EK-88/K

This product is discontinued!

Electronic Volume Corrector EK-88/K

Operating and Installation Instructions

Manual No.	73014640	Version	4.3
Issued	02/2001 (d)	Edition	03

Important!

Please exchange battery cells only

ONE BY ONE,

otherwise data will be lost!

After replacing the batteries, the capacity of one battery must be entered under reference code „L35“.
The device then determines the new operating months.

Changes with respect to the previous version

The EK-88 is available in two versions:

- EK-88: Order number 83461900
- EK-88/K: Order number 83461901

This operating manual describes the EK-88/K.

The new features of the EK-88/K compared to the EK-88 are outlined here to simplify the EK-88/K operation for the user who is already familiar with the EK-88.

1 K-value computation according to AGA-NX-19-mod and AGA-NX-19-mod-BR.KORR.3H

The EK-88/K can compute the gas law deviation factor according to AGA-NX-19-mod and AGA-NX-19-mod-BR.KORR.3H. The EK-88/K decides which of these two variants is used based on the entered calorific value (reference code L145).

In Germany the device is approved by the PTB for pressure ranges up to 35 bar. In this case the K-value computation according to AGA-... is valid as an approximation for the Standard Gerg-88 virial equation, because the deviations in the approved pressure ranges are negligible.

Using the parameter P8 you can set whether the device operates with a constant K-value (entered under P1) or a computed value. The momentary valid (constant or computed) K-value is displayed under L6.

The gas analysis is entered (under the user lock) under the following reference codes:

- L145 calorific value Ho,n
- L148 CO_2 content
- L168 density ratio
- L178 N_2 content

The computation of a K-value takes about 1.5 seconds. In order not to reduce the battery service life unnecessarily, the computation of a new K-value only occurs when the pressure and temperature have changed so much that the previously computed K-value has an error of 0.1% or larger (referred to the new measurements).

When setting the “K-value computation” (P8 = 2), the following should be taken into account:

- The battery service life is always stated as being less than that for the standard setting. The residual battery life displayed under “L35” takes into account however all operating conditions and is also, for example, valid with frequent K-value computations.
- If a keypad entry occurs during a K-value computation, the associated reaction on the display does not under some circumstances take place. The entry must in this case be repeated.

2 Higher pressure ranges

In applications subject to official calibration various pressure sensors are approved up to 35 bar for pressure ranges 1:2.5 (see Chapter C-5).

For applications where official calibration is not required sensors for higher pressures (up to 125 bar) and larger pressure ranges (up to 1:10) are available.

3 Displaying the residual battery service life

The initial capacity of the batteries used and the remaining operating life in months can be called up under the reference code L35.

If the residual battery life is less than 2 months, the warning “E.7” is displayed in the status register L4.

After replacing the batteries, the capacity of one of the new batteries that have been used should be entered under L35. With the standard batteries this is 5.0 Ah.

4 Modified calibration lock

The calibration lock is implemented as a button. To open it, the button must be briefly pressed with the aid of a pointed object (e.g. a screwdriver). The display then automatically switches to the status register. Here with the calibration lock open, the message “E.30” (“Calibration lock open”) is displayed.

However, the calibration lock can only be opened with the button! To close it the value “0” must be entered under the reference code P90. P90 = 1 means “Calibration lock open”. This value cannot though be entered!

The calibration lock is closed automatically if after 1 hour neither keypad entry nor data traffic via the interface occur.

5 Selection of the pulse generator via the keypad

The pulse generator to be used can be programmed via P5:

- P5 = 0: No pulse generator
- P5 = 1: External pulse generator
- P5 = 2: Internal pulse generator

With the settings “P5 = 1” and “P5 = 2” a change is only possible with the calibration lock open, but with “P5 = 0” it is also subject to the user lock.

The latter is particularly useful during initial operation and test on site (before sealing by the weights and measures official). P5 is set to “0” ex-works as standard. This means that during installation of the device, the pulse generator to be used can be selected just once without the presence of a calibration official.

6 Detection of tampering

The device offers the possibility of assessing external contact during tampering, signalling manipulation of the volume counting (e.g. by using a magnet or by breaks in the cable).

When tampering is detected, the message “E.21” is displayed in the status register.

Programming is carried out using P39:

- P39 = 0: Tampering detection switched off.
- P39 = 1: Tamper contact implemented as normally closed contact.
  Input open means: Tampering is taking place (“E.21” is recorded).
- P39 = 2: Tamper contact implemented as normally open contact.
  Input closed means: Tampering is taking place (“E.21” is recorded).

A normally closed contact is to be preferred as tamper contact, because in this case a cable break also produces a signal.

See Chapter 2.12 for a detailed description of the tamper detection.

7 Additional signal output functions

The following signal output functions can now be programmed via P16:

- P16 = 0: No function, delete pulse memory.
- P16 = 1: V, undisturbed (→ Counter H1)
- P16 = 2: V_n, undisturbed (→ Counter H2)
- P16 = 3: V, disturbed (→ Counter H3)
- P16 = 4: V_n, disturbed (→ Counter H4)
- P16 = 5: V, total (→ Counter H5)
- P16 = 6: V_n, total (→ Counter H6)
- P16 = 7: Alarm (→ Code “[A]”, see Chap. 2.7)
- P16 = 8: Warning (→ Code “[W]”, see Chap. 2.7)
- P16 = 9: Alarm and warning (→ Code “[A]” or “[W]”, see Chap. 2.7)

8 Date and time can be entered fully

Previously the internal clock could only be adjusted second-by-second. The date (L7) and time (L8) can now be set via the keypad subject to the calibration lock (for more than 5 minutes adjustment) or subject to the user lock (for less than 5 minutes adjustment).

Important!
Changes to the date and time can have marked effects on the integral DS-100 function! If the clock is put back by 1 hour or more, all the tariff data recorded to date is lost.

9 Entering the calibration data for pressure and temperature

The (new) reference codes P145 to P148 are normally only used for test and service purposes. The mathematical equations for pressure (L1) and temperature (L2), produced by the calibration process (with P27 and P28), are shown as functions of the binary values (L47 and L48).

In cases where data is lost, the calibration can be simply restored by entering the data contained on the design data sheet.

10 Printer log and process data block

With the functions “Printer log” (P56 to P58) and “Process data block” (P67) the momentary values of the actual flow rate Q and the standard flow rate Q_n are output in addition to the previous data.

11 Display format for “P0” and “P10”

The display of the parameters P0 (“Enter supplier’s code”) and P10 (“Enter customer’s code”) have been slightly modified. The entry has not been changed.

12 Other new or modified entry and output methods

Ref. code	Meaning	Previous	Now
L27	Temperature range	Not possible	-10 to +60 °C
L156	Standard pressure	Not possible	0.990 to 1.050 bar
L157	Standard temperature	Not possible	0 to +20 °C
P3	Substitute temperature	0 to +20 °C	-10 to +60 °C
P91	Automatic switchover to V_n	Not possible	0 (off) or 1 (on)
H58	Frozen p, T, K, Z	p, T, Z	p, T, K, Z (K-value is also frozen)

Contents

1 Brief description

1.1 Function and performance characteristics

The **Volume Corrector EK-88** detects low frequency pulses from turbine flowmeters and positive displacement gas meters. The **actual volume (V)** is calculated from the detected pulses and the programmed counting pulse value (cp value).

Together with the measured values for **pressure (p)** and **temperature (T)** and an entered value for the **gas law deviation factor (K-value)**, the **standard volume (Vn)** is calculated from the actual volume.

The prevailing and the maximum values of the actual and the standard flow rate are determined from the volumes.

The necessary data and parameters such as for example the counting pulse value of the gas meter (cp value) and gas law deviation factor (K-value) can be displayed and programmed by means of a keypad.

The power supply is provided by two internal batteries. In standard applications these guarantee a working life of at least 5 years. Working with an external power supply (optional) provides a correspondingly high power reserve. If the mains power supply should fail, the unit switches over automatically to battery operation without any loss of data.

The volume corrector incorporates various monitoring functions and two status registers for monitoring the operating conditions and has a convenient trouble-shooting facility.

Overview of the performance features on the EK-88:

Pulse input:

- 1 meter input for low frequency generator

Analogue inputs:

- Pressure input, ranges up to 125 bar (absolute)
- Temperature input Pt100

Outputs:

- 1 output programmable as alarm/warning or pulse output (alternative with or without external power supply)
- 1 data output with serial interface

Operation:

- Keypad with 16 keys
- 8-figure seven-segment display with allocation indicators

Volume measurement:

- Actual volume (V)
- Standard volume (V_n)
- Disturbance values of actual volume (V_d)
- Disturbance values of standard volume (V_{nd})
- Total actual volume V_t
- Total standard volume V_{nt}
- Adjustable supplementary counter for actual volume (total)
- Adjustable supplementary counter for standard volume (total)

Flow rate:

- Actual flow rate (Q)
- Standard flow rate (Q_n)

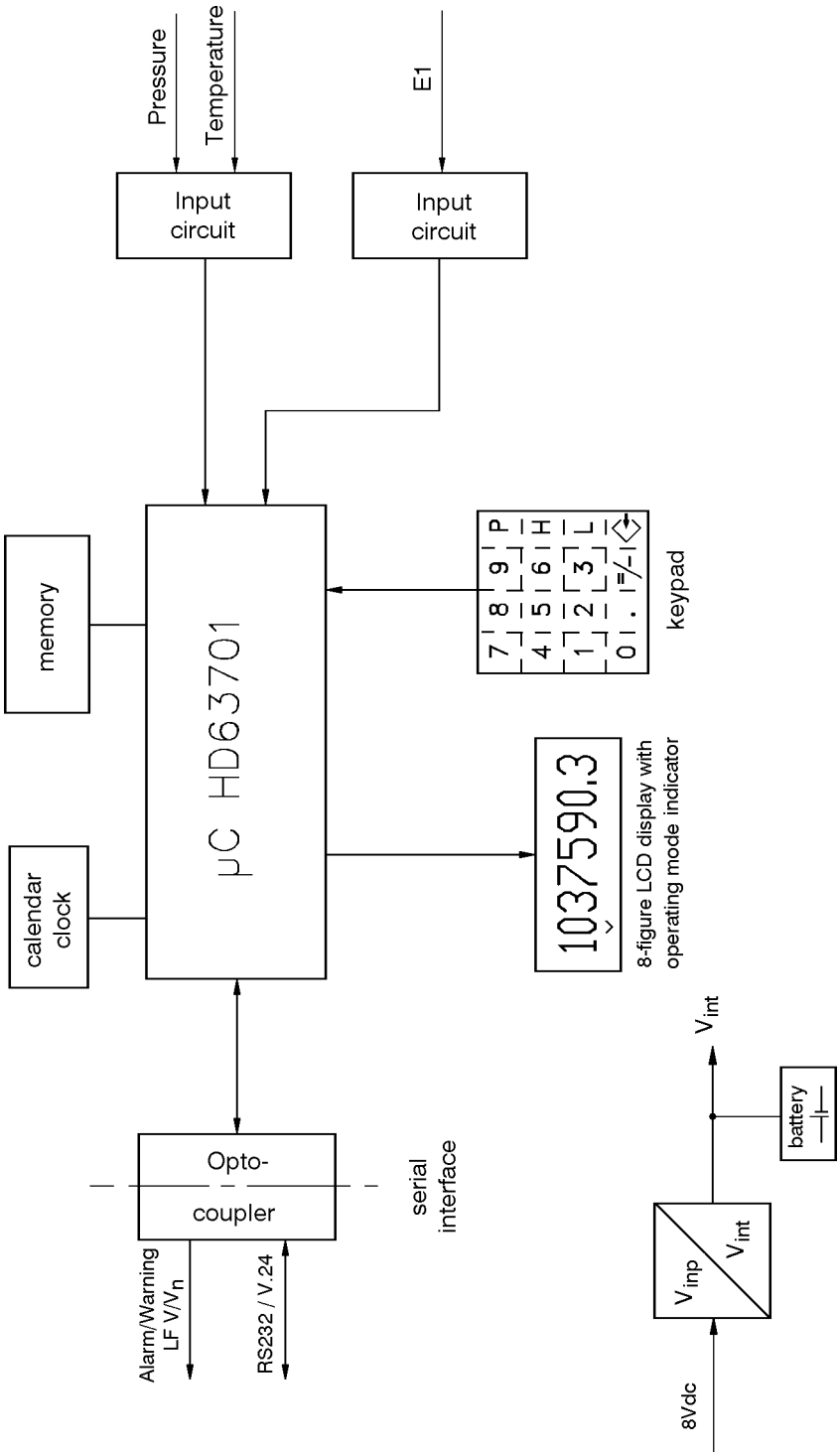
Power supply:

- Supply through internal batteries, service life at least 5 years.
- Optional supplementary external power supply.

Miscellaneous:

- K-value computation according to AGA-NX-19-mod and AGA-NX-19-mod-BR.KORR.3H
- Z-value computation from the p, T and K-value
- Data storage for actual volume, standard volume, pressure and temperature (each with hourly values over last 6 months)
- Passing of original volume corrector meter readings to the data storage function (DS-100 function)
- EEx ib IIB T1 approval for applications in Zone 1 according to DIN VDE 0165 (see Appendix E for Certificate of Conformance BVS 92.2034 X).

1.2 Block diagram of the EK-88 Electronic Volume Corrector



2 Operation

The unit is operated using the 8-digit LCD display and a keypad with 16 keys.

To identify data, so-called “reference codes” are used. Entering the reference code via the keypad results in the desired value being displayed together with its reference code.

Reference codes consist of a letter (H, L or P) and a number (one, two or three-figure).

The entry and output are divided into the areas:

- PARAMETERS (Reference codes P1 to P148)
- METER READINGS AND FLOW RATES (Reference codes H1 to H58)
- OTHER DATA (Reference codes L1 to L178)

Parameters are used to program the unit functions.

Parameters affecting the metering of standard or actual volumes can only be changed under the supervision of the Weights and Measures Inspector.

2.1 Keypad

The entry of data and the display of measured values is carried out via a keypad with 16 keys:

7	**8**	**9**	**P**
4	**5**	**6**	**H**
1	**2**	**3**	**L**
0	**,**	**=/-**	**←**

These keys have the following meaning:

[P],[H],[L] : Entry of the reference code identification

[0]...[9] : Entry of the reference code and input data

[,] : Entry of the decimal point

[=/-] : Calling a value

[←] : Acceptance of the entered data

2.2 Display

Normally all data is shown on the display with the associated reference code.

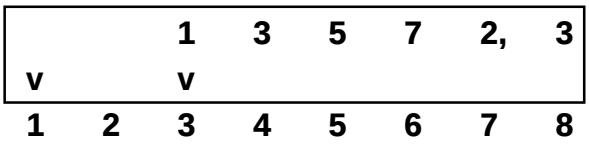
If the reference code begins with an “L” or “P”, this letter appears in the first position of the display (left). If no letter is displayed there, it is a reference code beginning with “H”.

The number associated with the reference code is represented by pointers (allocation indicators) which refer to the figures immediately below the display. With two and three-figure numbers the figure on the left (the smaller) must be read first. Consequently, no reference code can be displayed which has a first figure greater than the second (for example, “P54” is not possible).

Display Examples:

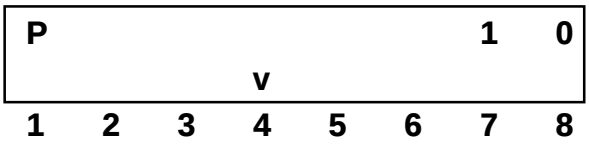
Note: **v** = allocation indicator

1. H13 = 13572,3



This display represents the standard flow rate Q_n = 13572.3 m^3/h. H13 is the reference code for the standard flow rate.

2. P4 = 10



This display represents the cp value 10 pulses/m^3.

2.3 Display and input of data

The display of a required value is activated by entering the reference code and then pressing the [=/-] key. The reference code consists of a code letter and a one, two or three-figure code number. Pressing the [=/-] key or the [←] key again without entering a reference code causes the next parameter or measurement value to be displayed.

Some values can be changed by entering one or more figures after they have been displayed. The transfer of the number entered in this way takes place by pressing the [←] or [=/-] key. If the input is impossible or incorrect, an error message appears as described in Appendix A-4.

The momentary entry can be cancelled at any time by pressing one of the keys [P], [H] or [L] and the system then awaits the entry of the number associated with the reference code.

A list of the reference codes can be found in Appendix “A”.

2.4 Volumes and flow rates

H1 Actual volume V [E] Units: m³

This counter represents the so-called “undisturbed” volume, i.e. here only volumes are added which have been measured during undisturbed operating conditions.

The actual volume (V) is computed in the EK-88 via the specified cp value according to the equation

$$V = N / cp$$

where: V = Actual volume
N = Number of pulses
cp = cp value (meter constant)

The units in the display always correspond here to the reciprocal of the cp value. This counter can be set to any value with the calibration switch open.

H2 Standard volume V_n [E] Units: m³

Similarly as with “H1” (see above), this counter represents an ‘undisturbed’ volume. The standard volume V_n is computed from the actual volume using the equation

$$V_n = V \cdot Z$$

where: V = Actual volume
V_n = Standard volume
Z = Z-value (reference code L3)

Three decimal places of the standard volume V_n are displayed after repeated pressing of the [=/-] key.

Example:

H2	[=/-]	12345678	(pre-decimal places)
	[=/-]	.123	(post-decimal places)

Entries for the ‘pre-decimal places’ (full m^3) are possible for H2 under the calibration lock. Here, the ‘post-decimal places’ are always deleted.

H3 Disturbance actual volume V_d [E] Units: m³

In the case of a fault the actual volume only continues to be measured in this register until the fault is rectified. All faults that cause an alarm count as disturbances.

H4 Disturbance standard volume V_{nd} [E] Units: m³

In the case of a fault the standard volume only continues to be measured in this register until the fault is rectified. All faults that cause an alarm count as disturbances. The display occurs in full m^3.

H5 Total actual volume V_t **Units: m^3**

Here the total actual volume (undisturbed and disturbed) is measured (H5 = H1 + H3).

H6 Total standard volume V_{nt} **Units: m^3**

Here the total standard volume (undisturbed and disturbed) is measured (H6 = H2 + H4). The display shows full m^3.

H0 Data storage function

See Chapter 3.

H12 Actual flow rate Q **Units: m^3/h**

The actual flow rate is calculated from the corresponding actual volume V that has passed through using the equation

$$Q = \Delta (V) / \Delta (t)$$

The units for the flow rate correspond to the volume (e.g. V in [m^3] gives Q in [m^3/h]).

H13 Standard flow rate Q_n **Units: m^3/h**

The standard flow rate is computed similar to the actual flow rate Q_b.

$$Q_n = \Delta (V_n) / \Delta (t)$$

H23 Adjustable actual volume **[B]** **Units: m^3**

This counter acquires the “total actual volume”, i.e. disturbed and undisturbed volumes and can be set to any arbitrary value, e.g. to 12.7 m^3, by entering

H23 [=/-] 12.7 [←]

Note: The adjustable counters H23 and H24 can only be adjusted with the user lock open.

H24 Adjustable standard volume **[B]** **Units: m^3**

This counter acquires the “total standard volume” and, with the user lock open, can be set to any arbitrary integer value similar to H23 (see above).

H55 “Freezing” function

After entering

H55 [=/-]

the current values of the actual volume (V), standard volume (V_n), pressure (P), temperature (T) and the correction factor (Z-value) are stored simultaneously. The data thus “frozen” can be called up under the reference codes H56 ... H58 at any time. The acknowledgement of the freezing of data is given in the “H” display.

H56 Frozen actual volume **Units: m³**

The content of the undisturbed actual volume counter V at the moment of the last freezing (with H55) can be displayed under H56.

H57 Frozen standard volume **Units: m³**

The content of the undisturbed standard volume counter at the moment of the last freezing (with H55) can be displayed under H57. Repeated pressing of the [=/-]-key displays the post-decimal places of the frozen V_n.

H58 Frozen pressure **Units: bar**

Frozen temperature **°C**

Frozen K-value

Frozen Z-value

After entering H58 the pressure prevailing at the time of the last freezing (with H55) appears.

By continuing to enter [=/-] (scroll function) the frozen temperature, K-value and Z-value can be called up consecutively.

2.5 Other data

L1 Absolute pressure P **Units: bar**

The momentary gas pressure is displayed in the units [bar].

L2 Absolute temperature T **Units: °C**

The current gas temperature is displayed in the units [°C].

L3 Gas law deviation factor (Z-value)

The EK-88 determines the Z-value necessary for calculating the standard volume from the measured values for pressure (p), temperature (T) and K-value (K) according to the equation

$$Z = \frac{T_n}{K \cdot p_n} \cdot \frac{p}{T}$$

where: K = K-value
gas law deviation factor of the gas
(input via P1 or computed by AGA-NX-19-mod)
p = Pressure in bar
p_n = Standard pressure (1.01325 bar)
T = Temperature in Kelvin
T_n = Standard temperature (273.15K)

L4 Status Register 1

There are two status registers in the EK-88 for detecting and analysing fault states.

In Status Register 1 (L4) messages about faults which have occurred are entered (see Chapter 2.7).

The output is in the format

	L		E.	x.	y.	z.	u.	
				v				
H	1	2	3	4	5	6	7	8

with L4 = Status Register 1
E = Fault identifier
x = Fault number of the first fault
y,z,u = Fault numbers of further faults
v = Allocation indicator, points on the front panel
to the figure “4” associated with the reference code.

The messages are displayed in order of importance. If there is insufficient space in the display for all the messages only the most important are visible.

By entering the sequence

L4 [=/-] 0 [←]

the error messages in it are transferred to Status Register 2 (L5, see below) and Status Register 1 (L4) is deleted. If L4 is empty (L4 = 0), the transfer does not take place. The last message is consequently always retained.

L5 Status Register 2

In Status Register 2 (L5) the fault messages are displayed in the same format as in Status Register 1 (L4). Because in this case the last messages must always be stored, this register cannot be deleted.

L6 K-value Units: [1]

The current K-value used for the computation of the standard volume is displayed under this parameter. This K-value depends on the set K-value mode (see under “P8”).

For “P8 = 0” the “constant K-value” entered under “P1” is used for the computation of the standard volume and displayed under “L6”.

For “P8 = 2” the K-value computed according to AGA-NX-19-mod is used for the computation of the standard volume and displayed under “L6”.

L7 Date [E]

The current date appears in the format

L DD.MM.YY

where DD : 2 places for the day
MM : 2 places for the month
YY : 2 places for the year

Example: “L 01.06.90”

With the calibration lock open the date can be changed to any sensible value. The newly entered date is however only accepted after a new time (reference code L8, see below) has been entered.

Important!
Changes to the date or time can have marked effects on the integral DS-100 function. If the clock is put back by 1 hour or more, all the tariff data recorded to date is lost.

L8 Time [E/B]

The current time appears in the format

L hh.mm.ss

where hh : 2 places for the hours
mm : 2 places for the minutes
ss : 2 places for the seconds

With the calibration lock open the time can be changed to any sensible value. With the user lock open changes of less than 5 minutes are possible.

Important!
Changes to the date and time may have marked effects on the integral DS-100 function! If the clock is put back by 1 hour or more, all the tariff data recorded to date is lost.

L16 Pressure sensor serial number [E]

This number, which may be up to 6 figures long, identifies the sensor relating to the EK-88. The serial number of the pressure sensor is only visible with an opened housing. It is set ex-works and should not therefore be altered.

This number can only be changed under the supervision of the Weights and Measures Inspector!

L17 Temperature sensor serial number [E]

This number identifies the temperature sensor associated with the EK-88 and it may be up to 8 figures long. No other sensor can be connected unless it has previously been tested.

This number can only be changed under the supervision of the Weights and Measures Inspector.

L26 Pressure range [E] Units: bar

Here the permissible gas pressure range is displayed.

The values give the absolute pressures in bar.

Example:

L 0.8 2.0

The permissible range is 0.8 bar to 2.0 bar.
The entry of these values takes place in two steps.

An example of the entry of the range 0.8 to 2.0 bar:

L26 [=/-] 0.8 [←] [=/-] 2.0 [←]

These values can only be entered under the supervision of the Weights and Measures Inspector.

The upper value of the pressure range determines the internal resolution of all the values which represent pressures. These are:

- pressure calibration (including pressure “L1”)
- upper pressure limit (“P23”)
- lower pressure limit (“P24”)
- substitute pressure (“P2”)
- frozen pressure (“H58”)

If the pressure range is re-entered, then the internal resolution and all of the above mentioned values may change. In this case the error message “E.13” is recorded in the Status Register L4. The programming of all pressure values must then be carried out in the following sequence:

1. Pressure range (“L26”)
2. Upper pressure limit and lower pressure limit (“P23”, “P24”, “P99”)
3. Equivalent pressure (“P2”)
4. Calibration (twice “P27”, “P99”)

L27 Temperature range [E] Units: °C

Here the permissible gas temperature range in °C is displayed.

Example:

L -10 60

The maximum permissible range is -10°C to +60°C. The entry of the two values is carried out in two steps as described under the parameter “L26”, but only integer values are permissible. The entry of a negative temperature is made by pressing the [=/-] key instead of the [←] key. The entered numerical value is then accepted as a minus temperature. The upper range limit can only assume positive values and must always be greater than the lower limit.

The temperature alarm limits result automatically from the temperature range limits. These are 1°C higher, resp. lower than the entered range limits (see Chapter 2.8.3).

L34 Software version number

The version number of the software can be called up via L34.

L35 Battery service life [B] [Ah and M]

Apart from the entered battery capacity of **one** battery, this reference code also shows the remaining operating months. The battery capacity is shown in the centre of the display with a value range from 0.1 ... 9.9 Ah, whereas the remaining operating months are output right justified. The EK-88 detects various operating conditions which cause different levels of current consumption. During the determination of the remaining operating months the momentary operating conditions are considered. (Operating conditions are, for example, ‘Calibration lock open’, ‘Data interchange via interface’ or ‘Permanent display switched on’.)

After replacing a battery, the battery capacity of **one** battery must be entered. The device then automatically determines the new operating months. If the remaining operating period is less than 2 months, then the warning “E.7” is displayed in Status Register “L4”.

If the operating period of the batteries has expired and despite this the batteries can still be used for further operation, the “remaining” operating months are counted further with a negative arithmetic sign. The display then represents the operating period which already exceeds the guaranteed minimum.

Note:
The following measurements, L45 to L56, are normally only used by service technicians.

L45 Ground measurement **Units: [1]**

Under this reference code the value for the ground potential read out direct from the analogue/digital converter is displayed.

Valid range: 65344 ... 65535 or 0 ... 192

L46 Instrument temperature measurement **Units: [1]**

Under this reference code the value for the temperature of the instrument read out directly from the analogue/digital converter is displayed. This value is used to compensate for temperature effects.

Valid range: 14000 ... 25000

L47 Pressure measurement **Units: [1]**

Under this reference code the value for the gas pressure read out directly from the analogue/digital converter is displayed. Valid range: 8000 ... 65440.

L48 Temperature measurement **Units: [1]**

Under this reference code the value for the gas temperature read out directly from the analogue/digital converter is displayed.

Valid range: 48000 ... 65440

A value outside the specified ranges of L45 .. L48 leads to an alarm and the error message “E.17” in Status Register L4.

L56 Battery voltage measurement **Units: [1]**

Under this reference code the value for the voltage on the internal battery read out directly from the analogue/digital converter is displayed. This value is only valid if no external power supply is connected.

Valid range: 50000 ... 65535

This value is reduced with the battery discharged.

L145 Calorific value $H_{o,n}$ [B] [kWh/m³]

The calorific value of the gas can be entered under this parameter. On entry it is checked for its range of validity and if the range is exceeded, the error message "---6----" is output. Various ranges of validity are then demanded for the other gas parameters depending on the gas calorific value. If, during the entry of the calorific value conflict arises with the validity of one of the other gas parameters, the error message "---3----" is output and the entered value is ignored. In this case first check the validity of the other gas parameters and correct them (see Chapter 2.8.2).

The entry of this value is subject to the user lock.

This data is only accepted with "P99"!

L148 CO_2 content [B] [Mole %]

This parameter states the CO_2 content of the gas. On entry it is checked for its range of validity and if the range is exceeded, the error message "---6----" is output. Various ranges of validity are then demanded for the other gas parameters depending on the gas calorific value. If, during the entry of the CO_2 content, conflict arises with the validity of one of the other gas parameters, the error message "---3----" is output and the entered value is ignored. In this case first check the validity of the calorific value and correct it (see Chapter 2.8.2).

The entry of this value is subject to the user lock.

This data is only accepted with "P99"!

L156 Standard pressure p_n [E] [bar]

The reference pressure (standard pressure) used for the computation of the Z-value can be called up under this reference number. With an open calibration lock entries in the range from 0.99000 to 1.05000 bar are possible. This value must be 1.01325 for the area of validity subject to German calibration regulations.

L157 Standard temperature T_n [E] [K]

The reference temperature (standard temperature) used for the computation of the Z-value can be called up under this reference number. With an open calibration lock entries in the range from 273.15 to 293.15 K are possible. This value must be 272.15 K for the area of validity subject to German calibration regulations.

L168 Density ratio [B] [1]

The gas density ratio is entered under this parameter. It is checked for its range of validity and if the range is exceeded, the error message "---6----" is output. Various ranges of validity are then demanded for the other gas parameters depending on the gas calorific value. If, during the entry of the density ratio, conflict arises with the validity of the calorific value, the error message "---3----" is output and the entered value is ignored. In this case first check the validity of the calorific value and correct it (see Chapter 2.8.2).

The entry of this value is subject to the user lock.

This data is only accepted with "P99" !

L178 N_2 content

This parameter states the N_2 content of the gas. On entry it is checked for its range of validity and if the range is exceeded, the error message “---6----” is output. Various ranges of validity are then demanded for the other gas parameters depending on the gas calorific value. If, during the entry of the N_2 content, conflict arises with the validity of one of the other gas parameters, the error message “---3----” is output and the entered value is ignored. In this case first check the validity of the calorific value and correct it (see Chapter 2.8.2).

The entry of this value is subject to the user lock.

This data is only accepted with “P99” !

2.6 Parameters for function programming

All values which affect the volume counting can only be modified with the calibration lock activated (see Chapter 4.2). They are denoted in the following by the symbol [E]. All values which can only be modified with the user lock opened are labelled with the symbol [B]. Also, “-” indicates that input is possible at any time and “L” means that this value can only be called and not set.

All values, for which the mutual time reference is important when being modified, are activated simultaneously by selecting “P99”. At this moment all data modified since the last selection of “P99” will be transferred simultaneously. An appropriate note is given for each of the parameters involved.

For the method of calibrating the analogue inputs for pressure and temperature sensors (with P27 and P28) reference should be made to Chapter 4.11.

P0 User lock (supplier) open [-]

The user lock can be opened or closed by entering the supplier’s code in combination with the customer’s code (see Chapter “User lock”).

P1 Constant and substitute K-values [B/E]

The gas law deviation factor is required for calculating the Z-value. With the EK-88 in the mode “K constant” there is the possibility of using a constant K-value as well as the momentary K-value according to AGA-NX-19-mod (see under “P8”). The constant K-value is called up under this parameter and can be entered if the calibration lock is open. In the mode “K-AGA” this parameter is used as the substitute K-value if the measured values for pressure or temperature are not located in the range valid for the K-value computation (see Chapter 2.8.3). In this mode the parameter is only subject to the user lock. (Here see also the Chapter “Computing the gas law deviation factor”).

This data is only accepted with “P99” !

P2 Substitute pressure [B/E] Units: bar

With the pressure measurement switched on, the substitute pressure is used for calculating the standard volume when the measured gas pressure lies outside permitted limits (cf. P23, P24). Here, the value can only be programmed when the user lock is open.

If the EK-88 is operated as a temperature corrector (pressure measurement switched off), the substitute pressure is subject to the calibration lock.

P3 Substitute temperature [E] Units: °C

The substitute temperature is used for calculating the standard volume when the measured gas temperature lies outside permitted limits (-10°C / +60°C).

P4 cp value pulse generator [E] Units: 1/m³

The actual volume is calculated from the counted flow pulses via the cp value of the connected pulse generator.

Possible cp values are; 100: 10; 1; 0.1 and 0.01.

This data can only be activated using “P99”!

P5 External/internal pulse generator [B/E]

Selection of the pulse generator for the gas volume is possible under this reference code. The are three ways of programming:

P5 = 0: No pulse generator selected.
= 1: External pulse generator active.
= 2: Internal pulse generator active.

The reference code can be reprogrammed in dependence of its content:

With P5 = 0: Entry under calibration and user locks possible.
P5 > 0: Entry only possible under the calibration lock.

With this procedure and with the ex-works setting of “P5 = 0”, the customer therefore has the possibility of selecting the pulse generator **once** without the Weights and Measures Inspector.

Note:
By changing the setting of P5, it may be possible to count 1 pulse depending on the position of the connected generator.

P8 K-value mode [E]

The use of the gas law deviation factor for the computation of the Z-value is defined under this reference code. There is the possibility of using a constant K-value (entered under “P1” in K-constant mode) for the computation of the correction factor instead of the K-value computed according to AGA-NX-19-mod (K-AGA mode).

In order to carry the computations with a constant K-value

"P8 = 0"

must be set. Thereafter, the constant K-value is displayed under the reference code "L6" as the current K-value.

If "P8 = 2" is set, the K-value computed according to AGA-NX-19-mod is displayed under "L6" and used for the computation of the Z-value.

If "P8 = 2" is set, the reaction to a keypad entry might be delayed by approx. 1 second. Refer to Chapter 2.8.2.

P9 Changing the supplier's code [B]

If the supplier's lock is open, the supplier's code can be changed under P9. It has a maximum of 6 figures (see Chapter "User lock").

P10 User lock (customer) [-]

The user lock is opened or closed by entering the customer's code in combination with the supplier's code (see Chapter "User lock").

P11 Changing the customer's code [B]

If the customer lock is open, the customer's code can be changed under P11. It has a maximum of 6 figures (see Chapter "User lock").

P12 Pressure mode [E]

P12 is used for selecting one of the two pressure modes:

P12 = 1: Pressure measurement switched on.
P12 = 0: Pressure measurement switched off.

When the pressure measurement is switched on the measured absolute pressure (L1) is used for calculating the standard volume V_n.

When the pressure measurement is switched off, the substitute value for the pressure, programmed under P2, must be used for calculating the standard volume V_n.

This data can only be transferred using "P99"!

P13 Temperature mode [E]

P13 is used for selecting one of the two possible temperature modes:

P13 = 1: Temperature measurement switched on.
P13 = 0: Temperature measurement switched off

When the temperature measurement is switched on, the measured temperature (L2) is used for calculating the standard volume V_n.

When the temperature measurement is switched off, the substitute value for the temperature programmed under P3 must be used for calculating the standard volume V_n.

This data can only be activated using "P99"!

P14 Measurement cycle [E] Units: s

The cycle time is the time interval (in seconds) in which measurement data is acquired in battery operation. Since the cycle time affects the operating period of the device, the standard value of 20s should be retained where possible.

During operation with an external power supply, the measurement cycle is always 1 s irrespective of the entered value.

Please take note of Chapter 4.9 “Power supply”.

P15 Continuous display on/off [E] Units: -

In the normal case (P15 = “0”) the display of the EK-88 is only activated after operating the keypad and it switches off again after about 60 seconds. If however the parameter P15 is set to “l”, the display remains active continuously and the updating of the displayed values takes place at the rate of the measuring cycle (see “P14” above):

P15 = 1: Continuous display on
P15 = 0: Continuous display off

Important: Switching on the continuous display affects the power consumption of the unit and consequently the working life of the batteries! For further details see Chapter 4.9.

During operation with an external power supply the parameter P15 has no significance and in this case the display is always switched on.

This data can only be activated using “P99”!

P16 Output function [B] Units: -

With P16 the output of the EK-88 can be programmed to execute one of ten possible functions in accordance with the following table:

P16	Output function	Corresponding counter
0	Delete pulse memory, output has no function	-
1	Pulse output V undisturbed	H1
2	Pulse output V_n undisturbed	H2
3	Pulse output V disturbed	H3
4	Pulse output V_n disturbed	H4
5	Pulse output V total	H5
6	Pulse output V_n total	H6
7	Alarm output	-
8	Warning output	-
9	Alarm and warning output	-

By selecting the pulse output (V or V_n) the weighting of the output pulses (cp value) can be adjusted by means of P17 (see below).

If the volume to be output enters faster than the pulse output can output it, buffering takes place in an internal intermediate store which can hold up to 65535 pulses. If it is full and more pulses need storage, the message “E.24” in Status Register L4 is given because the pulses to be added are lost. In this case the cp value of the pulse output (programmable under P17, see below) should be reduced.

After entering “P16 = 0” all pulses existing in the intermediate store are deleted.

If P16 is changed to a value greater than 1, all pulses buffered in the intermediate store are retained. They are still output provided the output is programmed for any pulse output (i.e. to a value between 1 and 6).

If, for example, the function of outputting an actual volume is to be changed into the output of a standard volume, it is practicable to enter “P16 = 0” to delete any V pulses present in the intermediate store.

Example: After entering

P16 [=/-] 4 [←]

the output becomes the alarm output.

For a precise description of the output see Chapter 4.8.

P17 Pulse output weighting [B] Units: 1/m³

The weighting of the output pulses can be programmed by P17. The following inputs are possible:

P17 = 0.01; 0.1; 1; 10; 100 pulses/m^3

To ensure that no pulses are lost, P17 should be smaller or equal to the cp value of the pulse generator (P4). Further details can be found under “P16” (previous paragraph) and Chapter 4.8.

With P17 = 0 the pulse output is switched off. The incoming pulses are however temporarily buffered and then output when the cp value is entered again.

The programming of P17 only has an effect on the output if it has been set with P16 to output the volume pulses (i.e. to values between 1 and 6).

P23 Upper pressure limit [E] Units: bar

Exceeding the maximum permissible pressure value programmed here causes an alarm and disturbed volume counting.

This data should only be activated using “P99”!

P24 Lower pressure limit [E] Units: bar

Undershooting the minimum permissible pressure value programmed here causes an alarm and disturbed volume counting.

This data should only be activated using “P99”!

P27 Default value for pressure [E] Units: bar

Only for calibrating the pressure measuring circuit (see Chapter 4.11).

P28 Default value for temperature [E] Units: °C

Only for calibrating the temperature measuring circuit (see Chap. 4.11). Entry of a negative temperature is made by pressing the [=/-] key instead of the [←] key. The entered number is then taken to be a “minus” temperature (see Chapter 4.11).

P39 Detection of tampering [B]

The EK-88 offers the possibility of evaluating an external tamper contact which signals tampering with the volume counting (e.g. using magnets or by cable interruptions).

The message “E.21” is recorded in Status Register “L4” when tampering is detected.

Programming occurs via P39:

- P39 = 0 : Tamper detection switched off.
- P39 = 1 : Tamper detection implemented as normally closed contact.
  Input open means: Tampering is taking place (“E.21” is recorded).
- P39 = 2 : Tamper detection implemented as normally open contact.
  Input closed means: Tampering is taking place (“E.21” is recorded).

A normally closed contact is to be preferred as tamper contact, because in this case a cable break also produces a message.

See Chapter 2.12 for a detailed description of the tamper detection.

P48 Clear counters [E]

By entering

P48 [=/-] 0 [←]

all non-adjustable volume counters (also in the DS-100 module) are simultaneously cleared.

The remaining functions remain unchanged.

P56 Immediate log output [-]

A log printout is output immediately by entering:

P56 [=/-] 1 [←]

The printing of the log is indicated with a “1” in the right margin of the display. When the output has finished, a “0” appears in this position and the printout can be repeated by entering [1] [←] again.

Please also note the special Chapter “Printer log”!

P57 Periodic log output [B]

This value gives the time period between the outputs of the printer logs. A log is printed out on the hour, every hour and at each multiple of this time period. The periodic output no longer occurs after “zero” is entered.

If, for example, the following is entered:

P57 [=/-] 7 [←]

a printout occurs at the following times:

8:00	8:35	9:00!!!
8:07	8:42	9:07
8:14	8:49	9:14
8:21	8:56	9:21 etc.
8:28		

Important! The functions P57 and P58 are mutually interlocking. Any attempt at calling P58 when the P57 function is activated, leads to the error message “---1----” (code word not present).

Please also note the special Chapter “Printer log”!

P58 Daily log output [B]

This value represents the time at which a daily log output is to be provided.

Values between “1” and “24” can be entered.

Entering “0” terminates the output.

Important! The functions P57 and P58 are mutually interlocking. Any attempt at calling P57 when the P58 function is activated, leads to the error message “---1----” (code word not present).

Please also note the special Chapter “Printer log”!

P67 Output processor data block [L]

This parameter is available for outputting the unit’s process data via the data interface.

The process data is output by entering

P67 [=/-] 1 [←]

Outputting of data is indicated by an “L” on the right margin of the display. Here a “0” is output after the termination of the transfer.

P88 Display test [L]

By entering

P88 [=/-]

all segments of the display are activated until a new keypad input takes place. The remaining functions continue unchanged.

P90 Close calibration lock

The calibration lock can only be **opened** using the built-in keypad. The lock can be closed in two ways:

a) The opened lock is automatically closed if after 1 hour there has not been any keypad entry nor has the interface been activated.

b) By entering a “0” under the reference code “P90”.

Similarly to the status message “E.30” in Status Register “L4”, P90 indicates the status of the calibration lock:

P90 = 0: Calibration lock closed
P90 = 1: Calibration lock open

The calibration lock can only be **closed** with this **reference code**. Closing of the calibration lock automatically clears the message “E.30” in Status Register “L4”.

P91 Automatic switchover to V_n/L4 [E]

The automatic switchover to V_n or L4 after about 1 min. can be switched in or out with this reference code.

For: P91 = 0 It is switched out.

And for

P91 = 1 It is switched in.

Remark:
Automatic switchover is always switched out when the calibration lock is open.

P99 Transfer of the calculation parameters [E]

P99 serves as termination of the input of all parameters for which the mutual time relationship is important.

All such parameters entered since the last transfer are used for the on-going calculations only after P99 has been selected by means of

P99 [=/-]

As acknowledgement for the user after entering the above line the identifier “P.” appears on the display.

With each relevant parameter an appropriate explanation is given in the description above it.

Remark:
The following reference codes P145 to P148 are normally only used for test and service purposes. The mathematical equations for pressure (L1) and temperature (L2), obtained during the calibration procedure (with P27 and P28), are displayed as functions of the binary values (L47 resp. L48).

In cases where data is lost, the calibration can be simply restored by entering the data contained on the design data sheet.

P145 Pressure equation offset [E] [1]

The offset of the pressure equation can be entered under this parameter (see Chap. 4.11). It is checked on entry for its range of validity (see Table A-3).

The entry of this value is subject to the calibration lock.

P146 Pressure equation slope [E] [1]

The slope of the pressure equation can be entered under this parameter (see Chap. 4.11). It is checked on entry for its range of validity (see Table A-3).

The entry of this value is subject to the calibration lock.

P145 and P146 can only be entered in pairs. If only one of these values is entered, it is not accepted by “P99”.

P147 Temperature equation offset [E] [1]

The offset of the temperature equation can be entered under this parameter (see Chap. 4.11). It is checked on entry for its range of validity (see Table A-3).

The entry of this value is subject to the calibration lock.

P148 Temperature equation slope [E] [1]

The slope of the temperature equation can be entered under this parameter (see Chap. 4.11). It is checked on entry for its range of validity (see Table A-3).

The entry of this value is subject to the calibration lock.

P147 and P148 can only be entered in pairs. If only one of these values is entered, it is not accepted by “P99”.

2.7 Error Messages

The following overview describes the messages occurring in Status Registers L4 and L5.

Errors which cause an alarm are marked with an [A]. While this error is present (actually still active), disturbance volumes are counted in H3 and H4 (instead of undisturbed volumes in H1 and H2) and the signal output is activated if it has been programmed under P16 as “Alarm output” or “Alarm and warning output”.

If a message describes a condition which releases a warning, then it is identified with a [W]. While this condition is present, the signal output remains activated if it has been programmed under P16 as “Warning output” or “Alarm and warning output”.

Messages about errors and conditions which are no longer present, remain in Status Register 1 (L4) and can he acknowledged (i.e. cleared) by entering

L4 [=/-] 0 [←]

The previous content of L4 is copied into Status Register 2 (L5).

If Status Register 1 is already empty, then it is not possible to clear it again. This ensures that Status Register 2 cannot be cleared, i.e. the messages last recorded in Status Register 1 are always retained in Status Register 2.

A tabular overview of all messages can be found in Appendix A-4.

E.0 No error

This message appears if “L4” is called up when the instrument has no error conditions.

E.1 New start [A]

The EK-88 has been started up without any usable data in the memory.

This message should not appear in normal operation, because even in the event of the failure of the (optional) external power supply the instrument automatically switches over to battery operation.

If this error appears, the internal battery must be replaced and the instrument recalibrated (see also “E7” below).

E.2 Old start [A]

This message occurs after temporary failure of the supply voltage (e.g. during battery replacement). All the data is however retained in the memory and the internal clock carries on running, but no data is acquired during this period.

E.6 Data error [A]

During the instrument self-test an error has been detected in the data memory. Reliable functioning of the instrument is no longer guaranteed.

E.7 Replace battery [W]

The calculated figure for the remaining battery service life has reached the warning limit (see “L35”).

The batteries should be changed as soon as possible.

E.13 Pressure not calibrated [A]

This error message occurs after a device is first started, i.e. a new start, to indicate that calibration of the pressure sensor input is required.

E.13 also appears after changing the pressure range (“L26”), if recalibration of the pressure input is required due to this change.

Procedure: see Chapter 2.5 under “L26”.

E.14 Temperature not calibrated [A]

This error message occurs after a device is first started, i.e. a new start, to indicate that calibration of the temperature sensor input is required.

E.15 Pressure outside the limits [A]

The measured pressure was outside the limits programmed with “P23” and “P24” (see Chapter 2.6).

E.16 Temperature outside the limits [A]

The computation of the K-value (for the setting P8 = 2) is only valid in the temperature range -5°C to +35°C. Depending on the operating mode set under P8 different temperature limits are therefore valid, the violation of which is signalled by E.16:

1) Operating mode “constant K-value” (P8 = 0):
   The measured gas temperature has violated the permissible range of “L27” by more than 1°C. The substitute temperature has been used for the computation of the Z-value.
2) Operating mode “K-AGA mode” (P8 = 2, K-value computation):
   The temperature was outside of the valid limits (-5°C to 35°C) for the computation of the K-value. The substitute K-value has been used for the computation of the Z-value.

E.17 Analogue converter plausibility error [A]

During the internal test of the analogue converter for pressure and temperature, an error was detected. The EK-88 is possibly defective.

E.21 Tamper detection active [W]

This message occurs when an active signal is applied to the tamper input. See Chap. 2.12 for the tamper detection function.

E.24 Overflow of intermediate buffer for pulse output

The intermediate buffer for volume pulses has overflowed (more than 65535 pulses to be output), because more pulses have been recorded over an extended period than have been transferred via the output. This means that volume pulses have been lost at the pulse output. The cp value of the pulse output (P17) must be reduced in this case.

This error also occurs if no volume pulses can be output because the cp value of the pulse output (P17) has been set to “0”.

E.28 Overflow of the actual volume counter

The actual volume counter (H1) has overflowed, i.e. after exceeding the maximum reading it starts again at 0 m^3.

This information is for information only and is not significant for the further functioning of the EK-88.

E.29 Changed gas analysis

The gas analysis (reference codes L145 to L178) are temporarily stored on entry for computation of the K-value and are only activated following the entry of “P99”. If the activation after the entry has been forgotten, the gas analysis values remain in the intermediate store and may perhaps be unintentionally activated later together with other changed values by using “P99”.

In order to inform the user of this problem, the message “E.29” remains in Status register L4 while the inactivated gas analysis values are located in the intermediate store. The message can only be cleared after the gas analysis has been activated with “P99”.

E.30 Calibration lock open

This message is recorded in Status Register “L4” when the calibration lock is open. It is automatically cleared when the calibration lock is closed.

E.31 Temperature in the vicinity of a limit [W]

The measured gas temperature was in the vicinity of a limit for the computation of the K-value. All measured and computed values (e.g. gas temperature, K-value) are still valid though (see Chapter 2.8.3).

This message can only occur if a high calorific value (for H gas) has been entered under “L145”.

2.8 Computation of the gas law deviation factor

The K-value computation for natural gases can be carried out according to the Technical Guideline G9 from the PTB, TR G9 8/82 (K-AGA mode). This procedure conforms to the new issue of this guideline (TR G9 12/93) as an approved approximation method.

It is also possible to correct volumes with a constant K-value (K constant mode).

These modes can be selected under the reference code “P8” with the calibration lock open. The following can be set:

P8 = 0 K constant mode

and

P8 = 2 K-AGA mode.

The current K-value is displayed under the new reference code “L6”.

2.8.1 K constant mode

In this mode the constant K-value entered under the reference code “P1” is used for the computation of the Z-value and is therefore also displayed under “L6”.

2.8.2 K-AGA mode

The following gas analysis input variables are required for the computation of the K-value according to AGA-NX-19-mod:

L 145 :	Calorific value	$H_{o,n}$	[kWh/m³]
L 148 :	CO_2 content	CO_2	[mole %]
L 168 :	Density ratio	d	[1]
L 178 :	N_2 content	N_2	[mole %]

These values are subject to the user lock and can be entered with three post-decimal places. They are checked on entry for their permissible range and, if invalid, they are acknowledged with the entry error “3” or “6” (see Appendix A-5). The permissible ranges for L and H gases are specified as follows according to TR G9:

L gas:	8.833	≤	$H_{o,n}$	[kWh/m³]	≤	11.055
	0.554	≤	d	[1]	≤	0.750
	0.000	≤	N_2	[mole %]	≤	15.000
	0.000	≤	CO_2	[mole %]	≤	15.000
H gas:	11.055	<	$H_{o,n}$	[kWh/m³]	≤	12.833
	0.554	≤	d	[1]	≤	0.691
	0.000	≤	N_2	[mole %]	≤	7.000
	0.000	≤	CO_2	[mole %]	≤	2.500

The value “0.0” is also valid for the calorific value $H_{o,n}$. This prevents the K-value computation taking place according to AGA-NX-19-mod-BR.KORR.3H. The K-value is then on carried out according to the equation AGA-NX-19-mod for natural gases with a low calorific value (L gas).

Due to the extended program running time for the computation of the K-value, it is not recalculated for each measurement cycle. A computation is carried out if the temperature has changed by more than 1°C or the pressure has changed by more than a value Δp. Δp is automatically selected for each pressure range such that the max. K-value error does not exceed 0.1%.

The computation of a new K-value takes about one second. During this period the reaction of the EK-88 to a keypad entry or change of measurement (i.e. a corresponding change in the display) may be delayed by up to one second.

2.8.3 Permissible ranges for pressure and temperature

The permissible ranges for pressure and temperature are specified as follows:

“P24” ≤ p ≤ “P23”,

“L27, lower limit” - 1°C ≤ T ≤ “L27, upper limit” + 1°C.

Outside of these limits the alarms “E.15” and E.16" become active and the correction of the standard volume is carried out with the appropriate substitute values.

In the special case of the K-value computation of H gas (P8 = 2 and L145 > 11.055) the permissible ranges for the pressure and temperature are specified as follows:

0 bar ≤ p ≤ 80 bar ; if exceeded: E.15
-5°C ≤ T ≤ 35 °C ; if exceeded: E.16

In addition, in this case the temperature is specially monitored over the ranges:

-5°C ≤ T ≤ 0°C and 30 °C ≤ T ≤ 35°C

and the message “E.31” is output within these limits. This does not affect the volume correction.

2.9 Printer log

As a supplementary function the EK-88 can provide a log output via the serial interface.

This printer log contains the following information:

Special symbols, date, time, V_n(H2), V(H1), Q_n, Q, pressure, temperature, K-value, Z-value and the currently active errors in the status register.

Important: To save the battery service life the use of an external power supply (USV-88/B, USV-88/N or USV-88/X) is recommended. With cyclical output of the printer logs without external power supply to the EK-88, the CTS signal on the EK-88 interface must not be continuously activated so that the internal batteries do not discharge within just a few days! The CTS signal should only be activated for the duration of the data transmission or not at all. However, without an active CTS signal the starting of a printer log output is only possible via the EK-88 keypad and not via the interface. With output cycles of less than 5 minutes and without an external power supply, the guaranteed battery service life reduces to a value below 5 years.

a) Output options

There are 3 output options available:

- immediate data output (see P56)
- cyclic output at minute intervals (see P57)
- daily output at a specified hour (see P58)

In addition an output log is obtained immediately following a fault.

Apart from the output occurring in response to the entry of the code number via the keypad, the function can also be called by a control symbol externally using the serial interface (e.g., by a connected station computer). Valid control symbols are characters with the format

P56
P57mm
P58hh

where mm represents the minutes and hh the hours.

b) Output format

Examples of a log printout:

Day	Time	V_n	V	Q_n	Q	T	P	K-value	Z-value	SR
*28	14:27	411004.	266858.0	4514.7	3006.6	1.97	1.532	1.0000	1.5016	0
28	14:30	411359.	267094.9	5135.6	3420.1	1.97	1.532	1.0000	1.5016	0
!28	16:32	429845.	279402.4	4969.4	3305.0	1.97	1.534	1.0000	1.5036	24

The special symbols in the first line identify the immediate output of a log, where the following meaning applies:

* - the normal, once only output according to P56 and
! - the output directly after the occurrence or disappearance of an error.

The number in the column “SR” (status register) corresponds to the most important (lowest) active status message.

2.10 Process data output

For applications in the field of process control (e.g. temperature control) and data communications, all the important data can be recalled from the volume corrector function via the serial interface.

This data is output directly to the serial interface by entering the character sequence

P67 (=/-] 1 [←]

This supplementary function runs independently of the DS-100 data communication. However, since only one interface is available, simultaneous operation is not possible. Alternate reading out of the DS-100 function and the volume corrector function is allowed.

With cyclical interrogation of the process data block via the interface without an external power supply to the EK-88 its CTS signal must not remain continually active otherwise the internal batteries will be discharged within a few days. The CTS signal should be activated for a brief period (e.g. 1 second) before each data request from the receiving device and then switched off again directly after the data request. The CTS signal can remain continually inactive (or open) when starting the data output from the EK-88 keypad (see above).

The interface has no effect on the volume correction.

If this output occurs without an external power supply, the most significant bit in the hexadecimal code for the status register is set as a label indicating “battery operation”. This label **is not** however displayed on the display of the volume corrector in Status Register “L4”.

The request for data is made via the serial interface by the following character string

“SOH” “P” “6” “7” “CR” “ETB”

and the output of the process data is initiated in the following sequence and format:

STX 153,ELS,EK-88,9222,111111111111,222222222222,333333333333,
YYMMDDhhmmss,444444444444D-3,555555555555Dxx,27315D-2,
0101325D-5,010000D-4,0012000D-4,0000C001,0048224D-1,
002516D-1,%4711,LF CR ETX

Explanation of the symbols:

SOH	01hex	Ctrl A	Start of frame for process data
ETB	17hex	Ctrl W	End of frame for process data. Any number of interrogations can be made between SOH and ETB.
STX	02hex	Ctrl B	Introduces a data block. From now on only characters in the ASCII table are output. The data is delimited with a comma (2C hex).

178	Three decimal numbers giving the number of bytes to be transferred from the following "E“ up to and excluding the ETX at the end of the block. The commas for delimiting the data are also counted. The number is always 178 for the EK-88.
ELS	Company logo and comma, 4 ASCII characters.
EK-88	Device identification in plain text and comma, 6 ASCII characters
9222	Elster version number and comma, 5 ASCII characters, with 92: device identification and 22: version number (e.g. 2.2)
111111111111	Meter number and comma, 13 ASCII characters.
222222222222	Customer number and comma, 13 ASCII characters.
333333333333	Equipment number and comma, 13 ASCII characters.
YYMMDDhhmmss	Date, time and comma, 13 ASCII characters.
444444444444Dxy	Standard volume, 12 figure integer followed by "D“ and single figure exponent with sign. All ASCII characters. Example: 000000012345D-3 corresponds to 12.345 m^3
555555555555Dxy	Actual volume, format as for standard volume. Example: 000345678903D-2 corresponds to 3456789.03 m^3.
27315D-2	Present gas temperature, 5 figure integer with signed exponent. Example: 27315D-2 corresponds to 273.15 Kelvin.
00101325D-5	Present gas pressure, 7 figure integer with signed exponent. Example: 0101325D-5 corresponds to 1.01325 bar.
010000D-4	K-value, 6 figure integer with signed exponent, which is always "-4“. Example: 010000D-4 corresponds to K = 1.0000.
0012000D-4	Z-value computed by the EK-88, 7 figure integer with signed exponent which is always "-4“. Example: 0012000D-4 corresponds to Z = 1.2000.
0000C001	Status register, 8 character, active errors of EK-88 32-bit status register. Example: 0000C001 corresponds to error messages 1, 15 and 16
0048224D-1	Standard flow rate, 7 figure integer with signed exponent, e.g. 0048224D-1 = 4822.4 m^3/h.
002516D-1	Actual flow rate, 6 figure integer with signed exponent, e.g. 002516D-1 = 251.6 m^3/h.
%4711	4 hexadecimal numbers: checksum MOD 65536 for all transferred ASCII characters from STX up to and including "%“
LF CR ETX	End of the process data block and of the ASCII characters (LF = OA hex, Ctrl 9; CR = OD, Ctrl M; ETX = 03 hex, Ctrl C)

2.11 User lock

The EK-88 has a user combination lock consisting of two parts for locking the user parameters: the customer and supplier locks. These are identified in the description with [B] and they can only be modified when the lock is open.

The correct entry of two code numbers, each up to 6 figures long, for the customer's and supplier's locks is needed to open the lock.

The following reference codes are available:

P0 = Entry of the supplier's code for opening and closing the supplier's lock.

P10 = Entry of the customer's code for opening and closing the customer's lock.

P9 = Changing the supplier's code.

P11 = Changing the customer's code.

With the calibration lock open (recognised through P90 = "1" and the message "E.30" in Status Register L4) the user lock is always open.

The user combination lock is also open as supplied ex-works and both codes have the number "0".

Note:
Please note the code numbers carefully, because these cannot be read out. If the numbers are lost, the user lock can only be opened using the calibration official's switch.

With the supplier's and customer's locks opened the code number can be changed by entering a new number, up to 6 figures long, (without leading zeros).

For example the entry of P 0 [=/-] when the supplier's lock is open causes the following output on the display:

P0 - 1 -

The "1" on the right-hand side of the display signals that the supplier's lock is open. If the supplier's code is now entered, then the lock closes and the display signals this with the following display:

P0 - 0 -

Re-entering the supplier's code would now open the supplier's lock again.

The customer's lock is opened and closed in a similar manner under the reference code P10.

2.12 Tamper detection

The volume pulse transmitter on the EK-88 is a reed contact controlled by a magnet which is moved by the gas meter. Therefore, tampering, i.e. the inhibiting of volume pulses is possible with a strong magnet. To detect this, the tamper detection on the EK-88 can be activated under the reference code “P39”:

- P39 = 0: Tamper detection switched off.
- P39 = 1: Tamper contact implemented as normally closed contact.
  Input open means: Tampering is taking place (“E.21” is recorded).
- P39 = 2: Tamper contact implemented as normally open contact.
  Input closed means: Tampering is taking place (“E.21” is recorded).

Another reed contact, which is only influenced by an external magnetic field, but not by the magnet on the gas meter, must be fitted in the vicinity of the pulse generator. The state of this so-called tamper contact is continuously monitored by the EK-88. When the presence of an external magnetic field on the tamper contact and therefore also on the pulse generator is detected, the message “E.21” = “Tamper detection active” is recorded in Status Register “L4”.

A normally closed contact is to be preferred as tamper contact, because in this case a cable break also produces a message.

When using a tamper contact, it is connected to the same connector as the external pulse generator (see Appendix C-4: Chapter “Pulse generator and tamper contact”).

3 Operating instructions DS-100 function

In the measurement and data chain in the long-term pulse detection system, the DS-100 function built into the EK-88 has the task of “local” data acquisition.

Consequently, the DS-100 function does not represent an independent instrument, it is in fact a software module, which works in a similar way to a 4-channel DS-100 in the EK-88 independently of the volume corrector function. In contrast to a DS-100 instrument there are no external inputs available and the data to be acquired is accepted directly from the volume corrector module, acquired and stored in time sequence. The channels concerned are:

- Channel 1: V [m^3]
- Channel 2: V_n [m^3]
- Channel 3: Pressure [bar]
- Channel 4: Temperature [K]

The DS-100 function does not have its own display, nor does it have a separate channel or data key. Instead the existing display and keypad are used. The changeover to the DS-100 function is made by activating the function “H0” (return to the original state by entering “H”, “L” or “P”). The DS-100 mode is indicated on the display by the flashing of the allocation indicators in the display (“pointers”). The data acquisition with the DS-100 function works independently of the selection of the display mode, i.e. even if the display is allocated to the volume corrector function, data from the DS-100 function is acquired and stored.

The existing memory capacity allows for the acquisition of the values read in over a period of approximately 0.5 years with an interval of 60 minutes. With shorter intervals the available period correspondingly reduces. Possible interval times are 5, 10, 15, 20, 30 and 60 minutes.

3.1 Differences between the DS-100 instrument and the DS-100 function

The DS-100 function in the EK-88 processes two different forms of input signal, on the one hand “digital” values (V, V_n) and on the other "analogue" values (pressure, temperature). This difference also shows up in the further processing.

In the case of the digital values, “pulses” are counted, whilst in the case of the analogue values average values are derived.

With the time-related storage the difference only exists in the different sources (sum or average). The transfer of values from the volume corrector module to the DS-100 function will now be explained, with analogue and digital values considered separately:

3.1.1 Digital values (Channel 1 = V and Channel 2 = V_n)

A DS-100 **device** acquires the pulses arising at the input and stores them referred to time. In the DS-100 **function** from Version 3.1 onwards the **counter readings** are however accepted directly from the volume corrector module, i.e. there are no input terminals since the data is transferred directly inside the device. This has the advantage that when transporting the DS-100 data using a readout device, modem or a similar unit the **original** counter readings (OCR) of the officially calibrated part are always directly transmitted and are immediately available for subsequent processing. The flow rates are calculated from the difference of the counter readings from the beginning to the end of the interval.

During the transmission of the original counter readings only figures are transmitted (without labelling of the decimal point), as is usual in the DS-100. A suitable decimal factor is needed for the conversion into gas quantities. For the original counter readings the cp value which would normally be used for the DS-100 function **is not** used here, but instead a “conversion factor” that reflects the representation of the counter readings in the volume corrector. In contrast to the DS-100 cp value (which is still responsible for the interval values), it cannot be changed using the readout device. In Channel 1 it is the same as the cp value of the volume corrector (“P4”) and is constant at 1 in Channel 2. The “conversion factor” is only relevant for programs which process data supplied by the DS-100 function.

The DS-100 “cp value” is used for the storage, display and data transmission of the consumption values (interval values) and maxima. The set cp value can be seen in the display of the maxima (H4, H5) and the last consumption (H6) based on the position of the decimal point (see Chapter 3.4 “Description of general data”).

There are two possible methods of setting the cp vague:

a) Matching of the cp value in Channels 1 and 2 of the DS-100 function is automatically carried out after each change of the cp value (P4).

b) The cp value can be changed with the aid of the read-out device. However, with the EK-88 the following restrictions should be noted:

Channel 1 (V):	cp = cp(VC)	The cp value is always the same as that of the volume corrector (P4) and cannot be changed.
Channel (V_n):	cp = 0,01...10	The cp value can only be the same or lower than that of the volume corrector (P4).

Depending on the maximum flow rate (Q or Q_n), suitable cp values are produced according to the following table (for an interval period of 60 min):

Q_{max}	DS-100 cp value
≤ 407,9 m³/h	10 m^{-3}
≤ 4079 m³/h	1 m^{-3}
≤ 40790 m³/h	0,1 m^{-3}
≤ 407900 m³/h	0,01 m^{-3}

The quoted Q values increase with a corresponding reduction in the interval period.

A rule of thumb for the setting of the cp value in Channel 2 (V_n) is:

The cp value in Channel 2 must be reduced compared to the value in the volume corrector (P4), if the following condition is satisfied:

$$Z \cdot f > 1$$

where Z = maximum expected gas law deviation factor (L3).
f = maximum expected frequency of the volume pulse generator in Hertz.

A cp value which has been changed via the interface (e.g. read-out unit) or keypad (P4) is temporarily stored and is only accepted into the DS-100 function at the start of the next measurement period (interval).

3.1.2 Analogue values (Channel 3 = Pressure and Channel 4 = Temperature)

The average values to be stored in the DS-100 memory are represented by figures in the range from 0 to 4079. The resolution (increment) of the stored values is limited due to the defined number range.

For the DS-100 function the pressure resolution is automatically determined after entry of the upper limiting value (“P23”) and it cannot be changed with the read-out unit via the interface.

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 ... 125 bar	32 mbar

The resolution of the temperature is a constant 0.1K. Consequently, it is possible to store the temperatures as absolute values in Kelvin.

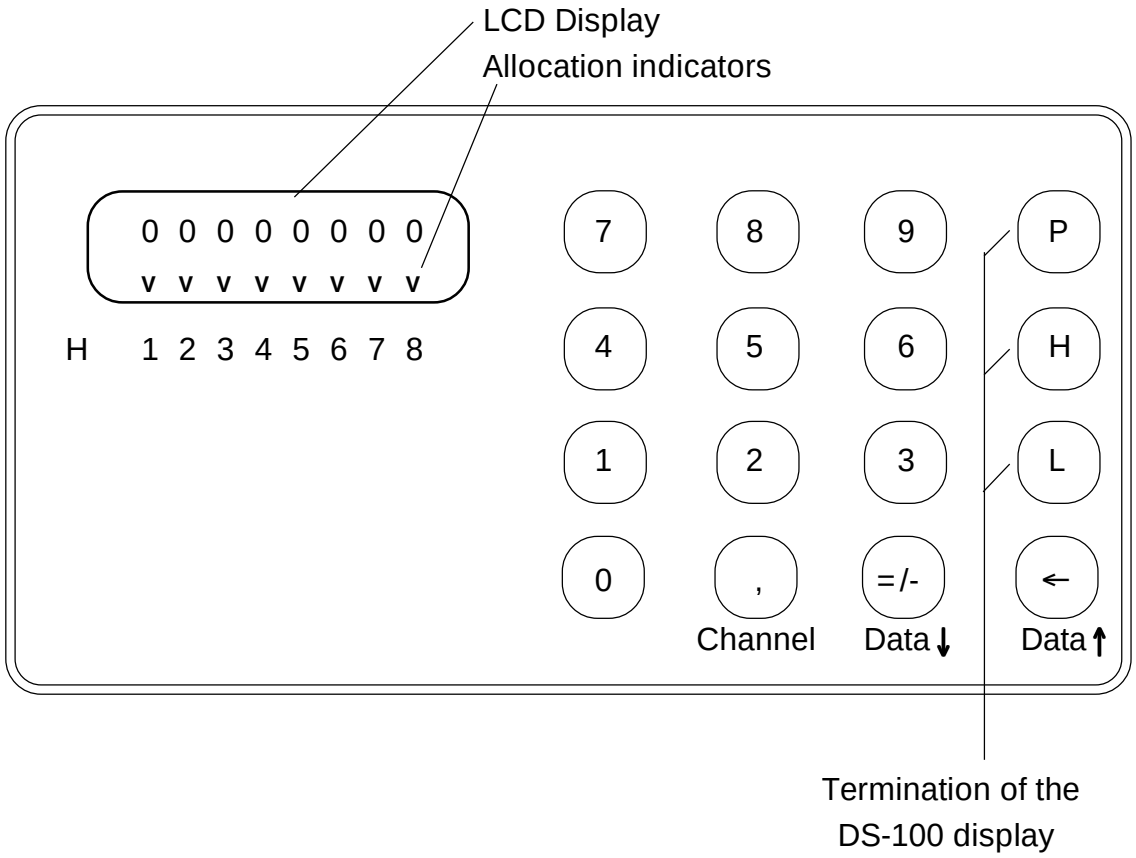
3.2 Display and keypad in the DS-100 function

By entering “H0” on the EK-88 keypad, the display and the keypad are changed over to the DS-100 function.

By entering “H”, “L” or “P”, the display and the keypad are returned to the volume corrector function.

If the display is set to continuous operation, after approximately 1 minute a changeover to the standard volume of the volume corrector (H2) takes place automatically if this changeover has not been inhibited by “P91 = 0”.

Diagram of the EK-88 front panel:
(With the elements relevant for the DS-100 function)



3.2.1 Display

In order that the two display modes (volume corrector or DS-100) can be distinguished, one or two pointers (allocation indicators) in the display, depending on the displayed data, flash at a rate of once per second.

3.2.2 Keypad

In the same way as the DS-100 instruments, only two keys on the EK-88 keypad are used for selecting the channels and the relevant data.

- channel key = **,**

Changeover from data to channel display.
Advance to next channel.

- Data key = **=/-** (down) ← (up)

Changeover from channel to data display.
Advance to next value (up or down).

The function of the keys depends on the particular status of the display:

If data is displayed, pressing the data key (“=/-”) causes the display to advance to the next value and the data key “backspace” ("←") causes the display to return to the previous value**.** Pressing the channel key (“,”) causes a changeover to the channel display.

If the channel is displayed, the channel key is used to advance to the next channel and the data key to change back to the data display.

Approximately two seconds after the last pressing of the channel key the DS-100 function automatically switches back to the data display. The same parameter as before the channel changeover is displayed, but with the value of the newly selected channel.

On starting a readout or selection process with the AS-100, the DS-100 function automatically displays the channel number. This takes place however only if the display and the keypad have been changed over previously to the DS-100 function by entering “H0”. After the readout or programming (selection) of a channel has been completed, the DS-100 function switches to the next channel independently of the display mode (volume corrector or DS-100).

The allocation of channels P-1 to P-4 is:

P-1 = Actual volume

P-2 = Standard volume

P-3 = Pressure

P-4 = Temperature

The allocation indicators (pointers) on the display refer to the reference codes which identify the displayed data. The significance of the reference codes is explained in a separate chapter.

- Data key (backspace) = 

Complementary to the data key (“ = /-”), the data key “backspace” can be used in the DS-100 mode for switching the display back to the previous value. This enables access to a previous value without having to key through the complete display loop.

3.3 Displaying data

The data key (“ = /-”) in the keypad is provided for displaying the data present in the instrument. With this key all values can be displayed consecutively in an “endless loop”. This is however only possible when the display and the keypad have been changed over to the DS-100 function.

The values are available for each channel independently of each other, though a differentiation must be made between the “digital” (V, V_n) and the “analogue” channels (pressure, temperature), because most of the reference codes are dual assigned. For example, with the Channels 1 (V) and 2 (V_n), consumption figures, loads or their maxima are displayed, whilst for Channels 3 (pressure) and 4 (temperature) average values or their minima or maxima are displayed. Therefore the overview for the two groups is implemented separately.

3.3.1 Displaying data for V and V_n

The following summary shows the data displayed for Channels 1 and 2 after a key has been pressed, starting with the display of the status register.

Keystroke	Displayed value	Ref. code/ indicator
	Status register	H23
1	Date	H24
2	Time	H25
3	Volume corrector totaliser reading	H1
4	Adjustable or undisturbed counter of volume corrector	H2
5	Month-end reading, Counter H2 (see above)	H3
6	Date of month-end reading	H3
7	Time of month-end reading	H3
8	Max. daily consumption of current month	H4
9	Date of daily maximum of current month	H4
10	Time of daily maximum of current month	H4
11	Max. daily consumption previous month	H4
12	Date of daily maximum previous month	H4
13	Time of daily maximum previous month	H4
14	Maximum flow rate of current month	H5
15	Date of maximum flow rate of current month	H5
16	Time of maximum flow rate of current month	H5
17	Maximum flow rate, previous month	H5
18	Date of maximum flow rate, previous month	H5
19	Time of maximum flow rate, previous month	H5
20	Consumption in last measuring period	H6
21	Measuring period (interval)	H7
22	Customer No., first 4 chars.	H16
23	Customer No., last 8 chars.	H16
24	Meter No., first 4 chars.	H17
25	Meter No., last 8 chars.	H17
26	Instrument No., first 4 chars.	H18
27	Instrument No., last 8 chars.	H18
28	Status register	H23
29	Date	H24
	etc.	

3.3.2 Displaying data for pressure and temperature

The following summary shows the data displayed for Channels 3 and 4 after a key has been pressed, starting with the display of the status register.

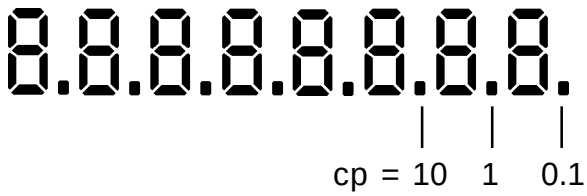
For Channel 3 (pressure) the display is in bar and for Channel 4 (temperature) in °C.

Keystroke	Displayed value	Ref. code/ indicator
	Status register	H23
1	Date	H24
2	Time	H25
3	Current value	H1
4	Monthly mean value, current month	H2
5	Monthly mean value, previous month	H3
6	Date of last monthly mean	H3
7	Time of last monthly mean	H3
8	Minimum mean value of current month	H4
9	Date of min. mean val. of current month	H4
10	Time of min. mean val. of current month	H4
11	Minimum mean value previous month	H4
12	Date of min. mean val. previous month	H4
13	Time of min. mean val. previous month	H4
14	Maximum mean value of current month	H5
15	Date of max. mean val. of current month	H5
16	Time of max. mean val. of current month	H5
17	Maximum mean value previous month	H5
18	Date of max. mean val. previous month	H5
19	Time of max. mean val. previous month	H5
20	Mean value for last measuring period	H6
21	Measuring period (interval)	H7
22	Customer No., first 4 chars.	H16
23	Customer No., last 8 chars.	H16
24	Meter No., first 4 chars.	H17
25	Meter No., last 8 chars.	H17
26	Instrument No., first 4 chars.	H18
27	Instrument No., last 8 chars.	H18
28	Status register	H23
29	Date	H24
	etc.	

3.4 Description of the displayed data

3.4.1 Description of the general data

Volumes (meter readings) are shown in m^3, taking the decimal point into account. The selected cp value (pulses/m^3) can be seen by the position of the decimal point:



Any reprogramming of the cp value only becomes active at the start of the next measuring period and is only then displayed.

H16 = Customer number

The customer number is used as the most important reference quantity in the subsequent processing steps. Like the meter and the instrument number it can be set and read out by the AS-100 Readout Device.

H17 = Meter number

The meter number is used for identifying the connected gas meter (in particular where the customer has several meters). It can for example be matched to the serial number of the gas meter and is automatically passed on like the customer and instrument numbers.

H18 = Instrument number

The instrument number identifies the DS-100 function and its channels and is set in the factory. Apart from one digit, it coincides with the number on the name-plate. The “ten thousands digit” is always “0” on the name-plate, but in the case of the stored and displayed instrument number it represents the channel.

For example:

Serial number on the name-plate	1300045
Instrument No., corresponding to Channel 1:	1310045
Instrument No., corresponding to Channel 2:	1320045
Instrument No., corresponding to Channel 3:	1330045
Instrument No., corresponding to Channel 4:	1340045

The top five digits are set to zero and can be used for later extensions or customer-specific applications.

The lower seven figures of the instrument number and channel numbers which have been set ex-works should normally not be changed.

H23 or E in display = status register

For each channel, faults and warning messages are stored in the status register.

This gives a good overview of the operating state and facilitates rapid fault-finding. The content of the register is cleared after reading out the channel and transferring the data into the AS-100.

The status register display is identified by the function pointer - because of the differentiation between the EK-88 and DS-100 displays - and also by the letter “E”.

A maximum of 6 faults can be displayed. The error numbers are always separated by a point.

The status register of the DS-100 function is not identical to the EK-88 status register, although some errors of the EK-88 are logged in the status register of the DS-100 function (for further details see Chapter 3.6).

Example: E 5

The fault number 5 (correctable counter error) is reported.

H24 = Date, H25 = Time

The absolute values for the date and time (Central European Time or local time) are necessary for storing the consumption values.

There is no provision for changing over to Summer Time (Central European Summer Time). A “time shift” is possible in the evaluation software (AWS-100) for billing documentation, for example.

On each readout the time is independently corrected via the readout unit (AS-100) if the deviation is less than 5 minutes. In the case of time differences of between 5 and 29 minutes, the correction is only made after confirming the query in the readout unit. In the case of deviations of 30 minutes and more no correction is carried out, because there may be an instrument fault.

Date and time are identical for all channels, because there is only one internal clock (RTC).

3.4.2 Description of the digital data (V and V_n)

In the DS-100 function original counter readings (OCR) of the volume corrector are displayed under the reference codes H1 and H2.

H1 = Totaliser readings in volume corrector

The (totalisers) total counters in the volume corrector are displayed under this reference code:

Channel 1 (V) : V counter “**H1**” in volume corrector
Channel 2 (V_n) : V_n totaliser “**H6**” in volume corrector

H2 = Adjustable or undisturbed volume corrector counter reading

Depending on the DS-100 channel various volume corrector counters are displayed under this reference code.

Channel 1 (V) : adjustable V counter **“H23”** of volume corrector
Channel 2 (V_n): undisturbed V_n counter **“H2”** of volume corrector

It is not possible to adjust these counters via the AS-100 Readout Device. However, for synchronisation to the gas meter any value can be entered for the adjustable V counter in the volume corrector (“H23”) displayed in Channel 1 by using the keypad (see also Chap. 3.1.1).

H3 = End of month reading of counter H2 (see above)

The counter reading (H2) is stored on the first of each month on the change of day (e.g. 06:00 hours) and can be called up during the current month.

H4 = Maximum daily consumption

During the counting process the consumption within one day is continuously monitored and the maximum value with date and time stored. If a higher value than the one already entered is measured, the new figure will be entered.

This process will be started afresh at the beginning of each month.

The maximum daily consumption for the current month and for the last month are displayed consecutively. Both values are labelled with “H4”. The display of time and date enables the two values to be differentiated.

H5 = Maximum flow

As with the daily maximum, the consumption within an interval is continually monitored and the maximum value with date and time stored.

For the display this value is converted to the units m^3/h.

The maximum for the current month and for the last month are displayed consecutively. Both values are labelled with “H5”. The display of time and date enables the two values to be differentiated.

H6 = Last consumption

The consumption in the last interval is displayed with this value.

This makes it possible to easily check the stored “on-site” hours value by noting the counter readings at the beginning and end of a time interval and then comparing the difference with the displayed value of H6.

H7 = Measuring period

The measuring period (interval) is the smallest time unit in which consumption figures are stored. It is synchronised with the time, i.e. a 60 minute measuring period runs for example from 14:00:00 hours to 15:00:00 hours.

The measuring period can be adjusted to whole-number divisors of 60 minutes (5, 10, 15, 20, 30 and 60)in the range from 5 to 60 minutes using the AS-100 Readout Device. A new measuring period is temporarily stored and transferred only when the next full hour is exceeded.

The measuring period is displayed in minutes.

3.4.3 Description of the “analogue” data (pressure, temperature)

H1 = Present measurement

The measurement transferred from the volume corrector to the DS-100 function is displayed and also used for forming the mean value.

Differences in the indication of pressure and temperature compared with the values displayed directly by the volume corrector are possible, because due to the value adjustment (lower resolution of the DS-100 function due to system reasons) the last digit of the DS display can deviate by ±1 from the volume corrector display. In the temperature display a deviation of even ±0.2°C is possible, because the internal temperature is processed and stored as absolute temperature and only converted into °C for display purposes.

H2 = Monthly mean value for the current month

The monthly mean value is calculated from the interval mean values. The monthly mean value of the current month is displayed.

H3 = Monthly mean value of the last month

The monthly mean value of the last month is displayed with date and time.

H4 = Minimum mean value

When forming the mean value, the interval mean value is continuously monitored and the smallest value stored with date and time.

If a smaller value than the one already entered is measured, the new value is entered.

The minimum for the current month and for the last month are displayed consecutively. Both values are labelled with H4. The two values can be differentiated by the display of time and date.

H5 = Maximum mean value

When forming the mean value the interval mean is continuously monitored and the largest value stored with date and time.

If a larger value than the one already entered is measured, the new value is entered.

The maximum means for the current month and for the last month are displayed consecutively. Both values are labelled with H5. The two values can be differentiated by the display of time and date.

H6 = Last mean value

The arithmetic mean value calculated in the measurement interval from the measurements transferred from the volume corrector is accepted at the end of an interval. The means of pressure and temperature over the last interval are displayed here.

H7 = Measurement period

The measurement period (interval) is the smallest time unit in which the determined mean values can be stored.

It is synchronised with the time, i.e. a 60 minute measuring period runs for example from 14:00:00 hours to 15:00:00 hours.

The measuring period can be adjusted to whole-number divisors of 60 minutes in the range from 5 to 60 minutes using the AS-100 Readout Device. A new measuring period is temporarily stored and transferred only when the next full hour is exceeded.

The measuring period is displayed in minutes.

3.5 Putting the DS-100 function into operation

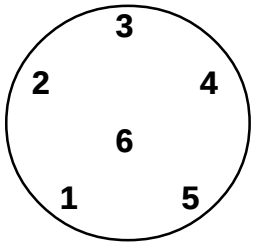
3.5.1 Making the cable connection

Before the DS-100 function can be put into operation, the installation of the EK-88 must be completed. See Chapter 4 “Setting up” for further details. Special wiring for operating the DS-100 function is not required.

3.5.2 Pin assignment on the serial interface

On the right side of the housing there is a 6-pole socket to which an AS-100 can be connected.

Pin assignment on the connection socket:



(View from outside on the EK-88)

Pin No	Assignment
1	Vcc + 5V supply on ser. interface
2	TxD (Send Data)
3	RxD (Receive Data)
4	RTS (hardware handshake output)
5	CTS (hardware handshake input)
6	Gnd (signal ground)

3.5.3 Activating the DS-100 function

In order to activate the DS-100 function the time must be set via an AS-100; only then will the DS-100 function store the acquired data. Normally this is carried out at the factory, so the DS-100 function is working on delivery.

3.6 Fault tables

3.6.1 DS-100 Status register

0 = No fault present.

1 = New start
After activating the instrument there is no data in the memory.
The DS-100 function does NOT yet COUNT OR ACQUIRE DATA, but only after the clock has been set by the AS-100.

2 = Power failure
The internal power supply has failed during operation. During this period no counting or data acquisition took place. The existing data remains stored and the internal clock continues to run.

3 = Incorrect value
This error message can have two causes:

a) The interval counter or mean value store has overflowed, e.g. more than 4079 pulses per interval were counted. If this fault occurs in Channel 2 (V_n), the cp value should he reduced.

b) The volume corrector has produced the error “E8” (see Chap. 2.7).
The associated interval value is incorrect.

4 = Substitute value
This error message indicates that substitute values were supplied by the volume corrector to form an interval value (see Chap. 3.6.2).

5 = Corrected value / warning
This fault message can have two different meanings:

a) Corrected value: The fault message is caused by a volume corrector fault or warning (see Chapter 3.6 2)

b) Warning: The cp value set in Channel 2 (V_n) is too large. Pulse losses may occur (see Fault “3”).
The associated interval value is probably correct

6 = Data error in memory
This fault is detected by a processor test procedure. If this fault occurs the instrument is defective.

7 = Replace batteries
The internal batteries are almost fully discharged. The proper functioning of the device can no longer be guaranteed. This may be due to one of two causes:

- A battery voltage that was too low was measured during an internal battery test.
- The computed battery service life has reached the limit “0 hours” (see L35).

8 = (Reserved for production test.)

3.6.2 Volume corrector fault / warning in the DS-100 status register

The error messages in the volume corrector function which are important for the DS-100 function and for conversion are combined into error messages and entered in the DS-100 status register, depending on their effect.

Channel-specific allocation of the DS-100 error messages

Volume corrector error message		DS-100-error			
No.	Error text	K1	K2	K3	K4
6	Data error in memory	6	6	6	6
7	Replace batteries	7	7	7	7
13	Pressure not calibrated	-	3	3	-
14	Temperature not calibrated	-	3	-	3
15	Pressure outside limits	-	4	4	-
16	Temperature outside limits	-	4	-	4
17	Plausibility error analogue converter	-	5	5	5
21	Tamper detection active	5	5	-	-
24	Intermediate buffer overflow for V/ V_n output	-	-	-	-
28	Overflow of the actual volume counter	-	-	-	-
29	Gas analysis changed	-	-	-	-
30	Calibration lock open	-	-	-	-
31	Temperature outside of conversion limits	-	5	-	-

Error number in the corresponding channel

The DS-100 error messages are stored both in the DS-100 status register and also, time-related, in the data memory. The status register is erased after each readout (e.g., with the AS-100 Readout Device).

4 Setting up

The following actions are required to set up the device:

1. Mounting the EK-88 on the gas meter or on the wall.

2. Connecting the pressure line and the temperature sensor
(Wiring diagram: See Appendix B-1)

☞ *If the EK-88 is supplied ready-mounted on a gas meter, then mounting and installation work on site is not required.*

3. Programming the necessary parameters (see Chap. 2.6).

☞ *If required, the device can be supplied adjusted according to the appropriate data and programmed.*

4. If necessary, connection of the external power supply or the external pulse generator and, where applicable, the following equipment (Wiring diagram: see Appendix B-1).

☞ *For applications in Ex Zones 1 or 2 make sure that the limits stated in the certificate of conformance are not exceeded by the device to be connected (guaranteed with the USV-88/X).*

5. Sealing of the instrument by the Weights and Measures Inspector. (Sealing diagram see Appendix B-2).

☞ ***Note about the presence of the calibration official during the installation or modification:***
"The responsible calibration authorities should be immediately informed. They will carry out a measurement test in the prevailing operating state with a check of the correctness of signal transmission, thereafter securing the signal leads."

4.1 Wiring and sealing

The wiring diagram can be found in Appendix B-1.

All cables are connected by means of round plugs. These are of non-interchangeable design in order to avoid incorrect connections.

The cables are supplied ready to fit. The standard lengths indicated below can be modified if required.

The wiring parts which have to be wire-sealed have a hole. This is located

- at the cable outlet on plug connections
- on the union nut on the pressure connection.

The sealing diagram can be seen in Appendix B-2.

4.2 Calibration switch

Programmable values which affect the volume counting can only be modified when the calibration switch is activated (see Chapter 2.6). This switch is located inside the volume corrector and is accessible through a hole on the front panel. After removing the sealed screw the switch can be switched by means of a screwdriver or similar tool.

The button is pressed to activate the switch. The display switches automatically to the Status Register “L4” when the calibration lock is opened.

When the calibration switch is activated, measurement and display are automatically switched to the permanently active mode, so that the power consumption of the PCB increases. Therefore, the calibration switch should only be activated during calibration in order to avoid unnecessary loads on the batteries.

The calibration lock can only be **opened** with this button. The lock is closed using the reference code “P90” (see Chap. 2.6). If the user forgets to close the calibration lock, then this occurs automatically after 1 hour if no key has been pressed and the interface has not been activated during this period.

4.3 Pressure connection

The EK-88 possesses an integral pressure sensor, i.e. the pressure line is connected directly to the corresponding screwed connection on the volume corrector. The precise technical data can be taken from Appendix C-5.

The nut supplied for the pressure connection has a hole for accommodating a sealing wire.

Please follow the mounting information in Appendix C-5 (pressure sensor).

4.4 Temperature sensor

The temperature sensor (Pt100) is connected to the volume corrector via a 4-pole plug (see Appendix B-1). The plug has a hole for accommodating a sealing wire on the cable outlet (see Appendix B-2).

There are a total of five different temperature sensors for installation in a pipe or a gas meter. They have different installation lengths (50 mm, 140 mm and 160 mm) and different cable connections (permanently connected cable or sensor with connection terminals). The sensor with the 140 mm installation length can be installed directly, without a sensor pocket.

Certain connection constraints apply to systems in applications subject to official calibration and these must be observed. There are additional standards and requirements for cable used in intrinsically safe systems. These can be found in Appendix C-6g where the optional connection cable for sensors with connection terminals is described. The relevant wiring diagram and information about earthing and connection of the cable screen can also be found here.

4.5 Pulse generator

There are two ways of connecting a pulse generator to the EK-88. The choice of the generator used is made via the reference code “P5” (see Chap. 2.6).

The internal pulse generator is built into the volume corrector. It can be used when the EK-88 is mounted directly on a gas meter.

☞ *Switchover between the internal and external pulse generators is only possible with the calibration lock open.*

If no pulse generator has been selected (ex-works setting “P5 = 0”), the customer then has the possibility of selecting the **pulse generator just once** without the presence of the calibration official.

An external pulse generator can be connected by means of a 5-pole plug (see Appendices B-1 and C-4).

A ready-to-use cable for this can be supplied if details of the required length are given.

4.6 Tamper input

A tamper contact can be connected via a 5-pole connector (see Appendices B-1 and C-4). A ready-to-use cable can be supplied for this if details of the required length are given.

The precise function of the tamper detection is described in Chapter 2.12.

4.7 Data Interface

Data communication with the volume corrector and the DS-100 module is possible via the serial data interface (6-pole connector, see Appendices B-1 and C-7).

There is a read-only access to all the process data of the volume corrector module and values can also be set and read out in the DS-100 function.

With the AS-100 Readout Device the recorded data of the data memory function (DS-100 function) can be read out via the data interface. The corresponding connecting cable is included in the supply of the readout device. The connection of a modem for remote data transmission is also possible. Please contact Elster Sales or Electronics Departments for further information about interface formats.

For further details on the data memory function: see Chapter 3 (DS-100).

The interface is activated by inserting the plug and switching on the connected readout device. In this case measurement and display are automatically switched to permanent active mode, so that the power consumption of the board increases (see Chapter 4.9 Power supply).

In order not to load the batteries unnecessarily, the interface should not be activated longer than necessary. The reading out of the 4 channels takes approximately 8 minutes for the hourly values of one month.

4.8 Alarm/warning and pulse outputs

The alarm/warning and pulse outputs as well as the power supply are brought out to the same connector (labelled as “external power supply” in Appendix B-1). An appropriate cable can be supplied (see Chap. 4.9).

The output can be programmed for the following functions with the parameter “P16”:

P16	Output function	Corresponding counter
0	Clear pulse memory, output has no function	-
1	Pulse output V undisturbed	H1
2	Pulse output V_n undisturbed	H2
3	Pulse output V disturbed	H3
4	Pulse output V_n disturbed	H4
5	Pulse output V total	H5
6	Pulse output V_n total	H6
7	Alarm output	-
8	Warning output	-
9	Alarm and warning output	-

The alarm output is activated while ever an error is present which causes an alarm. The relevant errors are described in Chapter 2.7.

The warning output is activated while ever an error is present which causes a warning. The relevant errors are described in Chapter 2.7.

The alarm/warning output is activated in all cases of an alarm and in all cases of a warning.

The output of the volume pulses occurs in pulse packets. Therefore, it is not possible to determine a momentary flow rate.

The cp-value (pulse weighting) of the pulse output can be adjusted by means of “P17”. The output of the pulses takes place at a frequency with a maximum of 2Hz. The precise description of the parameters “P16” and “P17” can be found in Chapter 2.6.

It is only possible to use the alarm/warning output if the volume corrector is operated with an external power supply. The output of the volume pulses is also possible without an external power supply. However, the battery service life is substantially reduced in this case.

The frequency of the output volume pulses is different for use with and without an external power supply:

	Battery operation	With ext. power supply
Frequency	Maximum 1.1 kHz	Maximum 2 kHz
Pulse duration	Constant 50 ms	Constant 250 ms

The battery life (cf. Chap. 4.9 “Power supply”) when using the pulse output in battery operation depends on the average and the maximum pulse output frequency. The relevant values for the case of the standard setting (cf. Chap. 4.9) can be taken from the following table:

Table: Battery life in dependence of the maximum and the average pulse output frequency

Fm [Hz]	Battery life						
1	55	42	30	19	9.5 m	5.1 m	
0.5	56	43	31	20	9.8 m	-	
0.2	57	45	33	21	-	-	
0.1	58	48	37	-	-	-	
0.05	> 60	57	-	-	-	-	
	0.02	0.05	0.1	0.2	0.5	1	Fd [Hz]

Fm = Maximum pulse output frequency.
Fd = Average pulse output frequency.

With an average pulse output frequency of 0.04 Hz or lower (average over whole service life) a battery life of at least 5 years is always guaranteed.

To determine the initial values:

Fm = Qm · cp / 3600 with Qm: maximum flow rate at pulse output (in m^3/h)
cp: cp value of the pulse output (P17)

Fd = Vt · cp / Tt with Vt: total volume (in m^3) previously output as pulses
cp: cp value of pulse output (P17)
Tt: total time since activating the pulse output (in seconds)

In order to obtain an idea of the probable battery life, it is necessary to first estimate the average and the maximum pulse output frequency.

If actual volume pulses are to be output, this can be done as follows:

Fm = Qzm · cp / 3600 with Qzm: maximum flow rate of the gas meter
cp: cp value of the pulse output (P17)

and for standard volume pulses:

Fm = Qzm · Zm · cp / 3600 with Qzm: maximum flow rate of the gas meter
cp: cp value of the pulse output (P17)
Zm: expected maximum gas law deviation factor (L3)

Fd can be first estimated simply based on the previous average consumption (over as long a time period as possible).

The battery life can also be represented in the form of output pulses. Similarly, the output frequency can be converted to the “pulse flow rate” (= flow rate multiplied by the cp value of the pulse output (P17)).

The following table gives an appropriate overview.

Table: Battery life as output volume pulses in dependence of Qm · cp and Qd · cp

Qm·cp [1/h]	Output volume pulses in millions						
3600	2.9	5.5	7.8	10	12	13	
1800	2.9	5.6	8.2	10	12	-	
720	3.0	6.0	8.8	11	-	-	
360	3.0	6.3	9.7	-	-	-	
180	> 3	7.5	-	-	-	-	
	72	180	360	720	1800	3600	Qd·cp [1/h]

Qm = maximum flow rate measured at pulse output
Qd = average flow rate measured at pulse output
cp = cp value of the pulse output (P17)

With an average pulse flow rate of 144 pulses per hour or lower (average over the complete operating period) a battery life of at least 5 years is always guaranteed.

The maximum and the average flow rate at the pulse output can be found very simply with the aid of the DS-100 function built into the volume corrector, in particular in combination with the AWS-100 Evaluation Software (see Chap. 3).

4.9 Power supply

Normally the EK-88 receives its power supply from its internal batteries with a guaranteed working life of 5 years on standard setting. Standard setting means

- Measurement cycle 20 seconds (see Chapter 2.6, “P14”)
- Continuous display switched off (see Chapter 2.6, “P15”)
- No output of process data or data printout (see Chapter 2.9 and 2.10)
- Pulse output not used (see Chapter 4.8)
- Constant K factor (“P8” = 0).

The service life of the batteries in the standard setting can be taken from the following tables:

Continuous Display OFF	
Measurement cycle	Service life
20 seconds	5 years
10 seconds	2.5 years
5 seconds	1 year

Continuous Display ON	
Measurement cycle	Service life
20 seconds	4 years
10 seconds	2 years
5 seconds	1 year

If required the EK-88 can also be operated with an external power supply. As the table above shows, if the mains supply should fail there is still a high operating reserve.

The functions “Measurement cycle” and “Continuous display” (P14, P15) are deactivated during operation with an external power supply and the following mode is activated:

- The display is switched to continuous operation with updating every second
- The measurement cycle is automatically set to 1 s.

Operation with an external power supply offers the following advantages:

- Longer working life without battery replacement
- Continual updating of the display
- Alarm or pulse output can be used without restriction (see Chapter 4.8)

An external power supply can be connected by means of a 3-pole plug (see Appendix B-1). The following can be supplied:

- Power supply (USV-88/N for 220V mains voltage or USV-88/B for 24V)
- Ready-made cable for USV-88 (standard length 10m, other lengths on request)

Please note: Where power supplies are used which have not been expressly recommended by Elster for connection to the EK-88, no guarantee can be given for the specified error limits during volume correction.

4.9.1 Battery replacement

The internal battery is intended to provide a service life of more than 5 years (for the standard setting, see above).

The EK-88 is fitted with two separate battery compartments which are accessible externally, i.e. it is not required to open the device. The receptacles have screw-down covers which are fitted with factory seals as supplied.

Replacing the battery module is very easily accomplished by removing the module and separating the cable plugs. To prevent loss of data the batteries must be replaced

one by one

The battery modules are specially produced and should therefore only he obtained from ELSTER

After replacing the batteries, the capacity of one battery must be entered under reference code „L35“! The device then automatically determines the new operating months.

4.10 Earthing

The housing of the EK-88 should always be earthed to divert high-energy and high-voltage electromagnetic interference. A screw is provided for this purpose on the left hand side of the housing (see Appendix B-1).

The earthing should be of as low a resistance as possible. The best conditions are obtained when a direct connection by a thick cable (at least 4 mm^2), which is as short as possible, is made to the local potential equalisation strips.

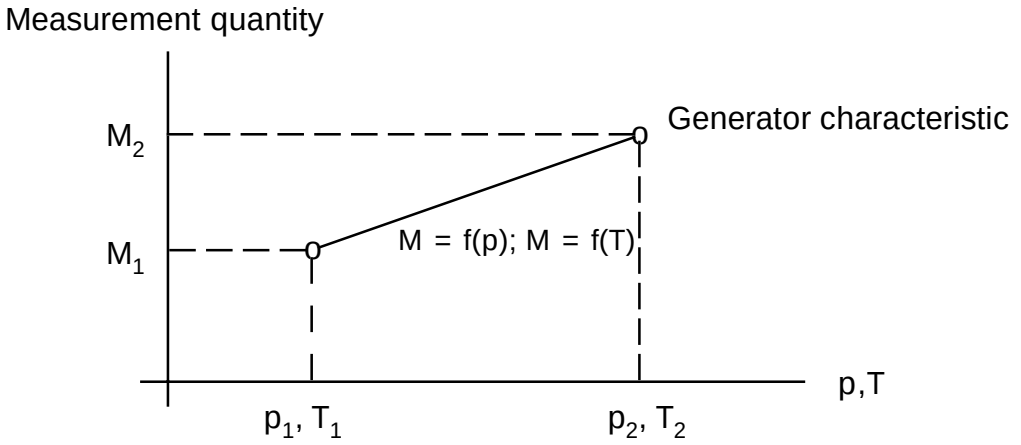
All connection cables have a screen which must be earthed at both ends in order to prevent interference due to high frequency electromagnetic fields. The screen must be connected completely and flat. This occurs at the EK-88 end when the screen is connected properly to the connector housing.

In order to minimise inductive coupling of interference, all cables should be laid such that they encompass as small an area as possible, i.e. they should run parallel to one another.

With a proper cable screen connection and correct cable routing, transient current effects should not be expected. If however interference does occur, potential equalisation strips can be laid parallel to the cables. The strips should be connected as close as possible to the cable screen connection points.

4.11 Calibration of pressure and temperature

The reference codes P27 (Default value pressure), P28 (Default value temperature) and P99 (Data transfer) are necessary for calibrating the two generators for pressure and temperature.



The characteristics for the pressure and temperature sensors are approximately linear and are determined by two points. For recording a characteristic for the pressure range two pressure values are entered under the reference code P27 one after the other after these values actually appear on the pressure generator.

The recording of a characteristic for the temperature range (reference code P28) takes place in an analogous manner.

Practical reference measuring points are for P1 about ¼ and for P2 about ¾ of the measurement range. Similar points for the temperature are T1 = 0°C and T2 = 40°C, because the computation method is optimised for these temperatures. The entered pressure and temperature values are internally allocated to two digital measurement quantities.

By entering

P99 [=/-]

the previously determined pressure or temperature range is activated.

Example:

1st	step:	P27	[=/-]	1.152	[←]	Measurement point P1=1.152 bar
2nd	step:	P27	[=/-]	1.650	[←]	Measurement point P2=1.650 bar
3rd	step:	P28	[=/-]	0.10	[←]	Measurement point T1=0.10°C
4th	step:	P28	[=/-]	40.20	[←]	Measurement point T2=40.20°C
5th	step:	P99	[=/-]			Activation of calibration

Storage of the pressure parameters can take place between steps 2 and 3 if required using P99.

It is possible to record only one characteristic, for the temperature range for example. In this case only the two temperature values under P28 must be entered after the corresponding values also appear on the generator. Finally the data transfer (reference code P99) should be activated.

If the data transfer (reference code P99) is selected, without having entered the second pressure or temperature value, no new characteristic is recorded. Instead the old values continues in use.

Successful data transfer is indicated with the display “P.”.

Devices already calibrated by ELSTER can be recalibrated if required using a simplified procedure. To do this, the parameters for the analogue value equations shown in the design data sheet are entered via the reference codes P145 to P148 (see Chapter 2.6).

Appendices

A Tables

A-1 Volumes and Flows

Code	Quantity	Max. value	Units	E/B
H0	Data storage function			
H1	Actual volume (V)	99999900	m^3	E
H2	Standard volume (V_n)	99999900	m^3	E
H3	Actual volume disturbance value (V_d)	99999900	m^3	E
H4	Standard volume disturbance value (V_{nd})	99999900	m^3	E
H5	Total actual volume (V_t)	99999900	m^3	L
H6	Total standard volume (V_{nt})	99999900	m^3	L
H12	Flow rate (Q)	99999	m^3/h	L
H13	Standard flow rate (Q_n)	99999900	m^3/h	L
H23	Actual volume (V adjustable)	99999900	m^3	B
H24	Standard volume (V_n adjustable)	99999900	m^3	B
H55	„Freeze“ function			-
H56	Frozen V	99999900	m^3	L
H57	Frozen V_n	99999900	m^3	L
H58	Frozen pressure (P)	120	bar	L
	Frozen temperature (T)	60.5	°C	L
	Frozen K factor	1.5		L
	Frozen Z factor	99.9		L

The entries in the E/B column mean:

E: Entry only possible with the calibration official’s switch activated (open)
B: Entry only possible with the user lock (supplier + customer locks) open
- : Entry possible at any time
L: Can only be called

A-2 Other measurement data

Code	Quantity	Max. Value	Units	E/B
L1	Pressure (absolute)	120.000	bar	-
L2	Temperature	60.99	°C	-
L3	Z-factor	99.9999	1	-
L4	Status Register 1	E.x.y.z.u	1	-
L5	Status Register 2	E.x.y.z.u	1	-
L6	K factor	1.5000	1	-
L7	Date	DD.MM.YY	1	E
L8	Time	hh.mm.ss	1	E/B
L16	Serial no of pressure sensor	999999	1	E
L17	Serial no. of temperature sensor	99999999	1	E
L26	Pressure range (absolute)	120.0	bar	E
L27	Temperature range	60.0	°C	E
L34	Version no. of software		1	-
L35	Battery service life	9.9 / 116	Ah/M	B
L45	Ground potential (binary)	192	1	-
L46	Device temperature (binary)	65000	1	-
L47	Pressure (binary)	65440	1	-
L48	Temperature (binary)	65440	1	-
L56	Battery voltage (binary)	65535	1	-
L145*	Calorific value $H_{o,n}$	12.833	kWh/m³	B
L148*	CO_2 content	15.000	mole %	B
L156*	Standard pressure p_n	1.05000	bar	E
L157*	Standard temperature T_n	293.15	K	E
L168*	Density ratio	0.7500	1	B
L178*	N_2 content	15.000	mole %	B

All parameters marked with an asterisk (*) are transferred only after selecting "P99".

A-3 Parameters

Code	Quantity	Range	Units	Default	E/B
P0	Enter supplier's code	1...999999	1	0	-
P1*	Subst./const. K factor	0.5000...1.5000	1	1	B/E
P2	Substitute pressure	0.400...125.0	bar	1	B/E
P3	Substitute temperature	-10.00...99.00	°C	10	B
P4*	cp value pulse generator	100; 10; 1 0.1; 0.01	$1/m^3$	1	E
P5	Pulse generator selection	0;1;2	-	0	B/E
P8*	K factor mode	0;2	-	0	E
P9	Change supplier's code	1...999999	1	0	B
P10	Enter customer code	1... 999999	1	0	-
P11	Change customer code	1...999999	1	0	B
P12*	Pressure mode	0;1	-	1	E
P13*	Temperature mode	0;1	-	1	E
P14	Cycle time	1...20	s	20	E
P15	Continuous display on/off	0; 1	-	0	E
P16	Output function	0;1;2;3;4;5;6	-	0	B
P17	cp-value, pulse output (see note)	100; 10; 1 0.1; 0.01	$1/m^3$	1	B
P23*	Pressure upper limit (P)	0.400...125.0	bar	2	E
P24*	Pressure lower limit (P)	0.400...125.0	bar	0.5	E
P27*	Default pressure	0.400...125.0	bar	-	E
P28*	Default temperature	-11.0...61.0	°C	-	E
P39	Tamper detection	0;1;2	-	0	B
P48	Clear counters	0	-	-	E
P56	Log output, immediate	0;1	-	0	-
P57	Log output, period.	0...60	min.	0	-
P58	Log output, daily	0...24	h	0	-
P67	Process data block, output	0;1	-	0	-
P88	Display test	-	-	-	-
P90	Calibration lock status	0;1	-	0	-
P91	Automatic changeover V_n/L4	0;1	-	1	E
P99	Transfer parameters	-	-	-	-
P145*	Pressure equation offset	0...65535	(-)	0	E
P146*	Pressure equation slope	0...999999	(-)	34900	E
P147*	Temperature equation offset	0...65535	(-)	1473	E
P148*	Temperature equation slope	0...999999	(-)	34612	E

All parameters marked with an asterisk (*) are transferred only after selecting "P99".

Note: The cp value for the pulse output may only be smaller than or equal to the cp value for the pulse generator (P4).

A-4 Status messages

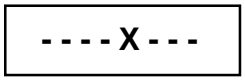
Status	Message	S
E.0	No fault	-
E.1	Memory data loss or restart	A
E.2	Old start, battery volt. temporarily failed	A
E.6	Data error in memory	A
E.7	Replace batteries	W
E.13	Pressure not calibrated	A
E.14	Temperature not calibrated	A
E.15	Pressure outside specified limits	A
E.16	Temperature outside specified limits	A
E.17	Analogue converter plausibility error (for P, T)	A
E.21	Tamper detection active	W
E.24	Overflow of intermed. buffer for V_n and V outputs	-
E.28	Actual volume counter overflow	-
E.29	Gas analysis has been changed	-
E.30	Calibration lock open	-
E.31	Temperature in vicinity of corrector limits	W

The letter "A" in the "S" column means that the fault causes an alarm. While ever the fault is present (i.e. actually occurring), disturbance volumes are counted in H3 and H4 (instead of undisturbed volumes in H1 and H2) and the signal output is activated if it has been programmed under P16 as "Alarm output" or "Alarm and warning output".

A "W" means that the fault causes a warning. While ever the fault is present, the signal output is activated if it has been programmed under P16 as "Warning output" or "Alarm and warning output".

A-5 Entry errors

The EK-88 reacts to incorrect keypad entries by displaying various error messages in the form:

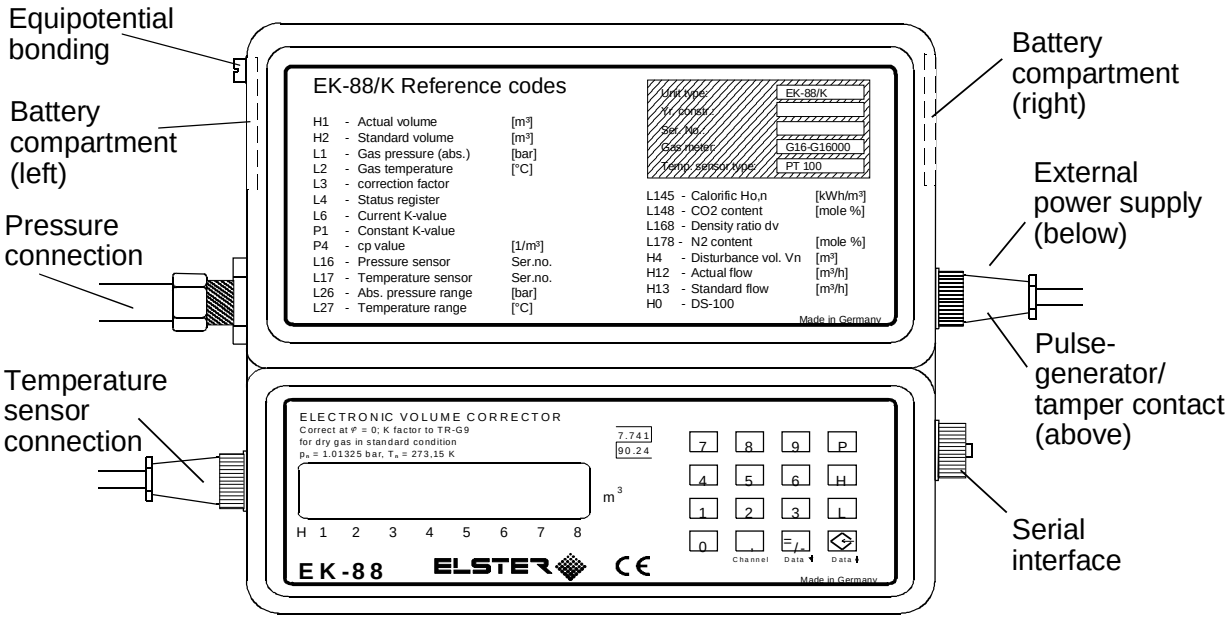


where X = the error number as in the following table:

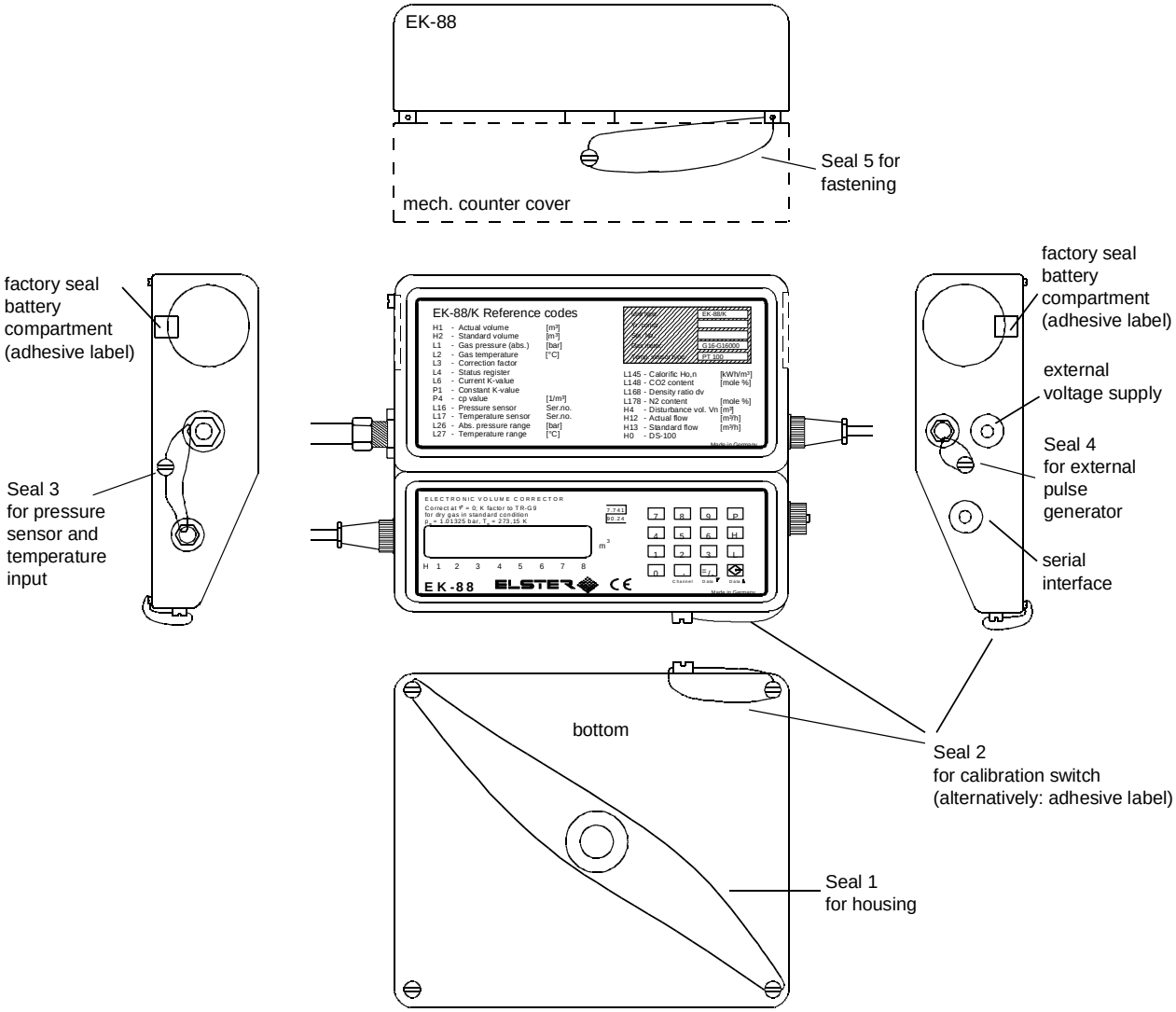
Error	Meaning
1	Incorrect or non-existent codeword entry
3	Value conflict with associated values
4	Parameter is write-protected
5	Calibration lock/user lock closed
6	Entered value is outside of permissible limits
7	Incorrect user code

B Figures

B-1 Wiring diagram

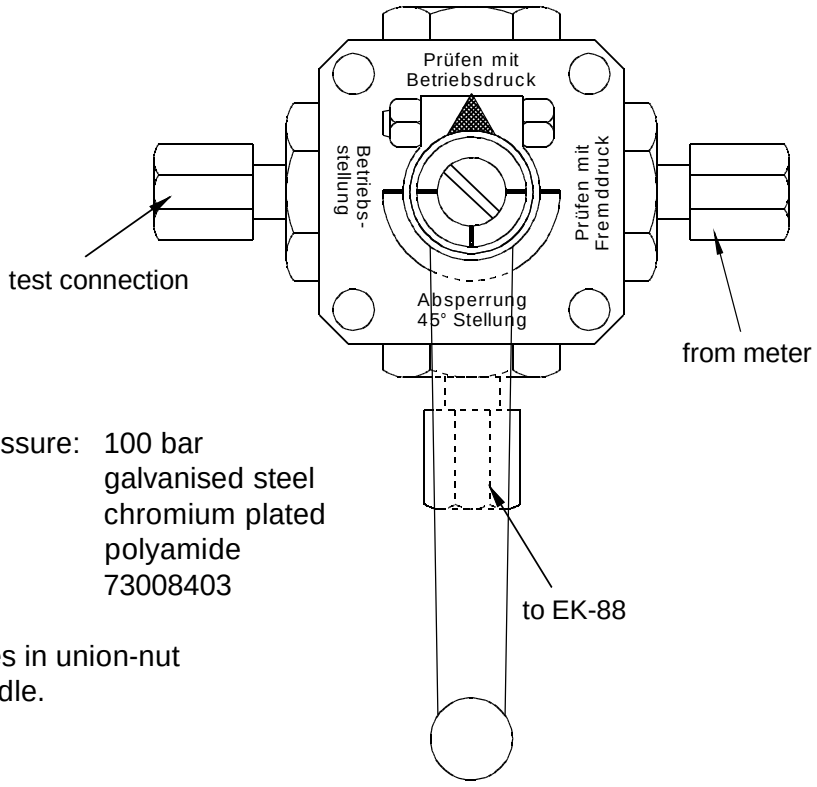


B-2 Sealing diagram



B-3 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 - Ident. no.: 73008403) have the following construction:



Working pressure:	100 bar
Housing:	galvanised steel
Ball:	chromium plated
Seal:	polyamide
Ident. no.:	73008403

Sealing holes in union-nut
and tap handle.

Explanation:

"from meter"	From the **"*p connection*"** on the gas meter; with dry gas meters the pressure is obtained from the input side of the meter.
"to EK-88"	For connection of the pressure sensor used.
"test connection"	Here there is the option of obtaining a test pressure or subjecting the EK-88 pressure sensor to an external pressure.

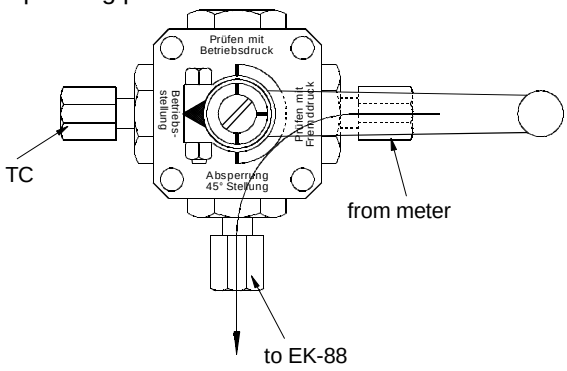
☞ *When mounting the three-way tap, it is essential to ensure that the position of the operating lever is checked by noting the direction of flow, because the lever can be removed and may be mounted the wrong way round!*

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.

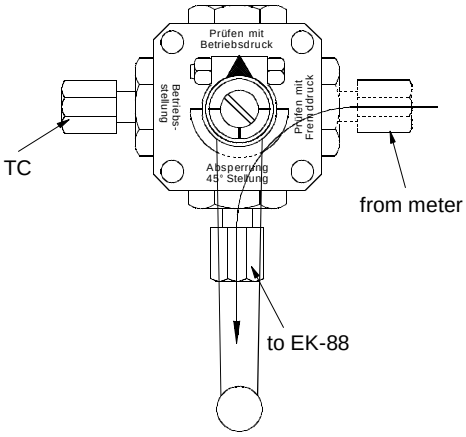
Operating position



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.

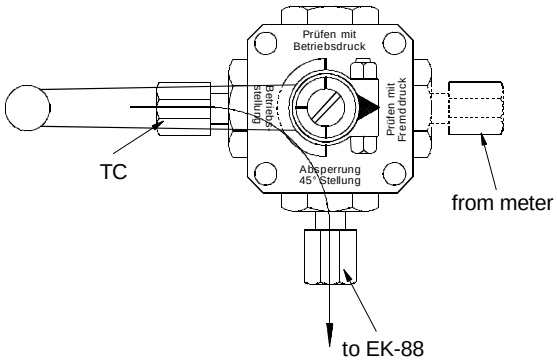
Testing with operating pressure



Testing with external pressure

The EK-88 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.

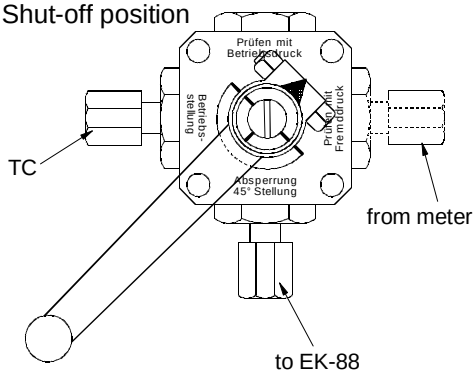
Testing with external pressure



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 Technical data

C-1 General data

Dimensions (W x H x D):	156 x 70 x 136 mm
Weight:	approx. 1.5 kg
Protection:	IP 64
Ambient temperature:	-10...50°C

C-2 Internal power supply

2 lithium batteries

Type:	ELSTER Battery Module SL-770 (Sonnenschein) Order no.: 73013211

Ratings:

Voltage:	Each 3.6 V
Capacity:	Each 5 Ah
Service life:	> 5 years (see Chap. 4.9)

> Important!
> When replacing the batteries, replace them ONE BY ONE
> **or data may be lost!**

C-3 External power supply

Optional in addition to internal power supply.

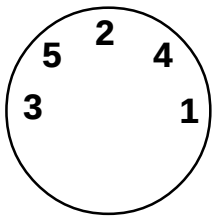
Ratings:

Voltage, general:	7...13 V
Voltage for explosion protection:	≤ 8 V
Current consumption:	≤ 30 mA

Connection:

Connector: 5-pole round plug

Pin assignment:
1: Uv+ (white conductor)
2: (not connected)
3: Uv- (brown conductor)
4: A+ (yellow conductor)
5: A- (green conductor)



View from outside the EK-88

"Uv" = Power supply
"A" = Output
The pin numbers can be found on the solder side of the plug.

Cable:	2 x 2 x 0.2...0.75 mm^2 Twisted in pairs, with overall screen

Pins 4 and 5 (A+ and A-) are provided for the alarm/warning or pulse output (see also Appendix C-8).

C-4 Pulse generator and tamper contact

An internal pulse generator is built into the housing. The external pulse generator can be used as an option, but **not** simultaneously.

Pulse generator ratings:

cp value:	cp	=	100; 10; 1; 0.1; 0.01; $1/m^3$
Frequency:	f	≤	1.5 Hz
Flow rate:	Q	≤	25,000 m^3/h
Mech. torque:	M	<	0.1 Nmm

Pulse input ratings:

No-load voltage:	Uo	=	3 V
Internal resistance:	Ri	≥	1 MΩ
Short-circuit current:	Ik	≤	3 µA
Switching point "on" (pulse)			
- Resistance:	Re	≤	10 kΩ
- Voltage:	Ue	≤	0.4 V
Switching point "off" (pulse)			
- Resistance:	Ra	≥	5.0 MΩ
- Voltage:	Ua	≥	2.0 V
Pulse duration:	te	≥	200 ms
Pause duration:	ta	≥	200 ms
Counting frequency:	f	≤	1.5 Hz

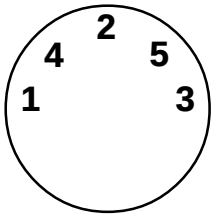
Tamper input ratings:

No-load voltage:	Uo	≤	5 V
Internal resistance:	Ri	≥	50 kΩ
Short-circuit current:	Ik	≤	100 mA
Switching point "on" (closed)			
- Resistance:	Re	≤	5 kΩ
- Voltage:	Ue	≤	0.4 V
Switching point "off" (open)			
- Resistance:	Ra	≥	100 MΩ
- Voltage:	Ua	≥	2.0 V

Connection:

For external pulse generator (E1) and tamper contact (M)

Connector:	5-pole round socket		
Pin assignment:	1:	E1+	(white conductor)
	2:		(not connected)
	3:	E1-	(brown conductor)
	4:	M+	(yellow conductor)
	5:	M-	(green conductor)



View from outside on the EK-88

Cable: 2 x 0.2...0.75 mm^2 or
2 x 2 x 0.2...0.75 mm^2
each twin twisted, with overall screen.

C-5 Pressure sensor

Pressure sensor built into housing.

Ratings:

Measurement ranges for applications with official calibration:

0.8	... 2.0	bar abs.
1.4	... 3.5	bar abs.
2.0	... 5.0	bar abs.
3.0	... 7.5	bar abs.
4.0	... 10	bar abs.
8	... 20	bar abs.
14	... 35	bar abs.

Sensors for higher pressures (up to 125 bar) and wider pressure ranges (measurement ranges of 1:5 or 1:10) are also available on request for use outside of the field subject to official calibration. With wider pressure ranges the data quoted in Chapter "C-9" changes with respect to the measurement uncertainty for pressure and standard volume. The measurement uncertainty always remains however within the calibration error limits.

Overpressure:

Without affecting the accuracy	twice the rated pressure
Bursting pressure	140 bar

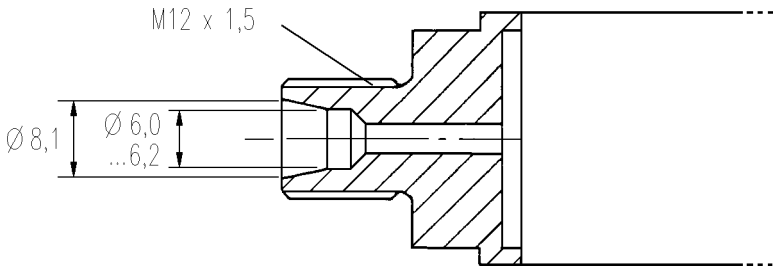
Connection:

Pressure connection:	Ermeto M12 x 1.0 external thread
	Useful length approx. 7 mm

Installation note:

When connecting the pressure line to the integral pressure sensor, attention should be paid to the external pipe diameter to avoid damage and incorrect sealing of the screw fitting. In particular, a check of the pipe joint should be made for burrs and flaring which may cause an increase in the external pipe diameter (see the following drawing of the Ermeto connection on the pressure sensor).

Cross-section through the pressure sensor connection



C-6 Temperature sensor

Temperature sensor type Pt 100 to DIN IEC 751

Ratings:

Measuring range:	-10...+60°C

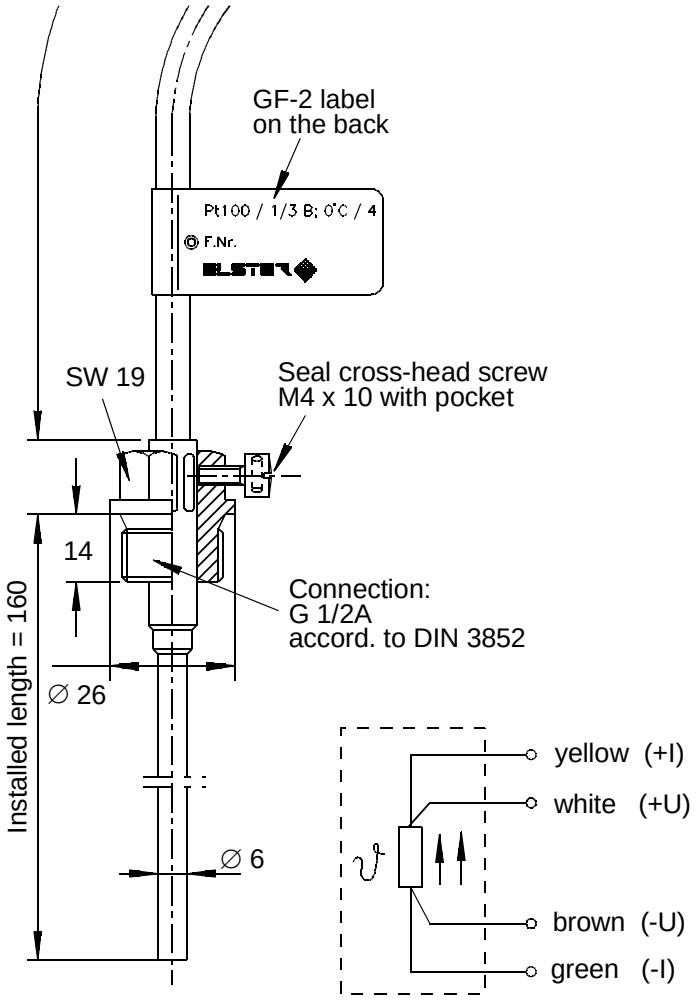
Connection:

Plug connection:	4-pole round socket		
Pin assignment:	1:	I+	(yellow conductor)
	2:	I+	(green conductor)
	3:	U+	(white conductor)
	4:	U-	(brown conductor)
Cable:	4 x 0.2...0.75 mm^2		
	Twin-twisted, with overall screen		
	Colour code to DIN 47100		

C-6a Temperature sensor Pt100 “EBL 160KF”

Temperature sensor type:	Pt100 according to DIN IEC 751
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:	Stranded copper wire: LIFTCY
	2x2x0.2mm connection length: 2.5m
	Can be extended via Ex terminal box
	(Order no.: 73010430)
Explosion protection:	Approved as EK-88 system component
Order designation:	Order no.: 73012554

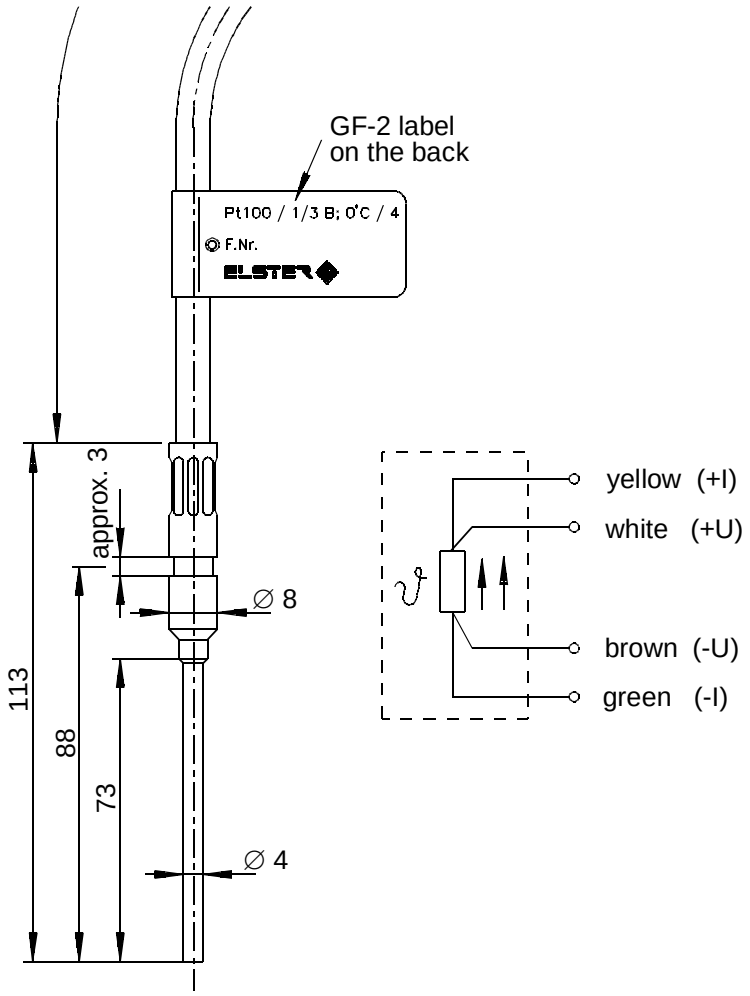
Dimensions and sealing plan (EBL 160KF):



C-6b Temperature sensor Pt100 “EBL50KF”

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:	Stranded copper wire: LIFTCY
	2x2x0.2mm connection length: 2.5m
	Can be extended via Ex terminal box
	(Order no.: 73010430)
Explosion protection:	Approved as EK-88 system component
Order designation:	Order no.: 73012553

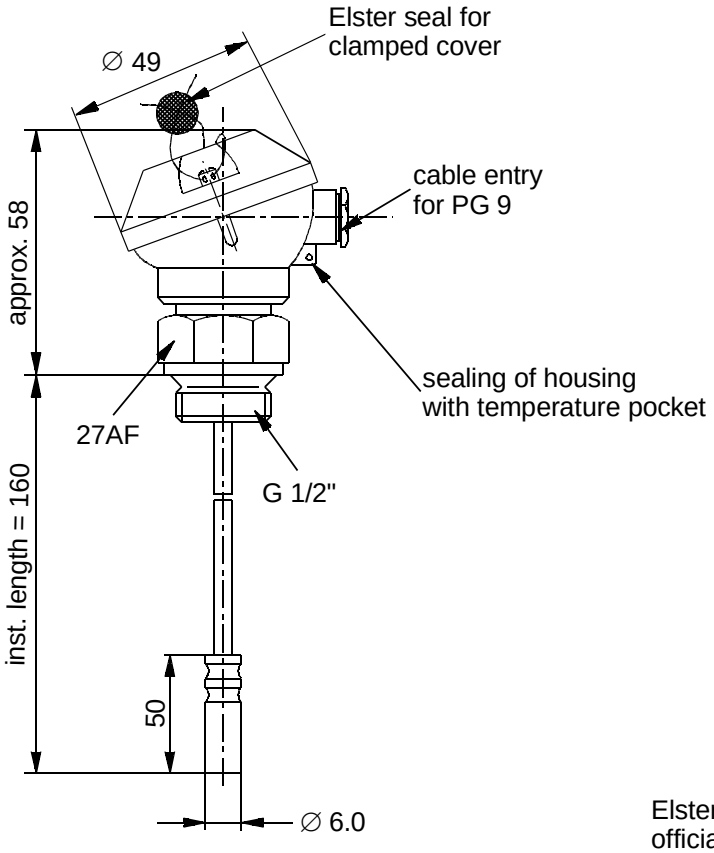
Dimensions and sealing plan (EBL 50KF):

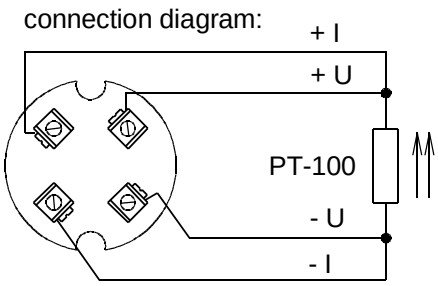


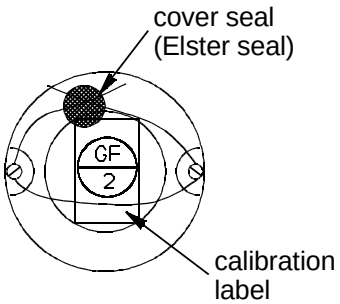
C-6c Temperature sensor Pt100 “EBL160AF/EX-1”

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 mm^2 with core sleeves;
Explosion protection:	EEx ib II C T3
Order designation:	EBL160AF/EX-I; Order no.: 73014105

Dimensions and sealing plan (EBL160AF/EX-I):





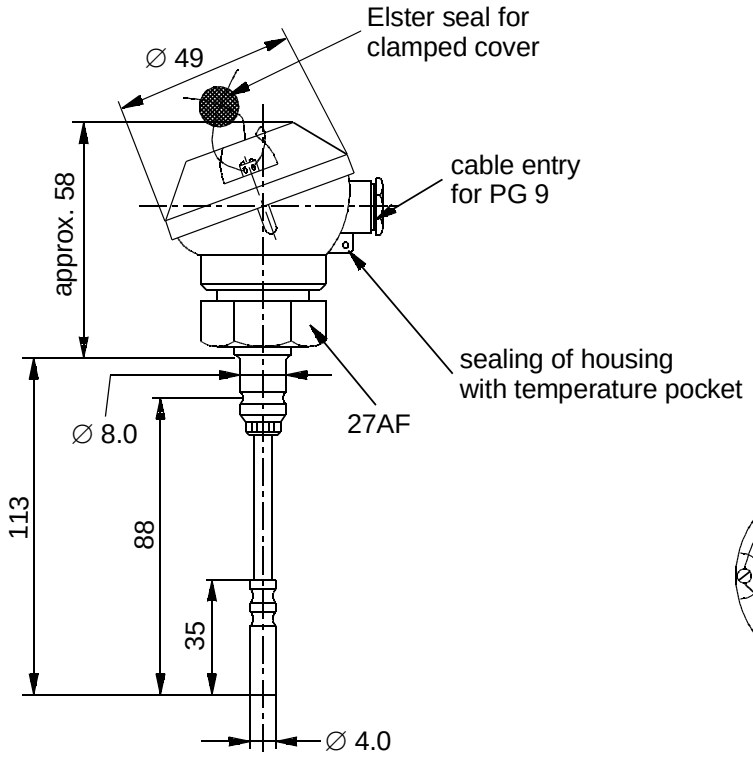


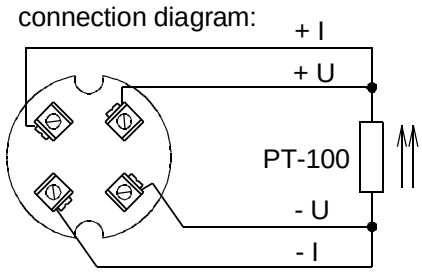
Elster seals must be replaced by official seals after initial operation!

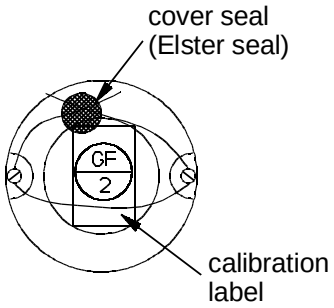
C-6d Temperature Sensor Pt100 „EBL50AF/EX-I“

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 10x1 mm
	Cable connection: PG 9 for cable diameter 5-8 mm, 4 x 0.5 mm^2 with core sleeves
Explosion protection:	EEx ib II C T3
Order designation:	EBL50AF/EX-I; Order no.: 73014104

Dimensions and sealing plan (EBL50AF/EX-I):





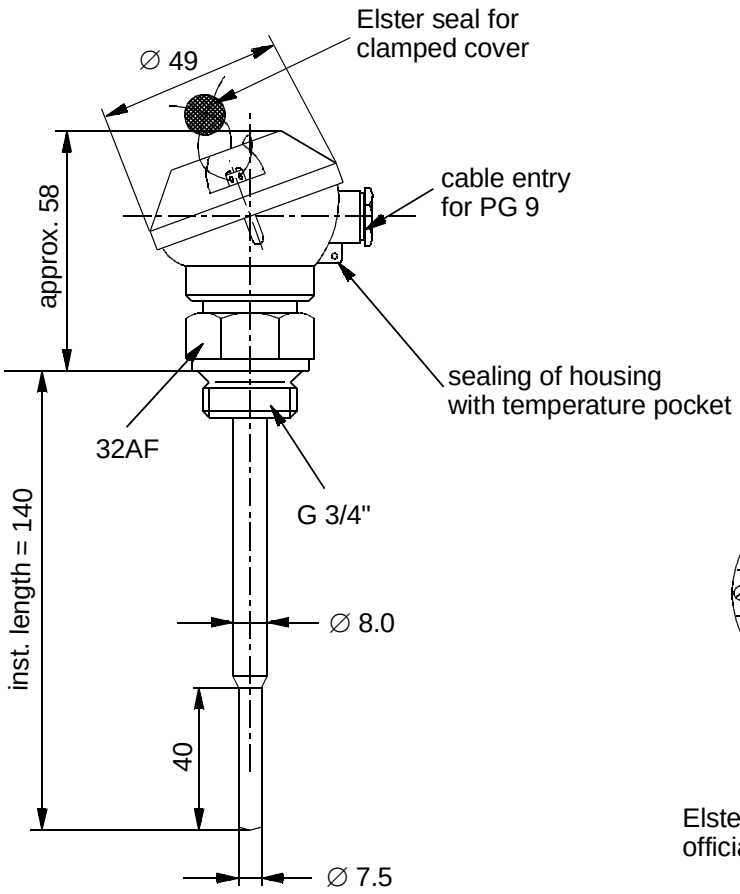


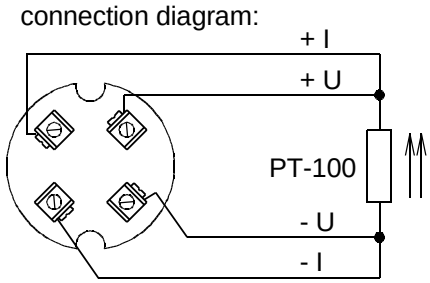
Elster seals must be replaced by official seals after initial operation!

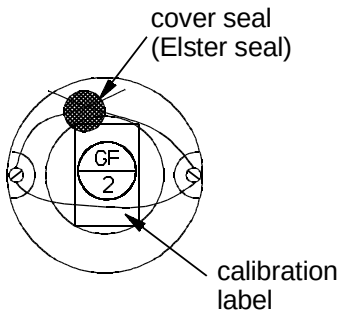
C-6e Temperature Sensor Pt100 “EBL140AD/EX-I”

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, 4x0.5 mm^2 with core sleeves;
Explosion protection:	EEx ib II C T4
Order designation:	EBL140AD/EX-I; Order no.: 73014103

Dimensions and sealing plan (EBL140AD/EX-I):







Elster seals must be replaced by official seals after initial operation!

C-6f 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

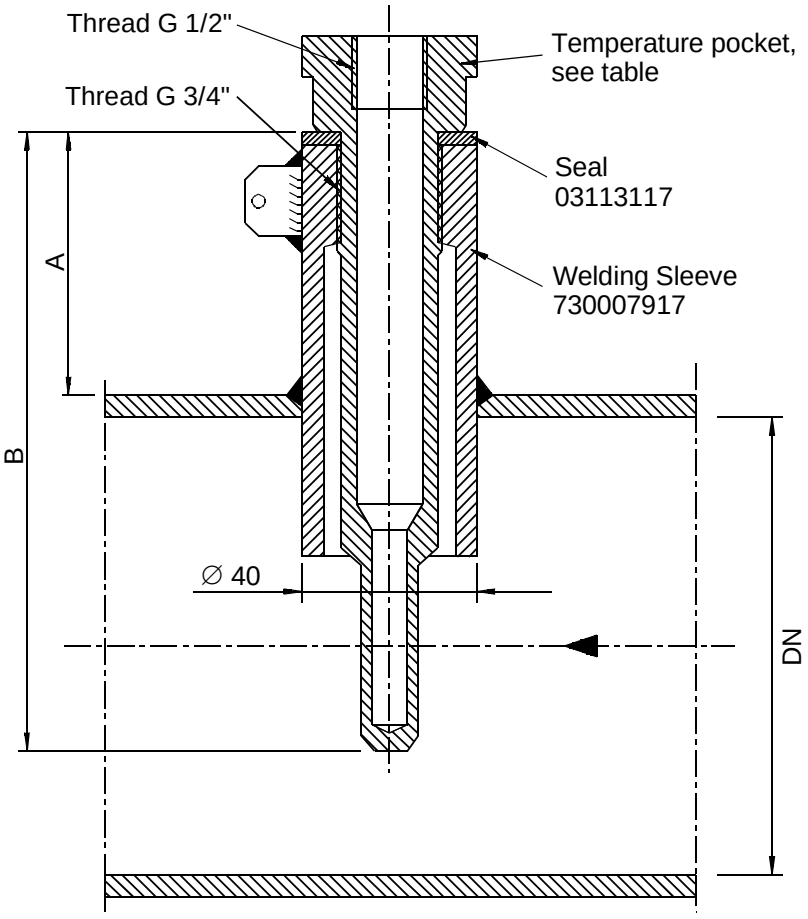
Temperature pockets in Elster meter housings			
DN (housing/ measurement cartridge) (PN;ANSI)		**Type (installed length)**	**Order no. (pocket)**
80 / 50	PN 10 to ANSI 600	EBL 58	73013524
80	PN 10 to ANSI 600	EBL 45	73013410
100/80	PN 10 to ANSI 600	EBL 58	73013524
100	PN 10 to ANSI 600	EBL 50	73012556
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

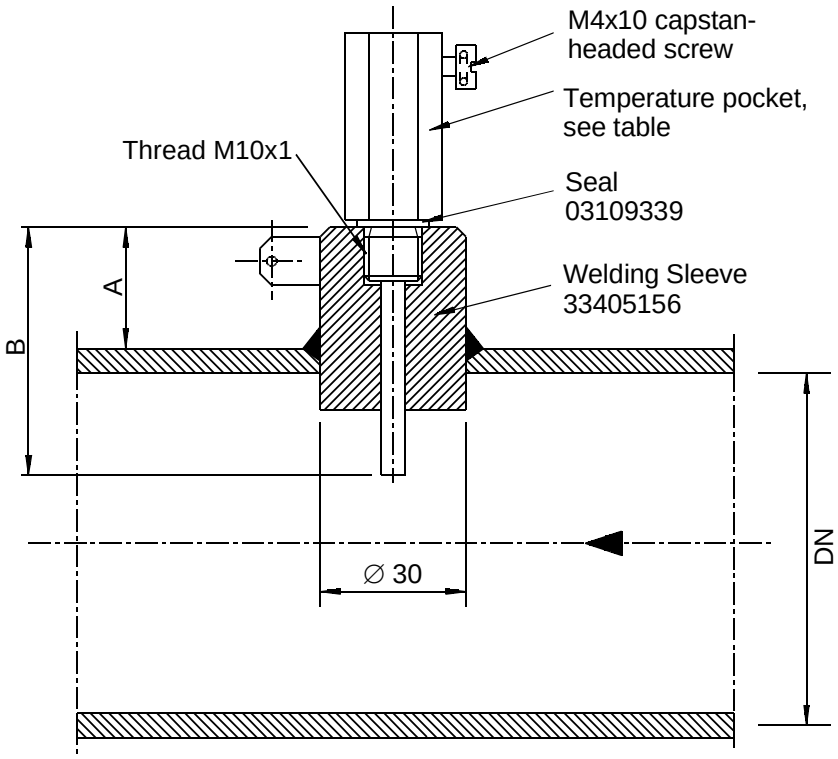


The pocket is suitable for Pt100 temperature probes with an installation length (EBL) of 160 mm. It consists of the temperature pocket, the seal and the welding sleeve (article number for the complete pocket: 73012100). The welding sleeve is suitable for a pipe diameter from DN 80 upwards.

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.

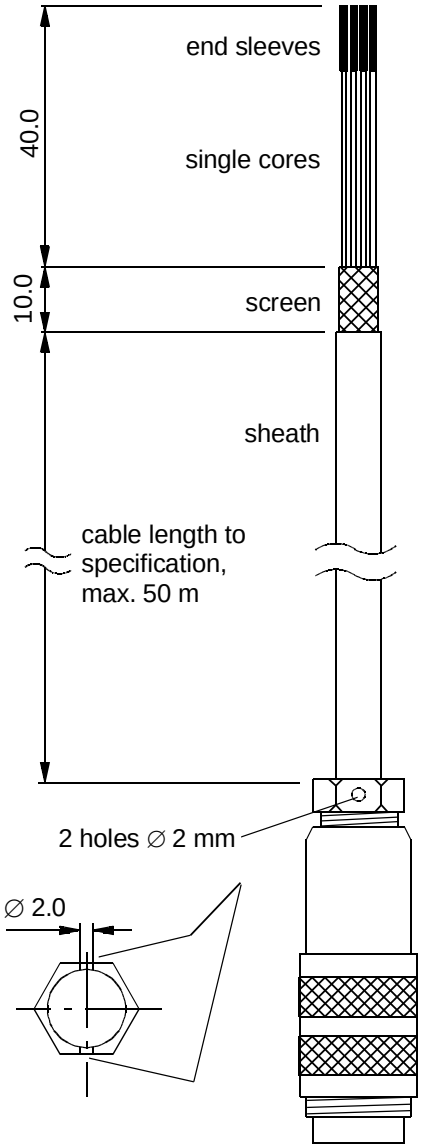
The welding sleeve is suitable for pipe diameters from DN 40 to DN80. The maximum system operating pressure must not exceed 16 bar for this welding sleeve.

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-6g Connecting cable for temperature sensors with terminals

For systems in applications subject to official calibration it is essential to observe certain valid connection conditions. The standards mentioned below are also valid for cables which are used in **intrinsically safe systems**.

DIN VDE 0165 however only applies to cable connected to components which have their **own** Ex approval. It does not therefore apply to the temperature sensor of the type “EBL..KF”, because this is approved as a constituent part of the EK-88. When using one of the temperature sensors with terminal connections (type “EBL..A..), the cable used must conform to the standards mentioned here. A ready made-up cable for this can be obtained from Elster conforming to the drawing below (Order no. 73014580). The standard length is 2.5m, but all other lengths up to 50 m are available on request.



Cable:
Cable L1YCY or L1fCY 2x2x0.5...0.56 sq. mm
twin twisted, with overall screen
Overall diameter: 6.5 - 8 mm
Colour coding of cores to DIN 47100

Conforms to following standards
(for intrinsically safe systems):
DIN VDE 0298 Parts 1 and 3
DIN VDE 0891 Parts 1, 5 and 6
Combustibility properties to DIN VDE 0472 Part 804, Test type B
Voltage strength conductor - screen
accord. to DIN VDE 0165 Para. 6.1.3.2.1: 500 Vrms
Min. single-core diameters
accord. to DIN VDE 0165 Para. 6.1.3.2.1: 0.1 mm
Min. conductor cross-section:
accord. to DIN VDE 0165 Para. 5.6.1.3: 0.5 sq. mm
With overall screen min. 60% coverage
Sheath colour bright blue accord. to RAL 5015

Connectors:
Binder Series 423
Connecting plug 4 pole
Order no. 99-5609-15-04

Solder side

Wiring plan

ye	1
gn	2
wh	3
br	4

Screen connection:
Screen completely connected around circumference and over a wide area.
Assembly instruction:
See connector data sheet.

Wiring plan

Cable (core colour)	Temperature sensor (Terminal designation)
yellow	I+
green	I-
white	U+
brown	U-
screen	(see below)

Connecting the screen

In order to avoid earth loops and their associated problems, the cable screen should **not** be connected at the temperature sensor if its housing is already connected to earth due to installation in the gas meter or in the gas pipe. The exposed screen on the cable should in this case be cut flush with the cable sheath or insulated (e.g. with adhesive tape).

If the gas meter or the gas pipe is not earthed, the screen is connected to the special PG gland on the sensor. Here the screen, which protrudes about 10 mm from the sheath, is **slightly** opened up, placed on the integral olive in the gland and pressed down when the cable is screwed tight.

C-7 Serial interface

Interface similar to RS232 or V.24.
Electrically isolated

Limits:

Voltages measured with respect to V- (Pin No. 6):

Input voltage V+:	0...+55 V
Input voltage CTS:	-18...+55 V
Input voltage RXD	-18...+18 V

Ratings:

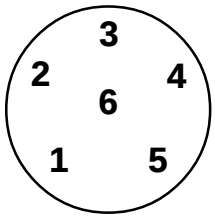
At V+ = +5V, V- = 0 V:

Input level “1”		Ue	≥	2 V	
Input level “0”		Ue	≤	0.5 V	
Input current		Ie	≤	1 mA	
Rated current	“1” signal:	Iah	≥	1mA	(Ua ≥ 3 V)
	“0” signal:	Ial	≥	0.2 mA	(Ua ≥ 1 V)

Data format:

Baud rate	4800 Bd
Number of data bits	8
Number of stop bits	1
Parity	None

Connections:



Viewed from outside on the EK-88

Plug connector:	6-pole round socket
Pin assignment:	1: V+ (Voltage supply “+”)
	2: TXD (Data output)
	3: RXD (Data input)
	4: RTS (Control output)
	5: CTS (Control input)
	6: V- (Voltage supply “-”)

C-8 Alarm / warning and pulse output

The alarm/warning or pulse output is an electrically isolated transistor output (optocoupler).

The output is located on the power supply connector. The output can also be connected to signal inputs with NAMUR signals (DIN 19234).

The use of the alarm / warning output is only possible with an external power supply.

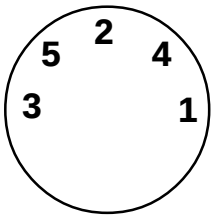
Ratings:

Max. switching voltage:	55 V	
Rated current:	1 mA	
Voltage drop at rated current:	≤ 1 V	
Voltage drop at 2.1 mA	≤ 6 V (Namur)	
Leakage current (for “Off” signal)	≤ 0.001 mA (at U ≤ 24 V)	
Pulse duration	50 ms	(battery operation)
	250 ms	(with external power supply)
Output frequency	Max. 1.1 Hz	(battery operation)
	Max. 2 Hz	(with external power supply)

Connections:

Plug connector: 5-pole round plug

Pin assignment:
1: Uv (white conductor)
2: (not connected)
3: Uv (brown conductor)
4: A+ (yellow conductor)
5: A- (green conductor)



Viewed from outside on the EK-88

"Uv" = Power supply
"A" = Output
The pin numbers are located
on the solder side of the mating plug.

C-9 Error limits (limits for measurement deviations)

The error limits (limits for measurement deviations) conform to (pr) EN 12405.

More precise details are available on request.

D Certificate of conformance

DMT-Gesellschaft für Forschung und Prüfung mbH

Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke **BVS**

Elektrische Betriebsmittel für explosionsgefährdete Bereiche

(1) Konformitätsbescheinigung

(2) BVS 92.C.2034 X

(3) Diese Bescheinigung wird ausgestellt für:

Mengenumwerter Typ EK-88

(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 IIB T1

(8) Diese Bescheinigung darf nur vollständig und unverändert vervielfältigt werden.

BVS 92.C.2034 X vom 26.06.1992

DMT

(9) Konformitätsbescheinigung BVS 92.C.2034 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 26.06.1992
BVS-Tha/Hid A 9100585

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

DMT

Anhang zur Konformitätsbescheinigung
BVS 92.C.2034 X

(A 1) Mengenumwerter Typ EK-88

(A 2) Beschreibung

Das Gerät dient zur Erfassung und Speicherung von Daten sowie zur Ausgabe von der momentanen Betriebs- oder Normalbelastung proportionaler Signale über eine potentialgetrennte Schnittstelle. Das Gerät ist batteriebetrieben, kann aber auch zusätzlich von einem eigensicheren Stromkreis versorgt werden. Der Druckaufnehmer des Gerätes ist in die wiederkehrende Druckprüfung der Anlage einzubeziehen.

(A 3) Darstellende Unterlagen

3.1 Beschreibung (64 Bl.), unterschrieben am 06.05.92

3.2 Zeichnung Nr.:

Zeichnung Nr.	vom:	unterschrieben am:
800-5-700	15.02.90	06.05.92
73013211 (5 Bl.)	10.12.90/20.01.92	06.05.92
73012561	25.11.91	02.06.92
S13536	18.12.91	06.05.92
73012568	10.04.90/20.01.92	06.05.92
73012571	10.04.90/20.01.92	06.05.92
73012562	27.07.90	06.05.92
E-A3-1039 (3 Bl.)	07.11.89/22.03.90	06.05.92
C-A4-0313	02.03.87/30.09.89	06.05.92
E-A2-0998 (3 Bl.)	05.05.89/27.07.89	06.05.92
E-A2-1000 (2 Bl.)	05.05.89	06.05.92
55-1208-900217	29.03.90/24.01.92	06.05.92
55-1208-900216	04.05.90/27.01.92	06.05.92
800-5-702	10.04.90/13.05.91	06.05.92
73013422	06.05.92/02.06.92	02.06.92
Y73012561 (3 Bl.)	14.01.92	06.05.92
73012478	10.04.90/18.03.92	06.05.92
73012479	10.04.90/19.06.90	15.01.92
73013057	24.10.90/25.02.91	06.05.92
73012579	23.02.90/02.11.90	06.05.92
73012480	19.12.89/14.06.91	06.05.92
73012566	10.04.90/20.01.92	06.05.92
73012567	10.04.90/20.01.92	06.05.92
73012569	10.04.90/20.01.92	06.05.92
73012570	10.04.90/20.01.92	06.05.92
73013212	23.10.90/20.01.92	06.05.92

DMT

Anhang zur Konformitätsbescheinigung

BVS 92.C.2034 X

3.3 Stückliste Nr.:	vom:	unterschrieben am:
L73012561 (7 Bl.)	25.11.91	06.05.92
LS13536 (2 Bl.)	07.01.92	06.05.92
L73012562	30.09.91	06.05.92

(A 4) Elektrische Daten

Eingangs- und Impuls-stromkreis (Stecker Nr. S 5)	in Zündschutzart Eigensicherheit EEx ib IIB nur zum Anschluß an bescheinigte eigensichere Stromkreise mit folgenden Höchstwerten: U_o = 10 V I_k = 80 mA Die wirksame innere Induktivität ist $\leq$ 760 µH Die wirksame innere Kapazität ist $\leq$ 10 µF
Serielle Schnittstelle (Stecker Nr. S 2)	nur zum Anschluß an einen bescheinigten eigensicheren Stromkreis mit folgenden Höchstwerten: U_o = 10 V I_k = 100 mA P = 1 W Die wirksame innere Induktivität und Kapazität sind vernachlässigbar klein.
Impulseingang (Stecker Nr S 3)	nur zum Anschluß an einen potentialfreien Kontaktgeber höchstzul. äußere Kapazität Cext = 0,1 µF höchstzul. äußere Induktivität Lext = 0,1 mH

DMT

Anhang zur Konformitätsbescheinigung

BVS 92.C.2034 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 EK-88
EEx ib IIB T1
Fertigungsnummer
BVS 92.C.2034 X

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

Der Umgebungstemperaturbereich beträgt - 25 °C bis + 50 °C.

4600 Dortmund-Derne, den 26.06.1992
BVS-Tha/Hid A 9100585

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

Bergbau-Versuchsstrecke **BVS**

1. Nachtrag

zur Konformitätsbescheinigung

BVS 92.C.2034 X

der ELSTER Produktion GmbH, D - 55248 Mainz-Kastel

Mengenumwerter Typ EK-88

Kennzeichen: EEx ib IIB T1

Das Mengenumwerter kann auch nach den unten aufgeführten Prüfungs-unterlagen gefertigt werden.

Prüfungsunterlagen

1 Beschreibung Nr.:	vom:	unterschrieben am:
E8AEXAE1.DOC (7 Bl.)	21.02.95	02.05.95
E8AEXANT.DOC (5 Bl.)	21.02.95	02.05.95

2 Zeichnung Nr.:	vom:	unterschrieben am:
800-5-722	02.05.95	02.05.95
73013211 (4 Bl.)	10.08.94/10.08.94	02.05.95
73014255	21.02.95/21.02.95	02.05.95
83461901	21.02.95/21.02.95	02.05.95
73012568	06.04.95/06.04.95	02.05.95
73012562	27.07.90/03.12.92	02.05.95
73013422	09.03.94	02.05.95
73014255 (7 Bl.)	07.03.95	02.05.95
73014258	28.03.94/31.08.94	02.05.95
73014172	29.06.93/29.06.93	02.05.95
73012566	10.04.90/01.03.93	02.05.95
73014256	30.09.94/30.09.94	02.05.95
73012570	06.04.95/06.04.95	02.05.95
73013212	23.10.90/12.03.93	02.05.95

3 Stückliste Nr.:	vom:	unterschrieben am:
73014255 (5 Bl.)	13.04.95	02.05.95
83461901 (3 Bl.)	21.02.95	02.05.95
73012562	03.12.92	02.05.95

44329 Dortmund, den 12.05.1995
BVS-Tha/Hid A 9500151

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 1/1

Certificate of conformance

(Translations of German certificate)

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.2034 X**

(3) This certificate is issued for:
Volume Corrector Type EK-88

(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 IIB T1

(8) This certificate must only be reproduced in its entirety and unmodified.

BVS 92.C.2034 X of 26.06.1992

(9) Certificate of conformance BVS 92.C.2034 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, 26.06.1992
BVS-Tha/Hid A 9100585

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.2034 X

(A1) Volume Corrector Type EK-88

(A2) Description

The device is used for the measurement and storage of data as well as for the output of signals proportional to the momentary actual and standard flows via an electrically isolated interface. The device is battery operated, but can also be supplied from an intrinsically safe circuit. The pressure sensor must be included in the regular pressure testing of the system.

(A3) Explanatory documentation

3.1 Description (64 pages), signed on 06.05.92

3.2

Drawing no.:	of:	signed on:
800-5-700	15.02.90	06.05.92
73013211 (5 Pg.)	10.12.90/20.01.92	06.05.92
73012561	25.11.91	02.06.92
S13536	18.12.91	06.05.92
73012568	10.04.90/20.01.92	06.05.92
73012571	10.04.90/20.01.92	06.05.92
73012562	27.07.90	06.05.92
E-A3-1039 (3 Pg.)	07.11.89/22.03.90	06.05.92
C-A4-0313	02.03.87/30.09.89	06.05,92
E-A2-0998 (3 Pg.)	05.05.89/27.07.89	06.05.92
E-A2-1000 (2 Pg.)	05.05.89	06.05.92
55-1208-900217	29.03.90/24.01.92	06.05.92
55-1208-900216	04.05.90/27.01.92	06.05.92
800-5-702	10.04.90/13.05.91	06.05.92
73013422	06.05.92/02.06.92	02.06.92
Y73012561 (3 Pg.)	14.01.92	06.05.92
73012478	10.04.90/18.03.92	06.05.92
73012479	10.04.90/19.06.90	15.01.92
73013057	24.10.90/25.02.91	06.05.92
73012579	23.02.90/02.11.90	06.05.92
73012480	19.12.89/14.06.91	06.05.92
73012566	10.04.90/20.01.92	06.05.92
73012567	10.04.90/20.01.92	06.05.92
73012569	10.04.90/20.01.92	06.05.92
73012570	10.04.90/20.01.92	06.05.92
73013212	23.10.90/20.01.92	06.05.92

Appendix to Certificate of Conformance

BVS 92.C.2034 X

3.3	Parts List No.:	of:	signed on:
	L73012561 (7 pg.)	25.11.91	06.05.92
	LS13536 (2 pg.)	07.01.92	06.05.92
	L73012562	30.09.91	06.05.92

(A4) Electrical data

Input and pulse circuits
(Connector no. S 5)

In explosion protection
intrinsically safe EEx ib IIB
for connection to approved intrinsically safe circuits
with the following max. values:

U_o = 10 V

I_k = 80 mA

The effective internal inductance
is ≤ 760 mH

The effective internal capacitance
is ≤ 10 mF

Serial interface
(Connector no. S 2)

For connection to approved intrinsically safe circuit
with the following max. values:

U_o = 10 V

I_k = 100 mA

P = 1 W

The effective internal inductance and capacitance
are so small as to be negligible.

Pulse input
(Connector no. S 3)

For connection to a voltage-free contact generator
of max. permissible capacitance
Cext = 0.1 mF

Max. permissible external inductance
Lext = 0.1 mH

Appendix to Certificate of Conformance

BVS 92.C.2034 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 EK-88
EEx ib IIB T1
Production number
BVS 92.C.2034 X

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

The ambient temperature range is -25°C to +50°C.

4600 Dortmund-Derne, 26.06.1992
BVS-Tha/Hid A 9100585

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section Responsible official

Mining Test Section **BVS**

1st Supplement to Certificate of Conformance

BVS 92.C.2034 X

from ELSTER Produktion GmbH, D-55248 Mainz-Kastel

Volume Corrector Type EK-88

Label: EEx ib IIB T1

The volume corrector can also be produced according to the following documents.

Test documentation

1 Description no.:	of:	signed on:
E8AEXAE1.DOC (7 pg.)	21.02.95	02.05.95
E8AEXANT.DOC (5 pg.)	21.02.95	02.05.95

2 Drawing no.:	of:	signed on:
800-5-722	02.05.95	02.05.95
73013211 (4 pg.)	10.08.94/10.08.94	02.05.95
73014255	21.02.95/21.02.95	02.05.95
83461901	21.02.95/21.02.95	02.05.95
73012568	06.04.95/06.04.95	02.05.95
73012562	27.07.90/03.12.92	02.05.95
73013422	09.03.94	02.05.95
73014255 (7 Pg.)	07.03.95	02.05.95
73014258	28.03.94/31.08.94	02.05.95
73014172	29.06.93/29.06.93	02.05.95
73012566	10.04.90/01.03.93	02.05.95
73014256	30.09.94/30.09.94	02.05.95
73012570	06.04.95/06.04.95	02.05.95
73013212	23.10.90/12.03.93	02.05.95

2 Parts list:	of:	signed on:
73014255 (5 pg.)	13.04.95	02.05.95
83461901 (3 pg.)	21.02.95	02.05.95
73012562	03.12.92	02.05.95

44329 Dortmund-Derne, 12.05.1995
BVS-Tha/Hid A 9500151

DMT-Gesellschaft für Forschung und Prüfung mbH
Specialists for the safety of electrical equipment
Mining Test Section Responsible official

E EC Declaration of Conformance

EG-Konformitätserklärung

gemäß „Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)"
bzw. EMV-Richtlinie 89/336/EWG des Rates vom 3. Mai 1989 (EMV-Richtlinie)

Der elektronische Mengenumwerter

Typ EK-88

erfüllt die EMV-Anforderungen gemäß

DIN EN 50082 Teil 1
sowie
DIN VDE 0878 Teil 3 bzw. EN 55022

i.V. Pfaff

i.A. Dörfler

Mainz-Kastel, den 16. März 1995

ELSTER

Elster Produktion GmbH, Steinernstraße 19, 55252 Mainz-Kastel
Telefon: 06134/605-0, Telefax: 06134/605-390, Telex: 6 134 915

EC Declaration of Conformance

(Translation of German document)

EC Declaration of Conformance

according to “Law on the electromagnetic compatibility of equipment (EMCL)” and the EMC Guideline 89/336/EWG of the Council of 3rd May 1989 (EMC Guideline)

The Electronic Volume Corrector

Type EK-88

fulfils the EMC requirements according to

DIN EN 50082 Part 1
and
DIN VDE 0878 Part 3 or EN 55022

Mainz-Kastel, 16th March 1995

ELSTER

Elster Produktion GmbH, Steinernstraße 19, 55252 Mainz-Kastel, FRG
Telephone: +49-6134-605-0, Telefax: +49-6134-605-390, Telex: 6 134 915