

1.1 Intelligent modularity

The H250 all-metal variable area flowmeters cover the entire range of requirements of the process industry. The modular device design and flexible production structure form the basis for application and customer-based device versions.



The basis of the H250 M40 is its purely mechanical design.

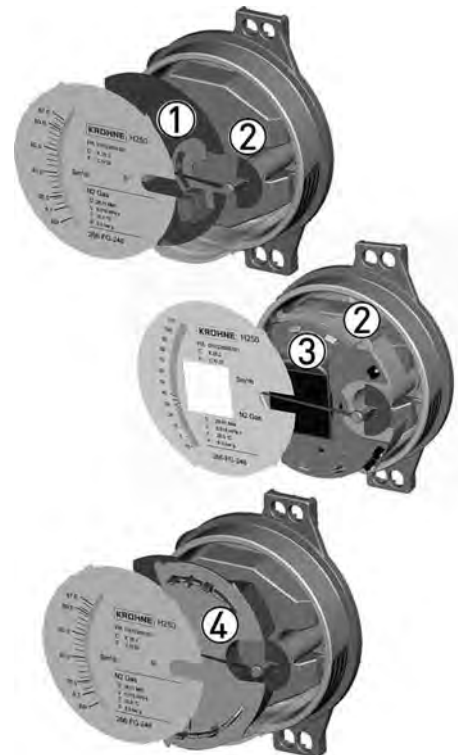
Additional electronic modules can be added or replaced at any time without interrupting the process.

This way, the functionality of the device adapts to any changed requirements.

From analogue flow measurement without auxiliary power up to digital integration into a fieldbus system.

Simply screw off the cover, insert the module until it clicks, screw the cover back on and that's it. It is just as easy to replace the measuring scale in the event of a change in application.

- ① 1 or 2 limit switches, type NAMUR Transistor (3-wire) or Reed
- ② 2-wire signal output 4...20 mA with HART®
- ③ Additional LCD for flow rate value and/or volume counter, 2 configurable binary outputs for limit or pulse output and 1 binary input for starting/stopping or resetting the counter.
- ④ 2-wire fieldbus communication Foundation Fieldbus or Profibus PA



All modules are intrinsically safe (Ex i) and can be built into a secondary pressure containment (Ex d, Ex t, Ex nA) as an option.

Highlights

- Simple, low-cost installation: Measurement and indication without auxiliary power supply
- Universal Ex concept: Ex i and Ex d
- Modular scalability – from mechanical to fieldbus
- Any installation position: vertical upward, horizontal, vertical downward
- Robust measuring tube construction for high process temperatures and extreme operating pressures
- Choice of material: stainless steel, Hastelloy®, titanium, Monel, PTFE/TFM etc.
- Many connection variants: flanged, screwed, clamped, weld-on ends etc.
- Extended measuring span: up to 100 : 1
- High application safety, even with extremely low flows

Industries

Can be used in all industrial sectors, for example:

- Chemicals
- Petrochemicals
- Pharmaceuticals
- Machine building
- Food & Beverage
- Oil & Gas
- Iron, Steel & Metals
- Power plants
- Pulp & Paper
- Water & Wastewater

Applications

- Nitrogen inerting to avoid explosive atmospheres
- Measurement of additives such as catalysts, tensides, anti-foaming and anti-corrosion agents
- Measurement of chlorine, sulphur and ethylene compounds
- Measurement of distilled or demineralised water
- Monitoring of lubricating and cooling agents for process pumps and rotating machines
- Monitoring of sealing systems on compressors
- Gas measurement for industrial furnaces
- Hygienic applications in the food industry and in pharmaceuticals

1.2 Options and variants

Robust design for harsh process conditions



(Example: H250 M40R)

The measuring principle allows for a robust, closed design without sensor integration, as the height of the float is transferred to the indicator by way of a magnetic coupling. This enables high pressure versions that can withstand up to 900 barg / 13000 psig.

All wetted, pressurised parts are made as standard of 1.4404/316L stainless steel and meet the requirements of the NACE MR0175 standard.

To guarantee the durability of the device even with chemically harsh products, it is possible to use special materials such as Hastelloy®, titanium, Monel®, etc. in production.

In addition, the H250 M40 is also available with a PTFE liner for applications involving aggressive acids and bases.

Hygienic design for FOOD & PHARMA



(Example: H250F M40R)

Smooth stainless steel surfaces with a surface roughness of $\leq 0.8 \mu\text{m}$ or $0.6 \mu\text{m}$ of the wetted parts make it difficult for deposits and are very easy to clean.

Combined with a design featuring no dead spaces or stagnation zones, micro-organisms have no chance to adhere and multiply.

The measuring devices can be cleaned (CIP) and sterilised (SIP) in place.

The appropriate connections and FDA and EC 1935/2023 compliant materials are available for Food & Pharma.

Versions for special installation positions



(Example: H250H / H250U)

Variable area flowmeters typically have a vertically positioned measuring cone through which the medium flows from bottom to top, lifting a float against the weight.

If the installation structure does not permit otherwise, versions for horizontal or inverted (from top to bottom) installation positions are used.

The missing reset force of the variable area float weight is replaced by a spring.

Version with extended measuring span 100 : 1



The usual measuring span of the H250 measuring device is 10 : 1.

A measuring span of 100 : 1 can be achieved by inserting a spring which, from a defined float travel, acts as a restoring force in addition to the weight. This eliminates the need for an additional device for minimal volumes.

Display options

M40	Aluminium, two-layer powder coating (epoxy / polyester)
M40R	Stainless steel without coating
M40HT	High temperature version

Offshore wet coating for aluminium or stainless steel housing as well as for the measuring unit on request

1.3 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 F_1 acting on it, the form resistance F_2 and its weight F_3 are in equilibrium: $F_3 = F_1 + F_2$

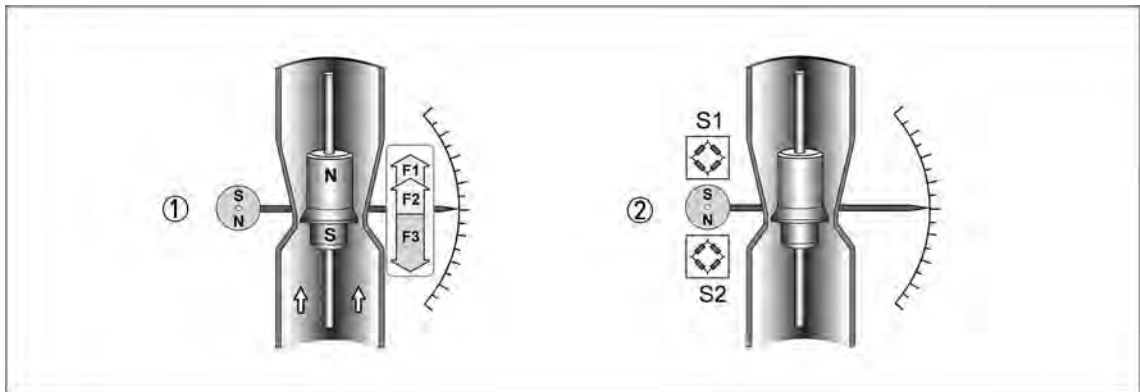


Figure 1-1: Measuring principle - general

- 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.

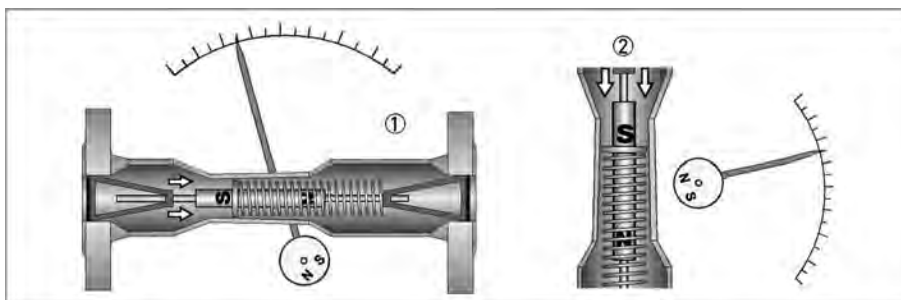


Figure 1-2: Measuring principle for H250H and H250U

- 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.

2.1 Technical data

- 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/VDE 3513, 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 = 40 barg / 580 psig, TS = 300°C / 572°F
DN80...DN100	PS = 25 barg / 363 psig, TS = 300°C / 572°F
Ingress protection	
M40, M40R	IP66/68 according to EN 60529, NEMA 4/4X/6 according to NEMA 250
M40R	IP69K according to DIN 40050-9
Float damping during gas measurement recommended	
DN15...25 / 1/2...1"	Operating pressure <0.3 barg / 4.4 psig
DN50...100 / 2...4"	Operating pressure <0.2 barg / 2.9 psig

Installation conditions according to VDI/VDE 3513, sheet 3

Inlet section	$\geq 5 \times \text{DN}$
Outlet section	$\geq 3 \times \text{DN}$

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 ₂ O ₃ with FFKM gasket	Al ₂ O ₃ and PTFE	Al ₂ O 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 ①	-40...+70	-40...+158
Limit switches SJ3,5-SN / I7S23,5-N / Reed SPST	-40...+70	-40...+158
Limit switches SC3,5-N0 / SJ3,5-S1N / SB3,5-E2	-25...+70	-13...+158

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

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]

EN	ASME	Version with	$T_{amb} < +40^{\circ}\text{C}$		$T_{amb} < +60^{\circ}\text{C}$ ①	
			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-temperature version
ESK4 / ESK4A	2-wire current output 4...20 mA 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	2.5 mm ²				
Limit switches	I7S23,5-N SC3,5-N0	SJ3,5-SN ①	SJ3,5-S1N ①	SB3,5-E2	Reed
NAMUR (IEC 60947-5-6)	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	8.2 VDC	8.2 VDC	8.2 VDC	10...30 VDC	max. 32 VDC ②
Pointer vane not detected	≥ 3 mA	≥ 3 mA	≤ 1 mA	≤ 0.3 VDC	U ₀
Pointer vane detected	≤ 1 mA	≤ 1 mA	≥ 3 mA	U _B - 3 VDC	0 VDC
Continuous current	-	-	-	Max. 100 mA	Max. 100 mA
No load current I ₀	-	-	-	≤ 15 mA	-
Switching cycles	-	-	-	-	100000

① safety oriented

② no inductances

Current output ESK4 / ESK4A

Terminal connection	2.5 mm ²
Power supply	14...32 VDC (12...32 VDC without ESK4-T), intrinsically safe max. 30 VDC
Min. power supply for HART®	20 VDC at 250 Ω load
Measuring signal	4.00...20.00 mA = 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 30 VDC
Min. load for HART®	250 Ω
NAMUR conformity	NE43, NE107, NE21

ESK4 HART® configuration

Manufacturer name (code)	KROHNE 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 3.6 mA]
Multidrop operation		4.5

ESK4-FF

Physical Layer	IEC 61158-2 and FISCO model
Communication standard	H1 FOUNDATION Fieldbus protocol
ITK version	6.3 (FW ≥ V 2.01)
Power supply	Bus supply: 9...32 VDC, intrinsically safe max. 30 VDC
Nominal current	16 mA typical (17 mA rated)
Error current	23 mA
Boot-up current after 10 ms	< Nominal current

For more details refer to the supplementary instructions "H250 M40 Foundation Fieldbus".

ESK4-PA

Physical Layer	IEC 61158-2 and FISCO model
Communication standard	Profibus PA profile 3.02
PNO ID	4531 HEX
Power supply	Bus supply: 9...32 VDC, intrinsically safe max. 30 VDC
Nominal current	16 mA
Error current	23 mA
Boot-up current after 10 ms	< Nominal current

For more details refer to the supplementary instructions "H250 M40 Profibus PA".

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

Binary output

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

Pulse output

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

Binary input

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

LC display

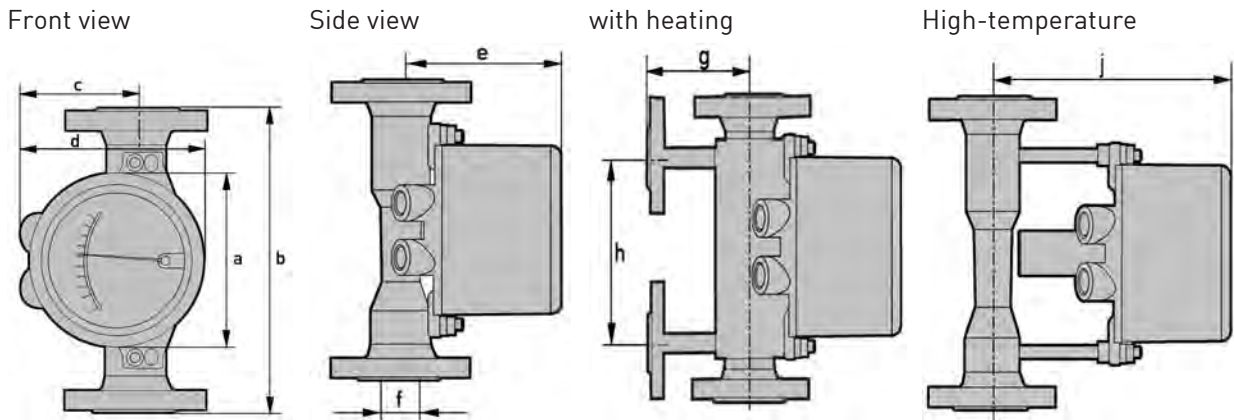
Technology	Passive graphic LCD
Display	Measurement with units and/or counter reading with units. Counter reading max. 11-digit with power failure proof storage. Binary flags for limit value status. 0...100% bargraph for measurement. NE 107 diagnostic status symbols. Plain text menu for configuration.
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

2.2 Dimensions and weight

Dimensions H250/M40

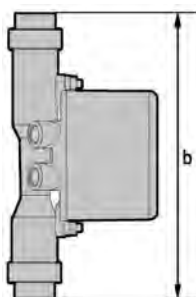


	a		b		d		h	
	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
H250/RR flange, H250/F Clamp connection	141	5.56	250	9.85	150	5.91	150	5.91
H250/RR from 2" 600 lb, ISO 228, ASME B1.20.1, SMS			300	11.82				

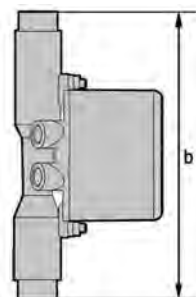
EN	ASME	c ①		e ②		Ø f		g		j	
		[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]	[mm]	["]
DN15	½"	94	3.70	114	4.49	20	0.80	97	3.82	197	7.76
DN25	1"	94	3.70	127	5.00	32	1.28	109	4.27	209	8.23
DN50	2"	107	4.22	141	5.55	65	2.57	125	4.90	222	8.74
DN80	3"	107	4.22	157	6.18	89	3.51	143	5.61	238	9.37
DN100	4"	107	4.22	167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

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

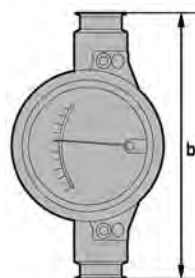
ISO 228 / ASME B1.20.1
Female thread screwed



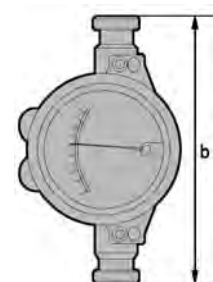
ISO 228 / ASME B1.20.1
Female thread welded



H250/F ① Clamp
connection



H250/F screw connection
DIN 11851



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

Weight

		H250		Heating			
Nominal size		EN 1092-1		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		EN 1092-1		ASME 150 lb		ASME 300 lb		DIN 11864-1	
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)	EN 1092-1	DN15...150	PN16...250
	ASME B16.5	1/2...6"	150...2500 lb
	JIS B2220	15...100	10...20K
Clamp connections (H250/RR /F)	DIN 32676	DN15...100	10...16 bar
	ISO 2852	Size 25...139.7	10...16 bar
Screw connections (H250/RR /HC /F)	DIN 11851	DN15...100	25...40 bar
	SMS 1146	1...4"	6 barg / 88.2 psig
Female thread welded (H250/RR /HC)	ISO 228	G1/2...G2"	≥ 50 barg / 735 psig
	ASME B1.20.1	1/2...2" NPT	
Female thread (H250/RR /HC) with insert, FPM gasket and union nut	ISO 228	G1/2...2	≤ 50 barg / 735 psig
	ASME B1.20.1	1/2...2" NPT	
Thread connection aseptic (H250/F)	DIN 11864-1	DN15...50	PN40
		DN80...100	PN16
Flange aseptic (H250/F)	DIN 11864-2	DN15...50	PN40
		DN80...DN100	PN16
Measuring device (H250/RR /HC) with heating:			
Heating with flange connection	EN 1092-1	DN15	PN40
	ASME B16.5	1/2"	150 lb / RF
Heating pipe connection for Ermeto	-	E12	PN40

Higher pressure ratings and other connections on request.

Bolts and tightening torques

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

Nominal sizes EN

Nominal size according to EN 1092-1	Stud bolts		Tightening torques	
	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

Nominal size acc. to ASME B16.5	Stud bolts		Tightening torques	
	Quantity x size		[Nm]	[lb-ft]
	150 lb	300 lb		
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

2.3 Measuring ranges

H250/RR - stainless steel, H250/HC - Hastelloy®

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

Float ▶		Water			Air			Max. pressure loss			
		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 > 0.5 bar

② with TR float

③ 300 mbar with damping (gas measurement)

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

Nl/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

H250/RR - stainless steel, H250/HC - Hastelloy®

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

Float ▶		Water			Air			Max. pressure loss			
		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 > 7.4 psig

② with TR float

③ 4.4 psig with damping [gas measurement]

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

H250/C - Ceramic/PTFE

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

Liner / Float ▶		Flow rate				Max. pressure loss			
		Water		Air		Water		Air	
Nominal size	Cone	PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.	PTFE	Ceram.
		[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
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

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to

Nl/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

H250/C - Ceramic/PTFE

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

		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

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

H250H - Horizontal installation position

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

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	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
DN50	2"	K 25.5	10000	260	336
		K 55.1	10000	260	240
		K 55.2	16000	420	230
DN80	3"	K 55.3	22000	580	220
		K 55.3	34000	900	420
		K 85.1	25000	650	130
DN100	4"	K 85.2	35000	950	130
		K 85.2	60000	1600	290
		K 105.1	80000	2200	250
		K 105.1	120000	3200	340

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

Nl/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

H250H - Horizontal installation position

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

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
DN25	1"	K 15.8	634	37.2	23.5
		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
DN50	2"	K 25.5	2642	161	4.94
		K 55.1	2642	161	3.53
		K 55.2	4227	260	3.38
		K 55.3	5812	360	3.23
DN80	3"	K 55.3	8982	558	6.17
		K 85.1	6604	403	1.91
		K 85.2	9246	589	1.91
DN100	4"	K 85.2	15851	992	4.26
		K 105.1	21134	1364	3.68
		K 105.1	31701	1984	5.00

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

H250U - Vertical installation position

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

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

Nl/h or Nm³/h: Volume flow at standard (norm.) conditions 0°C / +32°F, 1.013 bara / 14.7 psia (DIN 1343)

H250U - Vertical installation position

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

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

Reference condition for gas measurements:

Flow measurements for gases are attributed to:

SCFM or SCFH: Volume flow at standard (std.) conditions +15°C / +59°F, 1.013 bara / 14.7 psia (ISO 13443)

3.1 Intended use

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.

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.

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

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

Intended use:

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

Use suitable measures to eliminate compression vibrations during gas measurements:

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

Observe installation conditions according to VDI/VDE 3513-3.

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

Do not use any abrasive media containing solid particles or highly viscous media.

3.2 Installation conditions

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

- *The variable area flowmeter must be installed vertically (measuring principle). Flow direction from bottom to top. For installation recommendations please refer also to directive VDI/VDE 3513, sheet 3.*
H250Hs are installed horizontally and H250U devices are installed vertically with the flow direction from top to bottom.
- *A straight unimpeded inlet run of ≥ 5 DN upstream of the device and a straight outlet run of ≥ 3 DN downstream of the device are recommended.*
- *Screws, bolts and gaskets are to be provided by the customer and must be selected in accordance with the pressure rating of the connection or the operating pressure.*
- *The inner diameter of the flange deviates from the standard dimensions. Flange seal standard DIN 2690 or ASME B16.21 can be applied.*
- *Align the gaskets. Tighten the nuts with the tightening torques of the appropriate pressure rating.*
For devices with PTFE liner or ceramic liner and PTFE raised faces, refer to chapter "Tightening torques".
- *Control devices are to be positioned downstream of the measuring device.*
- *Shutoff devices are preferably to be positioned upstream of the measuring device.*
- *Before connecting, blow or flush out the pipes leading to the device.*
- *Piping for gas flow need to be dried before the device is installed.*
- *Use connectors suitable for the particular device version.*
- *Align the piping centrally 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 $> 300 \text{ mm} / 11.8''$ between the devices is necessary.

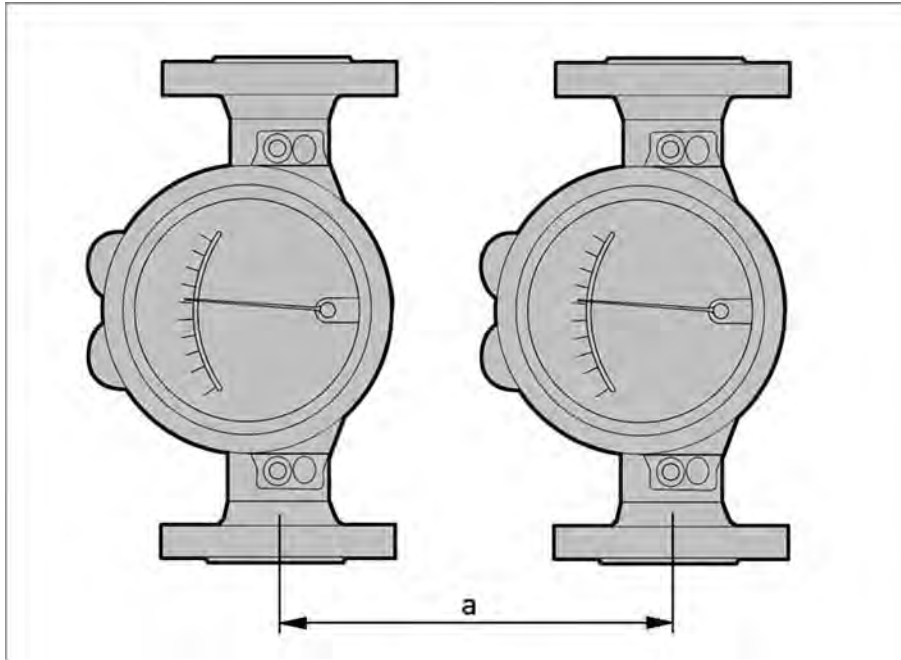


Figure 3-1: Minimum distance between devices

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

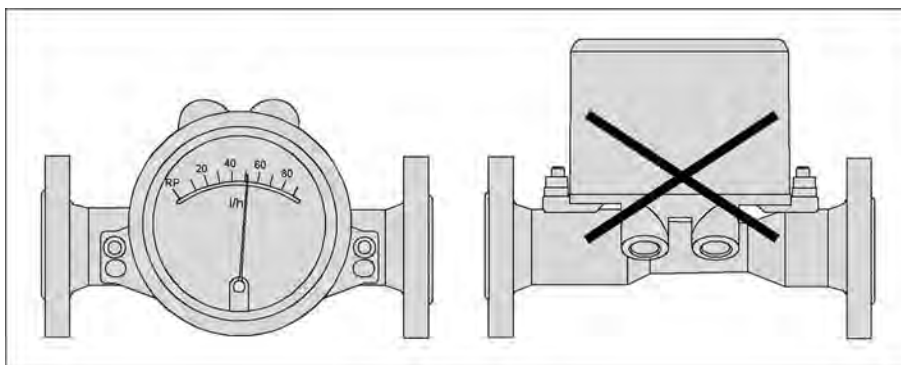


Figure 3-2: Installation position for H250H

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

3.2.1 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			
EN 1092-1		ASME B16.5		EN	ASME		EN 1092-1		ASME 150 lb	
DN	PN	Inch	lb		150 lb	300 lb	Nm	ft*lb	Nm	ft*lb
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

3.2.2 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 100 mm / 4"
- ② Type FS - fitting part without flange - overall length 50 mm / 2"

3.2.3 Heat insulation

The indicator housing may not be heat-insulated.

The heat insulation ③ may only reach as far as the housing fastening ④.

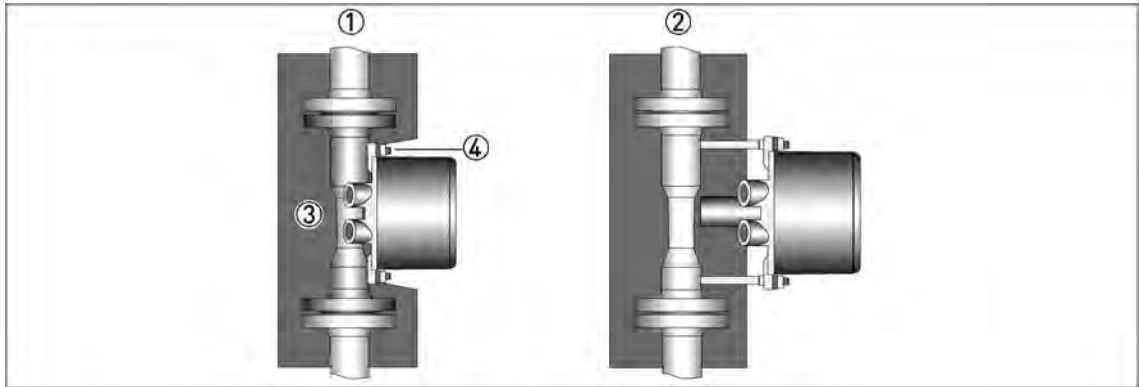


Figure 3-4: Heat insulation

- ① Standard indicator M40
- ② Indicator with HT extension

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.

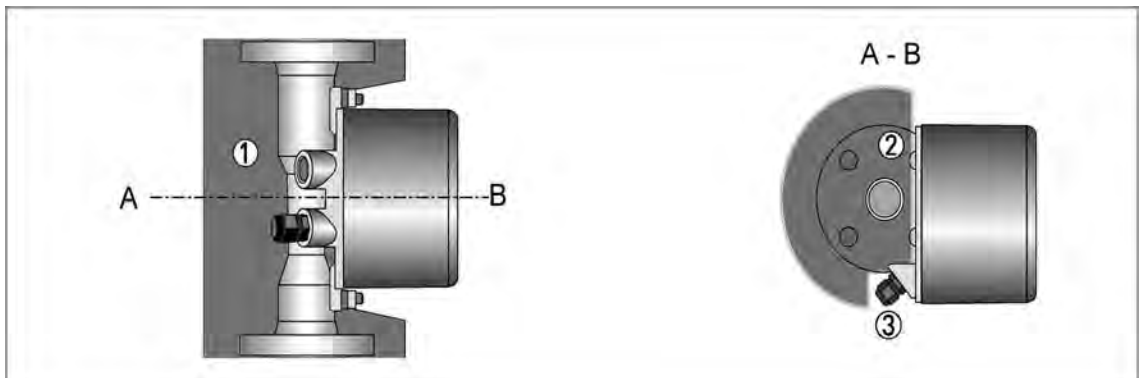


Figure 3-5: Heat insulation - cross-section

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

Nominal size according to		Operating primary pressure	
EN 1092-1	ASME B16.5	[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

3.2.5 Pointer damping

In principle, the indicating element with its magnetic system contains indicator damping. An additional eddy current brake is advantageous in the event of fluctuating or pulsing flows. The magnets on the eddy current brake surround the pointer vane without touching it, damping its movement. The result is a much steadier pointer position, without distorting the measured value. The eddy current brake can be retrofitted during operation without recalibration. Note the maximum tightening torque (0.12 Nm) for the turnbuckle!

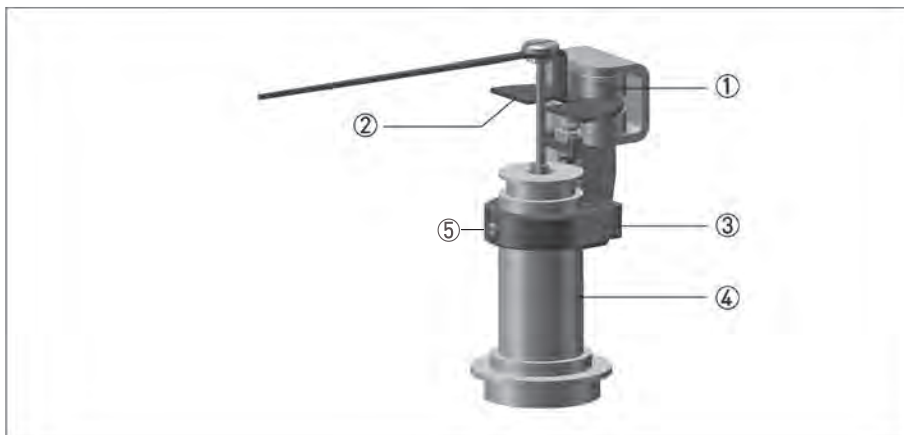


Figure 3-6: Pointer damping

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

4.1 Safety instructions

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

Observe the national regulations for electrical installations!

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

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.

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.

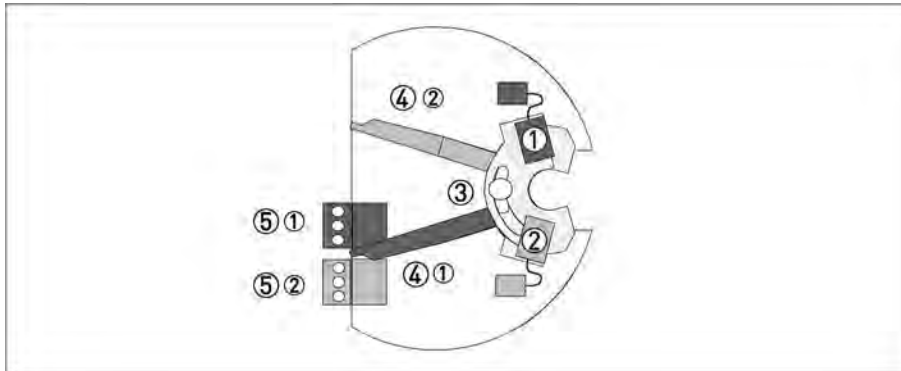


Figure 4-1: Design of limit switch module

- 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 removed to connect the cables. The built-in limit switch types are shown 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

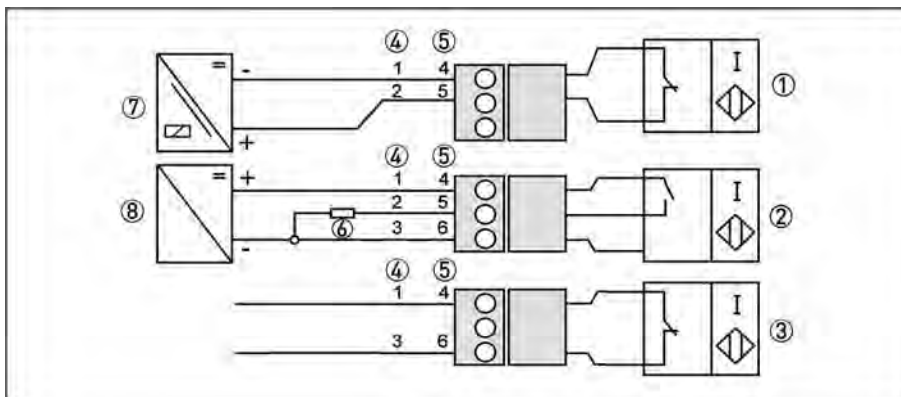


Figure 4-2: Connection terminals for limit switches

- 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

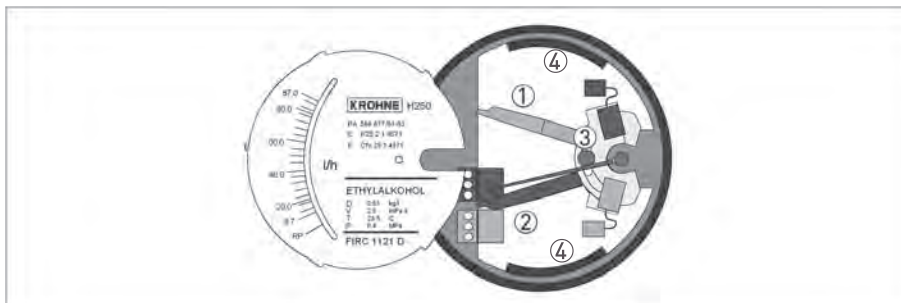


Figure 4-3: Limit setting

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

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

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

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

Definition of switch contact

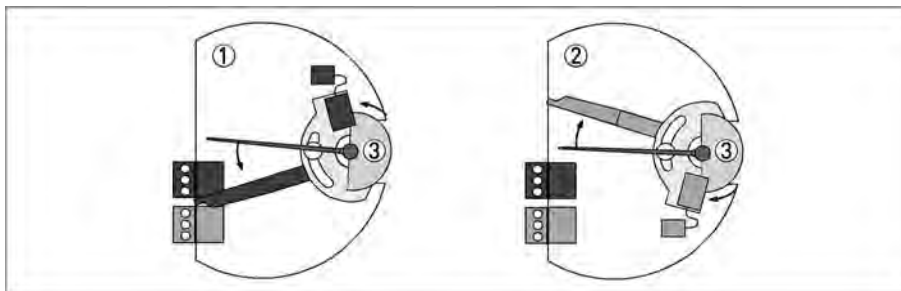


Figure 4-4: Definition of switch contact

- 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.

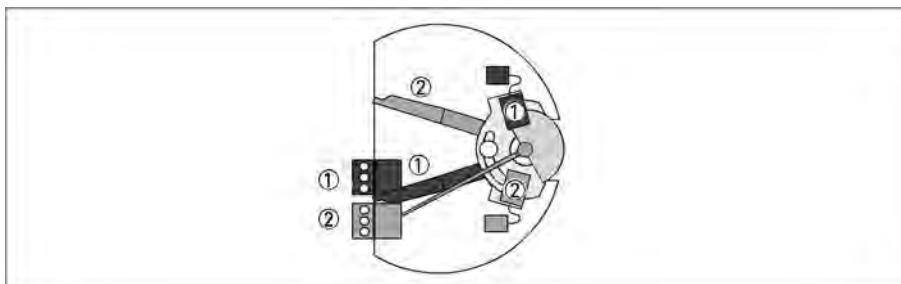


Figure 4-5: Definition MIN-MIN - MAX-MAX

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

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

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.

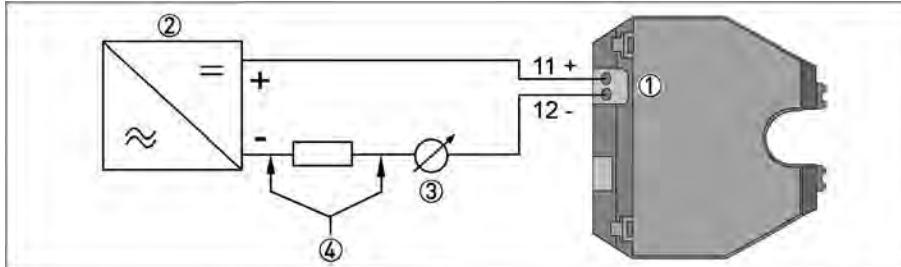


Figure 4-6: ESK4 / ESK4A connection

- ① Current output of ESK4 / ESK4A
- ② Power supply 14...30 VDC
- ③ Measuring signal 4...20 mA
- 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.

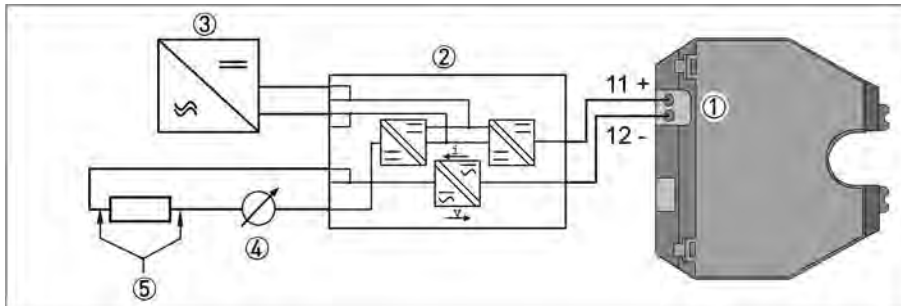


Figure 4-7: Power supply M40 with galvanic isolation

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

Power supply

The supply voltage has to be between 14 VDC and 30 VDC. This is based on the total resistance of the measuring loop. To calculate this, the resistance 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:

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

with

$U_{\text{ext.}}$ = minimum supply voltage

R_L = total measuring loop resistance

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

HART® communication

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

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

Load for HART® communication

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

The maximum load resistance is calculated as follows:

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

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 NE 21 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 charge from the website of the manufacturer.

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

Self monitoring - Diagnostics

During both start-up and operation, a wide variety of diagnostic functions are performed cyclically in the ESK4 / ESK4A in order to guarantee function reliability. When an error is detected, a failure signal (high) is activated (current > 21 mA, typically 22 mA) via the 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 measuring range of the internal sensors
- Temperature compensation of the internal sensors
- Calibration based on the application
- Plausibility of counting value
- Plausibility of physical unit, system and selected unit

For ESK4A (HART® 7) the diagnosis is reported in compliance with NE 107.

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.

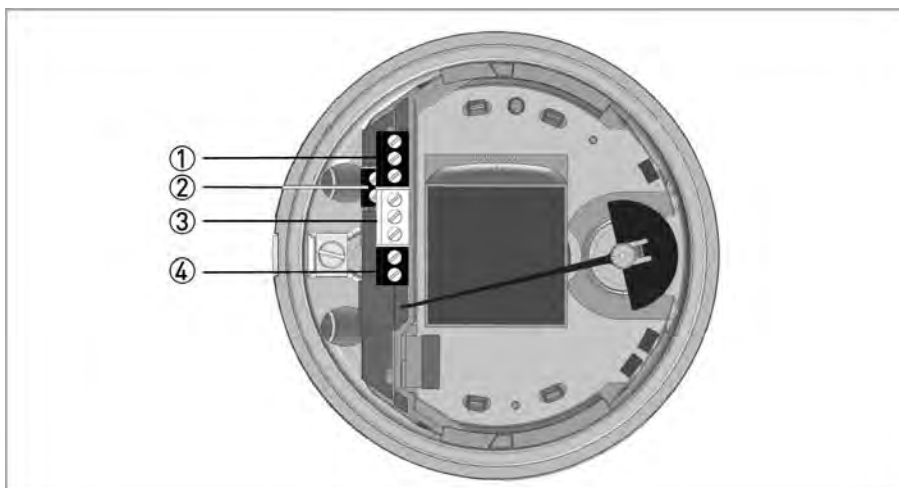


Figure 4-8: Position of the connection terminals

- 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.

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.

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 EN 60947-5-6)
- Transistor output (passive, Open Collector)

Binary output	B1			B2		
	1	2	3	4	5	6
Connection NAMUR	+	-		+	-	
Connection transistor output	+		B _{OC}	+		B _{OC}

Table 4-3: Terminal assignment of the binary output

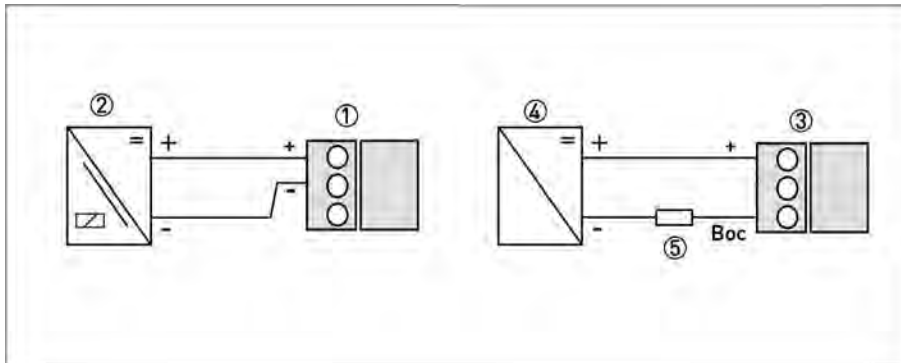


Figure 4-9: Connection switching output

- 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	< 1 mA	> 3 mA
Switching value not reached	> 3 mA	< 1 mA

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 $R_i = 1$ k 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 1 k Ω is recommended for the passive transistor output with a nominal voltage of 24 VDC.

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

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

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 100 mA.

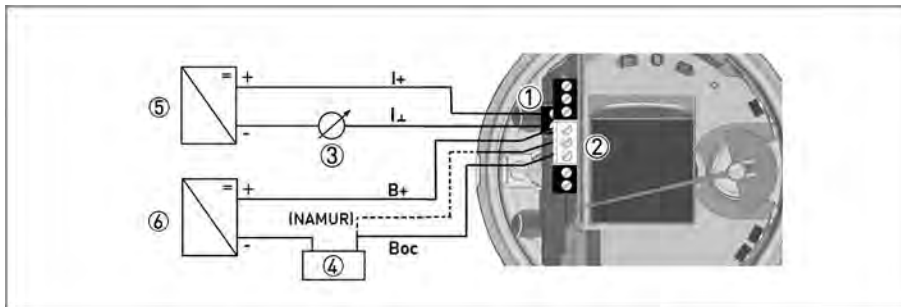


Figure 4-10: Electrical connection of pulse output

- ① Terminal for power supply - current output
- ② Terminal B2
- ③ Flow measurement 4...20 mA
- 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 electrically isolated from the current output and output B1. It can be operated as a low-resistance output or as a NAMUR output.

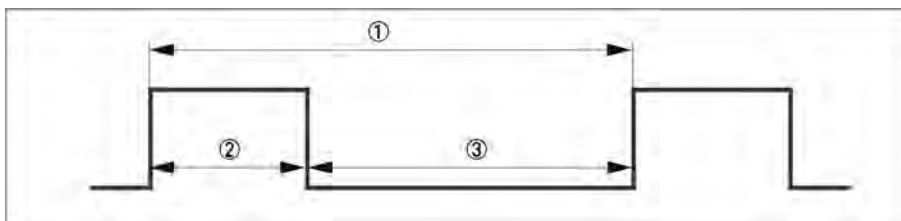


Figure 4-11: Data for pulse output

- ① $f_{max} = 10 \text{ Hz}$
- ② t_{on}
- ③ t_{off}

The pulse width t_{on} can be configured from 50...500 ms 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

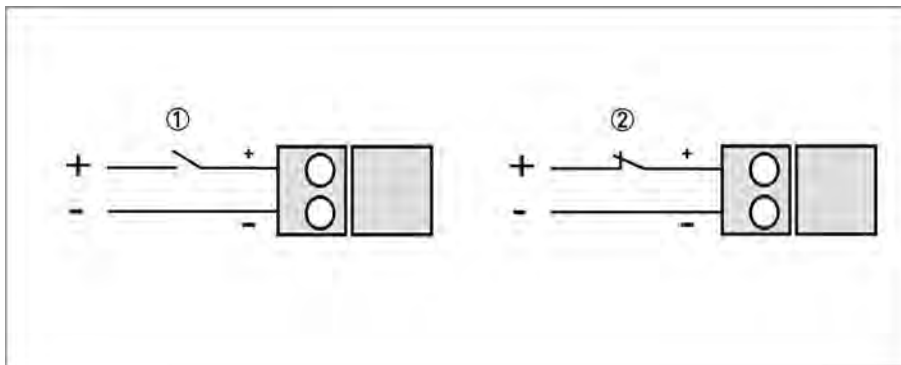


Figure 4-12: Binary input

- 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.

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 20 k Ω .

4.2.6 ESK4-FF / ESK4-PA fieldbus communication

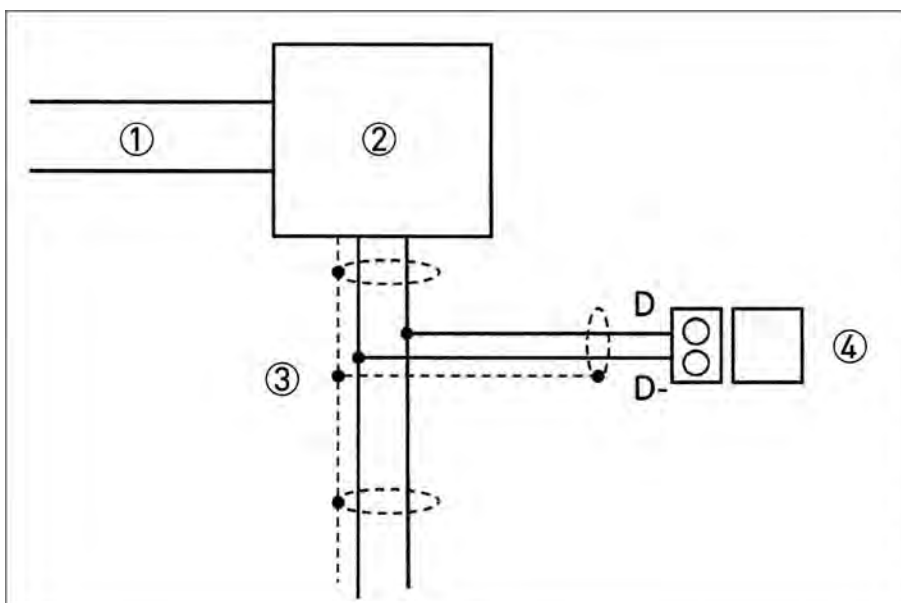


Figure 4-13: ESK4-FF / ESK4-PA fieldbus communication

- 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...32 VDC
- Nominal current 16 mA

4.3 Grounding connections



Figure 4-14: Grounding connections

- ① Grounding connection on the indicator
- ② Outer grounding connection

*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.

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.

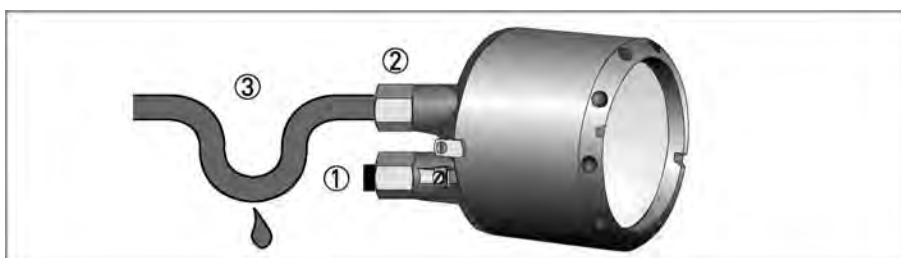


Figure 4-15: Laying the cable

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

You can help us to assist you the best possible way by giving us the following information:

Device data

Connection type:					
Nominal connection size:					
Pressure rating:					
Raised face:					
Material of pipeline:					
Display options:	_ K1:	1 limit			
	_ K2:	2 limits			
	_ ESK4:	4...20 mA / HART®			
	_ ESK4-T:	4...20 mA / HART® / LCD counter, pulse output			
	_ ESK4-FF:	Foundation Fieldbus			
	_ ESK4-PA:	Profibus PA			
	_ M40	Aluminium, two-layer powder coating (epoxy / polyester)			
	_ M40R	Stainless steel without coating			
Approvals:	_ None	_ ATEX / IECEx	_ FM / FMc	_ NEPSI	_ Others:

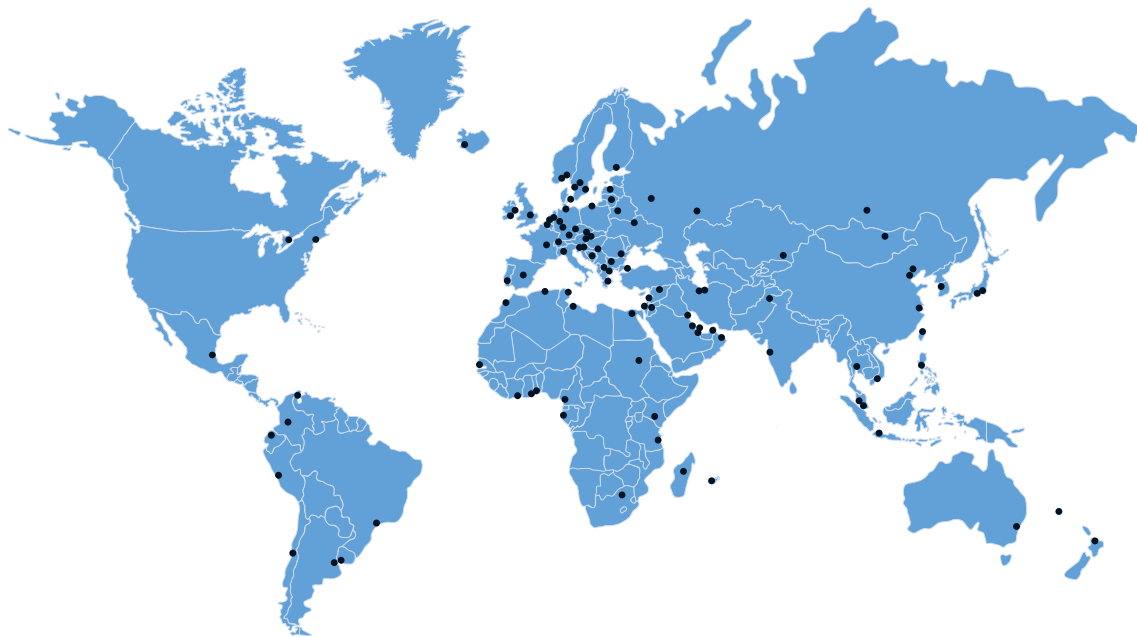
Rating data

Medium:				
Operating pressure:		_ Absolute pressure	_ Gauge pressure	
Rated pressure:				
Operating temperature:				
Rated temperature:				
Density:		_ Standard density	_ Operating density	
Viscosity:				
Flow range:				
Comments:				

Contact data

Company:	
Contact person:	
Telephone number:	
Fax number:	
E-mail:	





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