BW25 Handbook

Level meter

KROHNE

IMPRINT

1.1 Intended use

The level meter is suitable for measuring liquids and separation layers in liquids.
The devices are especially well suited for the measurement of:

- Liquids
- Water
- Chemicals with low corrosiveness

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

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

1.2 Certifications

CE marking

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

- Pressure Equipment Directive 97/23/EC Article 3.3
- EC directive 94/9 EC - ATEX directive
- EMC Directive 89/336/EC

as well as

- EN 61010
- EMC specification acc. to EN 61326/A1
- NAMUR recommendations NE 21 and NE 43

The manufacturer certifies successful testing of the product by applying the CE marking.

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

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1.3.2 Disclaimer

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

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

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

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

1.3.3 Product liability and warranty

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

1.3.4 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 applicable national standards, safety requirements and accident prevention regulations.

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

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

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

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

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

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

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

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

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

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

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

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

1.4 Safety instructions for the operator

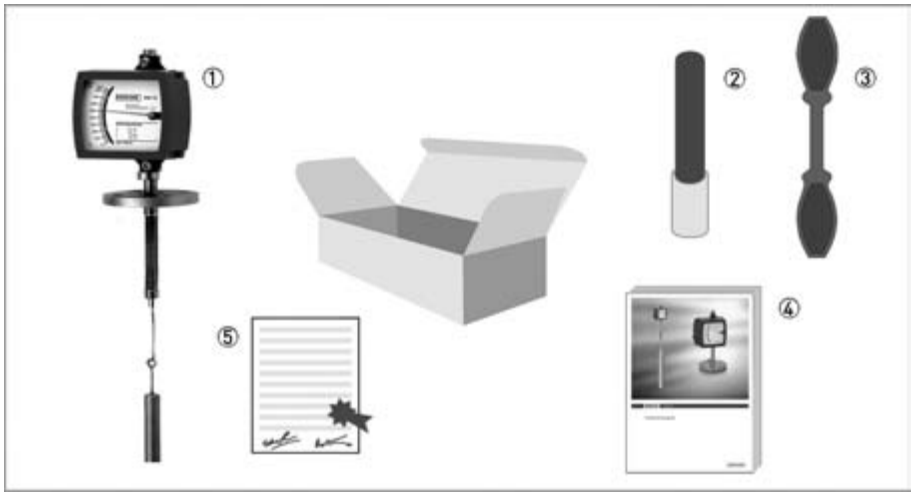
WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

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

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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.



① Measuring device in ordered version
② For indicator M10 - bar magnet
③ For indicator M10 - key
④ Handbook
⑤ Certificates, calibration report (supplied to order only)

2.2 Device version

① BW25 with indicator M9
② BW25 with indicator M10

① BW25/M9

- Local indicator without auxiliary power
- Max. 2 limit switches, type NAMUR, NAMUR safety-oriented
- 2-wire current output 4...20 mA, HART® communication

② BW25/M10

- Ex d flameproof enclosure
- 2 digital adjustable limit switches, 2-wire open collector or type NAMUR
- 2-wire current output 4...20 mA, HART® communication

2.3 Nameplate

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

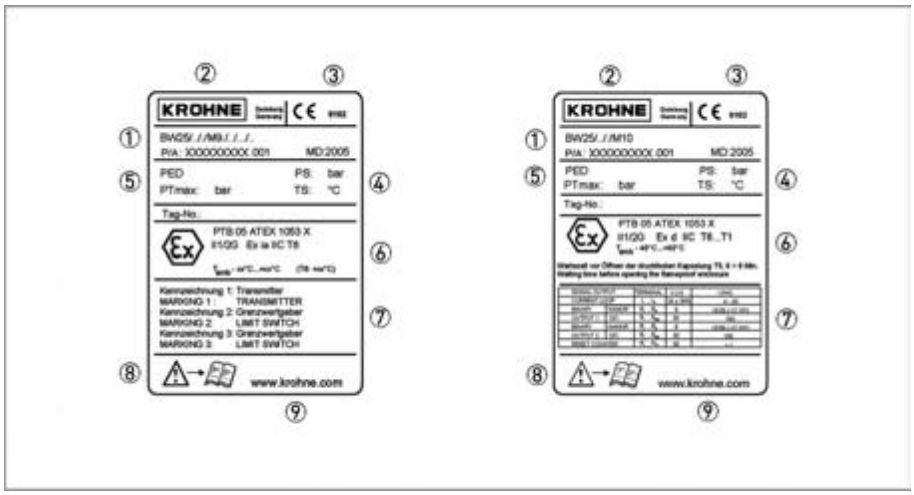


Figure 2-1: Nameplates on the indicator

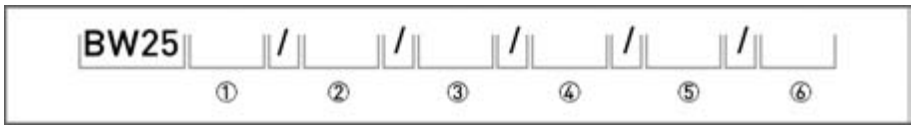
① Device type
② Manufacturer
③ Notified ATEX body
④ Sizing data: temperature & pressure rating
⑤ PED data
⑥ Ex data
⑦ Electrical connection data
⑧ Note manual
⑨ KROHNE website

Additional markings on the indicator

- SO - sales order / item
- PA - order
- Vx - product configurator code
- AC - article code

2.4 Description code

The description code* consists of the following elements:



① Materials / versions
RR - Stainless Steel
Ti - rust-proof steel (device flange), titanium (displacement rod)

② Version with bypass chamber
B - with bypass chamber

③ Series of indicators
M9 - Indicator M9 standard indicator
M9S - Indicator with knock-resistant sight glass
M9R - Indicator in Stainless Steel housing
M9T - Stainless steel indicator with knock-resistant sight glass
M10 - Indicator or signal converter M10

④ High temperature version
HT - Version with HT extension

⑤ Electrical signal output
ESK - Electronic transmitter

⑥ Limit switch
K1 - One limit switch
K2 - Two limit switches

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

3.1 Notes on installation

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

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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

3.2 Storage

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

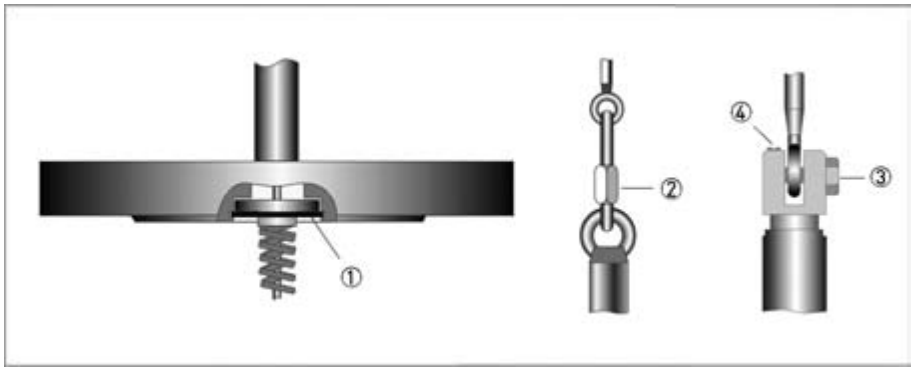
3.3 Installation condititions

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

- *Before installation, compare the serial number of the display (nameplate) with the serial number on the displacement rod, the flange and the magnet.*
- *In the case of level displays with a bypass chamber, the BW25 serial number on the bypass chamber should be compared with the serial number on the display.*
- *Avoid combining parts with differing serial numbers.*
- *Ensure the material compatibility of the parts in contact with the product.*
- *Screws, bolts and gaskets are to be provided by the customer and must be selected in accordance with the pressure rating of the mounting flange or the operating pressure.*
- *Align the gaskets. Tighten the nuts with the tightening torques of the appropriate pressure rating.*
- *Do not lay signal cables directly next to cables for the power supply.*

3.4 Installation

The sealing surface of the tank flange must be horizontal to ensure the perfect function of the level measurement unit.



① Lock ring
② Quick-action lock
③ Retaining screw
④ Cover stop

- Insert the spring suspension pin in the flange system and secure it with a retaining ring ①.
- Install the retaining ring ① properly and check for a correct seat all round.
- Place the seal on the tank flange.
- Suspend the displacer body on the spring suspension pin.
- Tighten the locking elements of the quick-action lock ② (standard) or, with the variant, ③ and ④ and check for a tight fit.
- Insert the displacer element and the spring suspension pin into the tank through the tank flange or into the preinstalled bypass chamber.
- Tighten the flange connection.

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.

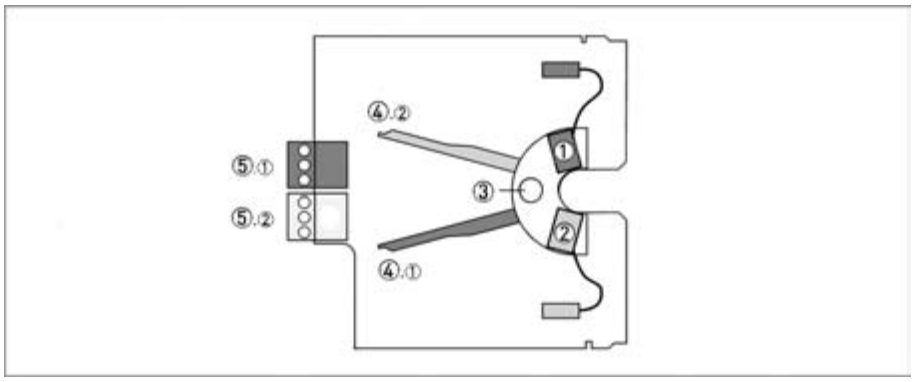
INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Electrical connection indicator M9

4.2.1 Limit switch

Indicator M9 can be equipped with a maximum of two electronic limit switches. The limit switch functions with a slot sensor which is operated inductively through the semicircular metal vane belonging to the measuring pointer. The switching points are set through the contact pointers. The position of the contact pointer is indicated on the scale.

Limit switch module



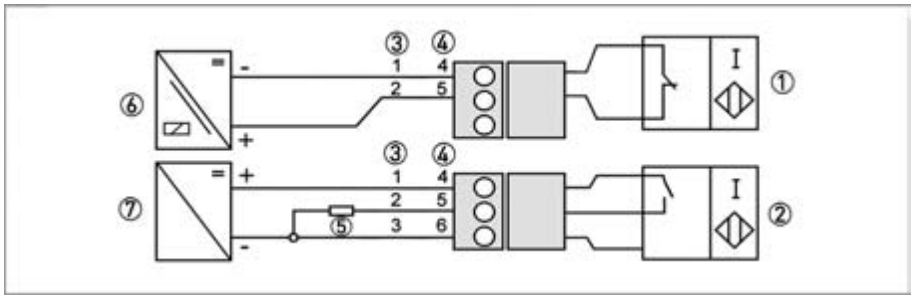
① Min. contact
② Max. contact
③ Locking screw
④ Maximum pointer
⑤ Connection terminal

The connecting terminals have a pluggable design and can be removed in order to connect the lines. The built-in contact types are shown on the nameplate of the indicator.

Electrical connection of the limit switches

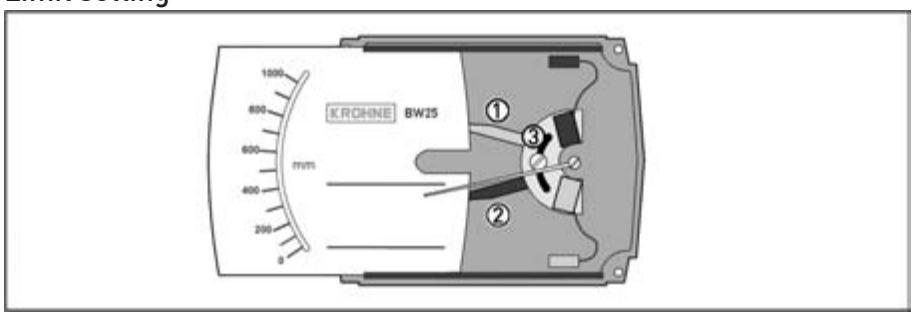
Contact	MIN			MAX		
Terminal no.	1	2	3	4	5	6
Connection 2-wire NAMUR	-	+		-	+	
Connection 3-wire	+		-	+		-

Limit switch connection terminals



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

Limit setting



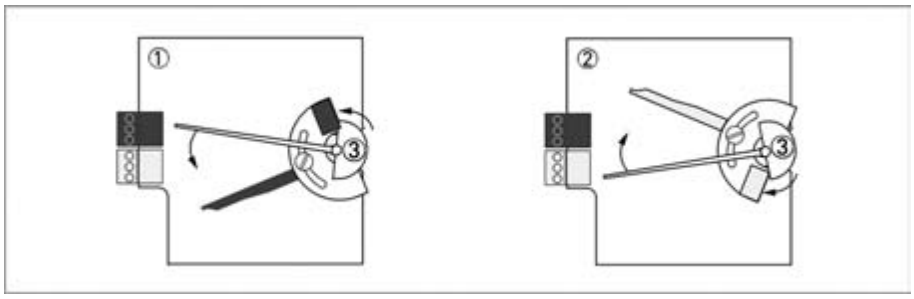
① Contact pointer MAX
② Contact pointer MIN
③ Locking screw

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

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

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

Switch contact definition

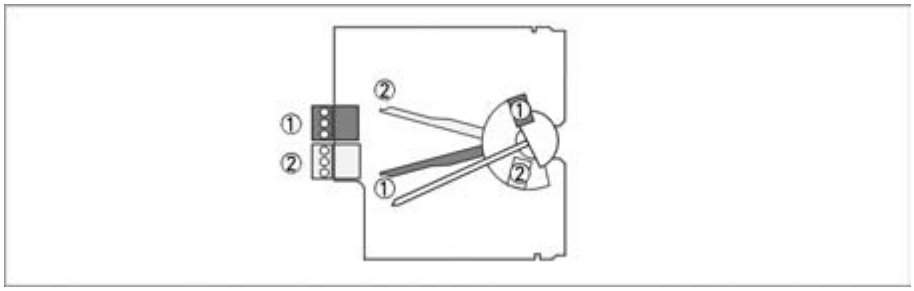


① MIN contact
② MAX contact
③ Pointer vane with switching vane

If the measuring pointer vane goes into the slot an alarm is triggered. If the pointer vane lies outside the slot sensor, a wire break also causes the alarm to be triggered.

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

Definition MinMin - MaxMax



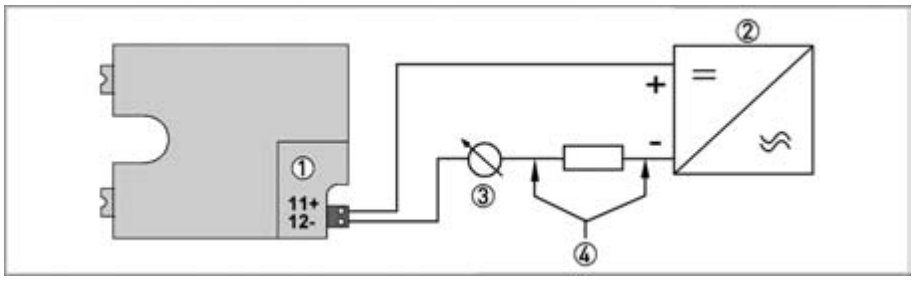
① MIN 2 contact or MAX 1 contact
② MIN 1 contact or MAX 2 contact

Current consumption in the position shown:

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

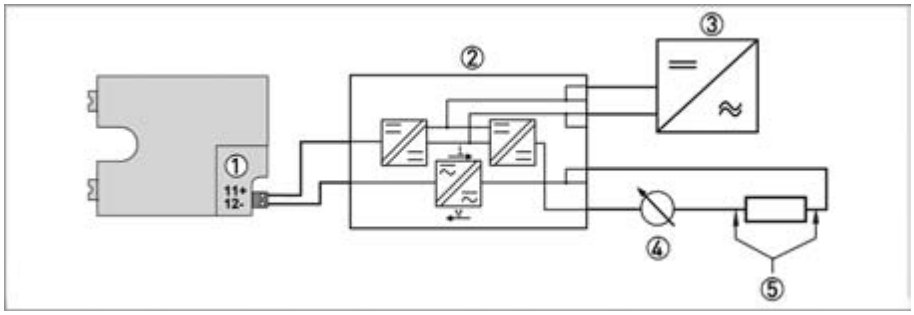
4.2.2 Electrical signal output ESK

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



① ESK2A current transmitter
② Power supply 12...30VDC
③ Measurement signal 4...20 mA
④ External load, HART® communication

The circuitry for connection to other devices such as digital evaluator units or process control equipment must be designed with special care. In some circumstances, internal connections in these devices (e.g. GND with PE, ground loops) may lead to impermissible voltage potentials, which can compromise the function of the device itself or a connected device. In such cases a protected extra-low voltage (PELV) is recommended.



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

HART® communication

When HART® communication is carried out with the ESK, this will not in any way impair analog measured-data transmission (4...20 mA). Exception: multidrop operation. In multidrop operation a maximum of 15 devices with HART® function can be operated in parallel, whereby their analog outputs are switched inactive. (I approx. 4 mA per device).

Power supply

INFORMATION!
The supply voltage has to be between 12 VDC and 30 VDC. This is based on the total resistance of the measuring loop. To determine this, add up the resistances of each component in the measuring loop (not including the level meter).

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

$U_{ext.} = R_L \cdot 22\ mA + 12\ V$

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

INFORMATION!
The power supply has to be able to supply a minimum of 22 mA.

Load for HART® communication

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

The maximum load resistance is calculated as follows:

$$R_L = \frac{U_{ext.} - 12\ V}{22\ mA}$$

DANGER!
Use a twisted two-core cable to prevent electrical interference from impeding the DC output signal.
In some cases a shielded cable may be necessary. The cable shield may only be earthed (grounded) at one place (on the power supply unit).

Configuration

The ESK can be configured via HART® communication. DD (Device Description) for AMS 6.x and PDM 5.2 as well as a DTM (Device Type Manager) are available for configuration (go to download centre at www.krohne.com).

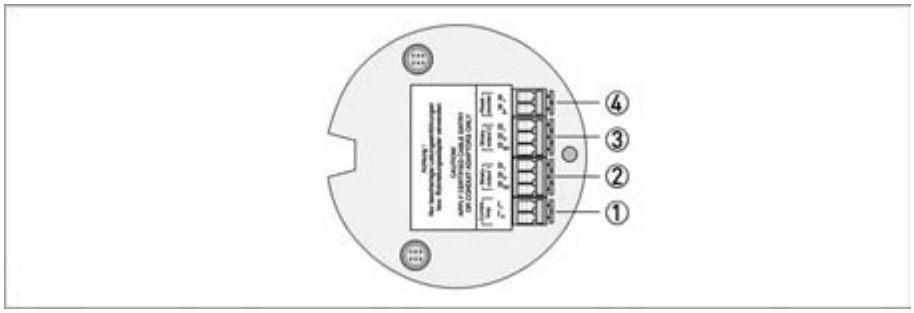
With the integrated HART® communication, the current level can be transmitted. Two limit values can be monitored.

4.3 Electrical connection indicator M10

4.3.1 Electrical connection and functions

The display can be removed after the housing lid has been unscrewed. The connection terminals have a spring locking system.

Terminal connection

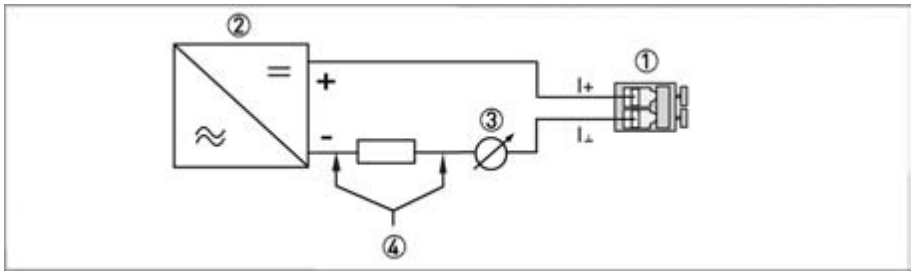


① Power supply - current output
② Switching output B1
③ Switching output B2
④ Not used for BW25

4.3.2 M10 Power supply - current output

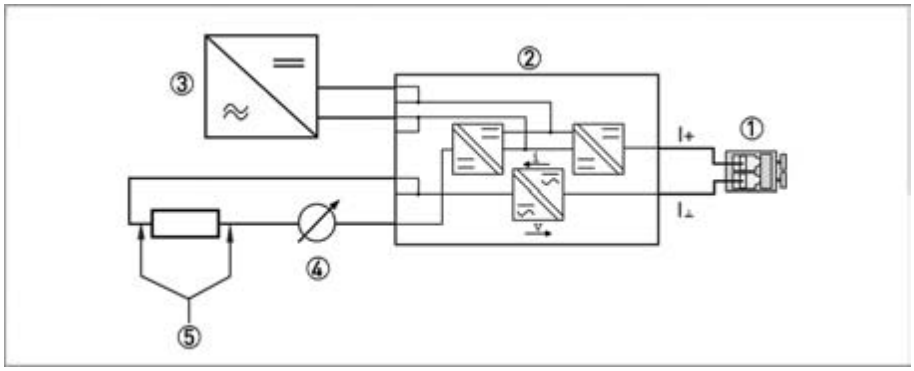
The electrical connection is reverse-polarity protected.

M10 - terminal connection I



① Terminal connection
② Power supply 16...32VDC
③ Measurement signal 4...20 mA
④ External load, HART® communication

The circuitry to other devices must be designed with especial care. In some circumstances internal connections in these devices (e.g. GND with PE, ground loops) may lead to impermissible voltage potentials, which can compromise the function of the device itself or a connected device. In such cases a protected extra-low voltage (PELV) is recommended.



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

HART® communication

When HART® communication is carried out with the M10, this will not in any way impair analogue measured data transmission (4...20 mA).
Exception for multidrop operation. In multidrop operation, a maximum of 15 devices with HART®TM function can be operated in parallel, for which the current outputs are switched to inactive (I approx. 4 mA per device).

Power supply

INFORMATION!
The supply voltage has to be between 16 VDC and 32 VDC. This is based on the total resistance of the measuring loop. To determine this, add up the resistances of each component in the measuring loop (not including the level meter).

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

$U_{ext.} = R_L \cdot 22\ mA + 16\ V$

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

INFORMATION!
The power supply has to be able to supply a minimum of 22 mA.

Load for HART® communication

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

The maximum load resistance is calculated as follows:

$$R_L = \frac{U_{ext.} - 16\,V}{22\,mA}$$

DANGER!
Use a twisted two-core cable to prevent electrical interference from impeding the DC output signal.
In some cases a shielded cable may be necessary. The cable shield may only be earthed (grounded) at one place (on the power supply unit).

Configuration

The electronic M10 indicator can be configured using HART® communication. DD (Device Description) for AMS 6.x and PDM 5.2 as well as a DTM (Device Type Manager) are available for configuration (go to download centre at www.krohne.com).

The current level can be transmitted using the integral HART® communications. Two limit values can be monitored.

4.3.3 M10 switching outputs B1 and B2

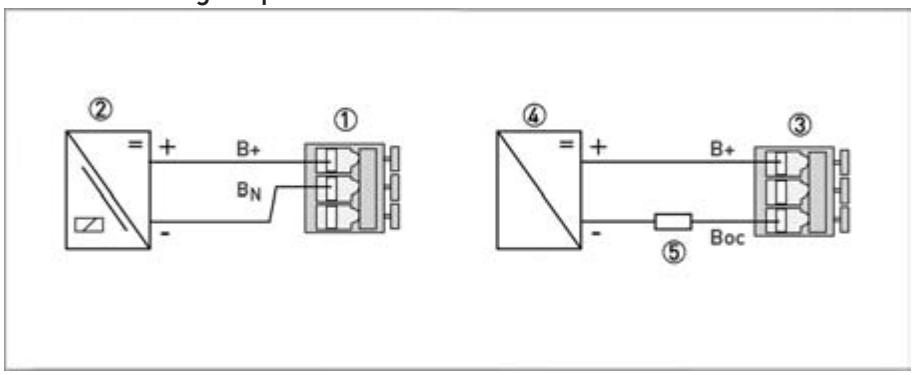
The switching outputs are electrically isolated from each other and from the current output.

CAUTION!
The switching outputs can only be operating if the power supply is applied to terminals I+ and I-.

Switching outputs B1 and B2 can be electrically connected in two ways:

- NAMUR switching output - Ri approx. 1kOhm
- Low-resistance switching output with PNP technology

M10 - switching outputs



① NAMUR terminal connection
② Isolation switching amplifier
③ PNP technology terminal connection
④ Power supply
⑤ Load

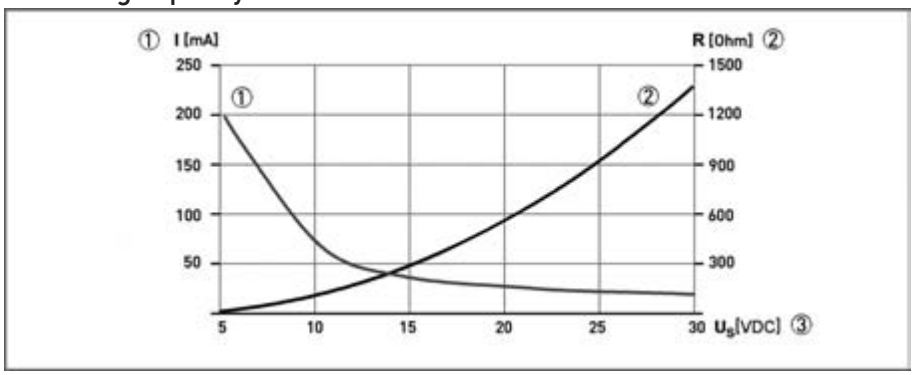
Switching values

	NC contact		NO contact	
	NAMUR	OC	NAMUR	OC
Switching value reached	≤1 mA	≤1 mA	> 3mA	max. 100 mA
Switching value not reached	> 3mA	max. 100 mA	≤1 mA	≤1 mA

Switching capacity of B1 and B2 with PNP technology

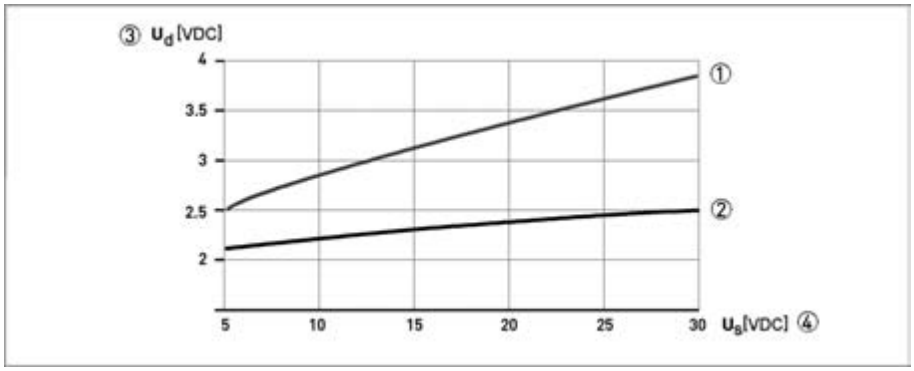
Due to the PNP technology and the associated protective elements, there is a voltage drop Uv for the load to be operated.

Switching capacity of B1 and B2



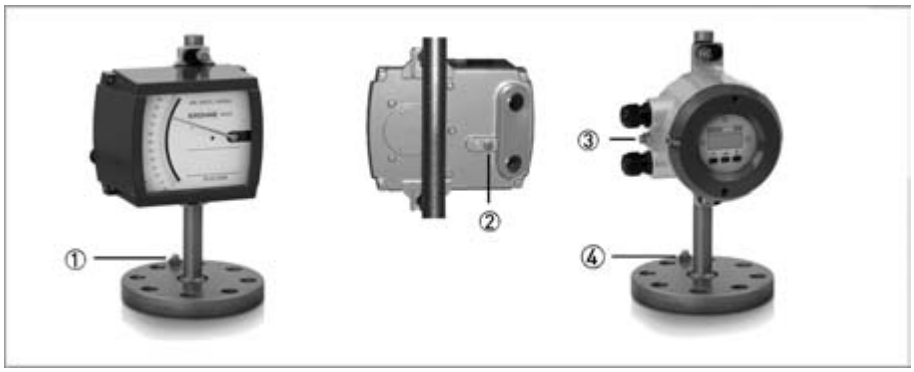
① Max. switching current I [mA]
② Minimum load impedance R_L [Ohm]
③ Power supply $U_{ext.}$

Power loss of B1 and B2



① Load impedance R_L 100 Ohm
② Load impedance R_L 1000 Ohm
③ Power loss U_d
④ Power supply $U_{ext.}$

4.4 Grounding



① Grounding on the flange
② Grounding indicator M9
③ Grounding indicator M10

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

4.5 Protection category

The measuring device meets all requirements of protection category IP67, NEMA 4x.

DANGER!
After all servicing and maintenance work on the measuring device, the specified protection category has to be ensured again.

Therefore it is essential to observe the following points:

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

5.1 Start-up

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

- *Compare the serial number on the indicator (nameplate) with the serial number on the displacement rod, the pressure sleeve and the flange.*
- *Avoid assembling components that have different serial numbers.*
- *Ensure material compatibility of the wetted parts.*
- *The indicator system has been factory set such that when the displacement rod is not immersed (empty tank) the indicator shows "0" at an operating temperature of 20° C.*
- *Do not change the factory setting of the pointer. This applies in particular where high pressures and high temperatures are involved.*

5.2 Indicator M10

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

Start

After the device is switched on, the display shows the following in sequence

- "Test",
- the device type and
- the version number.

Afterwards the device performs a self-test and switches to measurement mode. Here all of the parameters preset for the customer are analysed and checked for plausibility, and the current measured value is displayed.

Operation

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

6.1 Operating elements

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 under the glass disc over the appropriate circle. Only touch the circle vertically and from the front using the bar magnet. Touching it from the side may cause a malfunction.

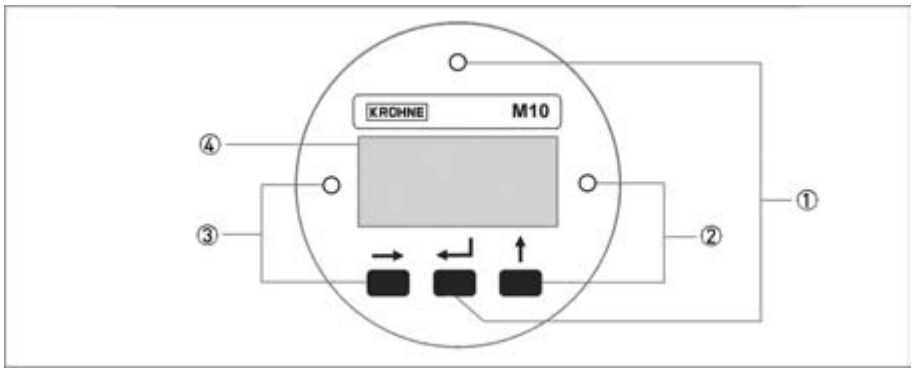


Figure 6-1: Display and operating elements

① Enter button (circuit for bar magnet)
② Up button (circuit for bar magnet)
③ Right button (circuit for bar magnet)
④ Display

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:

M10 operation keys

Button	Symbol
right	→
up	↑
Enter	↵

6.2 Basic principles of operation

6.2.1 Functional description of the buttons

→	Switch from measuring mode to menu mode
	Switch to one menu level lower
	Open menu item and activate change mode
	In change mode: Move the input cursor one position to the right; after the last digit the input cursor jumps back to the beginning.
↑	**In measuring mode:** Switch between measured values and error messages
	Change between the menu items within a menu level
	In change mode: Changing parameters and settings; running through the available characters; shifting the decimal point to the right.
↵	Switch to one menu level higher
	Return to measuring mode with a query whether the data should be accepted

6.2.2 Navigation within the menu structure

Navigation within the menu is by means of the → and ↵ buttons. Pressing button → takes you one menu lower, ↵ takes you one menu higher.
If you are already located at the lowest level (function level), you can use the button → to go the the change mode, which can be used to set data and values.
If you are located at the first level (main menu), you can use the ↵ key to exit the menu mode and return to the measuring mode.

Measuring mode	→ / ↵	Main menu ↑	→ / ↵	Sub-menu ↑	→ / ↵	Function ↑	→ / ↵	Edit → ↑ ↵

6.2.3 Changing the settings in the menu

Starting operation
Operation is started using the → key
If a different key is pressed, it is necessary to wait 5 seconds before activating the → key.
If a control lockout is set, the code → → → ↵ ↵ ↵ ↑ ↑ ↑ must be entered. If no key is pressed within 5 seconds, code input is exited.

Exiting operator input
Operation is exited by pressing the ↵ key several times.

If data have been changed:		
Save Yes	→	Changes saved. An update is carried out and the display returns to measuring mode.
Save No	↵	Changes not saved. The display returns to measuring mode.

CAUTION!
Each time parameters or settings are changed, the measuring device carries out an internal plausibility check.
If implausible inputs have been made, the indicator remains in the current menu, and the changes are not accepted.

Example: changing the default parameter from m to cm

	Display			Display
Example:	5.0 m		1x →	Fct. 3.13.**1** LEVEL
1x →	Fct. **1**.0 OPERATION		1x →	5.0000 m
2x ↑	Fct. **3**.0 INSTALLATION		6x ↑	500 cm
1x →	Fct 3.**1** LANGUAGE		1x ↵	Save Yes
12x ↑	Fct 3.**13** END&UNIT		3x ↵	500 cm

6.2.4 Measures in the event of faulty indications

If the indications on the display or the responses to keypad commands are faulty, you have to do a hardware reset. Switch the power supply OFF and ON again.

6.3 Overview of the most important functions and indicators

INFORMATION!
A complete list of all functions and short descriptions is provided in the appendix. All default parameters and settings are adapted for the specific customer.

Level	Designation	Explanation
1.4	TIME CONST.	Time constant, damping value [s]
1.5.2	ERROR	Error indicator Yes: Error messages are deleted No: error messages are suppressed.
2.1	4-20mA OUT	Check current output
2.2 - 2.4	OUTPUT B	Testing the switching output
3.1	LANGUAGE	Select the menu language
3.13.1	LEVEL	Maximum level of the liquid The value set is represented by a 20 mA analogue current output. If the current value exceeds the preset value, an alarm is indicated.

M10 level units

The following units are supported: m - cm - mm - inch - feet

6.4 Error messages

Error message	Description	Category	Remedy
NOT LINEARIZED	Linearization faulty or not activated = measuring error	Errors	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 non-existent data in the linearisation table = measuring error	Error	Check 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 a check of the linearization.
NOT MONOTONOUS	The sequence of the linearisation values does not rise monotonously.	Error	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 level value of the linearisation table is not 0%		
LAST NOT 100 %	The last level value of the linearisation table is not 100%		
LINEARIZATIO UNDER CONFIG	The device is in linearization mode = measuring error	Error	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 of the linearisation value is not correct for the select level meter.	Error	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 linearisation table does not have enough support points.	Error	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.
NO ZERO CAL OF AO	The analog output zero point 4.00 mA is not calibrated. = Possible measurement error in the process control system	Warning	Perform calibration using ammeter and menu 3.10 or using standard HART® tools/process control system and poss. external ammeter. Caution: during calibration, switch the measuring point to manual control.
NO F.SC. CAL OF AO	The current output 100% = 20.00mA is not calibrated. = potential measuring error in process control	Warning	Perform calibration using ammeter and menu item 3.11 or using standard HART® tools and external ammeter if necessary. Caution: during calibration, switch the measuring point to manual control.
NO TEMP. COMPENSATION	The sensor temperature compensation of the device is faulty or has not been carried out = possible measuring error	Error	The device, together with an indication of the error, must be sent back to the manufacturer for checking.
OUTPUT NOT LINEARIZED	Linearization is not activated = measuring error	Error	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.

Error message	Description	Category	Remedy
FRAM WRITE FAULT	Internal communication error	Error	Check whether the display is plugged in correctly and restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
ROM/FLASH ERROR	Memory error detected during self-test.	Error	Restart the device. If the error occurs again: send the device back to the manufacturer with an indication of the error.
RESTART OF DEVICE	A device restart has taken place	Information	The device has been restarted using menu item 1.5.2 since the last time the error messages were reset.
MULTIDROP MODE	The HART® multidrop mode is activated. The current output is set to a fixed value of 4.5 mA.	Information	The HART® multi-drop mode is activated by selecting a polling address not equal to 0 using menu item 3.9. Polling address 0 reactivates the current output.
CRYSTAL OSC FAULT	Internal error in device	Error	The device must be sent back to the manufacturer with an indication of the error.
REF VOLTAGE FAULT			
SENSOR A FAULT			
SENSOR B FAULT			
MEMORY CORRUPTION	Internal memory error, caused by a hardware or software problem	Error	Restart the device; if the error occurs again the device must be sent back to the manufacturer with an indication of the error.
AO FIXED	The current output is set to a fixed value.	Information	The current output is fixed and does not reflect the measured value. This is the case in multidrop mode, with current output test/calibration using the menu or HART®
AO SATURATED	Current output saturated	Information	The current output is saturated at 20.4 or 22.0 mA (depending on whether the alarm current is activated or deactivated in menu item 3.12), and is no longer coupled with the measured value.

DDs ("driver") for HART® Tools, process control (e.g. Siemens PDM or AMS) PACTware™ and HART® DTMs are available at the KROHNE Download Center.

6.5 Menu indicator M10

6.5.1 Factory Settings

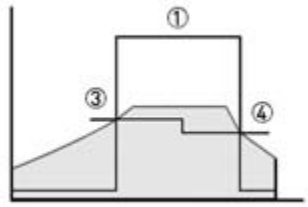
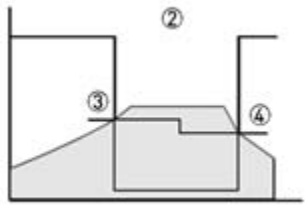
Menu	Function	Setting
1.1.1	Switching value B1	0.0
1.1.2	Hysteresis B1	0.0
1.2.1	Switching value B2	0.0
1.2.2	Hysteresis B2	0.0
1.3	Display	Flow rate
1.4	Time constant	3 s
1.5.2	Reset error	NO
3.1	Language	DEUTSCH
3.2	Function B1	INACTIVE
3.3	Contact B1	NC contact
3.4	Function B2	INACTIVE
3.5	Contact B2	NC contact
3.9	Multidrop polling address	0
3.12	Alarm current	OFF
3.13.1	Level meter	see nameplate
3.15	Input code	NO

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

6.5.2 Menu structure

Menu	Sub-menu 1	Sub-menu 2
1 Operation	1.2 OUTPUT B2	1.1.1 Switching value B1
		1.1.2 Hysteresis B1
	1.2 OUTPUT B2	1.2.1 Switching value B2
		1.2.2 Hysteresis B2
	1.3 Display	
	1.4 Time constant	
	1.5 Reset	1.5.1 Inactive
		1.5.2 Error reset
2 Test & Info	2.1 4...20 mA output	
	2.2 OUTPUT B1	
	2.3 OUTPUT B2	
	2.4 Inactive	
	2.5 Serial no.	
	2.6 Software Version	
	2.7 Tag no.	
3 Installation	3.1 Language	
	3.2 Function B1	
	3.3 Contact B1	
	3.4 Function B2	
	3.5 Contact B2	
	3.6 Inactive	
	3.7 Inactive	
	3.8 Inactive	
	3.9 Multidrop	
	3.10 Calibration 4mA	
	3.11 Calibration 20mA	
	3.12 Alarm current	
	3.13 Upper range value and unit	3.13.1 Level
		3.13.2 Inactive
	3.14 Inactive	3.14.1 Inactive
		3.14.2 Inactive
		3.14.3 Inactive
	3.15 Input code	
	3.16 Basic setting	

6.5.3 Menu explanations

Level	Designation	Selection/input options	Explanation
1.1.1	OUTPUT B1	INACTIVE	
		LEV.VALUE B1	Level value switching point. A numeric value between 0.0 ... 100% of the level value can be set. If the current level value exceeds this set switching point, then output B1 is activated. **Note** The function NC or NO can be selected using menu 3.3.
1.1.2	OUTPUT B1	HYST.B1	Hysteresis setting for the level value switching point. Value range 0...switching point. Example: If, under 1.1.1, a switching point of 200 is set, a hysteresis value of 0...200 can be set. If a value of 0 is entered, this output has no hysteresis. If a value of 20 is entered, the output works as follows: If the current level value exceeds the value of 200, the output switches. ③ If the current level value is under the hysteresis value of 180, the switching output returns to its normal state. ④ **Note** If this function is inverted, the output under menu 3.3 must be set from NO ① to NC ② or vice versa. This function is not activated with the counter switching point.
 			
1.2.1	OUTPUT B2	INACTIVE	
		LEV.VALUE B2	See LEV.VALUE B1
1.2.2	OUTPUT B2	HYST.B2	See HYST. B1
1.3	DISPLAY	LEVEL	
		%	
		LEVEL & %	
1.4	TIME CONST.		Setting : 1 ... 20 seconds **Note** The settable time constant affects the current output and the displayed current level. It thus allows attenuated depiction when the display is not calm. If the current level is polled via HART communication, then the transferred measured value is dependent on the time constant.

1.5.1	Inactive		
1.5.2	RESET	ERROR	YES - NO
2.1	4-20mA OUT		The analogue current output can be set to fixed values in 10 % increments from 4.00...20.00mA. This function has no influence on the binary switching outputs. **Note** This test function is switched off in multi-drop mode. Display: "NOT AVAILABLE".
2.2	OUTPUT B1	OPEN	The function assignment in menu 3.2 is not taken into consideration here.
		CLOSED	
2.3	OUTPUT B2	OPEN	The function assignment in menu 3.2 is not taken into consideration here.
		CLOSED	
2.4	Inactive		
3.1	LANGUAGE	ENGLISH	
		DEUTSCH	
		FRANCAIS	
		ITALIANO	
		ESPANOL	
		CESKY	
		POLSKI	
		NEDERLANDS	
3.2	FUNCTION B1	INACTIVE	Output B1 is switched off.
		SWITCHING POINT	The output B1 switches at a set value depending on the current level value.
3.3	CONTACT B1	NC contact	Output B1 is normally closed. If an alarm situation occurs, the contact opens.
		NO CONTACT	Output B1 is normally open. If an alarm situation occurs, the contact closes.
3.4	FUNCTION B2	INACTIVE	See FUNCTION B1
		SWITCHING POINT	See FUNCTION B1
3.5	CONTACT B2	NC contact	See CONTACT B1
		NO CONTACT	See CONTACT B1
3.6	Inactive		
3.7	Inactive		
3.8	Inactive		
3.9	MULTIDROP	0...15	Multi-drop mode means that the device is continuously working in bus mode via HART® communication (max. 15 parallel devices). The analogue current output is then fixed to 4.1 mA. Measured values are transmitted via HART® communication. However, the display allows local reading of the measured values. The polling address can be set to 1 .... 15. Larger whole numbers are not permitted. If the polling address is set to 0, HART® bus mode is switched off. The device functions as analogue. The current output of 4-20mA is active. Standard HART® communication is further guaranteed.

3.10	4mA CALIBR.		This menu item allows precise calibration of the current output. The device generates a fixed analogue output of 4.00 mA. If the measured value differs from the one displayed, the measured value must be entered. When the menu is exited, the corrected value is saved.
3.11	20mA CALIBR.		This menu item allows precise calibration of the current output. The device generates a fixed analog output of 20.00 mA. If the measured value deviates from the displayed one, then the measured value must be input. When the menu is exited, the corrected value is saved.
3.12	ALARM CURRENT	OFF	Measured values > 100% are indicated as a current signal up to a maximum of 22 mA.
		ON	In the event of an error the current output is set to the fixed value of 22m A.
3.13	END & UNIT		The level meter and end value can be changed.
3.13.1	LEVEL		For a units list, see Section 7.4 of the manual
3.13.2	Inactive		
3.14	Inactive		
3.15	INP. CODE	YES	The input code is used to prevent authorised adjustment of the measurement parameters. The input code is not active by default. If YES is selected, the last code entered must be typed in. The default code is: → → → ↵ ↵ ↵ ↑ ↑ ↑ If, after confirmation with YES, the key → is pressed, then a new individual, nine-digit code can be typed in. The display shows the required key combination.
		NO	
3.16	BASIC SETTING	YES	This menu item can be used to select the calibrated basic setting. This can be helpful if operating data have been changed a number of times. This menu item cannot be used to reset the calibration.
		NO	

7.1 Maintenance

During routine operational maintenance of the system, the level meter should also be checked for soiling, corrosion and mechanical wear or damage to the displacer rod, pressure sleeve and the display.
We advise that inspections be carried out at least once per year. The device must be removed before cleaning.

CAUTION!
Before dismantling, ensure that the tank is depressurised and vented.

In the case of devices used for measuring aggressive media, appropriate safety precautions must be taken with regard to residual liquids on the measuring unit.
Avoid electrostatic charges when cleaning the surfaces (e.g. sight window)!

7.2 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 Availability of services

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

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

7.4 Returning the device to the manufacturer

7.4.1 General information

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

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

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

CAUTION!

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

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

7.4.2 Form (for copying) to accompany a returned device

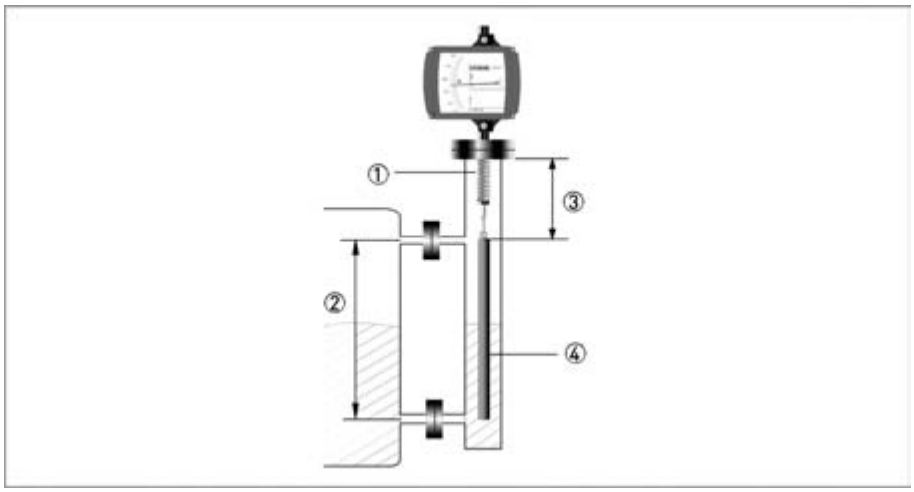
Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.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

7.5 Disposal

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

8.1 Operating principle

The device works according to the displacement principle.
The length of the displacer rod ④ corresponds to the measuring range ②.
The displacer rod ④ suspended from a measuring spring ① is immersed in the liquid and detects a lifting force, which is proportional to the mass of the displaced liquid.
Each change to the rod weight corresponds to the change in the length of the spring and is thus a measure of the filling height.
The expansion of the spring and thus the measuring stroke is transmitted to a display using a solenoid coupling from the measuring chamber.
If the device cannot be installed from above, e.g. because there is an agitator in the tank, then there is a special bypass chamber available for side mounting.
The lift of the proportional rod is dependent on the density of the product.
The level indication must be displayed for the liquid to be measured.
The difference in density between the tank atmosphere and liquid must be at least 100 g/l.
The atmospheric pressure and temperature must be known.
Due to the length of the spring suspension pin ③, the unmeasureable area is L = 340 mm.



① Measuring spring
② Measuring range
③ L ≥ 340mm
④ Displacer rod

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 representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Application range	Level measurement
Operating method / measuring principle	Displacement principle
Measured value	Level, separating layer

Measuring accuracy

Standard	< 1.5% full scale value
Min. measuring range	0.3 m / 12"
Max. measuring range	6 m / 20 ft
Medium	Liquids
Density	≥ 0.45 kg/l / 28.1 lbs/ft^3

Materials

Housing	Aluminium with artificial resin coating
Housing option	Stainless steel (indicator M9)
Displacer rod	Stainless steel 1.4404
Displacer rod option	Titanium
Spring	Stainless steel 1.4571 (T_m < 100°C / 212°F)
Spring option	ATS 340 (T_m > 100°C / 212°F)
Flange	Stainless steel 1.4404
Pressure sleeve	Stainless steel 1.4404

Process connections

Max. operating pressure	40 bar - optional to 400 bar / 580 - optional 5802 psig
Standard flange	DN50 - PN40 / 2" ASME 300 lbs
Optional flange	...DN100 - ...PN400 / ...4" ASME ...2.500 lbs

Approvals

ATEX, indicator M9 with electrical installations	Cat. II 1/2G, EEx ia IIC T6
ATEX, indicator M10	Cat. II 1/2G, EEx d IIC T6
ATEX, indicator M9 without electrical installations	
for Zone 0 tanks	Cat. II 1/2 Gc
for Zone 1.21	Cat. II 2 GD
for Zone 2.22	Cat. II 3 GD

Temperatures

Indicator M9 without electrical installations

Product or flange temperature	-40...+400°C	-40...+752°F
Ambient temperature $T_{amb.}$	-40...+60°C	-40...+140°F
Storage temperature	-40...+60°C	-40...+140°F

Indicator M9 with electrical installations

Product or flange temperature	-20...+295°C	-4...+563°F
Product or flange temperature, HT version	-40...+400°C	-40...+752°F
Ambient temperature $T_{amb.}$	-40...+60°C	-40...
Storage temperature	-40...+60°C	-40...+140°F

Indicator M10

Product or flange temperature	-40...+200°C	-40...+392°F
Ambient temperature $T_{amb.}$	-40...+60°C	-40...+140°F
Storage temperature	-40...+60°C	-40...+140°F

Technical data, indicator M9
M9 cable glands

Cable gland	Material	Cable diameter	
M 16x1.5 Standard	PA	3...7 mm	0.118...0.276"
M20 x 1.5	PA	8...13 mm	0.315...0.512"
M 16x1.5	Nickel-plated brass	5...9 mm	0.197...0.355"
M20 x 1.5	Nickel-plated brass	10...14 mm	0.394...0.552"

M9 limit switches

Terminal connection	2.5 mm^2			
Limit switch	I7S23,5-N SC3,5-N0	SJ3,5-SN ①	SJ3,5-S1N ①	SB3,5-E2
NAMUR	yes	yes	yes	no
Connection type	2-wire	2-wire	2-wire	3-wire
Switching element function	NC contact	NC contact	NO contact	PNP NO contact
Nominal voltage U_0	8 VDC	8 VDC	8 VDC	10...30 VDC
Pointer vane not detected	≥ 3 mA	≥ 3 mA	≤ 1 mA	≤ 0.3 VDC
Pointer vane detected	≤ 1 mA	≤ 1 mA	≥ 3 mA	U_B - 3 VDC
Continuous current	-	-	-	max. 100 mA
No load current I_0	-	-	-	≤ 15 mA

① safety oriented

M9 current output ESK2A

Terminal connection	2.5 mm^2
Power supply	12...30 VDC
Min. power supply for HART TM	18 VDC
Measuring signal	4.00...20.00 mA = 0...100% level value in 2-wire technology
Power supply influence	< 0.1%
Dependence on external resistance	< 0.1%
Temperature influence	< 5 uA / K
Max. external resistance / load	800 Ohm (30 VDC)
Min. load for HART TM	250 Ohm
Software firmware version	02.14
Ident No:	3210680500

M9 ESK2A HART

ESK2A HART® configuration	
Manufacturer name (code)	KROHNE Messtechnik (69 = 45h)
Model name	ESK2A (226 = E2h)
HART TM protocol revision	5.9
Device revision	1
Physical layer	FSK
Device category	Transmitter without galvanic isolation

M9 ESK2A process variable

ESK2A process variable, level	Values [%]	Signal output [mA]
Over range	+102.5 (± 1%)	20.24...20.56
Device error identification	> 106.25	> 21.00
Maximum	131.25	25
Multi-drop operation	-	4.5
Min. $U_{ext.}$	12VDC	

Technical data, indicator M10

Cable gland	Standard: without
Terminal connection	2,5mm^2
Power supply	24 VDC +/- 30%
Min. power supply for HART TM	18 VDC
Measuring signal	4.00...20.00 mA = 0...100% level value in 2-wire technology
Power supply influence	< 0.1 %
Dependence on external resistance	< 0.1 %
Temperature influence	< 5 µA/K
Max. external resistance / load	≤ 630 Ohm
Min. load for HART	≥ 250 Ohm
Software firmware version	02.14
Ident No:	3209470500

M10 HART

Manufacturer name (code)	KROHNE Messtechnik (69 = 45h)
Model name	M10 (234 = EA)
HART TM protocol revision	5.9
Device revision	1
Physical layer	FSK
Device category	Transmitter

M10 process variable

	Values [%]	Signal output [mA]
Over range	+105 (± 1%)	20.64...20.96
Device error identification	> 110	> 21.60
Maximum	112.5	22
Multi-drop operation	-	4.5
Min. $U_{ext.}$	12 VDC	

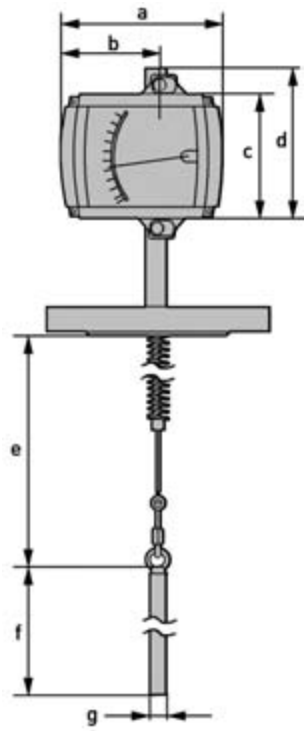
M10 binary output

Two binary outputs	Galvanically isolated	
Operating mode	Switch output	NAMUR or open collector
Configurable as	switch contact or pulse output	Open / closed or max. 10 P/s
NAMUR switch output		
Power supply $U_{ext.}$	8 VDC	
Signal current	> 3 mA switching value not reached;	< 1 mA switching value reached
Switch output, open collector		
Power supply	8...30 VDC	
Pmax	500 mW	
Imax	100mA	

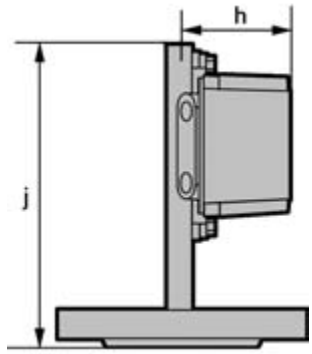
8.3 Dimensions

Dimensions with M9 indicator

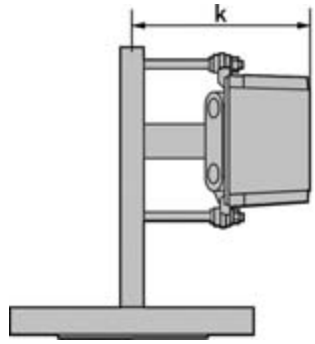
Front view



Side view



Side view HT



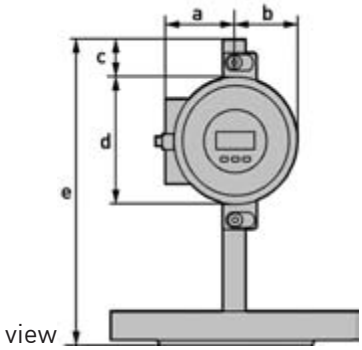
HT - high temperature version

	a	b	c	d	e	f	g	h	j	k
[mm]	181	110	138	168	min. 340	①	≥ 20 ②	106	303	185
["]	7.13	4.33	5.44	6.62	min 13.39	①	≥ 0.79 ②	4.18	11.94	7.29

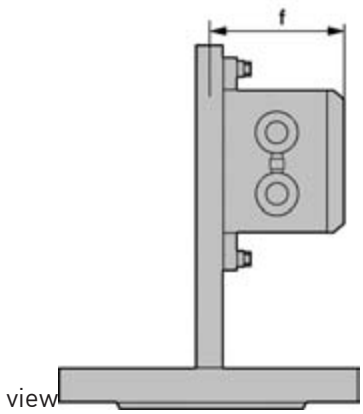
① Length of the displacer rod (measuring area)
② According to the operating conditions

Dimensions M10 indicator and bypass chamber

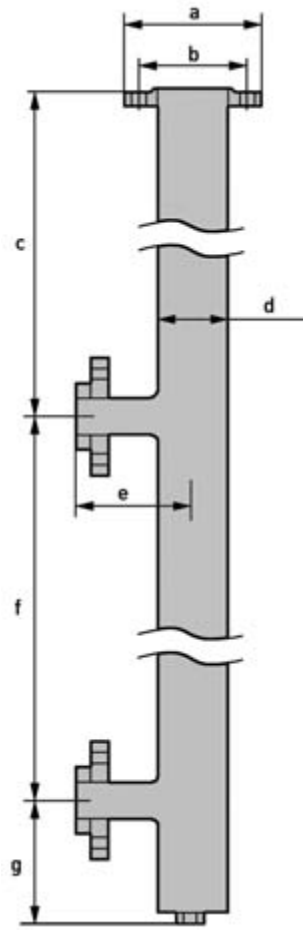
Indicator M10 front



Indicator M10 side



Bypass chamber.



Dimensions with M10 indicator

	a	b	c	d	e	f
[mm]	71	64	37	124	302	114
["]	2.8	2.5	1.5	4.9	11.9	4.5

Dimensions of bypass chamber

	a	b	c	d	e	f	g
[mm]	①	①	340	72	115	②	120
["]	③	③	13.4	2.8	4.5	②	4.7

① Connection according to DIN EN 1092-1
② Length of the displacer rod (measuring area)
③ Connection according to ASME B16.5

KROHNE product overview

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

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