KVM
User's Manual
As of version: V.01.01

Küppers Elektromechanik GmbH
Quality system certified to DIN EN ISO 9001

Contents

1. General

The electronic of the KVM serves the measurement, scaling and transforming of the transmitter frequency. Measuring values and operational parameters are shown in the LCD display while operation and parameter settings are effected via the foil touch keyboard.

Special features of the KVM are fast response time, high accuracy as well as simple and safe programming of all parameters.

The following features are available for evaluation:

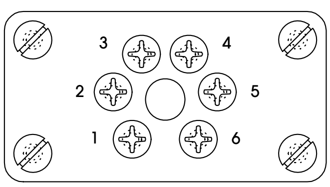
- Analogue output with switchable 10-point-linearisation
- Analogue output two-wire, galvanically free (4-20 mA), resolution 12 bit
- Pulse output: direct measuring frequency or divider pulses

2. Specifications

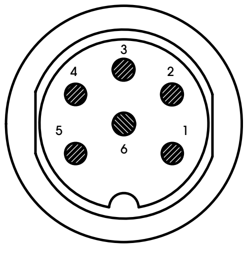
2.1 Technical Data

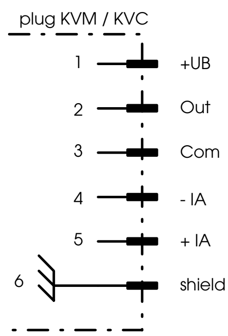
housing	aluminium, blue anodised, IP65 as per DIN 40050
ambient temperature	–40 bis +70 °C
medium temperature	–40 bis +260 °C
power supply	12–30 V DC; power consumption max. 1.5 VA (with frequency output) Ubmin = (Rload x 20mA) +14 V (with analogue output)
analogue output	resolution 12 bit, response time ≥ 20 ms current (4–20mA): max. 800 Ω load linearity: 0.05% of final value temperature drift: 0.05% each 10 K residual ripple: 0.05 % of final value
frequency/pulse output	galvanically free: push-pull output Uout high level = Usupply – 0.2V
operation and display	input of all operational parameters via foil touch keyboard display: 8-digit LCD, 14 segments
electrical connection	6-pin plug with socket or junction box

Junction box

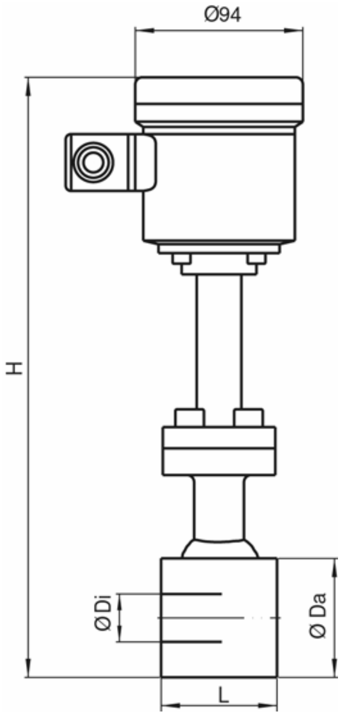


socket



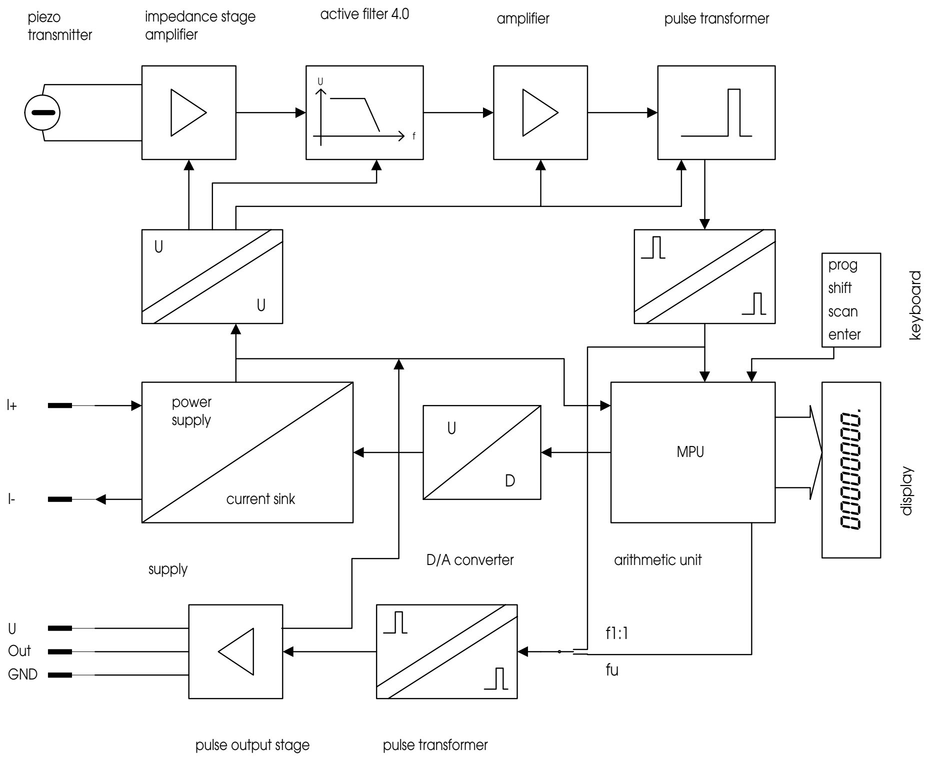


2.2 Dimensional drawing (mm)



Typ (DN)	Da	Di	H	L
KVM 015	95	16	335	65
KVM 025	67	27	330	65
KVM 040	85	41,5	340	65
KVM 050	105	53	340	65
KVM 080	136	80	355	65
KVM 100	164	103	370	65
KVM 150	220	154	395	90
KVM 200	275	202	425	120
KVM 250	330	253	440	140

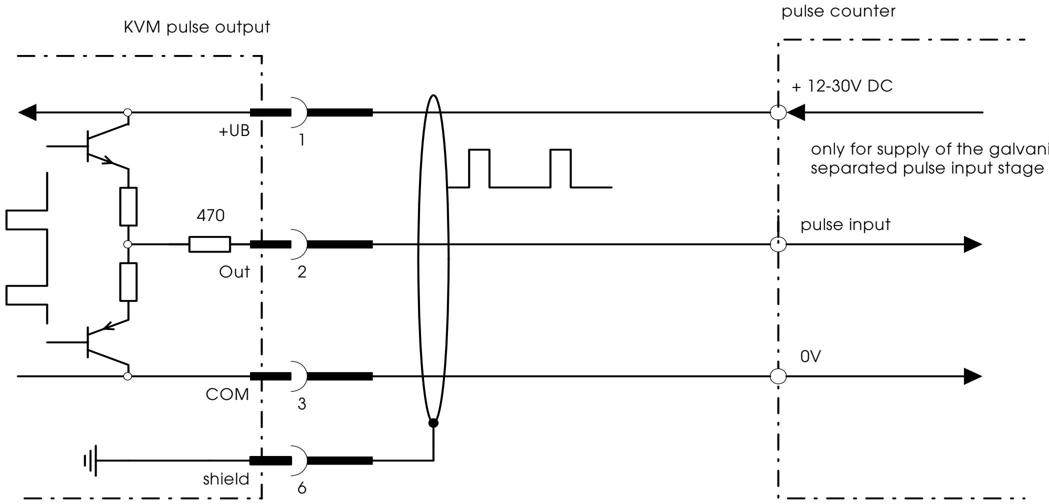
2.3 Functional diagram



2.4 Outputs

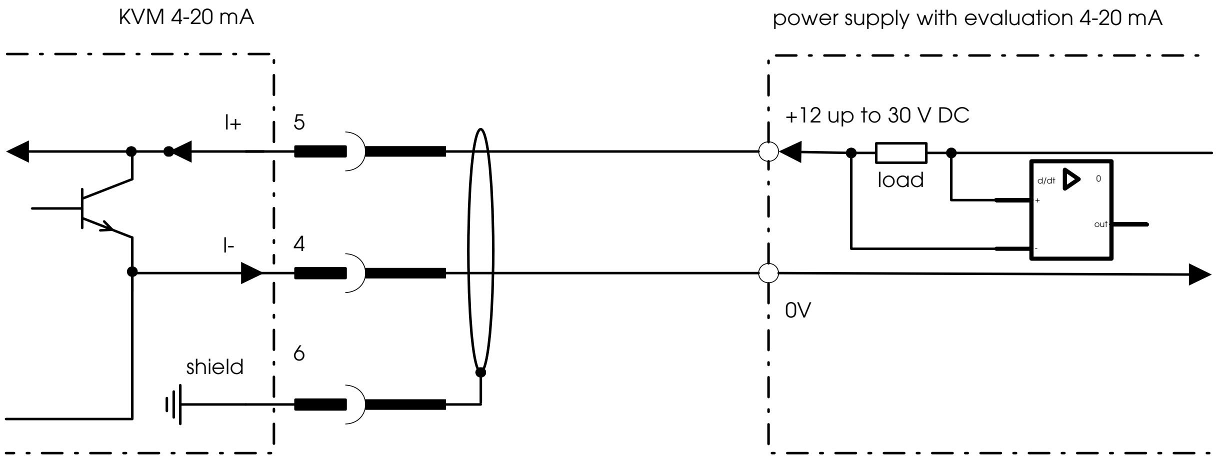
2.4.1 Pulse output (low active)

The KVM may optionally be equipped with a pulse output which can either provide standardised pulses (e.g. in m³) or the direct measuring frequency of the flow meter (programmable via parameter IMP-OUT). The wiring is as follows:



2.4.2 Analogue output 4–20 mA

The primary current of 4 mA powers the entire electronic of the KVM. The measuring signal of up to 16 mA is added resulting in a current consumption of 4 to 20 mA. The wiring may be taken from the scheme below:



2.5 Notes on installation

Connect metal housing with PE

Built-in devices have to be installed in a metal housing connected with protected earth.
Observe a low impedance connection of PE and a measurement of the PE resistor according to VDE 0701. Also observe a sufficient shielding for the employed cabinet.

Keep distance

Keep current-carrying cables at least 30cm away from the KVM. Only shall indicated terminals and contacts be used for power supply. Keep mobiles, ISM-units or switching inductivities like engines or solenoid valves at least 2 metres away from the digital measuring and control electronics. Avoid sources of electrostatic charges in the closer environment of the KVM. Operators should also consider appropriate clothing and wear of shoes with discharging ability.

Avoid parallel arrangement of current-carrying cables

3. Start up

After connecting the power supply the following messages will appear in the display:

READ-DAT	All outputs take a neutral state. Parameters in the E are being read.
KVM	Type
VER-01.01	Software version
TEST REG	Calculation of all working parameters.
OKAY	On successful check of all data the KVM will automatically activate the measuring mode and display the current operational parameters in accordance with the selected measuring mask.

Please note

P-ERROR	Parameter are saved twice in different banks of the E . In case of deviations between both parameter banks the display will show an error message.

Press E to restore all defaults and reset the totaliser to 0000. Afterwards the operation software will start the programming mode and parameter settings may be repeated.

Please note: The restoring of defaults may be started manually at any time (cf. programming of parameter CLEAR).

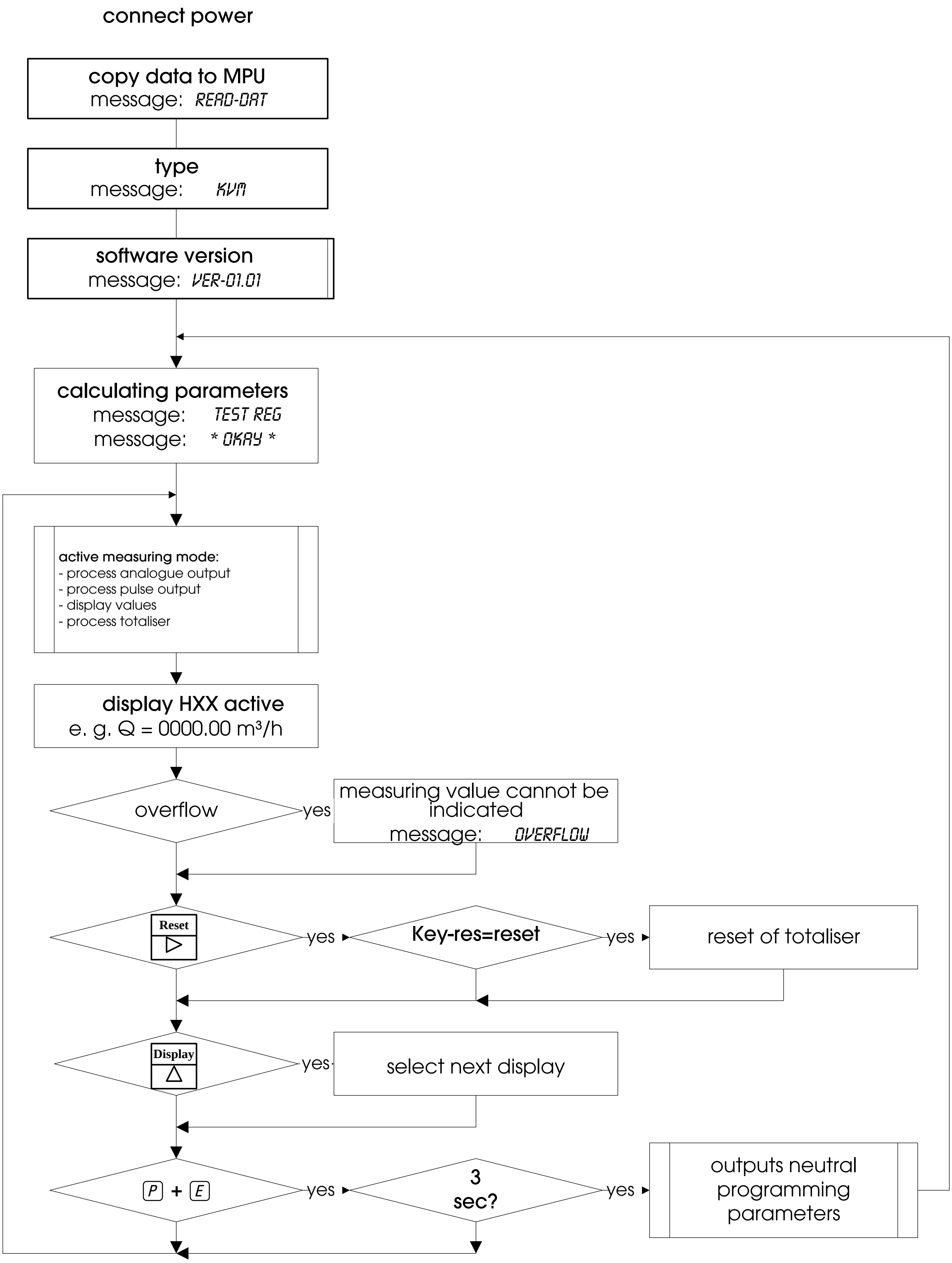
3.1 Error and status messages

During the measuring mode of after programming the following messages may appear in the display:

Message	Description
CLEAR	erasing E /data memory
P-ERROR	parameter error in E proceed with E
OVERFLOW	display range exceeded, measuring value cannot be indicated
SET.DEF	set defaults in M
W	cut off frequency passed
READ-DAT	copying data to M
TEST-REG	calculating operational parameters
WRITE	writing data in E

3.2 MPU programme flow chart

The scheme shows the job stream of the MPU unit and the operation facilities during the measuring mode considering the parameters KEY-RES and DIS-MODE.



4. Measuring mode

The measuring mode allows for indicating either real-time values or totals. Press ↑ to select the desired measuring mask. On the furthest left-hand digit your selection is indicated by a Q for real-time value or V for totals. The way of indication (decimal point, flow rate unit etc.) depends on the adjustments in level PARAMET.
In case the special character W should appear right to the display description (Q or V), the cut off frequency, parameter F-CUT, has been passed.

For start up or test purposes the display mode may be changed to test mode by programming the parameter DIS-MODE to TEST-MOD (cf. p. 18). In the test mode the display may indicate up to 10 different measuring masks as listed in the table below.

4.1 Measuring masks

Meas. mask	Display	Unit (not displayed)	Start up DIS-MODE = TEST-MOD	Meas. mode DIS-MODE = MESS-MOD
Q	real time value	flow rate unit	yes	yes
V	totals	flow rate unit	yes	yes
2	direct meas. frequency	000.0 Hz	yes	no
3	gate frequency	000.0 Hz	yes	no
4	direct transmitter pulses	pulses	yes	no
5	D/A value	decimal (0..4095)	yes	no
6	analogue out factor	none	yes	no
7	divider	pulses	yes	no
8	K-factor	flow rate unit	yes	no
9	programming counter	none	yes	no

4.1.1 Real-time value (measuring mask Q)

The real-time value is indicated in accordance with the adjusted flow rate unit FLOW-DIM and decimal point position FLOW-DP. The calculation is based on the currently measured frequency and the K-factor of the flow meter. The calculation is upgraded every 0.5 sec corresponding to approx. 2 Hz. The internal upgrading and resultant response time of the analogue output and divider depends on the parameters GATE-TIME and A-TIME.

4.1.2 Totals (measuring mask V)

The integral totaliser of the KVM adds the transmitter pulses standardised in the adjusted flow rate unit (FLOW-DIM). Thus flow rates over a long period of time may be detected. The decimal point position depends on the adjusted flow rate unit. The KVM will automatically display totals as accurate as possible.

Example: flow rate unit = m^3/h. Totals are indicated in m^3, e. g. 12.345 m^3

If the measuring value exceeds the display range, it will be assigned accordingly (e. g. 1234.567m^3will be display as 1234.56m^3). If the measuring value is too high to be displayed by fading out digits, it will be displayed using exponential notation (e. g. 1234567.89m^3 will be displayed 1.23E06).

The totaliser may be reset via key provided that the parameter KEY-RES is programmed accordingly.

The following masks are only available in the test mode of the display (cf. p. 18)

4.1.3 Direct measuring frequency (measuring mask 2)

With start up or service requirements it may be of advantage to indicate the transmitter frequency. Select mask 2 pressing [↑]. The direct measuring frequency is indicated with resolution of 1/100 Hz, i. e. *0.00 HZ*.

4.1.4 Gate frequency (measuring mask 3)

With the *GATE-TIM* parameter you may define a measuring period and the frequency measuring result will be a mean value over this period. Select mask 3 pressing [↑] (wait until the code »2« appears in the display and press again). The gate frequency is indicated with a resolution of 1/100 Hz, i. e. *0.00 HZ*.

4.1.5 Direct transmitter pulses (measuring mask 4)

This measuring mask shows the unscaled transmitter pulses in the format *000000*. The mask may be used for calibrations on site or reference measurements. When the number of pulses exceeds the display range of 6 digits, this mask will behave like the measuring mask V »totals« (cf. p. 11).
The totaliser may be reset via key provided that the parameter *KEY-RES* is programmed accordingly.

4.1.6 D/A value (measuring mask 5)

This measuring mask shows the decimal value of the D/A-converter, which is derived from the measuring frequency and scaling. The D/A-converter has a resolution of 12 bit corresponding to 4,095 steps of resolution for 16 mA(4-20 mA). The display shows *0000* corresponding to 4 mA and *4095* corresponding to 20 mA.

Example: With 6,000 m^3 the analogue output provides 20mA (16 mA modulated + 4 mA primary current). The display will show *4095*.
If the actual flow is 3,000 m^3, the display will show *2048* corresponding to 8 mA modulated current + 4 mA primary current. The analogue output provides 12 mA.

4.1.7 Analogue out factor (measuring mask 6)

This mask shows the internal analogue scaling factor, which is calculated by the ratio of the converter resolution (12 Bit = 4095) and the frequency which corresponds to 20 mA. This frequency is calculated considering K-factor, flow rate unit and the analogue full scale value.

Example: Frequency with analogue full scale of 6,000 m^3/h = 234.56 Hz
Calculation: 4095 : 234.56 Hz = 17.458; i. e. with each Hz the D/A-converter will be increased by 17,458 steps. The display will show the factor as *17458*.

4.1.8 Divider in direct transmitter pulses (measuring mask 7)

The programmed dividing factor in flow rate unit is converted into measuring pulses via the parameter *K-FACTOR*. This mask shows the number of transmitter pulses corresponding to one divider pulse.

Example: K-factor = 835.21 pulses/m^3: dividing factor = 0.130 m^3
Divider pulses = 835.21 Imp/m^3 x 0.130 m^3 = 108.577 pulses → display = *109*

4.1.9 K-Factor in programmed unit (measuring mask 8)

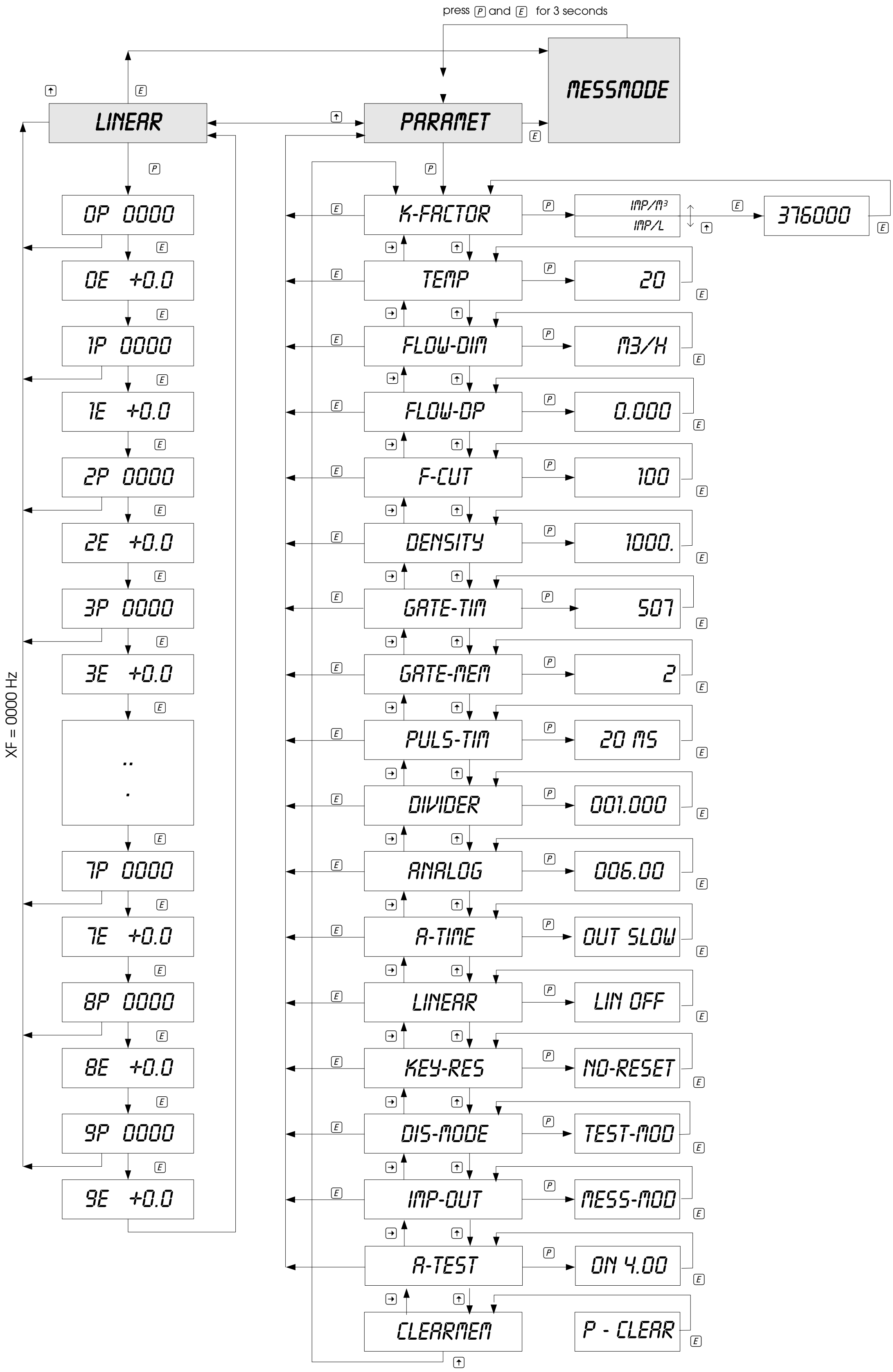
The K-FACTOR defines the calibration factor of the KVM, which can be found in the calibration record.
The K-factor is usually stated in pulses/volume unit (e. g. 376000 pulses/m^3). In this mask you can see the K-factor converted in accordance with the programmed flow rate unit. The decimal point is fixed 0000.00

Example: K-factor = 376000 Imp/m^3, flow rate unit = gal/h → volume unit gal (US)
376 Imp/dm^3 x 3.7854 dm^3/gal = 1423.31 Imp/gal → display: 1423.31

4.1.10 Programming counter (measuring mask 9)

This counter registers how often the programming mode has been started. You may use this to check, whether parameters have been changed since the last programming.

5. Programming



5.1 Starting the programming mode

Simultaneously press P and E for 3 seconds to start the parameter programming.
The measuring mode will be interrupted and all outputs take a neutral state. The display shows the first parameter level:

PARAMET.

Pressing ↑ you may select from the levels PARAMET (operating data) and LINEAR (linearisation).
Press P to select the first parameter of the selected level.

1st parameter of level PARAMET (operating data)		1st parameter of level LINEAR (Linearisation)
K-FACTOR	or	OP 0000.

Press ↑ to scroll the parameters of the level.
Press P to start programming.

Having started the programming, the display shows the current value of the parameter. It may be adjusted by entering either numericals or selecting from presets.

5.2 Entering numericals

When a numerical parameter appears in the display the up right-hand digit will flash asking you to enter a value.

→ to select the decimal position. The present position is flashing.

P to select decimal point.

↑ each pressing will increase the value by 1 (0, 1, 2, 3 ...9, 0, 1).

E to save the adjustment. Afterwards the display shows the parameter name again.

↑ to select the next parameter. P to start programming.

E to complete the programming mode.

5.3 Selecting from presets

For some parameters, e. g. flow rate unit, you may select from presets. Having selected such a parameter you may scroll the presets pressing ↑. When the suitable unit appears save with E.
The parameters concerned and their respective presets can be found from page 15 onwards.

5.4 Level PARAMET: operational parameters

5.4.1 Table of parameters

A detailed description can be found on the following pages.

Parameter	Description/Function	Unit	Default
K-FACTOR	K-factor of the flow meter	pulses/m³ or l	376000.
TEMP	temperature of measuring medium	°C	20
FLOW-DIM	flow rate unit	m³/h	M³/H
FLOW-DP	flow decimal point	none	0.00
F-CUT	cut off frequency	Hz	100
DENSITY	specific gravity of the medium	kg/m³	1000.
GATE-TIM	gate time/measuring time	ms	1521
GATE-MEM	gate memory	none	50
PULS-TIM	pulse time of divider output	ms	20
DIVIDER	divider	m³	1.000
ANALOG	analogue full scale	m³/h	6.000
A-TIME	response time analogue output	none	OUT-SLOW
LINEAR	linearisation on/off	none	LIN OFF
KEY-RES	totaliser reset via keyboard	none	NO-RESET
DIS-MODE	display mode during measuring mode	none	MESS-MOD
IMP-OUT	source for the pulse output	none	DIVIDER

5.4.2 Invalid programming

Invalid values or values which are not included in the respective range will be erased after pressing E. Afterwards the last value will re-appear in the display and you repeat programming.

5.5 Parameters

5.5.1 K-FACTOR: K-factor of the flow meter

Each flow meter is supplied with a calibration record indicating the mean K-factor. This factor defines the no. of pulses per volume unit (m³) over the entire measuring range of the flow meter. The linearity error of the mean K-factor over the entire measuring range is also shown in the calibration record.
In addition to the mean K-factor and error, the calibration record does also include K-factors and errors at certain flow rates. With constant flow rates you may reach a higher accuracy by selecting the K-factor which is the closest to the flow rate in your application.

Select the desired unit (m³ or l) via ↑ and confirm with E.
Enter the number for each position via the ↑ and → key as described under 5.2, p. 15. The decimal point may be moved via the PROG key. Press E to save.

5.5.2 *TEMP*: Temperature of the measuring mediums

The transducer (pipe and bluff body) stretches in accordance with temperature affecting the calibration values of the flow meter. The influence is proportional with the difference between process and calibration temperature. Programming the mean temperature of the measuring medium enables for a compensation concerning the totalizer and analogue output. The sensor output signal cannot be influenced internally.

5.5.3 *FLOW-DIM*: flow rate unit

Your selection will apply for the real-time value and totals as well as the scaling of the indicated value, analogue output and pulse divider. The unit itself is not indicated. You may select from the 10 presets which can be scrolled via [↑]. Press [E] to save and proceed.

presets	L/MIN	L/H	KG/MIN	KG/H	GAL/MIN	GAL/H	LB/MIN	LB/H	M^3/MIN	M^3/H
operation	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]

Example: Flow rate unit is l/min. The real-time value is indicated in ltr./min and totals in litres. Programming of the analogue full scale and pulse divider are effected in ltr/min and litres respectively.

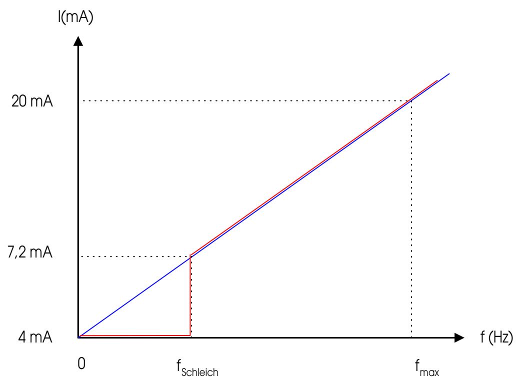
5.5.4 *FLOW-DP*: Flow decimal point

The adjustment applies for the indication of real-time values.

decimal point	0000.	000.0	00.00	0.000
meaning	1/1	1/10	1/100	1/1000
operation	[→]	[→]	[→]	[→]

5.5.5 *F-CUT*: Cut off frequency

When the flow rate bypasses the minimum flow range of the flow meter, the output frequency will be outside the linear range of the meter. The frequency corresponding to the minimum flow range (see calibration record) is called »cut off frequency«. The analogue output, display and limits will not work below this frequency. The analogue output takes its offset value, the real-time values are display 0000 and the limits are out of operation.
The decimal point position for the cut off frequency is fixed to 000.0Hz. Press [↑] to programme the value for each digit. Press [→] to move and [E] to save.



5.5.6 *DENSITY*: Specific gravity of the measuring medium

In case a mass-related unit was selected for the flow rate, you may enter the density of the measuring medium in kg/m^3 and the measuring values will be calculated considering the K-factor and density. The decimal point may be moved via the [P] key.
Please note, when a volumetric unit (e. g. ltr/min) was selected for the flow rate, the KVM will skip the density programming.

5.5.7 GATE: Gate time/Measuring time

The parameter »gate time« enables you to adapt the temporary transmission behaviour between frequency and analogue output to your requirements.
After the gate time has passed, the MCM calculates an average frequency for the measuring interval thereby calming signal fluctuations.

Periodic disturbances, e. g. pressure fluctuations, will be included in the displayed values, if the gate time is too short. You may avoid this by choosing an appropriate interval.

Example: flow variations with a period of 0.5 seconds require a gate time of ≥ 0.5 seconds.

You may select intervals from 507 msec to 3042 msec in steps of 507 msec via the [↑] key. Save your selection with [E].

presets	507	1014	1521	2028	2535	3042
meaning	ms	ms	ms	ms	ms	ms
operation	[↑]	[↑]	[↑]	[↑]	[↑]	[↑]

5.5.8 GATE MEM (Gate memory)

This parameter determines the number of measurements which will be considered for calculating the actual measuring frequency (the response time of the measuring results depends on the gate time setting). With n > 0, an average value is calculated considering the last n measurements and the actual measurement.
This way unique or rare disturbances are prevented from fully affecting the measuring results. Adaption of both parameters gate time and -memory enables for any temporary behaviour whatever.

5.5.9 PULS-TIM: Pulse time of divider output

In order to further process the divider output signal by additonal units (preset counters, PLC etc.) 3 different the pulse time adjustments are available:

presets	1	20	50
meaning	ms	ms	ms
operation	[↑]	[↑]	[↑]

5.5.10 DIVIDER: Dividing factor for the pulse output

In order to detect the flow rate with an external counter, the KVM may divide the frequency signal of the transmitter in a way the pulse output will generate a volume- or mass-proportional pulse.
You may now programme the dividing factor with a value that shall correspond to one output pulse.
Please consider the following when programming:

- The flow rate unit as per FLOW-DIM applies (e. g. m^3/h or l/min)
- The parameter IMP-OUT has to be set to DIVIDER
- The maxfrequency of the pulse output must not exceed 15 Hz.

Example: An external totaliser shall count integer m^3. Select m^3/min or m^3/h for FLOW-DIM. Enter 1.000 for the dividing factor and each output pulse will correspond to 1 m^3.

The internal totaliser of the KVM is not affected by the dividing factor.

5.5.11 ANALOG: Analogue output full scale

The KVM may provide a flow-proportional current signal of 4-20 mA. You may now enter the real-time value which shall correspond to 20 mA (flow rate unit according to parameter FLOW-DIM). For a maximum accuracy, this parameter allows for moving the decimal point independent of the adjustment for FLOW-DP. Press [P] to move the decimal point to the desired position. Save with [E].

5.5.12 A-TIME: Response time analogue output

The FAU can convert the measuring frequency into an analogue signal based on the incoming frequency (fast) or based on the »calmed« frequency (slow). The calmed frequency is calculated in accordance with the adjustments for parameters GATE-TIME.
Select with [↑] and save with [E].

presets	OUT-FAST	OUT-SLOW
meaning	fast	slow
operation	[↑]	[↑]

5.5.13 LINEAR: Activate linearisation

This parameter can be used to either activate or deactivate the 10-point-linearisation for real-time values, analogue output and divider. With active linearisation the KVM will correct the measuring frequency according to the programmed error and frequency figures.
The programming of these figures is performed in level LINEAR (see page 21).

presets	LIN OFF	LIN ON
meaning	off	on
operation	[↑]	[↑]

5.5.14 KEY-RES: Reset via keyboard

The totaliser of the KVM may be reset via keyboard when KEY-RES is selected here. Select with [↑] and save with [E].

presets	NO-RESET	KEY-RES
meaning	block	allow
operation	[↑]	[↑]

5.5.15 DIS-MODE: Display mode in the meas. mode

For the usual measuring mode select MESS-MOD for this parameter which includes the real-time values (mask Q) and totals (mask V).
For start up or test purposes the TEST-MOD offers further measuring masks. For details see page 10. Select with [↑] and save with [E].

presets	TEST-MOD	MESS-MOD
meaning	all masks	Q- and V-mask
operation	[↑]	[↑]

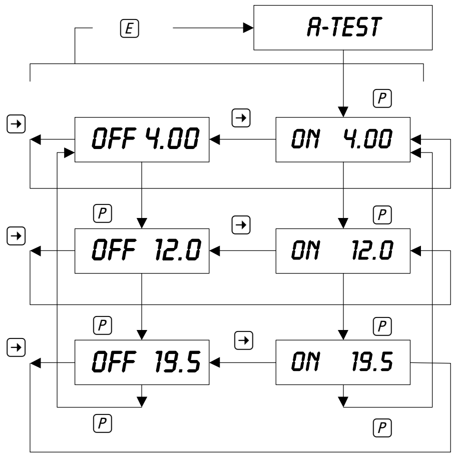
5.5.16 IMP-OUT: Signal source pulse output

The pulse output may either provide the transmitter frequency or volume-/mass-proportional pulses (cf. parameter DIVIDER). Select with [↑] and save with [E].

presets	DIVIDER	M-FREQU
meaning	divided frequency	transmitter freq.
operation	[↑]	[↑]

5.5.17 *A-TEST* : Check of the analogue output

The analogue output may be checked with respect to performance and linearity.
Three preset output values are available via keyboard.
Press [P] to select from the presets. Via [→] you may turn the current modulation either on or off. Press [E] to quit the test.



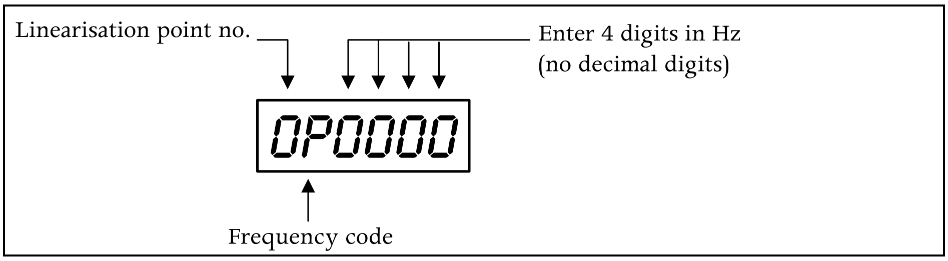
5.5.18 *CLEARMEM*: Restoring defaults

This function will restore the defaults erasing all parameter adjustments and counts. Having selected the mode via [P] the display shows *P-CLEAR* . To quit press [E]. To restore defaults press [P]. Afterwards the E with all operational parameters and counts will be erased. During this process the message * *CLEAR*/*CLEAR* * will appear in the display.

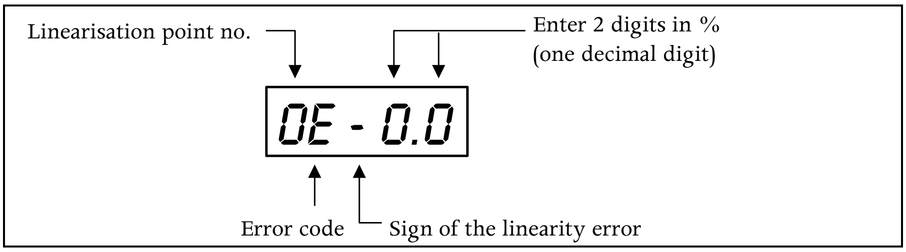
5.6 Level *LINEAR*: Linearisation

The mean K-factor of the flow meter defines a pulse rate per volume unit, which contains an error over the complete measuring range. The linearisation allows to compensate for this error by entering 10 linearisation points over the measuring range, i. e. 10 frequencies with their respective errors. This will enable you to reduce the measuring error to the repeatability which is usually ±0.1% for KEM flow meters. Please note the linearisation affect the analogue output and display value only.

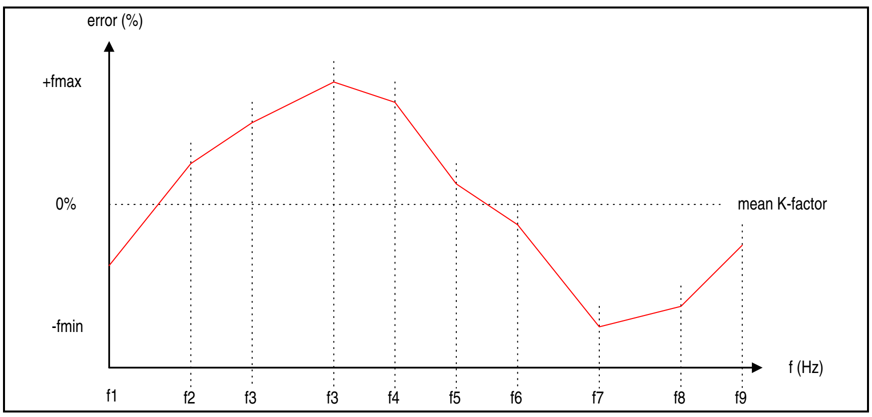
Having selected parameter level 2 press [P] to start programming the first frequency:



The programming starts off with the first frequency (=0). You may enter the frequency figures using the [↑] and [→] key. Frequencies are to be entered as integer numbers in Hz. The figures can be found in the calibration record of the flow meter. On completion of this parameter, you are requested to enter the respective linearity error. The display shows the following:



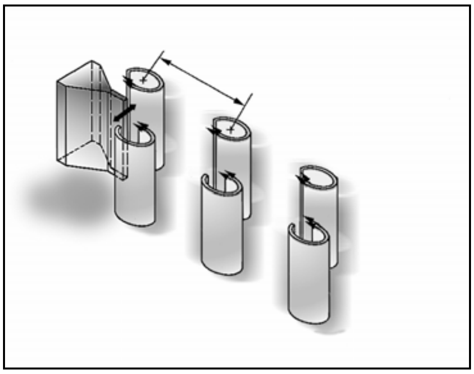
The linearisation point no. is automatically maintained. Use [P] to select the sign of the error, either + or –. Enter the linearity error with one decimal digit in 1/10% via [↑] and [→].
On completion the MCM will automatically go back to the frequency display for programming the next frequency. This process will repeat until a frequency has been programmed as 0 or when 10 linearisation points have been completed (last linearisation point no. is 9). After saving the last error the KVM goes back to the parameter level.



Calibration Diagram

Figures for frequencies and errors can be taken from the table of the calibration record.

6. Vortex Principle

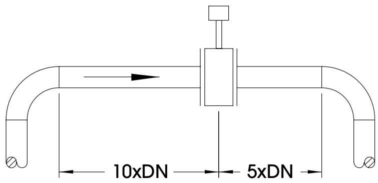


The medium flows against a trapezoidal bluff body* inside the vortex body and separates from the body surface periodically forming vortices – cf. »Karman Vortex Street«.
The vortex shedding (vortex frequency) creates pressure differences behind the bluff body which will act on the rear part of the bluff body termed vortex detection area.
A piezo-electrical sensor element inside the bluff body detects the resultant force of the vortex shedding and supplies a sinusoidal alternating voltage with a frequency corresponding to the vortex frequency thus being proportional to the flow velocity. The transmitter will convert the sensor signal and finally supply a frequency, NAMUR or analogue signal (4–20mA) for further processing.

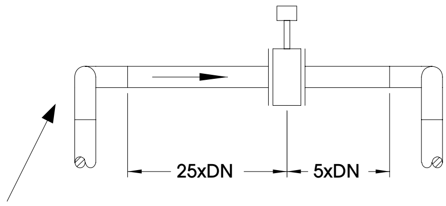
* The bluff body has no bores or welding seams and is therefore particularly tough and resistant to contamination. The external construction and the precise positioning of the sensor element enable for wide measuring ranges as a linear relation exists between the volume flow and the vortex frequency over a wide range of flow velocities

7. In- and Outlet Sections

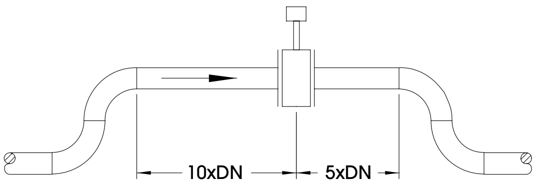
To receive an ideal linearity the flow should be free of interference. Therefore keep a minimum length of straight pipe up- and downstream, do also keep distance from sources of interference.



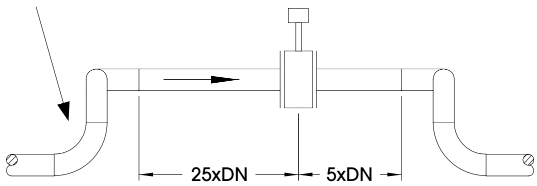
quarter bend

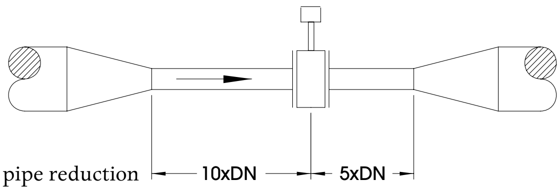


Two or several quarter bends in different levels

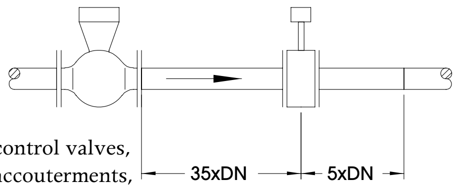


Two quarter bends in different levels





pipe reduction



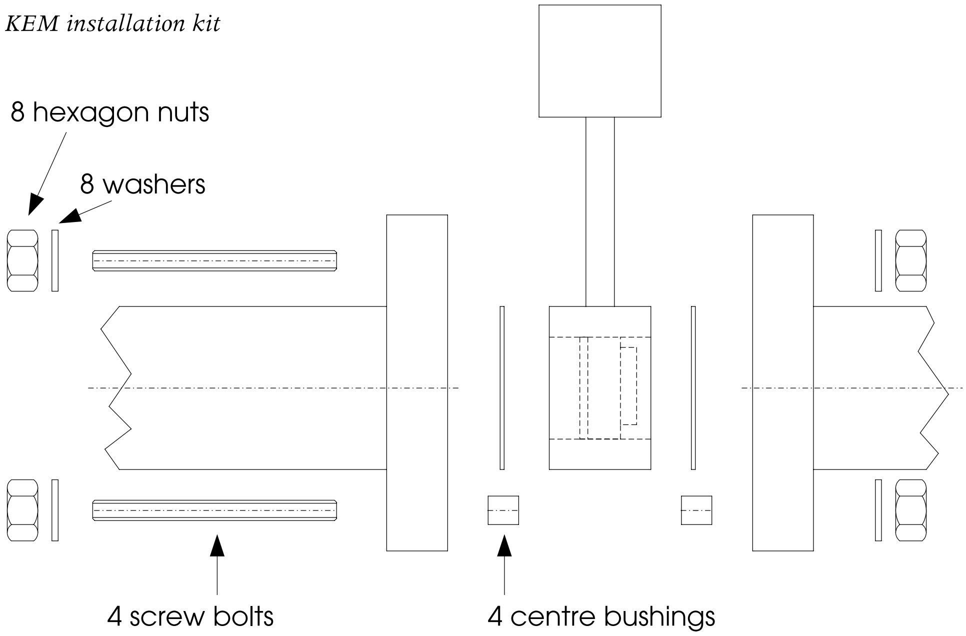
control valves,
accouterments,
gate partially opened

8. Installation

8.1 KVM series with wafer connections

Use the KEM installation kit.

KEM installation kit



8.2 General

- Ensure a proper distance between both flanges, the pipe must not be twisted by the flow meter.
- The internal diameter of the flat seals must be larger than the internal diameter of the tube as otherwise the flow behaviour might be affected by the seal.
- The outer diameter of the flat seal should correspond to the outer diameter of the sensor to ensure the seal is fixed in a centric position by the centre bushings.
- In outdoor applications or use in a wet environment the electrical connector should point down to prevent water from entering the housing via the cable.
- The tubes must be aligned well. Misalignment must be kept down to a minimum.
- In high temperature applications the electronic should be in lateral postion pointing down to avoid damage by rising hot air.
- The use of KEM in- and outlet sections is recommended to avoid false installation.

8.3 Installation in a horizontal position

- Insert the bottom screw bolt in one flange
- Slip on the centre bushings
- Push the screw bolt through the second flange. Fix the screw bolt with washers and nuts.
- Insert the vortex meter (electronic in a lateral position at high temperatures)
- Insert the seals on both sides (take care of a centric position of seals and flow metrer).
- Fix the flow meter by slightly tightening the screws
- Insert the top screw bolts.
- Fix the top screw bolts with washers and screws
- Tighten the screws in opposing order (consider torque specifications where applicable)
- Re-tighten the screws after start up if necessary.

8.4 Installation in a vertical position

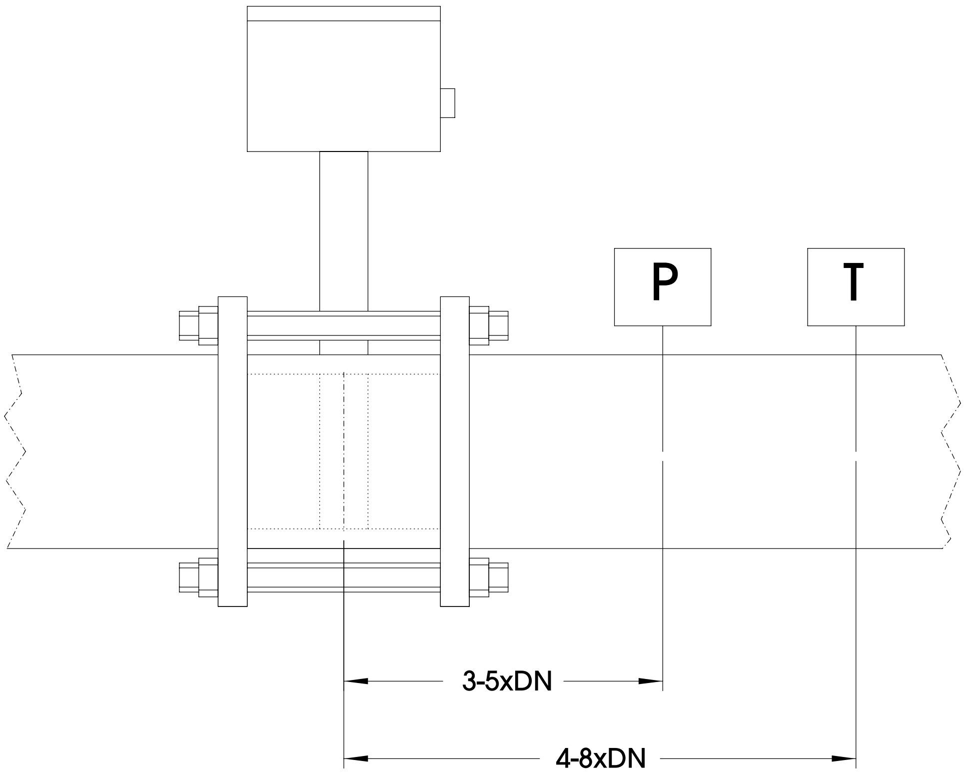
- Insert 2 screw bolts, each with 2 centre bushes.
- Fix the top and bottom screw bolts with nuts and washers.
- Insert the flow meter with both flat seals. The flow meter must sit close to the top and bottom centre bushings. Make sure the flow meter and the flat seals are in a centric position.
- Insert both front screw bolts. Fix them with washers and nuts. Tighten the screws in opposing order (consider torque specifications where applicable).
- Re-tighten the screws after start up if necessary.

Alternatively with well-aligned tubes:

- Insert 2 screw bolts, each with 1 centre bush.
- Fix the top and bottom screw bolts with nuts and washers.
- Insert the flow meter with both flat seals. The flow meter must sit close to the top and bottom centre bushings. Make sure the flow meter and the flat seals are in a centric position.
- Insert the front screw bolts with 1 centre bush. Fix with washers and nuts (in accordance with the flange bore tolerances the last 2 centre bushes may not be required).
- Centrically align the flow meter between both flanges.
- Tighten the screws in opposing order (consider torque specifications where applicable).
- Re-tighten the screws after start up if necessary.

8.5 Pressure and temperature transmitters

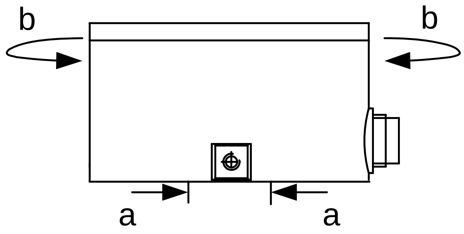
Please consider the following average values for positioning.

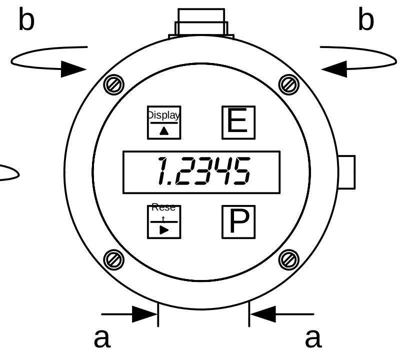


9. Positioning the electronic

9.1 Positioning of the housing

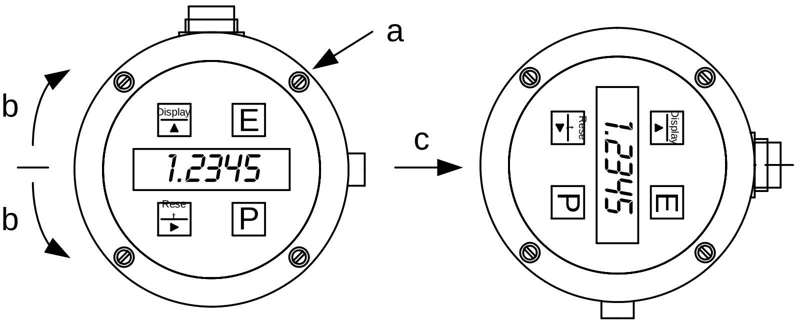
1. Slacken grub screws (a).
2. Move housing to the desired position (b).
3. Tighten grub screws.





9.2 Positioning the display

1. Unscrew the four fixing screws (a).
2. Remove the top and turn it in any direction (b) you like in steps of 90° (c).
   Please ensure the supply core is not twisted by more than 270°.
3. Put on the top and screw in the fixing screws.



Subject to change without notice, V.-01.01, Zi Rev 001/08/06