EK-86/S

This product is discontinued!

Electronic Volume Corrector EK-86/S

Operating Manual and Installation Instructions

Issued	6/94	Manual No.	73014209
Version	V2.2	Edition	02

Preface

The EK 86 Volume Corrector is the device at the top of the Elster range of Electronic System Volume Correctors. With this operating manual the user has available a comprehensive aid in the operation and setting up of the EK-86 Electronic System Volume Corrector. Due to the wide variety of possibilities presented by the EK-86, its operating manual is also extensive. In order to give a detailed, but clear explanation of the various settings and possibilities, the operating manual is subdivided into two parts:

PART 1: Operating the EK-86

PART 2: Setting up the EK-86

In **PART 1** the basic **description of the volume corrector** and the **user environment** is explained. Comprehensive details of the operation and the menu structure together with the individual settings are given. This part is intended as a reference section and should always be available to the user.

PART 2 mainly deals with the points required for the **mounting and setting up** of the volume corrector. This particularly includes the connection of the leads and lines, the correct setting of the parameters and the checking of the settings which have been made as well as fitting seals to the EK-86. This section is usually only needed during setting up or if the connections are modified.

Supplementary to the two parts mentioned above is an **appendix** containing a summary of the most important **tables** (volumes, measurements, parameters), **figures** (e.g.: terminal space, circuit diagrams for the sensors), **technical data** (supply values, dimensions, etc.), manufacturer's declaration and the index for the easy finding of terms and subjects.

Safety information

The EK-86/S can be supplied with mains voltage at 230 V. Mains voltage presents a hazard to life!

☞ *Only switch the mains voltage on after all leads have been connected and the hinged cover is closed. With modifications to the connections it is essential that you make sure that the device is not under voltage and is secured against switching on.*

In the device modules are installed which are approved as “associated electrical equipment” in Category “ib” conforming to DIN EN 50020 when used with intrinsically safe electrical circuits. The EK-86/S is therefore suitable for connection to sensors and pulse generators located in areas subject to explosion hazards (e.g.: Zone 1). The EK-86/S itself must be installed outside of Ex Zone 2.

It is essential that the following instructions are followed:

☞ *Follow the regulations in the relevant standards, in particular DIN VDE 0165.*

☞ *Make sure that the limits stated in the conformity certificates for the cards to be connected are observed (see Appendix D).*

☞ *Using a separate cable, the EK-86/S must be connected via the earthing screw fitted to the right of the housing directly to the potential equalisation strips.*

Further information can be taken from the chapter “Installation” in Part 2 of the operating manual.

Contents

Part 1: Operation of the EK-86/S

PART 2: Setting up the EK-86

Appendices

1 Device description

1.1 Function and features

The EK-86 Electronic System Volume Corrector is an all-state volume corrector with system capabilities and offers extensive integral features such as: K value computation to SGERG-88 or AGA-NX19-mod-BR.KORR.3H, large LCD display with 2 standard displays for simple checking of the most important measurements, menu structure, 4-channel data storage function (DS-100), minimum of 7 switching or pulse outputs, calibration table, etc.

The EK-86 Volume Corrector acquires low and high frequency pulses from impeller-type and dry gas meters. The incoming volume pulses are converted with the entered cp value and saved as actual volumes (V). Using the measurements of pressure (p) and temperature (T) together with the computed or entered value for the K value, the standard volumes (Vn) are computed from the actual volumes and saved. If disturbances occur, counting takes place in separate disturbance volume counters. The actual and standard flows are calculated and the maximum values saved. Various measurements are determined for checking or control purposes and output via the LCD display or the interface.

There are also seven digital outputs with electrical isolation available. Two of them are defined as alarm and warning outputs and can be operated by relays with changeover, normally closed or normally open contacts. The other outputs can be freely programmed, the default settings ex-works for the outputs being the standard volume (2 outputs), actual volume and the upper and lower limits.

A number keypad (0-9, “-”, “,”), a separate control block with 4 keys (“→”, “C”, “↑” and “↵”) and an LCD display with 4x40 figures are available to the user for operation. The displays and messages are provided in clear text. Other interfaces for reading out and setting parameters and for communication with external devices (modem, printer, etc.) are present. The setting of the parameters can take place using the keypad or with the aid of a PC/laptop.

Alternative power supplies are the 230 V mains or a 24 V DC supply. If a 24 V UPS is used, volume correction is guaranteed even during a power failure. In addition all important data is backed up for at least 5 years without any power supply.

Other checks, e.g. automatic checking of the internal processor functions, line monitoring of all sensors with appropriate entry in the status register and recording in log books, provide monitoring of the operational status and help the rapid rectification of faults.

Performance features

- Electronic system (all-state) volume corrector.
- Takes K value into account with three different modes:
  Computation of the K value to **SGERG-88**, to **AGA-NX-19-mod-BR.KORR.3H** or K = constant (adjustable between 0.90000 and 1.10000).
- Large, 4-line LCD display (each line 40 characters) and 16-key keypad as controls; status display via LEDs for mains, alarm and warning.

Software functions:

- Clearly divided menu structure with two standard displays:
  Standard Display I: V_n, V, p, T, k value, Z factor.
  Standard Display II: V_n, V, V_{nd}, V_d, V_{nt}, V_t, Q_n, Q.
- Automatic monitoring of the device function and logging of any faults occurring (in status register + logbook).
- Freeze function for two sets of consumption data dependent on:
  Time period (up to 999 min.), consumption (in m^3), time point and time interval.
- 4-channel **DS-100** function with time-referred saving of the daily/hourly values for the standard/actual volumes, pressure and temperature.

  or as option

  ETG-3000 function with time-referred saving of the daily/hourly values for the standard/actual volumes, pressure and temperature.
- Characteristic correction of the pressure/temperature sensor via up to three reference points (can be measured or entered as a table).
- Setting of parameters with PC/laptop via a serial interface.

Technical features:

Pulse inputs:

- Four **intrinsically safe NAMUR** inputs (DIN 19234): 2x HF (1x LF), 2x AUX connection for A1S/A1R and E1 Generators.

Analogue inputs:

- Two analogue inputs - designed as intrinsically safe; intrinsically safe or pressure resistive sensors connected, but mixed operation of both types of sensor is not possible.
- Connection of a Pt-100 temperature sensor using 4-wire technique.
- Connection of a pressure sensor (absolute/relative) using two-wire technique.

Outputs:

- Basic device: 7 freely configurable switching/frequency outputs (default settings are alarm, warning, 2 x Vn, V, 2x limits)
- Four freely programmable analogue outputs (0/4 to 20 mA) as option. Default settings are standard flow and actual flow, pressure and temperature.
- Expansion of digital or analogue output cards.
- Serial interface to RS-232/V24 for data communication with the **AS-100** Readout Device, PC or laptop for setting parameters, printer or with a control station via a modem (e.g. Elster EM-100 Industrial Modem).
- DSfG interface, DCF77 Radio Clock as option.

Mechanical details:

- 19” housing design, 3 ht. divs., depth 270 mm; protection class IP20.
- Power supply: 24 VDC or 230 VAC; data back-up of the system settings by back-up battery (service life ≥5 years).
- Expandable using analogue output cards (73014274), digital pulse output cards (73013957), 1x DSfG card (73014275) or 1x DCF-77 Receiver (73014276).

1.2 Block diagram

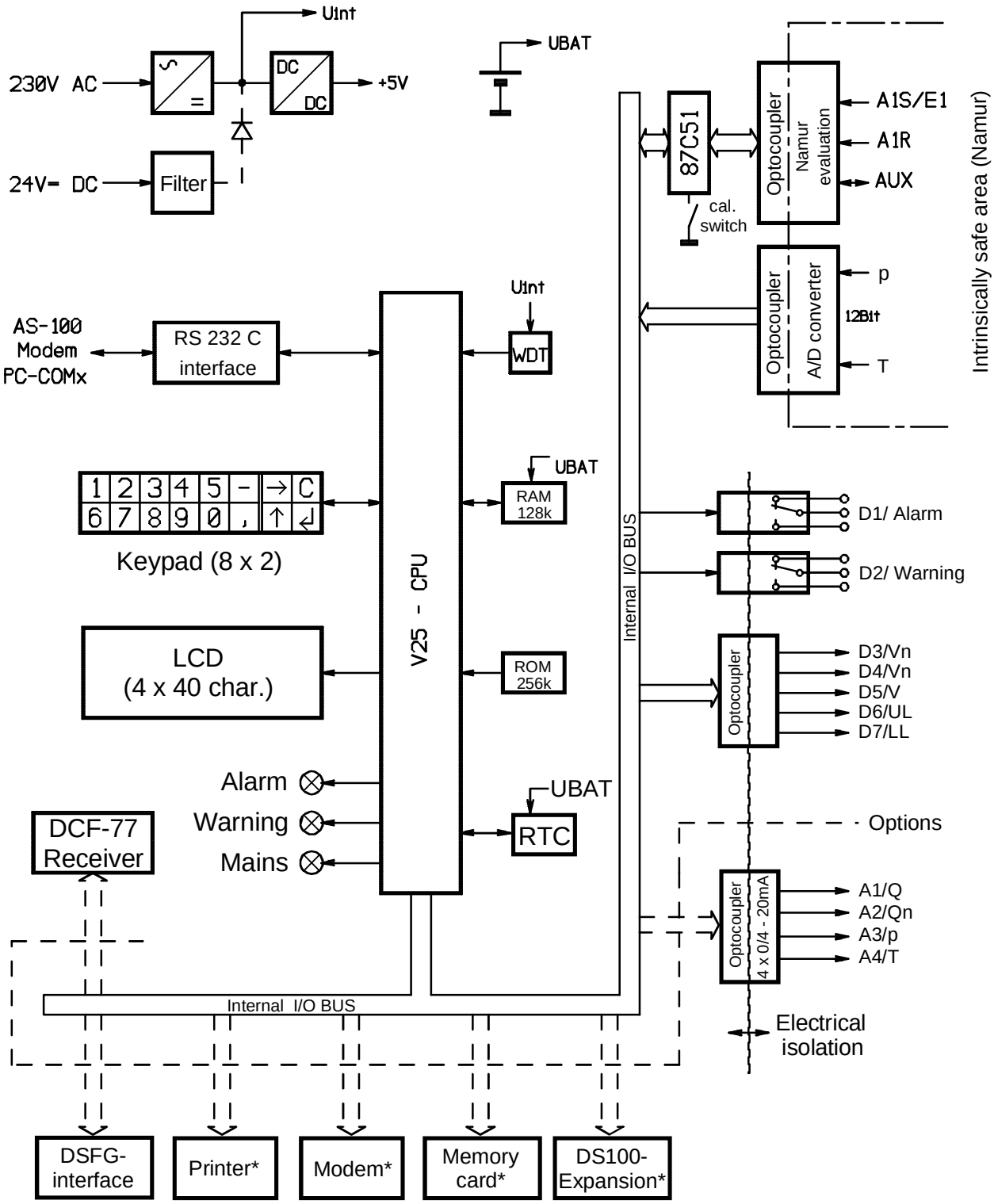


Fig. 1.2-1: Block diagram of EK-86/S

2 Operation

2.1 Keypad

A number block with 10 keys (**0-9**), 2 function keys (-/,) and a control block with 4 keys are provided as an interface between the operator and the EK-86.

Complete operation of the EK-86 is possible using the keypad. By using a special selection function it is also possible to select text from a list.

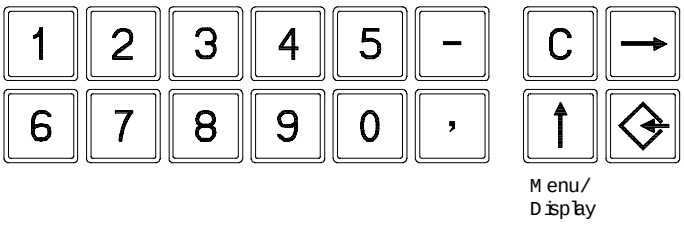


Fig. 2.1-1: EK-86 keypad

Meaning of the keys

"**0**" **-** "**9**" **Numbers**

"**-**" **Minus sign**

"**,**" **Decimal point**

"→" **Selection key**

Selects a menu point in the menu structure.
Selection where there are a number of options (yes, no; text, etc.)

☞ *This key only causes a changeover (e.g.: from the display "yes" to the display "no"); the selection must be confirmed by the key* ***Enter (↵)****.*

"↑" **Scroll-back key**

This causes scrolling between the standard displays, main menu and the DS function.
In submenus it causes a return to the next higher menu level.

"C" Correction key

The key enables the correction of an incorrect entry. A character is deleted each time the key is pressed. Within the menu structure, the direct selection function is called (see Part 1, Chapter 3.1).

"↵" **Enter key**

A number entry or the selection of a "yes/no" decision is terminated with this key.
In the menu structure a branch is made to the selected menu.

The function of the individual keys is again explained during the introduction to the menu structure.

Calibration lock and calibration switch

The calibration lock is used for securing access to those parameters affecting the official calibration. The calibration switch for opening/locking this calibration lock is located on the front panel and is sealed against unauthorised access. The operator is reminded of an opened calibration switch by the message “Calibration lock open” in **Standard Display I** (see Part 1, Chapter 3.2). If the lock is locked, then certain menu points are blocked or only the set values are displayed. But these cannot be changed!

The switch is released by withdrawing and twisting the locking mechanism and opened by shifting it to the left.

2.2 Displays

LCD display

The display consists of a 4-line LCD, each line consisting of 40 characters. Each character is displayed on a 5x7 matrix. Therefore it is possible to simultaneously display a number of values with figures and letters. Messages are output in clear text and there are no abbreviated codes (value numbers) to be looked up in the operating manual. This makes it possible for inexperienced users to immediately operate the EK-86 without any aids.

However, the most important advantage is that the software operating environment can be formed in a menu structure. The parameters are then not saved in large lists, but are shown in associated groups in a display (= menu).

Operation/status indicators

Three light emitting diodes give a quick check of the operational status. The **Mains** LED indicates that the EK-86 is connected to the power supply and is operating.

The **Alarm** LED brings the user’s attention to the fact that a disturbance has occurred, affecting the volume correction. A flashing LED indicates that the fault is still active and a continuously lit LED shows that the fault has been rectified and is no longer present. An example of the first case could be that the line to the pressure sensor has been broken and an example of the second case would be the temperature briefly exceeding the alarm limit, but having in the meantime returned to the permissible range.

When a fault is active, correction takes place with the programmed substitute values and counting takes place in the disturbance volume counter.

The **Warning** LED functions similar to the Alarm LED and indicates when the limits for a user-specific quantity have been violated. Counting does not take place in the disturbance volume counter! An example here would be the exceeding of a limit defined by the user, e.g. the flow. The limits for a “Warning” are held available subject to the user lock.

Displaying values

The menu display varies depending on various specified values. The **Calibration Lock** plays an important role here. If it is locked, certain menus listed in Part 1, Chap. 3 cannot be called or only the set values are displayed. The reason for this is that certain values are subject to official calibration and may only be changed when the calibration lock is open. The displayed values are therefore labelled at the end of the line with a (**C**), (under calibration switch).

Similar effects occur with a locked **User Lock**. Using the user lock, quantities are secured which are specified by the operating authority and may not be changed by unauthorised persons. These labelled by an (**U**).

The post-decimal places in the meter readings in the Standard Displays I and II can be called by pressing the comma key once. They remain visible in the display until the key is pressed again.

3 Menu environment

3.1 Introduction to the menu structure

The EK-86 menu environment and the basic menu structure is explained in this chapter. The complete **Menu Structure** is illustrated in the appendix under **B-2**. The formation of the structure is explained with the possible branches and the addresses in the direction selection function.

The menu environment is formed similar to a tree structure. Access to the individual menus is obtained by moving from the trunk (= Main Menu) to the individual branches (= Submenu) until access to the required leaf is finally obtained (e.g. a particular measurement) (see Fig. 3.1-1).

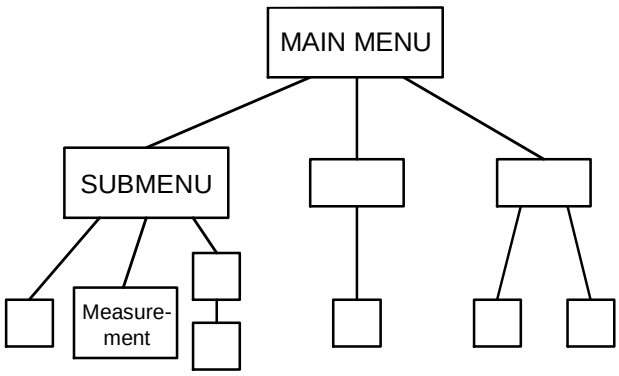


Fig. 3.1-1: Tree structure

Branching within the menu structure

An example of the composition of the menu structure and of branching within it is given in Figure 3.1-2. It describes the menu **Correction**.

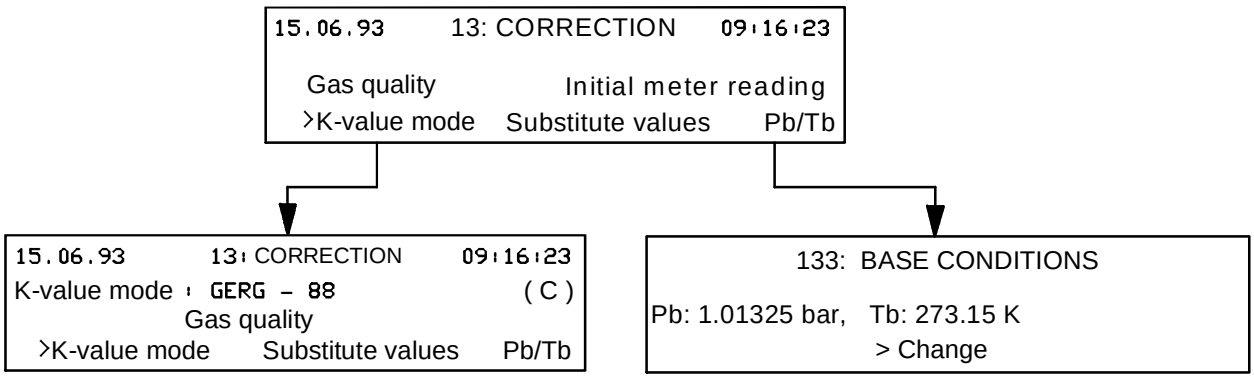


Fig. 3.1-2: Example: Correction menu

Display of a selected menu

The currently selected submenu is displayed by the right arrow, termed the **Cursor**.

Selecting a submenu

The selection of a submenu is carried out using the **Selection** key (→). In Fig. 3.1-2 the cursor is located on the menu **K value mode**. By pressing the **Section** key (→), the menu **Reference variables** is selected and branching to this menu occurs after termination with the **Enter** key (↵). The menu shown at the lower right appears.

Return to the next menu level above

The return to a menu level above the current one is made using the **Scroll-back key** (↑). A return from the menu **Reference variables** into the menu **Correction** is achieved in the above example by pressing this key. Access to the main menu is also obtained by pressing the key the appropriate number of times.

Note:

At the lower left of the menu in Fig. 3.1-2 an example is shown of a display with a locked calibration lock. This display is produced when the menu point **K value mode** is selected in the menu **Correction**. The method currently being used for the K value computation is shown in the second line. In addition the menu **Initial meter reading** in the third line no longer appears. The reason is that setting the initial meter reading is only permitted with an open calibration lock, so the menu is not shown at this point.

Direct selection

Direct selection is used for simplified operation and for calling familiar submenus. It enables certain menus to be called directly without having to move through the whole structure. Powerful EK-86 operation is therefore available to the practised user.

For example, it is possible to directly call the menu **Output assignment DS:16242** from the menu **Flows DS:154**.

The procedure is as follows:

You press the key **C** in the **Menu environment**. This calls the **Menu selection** (Fig. 3.1-3).

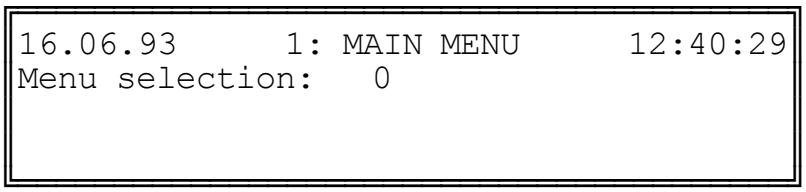


Fig. 3.1-3: Direct selection menu

You then enter the required address (e.g. 16242 for the menu Output assignment), terminating the entry with the **Enter** key. You are then immediately transferred to the required menu.

You can jump back to the last menu by entering the number **0**. The user is informed in the case of erroneous entry or if the selected menu is blocked by a locked calibration lock. The EK-86 then remains in the menu from which the direct selection was called.

3.2 Standard Display I DS: none

Standard Display I is the default setting of the display which is shown without any key being pressed. It is also automatically selected when no key has been pressed for 3 minutes. No return to the display occurs when the calibration lock is open (e.g. practicable during the installation / operating point test)! There is no direct selection for this menu. The most important values are shown in Standard Display I (Fig. 3.2-1):

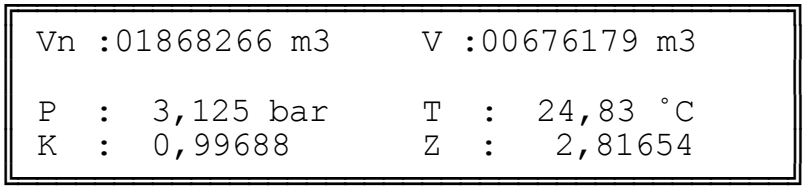


Fig. 3.2-1: Standard Display I

The display has the following meaning:

Actual volume V **Unit: m^3**

This counter shows the so-called “undisturbed” volume, i.e. here only volumes are added which have been acquired during undisturbed operation.

The actual volume **V** is formed as follows in the EK-86:

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

V	=	actual volume	m^3
N	=	Number of pulses	1
cp	=	cp value	$1/m^3$

The actual volume is normally displayed with 8 figures. By pressing the **Comma** key the 3 post-decimal places are superimposed. Pressing the key again switches back to the normal display.

The display can be matched using a **display factor** of ·**1** to ·**100** (see Part 1, Chap. 3.4.6.1). This gives the following displays (n.d.: with no decimal point; w.d.: with decimal point):

Display factor ·1	n.d.: 12345678 m3	w.d.: 12345678,123
Display factor ·10	n.d.: 12345678 · 10 m3	w.d.: 123456789,12
Display factor ·100	n.d.: 12345678 · 100 m3	w.d.: 1234567890,1

All meter readings are stored 3 times internally. This provides a large safety margin against faults in the internal memory, since a comparison of the internal counters is carried out continuously. If a deviation is found in one of the three counters, a warning is output (E04); the EK-86 function is not restricted though.

Standard volume V_n Unit: m^3

This counter also represents an “undisturbed” volume. The standard volume $\mathbf{V_n}$ is formed in the EK-86 as follows:

Vn = V · Z

Vn	=	standard volume	m^3
V	=	actual volume	m^3
Z	=	gas law deviation factor (Z factor)1	

The above explanations for the display of the post-decimal figures and the display factor also apply here. It is important that a separate display factor can be set for the both volumes (V and V_n).

Pressure p Unit: bar

The analogue value measured at the input terminals is converted into the physical unit bar and displayed. The **“Absolute pressure”** in bar is displayed (even with relative pressure sensors).

Temperature T **Unit: °C**

The analogue value of the gas temperature measured at the input terminals is converted to the physical unit Kelvin. However, since the display is given in °C, the following conversion is necessary:

T(°C) = T (K) - 273.15

Compressibility factor (K value) **Unit: 1**

The currently valid gas compressibility factor is displayed. It is, for example, required for the computation of the standard volume. The K value can be specified/ calculated in three different ways:

a.) Calculation according to SGERG-88
b.) Calculation according to AGA-NX-19-mod-BR.KORR.3H
c.) Fixed value with K = constant.

The significance of the different modes and the selection of the methods is described in more detail in Part 1, Chapter 3.4.3.3).

Gas law deviation factor (Z factor) **Unit: 1**

The Z factor needed for the computation of the standard volume is calculated from the measurements for pressure and temperature and the computed or entered K value according to the following equation:

$$Z = \frac{Tb \cdot p}{T \cdot pb \cdot K}$$

Z	=	gas law devn. factor	1	
T_b	=	base temperature	K	(273,15 K)
p	=	current pressure	bar	
T	=	current temperature	K	
p_b	=	base pressure	bar	(1.01325 bar)
K	=	compressibility factor	1	

The values for the base temperature and base pressure can be adapted to the local conditions (see Part 1, Chap. 3.4.3.5).

3.3 Standard Display II DS: none

By pressing the **Scroll-back key** (¡) once access to **Standard Display II** (Fig. 3.3-1 and 3.3-2) is obtained:

In Standard Display II values for the relevant disturbance volumes and total volumes are displayed in addition to the standard and actual volumes described above. The currently valid standard and actual flows are displayed:

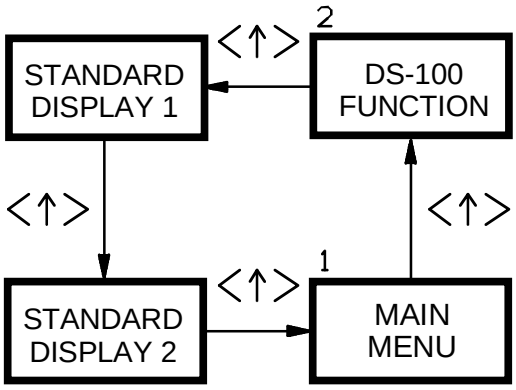


Fig. 3.3-1: Std. Display II

```
Vn :01868266 m3      V :00676179 m3
Vnd:00000012 m3      Vd:00000008 m3
Vnt:01868278 m3      Vt:00676187 m3
Qn :     4,0 m3/h    Q :   225,7 m3/h
```

Fig. 3.2-2: Display: Standard Display II

Disturbance volumes V_{nd} and V_d **Unit: m³**

If a disturbance occurs which affects the volume correction, the EK-86 enters the alarm state (ALARM LED comes on). The volume pulses now measured are counted in separate disturbance volumes. If the measurement of the actual volume is affected, then the standard and actual volumes are automatically measured as disturbance volumes.

Total volumes V_{nt} and V_t **Unit: m³**

The total standard volume V_{nt} is produced as follows:

Vnt = Vn + Vnd

V_{nt}	=	total standard volume	m^3
V_n	=	standard volume	m^3
V_{nd}	=	disturbance standard volume	m^3

Similarly, the following applies for the total actual volume V_t:

Vt = V + Vd

V_t	=	total actual volume	m^3
V	=	actual volume	m^3
V_d	=	disturbance actual volume	m^3

Standard and actual flow Q_n/Q **Unit: m^3/h**

The current value of the flow is acquired from the standard or the actual volume in dependence of a time interval and displayed. For the **standard flow Q_n** the following applies:

$$Qn = \frac{\Delta Vnt}{\Delta t}$$

Q_n	=	standard flow	m^3/h
ΔV_{nt}	=	total standard volume	m^3
Δt	=	time interval	h

The values are determined every second and calculated over an hour. Similarly, the **actual flow Q** is:

$$Q = \frac{\Delta Vt}{\Delta t}$$

Q	=	actual flow	m^3/h
ΔV_t	=	total actual volume	m^3
Δt	=	time interval	h

3.4 Main menu DS: 1

Access to the **Main menu** is gained by pressing the **Scroll-back key** (↑) twice in Standard Display I (see Fig. 3.4-1).

Fig. 3.4-1: Main menu

All values which are present in the EK-86 can be called up via the main menu. Calling the submenus using the direct selection function is also possible from here. The main menu can be called under Direct Selection Address 1. The structure of the menu is shown in Figure 3.4-2:

```
28.06.93      1: MAIN MENU      15:25:39

>Faults         User lock     Correction
 Logbook        Measurements  System
```

Fig. 3.4-2: Main menu display

Display test

A display test can be executed in the main menu by pressing the **Comma** key. All segments are switched on for about 2 s and then switched off for about 2 s. Then operation is returned to the main menu.

3.4.1 Faults

The EK-86 Volume Corrector is equipped with an automatic monitoring function. This includes the monitoring of the sensor lines for line breakage, monitoring for measurement limit violation and the checking of the device's own processor functions using various internal routines.

Differences between fault messages

An **Alarm** is triggered when a fault occurs which affects the volume correction. For example, this is the case when a pressure sensor fails, because the currently applied pressure is needed for determining the Z factor. Correct volume correction is therefore not possible! In this case the **substitute** value of the pressure is used for the calculation and volumes found in this way are counted as disturbance volumes.

A different procedure occurs with **Warning**. This is output when a user-specified quantity is violated. This might occur, for example, when the programmed maximum value for the current output is exceeded. No disturbance volume counting takes place.

Another fault message is **Info**. This fault has less effect than a warning. It is not displayed via LEDs, but is entered in the logbook and output via an appropriately programmed output. Info is only intended to 'inform' the user of irregularities.

3.4.1.1 Fault messages and displays

If a fault occurs in operation, the user is informed through the various forms of display:

- **Indication in the display**
  In the case of an **Alarm** or a **Warning** the fault is shown in the second line of Standard Display I and in the main menu. The display is overwritten until the fault is no longer present. The faults are displayed according to their current numbers in ascending order and the next one is displayed after the displayed fault has been acknowledged (see Appendix A-6a).

- **Indication via light emitting diodes**
  Two light emitting diodes are used to give direct information: a **yellow** LED for **Warnings** and a **red** LED for **Alarms**. If an LED **flashes**, this means that a fault is currently present and a continuously **lit** LED indicates that the fault is now no longer present (e.g. if the flow has only been briefly exceeded).

  Another indicator, a **green** LED (as **mains** indicator) shows that the volume corrector is connected to the power supply. This always lights as an operation indicator.

- **Setting the Warning/Alarm output**
  Messages can be passed to external devices (e.g. control stations) with appropriate configuration of the digital outputs. Two outputs on the EK-86 are permanently programmed as Warning and Alarm outputs (as relay changeover contacts). In addition, the digital outputs can be configured for any fault messages (see Part 1, Chapter 4.2.3).

Calling fault messages **DS: 11**

Other messages which cannot be directly shown in the display can be called in the menu "**Faults**" (see Fig. 3.4.1-1). The faults are displayed in the sequence of their chronological occurrence.

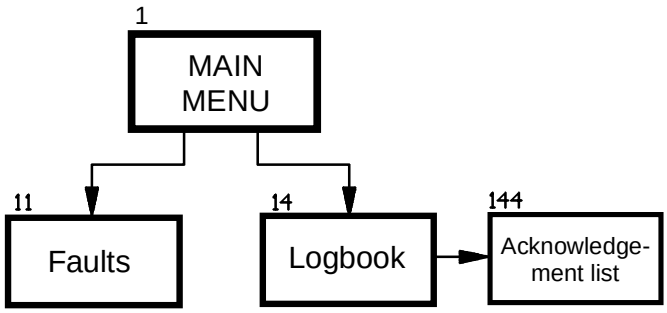


Fig. 3.4.1-1: Faults

If no faults have occurred, this is displayed in the second line after calling the menu "Faults" ("Fault list empty"), otherwise operation continues in the main menu. The procedure is different if a fault is present or one has occurred in the past (Fig. 3.4.1-2). Here the fault is displayed, together with the date and time of occurrence and the effect (here Alarm). This fault cannot be acknowledged since it is currently present.

```
17.06.93   11: FAULTS          15:29:01
E12 Pressure measurement faulty  (ALARM)
Start:17.06 15:28:57
       >Backwards        Forwards
```

Fig. 3.4.1-2: Menu: Faults (fault currently present)

Other faults can be displayed with "**Forwards**" or "**Backwards**" and acknowledged as the case may be.

A fault that has occurred briefly, but is no longer present, is displayed in Fig. 3.4.1-3:

```
17.06.93   11: FAULTS          15:29:20
E12 Pressure measurement faulty  (ALARM)
Start:17.06 15:28:57finish17.06 15:29:13
  >Backwards    Forwards    Acknowledge
```

Fig. 3.4.1-3: Menu: Faults (past fault)

The start and finish of a fault are recorded. After the fault has finished, the fault can be deleted from the Fault List with "**Acknowledge**". The record is then transferred into the "**Acknowledgement list**" or in the "**Logbook**" (see following chapter) where it can be called again.

The list of fault messages which can occur in the volume corrector and their meanings of the faults are described in the Appendix in Chapter A-6a.

3.4.1.2 Logbook DW: 14

The "Logbook" is a very large fault list which accepts any number of entries. Each Alarm, Warning or Info is transferred into the logbook when it occurs. The same applies if the fault disappears or is acknowledged. All messages that have ever occurred can be called as often as required in the logbook. Deletion of the logbook is not possible. The menu structure is displayed in Figure 3.4.1-5:

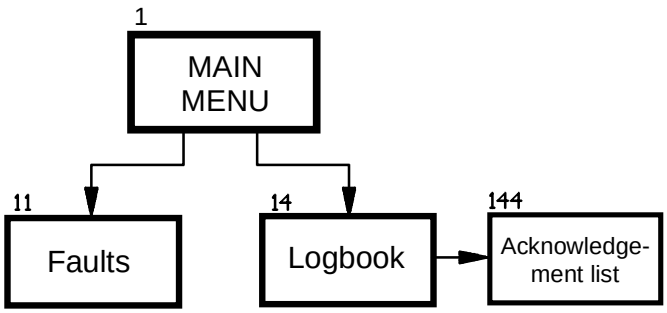


Fig. 3.4.1-4: Logbook

```
17.06.93     14: LOGBOOK       15:30:59
E04 New start of system
17.06.93 15:30:00 Alarm  acknowledged
>Backwards  Forwards  Date  Acknowl.list
```

Fig. 3.4.1-5: Menu: Logbook

Every event is kept separate. The entries are ordered strictly according to their chronological occurrence. Therefore, for each fault, its occurrence, termination and acknowledgement are all recorded. Paging through previous or following

messages is possible with "**Backwards**" resp. "**Forwards**". Messages for a certain day/time can be called using "**Date**". The entry is as follows:

DD ↵ MM ↵ YY ↵ hh ↵ mm ↵ ss ↵

The message is found which occurred directly before the stated point in time.

3.4.1.3 Acknowledgement list DS: 144

The acknowledgement list is located in the menu „**Logbook**" (see Fig. 3.4.1-4). It is an extract from the logbook and only contains all acknowledged messages. The menu structure is shown in Figure 3.4.1-6:

```
      144: ACKNOWLEDGEMENT LIST
E34 Upper warn. limit, pressure  s/f/ack
23.06 15:28  23.06 09:15  23.06 10:24:15
      >Backwards          Forwards
```

Fig. 3.4.1-6: Menu: Acknowledgement list

The start (s), finish (f) and acknowledgement (ack) of the fault are displayed with dates and times. Calling the previous and following messages is also possible here with "**Backwards**" and "**Forwards**". The acknowledgement accommodates up to 200 entries.

3.4.2 User lock DS: 12

The user lock is used for securing parameters not subject to calibration laws, but which are not to be changed without authority. No values subject to official calibration can be secured with the user lock.

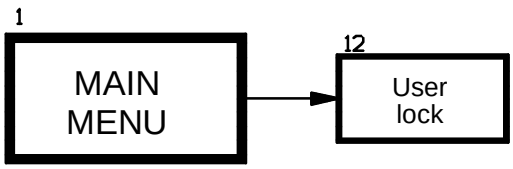


Fig. 3.4.2-1: User lock

These values are locked using the "**user lock**" (see Part 2, Chap. 3.1). It should be noted that the calibration lock has higher priority. This means that the parameters protected by the user lock can be changed when the calibration lock is open.

Furthermore, the simultaneous acceptance of all changed parameters occurs in the menu User lock (see Part 1, Chap. 3.4.2.2).

3.4.2.1 Customer and supplier's keys

The user lock is divided by two independent codes - the **supplier's code** and the **customer's code**. This means that parameters can only be changed if both codes have been correctly entered. A mutual check by the gas supplier and the customer is therefore possible. Both codes must consist of a 6-figure number. As supplied ex-works, the user lock is open and set to "000000".

Setting the user code

The display after calling the menu User lock is shown in Fig. 3.4.2-2 without a user code being set:

```
17.06.93     12: USER LOCK      15:29:30

   Parameter:     >Accept        Discard
            Locks:             Change
```

Abb. 3.4.2-2: Menu: User lock - without set code

The only option is the setting of both user codes with the call "**Change**":

```
17.06.93     12: USER LOCK      15:29:35
Enter supplier's code: xxxxxx
```

Fig. 3.4.2-3: Menu: User lock - entering the code

A 6-figure code **must** be entered. After confirmation with the **Enter** key (↵), the customer code must be entered in a similar manner.

Locking the user lock

When the user codes have been set and the lock is still open, the following display appears:

```
17.06.93   12: USER LOCK        15:29:55

  Parameter:     Accept         Discard
   Locks:         >Lock          Change
```

Fig. 3.4.2-4: Menu: User lock - open state

Here, two new codes can be set via the option “**Change**” or the user lock can be locked with the option “**Lock**”. It is assumed that the calibration lock is locked! If this not the case, it is indicated in the display. The display is shown in Fig. 3.4.2-2.

Opening the user lock

If the user lock and the calibration lock are locked, only one option is possible after calling the menu:

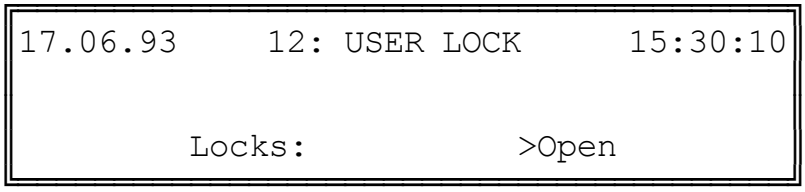


Fig. 3.4.2-5: Menu: User lock - locked state

Both codes must be entered to open the user lock. Only “?” is displayed as the returned character. If the codes are correct, Fig. 3.4.2-4 appears; otherwise the menu 3.4.2-5 is displayed again and the code must be entered once more.

3.4.2.2 Parameter transfer

The transfer of changed parameters is also possible in the same menu as the user lock (see Fig. 3.4.2-4). The purpose of the complete transfer is that with changes of a number of parameters, they are all transferred and become valid at the same point in time.

☞ *Transfer is generally needed for all changed parameters!*

A requirement is that depending on the relevant parameter, the calibration lock or the user lock is open. The original state can be restored by selecting “**Discard**”.

Important! Parameters which have been transferred by “**Accept**” cannot be restored again by “**Discard**”.

3.4.3 Volume correction DS: 13

In this menu all parameters are set which are relevant to the volume correction. The menu is displayed in Figure 3.4.3-2. This only applies to the case when the calibration lock is open. If it is locked, the menu "**Initial meter reading**" is not displayed.

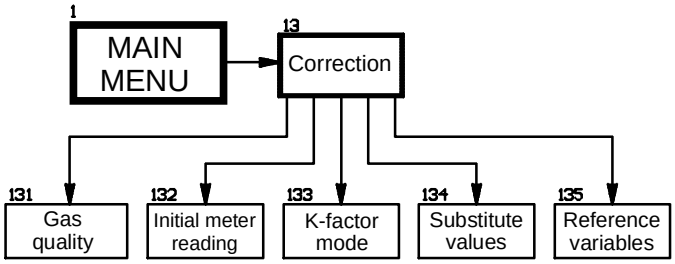


Fig. 3.4.3-1: Volume correction

```
17.06.93      13: CORRECTION    15:30:19

 >Gas quality     Initial meter reading
 K value mode Substitute values Pn/Tn
```

Fig. 3.4.3-2: Menu: Volume correction

3.4.3.1 Gas quality DS: 131

The composition of the gas is entered under this menu point (see Fig. 3.4.3-3). In the case of a constant K value all the entries have no meaning. When called, the set K value mode and the set K value are displayed in the second line of Fig. 3.4.3-2. The values for the gas analysis are subject to the user lock.

```
     131: GAS QUALITY     (GERG - 88)
Hon :10.300 kWh/m3 RHOn:  0.8301 kg/m3
xCO2: 1.29  Mol-%   xH2: 0.00  Mol-%
                >Change
```

Fig. 3.4.3-3: Menu: Gas quality (with GERG-88)

The following limits apply for computation according to **SGERG-88**:

Calorific value	**$H_{o,n}$**	(Hon)	$6.0 \le H_{on} \le 13.6$	kWh/m³
Standard density	**Rho_n**	(RHOn)	$0.71 \le Rho_n \le 1.16$	kg/m³
H_2 proportion	**H_2**	(xH2)	$0 \le H_2 \le 10.0$	Mol-%
CO_2 proportion	**CO_2**	(xCO2)	$0 \le CO_2 \le 30.00$	Mol-%

☞ *Mol % = Molar proportion expressed in % (0-100%)*

☞ *The entry of the standard density **$H_{o,n}$** must be made referred to the base temperature of 273.15 K and the base pressure of 1.01325 bar. With a change of the base temperature or the base pressure (in the menu: Reference variables DS:135), the standard density to be entered must be converted.*

Furthermore, the following limits must be guaranteed by the operator:

Methane	**CH_4**	50-100 %	**Propane**	**C_3H_8**	0 - 5 %
Nitrogen	**N_2**	0 - 50 %	**Butane**	**C_4H_{10}**	0 - 1 %
Ethane	**C_2H_6**	0 - 20 %	**Pentane**	**C_5H_{12}**	0 - 0.5 %

In the case of computation with **AGA-NX-19** the proportion x_{N2} is displayed instead of x_{H2} and the density ratio dv instead of the standard density Rho_n.

The following limits then apply for natural gases with a low calorific value:

Calor. value	**$H_{o,n}$**	(Hon)	$8.833 \leq H_{on} \leq 11.055$	kWh/m^3
Density ratio	**d**	(d)	$0.55\,40 \leq d \leq 0.7500$	1
N_2 part	**N_2**	(xN2)	$0 \leq N_2 \leq 15.0$	Mol %
CO_2 part	**CO_2**	(xCO2)	$0 \leq CO_2 \leq 15.00$	Mol %

The following limits apply for natural gases with a high calorific value:

Calor. value	**$H_{o,n}$**	(Hon)	$11.055 \leq H_{on} \leq 12.833$	kWh/m^3
Pressure	**p**		$0 \leq p \leq 80$	bar
Temperature	**T**		$0 \leq T \leq 30$	°C
Density ratio	**d**	(d)	$0.5540 \leq d \leq 0.6910$	1
N_2 part	**N_2**	(xN2)	$0 \leq N_2 \leq 7.0$	Mol %
CO_2 part	**CO_2**	(xCO2)	$0 \leq CO_2 \leq 2.50$	Mol %

At temperatures of -5°C...0°C and 30°C...35°C the warning E43 - Correction: Temperature value warning limit! is output.

☞ *Also with the density ratio dv the entry must be referred to the base temperature of 273.15 K and to the base pressure of 1.01325 bar.*

Furthermore, the following limits must be guaranteed by the operator for natural gases with a high calorific value:

Methane	**CH_4**	> 82 %	**Propane**	**C_3H_8**	0 - 4.5 %
Ethane	**C_2H_6**	0 - 12 %	**Hydrogen**	**H_2**	0 - 4 %

3.4.3.2 Setting initial meter reading DS: 132

This menu can only be called up with the calibration lock open. Here it is possible to set all the meter readings to any value (e.g. on replacing a device) or to set them to zero using "**Delete all readings**". The entry of the meter readings takes place in full cubic metres:

```
132: SET/DELETE INITIAL METER VALUES

Set init. meter val.:  >Vn  V   Vnd  Vd
                      delete all readgs
```

Fig. 3.4.3-4: Menu: Setting initial meter reading

3.4.3.3 K value computation method DS: 133

The menu can only be called with the calibration lock open. If this is not the case, the currently set computation method is displayed in the second line. The method by which the K value is computed is defined in the menu. The following methods are possible:

- **Standard GERG-88 V33** Display: GERG-88
- **AGA-NX-19-mod-BR.KORR.3H** Display: AGA-NX19
- **K = constant** Display: K = const.

The valid setting is displayed at the upper right in the menu (see Fig. 3.4.3-5):

```
     133: K VALUE MODE (GERG - 88)

Select K VALUE MODE:
  >GERG-88     AGA-NX19     K=c onst.
```

Fig. 3.4.3-5: Menu: K-Factor mode

With the selection K = const. the K value must be entered within the limits:

0.5 ≤ K value ≤ 1.50000

The K value is set to K = 1.00000 as supplied ex-works. Acceptance of the selected computation method only takes place on confirmation in Menu: 12 - Accept parameters.

Important:

In the case of a change of the method of computation the limits of the gas analysis or the substitute values should be noted (see Part 1, Chap. 3.4.3.1).

3.4.3.4 Substitute values DS: 134

In this menu the substitute values for **pressure, temperature** and **K value** are entered subject to the user lock (see Fig. 3.4.3-6).

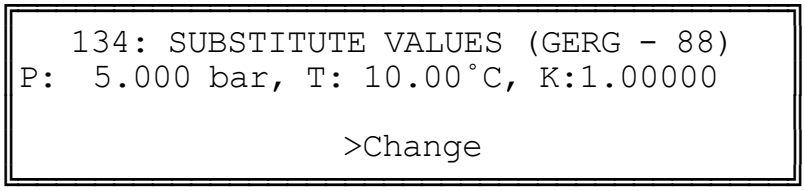


Fig. 3.4.3-6: Menu: Substitute values (user lock open)

Entry of a substitute value for the pressure, resp. temperature is possible for all the computation methods. If the permissible measurement range is violated or a sensor fails, e.g. due to line breakage, volume correction takes place using the substitute values for pressure, resp. temperature.

The following applies for the substitute K value:

In the case of the computation method **K=const.** no substitute K value can be entered; this is indicated by **K=--**.

With computation according to **AGA-NX-19** the substitute K value is important, because the ranges for pressure and temperature with a low calorific value (L-Gas) are lower than the permissible ranges for the pressure and temperature sensors. If these ranges are violated, then the substitute K value is used.

With the computation method according to **GERG-88** the K value is not required. If a sensor fails in this case, its substitute value is used to calculate the K value.

3.4.3.5 Base conditions DS: 135

The base conditions are saved under this menu (see Fig. 3.4.3-7). They are subject to the calibration lock.

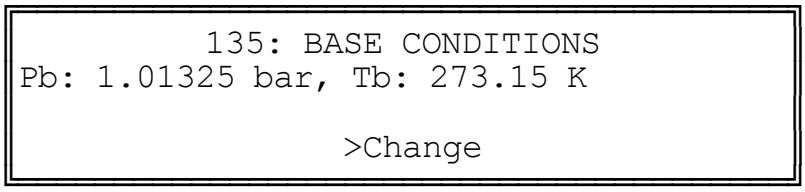


Fig. 3.4.3-7: Menu: Reference variables

In this menu it is possible to match the base conditions to local conditions within the limits of $0.9000 \leq p_b \leq 1.3000$ bar and $270 \leq T_b \leq 299$ K.

3.4.4 Measurements DS: 15

In the Measurements submenu the measured analogue values for pressure and temperature, together with the current flow and their maxima and minima can be called. The “Freeze” function and the “Adjustable counters” are also situated in this menu.

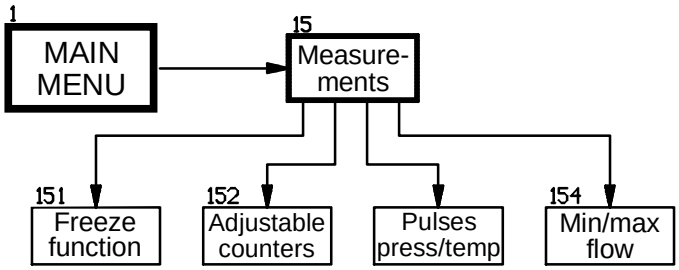


Fig. 3.4.4-1: Measurements

```
17.06.93    15: MEASUREMENTS    15:31:23

>Freeze function     Adjustable counters
 Pulses/Press./Temp.        Maximum flow
```

Fig. 3.4.4-2: Menu: Measurements

3.4.4.1 Freeze function DS: 151

a.) Introduction

Two blocks of consumption data can be retained separately or in dependence of one another using the freeze function. The freeze function is needed, for example, when testing the operating point. The following values are held in each frozen block:

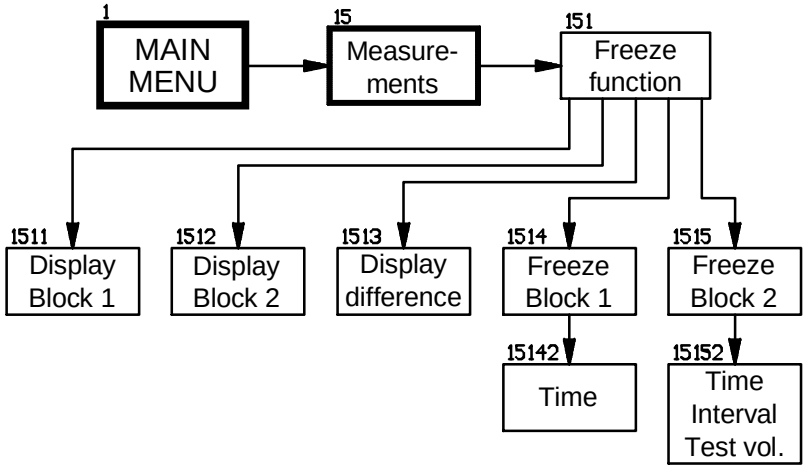


Fig. 3.4.4-3: Freeze function

- pressure (p),
- temperature (T),
- K value (K),
- Z factor (Z),
- freezing mode and time,
- standard volume (V_n), disturbance standard volume (V_{nd}), total standard volume (V_{nt});
- actual volume (V), disturbance actual volume (V_d), total actual volume (V_t),
- actual flow (Q) and standard flow (Q_n).

The menu structure for the freeze function is displayed in Figure 3.4.4-4:

```
17.06.93 151:  FREEZE FUNCTION  15:29:01

 Display:  >Block 1  Block 2  Difference
 Freeze:    Block 1  Block 2
```

Fig. 3.4.4-4: Menu: Freeze function

The frozen data blocks for the 1st and 2nd blocks can be called under "**Display**" as well as the difference between the two data blocks.

The conditions for freezing the values are specified in the menu point "**Freeze**".

b.) Freeze conditions **DS: 1514/1515**

The freeze options are specified by calling the menu "**Freeze - Block 1**" or "**Freeze - Block 2**". Numerous options for freezing consumption values are provided; first, taking the same freeze conditions for Block 1 and Block 2:

- Immediate freezing:

```
        1514: FREEZE BLOCK 1
Vn :00787674 m3      V :00451156 m3
Freeze mode: Now
 Freeze:    >Now     Cyclic
```

Fig. 3.4.4-5: Menu; Freeze condition for Block 1

The current values for the standard and actual volumes are displayed in the second line. It is then very easy to freeze at a certain meter reading. The last selected freeze mode is displayed in the third line (here **Now** = Immediate freezing). The immediate freezing of Block 1 or Block 2 is triggered by selecting the menu point "**Now**" and confirming with the **Enter** key.

- Cyclic freezing at a fixed point in time: **DS: 15142/15152**

Using the menu point "**Cyclic**" it is possible to execute the freeze function at a certain point in time.

The options provided by cyclic freezing of Block 1 or 2 are as follows:

- each year on date xx.xx at yy:yy hrs
- each month on day xx at yy:yy hrs
- each day at xx:xx hrs
- each hour at minute xx

- x hour cycle *1
- x minute cycle *2

*1 possible values: 1, 2, 3, 4, 6, 8, 12 - hourly cycle
*2 possible values: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 minute cycle

One of the above conditions is selected with “**Select**”. The exact date/time is specified under “**Specify**”. It is possible, for example, to trigger freezing each month on the 1st at 06:30 hours in the morning (see Fig. 3.4.4-6):

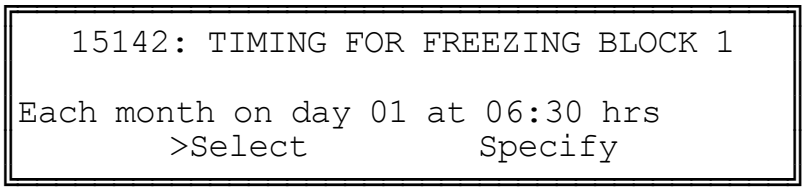


Fig. 3.4.4-6: Menu: The setting “Freezing each month”

After returning to the menu in the next upper level (1514/1515), the freeze condition now valid is shown in the 3rd line of the display.

☞ *The previously mentioned methods for the two Freeze Blocks 1 and 2 are identical. The following freezing methods now refer exclusively to Data Block 2.*

- Time-dependent freezing:

In Data Block 2 there is also the option of triggering the freeze function in dependence of Data Block 1. Therefore, there are two additional selection options in the freeze condition for Block 2:

- xx hours after Block 1
- xx minutes after Block 1

The procedure is as follows:

Data Block 2 is, for example, to be frozen 2 hours after Data Block 1. To do this, the necessary settings are first made in Freeze Block 2:

- 02 hours after Block 1.

Then the freeze condition for Block 1 must be set to “**Now**”. Block 1 is immediately frozen and the condition for Block 2 is “primed”. Block 2 is then frozen after 2 hours. The values of an earlier freeze are displayed in the Menu: Display Freeze Block 2 (1512) until the freeze condition for Block 2 is satisfied.

- Volume-dependent freezing:

In Freeze Block 2 there is also the option of freezing in dependence of a volume increment in the actual volume V (test volume):

```
        1515: FREEZE BLOCK 2
Vn :00788266 m3      V :00451486 m3
Freeze mode: Test volume
  Freeze:    Now    Cyclic    >Test vol.
```

Fig. 3.4.4-7: Menu: Freeze condition for Block 2

The procedure is similar to that described in the previous section, except that here an appropriate "**Test volume**" is entered instead of the point in time (Fig. 3.4.4-8):

```
        1515: FREEZE BLOCK 2
  Freeze at test volume   V=       50 m3
```

Fig. 3.4.4-8: Entering the volume for Freeze Block 2

Using this function, Freeze Block 2 is triggered when, for example, 50 m^3 of gas has flowed after the freezing of Block 1. This must also be triggered via the setting "**Now**". Then the display "Acquiring Block 2" is superimposed (see Fig. 3.4.4-9) and it can be monitored under "**Display Block 2**" (1512) under the point "**Basis**" (see next section).

```
        1514: FREEZE BLOCK 1
   Block 1 frozen. Acquiring Block 2
   Freeze mode: Now
   Freeze:    >Now     Cyclic
```

Fig. 3.4.4-9: Menu: Freeze condition, Block 2 "primed"

c.) Displaying the frozen values DS: 1511-1513

Calling the frozen values for Block 1, 2 or the difference is possible in the third line in Figure 3.4.4-4 under the function "**Display**". After calling the menu, the following figure appears:

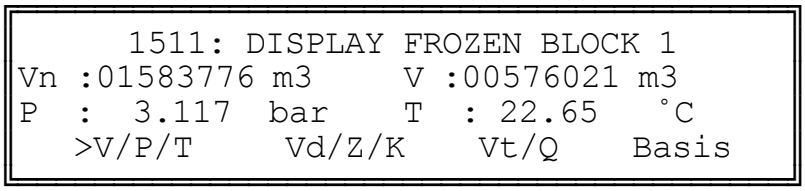


Fig. 3.4.4-10: Menu: Frozen Block 1 - Display

The frozen values for the standard volume, actual volume, pressure and temperature are displayed under "**V/p/T**". The frozen values for the standard and actual disturbance volumes and the Z and K values are called under the function "**Vd/Z/K**" and the values for the total standard and actual volumes, together with the standard and actual flow are called under "**Vt/Q**". The date/time of the freezing and the freezing mode are displayed under "**Basis**". Possible modes are (see Fig. 3.4.4-11):

- spontaneous ("Now" freezing mode)
- point in time (freezing at a certain time point/interval)
- test volume (freezing at a certain volume)

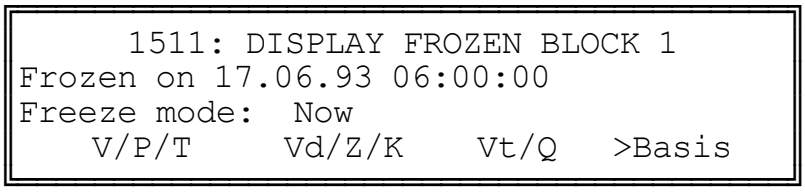


Fig. 3.4.4-11: Example: Freezing basis Block 1 - Now

The values for Frozen Block 2 are called in a similar manner.

The difference between Frozen Blocks 1 and 2 is displayed under the submenu "**Difference**" (1513). Of course, it is also possible that the difference between the two temperature or pressure values and the K value and Z factor show negative values (see Fig. 3.4.3-12).

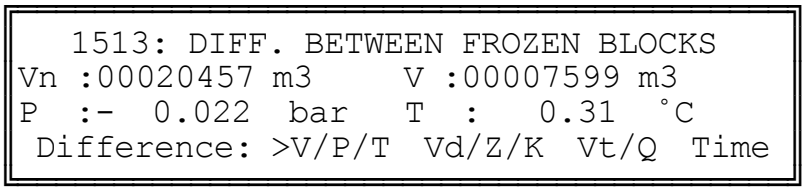


Fig. 3.4.4-12: Menu: Difference between the frozen blocks

The point in time of freezing of Block 1 and Block 2 and the time difference for freezing are displayed under the menu "**Time**".

3.4.4.2 Adjustable counters DS: 152

In this menu it is possible to set an additional actual volume counter (V_{Ad}) and a standard volume counter (V_{nAd}) at any meter reading.

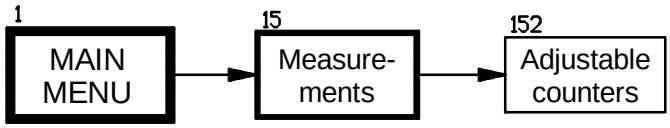


Fig. 3.4.4-13: Adjustable counters

The adjustable counters are subject to the user lock. The menu is organised as follows:

```
      152: ADJUSTABLE TOTALISER
VnA/VA:28288167 m3     / 25085121 m3

     Set totaliser:    >VnAd     VAd
```

Fig. 3.4.4-14: Menu: Adjustable counters

These counters are mainly used so that they can be matched to a calibrated mechanical counter. With connection to an electronic counter (e.g. **Z-90**) this function is not required, because the EK-86 obtains the **Genuine meter reading** from the electronic counter via a serial interface. It is then displayed and processed as the totaliser reading V.

3.4.4.3 Sensor measurements DS: none

The input frequency currently present on the pulse generator and the momentary flow rate computed from it can be called with this menu.

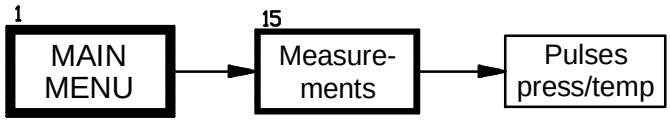


Fig. 3.4.4-15: Sensor measurements

The HF and LF displays are selected automatically in dependence of the cp value and Q_{max} (see Part 1, Chap. 4.1.1). If only one generator is used, it is displayed in the first line. The second line then remains blank.

With low frequency generators the flow display is set to “0”, if, after a period corresponding to Q_{max} - 100th, no pulse is received. This takes up to 92 min., for example, with a G 250 Gas Meter with E1 Generator.

Furthermore, the measured analogue values for the pressure and temperature sensors and their converted values are displayed in the menu. The limits for the display extend from 0 - 20.450 mA on the pressure input and from 0 - 125 Ω on the temperature input. If the values are outside of these ranges, they cannot be measured and “**??**” then appears on the display.

```
HF1:    1099 Hz        Q1:  2197.9 m3/h
HF2:    1100 Hz        Q2:  2198.9 m3/h
I  :   5.457 mA        P  :   3.047 bar
R  :  112.16 Ω         T  :   31.27 °C
```

Fig. 3.4.4-16: Menu: Sensor measurements

☞ *The display "**Sensor measurements**" **cannot** be called via the direct selection function, because a menu is not involved, but instead a display. The menu can only be obtained via the next higher menu "15 - Measurements".*

3.4.4.4 Flow rate values DS: 154

The actual and standard flow of the EK-86 are continuously monitored and the maximum and minimum values are saved. These can then be displayed in the menu "**Flow values**" with date and time of their occurrence (see Fig. 3.4.4-18 and 3.4.4-19).

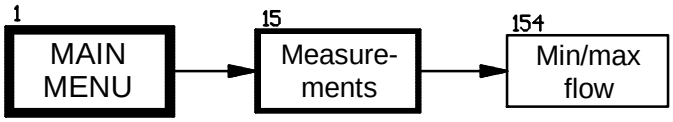


Fig. 3.4.4-17: Max. and min. flow values

```
154: MAX. FLOW SINCE 17.06.93 15:29:57
Qnmax:021073.8 m3/h on 28.06.93 13:20:22
Qmax:  3673.9 m3/h  on 24.06.93 16:41:21
     >Qmax       Qmin       Delete
```

Fig. 3.4.4-18: Menu: Maximum flow values

```
154: MAX. FLOW SINCE 17.06.93 15:29:57
Qnmin:     0.0 m3/h on 22.06.93 03:37:04
Qmin:      0.0 m3/h on 22.06.93 03:37:04
      Qmax      >Qmin       Delete
```

Fig. 3.4.4-19: Menu: Minimum flow values

The values can only be deleted together (all four values are deleted after calling "**Delete**"). The next measurement is saved as maxima and minima after the deletion. The maximum/minimum actual flows Q_{max}/Q_{min} refer to the A1S or E1 Generators.

3.4.5 System DS: 16

In the menu “System” the set values in the calibration configuration can be called up, the setting of the device data carried out and the clock and printer configured.

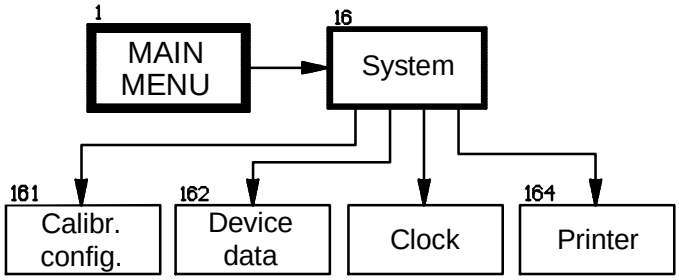


Fig. 3.4.5-1: System

3.4.5.1 Calibration configuration DS: 161

All the values which are subject to the calibration lock are listed in the “**Calibration configuration**”. The menu structure is shown in Figure 3.4.5-3.

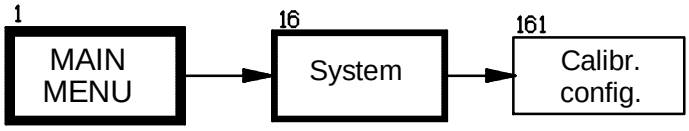


Fig. 3.4.5-2: Calibration configuration

In this menu it is only possible to check the set parameters. Changing the values can only take place in the appropriate menus.

```
17.06.93  161: CALIBR. CONFIG.  15:33:18
L18: Serial no. EK-86: 000000000000

       >Forwards        Backwards
```

Fig. 3.4.5-3: Menu: Calibration configuration

The complete calibration configuration table is listed in Appendix **A-5**.

3.4.5.2 Internal clock DS: none

The time and date are displayed in almost all the menus. The time and date can be set under this menu.

A change is only possible though if the user lock is open. Correction of the time is recorded in the consumption data.

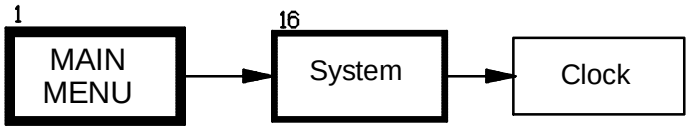


Fig. 3.4.5-4: Clock

3.4.6 Device data DS: 162

The EK-86 is set to the connected pulse generator and p/T sensors under the menu "**Device data**". Furthermore, the output assignment and the device values are saved here:

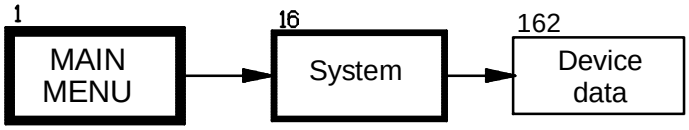


Fig. 3.4.6-1: Device data

```
17.06.93    162: DEVICE DATA    15:33:18

 Sensor:  >Gas meter   Pressure    Temp.
            Outputs     EK-86 device
```

Fig. 3.4.6-2: Menu: Device data

3.4.6.1 Gas meter details DS: 1621/16211

Matching to the connected pulse generator is carried out in the menu "**Gas meter details**". Most of this menu is subject to the calibration lock. The menu "**Gas meter**" (DS:1621) has no other contents except the submenu "**Parameters**" (DS: 16211). The structure is shown in Fig. 3.4.6-4:

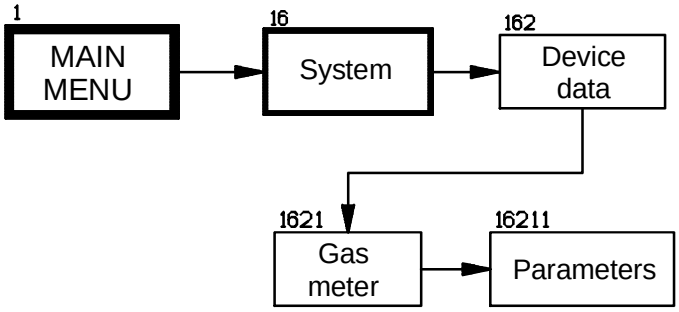


Fig. 3.4.6-3: Gas meter details

```
     16211: GAS METER DETAILS
Approval type: G16000
Serial number: 123456789012
>Forwards   Backwards   Summary  Change
```

Fig. 3.4.6-4: Menu: Gas meter details

The following values can be called up through the menus "**Forwards**" and "**Backwards**" in the menu "**Gas meter details**":

- **Approval type** (default: G16000) (C)
  Setting options: G16, G25, G40, G65, G100, G160, G250, G400, G650, G1000, G1600, G2500, G4000, G6500, G10000 or G16000.

Note: The selection of the required approved type is made using the **Selection** key (→); no number input is allowed. The selection is confirmed with the **Enter** key (↵).

- **Serial number** of the gas meter (12-figure) (C)

- **cp value of Generator 1 + line breakage monitoring** (Yes/No) (C)
  The entry of the cp value in different formats depending on the range:

xxx,yyyyy	min:	0.00001	$1/m^3$
xxxx,yyyy			
xxxxx,yyy	max:	99999.999	$1/m^3$

  The cut-off frequency of the generator and the differentiation of whether it should be treated as a high frequency generator (Hf) or as a low frequency generator (Lf) is carried out in conjunction with the set cp value and the maximum flow Qmax (see Part 1, Chap. 4.1.1):

$cp \cdot 1.8 \cdot Q_{max} + 1 < 10\ Hz$ → Nf generator; cut-off frequency = 10 Hz

$cp \cdot 1.8 \cdot Q_{max} + 1 \geq 10\ Hz$ → Hf generator; cut-off frequency = 3000 Hz

☞ *With switching contacts the line breakage monitoring should be switched off (e.g. various E1 Generators), because otherwise this leads to continual warnings (Fault E13 or E14).*

- If applicable, **cp value of Generator 2 + line breakage monit.**(Yes/No) (C)
  Setting, see Generator 1

- **Permissible deviation** between the two generators (C)
  Limits: 0.4 - 99.9%
  Only required and displayed in two-channel operation.

☞ *With very small permissible deviations or with the combination of HF/NF generators counting may take a long time with a fault message occurring (400 pulses at 0.4% deviation). With the combination of HF with NF generator **volume losses** may occur for a deviation of the HF generator until the fault detection switches over to the second channel (E1).*

- **Display factor** for V and V_n (*1; *10 or *100) (C)
  The display factor is also accepted into the DS-100 function.

- **Maximum flow Q_{max}** (C)
  Limits: 0.0 - 99,999.9 m^3/h
  The maximum flow is a parameter of the connected gas meter. A fault message is only triggered on exceeding $1{\cdot}1{\cdot}Q_{max}$ (Fault E20 and disturbance volume counting). Monitoring of the lower flow limit does not take place, i.e. all incoming pulses are counted.
  With a change of the maximum flow the cp value and the interval period in the DS-function should be checked so that no overload of Channels 1 (V) and 2 (V_n) can occur.

- **Minimum flow Q_{min}** (C)
  Limits: 0.0 m^3/h - Q_{max}
  The minimum flow is a parameter of the connected gas meter. The value must be lower than Q_{max}. With low frequency operation (E1 Generator) the minimum flow **must** be set to "0". Monitoring of the lower flow limit does not take place, i.e. all incoming pulses are counted.

- **Lower flow limit Q_{LL}** (U)
  Limits: 0.0 - Q_{min} m^3/h
  The lower flow limit Q_{LL} identifies the end of the run-up period or the beginning of the run-down period. It is lower or equal to the minimum flow Q_{min}. With low frequency operation (E1 Generator) the lower flow limit is automatically set to "0" and is **not** displayed in the menu.

- **Message limits for Q and Q_n** (U)
  Limits: Q: 0.0 - 99,999.9 m^3/h; Q_n: 0.0 - 999,999.9 m^3/h
  The upper and lower message limits for Q and Q_n are user-specific variables and are used, for example, for system control. Exceeding of the limits plus the limit hysteresis or undercutting the limits minus the limit hysteresis leads to info being issued (E52 - E55), an entry in the logbook and output via a programmed switching output.

- **Limit hysteresis** for the message limits Q and Q_n (U)
  Limits: 0.5 - 99.9%
  The hysteresis refers to x% of Q_{max} for Q_{ULi}/Q_{LLi} and to x% of the product $Q_{max} \cdot p_{max}$ for Q_{nULi} / Q_{nLLi}.

- **Run-up time/run-down time** for the impeller (C)
  Limits: 0 - 999 min.
  The **run-up time** is defined from the impeller at rest up to it exceeding the lower flow limit Q_{LL} and the **run-down time** extends from the undercutting of the lower flow limit Q_{LL} until the impeller is at rest. An entry of "0" for the run-up **or** the run-down time causes the run-up **and** the run-down time control to be switched

off. This is an essential requirement for Lf generators (E1 Generators). Exceeding the run-up time is reported as Warning E22 and exceeding the run-down time as Warning E23.

(C) indicates parameters that are subject to the calibration lock and **(U)** those that are subject to the user lock. The selection of the menu point "**Change**" in Fig. 3.4.6-4 is released or blocked depending on the setting of the locks. If the lock is locked, the label (C) or (U) is displayed at the end of the relevant line.

The required settings are carried out under the menu point "**Change**". With text parameters (gas meter type, YES/NO decisions, etc.) the relevant text string can be selected using the **Select** key (→). The selection is then accepted with the **Enter** key (↵).

The setting process is interrupted with the **Scroll-back key** (↑). Release of the settings can only take place in the menu "**User lock**" (DS: 12) under the point "A**ccept parameters**".

The following figure is called under the menu point "**Summary**":

```
No.:123456789012 Qmin/max: 200.0/ 4000.0
cp1:     1800 (L) QLL:    0.0/ 20/ 20min
cp2:     1800 (L) cp-dev: 6.6% LH:  2.0%
Li-Q: 500.0/ 1000.0 Qn: 1000.0/  10000.0
```

Fig. 3.4.6-5: Menu: Gas meter details: Summary

No. : Serial number
(L) : Line breakage monitoring ON
LH : Limit hysteresis
L : Message limits Q and Q_n

☞ *It should be ensured with the setting of **all limits** that when the new max. value to be set is lower than the old min. value, automatic matching of the **second** value occurs. This also applies, of course, in the reverse case. This prevents a max. value from being lower than a min. value.*

3.4.6.2 Pressure sensor DS: 1622

The settings for the connected pressure sensor are carried out in this menu. The parameters, such as for example the pressure range, serial number, sensor characteristic and the analogue card are entered.

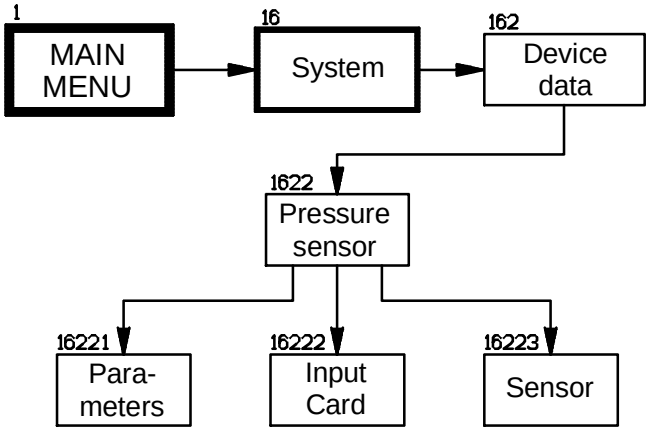


Fig. 3.4.6-6: Pressure sensor

The structure of the menu is shown in Figure 3.4.6-7:

```
17.06.93  1622: PRESSURE SENSOR 15:34:03

                >Parameters
 Calibration:   Input card      Sensor
```

Fig. 3.4.6-7: Menu: Pressure sensor

a.) Parameters DS: 16221

```
   16221: PRESSURE SENSOR PARAMETERS
Approval type:: 1151 AP (Rosemount)
Serial number: 123456789012
>Forwards  Backwards   Summary   Change
```

Fig. 3.4.6-8: Menu: Pressure sensor - Parameters

The following parameters are called in the display by the menus “**Forwards**” and “**Backwards**” (see Fig. 3.4.6-8):

- **Approval type** (default: 1151 AP) (C)
  Possible settings: 1151 AP, 3051, 2088, PTX 610

- **Serial number** of pressure sensor (12 figure) (C)

- **Approval range** (C)
  Limits: max. 0.000 - 120.00 bar depending on pressure sensor.

- **Measurement technique** + where applicable, **air pressure** (C)
  Absolute/relative pressure sensor; air pressure: 0.00000 - 1.09999 bar

- **Alarm limits** Limits: 0.000 - 120.00 bar depending on pressure sensor (C)

- **Warning limits** Limits: 0.000 - 120.00 bar depending on pressure sensor (U)
  Warning limits are user-specific variables and produce Warning E34 when the upper limit plus the limit hysteresis is exceeded and Warning E33 when the lower limit minus the limit hysteresis is undercut.

- **Limit hysteresis** for warning limits, Limits: 0.5 - 99,9% (U)
  The limit hysteresis for the pressure warning limits is referred to x% of the upper value of the approved range.

Also here, the parameters that are subject to the calibration lock are labelled with (**C**) and those subject to the user lock are labelled with (**U**). Selection of the menu point "**Change**" in Fig. 3.4.6-8 is released or blocked depending on the setting of the locks.

The required settings are carried out under the menu point "**Change**". With text parameters (type of pressure sensor, absolute/relative) the relevant text string can be selected with the **Select** key (→). In most cases the **alarm limits** correspond to the approved range for the pressure sensor, whereas the warning limits are variables which can be freely specified by the user (cf. Chapter 3.4.1 - Faults). The selection is accepted with the **Enter** key (↵). The setting process can be interrupted with the **Scroll-back key** (↑). Release of the settings can only take place in the menu "**User lock**" (DS: 12) under the point "**Parameters - Accept**". A summary of the set values is called under the menu point "**Summary**":

```
No:123456789012 Appr.: 0.000/10.000 bar
Method:absolute
Alarm  :    0.000 /  10.000 bar
Warning:    0.000 /   9.500 bar /  0.5 %
```

Fig. 3.4.6-9: Menu: Pressure sensor - Summary

The note in Part 1, Chap. 3.4.6.1 should be observed when setting the limits.

b.) Characteristic correction DS: 16222/16223

A special chapter in the setting up (see Chap. 3.4 in Part 2) is devoted to the characteristic correction. At this point therefore, the characteristic correction is only briefly mentioned. More attention is given to the menu structure and the description of the entry of values.

The correction of the analogue inputs is normally made in two stages:

1.) Calibration of the input card (current-current correction)
2.) Calibration of the sensor characteristic (current-pressure correction)

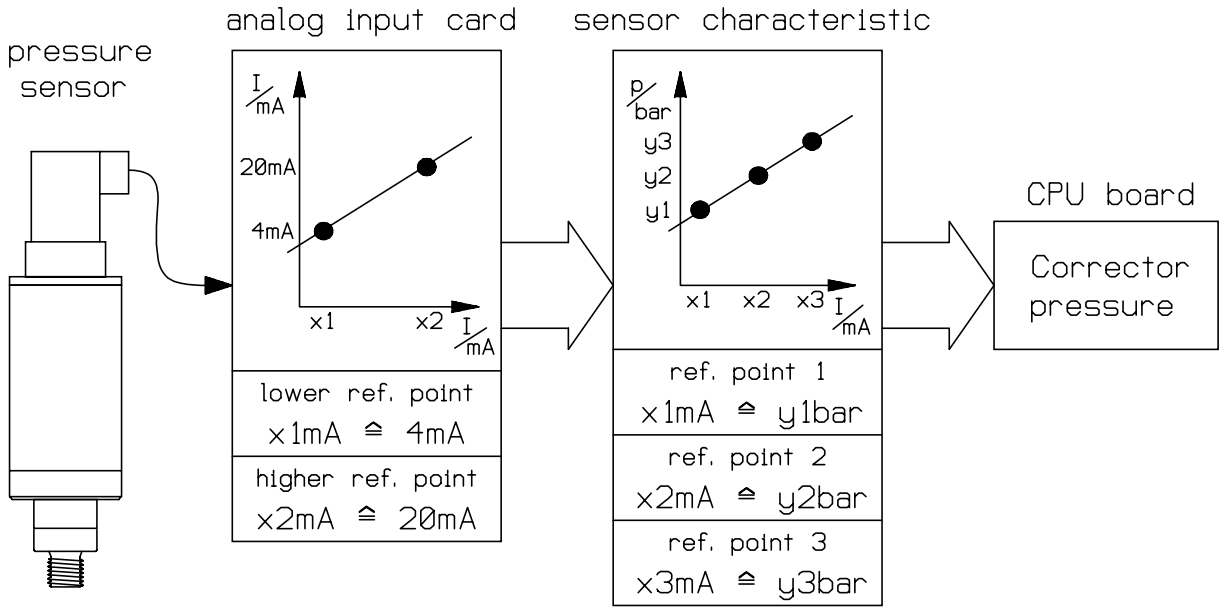


Fig. 3.4.6-10: Correction of the pressure sensor characteristic

This means that both the analogue card and also the sensor can be set very accurately. The pressure sensor calibration is subject to the calibration lock and therefore with a locked lock the set values are only displayed.

About 1.): Input card calibration DS: 16222

The menu "**Input card**" in Figure 3.4.6-7 is called to specify the analogue card characteristic.

The measured pressure is converted into a current between 4 mA and 20 mA in the EK-86. The current values represented by the lower and upper limits of the pressure are defined in Figure 3.4.6-11 under points "**4 mA**", respectively "**20 mA**". A DC current is to be applied which must be connected to the analogue input during the calibration.

```
 16222: PRESSURE SENSOR INPUT CARD
Ref. points are 4.000 and 20.000 mA
     Measure:      >4 mA     20 mA
       Enter calibrated card
```

Fig. 3.4.6-11: Menu: Pressure sensor - Calibration I

The following menu appears after calling "**4 mA**" resp. "**20 mA**".

```
 16222: PRESSURE SENSOR INPUT CARD
 Apply 4 mA to pressure input ( 4.014)
      Measure:        >Accept
       Enter calibrated card
```

Fig. 3.4.6-12: Menu: Pressure sensor - Calibration II

Now, 4 mA must set on the pressure input. The measurement of the previous characteristic is displayed as the returned value. Acceptance of the measurement is by the Enter key (↵). One condition is that the measurement is located in the vicinity of the 4 mA reference point. It is only then that the menu point "**Accept**" is superimposed in the third line. The procedure is similar for the upper measurement limit (20 mA). The release of the settings is carried out in the menu "**User lock - Accept parameters**" (DS: 12).

Instead of measuring the values a card calibrated and sealed in the calibration laboratory can be entered. To do this, the menu point "**Enter calibrated card**" is selected in the menu (see Fig. 3.4.6-11). Here, the two reference points are entered which are given in the enclosed documentation with the analogue input card. The menu has the following structure:

```
 16222: PRESSURE SENSOR INPUT CARD
Ref. points are 4.012 and 19.994 mA
```

Fig. 3.4.6-13: Menu: Pressure sensor - Calibration III

The current parameters, which have been measured on the analogue input card during adjustment and documented by a testing station, can now be entered. Further calibration of the card is not needed.

About 2.): Calibration of the sensor characteristic DS: 16223

The pressure sensor calibration data is now measured and entered under this menu point. The menu is called by selecting the menu point "**Sensor**" in the Figure 3.4.6-7. The following figure appears:

```
16223: PRESSURE SENSOR CALIBRATION

 Measure ref. point:  >1    2    3
  Enter calibrated ref. points
```

Fig. 3.4.6-14: Menu: Pressure sensor - Calibration IV

Two or three points on the characteristic can be set up and calibrated under "**Measure reference point**". A correction of the sensor characteristic is therefore not just possible as a straight line, but also as a third order equation. The following menus are called under the points "**1**", "**2**" or "**3**":

```
16223: PRESSURE SENSOR CALIBRATION
Ref. point 1:   2.000 bar
```

Fig. 3.4.6-15: Menu: Pressure sensor - Calibration V

Here, the pressure value is entered which is applied to the connected sensor (e.g. 2.0 bar). After entering the value and confirming it with the **ENTER** key, the following figure appears:

```
16223: PRESSURE SENSOR CALIBRATION
Ref. point 1:   2.000 bar    ( 4.009 mA)
 Measure ref. point:  1  2  3 > Accept
     Enter calibrated ref. points
```

Fig. 3.4.6-16: Menu: Pressure sensor - Calibration VI

The value which is to be accepted (2.000 bar) is displayed, together with the present measurement in mA and the function "**Accept**". The measurement is accepted as the analogue value for 2.000 bar. The procedure is similar for the 2nd, and where required the 3rd, reference point. The release of the reference points occurs in the menu "**User lock**" under the submenu "**Accept parameters**". Alternatively to the measured values, the reference points supplied with the pretested sensor can be entered as a table. To do this, the values are entered in the menu point "**Enter calibrated reference points**" (see Fig. 3.4.6-17):

```
   16223: PRESSURE SENSOR CALIBRATION
1:  2.000   2: 10.000   3:  -.--- bar
    4.012      19.998       -.--- mA
```

Fig. 3.4.6-17: Menu: Pressure sensor - Calibration VII

With this example two reference points are entered (2.000 bar/4.012 mA and 10.0 bar/19.998 mA).

3.4.6.3 Temperature sensor DS: 1623

IThe settings for the connected temperature sensor are made in this menu similar to the pressure sensor. Also here, the parameters and the characteristics for the sensor and the analogue card must be entered.

The menu structure is shown in Figure 3.4.6-19:

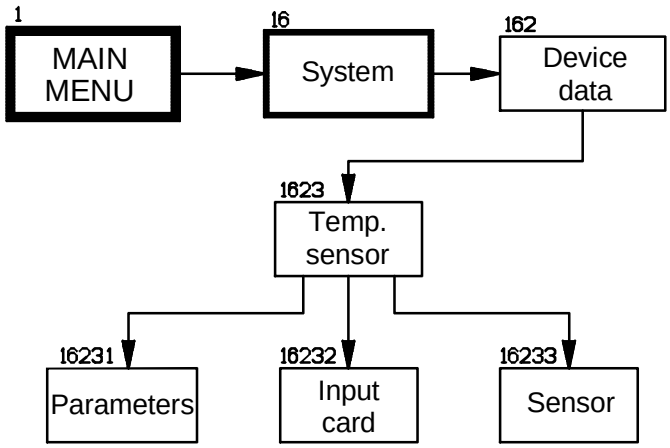


Fig. 3.4.6-18: Temperature sensor

```
17.06.93  1623:  TEMP. SENSOR   15:35:13

               >Parameters
 Calibration:  Input card          Sensor
```

Fig. 3.4.6-19: Menu: Temperature sensor

a.) Parameters DS: 16231

```
     16231: TEMP.SENSOR PARAMETERS
Approval type: PT-100 (EBL160AF/EX-D)
Serial number: 123456789012
>Forwards   Backwards   Summary   Change
```

Fig.3.4.6-20: Menu: Temperature sensor - Parameters

The following values are called into the display by the menus “**Forwards**” and “**Backwards**” (see Fig. 3.4.6-20):

- **Approval type** (def.: PT-100 (EBL160AF/EX-D)) (C)
  Possible settings: PT-100 (EBL160AF/EX-I)
  PT-100 (EBL140AD/EX-I)
  PT-100 (EBL50AF/EX-I)
  PT-100 (EBL160KF)
  PT-100 (EBL50KF)

  Meaning of the abbreviations:

  EBLxx ≡ nominal installation length xx mm (160 mm or 50 mm)
  A ≡ Connector head with terminals K ≡ Permanent cable connection
  F ≡ Use of a sensor pocket D ≡ Direct gas stream application
  EX-D ≡ Flameproof enclosure EX-I ≡ Intrinsically safe

- **Serial number** of temperature sensor (12-figure) (C)

- **Approval range** (C)
  Limits: -13.00 - +63.00 °C

- **Alarm limits**, Limits: -20.00 - +63.00 °C (C)

- **Warning limits**, Limits: -20.00 - +63.00 °C (U)
  Warning limits are user-specific variables and produce Warning E45 on exceeding the upper limit plus the limit hysteresis and Warning E44 on undercutting the lower limit minus the limit hysteresis.

- **Limit hysteresis**, (warning limits) (U)
  Entry limits: 0.5 - 99.9 %
  The limit hysteresis for the temperature warning limits refers to x% of the upper value of the approved range.

(C) indicates parameters that are subject to the calibration lock and **(U)** those that are subject to the user lock. The selection of the menu point “**Change**” in Fig. 3.4.6-20 is released or blocked depending on the setting of the locks.

The required settings are carried out under the menu point “**Change**”. With text parameters (type of temperature sensor) the relevant text string can be selected with the **Select** key (→). The selection is accepted with the **Enter** key (↵). The setting process can be interrupted with the **Scroll-back key** (↑). Release of the settings can only take place in the menu “**User lock**” (DS: 12) under the point “**Parameters - Accept**”.

A summary of the set values is called under the menu point “**Summary**”:

```
No.123456789012  Appr.:-10,00/ 60,00˚C

Alarm  :  -10.00 /  60.00 ˚C
Warning:  - 9.50 /  59.00 ˚C /  0.5 %
```

Fig. 3.4.6-21: Menu: Temperature sensor - Summary

The note in Part 1, Chap. 3.4.6.1 should be observed when setting the limits.

b.) Characteristic correction DS: 16232/16233

The correction of the analogue input card corresponds completely to the description for the pressure sensor input. The only difference is that resistances are required for the temperature characteristic instead of currents. The correction is also carried out in two stages:

1.) Calibration of the input card (resistance-resistance correction)
2.) Calibration of the sensor characteristic (resistance-temp. correction)

The temperature sensor calibration is subject to the calibration lock and with the switch locked the set values are only displayed.

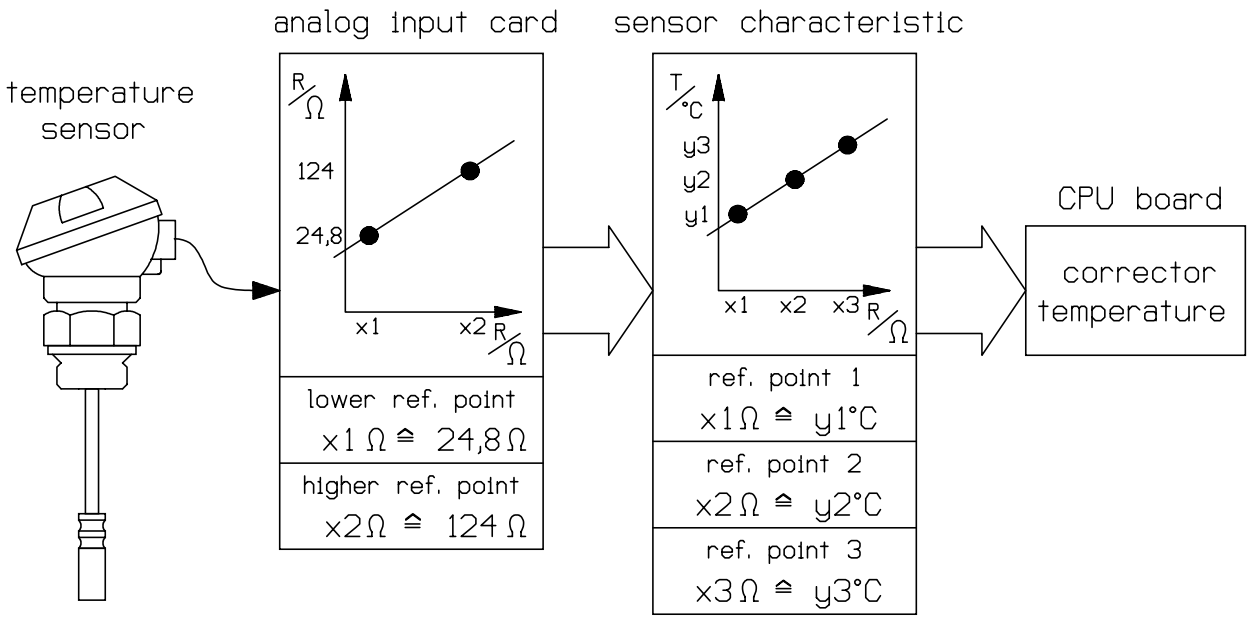


Fig. 3.4.6-22: Correction of the temperature sensor characteristic

About 1.) Input card calibration **DS: 16232**

To specify the analogue card characteristic the menu "**Input card**" in Figure 3.4.6-19 is called. The following figure appears:

```
  16232:  TEMP. SENSOR INPUT CARD
Ref. points are 24.80 and 124.00 Ω
     Measure:  >24.8 ohm     124 ohm
       Enter calibrated card
```

Fig. 3.4.6-23: Menu: Temperature sensor - Calibration I

The calibration resistances must be connected to the temperature input on the EK-86 using the four-wire technique. The resistances are only needed for the adjustment of the analogue input card. The lower and upper limits on the card are set under the points "**24.8 ohm**" resp. "**124 ohm**". These do not correspond to the temperature values that are to be later converted. The following menu appears after calling "**Measure: 24.8 ohm**" resp. "**124 ohm**":

```
   16232: TEMP. SENSOR INPUT CARD
Apply 24.8 Ω to temp. input (24.85)
     Measure:          >Accept
       Enter calibrated card
```

Fig. 3.4.6-24: Menu: Temperature sensor - Calibration II

The measurement of the previous characteristic is displayed as the returned value. The display "**Accept**" is superimposed if the connected resistance is located within the permissible limits. The acceptance of the measurement is then made with the **Enter** key (↵). The upper measurement limit (124 ohm) is specified in a similar manner. The transfer of the settings occurs in the menu "**User lock - Accept parameters**" (DS:12).

Entry of the base values of a card which has been measured and sealed by a calibration laboratory is also possible with the temperature input. To do this, the menu point "**Enter calibrated card**" is selected in the menu shown in Fig. 3.4.6-23. Here the two reference values given in the documentation enclosed with the analogue input card are entered:

```
  16232: TEMP. SENSOR INPUT CARD
Ref. points are 24.72 and 124.03 Ω
```

Fig. 3.4.6-25: Menu: Temperature sensor - Calibration III

About 2.) Calibration of the sensor characteristic DS: 16323

The temperature sensor calibration data is now measured and entered under this menu point. The menu is called by selecting the menu point "**Sensor**" in the Figure 3.4.6-19. The following figure appears:

```
  16233: TEMP. SENSOR CALIBRATION

   Measure ref. point:  >1    2    3
    Enter calibrated ref. points
```

Fig. 3.4.6-26: Menu: Temperature sensor - Calibration IV

Two or three points on the characteristic can be set up and calibrated under "**Measure reference point**". A correction of the sensor characteristic as a third order equation is also possible. The following menus are called under the points "**1**", "**2**" or "**3**":

```
  16233:  TEMP. SENSOR CALIBRATION
Ref. point  1:  -10.00˚C
```

Fig. 3.4.6-15: Menu: Temperature sensor - Calibration V

Here, the temperature value is entered which is applied to the connected sensor (e.g. -10.0°C). After entering the value and confirming it with the **ENTER** key, the following figure appears:

```
  16233: TEMP. SENSOR CALIBRATION
Ref. point 1:  -10.00˚C       ( 96.86 Ω)
 Measure ref. point:  1  2  3 >Accept
    Enter calibrated ref. points
```

Fig. 3.4.6-28: Menu: Temperature sensor - Calibration VI

The value which is to be accepted (-10.00°C) is displayed, together with the present measurement in Ω and the function "**Accept**". The measurement is accepted as the analogue value for -10.00°C. The procedure is similar for the 2nd, and where required the 3rd, reference point. The release of the reference points occurs in the menu "**User lock**" under the submenu "**Accept parameters**". The table for entering the reference points can be called under "**Enter calibrated reference points**":

```
   16233: TEMP. SENSOR CALIBRATION
1: -10.00   2:  20.00   3:   -.-- °C
    97.54      121.39        -.--  Ω
```

Fig. 3.4.6-29: Menu: Temperature sensor - Calibration VII

With this example two reference points have been entered (-10.00 °C ≡ 97.54 Ω and 20.00 °C ≡ 121.39 Ω).

3.4.6.4 Outputs DS: 1624

The pulse/switching outputs and the optional analogue outputs are set up in the menu "**Outputs**". The outputs are set to standard values as supplied ex-works, but they can be changed as required by the user. The assignment of the outputs is subject to the user lock. The menu structure is shown in Figure 3.4.6-31:

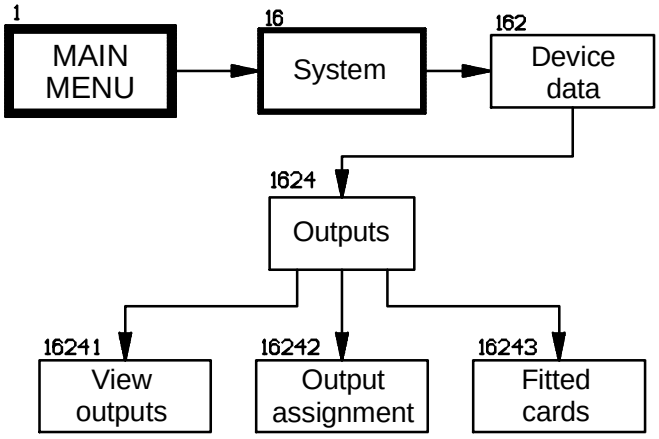


Fig. 3.4.6-30: Outputs

```
17.06.93    1624: OUTPUTS       15:35:53


 >View outputs        Output assignment
```

Fig. 3.4.6-31: Menu: Outputs

a.) Output assignment DS: 16242

The assignment of the required variables to the outputs and the scaling of the outputs is carried with the menu point "**Output assignment**" (see 3.4.6-31). The following display is visible after calling:

```
    16242: ASSIGNMENT CARD 2 CHANNEL
Assigned: Standard flow
4..20 mA,      0.0.. 100000.0 m3/h
>Card   Channel  Mode   Assign   Specify
```

Fig. 3.4.6-32: Menu: Output assignment I

The output card which is to be set (here Card 2 = analogue output card) is selected under "**Card**" and the output channel (here Channel 1 = Output AN1 on the connection board) is selected under "**Channel**". The other options depend on the selection of the card:

- Output assignment with an analogue output card (Card 2)

If Card 2 has been selected under "**Card**", the analogue outputs can be set (see Fig. 3.4.6-32). To do this, whether the 0-20 mA output 0-20 mA or the 4-20 mA output is to be used (here 4-20 mA) is defined under "**Mode**". The variable to be output is set under "**Assign**". The following measurements can be output:

- Unassigned (i.e. the output is inactive)
- Standard flow Q_n
- Actual flow Q
- Measured pressure -
- Corrector pressure p
- Measured temperature -
- Corrector temperature T

The variables "Measured pressure" and "Measured temperature" reflect the values measured on the input and the variables "Corrector pressure" and "Corrector temperature" reflect the corrected variables for the measured pressure and temperature.

The lower and upper base values for the output are set under "**Specify**". In the example a standard flow of 100,000 m^3/h corresponds to a current of 20.0 mA, whereas 0.0 m^3/h of flow corresponds to 4.0 mA of output current. The limits can be freely programmed. The following figure appears for a pressure or temperature output:

```
  16242:  ASSIGNMENT CARD 2 CHANNEL 3
Assigned: Corrector pressure
0..20 mA,    0.000..   10.000 bar
 Card  >Channel  Mode  Assigned  Specify
```

Fig. 3.4.6-33: Menu: Output assignment II

- Output assignment for the switching/pulse output card (Card 3)

If Card 3 (pulse/switching output) is selected under "**Card**", the menu differs from the above menu as follows:

```
   16242: ASSIGNMENT CARD 3 CHANNEL 1
Assigned: Any alarm
N/O contact with alarm present
 Card >Channel  Mode  Assignment Specify
```

Fig. 3.4.6-34: Menu: Output assignment III

The output which is to be programmed is set under "**Channel**".

The setting here is carried under "**Mode**" as though a switching output or a pulse output is associated with the channel to be set. The present setting can be seen on calling the menu "**Mode**". If the Text "Pulse" is output in the third line, a pulse output is involved. If "N/O contact" or "N/C contact" is displayed at this point, a switching contact is involved.

With a switching output it is assigned one of the following under "**Assign**":

- Any alarm
- Any warning
- Any message or
- A certain fault message

The possible faults which can be allocated to an output are described in Chapter A-6 in the Appendix. With a pulse output the following selection can be made under "**Assign**":

- Unassigned
- Actual volume, undisturbed V
- Standard volume, undisturbed V_n
- Actual volume, disturbed V_d
- Standard volume, disturbed V_{nd}
- Actual volume, total V_t
- Standard volume, total V_{nt}

With a switching output the manner in which the fault is displayed is decided under the menu point "**Specify**". The described output modes cannot be set though with all fault messages:

- Normally open contact with alarm present
- Normally open contact with unacknowledged alarm (corresponds to ALARM LED)
- Normally closed contact with alarm present
- Normally closed contact with unacknowledged alarm

If the output is set as a pulse output, the following figure appears:

```
   16242: ASSIGNMENT CARD 3 CHANNEL 1
Assigned: Vn (undisturbed) volumes
Pulse   1 pulse = 1.000 m3   fmax= 1
>Card  Channel  Mode  Assignment Specify
```

Fig. 3.4.6-35: Menu: Output assignment IV

Here is defined under "**Specify**" the pulse value for the volume and the maximum frequency, both as presented at the output.

☞ *Each output is fully programmable independently of the others. It is therefore possible, for example, to output Vn in Channel 3 with 5 pulses per m3 and with 1 pulse per m3 in Channel 4. A description of the output assignment is given with examples in Part 1, Chapter 4.2..*

b.) View outputs DS: 16241

Under "**View outputs**" in Figure 3.4.6-31 it is possible to check the set outputs:

```
    16241: VIEW CARD 2 CHANNEL 1
Assigned: Standard flow
Output:     1168.4 m3/h    =   0.233 mA
        >Card          Channel
```

Fig. 3.4.6-36: Menu: View outputs (analogue output)

In the Figure Analogue Output 1 (Card 2 = Analogue Output; Channel 1 = AN1) is shown as an example. In the figure it is shown with which variable the output is assigned (here the standard flow), the level of the present measurement (1168.4 m^3/h) and to which output value this measurement corresponds (0.233 mA). A current of 0.233 mA therefore flows at the output.

Violation of the upper or lower limits results in the output remaining at the corresponding maximum resp. minimum value (no output of a substitute value) and information "E51 - Info limit Current output" is produced. With an appropriately programmed output this can be viewed and also interrogated in the logbook.

The following menu appears with a switching output (Card 3 and Channel 1, 2 for ex-works setting):

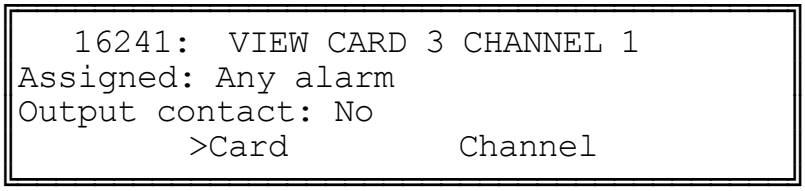


Fig. 3.4.6-37: Menu: View outputs (switching output)

The assignment (“Any alarm”) and the present valid status (“No - output deactivated”) are shown.

The following menu is displayed for a pulse output:

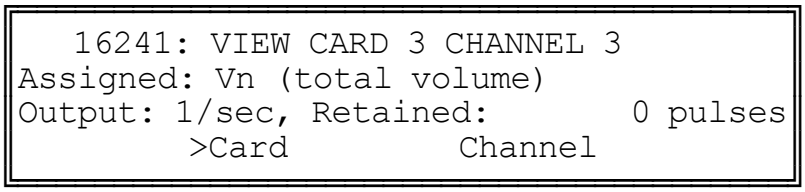


Fig. 3.4.6-38: Menu: View outputs (pulse output)

Also shown here are the assignment (Vn - total volume) and the present status (“0” - output inactive; “1” - output active).

If a larger volume occurs which must be output (e.g. if with Lf generators, a pulse arrives at high pressure) - the setting of the pulse output for example only permits a maximum of 1 Hz - the pulses must be temporarily stored and output at a point in time when lower volumes occur (e.g. with longer pulse intervals). This ensures that no output pulses are lost and pulse packets are avoided as far as possible. The number of the pulses still to be output is displayed under “**Retained: x pulses**”. A maximum of 999 pulses can be retained. If the number of pulses still to be output is higher than 999, then the message “E50 - pulse buffer overflow” is entered in the logbook and output to a programmed output. If this condition occurs, output pulses are lost! This can be prevented by reweighting the output or by increasing the permissible output frequency.

☞ *The retained pulses are set to “0” with the “Accept parameters” in the menu “User lock”.*

3.4.6.5 Device data DS: 1625

IIn the menu: "**EK-86 device**" the values typical to the EK-86 are retained. These are the serial number, software version number and the operating hours counter. The serial number is subject to the calibration lock and can therefore only be changed when the switch is open.

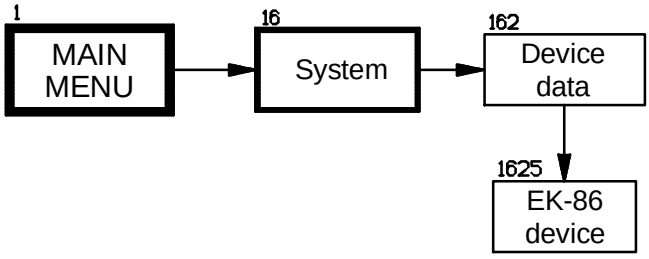


Fig. 3.4.6-39: EK-86 device

The software version number and the operating hours counter are fixed and cannot be changed. The menu has the following structure:

```
17.06.93   1625: EK-86 DEVICE  15:37:18
Device No:123456789012  Software: V 1.10
Operating hours counter:  362 hours
                >Change
```

Fig. 3.4.6-40: Menu: EK-86 device

3.5 Data storage function DS: 2

The data storage function in the EK-86 can be obtained by pressing the **Scroll-back key** (↑) three times in Standard Display I (cf. Fig. 3.3-1). The direct selection address of the main DS menu is "2" and its structure is shown in Fig. 3.5-2:

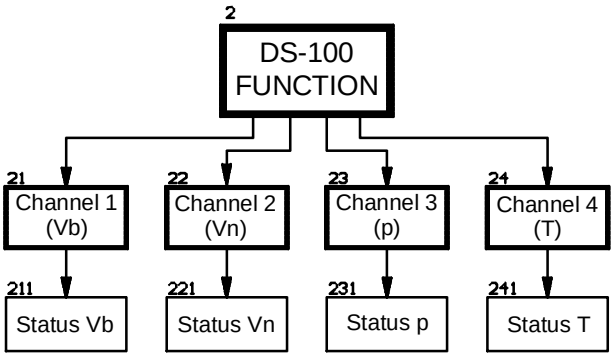


Fig. 3.5-1: Data storage function

```
17.06.93   2: DS-100 Function   15:27:39

 >Ch 1: uncor.volume  Ch 2: cor. volume
  Ch 3: pressure      Ch 4: temperature
```

Fig. 3.5-2: DS-100 main menu

3.5.1 Introduction to the data storage function

In the measurement and data chain within the Long-Term Pulse Acquisition System the DS-100 function (tariff device function) which is integrated in the EK-86 has the task of gathering data "at the point of measurement". The DS function therefore does not represent an independent device, but is instead a software module which operates similar to a 4-channel DS-100 in the EK-86 independent of the volume correction function. In contrast to a DS-100 device no additional external inputs are required. The data that is acquired is taken directly from the volume corrector module, measured and saved on a time-related basis. In the EK-86 the DS function is subdivided as follows:

Channel 1	Actual volume (V)	[m^3]	DS: 21
Channel 2	Standard volume (V_n)	[m^3]	DS: 22
Channel 3	Pressure (p)	[bar]	DS: 23
Channel 4	Temperature (T)	[°C]	DS: 24

The storage available in the EK-86 enables acquisition of values occurring over a period of approximately 0.5 years with an interval of 60 min. With shorter intervals the available period is reduced correspondingly. Two different forms of input signals are processed within the DS function in the EK-86; the "digital" values (V and V_n) and the "analogue" values (pressure and temperature). This difference can be seen in the following processing:

With the "digital" values pulses are counted or counter readings transferred and with the "analogue" values averages are formed from them which are then saved in the corresponding channels.

a.) Processing of the digital values (Channel 1 = V; Channel 2 = V_n)

A DS-100 **device** acquires the pulses arriving at the input and saves them related to time. However, in the DS-100 **function** in the EK-86 the **meter readings** are taken directly from the volume corrector module, i.e. no separate input terminals are required, because the data is transferred directly within the equipment. This has the advantage that with transfer of the DS-100 data by a read-out device, modem or similar equipment, the **original meter readings [OMR]** of the calibrated device section are always available. Therefore, the display factors of the volume corrector are used for the storage, display and data transfer of the meter readings. The display of the above mentioned values can therefore only be changed via the display factor of the volume corrector. The flow values are calculated from the difference of the meter readings from the beginning of the interval to the end of the interval.

A separate cp value, which can only be entered via an interface (e.g.: **AS-100**), is used for the consumption values (interval values) and maxima. This must be selected such that with $1.1 \cdot Q_{max}$ in Channel 1 (V) resp. $1.1 \cdot Q_{max} \cdot p_{max}$ in Channel 2 (V_n) and with the required interval period no pulse counter overflow (>4079 pulses) can be produced. This should be ensured when initialising the DS function using the AS-100 as follows:

Q_{max}	cp value
≤ 40.79 m³/h	100 pulses/m³
≤ 407.9 m³/h	10 pulses/m³
≤ 4079 m³/h	1 pulses/m³
≤ 40790 m³/h	0.1 pulses/m³
≤ 407900 m³/h	0.01 pulses/m³

The stated values refer to an interval period of 60 min. If the interval is reduced, the corresponding maximum flows are increased (e.g.: from 60 to 30 min → doubles the maximum flow).

In the **V_n channel** (Channel 2) it must be ensured that the standard flow is substantially higher in dependence of the Z factor. A rule of thumb is that the maximum standard flow Q_{nmax} is given by the product of Q_{max} and p_{max}:

$$Q_{nmax} \approx Q_{max} \cdot p_{max}$$

It should be noted that the change of cp value becomes valid at the start of the next measurement period (interval) and a change in the interval period becomes valid after the next full hour. The changes are only then displayed in the DS function.

b.) Processing the analogue values (Channel 3 = p; Channel 4 = T)

A value range from 0 to 4079 is also available for saving the means in the analogue channels. Consequently, the means cannot be saved with any resolution, but must instead be limited to practicable values. This limits the value range which is needed for displaying the analogue value.

Upper pressure limit		Resolution
Upper limit between	0 ≤ 4 bar	1 mbar
Upper limit between	4 ≤ 8 bar	2 mbar
Upper limit between	8 ≤ 16 bar	4 mbar
Upper limit between	16 ≤ 32 bar	8 mbar
Upper limit between	32 ≤ 64 bar	16 mbar
Upper limit between	64 ≤ 120 bar	32 mbar

The temperature resolution is constant at 0.1 K. It is therefore possible to save the temperature as the absolute temperature in Kelvin. The temperature is converted to °C for display in the EK-86.

3.5.2 Menu structure of the data storage function

The structure of the DS function and its menus is displayed in Figures 3.5-1 and 3.5-2. The DS main menu is called under the direct selection address 1. The required channel is called using the **Select** key (→) and branching to the selected channel occurs with the **Enter** key (↵). If a certain channel is to be read out or set during reading out or setting using an AS-100, the channel can be specified by jumping to the channel.

☞ *It is important that jumping to the channel must take place **before each** read-out or setting, since the EK-86 automatically switches to the next channel after each read-out/setting.*

e.g.: You would like to read out Channel 3 and then reset this channel.

Go to Channel 3 using "→" and then branch to the channel with "↵" (or by using direct selection address "23"). Now you can read out Channel 3 using the AS-100. Then you must return to the DS main menu (DW: 2) and branch to Channel 3 again. If you would now like to change values using the AS-100, you have directly entered the required Channel 3. If this is not done, you change values in Channel 4.

The structure of the individual channels is the same for all channels and is therefore only briefly explained here:

The following figure appears after calling Channel 1 (V) for example:

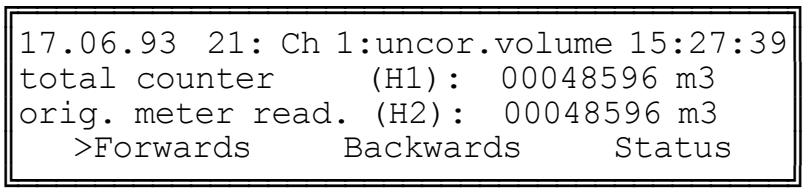


Fig. 3.5-3: Menu structure of DS function (Channel 1)

The current date is always displayed at the upper left and the current time at the upper right. The saved values are stored in a large table and, depending on the extent of the display, all or a number of values are shown together in the display. They can be called up consecutively in an "endless loop". The next values for the relevant channel are displayed using "**Forwards**" and a return to the previous value is obtained with "**Backwards**". The present state of the DS fault register for the selected channel can be called with "**Status**".

The display of the meter readings is dependent on the set **display factor** in the volume corrector (see Part 1, Chap. 3.4.6.1 - Gas meter details). The display of the interval values and the maxima takes place in conjunction with the set **cp value** of Channel 1 or Channel 2. This can only be set by the AS-100.

A "**computation factor**" is used with the analogue channels. This cannot be changed though by the AS-100 or similar devices. Instead it is automatically formed by the set pressure and temperature limits. It is displayed for checking purposes only.

3.5.3 Values in Channel 1 (V) and Channel 2 (V_n) DS: 21/22

No.	Displayed value	Display	In conjunction with
H1	Total counter V/Vn	xxxxxxxx m3	Disp. factor + comma
H2 and	Original meter reading (V) undisturbed counter (Vn)	xxxxxxxx m3	Disp. factor + comma
H3	Month-end reading of H2	D/T value	Display factor
H3	Previous month-end reading H2	D/T value	Display factor
H4	Max. daily consumption in current month	D/T value	DS cp value
H4	Max. daily consumption in previous month	D/T value	DS cp value
H5	Max. flow in current month	D/T value	-
H5	Max. flow in previous month	D/T value	-
H6	Last interval consumption	xxxx,yy	DS cp value
H7	Measurement period	5 - 60 min	-
H23	Status Channel 1/2	ok / Exx	-
-	cp value Channel 1/2	0.01 - 100	-
-	Customer number	xxxxxxxxxxxx	-
-	Meter number	xxxxxxxxxxxx	-
-	Device number	0000010axxxx	-

D/T value: Date / Time / Value

Disp. factor: Display depends on VC display factor

Comma: Calling post-decimal places possible with the "**comma**" key

DS cp value: Display depends on data store cp value

3.5.3.1 Meaning of the values in Channel 1 (V) and Channel 2 (V_n)

H1 = Volume corrector totaliser reading

The **present totaliser reading** in the volume corrector is displayed under this value number for the actual volume V (Channel 1) and the standard volume V_n (Channel 2), (see Standard Display II). The display format is based on the selected **display factors** for V and V_n (see Part 1, Chap. 3.4.6.1). The post-decimal places can be called with the **comma** key (,).

H2 = Original meter reading and undisturbed counter reading

Under this value number the **adjustable V counter** (see Part 1, Chap. 3.4.2) is displayed in Channel 1 and the **undisturbed V_n counter** in the volume corrector is displayed in Channel 2. The display format depends on the **display factors** selected for V and V_n (see Part 1, Chap. 3.4.6.1). The post-decimal places can be called with the **comma** key (,). Setting of the counters in the DS-100 function is **not** possible via the read-out device. Any value can be entered (→ replicated original meter reading of the gas meter) in the menu: "Adjustable counter -DS: 152" via the keypad for synchronising the gas meter in Channel 1. In Channel 2 (V_n) this value is fixed and cannot be changed.

H3 = Month-end and previous month-end readings of the meter H2

The readings of the **adjustable V counter** for Channel 1 and of the **undisturbed V_n counter** for Channel 2 are saved on the first of each month at the change of the day (e.g. 6:00 hours) and can be called during the current month.

In addition the previous month-end reading of the **adjustable V counter** is displayed for Channel 1 and the previous month-end reading of the **undisturbed V_n counter** for Channel 2.

H4 = Maximum daily consumption in the current and previous months

During the counting process the consumption during a day is continuously monitored and the maximum value saved with the date and time. If a higher value is measured than that already recorded, then the new figure is recorded.

This process is restarted at the beginning of each month.

The maximum daily consumptions of the current and previous months are displayed consecutively. Both values are identified with "H4".

H5 = Maximum flow in the current and previous months

As with the daily maximum, the consumption within an interval is continuously monitored and the maximum value saved with the date and time. The value is always displayed with one post-decimal place.

The maximum flow of the current and last month are displayed consecutively. Both values are identified with "H5".

H6 = Last interval consumption

The consumption in the last interval is displayed with this value. The display is dependent on the set data storage cp value. This enables a simple check of the saved hourly values "at the point of measurement" by noting the meter reading at the start and finish of a time interval and then comparing the difference with the value displayed by H6.

cp value for interval values

The currently valid cp value for saving the interval values is displayed. It is only displayed as a check and modification is only possible via the AS-100 (see Part 1, Chap. 3.5.1-a).

3.5.3.2 General values for Channels 1-4

H7 = Measurement period

The measurement period (interval) is the smallest time unit in which consumption values are saved. It is permanently associated with the time of day, i.e. a 60 minute measurement period runs for example from 14:00:00 hours to 15:00:00 hours.

The measurement period can be set by the AS-100 Read-out Device to integer divisors of 60 minutes in the range from 5 to 60 minutes separately for each channel (5, 10, 15, 20, 30 and 60 min.). A new measurement period is temporarily stored and only accepted with the passing of the next full hour.

H23 = Status register

Faults and warning messages are saved in the status register for each channel.

This gives a good overview of the operating status and enables prompt rectification of faults. After the channel has been read out and the data accepted into the AS-100, the content of the register is deleted if the faults are no longer present and have been acknowledged in the volume corrector section. Faults that are still present are then immediately entered and for messages that have not been acknowledged the status "E8 - Test point S" is recorded.

The exact listing of which faults are present can be interrogated in the menu "**Channel x**" (DS: 2x) under "**Status**" (DS: 2x1). Only a summary of the existing faults is displayed in the menu 2x. If no fault is present and the previous faults have been read out (= acknowledged), the text "ok" is output (the appropriate channel (1-4) should be substituted for "x").

H16 = Customer number

The customer number is used as the most important reference value in the following processing steps. As with the meter and device numbers, it can only be set and read out with the AS-100 Read-out Device. The customer number is set to "1" in the device as supplied ex-works.

H17 = Meter number

The meter number is used for the identification of the connected gas meter (in particular for customers with a number of meters). It can, for example, be set to the serial number of the gas meter and is automatically passed through the system, similar to the customer and device numbers. The meter number is set to "2" ex-works.

H18 = Device number

The device number identifies the DS-100 function together with its channels and is set at the factory. Apart from one figure, it is the same as the number on the name-plate. The "ten thousands figure" is always set to "0" on the name-plate, but represents the channel with the saved and displayed device number.

Example:

Ser. no. on the name-plate: 1100001

Device no., corr. to Channel 1:	1110001
Device no., corr. to Channel 2:	1120001
Device no., corr. to Channel 3:	1130001
Device no., corr. to Channel 4:	1140001

The upper five places are set to zero to be used for later expansions or customised applications.

The lower device numbers in the device as supplied should normally not be changed.

3.5.4 Values in Channel 3 (p) and Channel 4 (T) DS:23/24

Value no.	Displayed value	Display	Unit
H1	Present value, pressure/temperature	xxx,yyy *1	bar/°C
H2	Average in current month	xxx,yyy *1	bar/°C
H3	Average in last month	D/T/value	bar/°C
H3	Average in month before last	D/T/value	bar/°C
H4	Min. average in current month	D/T/value	bar/°C
H4	Min. average in previous month	D/T/value	bar/°C
H5	Max. average in current month	D/T/value	bar/°C
H5	Max. average in previous month	D/T/value	bar/°C
H6	Average of last measurement period	D/T/value	bar/°C
H7	Measurement period (interval)	5 - 60	min
H23	Status	0 / Exx	-
-	Computation factor	decimal	-
-	Customer number	12-figure	-
-	Meter number	12-figure	-
-	Device number	12-figure	-

***1** Display in Channel 3 (p): xxx,yyy and Channel 4 (T): xx,yy
D/T/value: Date/Time/Value

3.5.4.1 Meaning of the values in Channel 3 (p) and Channel 4 (T)

H1 = Present value

The measurement transferred from the volume corrector to the DS-100 function is displayed and also included in the formation of the mean.

Differences are possible in the displays for pressure and temperature compared with the values directly displayed by the volume corrector. This is because the last place in the DS display can deviate by ±1 from the volume corrector display depending on the pressure range and the value matching (the lower resolution of the DS-100 function due to system reasons). A deviation of ±0.2°C is even possible with the display of temperature, because the temperature is processed internally as the absolute temperature and is only converted to °C for the display.

H2 = Average in current month

The mean of the month is calculated from the interval means. The month mean for the current month is displayed.

H3 = Average of last month and month before last

The monthly means of the last month and the month before last are displayed with date and time.

H4 = Minimum average of current and previous months

During the formation of the mean the interval mean is continuously monitored and the lowest value is saved with the date and time.

If a value is measured which is lower than that recorded, then the new value is recorded with the date and time.

The minimum mean of the current and previous months are displayed consecutively. Both values are identified with "H4".

H5 = Maximum average of current and previous months

During the formation of the mean the interval mean is continuously monitored and the highest value is saved with the date and time.

If a value is measured which is higher than that recorded, then the new value is recorded with the date and time.

The maximum mean of the current and previous months are displayed consecutively. Both values are identified with "H5".

H6 = Average of the last measurement period

The arithmetical mean calculated from the measurements transferred from the volume corrector during the measurement interval are accepted at the end of the interval. The mean over the last interval is displayed here.

Computation factor

The valid computation factor for determining the pressure and temperature values in the DS-100 function is displayed. The EK-86 automatically determines the computation factor for the pressure channel from the entered pressure range (see Part 1, Chap. 3.4.6.2-a). It is permanently set to 0.1 for the temperature channel. Both computation factors are only showed as a check and it is not possible to change the values.

3.5.5 DS-100 status register DS: 2x1

Status	Fault message	Description
E0	No fault present	-
E1	New start	There is no data in the memory when the EK-86 is first switched on. The DS function is not yet acquiring data. This only occurs after the time has been set with the AS-100.
E2	Power failure	The power supply has failed after the DS function has been set into operation. No data has been acquired during this period; the saved data is however retained and the internal clock continues running.
E3	Wrong value	The interval counter has overflowed in Channel 1 or 2 (more than 4079 pulses per interval) or the values could not be acquired correctly in Channel 3 or 4. The fault can also be caused by a fault in the volume corrector. The interval value is incorrect!
E4	Substitute value	This message indicates that a substitute value has been used to form the interval value from the VC.
E5	Corrected value	This message is caused by a VC fault. The associated interval value is probably correct.
E6	Data error in memory	The EK-86 has been found faulty by internal test functions. The VC is defective.
E7	(Reserved for production tests)	-
E8	(Reserved for production tests)	Test point S; there are faults present in the volume corrector which must still be acknowledged.

☞ *The recorded fault messages can be reset by reading out with the AS-100 or by remote data transmission. For this to be effective, the fault must no longer be present and it must have been acknowledged in the volume corrector.*

Relationship: Volume corrector fault/warning and DS-100 status

The possibilities of displaying the fault messages in the DS function do not correspond to the comprehensive possibilities presented by the volume corrector module. The reason is that usually a number of volume corrector faults have the same effects in the corresponding channel of the DS function. This means that the fault messages are reduced to a few DS fault messages. The fault messages are stored and displayed until the next read-out operation, by for example the AS-100. In the data flow only the interval value is labelled in which the fault occurred.

Allocation of the VC fault messages (channel-specific)

No.	Volume corrector fault text	K1	K2	K3	K4
E01	New start of system (A)	1	1	1	1
E02	Power failure (A)	2	2	2	2
E03	Inconsistent data (A)	6	6	6	6
E04	Memory fault (A)	6	6	6	6
E10	Power failure on counter input (A)	3	3		
E11	Counter input 1 Frequency too high (A)	5	5		
E12	Counter input 2 Frequency too high (A)	5	5		
E13	Counter input 1 disturbed (W)	5	5		
E14	Counter input 2 disturbed (W)	5	5		
E15	Counter input 1 suspect (W)	5	5		
E16	Counter input 2 suspect (W)	5	5		
E20	Max. flow exceeded (A)	5	5		
E30	Pressure measurement disturbed (A)		4	4	
E31	Calibration limit, pressure (A)		4	4	
E32	Correction: Impermissible pressure (A)		4	4	
E40	Temperature measurement disturbed (A)		4		4
E41	Calibration limit, temperature (A)		4		4
E42	Correction: Impermissible temperature (A)		4		4

Note:

K1 - K4: DS-100 Channel 1 - 4.

The fault messages E1-5 are included in the data stream; Message E6 is only entered in the status register. All other volume corrector faults/warnings have no effect on the DS function and are not recorded.

3.5.6 Activating the data storage function

The installation and set-up of the volume corrector module and the DS function must be completed before the DS-100 function can be operated (see Part 1, Chap. 3). It is important that no faults are present (Alarm) and that all messages in the fault list have been acknowledged (see Part 1, Chap. 3.4.1.1).

The data storage function is basically ready for operation after a new start of the device. The storage of data however only follows after the time has been set. This can be carried out either in the volume corrector module in the menu "**Set clock**" DS: 16 or by using the **AS-100** Read-out Device. Since this setting has already been done ex-works, the DS-100 function is ready for operation as supplied.

With the display of maxima and minima of the previous month, the date 01.01.88 appears, because the EK-86 starts with this date. The display has no significance though and is later overwritten.

The settings which are to be checked for operation of the data storage function are described in Part 2 in Chapter 3.10.

3.5.7 Read-out function

☞ *Before sensible readings can be read out of the data storage function, the setting up of the EK-86 and the DS function must be completed (see Part 2, Chap. 3.10).*

Connecting the read-out device

Normally, an **AS-100** is used for reading out the DS function. A suitable connecting lead is included in the items supplied with the AS-100. Before connecting the device, it should be ensured that no potentially explosive gas mixture is present during the read-out process!

☞ *Generally, connection and disconnection should only occur with the AS-100 switched off. Furthermore, the connectors on both devices should - if possible - be screwed. This ensures reliable reading out.*

Of course, this also applies to all the other equipment such as the PC/laptop, modem and printer. For further information please contact Elster Sales or the Electronics Department.

Reading out the data storage function

The data saved in the EK-86 can be read out with the AS-100. To read out a certain channel you must select the relevant channel in the DS function of the EK-86:

Channel 1 (V)	Direct selection: 21
Channel 2 (V_n)	Direct selection: 22
Channel 3 (p)	Direct selection: 23
Channel 4 (T)	Direct selection: 24

It is important that branching to this channel occurs; calling the DS main menu (DS: 2) and positioning the cursor ">" on the channel is not sufficient.

After starting the read-out with the key "D" in the AS-100, the selected channel is displayed in the second line in the DS main menu (e.g.: **AS-100 <--> Channel V**). In the AS-100 the current channel and the transferred blocks are also displayed.

☞ *Please ensure that for correct recognition of the consumption data by the read-out software, entry of a customer number (e.g.: "1") is* ***essential****.*

After the read-out the internal clock in the EK-86 is corrected and, where required, the fault register (status) in the DS function is deleted.

3.5.8 Parameter setting function

Apart from reading out the consumption data, various values in the data storage function must be set. Normally, this is carried out during setting up (see Part 1, Chap. 3.10). Depending on local conditions, these must however be matched. To do this, the following values can be entered on the EK-86 and modified:

a.) Customer, meter or device number (B2)
b.) cp value (B0/B7)
c.) Interval period (B0)
d.) Set I/O mark (B8)
e.) Access code (B666)
f.) Set day boundary (B21)

The following values **cannot** be set in the EK-86:

g.) Adjustable counter (B0)
h.) cp value in the analogue channel (B0/B7)
i.) cpz value (B7)
k.) Set unit (B20)

About a.) **Customer, meter or device number (B2)**

It is essential that these numbers are set during setting up. The **customer number** is specified by the gas supplier. If not, it must be set to a valid value, e.g. "1", because otherwise no evaluation of the data is possible with the evaluation software. The **meter number** corresponds to the serial number of the connected gas meter and the **device number** corresponds to the serial number of the EK-86. Here, the 5th figure from the right identifies the relevant channel (1 = V, 2 = V_n, 3 = p, 4 = T).

All the numbers must be entered separately for each channel.

About b.) **cp value (B0/B7)**

The weighting with which the interval values, the previous day's consumption (H4) and the previous interval consumption (H6) contained in the consumption data are saved in Channel 1 (V) and Channel 2 (V_n) can be set with B0 and B7 on the AS-100. Possible values are:

0.01 0.1 1 10 100

It must noted that the required cp values should be selected in dependence of the maximum flow (Q resp. Q_n) as follows for an interval period of 60 min. if overflow of the interval counter is to be avoided:

Q_{max}	cp value (pulses/m^3)	Resolution (m^3/pul.)
≤ 40.79 m^3/h	100	0.01
≤ 407.9 m^3/h	10	0.1
≤ 4079 m^3/h	1.0	1.0
≤ 40790 m^3/h	0.1	10.0
≤ 407900 m^3/h	0.01	100.0

By reducing the interval period (see below), the stated max. flow values are increased accordingly. It should be noted that a change of the cp value only becomes valid at the start of the next interval.

About c.) **Interval period (B0)**

The interval period is the interval during which the incoming volume pulses (V and V_n) and the analogue values (p and T) are stored. A change of the interval period is needed if more than 4079 pulses in the actual or standard volume channel occurs in one interval. In this case the message "**E25 - Interval counter overflow**" is signalled. The interval period should then be shortened to the next shorter interval period; the following values are possible:

5, 10, 15, 20, 30 and 60 min.

It should be noted that a change in the interval period only becomes valid at the next full hour.

About d.) **Set I/O mark (B8)**

The I/O mark is a label in the data flow that indicates that a significant change has occurred, e.g. an I/O mark is set automatically after a change of the customer, meter or device number. This type of mark can also be set by the user under "B8" in the AS-100. It is termed a **fixed I/O mark**.

About e.) **Access code (B666)**

The function of the **access code** is similar to the user lock in the volume corrector. The values in the DS function can therefore only be changed with the same codes in the AS-100 and the EK-86. If the codes are different, this fact is displayed on the AS-100. The access code is set to "00000000" ex-works and is therefore not active. If an access code is set in the EK-86 via B666 in the AS-100, it is essential that the following is observed:

☞ *An access code once set can only be changed if it agrees with the access code of the connected AS-100. If this access code is forgotten, it can only be changed via B666 with an **open calibration lock**!*

About f.) **Set day boundary (B21)**

The start of the day can be changed via B21 in the AS-100. Ex-works this is set to 6:00 hours.

About g.) **Adjustable counter (B0)**

The adjustable counters are only intended for DS-100 devices and older volume correctors. The entry of an adjustable counter causes a fault message in the AS-100! With AS-100 versions <V5.0 this leads to "Cancellation of the transmission" and no transfer of changed values occurs. From Version V5.0 this fault is displayed ("Command '75' unknown"), but the other changes are accepted.

About h.) **cp value in the analogue channel (B0/B7)**

The entry of a cp value is not possible in the analogue channels (Channels 3 and 4). The storage and transfer of the analogue values takes place with the aid of a so-called "computation factor" which is permanently specified in the software.

About i.) **cpz value (B7)**

The cpz value reflects a non-decade cp value in some DS-100 devices. Since the volume corrector meter readings are passed directly to the DS function in the EK-86, the cpz value is not supported.

About k.) **Set unit (B20)**

The function "Set unit" has no meaning in the EK-86, because the units are fixed. These are m^3 in Channel 1 (V) and Channel 2 (V_n), bar in Channel 3 (p) and °C in Channel 4 (T).

4. Inputs and outputs

4.1 Generator inputs

4.1.1 Pulse generator

The pulse input card is designed according to **NAMUR specifications** and as **intrinsically safe** (BVS 92.C.2039 X, see Appendix D). The card is approved as **Associated Electrical Equipment for Ex Zone 1**. This means that generators which are located in Ex Zone 1 can also be connected to the EK-86. The inputs are electrically isolated from the system, but not from one another.

Setting the mode of operation

The EK-86/S has two counter inputs (channels) for the connection of a maximum of two pulse generators from a gas meter. The inputs are designed for use with high frequency pulses (HF generators) with the A1S/A1R Generator and also for low frequency pulses (LF generators) with E1 contacts. The operating modes using two HF generators, one LF generator and mixed operation with one HF and one LF generator are possible. The HF generator must be connected to the +1/-1 inputs for mixed operation. In the operating mode with only one generator (HF or LF) the generator must also be connected to the +1/-1 input. In addition Generator 2 can be cancelled in menu DS 16211.

Automatic setting of the cut-off frequency

Since an HF or an LF generator can be connected to the inputs, different cut-off frequencies must be available depending on the operating mode if interference is to be avoided (e.g. contact bounce). These limits are automatically set by the EK-86. The appropriate cut-off frequency is found by using the set cp value multiplied with the maximum flow Q_{max} (see menu 16211):

$cp \cdot 1.8 \cdot Q_{max} + 1 < 10$ Hz → LF generator; cut-off frequency = 10 Hz

$cp \cdot 1.8 \cdot Q_{max} + 1 \geq 10$ Hz → LF generator; cut-off frequency = 3000 Hz

e.g.:

G40(E300); cp value = 200 pulses/m^3; Q_{max} = 65 m^3/h

f = 200 pulses/m^3 • 1.8 • 65 m^3/h / 3600 s/h + 1 = 7.5 Hz → LF generator

G65(E300); cp value = 200 pulses/m^3; Q_{max} = 100 m^3/h

f = 200 pulses/m^3 • 1.8 • 100 m^3/h / 3600 s/h + 1 = 11.00 Hz → HF generator

Output of the warning "E11" or "E12" occurs when the frequency is higher than the frequency that occurs with 1.8 x Q_{max}:

e.g.: Q_{max} = 65 m^3/h (G40); cp value = 200 pulses/m^3;

→ $f_{(Qmax)}$ = 65 m^3/h • 200 pulses/m^3 : 3600 s/h = 3.611 Hz

→ $f_{(Warning)}$ = 1.8 • $f_{(Qmax)}$ = 1.8 • 3.611 = 6.5 Hz

This means that the warning is output at an input frequency > 6.5 Hz.

Monitoring generator deviations

With the connection of two generators, monitoring of the deviation between the generator pulses takes place. This is independent of whether the same generators (HF/HF or LF/LF)or different generators (LF/HF) are used. Since the monitoring is weighted according to volume (this permits any cp value), it may take a very long time until the fault message is output with a low permissible deviation and if the mixed operating mode is used (e.g.: 10 pulses at 10% and 100 pulses at 1% permissible deviation are needed, which can take a long time with LF generators). With mixed operation and the failure of the HF generator, it must be noted that with changeover to the LF generator the gas volume that has passed up to that point is lost (but no loss of pulses).

The monitoring of generator deviations occurs up to the flow corresponding to 1/50th of Q_{max}.

Line breakage monitoring

Each connected generator can be monitored for line breakage. This is achieved by setting the line breakage monitoring for Generator 1 and, where applicable, Generator 2 to "YES" in the menu 16211. The EK-86 then checks from time to time whether a current >0 mA is flowing in the pulse generator line. If this is not the case, the warning "E13 - Counter input 1 faulty" or "E14 - Counter input 2 faulty" is output.

Switching off the line breakage monitoring is practicable with reed contacts (E1 generators) and transistor switches, because they do not pass any current in the open state and therefore they continually produce the fault message "E13 - Counter input 1 faulty" or "E14 - Counter input 2 faulty".

With NAMUR generators this monitoring is important and should be switched on. The line breakage monitoring is switched off as supplied ex-works.

Gas meter parameters

The parameters of the connected gas meter are needed for the determination of the actual volume and the monitoring of the computed values. The following quantities are important: **maximum flow (Q_{max}),** the **cp values** for Generator 1

and, where applicable, Generator 2, the **line breakage monitoring**, the **run-up** and **run down times**, the **permissible deviation** of the generators and the **lower flow limit (Q_{LL}).** These values are essential for the processing.

With a change in the gas meter quantity and particularly with a change of the maximum flow, a check must be made of whether the flow limit at $1.1 \cdot Q_{max}$ can be exceeded in Channels 1 and 2 in the DS function. If necessary, the cp value and/or the interval period must be matched.

The **gas meter size** (G16 - G16000), which is set in the menu 16211, and the gas meter **serial number** are only needed for display. They have no significance in the processing and only provide information for the user. They are however subject to calibration laws!

The **display factor** is only needed for the display of the meter readings in the EK-86 and should be set to match the connected gas meter, e.g. the display can be extended by one place using a display factor of "x10" (by discarding a post-decimal place). This is practicable with larger meters, because the display does not overflow so quickly.

The **minimum flow (Q_{min})** has a similar meaning for gas meters, the set limit of which is not monitored. It just identifies the maximum of the lower flow limit.

The **lower flow limit (Q_{LL})** must be lower or the same as the minimum flow and is needed for the **run-up** and **run down checks**.

See Part 1, Chap. 3.4.6.1 for a more detailed description of the gas meter details.

4.1.2 Pressure sensor

The analogue input card, to the inputs of which the pressure and temperature sensors are connected, is designed as **intrinsically safe** (BVS 92.C.2046 X; see also Appendix D). The card is approved as **Associated Electrical Equipment for Ex Zone 1**. This means that sensors located in Ex Zone 1 can be connected to the EK-86.

☞ *The inputs are electrically isolated from the system, but not from one another. This means that only sensors of the same type can be used. If a flame-proof pressure sensor is used, a flame-proof temperature sensor must also be used and vice versa. Mixed operation of intrinsically safe and flame-proof sensors in **Ex Zone 1** is not allowed.*

The EK-86 is intended for the connection of a pressure sensor with a current output of 4.0 - 20 mA using the two-wire technique. Both **absolute** and **relative pressure sensors** can be connected. With relative pressure sensors the appropriate atmospheric pressure must be entered at the point of measurement.

The measured current is converted to the corresponding pressure value using a measured or entered characteristic and then processed further. The correction of the sensor characteristic can take place based on 2 or 3 reference points. With 2 reference points a linear characteristic is found and a quadratic one with 3 reference points. Better matching to the real characteristic is possible with 3 reference points. The reference points for the characteristic can be called under the Direct Selection: "16223". The calibration procedure is described in more detail in Part 1, Chap. 3.4.6.2 and in Part 2, Chap. 3.4.

The other pressure sensor parameters are set under Direct Selection "16221". The pressure sensor **serial number** is just information that is displayed only. The **approved limits** correspond to the limits of the pressure sensor approval (= name-plate figure) and are also displayed only. The upper approved limit is however also needed for the warning limit hysteresis (see below).

The limits at which the alarm and disturbance volume counting is triggered must be set by the **alarm limits**. Exceeding the limits is signalled by alarm "E31 - Alarm limit, pressure". Then the programmed substitute value is used for processing and counted in the disturbance volumes.

The situation is a little different with the **warning limits**. Violation of these limits produces a warning, but the incoming pulses continue to be counted as normal, i.e. no disturbance volume counting. Therefore, it is only subject to the user lock. The **hysteresis** must be taken into account with the warning limits. It is referenced to the upper approved value and is used as shown in the following example:

Approval: 14.0 - 70.0 bar; p_{ULi} = 60 bar; hysteresis = 5%

→ $Hyst_{(gas)}$ = 5 % • 70 bar = 3.5 bar; $\Delta Hyst = Hyst_{(gas)} : 2$ = 1.75 bar

→ $p_{ULiswitch}$ = 60 bar + 1.75 bar = 61.75 bar

$p_{ULireset}$ = 60 bar - 1.75 bar = 58.25 bar

This means that when 61.75 bar is exceeded the fault is displayed (E33 - Lower warning limit, pressure or E34 - Upper warning limit, pressure) and, where applicable, an output is set. If the pressure falls below 58.35 bar, the fault and the output are reset.

4.1.3 Temperature sensor

The temperature sensor input is located on the same card as the pressure sensor input. It is also designed to be **intrinsically safe** (BVS 92 C.2046 X; see also Appendix D). Therefore, please take note of the information in Chapter 4.1.2.

The input on the EK-86 is designed for the connection of a temperature sensor using the four-wire technique. This the best method and it enables the resistance of the temperature sensor to be measured very accurately; the length of the leads then has hardly any effect on the accuracy of the measurement. Temperature sensors to DIN IEC 751 with an accuracy 1/3 DIN Class B (= 0.1 K + 0.005 · t[°C]) are used.

The measured resistance is converted to the corresponding temperature value for further processing using a measured or entered characteristic. The sensor characteristic can be represented by 2 or 3 reference points. A linear characteristic is derived for two reference points and a quadratic characteristic for three points. Better matching to the real characteristic is possible using three reference points. The characteristic reference points can be called under Direct Selection "16233". The calibration procedure is described in more detail in Part 1, Chap. 3.4.6.3 and in Part 2, Chap. 3.4.

The other temperature sensor parameters are set under the Direct Selection "16231". The same applies to these parameters as for those of the pressure sensor (see Chap. 4.1.2).

4.2 Outputs

4.2.1 Relay outputs

The Digital Output Card (DIA7) is used for the output of alarm, warning or limit signals or for outputting pulses to the following equipment. The outputs are electrically isolated from the system and from one another. If required, they can be wired in parallel. Each output can be programmed as necessary; it is, for example, possible to define 4 alarm outputs and 3 switching outputs. However, outputs "1" and "2" have special features. They are designed as **relay changeover contacts** and can therefore be used to carry higher currents and for connection to alternating voltages. As supplied ex-works, they are configured as switching outputs for **alarm (Output 1)** and **warning (Output 2)**. Basically, any other output can be used as a switching output for alarm and warning functions.

It should be noted that the relays operate at a restricted speed and only enable output frequencies of < 1.0 Hz to be used. The technical data for the relay outputs is listed in Appendix C-2b and the terminal assignment is given in Appendix B-5a.

The relay output assignment takes place in the menu: "Output assignment" (DS:16242) under Card 3 (!) for Channels 1 and 2. After calling the required outputs the present configuration is displayed and can be modified as described in Chapter 3.4.6.4 in Part 1.

The following example explains the setting of Output 2:

The output should be set with the message "E06 - Calibration lock open" and "*Normally closed contact with message present*" (relay drops out for a message).

To do this, call the menu: 16242 - Output assignment. Set the switching/pulse output card (Card 3) and Channel 2. The output is declared as a switching output with **Mode** (display: *any alarm*). Via **Assignment** key through to the message "*E06 - Calibration lock open*" with the **Enter** key. Select normally open or normally closed contact with "**Specify**". The display should then appear as follows:

```
  16242: ASSIGNMENT CARD 3 CHANNEL 2
Assigned: E06 Calibration lock open
N/C contact with present alarm
>Card   Channel   Mode  Assign   Specify
```

Fig. 4.2.1-1: Example - Output assignment (switching output)

The acceptance of the setting must then be made in the menu: **12 - Accept parameters**. The output is then activated when the calibration lock is locked. This state can be checked in the menu: "**View outputs**" (DS:16241).

4.2.2 Transistor outputs

The **transistor outputs** on the digital pulse output card are electrically isolated from the system and from one another via optocouplers. They are intended as switching outputs (e.g. for limit messages), as fault outputs (for general or specific fault messages) and as pulse outputs (e.g. for the standard volume). As supplied ex-works they are set as 2 x **standard volume V_{nt} (Outputs 3 and 4)**, 1 x **actual volume V_t (5)**, 1 x **upper limit for Q_{nt} (6)** and 1 x **lower limit for Q_{nt} (7)**. Also here it is possible to set each output for any variable and to wire outputs in parallel.

It should be noted that these outputs are only designed for direct voltage (maximum 28.8 VDC) and a maximum current of 50 mA. The maximum frequency for the transistor outputs is 10 Hz. The technical data for the transistor outputs is listed in Appendix C-2b and the terminal assignment is given in Appendix B-5a.

The assignment of the transistor outputs is carried out in the menu: "Output assignment" (DS:16242) under Card 3 (!) for the outputs 3 to 7. After calling the required output the present configuration is displayed and can be modified as described in Chapter 3.4.6.4 in Part 1. The present state (active/inactive) can be monitored in the menu: "View outputs" (DS:16243).

The following example explains the setting of Output 5:

The output is to be set as a pulse output for the total actual volume (V_t) with the scaling 5 m^3/pulse and the maximum output frequency of 2 Hz.

To do this, call the menu: 16242 - Output assignment. Set the switching/pulse output card (Card 3) and Channel 5. The is declared as a pulse output using **Mode** (display: *V (undisturbed volume)*). At **Assignment** the **Enter** key is pressed until V_t is obtained. The scaling (5 m^3/pulse) and then the maximum frequency (2 Hz) is set via **Specify**. The display then appears as follows:

```
  16242: ASSIGNMENT CARD 3 CHANNEL 5
Assigned: Vt (total volume)
Pulse   1 pulse = 5.000m3   fmax= 2
>Card  Channel  Mode  Assign   Specify
```

Fig. 4.2.2-1: Example - Output assignment (pulse output)

The acceptance of the setting must then be made in the menu: **12 - Accept parameters** and the present state can be checked in the menu: "**View outputs**" (DS:16241). Here, the pulses to be output are displayed, together with any retained pulses.

4.2.3 Analogue outputs

The optional analogue output card is used for the output of direct currents which are proportional to the actual and standard flows, the measured or converted pressure or the measure or converted temperature, e.g. for a flow recorder.

A number of cards, each with 4 analogue outputs, can be employed in the EK-86/S. The outputs are electrically isolated from the system, but not from one another since they have a common ground. The outputs can be operated in the modes 0-20 mA or 4-20 mA and each of them has a resolution of 10 bits. Each output can be programmed as required. They are set as supplied ex-works with **standard flow Q_n (Output 1), actual flow Q (2), pressure p (3)** and **temperature T (4)**. Apart from in the modes (0/4-20 mA) the scaling of each output can be set separately. Even a negative relationship is possible, e.g.: 0 mA $\approx$ 10,000 m^3/h and 20 mA $\approx$ 100 m^3/h. The technical data for the analogue outputs is listed in Appendix C-2c.

In the case of a fault the current corresponding to the programmed substitute value (for pressure or temperature) is output for the relevant analogue channel. After a power failure the analogue outputs remain blocked for a period after which the correct analogue output values are established.

The assignment of the analogue outputs is carried out in the menu: "Output assignment" (DS:16242) under Card 2 (!) for all four channels. After calling the required output the present configuration is displayed and can be modified as described in Chapter 3.4.6.4 in Part 1. The present state (output value) with the momentary flowing current can be monitored in the menu: "View outputs" (DS:16243).

The terminal assignment on the analogue output card is as follows:

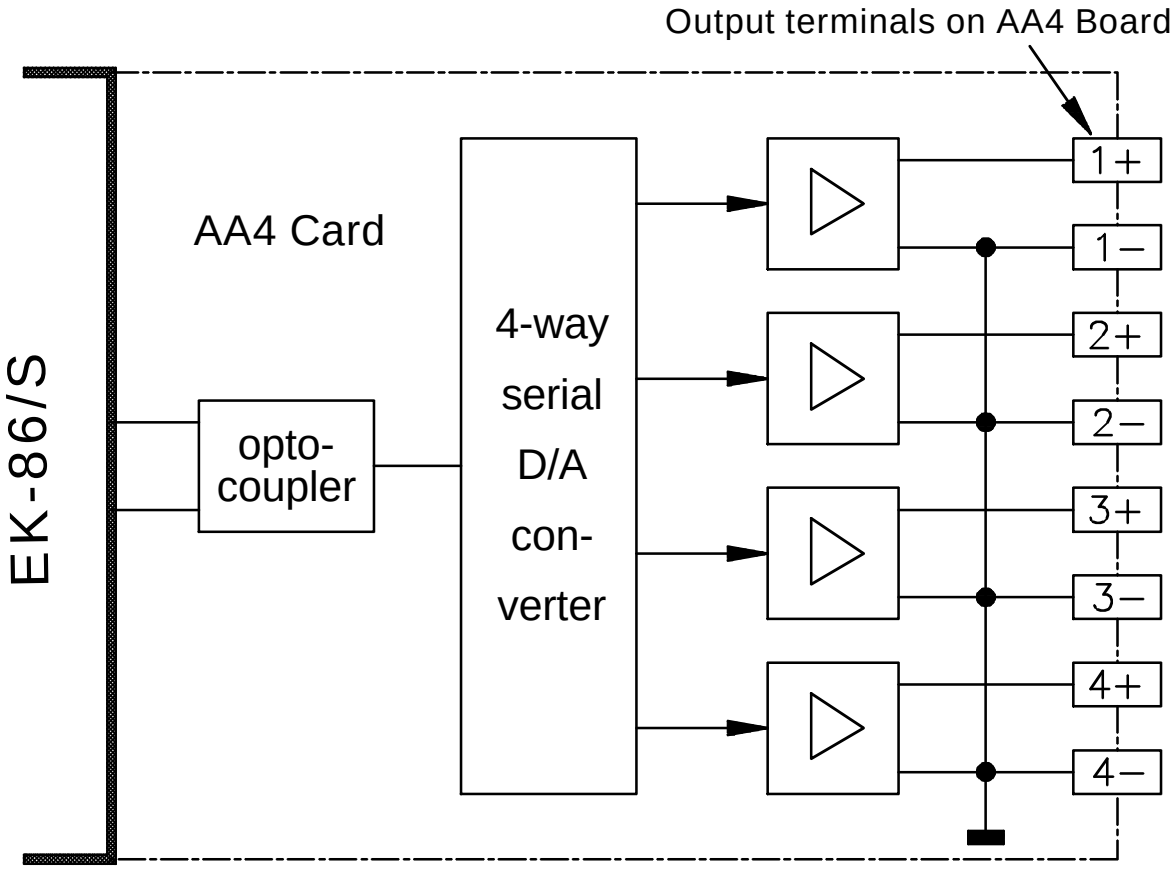


Fig. 4.2.3-1: Output assignment on the analogue output card

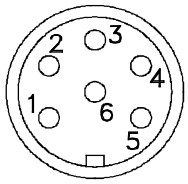
5. Interfaces

5.1 Read-out interface

The most important interface on the EK-86 is the so-called read-out interface. It is mainly used for reading out the data of the data storage function (DS function). The DS function is also configured via this interface. All the volume corrector parameters can be read out using the interface. The features of the read-out interface are supplemented with the output of a process data block and the output of the most important values to a printer.

A read-out device (e.g. **AS-100** from Elster), a PC/laptop, a serial printer or a modem can be connected to this interface. On the EK-86/S the interface is located on the front panel and, when not in use, it is covered with a flap. The interface has been designed to the RS-232/V24 standard as a serial interface with a simple hardware handshake. Connection is provided by a 6-pole round socket with the following pin assignment:

Pin 1	nc
Pin 2	TxD (Data output)
Pin 3	RxD (Data input)
Pin 4	nc
Pin 5	DTR (Control input)
Pin 6	GND



(View on interface)

Further technical data for the read-out interface is listed in Appendix C-2a.

Connection of an external device to the read-out interface

Normally, an ELSTER AS-100 Read-out Device or an ELSTER EM-100 Modem is connected to the interface. A suitable connecting lead is supplied with the AS-100/ EM-100.

☞ *Generally, connection and disconnection should only occur with the device switched off. Furthermore, the connectors should be screwed. This ensures reliable reading out.*

Of course, this also applies to all the other equipment such as the PC/laptop, modem and printer. For further information please contact Elster Sales or the Electronics Department.

5.2 Outputting the process data

For applications in the fields of process control (e.g. temperature control) and remote data transmission, all important data from the volume corrector function can be called through the serial interface.

This supplementary function takes place independent of the DS-100 data communication. However, since only one interface is available, simultaneous operation is not possible. Alternative reading out of the DS function and transmission of the process data block is possible though. The interface is always free of any interaction affecting the volume correction. Further documentation is available for detailed information. The data is called by transmitting the following ASCII character string via the interface:

SOH P 6 7 CR <data> ETB

The <data> is transmitted in the following sequence and format:

STX 186,ELS,EK-86,9016,zzzzzzzzzzzz,kkkkkkkkkkkk,ggggggg0gggg,
YYMMDDhhmmss,111111111111Dxy,222222222222Dxy,33333D-2,
4444444Dxy,555555D-5,6666666Dxy,7777777777777777,8888888D-1,
999999D-1,%4711,LF CR ETX

Explanation of the symbols

SOH	01_{hex}	Ctrl A	Start of communication frame
ETB	17_{hex}	Ctrl W	Finish of communication frame. Any number of interrogations (P67 CR) are possible between SOH and ETB.
STX	02_{hex}	Ctrl B	Introduces the data flow. From now on only characters in the ASCII table are output. The data delimiters are commas ($2C_{hex}$).
186			3 decimal numbers; no. of bytes to be transferred after the following "E" including the ETX at the end of the block. The commas are also counted.
ELS			Elster company logo.
EK-86			Device identification in plain text.
9016			Device identification (90 = EK-86) and software version no. (16 = V1.6).
zzzzzzzzzzzz			Meter number.
kkkkkkkkkkkk			Customer number.
ggggggg0gggg			Device number; 5th place from last = 0.
YYMMDDhhmmss			Current date and time.

111111111111Dxy	Standard volume, 12-figure integer number and single exponent figure with sign e.g.: 000000012345D-3 corresponds to 12.345 m^3.
222222222222Dxy	Actual volume, 12-figure integer number with single exponent figure with sign e.g.:000023627383D-2 corresponds to 236,273.83 m^3.
33333D-2	Present gas temperature, 5-figure integer number with signed exponent e.g.: 27315D-2 corresponds to 273.15 K.
4444444Dxy	Present gas pressure, 7 figure integer number with signed exponent e.g.: 0101325D-5 corresponds to 1.01325 bar.
555555D-5	Present K value, 6-figure integer number with signed exponent e.g.: 010000D-5 corresponds to K = 0.1
6666666Dxy	Present Z factor, 7-figure integer number with signed exponent; for Z factors ≥ 100 → only D-4! e.g.: 0120000D-5 corresponds to Z = 1.20000
7777777777777777	sPresent contents of the 60-bit status register, 16 characters e.g.: 000000000000C001 corresponds to faults 1, 15 and 16.
8888888D-1	Present standard flow, 7-figure integer number with signed exponent e.g.: 0253279D-1 corresponds to 25,327.9 m^3/h.
999999D-1	Present actual flow, 6-figure integer number with signed exponent e.g.: 015630D-1 corresponds to 1,563.0 m^3/h.
%4711	4 hexadecimal numbers, checksum MOD 65536 for all transmitted ASCII characters after STX up to and incl. "%".
LF CR ETX	End of process data block (LF = $0A_{hex}$,Ctrl J; CR = OD_{hex}, Ctrl M; ETX = 03_{hex}, Ctrl C).

5.3 Connecting a modem

Using a modem, the EK-86 can be read out from a distant control station via the read-out interface. It does not matter to the EK-86 whether an AS-100 Read-out Device or a PC with appropriate software is employed for the read-out. It is only important that the transmission format and the control commands conform to the AS-100 protocol specification. In this respect, further information can be obtained by referring to Appendix C-2a or contacting ELSTER Sales or Electronic Departments.

Commercially available modems which can transmit the format given in Appendix C-2a can be connected. We recommend the ELSTER **EM-100** Modem which is designed for connection to the EK-86 and which is also supplied with a suitable 6-pole round plug with connecting lead for the read-out interface. The plug can be obtained for other modems from ELSTER under the identification number 04115123.

The plug pin assignment and the transmission format are described in Appendix C-2a.

5.4 AUX interface

The EK-86/S has two other interfaces, the AUX (auxiliary) interfaces. They are located at the back of the device together with the pulse inputs (labelled: 3+ / 3- and 4+ / 4-). The interfaces are designed to the **NAMUR specification** and are **intrinsically safe** (BVS 92.C.2039 X, see Appendix D).

The interface is prepared for the later connection of an **electronic counting head**, e.g. **Z-90** from ELSTER. The meter reading for the actual volume is then found as a fixed value (→ **Original Meter Reading**) via this interface and not in the form of pulses.

6. Fault handling

6.1 Power failure

Power failure is a common fault during operation. The EK-86 has an internal back-up battery which guarantees data retention for at least 5 years. The time of the power failure and its restoration can be found in the menu "**Faults**".

☞ *However, during a power failure no incoming pulses are counted or corrected.*

Producing an output signal for a mains failure

If a signal is to be passed to a control station during power failure, then this can occur through any digital output (Card 3) by suitable programming. The settings for this are as follows:

Setting for e.g. Card 3, Channel 2 (Relay output 2):

"**E02 - Mains failure**" and "**Normally closed contact with alarm present**".

This means that in operation Output 2, Pins 2W and 2S are closed (see circuit diagram for the switching outputs in Appendix B-5a). This relay drops out with a mains failure and the output on Pins 2W and 2S opens. The reverse situation occurs with Output 2, Pins 2W and 2O which are open in normal operation and closed during a mains failure. Therefore, a closed circuit can be opened during a mains failure (via Pins 2W/2S) or an open circuit can be closed (via Pins 2W/2O).

☞ *It is important that this circuit is supplied from a power supply which is independent of the EK-86.*

In principle, it is also possible to output a signal via the transistor outputs. However, the only setting that is possible here is that the circuit is closed in normal operation and open when a fault occurs (→ normally closed function).

Reaction after power restoration

After the power has been restored, an internal check of the EK-86 takes place first. All outputs are set to "zero". The check lasts about 20 seconds. In this period volume correction is not carried out. Then the measurements return to their appropriate levels and an entry is made in the fault list. Since this fault represents an alarm, the alarm LED is set (continuously lit, because the fault has "passed"). After a further 10 seconds the outputs (switching, pulse and analogue outputs) are set to their appropriate levels and the EK-86 returns to normal operation.

The mains failure can be acknowledged via "**Faults**" (DS: 11).

Precautionary measures

By employing an uninterruptible power supply (UPS) mains failures can be bridged, avoiding loss of volume. The EK-86/S is only suitable without modification in the 24 VDC version for use with a 24V UPS. This must be rated for at least 12 W (24 VDC) and is available as a special accessory from ELSTER.

6.2 Trouble shooting

The following describes the procedure to be adopted to recognise faults which are present, how the input and output cards can be checked and how the EK-86 can be returned to normal operation.

6.2.1 Fault messages

An alarm or warning signalled by the light emitting diodes is also displayed in plain text in Standard Display I and in the main menu (see Part 1, Chap. 3.4.1). The fault description and suggestions for possible rectification are given in **Appendix A-6a**.

☞ *The complete list of all messages present (alarms, warnings and infos) can only be called in the menu "**Logbook**" via "Forwards/Backwards" (various infos are not displayed via LEDs or plain text)!*

6.2.2 Checking the input and output cards

There are various aids available to help the user find out if a card is defective and, if so, which one. A complete check is not possible, but a number of very helpful details can be obtained for the customer service. So it is essential that they are carried out first.

6.2.2.1 Checking the analogue input card (ExAe2)

a.) Fault messages E30 and E40

If this fault message is output, the analogue input card could be the problem. Therefore, check in the menu "**Measurements**" under "**Pulses/pressure/temperature**" whether values can be measured.

Then three question marks appear at the appropriate place and this signifies that the corresponding measurement cannot be acquired.

→ It is essential to contact the service department.

The reason may be that the card is defective or the line to the sensor may be broken or the sensor itself may be defective. This can though only be confirmed by opening the device or the sensor.

b.) Fault messages "E31 - E34" and "E41 - E45"

If these fault messages are output, it signifies that alarm limits, warning limits or validity limits (e.g. with K value according to AGA-NX-19 and H-gas: -5... + 35°C) have been violated. There is then the possibility of checking the actual measurements in the menu "**Measurements**" under "**Pulses/pressure/temperature**" and of coming to a conclusion regarding the fault.

☞ *With the fault messages "**E31** - **E34**" and "**E41 - E45**" it is essential that you check the actual measurements in the menu "**Measurements**" under "**Pulses/pressure/temperature**".*

If the measurements are in order, it may be that the alarm and warning limits have set incorrectly. This can be checked under the sensor parameters for pressure (DS:1622) and temperature (DS:16231), but do not change them!

6.2.2.2 Checking the pulse input card (ExZe4)

a.) Fault messages E10, E13, E14

With these faults either failure of the NAMUR supply (E10) is involved or the line breakage detection has tripped (E13, E14). Here, confirmation that the supply has failed or that a line breakage is present (HF1/LF1 or HF2 = "0" or "???") is provided in the menu "**Measurements**" under "**Pulses/pressure/temperature**".

→ It is essential to contact the service department.

The cause may be that the card is defective (E10), the line to the pulse generator is broken or that the generator itself is defective (E13, E14). However, this can only be confirmed by opening the device or exposing the line. With reed contacts the line breakage monitoring must be switched off (see Part 1, Chap. 4.1.1).

b.) Fault message E15, E16

These fault messages indicate that there is a deviation between the two pulse generators (e.g. fracture of a blade). With correct settings for the maximum permissible deviation of the generators and of the cp value of the generators (see menu: Gas meter details, DS: 16211) there is no EK-86 fault present.

→ The pulse generators should be checked.

c.) Fault messages E11, E12 and E20

Also here, faults are present which can be mainly found in the system. E11 and E12 are output when the input frequency is too high (see Part 1, Chap. 4.1.1) and E20 indicates that the maximum actual flow Q_{max} has been exceeded by over 10%. The setting for the maximum flow can be checked in the menu: Gas meter details (DS:16211). The reason may be that no fault is present (the maximum flow might actually have been exceeded), the pulse generator or the input card may be defective.

→ The service department should be called if the fault is not caused by the system.

d.) Fault message E22, E23

This message indicates that the run-up or run-down time has been exceeded. The definition of the times is explained in Part 1, Chap. 4.1.1.

The violation of the limits can also be caused by operation below the lower flow limit Q_{LL} (see DS:16211). The system should then be checked.

6.2.2.3 Checking the Digital Output Card (DIA7)

A check of the output cards can be carried out without opening the device and without the presence of a calibration official. The channel in question can be checked in the menu "**View outputs**". Here under Card 3 (= Digital Output Card) is displayed which value is to be output and also the present status of the output.

If question marks "**??**" are output at a point in conjunction with the message "**E05 - Card slot fault - start**" in the menu "**Logbook**", the digital output card is defective.

→ Service required.

With **switching contacts** (indicating alarm, warning, info or a certain fault message) the display shows whether the contact is closed ("**yes**") or open ("**no**"). This can be checked with an ohmmeter. When doing this, no leads must be connected to the output terminals.

With **pulse outputs** the display shows which value is output and whether pulses are in the "queue" to be output later. Here the changing display "**Output: 1/sec**" and "**Output: 0/sec**" indicates if pulses are to be output. This can also be checked using an ohmmeter. However, the output is only low resistance for a brief period.

6.2.2.4 Checking the Analogue Output Card (AA4)

The card's function can be very easily checked. The channel in question can also be checked here in the menu "**View outputs**". Here under Card 2 (= Analogue Output Card) is displayed which value is to be output with which current.

If question marks "**??**" are output at a point in conjunction with the message "**E05 - Card slot fault - start**" in the menu "**Logbook**", the analogue output card is defective. → Service required.

Otherwise the current to be output can be controlled using an ammeter. Here also, no additional leads should be connected to the output terminals that are to be connected.

7. Maintenance

The EK-86 and its measurement sensors largely operate without needing any maintenance. The recalibration dates for the pressure sensor that is used (see Appendix C-4 and the EK-86 approval certificate) should be noted.

7.1 Battery replacement

During recalibration a check must be made of whether the internal back-up battery must be replaced. To achieve this, an operational hours counter is provided in the EK-86 under the menu "**EK-86 Device**". The total running time that is to be taken into account minus the operating hours on the mains supply gives the time which must be bridged by the back-up battery:

e.g.:	Start of operation:	27.05.1994			
	Recalibration:	12.04.1999			
→	Total running time:	27.5.94 to 31.12.94	= 218 days	=	05232 h
		1.1.95 to 31.12.98	= 1459 days	=	35016 h
		1.1.99 to 12.4.99	= 102 days	=	02448 h
					42696 h
	Operating hours:				-40145 h
	Running time of back-up battery:				2551 h

The guaranteed battery service life is ≥ **45,000 h**. For this reason it is not necessary to replace the battery.

☞ *A battery replacement is practicable when - with a calculated average operating period on the battery per year - it cannot be guaranteed that the service life of the battery will extend up to the next recalibration.*

Replacing the back-up battery

If the back-up battery is to be replaced, then it should only be carried out by service personnel for reasons of safety.

The EK-86 housing must be opened for the replacement. Therefore, it is essential that a calibration official is present where the application is subject to official calibration. The back-up battery on the CPU board is exposed after unscrewing the front panel with the mounted LCD.

☞ *Battery replacement takes place with the device in operation. The complete settings in the EK-86 may be lost if the procedure is not carefully followed, requiring a new start. Battery replacement should therefore only be carried out by service personnel.*

After battery replacement a power failure longer than 3 min. should be produced and the set values then checked to ensure that the replacement has been properly carried out.

7.2 Replacing processing cards

a.) Replacing output cards

The settings and scaling of the values are not carried out in dependence of the card. The EK-86 is immediately ready for operation after the replacement.

b.) Replacing input cards

In applications subject to **calibration approval** there are certain restrictions on the replacement of input cards. After replacing the **pulse input card** no input of parameters is necessary, but at least an **operational test** must be carried out.

When replacing the **analogue input card** the card parameters must be entered with the calibration lock open. Also in this case, at least an **operational test** must be carried out. Replacement of analogue input cards is not permissible in applications subject to official calibration.

PART 2:
Setting up the EK-86

1. Supplied condition

The **EK-86** Volume Corrector is supplied complete with pressure and temperature sensors and, with the exception of the user specified modes, its parameters have been set ready for operation. To simplify setting up, the user-specified parameters can be set by **ELSTER**. The customer's system data must supplied in this case.

The other items supplied include the operating manual, brief instructions (plastic card with the menu structure), the connectors for the sensors and outputs, a screwdriver, mounting bracket for the pressure sensor with accompanying sealing sleeves and an adapter for 6 mm ERMETO pressure lines.

In addition a system data book is supplied in which the present configuration is entered. Any modifications are also recorded in this book.

The sensor combinations that are currently available and the prices of accessories for the **EK-86** can be taken from the current price list.

2. Installation

2.1 Mounting the EK-86/S

The EK-86/S is intended for installation within a 19" cabinet. The required mounting brackets are included in the supplied items. The mounting depth of 345 mm should be noted, so that the connection terminals located at the back of the device are accessible. It is recommended that the device is mounted in a swivel frame.

The EK-86/S is not suitable for direct application in Ex Zone 2.

2.2 Line connection

When connecting the generator, supply and signal leads, it must always be ensured that the device is not under voltage.

☞ *Changes to the wiring are only permissible when the power supply is switched off.*

The connection of the generator and signal lines to the EK-86/S is implemented using plug-in screw terminals which are located in a strong cable housing. The power supply feed connection is via permanent screw terminals.

The **intrinsically safe** circuits demand special attention. With the EK-86/S is must be ensured before switching on the power supply that the plug connections for the **pulse, pressure** and **temperature** inputs are connected, because it is only then that the **air path** of **50 mm** demanded by the relevant regulations can be maintained. Two sliding labels per cable housing are used for sealing the generator connections in that they fix the cable housing to the back panel of the device.

The relevant installation guidelines should be observed for the cable entry. The lines must be from of mechanical tension and should be provided with strain-relief bending protection if the EK-86/S is mounted in a swivel frame.

The lines connecting sensors which are subject to calibration regulations can also be routed via transfer terminals if required. These terminals must then in part satisfy the Ex regulations and must also be able to be sealed.

2.2.1 Power supply and earthing

The EK-86/S is supplied in two mains voltage versions, 230VAC and 24 VDC. The connection is made via screw terminals at the back of the unit using leads with an adequate cross-sectional area (min. 2.5 mm^2). Allen screws, labelled with earth symbols, are provided on the side parts of the device for the connection of potential equalisation using at least 2.5 mm^2 cable via 5 mm cable lugs. The EK-86/S is fused with a fuse rated 0.16 AT (slow-blow) (230V version) or 1.6 AT (slow-blow) (24 V version).

2.2.2 Pulse generator inputs

One or two pulse generators in NAMUR technology can be connected to the EK-86. Another, reserve input is provided as a serial data input. All inputs are intrinsically safe. Screened cable should be used to improve the interference suppression. With a cross-sectional area of 1.5 mm^2 the maximum length of line is 100 m. With longer line lengths it must be ensured that the lines are installed separate from other current carrying lines, so that interference is avoided.

The pulse sensor inputs on the EK-86/S are located at the back of the device on the subassembly **EXZE4**. The first sensor should be connected to the terminals 1+ and 1-. An optional second sensor is assigned to the terminals 2+ and 2-. The terminals 3+ and 3- and 4+ and 4- must not be used at present. The screen should be connected with a 3 mm cable lug to the earthing strips via the shortest path.

2.2.3 Pressure and temperature sensor inputs

The EK-86 has an intrinsically safe pressure sensor input which is implemented using the 4...20 mA two-wire technique and an intrinsically safe temperature input conforming to the Pt100 specification using the 4-wire technique. The supply for the pressure and transducer sensors is provided automatically. Screened cable should be used; the screen is connected only to the device. A maximum permissible line length of 100 m is guaranteed with a cross-sectional area of 1.5 mm^2. With longer line lengths it must be ensured that the lines are installed separate from other current carrying lines so that interference is avoided.

The terminals P+, P- and I+, U+, U-, I- are located at the back of the subassembly **EXAE2** for the connection of the pressure sensor and temperature sensor respectively. The screens for both sensors should be connected to the earthing strips by the shortest possible path using 3 mm cable lugs.

2.2.4 Other connections

2.2.4.1 Digital and pulse outputs

As standard, the EK-86 is fitted with a digital/pulse output card containing 2 relay changeover contacts and 5 transistor sections. The output assignment parameters can be freely selected.

On the EK-86/S the switching/pulse outputs are available on the **DIA7** subassembly. The relay outputs are available on the terminals **1O**, **1W, 1S** and **20, 2W** and **2S**. The transistor sections are brought out to the terminals **3+/3-** to **7+/7**. The cable screen is connected to the earthing strips using a 3 mm cable lug.

2.2.4.2 Analogue outputs

The EK-86 can be optionally fitted with one or more 4-channel analogue output cards. The card supplies current signals in the range 0/4 to 20 mA. The allocation of the analogue inputs can be freely selected.

The analogue outputs on the EK-86/S are available in the form of the **AA4** subassembly at the back of the device. The channels are labelled consecutively from 1+/1- to 4+/4-. The cable screen should be connected to the earthing strips using a 3 mm cable lug.

2.2.4.3 Serial interface

The serial interface connection in the form of a round socket is used to connect the EK-86/S to other equipment (e.g. **AS-100** Read-out Device or **PC**). Suitable connecting leads are supplied as accessories.

3. Setting up

This chapter briefly presents the main points to be considered during the setting up of the EK-86. It is assumed that the user is familiar with the menu structure of the device (see Part 1, Chap. 3). A check list, containing all the required steps in setting up, will be found as an aid at the end of this chapter.

3.1 Protection of the parameters against unauthorised access

The EK-86 functional features can be fully configured via a set of parameters. It will be immediately appreciated that modification of these parameters by unauthorised persons must be prevented. Therefore, the EK-86 has a two-stage security system that fulfils this purpose. This is represented by the **calibration lock** and the **user lock**.

3.1.1 Calibration lock

Opening the **calibration lock** gives the user access to all the EK-86 parameters. The calibration lock is controlled by a so-called **calibration switch**. In the second line of "**Standard Display I**" the message *Calibration lock open!* appears when the **calibration lock** is open.

With the EK-86/S the **calibration switch** for opening the calibration lock is situated on the front panel. It is opened by first pulling the locking pin and then turning to the left. The slide switch is then moved to the left.

Opening the **calibration lock** also opens the **user lock**.

3.1.2 User lock

Opening the **user lock** (with the **calibration lock** locked) gives the user access to the parameters which do not affect the part of the EK-86 function subject to legal calibration requirements. The **user lock** consists of a **supplier's code** and a **customer's code**, each of which must be entered as a 6-figure number. This subdivision enables mutual control by the gas supplier and the consumer. Both the **supplier's code** and the **customer's code** can be changed when the **calibration lock** or the **user lock** are open. See Part 1, Chap. 3.4.2 for further information.

3.2 Basic principles of setting the parameters

The EK-86 menu environment enables all the device parameters to be set. The number of parameters that can be changed depends on the status of the **user lock** and the **calibration lock**.

A parameter is changed either by selection from a list of possible parameters or by direct entry of the new value (incl. comma and minus sign). With direct entry any violation of the permissible value range is detected.

Changed parameters only become effective when they have been accepted. Until acceptance occurs, the previous set of parameters represents the device function. It is also possible to discard modified parameters. See Part 1, Chap. 3.4.2.2 for further details.

The EK-86 parameters are retained threefold in battery-buffered RAM. A permanent check routine runs in the background and compares the three records per parameter with one another, ensuring the highest possible data reliability by using a modified from three comparison.

A complete list of all the parameters used can be found in Appendix A-3.

3.3 Setting the pulse inputs

Two pulse generators in NAMUR or reed-contact technology can be connected to the EK-86. The maximum input frequency for LF operation is 10 Hz and 3000 Hz is permissible for HF operation. The EK-86 system software selects LF or HF operation automatically. The decisive criterion is the product from the set **cp value** and the maximum actual flow $\mathbf{Q_{max}}$.

Each pulse input can be monitored for line breakage. The line breakage monitoring system must not be switched on when reed-contact pulse generators are used. If two pulse generators are connected, a check of the actual volume pulses, which are weighted with the **cp value**, for deviation with respect to one another is carried out automatically. The permissible deviation is adjustable and a fault condition is detected if it is exceeded.

The gas meter details are also relevant when setting the pulse inputs. The various parameters should be set in the menu "**Gas meter details**", **DS 16211**.

3.3.1 Gas meter parameters

The gas meter parameters fully describe the device in all its functions. In addition, unambiguous identification as required by the calibration regulations is possible by the entry of a **serial number**. Apart from the **type of gas meter** (can be set from G16 to G16000), the flow limits $\mathbf{Q_{min}}$ and $\mathbf{Q_{max}}$ must also be set as parameters. Furthermore, the user-specific **warning limits** for **Q** and $\mathbf{Q_n}$ (for

minimum and maximum levels) can be set as parameters so that impermissible operating conditions can be detected. To suppress hunting about the user-specific warning limits, a **limit hysteresis** should be set. The EK-86 also monitors the turbine **run-up** and **run-down times** (adjustable in the minutes range) in relationship to a specified lower flow limit $\mathbf{Q_{LL}}$.

In addition to the above mentioned parameters, the **display factor** for the actual and standard volume counters can be set (*1, *10 or *100).

3.3.2 Setting all initial meter values

The EK-86 offers the possibility of setting an initial reading on all the counters. This takes place in the menu "**Set/delete initial meter values**", **DS 132**. This is useful, for example, when replacing a device. The menu is subject to the **calibration lock**.

Also, there are so-called adjustable counters in the EK-86. These can be changed in the menu "**Adjustable totalisers**", **DS 152**. Therefore matching to a calibrated mechanical counter is possible for checking purposes. These counters are subject to the **user lock**.

3.4 Setting the analogue inputs

The EK-86 is fitted with two intrinsically safe analogue inputs for the connection of a pressure sensor using the 4...20 mA technique and a temperature sensor in 4-wire technology. They are situated on the board **EXAE2**. This card has no adjustments for calibration, so that the characteristic correction for the A/D converter must be made via the EK-86 system software. The procedure for characteristic correction takes place in two stages for the pressure and the temperature input and is described in more detail in the following.

3.4.1 Input card calibration

The first stage of correction involves the A/D converter transfer function. The characteristic of an A/D converter channel can be described as a function of the 2nd order (simplified to a large extent). Using a suitable conversion calculation a corrected display value is required which matches the applied input variable. To execute this correction it is necessary to determine the two transfer coefficients. This occurs in a calibration procedure which is carried out using two precisely known input variables. The known input variables for the pressure input on the card are **X1 = 4.000 mA** and **X2 = 20.000 mA** and for the temperature input **X1 = 24.80 ohm** and **X2 = 124.00 ohm**. The correction variables for each card are determined in the manufacturer's test laboratory and

are enclosed with the documentation with each supplied EK-86. As supplied ex-works, the correction parameters appropriate to the input card have already been set, so that the user does not need to carry out the calibration procedure himself. If the analogue card is replaced at the point of measurement, the parameters have to be entered. For the pressure input this takes place under the menu "**Pressure sensor input card**", **DS 16222** and for the temperature input under "**Temp. sensor input card**", **DS 16232**.

3.4.2 Sensor calibration

Together with the first correction stage (input card calibration), a second correction stage is provided in the EK-86 to enable non-linearities and sensor deviations from the ideal characteristic to be compensated. In this way, the highest possible accuracy of the complete measurement system is ensured. The procedure is identical for both the pressure and temperature sensors and therefore only that for the pressure sensor is described here.

Without sensor calibration the EK-86 represents the set pressure range (e.g. 2 to 10 bar) by a current range from 4 to 20 mA. This means that a linear characteristic is assumed.

Of course, a sensor will only supply this characteristic in the ideal case. Therefore, a characteristic correction using two or three pairs of values for the variables pressure and temperature represented by current resp. resistance can be entered. If two pairs of values are entered, a straight line equation is computed such that the line passes through the co-ordinates defined by the two pairs of values. With the entry of three pairs of values a quadratic function (parabola) is calculated which passes through the three described co-ordinates.

The two or three pairs of values (reference points) can be entered either as parameters or be found by direct measurement via the EK-86. With the determination of the reference points by direct measurement the pressure/temperature reference point is entered and the corresponding current/resistance reference point is measured which can then be accepted by pressing a key.

The entry or measurement is carried out in the menu "**Pressure sensor calibration**", **DS 16223** and "**Temp. sensor calibration**", **DS 16233**.

3.4.3 Other sensor parameters

Further data is needed, e.g. pressure/temperature range, sensor type, etc., for the description of the pressure and temperature sensor. This data can be entered under "**Pressure sensor parameters**", **DS 16221** and "**Temp. sensor parameters**", **DS 16231**. The adjustable alarm and warning limits can also be set under these menu points.

3.5 Setting the volume correction method

The EK-86 provides three different volume correction methods. These are **k = const., GERG-88** and **AGA NX-19**. These can be selected in the menu "**K-factor mode**", **DS 133**. If the K factor is computed according to **GERG-88** or **AGA NX-19**, then details of the gas quality are needed. The relevant parameters are set in the menu "**Gas quality**", **DS 131**. The limits for the separate parameters are explained in Part 1, Chap. 3.4.3.1. Substitute values can be set for the correction in the case of a fault (generator failure, limits for the computational method) in the menu "**Substitute values**", **DS 134** depending on the set volume correction method. The variables **Pn** and **Tn**, which are relevant for the volume correction, can be set in "**Reference variables for standard state"**, **DS 135**.

3.6 Output assignment

As standard the EK-86 if equipped with a digital/pulse output card with seven channels. The EK-86/S is designed for the optional fitting of up to 6 output cards. When the device is switched on, it automatically detects the cards fitted, so that explicit setting of parameters for the card-slot assignment is not necessary. The output assignment is carried out in the menu "**Output assignment**", **DS 16242**. Here, there are differences depending on the type of card.

3.6.1 Output assignment of digital/pulse outputs

Either digital or pulse output signals can be assigned to the individual channels selected via "**Channel**" by using "**Mode**".

An alarm, warning, item of information or a certain fault message can be assigned to a digital output via "**Assign**". The various possibilities are listed in Appendix A-6. The type of digital output (normally closed or normally open contact) can be set with "**Specify**".

Either the actual volume **Vb** or the standard volume **Vn** (disturbed, undisturbed or total) can be assigned to a pulse output via "**Assign**". The pulse value and the maximum permissible output frequency are set via "**Specify**".

3.6.2 Output assignment of analogue outputs

The analogue outputs which can be selected using "**Channel**" can be set via "**Mode**" over a range from 0 to 20 mA or 4 to 20 mA. The decision of which measurement is output is made under "**Assign**". There is a choice here between standard or actual flow, measured or corrector pressure and measured or corrector temperature. The scaling of the measurement to be output can be specified via "**Specify**".

3.7 Checking the settings and measurements

The EK-86 parameters relevant to legal calibration requirements are particularly important. These parameters can be viewed under **DS 161: "Calibration config.".** The calibration official therefore has an effective control of the EK-86 configuration.

The measurements currently arriving from the sensors can be viewed on-line by selecting **DS 15: "Measurements"** under "**Pulse/pressure/temp.**".

It is also possible to monitor flow maxima and minima. This takes place via **DS 154: "Max. flows"**. A new time stamp is set using "**Delete**". The present values are then copied in the minimum and maximum memories and the fresh determination of the following maxima and minima begins.

The output signals supplied by he EK-86 can also be viewed. The output data currently generated at the relevant card can be displayed referred to the channel under **DS 16241: "View card"**. A check on the proper functioning of the outputs by comparison with the physical data can be simply carried out in this way.

A further aid is the so-called "**Freeze function**", **DS 151**. Here, up to two consumption data sets can be retained separately or dependent on one another. By forming the difference between both frozen data blocks the proper functioning of the corrector can be checked. Details of this powerful function can be found in Part 1, Chap. 3.4.4.1.

3.8 Sealing the device

Together with the proper sealing of the sensors (see also Appendices C4 and C5), the EK-86 must also be sealed against unauthorised access. Parts of the device have already been fitted with works seals which only need to be replaced by official calibration seals.

The EK-86/S is secured at the front and back with wire seals which are passed through some collar-head screws on the front and back sub-panels. The side parts are protected against unauthorised opening by official adhesive calibration labels. Furthermore, the (locked) **calibration lock**, which on the EK-86/S is situated on the front panel, must be secured with sealing wire which is passed

through the locking pin. The sealing of the sensor connections is implemented using official adhesive calibration labels which are fitted to the upper and lower parts of the cable housing for mounting on the back panel of the device.

Further details can be taken from the **sealing plan** (Appendix B-7).

3.9 Check list for setting up

The described check-list procedure for setting up the EK-86/S assumes that the device parameters have been partially set. This refers particularly to the calibration of the analogue input cards and to the calibration of the pressure and temperature inputs to suit the supplied temperature and pressure sensors. Furthermore, it is also assumed that the device installation has been properly carried out according to Chapter 2.

Security for the EK-86 parameters is partly provided by the **customer** and **supplier's codes** and by the **calibration lock**. As supplied ex-works, the **calibration lock** is locked and the **customer's** and **supplier's codes** are set to **000000**, so that the **user lock** is open.

Operation in the menu environment is substantially easier if the **direct select mode** is used. By pressing the "**Correction**" key (↵) within any menu and entering a decimal number access is obtained to another menu associated with this number. This method is used in the following. Further details about menu operation can be found in Part 1, Chap. 3.1.

1. Check that all process signals and the mains supply are properly connected. Switch on the EK-86 and wait until the device has run up (after max. 10 seconds). **Standard Display I** is displayed and the **Mains** LED lights. The **Alarm** LED and the **Warning** LED may (but not necessarily) light or flash.

2. Press the "**Scroll-back**" key twice. You then enter the "**Main menu**". Using **DS: 16**, branch to the menu "**System**". Check the date and time. If there are deviations from the actual time, the clock must be adjusted as explained under the following point in the check list. Otherwise proceed at Point 4.

3. You set the system clock by selecting the menu point "**Set clock**" in the menu "**System**". When entering the new time, bear in mind that the entered time is only accepted when the seconds entry is completed.

4. In the menu "**System**" select the menu point "**Calibration config.**". Here, all the EK-86 parameters affected by legal calibration requirements can be called by pressing "**Forwards**" and "**Backwards**". Check each parameter to ascertain if it is correct and consistent with the data of the connected sensor. If all parameters subject to calibration requirements are in order, proceed at **Point 18** on the check list.

5. You have found an inconsistency in the parameters subject to calibration regulations. To change this parameter, you must first open the **calibration lock**. With the EK-86/S the **calibration switch** is situated on the front panel. It is opened by first pulling the locking pin and turning it to the left and then moving the slide switch to the left. It may be possible for you to skip some of the following points in the check list, depending on which parameters are to be modified.

6. Using **DS: 16211**, branch to the menu "**Gas meter details**". First check whether all parameters found in this menu are suitably configured for the gas meter that is being used by moving forwards through the list of parameters. If a parameter is not suitable, then you can change it using "**Change**" to suit your requirements. If the list of parameters is consistent, then any changed parameter must be accepted. Using DS: 12 branch to the menu "**User lock**" and press "**Parameter: Accept**".

7. Branch to the menu "**Pressure sensor parameters**" via **DS: 16221**. Also here, check all parameters and modify them if necessary. Accept the parameters (**DS 12, "Parameter: Accept"**).

8. Branch via **DS: 16222** to the menu "**Pressure sensor input card**" and compare the reference points with the calibration data enclosed with each analogue input card. If discrepancies arise, change the reference points by selecting "**Enter calibrated card**". When the reference points have been changed, accept the parameters (**DS12, "Parameter: Accep**t".

9. Branch via **DS: 16223** to the menu "**Pressure sensor calibration**" and compare the reference points with those enclosed with the pressure sensor. Change them if necessary and accept the parameters (**DS: 12, "Parameter: Accept"**).

10. Branch via **DS: 16231** to the menu "**Temp. sensor parameters**". Also here, check the consistency of all parameters and change them if necessary. Accept the parameters (**DS: 12, "Parameter: Accept"**).

11. Branch via **DS: 16232** to the menu "**Temp. sensor input card**" and compare the reference points with the calibration data enclosed with each analogue input card. If discrepancies arise, change the reference points by selecting "**Enter calibrated card**". When the reference points have been changed, accept the parameters (**DS: 12, "Parameter: Accep**t".

12. Branch via **DS: 16233** to the menu "**Temp. sensor calibration**" and compare the reference points with those enclosed with the temperature sensor. Change them if necessary and accept the parameters (**DS: 12, "Parameter: Accept"**).

13. Enter the menu "**K-factor mode**" via **DS: 133**. Select the appropriate method and accept any change made (**DS: 12, "Parameter: Accept"**).

14. With **DS: 135** you gain access to the menu "**Reference variables for standard state**". Change them if necessary. (**DS: 12, "Parameter: Accept"**).

15. Branch via **DS: 132** to the menu "**Set/delete initial meter values**". If you have changed the counters in any way, do not forget: (**DS: 12, "Parameter: Accept"**).

16. Branch via **DS: 1625** to the menu "**EK-86 device**" and, if necessary, change the device number. Do not forget: (**DS: 12, "Parameter: Accept"**).

17. Close the calibration switch. Return to **Point 4!**

18. If the EK-86 computes the K factor according to **GERG-88** or **AGA NX-19**, you must enter the gas composition data. Otherwise, continue with the next point. The appropriate data is entered via **DS: 131, "Gas quality"**. The changes must be accepted (**DS: 12, "Parameter: Accept"**).

19. Substitute values must be entered for volume correction when a fault occurs. This is carried out in the menu "**Substitute values**", **DS: 134**. Do not forget: (**DS: 12, "Parameter: Accept"**).

20. Via **DS: 16242** select the menu "**Assignment Card**". Match the function and assignment of the outputs to your requirements. Take your time, because incorrect setting of parameters for the process outputs can lead to extensive fault finding. Do not forget: (**DS: 12, "Parameter: Accept"**).

21. Branch via **DS: 152** to the menu "**Adjustable totalisers**" and match them where necessary to your requirements. The changes must be accepted (**DS: 12, "Parameter: Accept"**).

22. Check the measurements coming from the sensors by selecting "**Pulses/ pressure/temperature**" under **DS: 15 "Measurements"**.

23. Check the output signals supplied by the EK-86 by comparing the data accessible under **DS: 16241 "View card"** with the actual physically generated output signals.

24. Enter the menu "**Faults**" via **DS: 11**. Acknowledge all fault messages. With appropriate configuration of the parameters the message appears *Fault list empty* and the **Alarm** and **Warning** LEDs extinguish.

25. Check for the correct functioning of the volume correction by using the freeze function. You enter the corresponding menu "**Freeze function**" via **DS: 151**. Select "**Freeze: Block 2**". Then select "**Freeze: Test vol.**" and enter a test volume appropriate to the application. Press the "**Scroll-back**" key and select "**Freeze: Block 1**" and then "**Freeze: Now**". The message *Block 1 frozen. Acquiring Block 2* appears in the second line of the display. Press the "**Scroll-back**" key again, select "**Display: Block 2**" and then "**Basis**". The increase in the volume can be seen in the third line. Wait until the message *Block 2 frozen* appears in the second line. Press the "**Scroll-back**" key and select "**Display: Difference**". The values for **Vn** and **Vb** should be noted. Press the "**Scroll-back**" key again and select "**Display: Block 1**". The values for **P** and **T** should be noted. The volume correction can be calculated "manually" using the noted values and checked against the gathered volumes for correctness.

26. The user lock must be configured. This is done by branching to the menu "**User lock**" via **DS: 12** and selecting the menu point "**Locks: Change**". You are then asked to enter the **supplier's code**. The previous value is shown in the display until you press a key. As supplied ex-works, this value is zero. Please note that the code has 6 figures and all 6 figures must be entered. Then a request for entry of the **customer's code** is made. This code also has 6 figures. Then select "**Locks: Lock**".

27. Fit seals to the housing. The EK-86/S Volume Corrector installation and configuration is then complete and the device is ready for operation.

3.10 Setting up the data storage function

In the device as supplied ex-works, the data storage function (DS function) is already ready for operation. However, in the system to be equipped there are still a few special settings to be made and checked which are described in the following. The settings are carried out using the ELSTER AS-100 Read-out Device.

1. First, the **customer, meter and device numbers** must be corrected. This is carried out using the AS-100 via "B2". It is important that the customer number is set at least to the value "1" so that evaluation can be carried out using the AWS-100 Evaluation Software. The meter number is formed from the connected gas meter number and the device number corresponds to the serial number of the EK-86 and normally does not need to be changed. The customer, meter and device numbers must be entered separately for each channel.
2. In addition the **cp value** and the **interval period** must be set. Here it should be ensured that overflow of the interval counter is prevented (see also Part 1, Chap. 3.5.8-b and -c). The cp value and the interval period are automatically interrogated by calling "B2".
3. If necessary, a software code for protecting the set parameters can be entered (**access code**). The access code is set with the AS-100 using "B666". It is essential that you follow the instructions in Part 1, Chap. 3.5.8-e!
4. In addition, the **beginning of the day** can be changed using "B21". Ex-works this is set to 6:00 hours.

The DS function settings that are required are now complete.

Appendices

A - Tables

A-1 Volume values / Frozen values

Value no.[*1]	Volume value	Value range	Unit
H1	Actual volume (V)	9,999,999,999.9[*2]	m^3
H2	Standard volume (Vn)	9,999,999,999.9[*2]	m^3
H3	Disturbance actual vol. (Vd)	9,999,999,999.9[*2]	m^3
H4	Disturbance standard vol. (Vnd)	9,999,999,999.9[*2]	m^3
H5	Total actual volume (Vt)	9,999,999,999.9[*2]	m^3
H6	Total standard volume (Vnt)	9,999,999,999.9[*2]	m^3
H12	Actual flow (Q1/Q2)	99,999.9	m^3/h
H13	Standard flow (Qn)	999,999.9	m^3/h
H14	Maximum value actual flow	99,999.9	m^3/h
H15	Maximum value standard flow	999,999.9	m^3/h
H16	Minimum value actual flow	9,999.9	m^3/h
H17	Minimum value standard flow	99,999.9	m^3/h
H23	Actual volume (V adjustable)	99,999,999[*2]	m^3
H24	Standard volume (Vn adjustable)	99,999,999[*2]	m^3
H100	Frozen Vn Block 1	9,999,999,999.9[*2]	m^3
H101	Frozen V Block 1	9,999,999,999.9[*2]	m^3
H102	Frozen Vnd Block 1	9,999,999,999.9[*2]	m^3
H103	Frozen Vd Block 1	9,999,999,999.9[*2]	m^3
H104	Frozen Vnt Block 1	9,999,999,999.9[*2]	m^3
H105	Frozen Vt Block 1	9,999,999,999.9[*2]	m^3
H106	Frozen pressure Block 1	0.000 - 120.000	bar
H107	Frozen temperature Block 1	-13.00 - 63.00	°C
H108	Frozen Z factor Block 1	0 - 130.00000	-
H109	Frozen K value Block 1	0.5 - 1.50000	-
H110	Frozen Qn Block 1	999,999.9	m^3/h
H111	Frozen Q Block 1	99,999.9	m^3/h

Value no.*1	Volume value	Value range	Unit
H112	Freezing date/time Block 1	-	-
H113	Freezing basis Block 1	-	-
H120	Frozen Vn Block 2	9,999,999,999.9*2	m^3
H121	Frozen V Block 2	9,999,999,999.9*2	m^3
H122	Frozen Vnd Block 2	9,999,999,999.9*2	m^3
H123	Frozen Vd Block 2	9,999,999,999.9*2	m^3
H124	Frozen Vnt Block 2	9,999,999,999.9*2	m^3
H125	Frozen Vt Block 2	9,999,999,999.9*2	m^3
H126	Frozen pressure Block 2	0.000 - 120.000	bar
H127	Frozen temperature Block 2	-13.00 - 63.00	°C
H128	Frozen Z factor Block 2	130.00000	-
H129	Frozen K value Block 2	0.5 - 1.50000	-
H130	Frozen Qn Block 2	999,999.9	m^3/h
H131	Frozen Q Block 2	99,999.9	m^3/h
H132	Freezing date/time Block 2	-	-
H133	Freezing basis Block 2	-	-
H140	Difference Vn	9,999,999,999.9*2	m^3
H141	Difference V	9,999,999,999.9*2	m^3
H142	Difference Vnd	9,999,999,999.9*2	m^3
H143	Difference Vd	9,999,999,999.9*2	m^3
H144	Difference Vnt	9,999,999,999.9*2	m^3
H145	Difference Vt	9,999,999,999.9*2	m^3
H146	Difference pressure p	± 120.000	bar
H147	Difference temperature T	± 80.00	°C
H148	Difference Z factor	± 130.00000	-
H149	Difference K value	± 1.00000	-
H150	Difference Qn	± 999,999.9	m^3/h
H151	Difference Q	± 99,999.9	m^3/h
H160	Freezing method Block 1	-	-
H161	Freezing method Block 2	-	-

*1: The value numbers are only required for transmission via the interface.

*2: Value display and resolution depending on display factor L101 or L102.

A-2 Analogue and other values

Value no.	Analogue / Other value	Value range	Unit	C/U
L1	Absolute pressure	0.0 - 120,000	bar	-
L2	Temperature	-13.00 - 63.00	°C	-
L3	Z factor	0 - 130.00000	-	-
L4	Status register	0 or E	-	-
L6	K value, current value	0.5 - 1.50000	-	-
L9	Operating hours counter	999,999	h	-
L16	Serial no., pressure sensor	12-figure	-	C
L17	Serial no., temperature sensor	12-figure	-	C
L18	Serial no., volume corrector	12-figure	-	C
L23	Frequency A1S, E1 Generators	0 - 3000 / 0 - 10	Hz	-
L24	Frequency A1R Generator	0 - 3000	Hz	-
L26	Pressure range (+ method)	0.000 - 120.000	bar	C
L27	Temperature range	-13.0 - 63.0	°C	C
L34	Software version number	-	-	C
L47	Pressure (current)	approx. 3.9 - 20.5	mA	-
L48	Temperature (resistance)	max. 125	ohm	-
L101	Display factor V	*1/*10/*100	-	C
L102	Display factor Vn	*1/*10/*100	-	C
L123	Customer number	12-figure	-	U
L124	Meter number, gas meter	12-figure	-	C
L125	Device number, Channel 1 (V)	12-figure	-	U
L126	Device number, Channel 2 (Vn)	12-figure	-	U
L127	Device number, Channel 3 (p)	12-figure	-	U
L128	Device number, Channel 4 (T)	12-figure	-	U
L145	Calorific value	6.000 - 13.000	kWh/m^3	U
L146	Standard density	0.7100 - 1.1600	kg/m^3	U
L147	Molar proportion H_2	0.00 - 10.00	%	U
L148	Molar proportion CO_2	0.00 - 30.00	%	U
L156	Base pressure	0.9000 - 1.3000	bar	C
L157	Base temperature	270.00 - 299.00	K	C
L158	Atmospheric pressure	0.90000 - 1.09999	bar	U
L168	Density ratio (AGA-NX19)	0.554 - 0.75	-	U
L178	Molar proportion N_2 (AGA-NX19)	0.0 - 15.00	%	U

Explanation: **"C"**: Value is subject to calibration lock; **"U"**: Value is subject to user lock.

A-3 Parameters

No.	Quantity	Value range	Unit	Default	C/U
P1	K value (K = constant)	0.5 - 1.50000	-	-	C
	or substitute K value	0.5 - 1.50000	-	-	U
P2	Substitute pressure	1.000 - 120.000	bar		U
P3	Substitute temperature	-10.00 - 60.00	°C	-	U
P4	cp (A1R/E1) measurement channel	0.0001-99,999.9	$1/m^3$	-	C
P5	cp (A1R) comparison channel	0.0001-99,999.999	$1/m^3$	-	C
P6	Qmax (Alarm)	0 - 99,999.9	m^3/h	25000.0	C
P7	Qmin	0 - 9,999.9	m^3/h	0.0	C
P8	Comp. method, K value	GERG/AGA/const	-	GERG	C
P9	Supplier's code	6-figure	-	000,000	U
P10	Customer's code	6-figure	-	000,000	U
P15	QnULi(message)	0 - 999,999.9	m^3/h	250000.0	U
P16	QnLLi (message)	0 - 99,999.9	m^3/h	0	U
P19	QULi (message)	0 - 99,999.9	m^3/h	25000.0	U
P20	QLLi (message)	0 - 9,999.9	m^3/h	0	U
P21	Tmax (Alarm)	-13.00 - +63.00	°C	-	C
P22	Tmin (Alarm)	-13.00 - +63.00	°C	-	C
P23	Pmax (Alarm)	0.000 - 120.00	bar	-	C
P24	Pmin (Alarm)	0.000 - 120.00	bar	-	C
P37	Z-90 (Orig. meter reading)	ON/OFF	-	OFF	C
	Generator 2 connected	YES/NO	-	NO	C
P48	Clear counter	0/1	-	-	C
P88	Display test	-	-	-	U
P99	Parameter acceptance	-	-	-	C
P100	Pressure sensor type	var.	-	-	C
P101	Pressure ULi (Warning)	0.000 - 120.000	bar	-	U
P102	Pressure LLi (Warning)	0.000 - 120.000	bar	-	U
P103	Pressure hyst. (Warning)	0.5 - 99.9	%	0.5	U
P104	Lin. pressure (Ref. Pt. 1)	0-120.000/4-20.000	bar/mA	-	C
P105	Lin. pressure (Ref. Pt. 2)	0-120.000/4-20.000	bar/mA	-	C
P106	Lin. pressure (Ref. Pt. 3)	0-120.000/4-20.000	bar/mA		C
P107	Lin. (lower ref. 4 mA)	3.880 - 4.120	mA	-	
P108	Lin. (upper ref. 20 mA)	19.500 - 20.450	mA	-	C

No.	Quantity	Value range	Unit	Default	C/U
P150	Temperature sensor type	-	-	-	C
P151	Temp. ULi (Warning)	-13.00 - 63.00	°C	-	U
P152	Temp. LLi (Warning)	-13.00 - 63.00	°C	-	U
P153	Temp. hyst. (Warning)	0.5 - 99	%	0.5	U
P154	Lin. temp (Ref. Pt. 1)	-10 - 60 / 90 - 125	°C/ohm	-	C
P155	Lin. temp (Ref. Pt. 2)	-10 - 60 / 90 - 125	°C/ohm	-	C
P156	Lin. temp (Ref. Pt. 3)	-10 - 60 / 90 - 125	°C/ohm	-	C
P157	Lin. (lower ref. Ω)	23.8 - 25.80	Ω	-	C
P158	Lin. (upper ref. Ω)	122.0 - 126.00	Ω	-	C
P200	Gas meter size	-	-	-	C
P201	Perm. deviation Chans. 1/2	0.5 - 99	%	-	U
P202	Line monitoring Channel 1	YES/NO	-	NO	C
P203	Line monitoring Channel 2	YES/NO	-	NO	C
P204	Limit hyst. (info)	0.5 - 99	%	-	U
P205	Run-up time	0 - 999	min.	-	U
P206	Run-down time	0 - 999	min.	-	U
P207	QLL	0.0 - 9999.9	m^3/h	-	U

Explanation: "C": Value is subject to calibration lock; **"U"**: Value is subject to user lock.

The stated **value numbers** are not normally displayed in the EK-86. The only exception is the menu: "Calibration configuration" (Direct Selection: 161). The value numbers are only used when interrogating via the interface.

A-4 Displaying the values in the DS function

A-4a Displaying the values Channel 1 (V) and Channel 2 (Vn)

Value no.	Displayed value	Display	Unit
H1	Total counter V/Vn	8/9-figure *1	m^3
H2	Undisturbed meter readg. (orig. meter readg)	8/9-figure *1	m^3
H3	Month-end reading of H2	D/T/value	m^3
H3	Previous month-end readg of H2	D/T/value	m^3
H4	Max. daily consumption in current month	D/T/value	m^3
H4	Max. daily consumption in previous month	D/T/value	m^3
H5	Max. flow in current month	D/T/value	$m^3/_h$
H5	Max. flow in previous month	D/T/value	$m^3/_h$
H6	Last interval consumption	4-figure	m^3
H7	Measurement period (interval)	5 - 60	min
H23	Status	0 / E	-
-	cp value for interval values	decade	pulses/m^3
n.d.	Customer number (see L23 in Appendix A-2)	12-figure	-
n.d.	Meter number (see L124 in Appendix A-2)	12-figure	-
n.d.	Device number (see L125 in Appendix A-2)	12-figure	-

*1: The display depends on the selected display factor. In the DS function the post-decimal places for H1 and H2 can be called using the **comma** key ",".

D/T/value: Date/Time/Value
n.d.: Value number not displayed

A-4b Displaying the values in Channel 3 (p) and Channel 4 (T)

Value no.	Displayed value	Display	Unit
H1	Present measurement, pressure /temperature	xxx,yyy *1	bar/°C
H2	Average in current month	xxx,yyy *1	bar/°C
H3	Average of last month	D/U/value	bar/°C
H3	Average of month before last	D/T/value	bar/°C
H4	Min. interval average in current month	D/T/value	bar/°C
H4	Min. interval average in previous month	D/T/value	bar/°C
H5	Max. interval average in current month	D/T/value	bar/°C
H5	Max. interval average in previous month	D/T/value	bar/°C
H6	Average of last measurement period	D/T/value	bar/°C
H7	Measurement period (interval)	5 - 60	min
H23	Status	0 / E	-
-	Computation factor	decimal	-
n.d.	Customer number (see L123 in Appendix A-2)	12-figure	-
n.d.	Meter number (see L124 in Appendix A-2)	12-figure	-
n.d.	Device number (see L125, L126 in Appendix A-2)	12-figure	-

*1: Display in Channel 3 (p): xxx,yyy and in Channel 4 (T) xx,yy.

D/T/value: Date/Time/Value
n.d.: Value number not displayed

A-5 Calibration configuration

In the following tables values are listed which can be called under the menu: "**Calibration configuration**" (Direct Selection: 161). They represent all the values/ parameters that are subject to calibration regulations and which must be checked after setting up by a calibration official.

Entry and changes of settings are not permitted in this menu; it is only provided as a way of checking the values.

Value no.	Displayed value	Value display
L18	EK-86 serial number	12-figure
P8	K-value mode *1	GERG/AGA/K = const.
L101	Display factor V	x 1 / x 10 / x 100
L102	Display factor Vn	x 1 / x 10 / x 100
L34	Software version number	V x,y
P100	Pressure sensor type	1151/2088/3051/PTX-610
L16	Pressure sensor serial number	12-figure
L26	Press. sensor approved rating + method	0.000 - 120.000 bar
L156	Base pressure	0.9900 - 1.3000 bar
P104	Ref. val. 1, press. sensor calib.	0 - 120 bar / 4 - 20 mA
P105	Ref. val. 2, press. sensor calib.	0 - 120 bar / 4 - 20 mA
P106	Ref. val. 3, press. sensor calib. *2	0 - 120 bar / 4 - 20 mA
P107	Ref. val. 1, input card (p)	3.880 - 4.120 mA
P108	Ref. val. 2, input card (p)	19.500 - 20.450 mA
P23	Upper alarm limit (Pmax)	max. 120.000 bar
P24	Lower alarm limit (Pmin)	min 0.000 bar
P150	Temperature sensor type	PT-100 EBLxxxXX/Ex-X
L17	Temperature sensor serial number	12-figure
L27	Temp. sensor approved rating	-10.00 bis + 60.00 °C
L157	Base temperature	270.00 - 299.00 K
P154	Ref. val. 1, temp. sensor calib.	-10 - 60°C / 90 - 125 Ω
P155	Ref. val. 2, temp. sensor calib.	-10 - 60°C / 90 - 125 Ω
P156	Ref. val. 3, temp. sensor calib. *2	-10 - 60°C / 90 - 125 Ω
P157	Ref. val. 1, input card calib. (T)	23.80 - 25.80 Ω

Value no.	Displayed value	Value display
P158	Ref. val. 2, input card calib. (T)	122.00 - 126.00 Ω
P21	Upper alarm limit (Tmax)	max. 63.00 °C
P22	Lower alarm limit (Tmin)	min. -13.00 °C
P200	Gas meter size	G xxx
L124	Gas meter serial number	12-figure
P4	Meter cp value, Generator 1	0.00001 - 99999.999 1/m³
P5	Meter cp value, Generator 2	0.00001 - 99999.999 1/m³
P6	Alarm limit Qmax	0 - 99,999.9 m³/h
P202	Line breakage monitoring Gen. 1	YES/NO
P203	Line breakage monitoring Gen. 2	YES/NO

*1 The K value display only occurs when setting the K value mode: K = const.

*2 The display of the third reference point for the pressure and temperature calibration depends on whether these reference points have been specified.

☞ *In general the stated formats in the value range depend on the relevant setting and may therefore be different.*

A-6 Status messages

A-6a Volume corrector fault messages

Status	Fault message	A/W/M
E00	No fault present	-
E01	New system start	A
E02	Power failure	A
E03	Inconsistent data	A
E04	Memory fault during comparison	W
E05	Card slot fault	M
E06	Calibration lock open	M
E10	Loss of voltage on counter input	A
E11	Counter Input 1, frequency too high	A
E12	Counter Input 2, frequency too high	A
E13	Counter Input 1, faulty	W
E14	Counter Input 2, faulty	W
E15	Counter Input 1, suspect	W
E16	Counter Input 2, suspect	W
E20	Max. flow exceeded	A
E22	Meter run-up time violated	W
E23	Meter run-down time violated	W
E24	Overflow, V counter	W
E25	Overflow, interval counter (DS-100)	M
E30	Pressure measurement faulty	A
E31	Alarm limit, pressure	A
E32	Volume correction: pressure value impermissible	A
E33	Lower warning limit, pressure	W
E34	Upper warning limit, pressure	W
E40	Temperature measurement faulty	A
E41	Alarm limit, temperature	A
E42	Volume correction: temperature value impermissible	A
E43	Volume correction: temperature value warning limit	W

Status	Fault message	A/W/M
E44	Lower warning limit, temperature	W
E45	Upper warning limit, temperature	W
E50	Pulse buffer overflow	M
E51	Message limit, current output	M
E52	Lower message limit Q_{LLi}	M
E53	Upper message limit Q_{ULi}	M
E54	Lower message limit Q_{nLLi}	M
E55	Upper message limit Q_{nULi}	M

Note: A = Alarm; W = Warning; M = Message.

Description of fault messages

E01 New system start (ALARM) SERVICE

The EK-86 has executed a new start with the acceptance of standard parameters. Therefore, it is essential that **recalibration** is undertaken after this fault message. If this message occurs in conjunction with E02 - Power failure, then the back-up batteries probably have to be replaced.

E02 Power failure (ALARM) -

The power supply has been interrupted; the time at which the power failure started can be called under "Start" in Menu 11 and the time of power restoration is held under "Finish". If power failures occur frequently, then the procurement of an uninterruptible power supply (UPS) should be considered. All the data is retained; consumption measurement and volume correction are not however carried out.

E03 Inconsistent data (ALARM) SERVICE

During an internal comparison process, it was found that the parameters which are retained two-fold in the EK-86 no longer match. This is a "severe fault" because the programmed settings are no longer guaranteed. The fault may be able to be corrected by changing a parameter and accepting it in Menu 12. Then the set parameters should be checked.

E04 Memory fault during comparison (Warning) SERVICE/Part 1, 3.4.1

All counters in the EK-86 are stored threefold. If one counter differs from the two others having the same values, fault E04 is output. The memory location is then overwritten with the correct value. If none of the counters match, fault E03 is output.

E05 Card-slot fault (Message) SERVICE/Part 1, 7.2

If an input or output card can no longer be correctly addressed, fault E05 is output. If a card is defective, a number of faults are usually output. This enables the defective card to be localised:

E13 or E14 Pulse input card defective

E30 or E40 Analogue output card defective

Faulty output cards can be detected in Menu 16241 by the output of "??".

E06 Calibration lock open (Message) Calibration official/Part 1, 3.4.2

Parameters subject to calibration regulations can be changed with the switch open. The switch must be closed for operation. This can only take place by opening the EK-86 and then sealing by the calibration authorities.

E10 Loss of voltage on counter input (ALARM) SERVICE/Part 1, 7.2

The NAMUR supply has failed on the pulse input card. Replacement of the card may be necessary.

E11 Counter Input 1, frequency too high (ALARM) SERVICE/Part 1, 4.1.1

The EK-86 computes the maximum permissible frequency from 1.8 x frequ. of the maximum flow Qmax. Exceeding this limit results in fault E11. If this fault could not have been produced by the system, then the pulse input card or the meter tapping point may be defective.

E12 Counter Input 2, frequency too high (ALARM) SERVICE/Part 1, 4.1.1

Analogous to E11 for Counter Input 2.

E13 Counter Input 1 faulty (Warning) SERVICE/Part 1, 3.4.6.1/4.1.1

A line breakage has been detected on Counter Input 1. With counter inputs that are not designed according to NAMUR, this fault occurs more frequently; if required, switch off the line breakage monitoring in Menu 16211. The link must be checked for NAMUR generators.

E14 Counter Input 2 faulty (Warning) SERVICE/Part 1, 3.4.6.1/4.1.1

Analogous to E13 for Counter Input 2.

E15 Counter Input 1 suspect (Warning) SERVICE/Part 1, 3.4.6.1

E16 Counter Input 2 suspect (Warning)

The specified deviation has been exceeded during a comparison of the two pulse inputs. That input which has counted the lowest volume is designated as being suspect. The second input is then used for the volume measurement.

The partial volume that has entered up to the switchover to the second generator is lower than the actual volume (but no loss of pulses). This applies particularly for mixed generators (HF and LF). The meter sensor system should be checked.

E20 Maximum flow exceeded (ALARM) Part 1, 3.4.6.1

A flow has been measured that is higher than 1.1 x Q_{max}.

E22 Run-up time counter violated (Warning) Part 1, 3.4.6.1

The period Tan, which is specified for run-up from a flow of Q = 0 to the set lower flow limit Q_{LL}, has been exceeded.

E23 Run-down time counter violated (Warning) Part1, 3.4.6.1

The period Taus, which is specified for run-down from undercutting the lower flow limit Q_{LL} to turbine standstill (Q = 0), has been exceeded.

E24 Overflow, V counter (Warning) -

The 8-figure counter for the actual volume (V) has produced an overflow (from 99,999,999 to 00,000,000).

E25 Overflow, interval counter (Message) Part 1, 3.5.1

In the data storage function an interval counter has overflowed before termination of the interval. The measurement period (interval period) should be set correctly in order to avoid an overflow.

E30 Pressure measurement faulty (ALARM) SERVICE/Part 1, 3.4.6.2/4.1.2

This fault occurs when the measured current to the pressure sensor is lower than 3 mA or higher than 20.2 mA or if the voltage supplied to the pressure sensor is outside its tolerance. The substitute value for pressure is used for processing. Possible causes are: Input card defective, line breakage, short circuit in pressure sensor or defective pressure sensor.

The fault due to the current limits is not output when the calibration lock is open, but there is still a defective power supply.

E31 Alarm limit, pressure (ALARM) Part 1, 3.4.6.2/4.1.2

The measured pressure is outside the limits specified in Menu 16221 under "Alarm limits" without taking into account any hysteresis. The substitute value for pressure is used for processing.

The fault is not output when the calibration lock is open.

E32 Volume corr., pressure value impermissible (ALARM) Part1,3.4.6.2/4.1.2

The measured pressure exceeds 120 bar where computation of the K value is carried out according to GERG-88 or 80 bar where AGA-NX-19 (H gas) is used. The fault is only output for a flow not equal to zero. → Substitute K value.

E33 Lower warning limit, pressure (Warning) Part 1, 3.4.6.2/4.1.2

E34 Upper warning limit, pressure (Warning)

The measured pressure is lower than the lower warning limit specified in Menu 16221 minus half the hysteresis, or respectively, it exceeds the spec. upper warning limit plus half the hysteresis.

E40 Temp. measurement faulty (ALARM) SERVICE/Part 1, 3.4.6.3/4.1.3

This fault occurs when the measured resistance of the temperature sensor is lower than 18.6 ohm or higher than 125.24 ohm or if the voltage of the supply to the temperature sensor is outside its tolerance. The substitute value for the temperature is used for processing. Possible causes are: Input card defective, line breakage, short circuit in temperature sensor or defective temperature sensor.

The fault due to the limits is not output when the calibration lock is open, but there is still a defective power supply.

E41 Alarm limit, temperature (ALARM) Part 1, 3.4.6.3/4.1.3

The measured temperature is outside of the limits specified in Menu 16231 under "Alarm limits" without taking into account any hysteresis. The substitute value for temperature is used for processing.

The fault is not output when the calibration switch is open.

E42 Vol. corrector, temp. value impermissible (ALARM)Part 1, 3.4.6.3/4.1.3

The measured temperature is lower than -10.0°C where computation of the K value is carried out according to GERG-88 or lower than -5.0°C where AGA-NX-19 (H gas) is used or it exceeds 62.0°C for GERG-88 or 35°C for AGA-NX-19 (H gas). The fault is only output for a flow not equal to zero. The substitute K value is used for the further computation.

E43 Vol. corrector, temp. value warning (Warning) Part 1, 3.4.6.3/4.1.3

The measured temperature is lower than 0.0°C for AGA-NX-19 (H gas) or higher than 30.0°C for AGA-NX-19 (H gas). The fault is only output for a flow not equal to zero. The fault has not effect on the processing.

E44 Lower warning limit, temperature (Warning) Part 1, 3.4.6.3/4.1.3

E45 Upper warning limit, temperature (Warning)

The measured temperature is lower than the lower warning limit specified in Menu 16231 minus half the hysteresis, or respectively, it is higher than the upper warning limit plus half the hysteresis.

E50 Pulse buffer overflow (Message) Part 1, 3.4.6.4

A maximum output frequency is specified in Menu 16242 for the output of pulses. If all pulses cannot be output at a certain point in time, they are stored temporarily and, if necessary, output later. If one of these output counters reaches the value of 1000, then fault E50 is output. This fault can be prevented by correction of the relevant output scaling or by increasing the maximum frequency.

E51 Message limit, current output (Message) Part 1, 3.4.6.4

This fault is output if, due to the programmed scaling, a current lower than 0 or 4 mA or greater than 20 mA would have had to be output on one of the analogue outputs. The output, however, remains at its physical limit and fault E51 is output. The fault can be also be avoided here by correcting the relevant output scaling.

E52 Lower message limit, Q_{LLi} (Message) Part 1, 3.4.6.1

E53 Upper message limit, Q_{ULi} (Message)

The actual flow Q is lower than the lower warning limit specified in Menu 16211 minus half the hysteresis, or respectively, it exceeds the spec. upper warning limit plus half the hysteresis.

E54 Lower message limit, Q_{nLLi} (Message) Part 1, 3.4.6.1

E55 Upper message limit, Q_{nULi} (Message)

The standard flow Qn is lower than the lower warning limit specified in Menu 16211 minus half the hysteresis, or respectively, it exceeds the spec. upper warning limit plus half the hysteresis.

A-6b DS-100 function - fault messages

Status	Fault message	Description
E0	No fault present	-
E1	New start	There is no data in the memory after first switching on the EK-86. The DS function is not yet acquiring data. This occurs when the time is set using the AS-100.
E2	Loss of voltage	The power supply has failed after starting operation of the DS function. No data was acquired during this period; the stored data is retained though and the internal clock continues running.
E3	Incorrect value	The interval counter has overflowed in Channel 1 or 2 (more than 4079 pulses per interval) or the values have not been correctly acquired in Channel 3 or 4. The fault may be caused by a fault in the volume corrector. The interval value is incorrect.
E4	Substitute value	This message indicates that a substitute value has been used for forming the volume corrector interval value.
E5	Corrected value	This message is caused by a VC fault. The associated interval value is probably correct.
E6	Data error in memory	The EK-86 has been found to be faulty by internal test functions. The VC is defective.
E7	(Reserved for production tests)	-
E8	(Reserved for production tests)	Test Point S; there are still faults in the volume corrector which need to be acknowledged.

☞ *The recorded error messages can be reset by reading out using an AS-100 or by remote data transmission. However, the fault must not be present any longer and it must have been acknowledged in the volume corrector.*

Relationship: Volume corrector faults/warnings and DS-100 status

The possibilities provided by the fault message display in the DS function do not correspond to the comprehensive features in the volume corrector module. The reason for this that usually a number of VC faults have the same effect in the corresponding channel in the DS function. This means that the fault messages are assigned to a few DS fault messages. The fault messages are stored and displayed until the next read-out, e.g. by the AS-100. In the data stream only the interval value is identified in which the fault occurred.

Assignment of the VC fault messages (by channel)

No.	Volume corrector fault text	K1	K2	K3	K4
E01	New system start (A)	1	1	1	1
E02	Power failure (A)	2	2	2	2
E03	Inconsistent data (A)	6	6	6	6
E04	Memory fault (A)	6	6	6	6
E10	Loss of voltage, counter input (A)	3	3		
E11	Counter Input 1, frequency too high (A)	5	5		
E12	Counter Input 2, frequency too high (A)	5	5		
E13	Counter Input 1 faulty (W)	5	5		
E14	Counter Input 2 faulty (W)	5	5		
E15	Counter Input 1 suspect (W)	5	5		
E16	Counter Input 2 suspect (W)	5	5		
E20	Max. flow exceeded (A)	5	5		
E30	Pressure measurement faulty (A)		4	4	
E31	Alarm limit, pressure (A)		4	4	
E32	Volume correction: pressure value impermissible (A)		4	4	
E40	Temperature measurement faulty (A)		4		4
E41	Alarm limit, temperature (A)		4		4
E42	Vol. correction: temperature value impermissible (A)		4		4

Note:

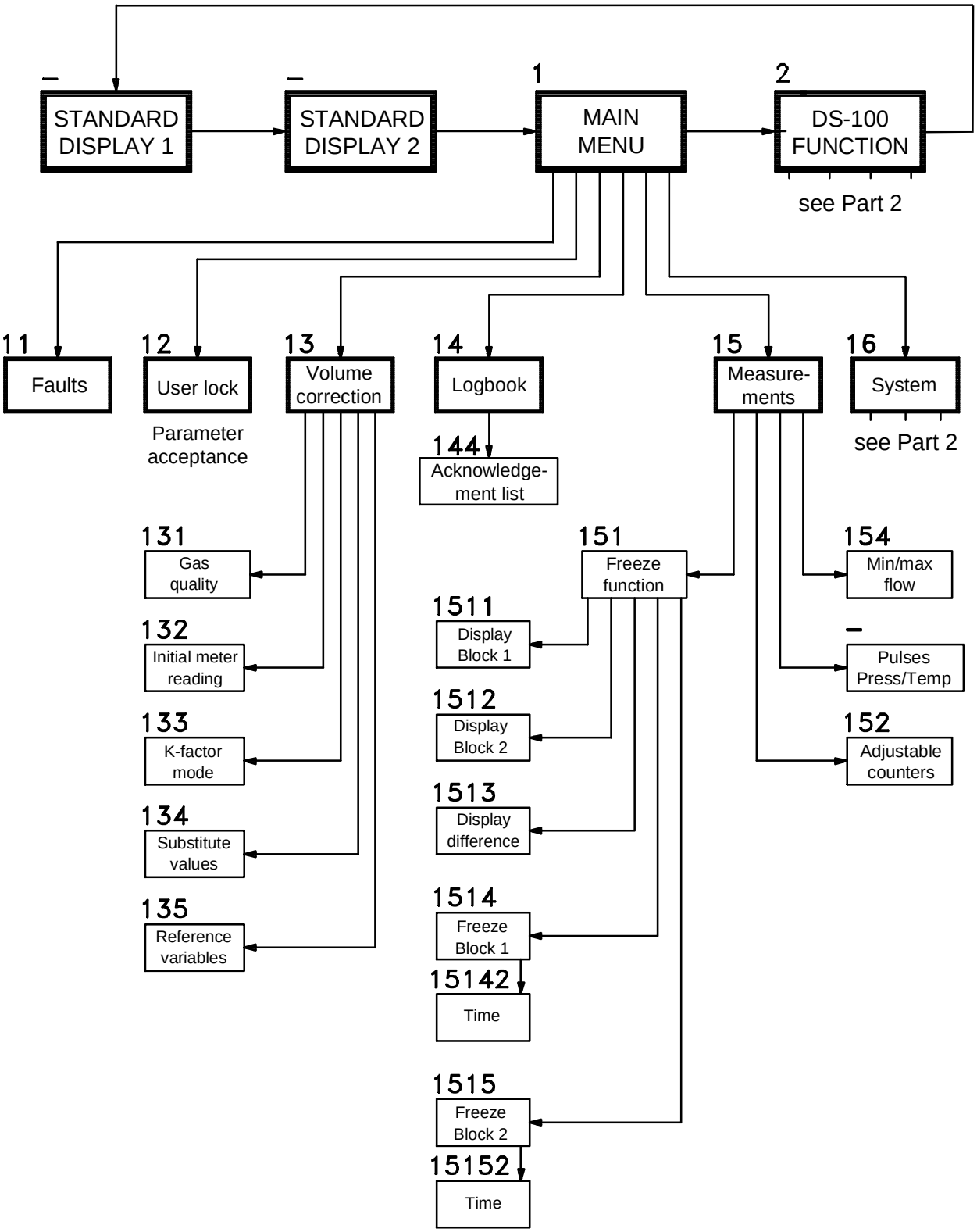
K1 - K4: DS-100 Channel 1-4

The fault messages E1-5 are accepted into the data stream; the message E6 is only entered into the status register. All other volume corrector faults/warnings have no effect on the DS function and are not recorded.

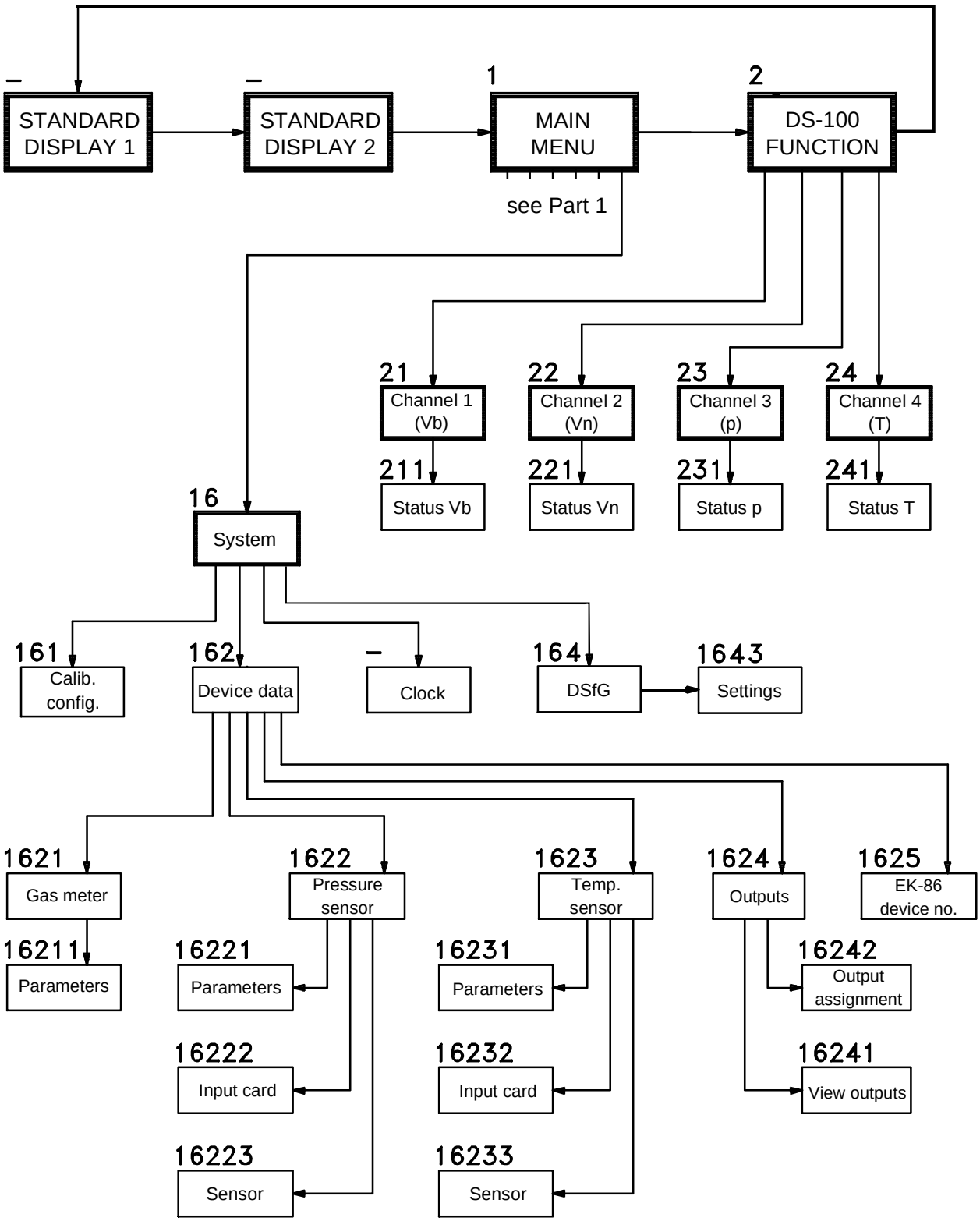
B Illustrations

B-1 List of illustrations

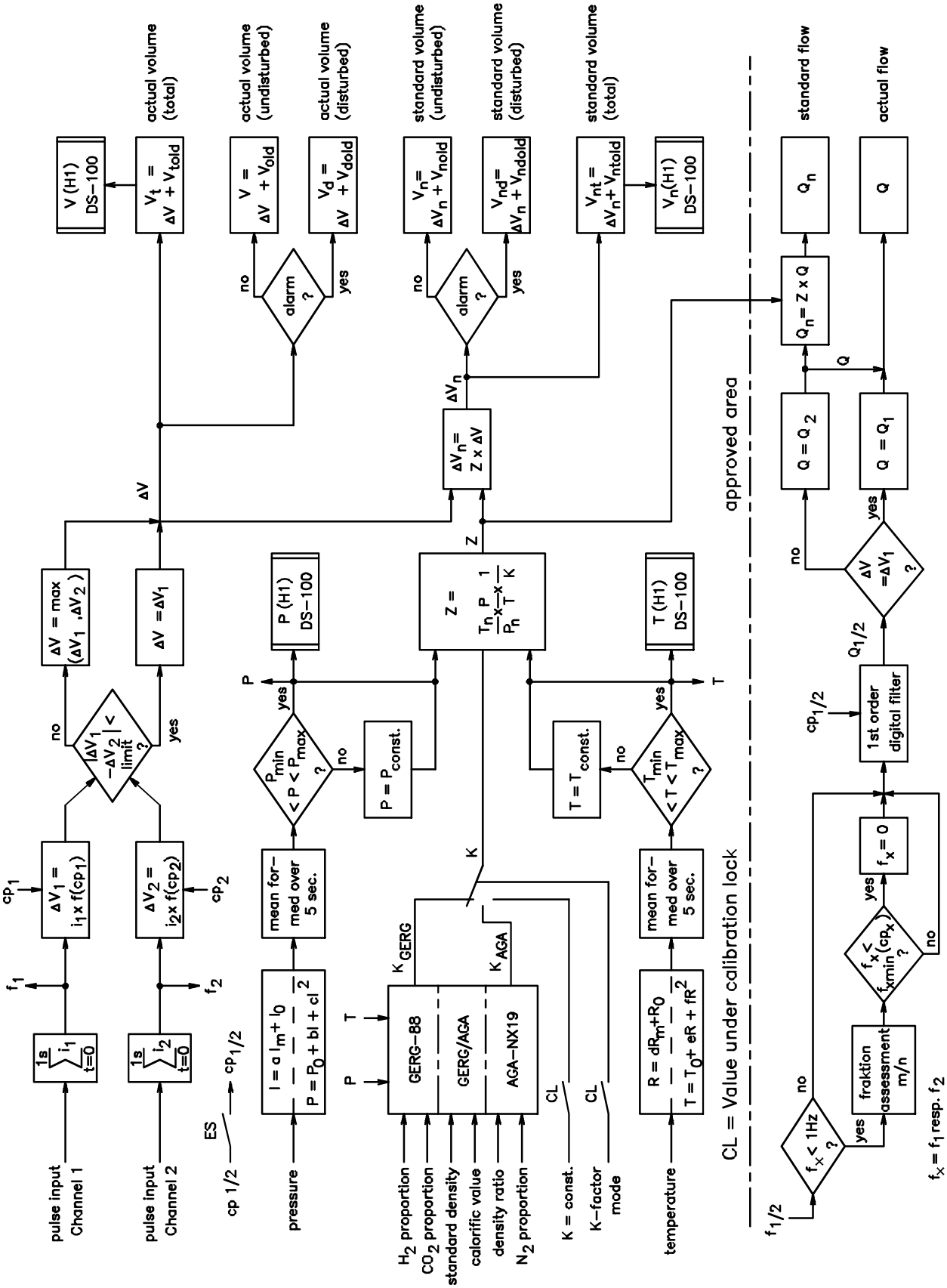
B-2 Menu structure - Part 1



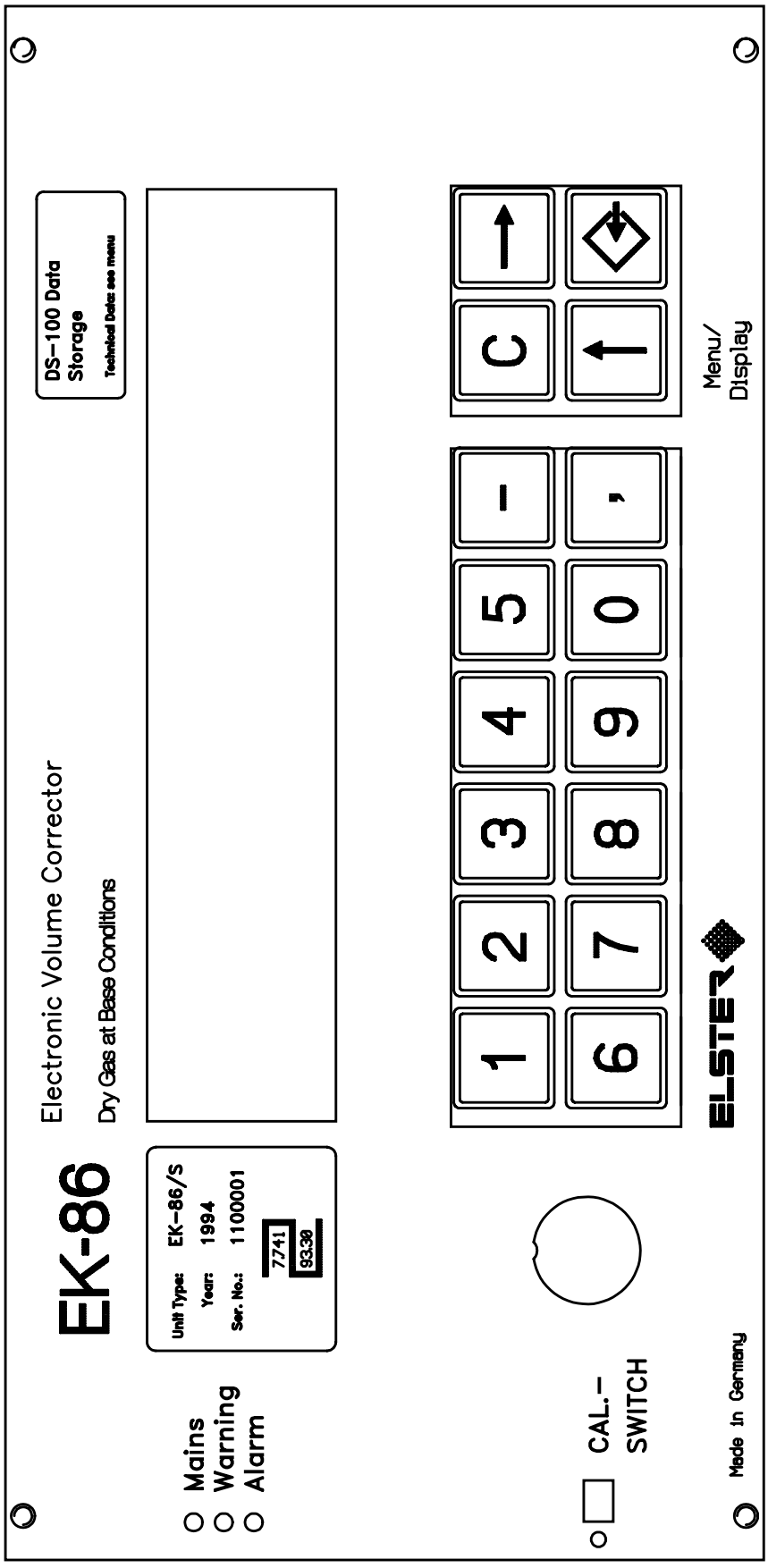
B-2 Menu structure - Part 2



B-3 Signal flow chart

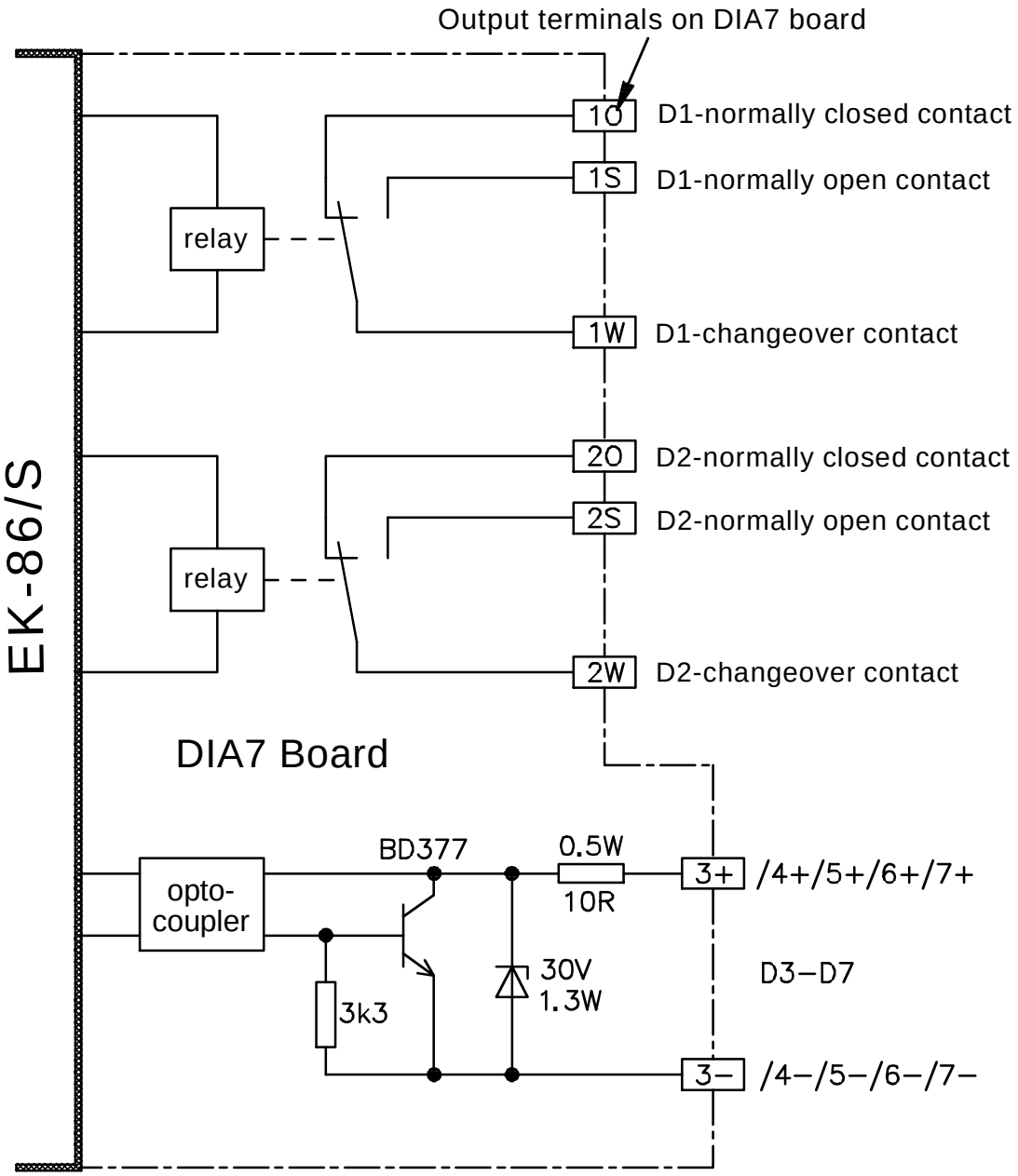


B-4 Front panel



B-5 Circuit diagrams

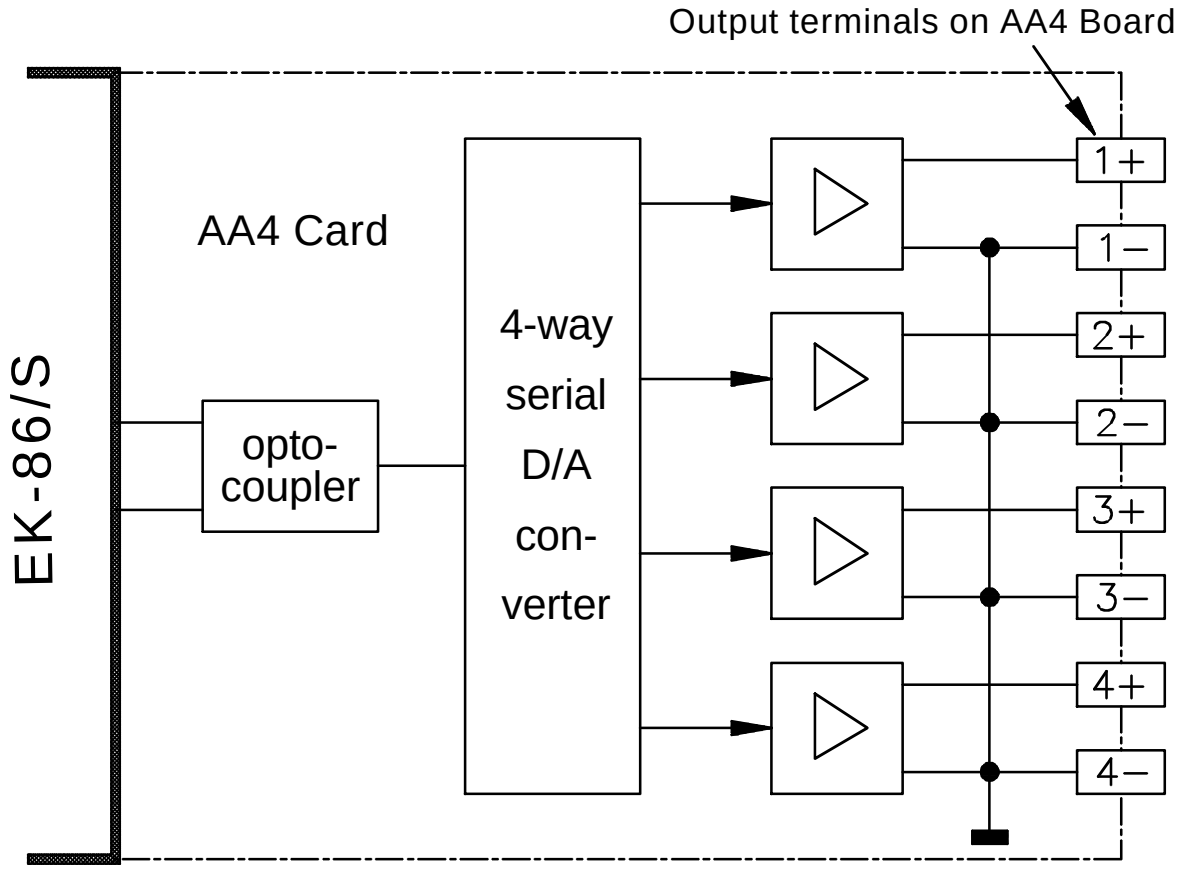
B-5a Circuit diagram of switching and pulse outputs



Default assignment for outputs:

Terminal 1O/1S/1W:	Alarm output	(switching output)
Terminal 2O/2S/2W:	Warning output	(switching output)
Terminal 3+/3-:	Standard Volume 2	(pulse output)
Terminal 4+/4-:	Standard Volume 1	(pulse output)
Terminal 5+/5-:	Actual volume	(pulse output)
Terminal 6+/6-:	E55 - Upper info limit Qn	(switching output)
Terminal 7+/7-:	E54 - Lower info limit Qn	(switching output)

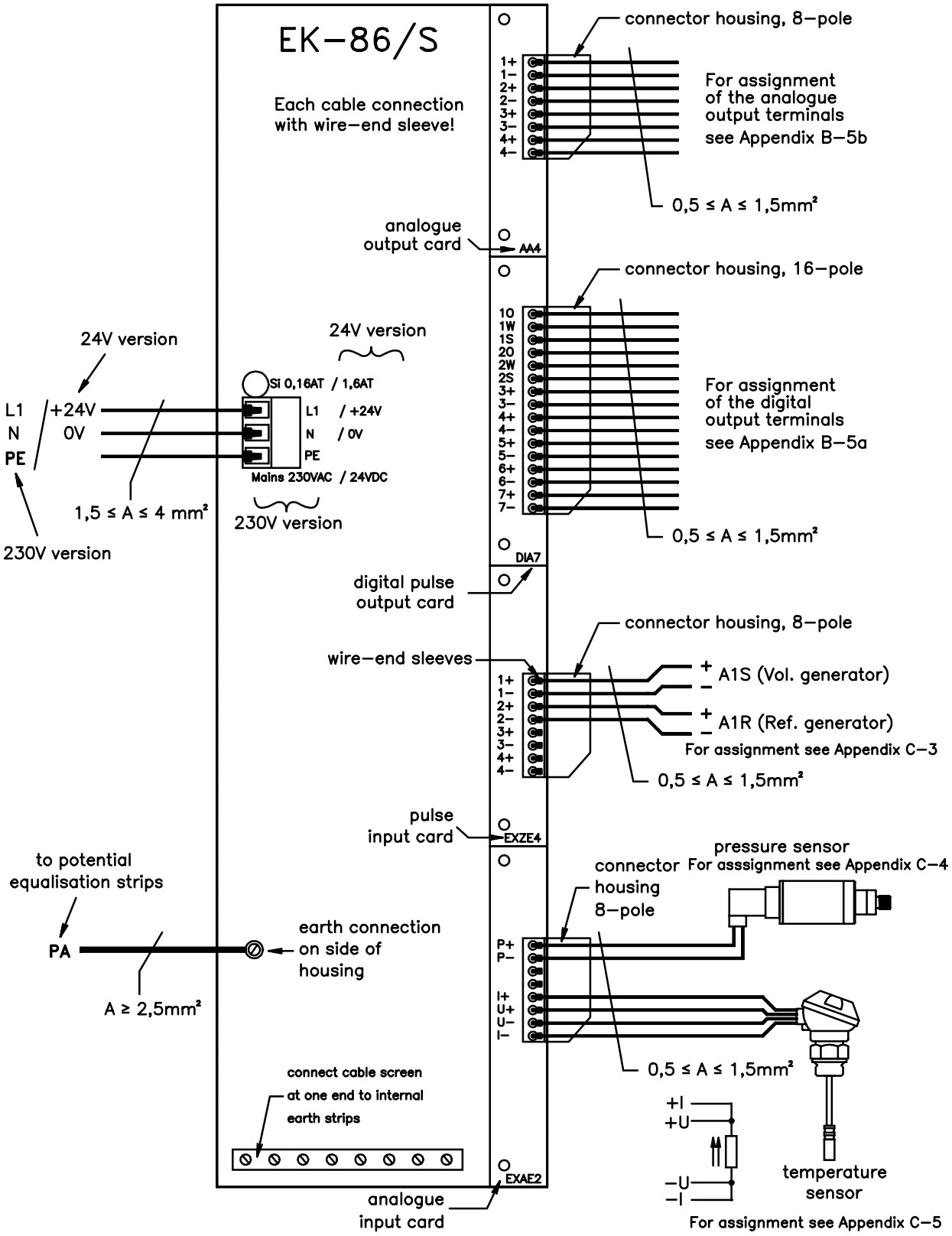
B-5b Circuit diagram of analogue outputs



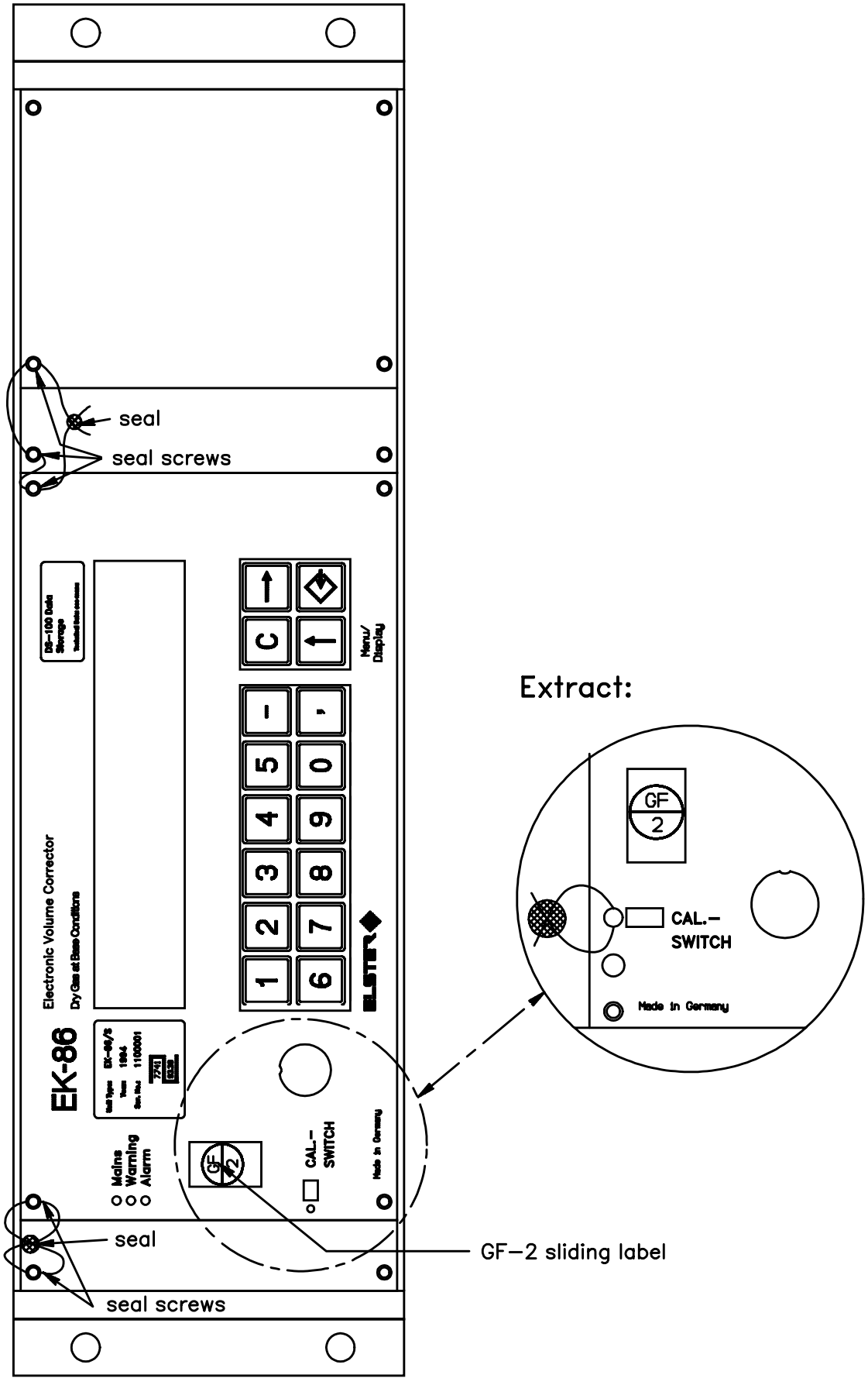
Default assignment of outputs:

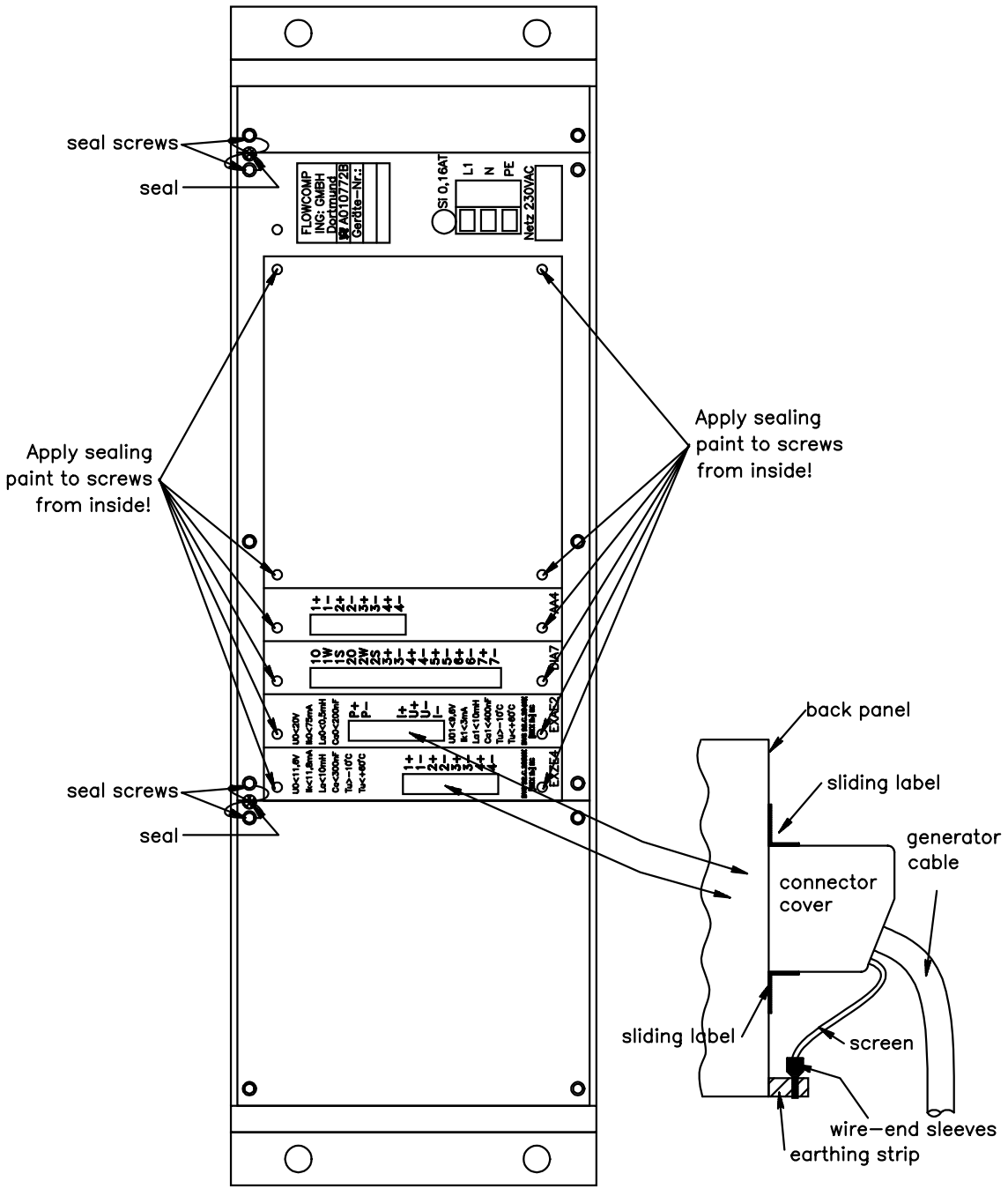
Terminal 1+/1-: Standard flow
Terminal 2+/2-: Actual flow
Terminal 3+/3-: Volume corrector pressure
Terminal 4+/4-: Volume corrector temperature

B-6 Wiring diagram



B-7 Sealing plan




seal screws
seal
Apply sealing paint to screws from inside!
Apply sealing paint to screws from inside!
seal screws
seal
back panel
sliding label
generator cable
connector cover
sliding label
screen
wire—end sleeves
earthing strip


sliding labels

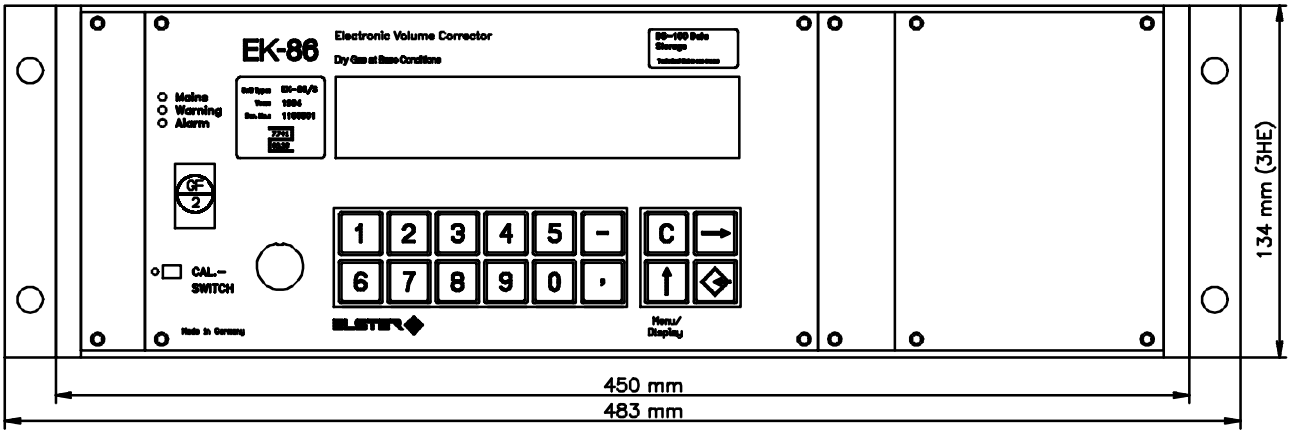
C Technical data

C-1 Mechanical details

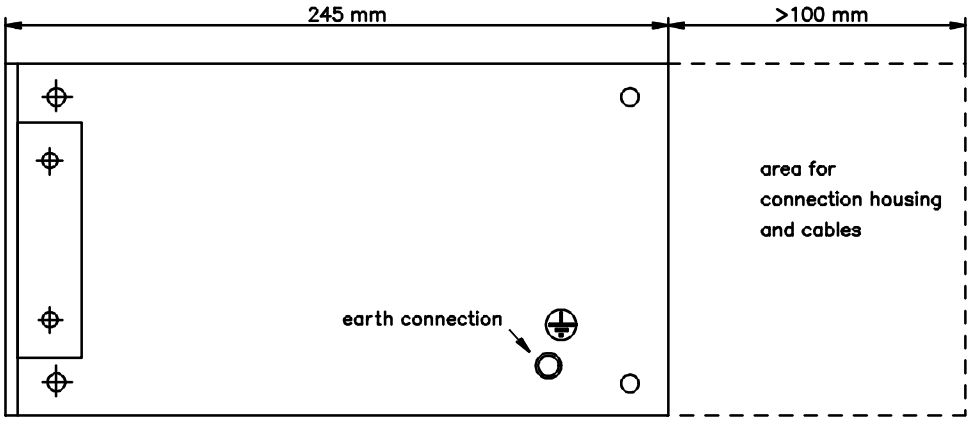
Housing type	19" rack housing, die-cast aluminium Cable feed via screw/plug-in terminals
Dimensions (WxHxD)	483 x 134 x 245 mm
Weight	approx. 6 kg
Protection	IP 20
Ambient temperature	-0.0 °C ... +40 °C
Relative humidity	max. 90% without condensation

Housing dimensions

front view



side view



C-2 Electrical data

Power supply

Supply voltage	230 VAC or	24 VDC
	Either of these supplies can be used, but not both!	
Voltage range	230 VAC +8%/-20%	24 VDC ±20%
Power consumption	15 VA	12 W
Fuses	0.16AT	1.6AT
Data backup	>45000 h	>45000 h
Terminal designation	L1; N; PE	+24 V; 0V; PE
Wire thickness	1.5...4 mm²	1.5...4mm²
	each fitted with core sleeves.	
Potential equalisation	>2.5 mm2 using earth screw at side	

Pulse generator inputs

Designation	1+; 1-; 2+; 2-
Additional input	4+; 4-
Conformance to	NAMUR DIN 19234
Open-circuit voltage U_{nom}	8.0 V±5%
Short-circuit current I_{nom}	8.0 mA ±5%
Switching level "on" I_{on}	2.1 mA±5%
Switching level "off" I_{off}	1.2 mA ±5%
Hysteresis I_{hyst}	0.25 mA ±20%
Explosion protection	[EEx ib] IIC; BVS 92.C.2039 X
Ex-related max. values	11.6 V; 11.8 mA; 10 mH; 300 nF
Elect. isol. to EK-86	Yes, U_{min} = 2.0 kV; no isol. relative to one another
Flow rate	Q_{max} = 25000 m³/h
Frequency (HF1/2)	f ≤ 3000 Hz (A1S/A1R; cp > 10)
(LF)	f ≤ 10 Hz (E1; cp < 10)
Type of connection	Screw/plug-in terminals; 8-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	mandatory; connected at one end to EK-86/S
Special features	Connection can be sealed via connector cover.

Pressure sensor input

Designation	P+; P-
Version	4-20 mA; 2-wire technology
Open-circuit volt. U_{nom}	17.5 V ±10%
Short-circuit current I_{nom}	Max. 24 mA
Burden	270 Ω
Measurement uncertainty over total temp. range	Max. 0.1% of measurement
Explosion protection	[EEx ib] IIC; BVS 92.C.2046 X
Ex-related max. values	20 V; 75 mA; 0.5 mH; 200 nF
Elect. isol. from EK-86	Yes, U_{min} = 2.0 kV; no isol. relative to one another
Type of connection	Screw/plug-in terminals; 8-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	mandatory; connected at one end to EK-86/S
Overall cable diam.	5.0...10.0 mm depending on sensor type
Special features	Connection can be sealed via connector cover

Temperature sensor input

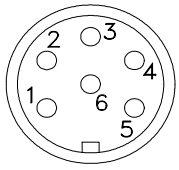
Designation	I+; U+; U-; I-
Version	Pt100 to DIN 43760; 1/3 DIN; connection in 4-wire technology
Measurement range	-10...+60°C
Open-circuit volt. U_{nom}	Max. 8 V (+I, -I)
Short-circuit current I_{nom}	0.4 mA
Measurement uncertainty over total temp. range	Max. 0.8% of resistance value
Explosion protection	[EEx ib] IIC; BVS 92.C.2046 X
Ex-related max. values	9.6 V; 3 mA; 10 mH; 400 nF
Elect. isol. from EK-86 to one another	Yes, U_{min} = 2.0 kV; no isol. relative
Type of connection	Screw/plug-in terminals; 8-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	mandatory; connected at one end to EK-86/S
Overall cable diam.	5.0...10.0 mm depending on sensor type
Special features	Connection can be sealed via connector cover

C-2a Data interface

Version	6-pole round socket on the front panel, conf. to RS232 and V24, short-circuit proof
Max. input voltage	≤ 30 V
Input level "1"	≥ 3 V
Input level "0"	≤ 0 V
Baud rate	4800 baud
Number of data bits	8
Number of stop bits	1
Parity	None

Connector pin assignment

Pin 1	NC
Pin 2	TxD (Data output)
Pin 3	RxD (Data input)
Pin 4	NC (Linked to Pin 5)
Pin 5	DTR (Control input)
Pin 6	GND



(view on interface)

C-2b Digital outputs

a.) Relay outputs

Designation	1O; 1S; 1W 2O; 2S; 2W
Version	Relay changeover contacts
Maximum voltage	30 VAC or DC
Maximum current	100 mA AC or DC
Leakage current	0.02 mA
Maximum frequency	1.0 Hz
Electr. isol. from EK-86	Yes, U_{min} = 1.2 kV
Electr. isol. from one another	Yes, U_{min} = 1.2 kV
Type of connection	Screw/plug-in terminals; 16-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	Recommended; connected at one end to EK-86/S
Default assignment	Alarm (1+/1-) and warning (2+/2-)

b.) Transistor outputs

Designation	3+; 3-; 4+; 4-; 5+; 5-; 6+; 6-; 7+; 7-
Version	Transistor outputs
Maximum voltage	28.8 VDC
Maximum current	50 mADC
Voltage drop	Max. 1.8 V at 50 mA
Leakage current	0.5 mA at 28.8 V
Maximum frequency	10 Hz
Electr. isol. from EK-86	Yes, U_{min} = 1.2 kV
Electr. isol. from one another	Yes, U_{min} = 1.2 kV
Type of connection	Screw/plug-in terminals; 16-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	Recommended; connected at one end to EK-86/S
Default assignment	Vn (3+/3-); Vn (4+/4-); V (5+/5-) OGW (6+/6-); UGW (7+/7-)

C-2c Analogue outputs (option)

Designation	1+; 1-; 2+; 2-; 3+; 3-; 4+; 4-
Version	Current output 0/4...20 mA
Maximum burden	600 ohm
Max. error	0.25% of measurement
Electr. isol. from EK-86	Yes, U_{min} = 500 V
Electr. isol. from one another	No
Type of connection	Screw/plug-in terminals; 16-pole; green
Wire thickness	0.5...1.5 mm²; mandatory core sleeves
Screen	Recommended; connected at one end to EK-86/S
Default assignment	Qn (1+/1-); Q (2+/2-); p (3+/3-); T (4+/4-)

C-2d Measurement uncertainty of complete unit

Actual volume (V)	No loss of pulses.
Standard volume (Vn)	< ±0.4% of measurement.
Pressure (p)	< ±0.3% of measurement.
Temperature (T)	< ±0.1% of measurement.
K value (K)	< ±0.01% of ref. value according to GERG-88

For HF generators:

Actual flow (Q)	< ±0.3% of measurement.
Standard flow (Qn)	< ±0.7% of measurement.

For LF generators:

Actual flow (Q)	< ±5% x f of measurement.
Standard flow (Qn)	< ±5% xf ±0.4% of measurement.

(f = input frequency in Hz; for f=0.1 Hz the error for Q is 0.5%)

C-3 Pulse generator

The details given in Appendix C-2 Pulse generator inputs should be observed when connecting pulse generators. The required limits and parameters are listed there. One HF generator or one LF generator (each to HF1), two HF generators (to HF1 and HF2) or two mixed generators (HF generator to HF2) and LF generator to HF1) can be connected. REED contacts or transistor switches (usually used as LF generators) are suitable as generators as well as proximity switches (A1S/A1R HF generators).

C-3a LF pulse generators (Elster turbines)

Elster turbine gas meters are fitted with low frequency pulse generators as standard. They are designed for applications in intrinsically safe circuits.

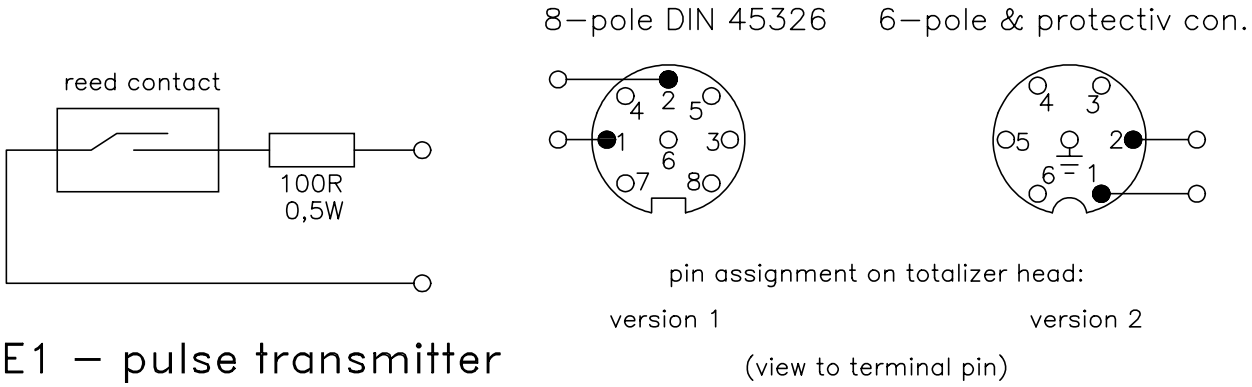
The mechanical counting mechanisms in Versions I and II are fitted as standard with a magnetically operated reed contact on the final counting roll. The maximum switching frequency depends on the variable being counted and is in the region between 0.018 and 0.44 Hz.

The contact is enclosed in a glass envelope filled with a protective gas so that contamination and corrosion are eliminated.

Technical data:

Switching voltage	U_{max}	= 24 V
Switching current	I_{max}	= 50 mA
Switching capacity	P_{max}	= 0.25 W/VA
Series resistance	R_i	= 100 Ω ± 20 %

Pin assignment

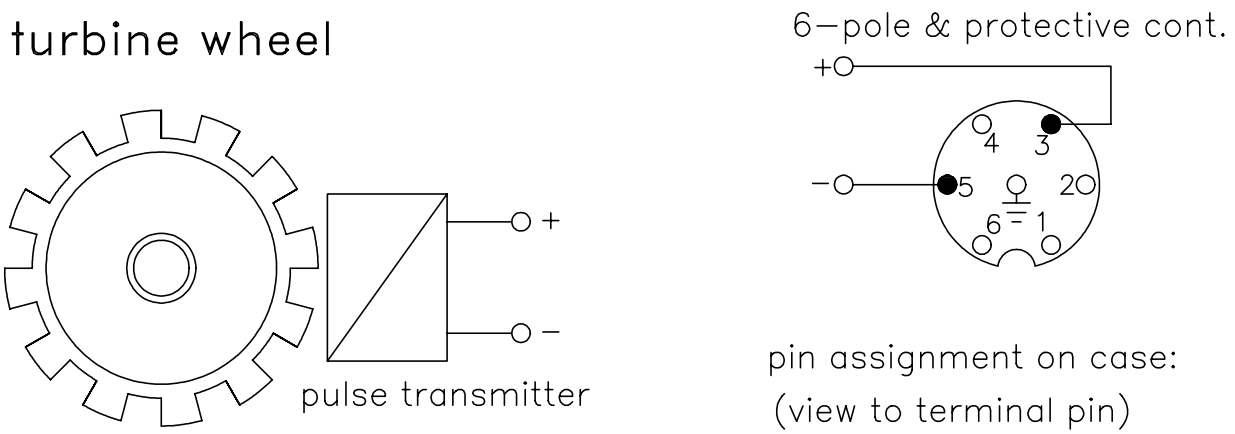


C-3b HF pulse generators (Elster turbines)

The optionally obtainable HF pulse generators for the Elster turbines (A1S and A1R Generators) consist of an inductive proximity switch having a cylindrical shape. Each turbine blade passing the A1S HF Pulse Generator or each hole (or mark) on the reference disc passing the A1R HF Pulse Generator produces an output pulse. The output pulses from the A1S and A1R Generators must be matched by appropriate cp values so that the same volumes are found.

Technical data according to DIN 19234:

Nominal voltage:		U_n	= 8 VDC
Current consumption	active surface free:	I	≥ 2.1 mA
	active surface covered:	I	≤ 1.2 mA



C-4 Pressure sensor

C-4a Pressure sensor "Rosemount - 1151"

Pressure sensor type: Codes 5-8: Absolute Pressure Transducer 1151 AP
Code 9: Relative Pressure Transducer 1151 GP

Standard measurement ranges (bar):

Code	5	6	7	7	7	8	8	9
Measure-ment span	0.5-1.9	0.9 7.0	1.5-21.0			4.0-70.0		20.0-100.0
Pmin	0.5	0.9	2	3	4	9	14	20
Pmax	1.9	4.5	10	15	20	45	70	100

The measurement range can be freely selected within the measurement spans taking into account the following restriction:

$$2.4 \leq \frac{P_{max}}{P_{min}} \leq 5$$

Measurement uncertainty: ≤ ± 0.3% of measurement

Perm. ambient temperature: -10... + 50°C (for applications subject to official calibr.)

Duration of calibr. validity: 5 years

Output signal: 4...20 mA

Explosion protection: EEx d II C T6

Protection: IP 65

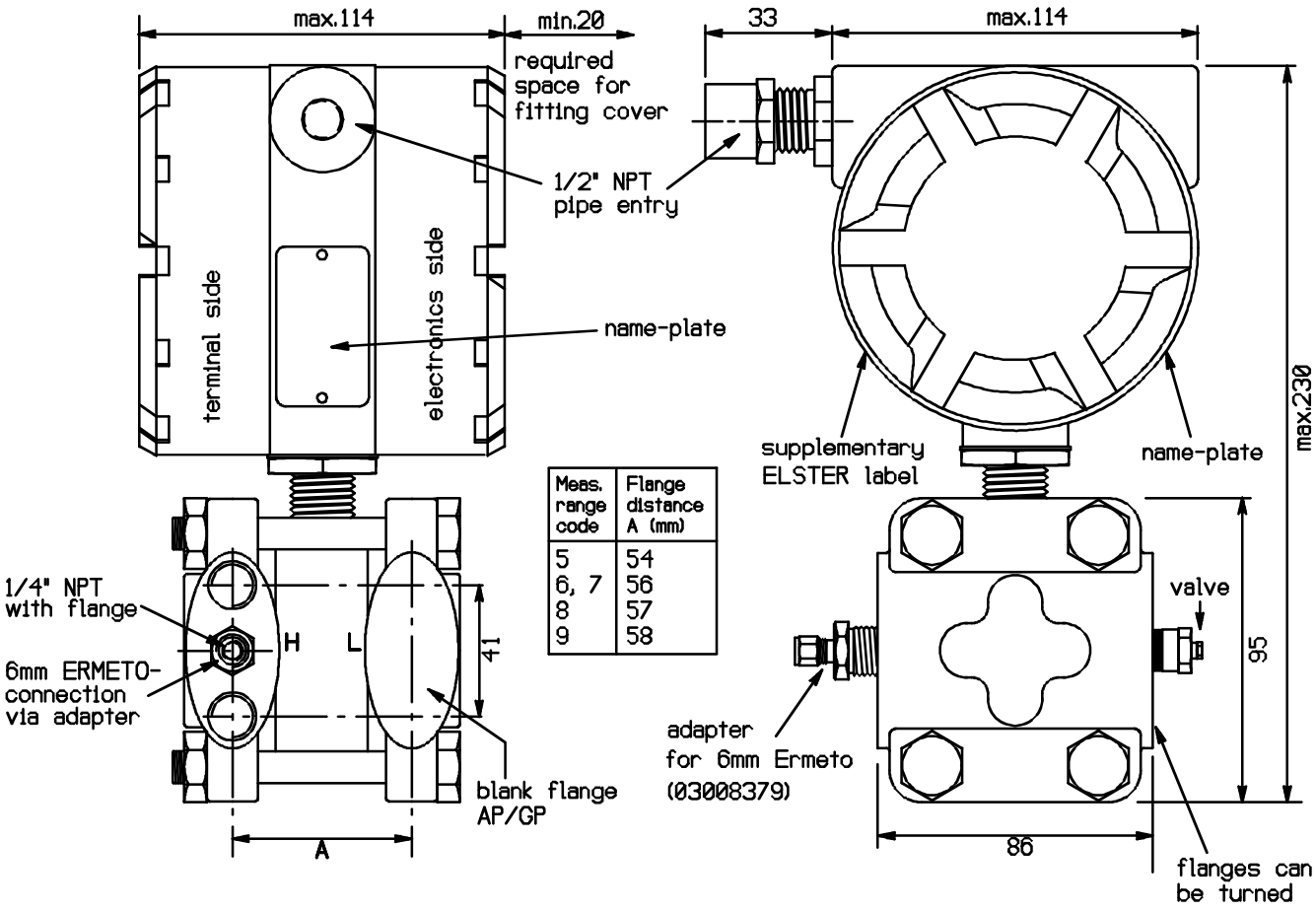
System connection: 6 mm Ermeto or 1/4" NPT internal thread

Cable gland: 1/2" NPT to terminal block

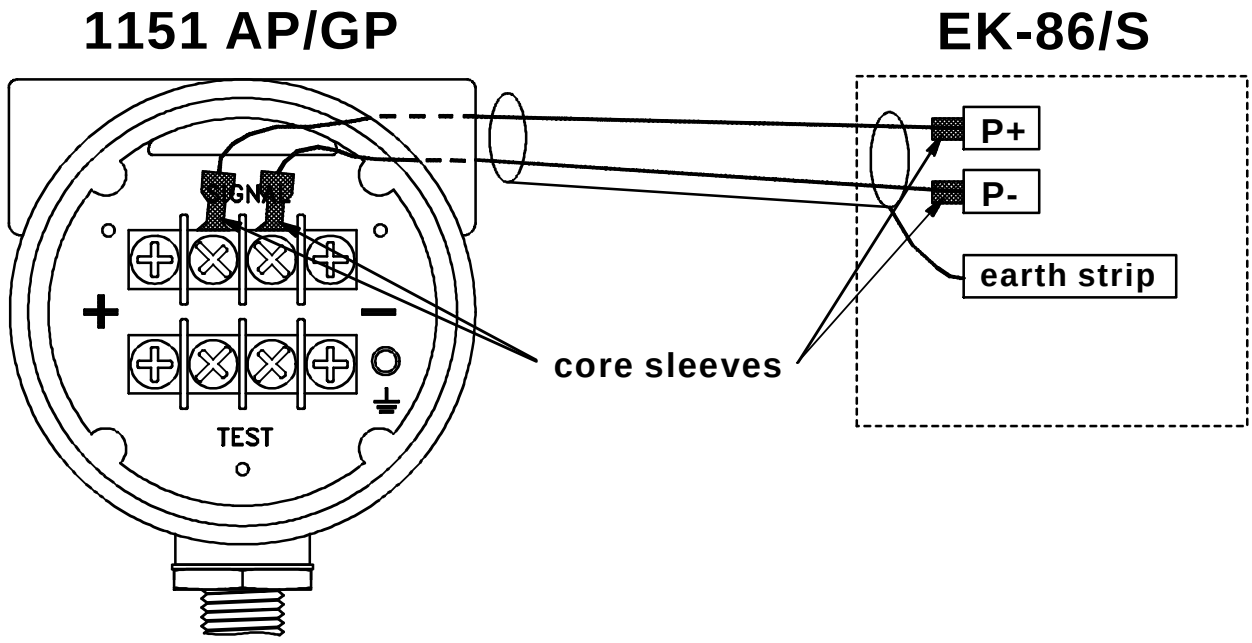
Weight: approx. 5.5 kg

Accessories: Wall Bracket B2, order no.: 04107106
Bracket for 2" pipe, no.: 04107105

Dimensions of 1151 AP/GP:

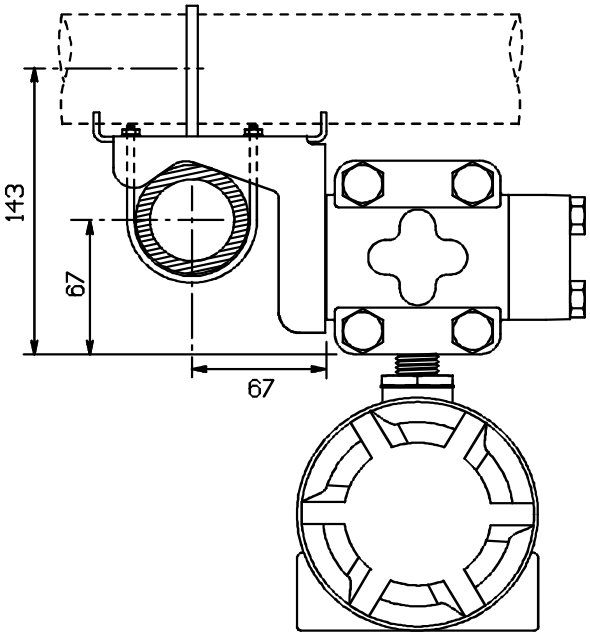


Connection assignment 1151 AP/GP:

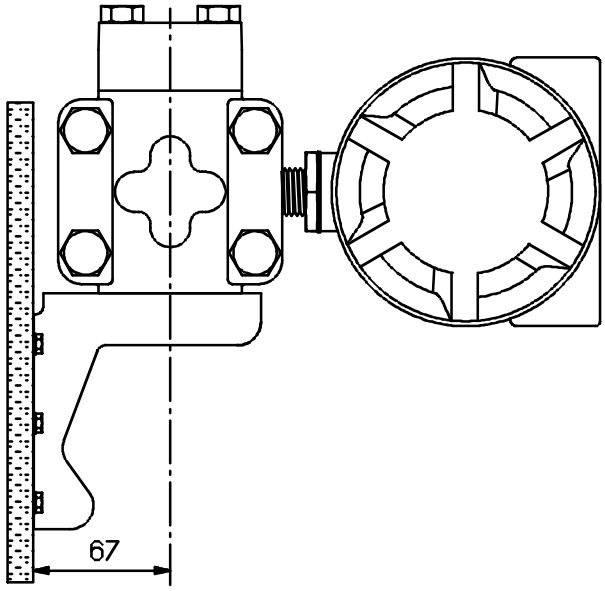


Wall/pipe fixtures for 1151 AP/GP:

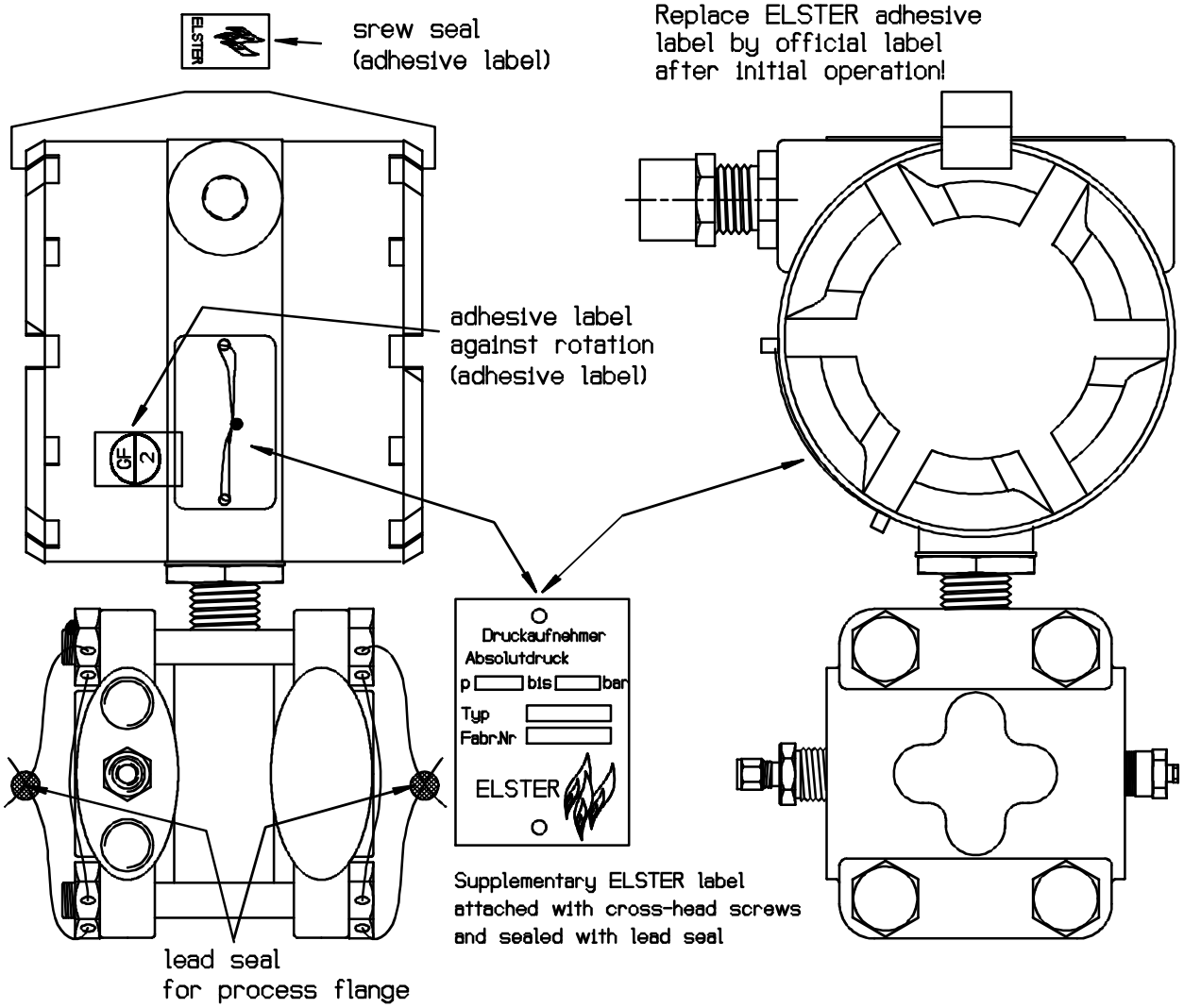
Mounting bracket for DN 50/2" pipe



Mounting bracket for wall installation



Sealing plan 1151 AP/GP:



C-4b Pressure sensor "Rosemount - 3051 CA"

Pressure sensor type: Absolute Pressure Sensor 3051 CA

Standard measurement ranges (bar):

Code	**2**	**2**	**3**	**3**	**3**	**3**	**4**	**4**
Measure-ment span	0.0 - 10.0		0.0 - 55.0				0.0 - 120.0	
Pmin	0.9	2	3	4	6	10	14	20
Pmax	4.5	10	15	20	30	50	70	100

The measurement range can be freely selected within the measurement spans taking into account the following restriction:

$$2.4 \leq \frac{P_{max}}{P_{min}} \leq 5$$

Measurement uncertainty: ≤ ± 0.3% of measurement

Perm. ambient temperature: -10...+40 °C (for applications subject to official calibr.)

Duration of calibr. validity: 1 year min.

Output signal: 4...20 mA

Explosion protection: flameproof EEx d IIC T6
Option: intrinsically safe (EEx ia IIC T4)

Protection: IP 65

System connection: 6 mm Ermeto or 1/4" NPT internal thread

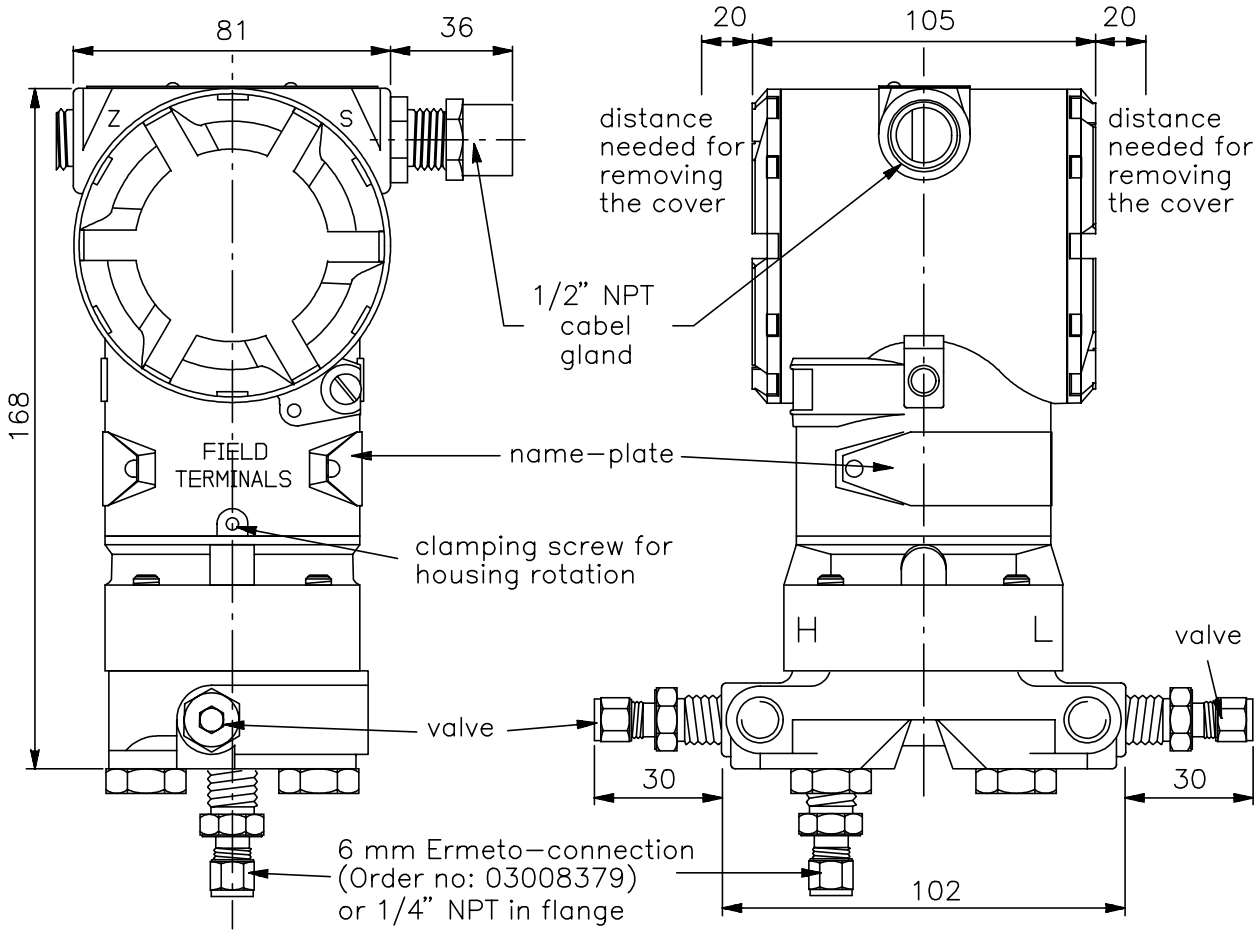
Cable gland: 1/2" NPT to terminal block

Weight: approx. 2.5 kg

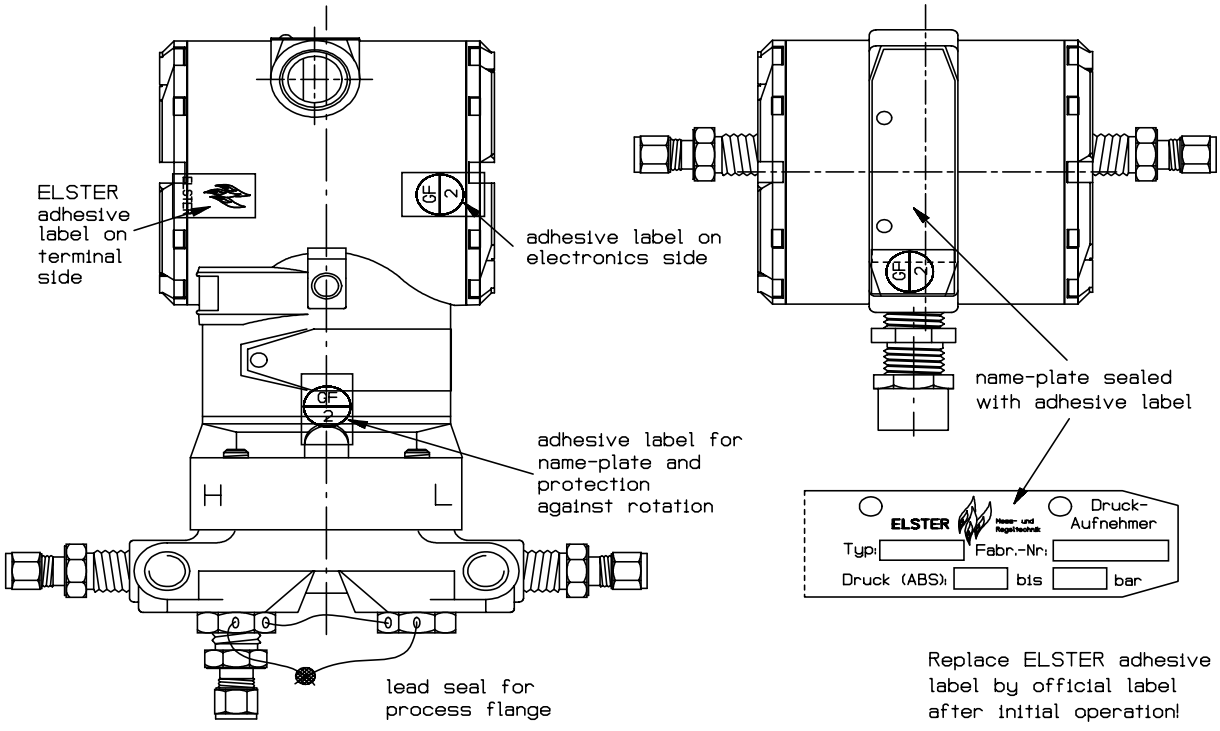
Accessories: Wall and Pipe Bracket B4, no.: 04107108
Adapter for 1/4" NPT to 6 mm Ermeto, order no.: 03008379

☞ *The Pressure Sensor 3051 also supplies valid current values outside the permissible limits. The alarm limits should therefore be set to the minimum "Lower perm. limit - 1.5%" and maximum "Upper perm. limit +1.5%", e.g.: permissible limits 14-70 bar → p_{min} = 13.70 bar and p_{max} = 71.00 bar.*

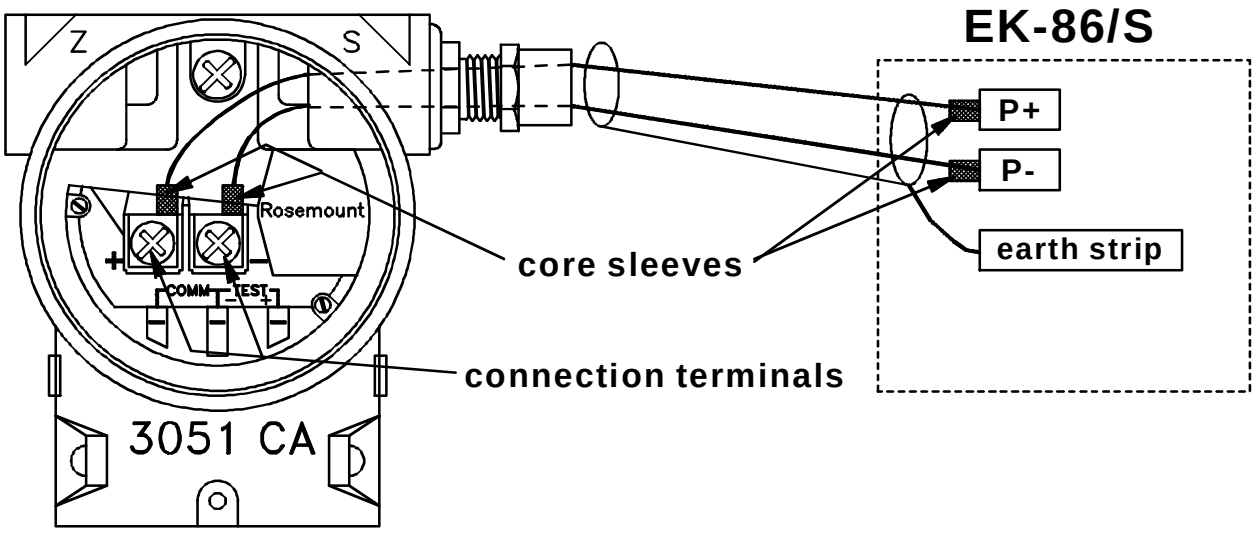
Dimensions of 3051 CA:



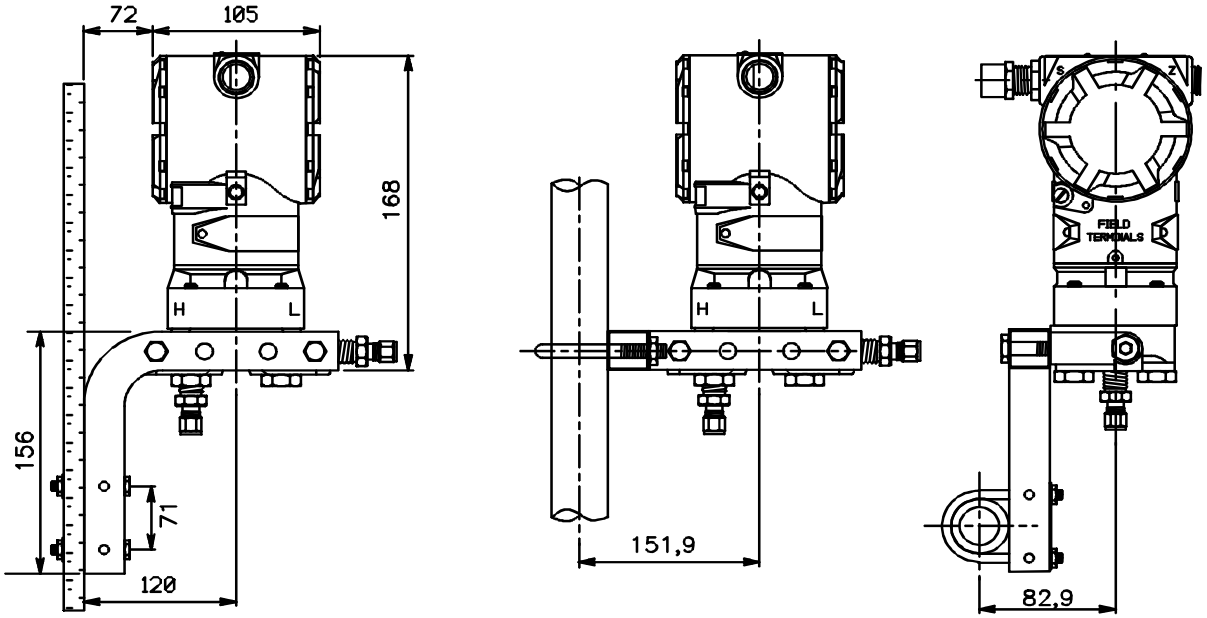
Sealing plan 3051 CA:

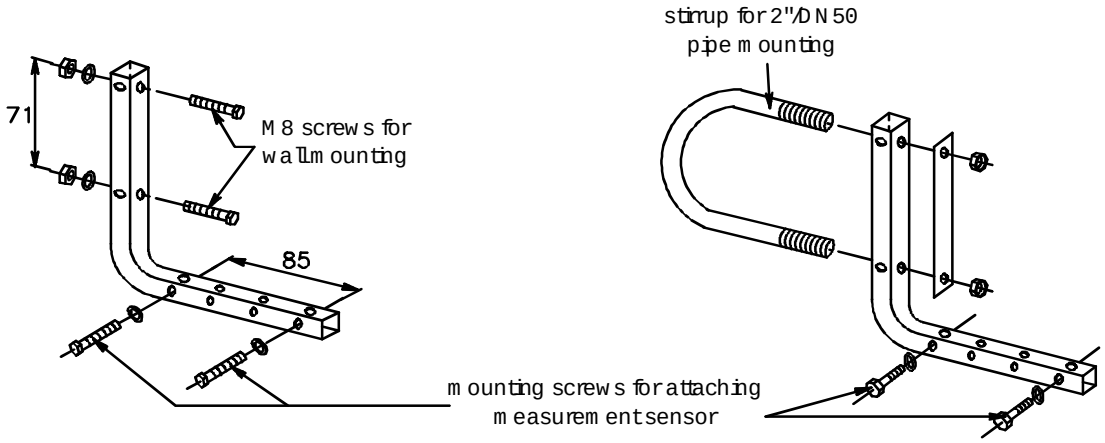


Connection assignment for 3051 CA:



Wall and pipe fixtures for 3051 CA:





C-4c Pressure sensor "Rosemount - 2088 A"

Pressure sensor type: Absolute Pressure Sensor 2088 A

Standard measurement ranges (bar):

Code	1	2	2	3	3	3	4
Measure-ment span	0.35 - 2.1	1.7 - 10.3		9.2 - 55.2			1.0 - 120.0
Pmin	0.6	0.9	2	3	4	10	1
Pmax	1.9	4.5	10	15	20	50	120

The measurement range for types 1 to 3 can be freely selected within the measurement spans taking into account the following restriction:

$$2.4 \leq \frac{P_{max}}{P_{min}} \leq 5$$

Type 4 is designed only for industrial applications and is not approved for applications subject to official calibration. The measurement range for type 4 can be freely selected within the specified limits.

Measurement uncertainty: ≤ ± 0.3% of measurement

Perm. ambient temperature: -10...+40 °C (for applications subject to official calibr.)

Duration of calibr. validity: 1 year min.

Output signal: 4...20 mA

Explosion protection: flameproof EEx d II C T4
Option: intrinsically safe (EEx ia II C T4)

Protection: IP 65

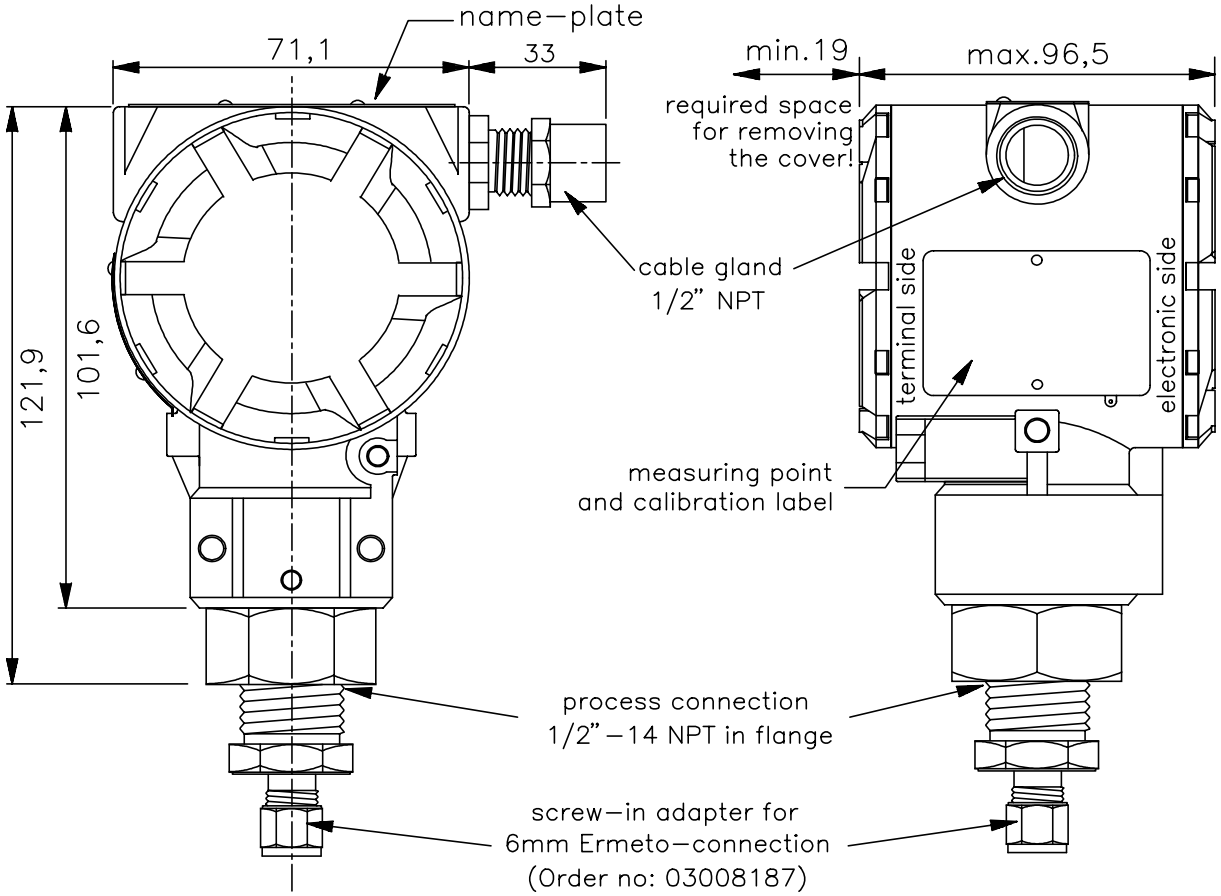
System connection: 6 mm Ermeto or 1/4" NPT internal thread

Cable gland: 1/2" NPT to terminal block

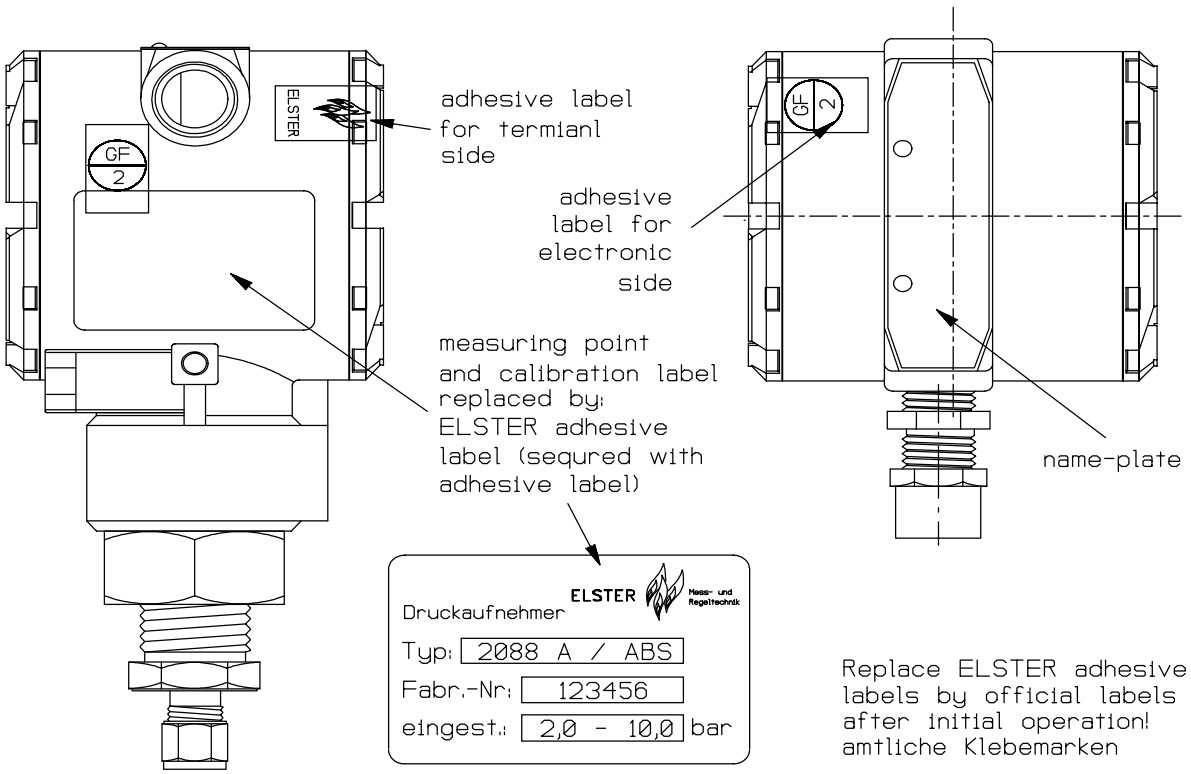
Weight: approx. 0.9 kg

Accessories: Wall and Pipe Bracket B4, no.: 04107107
Adapter for 1/4" NPT to 6 mm Ermeto, order no.: 03008187

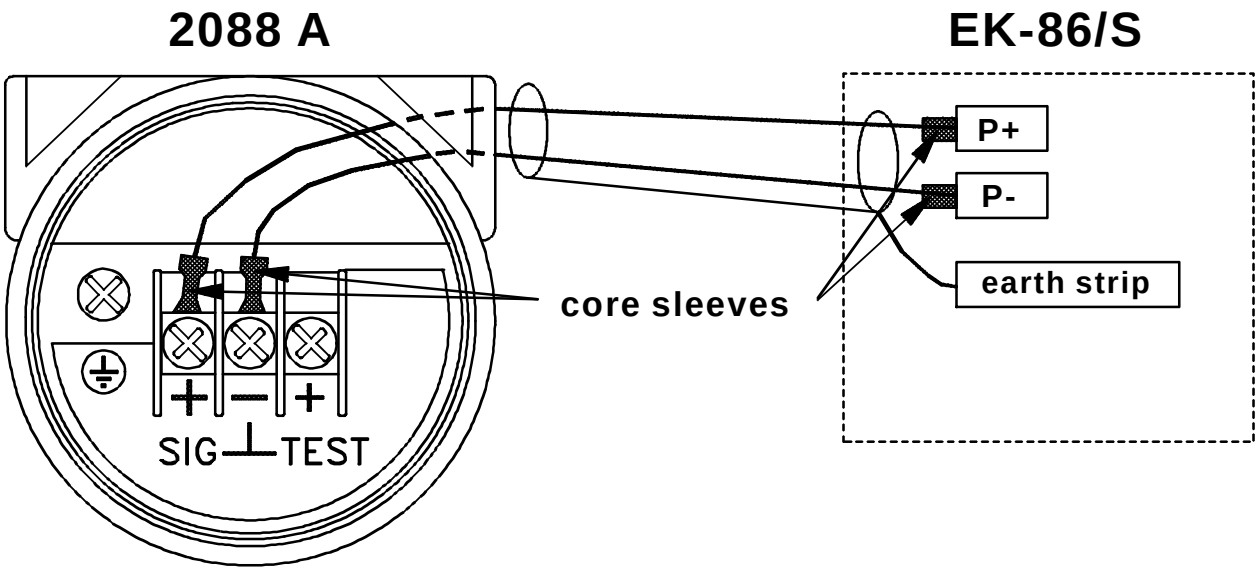
Dimensions of 2088 A:



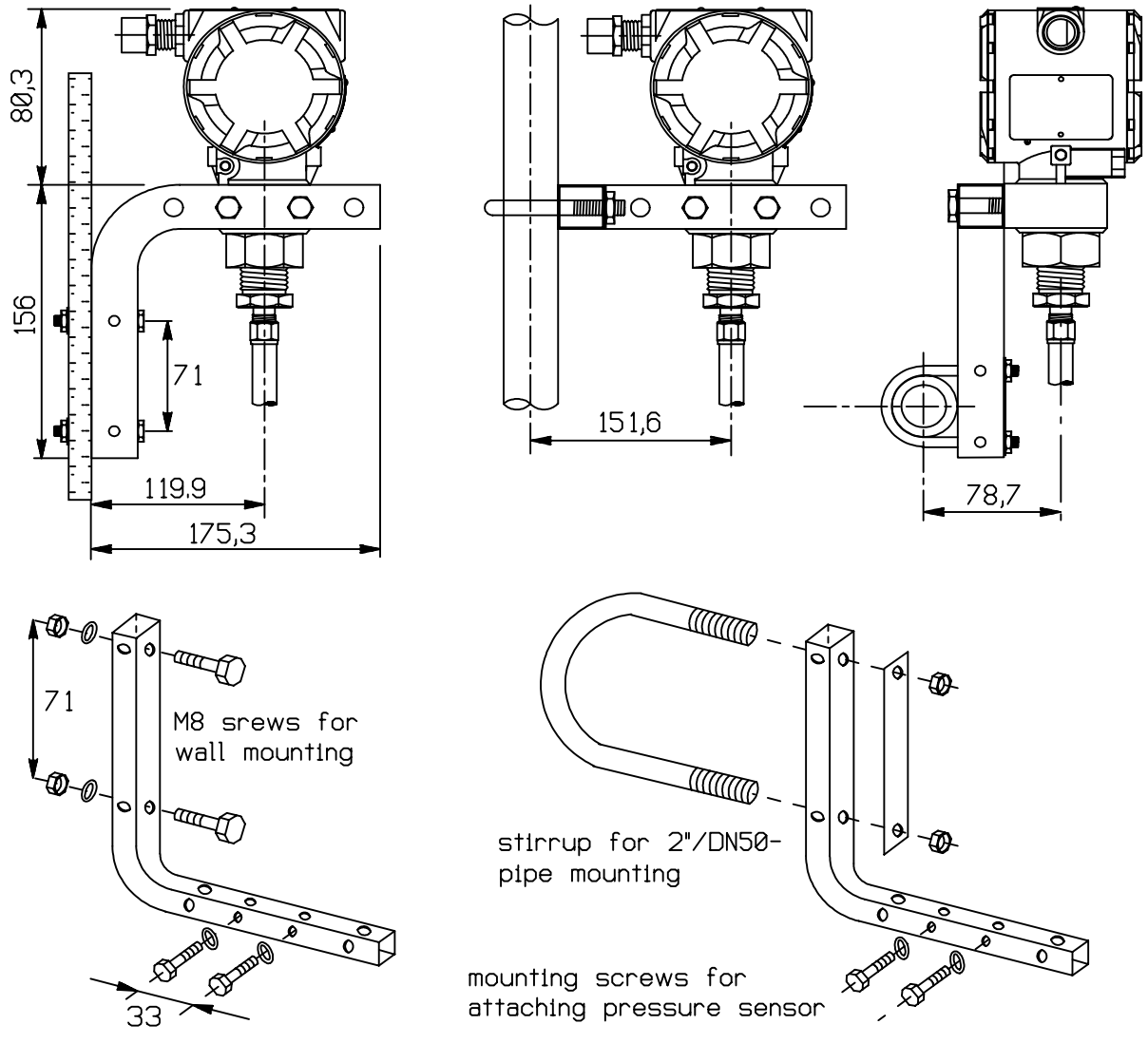
Sealing plan of 2088 A:



Connection assignment for 2088 A:



Wall and pipe fixtures for 2088 A:



C-4d Pressure Sensor "Druck - PTX-610"

Pressure sensor type: Absolute Pressure Sensor PTX 610

Fixed measurement ranges in applications subject to official calibrations (bar):

Pmin	0.64	0.92	1.6	2.4	4	6.4	10	16
Pmax	1.6	2.3	4	6	10	16	25	40

Fixed measurement ranges - only for use in the industrial sector (bar):

Pmin	24	40
Pmax	60	100

Measurement uncertainty: ≤ ±0.3% of measurement

Perm. ambient temperature: -10... +40 °C (for applications subject to official calibr.)

Duration of calibr. validity: 2 years

Output signal: 4...20 mA

Explosion protection: intrinsically safe; EEx ia IIC T4

Protection: IP 65

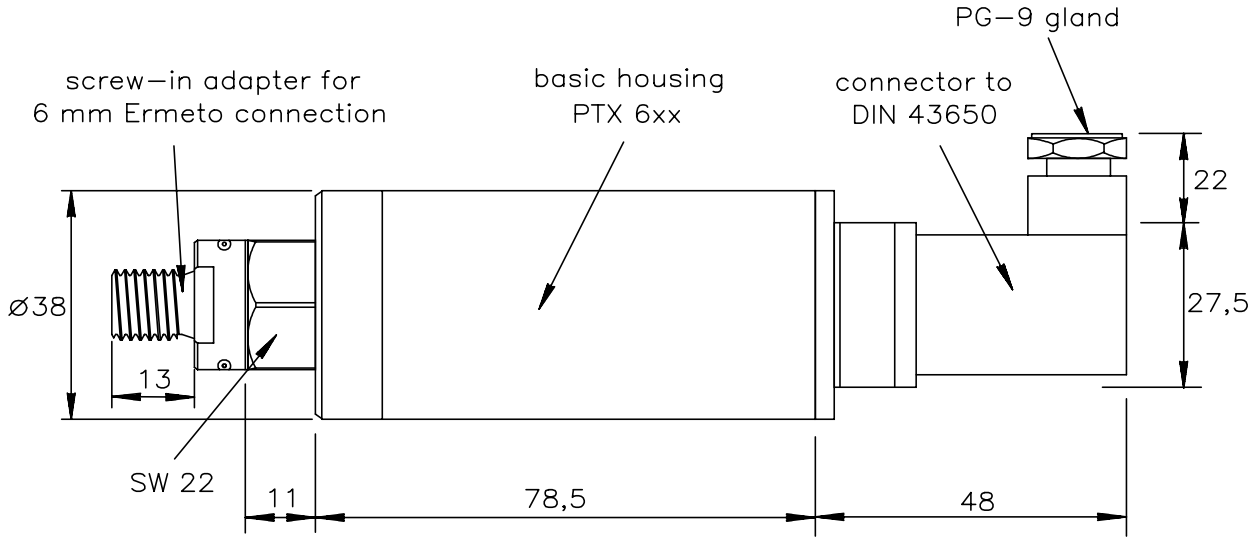
System connection: 6 mm Ermeto

Cable gland: DIN 43650 to terminal block, PG-9
Cable diameter 5-8 mm

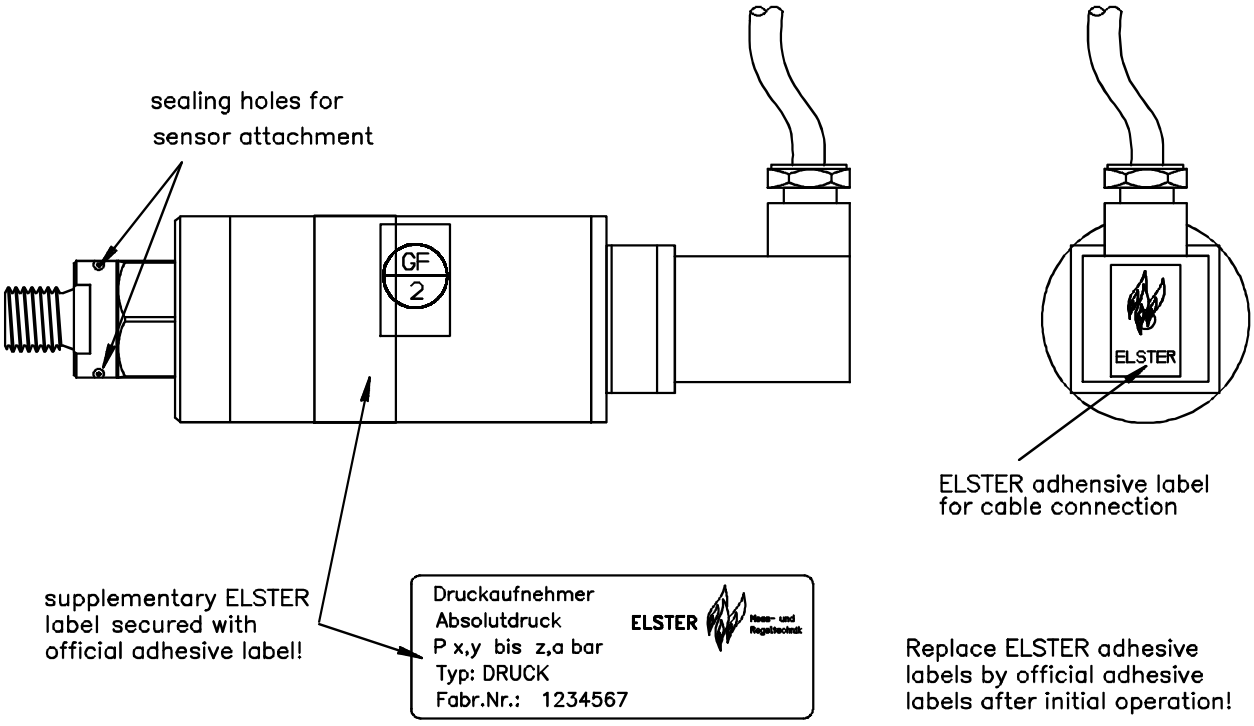
Weight: approx. 0.33 kg

Accessories: Wall Bracket, no.: 73013775

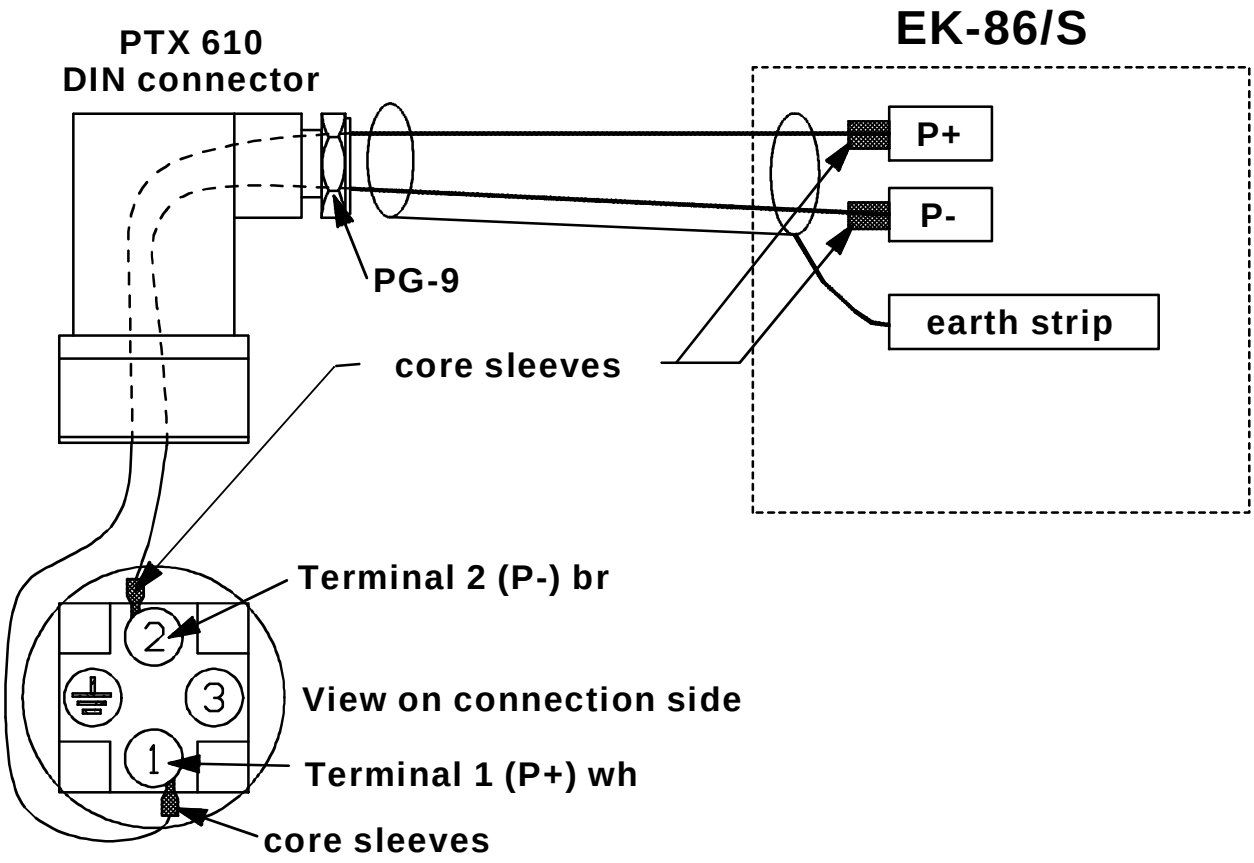
Dimensions of PTX 610:



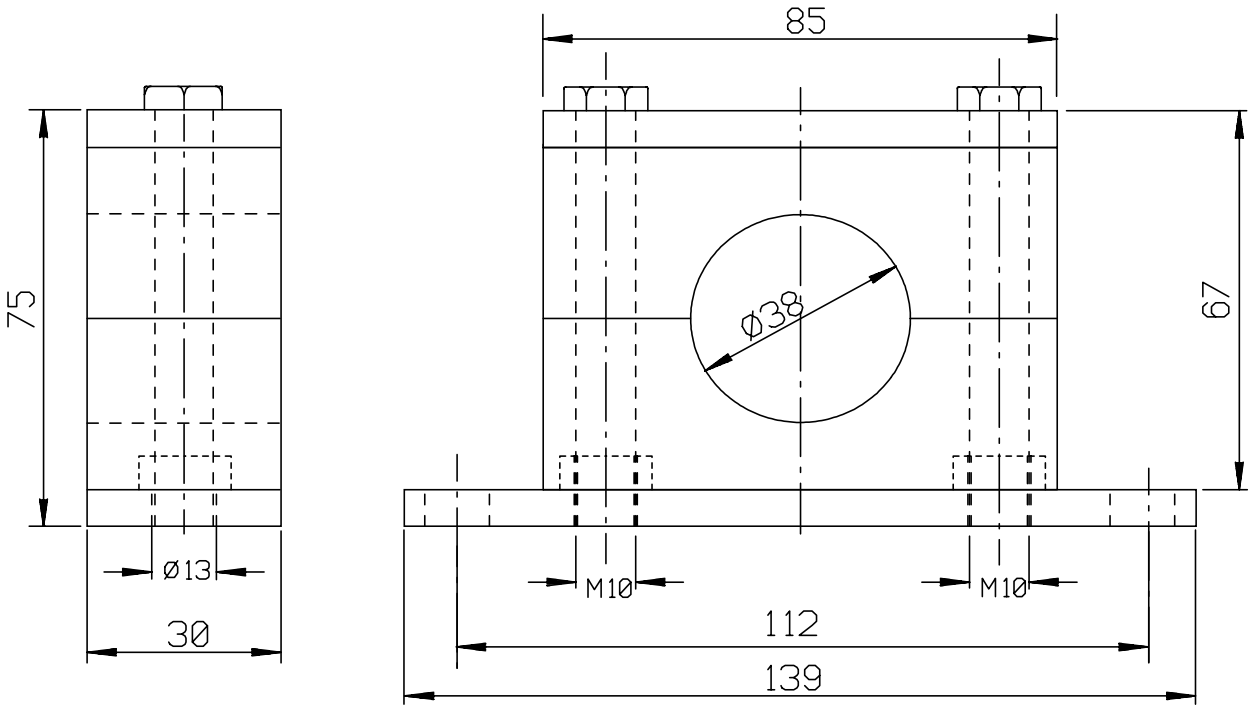
Sealing plan for PTX 610:



Connection assignment for PTX 610:



Wall mounting for PTX 610:



C-4e Connecting cables for pressure sensor

There are certain essential conditions for connection which must be observed for systems in the official calibration sector. The following standards apply for cables that are used in intrinsically safe systems:

- DIN VDE 0298 Parts 1 and 3
- DIN VDE 0891 Parts 1, 5 and 6
- Combustion characteristics according to DIN VDE 0472 Part 804, Test Type B
- Electric strength between conductor and screen according to DIN VDE 0165 Section 6.1.3.2.1: min. 500 Vrms.

This results in the following requirements for the connecting cables:

a.) Cables for intrinsically safe circuits (2088 Ex-i, 3051 Ex-i and PTX-610)

- Ex connecting cable for intrinsically safe circuits
- 2-core with screen (min. 60% coverage)
- core thickness ≥ 0.5 mm², single strands ≥ 0.1 mm²
- core colour coding according to DIN 47100
- cable diameter: 5-10 mm for 2088 and 3051, colour bright blue
- cable diameter: 5-8 mm for PTX-610, colour bright blue

e.g. Order number: **04250829**

- designation: 2x0.75 mm²; sheath LiYCY; sheath colour bright blue (RAL 5015); overall diam. 5.7 mm

or: Order number: **04250123**

- designation: 2 x 2 x 0.5 mm²; each with 2 cores joined; sheath LiYCY; sheath colour bright blue (RAL 5015); overall diam. ≤ 8.0 mm

b.) Cables for Ex-d circuits (1151, 2088 Ex-d and 3051 Ex-d)

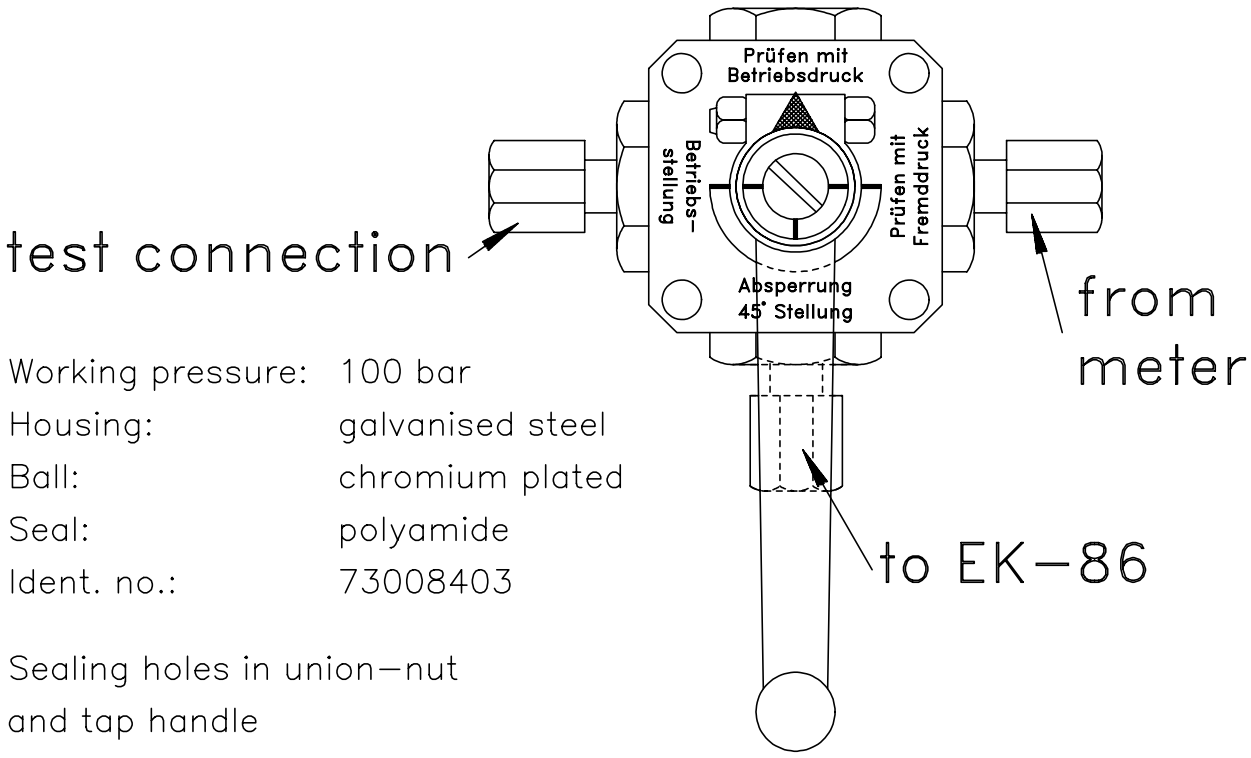
- 2-core with screen (min. 60% coverage)
- core thickness ≥ 0.5 mm²
- core colour coding according to DIN 47100
- cable diameter 8-10 mm

e.g.: Order number: **04250828**

- designation: 4 x 1.5 mm²; each with 2 cores joined; sheath LiYCY; sheath colour light grey (RAL 7032); overall diam. 9.0 mm

C-4f Three-way tap

Normally a three-way tap is installed when mounting the pressure sensor in order to be able test the pressure sensor in the installed condition or to be able to replace a defective sensor without needing to turn off the complete gas line. The three-way taps from ELSTER (special accessory - Order no.: 73008403) have the following construction:



Explanation:

"from meter" the	From the "**p_r connection**" on the gas meter; with dry gas meters pressure is obtained from the input side of the meter.
"to EK-86"	For connection of the pressure sensor used.
"test connection"	Here there is the option of obtaining a test pressure or subjecting the EK-86 pressure sensor to an external pressure.

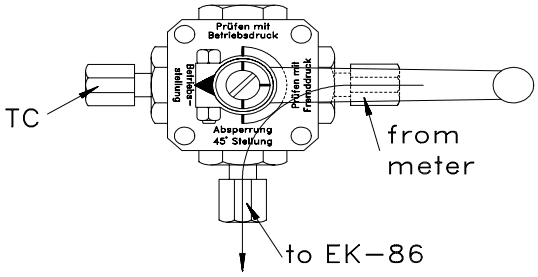
☞ *When mounting the three-way tap, it is essential to ensure that the position of the operating lever is checked by noting the direction of flow, because the lever can be removed and may be mounted the wrong way round!*

Meaning of separate positions

Operating position

This is the "normal position" for the three-way tap. The connection from the gas meter to the pressure sensor is open; all other connections are shut off. The three-way tap is sealed in this position. The TC point (test connection) is closed.

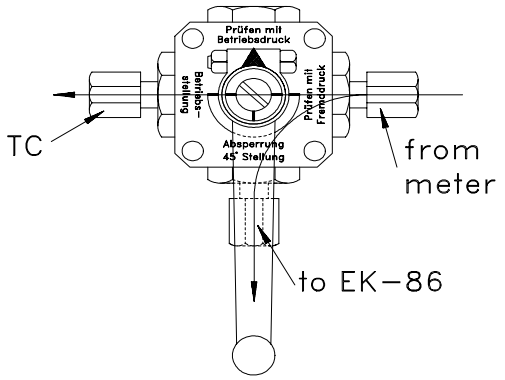
Operating position



Testing with operating pressure

The test connection (TC) is also opened in this position. Another pressure sensor can be connected to this point for a comparison.

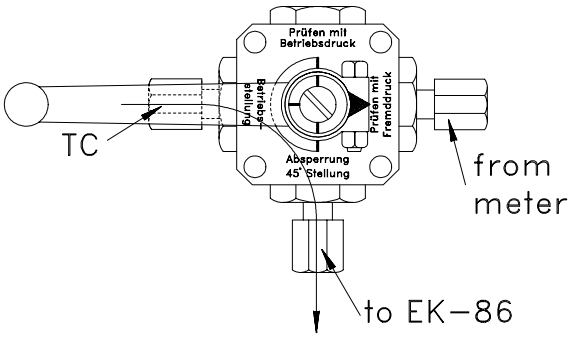
Testing with operating pressure



Testing with external pressure

The EK-86 pressure sensor can be subjected to an external pressure in this case. It can be used for checking/calibrating the pressure sensor. This can take place with the pressure sensor installed.

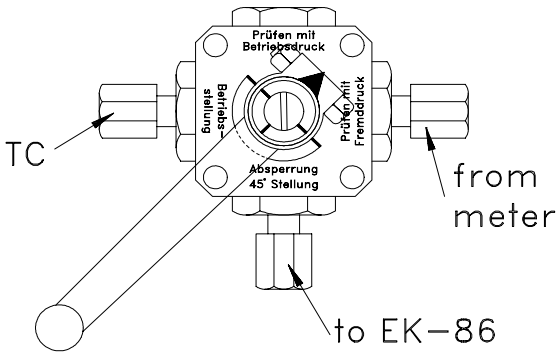
Testing with external pressure



Shut-off position

All connections are blocked in each of the 45° operating lever positions. This is required when replacing the pressure sensor for example.

Shut–off position

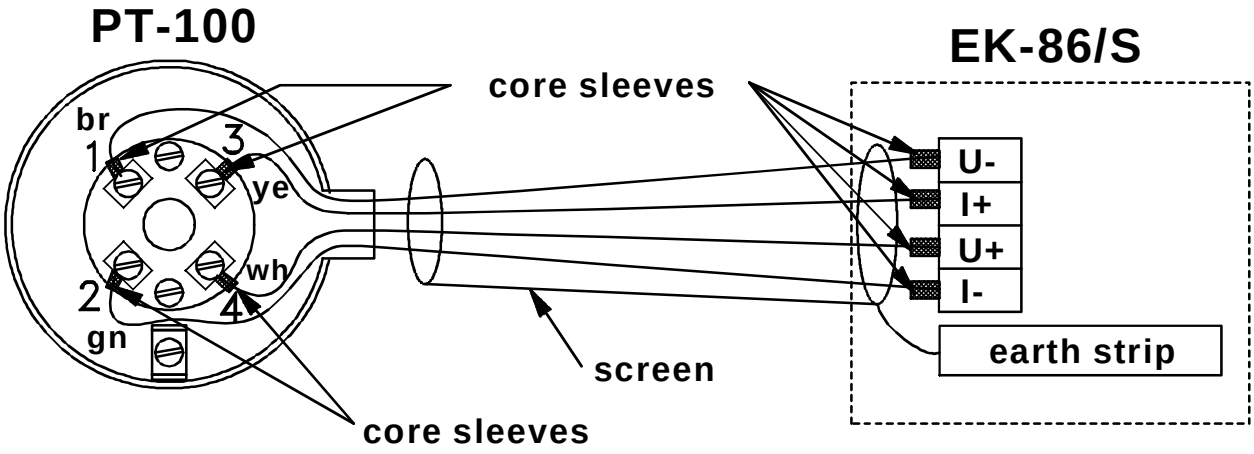


C-5 Temperature sensor

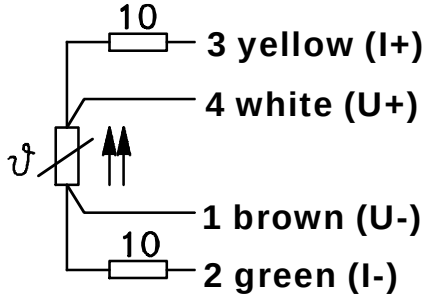
C-5a Temperature Sensor Pt100 "EBL160AF/EX-D"

Temperature sensor type:	Pt100 according to DIN IEC 751
Type of connection:	4-wire technology, used in sensor pocket
Measurement uncertainty:	≤ ± 0.1% of measurement
Perm. gas temp. range:	-10 °C... + 60 °C
Mech. dimensions:	installed length = 160 mm; system connection: G 1/2"; cable connection: DIN EN 50018 4 x 0.75 mm² with core sleeves; cable diameter: 8-10 mm
Explosion protection:	EEx d II C T6
Order designation:	EBL160AF/EX-D; Order no.: 04102001

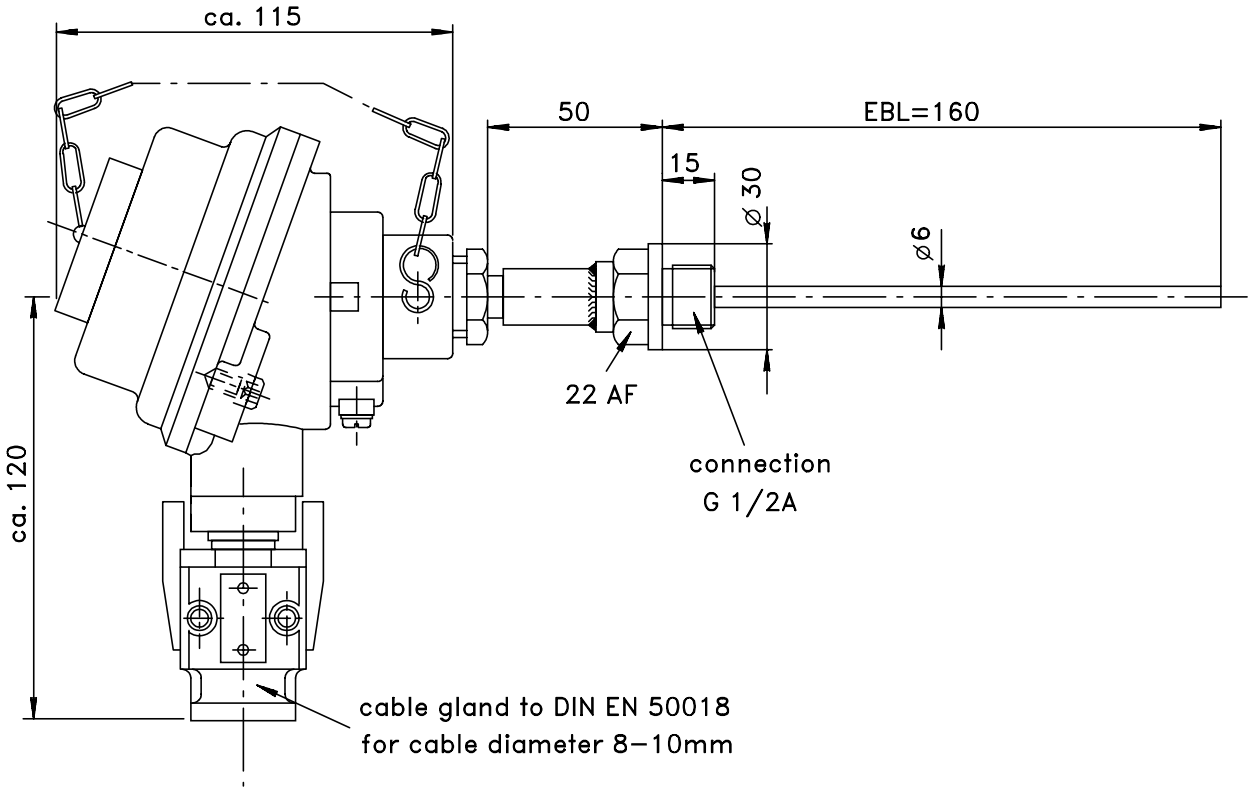
Connection assignment (EBL160AF/EX-D):



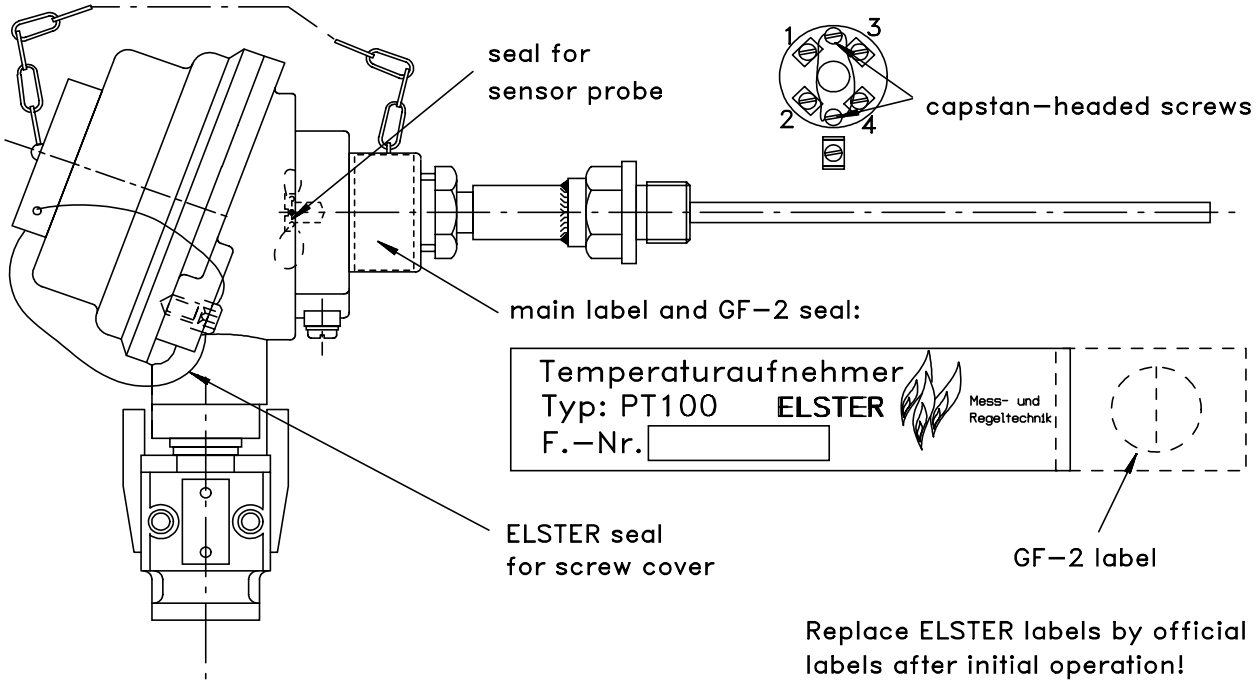
Circuit diagram



Dimensions (EBL160AF/EX-D):



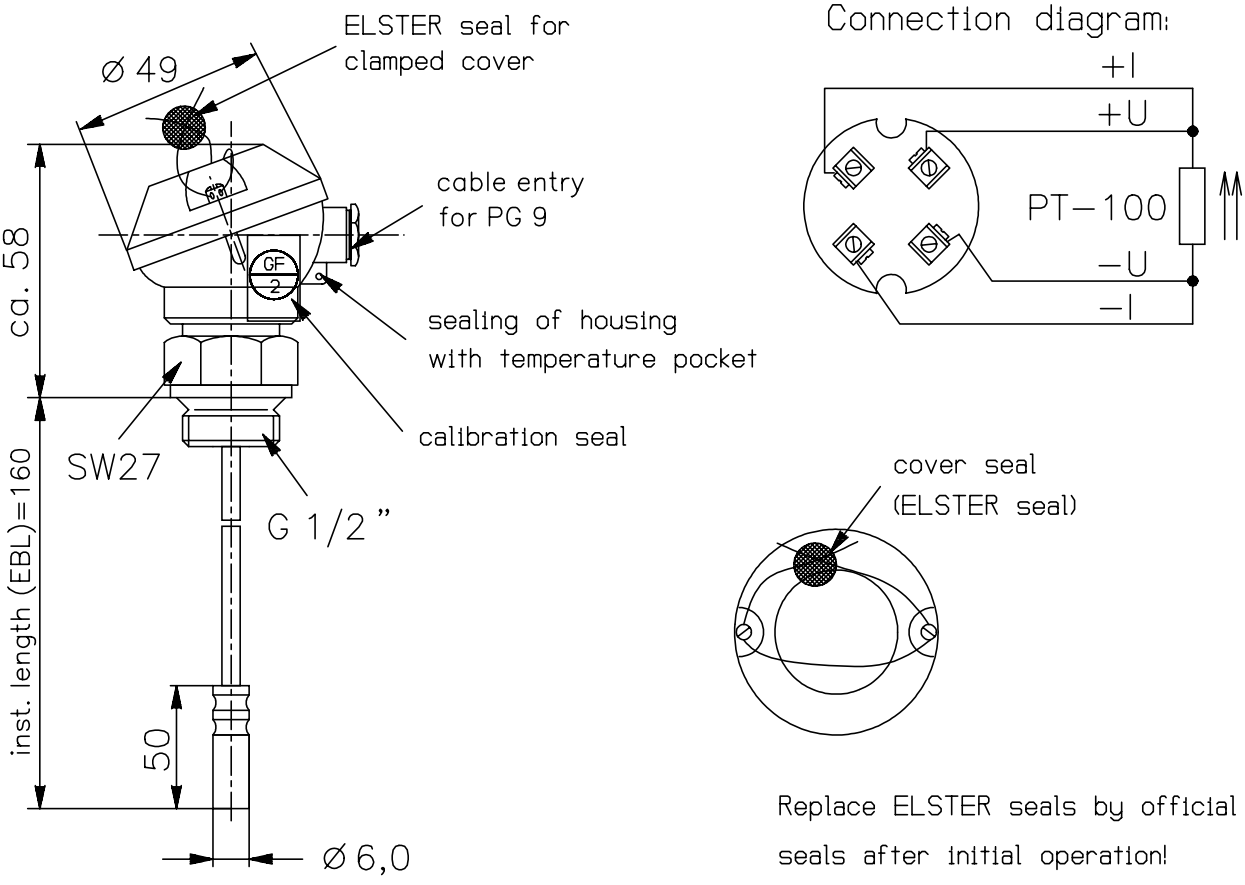
Sealing plan (EBL160AF/EX-D):



C-5b Temperature Sensor Pt100 "EBL160AF/EX-I"

Temperature sensor type:	Pt100 according to 1/3 DIN Cl. B
Type of connection:	4-wire technology Used in sensor pocket with installed length = 160 mm
Measurement uncertainty:	≤ ± 0.1% of measurement
Perm. gas temp. range:	-10 °C... + 60 °C
Mech. dimensions:	installed length = 160 mm; system connection: G 1/2"; cable connection: PG 9 for cable diameter 5-8 mm, 4 x 0.5 mm² with core sleeves;
Explosion protection:	EEx ib II C T4 (in preparation)
Order designation:	EBL160AF/EX-I; Order no.: 73014105

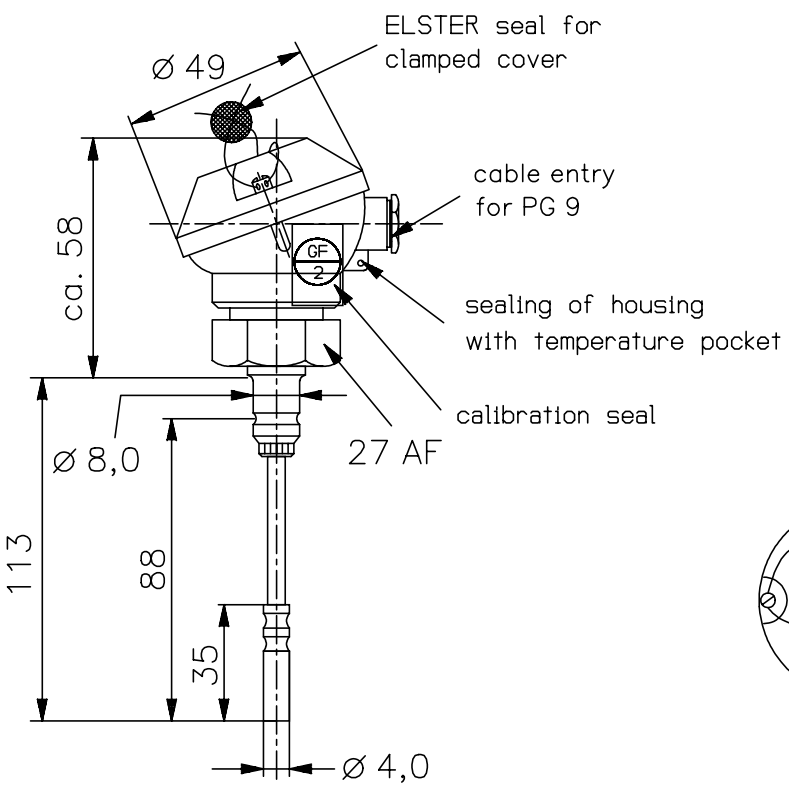
Dimensions and sealing plan (EBL160AF/EX-I):

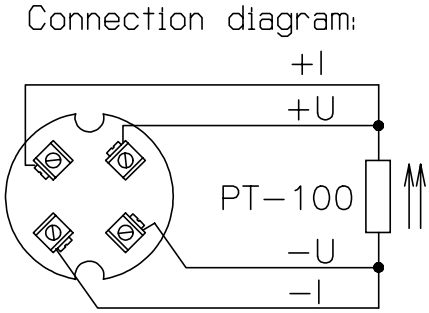


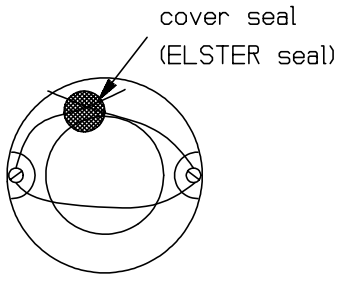
C-5c Temperature Sensor Pt100 "EBL50AF/EX-I"

Temperature sensor type:	Pt100 according to 1/3 DIN Cl. B
Type of connection:	4-wire technology Used in sensor pocket with installed length = 50 mm
Measurement uncertainty:	≤ ± 0.1% of measurement
Perm. gas temp. range:	-10 °C... + 60 °C
Mech. dimensions:	installed length = 50 mm; system connection: M 10 x 1 mm; cable connection: PG 9 for cable diameter 5-8 mm, 4 x 0.5 mm² with core sleeves;
Explosion protection:	EEx ib II C T4 (in preparation)
Order designation:	EBL50AF/EX-I; Order no.: 73014104

Dimensions and sealing plan (EBL50AF/EX-I):





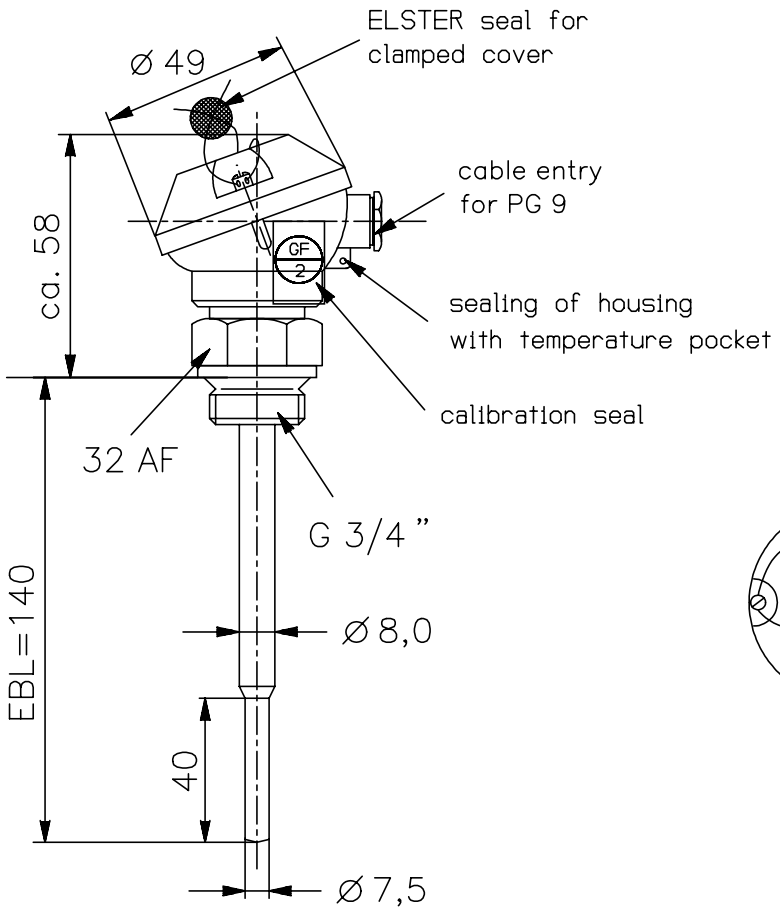


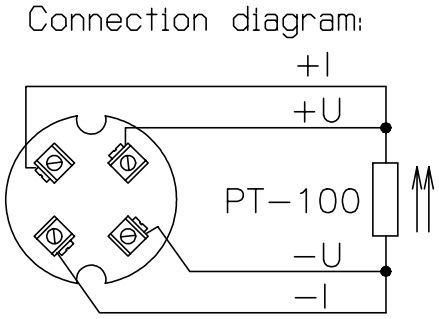
Replace ELSTER seals by official seals after initial operation!

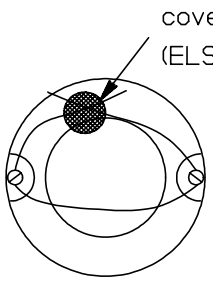
C-5d Temperature Sensor Pt100 "EBL140AD/EX-I"

Temperature sensor type:	Pt100 according to 1/3 DIN Cl. B
Type of connection:	4-wire technology Used direct in gas stream; PN 16
Measurement uncertainty:	≤ ±0.1% of measurement
Perm. gas temp. range:	-10 °C... +60 °C
Mech. dimensions:	installed length = 140 mm; system connection: G 3/4"; cable connection: PG 9 for cable diameter 5-8 mm, 4 x 0.5 mm² with core sleeves;
Explosion protection:	EEx ib II C T4 (in preparation)
Order designation:	EBL140AD/EX-I; Order no.: 73014103

Dimensions and sealing plan (EBL140AD/EX-I):







Replace ELSTER seals by official seals after initial operation!

C-5e Temperature pockets EBL160 and EBL50

The temperature sensor must be installed in a thermometer pocket on the gas meter. If no pocket is available, then with turbine and dry gas meters, the temperature sensor should be mounted up to 3D (but a maximum of 600 mm) after the meter and with rotary piston gas meters it should be mounted up to 2D before the meter (D = pipe diameter).

Various pockets are available for the installation depending on the pipe diameter:

a.) Temperature pockets in Elster meter housings

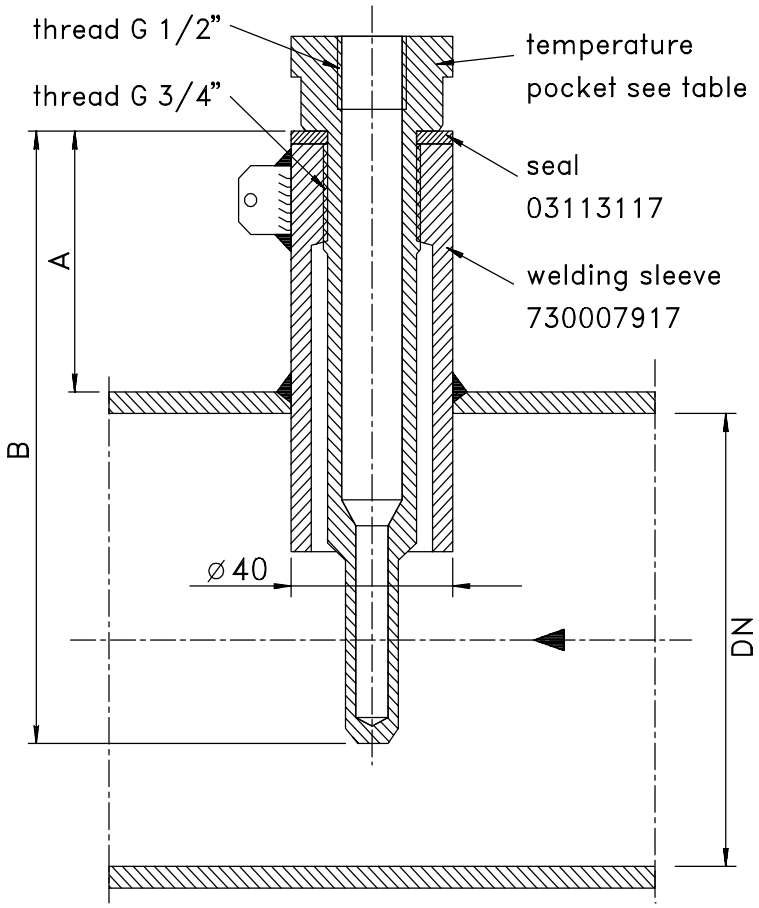
Temperature measurement point in Elster meter housing			
DN (housing/meas. cartridge) (PN;ANSI)		**Type (installed length in mm)**	**Order no. (pocket)**
80 / 50	PN 10 to ANSI 600	EBL 58	73013524
80	PN 10 to ANSI 600	EBL 45	73013410
100/80	PN 10 to ANSI 600	EBL 58	73013524
100	PN 10 to ANSI 600	EBL 50	73012556
150/100	PN 10 to ANSI 600	EBL 67	73013525
150	PN 10 to ANSI 600	EBL 50	73012556
200/150	PN 10 to ANSI 600	EBL 67	73013525
200	PN 10/16; ANSI 300/600	EBL 58	73013524
200	PN 25/40; ANSI 300/600	EBL 67	73013525
>250	PN10 to ANSI 600	EBL 160	73011620

The described pockets are supplied together with the meter.

b.) Temperature pockets for pipes

Temperature measuring point in pipe				
DN	**Type**	**A**	**B**	**Order no. (pocket)**
40	EBL 50	23	50	73012556
50	EBL 58	23	58	73013524
80	EBL 67	23	67	73013525
80	EBL 160	68	142	73011620
100	EBL 160	56	142	73011620
>150	EBL 160	34	142	73011620

Temperature pocket for EBL160

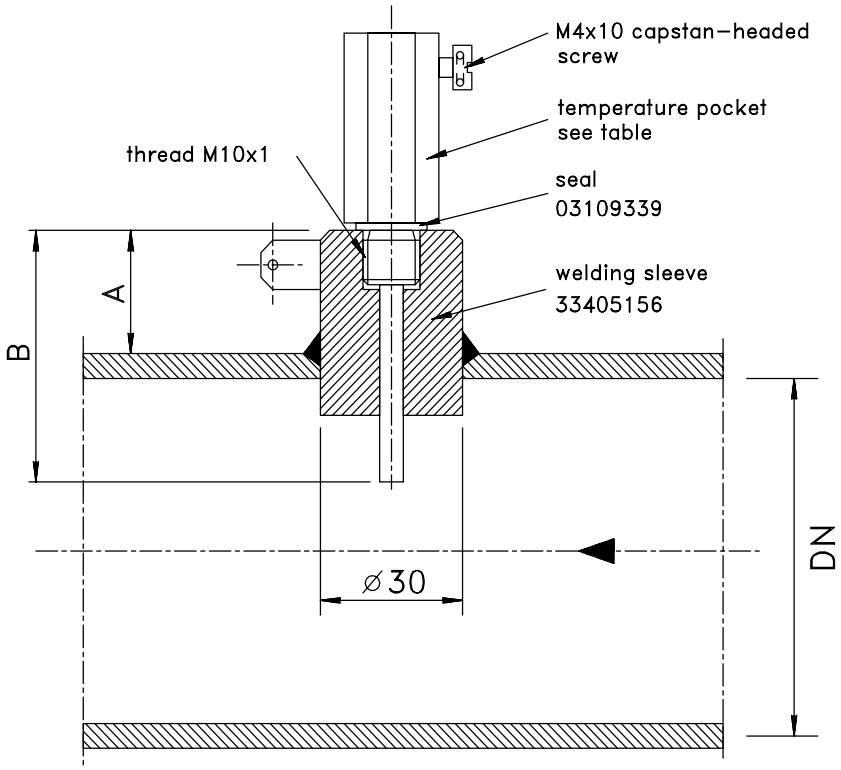


The pocket is suitable for PT100 temperature probes with an installation length (EBL) of 160 mm. It consists of the temperature pocket, the seal and the welding sleeve (article number for the complete pocket: 73012100). The welding sleeve is suitable for a pipe diameter from DN 80 upwards.

Important:

For acceptance of the system a second pocket is normally required for the comparison measurement. Also, it must be ensured that this pocket is fitted displaced from the sensor temperature pocket (note the size of the connecting head).

Temperature pocket for EBL45-67



The pocket is suitable for PT100 temperature probes with an installation length of 50 mm. The complete pocket (article no.: 73012634) consists of the temperature pocket, the seal and the welding sleeve.

The welding sleeve is suitable for pipe diameters from DN 80 to DN80. The maximum system operating pressure must not exceed 16 bar for this welding sleeve.

Important:

For acceptance of the system a second pocket is normally required for the comparison measurement. Also, it must be ensured that this pocket is fitted displaced from the sensor temperature pocket (note the size of the connecting head).

C-5f Connecting cables for the temperature sensor

There are certain connection conditions for systems subject to official calibration and it is essential that they are observed. The following standards apply to cables that are used in intrinsically safe systems:

- DIN VDE 0298 Parts 1 and 3
- DIN VDE 0891 Parts 1, 5 and 6
- Combustion characteristics according to DIN VDE 0472 Part 804, Test Type B
- Electric strength between conductor and screen according to DIN VDE 0165 Section 6.1.3.2.1: min. 500 Vrms.

This results in the following requirements for the connecting cables:

a.) Cables for intrinsically safe circuits (e.g.: JUMO temperature sensor)

- Ex connecting cable for intrinsically safe circuits
- 4-core with screen (min. 60% coverage)
- core thickness ≥ 0.5 mm2, single strands ≥ 0.1 mm²
- core colour coding according to DIN 47100
- overall cable diameter: 5-8 mm, colour bright blue

e.g. Order number: **04250123**

- designation: 2 x 2 x 0.5 mm²; sheath LiYCY; sheath colour bright blue (RAL 5015); overall diam. ≤ 8.0 mm

b.) Cable for Ex-d circuits (e.g.: Degussa temperature sensor)

- 4-core with screen (min. 60% coverage)
- core thickness ≥ 0.5 mm²
- core colour coding according to DIN 47100
- overall cable diameter 8-10 mm

e.g.: Order number: **04250124**

- designation: 2 x 2 x 0.5 mm²; stranded in pairs; sheath LifYCY; sheath colour light grey (RAL 7032); overall diam. 9.0 mm

or Order number: **04250828**

- designation: 4 x 1.5 mm²; sheath LiYCY; sheath colour light grey (RAL 7032); overall diam. 9.0 mm

D Certificates

D-1 Ex approvals

DMT-Gesellschaft für Forschung und Prüfung mbH

Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

BVS

DMT

Elektrische Betriebsmittel für explosionsgefährdete Bereiche

(1) **Konformitätsbescheinigung**

(2) **BVS 92.C.2046 X**

(3) Diese Bescheinigung wird ausgestellt für:

Analogeingabe-Karte Typ EXAE2 V1.0

(4) Hergestellt und zur Bescheinigung vorgelegt von:

ELSTER Produktion GmbH
W - 6503 Mainz-Kastel

(5) Die Bauart dieses elektrischen Betriebsmittels sowie die verschiedenen zulässigen Ausführungen sind im Anhang zu dieser Konformitätsbescheinigung festgelegt.

(6) Die Bergbau-Versuchsstrecke, zugelassene Stelle entsprechend Artikel 14 der Richtlinie des Rates der Europäischen Gemeinschaften 76/117/EWG vom 18. Dezember 1975,

- bescheinigt, daß das elektrische Betriebsmittel mit den folgenden Harmonisierten Europäischen Normen übereinstimmt:

  EN 50014-1977 + A1 - A5 (VDE 0170/0171 Teil 1/1.87) Allgemeine Bestimmungen
  EN 50020-1977 + A1 - A2 (VDE 0170/0171 Teil 7/1.87) Eigensicherheit "i"

  und mit Erfolg die nach diesen Normen vorgeschriebenen Typenprüfungen bestanden hat,
- bescheinigt, daß ein vertraulicher Prüfbericht über diese Prüfungen erstellt wurde.

(7) Das Kennzeichen des elektrischen Betriebsmittels ist:

[EEx ib] IIC

(8) Diese Bescheinigung darf nur vollständig und unverändert vervielfältigt werden.

Seite 1/5

BVS 92.C.2046 X vom 08.09.1992

DMT

(9) Konformitätsbescheinigung BVS 92.C.2046 X

(10) Durch die Kennzeichnung des gelieferten Betriebsmittels bestätigt der Hersteller in eigener Verantwortung, daß dieses elektrische Betriebsmittel mit den im Anhang zu dieser Bescheinigung erwähnten darstellenden Unterlagen übereinstimmt und mit Erfolg die nach den Harmonisierten Europäischen Normen, wie sie in (6) weiter oben erwähnt sind, vorgeschriebenen Stückprüfungen bestanden hat.

(11) Das gelieferte elektrische Betriebsmittel darf das in Anhang II der Richtlinie Nr. 84/47/EWG der Kommission vom 16. Januar 1984 dargestellte Gemeinschaftskennzeichen tragen. Dieses Kennzeichen erscheint auf der ersten Seite dieser Bescheinigung; es muß an dem elektrischen Betriebsmittel gut sichtbar, lesbar und dauerhaft angebracht sein.

(12) Steht das Zeichen X hinter der Nummer der Konformitätsbescheinigung, so bedeutet dies, daß dieses elektrische Betriebsmittel den besonderen im Anhang zu dieser Bescheinigung aufgeführten Auflagen/Bedingungen für die sichere Anwendung unterliegt.

4600 Dortmund-Derne, den 08.09.1992
BVS-Tha/Hid A 9200243

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Dr. Dill

DMT-Fachstelle für Sicherheit elektrischer Betriebsmittel - Bergbau-Versuchsstrecke
DMT

Seite 2/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2046 X

(A 1) Analogeingabe-Karte Typ EXAE2 V1.0

(A 2) Beschreibung

Die Analogeingabe-Karte Typ EXAE2 V1.0 dient zur eigensicheren Stromversorgung eines Zweidraht-Transmitters und eines Widerstandsgebers in Vierleitertechnik sowie zur Aufnahme, Umformung und Weitergabe der Signale an nichteigensichere Schaltungen.

Der zulässige Umgebungstemperaturbereich beträgt - 10 °C bis + 60 °C.

(A 3) Darstellende Unterlagen

3.1 Beschreibung (8 Bl.), unterschrieben am 10.07.92

3.2 Zeichnung Nr.:

	vom:	unterschrieben am:
EXAE2V1.0/Z02 (2 Bl.)	10.02.92	10.07.92
EXAE2V1.0/Z03	10.02.92	10.07.92
EXAE2V1.0/Z04	10.02.92	10.07.92
EXAE2V1.0/Z05	10.02.92	10.07.92
EXAE2V1.0/Z06	10.02.92	10.07.92
EXAE2V1.0/Z07	10.02.92	10.07.92
EXAE2V1.0/Z08	10.02.92	10.07.92

3.3 Stückliste Nr.:

	vom:	unterschrieben am:
EXAE2V1.0/Z01 (3 Bl.)	10.02.92	10.07.92

Seite 3/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2046 X

(A 4) Elektrische Daten

nichteigesichere Versorgungsspannung (Stecker ST1)	DC 24 V
Versorgungs-/ Signalstromkreise	in Zündschutzart Eigensicherheit EEx ib IIC
Zweidraht-Transmitter (Stecker ST3)	Höchstwerte: U_o = 20 V
	I_k = 75 mA
	lineare Kennlinie
	höchstzul. äußere Induktivität 0,5 mH
	höchstzul. äußere Kapazität 200 nF
Wiederstandsgeber (Stecker ST5/ST6)	Höchstwerte: U_o = 9,6 V
	I_k = 3 mA
	lineare Kennlinie
	höchstzul. äußere Induktivität 10 mH
	höchstzul. äußere Kapazität 400 nF
Datenausgang (Stecker ST2)	zum Anschluß an Geräte mit einer Nennspannung bis 250 V

Die Versorgungs-/Signalstromkreise sind von allen übrigen Stromkreisen bis zu einem Scheitelwert der Nennspannung von 375 V sicher galvanisch getrennt.

Seite 4/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2046 X

(A 5) Kennzeichnung

Die Kennzeichnung muß gut sichtbar, lesbar und dauerhaft sein; sie muß die folgenden Angaben umfassen:

5.1 Namen des Herstellers oder sein Warenzeichen
Typ EXAE2 V1.0
[EEx ib] IIC
Fertigungsnummer
BVS 92.C.2046 X
Tmin - 10 °C
Tmax + 60 °C

5.2 Die Kennzeichnung, die normalerweise für das betreffende elektrische Betriebsmittel in den Konstruktionsnormen vorgesehen ist.

(A 6) Stückprüfungen

Die Stückprüfungen sind von der ELSTER Produktion GmbH, W - 6503 Mainz-Kastel, nach 23 von EN 50014-1977 (VDE 0170/0171 Teil 1/5.78) durchzuführen.

(A 7) Besondere Auflagen/Bedingungen für die sichere Anwendung

7.1 Die Analogeingabe-Karte Typ EXAE2 V1.0 ist außerhalb des explosionsgefährdeten Bereiches zu errichten.

7.2 Die Analogeingabe-Karte Typ EXAE2 V1.0 ist so zu errichten, daß eine Schutzart von mindestens IP 20 gemäß IEC 529 erreicht wird.

4600 Dortmund-Derne, den 08.09.1992
BVS-Tha/Hid A 9200243

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Dr. Dill

DMT-Fachstelle für Sicherheit elektrischer Betriebsmittel - Bergbau-Versuchsstrecke - DMT

Der Sachverständige

Thater

Seite 5/5

DMT-Gesellschaft für Forschung und Prüfung mbH

Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

BVS

DMT

Ex

Elektrische Betriebsmittel für explosionsgefährdete Bereiche

(1) **Konformitätsbescheinigung**

(2) **BVS 92.C.2039 X**

(3) Diese Bescheinigung wird ausgestellt für:

Impuls-Eingangskarte Typ EXZE4

(4) Hergestellt und zur Bescheinigung vorgelegt von:

ELSTER Produktion GmbH
W - 6503 Mainz-Kastel

(5) Die Bauart dieses elektrischen Betriebsmittels sowie die verschiedenen zulässigen Ausführungen sind im Anhang zu dieser Konformitätsbescheinigung festgelegt.

(6) Die Bergbau-Versuchsstrecke, zugelassene Stelle entsprechend Artikel 14 der Richtlinie des Rates der Europäischen Gemeinschaften 76/117/EWG vom 18. Dezember 1975,

- bescheinigt, daß das elektrische Betriebsmittel mit den folgenden Harmonisierten Europäischen Normen übereinstimmt:

  EN 50014-1977 + A1 - A5 (VDE 0170/0171 Teil 1/1.87) Allgemeine Bestimmungen
  EN 50020-1977 + A1 - A2 (VDE 0170/0171 Teil 7/1.87) Eigensicherheit "i"

  und mit Erfolg die nach diesen Normen vorgeschriebenen Typenprüfungen bestanden hat,

- bescheinigt, daß ein vertraulicher Prüfbericht über diese Prüfungen erstellt wurde.

(7) Das Kennzeichen des elektrischen Betriebsmittels ist:

[EEx ib] IIC

(8) Diese Bescheinigung darf nur vollständig und unverändert vervielfältigt werden.

Seite 1/5

BVS 92.C.2039 X vom 03.08.1992

DMT

(9) Konformitätsbescheinigung BVS 92.C.2039 X

(10) Durch die Kennzeichnung des gelieferten Betriebsmittels bestätigt der Hersteller in eigener Verantwortung, daß dieses elektrische Betriebsmittel mit den im Anhang zu dieser Bescheinigung erwähnten darstellenden Unterlagen übereinstimmt und mit Erfolg die nach den Harmonisierten Europäischen Normen, wie sie in (6) weiter oben erwähnt sind, vorgeschriebenen Stückprüfungen bestanden hat.

(11) Das gelieferte elektrische Betriebsmittel darf das in Anhang II der Richtlinie Nr. 84/47/EWG der Kommission vom 16. Januar 1984 dargestellte Gemeinschaftskennzeichen tragen. Dieses Kennzeichen erscheint auf der ersten Seite dieser Bescheinigung; es muß an dem elektrischen Betriebsmittel gut sichtbar, lesbar und dauerhaft angebracht sein.

(12) Steht das Zeichen X hinter der Nummer der Konformitätsbescheinigung, so bedeutet dies, daß dieses elektrische Betriebsmittel den besonderen im Anhang zu dieser Bescheinigung aufgeführten Auflagen/Bedingungen für die sichere Anwendung unterliegt.

4600 Dortmund-Derne, den 03.08.1992
BVS-Tha/Hid A 9200115

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Dr. Wenzel

DMT-Fachstelle für Sicherheit elektrischer Betriebsmittel - Bergbau-Versuchsstrecke DMT

Seite 2/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2039 X

(A 1) Impuls-Eingangskarte Typ EXZE4

(A 2) Beschreibung

Die Impuls-Eingangskarte Typ EXZE4 dient zur eigensicheren Stromversorgung von bis zu vier Zweidrahtsensoren und zur Aufnahme, Umformung und Weitergabe der Signale an nichteigensichere Schaltungen.

Der zulässige Umgebungstemperaturbereich beträgt - 10 °C bis + 60 °C.

(A 3) Darstellende Unterlagen

3.1 Beschreibung (6 Bl.), unterschrieben am 10.06.92

3.2 Zeichnung Nr.:	vom:	unterschrieben am:
EXZE4V1.0/Z02 (2 Bl.)	17.12.91	10.06.92
EXZE4V1.0/Z03	17.12.91	10.06.92
EXZE4V1.0/Z04	17.12.91	10.06.92
EXZE4V1.0/Z05	17.12.91	10.06.92
EXZE4V1.0/Z06	17.12.91	10.06.92
EXZE4V1.0/Z07	17.12.91	10.06.92

3.3 Stückliste Nr.:	vom:	unterschrieben am:
EXZE4V1.0/Z01 (2 Bl.)	17.12.91	10.06.92

Seite 3/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2039 X

(A 4) Elektrische Daten

nichteigesichere Versorgungsspannung (Stecker ST1)	DC 24 V
Versorgungs-/ Signalstromkreise (Klemmen ST2 bis ST5)	in Zündschutzart Eigensicherheit EEx ib IIC
	Höchstwerte je Stromkreis:
	U_o = 11,6 V
	I_k = 11,8 mA
	lineare Kennlinie
	höchstzul. äußere Induktivität 10 mH
	höchstzul. äußere Kapazität 300 nF
Datenausgang (Stecker ST6)	zum Anschluß an Geräte mit einer Nennspannung bis 250 V

Die Versorgungs-/Signalstromkreise sind von allen übrigen Stromkreisen bis zu einem Scheitelwert der Nennspannung von 375 V sicher galvanisch getrennt.

(A 5) Kennzeichnung

Die Kennzeichnung muß gut sichtbar, lesbar und dauerhaft sein; sie muß die folgenden Angaben umfassen:

5.1 Namen des Herstellers oder sein Warenzeichen
Typ EXZE4
[EEx ib] IIC
Fertigungsnummer
BVS 92.C.2039 X
Tmin - 10 °C
Tmax + 60 °C

5.2 Die Kennzeichnung, die normalerweise für das betreffende elektrische Betriebsmittel in den Konstruktionsnormen vorgesehen ist.

Seite 4/5

Anhang zur Konformitätsbescheinigung

BVS 92.C.2039 X

(A 6) Stückprüfungen

Die Stückprüfungen sind von der ELSTER Produktion GmbH, W - 6503 Mainz-Kastel, nach 23 von EN 50014-1977 (VDE 0170/0171 Teil 1/5.78) durchzuführen.

(A 7) Besondere Auflagen für die sichere Anwendung

7.1 Die Impuls-Eingangskarte Typ EXZE4 ist außerhalb des explosionsgefährdeten Bereiches zu errichten.

7.2 Die Impuls-Eingangskarte Typ EXZE4 ist so zu errichten, daß eine Schutzart von mindestens IP 20 gemäß IEC 529 erreicht wird.

4600 Dortmund-Derne, den 03.08.1992
BVS-Tha/Hid A 9200115

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Dr. Wenzel

DMT-Fachstelle für Sicherheit elektrischer Betriebsmittel - Bergbau-Versuchsstrecke DMT

Der Sachverständige

Thater

Seite 5/5

Translations of German certificates:

D-1 Ex approvals

DMT-Gesellschaft für Forschung und Prüfung mbH

Specialists for the safety of electrical equipment
Mining Test Section BVS

Ex

Electrical equipment for areas subject to explosion hazard

(1) **Certificate of conformance**

(2) **BVS 92.C.2046 X**

(3) This certificate is issued for:
Analogue Input Card Type EXAE2 V1.0

(4) Manufactured and submitted for certification by:

Elster Produktion GmbH
W - 6503 Mainz-Kastel

(5) The construction of this electrical equipment and the various approved versions is specified in the appendix to this conformance certificate.

(6) The Mining Test Section, an approved station according to article 14 of the guideline from the Council of the European Community 76/117/EWG of 18th December 1975,

- confirms that this electrical equipment meets the following Harmonised European Standards:

  EN 50014-1977 + A1 - A5 (VDE 0170/0171 Part 1/1.87) General requirements
  EN 50020-1977 + A1 - A2 (VDE 0170/0171 Part 7/1.87) Intrinsic Safety “i”

  and has successfully passed the type tests specified according to these standards,

- confirms that a confidential test report on these tests has been produced.

(7) The symbol for the electrical equipment is:

[EEx ib] IIC

(8) This certificate must only be reproduced in its entirety and unmodified.

BVS 92.C.2046 X of 08.09.1992

(9) Certificate of conformance BVS 92.C.2046 X

(10) With the labelling of the supplied equipment the manufacturer confirms on his own responsibility that this electrical equipment conforms to the explanatory documentation mentioned in the appendix to this description and has successfully passed the routine check tests specified according the Harmonised European Standards, as mentioned above in (6).

(11) The supplied electrical equipment may bear the Community label shown in Appendix II of Guideline No. 84/47/EWG from the Commission of 16th January 1984. This label appears on the first page of this certificate; it must be fitted to the electrical equipment so that it is easily visible, readable and permanent.

(12) If the symbol X appears after the number of the conformance certificate, then it means that this electrical equipment is subject to the special conditions for safe application which are listed in the appendix to this certificate.

4600 Dortmund-Derne, 08.09.1992
BVS-Tha/Hid A 9200243

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section

Appendix to Certificate of Conformance
BVS 92.C.2046 X

(A1) Analogue Input Card Type EXAE2 V1.0

(A2) Description

The Analogue Input Card Type EXAE2 V1.0 is used for the intrinsically safe supply of power to a two-wire transmitter and a resistive transmitter in four-wire technology as well as for the acquisition, conversion and transfer of the signals to non-intrinsically safe circuits.

The permissible ambient temperature range extends from -10 °C to +60 °C.

(A3) Explanatory documentation

3.1 Description (8 pages), signed on 10.07.92

3.2 Drawing no.:	of:	signed on:
EXAE2V1.0/Z02 (2 pages)	10.02.92	10.07.92
EXAE2V1.0/Z03	10.02.92	10.07.92
EXAE2V1.0/Z04	10.02.92	10.07.92
EXAE2V1.0/Z05	10.02.92	10.07.92
EXAE2V1.0/Z06	10.02.92	10.07.92
EXAE2V1.0/Z07	10.02.92	10.07.92
EXAE2V1.0/Z08	10.02.92	10.07.92

3.3 Parts List No.:	of:	signed on:
EXAE2V1.0/Z01 (3 pages)	10.02.92	10.07.92

Appendix to Certificate of Conformance
BVS 92.C.2046 X

(A4) Electrical data

Non-intrinsically safe supply voltage (connector ST1)	DC 24 V	
Supply/signal circuits	in Intrinsically Safe explosion protection EEx ib IIC	
Two-wire transmitter (connector ST3)	Maximum values: U_0 = 20 V	
	Ik = 75 mA	
	linear characteristic	
	max. perm. external inductance	0.5 mH
	max. perm. external capacitance	200 nF
Resistive transmitter (connector ST5/ST6)	Maximum values: U_0 = 9.6 V	
	I_k = 3 mA	
	linear characteristic	
	max. perm. external inductance	10 mH
	max. perm. external capacitance	400 nF
Data output (connector ST2)	For connection to equipment with a nominal voltage up to 250 V	

The supply/signal circuits are safely electrically isolated from all other circuits up to a peak nominal voltage of 375 V.

Page 4/5

Appendix to Certificate of Conformance
BVS 92.C.2046 X

(A5) Labelling

The label must be easily visible, readable and permanent; it must include the following details:

5.1 Name of the manufacturer or his trademark
Type EXAE2 V1.0
[EEx ib] IIC
Production number
BVS 92.C.2046 X
Tmin - 10 °C
Tmax + 60 °C

5.2 The label which is normally provided for the relevant electrical equipment according to the design standards.

(A6) Routine check tests

Routine check tests must be carried out by ELSTER Produktion GmbH, W - 6503 Mainz-Kastel, according to 23 of EN 50014-1977 (VDE 0170/0171 Part 1/5.78).

(A7) Special conditions for safe use

7.1 The Analogue Input Card Type EXAE2 V1.0 should be set up outside of the area subject to explosion hazard.

7.2 The Analogue Input Card Type EXAE2 V1.0 should be installed such that protection to at least IP 20 according to IEC 529 is obtained.

4600 Dortmund-Derne, 08.09.1992
BVS-Tha/Hid A 9200243

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section **Responsible official**

DMT-Gesellschaft für Forschung und Prüfung mbH

Specialists for the safety of electrical equipment
Mining Test Section BVS

Ex

Electrical equipment for areas subject to explosion hazard

(1) **Certificate of conformance**

(2) **BVS 92.C.2039 X**

(3) This certificate is issued for:
Pulse Input Card Type EXZE4

(4) Manufactured and submitted for certification by:

Elster Produktion GmbH
W - 6503 Mainz-Kastel

(5) The construction of this electrical equipment and the various approved versions is specified in the appendix to this conformance certificate.

(6) The Mining Test Section, an approved station according to article 14 of the guideline from the Council of the European Community 76/117/EWG of 18th December 1975,

- confirms that this electrical equipment meets the following Harmonised European Standards:

  EN 50014-1977 + A1 - A5 (VDE 0170/0171 Part 1/1.87) General requirements
  EN 50020-1977 + A1 - A2 (VDE 0170/0171 Part 7/1.87) Intrinsic Safety “i”

  and has successfully passed the type tests specified according to these standards,

- confirms that a confidential test report on these tests has been produced.

(7) The symbol for the electrical equipment is:

[EEx ib] IIC

(8) This certificate must only be reproduced in its entirety and unmodified.

BVS 92.C.2046 X of 03.08.1992

(9) Certificate of conformance BVS 92.C.2039 X

(10) With the labelling of the supplied equipment the manufacturer confirms on his own responsibility that this electrical equipment conforms to the explanatory documentation mentioned in the appendix to this description and has successfully passed the routine check tests specified according the Harmonised European Standards, as mentioned above in (6).

(11) The supplied electrical equipment may bear the Community label shown in Appendix II of Guideline No. 84/47/EWG from the Commission of 16th January 1984. This label appears on the first page of this certificate; it must be fitted to the electrical equipment so that it is easily visible, readable and permanent.

(12) If the symbol X appears after the number of the conformance certificate, then it means that this electrical equipment is subject to the special conditions for safe application which are listed in the appendix to this certificate.

4600 Dortmund-Derne, 03.08.1992
BVS-Tha/Hid A 9200115

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section

Appendix to Certificate of Conformance
BVS 92.C.2039 X

(A1) Pulse Input Card Type EXZE4

(A2) Description

The Pulse Input Card Type EXZE4 is used for the intrinsically safe supply of power to up to four two-wire sensors and for acquisition, conversion and transfer of the signals to non- intrinsically safe circuits.

The permissible ambient temperature range extends from -10 °C to +60 °C.

(A3) Explanatory documentation

3.1 Description (6 pages), signed on 10.06.92

3.2 Drawing no.:	of:	signed on:
EXZE4V1.0/Z02 (2 pages)	17.12.91	10.06.92
EXZE4V1.0/Z03	17.12.91	10.06.92
EXZE4V1.0/Z04	17.12.91	10.06.92
EXZE4V1.0/Z05	17.12.91	10.06.92
EXZE4V1.0/Z06	17.12.91	10.06.92
EXZE4V1.0/Z07	17.12.91	10.06.92

3.3 Parts List No.:	of:	signed on:
EXZE4V1.0/Z01 (2 pages)	17.12.91	10.06.92

Appendix to Certificate of Conformance
BVS 92.C.2039 X

(A4) Electrical data

Non-intrinsically safe supply voltage (connector ST1)	DC 24 V	
Supply/signal circuits (Terminals ST2 to ST5)	in Intrinsically Safe explosion protection EEx ib IIC	
	Maximum values per circuit:	
	U_0 = 11.6 V	
	I_k = 11.8 mA	
	linear characteristic	
	max. perm. external inductance	10 mH
	max. perm. external capacitance	300 nF
Data output (connector ST6)	For connection to equipment with a nominal voltage up to 250 V	

The supply/signal circuits are safely electrically isolated from all other circuits up to a peak nominal voltage of 375 V.

(A5) Labelling

The label must be easily visible, readable and permanent; it must include the following details:

5.1 Name of the manufacturer or his trademark
Type EXZE4
[EEx ib] IIC
Production number
BVS 92.C.2039 X
Tmin - 10 °C
Tmax + 60 °C

5.2 The label which is normally provided for the relevant electrical equipment according to the design standards.

Appendix to Certificate of Conformance
BVS 92.C.2039 X

(A6) Routine check tests

Routine check tests must be carried out by ELSTER Produktion GmbH, W - 6503 Mainz-Kastel, according to 23 of EN 50014-1977 (VDE 0170/0171 Part 1/5.78).

(A7) Special conditions for safe use

7.1 The Pulse Input Card Type EXZE4 should be set up outside of the area subject to explosion hazard.

7.2 The Pulse Input Card Type EXZE4 should be installed such that protection to at least IP 20 according to IEC 529 is obtained.

4600 Dortmund-Derne, 03.08.1992
BVS-Tha/Hid A 9200115

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section
Responsible official

D-2 Approval certificate

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

Zulassungsschein

Innerstaatliche Bauartzulassung

Nr. 1.33-3271.80-ELS-N30

Auf Grund des § 9 des Eichgesetzes vom 11. Juli 1969 (BGBl. I S. 759) in Verbindung mit § 26 des Eichgesetzes in der Fassung vom 23. März 1992 (BGBl. I S. 711) sowie den §§ 16 Abs. 1-3 und 17 Abs. 1 der Eichordnung vom 12. August 1988 (BGBl. I S 1657) in ihren derzeit gültigen Fassungen wird der Firma:

Elster Produktion GmbH

55252 Mainz - Kastel

folgende Bauart zur innerstaatlichen Eichung zugelassen:

Zustands-Mengenumwerter

Die Bauart erhält folgendes Zulassungszeichen:

7.741

93.30

Die wesentlichen Merkmale und gegebenenfalls die Zulassungsauflagen, Befristungen und Bedingungen sowie inhaltlichen Beschränkungen sind in der Anlage festgelegt. Sie ist Bestandteil der Zulassung und umfaßt 6 Seite(n).

Physikalisch-Technische Bundesanstalt **Braunschweig,** 22.11.1993

Im Auftrag

H. Krebs

Dienststempel

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT 41

- Hinweise und Rechtsbehelfsbelehrung auf der Rückseite -

Zulassungsscheine ohne Unterschrift und ohne Dienststempel haben keine Gültigkeit.
Die Zulassungsscheine dürfen nur unverändert weiterverbreitet werden.
Auszüge oder Änderungen bedürfen der Genehmigung der Physikalisch-Technischen Bundesanstalt.

V 1-755 320 01-07.92

Translation of German original:

Physikalisch-Technische Bundesanstalt

Braunschweig and Berlin

Approval Certificate

National type approval
No. 1.33-3271.80-ELS-N30

Based on Paragraph 9 of the Calibration Law of 11th July 1969 (BGBl. lS. 759) in conjunction with Paragraph 26 of the Calibration Law in the version of 23rd March 1992 (BGBl. lS. 711) and Paragraphs 16 Sections 1-3 and 17 Section 1 of the Calibration Directive of 12th August 1988 (BGBl. 1S 1657) in their currently valid versions, the company

Elster Produktion GmbH
55252 Mainz-Kastel

is granted national calibration approval for the following type of construction:

All-State Volume Corrector

The construction is granted the following approval symbol:

7.741
93.30

The main features and, where applicable, the approval conditions and limitations as well as the restrictions regarding the contents are specified in the appendix. It is a constituent part of the approval and comprises 6 page(s).

Physikalisch-Technische Bundesanstalt **Braunschweig,** 22.11.1993

pp. official stamp

H. Krebs

- Information and legal advice on the back -

Approval certificates without signature and official stamp are not valid.
Approval certificates may only be reproduced without modification.
Extracts or modifications require permission from the Physikalisch-Technische Bundesanstalt.

E References

DVGW pub Title

G 260	Technische Regeln für Gasbeschaffenheit
G 280	Empfehlungen für Gasodorierung
G 281	Technische Regeln für die Güte und Prüfung von Odoriermitteln
G 461	Richtlinien für den Bau und Betrieb von Gasleitungen mit einem Betriebsdruck von mehr als 1 bar bis 16 bar aus Druckrohren und Formstücken aus duktilem Gußeisen
G 485	Digitale Schnittstelle für Gasmeßgeräte
G 486	Realgasfaktoren und Kompressibilitätszahlen von Erdgasen
G 490	Bau und Ausrüstung von Gas-Druckregelanlagen mit Eingangsdrücken über 100 mbar bis einschließlich 4 bar
G 491	Gas-Druckregelanlagen für Eingangsdrücke über 4 bar bis 100 bar
G 492 II	Anlagen für die Gasmengenmessung mit einem Betriebsdruck über 4 bar bis 100 bar (Planung und Errichtung)
G 495	Gas-Druckregelanlagen und Anlagen für die Groß-Gasmessung (Überwachung und Wartung)
G 600	Technische Regeln für Gas-Installationen (DVGW-TRGI ´86)
G 669	Verfahren der Erteilung des DIN-DVGW-Zeichens und des DVGW-Zeichens für Einrichtungen der Gasversorgung
G 685	Gasabrechnung
GW 100	Das DVGW-Regelwerk

The above can be obtained from the Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH, Josef-Wirmer-Str. 1-3, D-53123 Bonn.

PTB guidelines

G 7	Eichung bzw. Beglaubigung von Gaszählern mit Hochdruckgas
G 8	Gas-Druckregelgeräte für die thermische Abrechnung von Gas
G 9	Eichung von Zustands-Mengenumwertern...mit Zustandserfassung für Gas mit realem Zustandsverhalten (s.a. DVGW: G486)

Zu beziehen über die Schriftleitung Physikalisch- Technische Bundesanstalt Referat Prüfstellenwesen - Bundesallee 100, 38116 Braunschweig

Documentation available for ELSTER devices

ELSTER - Gasdruckregelgeräte

ELSTER - Quantometer

ELSTER - Belastungsdrucker HBD 85

ELSTER - Turbinenradgaszähler

ELSTER - Austausch Meßpatrone

ELSTER - Mengenumwerter K78

ELSTER - Quantocounter QC-86 (73013123)

ELSTER - Elektronischer Kompakt-Mengenumwerter EK-84 (730112528)

ELSTER - Elektronischer System-Mengenumwerter EK-87 (73012530)

ELSTER - Elektronischer System-Mengenumwerter EK-86/W (73012529)

ELSTER - Elektronischer System-Mengenumwerter EK-88 (730112531)

ELSTER - Durchflußmeßgerät DA-400 (730113125)

ELSTER - Prüfgenerator für Mengenumwerter PGM-300 (730113124)

ELSTER - Auslesegerät AS-100 (73013126)

ELSTER - Industrie-Modem EM-100/N (73013424)

ELSTER - Unterbrechungsfreie Stromversorgung USV-88 (73013875)

ELSTER - Schnittstellenadapter SA-88 (73013889)

ELSTER - Temperatur-Umwerter TU-90/T (73013881)

ELSTER - Langzeit-Impulserfassungssysteme (Datenspeicher) DS-100

(DS-100/A; DS-100/B; DS-100/; DS-100/E; DS-100/N; DS-100/T; DS-100/V; DS-100/W)

ELSTER - Kurzanleitung Tarifgerät ETG-3000 (73013131)

ELSTER - Auswertesoftware AWS-100 (73013289)

ELSTER - Direktauslesesoftware DAS-100 (73013290)

ELSTER - Daten-Exportsoftware DES-100 (73013883)

ELSTER - DFÜ-Einsteigerpaket (73013880)

F Index

Symbols

A

B

C

D

E

F

G

H

I

K

L

M

U

V

W

Z