IOTAFLOW
SYSTEMS PVT. LTD



Metal Tube Flow Meter User Manual

" If You Want To Manage It, Measure It "

www.iotaflow.com

IMPRINT

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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!
This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

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. Donot 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/VDE3513-3.

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

CAUTION!
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 EU directives:

- Pressure equipment directive
- For devices with electrical installations: EMC directive
- Devices for use in hazardous areas: ATEX directive

as well as

- NAMUR recommendations NE 21, NE 43 and NE 107

The manufacturer certifies succes sful testing of the product by applying the CE marking. An EU declaration of conformity regarding th e directives in question and the associated harmonised standards can be downloaded from our internet site.

1.3 Pressure equipment directive

A conformity assessment in accordance with pres sure equipment directive 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 the rating of the devices:

Example: PED/G1/III/H

G		Gases and vapours
11	group	Fluid
III		Category III
H		Conformity assessment method according to Module H

The PED key identification can be found on thenameplate of the device (for details refer to *Nameplate* on page 16).

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. ATEXapproval). Devices rated below category I 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).

Residual risk

A risk analysis in accordance with the pressure equipment directive has been carried out for the devices . The residual risk is described as follows:

- The devices are designed according to the validand applicable rules and standards for static operation and their pressure resistance is ca lculated for the declared maximum pressure and temperature (no calculation for cyclical change).
- Responsibility for the use of the measuring devices with regard to corrosion resistance of the used materials against the measured fl uid lies solely with the operator.
- Avoid abrasion.
- Avoid pulsation and cavitation.
- Protect devices from vibration and high-frequency oscillation.
- Draining (backflow) may be delayed due to the float in the measuring tube.
- Implement appropriate measures to counteract external fire hazards

1.4 Safety instructions from the manufacturer

1.4.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.4.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the eventany 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 th e 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.

1.4.3 Product liability and warranty

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

1.4.4 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 applic able 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 icons as shown below.

1.4.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.



DANGER!
This warning 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 imme diate danger when using this device in a hazardous atmosphere.



DANGER!
These warnings must be observedwithout fail. Even partial disregar d 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 dama ge to the device or to parts of the operator's plant.



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



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



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

i **RESULT**
This symbol refers to al l important consequences of the previous actions.

1.5 Safety instructions for the operator



WARNING!
In general, devices from the manufacturer may only be installe d, 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 packaging 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.

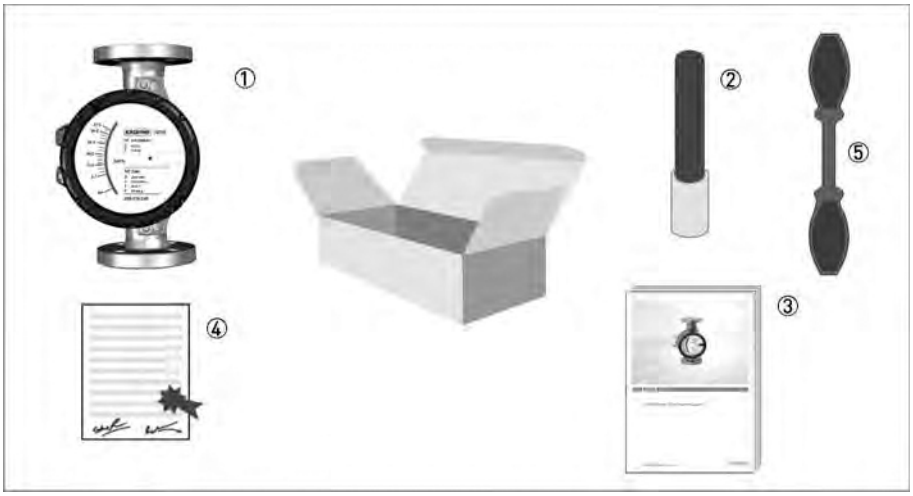


Figure 2-1: Scope of delivery

1 Measuring device in ordered version
2 For the ESK4-T version - bar magnet
3 Documentation
4 Certificates, calibration report (supplied to order only)
5 Wrench

2.2 Device version

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

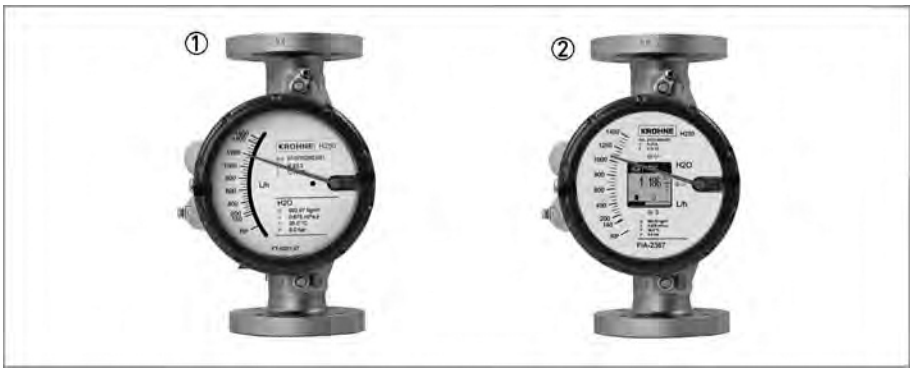


Figure 2-2: Device version - H250 with M40 indicator

Description of the device version

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...20mA, HART® or Fieldbus communication
- Intrinsically safe (Exi) or in explosion-proof enclosure (Exd)

2. H250/RR/M40

- Additional LCD, measured value and/or flow counter
- 2 configurable binary outputs, limit value or pulse output
- 1 binary input, Start / Stop / Reset flow counter
- 2-wire current output 4 …20mA, HART® communication
- Intrinsically safe (Exi) or in explosion-proof enclosure (Exd)

Optional versions:

- H250 with indicator M40 as high temperature version HT
- H250 with indicator M40 with increased corrosion protection (special paint finish)
- H250H for use in horizontal pipelines
- H250U for use in vertical fall pipes
- H250F with hygienic measuring tube design for Food & Pharma
- H250C with PTFE / TFM liner for aggressive media

Indicator options

- M40 - Aluminium, two-layer powder coating (epoxy/ polyester)
- M40R - Stainless steel without coating

Offshore wet coating for aluminiu m or stainless steel on request

2.2.1 Indicator versions

The M40 indicator can be fitted with various modules.

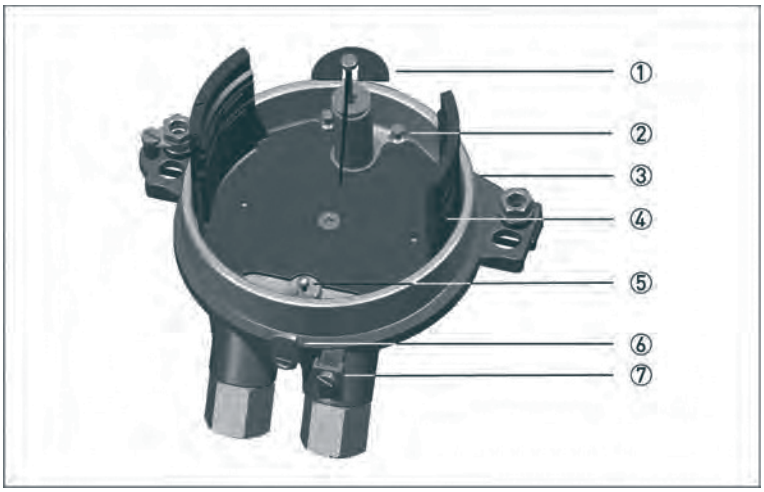


Figure 2-3: Basic version

1 Pointer module
2 Bolts for ESK4 / ESK4A attachment
3 Base plate
4 Module profile
5 Pressure piece for ESK4 / ESK4A attachment
6 Housing cover locking device
7 Ground terminal external

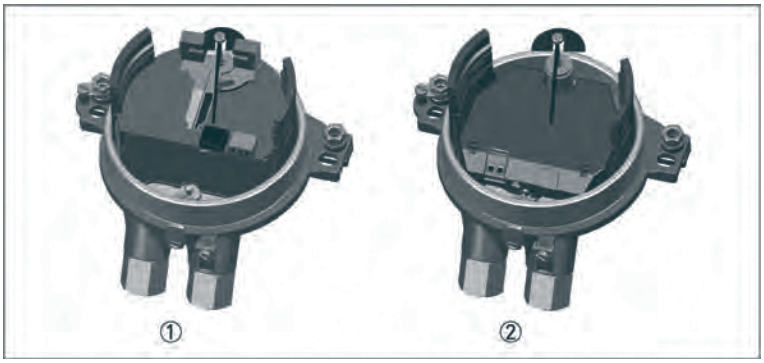


Figure 2-4: Versions K1 / K2 and ESK4 / ESK4A

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

Both versions can be combined with one another.

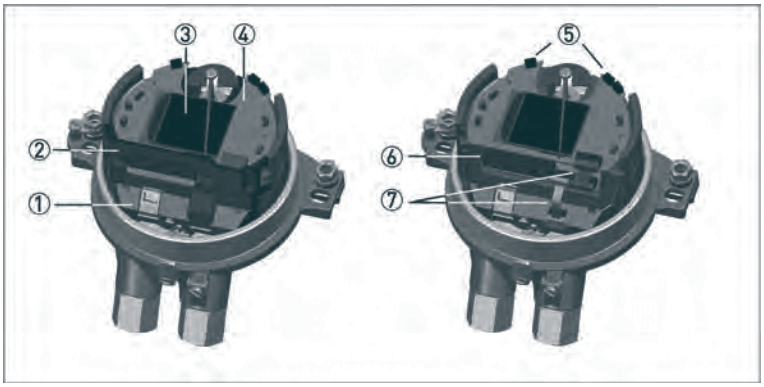


Figure 2-5: Version ESK4-T

1 ESK4 / ESK4A connection
2 Module cover
3 Display
4 Display module ESK4-IO
5 Operating keys ^ ↑
6 Connection binary outputs and reset input
7 Module connection cable

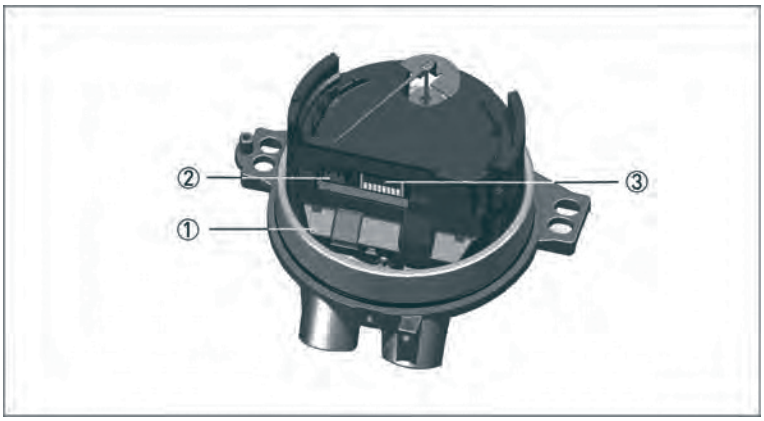


Figure 2-6: Version Fieldbus ESK4-FF / ESK4-PA

1 Basic module with electronic magnet sensors ESK4 / ESK4A
2 Connection bus module
3 DIP switch for bus settings

For more details refer to the supplementary instruct ions " Founda tion Fieldbus" or "H250M40ProfibusPA".

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 (refer to "Service").

Use of damping

- Generally when CIV and DIV floatsare used for gas measurement.
- For TIV floats (H250/RR andH250/HC only) with an operating primary pressure:

Nominal size according to		Operating primary pressure	
EN1092-1	ASMEB16.5	[bar]	[psig]
DN50	1/2"	≤0.3	≤4.4
DN25	1"	≤0.3	≤4.4
DN50	2"	≤0.2	≤2.9
DN80	3"	≤0.2	≤2.9
DN100	4"	≤0.2	≤2.9

2.2.3 Pointer damping

In principle, the indicating element with its ma gnetic 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 poin ter position, without distorting the measured value. The eddy current brake can be retrofitted during operation without recalibration. Note the maximum tightening torque (0.12Nm) for the turnbuckle!

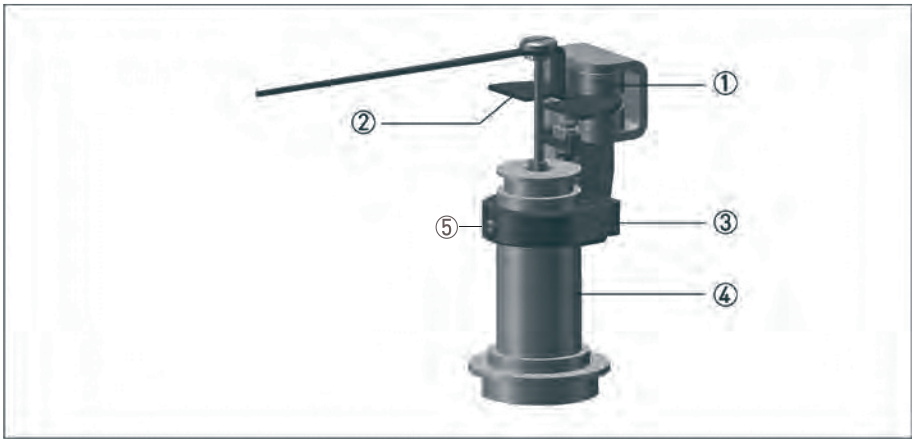


Figure 2-7: Pointer damping

1 Eddy current brake
2 Pointer vane
3 Support
4 Pointer cylinder
5 Turnbuckle, max. tightening torque is 0.12Nm

2.3 Nameplate

INFORMATION!
Check on the device nameplates, that the device is supplied according to your order.

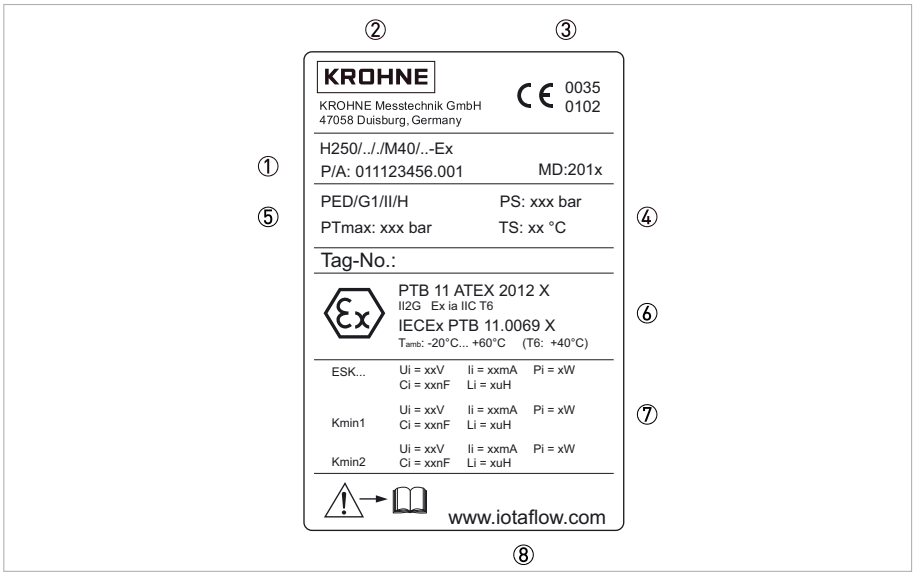


Figure 2-8: Example of a nameplate

1 Device type
2 Manufacturer
3 Notified body
4 Rating 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 *:



Figure 2-9: Description code

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
Mo - Monel
In - Inconel
F - aseptic version (food)
3 **Heating jacket version**
B - with heating jacket
4 **Type series of indicators**
M40 - Indicator M40
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 / ESK4A)
- optionally available with counter , I/O module and display (ESK4-T)
- Foundation Fieldbus (ESK4-FF)
- 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 Electronic revision

The electronic revision (sticker on the base module ESK4 / ESK4A) 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.

Electronic 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	Functional add-on to ER 2.1.x: Support of failure signal (low) according to NE43 for the ESK4 current output module
ER 3.0.x	Functional add-on: Update for HART® communication from 5.9 to 7.4 including new DD/DTM can be combined with ESK4-FF (Firmware version FF module from 1.0.2) Firmware Version ESK4-PA (... PA module from 1.0.0) Firmware Version ESK4-T (... T module from 1.2.0)

Table 2-1: Electronic revision

3.1 General installation notes



INFORMATION!
Inspect the packaging 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, dust-free location.
- Avoid direct exposure to the sun.
- Store the measuring device in the original packaging.
- The permissible storage temperatures for standard devices are: -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 ve rtically (measuring prin ciple). Flow direction from bottom to top. For installation recommendations please refer also to directive VDI/VDE3513, sheet3.*

  H250Hs are installed horizontally and H250U devices ae installed vertical ly with the flow direction from top to bottom.
- *A straight unimpeded inlet run of ≥ 5DN upstream of the device and a straight outlet run of ≥ 3DN 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 th e operating pressure.*
- *The inner diameter of the flange deviates from the standard dimensions. Flange seal standard DIN2690 or ASME B16.21 can be applied.*
- *Align the gaskets. Tighten the nuts with the ti ghtening torques of the appropriate pressure rating.*

  For devices with PTFE liner or ceramic liner and PTFE raised faces, refer to chapter "Tightening torques".
- *Control devices are to be positioned downstream of the measuring device.*
- *Shuto ffdevices are preferably to be positioned upstream of the measuring device.*
- *Before connecting, blow or flush out the pipes leading to the device.*
- *Piping for gas flow need to be dried before the device is installed.*
- *Use connectors suitable for th e particular device version.*
- *Align the piping 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.*

Minimum distance between devices

When several devices are installed next to each other, a minimum distance of > 300mm/ 11.8" between the devices is necessary.

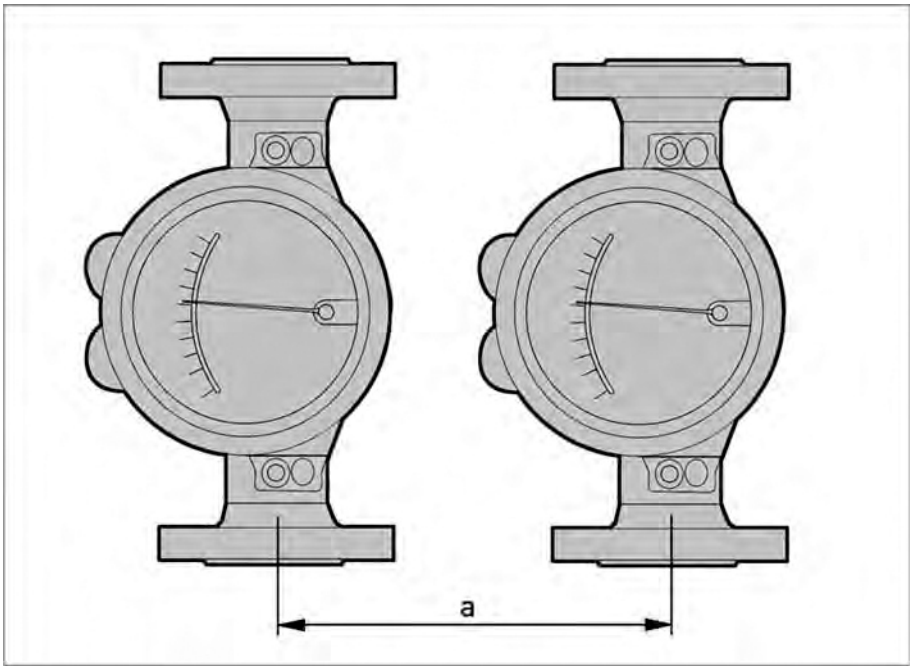


Figure 3-1: Minimum distance between devices

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

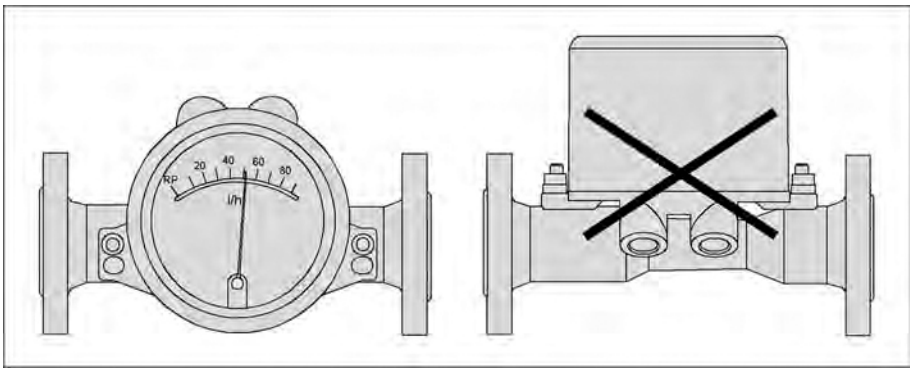


Figure 3-2: Installati on position for H250H

In order to comply with the rmal parameters and measuring ac curacy, H250H flowmeters for horizontal installation are to be inst alled in the pipeline so that th e display is located on the side of the measuring tube. The maximum product and ambient temperat ures indicated as well as the measuring accuracy are based on lateral installation of the indicator.

3.3.1 Tightening torques

For 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			
EN1092-1		ASMEB16.5		EN	ASME		EN1092-1		ASME 150lb	
DN	PN	Inch	lb		150lb	300lb	Nm	ft*lbf	Nm	ft*lbf
15	40	1/2"	150/300	4x M12	4x 1/2"	4x 1/2"	9.8	7.1	5.2	3.8
25	40	1"	150/300	4x M12	4x 1/2"	4x 5/8"	21	15	10	7.2
50	40	2"	150/300	4x M16	4x 5/8"	8x 5/8"	57	41	41	30
80	16	3"	150/300	8x M16	4x 5/8"	8x 3/4"	47	34	70	51
100	16	4"	150/300	8x M16	8x 5/8"	8x 3/4"	67	48	50	36

Table 3-1: Tightening torques

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: 1.4404/ 316L

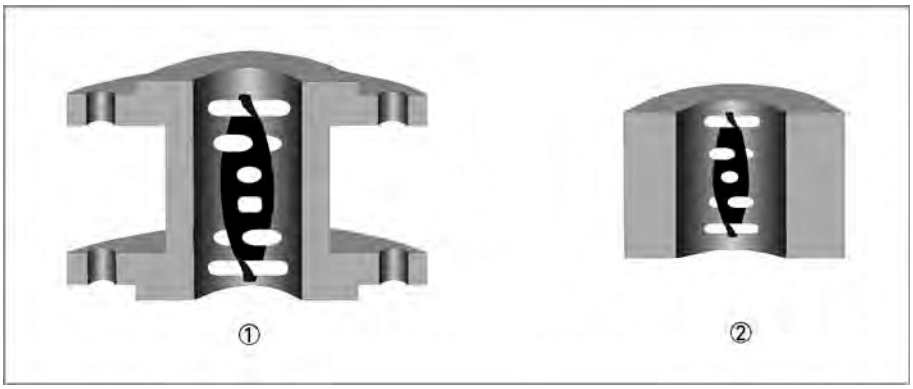


Figure 3-3: Types of magnetic filters

1 Type F - fitting part with flange - overall length 100mm/ 4"
2 Type FS - fitting part without flange - overall length 50mm/ 2"

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 .

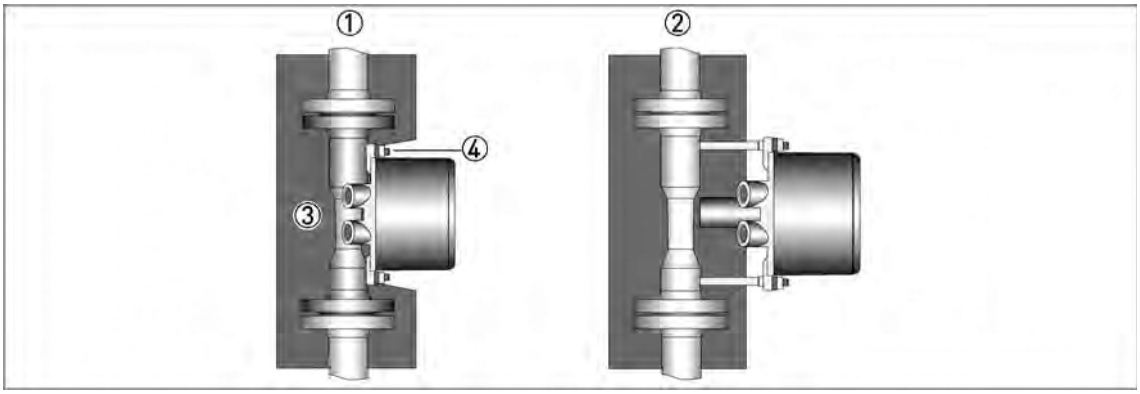


Figure 3-4: Heat insulation

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 around the cable entries 3 must be freely accessible.

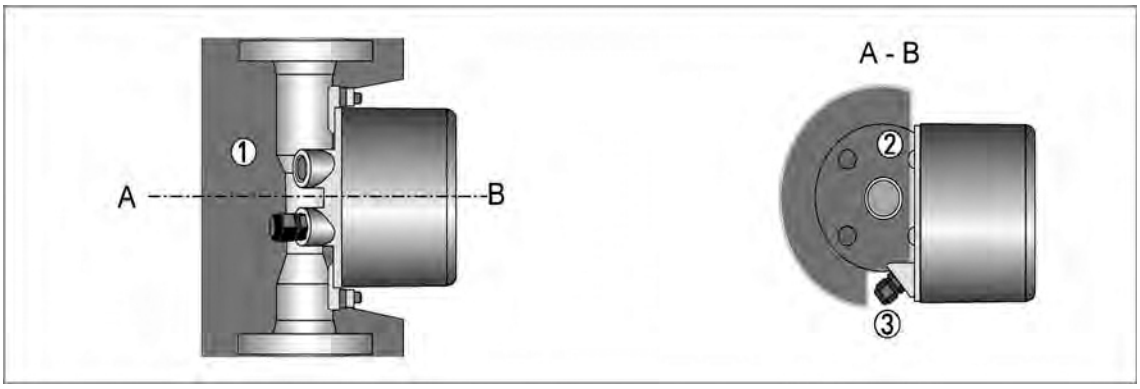


Figure 3-5: Heat insulation - cross-section

4 ELECTRICAL CONNECTIONS

4.1 Safety instructions



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 for indicator M40

4.2.1 Connection of the limit switches K1/K2

The M40 indicator can be fitted with a maximum of two limit switches.
The limit switch operates as a proximity switch which is activated inductively by the semicircular metal vane of the pointer. The switching points are set using the contact pointers.
The position of the contact pointers is indicated on the scale.

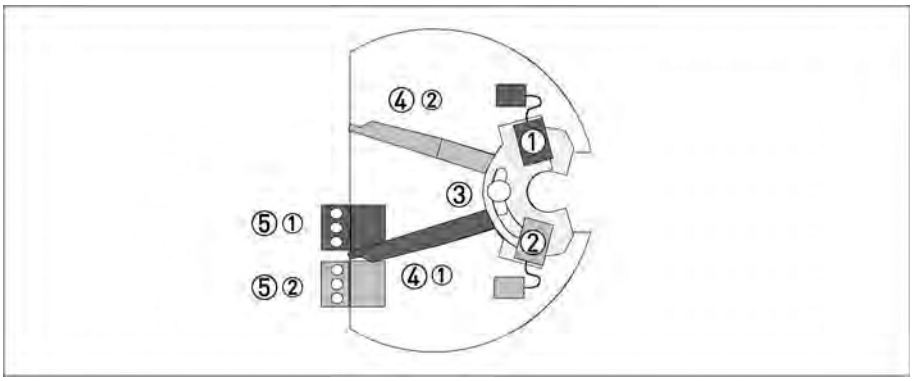


Figure 4-1: Design of limit switch module

1 MIN contact
2 MAX contact
3 Locking screw
4 Peak value
5 Connection terminal

The connection terminals have a pluggable design and can be removedto connect the cables.
The built-in limit switch types are sh own on the nameplate of the indicator.

Contact	MIN			MAX		
Terminal number	1	2	3	4	5	6
Connection 2-wire NAMUR	-	+		-	+	
Connection 3-wire	+		-	+		-
Connection Reed SPST	+		-	+		-

Table 4-1: Electrical connection of the limit switches

Connection diagram for the limit switches

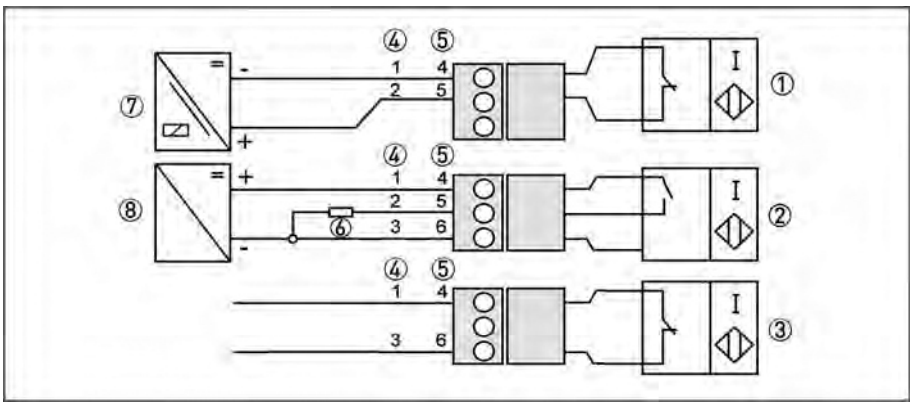


Figure 4-2: Connection terminals for limit switches

1 Limit switch 2-wire NAMUR
2 Limit switch 3-wire
3 Limit switch Reed SPST
4 Terminal connection of Min. contact
5 Terminal connection of Max. contact
6 3-wire load
7 NAMUR isolated switching amplifier
8 3-wire power supply

Limit setting

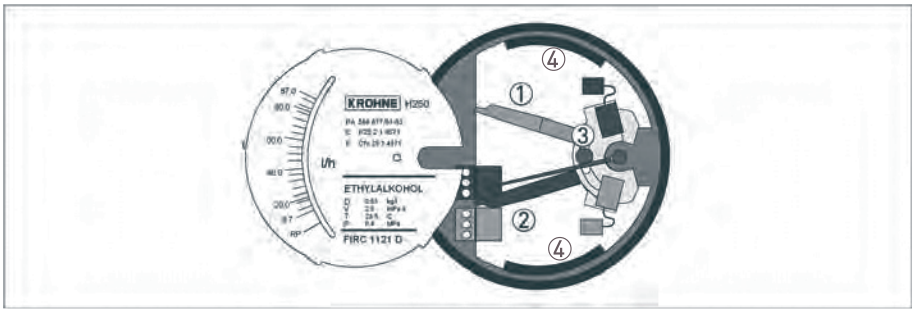


Figure 4-3: Limit setting

1 Contact pointer MAX
2 Contact pointer MIN
3 Locking screw (max. tightening torque is 0.2Nm)
4 Scale support

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

- Pull the upper scale support 2mm/ 0.08" flexibly upwards and pull out the scale from its locking point to the side.
- Loosen the locking screw 3 slightly.
- Slide in the scale up to the locking point.
- Set contact pointers 1 and 2 to the desired switching point.

After the setting:

- Pull the upper scale support 2mm/ 0.08" flexibly upwards and pull out the scale again from its locking point to the side.
- Tighten the locking screw 3 with max. 0.2Nm.
- Slide in the scale up to the locking point.

CAUTION!
If the maximum torque (0.2Nm) is exceeded, the locking screw can be torn off during tightening!

Definition of switch contact

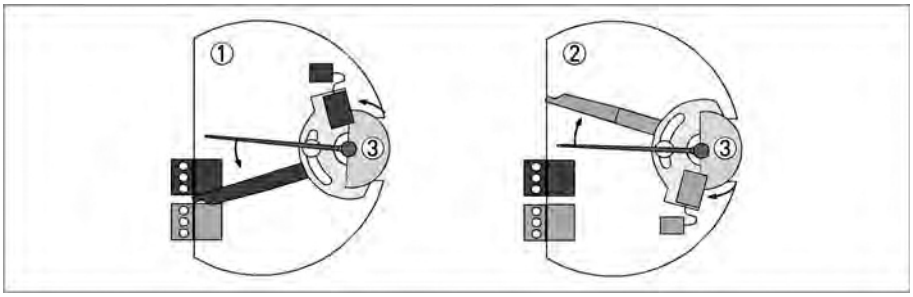


Figure 4-4: Definition of switch contact

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

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

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

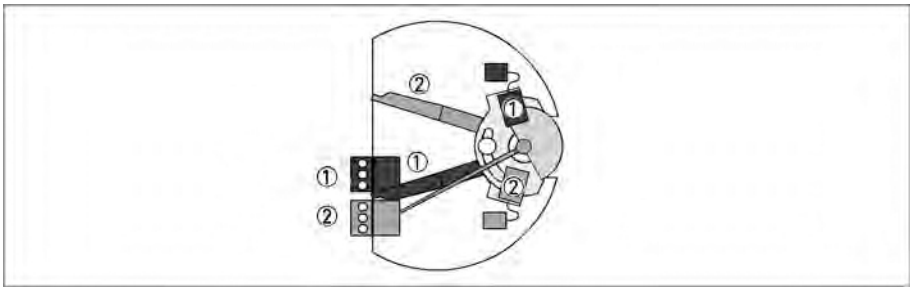


Figure 4-5: Definition MIN-MIN - MAX-MAX

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

Contact	Type	Current consumption
MIN 1	NAMUR	≤ 1mA
MIN 2	NAMUR	≤ 1mA
MAX 1	NAMUR	≥ 3mA
MAX 2	NAMUR	≥ 3mA

Table 4-2: Current consumption in the position shown:

4.2.2 Current output ESK4 / ESK4A

The connecting terminals of the ESK4 / ESK4A have a pluggable design and can be removed in order to connect the cables.

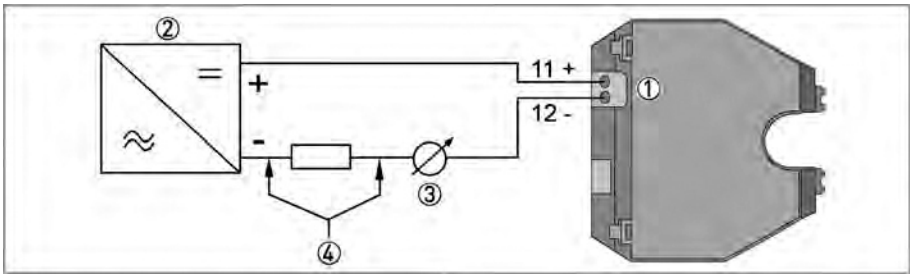


Figure 4-6: ESK4 / ESK4A connection

1 Current output of ESK4 / ESK4A
2 Power supply 14...30VDC
3 Measuring signal 4...20mA
4 External load, HART ® communication

Power supply M40 with galvanic 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 negatively affect 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.

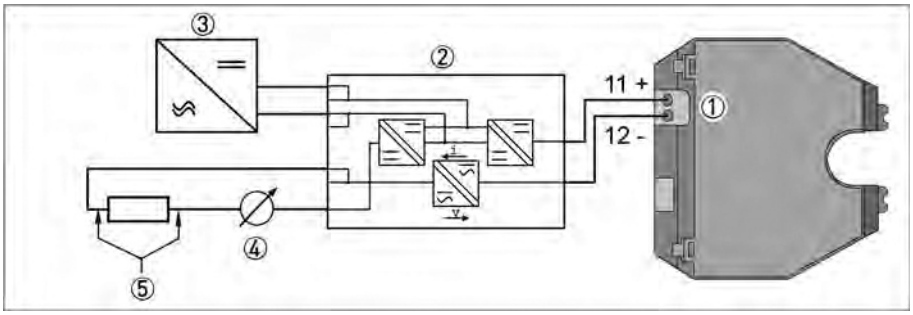


Figure 4-7: Power supply M40 with galvanic isolation

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

Power supply

INFORMATION!
The supply voltage has to be between 14VDC and 30VDC. This is based on the total resistance of the measuring loop. To calculate this, the resist ance of each component in the measuring loop (not including the device) must be added up.

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

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

with
$U_{ext.}$ = minimum supply voltage
R_L = total measuring loop resistance

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

HART® communication

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

Exception for multidrop operation. In multid rop operation a maximum of 15devices with HART® function can be operated in parallel, whereby their current outputs are switched to inactive (I approx. 4mA per device).

Load for HART® communication

INFORMATION!
For HART® communication a load of at least 230 Ω is required.

The maximum load resistance is calculated as follows:

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

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, e.g if noise levels higher than the NE21 specification are anticipated.

Configuration

The ESK can be configured via HART® communication. DD (Device Description) for AMS and PDM as well as a DTM (Device Type Manager) for PACTware™ are available for the configuration. They can be downloaded free of chargefrom the website of the manufacturer.

The current flow rate can be tran smitted 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 / ESK4A in order to guarantee function reliability. When an error is detected, a failure signal (high) is activated (current > 21mA, typically 22mA) via the analogue output. In addition more detailed information can be requested via HART® (CMD#48). The failure signal is not activated for information and warnings.

Diagnostic functions (Monitoring):

- Plausibility of FRAM data
- Plausibility of ROM data
- Working range of internal reference voltages
- Signal detection of the measurin g 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

For ESK4A (HART® 7) the diagnosis is reported in compliance with NE107.

4.2.3 ESK4-T limit outputs

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

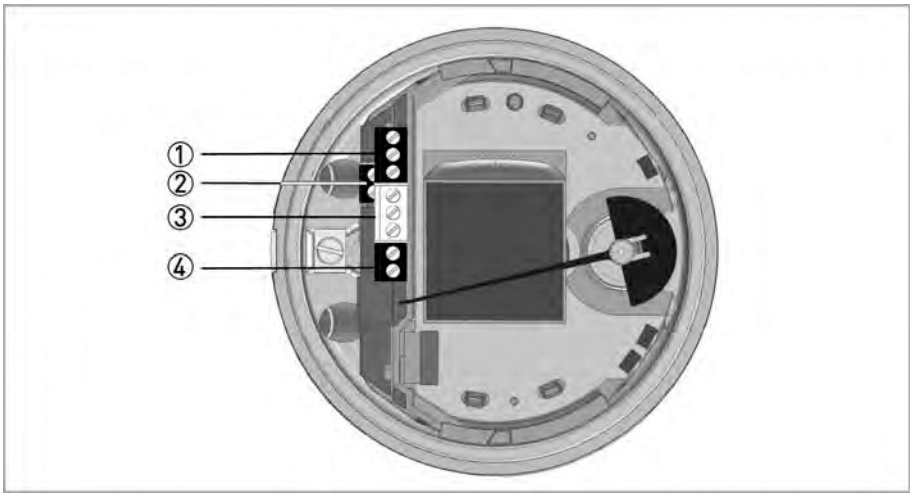


Figure 4-8: Position of the connection terminals

1 Binary output 1
2 ESK4 / ESK4A power supply / current output
3 Binary output 2
4 Binary input

The binary inputs/outputs are electrically isolated from each other and from the ESK4 / ESK4A current output.

INFORMATION!
The binary inputs/outputs can only be operated if the power supply is applied to ESK4 / ESK4A terminal 11+ and 12-. The binary inputs/outputs are inactive by default and must thus be activated prior to first use (for details refer to ESK4-T menu on page 46).

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 acc. to EN60947-5-6)
- 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}

Table 4-3: Terminal assignment of the binary output

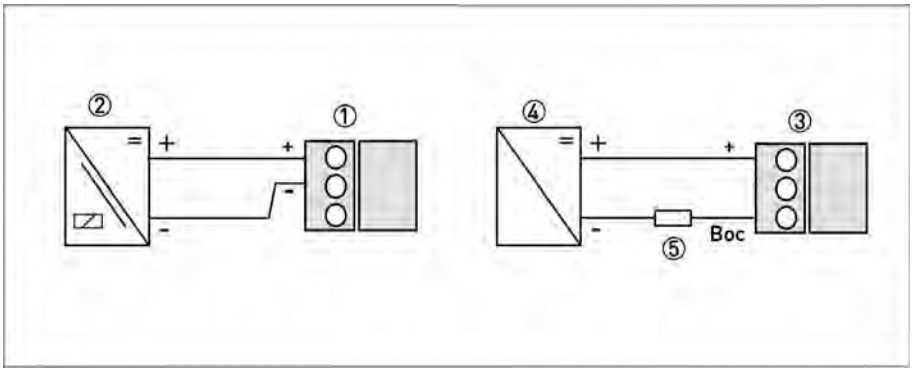


Figure 4-9: Connection switching output

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

	NC contact	NO contact
Switching value reached	< 1mA	> 3mA
Switching value not reached	> 3mA	< 1mA

Table 4-4: Value range for NAMUR

Value range applies only when connected to a switching amplifier with the following reference values:

- Open-circuit voltage U_0 = 8.2 VDC
- Internal resistance R_i = 1k Ω

Signal voltages	U_L [V]		U_H [V]	
	lower limit	upper limit	lower limit	upper limit
via load R_L	0	2	16	30

Table 4-5: Value range for transistor output

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

Table 4-6: Value range for transistor output

To ensure the value ranges, a load R_L between 250 Ω and 1k Ω is recommended for the passive transistor output with a nominal voltage of 24VDC.

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 (DINIEC946).

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

4.2.4 ESK4-T pulse output

INFORMATION!
The binary outputs can also be operated as pulse outputs. When using the binary outputs as a pulse output, two separate signal circuits are required. Each signal circuit requires its own power supply.
The total resistance 4 must be adapted so that the total current I_{tot} does not exceed 100mA.

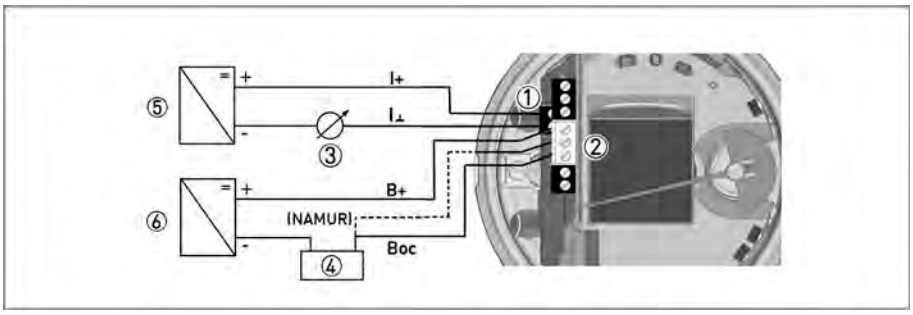


Figure 4-10: Electrical connection of pulse output

1 Terminal for power supply - current output
2 Terminal B2
3 Flow measurement 4...20mA
4 Pulse output load e.g. counter
5 Power supply for ESK4
6 Power supply for pulse output

The pulse output B2 is a passive "open collector" output which is electric ally isolated from the current output and output B1. It can be operat ed as a low-resistance output or as a NAMUR output.

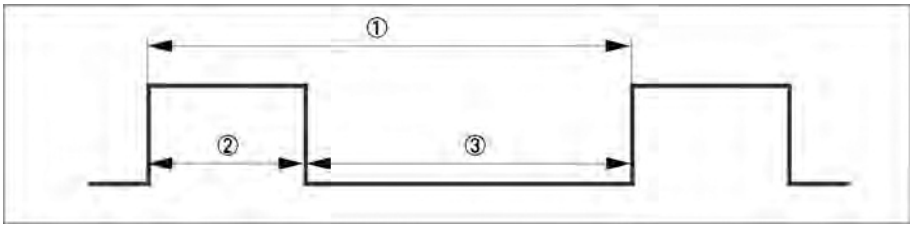


Figure 4-11: Data for pulse output

1 f_{max} = 10Hz
2 t_{on}
3 t_{off}

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

4.2.5 ESK4-T binary input

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

Binary input	B3	
Terminal no.	7	8
Connection	+	-

Table 4-7: Value range for NAMUR

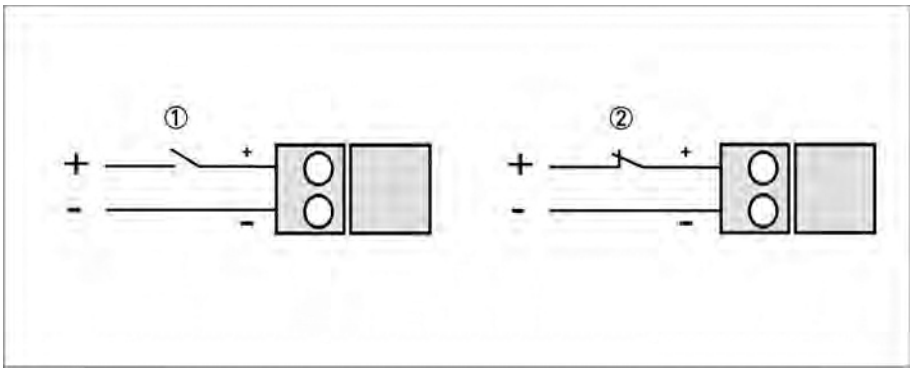


Figure 4-12: Binary input

1 Function active HI
2 Function active LO

This binary input can be activated in the menu of the indicator and can be configured to ACTIVE HI or ACTIVE LO.

If the input is set as ACTIVE LO, an interruption causes the counter to be reset.

For further information on configur ation of each function refer to *ESK4-T menu* on page 46.

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

Table 4-8: Value range

The binary input has an internal resistance R_i of 20k Ω.

4.2.6 ESK4-FF / ESK4-PA fieldbus communication

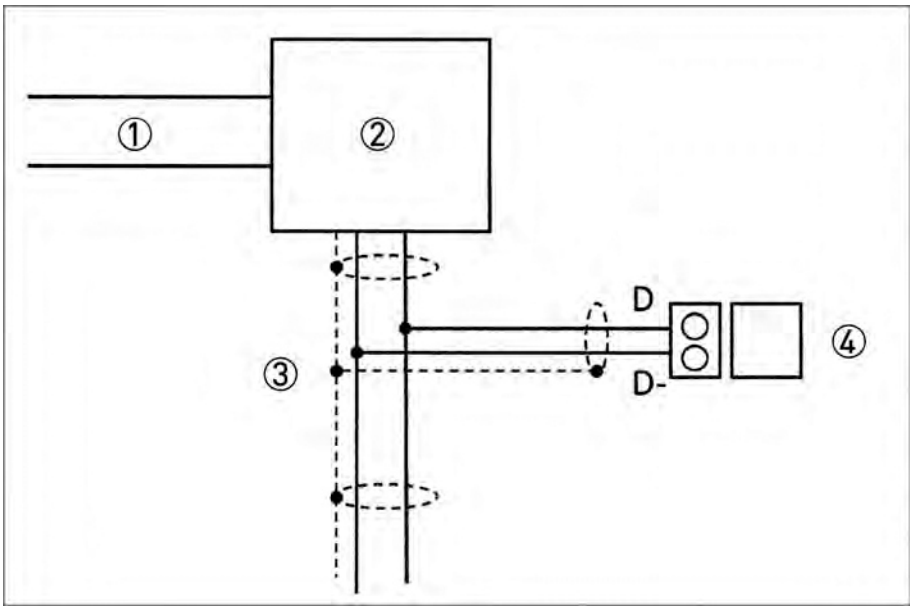


Figure 4-13: ESK4-FF / ESK4-PA fieldbus communication

1 FF HSE Bus / Profibus DP
2 Linking device / bus coupler
3 FF H1 Bus / Profibus PA, 2-wire with shielding
4 H250/M40/ESK4-FF / H250/M40/ESK4-PA

ESK4-FF / ESK4-PA

- 2-wire, bus-supplied
- Polarity protected
- Bus voltage 9...32VDC
- Nominal current 16mA

4.2.7 Harting HAN 7D connection

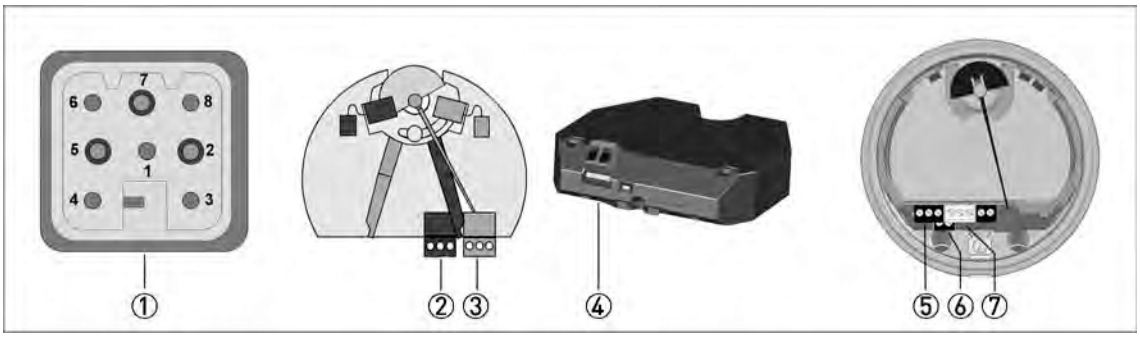


Figure 4-14: Terminal assignment

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

1 Pin number HAN® 7D	K1/K2 NAMUR contacts	R1/R2 Reed contacts	ESK4/ESK4A	Terminal number	
				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	-	-	-		

Table 4-9: Terminal assignment - Harting plug to terminal number

Combinations of K1 / K2 and ESK4 / ESK4A are possible.

1 Pin number HAN® 7D	ESK4-T	Terminal number
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	-	

Table 4-10: Terminal assign ment - Harting plug to terminal number for ESK4-T

INFORMATION!
No Harting connection for module ESK4-FF/PA is provided and is only available on request.

4.3 Grounding connections

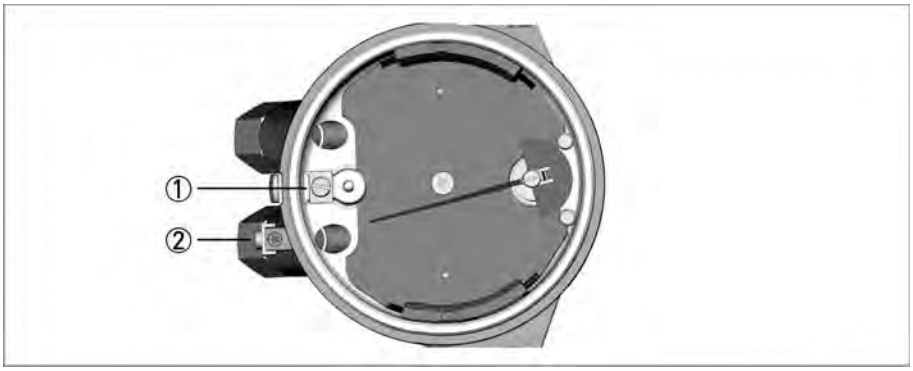


Figure 4-15: Grounding connections

1 Grounding connection on the indicator
2 Outer 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 Ingress protection

The measuring device meets all requirements of ingress protection 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 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 .

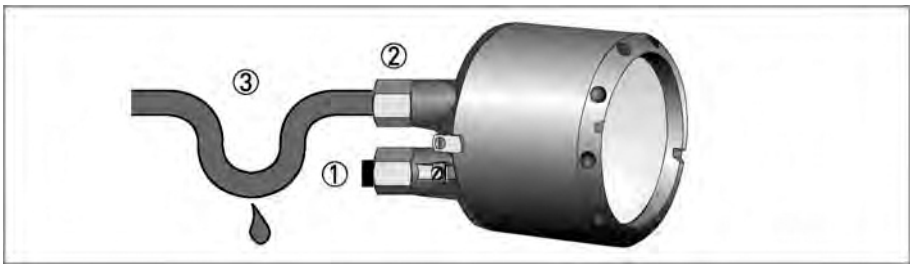


Figure 4-16: Laying the cable

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 ensure that the pipelines are carefully evacuated.*
- *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 / ESK4A - Loop Check Mode

The ESK4 / ESK4A 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 .



Figure 6-1: Position of the microswitch

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

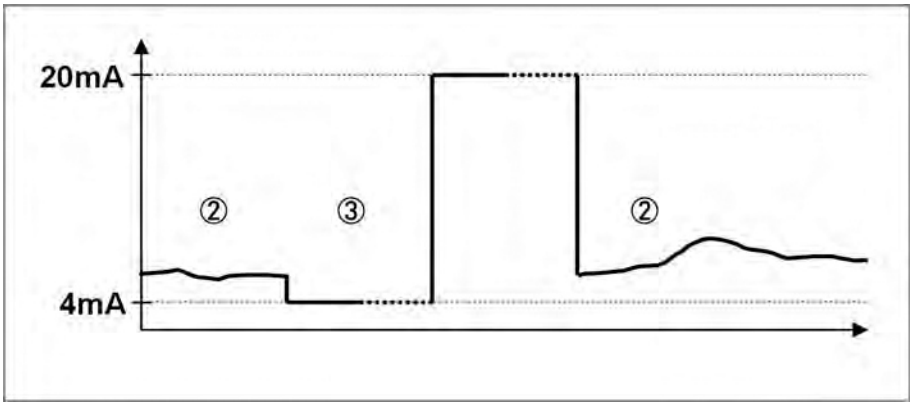


Figure 6-2: Loop Check Mode

- Press and hold the microswitch 1 for more than 6seconds to activate the loop check mode3 . The current output jumps to constant 4mA.
- Change the current output from constant 4mA to constant 20mA as often as you like by briefly pressing it (less than 6seconds) to check the function of the measuring circuit.
- Exit loop check mode by holding down the microswitch (longer than 6seconds). The current output jumps back to measuring mode 2 .

INFORMATION!
If the microswitch has not been pressed for longer than 60seconds, the ESK4 / ESK4A automatically returns 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 an error in the measurem ent as the float position is recorded by the magnetic field sensors.

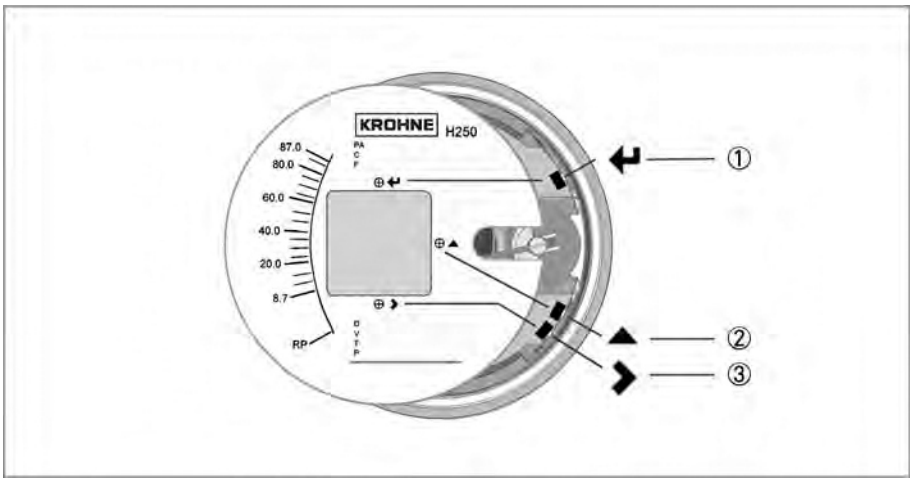


Figure 6-3: Display and operating elements

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:

	Key	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 Description of the operating keys

→	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 menuitems 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. Using the ↑ key takes you one menu item 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), the key takes you to the change mode, where you can set data and values.

If you are 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 savedwill appear. Confirm this query with the → key or cancel it with the ^^ key.

Measuring mode	→	Main menu ↑	→	Submenu ↑	→	Function ↑	→	Edit → ↑^^
	^^		^^		^^		^^	

Table 6-3: Navigation within the menu structure

6.3.3 Change thesettings in the menu

Starting operation

Operation is started using the → key.

If an operation lock is set, the code (↦ → → ^ ^ ^ ↑ ↑ ↑) must be entered. The code can be set in menu 3.13. The code shown hereis set at the factory but not activated. If no key is activated within 5seconds or an incorrect code is en tered, a warning message is displayed and the indication returns to measuring mode.

Exit operation

Operation is exited by pressing the ^^ key several times.

If data have been changed:

Save Yes	→	Changes are accepted. An update is carried out and the display returns to measuring mode.
Save No	^^	Changes are discarded and the display returns to measuring mode.

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

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

	Display			Display
Example:	7.2 m^3/h		1x →	Fct. 3.11.**1** MEASD VALUE
1x →	Fct. **1** OPERATION		1x →	10.0000 m^3/h
2x ↑	Fct. **3** INSTALLATION		4x ↑	10000 l/h
1x →	Fct 3.**1** LANGUAGE			Confirm with → deny ^
10x ↑	Fct 3.**11** F.S.& UNIT		3x ^^	7200 l/h

6.4 Overview of the units ESK4-T

Volume units can either represent real operating volumes (no prefix before the unit) or standard volumes virtually converte d to reference statuses.

Prefix	Volume definition
None	Operating volume flow e.g. m^3/h or ft^3/h
N	Volume flow at standard (norm.) conditions (0°C - 1.013bara) acc. to DIN1343 e.g. Nm^3/h
S	Volume flow at standard (std.) conditions (15°C - 1.013bara) acc. to ISO13443 e.g. Sft^3/h

Measured variables	Units			
Operating volume flow	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
Standard (norm.) volume flow	Nm^3/s	Nm^3/min	Nm^3/h	Nm^3/d
	NL/s	NL/min	NL/h	-
Standard (std.) volume flow	Sm^3/s	Sm^3/min	Sm^3/h	Sm^3/d
	SL/s	SL/min	SL/h	-
	Sft^3/s	Sft^3/min	Sft^3/h	Sft^3/d
Mass flow	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
Operating volume totalizer	m^3	l	hl	ft^3
	ImpGal	gallon	bbl	bbl (liq)
Standard (norm.) volume totalizer	Nm^3	NL		
Standard (std.) volume totalizer	Sft^3	SL	Sm^3	
Mass totalizer	kg	g	t	lb
	STon	LTon		
Temperature	°C	°F	K	

Table 6-4: Overview of the units ESK4-T

In addition to the predefined units shown here, a user-defined unit can be activated in Menu 3.12 by entering a conversion factor and a unit designation as free text.

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 ta ble below contains a description of possible error messages.

Symbol	NE107 Category	Description	Consequence
	**F**	Failure	No measured value available Output signal invalid. Error current signal is output.
	S	Out of specification	Measurement available but increasing measurement uncertainty. Device must be checked.
	M	Maintenance required	Measurement still sufficiently accurate but maintenance required.
	C	Check request	Device is in test or linearization mode. The output signal temporarily does not correspond to the measurement.
	I	Information	No influence on the measurement, information only.

Table 6-5: Description of the symbols

Error message	Description	Category	Remedy
NOT LINEARIZED	Linearization faulty or not activated = measuring error	S	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	S 1	
LINEARIZATIO UNDER CONFIG	The device is in linearization mode = measuring error	S	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)	S	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	S	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	S	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%		

Error message	Description	Category	Remedy
NO ZERO CAL OF AO	The current output zero point 4.00mA is not calibrated. = possible measuring error in process control.	S	Perform calibration using ammeter and menu 3.10 or using standard HART® tools/process control system and poss. external ammeter. Caution: during calibratio n, 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.	S	Perform calibration using ammeter and menu item 3.11 or using standard HART® tools and external ammeter if nece ssary. 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	S	The device, together with an indication of the error, must be sent back to the manufacturer for checking.
WRONG ELEC.REV.	The ER revision of the ESK4/ ESK4A is not compatible with the add-on module, or the ribbon cable connection is not connected properly.	S	Check that the ribbon cable fits properly. Check module compatibility (f or details refer to *Electronic revision* on page 18).
OUTPUT NOT LINEARIZED	Linearization is not activated = measuring error	S	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	S 1	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.
FRAM WRITE FAULT	Internal communication error	F	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.	F	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	I	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 4.5mA.	I	The HART® multidrop mode is activated with selection of a polling address not equal to 0 using menu item 3.7. Polling address 0 reactivates the current output.
CRYSTAL OSC FAULT	Internal error in device	F	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	F 1	
SENSOR B FAULT	Internal error in device		
MEMORY CORRUPTION	Internal memory error, caused by a hardware or software problem	F	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.	I	The current output is fi xed 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	I	The current output is saturated at >20.4mA and is no longer linked to the measurement.

Error message	Description	Category	Remedy
ERROR TIMEOUT	Data not transferred, or transferred incorrectly from the ESK to the counter module	F	Confirm menu item "1.6.3 WRITE INFO I/O".
WARNING TIMEOUT		I	

Table 6-6: Error messages ESK4-T

1 Category can be changed by user.

6.6 ESK4-T menu

6.6.1 Factory settings

Function	Setting
1.1.1 OUTPUT B1	INACTIVE
1.2.1 OUTPUT B2	INACTIVE
1.3.1 PULSE WIDTH	50ms
1.3.2 PULSE/UNIT	1 Pulse/Unit
1.4 DISPLAY	MEASD VALUE
1.4.2 ROTATION	0°
1.5 TIME CONST	1.0s
1.6.1 COUNTER	NO
1.6.2 ERROR	NO
1.6.3 RE-INIT IO	NO
3.1 LANGUAGE	ENGLISH
3.2 FUNCTION B1	INACTIVE
3.3 CONTACT B1	NORM.OPEN
3.4 FUNCTION B2	INACTIVE
3.5 CONTACT B2	NORM.OPEN
3.6 FUNCTION B3	INACTIVE
3.7 MULTIDROP	POLLING ADD: 00
3.8 4mA CALIBR.	4.000mA
3.9 20mA CALIBR.	20.000mA
3.10 ALARM CURR.	ALARM HIGH
3.11 F.S.& UNIT	Application specific
3.11.2 COUNTER	Application specific
3.12 USER DEFINED	User defined unit / factor
3.13 L.FL.CUTOFF	4% ON; 6% OFF
3.14 DESCRIPTOR	Free text
3.15 ENTRY CODE	OFF
3.16 DEFAULT VAL.	NO

Table 6-7: Factory settings

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

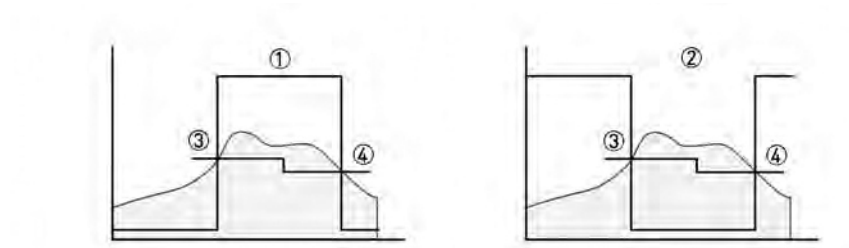
Main menu	Submenu 1	Submenu 2
1 OPERATION	1.1 OUTPUT B1	1.1.1 INACTIVE, MEAS.VAL. B1, CNT. VAL. B1, PULSE WIDTH
		1.1.2 HYST. B1, PULSE/UNIT
	1.2 OUTPUT B2	1.2.1 INACTIVE, MEAS.VAL. B2, CNT. VAL. B2, PULSE WIDTH
		1.2.2 HYST. B2, PULSE/UNIT
	1.3 PULSE OUTP.	1.3.1 PULSE WIDTH
		1.3.2 PULSE/UNIT
	1.4 DISPLAY	1.4.1 MEAS'D VALUE, COUNTER, MV/COUNTER, MV&COUNTER, 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 OUTP	2.1.1 NORMAL OP
		2.1.2 4.0mA
		2.1.3 5.6mA
		2.1.4 7.2mA
		2.1.5 8.8mA
		2.1.6 10.4mA
		2.1.7 12.0mA
		2.1.8 13.6mA
		2.1.9 15.2mA
		2.1.10 16.8mA
		2.1.11 18.4mA
		2.1.12 20.0mA
		2.1.13 21.6mA
	2.2 ALARM CURR.	ALARM HIGH, ALARM LOW
	2.3 OUTPUT B1	2.3.1 NORMAL OP
		2.3.2 OPEN
		2.3.3 CLOSED
	2.4 OUTPUT B2	2.4.1 NORMAL OP
		2.4.2 OPEN
		2.4.3 CLOSED
	2.5 INPUT B3	ACTIVE HI, ACTIVE LO, ON, OFF
	2.6 DEV. IDENT.	2.6.1 ELEC. REV.
		2.6.2 SN ESK4
		2.6.3 PROD. ORDER
		2.6.4 DEV. SN.

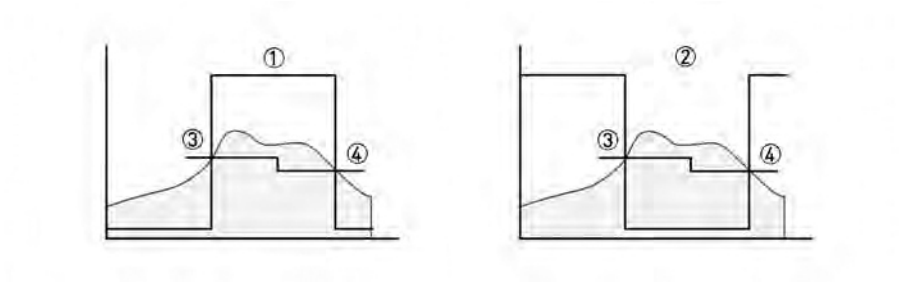
Main menu	Submenu 1	Submenu 2
2 TEST & INFO	2.7 SOFT.VERSION	2.7.1 FW. ESK4
		2.7.2 FW. ESK4 I/O
	2.8 TAG NB.	8 characters
	2.9 LONG TAG	32 characters
3 INSTALLATION	3.1 LANGUAGE	3.1.1 ENGLISH
		3.1.2 DEUTSCH
		3.1.3 FRANCAIS
		3.1.4 ITALIANO
		3.1.5 ESPANOL
		3.1.6 CESKY
		3.1.7 POLSKI
		3.1.8 NEDERLANDS
		3.1.9 DANSK
	3.2 FUNCTION B1	INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.
	3.3 CONTACT B1	NORM.OPEN, NORM.CLOSED
	3.4 FUNCTION B2	INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.
	3.5 CONTACT B2	NORM.OPEN, NORM.CLOSED
	3.6 FUNCTION B3	INACTIVE, ACTIVE HI, ACTIVE LO, STARTH STOPL, STARTL STOPH
	3.7 MULTIDROP	POLLING ADD.
	3.8 4mA CALIBR.	4.000mA
	3.9 20mA CALIBR.	20.000mA
	3.10 ALARM CURR.	OFF, ALARM HIGH, ALARM LOW
	3.11 F.S.& UNIT	3.11.1 MEAS'D VALUE
		3.11.2 COUNTER
	3.12 USER DEFINED	3.12.1 MEAS'D VALUE
		3.12.2 COUNTER
	3.13 L.FL.CUTOFF	3.13.1 CONTROL ON, CONTROL OFF
		3.13.2 ON VALUE
		3.13.3 OFF VALUE
	3.14 DESCRIPTOR	Free text
	3.15 ENTRY CODE	OFF, ON
	3.16 DEFAULT VAL.	SET ALL

Table 6-8: Menu structure

6.6.3 Menu description

1 OPERATION

Selection / Input	Explanation
1.1 OUTPUT B1	Output B1 is a binary switching output. In Fct.3.2, one of the following functions can be selected for this output: INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.
	One of the following functions can be selected as contact type in Fct.3.3: NORM.OPEN 1 / NORM.CLOSED 2 
1.1.1	
INACTIVE	-
MEAS.VAL. B1	Switching point of flow value Value range: 0.0…full scale range The switching point is entered in flow units. If the current flow value exceeds this pre-determined switching point, output B1 changes its binary state 3 . In Fct.1.1.2 a hysteresis can be specified additionally.
CNT. VAL. B1	Switching point of 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 pre-determined switching point, output B1 changes its binary state 3 . There is no hysteresis setting for the switching point of the counter value.
PULSE WIDTH	Pulse weight (pulse/unit) The weight is only displayed here. A configuration takes place in Fct.1.3.1 PULSE WIDTH, 1.3.2 PULSE/UNIT and 3.11.2 COUNTER.
1.1.2 HYST. B1	Hysteresis for the switching point of the flow value Value range: 0.0…switching point If the current flow value exceeds the pre-determined 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**: In 1.1.1, a switching point of 200L/h is set. The possible value range for the hysteresis is then 0.0…200L/h. With a hysteresis value of 0, the switching point has no hysteresis (3 =4). If a hysteresis value of 20L/h is entered, output B1 changes its binary state to the initial setting, if it drops below 180L/h 4 .

Selection / Input	Explanation
1.2 OUTPUT B2	Output B2 is a binary switching output. In Fct.3.4, one of the following functions can be selected for this output: INACTIVE, SWITCH POINT, COUNT. LIMIT, PULSE OUTP.
	One of the following functions can be selected as contact type in Fct.3.5: NORM.OPEN 1 / NORM.CLOSED 2 
1.2.1	
INACTIVE	-
MEAS.VAL. B2	Refer to MEAS.VAL. B1 In Fct.1.2.2 a hysteresis can be specified additionally.
CNT. VAL. B2	Refer to CNT. VAL. B1
PULSE WIDTH B2	Refer to PULSE WIDTH B1 A configuration takes place in Fct.1.3.1 PULSE WIDTH, 1.3.2 PULSE/UNIT and 3.11.2 COUNTER.
1.2.2 HYST. B2	Refer to HYST. B1
1.3 PULSE OUTP.	-
1.3.1 PULSE WIDTH	
50ms	T_i = 50ms; f_{max} = 10Hz max. pulses/h = 36000
100ms	T_i = 100ms; f_{max} = 5Hz max. pulses/h = 18000
200ms	T_i = 200ms; f_{max} = 2.5Hz max. pulses/h = 9000
500ms	T_i = 500ms; f_{max} = 1Hz max. pulses/h = 3600
1.3.2 PULSE/UNIT	0.001...1000 Pulse per volume or mass unit of counter (setting in Fct.3.11.2), which can be output via one of the binary outputs. The maximum frequency for the pulse output (refer to Fct1.3.1) cannot be exceeded, even at maximum flow rate (full scale). **Example**: Final value Q_{max} = 1200L/h; volume unit of counter = Litre; pulse width = 100ms; If the factor 1 is entered, 1 pulse/litre = 1200pulses are generated in one hour at maximum flow rate. Number of max. permissible pulses: $\frac{\frac{Pmax}{h}}{Qmax} = \frac{18000\frac{P}{h}}{1200\frac{l}{h}} = 15\frac{P}{l}$

1.4 DISPLAY	Different measured values can be selected for permanent or alternating display. The reading on the display can be rotated.
1.4.1	
MEASD VALUE	Permanent display of flow in flow units
COUNTER	Permanent display of totalizer
MV/COUNTER	Alternating display of flow value in flow units and totalizer
MV&COUNTER	Simultaneous display of flow value and totalizer
PERCENT	Permanent display of flow value in percent
1.4.2 ROTATION	
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°.
1.5 TIME CONST	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.
1.6 RESET	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 RE-INIT IO	As a general rule, data is transferred from the counter module to the ESK4 and vice versa when the device starts. For safety, another data transmission can be performed by selecting this menu item and confirming with "YES".

Table 6-9: Menu description - 1 OPERATION

2 TEST & INFO

Selection / Input	Explanation
2.1 4-20mA OUTP	Testing the current loop by setting various current values. **Note:** The test is not available in HART® multi-drop mode (refer to 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 4.0mA	The value of the current loop no longer follows the current process. It is set to the selected current value.
2.1.3 5.6mA	
2.1.4 7.2mA	
2.1.5 8.8mA	
2.1.6 10.4mA	
2.1.7 12.0mA	
2.1.8 13.6mA	
2.1.9 15.2mA	
2.1.10 16.8mA	
2.1.11 18.4mA	
2.1.12 20.0mA	
2.1.13 21.6mA	
2.2 OUTPUT B1	<3.6 / >21mA Testing the alarm current HIGH/LOW according to the settings in Fct.3.10.
2.3 ALARM CURR.	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.
2.3.1 NORMAL OP	The binary status of the switching output corresponds to the current process.
2.3.2 OPEN	The binary status of the switching output no longer corresponds to the current process. The selected status is tested.
2.3.3 CLOSED	
2.4 OUTPUT B2	Refer to 2.2 OUTPUT B1
2.4.1 NORMAL OP	
2.4.2 OPEN	
2.4.3 CLOSED	
2.5 INPUT B3	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 if the function B3 is activated (refer to Fct.3.6).

Selection / Input	Explanation
2.6 DEV. IDENT.	Information for device identification
2.6.1 ELEC. REV.	Electronic revision
2.6.2 SN ESK4	Serial number ESK4
2.6.3 PROD. ORDER	Production order for the complete flowmeter
2.6.4 DEV. SN.	Serial number for th e complete flowmeter
2.7 SOFT.VERSION	Information about software revision status
2.7.1 FW. ESK4	Software revision status for device insert ESK4-Basic
2.7.2 FW. ESK4 IO	Software revision status for optional add-on module ESK4-T
2.8 TAG NB.	8 digits Measuring point identifier Alphanumerical characters. Up to eight digits are possible.
2.9 LONG TAG	32 digits Measuring point identifier Alphanumerical characters. Up to 32 digits are possible.

Table 6-10: Menu descri ption - 2 TEST & INFO

3 INSTALLATION

Selection / Input	Explanation
3.1 LANGUAGE	Language selection for the displayed menu texts.
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	
3.2 FUNCTION B1	-
INACTIVE	The binary switching output B1 has no function.
SWITCH POINT	The binary switching point B1 acts as a limit switch depending on the current flow value. Configuration of the switching point is in Fct.1.1.1 MEAS.VAL. B1.
COUNT. LIMIT	The binary switching point B1 acts as a limit switch depending on the current counter value. Configuration of the switching point is in Fct.1.1.1 MEAS.VAL. B1.
PULSE OUTP.	The binary switching point B1 acts as a pulse output depending on the current flow value. Pulses of a maximum of up to 10Hz can be generated. The configuration is in Fct.1.3.1 PULSE WIDTH and 1.3.2 PULSE/UNIT. **Note**: The configuration in 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.
3.3 CONTACT B1	-
NORM.OPEN	The contact type of the binary switching output B1 is "normally open".
NORM.CLOSED	The contact type of the binary switching output B1 is "normally closed".

Selection / Input	Explanation
3.4 FUNCTION B2	-
INACTIVE	Refer to FUNCTION B1
SWITCH POINT	Refer to FUNCTION B1 Configuration of the switching point is in Fct.1.2.1 MEAS.VAL. B2.
COUNT. LIMIT	Refer to FUNCTION B1 Configuration of the switching point is in Fct.1.2.1 MEAS.VAL. B2.
PULSE OUTP.	Refer to FUNCTION B1 The configuration is in Fct.1.3.1 PULSE WIDTH and 1.3.2 PULSE/UNIT.
3.5 CONTACT B2	-
NORM.CLOSED	Refer to CONTACT B1
NORM.OPEN	Refer to CONTACT B1
3.6 FUNCTION B3	-
INACTIVE	The binary switching input B3 has no function.
ACTIVE HI	The internal flow counter is reset to 0.0 if there is an H level at input B3 for at least 100ms.
ACTIVE LO	The internal flow counter is reset to 0.0 if there is an L level at input B3 for at least 100ms.
STARTH STOPL	The counter is started by creating an H level at input B3 and stopped by creating an L level at input B3.
STARTL STOPH	The counter is started by creating an L level at input B3 and stopped by creating an H level at input B3.
3.7 MULTIDROP	0…15
	Polling address 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 "4.5mA") and no longer follows the current process.
3.8 4mA CALIBR.	D/A calibration for lower range value (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 an ampere meter detects in the 4...20mA loop a deviation from the desired value of "4.000mA", the measured value must be entered. The correction value is accepted following the query to save and confirm with yes.
3.9 20mA CALIBR.	D/A calibration for the full scale value (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 an ampere meter detects in the 4...20mA loop a deviation from the desired value of "20.000mA", the measured value must be entered. The correction value is accepted following the query to save and confirm with yes.
3.10 ALARM CURR.	-
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.

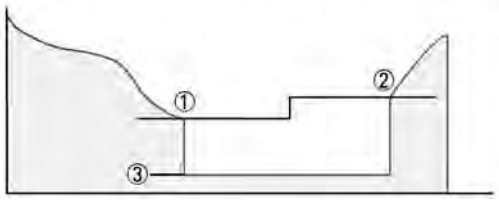
Selection / Input	Explanation
ALARM HIGH	Error indication via the current loop is acti vated (failure signal "high" acc. to NE43). **Note**: This function is not available in HART® multi-drop mode.
ALARM LOW	Error indication via the current loop is acti vated (failure signal "low" acc. to NE43). **Note**: 1) This function is not available in HART® multi-drop mode. 2) This function is supported from ER2.2.x.
3.11 END&UNIT	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 MEAS'D VALUE	For units for volume flow or mass flow, refer to *Overview of the units ESK4-T* on page 43.
3.11.2 COUNTER	For units for volume counter or mass counter and pulse output, refer to *Overview of the units ESK4-T* on page 43.
3.12 USER DEFINED	User-defined unit with conversion to calibrated unit.
3.13 L.FL.CUTOFF	L.FL.CUTOFF stands for low flow cutoff. To ensure a stable zero point of the current output, the current output can be set to a stable value of "4.00mA" 3 in a selectable range. 
3.13.1	
CONTROL OFF	LFC function is not active.
CONTROL ON	L.FL.CUTOFF function is active.
3.13.2 ON VALUE	Switch-on value 1 : Value range 1…19% (of full scale range) The flow is greater than the switch-on value. The current output corresponds to this. If the flow rate falls, the current ou tput follows until the switch-on value 1 . If the flow value continues to fall, the current output is switched to "4.00mA" 3 . **Note**: The switch-on value to be set must be smaller than the previously selected switch-o ffvalue.
3.13.3 OFF VALUE	Switch-o ffvalue 2 : Value range 2…20% (of full scale range) The flow rate is 0. The current output is "4.00mA" 3 . If the flow rate increases, th e current output remains at "4.00mA" until it has reached the switch-o ffvalue 2 . **Note**: The switch-o ffvalue to be set must be greate r than the previously selected switch-on value.
3.14 DESCRIPTOR	12 digits Free text input for header in LCD
3.15 ENTRY CODE	Entry code for the local operating menu. The entry code is not active by default.
3.15.1 OFF	The use of an entry code is not activated.
3.15.2 ON	If "YES" is selected, the last code that was entered has to be typed in. Factory code: →→→^ ^ ^ ↑↑↑ If, after confirmation with "YES", the → key is pressed additionally, then a new, individual, nine digits code can be typed in. The display shows the required key combination.
3.16 DEFAULT VAL.	Resetting parameters to factory default. There is always a safety prompt ("YES/ NO"), to avoid accidental resetting.

Table 6-11: Menu description - 3 INSTALLATION

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 the indicator.
We advise that inspections are carried out at least once per year.
The device must be removed from the pipeline before cleaning.



CAUTION!
Pressurised pipes have to be depressurised before removing the device.
Empty the pipelines 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.
New gaskets have to be used when re-installing the device in the pipeline.
Avoid electrostatic charges when cleaning the surfaces (e.g. sight window)!

7.2 Replacement and retrofitting

Some components of the variable area flowmeter can be retrofitted:

- Float damping

Indicator M40:

- Limit switch module K1 / K2
- Current output 4..20mA ESK4 / ESK4A
- Counter module with LCD and I/O ESK4-T
- Fieldbus interface ESK4-PA / FF

7.2.1 Replacing floats



- Remove the device from the pipeline.
- Take the upper span 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 stop. While doing this, the float's upper guide rod must be guided through the middle hole of the float stop.
- Insert the span ring into the measuring unit.
- Fit the device back into the pipeline.



CAUTION!
Without a recalibration an additional measuring error is to be expected.

7.2.2 Retrofitting of the float damping

- Take the upper span ring 1 out of the measuring unit.
- Take the upper float stop 2 and float 5 out of the measuring unit.
- Fasten the re taining 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 retaining ring 3 .
- Insert float into the lower floa t guide in the measuring unit.
- Retrofit the supplied damping cylinder with the integr ated float stop 2 into the measuring unit.
- Insert upper span ring 1 .

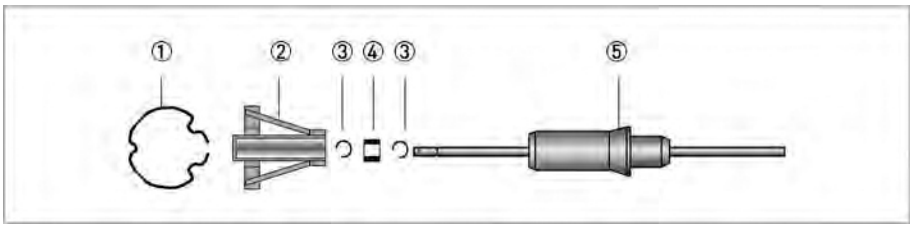


Figure 7-1: Design of the float damping

1 Span ring
2 Float stop
3 Retaining ring
4 Ceramic sleeve
5 Float

7.2.3 Retrofitting of the limit switch

- Remove ESK4/ ESK4A 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.

For the setting of the limits refer to *Connection of the limit switches K1/K2* on page 25.

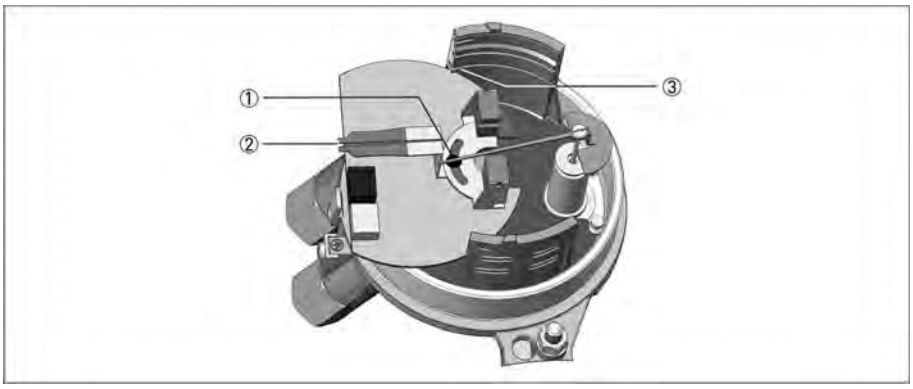


Figure 7-2: Retrofitting of the limit switch

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

WARNING!
Do not damage the indicating element!

7.2.4 Replacement - Retrofitting ESK4 / ESK4A

CAUTION!
When replacing or retrofitting an ESK4 / ESK4A, it is mandatory to indicate the serial number (SN) or sales order (SO) when ordering.
This information can be found on the indicator nameplate.

The ESK4 / ESK4A is factory calibrated, making it possible to replace it or retrofit it without recalibrating.

- De-energise the ESK4 / ESK4A.
- Lift and remove the ESK4 / ESK4A with a screwdriver.

WARNING!
Do not damage the indicating element!

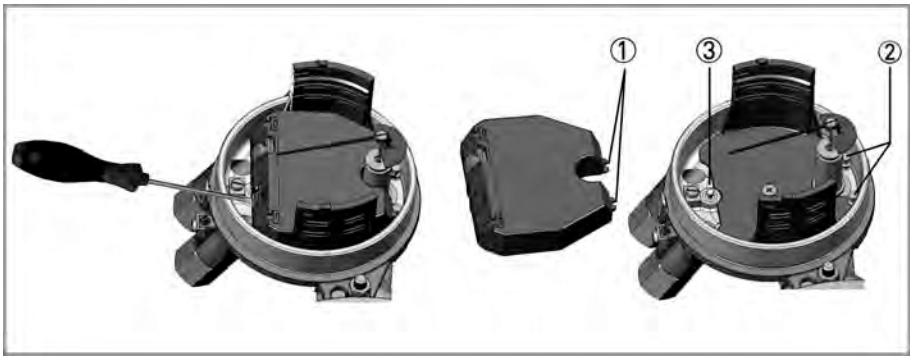


Figure 7-3: Replacement - Retrofitting ESK4 / ESK4A

- The ESK4 / ESK4A plug-in tongues 1 are plugged in under the two bolts 2 on the base plate.
- Slight pressure is used to press the ESK4 / ESK4A onto the spring pins 3 until it stops, firmly attaching the ESK4 / ESK4A.

If a change in measuring range, product temperature, product, density, viscosity or pressure is desired, this can be done with the help of a variable area calculation program and with a HART® modem.
However, each measuring unit is subject to its own physical limits, which the variable area calculation program correctly 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 / ESK4A:

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

7.2.5 Replacement - Retrofitting add-on module ESK4-T / PA / FF

The add-on module for the ESK4 /ESK4A can be replaced or retrofitted on-site without removing the device from the process control.

- ESK4-T (Display module with LCD and I/O)
- ESK4-PA (Profibus PA interface)
- ESK4-FF (Foundation Fieldbus interface)

More detailed information can be found in the service manual included with each retrofit or replacement set.

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 number
DN15	
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 retaining rings	X251053100
Damping bush (7x8) PEEK incl. 2 retaining rings	X251053200
DN25	
Float CIV 25, 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 retaining rings	X252053100
Damping bush (12x8) PEEK incl. 2 retaining rings	X252053200

Spare part	Order number
DN50	
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 retaining rings	X253053100
Damping bush (14x10) PEEK incl. 2 retaining rings	X253053200
DN80	
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 retaining rings	X254053100
Damping bush (18x14) PEEK incl. 2 retaining rings	X254053200
DN100000	
Float CIV 105, 1.4404	X255041000
Float DIV 105, 1.4404	X255042000
Float DIVT 105, 1.4404	X255044000
Set float stop; standard (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 retaining rings	X254053100
Damping bush (18x14) PEEK incl. 2 retaining rings	X254053200

Indicator M40	
Housing components	
Standard indicator housing M40 complete, no scale *	X251110000
Standard indicator housing M40R complete, no scale* (stainless steel, non-coated)	X251111000
Standard cover M40	X251110100
Standard cover M40R (stainless steel, non-coated)	X251110400
Cover seal	X251112100
M40R standard base plate (stanless steel, non-coated) *	X251120300
Standard = not pressure-tight	
Housing components indicator M40	
Retrofit kit HT extension	X251021000
Module carrier (profile rail)	X251121100
Set housing attachment parts	X251121300
Pointer system, complete *	X251122100
Magnetic brake for indicating element	X251122200
* Accuracy loss without recalibration	
NAMUR 2-wire limit module	
Contact module K1 min I7S23,5-N	X251135100
Contact module K1 max I7S23,5-N	X251135200
Contact module K2 min / max I7S23,5-N	X251135300
Contact module K1 min SC3,5 N0	X251133100
Contact module K1 max SC3,5 N0	X251133200
Contact module K2 min / max SC3,5 N0	X251133300
Contact module K2 min / min min - SJ3,5 S1N / SJ 3,5 SN	X251133400
Contact module K2 max / max max - SJ3,5 S1N / SJ 3,5 SN	X251133500
Contact module K1 min SJ3,5 SN	X251133600
Contact module K1 max SJ3,5 SN	X251133700
Contact module K1 min / max SJ3,5 SN	X251133800
3-wire limit module, normally closed	
Contact module K1 min SB3,5 E2 - act.Low	X251133900
Contact module K1 max SB3,5 E2 - act.Low	X251134000
Contact module K1 min / max SB3,5 E2 - act.Low	X251134100
3-wire limit module, normally open	
Contact module K1 min SB3,5 E2 - act.High	X251134200
Contact module K1 max SB3,5 E2 - act.High	X251134300
Contact module K1 min / max SB3,5 E2 - act.High	X251134400

Electronic modules	
ESK4, ESK4-FF, ESK4-PA, ESK4-T FF (serial number required)	
Cover for add-on modules	X251121500
Connection cable ESK4 to add-on modules	X251121600
Plugs (10 pcs) for ESK4 connection for bus modules	X251132500
Replacement connector	
Replacement connector 11/12 for ESK4	X251121700
Replacement connector D/D+ for ESK4-FF or ESK4-PA	X251121800
Replacement connectors 1/2/3, 4/5/6, 7/8 for ESK4-T	X251121900
Replacement cable gland	
Single cable gland M20x1.5 black, plastic - for non-Ex / Ex-i	X251150300
Single cable gland M20x1.5 blue, plastic - for non-Ex / Ex-i	X251150100
Single cable gland M20x1.5 brass - for non-Ex / Ex-i / Ex-nA	X251151000
Single cable gland M20x1.5 brass Ex-d/t - for Ex-d / Ex-t	X251152000
Single plug M20x1.5 brass Ex-d/t - for Ex-d / Ex-t	X251153000
Single cable gland M20x1.5 stainless steel Ex-d/t - for Ex-d / Ex-t	X251154000
Single plug M20x1.5 stainless steel Ex-d/t - for Ex-d / Ex-t	X251155000

INFORMATION!
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.

WARNING!
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 the personnel, the 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.*

WARNING!
If the device has been operatedwith toxic, caustic, radioactive, 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 it is safe to handle and stating the product used.*

7.5.2 Form (for copying) to accompany a returned device



CAUTION!
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:
Department:		Name:
Tel. no.:		Fax no. and/or Email address:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	radioactive
	☐	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



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

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:



According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

7.7 Disassembly and recycling

This section describes how to handle and disassemble the device in order to dispose of it following end of use. The information provided enables the end user to identify and separate the main components of the device for the purpose of recycling.

INFORMATION!

- *Wear personal protective equipment*
- *Make sure to use a stable workstation/ bench to disassemble*

7.7.1 Description of the device components

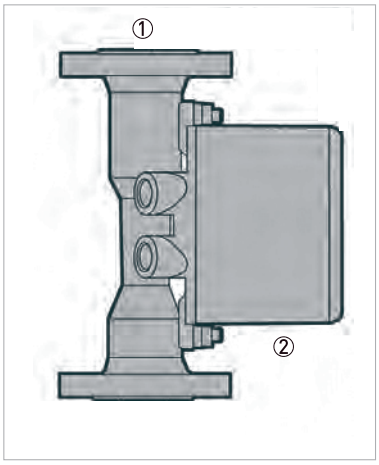


Figure 7-4: Description of the device components

1 Measuring unit
2 Indicator housing

The variable area flowmeter consists of a mechanical, metallic measuring unit 1 and an indicator housing attached to it 2 , which may contain electronic components.
The metallic measuring unit can be sent to metal recycling after the indicator housing has been removed. Depending on the version, the measuring unit may weigh between 2...50kg/ 4.4...110.2lb.

CAUTION!
Check and ensure that the measuring units, including all cavities, are free of hazardous substances by rinsing or neutralising if required. This should be done especially in the case of devices that have been operated with toxic, corrosive, radioactive, flammable or water-contaminating products to protect both the environment and the health and safety of staff.

7.7.2 Indicator versions

The following discusses the indicator housing and optional electronics in more detail. The indicator housing can be fitted with various el ectronic modules. These can be easily removed from the housing in order to send th em to electronics recycling/disposal.

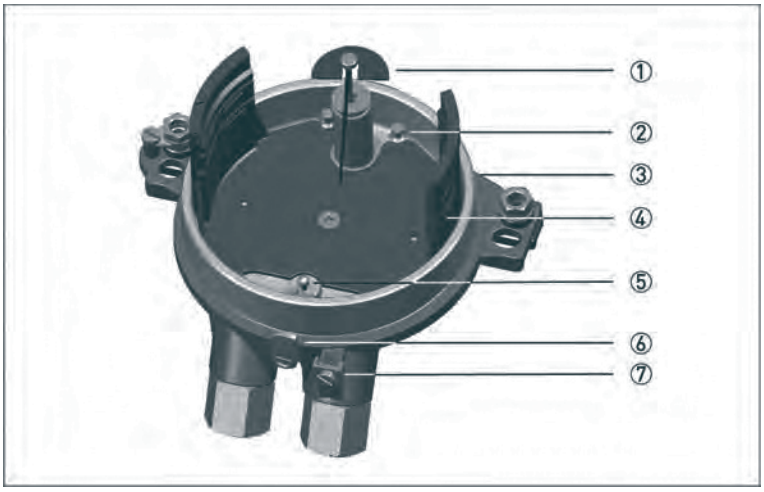


Figure 7-5: Basic version

1 Pointer module
2 Bolts for ESK4 / ESK4A attachment
3 Base plate
4 Module profile
5 Pressure piece for ESK4 / ESK4A attachment
6 Housing cover locking device
7 Ground terminal external

The indicator housing consists of the following components:

Approx. information	Weight	Remarks
Glass panel	135cm ² / 20.9in ²	-
Coated aluminium, cover + base plate	1.2...1.4kg/ 2.6...3.1lb	For M40 indicator type (see nameplate)
Stainless steel, cover + base plate	3.2...3.7kg/ 7.1...8.2lb	For M40R indicator type (see nameplate)
Other metal parts, pressure pin, bolts, grounding connection	50g/ 0.1lb	-
PA module profile	75g/ 0.17lb	Can be removed by taking out the screw
Pointer system		Can be removed after removing the module profile
Aluminium	30g/ 0.07lb	
Plastic	1g/ 0.002lb	
Magnetic material	10g/ 0.02lb	
Other metals	2g/ 0.004lb	

The indicator housing may contain optional electronic components which can be seen when the cover is opened. They may be removed individually from th e indicator housing.

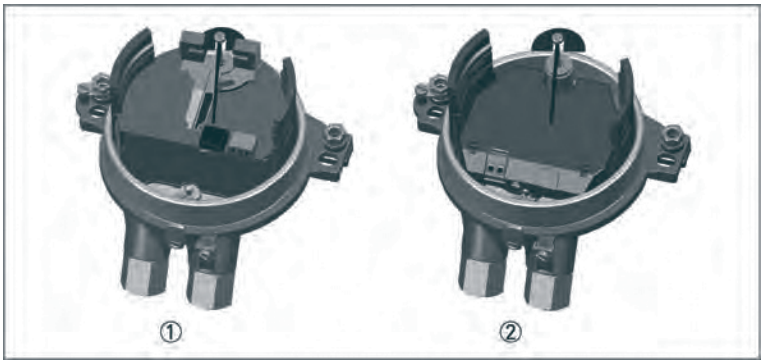


Figure 7-6: Versions K1 / K2 and ESK4 / ESK4A

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

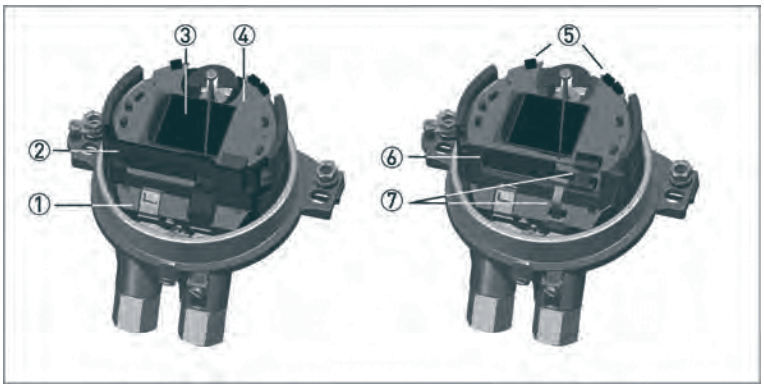


Figure 7-7: Version ESK4-T

1 ESK4 / ESK4A connection
2 Module cover
3 Display
4 Display module ESK4-IO
5 Operating keys ^ ↑
6 Connection binary outputs and reset input
7 Module connection cable

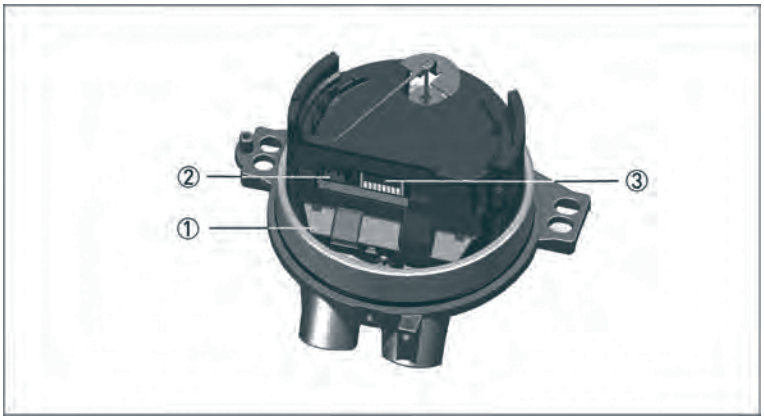


Figure 7-8: Version Fieldbus ESK4-FF / ESK4-PA

1 Basic module with electronic magnet sensors ESK4 / ESK4A
2 Connection bus module
3 DIP switch for bus settings

The optional electronic modules consist of the following main components:

All information is approximate	ESK4	ESK4-I/O	ESK4-FF/ ESK4-PA	Contact module K1/K2
PCB	68cm ² / 10.5in ²	2x62cm ² / 2x9.6in ²	62cm ² / 9.6in ²	75cm ² / 11.6in ²
PA housing	63g/ 0.14lb	42g/ 0.09lb	42g/ 0.09lb	-
Potting (silicone)	135g/ 0.30lb	100g/ 0.22lb	100g/ 0.22lb	5g/ 0.01lb
Batteries	-	-	-	-
Electrolytic capacitors	-	-	-	-
LC display	-	16cm ² / 2.5in ²	-	-

INFORMATION!
Silicone is used when potting the PCBs in the PA housings. It is thus not easy to separate the components by hand.

8.1 Functional principle

The H250 flowmeter operates in accordance with the float measuring principle. The measuring unit consists of a metal cone in which a float can move freely up and down. The medium flows through the flowmeter from bottom to top. The float adjusts itself so that the buoyancy force F1 acting on it, the form resistance F2 and its weight F3 are in equilibrium: F3 = F1 + F2

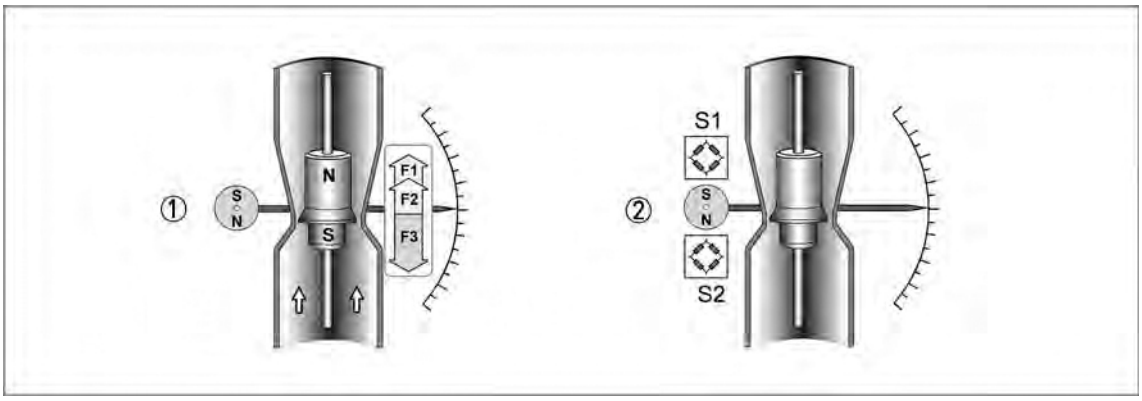


Figure 8-1: Measurin g principle - general

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 / ESK4A), the flow-dependent height of the float in the measuring unit is detected by the S1 and S2 magnetic field sensors and electronically processed.

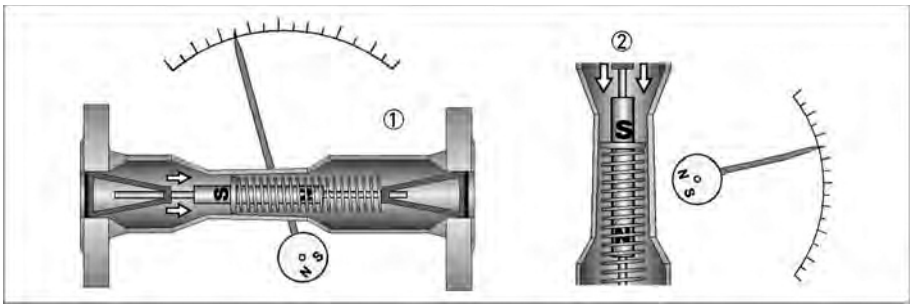


Figure 8-2: Measuring prin ciple for H250H and H250U

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

The flowmeter operates in accordance with 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 (Downloadcenter).*

Measuring system

Application range	Flow measurement of liquids, gases and vapours
Function / Measuring principle	Float measuring principle
Measured value	
Primary measured value	Float position
Secondary measured value	Operating volume flow, standard volume flow or mass flow

Measuring accuracy

Directive	VDI/VDE3513, sheet 2 (q_G = 50%)
H250 /RR /HC /F	1.6%
H250/C (ceramic, PTFE), H250H, H250U, H250 (100 : 1	2.5%
Precision (repeatability)	
H250 /RR /HC /F	0.25%
H250H, H250U, H250 (100 : 1)	0.5%

Operating conditions

Temperature	
Max. operating temperature TS	-196...+300°C/ -321...+572°F Depending on the version (refer to nameplate)
Pressure	
Max. operating pressure PS, max. test pressure PT	Depending on the version (refer to nameplate)
Min. required operating pressure	2 times greater than pressure loss (refer to measuring ranges)
Pressure/temperature heating for measuring cone	
DN15...DN50	PS = 40barg/ 580psig, TS = 300°C/ 572°F
DN80...DN100	PS = 25barg/ 363psig, TS = 300°C/ 572°F
Ingress protection	
M40, M40R	IP66/68 according to EN60529, NEMA 4/4X/6 according to NEMA 250
M40R	IP69K according to DIN40050-9
Float damping during gas measurement recommended	
DN15...25/ 1/2...1"	Operating pressure <0.3barg/ 4.4psig
DN50...100/ 2...4"	Operating pressure <0.2barg/ 2.9psig

Installation conditions according to VDI/VDE3513, sheet 3

Inlet section	≥ 5 x DN
Outlet section	≥ 3 x DN

Materials

Device	Flange	Measuring tube	Float	Float guide	Ring orifice
H250/RR	CrNi steel 1.4401/ 1.4404, 316/ 316L (dual certification)		1.4404, 316L		
H250/HC	Hastelloy® C4 (2.4610) solid or plated	Hastelloy® C4			
H250/F - Food	CrNi steel 1.4435		CrNi-steel 1.4435/ 1.4404		
H250/C - Ceramic/PTFE 1	CrNi steel 1.4571 with TFM/PTFE 2		PTFE or Al_2O_3 with FFKM gasket	Al_2O_3 and PTFE	Al_2O_3

1 DN100/4" only PTFE

2 TFM/PTFE liner (electrically non-conductive), conductive PTFE on request

Other options on request:

- Special materials: e.g. SMO 254/6Mo/1.4547, Titanium Grade 2, Hastelloy® C276/2.4819, Monel®/2.4360, Inconel®/2.4856 a.o.
- Float damping: PEEK (only for gas) or ceramic
- Standard gasket for devices with female thread as insert: O-ring FPM / FKM, others optional e.g. FFKM, EPDM

M40	Aluminium, two-layer powder coating (epoxy/ polyester)
M40R	Stainless steel without coating 1.4408/ CF8M
Offshore	Wet coating on request

Temperatures

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

Temperatures H250/M40 - mechanical indicator without auxiliary power

	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 FPM/FKM			-20...+200	-4...+392	-20…+120	-4…+248
H250/HC	Hastelloy®		-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 1.4301		-40...+100	-40…+212	-40…+120	-40…+248
	Spring material Hastelloy® 2.4610		-40...+200	-40...+392	-40…+120	-40…+248

Ambient temperatures T_{amb} with electrical components

Version	[°C]	[°F]
ESK4, ESK4A, ESK4-FF, ESK4-PA	-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.

INFORMATION!
The device must not be heated by radiated heat (e.g. exposure to the sun) to an electronics housing surface temperature above the maximum permissible ambient temperature. A sunshade is available as option.

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

			T_{amb} < +40 °C		T_{amb} < +60 °C 1	
EN	ASME	Version with	Standard	HT	Standard	HT
DN15, DN25	1/2", 1"	ESK4 / ESK4A, -FF, -PA	+200	+300	+180	+300
		ESK4-T	+200	+300	+140	+290
		Limit switch NAMUR	+200	+300	+200	+300
		Limit switch 3-wire	+200	+300	+130	+295
DN50	2"	ESK4 / ESK4A, -FF, -PA	+200	+300	+165	+300
		ESK4-T	+200	+300	+140	+290
		Limit switch NAMUR	+200	+300	+200	+300
		Limit switch 3-wire	+200	+300	+120	+195
DN80, DN100	3", 4"	ESK4 / ESK4A, -FF, -PA	+200	+300	+150	+250
		ESK4-T	+200	+300	+130	+270
		Limit switch NAMUR	+200	+300	+200	+300
		Limit switch 3-wire	+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	1/2", 1"	ESK4 / ESK4A, -FF, -PA	392	572	356	572
		ESK4-T	392	572	284	554
		Limit switch NAMUR	392	572	392	572
		Limit switch 3-wire	392	572	266	563
DN50	2"	ESK4 / ESK4A, -FF, -PA	392	572	165	572
		ESK4-T	392	572	284	554
		Limit switch NAMUR	392	572	392	572
		Limit switch 3-wire	392	572	248	383
DN80, DN100	3", 4"	ESK4 / ESK4A, -FF, -PA	392	572	302	482
		ESK4-T	392	572	266	518
		Limit switch NAMUR	392	572	392	572
		Limit switch 3-wire	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/ +212°F)

Abbreviation

HT	High-temperatu re version
ESK4 / ESK4A	2-wire current output 4 …20mA with HART 5® / HART 7®
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

	Material	Cable diameter	
		[mm]	[Inch]
M20x1.5 Standard	PA	8...13	0.315...0.512
M20x1.5	Nickel-plated brass	10...14	0.394...0.552
M20x1.5	Stainless steel	10...14	0.394...0.552

Limit switches K1/K2

Terminal connection	2.5mm 2				
Limit switches	I7S23,5-N SC3,5-N0	SJ3,5-SN1	SJ3,5-S1N1	SB3,5-E2	Reed
NAMUR (IEC60947-5-6)	Yes	Yes	Yes	No	No
Connection type	2-wire	2-wire	2-wire	3-wire	2-wire
Switching element function	Normally closed	Normally closed	Normally open	PNP NO	NC SPST
Nominal voltage U_0	8.2VDC	8.2VDC	8.2VDC	10...30VDC	max. 32VDC 2
Pointer vane not detected	≥ 3mA	≥ 3mA	≤ 1mA	≤ 0.3VDC	U_0
Pointer vane detected	≤ 1mA	≤ 1mA	≥ 3mA	U_B - 3VDC	0VDC
Continuous current	-	-	-	Max. 100mA	Max. 100mA
No load current I_0	-	-	-	≤ 15mA	-
Switching cycles	-	-	-	-	100000

1 safety oriented
2 no inductances

Current output ESK4 / ESK4A

Terminal connection	2.5mm 2
Power supply	14...32VDC (12...32VDC without ESK4-T), intrinsically safe max. 30VDC
Min. power supply for HART®	20VDC at 250Ω load
Measuring signal	4.00...20.00mA = 0...100% flow value in 2-wire technology
Power supply influence	<0.1%
External resistance dependency	<0.1%
Temperature influence	<5 µA/K
Max. external resistance / load	650 Ω at 30VDC
Min. load for HART®	250 Ω
NAMUR conformity	NE43, NE107, NE21

ESK4 HART® configuration

Manufacturer name (code)	IOTAFLOW Messtechnik (0x45 = 69)
Model name / HART® revision	ESK4 (214 = 0xD6) / HART 5.9
	ESK4A (17854 = 0x45BE) / HART 7.4
Physical Layer	FSK

ESK4 / ESK4A process variable

	Values [%] from full scale range	Signal output [mA]
Upper range limit	+102.5 (±1%)	20.24...20.56
Device error identification	> 106.25	>21.00 (changeable to 3.6mA)
Multidrop operation		4.5

ESK4-FF

Physical Layer	IEC61158-2 and FISCO model
Communication standard	H1 FOUNDATION Fieldbus protocol
ITK version	6.3 (FW≥ V 2.01)
Power supply	Bus supply: 9...32VDC, intrinsically safe max. 30VDC
Nominal current	16mA typical (17mA rated)
Error current	23mA
Boot-up current after 10ms	< Nominal current

For more details refer to th e supplementary inst ructions " Fo undation Fieldbus".

ESK4-PA

Physical Layer	IEC61158-2 and FISCO model
Communication standard	Profibus PA profile 3.02
PNO ID	4531 HEX
Power supply	Bus supply: 9...32VDC, intrinsically safe max. 30VDC
Nominal current	16mA
Error current	23mA
Boot-up current after 10ms	< Nominal current

For more details refer to the supplementa ry instructions "H 250 M40 Profibus PA".

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

Binary output

Two binary outputs	Galvanically isolated, passive	
Mode	Switching output	NAMUR or transistor (OC)
Configurable as	switch contact or pulse output	NC/ NO or max. 10pulses/s
NAMUR switching output		
Power supply	8.2VDC	
Signal current	> 3mA switching value not reached;	< 1mA switching value reached
Switching output transistor (Open Collector)		
Power supply	Nominal 24VDC, maximum 30VDC	
P_{max}	500mW	
Continuous current	Max. 100mA	
No load current I_0	≤ 2mA	

Pulse output

T_{on}	Configurable from 50...500ms
T_{off}	Depending on flow rate
Pulse weight	Configurable in flow units e.g. 5pulses/m^3

Binary input

Input	Galvanically isolated
Mode	Reset counters or Start / Stop
Configurable as	active HI / active LO
H signal	16...30VDC
Internal resistance R_i	Typical 20k Ω
T_{on} (active)	≥ 500ms

LC display

Technology	Passive graphic LCD
Display	Measurement with units and/or counter reading with units. Counter reading max. 11-digit with power failure proof storage. Binary flags for limit value status. 0...100% bargraph for measurement. NE107 diagnostic status symbols. Plain text menu for configuration.
Configuration	Local plain text menu navigation via microswitch or bar magnet or using DD/DTM software

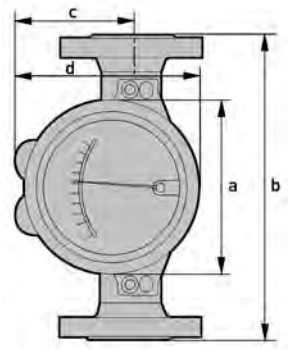
Approvals

Standard	Indicator	Marking
ATEX / IECEx	M40 mechanical	II2GD IIC II3GD IIC
	M40 electrical	II2G Ex ia IIC T6 Gb II2G Ex d IIC T6 Gb II3G Ex nA IIC T6 Gc II2D Ex t IIIC T70°C Db II2D Ex ia IIIC T85°C Db
FM (USA) NEC500 FM (Canada) NEC505	M40 electrical	IS Class I Div 1, Class I Zone 1 AEx ia XP Class I Div 1, Class I Zone 1 AEx d NI Class I Div 2, Class I Zone 2 AEx nA DIP Class II / III Div 1, Class II/III Zone 21 AEx tb
NEPSI	M40 electrical	Ex ia, Ex d, Ex nA, Ex t
CCOE/PESO	M40 electrical	Ex ia, Ex d
EAC	M40 mechanical	Ex c
	M40 electrical	Ex ia, Ex d, Ex nA, Ex t
INMETRO	M40 electrical	Ex ia, Ex d, Ex nA, Ex t
KGS	M40 electrical	Ex ia, Ex d, Ex nA, Ex t

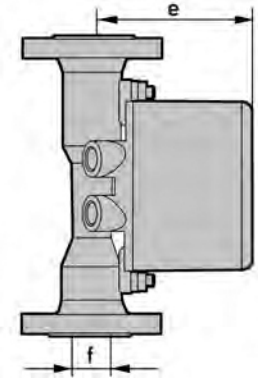
8.3 Dimensions and weight

Dimensions H250/M40

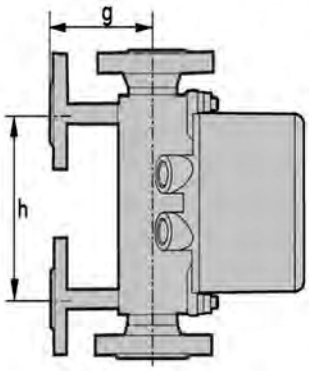
Front view



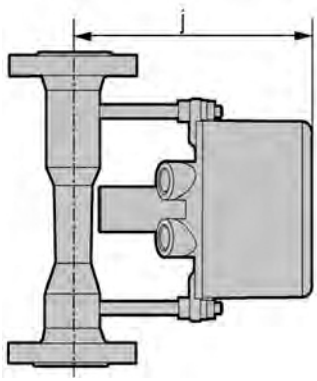
Side view



with heating



High-temperature

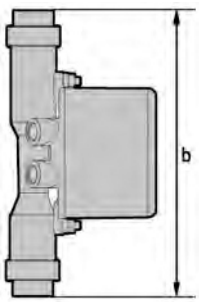


	a		b		d		h	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
H250/RR flange, H250/F Clamp connection	141	5.56	250	9.85	150	5.91	150	5.91
H250/RR from 2" 600 lb, ISO 228, ASMEB1.20.1, SMS			300	11.82				

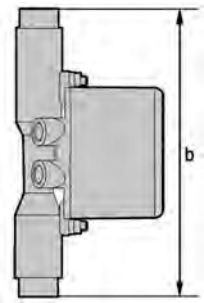
EN	ASME	c 1		e 2		Ø f		g		j	
		[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DN15	½"	94	3.70	114	4.49	20	0.80	97	3.82	197	7.76
DN25	1"	94	3.70	127	5.00	32	1.28	109	4.27	209	8.23
DN50	2"	107	4.22	141	5.55	65	2.57	125	4.90	222	8.74
DN80	3"	107	4.22	157	6.18	89	3.51	143	5.61	238	9.37
DN100	4"	107	4.22	167	6.57	114	4.50	150	5.91	248	9.76

1 without cable gland; 2 Ex d, Ex t, Ex nA +10mm/ 0.39"

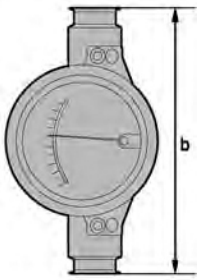
ISO228 / ASMEB1.20.1
Female thread screwed



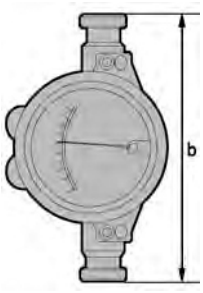
ISO228 / ASMEB1.20.1
Female thread welded



H250/F 1 Clamp
connection



H250/F screw connection
DIN11851



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

Weight

		H250		Heating			
Nominal size		EN1092-1		with flange connection		with Ermeto connection	
EN	ASME	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
DN15	1/2"	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 connection	
Nominal size		EN1092-1		ASME 150lb		ASME 300lb		DIN11864-1	
EN	ASME	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]	[kg]	[lb]
DN15	1/2"	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)	EN1092-1	DN15...150	PN16...250
	ASMEB16.5	1/2...6"	150...2500lb
	JISB2220	15…100	10...20K
Clamp connections (H250/RR /F)	DIN32676	DN15...100	10...16bar
	ISO2852	Size 25...139.7	10...16bar
Screw connections (H250/RR /HC /F)	DIN11851	DN15...100	25...40bar
	SMS1146	1...4"	6barg/ 88.2psig
Female thread welded (H250/RR /HC)	ISO228	G1/2...G2"	≥ 50barg/ 735psig
	ASMEB1.20.1	1/2…2" NPT	
Female thread (H250/RR/HC) with insert, FPM gasket and union nut	ISO228	G1/2…2	≤ 50barg/ 735psig
	ASMEB1.20.1	1/2…2" NPT	
Thread connection aseptic (H250/F)	DIN11864-1	DN15…50	PN40
		DN80…100	PN16
Flange aseptic (H250/F)	DIN11864-2	DN15…50	PN40
		DN80…DN100	PN16
Measuring device (H250/RR /HC) with heating:			
Heating with flange connection	EN1092-1	DN15	PN40
	ASMEB16.5	1/2"	150lb/ 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 according to EN1092-1	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 size acc. to ASMEB16.5	Quantity x size		[Nm]	[lb-ft]
	150lb	300lb		
1/2" 150 lb / 300 lb 1	4x 1/2"	4x 1/2"	5.2	3.8
1" 150 lb / 300 lb 1	4x 1/2"	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 3/4"	70	51
4" 150 lb / 300 lb 1	8x 5/8"	8x 3/4"	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 size	Float	Liner	[mbara]	[psia]	[mbara]	[psia]	[mbara]	[psia]
DN15...100	PTFE	PTFE	100	1.45	-	-	-	-
DN15...80	Ceramic	PTFE	100	1.45	250	3.63	-	-
DN15...80	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, 1.013bara/ 14.7psia

		Water			Air			Max. pressure loss			
Float		TIV	CIV	DIV	TIV Alu.	TIV	DIV	TIV Alu.	TIV	CIV	DIV
Nominal size	Cone	[l/h]			[Nm 3/h]			[mbar]			
DN15, 1/2"	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 1	13	22	32	50
	K 15.8	-	-	1600 2	-	-	50 2	-	-	-	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 1	12	26	38	78
	K 25.5	3200	4000	6300	62	95	180 1	13	30	45	103 3
DN50, 2"	K 55.1	2700	6300	8400	58	80	230 1	8	13	74	60
	K 55.2	3600	10000	14000	77	110	350 1	8	13	77	69
	K 55.3	5100	16000	25000	110	150	700 1	9	13	84	104
DN80, 3"	K 85.1	12000	25000	37000	245	350	1000 1	8	16	68	95
	K 85.2	16000	40000	64000	280	400	1800 1	9	16	89	125
DN100, 4"	K105.1	19000	63000	100 000	-	550	2800 1	-	-	120	220

1 P >0.5bar
2 with TR float
3 300mbar 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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to:
Nl/h or Nm 3/h: Volume flow at standard (norm.) conditions 0 °C/ +32 °F, 1.013 bara/ 14.7psia (DIN1343)

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, 1.013bara/ 14.7psia

		Water			Air			Max. pressure loss			
Float		TIV	CIV	DIV	TIV Alu.	TIV	DIV	TIV Alu.	TIV	CIV	DIV
Nominal size	Cone	[GPH]			[SCFM]			[psig]			
DN15, 1/2"	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 1	0.19	0.32	0.47	0.74
	K 15.8	-	-	423 2	-	-	31.0 2	-	-	-	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 1	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 3
DN50, 2"	K 55.1	713	1664	2219	36.0	49.6	143 1	0.12	0.19	1.09	0.88
	K 55.2	951	2642	3698	47.7	68.2	217 1	0.12	0.19	1.13	1.01
	K 55.3	1347	4227	6604	68.2	93.0	434 1	0.13	0.19	1.23	1.53
DN80, 3"	K 85.1	3170	6604	9774	152	217	620 1	0.12	0.24	1.00	1.40
	K 85.2	4227	10567	16907	174	248	1116 1	0.13	0.24	1.31	1.84
DN100, 4"	K105.1	5019	16643	26418	-	341	1736 1	-		1.76	3.23

1 P >7.4psig
2 with TR float
3 4.4psig 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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to:
SCFM or SCFH: Volume flow at standard (std.) conditions +15°C/ +59 °F, 1.013 bara/ 14.7psia (ISO13443)

H250/C - Ceramic/PTFE

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia

		Flow rate				Max. pressure loss			
		Water		Air		Water		Air	
Liner/ Float		PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.
Nominal size	Cone	[l/h]		[Nm 3/h]		[mbar]			
DN15, 1/2"	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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
Nl/h or Nm 3/h: Volume flow at standard (norm.) conditions 0 °C/ +32 °F, 1.013 bara/ 14.7psia (DIN1343)

H250/C - Ceramic/PTFE

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia

		Flow rate				Max. pressure loss			
		Water		Air		Water		Air	
Liner/ Float		PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.
Nominal size	Cone	[GPH]		[SCFM]		[psig]			
DN15, 1/2"	E 17.2	6.60	7.93	0.43	-	0.94	0.90	0.94	0.90
	E 17.3	10.6	13.2	0.68	1.12	0.96	0.93	0.96	0.93
	E 17.4	16.6	18.5	1.12	1.49	0.96	0.96	0.96	0.96
	E 17.5	26.4	34.3	1.74	2.48	0.99	0.99	0.99	0.99
	E 17.6	42.3	52.8	2.98	4.03	1.04	1.02	1.02	1.02
	E 17.7	66.0	66.0	4.34	5.58	1.25	1.04	1.25	1.04
	E 17.8	106	-	6.2	-	1.61	-	1.61	-
DN25, 1"	E 27.1	166	132	9.92	11.2	1.02	0.80	1.02	0.80
	E 27.2	264	185	18.6	13.6	1.16	0.87	1.16	0.87
	E 27.3	423	291	27.9	18.6	1.57	1.02	1.57	1.02
	E 27.4	660	423	43.4	31.0	2.29	1.19	2.29	1.19
	E 27.5	1056 1	660	74.4	46.5	4.21	1.45	2.81	1.45
DN50, 2"	E 57.1	1057	1189	68.2	86.8	1.18	1.02	1.18	1.02
	E 57.2	1664	1664	111.6	124	1.60	1.16	1.60	1.16
	E 57.3	2642	2906	155	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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to:
SCFM or SCFH: Volume flow at standard (std.) conditions +15°C/ +59 °F, 1.013 bara/ 14.7psia (ISO13443)

H250H - Horizontal installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia

EN	ASME	Cone	Water [l/h]	Air [Nm ^{3}/h]	Pressure loss [mbar]
DN15	1/2"	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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to:
Nl/h or Nm ^{3}/h: Volume flow at standard (norm.) conditions 0 °C/ +32 °F, 1.013 bara/ 14.7psia (DIN1343)

H250H - Horizontal installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia

EN	ASME	Cone	Water [GPH]	Air [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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to
SCFM or SCFH: Volume flow at standard (std.) conditions +15°C/ +59 °F, 1.013 bara/ 14.7psia (ISO13443)

H250U - Vertical installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia
Flow direction:	Vertical downwards		

EN	ASME	Cone	Water [l/h]	Air [Nm ^{3}/h]	Pressure loss [mbar]
DN15	1/2"	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 directive3513.

Reference condition for gas measurements:
Flow measurements for gases are attributed to:
Nl/h or Nm ^{3}/h: Volume flow at standard (norm.) conditions 0 °C/ +32 °F, 1.013 bara/ 14.7psia (DIN1343)

H250U - Vertical installation position

Measuring span:	10 : 1		
Flow values:	Values = 100%	Water: +20°C/ +68°F	Air: +20°C/ +68°F, 1.013bara/ 14.7psia
Flow direction:	Vertical downwards		

EN	ASME	Cone	Water [GPH]	Air [SCFM]	Pressure loss [psig]
DN15	1/2"	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!
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9 NOTES



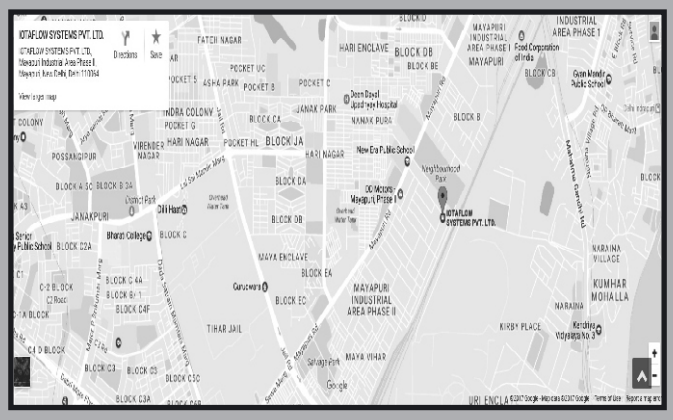
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Metal Tube Flow Meter
User Manual

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