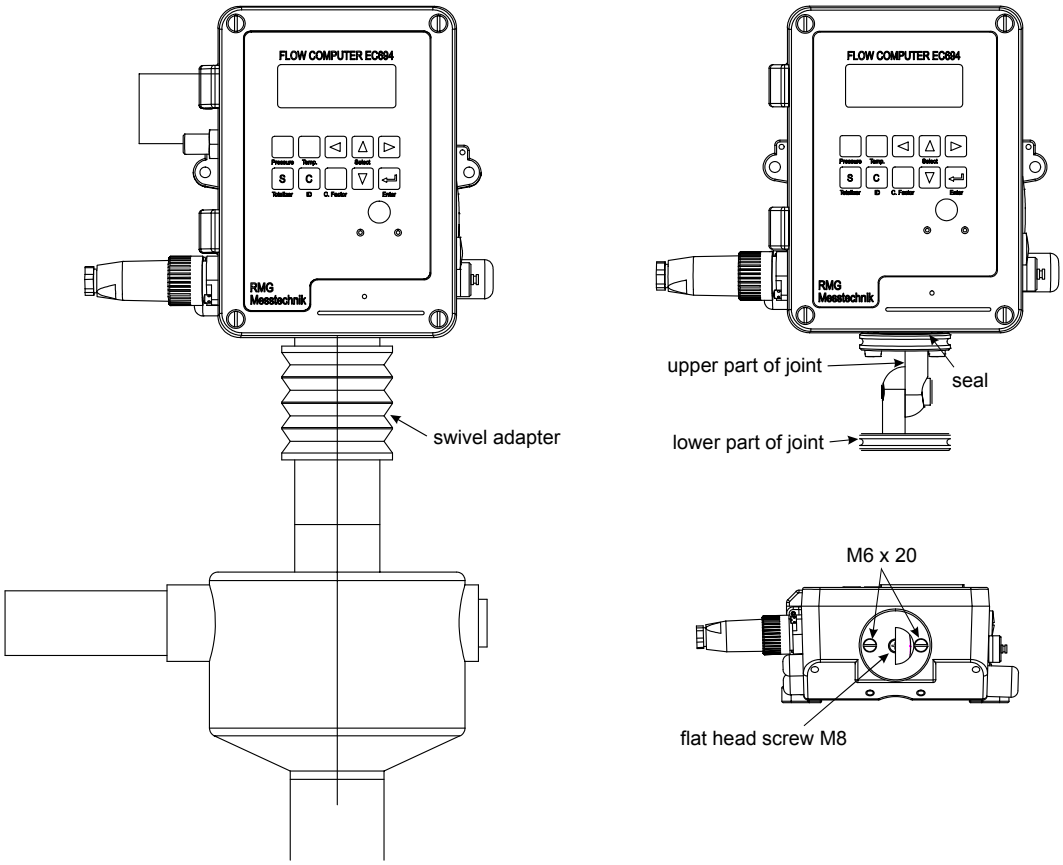


The pipe from the pressure transducer to the 3-way check valve must be installed sloping towards the check valve, whereas the pipe from the pressure transducer or 3-way check valve to the gas meter must be installed sloping towards the gas meter.

Gas meter mounting on an RMG Type “D” meter head

Mounting with a swivel adapter

Required parts: 1 swivel adapter (Order No.: 50.36.758.00), 2 cylinder head screws M 6x20 or
1 upper part of joint, 2 cylinder head screws M 6x20 (for conversion from EC 685 to EC 694; included in the conversion kit, Order No.: 50.36.759.00)



When mounting the EC 694 for the first time, put the swivel adapter on the mechanical drive shaft of the meter head and fix it by means of the two clamping screws.

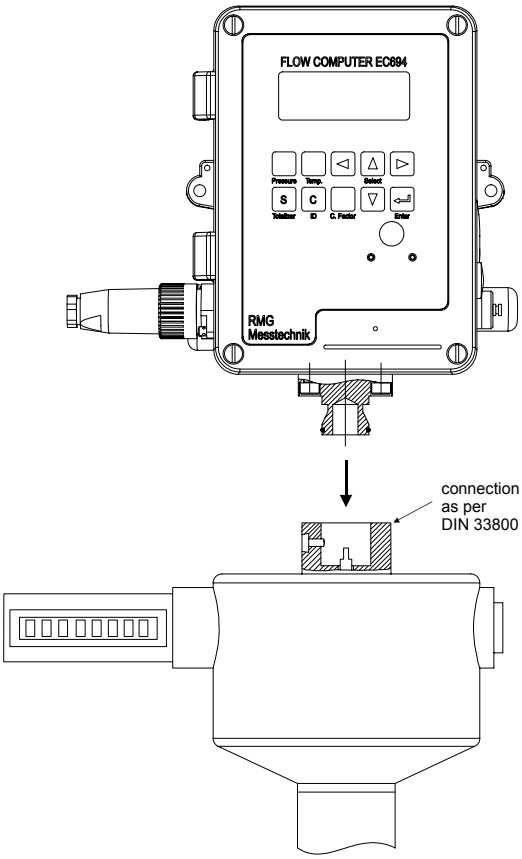
For conversion, loosen the hexagon socket screw of the joint and replace the old upper part of the joint by the new one.

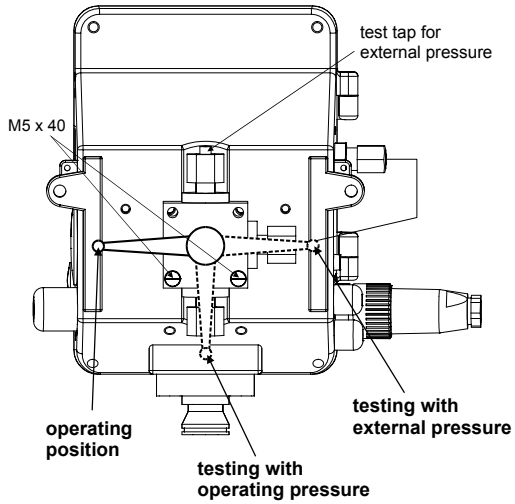
If you use a swivel adapter with a reed contact pulse transducer, you must in both cases remove the M8 flat head screw within the enclosure of the EC 694 covering the wire feed-through prior to mounting.

Install the 3-way check valve in the same way as with the fitted adapter (see next page).

Mounting with a fitted adapter on connections as per DIN 33800

Required parts: 1 fitted adapter (Order No.: 50.36.757.00), 2 cylinder head screws M 6x16
(with 3-way check valve: additional 2 cylinder head screws M 5x40)



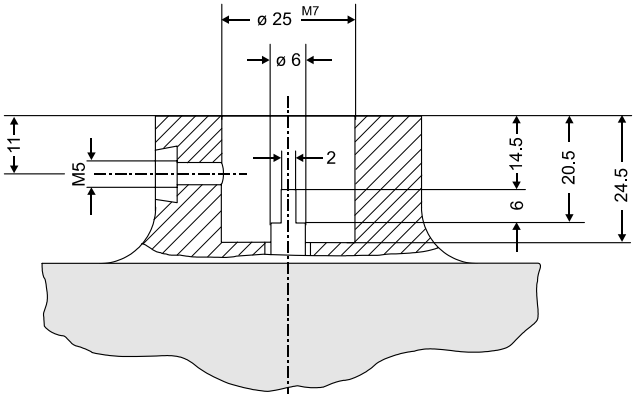


When mounting the EC 694 with a 3-way check valve, the following must be noted:

1. The pipe from the pressure transducer to the 3-way check valve must be installed sloping towards the check valve.
2. Prior to mounting, two M5 threaded holes must be drilled

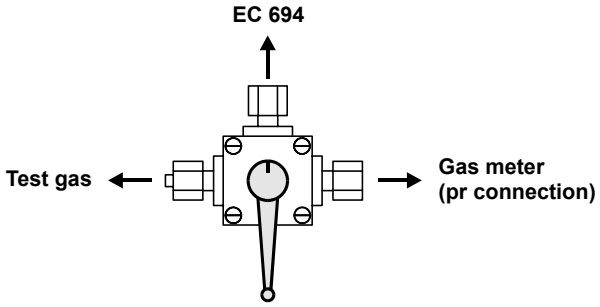
During installation, first remove the M8 flat head screw which plugs the wire feed-through on the bottom of the enclosure.

Connection as per DIN 33800:



Mounting and operation of the 3-way check valve

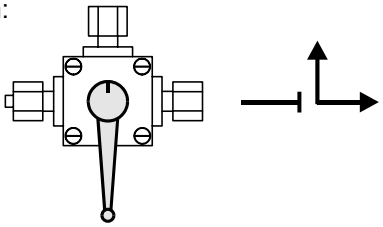
Installation



When mounting the 3-way check valve, ensure that the piping from the gas meter to the corrector has a slope towards the gas meter. Connection: ERMETO 6L (6 mm pipe).

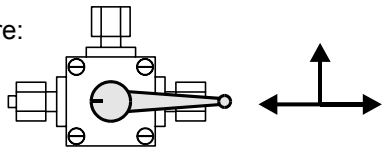
Valve positions

operating position:



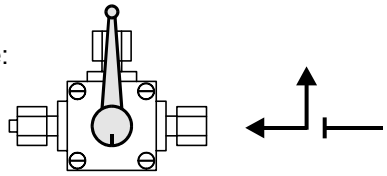
In the operating position the pressure from the gas meter is connected through to the corrector.

testing with operating pressure:



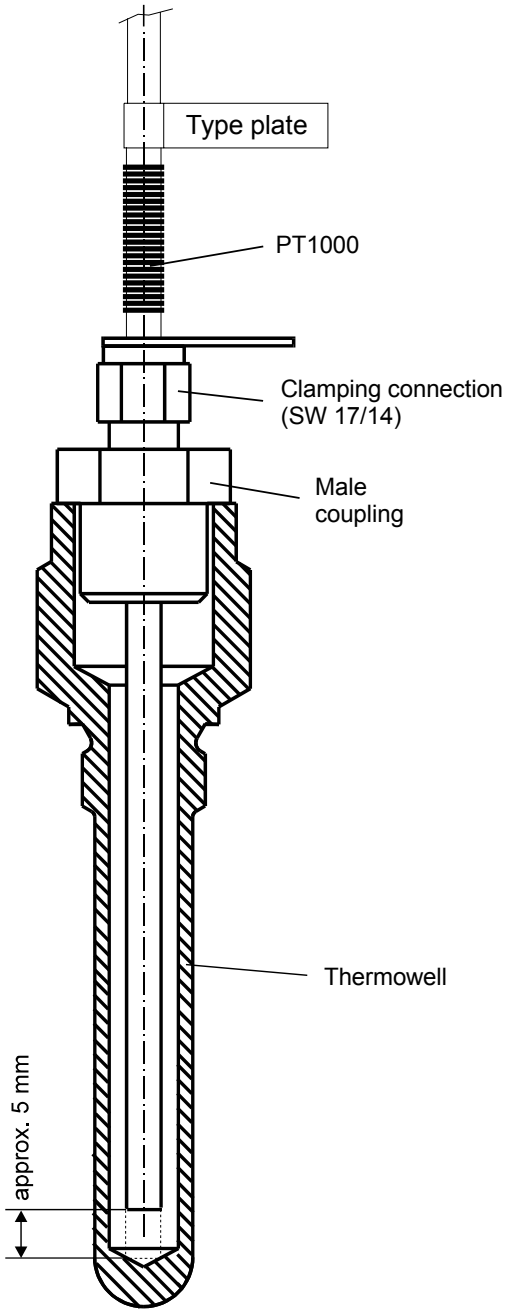
In this position the pressure from the gas meter is connected through to to the corrector and to the test gas connection.

testing with external pressure:



In this position the test gas connection is connected through to the corrector.

Mounting the resistance thermometer



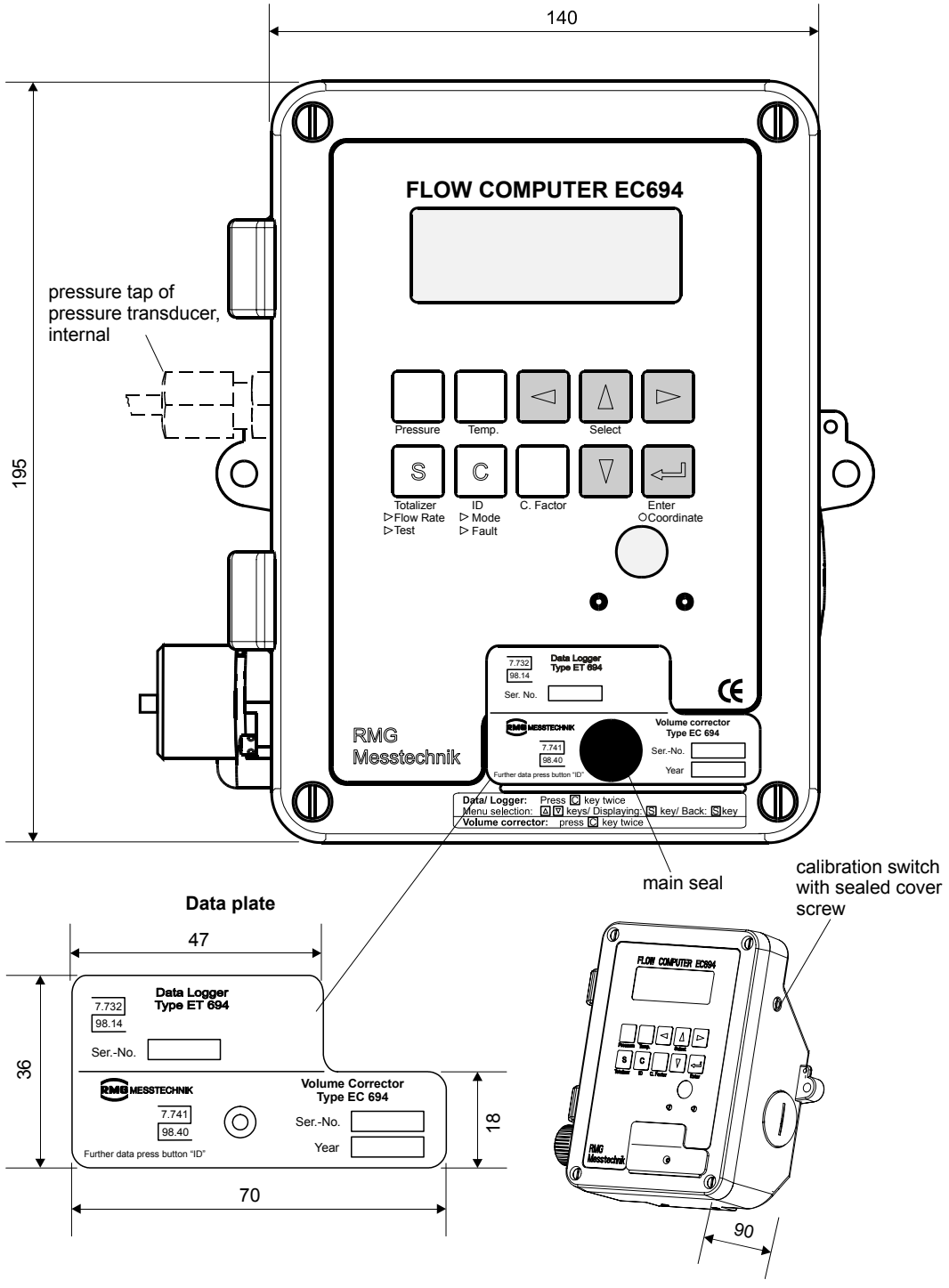
The thermowell for the PT 1000 resistance thermometer should be installed perpendicularly, since oil is filled into the thermowell for better heat transmission.

Follow these steps to screw the resistance thermometer into the thermowell:

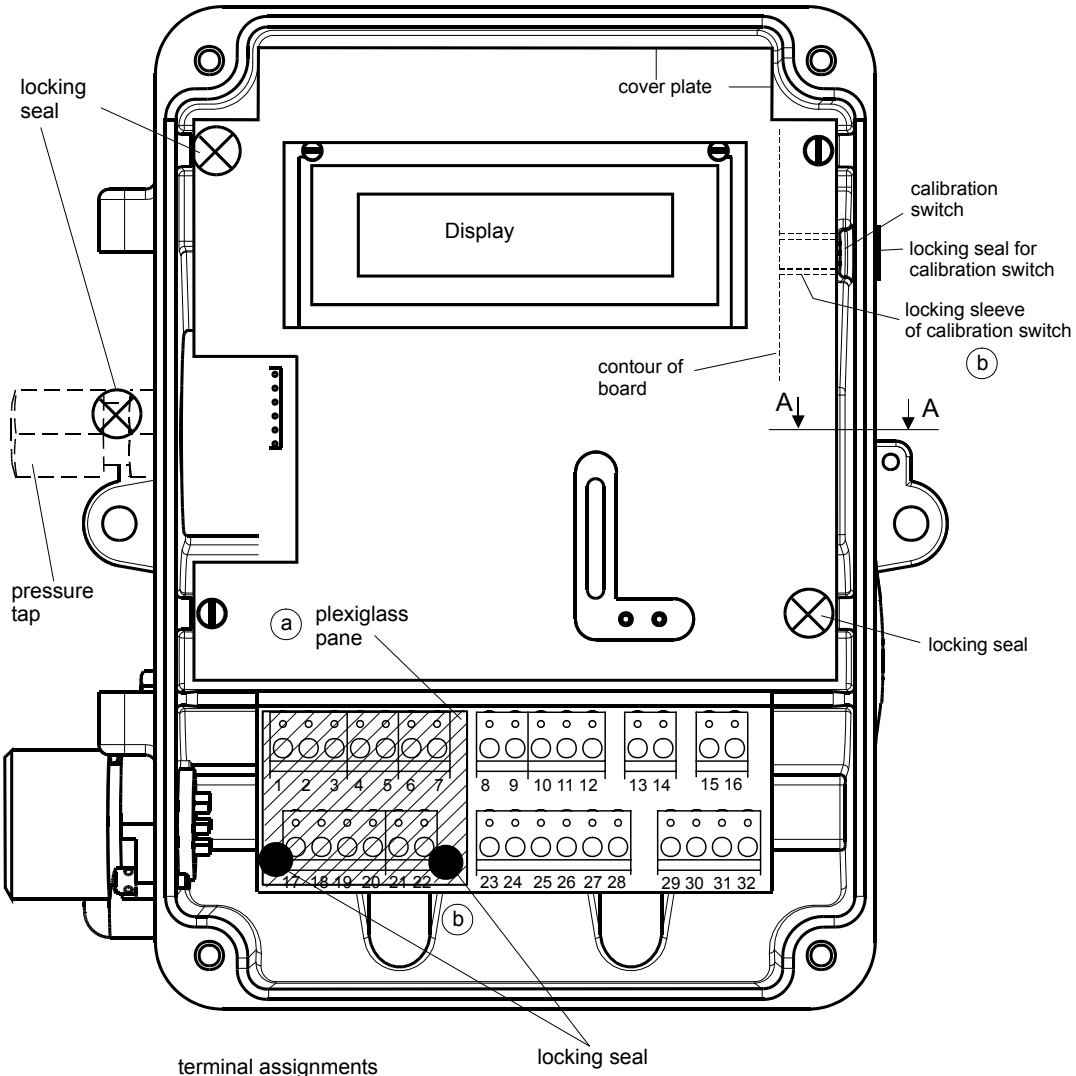
1. Screw the male coupling into the thermowell.
2. Slide the resistance thermometer through the male coupling into the thermowell until it stops, and then draw it back approx. 5 mm.
3. Use the clamping connection (SW 17/14) to clamp the resistance thermometer onto the male coupling.

G Seal Diagrams

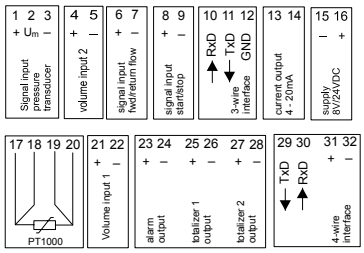
Seals located on the enclosure

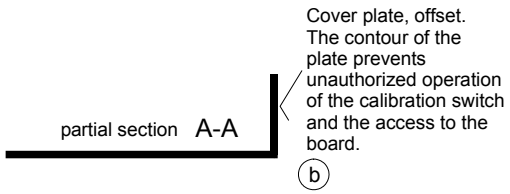


Seals located on the terminals

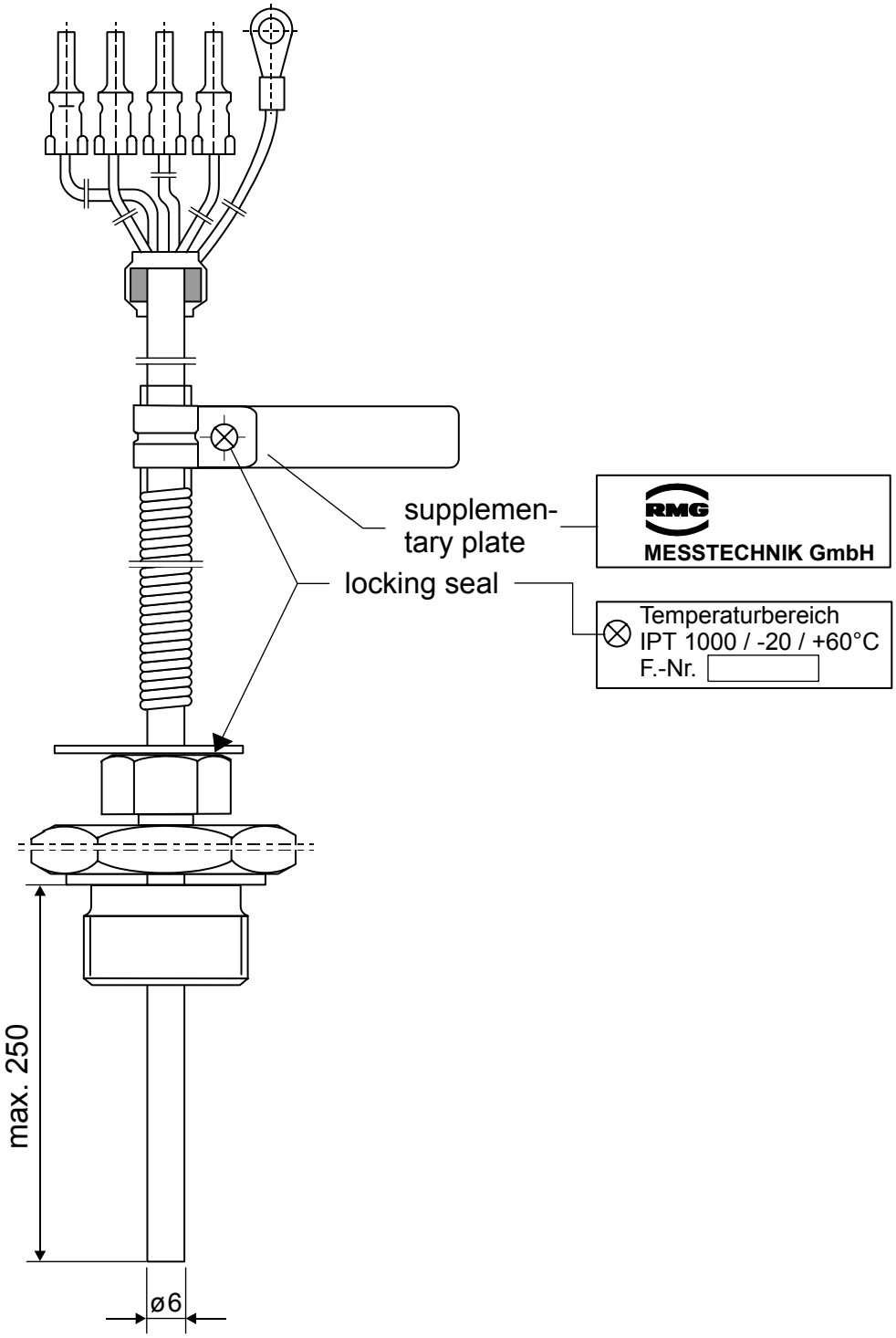


terminal assignments

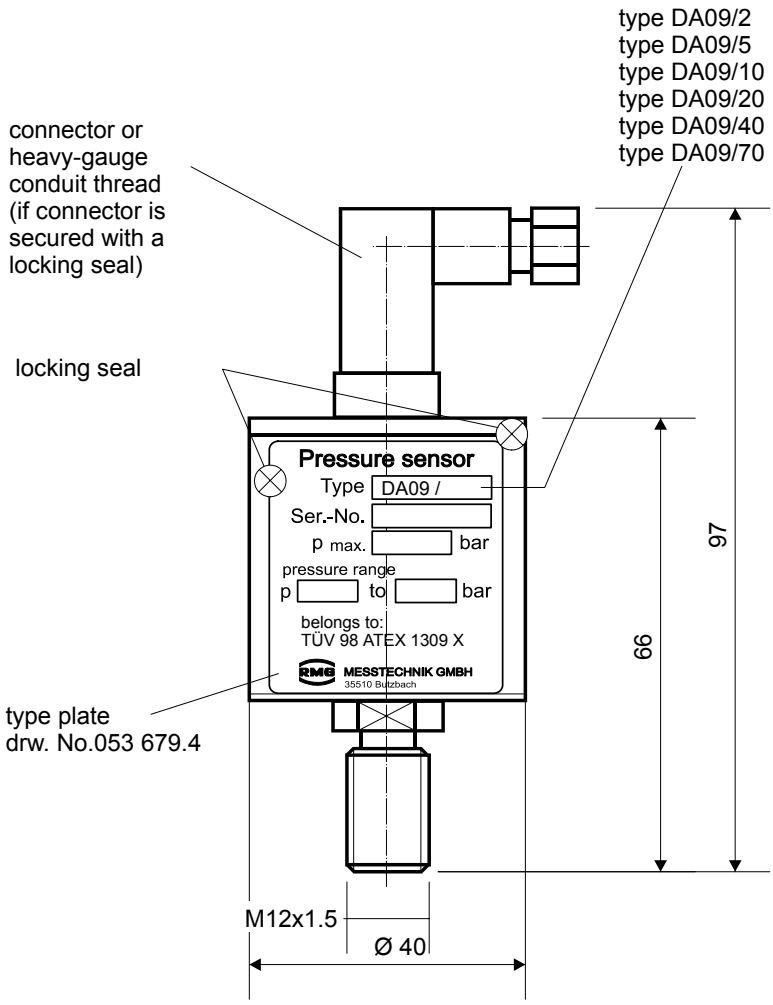




Seals located on the resistance thermometer



Seals located on the **external** pressure transducer



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