H250 M40 Handbook

Variable area flowmeter

KROHNE

IMPRINT

1.1 Intended use

CAUTION!
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The variable area flowmeters are suitable for measuring clean gases, vapours and liquids.

Intended use:

- The product may not contain any ferromagnetic particles or solids. It may be necessary to install magnetic filters or mechanical filters.
- The product must be sufficiently liquid and free of deposits.
- Avoid pressure surges and pulsing flows.
- Open valves slowly. Do not use solenoid valves.

Use suitable measures to eliminate compression vibrations during gas measurements:

- Short pipeline lengths to next restriction
- Nominal pipe size not greater than nominal device size
- Use of floats with damping
- Increase in operating pressure (while taking into account the resulting change in density and thus change in scale)

Observe installation conditions according to VDI/VDE 3513-3

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

WARNING!
Responsibility for the use of the measurement devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.
Do not use any abrasive media containing solid particles or highly viscous media.

1.2 Certifications

CE marking

The device fulfils all applicable statutory requirements of the following EC directives:

- Pressure equipment directive 97/23/EC
- For devices with electrical installations: EMC Directive 2004/108/EC
- Devices for use in hazardous areas: ATEX Directive 94/9/EC

as well as

- NAMUR recommendations NE 21 and NE 43
  The manufacturer certifies successful testing of the product by applying the CE mark.

1.3 Pressure equipment directive

A conformity assessment in accordance with pressure equipment directive 97/23/EC has been carried out for the devices described. Conformity is certified by applying the CE mark. The number of the notified body is also stated.

The PED – Key describes rating of devices:

PED/G1/III/H	
G	Gases and steams
1	Fluid group 1
III	Category III
H	Conformity assessment method according to Module H

The PED key identification can be found on the nameplate of the device (see section 2.3 Nameplate)

INFORMATION!
The stated pressures (PS) and temperatures (TS) only apply as refers to the pressure resistance of the sensor body. As regards the functionality of the entire device, further restrictions of the maximum temperature may need to be observed (e.g. ATEX approval). Devices rated below Category I (Article 3/3) due to their size, do not receive the CE mark in the scope of the PED. These devices are subject to applicable Sound Engineering Practice SEP.

1.4 Safety instructions from the manufacturer

1.5 Copyright and data protection

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1.5.1 Disclaimer

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This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.5.2 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.5.3 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.5.4 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

1.6 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

INFORMATION!
Inspect the cartons carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

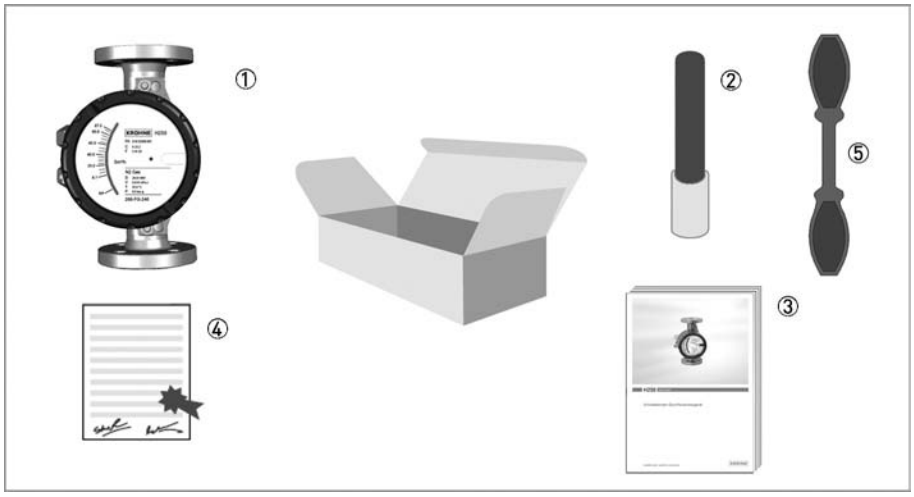
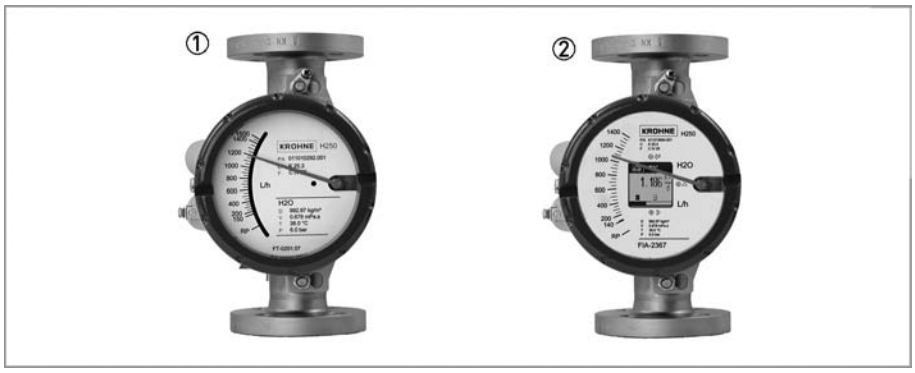


Figure 2-1: Scope of delivery

① Measuring device in ordered version
② For the ESK4T version - bar magnet
③ Documentation
④ Certificates, calibration report (supplied to order only)
⑤ Key

2.2 Device version

- H250 with indicator M40
- H250 with M40 indicator with display cut-out for ESK4-T



1. H250/RR/M40
- Local indicator without auxiliary power
- max. 2 limit switches, type NAMUR, NAMUR safety-oriented or transistor (3-wire)
- Electrical signal output 4...20 mA, HART® or Fieldbus communication
- Optionally intrinsically safe (Ex i) or in explosion-proof enclosure (Ex d)

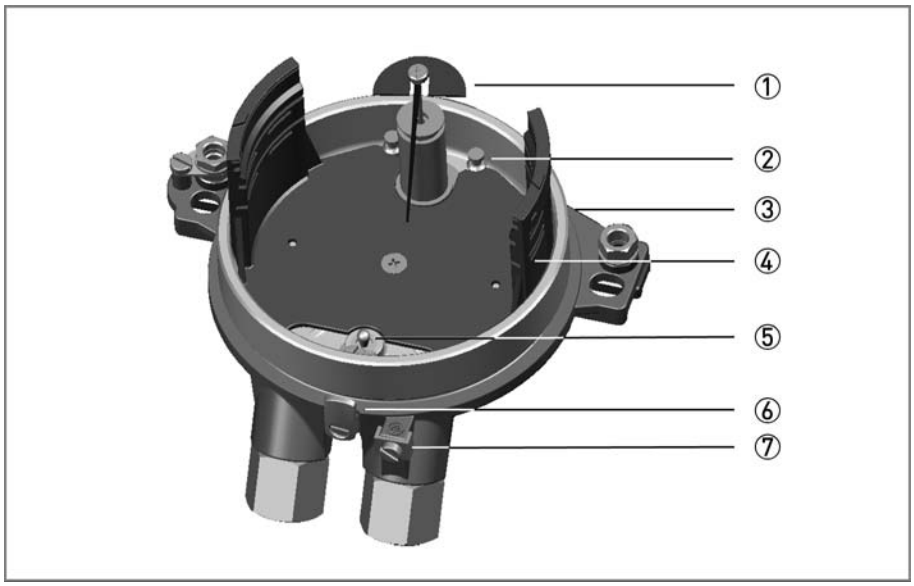
2. H250/RR/M40
- additional LCD, measured value and/or flow counter
- 2 configurable binary outputs, limit value or 10Hz pulse output
- 1 binary input, Start / Stop / Reset flow counter
- 2-wire current output 4...20 mA, HART® communication
- Optionally intrinsically safe [Ex i] or in explosion-proof enclosure [Ex d]

The following designs are available as options:
- H250 with indicator M40 as high-temperature version HT
- H250 with indicator M40 with added impact and corrosion protection (special paint finish)
- H250H for use in horizontal pipelines
- H250U for use in vertical fall pipes
- H250F featuring hygienic measuring tube design for Food & Pharma
- H250C with PTFE / TFM liner for aggressive media

2.2.1 Indicator versions

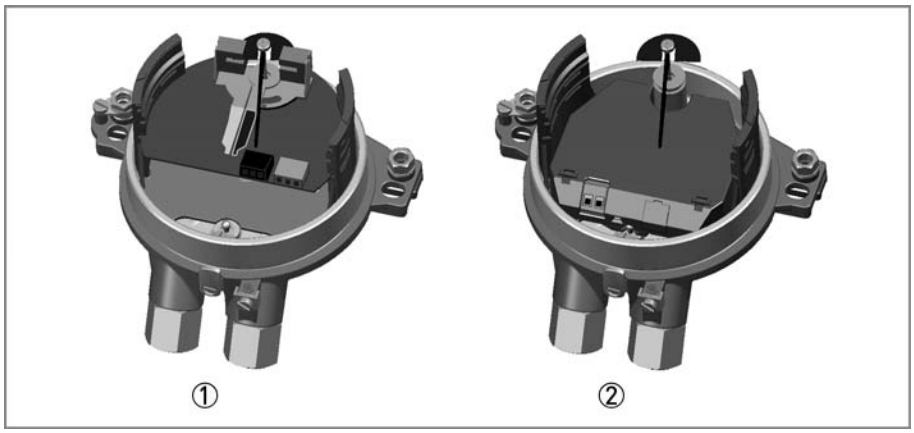
The M40 indicator can be fitted with various modules.

Basic version



① Pointer module
② Bolts for ESK4 attachment
③ Baseplate
④ Module profile
⑤ Pressure piece for ESK4 attachment
⑥ Housing cover locking device
⑦ Earth terminal external

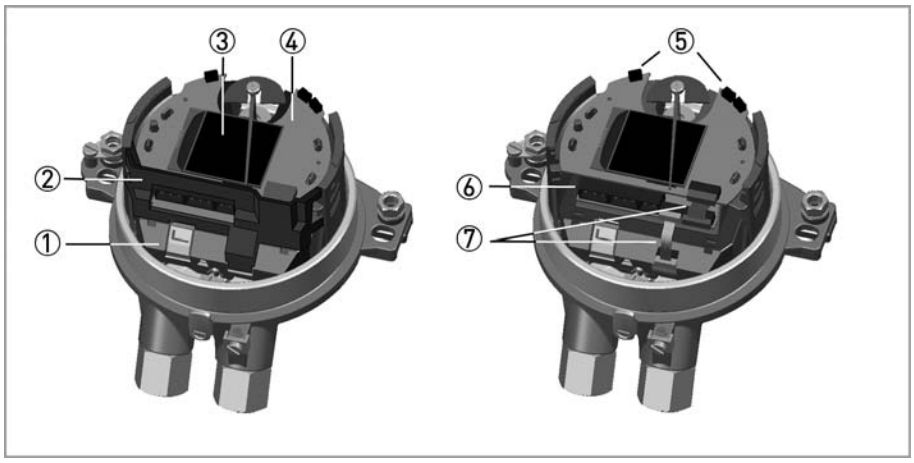
Versions K1 / K2 and ESK4



① Indicator with K2 contact module
② Indicator with ESK4 current output 4...20 mA

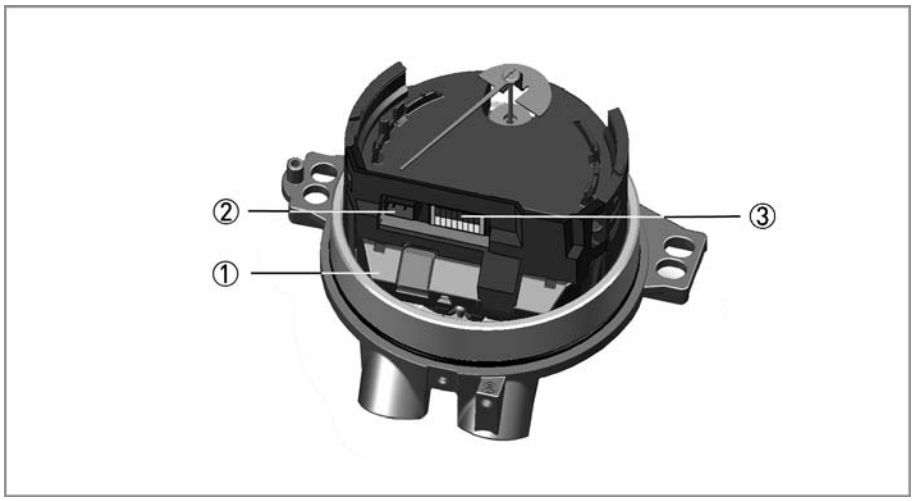
Both versions can be combined with one another.

Version ESK4-T



① ESK4 connection
② Module cover
③ Display
④ Display module
⑤ Operating keys ↵ ↑
⑥ Connection binary input/outputs
⑦ Connection cable module

Version Fieldbus ESK4-FF / ESK4-PA



① Basic module with electronic magnet sensors
② Connection bus module
③ hardware settings

For more details see the supplementary instructions "H250 M40 Foundation Fieldbus"

2.2.2 Float damping

Float damping is characterised by high standstill times and self-centering. The damping sleeve is made of high performance ceramic or PEEK, depending on the medium and the application. Float damping can also be retrofitted for the user (see Service).

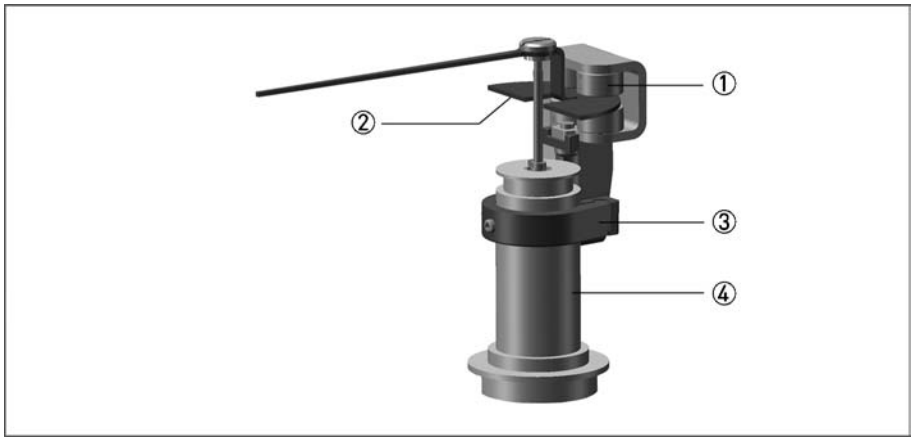
Use of damping

- Generally when CIV and DIV floats are used for gas measurement.
- For TIV floats (H250/RR and H250/HC only) with an operating primary pressure:

Nominal size acc. to		Operating primary pressure	
EN 1092-1	ASME B16.5	[bar]	[psig]
DN 50	½"	≤0.3	≤4.4
DN25	1"	≤0.3	≤4.4
DN50	2"	≤0.2	≤2.9
DN80	3"	≤0.2	≤2.9
DN 100	4"	≤0.2	≤2.9

2.2.3 Pointer damping

In principle, the indicating element with its magnetic system contains indicator damping. An additional eddy current brake is advantageous in the event of fluctuating or pulsing flows. The magnets on the eddy current brake surround the pointer vane without touching it, damping its movement. The result is a much steadier pointer position, without distorting the measured value. A turnbuckle ensures a proper fit. The eddy current brake can be retrofitted during operation without recalibrating (see Service).



① Eddy current brake
② Pointer vane
③ Bracket
④ Pointer cylinder

2.3 Nameplate

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

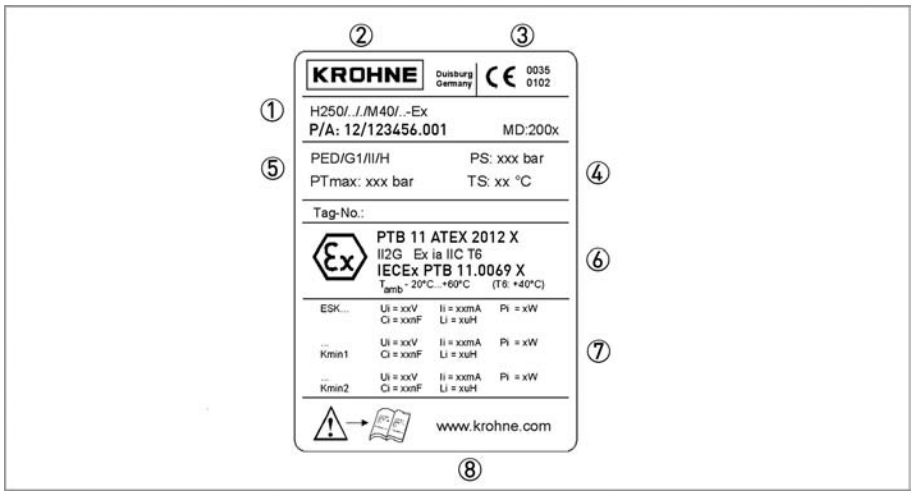


Figure 2-2: Nameplate on the indicator

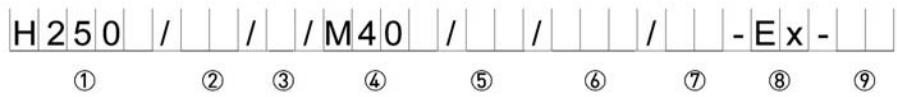
① Device type
② Manufacturer
③ Notified ATEX & PED body
④ Sizing data: temperature & pressure rating
⑤ PED data
⑥ Ex data
⑦ Electrical connection data
⑧ Internet site

Additional markings on the indicator

- SN - serial number
- SO - sales order / item
- PA - Production order
- Vx - product configurator code
- AC - article code

2.4 Description code

The description code* consists of the following elements:



① Device type
H250 - standard version
H250H - horizontal flow direction
H250U - flow direction from top to bottom

② Materials / versions
RR - Stainless Steel
C - PTFE or PTFE/ceramics
HC - Hastelloy
Ti - Titanium
F - aseptic version (food)

③ Heating jacket version
B - with heating jacket

④ Series of indicators
M40 - Indicator M40
M40S - Indicator with added corrosion protection
M40R - Indicator in Stainless Steel housing

⑤ High temperature version
HT - Version with HT extension

⑥ Electrical signal output
ESK - Electrical signal output 4...20mA (ESK4)
- optionally available with counter, I/O module and display (ESK4-T) or
- Foundation Fieldbus (ESK4-FF) or
- Profibus PA (ESK4-PA)

⑦ Limit switches
K1 - One limit switch
K2 - Two limit switches

⑧ Explosion protection
EX - Explosion-protected equipment

⑨ SIL Version
SE - SIL compliant electronic signal output
SK - SIL compliant limit switch

* positions which are not needed are omitted (no blank positions)

2.5 Electronics revision

The Electronic Revision (sticker on the base module ESK4) indicates the respective hardware/software status of the electronics. All add-on modules (ESK4-T, ESK4-FF and ESK4-PA) have an additional sticker indicating their respective firmware version.

Electronics revision	Explanations
ER 1.1.x	Basic version (cannot be combined with other indicator versions): ESK4 / Current output 4...20mA with HART® communication; (ESK4 HART DD 01.01. AMS10x AMS11x ESK4 HART DD 01.01. PDM6.0 ESK4 HART DTM 1.0.3 FDT1.2)
ER 2.0.x	Functional add-on to ER 1.1.x: can be combined with indicator version ESK4 FF / Foundation Fieldbus; (Firmware Version FF module from 1.0.2)
ER 2.1.x	Functional add-on to ER 2.0.x can be combined with indicator version ESK4-PA / Profibus PA; (Firmware Version PA module from 1.0.0) can be combined with indicator version ESK4-T / LCD, binary inputs/outputs; (Firmware Version T module from 1.1.0)
ER 2.2.x (in preparation)	Functional add-on to ER 2.1.x (in preparation): Support of failure signal (low) according to NE43 for the ESK 4 current output module

3.1 Notes on installation

INFORMATION!
Inspect the cartons carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Storage

- Store the device in a dry and dust-free location.
- Avoid lasting direct exposure to the sun.
- Store the device in its original packing.
- The permissible storage temperature for standard devices is -40...+80°C / -40...+176°F.

3.3 Installation conditions

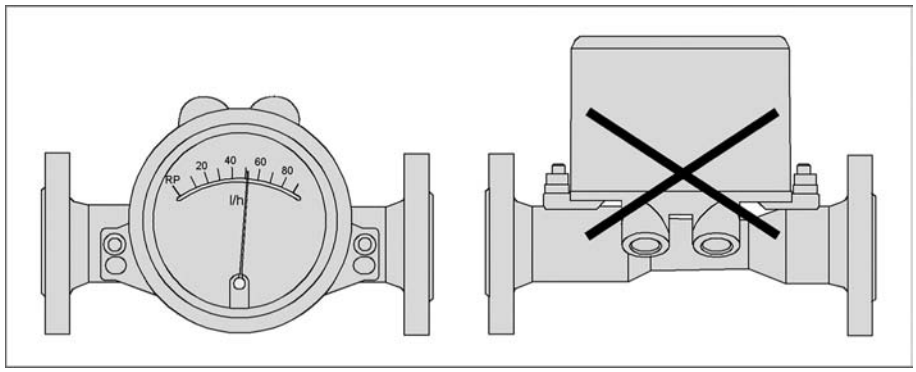
CAUTION!
When installing the device in the piping, the following points must be observed:

- *The variable area flowmeter must be installed vertically (measuring principle). Flow direction from bottom to top. For installation recommendations please refer also to VDI/VDE 3513 Sheet 3.*

  H250Hs are installed horizontally and H250U devices are installed vertically with the flow direction from top to bottom.
- *A straight unimpeded inlet run of ≥ 5x DN upstream of the device and a straight outlet run of ≥ 3x DN downstream of the device are recommended.*
- *Screws, bolts and gaskets are to be provided by the customer and must be selected in accordance with the pressure rating of the connection or the operating pressure.*
- *The inside diameter of the flange deviates from the standard dimensions. Flange seal standard DIN 2690 can be applied without any limitation.*
- *Align the gaskets. Tighten the nuts with the tightening torques of the appropriate pressure rating.*

  For devices with PTFE liner or ceramic liner and PTFE raised faces, see chapter "Tightening torques".
- *Control devices are to be positioned downstream of the measuring device.*
- *Shutoff devices are preferably to be positioned upstream of the measuring device.*
- *Before connecting, blow or flush out the pipes leading to the device.*
- *Pipes for gas flow need to be dried before the device is installed.*
- *Use connectors suitable for the particular device version.*
- *Align the pipes centrically with the connection bores on the measuring device so they are free of stresses.*
- *If necessary, the piping has to be supported to reduce the vibrations transmitted to the measuring device.*
- *Do not lay signal cables directly next to cables for the power supply.*

Take special note of the installation position for the H250H with horizontal flow direction:



In order to comply with thermal parameters and measuring accuracy, H250H flowmeters for horizontal installation are to be installed in the pipeline so that the display is located on the side of the measuring tube. The maximum medium and ambient temperatures indicated as well as the measuring accuracy are based on lateral installation of the display.

3.3.1 Tightening torques

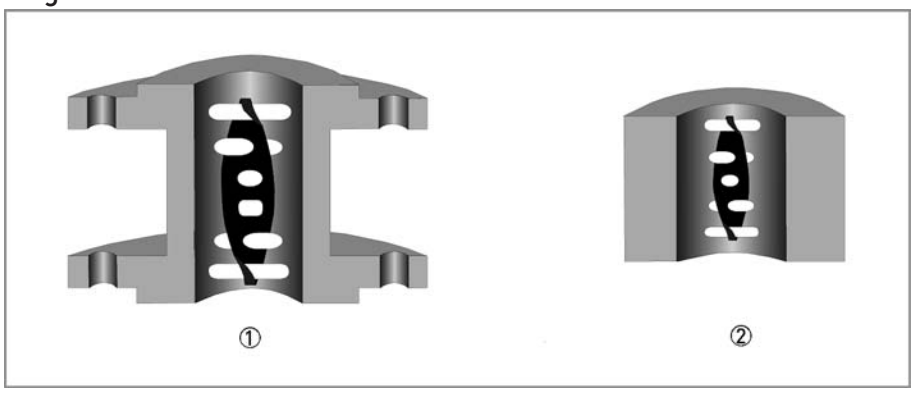
For measuring devices with PTFE liner or ceramic liner and PTFE raised face, tighten the flange threads with the following torques:

Nominal size according to				Stud bolts			Max. torque			
EN 1092-1		ASME B 16.5		EN 1092-1	ASME		EN 1092-1		ASME 150 lb	
DN	PN	inch	lb		150 lb	300 lb	Nm	ft*lbf	Nm	ft*lbf
15	40	½“	150/300	4 x M 12	4 x ½"	4 x ½"	9.8	7.1	5.2	3.8
25	40	1“	150/300	4 x M 12	4 x ½"	4 x 5/8“	21	15	10	7.2
50	40	2“	150/300	4 x M 16	4 x 5/8“	8 x 5/8“	57	41	41	30
80	16	3“	150/300	8 x M 16	4 x 5/8“	8 x ¾"	47	34	70	51
100	16	4“	150/300	8 x M 16	8 x 5/8“	8 x ¾"	67	48	50	36

3.3.2 Magnetic filters

The use of magnetic filters is recommended when the medium contains particles which can be influenced magnetically. The magnetic filter is to be installed in the flow direction upstream of the flowmeter. Bar magnets are positioned helically in the filter to provide optimal efficiency at low pressure loss. All of the magnets are coated individually with PTFE to protect against corrosion. Material: 1.4571

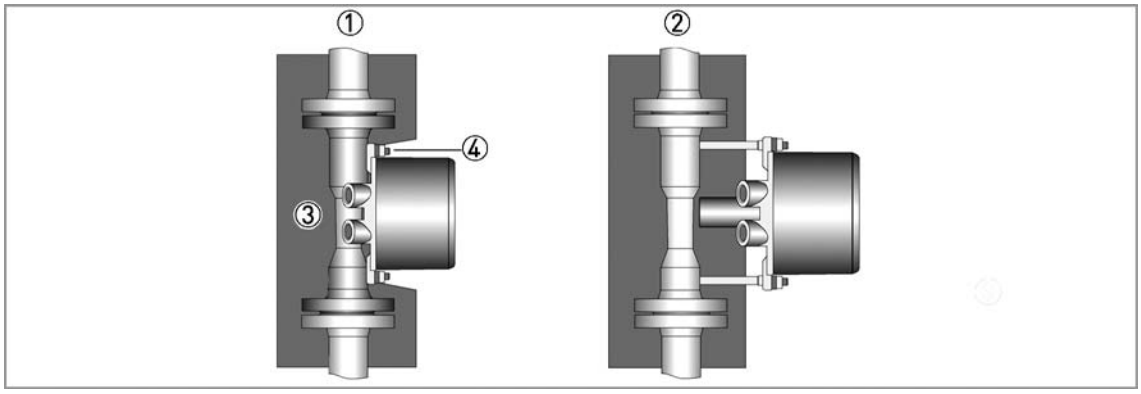
Magnetic filters



① Type F - fitting part with flange - overall length 100 mm
② Type FS - fitting part without flange - overall length 50 mm

3.3.3 Heat insulation

CAUTION!
The indicator housing may not be heat-insulated.
The heat insulation ③ may only reach as far as the housing fastening ④.



① Standard indicator M40
② Indicator with HT extension

CAUTION!
The heat insulation ① may only reach to the rear of the housing ②. The area of the cable entries ③ must be freely accessible.

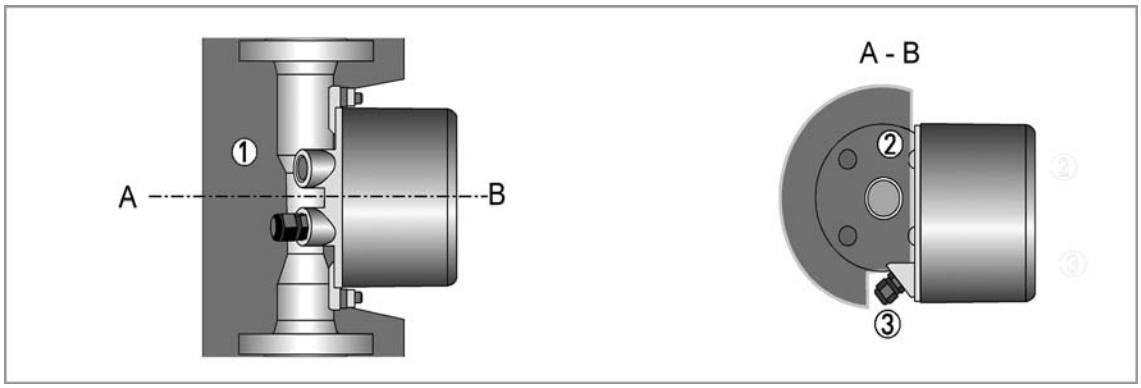


Figure 3-1: Insulation - cross section

4.1 Security information

DANGER!
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

DANGER!
Observe the national regulations for electrical installations!

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

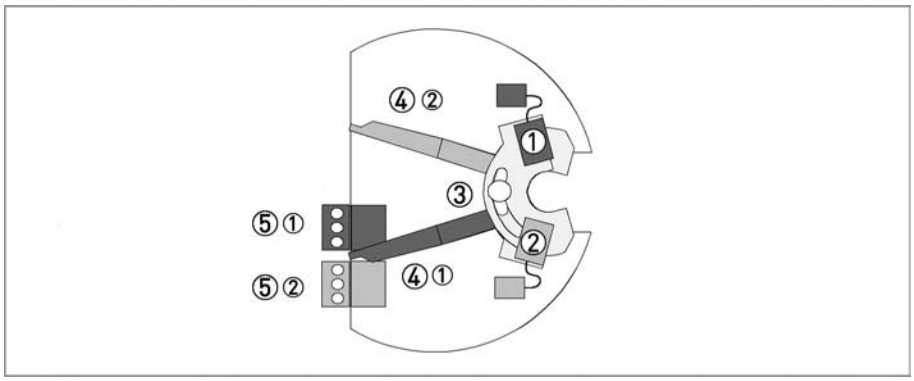
INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Electrical connection indicator M40

4.2.1 Indicator M40 - limit switches

The M40 indicator can be fitted with a maximum of two limit switches. The limit switch works as a slot sensor which is inductively activated via the semi-circular metal vane of the pointer. The switching points are set using the contact pointer. The position of the contact pointer is displayed on the scale.

Limit switch module



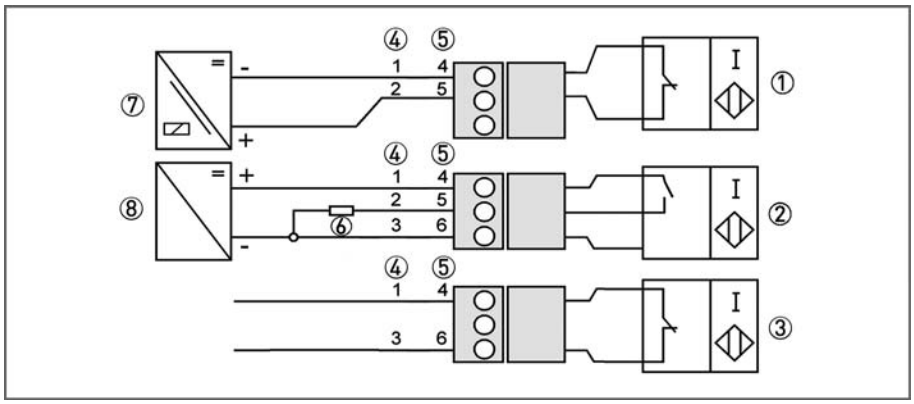
① Min. contact
② Max. contact
③ Locking screw
④ Maximum pointer
⑤ Connection terminal

The connecting terminals have a pluggable design and can be removed in order to connect the cables. The built-in limit switch types are shown on the indicator.

Electrical connection of the limit switches

Contact	MIN			MAX		
Terminal no.	1	2	3	4	5	6
Connection 2-wire NAMUR	-	+		-	+	
Connection 3-wire	+		-	+		-
Connection Reed SPST	+		-	+		-

Limit switch connection terminals



① 2-wire limit switch NAMUR
② 3-wire limit switch
③ Limit switch Reed SPST
④ Terminal connection min contact
⑤ Terminal connection max contact
⑥ 3-wire load
⑦ NAMUR isolated switching amplifier
⑧ 3-wire power supply

Limit setting

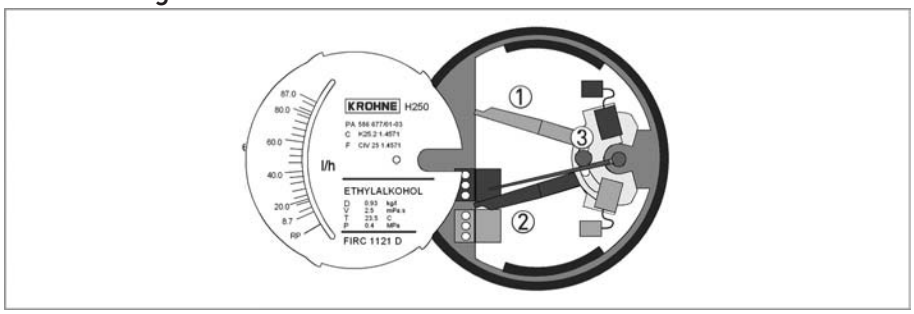


Figure 4-1: Limit switch settings

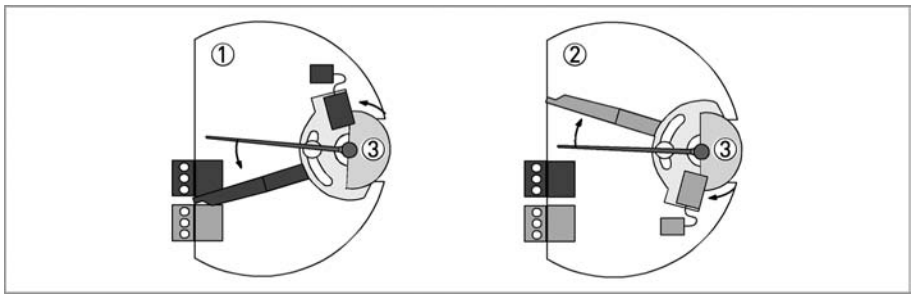
① Contact pointer MAX
② Contact pointer MIN
③ Locking screw

Setting is carried out directly via contact pointers ① and ②:

- Slide the scale away
- Loosen the locking screw ③ slightly
- Slide the scale back to the latching point
- Set contact pointers ① and ② to the desired switching point

After setting has been carried out: Fix the contact pointers with the locking screw ③.

Switch contact definition

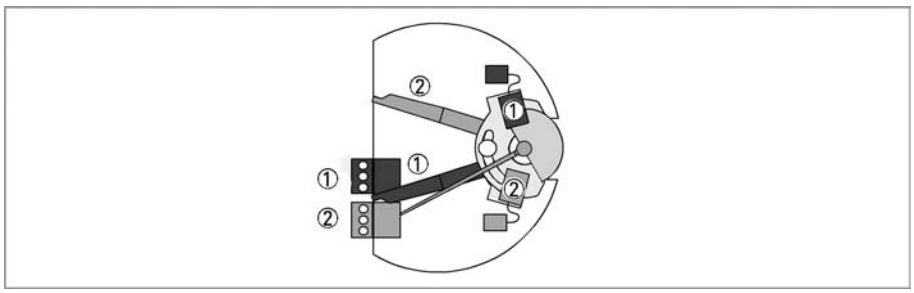


① MIN contact
② MAX contact
③ Pointer vane with switching vane

If the measuring pointer vane goes into the slot an alarm is triggered. If the pointer vane is outside the slot sensor, a wire break in a NAMUR contact also triggers the alarm.

The 3-wire limit switch does not have any wire break detection.

Definition MinMin - MaxMax



① MIN 2 contact or MAX 1 contact
② MIN 1 contact or MAX 2 contact

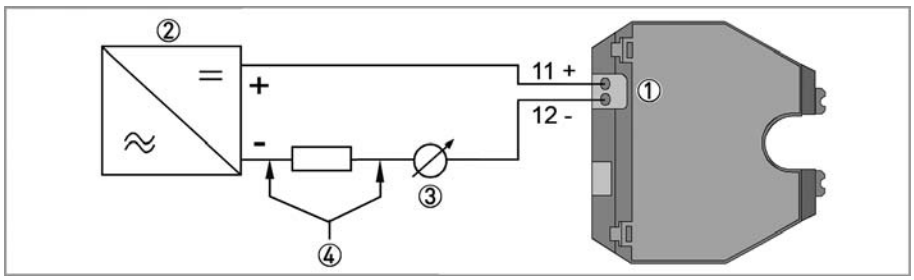
Current consumption in the position shown:

Contact	Type	current
MIN 1	NAMUR	≤ 1 mA
MIN 2	NAMUR	≤ 1 mA
MAX 1	NAMUR	≥ 3 mA
MAX 2	NAMUR	≥ 3 mA

4.2.2 Current output ESK4

The connecting terminals of the ESK4 have a pluggable design and can be removed in order to connect the cables.

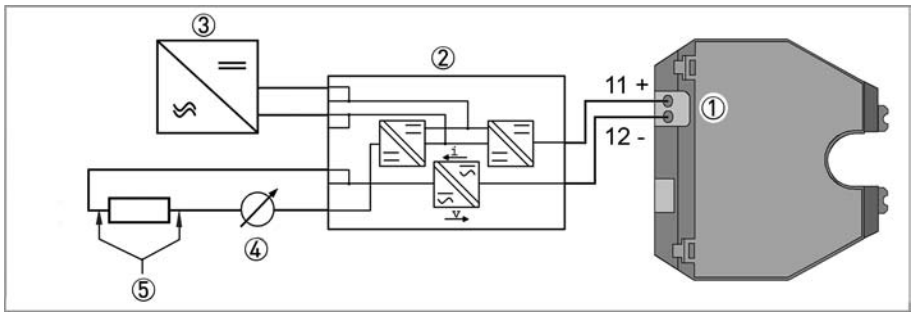
ESK4 connection



① ESK4A current output
② Power supply 14...30 VDC
③ Measuring signal 4...20 mA
④ External load, HART® communication

Power supply M40 with electrical isolation

Wiring must be planned with great care when it comes to connecting other devices such as evaluation units or process control. Internal connections in these devices (e.g. GND with PE, mass loops) may lead to non-permitted voltage potentials which could impair the function of the converter itself or that of a device connected to it. In such cases a protected extra-low voltage (PELV) is recommended.



① Terminal connection
② Converter supply isolator with electrical isolation
③ Power supply (see supply isolator information)
④ Measuring signal 4...20 mA
⑤ External load, HART® communication

Power supply

INFORMATION!
The feed voltage must be between 14 VDC and 30 VDC. This is based on the total resistance of the measuring loop. To determine this, add up the resistances of each component in the measuring loop (not including the level meter).

The required supply voltage can be calculated using the formula below:

$U_{ext.} = R_L \cdot 24\ mA + 14\ V$

where
$U_{ext.}$ = the minimum supply voltage and
R_L = the total measuring loop resistance.

INFORMATION!
The power supply has to be able to supply a minimum of 30 mA.

HART® communication

When HART® communication is carried out with the ESK4, the analogue measured data transmission (4...20 mA) is not impaired in any way.

Exception for multidrop operation. In multidrop mode, a maximum of 15 devices with HART® function can be operated in parallel, whereby their current outputs are switched inactive (I approx. 4.5 mA per device).

Load for HART® communication

INFORMATION!

A load of at least 230 Ohm is required for HART® communication.

The maximum load resistance is calculated as follows:

$$R_L = \frac{U_{ext.} - 14V}{24\,mA}$$

DANGER!

Use a twisted two-core cable to prevent electrical interference from impeding the DC output signal.

In some cases a shielded cable may be necessary. The cable shield may only be earthed (grounded) at one place (on the power supply unit).

Configuration

The ESK can be configured via HART® communication. DD (Device Descriptions) for AMS 10x, AMS 11x and PDM 6.0 as well as a DTM (Device Type Manager) for PACTware™ 3.0.2.28(3.0 SP5), 3.6.0.3(3.6 SP2) and 4.0.0.6 are available for configuration. They can be downloaded free of charge from our website.

The current flow rate can be transmitted using the integrated HART® communication. A flow counter can be configured. Two limit values can be monitored. The limit values are assigned either to flow values or to the counter overflow.

Self monitoring - Diagnostics

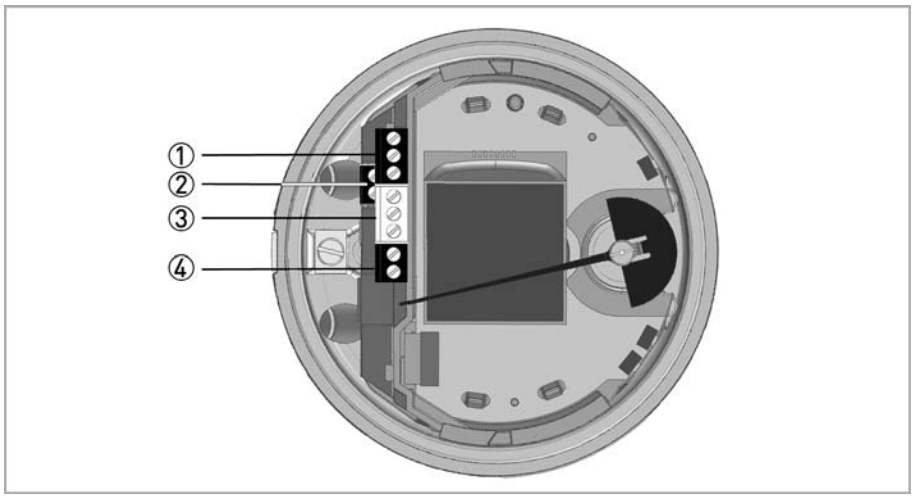
During both start-up and operation, a wide variety of diagnostic functions are performed cyclically in the ESK4, in order to guarantee function reliability. When an error is detected, a failure signal (high) is activated (current > 21 mA, typically 22 mA) via the analog output. More detailed information can also be obtained via HART®(CMD#48). The failure signal is not activated in the event of information and warnings.

Diagnostic functions (Monitoring):

- Plausibility of FRAM data
- Plausibility of ROM data
- Working range of internal reference voltages
- Signal detection of the measuring range of the internal sensors
- Temperature compensation of the internal sensors
- Calibration based on the application
- Plausibility of counting value
- Plausibility of physical unit, system and selected unit

4.2.3 Binary inputs/outputs ESK4-T

Once the housing cover has been unscrewed, the scale can be removed. The connection terminals feature a pluggable design and can be removed to connect the cables.



① Binary output 1
② Power supply / durrent output ESK4
③ Binary output 2
④ Binary input

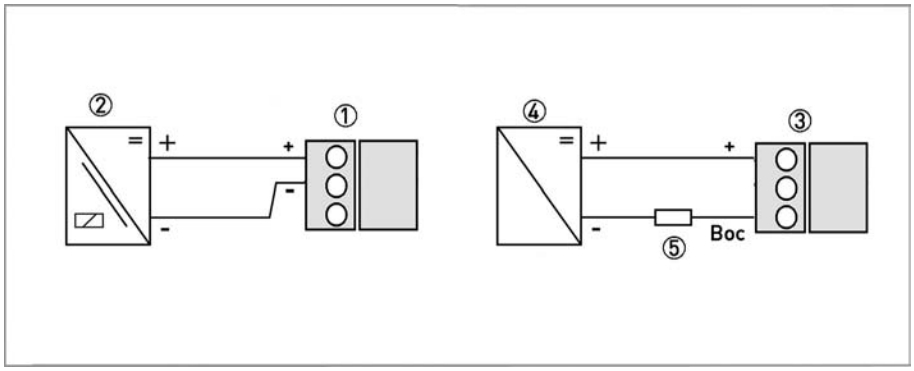
The binary inputs/outputs are electrically isolated from each other and from the ESK4 current output.

INFORMATION!
The binary inputs/outputs can only be operated if the power supply is applied to ESK4 terminals Klemme 11+ and 12-. The binary inputs/outputs come inactive by default and must thus be activated prior to first use (see Section 6.6 Menu ESK4-T)

Connection binary outputs
In accordance with the desired signal transmission, select one of the following connection types for binary outputs B1 and B2:

- NAMUR (DC interface in accordance with EN 60947-5-6)
- Transistor output (passive, open collector)

Binary output	B1			B2		
Terminal no.	1	2	3	4	5	6
Connection NAMUR	+	-		+	-	
Connection transistor output	+		B_{OC}	+		B_{OC}



① NAMUR terminal connection
② Isolated switching amplifier
③ Terminal connection transistor output
④ Power supply $U_{ext.}$
⑤ Load R_L

Value range NAMUR

	Normally closed	Normally open
Switching value reached	≤1 mA	> 3mA
Switching value not reached	> 3mA	≤1 mA

Range of values applies only when connected to a switching amplifier with the following reference values:

- Open-circuit voltage Uo = 8,2 V DC
- Internal resistance Ri = 1kOhm

Range of values transistor output

Signal voltages	U_L [V]		U_H [V]	
	lower Limit	upper Limit	lower Limit	upper Limit
over load R_L	0	2	16	30

Signal currents	I_L [mA]		I_H [mA]	
	lower Limit	upper Limit	lower Limit	upper Limit
Category 2	0	2	20	110

To safeguard the range of values, a load RL between 250 Ohm and 1kOhm is recommended for the passive transistor output with a nominal voltage of 24V DC.

If other loads are used, caution is advised as the range of values of the signal voltages then no longer corresponds to the range of values for the inputs of process control systems and controls (DIN IEC 946).

CAUTION!
The upper limit of the signal current may not be exceeded as this may damage the transistor output.

Pulse output mode

INFORMATION!
The binary outputs can also be operated as pulse outputs.

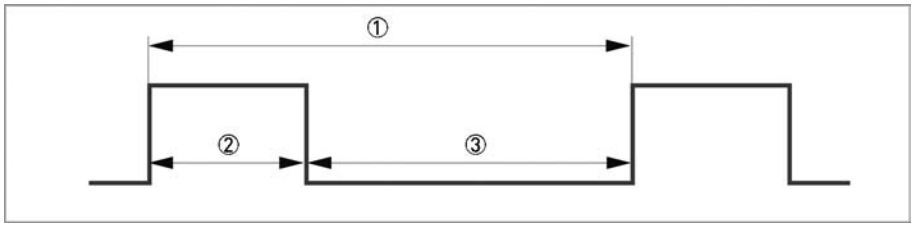


Figure 4-2: Data pulse output

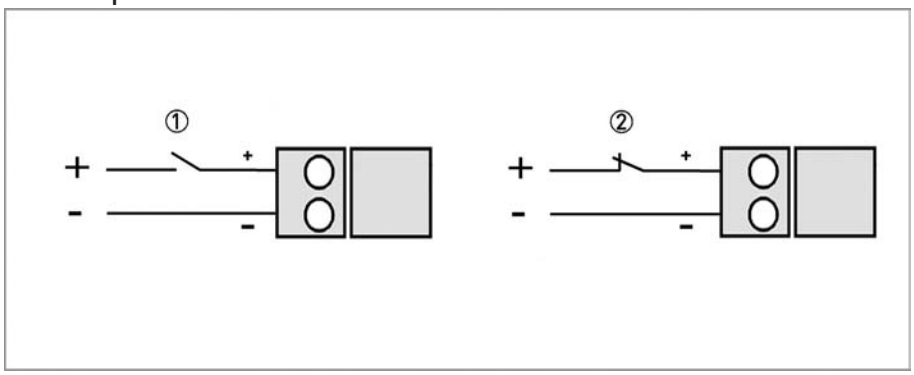
① f_{max} = 10 Hz
② t_{on}
③ t_{off}

The pulse width t_{on} can be configured from 50...500 ms in the indicator menu.

Connection binary input

The binary input can be used to control the internal flow counter (start/stop/reset).

Reset input



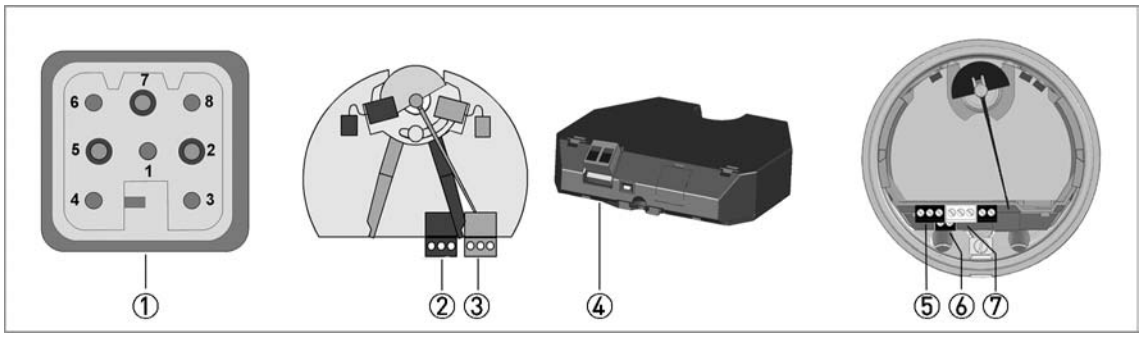
① Function active HI
② Function active LO

As standard, the binary input is inactive and can be activated in menu point 3.6.

Range of values

Input voltage	U_L [V]		U_H [V]	
	lower Limit	upper Limit	lower Limit	upper Limit
Terminal (7) (8)	0	2	16	30

4.2.4 Connection Harting HAN® 7D



① Terminal pin assignment HAN® 7D - View of plug connection

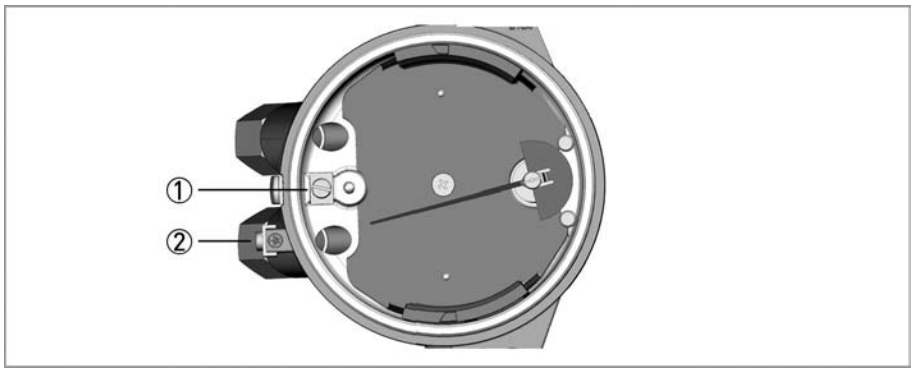
① Pin No. HAN® 7D	K1/K2: NAMUR contacts	R1/R2 Reed contacts	ESK4	Terminal no.	
				NAMUR	Reed
1	② NAMUR MIN (-)	② Reed MIN	-	1	1
2	② NAMUR MIN (+)	② Reed MIN	-	2	3
3	③ NAMUR MAX (-)	③ Reed MAX	-	4	4
4	③ NAMUR MAX (+)	③ Reed MAX	-	5	6
5	-	-	④ 4...20mA (+)	11	
6	-	-	④ 4...20mA (-)	12	
7	-	-	-		
8	-	-	-		

Combinations of K1 / K2 and ESK4 are possible.

① Pin No. HAN® 7D	ESK4-T	Terminal no.
1	⑤ Binary output B1 open coll. (+)	1
2	⑤ Binary output B1 open coll. (-)	3
3	⑦ Binary output B2 open coll. (+)	4
4	⑦ Binary output B2 open coll. (-)	6
5	⑥ 4...20mA (+)	11
6	⑥ 4...20mA (-)	12
7	-	
8	-	

INFORMATION!
No Harting connection for module ESK4-FF/PA is provided.

4.3 Grounding connections



① Grounding connection in the indicator
② External grounding connection

DANGER!
The grounding wire may not transfer any interference voltage. Do not use this grounding cable to ground any other electrical devices.

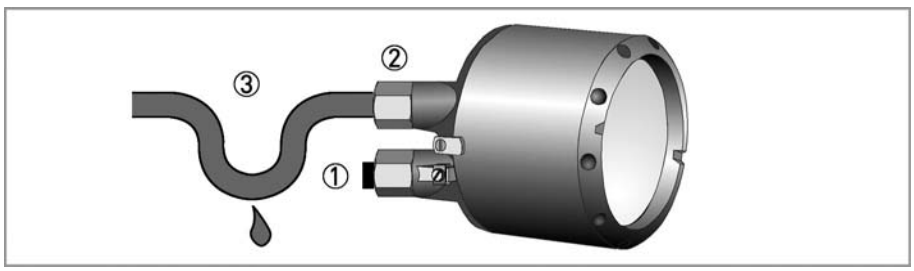
4.4 Protection category

The measuring device meets all requirements of protection category IP66/68.

DANGER!
After all servicing and maintenance work on the measuring device, the specified protection class must be ensured again.

Therefore it is essential to observe the following points:

- Use only original gaskets. They must be clean and free of any damage. Defective gaskets must be replaced.
- The electrical cables used must be undamaged and must comply with regulations.
- The cables must be laid with a loop ③ upstream of the measuring device to prevent water from getting into the housing.
- The cable feedthroughs ② must be tightened.
- Close the unused cable feedthroughs using blanking plugs ①.



① Use blanking plugs if no cable is routed through
② Tighten cable feedthrough firmly
③ Lay the cable in a loop

5.1 Standard device

CAUTION!
When starting up the device, the following points must be observed:

- *Compare the actual operating pressure and the product temperature of the system with the specifications on the nameplate (PS and TS). These specifications may not be exceeded.*
- *Make sure materials are compatible.*
- *Slowly open the shut-off valve.*
- *When measuring liquids, vent the pipes carefully.*
- *When measuring gases, increase pressure slowly.*
- *Avoid float impact (e.g. caused by solenoid valves), as this is likely to damage the measuring unit or float.*

A minimum operating pressure (primary pressure) is necessary to operate the device:

Medium	Pressure loss : operating pressure
Liquids	1 : 2
Gases without float damping	1 : 5
Gases with float damping	1 : 2

5.2 Indicator ESK4-T

INFORMATION!
The device is always preset for the user and his application.

Start

After the device is switched on, the display shows

- "INITIALISING"
- Firmwareversion IO-Modul

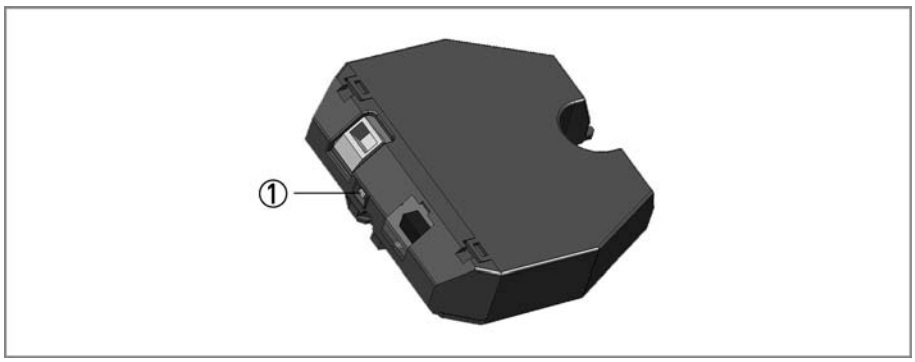
The device first performs a self-test. Here, all of the parameters preset for the customer are analysed and checked for plausibility. The device then switches to measuring mode and indicates the current measured value.

Operation

INFORMATION!
The device is low-maintenance
Comply with the application limits with regard to temperature of the medium and ambient temperature.

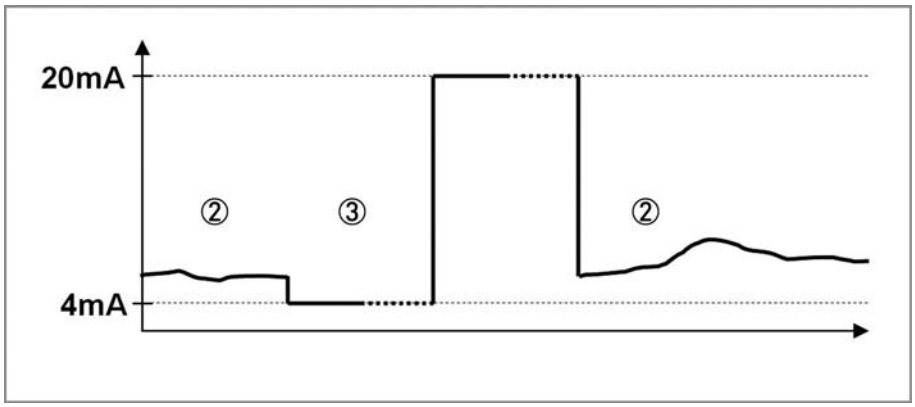
6.1 ESK4- Loop Check Modus

The ESK4 is equipped with a loop check function, enabling a simple test of the entire 4...20mA current loop.



It is activated and operated using a microswitch ①.

CAUTION!
When activating the loop check mode, ensure that no alarms are unintentionally triggered in the downstream system components.



- Press and hold the microswitch ① for more than 6 seconds to activate loop check mode ③. The current output jumps to constant 4mA.
- Change the current output from constant 4 to constant 20mA as often as you like by briefly pressing it (less than 6 seconds) to check the function of the measuring circuit.
- Exit loop check mode by holding down the microswitch (longer than 6 seconds). The current output jumps back to measuring mode ②.

INFORMATION!
If the microswitch has not been pressed for longer than 60 seconds, the ESK4 automatically reverts to measuring mode ②.

6.2 Operating elements ESK4-T

The device is operated with the cover on the front open, using the mechanical **keys**, or with the cover closed using a **bar magnet**.

CAUTION!
The switching point of the magnetic sensors is directly at the height of the corresponding circle (see figure). Only touch the circle vertically and from the front using the bar magnet. Touching it from the side may cause a malfunction.

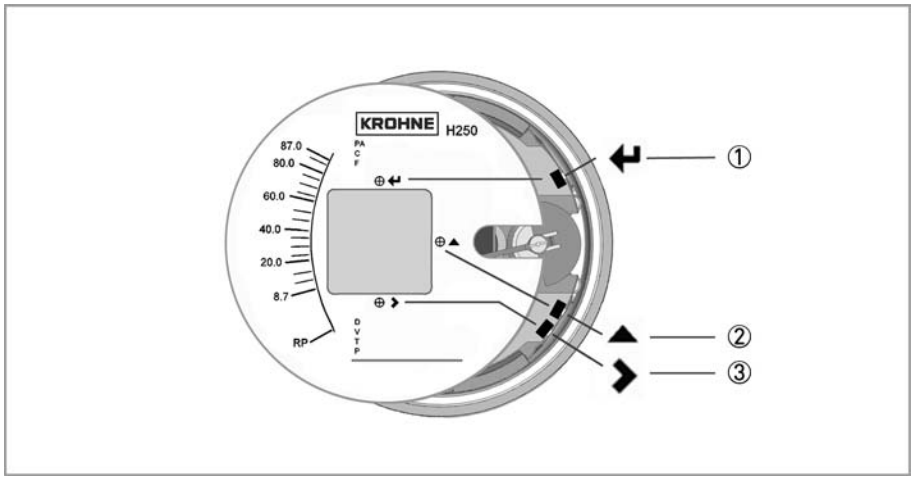


Figure 6-1: Display and operating elements

① Enter button (circuit for bar magnet)
② Up button (circuit for bar magnet)
③ Right button (circuit for bar magnet)

The mechanical keys and keys for the bar magnet have the same functionality. In this documentation the keys are represented as symbols to describe the operating functions:

	Button	Symbol
①	Enter	↵
②	up	↑
③	right	→

Table 6-1: ESK4-T operation keys

6.3 Basic principles of operation ESK4-T

6.3.1 Functional description of the buttons

→	Switch from measuring mode to menu mode
	Switch to one menu level lower
	Open menu item and activate change mode
	Confirm query whether data should be accepted.
	In change mode: Move the input cursor one position to the right. After the last digit the input cursor jumps back to the beginning.
↑	Change between the menu items within a menu level
	In measuring mode: Switch between measured values and error messages
	In change mode: Changing parameters or settings. Run through the available characters (including decimal point.
↵	**In measuring mode:** Switch between measured value display and error messages / warnings
	Switch to one menu level higher
	Return to measuring mode with a query whether the data should be accepted
	Cancel the query, whether data should be accepted.

Table 6-2: Description of the operating keys

6.3.2 Navigation within the menu structure

Navigate through the menu using the →, ↑ and ↵ keys. Pressing the → key takes you one menu lower. Use the ↑ key to go one menu point higher (e.g. from 1 to 2). Pressing the ↵ key takes you one menu higher.

If you are already at the lowest level (function level), you can use the button to go to the change mode, which can be used to set data and values.

If you are located at the first level (main menu), you can use the ↵ key to exit the menu mode and return to the measuring mode.

If settings were changed, the query whether they should be saved will appear. Confirm this query with the → key or cancel it with the ↵ key.

measuring mode	→ ↵	Main menu ↑	→ ↵	Submenu ↑	→ ↵	Function ↑	→ ↵	Edit → ↑ ↵

Table 6-3: Navigation menu structure

6.3.3 Changing the settings in the menu

Starting operation

Operation is started using the → key

If a control lockout is set, the set code → → → ↵ ↵ ↵ ↑ ↑ ↑ must be entered. The code can be set in Menu 3.13. The code shown here is set at the factory but not activated. If no key is pressed within 5 seconds or if an incorrect code is entered, a warning message is displayed and the display returns to measuring mode.

Exiting operator input

Operation is exited by pressing the ↵ key several times.

If data have been changed:

Save Yes	→	Changes saved. An update occurs and the indicator jumps back to measuring mode.
Save No	↵	Changes are discarded and the indicator jumps back to measuring operation.

CAUTION!
Each time parameters or settings are changed, the measuring device carries out an internal plausibility check.
If inplausible entries were made, a warning message is shown. If this warning is confirmed with the ↵ key, the display returns to the respective menu point without saving the relevant change. A new entry can now be made.

Example: Changing the flow unit from m^3/h to l/h

	Screen			Screen
Example:	7.2 m^3/h		1x →	Fct. 3.11.**1** FLOW RATE
1x →	Fct. **1** OPERATION		1x →	10.0000 m^3/h
2x ↑	Fct. **3** INSTALLATION		4x ↑	10000 l/hr
1x →	Fct 3.**1** LANGUAGE			Confirm with → deny ↵
10x ↑	Fct 3.**11** FS&UNIT		3x ↵	7200 l/hr

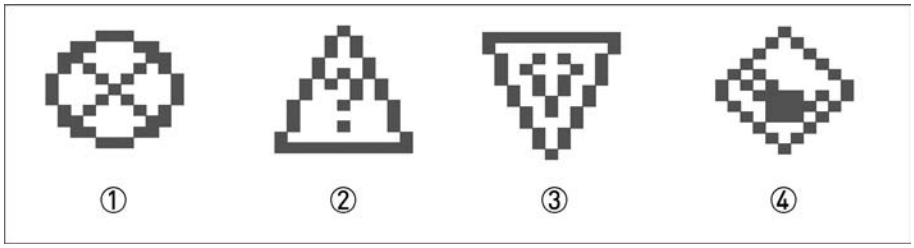
6.4 Overview of the units ESK4-T

Measured variables	Units			
volume	m^3/s	m^3/min	m^3/h	m^3/d
	L/s	L/min	L/h	-
	ft^3/s	ft^3/min	ft^3/h	ft^3/d
	gal/s	gal/min	gal/h	gal/d
	bbl/s	bbl/min	bbl/h	bbl/d
	ImpGal/s	ImpGal/min	ImpGal/h	ImpGal/d
mass	g/s	g/min	g/h	-
	kg/s	kg/min	kg/h	kg/d
	-	t/min	t/h	t/d
	lb/s	lb/min	lb/h	lb/d
	-	STon/min	STon/h	STon/d
	-	-	LTon/h	LTon/d
Volume Totalizer	m^3	l	hl	ft^3
	ImpGal	gallon	bbl	bbl (liq)
mass totalizer	kg	g	t	lb
	STon	LTon		
Temperature	°C	°F	K	

6.5 Error messages ESK4-T

Error messages and warnings are indicated by one of the following symbols in the bottom left corner of the display. The ↵ key switches from the measured value display to the display of current errors / warnings. The table below contains a description of possible error messages.

Symbols



① Error
② Warning - out of specification
③ Function check
④ Maintenance necessary.

Error Message	Description	Category	Remedy
NOT LINEARIZED	Linearization faulty or not activated = measuring error	Maintenance	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.
NEW LINEARI. TABLE BAD	Faulty or missing data in the linearization table = measuring error	Warning	
LINEARIZATIO UNDER CONFIG	The device is in linearization mode = measuring error	Warning	Complete the linearization and activate it (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.
UNIT SYSTEM CONFLICT	The unit for the linearization flow is incompatible with the selected flow type (mass/volume)	Warning	Correct error, carry out linearization again if necessary (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.
TOO FEW ENTRIES	The linearization table has too few data points	Warning	Carry out linearization at at least 5 points (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.
NOT MONOTONOUS	The sequence of the linearization values is not strictly monotonic increasing	Warning	Check linearization and/or carry it out again (HART® communication and linearization software are required), or send the device back to the manufacturer for linearization.
FIRST NOT 0 %	The first flow value if the linearization table is not 0%		
LAST NOT 100 %	The last flow value if the linearization table is not 100%		
NO ZERO CAL OF AO	The current output zero point 4.00mA is not calibrated. = possible measuring error in process control.	Maintenance	Perform calibration using ammeter and menu 3.10 or using standard HART® tools/process control system and poss. external ammeter. Caution: during calibration, switch the measuring point to manual control.
NO F.SC. CAL OF AO	The current output 100% = 20.00mA is not calibrated. = possible measuring error in process control.	Maintenance	Perform calibration using ammeter and menu item 3.11 or using standard HART® tools and external ammeter if necessary. Caution: during calibration, switch the measuring point to manual control.
NO TEMP. COMPENSATION	The sensor temperature compensation of the device is faulty or was not carried out. = possible measuring error	Maintenance	The device, together with an indication of the error, must be sent back to the manufacturer for checking.
OUTPUT NOT LINEARIZED	Linearization is not activated = measuring error	Maintenance	Activate linearization or carry it out again (HART® communication and linearization software are required; the original calibration values must be known), or send the device back to the manufacturer for linearization.
COUNTER LOST	Totalizer value was reset by error/overflow	Warning	Because the reset time is not known: Controlled reset of the counter using menu item 1.6.1 or using HART® tools/process control system.

Error Message	Description	Category	Remedy
FRAM WRITE FAULT	Internal communication error	Error	Check whether the display is plugged in correctly and restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
ROM/FLASH ERROR	Memory error detected during self-test.	Error	Restart device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
RESTART OF DEVICE	A device restart has taken place	information	The device has been restarted using menu item 1.6.2 since the last time the error messages were reset.
MULTIDROP MODE	The HART® multidrop mode is activated. The current output is set to a fixed value of 4.5 mA.	information	The HART® multidrop mode is activated with selection of a polling address not equal to 0 using menu item 3.7. . The polling address 0 reactivates the analog output.
CRYSTAL OSC FAULT	Internal error in device	Error	The device must be sent back to the manufacturer with an indication of the error.
REF VOLTAGE FAULT	Internal error in device		
SENSOR A FAULT	Internal error in device		
SENSOR B FAULT	Internal error in device		
MEMORY CORRUPTION	Internal memory error, caused by a hardware or software problem	Error	Restart the device; if the error occurs again the device must be sent back to the manufacturer with an indication of the error.
AO FIXED	The current output is set to a fixed value.	information	The current output is fixed and does not reflect the measured value. This is the case in multidrop mode, with current output test/calibration using the menu or HART®.
AO SATURATED	Current output saturated	information	The current output is saturated at 20.4 or 22.0 mA (depending on whether the alarm current is activated or deactivated in menu item 3.10), and is no longer coupled with the measured value.
ERROR TIMEOUT	Data not transferred, or transferred incorrectly from the ESK to the counter module	Error	Confirm menu point 1.6.3 WRITE INFO I/O.
WARNING TIMEOUT		Warning	

6.6 Menu indicator ESK4-T

6.6.1 factory settings

Menu	Function	Adjustment
1.1.1	OUTPUT B1	INACTIVE
1.2.1	OUTPUT B2	INACTIVE
1.3.1	Pulse width	100 ms100ms
1.3.2	Pulses / unit	1,000000 Pulses / L
1.4.1	Screen	FLOW RATE
1.4.2	DISPLAY	ROTATION 0°
1.5	TIME CONST.	001.0 s
1.6.1	RESET COUNT.	NO
1.6.2	RESET ERROR	NO
1.6.3	WRITE INFO I/O	NO
3.1	LANGUAGE	ENGLISH
3.2	FUNCTION B1	INACTIVE
3.3	CONTACT B1	NO CONTACT
3.4	FUNCTION B2	INACTIVE
3.5	CONTACT B2	NO CONTACT
3.6	FUNCTION B3	INACTIVE
3.7	MULTIDROP	POLLING ADD: 00
3.8	4mA CALIBR.	4.000 mA
3.9	20mA CALIBR.	20.000 mA
3.10	ALARM CURRENT	ALARM HIGH
3.11.1	FS&UNIT	l/hr
3.11.2	COUNTER	l
3.12	Low flow cutoff treshold	4% ON 6% OFF
3.13	ENTRY CODE	OFF
3.14	BASIC SETTING	NO

INFORMATION!
The measuring device has been preset at the factory in accordance with the customer order. Therefore subsequent configuration via the menu is only necessary if the intended use of the device is changed.

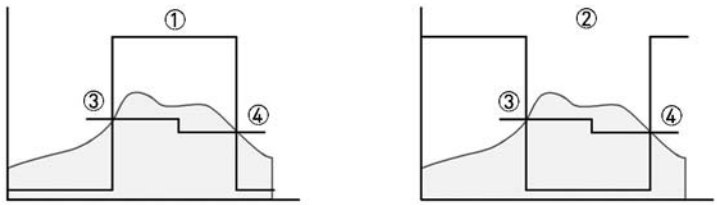
6.6.2 Menu structure

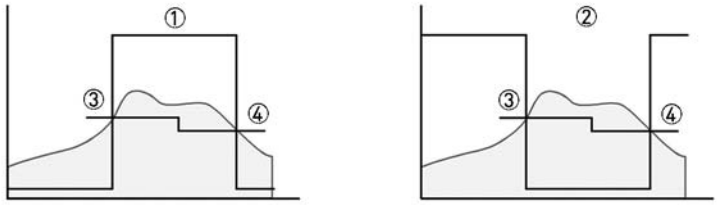
Main menu	Submenu 1	Submenu 2	
1 OPERATION	1.1 OUTPUT B1	1.1.1 INACTIVE, FLW VAL B1. CNT VAL B1, PULSE WDTH	
		1.1.2 HYST. B1, PULSE/UNIT	
	1.2 OUTPUT B2	1.2.1 INACTIVE, FLW VAL B2. CNT VAL B2, PULSE WDTH	
		1.2.2 HYST. B2, PULSE/UNIT	
	1.3 PULSEOUTP.	1.3.1 PULSEWDTH	
		1.3.2 PULSE/UNIT	
	1.4 DISPLAY	1.4.1 FLOW, COUNTER; FLOW&CNT; FLOW&CNT 1, PERCENT	
		1.4.2 ROTATION	
	1.5 TIME CONST.	-	
	1.6 RESET	1.6.1 COUNTER	
		1.6.2 ERROR	
		1.6.3 WRITE INFO IO	
2 TEST & INFO	2.1 4-20mA OUTPUT	2.1.1	NORMAL OP
		2.1.2	4.0 mA
		2.1.3	5.6 mA
		2.1.4	7.2 mA
		2.1.5	8.8 mA
		2.1.6	10.4 mA
		2.1.7	12.0 mA
		2.1.8	13.6 mA
		2.1.9	15.2 mA
		2.1.10	16.8 mA
		2.1.11	18.4 mA
		2.1.12	20.0 mA
		2.1.13	21.6 mA
	2.2 OUTPUT B1	2.2.1 NORMAL OP	
		2.2.2 OPEN	
		2.2.3 CLOSED	
	2.3 OUTPUT B2	2.3.1 NORMAL OP	
		2.3.2 OPEN	
		2.3.3 CLOSED	
	2.4 INPUT B3	ACTIV HI INPUT; ACTIV LO, ON, OFF	
	2.5 DEVICE ID	2.5.1 ELEC. REV.	
		2.5.2 SN ESK4	
		2.5.3 PA ORDER	
		2.5.4 DEVICE SN.	
	2.6 SOFT.VERSION	2.6.1 FW. ESK4	
		2.6.2 FW. ESK4 I/O	
	2.7 TAG No.		

Main menu	Submenu 1	Submenu 2
3 INSTALLATION	3.1 LANGUAGE	3.1.1 English
		3.1.2 Deutsch
		3.1.3 Francais
		3.1.4 Italiano
		3.1.5 Espanol
		3.1.6 Cesky
		3.1.7 Polski
		3.1.8 Nederlands
		3.1.9 Dansk
	3.2 FUNCTION B1	INACTIV, SWITCHPOINT, CONTERLIM., PULSEOUTP.
	3.3 CONTACT B1	NO contact, NC contact,
	3.4 FUNCTION B2	INACTIV, SWITCHPOINT, CONTERLIM., PULSEOUTP.
	3.5 CONTACT B2	NO contact, NC contact,
	3.6 FUNCTION B3	INACTIV, ACTIV HI, ACTIV LO, STARTH STOPL, STARTL STOPH
	3.7 MULTIDROP	POLLING ADR.
	3.8 4mA CALIBR.	4.000 mA
	3.9 20mA CALIBR.	20.000 mA
	3.10 ALARM CURR.	OFF, ALARM HIGH, ALARM LOW
	3.11 FS&UNIT	3.11.1 FLOW
		3.11.2 COUNTER
	3.12 LFC	3.12.1 CONTROL ON, OFF
		3.12.2 LFC ON VAL
		3.12.3 LFC OFF VAL
	3.13 ENTRY CODE	OFF, ON
	3.14 BASIC SETTING	SET ALL NO, SET ALL YES

6.6.3 Menu explanations

1 Operation

Label	Level	Select / Input	Explanation
OUTPUT B1	1.1		Output B1 is a binary switching output. Under Fct. 3.2, one of the following functions can be attributed to this output INACTIVE, SWITCHPOINT, COUNTERLIM. or PULSEOUTP.
		One of the following functions can be selected as contact type under Fct. 3.3: NO contact ① / NC contact ②  	
	1.1.1	INACTIVE	
		FLOW.VAL B1	Flow value switching point Value range: 0.0 ... measuring range end value The switching point is entered in flow units. If the current flow value exceeds this predetermined switching point, output B1 changes its binary state ③. Under Fct. 1.1.2 a hysteresis can also be specified.
		COUNTER.VAL B1	Switching point totaliser value Value range 0.0 ... counter limit The switching point is entered in volume or mass units. If the the current counter value exceeds this predetermined switching point, output B1 changes its binary state ③. There is no hysteresis setting for the counter value switching point.
		Pulse width	Pulse value (pulse/unit) The value is now displayed here. Configuration takes place under Fct. 1.3.1 (pulse width) and Fct. 1.3.2 pulse/unit).
	1.1.2	HYST.B1	Hysteresis for the flow value switching point Value range 0.0 ... switching point If the current flow value exceeds the predetermined switching point from Fct. 1.1.1, output B1 changes its binary state ③. In order for output B1 to change its binary state back to the initial setting, the switching point made smaller by the hysteresis must be undershot ④. **Example:** Under 1.1.1, a switching point of 200 L/h is set. The possible value range for the hysteresis is then 0.0 ... 200 L/h. With a hysteresis value of 0, the switching point has no hysteresis (③=④). If a hysteresis value of 20 L/h is entered, output B1 changes its binary state to the initial setting if 180 L/h is undershot ④.

Label	Level	Select / Input	Explanation
OUTPUT B2	1.2		Output B2 is a binary switching output. Under Fct. 3.4, one of the following functions can be attributed to this output INACTIVE, SWITCHPOINT, COUNTERLIM. or PULSEOUTP.
		One of the following functions can be selected as contact type under Fct. 3.5: NO contact ① / NC contact ② 	
	1.2.1	INACTIVE	
		FLOW.VAL B2	see FL.R. VALUE B1 Under Fct. 1.2.2 a hysteresis can also be specified.
		COUNTER.VAL B2	See COUNTER.VAL B1
		PULSE WDTH B2	see PULSE WDTH Fct. 1.1.1 Configuration takes place under Fct. 1.3.1 (pulse width) and Fct. 1.3.2 (pulse/unit).
	1.2.2	HYST.B2	See HYST. B1
PULSEOUTP.	1.3		
	1.3.1	Pulse width	
		50ms	T_i = 50 ms; f_{max} = 10 Hz max. pulse / h = 36000
		4ms	T_i = 100 ms; f_{max} = 5 Hz max. pulse / h = 18000
		200ms	T_i = 200 ms; f_{max} = 2,5 Hz max. pulse / h = 9000
		500ms	T_i = 500 ms; f_{max} = 1 Hz max. pulse / h = 3600
	1.3.2	PULSE/UNIT 0.001 ... 1000	Pulses per volume or mass unit, which can be output via one of the binary outputs. The maximum frequency for the pulse output (see Fct 1.3.1) cannot be exceeded, even at maximum flow rate (final value). **Example:** Final value Qmax = 1200 l/h; volume unit counter = Litre; pulse duration = 100 ms; If the factor 1 is entered, 1 pulse/litre = 1200 pulses are generated in one hour at maximum flow rate. Number of max. permissible pulses: $\frac{\frac{Pmax}{h}}{Qmax} = \frac{18000\,\frac{P}{h}}{1200\,\frac{l}{h}} = 15\,\frac{P}{l}$

Label	Level	Select / Input	Explanation
DISPLAY	1.4		Different measured values can be selected for permanent or alternating display. The display can be rotated.
	1.4.1	FLOW RATE	permanent display of flow in flow units
		COUNTER	permanent display totalizer
		FLOW&COUNT	alternating display flow value in flow units and totalizer
		FLOW&COUNT 1	simultaneous display of flow value and totaliser
		PERCENT	permanent display flow value in percent
	1.4.2	0°	The reading is not rotated.
		90°	The reading on the display is rotated by 90°.
		180°	The reading on the display is rotated by 180°.
		270°	The reading on the display is rotated by 270°.
TIME CONST.	1.5	0.0...20.0s	Given in seconds The output variables (value of the current loop and indicated flow value) follow the current process by the value set here (in seconds) with a time delay. **Note:** If the current flow is polled via HART® communication, the transferred measured value is also played back with a delay.
CONFIG/RESET	1.6		Local resetting of totalizer and acknowledgement of warnings. There is always a safety prompt (yes/no), to avoid accidental resetting. **Note:** External resetting of the totalizer can be installed with the binary input B3.
	1.6.1	COUNTER	Confirming with YES resets the value of the totalizer to 0.0.
	1.6.2	ERROR	Confirming with yes acknowledges all existing warnings. **Note:** Confirming with YES acknowledges existing errors and warnings.
	1.6.3	WRITE INFO IO	As a general rule, data is transferred from the counter module to the ESK4 and vice versa when the device starts. To make sure, selecting this menu point when confirming with YES can perform another data transmission.

2 TEST & INFO

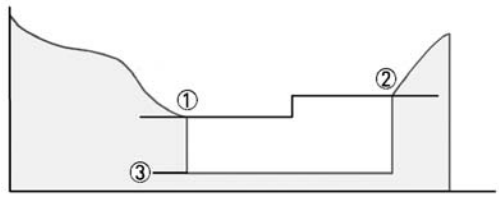
Label	Level	Select / Input	Explanation
4-20mA OUT	2.1		Testing the current loop by setting various current values **Note:** The simulation is not available in HART® multi-drop mode (see Fct. 3.7). **Attention:** During the test, the value of the current loop does not follow the current process.
	2.1.1	NORMAL OP	The value of the current loop follows the current process.
	2.1.2	4.0 mA	The value of the current loop no longer follows the current process. It is set to the selected current value.
	2.1.3	5.6 mA	
	2.1.4	7.2 mA	
	2.1.5	8.8 mA	
	2.1.6	10.4mA	
	2.1.7	12.0 mA	
	2.1.8	21.6 mA	
	2.1.9	15.2 mA	
	2.1.10	16.8 mA	
	2.1.11	18.4 mA	
	2.1.12	20.0 mA	
	2.1.13	21.6 mA	
OUTPUT B1	2.2		Testing the binary switching output B1 by changing its binary status. **Attention:** During the test, the binary status does not correspond to the current process.
	2.2.1	NORMAL OP	The binary status of the switching output corresponds to the current process.
	2.2.2	OPEN	The binary status of the switching output no longer corresponds to the current process. The selected status is tested.
	2.2.3	CLOSED	
OUTPUT B2	2.3		see test OUTPUT B1
	2.3.1	NORMAL OP	
	2.3.2	OPEN	
	2.3.3	CLOSED	
INPUT B3	2.4	ACTIVE HI ACTIVE LO ON OFF	The current binary status of the binary input B3 is displayed. External switching of the voltage applied to input B3 activates a change of the displayed binary status. **Note:** A reaction to the switching of the voltage applied to input B3 only occurs when the function of B3 is activated (see Fct. 3.6).
DEVICE ID	2.5		Information for device identification
	2.5.1	ELEC. REV.	Electronics revision
	2.5.2	SN ESK4	Serial number ESK4
	2.5.3	PA ORDER	Production order for the complete flowmeter
	2.5.4	DEVICE SN.	Serial number for the complete flowmeter

Label	Level	Select / Input	Explanation
SOFT.VERSION	2.6		Information about software revision status
	2.6.1	FW. ESK4	Software revision status for device insert ESK4-Basic
	2.6.2	FW. ESK4 I/O	Software revision status for optional add-on module ESK4-T
TAG NO.	2.7	xxxxxxxx	Measuring point identifier Alphanumerical characters. Up to eight digits possible

3 INSTALLATION

Label	Level	Select / Input	Explanation
LANGUAGE	3.1		Language selection for the menu texts displayed
	3.1.1	ENGLISH	The menu texts are displayed in the selected language.
	3.1.2	DEUTSCH	
	3.1.3	FRANCAIS	
	3.1.4	ITALIANO	
	3.1.5	ESPANOL	
	3.1.6	CESKY	
	3.1.7	POLSKI	
	3.1.8	NEDERLANDS	
	3.1.9	DANSK	
FUNCTION B1	3.2	INACTIVE	The binary switching output B1 has no function.
		SWITCHING POINT	The binary switching point B1 functions as a limit switch depending on the current flow value. Configuration of the switching point takes place under Fct. 1.1.1 (FLOW. VAL B1).
		COUNTERLIM.	The binary switching point B1 functions as a limit switch depending on the current counter value. Configuration of the switching point takes place under Fct. 1.1.1 (ZHL. WERT B1)
		PULSEOUTP.	The binary switching point B1 functions as a pulse output depending on the current flow value. Pulses can be generated up to a maximum of 10 Hz. Configuration occurs under Fct. 1.3.1 (pulse duration) and Fct. 1.3.2 pulse/unit). **Note:** Configuration under Fct 3.6 / Fct. 1.3.1 and Fct. 1.3.2 applies to both pulse outputs. If both B1 and B2 are configured as pulse outputs, both binary outputs behave in exactly the same way.
CONTACT B1	3.3	NO CONTACT	Binary switching output B1 is an NO contact.
		NC contact	Binary switching output B1 is an NC contact.
FUNCTION B2	3.4	INACTIVE	See FUNCTION B1
		SWITCHING POINT	See FUNCTION B1 Configuration of the switching point takes place under Fct. 1.2.1 (FLOW. VALUE B2).
		COUNTERLIM.	See FUNCTION B1 Configuration of the switching point takes place under Fct. 1.2.1 (COUNTER. VAL B2)
		PULSEOUTP.	See FUNCTION B1 Configuration occurs under Fct. 1.3.1 (pulse width) and Fct. 1.3.2 (pulse/unit).
CONTACT B2	3.5	NC contact	See CONTACT B1
		NO CONTACT	See CONTACT B1

Label	Level	Select / Input	Explanation
FUNCTION B3	3.6	INACTIVE	The binary switching input B3 has no function.
		ACTIV H	The internal flow counter is reset to 0.0 if there is an H-level at input B3 for at least 100 ms.
		ACTIV L	The internal flow counter is reset to 0.0 if there is an L-level at input B3 for at least 100 ms.
		STARTH STOPL	The counter is started by creating an H level at the B3 input and stopped by creating an L level at the B3 input.
		STARTL STOPH	The counter is started by creating an L level at the B3 input and stopped by creating an H level at the B3 input.
MULTIDROP	3.7	0...15	Polling adress for HART® Multi-Drop Mode When the address is 0, the HART® multi-drop mode is disabled. **Attention:** When the HART® multi-drop mode (Address 1...15) is activated, the current loop is inactive (fixed current value of 4.5 mA) and no longer follows the current process.
4mA CALIBR.	3.8		D/A calibration for beginning of measuring range (4mA) **Note:** This function is not available in HART® multi-drop mode. **Attention:** During calibration, the value of the current loop does not follow the current process. If a current measuring device in the 4...20mA loop detects a deviation from the desired value 4,000mA, the measured value must be entered. The correction value is accepted following the query Save and Confirm with YES.
20mA CALIBR.	3.9		D/A calibration for the final value of the measuring range (20mA) **Note:** This function is not available in HART® multi-drop mode. **Attention:** During calibration, the value of the current loop does not follow the current process. If a current measuring device in the 4...20mA loop detects a deviation from the desired value 20,000mA, the measured value must be entered. The correction value is accepted following the query Save and Confirm with YES.
ALARM CURRENT	3.10	OFF	Error indication via the current loop is deactivated. The current loop follows the current process. **Note:** This function is not available in HART® multi-drop mode.
		ALARM HIGH	Error indication via the current loop is activated (failure signal "high" as per NE43). **Note:** This function is not available in HART® multi-drop mode.
		ALARM LOW	Error indication via the current loop is activated (failure signal "low" as per NE43). **Note:** 1) This function is not available in HART® multi-drop mode. 2) This function is supported as of Electronic Revision 2.2.x.

Label	Level	Select / Input	Explanation
END&UNIT	3.11		By changing the unit, the respective final value is scaled accordingly. Depending on calibration, either units for volume or mass flow measurement are available for selection.
	3.11.1	FLOW RATE	For units for volume flow or mass flow, refer to *Overview of the units ESK4-T* on page 40
	3.11.2	COUNTER	For units for volume counter or mass counter refer to *Overview of the units ESK4-T* on page 40
Low flow cutoff treshold	3.12		LFC stands for **L**ow **F**low **C**utoff To ensure a stable zero point of the current output, the current output can be stably set to 4.00 mA ③ in a range to be selected. 
	3.12.1	CONTROL OFF	LFC function is not active.
		CONTROL ON	LFC function is active.
	3.12.2	LFC ON_VALUE	Switch-on value ①: Value range 1 ... 19% (from final value of measuring range) Flow is greater than the switch-on value. The current output corresponds to this. If the flow rate falls, the current output follows until the switch-on value ①. If the flow value continues to fall, the current output is switched to 4.00 mA ③. **Note:** The switch-on value to be set must be smaller than the previously selected switch-off value.
	3.12.3	LFC OFF_VALUE	Switch-off value ②: Value range 2 ... 20% (from the measuring range final value) The flow rate is 0. The current output is 4.00 mA ③. If the flow rate increases, the current output remains at 4.00 mA until it has reached the switch-off value ② . **Note:** The switch-off value to be set must be greater than the previously selected switch-on value.
INP. CODE	3.13		Input code for the local operating menu The input code is not active by default.
	3.13.1	OFF	Use of an input code is not activated.
	3.13.2	ON	If YES is chosen, the most recently input code must be typed in. Factory code: → → → ↵ ↵ ↵ ↑ ↑ ↑ If, after confirmation with YES, the → button is also pressed, then a new, individual, nine-element code can be typed in. The display shows the required key combination.
BASIC SETTING	3.14		Resetting parameters to factory default There is always a safety prompt (yes/no), to avoid accidental resetting.

7.1 Maintenance

Within the scope of routine maintenance of the system and pipelines, the flowmeter should also be inspected for signs of fouling, corrosion, mechanical wear and leaks, as well as damage to the measuring tube and indicator.
We advise that inspections be carried out at least once per year.
The device must be removed from the piping before cleaning.

CAUTION!
Pressurized pipes must be depressurized before removing the device.
Empty pipes as completely as possible.
In the case of devices used for measuring aggressive or hazardous media, appropriate safety precautions must be taken with regard to residual liquids in the measuring unit.
Always use new gaskets when reinstalling the device in the pipeline.
Avoid electrostatic charges when cleaning the surfaces (e.g. sight window)!

7.2 Replacement and retrofitting

Some of the variable area flowmeter components can be retrofitted:

- Float damping

Indicator M40:

- Limit switch module
- Current output 4-20 mA
- Counter module with LCD and I/O
- Fieldbus interface

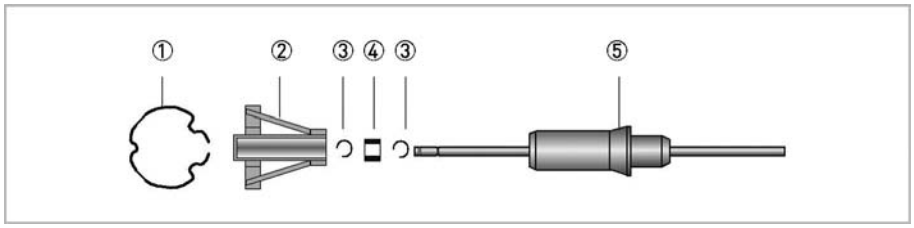
7.2.1 Replacing floats

- Remove the device from the piping.
- Take the upper snap ring out of the measuring unit.
- Take the upper float stop and float out of the measuring unit.
- Insert the new float into the centre hole of the lower float stop and push into the measuring unit along with the upper float catcher. While doing this, the float's upper guide rod must be guided through the middle hole of the float stop.
- Insert the snap ring into the measuring unit.
- Fit the device back into the piping.

CAUTION!
An additional measuring error is to be expected if recalibration is not conducted.

7.2.2 Retrofitting float damping

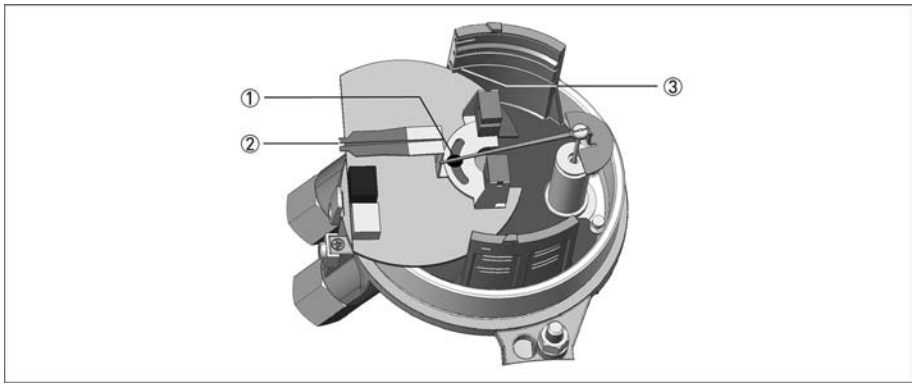
- Take the upper snap ring ① out of the measuring unit.
- Take the upper float stop ② and float ⑤ out of the measuring unit.
- Fasten the snap ring ③ into the lower slot of the float's guide rod.
- Slide ceramic sleeve ④ on to the float's guide rod and attach it to the top slot using the span ring ③.
- Insert float into the lower float guide in the measuring unit.
- Retrofit the supplied damping cylinder with the integrated float stop ② into the measuring unit.
- Insert upper snap ring ①.



① Snap ring
② Float catcher
③ Spring washer
④ Ceramic sleeve
⑤ Float

7.2.3 Retrofitting limit switch

- Remove ESK4 add-on module (if available).
- Merge contact pointer ② in the middle.
- Loosen the locking screw ① on the contact pointer.
- Insert the contact module into slot ③ of the bracket until the semi-circle ① on the contact board surrounds the pointer cylinder.



The contact module connecting terminals feature a pluggable design and can be removed in order to connect the cables.

WARNING!
Do not damage the indicating element!

7.2.4 Replacement - Retrofitting ESK4

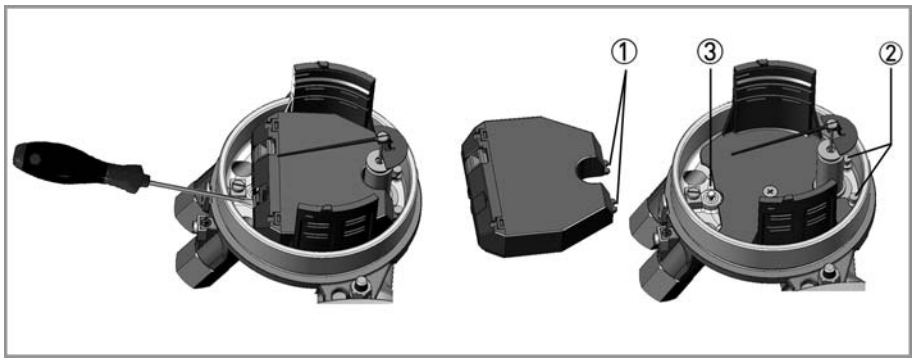
When replacing or retrofitting an ESK4, the following are required at the time of ordering:

- SN - serial number or
- SO - sales order
  This information can be found on the indicator nameplate.

The ESK4 is factory calibrated, making it possible to replace it or retrofit it without recalibrating.

- De-energise the ESK4.
- Lift and remove the ESK4 with a screwdriver.

WARNING!
Do not damage the indicating element!



- The ESK4 plug-in tongues ① are plugged in under the two bolts ② on the baseplate.
- Slight pressure is used to press the ESK4 onto the spring pins ③ until it stops, firmly attaching the ESK4.

If a change in measuring range, product temperature, product, density, viscosity or pressure is desired, this can be done with the KroVaCal program and with a HART® modem. However, each measuring unit is subject to its own physical limits, which the DroVaCal program correHowever, each measuring unit is subject to its own physical limits, which the KroVaCal program correctly calculates, and may thus reject the desired change. ctly calculates, and may thus reject the desired change. If a change is performed using the program, the new data is also transmitted to the ESK4.

- Device identification
- Device address
- Serial Number
- Measuring point designation
- Digital measured value query in flow units, % and mA
- Test / setting functions
- Calibration 4.00 and 20.00 mA
- Set current output to any desired value

7.3 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

7.3.1 List of spare parts

Spare part	Order no.
DN 15	
Float CIV 15, 1.4404	X251041000
Float DIV 15, 1.4404	X251042000
Float TIV 15, 1.4404	X251043000
Float DIVT 15, 1.4404	X251044000
Float TIV 15, Aluminium	X251043100
Float TIV 15, Titanium	X251043200
Set float stop; standard (1 float stop, 1 span ring)	X251050100
Set float stop; gas damping (ZrO_2)	X251050200
Set float stop; gas damping (PEEK)	X251050300
Damping bush (7x8) ZrO_2 incl. 2 span rings	X251053100
Damping bush (7x8) PEEK incl. 2 span rings	X251053200
DN 25	
Float CIV 15, 1.4404	X252041000
Float DIV 25, 1.4404	X252042000
Float TIV 25, 1.4404	X252043000
Float DIVT 25, 1.4404	X252044000
Set float stop; standard (1 float stop, 1 span ring)	X252050100
Set float stop; gas damping (ZrO_2)	X252050200
Set float stop; gas damping (PEEK)	X252050300
Damping bush (12x8) ZrO_2 incl. 2 span rings	X252053100
Damping bush (12x8) PEEK incl. 2 span rings	X252053200
DN 50	
Float CIV 55, 1.4404	X253041000
Float DIV 55, 1.4404	X253042000
Float TIV55, 1.4404	X253043000
Float DIVT 55, 1.4404	X253044000
Set float stop; standard (1 float stop, 1 span ring)	X253050100
Set float stop; gas damping (ZrO_2)	X253050200
Set float stop; gas damping (PEEK)	X253050300
Damping bush (14x10) ZrO_2 incl. 2 span rings	X253053100
Damping bush (14x10) PEEK incl. 2 span rings	X253053200

DN 80	
Float CIV 85, 1.4404	X254041000
Float DIV 85, 1.4404	X254042000
Float TIV 85, 1.4404	X254043000
Float DIVT 85, 1.4404	X254044000
Set float stop; standard (1 float stop, 1 span ring)	X254050100
Set float stop; gas damping (ZrO_2)	X254050200
Set float stop; gas damping (PEEK)	X254050300
Damping bush (18x14) ZrO_2 incl. 2 span rings	X254053100
Damping bush (18x14) PEEK incl. 2 span rings	X254053200
DN 100	
Float CIV 105, 1.4404	X255041000
Float DIV 105, 1.4404	X255042000
Float DIVT 105, 1.4404	X255044000
Set float stop; stand. (1 float stop, 1 span ring) only for bottom !	X255050100
Set float stop; gas damping (ZrO_2)	X255050200
Set float stop; gas damping (PEEK)	X255050300
Damping bush (18x14) ZrO_2 incl. 2 span rings	X254053100
Damping bush (18x14) PEEK incl. 2 span rings	X254053200
Indicator M40	
Indicator housing complete no scale	X251110000
Cover M40 complete, standard	X251110100
Cover M40 complete, salt water resistant	X251110200
M40 baseplate standard	X251120100
M40 baseplate salt water resistant	X251120200
Retrofit kit HT extension	X251021000
Module carrier (profile track)	X251121100
Pointer system, complete	X251122100
Printed scale (serial number required)	On request

Other spare parts on request

7.4 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

7.5 Returning the device to the manufacturer

7.5.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

7.5.2 Form (for copying) to accompany a returned device

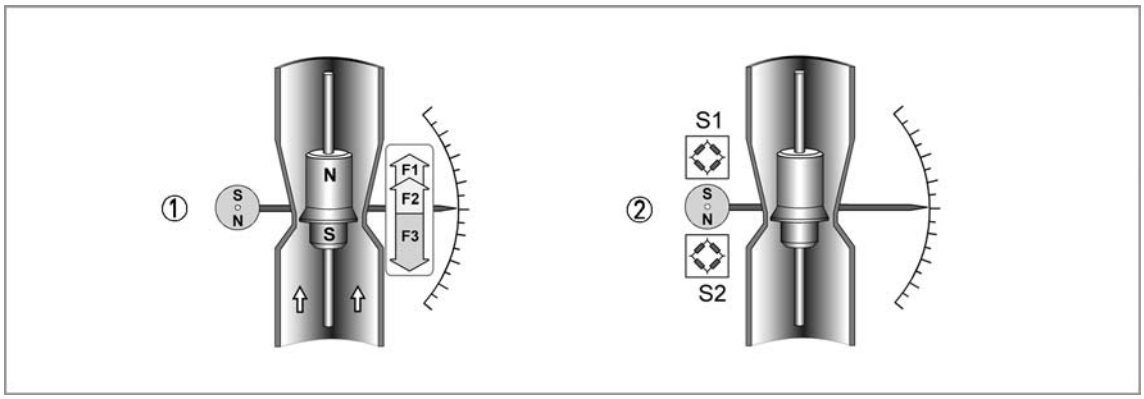
Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.
	☐	We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

7.6 Disposal

CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

8.1 Functional principle

The H250 flowmeter operates on the float measuring principle. The measuring unit consists of a metal cone, inside of which a float can move up and down freely. The flow goes from bottom to top. The float changes position so that the lifting force acting on it F1 is in equilibrium with the form drag F2 and its weight F3: F3 = F1 + F2



① Indication principle M40 magnetic coupling
② Magnetic coupling sensors

① For the indicator, the flow-dependent height of the float in the measuring unit is transmitted by means of a magnetic coupling and displayed on a scale.

② For a built-in signal converter (ESK4), the flow-dependent height of the float in the measuring unit is detected by the S1 and S2 magnetic field sensors and electronically processed.

Operating principle of H250H and H250U

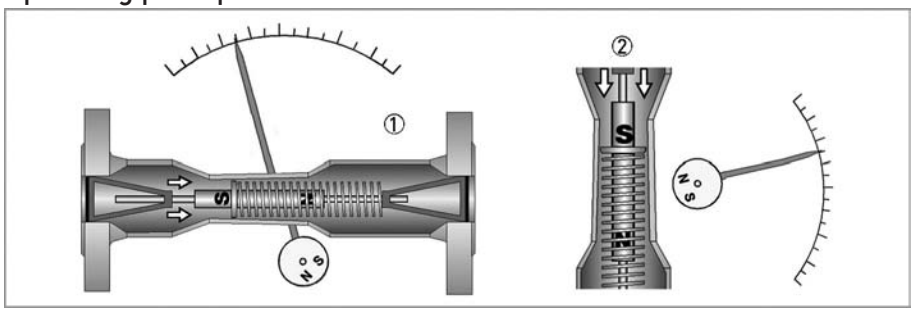


Figure 8-1: Operating principle H250H and H250U

① H250H - horizontal flow direction
② H250U - flow direction from top to bottom

The flowmeter operates based on a modified float measuring principle. The guided float adjusts itself so that the flow force acting on it is in equilibrium with the opposing spring force. The flow-dependent position of the float in the measuring unit is displayed on a scale by means of a magnetic coupling.

8.2 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Application range	Flow measurement of liquids, gases and vapors
Function / Measuring principle	Variable area measuring principle
Measured value	
Primary measured value	Float position
Secondary measured value	Operating and standard volumetric flow

Measuring accuracy

Directive	VDI / VDE 3513, sheet 2 (q_G = 50%)
H250 /RR /HC /F	1.6%
H250/C (Ceramic, PTFE) H250H, H250U, H250 (100 : 1)	2.5%

Operating conditions

Temperature	
Max. operating temperature TS	-196..+300°C / -321...+572°F
Pressure	
Max. operating pressure PS	Depending on the version, up to 400 bar / 5802 psig ①
Max. test pressure PT	Pressure equipment directive 97/23/EC or AD 2000-HP30
Min. required operating pressure	2 times greater than pressure loss (see measuring ranges)
Protection category	
M40, M40S, M40R	IP 66/68 acc. to EN60529, NEMA 4/4X/6 acc. to NEMA 250
M40R	IP69K acc. to DIN 40050-9
Float damping during gas measurement recommended:	
DN15...25 / ½"...1"	Operating pressure <0.3 bar / 4.4 psig
DN50...100 / 2"...4"	Operating pressure <0.2 bar / 2.9 psig

Installation conditions acc. to VDI/VDE 3513 Sheet 3

Inlet run	≥ 5 x DN
Outlet run	≥ 3 x DN

① higher operating pressures on request

Materials

Item	Flange / raised face	Measuring tube	Float	Float stop / guide	Ring orifice
H250/RR stainless steel	CrNi steel 1.4404 massive ①	CrNi steel 1.4404 ①			-
H250/HC Hastelloy®	CrNi steel 1.4571 with plated Hastelloy® C4 (2.4610) ①	Hastelloy® C-22 (2.4602)			-
H250/C Ceramics/PTFE ②	CrNi-Stahl 1.4571 with TFM/PTFE liner ③		PTFE or Al_2O_3 with FFKM gasket	Al_2O_3 and PTFE	Al_2O_3
H250/F - Food	CrNi-Stahl 1.4435				-

① CrNi steel 1.4571 on request, for clamp connection CrNi steel 1.4435
② DN100/4" only PTFE
③ TFM/PTFE liner (electrically non-conductive)

Other options:

- Special materials on request: e.g. SMO 254, titanium, 1.4435
- Float damping: ceramic or PEEK
- Gasket for devices with female thread as insert: O-ring FPM / FKM

Temperatures

For devices to be used in hazardous areas, special temperature ranges apply. These can be found in the separate instructions

Temperatures H250/M40 - mechanical indicator without power supply

	Material		Product temperature		Ambient temperature	
	Float	Liner	[°C]	[°F]	[°C]	[°F]
H250/RR	stainless steel		-196...+300	-321...+572	-40...+120	-40...+248
H250/RR screw fitting			-196...+300	-321...+572	-20...+120	-4...+248
H250/HC	Hastelloy® C4		-196...+300	-321...+572	-40...+120	-40...+248
H250/C	PTFE		-196...+70	-321...+158	-40...+70	-40...+158
H250/C	Ceramic	PTFE	-196...+150	-321...+302	-40...+70	-40...+158
H250/C	Ceramic	TFM / Ceramic	-196...+250	-321...+482	-40...+120	-40...+248
H250 H/U	Spring material Stainless Steel 316		-40...+100	-40...+212	-40...+120	-40...+248
	Spring material Hastelloy		-40...+200	-40...+392	-40...+120	-40...+248

Ambient temperatures $T_{amb.}$ with electrical components

Version	[°C]	[°F]
ESK4, ESK4-FF, ESK4-PA	-40...+70	-40...+158
ESK4-T ①	-40...+70	-40...+158
Limit switches SJ3,5-SN / I7S23,5-N / Reed SPST	-40...+70	-40...+158
Limit switches SC3,5-N0 / SJ3,5-S1N / SB3,5-E2	-25...+70	-13...+158

① Display contrast out of the temperature range 0...60 °C / 32..140°F decreasing.

Temperatures H250/M40 - with electrical components [°C]

			Tamb. < +40 °C		Tamb. < +60 °C	
EN	ASME	Version with	Standard	HT	Standard	HT
DN15, DN25	½", 1"	ESK4, ESK4-FF, ESK4-PA	+200	+300	+180	+300
		ESK4-T	+200	+300	+80	+130
		Limit switch NAMUR	+200	+300	+200	+300
		3-wire limit switch	+200	+300	+130	+295
DN50	2“	ESK4, ESK4-FF, ESK4-PA	+200	+300	+165	+300
		ESK4-T	+180	+300	+75	+100
		Limit switch NAMUR	+200	+300	+200	+300
		3-wire limit switch	+200	+300	+120	+195
DN80, DN100	3“, 4"	ESK4, ESK4-FF, ESK4-PA	+200	+300	+150	+250
		ESK4-T	+150	+270	+70	+85
		Limit switch NAMUR	+200	+300	+200	+300
		3-wire limit switch	+190	+300	+110	+160

Maximum product temperatures H250/M40 - with electrical components [°F]

			$T_{amb.}$ < +104 °F		$T_{amb.}$ < +140 °F ①	
EN	ASME	Version with	Standard	HT	Standard	HT
DN15, DN25	½", 1"	ESK4, ESK4-FF, ESK4-PA	392	572	356	572
		ESK4-T	392	572	176	266
		Limit switch NAMUR	392	572	392	572
		3-wire limit switch	392	572	266	563
DN 50	2“	ESK4, ESK4-FF, ESK4-PA	392	572	165	572
		ESK4-T	356	572	167	212
		Limit switch NAMUR	392	572	392	572
		3-wire limit switch	392	572	248	383
DN 80, DN100	3“, 4"	ESK4, ESK4-FF, ESK4-PA	392	572	302	482
		ESK4-T	302	518	158	185
		Limit switch NAMUR	392	572	392	572
		3-wire limit switch	374	572	230	320

① if there are no heat insulation measures, a heat-resistant cable is necessary (continuous operating temperature of the cable to be used: +100°C)

Abbreviation

HT	High-Temperature version
ESK4	Current output 2-wire 4...20 mA
ESK4-T	ESK4 with LCD, binary status outputs, digital counter and pulse output.
ESK4-FF	FOUNDATION FIELDBUS interface
ESK4-PA	PROFIBUS PA interface

Cable glands

Cable gland	Material	Cable diameter	
M 20x1.5 Standard	PA	8...13 mm	0.315...0.512"
M20 x 1.5	Nickel-plated brass	10...14 mm	0.394...0.552"

Limit switches

Terminal connection	2.5 mm^2				
Limit switches	I7S23,5-N SC3,5-N0	SJ3,5-SN ①	SJ3,5-S1N ①	SB3,5-E2	Reed
NAMUR (IEC60947-5-6)	Yes	Yes	Yes	no	no
Type of connection	2-wire	2-wire	2-wire	3-wire	2-wire
Switching element function	Normally closed	Normally closed	Normally open	PNP NO contact	NC SPST
Nominal voltage U_0	8,2 VDC	8,2 VDC	8,2 VDC	10...30 VDC	max. 32 VDC
Pointer vane not detected	≥ 3 mA	≥3 mA	≤1 mA	≤ 0.3 VDC	U_0
Pointer vane detected	≤ 1 mA	≤ 1 mA	≥ 3 mA	U_B - 3 VDC	0 VDC
Continuous current	-	-	-	max. 100 mA	max. 100mA
No load current I_0	-	-	-	≤ 15 mA	-
Operating cycles	-	-	-	-	100.000

① safety oriented

Current output ESK4

Terminal connection	2.5 mm^2
Power supply	14...30 VDC
Min. power supply for HART®	20 VDC at 250 Ohm load
Measuring signal	4.00...20.00 mA = 0...100% flow value in 2-wire technology
Power supply influence	<0.1%
Dependence on external resistance	<0.1%
Temperature influence	5 µA / K
Max. external resistance / load	650 Ohm at 30 VDC
Min. load for HART®	250 Ohm
ESK4 HART® configuration	
Manufacturer name (code)	KROHNE Messtechnik (69 = 45h)
Model name	ESK4 (214 = 0xD6)
HART® protocol revision	5.9
Device revision	1
Physical layer	FSK
Device category	Transmitter without galvanic isolation

ESK4 process variable

	Values [%] from full-scale range	Signal output [mA]
Over range	+102.5 (±1%)	20.24...20.56
Device error identification	> 106.25	>21.00
Max. current consumption	131.25	25
Multi-drop operation		4.5

ESK4-FF

Physical layer	IEC 61158-2 and FISCO Modell
Communication standard	H1 FOUNDATION Fieldbus protokol
ITK version	5.2
Power supply	Bus supply
Nominal current	16 mA
error current	23 mA
Starting current after 10 ms	< Nominal current

For more details see the supplementary instructions "H250 M40 Foundation Fieldbus"

ESK4-PA

Physical layer	IEC 61158-2 and FISCO Modell
Communication standard	Profibus PA Profil 3.02
PNO ID	4531 HEX
Power supply	Bus supply
Nominal current	16 mA
error current	23 mA
Starting current after 10 ms	< Nominal current

For more details see the supplementary instructions "H250 M40 Profibus PA"

ESK4-T with LCD, binary inputs and outputs and digital counter

Binary output

Two binary outputs	Galvanically isolated, passive	
Mode	Switch output	NAMUR or transistor (open collector)
Configurable as	Switch contact or Pulse output	Opener/NO contact or max. 10 pulses / s
NAMUR switch output		
Power supply	8,2 VDC	
Signal current	> 3 mA switching value not reached;	< 1 mA switching value reached
Switch output transistor (open collector)		
Power supply	Nominal 24 VDC, maximal 30 VDC	
P_{max}	500 mW	
Continuous current	max. 100 mA	
No load current I_0	≤ 2mA	

Pulse output

T_{on}	configurable from 50...500 ms
T_{off}	depending on flow rate
Pulse value	configurable in flow units e.g. 5 pulses / m^3

Binary input

Input	Galvanically isolated
Mode	Reset counters or run/stop
Configurable as	active Hi / active Lo
H- signal	16...30 VDC
Internal resistance R_i	typ. 20 kOhm
T_{on} (active)	≥500 ms

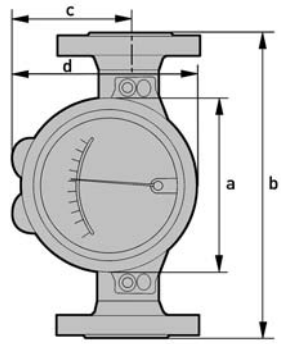
Approvals

Standard	Screen	Marking
ATEX / IECEx	M40 mechanical	II2GD IIC II3GD IIC
	M40 electrical	III2G Ex ia IIC T6 Gb II2G Ex d IIC T6 Gb II3G Ex nA IIC T6 Gc II2D Ex t IIIC T70°C Db
FM (USA) FM (Canada)	M40	pending
NEPSI	M40	pending

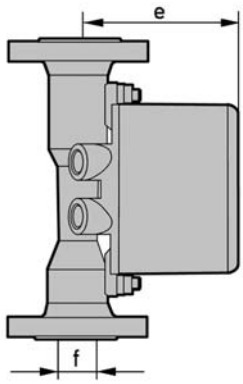
8.3 Dimensions and weights

Dimensions H250/M40

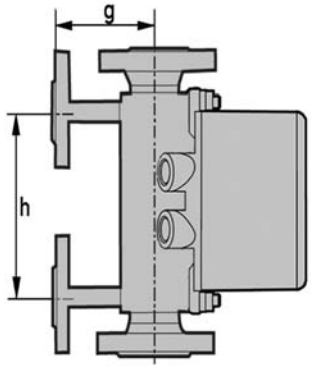
Front view



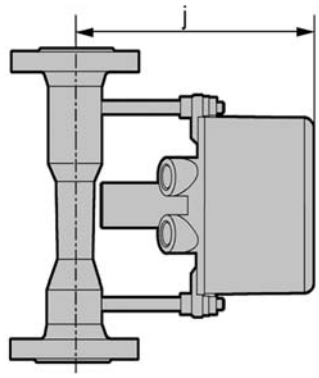
Side view



with heating



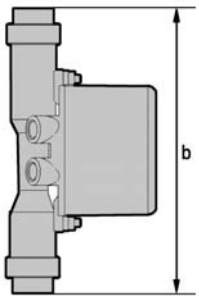
High temperature



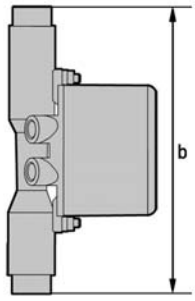
	a		b		d		h	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
All nominal sizes	138	5.44	250	9.85	160	6.30	150	5.91
ISO 228			300	11.82				
H250/C - 3"/300 lb			300	11.82				

EN	ASME	c		e		Ø f		g		j	
		[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DN15	½"	94	3.70	114	4.49	20	0.79	100	3.94	197	7.76
DN25	1"	94	3.70	125	4.92	32	1.26	106	4.18	208	8.19
DN50	2"	107	4.22	139	5.48	65	2.56	120	4.73	222	8.75
DN80	3"	107	4.22	155	6.11	89	3.51	145	5.71	238	9.38
DN100	4"	107	4.22	164	6.46	114	4.49	150	5.91	247	9.73

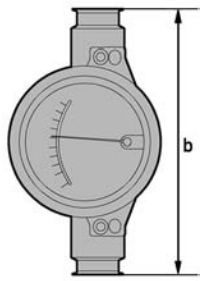
ISO 228
Female thread
screwed



ISO 228
Female thread
welded

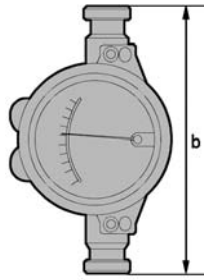


H250/F
Clamp connection



①

H250/F
Screw connection
DIN 11851



① Stainless steel 1.4435 - EHEDG tested - wetted surfaces Ra ≤ 0.8 / 0.6 µm

Weights

		H250		with heating			
Nominal meter size		EN 1092-1		Flange connection		Ermeto connection	
EN	ASME	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
DN15	½“	3.5	7.7	5.6	12.6	3.9	8.6
DN25	1“	5	11	7.5	16.5	5.8	12.8
DN50	2“	8.2	18.1	11.2	24.7	9.5	21
DN80	3“	12.2	26.9	14.8	32.6	13.1	28.9
DN100	4“	14	30.9	17.4	38.4	15.7	34.6

		H250/C [Ceramic / PTFE]						Screw connec.	
Nominal meter size		EN 1092-1		ASME 150 lb		ASME 300 lb		DIN 11864-1	
EN	ASME	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
DN15	½“	3.5	7.7	3.2	7.1	3.5	7.7	2	4.4
DN25	1“	5	11	5.2	11.5	6.8	15	3.5	7.7
DN50	2“	10	22.1	10	22.1	11	24.3	5	11
DN80	3“	13	28.7	13	28.7	15	33.1	7.6	16.8
DN100	4“	15	33.1	16	35.3	17	37.5	10.3	22.7

Process connections

	Standard	Conn. dim.	Pressure rating
Flanges (H250/RR /HC /C)	EN 1092-1	DN15...150	PN16...250
	ASME B16.5	½...6"	150...2500 lb
	JIS B 2220	15...100	10...20K
Clamp connections (H250/RR /F)	DIN 32676	DN15...100	10...16 bar
	ISO 2852	Size 25...139.7	10...16 bar
Screw connections (H250/RR /HC /F)	DIN 11851	DN15...100	25...40 bar
	SMS 1146	1...4"	6 bar / 88.2 psig
Female thread welded (H250/RR /HC)	ISO 228	G½...G2"	≥ 50 bar / 735 psig
	ASME B1.20.1	½...2" NPT	
Female thread (H250/RR /HC) with insert, FPM gasket and union nut	ISO 228	G½...2"	≤ 50 bar ≤ 735 psig
	ASME B1.20.1	½...2" NPT	
Thread connection aseptic (H250/F)	DIN 11864 - 1	DN15...50	PN40
		DN80...100	PN 16
Flange aseptic (H250/F)	DIN 11864 - 2	DN15...50	PN40
		DN80...DN100	PN 16
Meters (H250/RR /HC) with heating:			
Heating with flange connection	EN 1092-1	DN15	PN40
	ASME B16.5	½"	150 lb / RF
Heating pipe connection for Ermeto	-	E12	PN40

Higher pressure ratings and other connections on request

Bolts and tightening torques

For measuring devices with PTFE liner or ceramic liner and PTFE raised face, tighten the flange threads with the following torques:

Nominal sizes EN

	Stud bolts	Tightening torques	
Nominal size acc. to EN 1092-1	Quantity x size	[Nm]	[lb-ft]
DN15 PN40 ①	4x M12	9.8	7.1
DN25 PN40 ①	4x M12	21	15
DN50 PN40 ①	4x M16	57	41
DN80 PN16 ①	8x M16	47	34
DN100 PN16 ①	8x M16	67	48

① standard connections; other connections on request

Nominal size ASME

	Stud bolts		Tightening torques	
Nominal sizes acc. to ASME B 16.5	Quantity x size		[Nm]	[lb-ft]
	150 lb	300 lb		
½" 150 lb / 300 lb ①	4x ½"	4x ½"	5.2	3.8
1" 150 lb / 300 lb ①	4x ½"	4x 5/8"	10	7.2
2" 150 lb / 300 lb ①	4x 5/8"	8x 5/8"	41	30
3" 150 lb / 300 lb ①	4x 5/8"	8x ¾"	70	51
4" 150 lb / 300 lb ①	8x 5/8"	8x ¾"	50	36

① standard connections; other connections on request

Pressure tightness (vacuum) H250/C

Max. process temperature ▸			+70°C (+158°F)		+150°C (*302°F)		+250°C (+482°F)	
			Min. operating pressure					
Nominal meter size	Float	Liner	[mbar abs.]	[psia]	[mbar abs.]	[psia]	[mbar abs.]	[psia]
DN15...DN100	PTFE	PTFE	100	1.45	-	-	-	--
DN15...DN80	Ceramic	PTFE	100	1.45	250	3.63	-	-
DN15...DN80	Ceramic	TFM / Ceramic	100	1.45	100	1.45	100	1.45

8.4 Measuring ranges

H250/RR - Stainless Steel, H250/HC - Hastelloy®

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

		Water			Air			Max. pressure loss			
Float ▸		TIV	CIV	DIV	TIV Alu	TIV	DIV	TIV Alu	TIV	CIV	DIV
Nominal meter size	Cone	[l/h]			[Nm³/h]			[mbar]			
DN15, ½"	K 15.1	18	25	-	0.42	0.65	-	12	21	26	-
	K 15.2	30	40	-	0.7	1	-	12	21	26	-
	K 15.3	55	63	-	1	1.5	-	12	21	26	-
	K 15.4	80	100	-	1.7	2.2	-	12	21	26	-
	K 15.5	120	160	-	2.5	3.6	-	12	21	26	-
	K 15.6	200	250	-	4.2	5.5	-	12	21	26	-
	K 15.7	350	400	700	6.7	10	18 ①	12	21	28	38
	K 15.8	500	630	1000	10	14	28 ②	13	22	32	50
	K 15.8	-	-	1600 ③	-	-	50 ③	-	-	-	85
DN25, 1"	K 25.1	480	630	1000	9.5	14	-	11	24	32	72
	K 25.2	820	1000	1600	15	23	-	11	24	33	74
	K 25.3	1200	1600	2500	22	35	-	11	25	34	75
	K 25.4	1700	2500	4000	37	50	110 ②	12	26	38	78
	K 25.5	3200	4000	6300	62	95	180 ②	13	30	45	103 ④
DN50, 2"	K 55.1	2700	6300	8400	58	80	230 ②	8	13	74	60
	K 55.2	3600	10000	14000	77	110	350 ②	8	13	77	69
	K 55.3	5100	16000	25000	110	150	700 ②	9	13	84	104
DN80, 3"	K 85.1	12000	25000	37000	245	350	1000 ②	8	16	68	95
	K 85.2	16000	40000	64000	280	400	1800 ②	9	16	89	125
DN100, 4"	K105.1	19000	63000	100 000	-	550	2800 ②	-	-	120	220

① P >0.5 bar
② P >0,5 bar
③ with TR float
④ 300 mbar with damping (gas measurement)

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
Nl/h or Nm³/h: Volume current in standard state 0°C - 1.013 bar abs. (DIN 1343)

H250/RR - Stainless Steel, H250/HC - Hastelloy®

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

		Water			Air			Max. pressure loss			
Float ▸		TIV	CIV	DIV	TIV Alu	TIV	DIV	TIV Alu	TIV	CIV	DIV
Nominal meter size	Cone	[GPH]			[SCFM]			[psig]			
DN15, ½"	K 15.1	4.76	6.60	-	0.26	0.40	-	0.18	0.31	0.38	-
	K 15.2	7.93	10.6	-	0.43	0.62	-	0.18	0.31	0.38	-
	K 15.3	14.5	16.6	-	0.62	0.93	-	0.18	0.31	0.38	-
	K 15.4	21.1	26.4	-	1.05	1.36	-	0.18	0.31	0.38	-
	K 15.5	31.7	42.3	-	1.55	2.23	-	0.18	0.31	0.38	-
	K 15.6	52.8	66.0	-	2.60	3.41	-	0.18	0.31	0.38	-
	K 15.7	92.5	106	185	4.15	6.20	11.2 ①	0.18	0.31	0.41	0.56
	K 15.8	132	166	264	6.20	8.68	17,4 ②	0.19	0.32	0.47	0.74
	K 15.8	-	-	423 ③	-	-	31.0 ③	-	-	-	1.25
DN25, 1"	K 25.1	127	166	264	5.89	8.68	-	0.16	0.35	0.47	1.06
	K 25.2	217	264	423	9.30	14.3	-	0.16	0.35	0.49	1.09
	K 25.3	317	423	660	13.6	21.7	-	0.16	0.37	0.50	1.10
	K 25.4	449	660	1057	22.9	31.0	68,2 ②	0.18	0.38	0.56	1.15
	K 25.5	845	1057	1664	38.4	58.9	111 ①	0.19	0.44	0.66	1.51 ④
DN50 2"	K 55.1	713	1664	2219	36.0	49.6	143 ②	0.12	0.19	1.09	0.88
	K 55.2	951	2642	3698	47.7	68.2	217 ②	0.12	0.19	1.13	1.01
	K 55.3	1347	4227	6604	68.2	93.0	434 ②	0.13	0.19	1.23	1.53
DN80 3"	K 85.1	3170	6604	9774	152	217	620 ②	0.12	0.24	1.00	1.40
	K 85.2	4227	10567	16907	174	248	1116 ②	0.13	0.24	1.31	1.84
DN100 4"	K105.1	5019	16643	26418	-	341	1736 ②	-		1.76	3.23

① P >7.4 psig
② P >7,4 psig
③ with TR float
④ 4.4 psig with damping (gas measurement)

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition during gas measurements:
Flow measurements for gases are attributed to
SCFM or SCFH: Volume current in standard state 15°C - 1.013 bar abs. (ISO 13443)

H250/C - Ceramic/PTFE

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

		Flow				Max. pressure loss			
		Water		Air		Water		Air	
Liner / Float ▸		PTFE	Ceramic	PTFE	Ceramic	PTFE	Ceramic	PTFE	Ceramic
Nominal meter size	Cone	[l/h]		[Nm³/h]		[mbar]			
DN15, ½"	E 17.2	25	30	0,7	-	65	62	65	62
	E 17.3	40	50	1,1	1.8	66	64	66	64
	E 17.4	63	70	1,8	2.4	66	66	66	66
	E 17.5	100	130	2,8	4	68	68	68	68
	E 17.6	160	200	4,8	6.5	72	70	72	70
	E 17.7	250	250	7	9	86	72	86	72
	E 17.8	400	-	10	-	111	-	111	-
DN25, 1"	E 27.1	630	500	16	18	70	55	70	55
	E 27.2	1000	700	30	22	80	60	80	60
	E 27.3	1600	1100	45	30	108	70	108	70
	E 27.4	2500	1600	70	50	158	82	158	82
	E 27.5	4000 ①	2500	120	75	290	100	194	100
DN50, 2"	E 57.1	4000	4500	110	140	81	70	81	70
	E 57.2	6300	6300	180	200	110	80	110	80
	E 57.3	10000	11000	250	350	170	110	170	110
	E 57.4	16000 ①	-	-	-	284	-	-	-
DN80, 3"	E 87.1	16000	16000	-	-	81	70	-	-
	E 87.2	25000	25000	-	-	95	85	-	-
	E 87.3	40000 ①	-	-	-	243	-	-	-
DN100, 4"	E 107.1	40000	-	-	-	100	-	-	-
	E 107.2	60000 ①	-	-	-	225	-	-	-

① special float

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition during gas measurements:
Flow measurements for gases are attributed to
Nl/h or Nm³/h: Volume current in standard state 0°C - 1.013 bar abs. (DIN 1343)

H250/C - Ceramic/PTFE

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

		Flow				Max. pressure loss			
		Water		Air		Water		Air	
Liner / Float ▸		PTFE	Ceramic	PTFE	Ceramic	PTFE	Ceramic	PTFE	Ceramic
Nominal meter size	Cone	[GPH]		[SCFM]		[psig]			
DN15, ½"	E 17.2	6.60	7.93		-	0,94	0,90	0,94	0,90
	E 17.3	10.6	13.2		1.12	0,96	0,93	0,96	0,93
	E 17.4	16.6	18.5		1.49	0,96	0,96	0,96	0,96
	E 17.5	26.4	34.3		2.48	0,99	0,99	0,99	0,99
	E 17.6	42.3	52.8		4.03	1,04	1,02	1,02	1,02
	E 17.7	66.0	66.0		5.58	1,25	1,04	1,25	1,04
	E 17.8	106	-		-	1,61	-	1,61	-
DN25, 1"	E 27.1	166	132		11.2	1,02	0,80	1,02	0,80
	E 27.2	264	185		13.6	1,16	0,87	1,16	0,87
	E 27.3	423	291		18.6	1,57	1,02	1,57	1,02
	E 27.4	660	423		31.0	2,29	1,19	2,29	1,19
	E 27.5	1056 ①	660		46.5	4,21	1,45	2,81	1,45
DN50, 2"	E 57.1	1057	1189		86.8	1,18	1,02	1,18	1,02
	E 57.2	1664	1664		124	1,60	1,16	1,60	1,16
	E 57.3	2642	2906		217	2,47	1,60	2,47	1,60
	E 57.4	4226 ①	-		-	4,12	-	-	-
DN80, 3"	E 87.1	4227	4227		-	1,18	1,02	-	-
	E 87.2	6604	6604		-	1,38	1,23		-
	E 87.3	10567 ①	-		-	3,55	-		-
DN100, 4"	E 107.1	10567	-		-	1,45	-		-
	E 107.2	15850 ①	-		-	3,29	-		-

① special float

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
SCFM or SCFH: Volume current in standard state 15°C - 1.013 bar abs. (ISO 13443)

H250H - Horizontal installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

EN	ASME	Cone	Water [l/h]	Air [Nm^3/h]	Pressure loss [mbar]
DN15	½	K 15.1	70	1.8	195
		K 15.2	120	3	204
		K 15.3	180	4.5	195
		K 15.4	280	7.5	225
		K 15.5	450	12	250
		K 15.6	700	18	325
		K 15.7	1200	30	590
		K 15.8	1600	40	950
		K 15.8	2400	60	1600
DN25	1"	K 25.1	1300	35	122
		K 25.2	2000	50	105
		K 25.3	3000	80	116
		K 25.4	5000	130	145
		K 25.5	8500	220	217
		K 25.5	10000	260	336
DN50	2"	K 55.1	10000	260	240
		K 55.2	16000	420	230
		K 55.3	22000	580	220
		K 55.3	34000	900	420
DN80	3"	K 85.1	25000	650	130
		K 85.2	35000	950	130
		K 85.2	60000	1600	290
DN100	4"	K 105.1	80000	2200	250
		K 105.1	120000	3200	340

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
Nl/h or Nm^3/h: Volume current in standard state 0°C - 1.013 bar abs. (DIN 1343)

H250H - Horizontal installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]

EN	ASME	Cone	Wasser [GPH]	Luft [SCFM]	Pressure loss [psig]
DN15	1/2"	K 15.1	18.5	1.12	2.87
		K 15.2	31.7	1.86	3.00
		K 15.3	47.6	2.79	2.87
		K 15.4	74.0	4.65	3.31
		K 15.5	119	7.44	3.68
		K 15.6	185	11.2	4.78
		K 15.7	317	18.6	8.68
		K 15.8	423	24.8	14.0
		K 15.8	634	37.2	23.5
DN25	1"	K 25.1	343	21.7	1.79
		K 25.2	528	31.0	1.54
		K 25.3	793	49.6	1.71
		K 25.4	1321	80.6	2.13
		K 25.5	2245	136	3.19
		K 25.5	2642	161	4.94
DN50	2"	K 55.1	2642	161	3.53
		K 55.2	4227	260	3.38
		K 55.3	5812	360	3.23
		K 55.3	8982	558	6.17
DN80	3"	K 85.1	6604	403	1.91
		K 85.2	9246	589	1.91
		K 85.2	15851	992	4.26
DN100	4"	K 105.1	21134	1364	3.68
		K 105.1	31701	1984	5.00

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
SCFM or SCFH: Volume current in standard state 15°C - 1.013 bar abs. (ISO 13443)

H250U - Vertical installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]
Flow direction	vertical downwards		

EN	ASME	Cone	Water [l/h]	Air [Nm^3/h]	Pressure loss [mbar]
DN15	½"	K 15.1	65	1.6	175
		K 15.2	110	2.5	178
		K 15.3	170	4	180
		K 15.4	260	6	200
		K 15.5	420	10	220
		K 15.6	650	16	290
		K 15.7	1100	28	520
		K 15.8	1500	40	840
DN25	1"	K 25.1	1150	30	97
		K 25.2	1800	45	85
		K 25.3	2700	70	92
		K 25.4	4500	120	115
		K 25.5	7600	200	172
DN50	2"	K 55.1	9000	240	220
		K 55.2	15000	400	230
		K 55.3	21000	550	240

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
Nl/h or Nm^3/h: Volume current in standard state 0°C - 1.013 bar abs. (DIN 1343)

H250U - Vertical installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water 20°C / 68°F	Air: 20°C [68°F], 1,013 bar abs. [14,7 psia]
Flow direction	vertical downwards		

EN	ASME	Cone	Wasser [GPH]	Luft [SCFM]	Pressure loss [psig]
DN15	½"	K 15.1	17.2	0.99	2.57
		K 15.2	29.1	1.55	2.62
		K 15.3	44.9	2.48	2.65
		K 15.4	68.7	3.72	2.94
		K 15.5	111	6.20	3.23
		K 15.6	172	9.92	4.26
		K 15.7	291	17.4	7.64
		K 15.8	396	24.8	12.3
DN25	1"	K 25.1	304	18.6	1.42
		K 25.2	476	27.9	1.25
		K 25.3	713	43.4	1.35
		K 25.4	1189	74.4	1.69
		K 25.5	2008	124	2.53
DN50	2"	K 55.1	2378	149	3.23
		K 55.2	3963	248	3.38
		K 55.3	5548	341	3.53

INFORMATION!
The operating pressure should be at least double the pressure loss for liquids and five times for gases. The indicated pressure losses are valid for water and air at maximum flow rate. Other flow ranges on request. Conversion of other media or operating data is performed using the calculation method in accordance with VDI /VDE Directive 3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
SCFM or SCFH: Volume current in standard state 15°C - 1.013 bar abs. (ISO 13443)

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Products and systems for the oil & gas industry
- Measuring systems for the marine industry

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