BA01170K/09/EN/09.24-00
71681509
2024-09-30

Valid as of firmware version:
ISU00XA (Standard+FMG50): V01.07.xx
ISU01XA (CM82): V01.05.xx
ISU03XA (NMS8x): V01.06.xx

Operating Instructions
RIA15

Loop-powered Ex ia process indicator as a field device or panel-mounted instrument for 4 to 20 mA signals or HART® protocol

Endress+Hauser
People for Process Automation

Table of contents

1 About this document

1.1 Document conventions

1.1.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠ CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.1.2 Electrical symbols

Symbol	Meaning
⎓	Direct current
~	Alternating current
⎓ ~	Direct current and alternating current
⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⊕	**Potential equalization connection (PE: protective earth)** Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: ▪ Interior ground terminal: potential equalization is connected to the supply network. ▪ Exterior ground terminal: device is connected to the plant grounding system.

1.1.3 Symbols for certain types of information

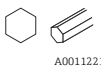
Symbol	Meaning
✓	**Permitted** Procedures, processes or actions that are permitted.
✓✓	**Preferred** Procedures, processes or actions that are preferred.
✗	**Forbidden** Procedures, processes or actions that are forbidden.
ℹ	**Tip** Indicates additional information.
📖	Reference to documentation
📄	Reference to page

Symbol	Meaning
	Reference to graphic
	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.1.4 Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers	1., 2., 3...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
	Hazardous area		Safe area (non-hazardous area)

1.1.5 Tool symbols

Symbol	Meaning
 A0011220	Flat-blade screwdriver
 A0011221	Allen key
 A0011222	Open-ended wrench
 A0013442	Torx screwdriver

1.2 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

Document type	Purpose and content of the document
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

1.3 Registered trademarks

HART®
Registered trademark of the HART® Communication Foundation

2 Safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

2.2 Intended use

The process indicator displays analog process variables or HART process variables (option) on its screen.

By means of HART communication, selected Endress+Hauser field devices/sensors (with the appropriate option) can also be very flexibly configured and commissioned or their diagnostic messages read out and displayed.

The device is powered via the 4 to 20 mA current loop and does not require an additional power supply.

- The manufacturer accepts no liability for damages resulting from improper or non-intended use. The device must not be converted or modified in any way.
- Panel-mounted device:
  The device is designed for installation in a panel and must only be operated in an installed state.
- Field device:
  The device is designed for mounting in the field.
- The device may be operated only under the permitted ambient conditions → 63.

2.3 Product liability

The manufacturer does not accept any responsibility for damage that results from non-designated use and from failure to comply with the instructions in this manual.

2.4 Workplace safety

When working on and with the device:
- ▶ Wear the required personal protective equipment as per national regulations.

2.5 Operational safety

Damage to the device!
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!
- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.6 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device.

2.7 IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Product description

3.1 Function

The RIA15 process indicator is integrated into the 4 to 20 mA/HART loop and displays the measuring signal in digital form. The process indicator does not require an external power supply. It is powered directly from the current loop.

By means of HART communication, the RIA15 enables extremely flexible configuration and commissioning of selected field devices and readouts of device/sensor diagnostic messages. The prerequisite is that the RIA15 was ordered with the appropriate "level" or "analysis" option (e.g. RIA15 level option FMR20 + FMR20B + FMR30B + FMX21+ FMG50).

Detailed description of supported applications → 🖹 8

The device meets the requirements of the HART Communication Protocol Specifications and can be used with devices with HART Revision ≥ 5.0 and higher.

3.2 Operating modes

The process indicator can be used purely as an indicator or as an indicator with an onsite configuration/diagnostic function.

3.2.1 Display functions

The indicator supports two different display modes:

4 to 20 mA mode:

In this operating mode, the process indicator is incorporated into the 4 to 20 mA current loop and measures the transmitted current. The variable calculated based on the current value and range limits is displayed in digital form on the 5-digit LCD. In addition, the associated unit and a bar graph can be displayed.

HART mode:

The device functions as an indicator even when operating with a HART sensor/actuator. In this case, the indicator is also powered from the current loop.

In the HART loop, the process indicator has the option of functioning either as a primary master or as a secondary master (default). When it functions as a master, the device can read process values from the measuring instrument and display them. HART communication operates according to the master/slave principle. As a general rule, the sensor/actuator is a slave and only transmits information if a request has been made by the master.

A HART loop can have a maximum of two HART masters at any one time. For these HART masters, a distinction is made between the primary (e.g. the control system) and the secondary master (e.g. a handheld device for on-site operation of the measuring instruments). The two masters in the loop/in the network cannot be masters of the same type, e.g. they cannot be two "secondary masters".

If a third HART master is added to the network, one of the other masters must be disabled; otherwise a collision occurs in the network.

If the process indicator is operating as a "secondary master", for example, and another "secondary master" (e.g. a handheld device) is added to the network, the device interrupts HART communication as soon as it detects the presence of another "secondary master". The display alternates between error message C970 "Multi master collision" and "- - -". A measured value is not displayed in this case. The device leaves the HART loop for 30

seconds and then tries to re-establish HART communication once again. Once the additional "secondary master" is removed from the network, the device continues communication and displays the measured values of the sensor/actuator once more.

Please note that if two process indicators are to be used in a Multidrop connection, one device must be configured as the "primary master" and the other as the "secondary master" to prevent a master collision.

In HART mode, the process indicator can display up to four device variables of a multivariable measuring instrument. These variables are referred to as the Primary Variable (PV), Secondary Variable (SV), Tertiary Variable (TV) and Quaternary Variable (QV). These variables are placeholders for measured values that can be retrieved using HART communication.

For a flowmeter, such as the Promass, these four values can be as follows:
- Primary process variable (PV) → Mass flow
- Secondary process variable (SV) → Totalizer 1
- Third process variable (TV) → Density
- Fourth process variable (QV) → Temperature

The HART section at the end of these Operating Instructions provides examples of these four device variables for multivariable measuring instruments → 🖹 73.

Refer to the Operating Instructions for each device for details on the variables that are set as default on the sensor/actuator and how they can be changed.

The process indicator can show each of these values. The individual values must be activated in the **SETUP** – **HART1** to **HART4** menu for this purpose. The individual parameters are assigned to fixed process variables in the device in this case:

HART1 = PV

HART2 = SV

HART3 = TV

HART4 = QV

For example, if the PV and TV are to be displayed on the process indicator, **HART1** and **HART3** must be activated.

The values can either be shown alternately on the process indicator or one value is displayed continuously and the other values are only shown by pressing '+' or '–'. The switching time can be configured in the **EXPRT – SYSTM – TOGTM** menu.

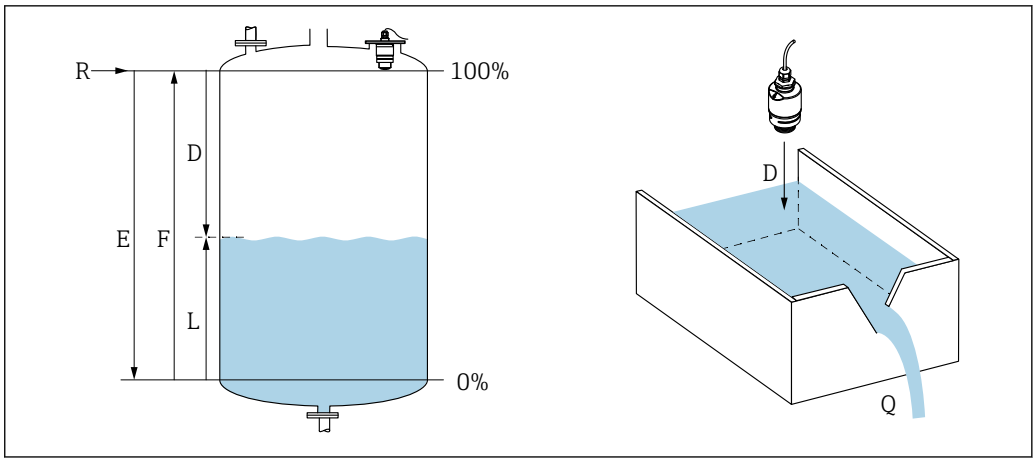
3.2.2 The RIA15 as an indicator with configuration function

For specific sensors/transmitters from Endress+Hauser, the RIA15 can be used for configuration/diagnostics in addition to its display function.

The RIA15 as a remote indicator and for operation of the Micropilot FMR20/ FMR20B/FMR30B

The Micropilot is a "downward-looking" measuring system that functions according to the time-of-flight (ToF) method. It measures the distance from the reference point (process connection of measuring instrument) to the surface of the medium. Radar signals are transmitted via an antenna, reflected by the surface of the medium and received back by the radar system.

In the HART mode, the RIA15 with the "level" option supports basic configuration of the Micropilot. The Micropilot can be adjusted under the **SETUP → LEVEL** menu item (see operating matrix). The value displayed on the RIA15 in display mode corresponds to the linearized level. In addition, the measured distance, the relative echo amplitude and the temperature of the sensor can be displayed.



1 *Calibration parameter Micropilot*

E Empty calibration (= zero)
F Full calibration (= span)
D Measured distance
L Level (L = E - D)
Q Flow rate at measuring weirs or channels (calculated from the level using linearization)

Operating principle of the Micropilot FMR20/FMR20B/FMR30B

The reflected radar signals are received by the antenna and transmitted to the electronics module. There, a microprocessor evaluates the signal and identifies the level echo caused by the reflection of the radar signals off the surface of the medium.

The distance **D** to the surface of the medium is proportional to the time-of-flight **t** of the radar signal:

$D = c \cdot t/2$,

where **c** is the speed of light.

Based on the known empty distance **E**, the level **L** is calculated:

$L = E - D$

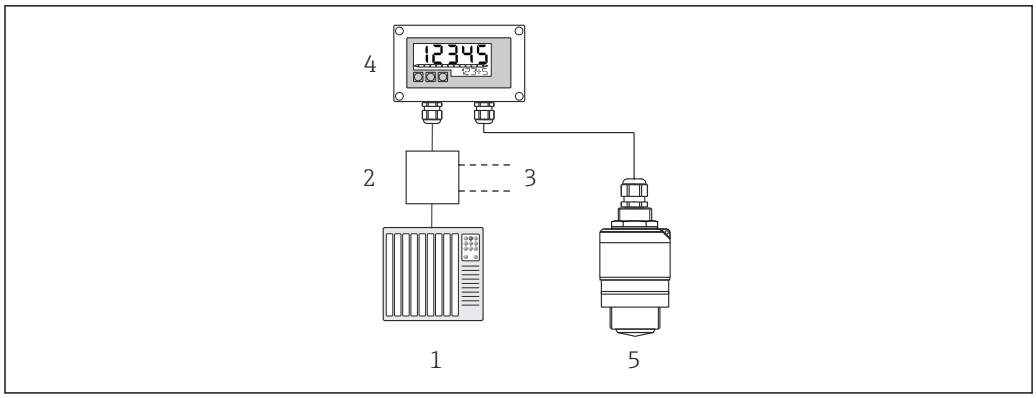
The Micropilot is calibrated by entering the empty distance **E** (= zero point) and the full distance **F** (= span).

Outputs and basic commissioning of the Micropilot FMR20/FMR20B/FMR30B

The RIA15 can be used as a local indicator of measured values as well as for the basic commissioning of the Micropilot radar level sensor via HART.

The following values are output here:

Digital output (HART):
PV: Level linearized
SV: Distance
TV: Relative echo amplitude
QV: Temperature (sensor)



2 Remote operation of the Micropilot via the RIA15

1 PLC
2 Transmitter power supply (with communication resistor) e.g. Endress+Hauser RN series active barrier
3 Connection for Commubox FXA195 and Field Communicator 375, 475
4 Loop-powered RIA15 process indicator
5 Micropilot transmitter

The following settings for the Micropilot can be made using the three operating keys on the front of the RIA15:
- Units
- Empty and full calibration
- Mapping

Further information on the operating parameters → 41

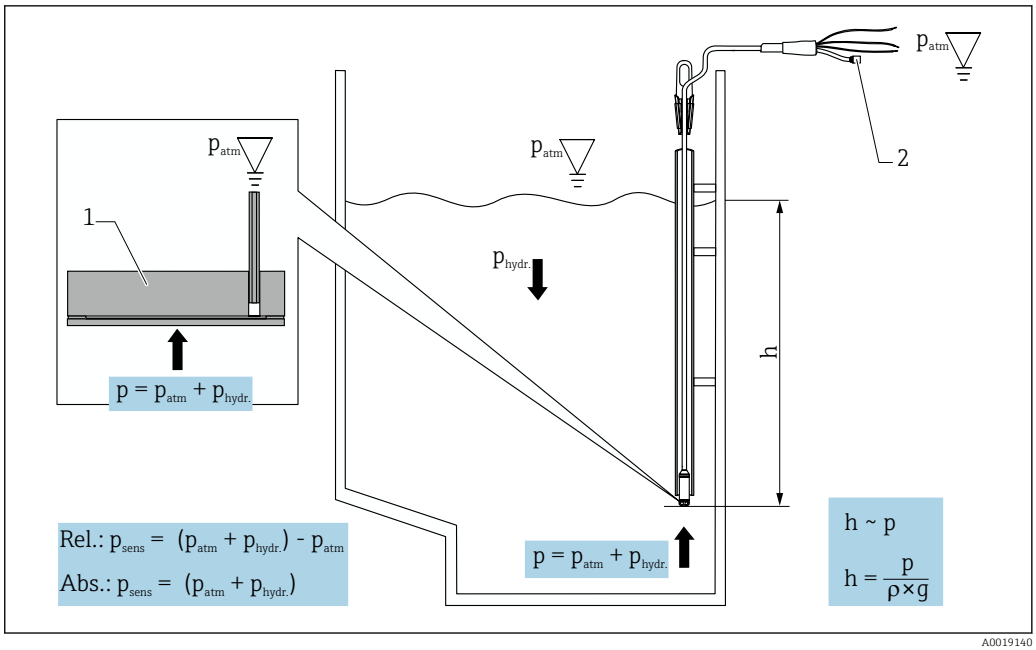
The following order options are available to be able to use this function:
- FMR20, FMR20B or FMR30B product structure
- RIA15 product structure, feature 030 "Input":
  Option 3: "4 to 20 mA current signal + HART + level, option for FMR20 etc"

The RIA15 as a remote indicator and for operation of the Waterpilot FMX2

The Waterpilot is a transmitter with a capacitance, oil-free ceramic measuring cell for hydrostatic level measurement. The device with integrated temperature measurement is certified for drinking water applications. A version for wastewater applications and sludges as well as a metal-free version for use in saltwater are also available.

In the HART mode, the RIA15 with the "level" option supports basic configuration of the FMX21. The FMX21 can be adjusted under the **SETUP → LEVEL** menu item (see operating matrix). The value displayed on the RIA15 in display mode corresponds to the level measured (initial setting). The pressure and the temperature can also be displayed.

When the **LEVEL** menu is called up, the RIA15 automatically performs the following initial settings on the FMX21:
- Operating mode: level
- Calibration mode: dry
- Level selection: in pressure
- Lin mode: linear



3 *Waterpilot FMX21 calibration parameters*

1 *Ceramic measuring cell*
2 *Pressure compensation tube*
h *Level height*
p *Total pressure = atmospheric pressure + hydrostatic pressure*
ρ *Density of the medium*
g *Acceleration due to gravity*
$P_{hydr.}$ *Hydrostatic pressure*
P_{atm} *Atmospheric pressure*
P_{sens} *Sensor gauge pressure*

Operating principle of the FMX21

The total pressure, comprising atmospheric pressure and hydrostatic pressure, acts directly on the process membrane of the Waterpilot FMX21. Changes in air pressure are guided through a cable gland with pressure compensation membrane installed in the RIA15 via the pressure compensation tube in the extension cable to the rear of the ceramic process membrane in the FMX21 and are compensated for.

A pressure-dependent change in capacitance, caused by the movement of the process membrane, is measured at the electrodes of the ceramic carrier. The electronics unit then converts this to a signal that is proportional to the pressure and linear to the level.

The Waterpilot FMX21 is calibrated by configuring the lower-range value and the upper-range value by entering pressure and level values. For devices with a gauge pressure measuring cell, there is the option of performing a zero-point adjustment.

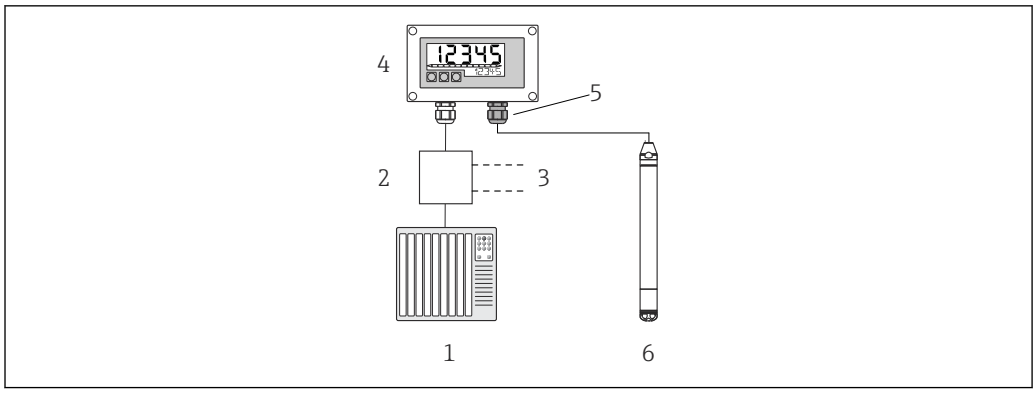
The preset span corresponds to 0 to URL, where **URL** is the upper range limit of the selected sensor. A different span can be ordered from the factory by selecting a customer-specific measuring range.

Output and basic commissioning of the FMX21

The RIA15 can be used as a local indicator and for the basic configuration of the Waterpilot FMX21 hydrostatic level sensor via HART.

The following values are output here:

Digital output (HART):
PV: Level linearized
SV: Measured pressure
TV: Pressure after position adjustment
QV: Temperature (sensor)



A0035931

4 *Remote operation of the FMX21 via RIA15*

1 *PLC*
2 *Transmitter power supply (with communication resistor) e.g. Endress+Hauser RN series active barrier*
3 *Connection for Commubox FXA195 and Field Communicator 375, 475*
4 *Loop-powered RIA15 process indicator*
5 *Cable gland M16 with pressure compensation membrane*
6 *FMX21 transmitter*

The following settings for the FMX21 can be made using the three operating keys on the front of the RIA15:
- Pressure unit
- Level unit
- Temperature unit
- Zero adjustment (only for gauge pressure measuring cells)
- Empty and full pressure adjustment
- Empty and full level calibration
- Reset to factory defaults

Further information on the operating parameters → 42

The following order options are available to be able to use this function:
- FMX21 product structure
- RIA15 product structure, feature 030 "Input":
  Option 3: "4 to 20 mA current signal + HART + level... FMX21"

NOTICE

Compensation of atmospheric pressure

- ▶ When installing the FMX21, compensation of the atmospheric pressure must be guaranteed. Pressure compensation takes place through a pressure compensation tube in the extension cable of the FMX21 in conjunction with a special cable gland with integrated pressure compensation membrane, which must be attached on the right of the RIA15. This cable gland is supplied in black so that it can be easily distinguished from other cable glands.
- ▶ If necessary, the cable gland with integrated pressure compensation membrane can be ordered as a spare part at a later stage→ 61.

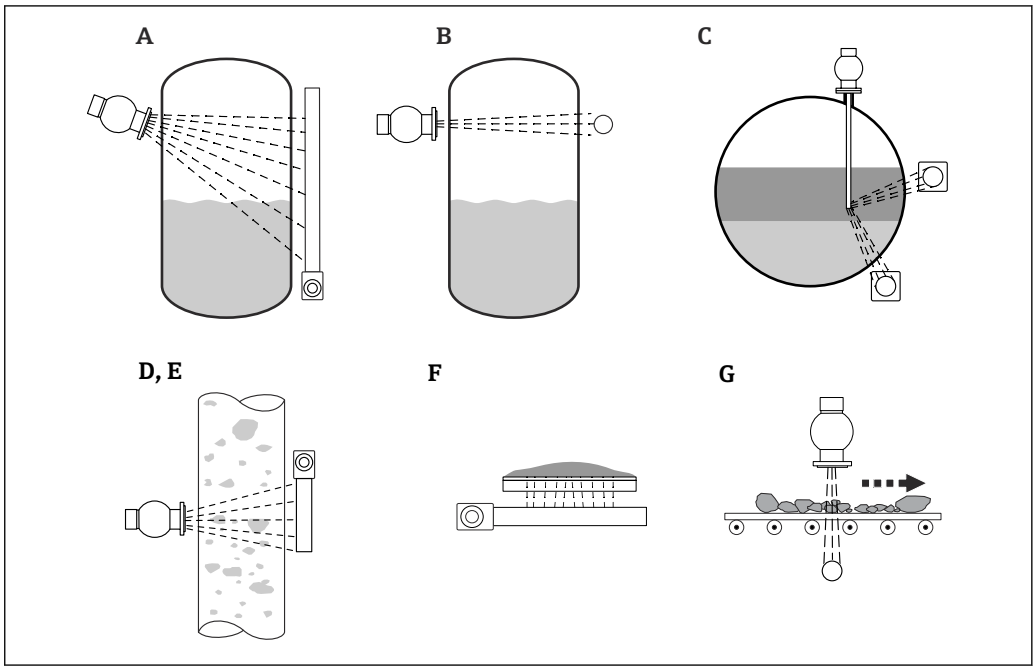
The RIA15 as a remote indicator and for operation of the Gammapilot FMG50

The Gammapilot FMG50 is a compact transmitter for non-contact measurement through vessel walls.

Applications
- Measurement of level, interface, density and concentration, as well as point level measurement
- Measurement in liquids, solids, suspensions or sludges
- Use under extreme process conditions
- All types of process vessels

Operating principle of the Gammapilot FMG50

The radiometric measuring principle is based on the fact that gamma radiation experiences attenuation when it penetrates materials. Radiometric measurement can be used for a variety of measuring tasks:



5 *Measuring tasks of the Gammapilot FMG50*

A Continuous level measurement
B Point level measurement
C Interface measurement
D Density measurement
E Concentration measurement (density measurement followed by linearization)
F Concentration measurement with radiating media
G Measurement of mass flow (solids)

Continuous level measurement

A source container with a radiation source and a Gammapilot FMG50 (to receive the gamma radiation) are mounted on opposite sides of a vessel. The radiation given off by the radiation source is absorbed by the medium in the vessel. The higher the level rises, the more radiation is absorbed by the medium. This means that the Gammapilot FMG50 receives less radiation the more the level of the medium rises. This effect is used to determine the current level of the medium in the vessel. As the Gammapilot FMG50 is available in different lengths, the detector can be used for measuring ranges of different sizes.

Point level measurement

A source container with a radiation source and a Gammapilot FMG50 (to receive the gamma radiation) are mounted on opposite sides of a vessel. The radiation given off by the radiation source is absorbed by the medium in the vessel. In the case of point level detection, the radiation received by the Gammapilot FMG50 is normally absorbed completely if the beam path between the radiation source and the detector is completely filled with medium. In this case, the level of the medium in the vessel is at the defined limit value. The Gammapilot FMG50 indicates the uncovered state (no medium in the beam path) as 0% and the covered state (beam path filled with medium) as 100%.

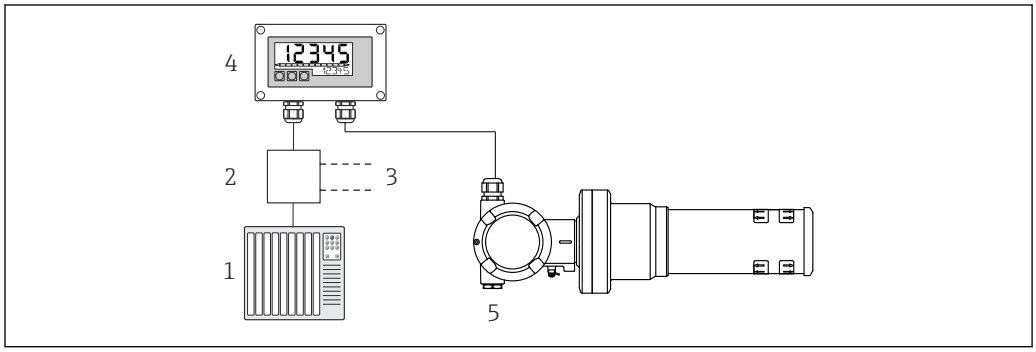
Density measurement

A source container with a radiation source and a Gammapilot FMG50 (to receive the gamma radiation) are mounted on opposite sides of a pipe. The radiation given off by the radiation source is absorbed by the medium in the vessel. The denser the medium in the beam path between the radiation source and the detector, the more radiation is absorbed.

The Gammapilot FMG50 therefore receives less radiation the more the density of the medium increases. This effect is used to determine the current density of the medium in the vessel. The density unit can be selected via a menu.

Outputs and basic configuration of the FMG50

The RIA15 can be used as a local display unit for measured values and for the basic configuration of the Gammapilot FMG50 via HART. 4 HART output values (PV, SV, TV and QV) can be configured via the FMG50.



6 Remote operation of the FMG50 via RIA15

1 PLC
2 Transmitter power supply (with communication resistor) e.g. Endress+Hauser RN series active barrier
3 Connection for Commubox FXA195 and Field Communicator 375, 475
4 Loop-powered RIA15 process indicator
5 Gammapilot FMG50

The following settings for the FMG50 can be made using the three operating keys on the front of the RIA15:
- Basic configuration of the "Level" operating mode (continuous level measurement)
- Basic configuration of the "Point Level" operating mode (point level measurement)
- Basic configuration of the "Density" operating mode (density measurement)

Further information on the operating parameters → 43

The following order options are available to be able to use this function:
- FMG50 product structure
- RIA15 product structure, feature 030 "Input":
  Option 3: "4 to 20 mA current signal + HART + level ... FMG50"

The RIA15 as a remote indicator and for operation of the Proservo NMS8x

The Proservo NMS8x series of intelligent tank gauges has been designed for highly accurate liquid level measurement in storage and process applications. The devices are perfectly tailored to the demands of tank inventory management, inventory control, custody transfer and loss control, while also offering cost savings and operational safety.

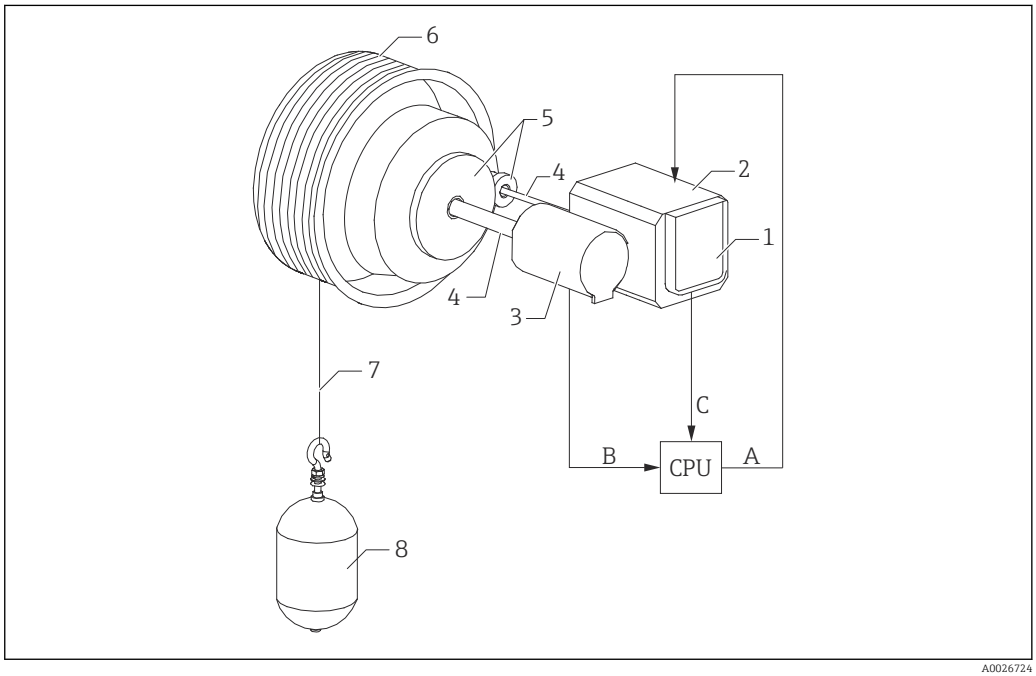
Operating principle of the NMS8x

NMS8x is an intelligent tank gauge for measuring liquid levels with high precision. The system is based on the principle of gauging displacement. A small displacer is accurately positioned in a liquid medium using a stepping motor. The displacer is then suspended on a measuring wire which is wound onto a finely grooved measuring drum. The NMS8x counts the rotations of the measuring drum in order to calculate how much wire is unwound and therefore calculate the change in the liquid level.

The drum is driven via coupling magnets that are completely separated by the drum housing. The outer magnets are connected to the measuring drum, and the inner magnets are connected to the drive motor. As the inner magnets turn, their magnetic attraction causes the outer magnets to turn as well, causing the entire drum assembly to rotate. The weight of the displacer on the wire causes a torque on the outer magnets, which causes a

change in the magnetic flux. These changes acting between the components of the measuring drum are detected by a special electromagnetic transducer on the inner magnets. The transducer transmits the weight signal to a CPU according to a patented non-contact principle. The motor is actuated to keep the weight signal constant at a predefined value which was defined by the measurement command.

When the displacer is lowered and touches the liquid, the weight of the displacer is reduced by the buoyancy force of the liquid, which is measured by a temperature-compensated magnetic transducer. As a result, the torque in the magnetic coupling changes, and this is measured by six hall sensors. A signal indicating the weight of the displacer is sent to the motor control circuit. Whenever the liquid levels rise or fall, the position of the displacer is adjusted accordingly by the drive motor. The rotation of the measuring drum is continuously evaluated to determine the level value using a magnetic rotary encoder. In addition to measuring the level, the NMS8x can also measure the interfaces between up to three liquid phases as well as the tank bottom, the spot density and profile density.

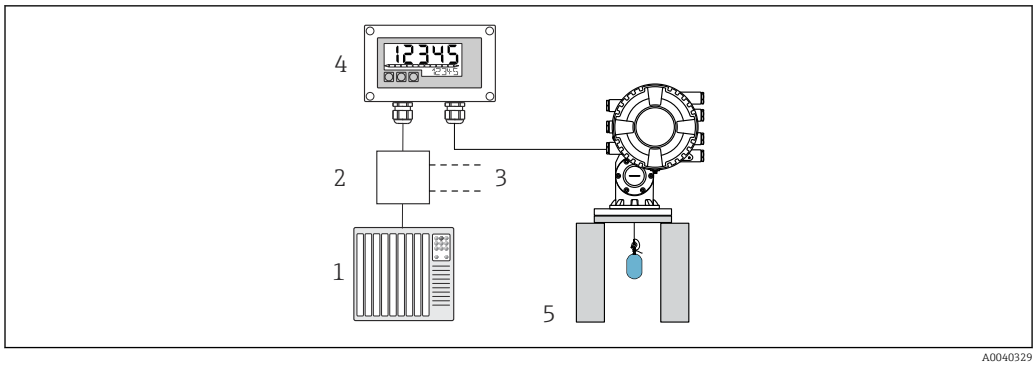


7 *NMS8x operating principle*

A Displacer position data
B Weight data
C CPU
1 Encoder
2 Motor
3 Rotary encoder
4 Shafts
5 Gears
6 Measuring drum
7 Measuring wire
8 Displacer

Outputs and basic configuration of the NMS8x

The RIA15 can be used as a local display unit for measured values and for the basic configuration of the NMS8x. Furthermore, measurement commands can be sent to the NMS8x via HART and the measuring status of the NMS8x can be displayed. 4 HART output values (PV, SV, TV and QV) can be configured via the NMS8x.



8 Remote operation of the NMS8x via the RIA15

1 PLC
2 Transmitter power supply (with communication resistor) e.g. Endress+Hauser RN series active barrier
3 Connection for Commubox FXA195 and Field Communicator 375, 475
4 Loop-powered RIA15 process indicator
5 NMS8x

The following settings for the NMS8x can be made using the three operating keys on the front of the RIA15:
- Measurement command
- Measurement status
- Balance status

Further information on the operating parameters → 47

The following order options are available to be able to use this function:
- NMS8x product structure
- RIA15 product structure, feature 030 "Input":
  Option 5: "4 to 20 mA current signal + HART + level, option for NMS8x"

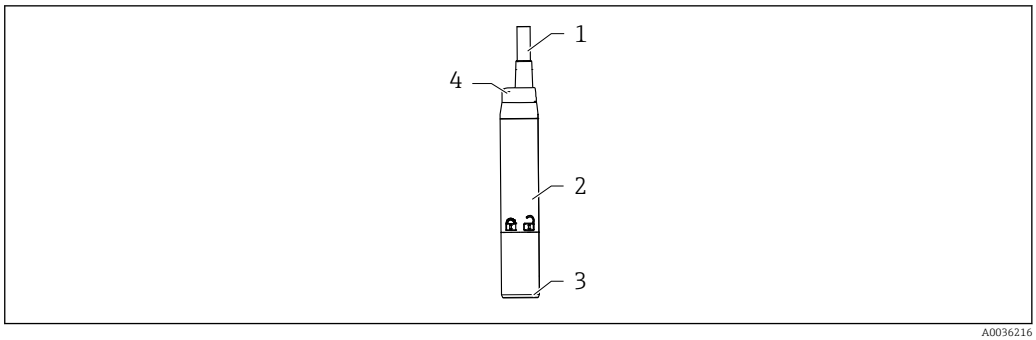
The RIA15 as a remote indicator and for operation of the Liquiline CM82

The Liquiline CM82 is a compact two-wire single-channel transmitter for connecting digital sensors with Memosens technology. It is suitable for demanding applications in the Life Sciences, water/wastewater and chemical industries.

The RIA15 with the "analysis" option supports basic configuration of the CM82 in the HART mode. The CM82 can be adjusted under the **SETUP → CT** menu item (see operating matrix). The value displayed on the RIA15 in display mode corresponds to the measured value (default setting).

Operating principle of the CM82

Digital sensors are connected via Memosens to the Liquiline CM82 transmitter using Plug and Play. The sensor's Memosens technology digitizes the sensor's measured value and transfers it to the transmitter via a non-contact connection. The transmitter converts this measured value to a 4 to 20 mA and HART signal for direct connection to the PLC. Maintenance and commissioning of the transmitter can be performed via the Bluetooth interface using a smartphone, tablet or laptop. The RIA15 (HART) can be used for basic configuration and local display of the measured values.



9 *Design of the Liquiline CM82*

1 *Measuring cable*
2 *Housing*
3 *Memosens connection*
4 *LED for status display*

Measuring ranges and sensor connection

The CM82 transmitter is designed for digital Memosens sensors with an inductive plug-in head. The Memosens sensor is easily connected to the CM82 using Plug and Play.

Sensor types	Sensors
Digital sensors with Memosens protocol without additional internal power supply	▪ pH sensors ▪ ORP sensors ▪ pH/ORP combination sensors ▪ Oxygen sensors ▪ Conductivity sensors

The measuring ranges are dependent on the connected sensor and can be found in the relevant sensor documentation.

Local measured value display and basic commissioning of the CM82

The RIA15 can be used as a local indicator of the measured values as well as for the basic commissioning of the Liquiline CM82 via HART.

The following values are output here:

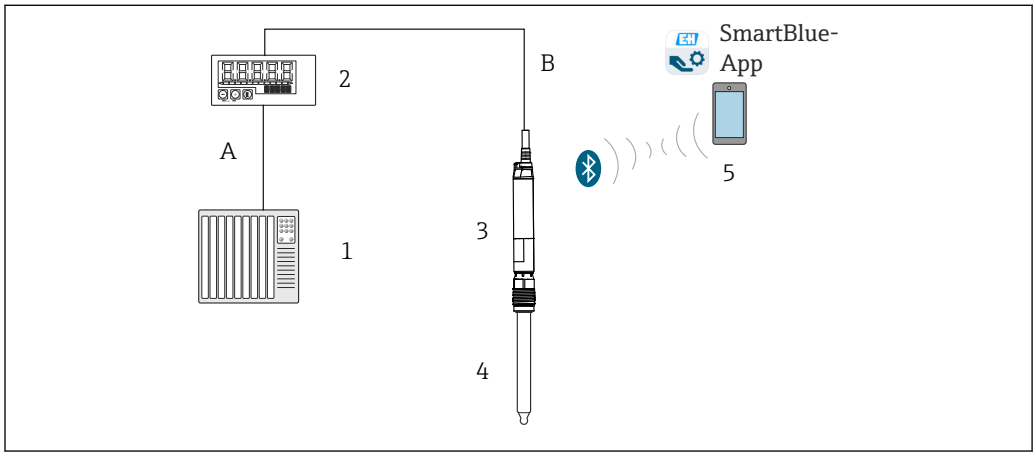
Digital output (HART): measured value and unit depending on the connected sensor
PV: Configured primary value (CMAIN operating parameter)
SV: Temperature (sensor)
TV: Dependent on the connected transmitter parameter + sensor type
QV: Dependent on the connected transmitter parameter + sensor type

Transmitter parameter	Sensor type	"TV" value	"QV" value
pH	Glass	Raw value in mV	Glass impedance in MOhm
pH	ISFET	Raw value in mV	Leak current in nA
pH	ORP	Relative ORP value as %	Raw value in mV
pH	pH/ORP combined sensor	pH	ORP in mV
Conductivity		Resistance	Conductivity raw value
Dissolved oxygen		Liquid concentration	Saturation as %

If "UC170" is displayed instead of the unit, see → 54

The following settings for the CM82 can be made using the three operating keys on the front of the RIA15:
- Units of connected sensor
- Current output range
- Retrieval of diagnostic information

Further information on the operating parameters → 50



10 *Remote operation of the CM82 via the RIA15*

1 *PLC*
2 *Loop-powered RIA15 process indicator*
3 *CM82 transmitter*
4 *Memosens sensor (e.g. pH sensor)*
5 *Connection via Bluetooth to the SmartBlue app*

The following order options are available to be able to use this function:
- CM82 product structure
- RIA15 product structure, feature 030 "Input":
  Option 4: "4 to 20 mA current signal + HART + analysis, option for CM82"

For further information on the CM82, see the associated Operating Instructions → BA01845C

3.3 Input channels

The process indicator has one analog 4 to 20 mA input. In "HART" operating mode, this channel can be used to retrieve and display HART values of a connected sensor/actuator. Here, a HART device can be directly connected to the process indicator in a point-to-point connection, or the process indicator can be incorporated into a HART Multidrop network.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.

3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

The device can be identified in the following ways:
- Nameplate specifications
- Enter the serial number from the nameplate into *Device Viewer* (www.endress.com/deviceviewer): all the information about the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number from the nameplate into the *Endress+Hauser Operations app* or scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations app*: all the information about the device and the technical documentation pertaining to the device is displayed.

4.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)
- Technical values, e.g. supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

▶ Compare the information on the nameplate with the order.

4.2.2 Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Wetzer GmbH + Co. KG
Address of manufacturer:	Obere Wank 1, D-87484 Nesselwang or www.endress.com

4.3 Storage and transport

Storage temperature: −40 to +85 °C (−40 to +185 °F)

Maximum relative humidity: < 95 % as per IEC 60068-2-30

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

Avoid the following environmental influences during storage:
- direct sunlight
- proximity to hot objects
- mechanical vibration
- aggressive media

5 Mounting

5.1 Installation conditions

Permitted ambient temperature: –40 to 60 °C (–40 to 140 °F)

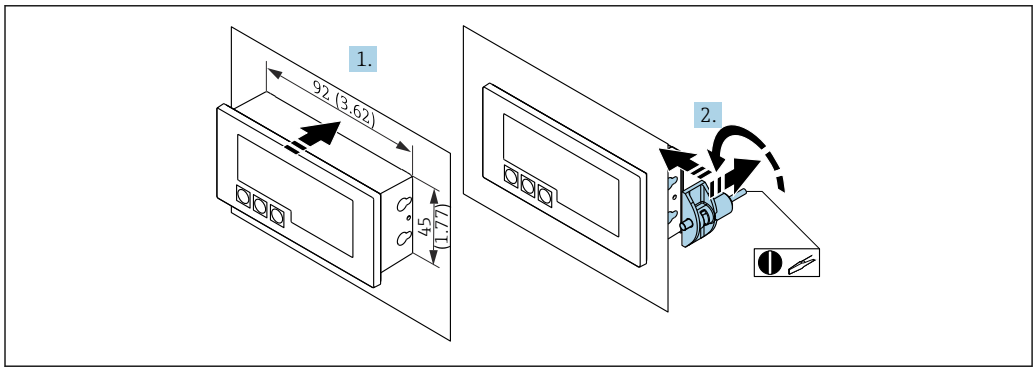
At temperatures below –25 °C (–13 °F) the readability of the display can no longer be guaranteed.

5.2 installation instructions

For the dimensions of the device, see "Technical data".

5.2.1 Panel housing

- Degree of protection: IP65 front, IP20 rear (not evaluated by UL)
- Mounting position: horizontal



11 *Installation instructions for the panel housing*

Installation in a panel with a panel cutout 92x45 mm (3.62x1.77 in), max. panel thickness 13 mm (0.51 in).

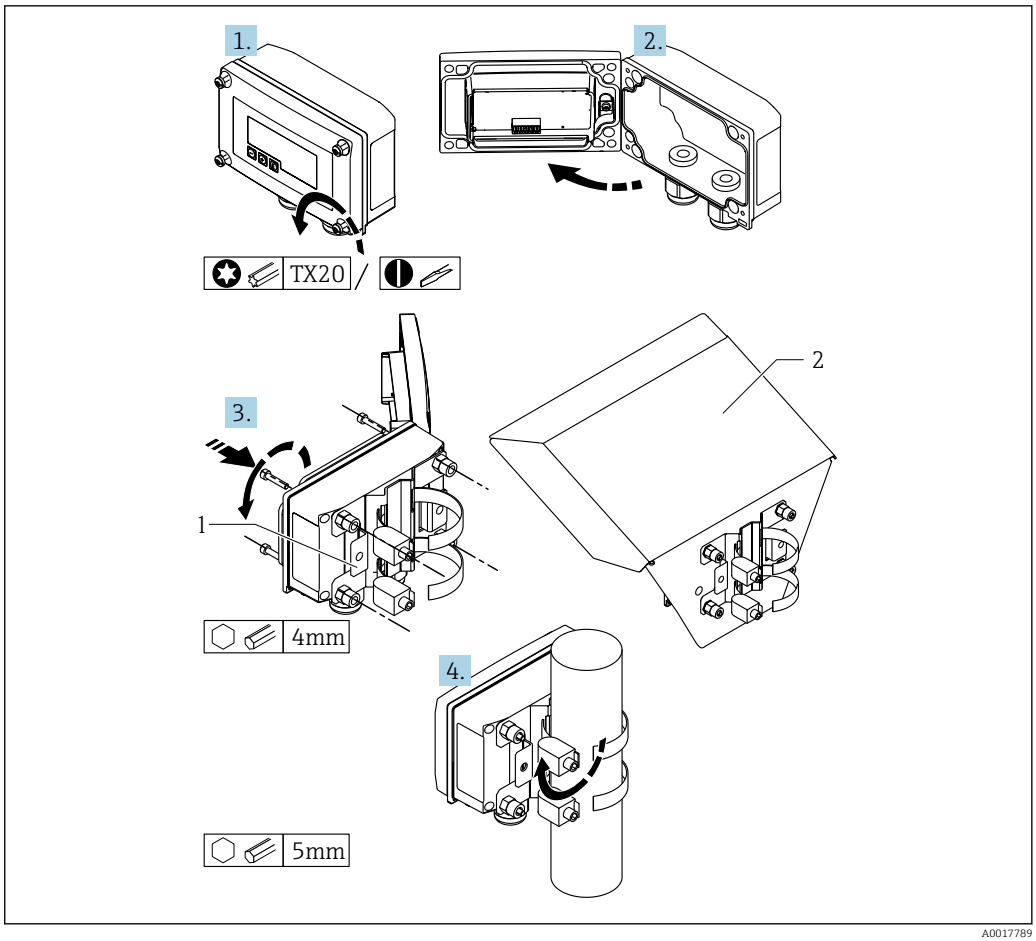
1. Slot the device into the panel cutout from the front.
2. Fit the mounting clips on the side of the housing and tighten the threaded rods (tightening torque: 0.4 to 0.6 Nm).

5.2.2 Field housing

- Degree of protection for aluminum housing: IP66/67, NEMA 4X (not evaluated by UL)
- Degree of protection for plastic housing: IP66/67 (not evaluated by UL)

Pipe mounting (with optional mounting kit)

The device can be mounted on a pipe with a diameter of up to 50.8 mm (2 in) with the mounting kit (optionally available).



12 *Mounting the process indicator on a pipe*

1 Mounting plate for pipe/wall mounting
2 Weather protection cover (optional)

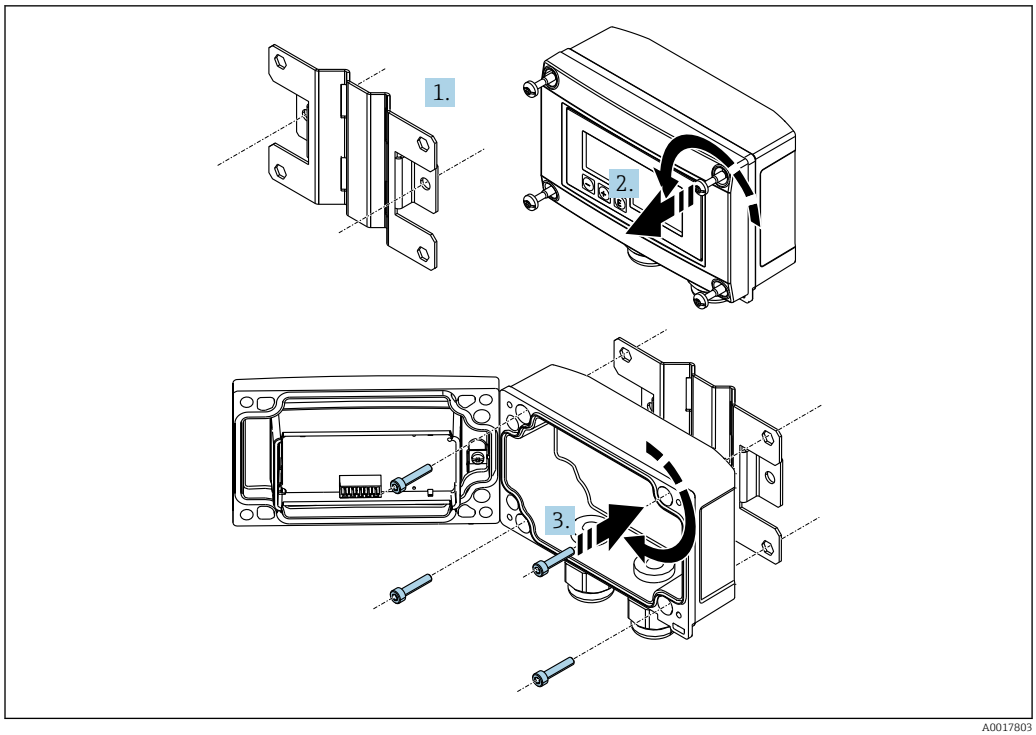
1. Release the 4 housing screws
2. Open the housing
3. Secure the mounting plate to the rear of the device with 4 screws supplied. The optional weather protection cover can be secured between the device and the mounting plate.
4. Guide the two gripper clamps through the mounting plate, fit them around the pipe and tighten.

Wall mounting

Wall mounting without a mounting kit:

1. Open the housing.
2. Use the device as a stencil for 4 6 mm (0.24 in) bore holes, 99 mm (3.9 in) apart on the horizontal plane, 66 mm (2.6 in) apart on the vertical plane.
3. Secure the indicator on the wall with 4 screws.
4. Close the cover and tighten the housing screws.

Wall mounting with mounting kit (optionally available):

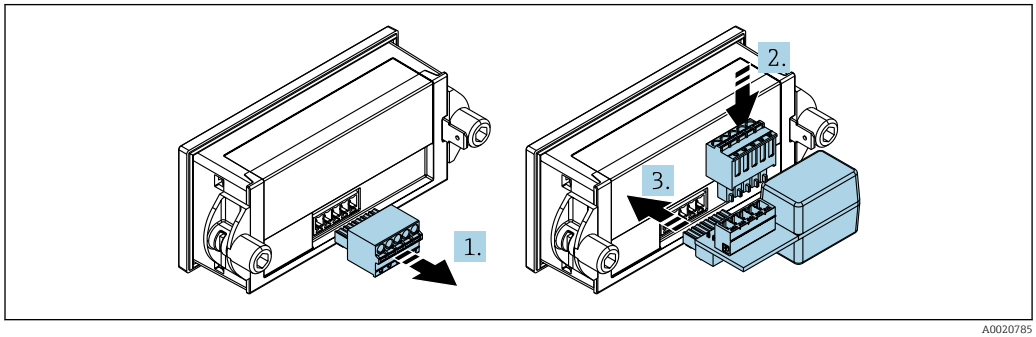


13 *Mounting the process indicator on a wall*

1. Use the mounting plate as a stencil for 2 6 mm (0.24 in) bore holes, 82 mm (3.23 in) apart, and secure the plate on the wall with 2 screws (not supplied).
2. Open the housing.
3. Secure the indicator on the mounting plate with the 4 screws supplied.
4. Close the cover and tighten the screws.

5.2.3 Installing the optional HART communication resistance module

The HART communication resistance module is available as an accessory; see the "Accessories" section.



14 *Installing the optional HART communication resistance module*

1. Disconnect the plug-in terminal block.
2. Insert the terminal block into the slot provided on the HART communication resistance module.
3. Insert the HART communication resistance module into the slot in the housing.

5.3 Post-installation check

5.3.1 Display unit in the panel-mount housing

- Is the seal undamaged?
- Are the mounting clips securely fastened on the housing of the device?
- Are the threaded rods properly tightened?
- Is the device located in the center of the panel cutout?

5.3.2 Display unit in the field housing

- Is the seal undamaged?
- Is the housing firmly screwed to the mounting plate?
- Is the mounting bracket firmly secured on the wall/pipe?
- Are the housing screws firmly tightened?

6 Wiring

⚠ WARNING

Danger! Electric voltage

▶ The entire connection of the device must take place while the device is de-energized.

Only certified devices (optionally available) may be connected in the hazardous area

▶ Observe the corresponding notes and wiring diagrams in the Ex-specific supplement to these Operating Instructions.

NOTICE

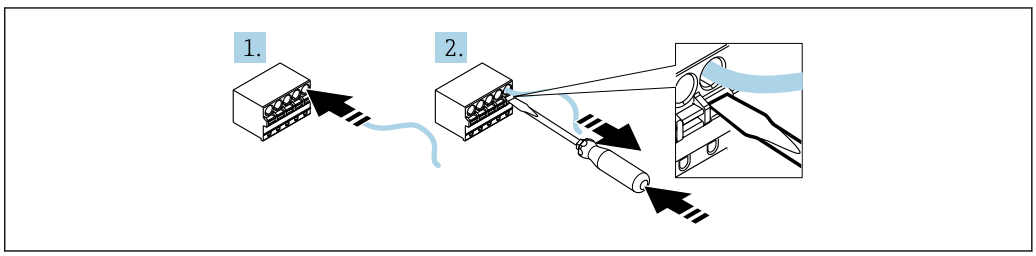
Device destroyed if current too high

▶ The device must be powered only by a power unit with an energy-limited circuit in accordance with UL/EN/IEC 61010-1, Section 9.4 and the requirements in Table 18.

▶ Do not operate the device at a voltage source without a current limiter. Instead, operate the device only in the current loop with a transmitter.

- **Panel housing:**
  The terminals are located on the rear of the housing.
- **Field housing:**
  The terminals are located inside the housing. The device has two M16 cable entries. The housing must be opened for wiring purposes.

Operation of the spring terminals



15 *Operation of the spring terminals*

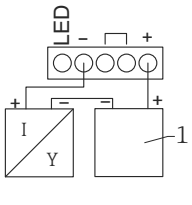
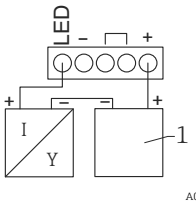
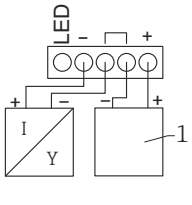
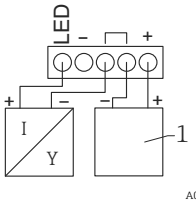
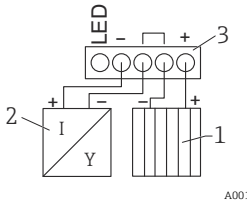
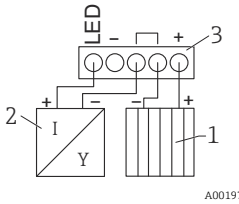
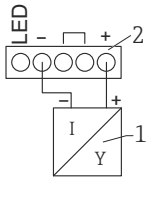
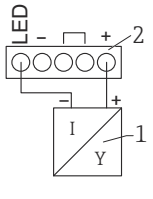
1. If using rigid cables or flexible cables with a ferrule, insert only the cable into the terminal to connect. No tools required. If using flexible cables without ferrules, the spring mechanism must be activated as shown in step 2.
2. In order to loosen the cable, push the spring mechanism in completely using a screwdriver or other suitable tool and pull out the cable.

6.1 Quick wiring guide

Terminal	Description
+	Positive connection, current measurement
-	Negative connection, current measurement (without backlighting)
LED	Negative connection, current measurement (with backlighting)
⊓	Auxiliary terminals (electrically connected internally)
⏚	Functional grounding: ▪ Panel-mounted device: Terminal on the rear of the housing ▪ Field device: Terminal in the housing

6.2 Connection in the 4 to 20 mA operating mode

The following diagrams show in a simplified way how the process indicator is connected in the 4 to 20 mA operating mode.

	Connection without backlighting	Connection with backlighting
Connection with transmitter power supply and transmitter	 *1 Transmitter power supply*	 *1 Transmitter power supply*
Connection with transmitter power supply and transmitter using the auxiliary terminal	 *1 Transmitter power supply*	 *1 Transmitter power supply*
Connection with PLC and transmitter	 *1 PLC* *2 Transmitter* *3 RIA15*	 *1 PLC* *2 Transmitter* *3 RIA15*
Connection without transmitter power supply directly in the 4 to 20 mA circuit	 *1 4 to 20 mA power source* *2 RIA15*	 *1 4 to 20 mA power source* *2 RIA15*

6.3 Connection in HART mode

The following diagrams show in a simplified way how the process indicator is connected in the HART operating mode.

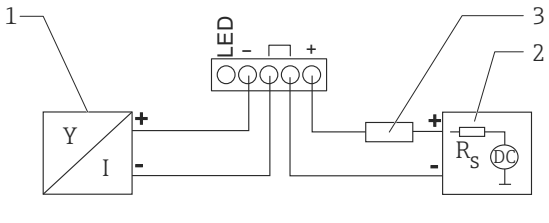
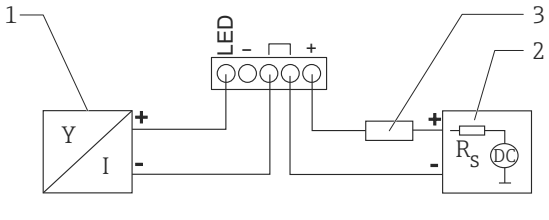
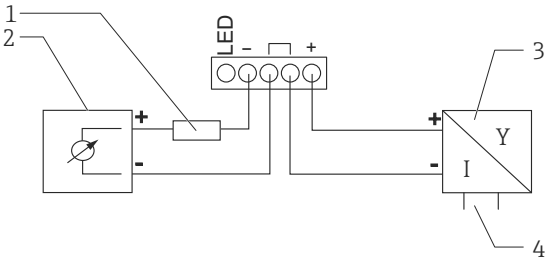
6.3.1 HART connection

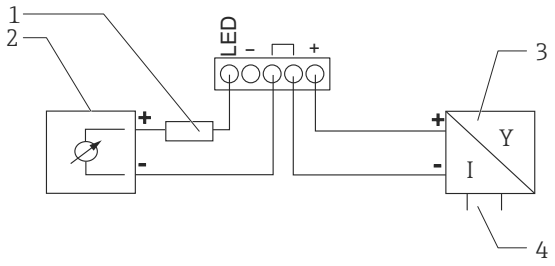
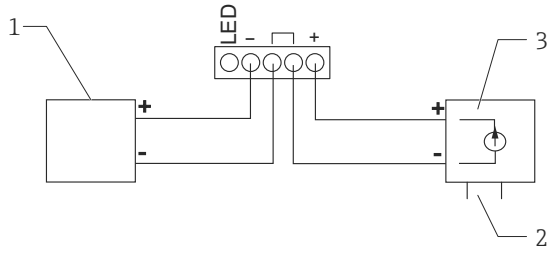
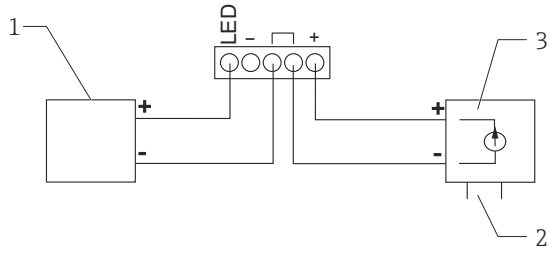
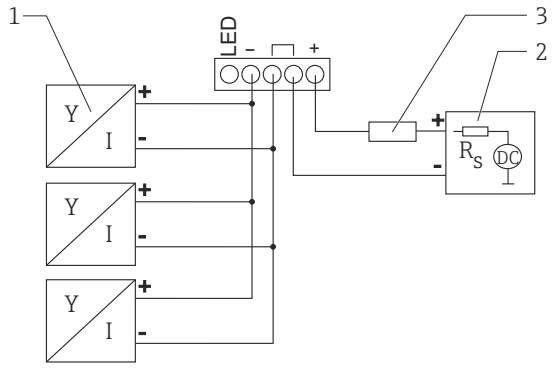
NOTICE

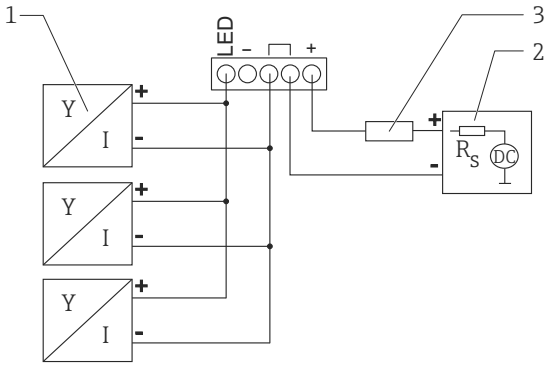
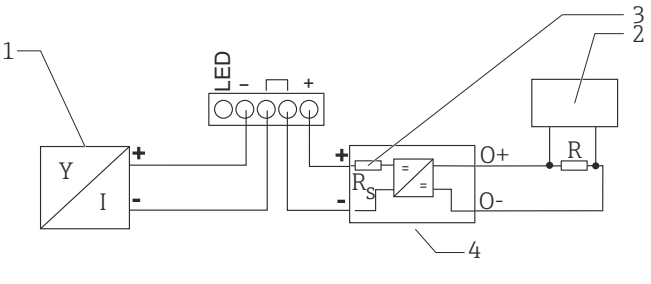
Undefined behavior due to incorrect wiring of an actuator

- When installing the process indicator together with an actuator, the Operating Instructions for the actuator must always be followed.

The 230 Ω HART communication resistor in the signal line is always necessary in the case of a low-impedance power supply. It must be installed between the power supply and the indicator.

	Circuit diagram / Description
2-wire sensor with process indicator and transmitter power supply, without backlighting	 A0019567 *1 Sensor* *2 Power supply* *3 Additional 230 to 600 Ω HART resistor inserted*
2-wire sensor with process indicator and transmitter power supply, with backlighting	 A0019568 *1 Sensor* *2 Power supply* *3 Additional 230 to 600 Ω HART resistor inserted*
4-wire sensor with process indicator and transmitter power supply, without backlighting	 A0019570 *1 HART resistor* *2 Current measuring instrument (optional)* *3 Sensor* *4 Power supply 4-wire device*

	Circuit diagram / Description
4-wire sensor with process indicator and transmitter power supply, with backlighting	 A0019571 *1 HART resistor* *2 Current measuring instrument (optional)* *3 Sensor* *4 Power supply 4-wire device*
Current output with process indicator and actuator (e.g. actuator valve), without backlighting	 A0019573 *1 Actuator* *2 Power supply 4-wire device* *3 Current output*
Current output with process indicator and actuator (e.g. actuator valve), with backlighting	 A0019574 *1 Actuator* *2 Power supply 4-wire device* *3 Current output*
Multidrop 2-wire sensors with process indicator and transmitter power supply	 A0019575 *1 Sensors* *2 Power supply* *3 HART resistor*

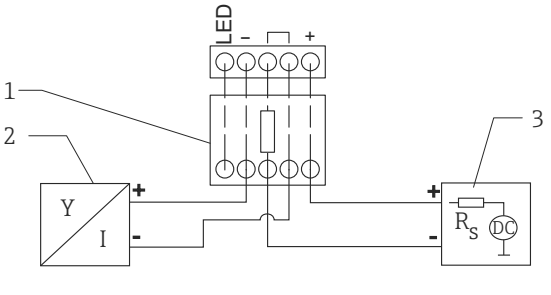
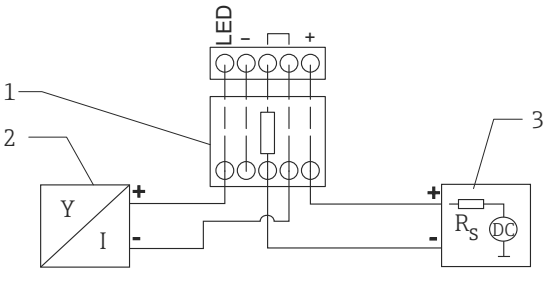
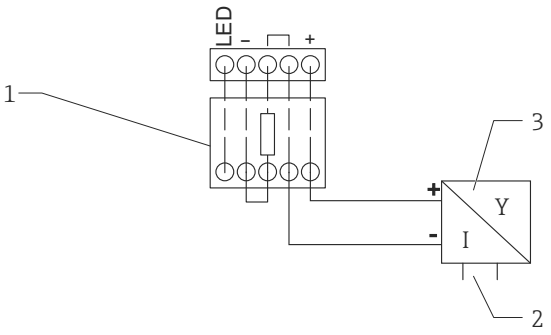
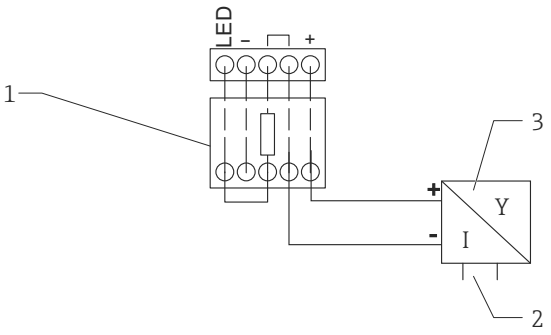
	Circuit diagram / Description
Multidrop 2-wire sensors with process indicator and transmitter power supply, with backlighting	 *1 Sensors* *2 Power supply* *3 HART resistor*
2-wire sensor with process indicator and active barrier (e.g. RN22 from Endress+Hauser) as transmitter power supply	 *1 Sensor* *2 HART primary master* *3 HART resistor* *4 Active barrier*

Optional HART communication resistance module

A HART communication resistance module is available as an accessory; see the "Accessories" section → 🖹 61.

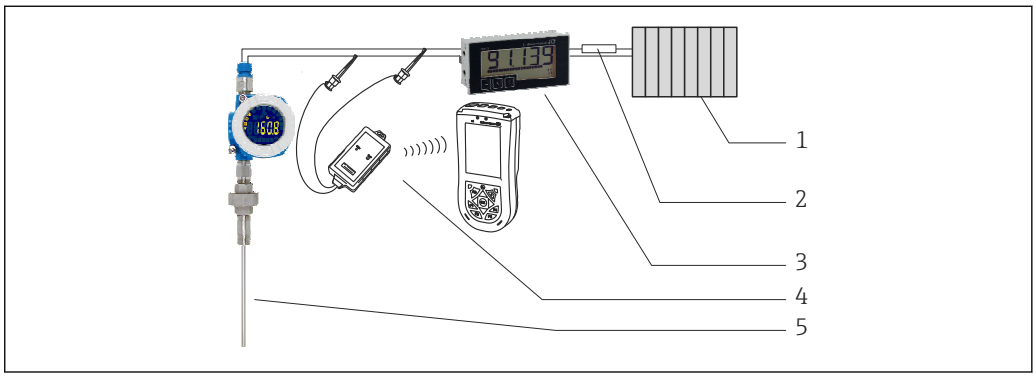
To mount the HART communication resistance module, see the Mounting section → 🖹 22

Wiring

	Circuit diagram / Description
2-wire sensor with process indicator and transmitter power supply, without backlighting	 A0020839 *1 HART communication resistance module* *2 Sensor* *3 Power supply*
2-wire sensor with process indicator and transmitter power supply, with backlighting	 A0020840 *1 HART communication resistance module* *2 Sensor* *3 Power supply*
4-wire sensor with process indicator and transmitter power supply, without backlighting	 A0020837 *1 HART communication resistance module* *2 Power supply 4-wire device* *3 Sensor*
4-wire sensor with process indicator and transmitter power supply, with backlighting	 A0020838 *1 HART communication resistance module* *2 Power supply 4-wire device* *3 Sensor*

Configuration of HART devices

HART devices are generally not configured via the process indicator. Configuration is done using the Field Xpert SFX100 device configurator, for example. An exception to this is the special options (e.g. RIA15 level & analysis option).



16 *Configuration of HART devices; example iTEMP TMT162*

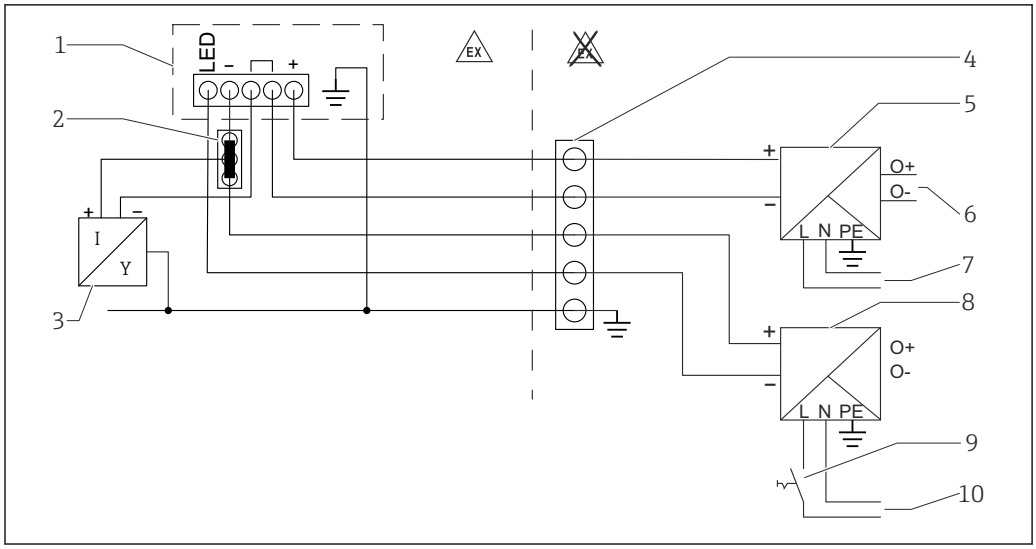
1 *HART primary master (e.g. PLC)*
2 *HART resistor*
3 *RIA15 process indicator*
4 *HART handheld terminal, e.g. Field Xpert SFX100*
5 *Sensor with HART transmitter, e.g. iTEMP TMT162*

6.4 Wiring with switchable backlighting

An additional current-limited power source (e.g. active barrier from the Endress+Hauser RN series) is required to implement switchable backlighting. This power source is used to supply the LED backlighting of up to seven RIA15 process indicators without generating an additional voltage drop in the measuring loop. The backlighting can be switched on and off using an external switch.

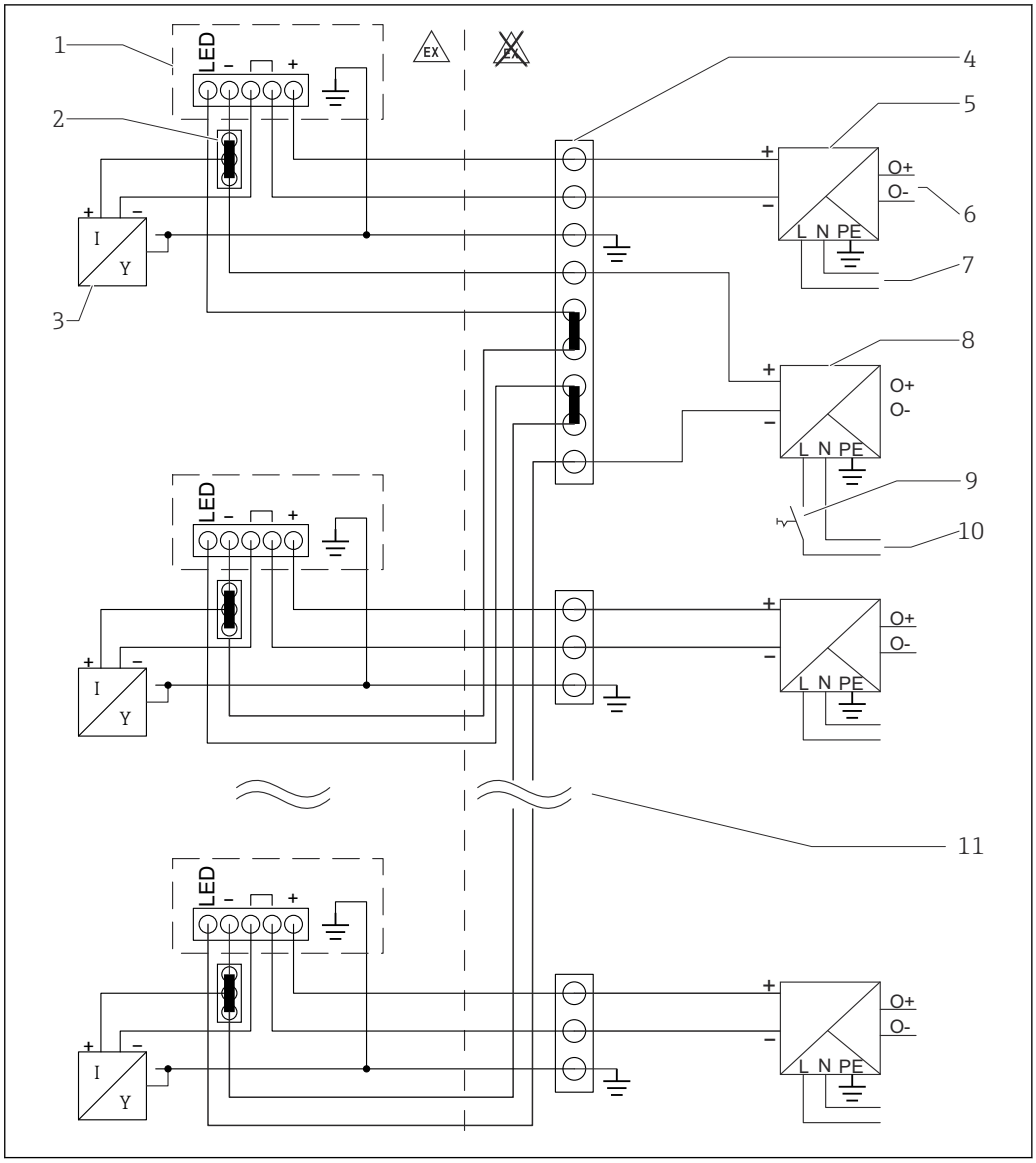
The following shows connection examples for the hazardous area. Wiring is similar for the non-hazardous area; however, it is not necessary to use Ex-certified devices.

6.4.1 Connection diagram for one process indicator



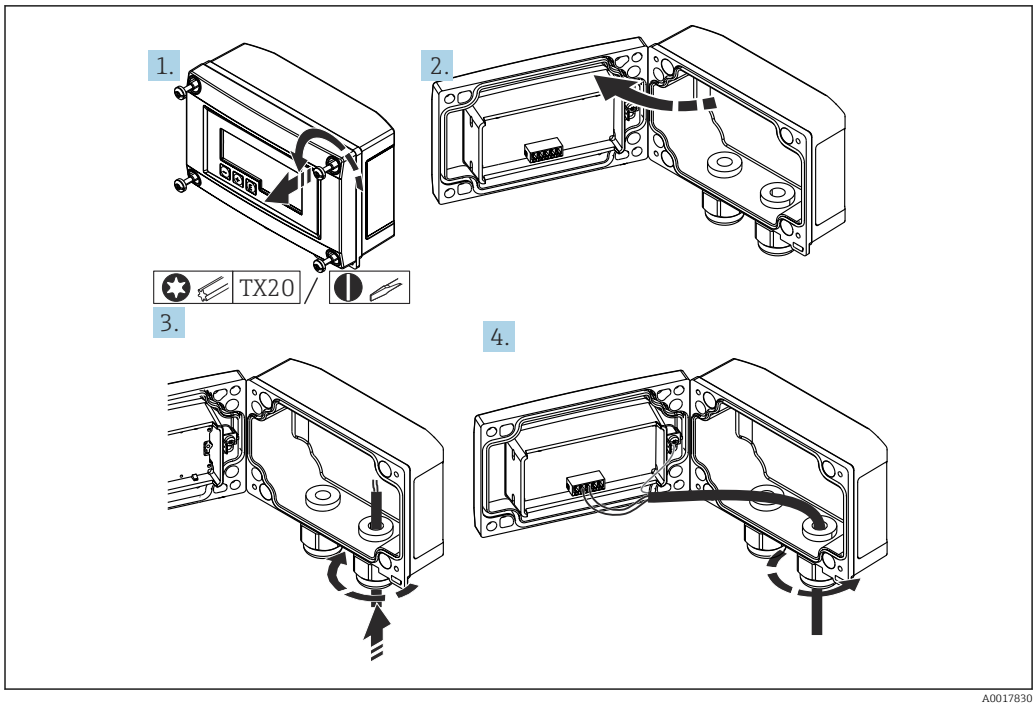
1 RIA15 process indicator
2 3-wire connector, e.g. WAGO 221 series
3 2-wire sensor
4 Terminal block on DIN rail
5 Active barrier (e.g. Endress+Hauser RN series)
6 4 to 20 mA output to the control unit
7 Power supply
8 Power source (e.g. Endress+Hauser RN series)
9 Switch to activate backlighting
10 Power supply

6.4.2 Connection diagram for multiple process indicators



1 RIA15 process indicator
2 3-wire connector, e.g. WAGO 221 series
3 2-wire sensor
4 Terminal block on DIN rail
5 Active barrier (e.g. Endress+Hauser RN series)
6 4 to 20 mA output to the control unit
7 Power supply
8 Power source (e.g. Endress+Hauser RN series)
9 Switch to activate backlighting
10 Power supply
11 Can be extended to 7 devices

6.5 Inserting the cable, field housing



17 *Inserting the cable, field housing*

Inserting the cable, field housing, connection without transmitter power supply (example)

1. Release the housing screws
2. Open the housing
3. Open the cable gland (M16) and insert the cable
4. Connect the cable including the functional grounding and close the cable gland

If using the communication resistance module in the RIA15, the cable of the FMX21 must be inserted into the right gland when connecting the FMX21 so that the integrated pressure compensation tube is not pinched.

6.6 Shielding and grounding

Optimum electromagnetic compatibility (EMC) can only be guaranteed if the system components and, in particular, the lines are shielded and the shield forms as complete a cover as possible. A shield coverage of 90% is ideal.

- To ensure an optimum EMC protective effect when communicating with HART, connect the shield as often as possible to the reference ground.
- For reasons of explosion protection, you should refrain from grounding however.

To comply with both requirements, three different types of shielding are possible when communicating with HART:
- Shielding at both ends
- Shielding at one end on the feed side with capacitance termination at the field device
- Shielding at one end on the feed side

Experience shows that the best results with regard to EMC are achieved in most cases in installations with one-sided shielding on the feed side (without capacitance termination at the field device). Appropriate measures with regard to input wiring must be taken to allow unrestricted operation when EMC interference is present. These measures have been taken into account for this device. Operation in the event of disturbance variables as per

NAMUR NE21 is thus guaranteed. Where applicable, national installation regulations and guidelines must be observed during the installation! Where there are large differences in potential between the individual grounding points, only one point of the shielding is connected directly with the reference ground. In systems without potential equalization, therefore, cable shielding of fieldbus systems should only be grounded on one side, for example at the supply unit or at safety barriers.

NOTICE

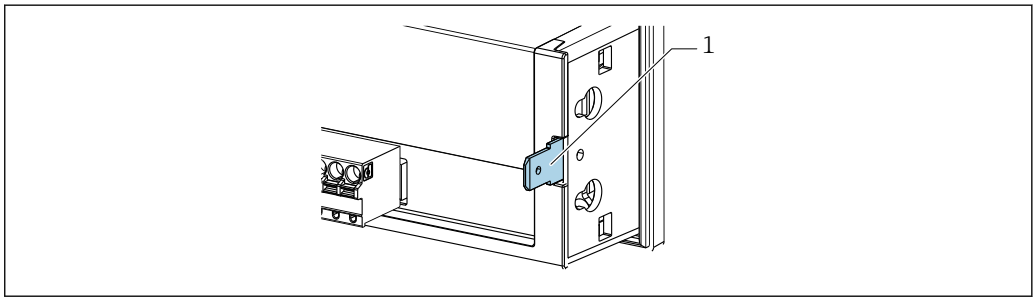
If the shielding of the cable is grounded at more than one point in systems without potential matching, power supply frequency equalizing currents can occur that damage the signal cable or have a serious effect on signal transmission.

- In such cases the shielding of the signal cable should be grounded on one side only, i.e. it must not be connected to the ground terminal of the housing. The shield that is not connected should be insulated!

6.7 Connecting to functional grounding

6.7.1 Panel-mounted device

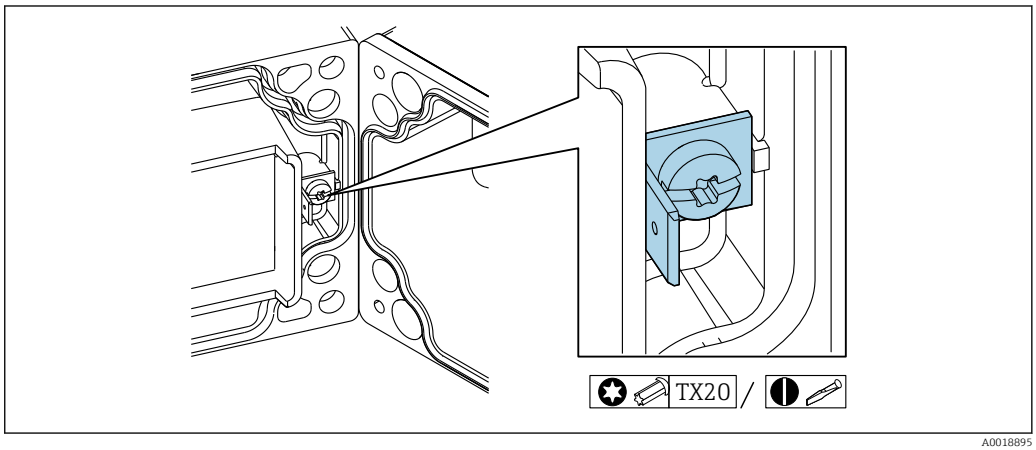
For EMC reasons, the functional grounding should always be connected. When the device is used in the hazardous area (with optional Ex approval) the connection is obligatory.



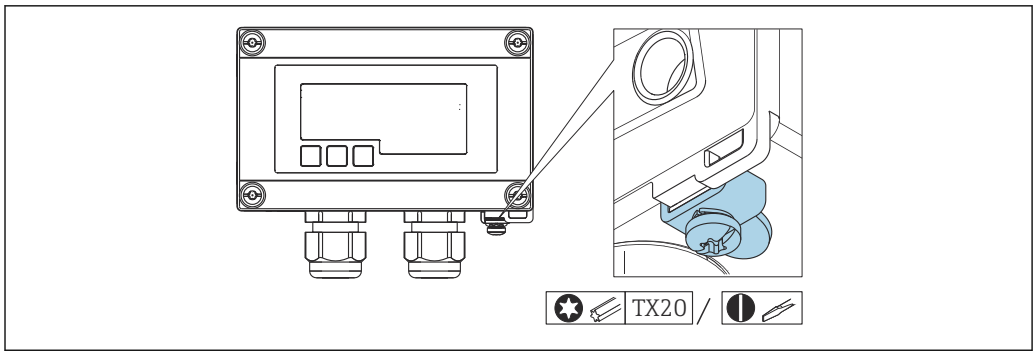
18 *Functional grounding terminal on panel-mounted device*

6.7.2 Field device

For EMC reasons, the functional grounding should always be connected. When used in the hazardous area (with optional Ex approval), the connection is obligatory and the field housing must be grounded via a grounding screw fitted on the outside of the housing.



19 *Functional grounding terminal in field housing*



20 *Ground terminal on field housing*

6.8 Ensuring the degree of protection

6.8.1 Field housing

The devices meet all the requirements of IP67. It is absolutely essential to comply with the following points to ensure this protection is guaranteed after mounting or servicing the device:

- The housing seal must be clean and undamaged when inserted into the groove. The seal must be cleaned, dried or replaced if necessary.
- The cables used for connection must be of the specified outside diameter (e.g. M16 x 1.5, cable diameter 5 to 10 mm (0.2 to 0.39 in)).
- Mount the measuring instrument in such a way that the cable entries point downwards.
- Replace unused cable entries with dummy plugs.
- The housing cover and the cable entries must be firmly tightened.

6.8.2 Panel housing

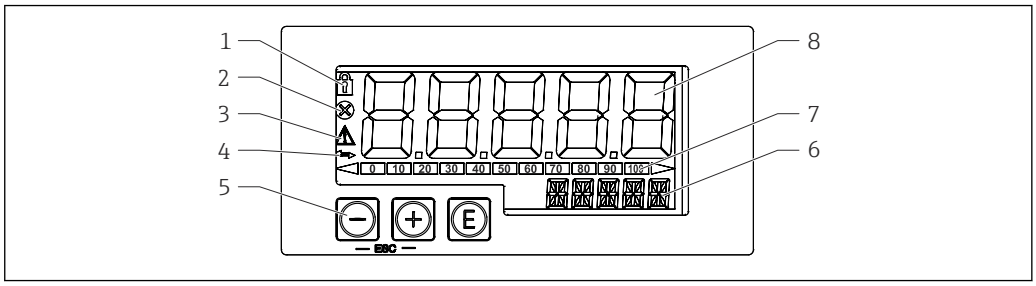
The front of the device meets the requirements of IP65. It is absolutely essential to comply with the following points to ensure this protection is guaranteed after mounting or servicing the device:

- The seal between the front of the housing and the panel must be clean and undamaged. The seal must be cleaned, dried or replaced if necessary.
- The threaded rods of the panel mounting clips must be firmly tightened (tightening torque: 0.4 to 0.6 Nm).

6.9 Post-connection check

Device condition and specifications	**Notes**
Are cables or the device damaged?	Visual inspection
Electrical connection	**Notes**
Does the supply current match the specifications on the nameplate?	-
Are the cables, incl. functional grounding, connected correctly and strain-relieved?	-
Field housing: Are the cable glands securely closed?	-

7 Operation



21 *Display and operating elements of the process indicator*

1 *Symbol: operating menu disabled*
2 *Symbol: error*
3 *Symbol: warning*
4 *Symbol: HART communication active (option)*
5 *Operating keys "-", "+", "E"*
6 *14-segment display for unit/TAG*
7 *Bar graph with indicators for under range and over range*
8 *5-digit 7-segment display for measured value, digit height 17 mm (0.67 in)*

The device is operated using three operating keys on the front of the housing. The device setup can be disabled with a 4-digit user code. If the setup is disabled, a padlock symbol appears on the display when an operating parameter is selected.

 A0017716	Enter key; for calling up the operating menu, confirming the selection/configuration of parameters in the operating menu
 A0017714	Selecting and setting/changing values in the operating menu; pressing the '-' and '+' keys simultaneously takes the user back up a menu level. The configured value is not saved.
 A0017715	

7.1 Operating functions

The operating functions of the process indicator are divided into the following menus. The individual parameters and settings are described in the "Commissioning" section.

If the operating menu is disabled by means of a user code, the individual menus and parameters can be displayed but not changed. To change a parameter, the user code must be entered. As the display unit can only display digits in the 7-segment display and not alphanumeric characters, the procedure for number parameters is different to that for text parameters.

If the operating position contains only numbers as parameters, the operating position is displayed in the 14-segment display and the configured parameter is displayed in the 7-segment display. To edit, press the 'E'-button followed by the user code.

If the operating position contains text parameters, only the operating position is initially displayed in the 14-segment display. If the 'E' button is pressed again, the configured parameter is displayed in the 14-segment display. To edit, press the '+' button followed by the user code.

Setup (SETUP)	Basic device settings → 🖹 36
Diagnostics (DIAG)	Device information, display of error messages → 🖹 38
Expert (EXPRT)	Expert settings for the device setup → 🖹 36 The Expert menu is protected from editing by an access code (default 0000).

8 Commissioning

8.1 Post-installation check and switching on the device

Perform the final checks before commissioning the device:
- Checklist for "post-installation check" → 🖹 23.
- Checklist for "post-connection check" → 🖹 34.

The device starts after being connected to the 4 to 20 mA/HART circuit. The firmware version appears on the display during the start-up phase.

When the device is being commissioned for the first time, program the setup in accordance with the descriptions in the Operating Instructions.

If you are commissioning a device that is already configured or preset, the device immediately starts measuring the current or making a HART request as defined in the settings. The values of the currently activated process variables appear in the display.

Remove the protective film from the display as this would otherwise affect the readability of the display.

8.2 Operating matrix

Default settings may differ for RIA15 with the options "Level for FMR20 + FMR20B + FMR30B + FMX21 + FMG50", "Analysis for CM82" and "Level for NMS8x".

Setup menu (SETUP)			
Parameter	**Values (default in bold)**	**Displayed when**	**Description**
LEVEL		Level option MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the FMR20/FMR20B/ FMR30B/FMX21 measuring instruments. The individual parameters are described in the "Operating matrix in conjunction with the Micropilot FMR20/FMR20B/FMR30B" → 🖹 41 section and the "Operating matrix in conjunction with the FMX21" → 🖹 42 section.
FMG50		Option FMG50 MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the Gammapilot FMG50. The individual parameters are described in the "Operating matrix in conjunction with the FMG50"→ 🖹 43 section.
OPRAT		Option NMS8x MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the Proservo NMS8x. The individual parameters are described in the "Operating matrix in conjunction with the NMX8x" section → 🖹 47.
CT		Analysis option MODE = HART CM82 connected	This menu contains the parameters for configuring the CM82 analytical measuring instrument. The individual parameters are described in the "Operating matrix in conjunction with the CM82" → 🖹 50section.

Setup menu (SETUP)			
Parameter	**Values (default in bold)**	**Displayed when**	**Description**
MODE	**4-20** HART		Use this function to select the operating mode for the indicator. 4-20: The 4 to 20 mA signal of the circuit is displayed. HART: Up to four HART variables (PV, SV, TV, QV) of a sensor/actuator in the loop can be displayed.
DECIM	0 DEC **1 DEC** 2 DEC 3 DEC 4 DEC	MODE = 4-20	Number of decimal places for the 4 to 20 mA display mode.
SC__4	Numerical value –19 999 to 99 999 Default: **0.0**	MODE = 4-20	5-digit value (number of decimal places as configured under DECIM) for scaling the measured value at 4 mA Example: SC__4 = 0.0 → 0.0 displayed at measuring current 4 mA The unit selected under UNIT is used to display the value.
SC_20	Numerical value –19 999 to 99 999 Default: **100.0**	MODE = 4-20	5-digit value (number of decimal places as configured under DECIM) for scaling the measured value at 20 mA Example: SC_20 = 100.0 → 100.0 displayed at measuring current 20 mA The unit selected under UNIT is used to display the value.
UNIT	% °C °F K USER	MODE = 4-20	Use this function to select the unit for displaying the value. If "USER" is selected, a user-defined unit can be entered in the TEXT parameter.
TEXT	Customized text, 5-digit	MODE = 4-20	User-defined unit, only visible if the "USER" option has been selected under UNIT.
SCAN	**NO** YES	MODE = HART	Select "YES" to start scanning. All addresses are then automatically scanned once in a HART application until a sensor/actuator is found. Scanning runs from 0 to 63. Only addresses up to 15 are permitted for HART 5. Once the address of the sensor/actuator whose values are to be displayed is found, the address must be confirmed by pressing the 'E' key. This address is adopted and is used even after a device restart. By pressing the '+' or '–' key, it is possible to search for other addresses. Pressing '+'- and '-' simultaneously will cancel scanning. If "NO" is selected, scanning is not active. The address of the sensor/actuator whose values are to be displayed on the process indicator must be configured manually using the operating keys.
ADDR	Numerical value 0 to 63 Default: **0**	MODE = HART	Use this function to enter manually the address of the HART sensor/actuator whose values are to be displayed. If the address of the HART slave is changed, it must also be changed on the process indicator. To do this, either enter the address manually or search using SCAN mode.
MTYPE	PRIM **SEC**	MODE = HART	Use this function to select the HART master type: PRIM = Primary master SEC = Secondary master
HART1-HART4		MODE = HART	Use this function to select which HART value of a sensor/actuator (PV, SV, TV, QV) should be activated and configured: HART1 = PV HART2 = SV HART3 = TV HART4 = QV Press the E key to open the configuration submenu.
DISP1–DISP4	OFF MAN AUTO Default: DISP1: **AUTO** DISP2: **MAN** DISP3: **MAN** DISP4: **MAN**	MODE = HART	Use this function to select how or whether the value should be displayed. OFF: Value is not displayed MAN: You can manually scroll through activated HART values by pressing '+' or '–'. Otherwise the values are not displayed. If all four HART values (HART1 to HART4) are set to "MAN", HART1 (PV) is displayed if you do not scroll manually through the values. AUTO: Activated HART values are displayed alternately (switching time can be configured in the EXPRT menu under "TOGTM"). If one value is set to AUTO, this value is displayed continuously on the device.

Setup menu (SETUP)			
Parameter	**Values (default in bold)**	**Displayed when**	**Description**
DEC1 – DEC4	0 DEC **1 DEC** 2 DEC 3 DEC 4 DEC	MODE = HART	Number of decimal places for the values HART1 - HART4.
BGLO1-BGLO4	Numerical value –19 999 to 99 999 Default: **0.0**	MODE = HART	5-digit value (number of decimal places as configured under DEC1-DEC4) for scaling the lower range of the bar graph for HART1 - HART4. The bar graph is disabled if BGLOx and BGHIx are set to "0.0".
BGHI1-BGHI4	Numerical value –19 999 to 99 999 Default: **0.0**	MODE = HART	5-digit value (number of decimal places as configured under DEC1-DEC4) for scaling the upper range of the bar graph for HART1 - HART4. The bar graph is disabled if BGLOx and BGHIx are set to "0.0".
UNIT1-UNIT4	**HART** % °C °F K USER	MODE = HART	Use this function to select the unit for displaying the HART value. If "HART" is selected, the unit configured on the sensor/actuator is automatically adopted for the relevant HART value. Only units with a maximum of 5 characters can be shown. Longer units are displayed as unit code "UCxxx". The table in the HART communication section at the end of these Operating Instructions provides an overview of the units that can be displayed. If "USER" is selected, a user-defined unit can be entered in the TEXT1-TEXT4 parameter.
TEXT1-TEXT4	Customized text, 5-digit	MODE = HART	User-defined unit. Only visible if the "USER" option has been selected under UNIT

Diagnostics menu (DIAG)		
Parameter	**Values**	**Description**
AERR	Read only	The current diagnostic message appears on the display. If several messages occur simultaneously, the message with the highest priority is shown on the display.
LERR	Read only	The last diagnostic message with the highest priority appears on the display
FWVER	Read only	The firmware version appears on the display
TERR [1)]	Read only	Displays the diagnostic code/error code pending at Endress+Hauser HART transmitters/sensors. Please refer to the Operating Instructions of the relevant Endress+Hauser transmitter/sensor for additional information about the meaning of the diagnostic number and the remedial measures.

1) For Endress+Hauser transmitters/sensors with HART communication, the diagnostic code/error code currently pending can be queried via Endress+Hauser command #231. This command is only supported by Endress+Hauser transmitters/sensors. Therefore, the TERR parameter is not visible if third-party devices are connected to the RIA15.

Expert menu (EXPRT); a code must be entered			
In addition to all the parameters in the Setup menu, the Expert menu also contains the parameters described in this table. If you call up the Expert menu, you will be asked to enter the user code (UCODE, default: 0000).			
Parameter	**Values (default in bold)**	**Displayed when**	**Description**
LEVEL		Level option MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the FMR20/FMR20B/FMR30B/FMX21 measuring instruments. The individual parameters are described in the "Operating matrix in conjunction with the Micropilot FMR20/FMR20B/FMR30B" → 🖹 41 section and the "Operating matrix in conjunction with the FMX21" → 🖹 42 section.
FMG50		Option FMG50 MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the Gammapilot FMG50. The individual parameters are described in the "Operating matrix in conjunction with the FMG50"→ 🖹 43 section.

Expert menu (EXPRT); a code must be entered				
In addition to all the parameters in the Setup menu, the Expert menu also contains the parameters described in this table. If you call up the Expert menu, you will be asked to enter the user code (UCODE, default: 0000).				
Parameter		**Values (default in bold)**	**Displayed when**	**Description**
OPRAT			Option NMS8x MODE = HART Measuring instrument connected	This menu contains the parameters for configuring the Proservo NMS8x. The individual parameters are described in the "Operating matrix in conjunction with the NMX8x" section → 🖹 47.
CT			Analysis option MODE = HART CM82 connected	This menu contains the parameters for configuring the CM82 analytical measuring instrument. The CT menu and all of the associated submenus are visible only if the RIA15 was ordered with the "analysis" option and an appropriate device is connected. Using this menu, the basic settings for the analytical measuring instrument can be made via the RIA15. Description of the individual parameters → 🖹 50
SYSTM				
	UCODE	Numerical value 0000 to 9999 Default: **0000**		4-digit user code With the user code it is possible to protect the device setup from unauthorized modifications. If the setup is disabled, a padlock symbol appears on the display when an operating parameter is selected. The user code is not active with the default setting "0000". This means that setup parameters can be changed without entering the code. The code must always be entered for the Expert menu, even for the default setting.
	FRSET	**NO** YES		Resets the device setup. The values are reset to the preset values for preconfigured devices, and to the default values for all other devices. Select "YES" and press "E" by way of confirmation to reset the device.
	TOGTM	**5** 10 15 20	MODE = HART	Select the switching time in seconds between the HART values if "AUTO" was selected in the DISP1-DISP4 menu.
INPUT				The following parameters are available in addition to the parameters from the Setup menu.
	CURV	**LINAR** SQRT		**Use this to select the calculation function for the process value (for MODE = 4-20)** **LINAR** (scaling with SC__4 and SC_20): Process value = (mA value - 4)/16 * (SC_20 - SC__4) + SC__4 + OFFST **SQRT** (square root extraction and scaling): Process value = Square root((mA value - 4)/16) * (SC_20 - SC__4) + SC__4 + OFFST Negative values when calculating the square root are set to 0. **Use this to select the calculation function for the HART1 value (PV) (for MODE = HART)** **LINAR**: HART1 value (PV) = "exported PV value" * FACT1 + OFFS1 **SQRT** (square root extraction and scaling with BGLO1 and BGHI1): HART1 value (PV) = (square root("exported percentage PV value" / 100) * (BGHI1 - BGLO1) + BGLO1) * FACT1 + OFFS1 Negative values when calculating the square root are set to 0. **Example for SQRT:** ▪ exported percentage PV value = 50 ▪ BGLO1 = 100.0 ▪ BGHI1 = 200.0 ▪ FACT1 = 1 ▪ OFFS1 = 0.0 HART1 value (PV) = (square root(50/100) * (200 - 100) + 100) * 1 + 0 = 170.7
	NAMUR	NO **YES**	MODE = 4-20	Used for determining the maximum permissible errors in accordance with standard NAMUR NE 43 → 🖹 54
	RNGLO	Numerical value	NAMUR = NO	Lower range limit. An error message is displayed if the measured current falls below this limit.

Expert menu (EXPRT); a code must be entered				
In addition to all the parameters in the Setup menu, the Expert menu also contains the parameters described in this table. If you call up the Expert menu, you will be asked to enter the user code (UCODE, default: 0000).				
Parameter		**Values (default in bold)**	**Displayed when**	**Description**
	RNGHI	Numerical value	NAMUR = NO	Upper range limit. An error message is displayed if the measured current exceeds this limit.
	OFFST	Numerical value −19 999 to 99 999	MODE = 4-20	Use this function to enter an offset value to display the measured value.
	FACT1-FACT4	1E-6 1E-5 1E-4 1E-3 1E-2 1E-1 **1** 1E1 1E2 1E3 1E4 1E5 1E6	MODE = HART	As the display is limited to 5 characters, the measured value must be multiplied by a factor if necessary. For example: conductivity 0.00003 S multiplied by factor 1E6 →30.000 µS. If a factor is used, it is recommended to set the unit under UNIT1-4 to "UNIT" and to enter user-defined text because the unit automatically delivered via HART no longer matches the displayed value.
	OFFS1-OFFS4	Numerical value −19 999 to 99 999	MODE = HART	Use this function to enter an offset value to display the HART1-HART4 measured value. If a factor is used, the offset is added to the multiplied value (displayed value = measured value*factor + offset)
	EXP1-EXP4	**YES** NO	MODE = HART	Measured value display for measured values greater than 99999. ▪ YES: If the display overruns, the measured value is displayed in exponential notation. ▪ NO: Values with more than 5 digits are not displayed if the display overruns. Value is displayed with leading zeros. **Example:** Measured value: 130002.4 YES => 1.30E5 NO => 0002.4
DIAG				
	CNTHI	Read only	MODE = HART	Counter for the number of values transmitted via HART, 5 top positions. The counter goes back to 0 after a device restart or scan.
	CNTLO	Read only	MODE = HART	Counter for the number of values transmitted via HART, 5 bottom positions. The counter goes back to 0 after a device restart or scan.
	RETRY	Read only	MODE = HART	Counter for the number of retries to establish HART communication. The counter goes back to 0 after a device restart or scan.
	FAIL	Read only	MODE = HART	Counter for the number of failed attempts to establish HART communication. The counter goes back to 0 after a device restart or scan.
	HLEVL			
	Tx mV	Read only	MODE = HART	Value of the peak-to-peak level of the transmission signal in mV
	Rx mV	Read only	MODE = HART	Value of the peak-to-peak level of the received signal in mV
	NOISE	Read only	MODE = HART	Displays the level of the interference signal LO = low interference signal MED = medium interference signal HI = high interference signal
	Rc Ω	Read only	MODE = HART	Value of the total resistance in the HART loop in Ohm

8.3 Operating matrix in conjunction with the Micropilot FMR20/FMR20B/FMR30B

In the HART mode, the RIA15 with the "level" option can be used for the basic commissioning of the Micropilot radar level sensor.

For additional information on the FMR20/FMR20B/FMR30B, see the associated Operating Instructions → BA01578F/BA02364F/BA02373F.

Basic commissioning of FMR20/FMR20B/FMR30B

The RIA15 must be in the HART mode (MODE = HART) to make the basic settings. The LEVEL menu is not visible in the analog mode (MODE = 4-20).

1. Press the E key.
   ↳ The **Setup** menu opens.
2. Press the E key.
   ↳ The **LEVEL** submenu opens.
3. Set the desired parameters. For parameter descriptions, see the following table.

Setup -> Level (LEVEL) menu		
The LEVEL menu is only visible if the RIA15 has been ordered with the "Level" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Micropilot radar level sensor can be made via the RIA15.		
Parameter	**Values**	**Description**
LEVEL		This menu contains the parameters for configuring the level transmitter. Using this menu, the basic settings for the Micropilot level transmitter can be made via the RIA15.
UNIT [1]	m ft	Use this function to select the displayed unit
DUNIT [2]	mm m in ft	Use this function to select the distance unit at the transmitter
LUNIT [2]	% mm m in ft	Use this function to select the level unit at the transmitter
EMPTY	Numerical value – 199.99 to 999.99	Empty calibration using keys -,+,E. Enter distance from process connection to min. level Valid range of adjustment: 0 to 100 m
FULL	Numerical value – 199.99 to 999.99	Full calibration using keys -,+,E. Enter span from max. level to min. level
DIST	Measured value	Measured value (measured distance)
MAP		
DI OK		To be selected if the distance displayed matches the actual distance. The device then carries out a mapping.
MAN [1]		To be selected if the range of mapping is to be defined manually in the 'MAPDI' parameter. A comparison between the distance displayed and the actual distance is not necessary in this case. Mapping becomes active after approx. 20 s.
DI UN		To be selected if the actual distance is unknown. No mapping is recorded.
FACT [1]		To be selected if the present mapping curve (if one exists) is to be deleted. The device returns to the "Confirm distance" parameter and a new mapping can be recorded.

Setup -> Level (LEVEL) menu			
The LEVEL menu is only visible if the RIA15 has been ordered with the "Level" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Micropilot radar level sensor can be made via the RIA15.			
Parameter		**Values**	**Description**
	EMPTY [2]		To be selected if the tank is empty. The device then carries out a mapping.
	MAPDI [1]		Enter the end of the mapping when the MAN parameter is selected.

1) only for FMR20
2) only for FMR20B and FMR30B

8.4 Operating matrix in conjunction with the Waterpilot FMX21

In the HART mode, the RIA15 with the "level" option can be used for the basic commissioning of the Waterpilot FMX21 level sensor.

For further information on the FMX21, see the associated Operating Instructions → BA00380P and BA01605P.

Basic commissioning of the FMX21

The RIA15 must be in the HART mode (MODE = HART) to make the basic settings. The LEVEL menu is not visible in the analog mode (MODE = 4-20).

1. Press the E key.
   ↳ The **Setup** menu opens.
2. Press the E key.
   ↳ The **LEVEL** submenu opens.
3. Set the desired parameters. For parameter descriptions, see the following table.

Setup -> Level (LEVEL) menu			
The LEVEL menu is only visible if the RIA15 has been ordered with the "level" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Waterpilot FMX21 level sensor can be made via the RIA15.			
Parameters		**Values**	**Description**
LEVEL			This menu contains the parameters for configuring the pressure measuring device for hydrostatic level measurement, FMX21. Using this menu, the basic settings for the FMX21 can be made via the RIA15. Once the LEVEL menu item is opened, the following parameters are automatically adjusted for easier operation: ▪ Operating mode: Level ▪ Calibration mode: Dry ▪ Level selection: In pressure ▪ Lin mode: Linear It is possible to reset these parameters to the factory default settings by performing a reset.
	PUNIT	mbar bar kPa PSI	Use this function to select the unit for pressure
	LUNIT	% m inch feet	Use this function to select the unit for level
	TUNIT	°C °F K	Use this function to select the unit for temperature

Setup -> Level (LEVEL) menu			
The LEVEL menu is only visible if the RIA15 has been ordered with the "level" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Waterpilot FMX21 level sensor can be made via the RIA15.			
Parameters		**Values**	**Description**
	ZERO	NO YES	For performing a position adjustment (gauge pressure sensor). The value 0.0 is assigned to the pressure value present. The current value is also corrected.
	P_LRV	-1999.9 ... 9999.9	Pressure empty calibration using keys -,+,E More in-depth description / valid value range: any value in the range indicated [1)] Number of decimal places depends on the configured pressure unit. Valid ranges of adjustment: 0 to 100 mbar or 0 to 20 bar
	P_URV	-1999.9 ... 9999.9	Pressure full calibration using keys -,+,E More in-depth description / valid value range: any value in the range indicated [1)] Number of decimal places depends on the configured pressure unit. Valid ranges of adjustment: 0 to 100 mbar or 0 to 20 bar
	EMPTY	-1999.9 ... 9999.9	Level empty calibration using keys -,+, E More in-depth description / valid value range: any value in the range indicated [1)] Number of decimal places depends on the configured level unit. For valid ranges of adjustment, see associated Operating Instructions of the FMX21 → BA00380P and BA01605P.
	FULL	-1999.9 ... 9999.9	Level full calibration using keys -,+, E More in-depth description / valid value range: any value in the range indicated [1)] Number of decimal places depends on the configured level unit. For valid ranges of adjustment, see associated Operating Instructions of the FMX21 → BA00380P and BA01605P.
	LEVEL	Measured value	Displays the measured level Number of decimal places depends on the configured level unit.
	RESET	NO YES	Reset the FMX21 to factory defaults

1) The values entered for "Empty calib./Full calib.", "Empty pressure/Full pressure" and "Set LRV/Set URV" must be at least 1% apart. The value will be rejected, and a message displayed, if the values are too close together. Further limit values are not checked, i.e. the values entered must be appropriate for the sensor module and the measuring task for the device to be able to measure correctly.

8.5 Operating matrix in conjunction with the Gammapilot FMG50

In the HART mode, the RIA15 with the "FMG50" option can be used for the basic configuration of the level mode, point level mode or density mode of the Gammapilot FMG50.

For additional information on the FMG50, see the associated Operating Instructions → BA01966F

Basic setup of the Gammapilot FMG50

The RIA15 must be in the HART mode (MODE = HART) to make the basic settings. The **FMG50** menu is not visible in the analog mode (MODE = 4-20).

1. Press the E key.
   ↳ The **SETUP** menu opens.
2. Press the E key.
   ↳ The **FMG50** submenu opens.
3. Set the desired parameters. For parameter descriptions, see the following table.

Menu SETUP -> FMG50 -> OPER (Operating Mode)			
The FMG50 menu is only visible if the RIA15 has been ordered with the "FMG50" option and the display unit is operated in the HART mode (MODE = HART). The basic configuration of the level mode, point level mode or density mode of the Gammapilot FMG50 can be performed via the RIA15 using this menu.			
Parameter		**Values**	**Description**
FMG50			This menu contains the parameters for the basic configuration of the Gammapilot FMG50 for level measurement, point level measurement or density measurement. The basic settings for the Gammapilot FMG50 can be made via the RIA15 using this menu.
	OPER	PLEV LEVEL DENS	Opens the "Operating Mode" menu where the user can select the measuring mode for the device. Users can choose from the following measuring modes: ▪ Point Level (point level measurement) ▪ Continuous Level ▪ Density For a detailed description of the individual operating modes, see the Operating Instructions for the FMG50.

Menu SETUP -> FMG50 -> OPER -> PLEV (Point Level)			
The basic configuration of the Gammapilot FMG50 for point level measurement can be performed via the RIA15 using this menu. **If "PLEV" (Point Level) has been selected as the operating mode, the linearization type is automatically set to "Linear".**			
Parameter		**Values**	**Description**
	LRV		Level value for 4 mA
		Numerical value	0.1 to 9 999.9
	URV		Level value for 20 mA
		Numerical value	0.1 to 9 999.9
	BEAMT		**Beam Type:** Choice of continuous or modulated radiation. Modulated radiation is used to suppress gammagraphy. The FHG65 modulator must be used in order to use modulated radiation.
		MOD	Modulated
		STD	Standard
	ISOTY		Use this function to select the isotope used for the measurement. The type of isotope is critical for correct decay compensation.
		CS137	Caesium 137
		CO60	Cobalt 60
	CTIME		Integration time for the calibration.
		Numerical value	1 to 8 000 s
	BCKCL		Background calibration is necessary for the measurement of natural background radiation.
		START	Starts the measurement of the pulse rate, which is caused by natural background radiation.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	PULSF		Full calibration: calibration of the pulse rate for "Full"
		START	**START** triggers a full calibration. The device determines the pulse rate in the "Full" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	FULL		Use this function to enter a level value for full calibration (for point level measurement = 100 %).
		Numerical value	100.0 to 60.0 %
	PULSE		Empty calibration: calibration of the pulse rate for "Empty"

Menu SETUP -> FMG50 -> OPER -> PLEV (Point Level)			
The basic configuration of the Gammapilot FMG50 for point level measurement can be performed via the RIA15 using this menu. **If "PLEV" (Point Level) has been selected as the operating mode, the linearization type is automatically set to "Linear".**			
Parameter		**Values**	**Description**
		START	**START** triggers an empty calibration. The device determines the pulse rate in the "Empty" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	EMPTY		Use this function to enter a level value for empty calibration (for point level measurement = 0 %).
		Numerical value	0.0 to 40.0 %
	PLSB		Displays the background pulse rate
	PLSF		Displays the full pulse rate
	PLSE		Displays the empty pulse rate

Menu SETUP -> FMG50 -> OPER -> LEVEL (Continuous Level)			
The basic configuration of the Gammapilot FMG50 for continuous level measurement can be performed via the RIA15 using this menu. **If "Continuous Level" has been selected as the operating mode, the linearization type is automatically set to "Standard".**			
Parameter		**Values**	**Description**
	LUNIT		Unit for continuous level measurement (percent only)
		%	Percent
	LRV		Level value for 4 mA
		Numerical value	0.1 to 9 999.9
	URV		Level value for 20 mA
		Numerical value	0.1 to 9 999.9
	BEAMT		**Beam Type:** Choice of continuous or modulated radiation. Modulated radiation is used to suppress gammagraphy. The FHG65 modulator must be used in order to use modulated radiation.
		MOD	Modulated
		STD	Standard
	ISOTY		Use this function to select the isotope used for the measurement. The type of isotope is critical for correct decay compensation.
		CS137	Caesium 137
		CO60	Cobalt 60
	CTIME		Integration time for the calibration.
		Numerical value	1 to 8 000 s
	BCKCL		Background calibration is necessary for the measurement of natural background radiation.
		START	Starts the measurement of the pulse rate, which is caused by natural background radiation.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	PULSF		Full calibration: calibration of the pulse rate for 100 %
		START	**START** triggers a full calibration. The device determines the pulse rate in the "Full" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress

Menu SETUP -> FMG50 -> OPER -> LEVEL (Continuous Level)			
The basic configuration of the Gammapilot FMG50 for continuous level measurement can be performed via the RIA15 using this menu. **If "Continuous Level" has been selected as the operating mode, the linearization type is automatically set to "Standard".**			
Parameter		**Values**	**Description**
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	PULSE		Empty calibration: calibration of the pulse rate for 0 %
		START	**START** triggers an empty calibration. The device determines the pulse rate in the "Empty" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	PLSB		Displays the background pulse rate
	PLSF		Displays the full pulse rate
	PLSE		Displays the empty pulse rate

Menu SETUP -> FMG50 -> OPER -> DENS (Density)			
The basic configuration of the Gammapilot FMG50 for density measurement can be performed via the RIA15 using this menu. **If "Density" has been selected as the operating mode, the linearization type is automatically set to "Multipoint Calibration".**			
Parameter		**Values**	**Description**
	DUNIT		Engineering unit for displaying and transmitting the density value.
		G/CM3 KG/M3 G/L LB/GA LB/IN	g/cm^3 kg/m^3 g/l lb/gal lb/in^3
	LUNIT		Unit of length for entering distances, e.g. length of the beam path
		MM INCH	mm inch
	LRV		Density value for 4 mA
		Numerical value	0.0 to 9 999.9 (the number of decimal places depends on the setting in the DUNIT parameter)
	URV		Density value for 20 mA
		Numerical value	0.0 to 9 999.9 (the number of decimal places depends on the setting in the DUNIT parameter)
	BEAMP		**Beam Path:** The length of the beam path is the distance between the source container and the detector. If this distance is not known, an approximate value or the pipe diameter can be used.
		Numerical value	0 to 99 999 mm (0.1 to 9 999.9 in)
	BEAMT		**Beam Type:** Choice of continuous or modulated radiation. Modulated radiation is used to suppress gammagraphy. The FHG65 modulator must be used in order to use modulated radiation.
		MOD	Modulated
		STD	Standard
	ISOTY		Use this function to select the isotope used for the measurement. The type of isotope is critical for correct decay compensation.
		CS137	Caesium 137
		CO60	Cobalt 60
	CTIME		Integration time for the calibration.
		Numerical value	1 to 8 000 s
	BCKCL		Background calibration is necessary for the measurement of natural background radiation.
		START	Starts the measurement of the pulse rate, which is caused by natural background radiation.

Menu SETUP -> FMG50 -> OPER -> DENS (Density)			
The basic configuration of the Gammapilot FMG50 for density measurement can be performed via the RIA15 using this menu. **If "Density" has been selected as the operating mode, the linearization type is automatically set to "Multipoint Calibration".**			
Parameter		**Values**	**Description**
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	PULS1		Pulse rate of 1st density calibration point The pulse rate that corresponds to the density of the material in the beam path is determined during the calibration. This value and the absorption coefficient are used to calculate the course of the calibration curve for density measurement.
		START	**START** triggers the calibration of the 1st density point. The device determines the pulse rate in the "Density point 1" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	DENS1		Use this function to enter the corresponding density value for the calibration of density point 1.
		Numerical value	0.1 to 999.9
	PULS2		Pulse rate of 2nd density calibration point The pulse rate that corresponds to the density of the material in the beam path is determined during the calibration. This value and the absorption coefficient are used to calculate the course of the calibration curve for density measurement.
		START	**START** triggers the calibration of the 2nd density point. The device determines the pulse rate in the "Density point 2" state.
		STOP	Stop the calibration
		WAIT	Calibration in progress
		DONE	Calibration is finished. The calibration point is activated by pressing the "E" key.
	DENS2		Use this function to enter the corresponding density value for the calibration of density point 2.
		Numerical value	0.1 to 9 999.9
	PLSB		Displays the background pulse rate
	PLSD1		Displays the pulse rate of the 1st density calibration point
	PLSD2		Displays the pulse rate of the 2nd density calibration point

8.6 Operating matrix in conjunction with the Proservo NMS8x

In the HART mode, the RIA15 with the "NMS8x" option can be used for the basic operation of the Proservo NMS8x tank gauging device.

For additional information on the NMS80, see the associated Operating Instructions → BA01456G.

For additional information on the NMS81, see the associated Operating Instructions → BA01459G.

For additional information on the NMS83, see the associated Operating Instructions → BA01462G.

Basic commissioning of the NMS8x

The RIA15 must be in the HART mode (MODE = HART) to make the basic settings. The **OPRAT** menu is not visible in the analog mode (MODE = 4-20).

1. Press the E key.
   ↳ The **OPRAT** menu opens.
2. Press the E key.
   ↳ The **CMD** submenu opens.
3. Set the desired parameters. For parameter descriptions, see the following table.

Menu OPRAT (Operating)		
The OPRAT menu is only visible if the RIA15 has been ordered with the "NMS8x" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Proservo NMS8x tank gauging device can be made via the RIA15.		
Parameters	**Values**	**Description**
OPRAT		This menu contains the parameters for the operation of the Proservo NMS8x and for reading out the current measurement status.
CMD		Command used to select the device measuring mode. The status of the execution of the command is indicated in the **STA** status parameter. For more information on the NMS8x, see the Operating Instructions for the device.
	STOP	Stop
	LEVEL	Level
	UP	Up
	BTM L	Bottom level
	UP IF	Upper I/F level
	LO IF	Lower I/F level
	U DEN	Upper density
	M DEN	Middle density
	L DEN	Lower density
	REPET	Repeatability
	W DIP	Water dip
	R OVR	Release overtension
	T Pro	Tank profile
	IFPro	Interface profile
	M Pro	Manual profile
	STBY	Level standby
	SELF	Self check
BAL		Indicates the validity of the measurement. If it is balanced, the corresponding value (Liquid Level, Upper Interface, Lower Interface, Tank Bottom) is updated.
	No	Level data of the device are not valid.
	Yes	Level data of the device are valid.
STA		Indicates the current measurement status of the device.
	REF	isplacer at reference position
	UP	Displacer hoisting up
	STOP	Displacer stop
	BAL	Level measurement balanced
	UIF B	Upper interface level balanced
	UDErr	Upper density error

Menu OPRAT (Operating)		
The OPRAT menu is only visible if the RIA15 has been ordered with the "NMS8x" option and the indicator is operated in the HART mode (MODE = HART). Using this menu, the basic settings for the Proservo NMS8x tank gauging device can be made via the RIA15.		
Parameters	**Values**	**Description**
	BTm B	Bottom measurement balanced
	UDDon	Upper density done
	MDDon	Middle density done
	LDDon	Lower density done
	REL	Release overtension
	CALIB	Calibration activated
	SEEK	Seek level
	FLW	Follow level
	S UIF	Seek upper interface level
	F UIF	Follow upper interface level
	MDErr	Middle density error
	F LIF	Follow lower interface level
	S BTm	Seek bottom level
	H STP	Stopped at high stop
	L STP	Stopped at low stop
	REPET	Repeatability testing
	S WL	Seek water level
	WLErr	Water level error
	T BAL	Temporary balanced
	LDErr	Lower density error
	SL UP	Slow hoist up
	MAINT	Maintenance
	LIF B	Lower Interface level balanced
	S LIF	Seek lower interface level
	RELSD	Overtension released
	Abv_L	Above liquid
	WDDon	Water dip finished
	P Don	Profile done
	B Don	Bottom done
	L Fnd	Level found
	P Err	Profile error
	WAIT	Wait for level
	S STb	Seek standby position
	MOVE	Move to target
	M DEN	Measure density
	M AIR	Measure in air
	B Err	Bottom error

8.7 Operating matrix in conjunction with the Liquiline CM82

In the HART mode, the RIA15 with the "analysis" option can be used for the basic commissioning of the Liquiline CM82.

For further information on the CM82, see the associated Operating Instructions → BA01845C

Basic commissioning of the CM82

The RIA15 must be in the HART mode (MODE = HART) to make the basic settings. The ANALYSIS menu is not visible in analog mode (MODE = 4-20).

1. Press the E key.
   ↳ The **Setup** menu opens.
2. Press the E key.
   ↳ The **CT** submenu opens.
3. Set the desired parameters. For parameter descriptions, see the following table.

Setup -> ANALYSIS menu			
The CT menu and all of the associated submenus are visible only if the RIA15 was ordered with the "analysis" option, the HART option has been configured and a CM82 has been detected by the RIA15. Using this menu, the basic settings for the CM82 can be made via the RIA15.			
Parameters		**Values**	**Description**
CT			This menu contains the parameters for configuring the CM82 compact transmitter.
CSET			Access the "CM82 setup" submenu
	TUNIT	°C °F °K	Select the unit for temperature on the CM82.
	OUTS		Access the "CM82 - Output Setting" submenu to change the setting on the CM82. The primary value (CMAIN) of the CM82 is assigned here and the measuring range (4-20mA) configured. Depending on the sensor type connected, only certain measured values can be configured/displayed.
		pH glass sensors	
		CMAIN	pH mV_PH IMPGL TEMP	pH: pH measured value in pH mV_PH: pH raw value in mV IMPGL: Glass impedance in MOhm [1)] TEMP: Temperature in °C/°F/K (unit as per setting in TUNIT)
		pH-ISFET sensors	
		CMAIN	pH mV_PH LEAKC TEMP	PH: pH measured value in pH mV_PH: pH raw value in mV LEAKC: ISFET leak current in "nA" [1)] TEMP: Temperature in °C/°F/K (unit as per setting in TUNIT)
		pH ORP sensors	
		CMAIN	mVORP %_ORP TEMP	mVORP: ORP measured value in mV %_ORP: Percentage ORP value as % TEMP: Temperature in °C/°F/K (unit as per setting in TUNIT)
		pH/ORP combination sensors	

Setup -> ANALYSIS menu			
The CT menu and all of the associated submenus are visible only if the RIA15 was ordered with the "analysis" option, the HART option has been configured and a CM82 has been detected by the RIA15. Using this menu, the basic settings for the CM82 can be made via the RIA15.			
Parameters		**Values**	**Description**
	CMAIN	pH mV_PH IMPGL IMPRE mVORP %_ORP RH TEMP	PH: pH measured value in pH mV_PH: pH raw value in mV IMPGL: Glass impedance in MOhm [1)] IMPRE: Reference impedance in Ohm mVORP: ORP measured value in mV %_ORP: Percentage ORP value as % RH: rH value in rH TEMP: Temperature in °C/°F/K (unit as per setting in TUNIT)
	Oxygen sensors		
	CMAIN	PAR_P %SAT C_LIQ C_GAS CURR RTIME TEMP	PAR_P: Partial pressure of oxygen in hPa %SAT: Percentage saturation as % C_LIQ: Liquid concentration (unit as per setting in UCLIQ) C_GAS: Gas concentration (unit as per setting in UCGAS) CURR: Raw value, measuring current of sensor in nA [1)] (visible only in the case of amperometric oxygen sensors) RTIME: Decay time, raw value in µs (visible only in the case of optical oxygen sensors) TEMP: Temperature in °C/°F/K (unit as per setting in TUNIT)
	UCLIQ	 mG_L uG_L PPM PPB	Unit of upper and lower turndown setting if the primary value (CMAIN) is set to C_LIQ mG_L: milligram/liter [1)] uG_L: microgram/liter PPM: parts per million PPB: parts per billion
	UCGAS	 %_VOL PPM_V	Unit of upper and lower turndown setting if the primary value (CMAIN) is set to C_GAS %_VOL: percent by volume PPM_V: parts per million
	Conductivity sensors		
	CMAIN	COND RESIS RAWC TEMP	COND: specific conductivity (unit as per setting in UCOND) RESIS: resistivity (unit as per setting in URES) RAWC: uncompensated conductivity (unit as per setting in UCOND) TEMP: temperature (unit as per setting in TUNIT)
	URES	 KO*CM MO*CM KO*M	Unit of upper and lower turndown setting if the primary value (CMAIN) is set to RESIS KO*CM: kOhm*cm MO*CM: MOhm*cm KO*M: kOhm*m
	UCOND	 uS/cm mS/cm S/cm uS/m mS/m S/m	Unit of upper and lower turndown setting if the primary value (CMAIN) is set to COND or RESIS uS/cm: microsiemens/cm mS/cm: millisiemens/cm S/cm: siemens/cm uS/m: microsiemens/m mS/m: millisiemens/m S/m: siemens/m
	for all sensors		

Setup -> ANALYSIS menu			
The CT menu and all of the associated submenus are visible only if the RIA15 was ordered with the "analysis" option, the HART option has been configured and a CM82 has been detected by the RIA15. Using this menu, the basic settings for the CM82 can be made via the RIA15.			
Parameters		**Values**	**Description**
	LOW	-19,999 ... 99,999	Configure turndown of current output. The measured value that corresponds to 4 mA is set here. The limits of adjustment vary depending on the sensor type and measured value. The position of the decimal point is permanently preset depending on the primary value (CMAIN) configured. **Valid ranges of adjustment:** **pH sensor:** PH: -2.00 to 16.00 pH mV_PH: -2000 to 2000 mV LEAKC: -4000.0 to 4000.0 nA IMPGL: 0 to 99999 MOhm IMPRE: 0 to 99999 Ohm mVORP: -2000 to 2000 mV %_ORP: -3000.0 to 3000.0 % RH: 0.0 to 70.0 rH TEMP: -50.0 to 150.0 °C (depending on the unit configured under TEMP) -58.0 to 302.0°F 223.1 to 423.1 K **dissolved oxygen sensor:** PAR_P: 0.0 to 2500.0 hPa %SAT: 0.02 to 200.00 % saturation C_LIQ: -0.02 to 120.00 mg/l -20.00 to 999.99 ug/l -0.02 to 120.00 ppm -20.00 to 999.99 ppb (depending on the unit configured in UCLIQ) C_GAS: -0.02 to 200 .00 % Vol -0.02 to 200 .00 % Vol -200.00 to 999.99 ppm Vol (depending on the unit configured under UCGAS) CURR: 0.0 to 9999.9 nA RTIME: 0.0 to 100.0 µs TEMP: -10.0 to 140.0 °C 14.0 to 284 °F 263.1 to 413.1 K (depending on the unit configured under TEMP) **Conductivity sensor:** COND: 0.000 to 99.999 uS/cm 0.000 to 99.999 mS/cm 0.000 to 2.000 S/cm 0.000 to 99.999 uS/m 0.000 to 99.999 mS/m 0.000 to 99.999 S/m (depending on the unit configured in UCOND) RESIS: 0.00 to 999.99 kOhm*cm 0.00 to 200.00 MOhm*cm 0.00 to 999.99 kOhm*m (depending on the unit configured in URES) RAWC: 0.000 to 99.999 uS/cm 0.000 to 99.999 mS/cm 0.000 to 2.000 S/cm 0.000 to 99.999 uS/m 0.000 to 99.999 mS/m 0.000 to 99.999 S/m (depending on the unit configured in UCOND)

Setup -> ANALYSIS menu				
The CT menu and all of the associated submenus are visible only if the RIA15 was ordered with the "analysis" option, the HART option has been configured and a CM82 has been detected by the RIA15. Using this menu, the basic settings for the CM82 can be made via the RIA15.				
Parameters			**Values**	**Description**
				TEMP: -50.0 to 250.0 °C -58.0 to 482.0 °F 223.1 to 523.1 K (depending on the unit configured under TEMP)
		HIGH	-19,999 ... 99,999	Configure turndown of current output. The measured value that corresponds to 20 mA is set here. The limits of adjustment vary depending on the sensor type and measured value. The position of the decimal point is permanently preset depending on the primary value (CMAIN) and the set units (UCLIQ, UCGAS, URES, UCOND) configured. For valid ranges of adjustment, see LOW (setting for 4 mA)
		ERRC	3.6 to 23.0	Configure the error current on the CM82 in mA
CDIAC				Access the "CM82 - Device diagnostics" submenu
	FCSM		Error category as per NAMUR and error number	Display the error message with the highest priority on the CM82
	DTAG		Device tag	Display the device tag of the CM82 (use +/- keys to scroll through text)
	DSER		Device serial number	Display the serial number of the CM82 (use +/- keys to scroll through text)
	SENOC		Sensor order code	Display the oder code of the sensor (use +/- keys to scroll through text)
	SENSN		Sensor serial number	Display the serial number of the sensor (use +/- keys to scroll through text)
CTRES				Access the "CM82 -Reset" submenu
	RBOOT		No YES	Trigger a restart of the CM82
	FDEF		No YES	Reset the CM82 to factory settings
CTSIM				Access the "CM82 -Simulation" submenu
	SIMUL		OFF ON	Switch on simulation for current output value on CM82
	VALUE		3.6 to 23.0	Configure current output value on CM82 for simulation in mA

1) If this parameter is selected, "UC170" appears in display mode for the unit. To display the unit, this must be individually configured in the "TEXT1" menu item. (SETUP => HART => HART1 => UNIT1 => TEXT1) → 🖹 54

9 Troubleshooting

9.1 Maximum permissible errors as per NAMUR NE 43

In Mode=4-20, the device can be set to maximum permissible errors as per NAMUR NE 43→ 38.

The device displays an error message if a value is outside these limits.

Current value	Error	Diagnostic code
≤ 3.6 mA	Under range	F100
3.6 mA < x ≤ 3.8 mA	Unpermitted measured value	S901
20.5 mA ≤ x < 21.0 mA	Unpermitted measured value	S902
> 21.0 mA	Over range	F100

9.2 Diagnostic messages

If several errors are pending simultaneously, the device always displays the error with the highest priority.

1 = Highest priority

Diagnostic number	Event text	Remedial action	Status signal	Diagnostic behavior	Priority
Diagnostics for the sensor					
F100	Sensor error	▪ Check electrical wiring ▪ Check sensor ▪ Check sensor settings	F	Alarm	6
S901	Input signal too small	▪ Check transmitter output for defect and conformity error ▪ Check transmitter for incorrect configuration	S	Warning	4
S902	Input signal too large		S	Warning	5
Diagnostics for the electronics					
F261	Electronics module	Replace electronics	F	Alarm	1
F283	Memory content	▪ Restart device ▪ Reset device ▪ Replace electronics	F	Alarm	2
F431	Factory calibration	Replace electronics	F	Alarm	3
Diagnostics for the configuration					
M561	Display overshoot	Check scaling	M	Warning	7

9.2.1 Display "UCxxx" instead of HART unit

By default, the unit of the transmitted measured value is automatically read out and displayed using a HART command. If the transmitted "unit code" cannot be uniquely assigned by the RIA15, the unit code (UCxxx) is displayed instead of the unit.

To remedy this, the unit must be set manually. (SETUP => HART => HART1-4 => UNIT1-4 => TEXT1-4).

For the affected units, see → 68

CM82 special case:

The unit codes 170 to 219 are assigned multiple times as per the HART specification. As the UC170 is also used with the CM82, the unit must be assigned manually. This applies to the following measured values/units:

PV (TEXT1):

Transmitter parameter	Primary value (CMAIN)	Unit
pH	Leak current (LEAKC)	nA
pH	Glass impedance (IMPGL)	MOhm
Dissolved oxygen	Liquid concentration (C_LIQ)	mg/l
Dissolved oxygen	Raw value of sensor (CURR)	nA

QV (TEXT4):

Transmitter parameter	Sensor type	Unit
pH	Glass	MOhm
pH	IsFET	nA

9.2.2 HART diagnostic messages

If several errors are pending simultaneously, the device always displays the error with the highest priority.

1 = Highest priority

Diagnostic number	Event text	Remedial action	Status signal	Diagnostic behavior	Priority
F960	HART communication (slave not responding)	▪ Verify HART slave address ▪ Check electrical wiring (HART) ▪ Check HART function sensor/actuator	F	Alarm	8
C970	Multi-master collision	▪ Check additional master in HART network (e.g. handheld) ▪ Check master setting (secondary/primary)	C	Check	9
F911	HART-HART slave device error (HART Field Device Status)	Check sensor/actuator configuration or check for defects	F	Alarm	10
S913	HART slave current output saturated (HART Field Device Status)	▪ Commissioning: Check sensor/actuator for incorrect configuration, check sensor/actuator configuration ▪ Operation: Process parameter outside valid range	S	Warning	11
S915	HART slave variable outside limits of range (HART Field Device Status)		S	Warning	12

9.2.3 Other diagnostics in the HART mode

The process indicator has an integrated HART diagnostics function. This function can be used to estimate the HART signal level, the applicable communication resistance, and the noise of the network.

The indicator can measure and display the following values:

Parameter	Description	Display	
Tx mV	Process indicator signal level	mV	Peak-to-peak level of the transmission signal
Rx mV	Slave signal level	mV	Peak-to-peak level of the received signal
NOISE	Weighting of the interference signal	LO / MED / HI	Categorization of the interference into low, medium or high
Rc Ω	Effective communication resistance	Ω	Resistance in Ohm

The values can be called up in the EXPRT – DIAG – HLEVL menu.

Measuring the transmission signal level "Tx":

The Tx measurement can be used to assess the signal level of the transmission signal.

Ideally this should vary between 200 mV and 800 mV . The following values are displayed:

Tx	< 120 mV	120 to 200 mV	200 to 800 mV	800 to 850 mV	> 850 mV
Display	LO	Level in mV			HI
Bargraph	<	<	0 to 100 %	>	>

Measuring the received signal level "Rx":

The Rx measurement can be used to assess the signal level of the received signal. Ideally this should vary between 200 mV and 800 mV .

The Rx signal measured value that is displayed is a filtered signal level as assessed by the process indicator. In this way, the value measured externally and the displayed value can differ from one another, for example in the case of a trapezoidal received signal.

The following values are displayed:

Rx	< 120 mV	120 to 200 mV	200 to 800 mV	800 to 850 mV	> 850 mV
Display	LO	Level in mV			HI
Bargraph	<	<	0 to 100 %	>	>

Measuring the "NOISE" interference signal:

When the interference signal level is measured, the interference signal determined is divided into three categories:

LO = low

MED = medium

HIGH = high

The noise measurement is also a filtered signal level as assessed by the process indicator. The value measured externally and the displayed value can therefore differ from one another, depending on the frequency and the form of the signal.

With low wanted signal levels (Rx, Tx), transmission errors can occur even if the interference signal level is low ("LO" displayed).

Measuring the communication resistance "Rc":

The "Rc" measurement can be used to determine the network resistance of the HART network. Ideally this should vary between 230 Ω and 600 Ω .

The network resistance is the sum of the HART communication resistance, the device's input resistance, the transmission line resistance and line capacitance.

The following values are displayed:

Rc	< 100 Ω	100 to 230 Ω	230 to 600 Ω	600 to 1000 Ω	> 1000 Ω
Display	LO	Resistance in Ω			HI
Bargraph	<	< .-	0 to 100 %	>	>

9.2.4 Error messages during basic configuration of connected transmitters

While configuring connected transmitters, it may happen that the transmitter responds with a response code not equal to 0. In this case, the response code is displayed briefly on the process indicator ("RC XX"). The current setting on the transmitter is then retrieved again and displayed on the process indicator.

The meaning of the response codes is explained in the following table.

Code	Description	Remedy
RC 02	Invalid selection	Check HART setting and firmware in the connected transmitter
RC 03	Value too large	Check basic settings for the connected transmitter → 🖹 41
RC 04	Value too small	Check basic settings for the connected transmitter → 🖹 41
RC 05	Not enough data bytes received	Check HART setting and firmware in the connected transmitter
RC 06	Device-specific command error	Check HART setting and firmware in the connected transmitter
RC 07	In the write-protected mode	Check write protection in the connected transmitter
RC 14	Span too small	Check basic settings for the connected transmitter → 🖹 41
RC 16	Access restricted	Check HART setting and firmware in the connected transmitter
RC 29	Invalid span	Check basic settings for the connected transmitter → 🖹 41
RC 32	Busy	Try to establish communication again

9.2.5 Other error messages that may occur during configuration

Code	Description	Remedy
F960	HART communication error	Check HART communication: ▪ Communication resistance ▪ Signal level ▪ Faults ▪ Sensor version
F013	CM82 transmitter/sensor type is not supported by the RIA15	Connect a supported transmitter/sensor type

9.3 Firmware history

Release

The firmware version on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 1.02.01).

XX	Change to main version. No longer compatible. The device and Operating Instructions change.
YY	Change to functions and operation. Compatible. The Operating Instructions change.
ZZ	Fixes and internal changes. No changes to the Operating Instructions.

Date	Firmware version	Software changes	Documentation
03/2013	ISU00XA: 1.01.00	HART option	BA01170K/09/EN/02.13
07/2013	ISU00XA: 1.02.00	HART level measurement	BA01170K/09/EN/03.13
11/2014	ISU00XA: 1.03.00	New EXP1-EXP4 parameter for HART option	BA01170K/09/EN/04.14
05/2016	ISU00XA: 1.04.00	New menus and parameters in "FMR20 basic commissioning"	BA01170K/09/EN/05.15
04/2018	ISU00XA (standard): 1.05.01 ISU01XA (CM82): 1.05.01	New menus and parameters "FMX21 / CM82 basic commissioning"	BA01170K/09/EN/06.18
07/2019	ISU00XA (standard +FMG50): 1.06.xx ISU01XA (CM82): 1.05.01 ISU03XA (NMS8x): 1.06.xx	▪ Configuration for FMG50 (ISU00XA) ▪ Configuration for NMS8X (ISU03XA) ▪ Display of the mA value in 4-20 mA mode via + or - key held down	BA01170K/09/EN/07.19
06/2023	ISU00XA (standard +FMG50): 1.06.xx ISU01XA (CM82): 1.05.01 ISU03XA (NMS8x): 1.06.xx	-	BA01170K/09/EN/08.23
11/2024	ISU00XA (standard +FMG50): 1.07.xx	FMR20B and FMR30B configuration	BA01170K/09/EN/09.24

10 Maintenance

No special maintenance work is required for the device.

10.1 Cleaning

A clean, dry cloth can be used to clean the device.

11 Repair

11.1 General information

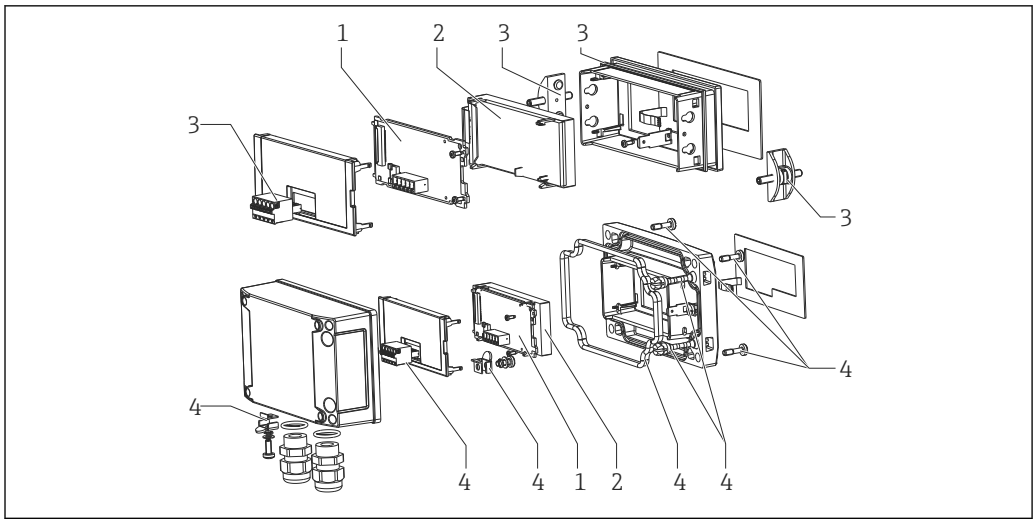
The device has a modular design and repairs can be carried out by the customer's electrotechnical personnel. For more information on service and spare parts, contact the supplier.

11.1.1 Repair of Ex-certified devices

- Only specialist personnel or the manufacturer may undertake repairs on Ex-certified devices.
- The prevailing standards, national hazardous area regulations, safety instructions and certificates must be observed.
- Only use original spare parts from the manufacturer.
- When ordering spare parts, check the device designation on the nameplate. Parts may only be replaced by identical parts.
- Carry out repairs according to the instructions. On completion of the repair, carry out the routine test specified for the device.
- A certified device may only be converted to another certified device version by the manufacturer only.
- Document all repairs and modifications.

11.2 Spare parts

Spare parts currently available for the device can be found online at: http://www.products.endress.com/spareparts_consumables. Always quote the serial number of the device when ordering spare parts!



22 *Spare parts of the process indicator*

Item no.	Name	Order number
1	Mainboard HART Mainboard HART with Level option (FMX21, FMR20 etc.) Mainboard HART with Analysis option (CM82)	XPR0005-ABA XPR0005-ACA XPR0005-ADA
2	LCD module	XPR0006-A1
3	Small parts set for panel-mount housing (5-pin plug-in terminal, seal on front frame, 2x fastening clip)	XPR0006-A2
4	Small parts set for field housing (5-pin plug-in terminal, seal on cover, 2x cover hinge, grounding connection on bottom, cover screws, grounding lug)	XPR0006-A3
4	Cable gland with integrated pressure compensation membrane (for FMX21)	RK01-BD
	Plastic field housing W18 RAL5012, conductive	XPR0006-A4

11.3 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information:
   https://www.endress.com/support/return-material
   ↳ Select the region.
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

11.4 Disposal

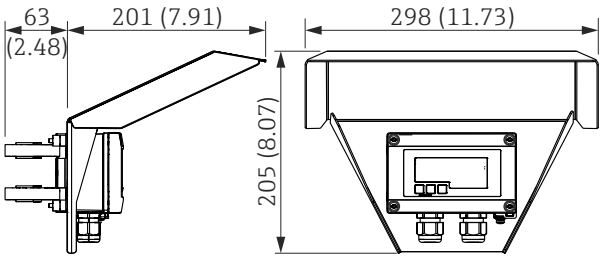
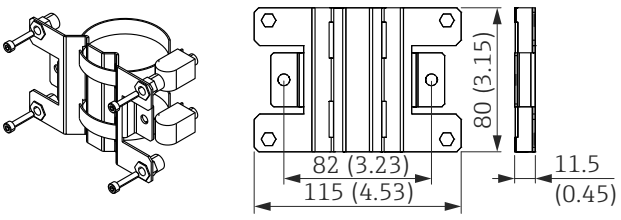
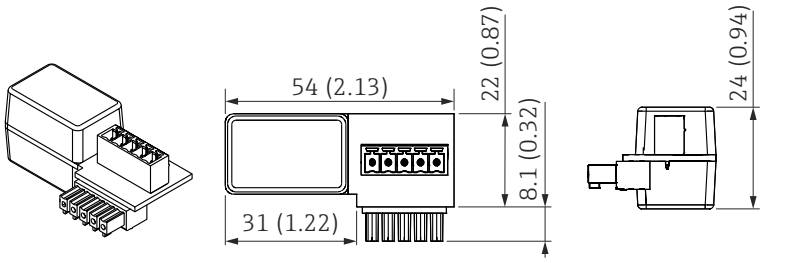
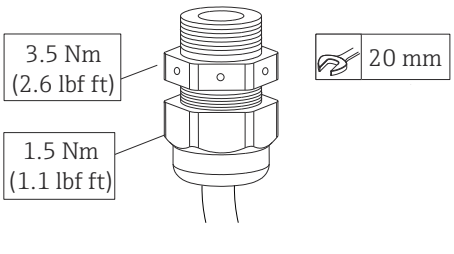
If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

12 Accessories

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

12.1 Device-specific accessories

Weather protection cover	 23 Dimensions of protective cover, engineering unit mm (in)
Mounting kit for wall/ pipe mounting Material: SS 316L	 24 Dimensions of mounting bracket, engineering unit mm (in)
HART® communication resistance module	 25 Dimensions of communication resistance module, engineering unit mm (in)
M16 cable gland with integrated pressure compensation membrane	

12.2 Online tools

Product information over the entire life cycle of the device: www.endress.com/onlinetools

12.3 System components

RN series active barrier

Single- or two-channel active barrier for safe separation of 0/4 to 20 mA standard signal circuits with bidirectional HART transmission. In the signal duplicator option, the input signal is transmitted to two galvanically isolated outputs. The device has one active and one passive current input; the outputs can be operated actively or passively.

For more information, please refer to: www.endress.com

13 Technical data

13.1 Input

Voltage drop	
Standard device with 4 to 20 mA communication	≤ 1.0 V
Device with HART communication	≤ 1.9 V
Display lighting	Additional 2.9 V

HART input impedance
Rx = 40 kΩ
Cx = 2.3 nF

Measured variable

The 4 to 20 mA current signal or the HART signal is the input variable.

HART signals are not affected.

Measuring range

4 to 20 mA (scalable, reverse polarity protection)

Max. input current 200 mA

13.2 Power supply

Supply voltage

NOTICE

SELV/Class 2 device

- The device may be powered only by a power unit with an energy-limited circuit in accordance with UL/EN/IEC 61010-1 Paragraph 9.4 or Class 2 as per UL 1310: 'SELV or Class 2 circuit'.

The process indicator is loop-powered and does not require any external power supply. The voltage drop is ≤1 V in the standard version with 4 to 20 mA communication, ≤1.9 V with HART communication and an additional 2.9 V if display lighting is used.

13.3 Performance characteristics

Reference operating conditions

Reference temperature 25 °C ±5 °C (77 °F ±9 °F)

Humidity 20 to 60 % relative humidity

Maximum measured error

Input	Range	Measured error of measuring range
Current	4 to 20 mA Over range up to 22 mA	±0.1 %

Resolution

Signal resolution > 13 bit

Influence of ambient temperature

< 0.02 %/K (0.01 %/°F) of measuring range

Warm-up period

10 minutes

13.4 Installation

Mounting location

Panel housing

The device is designed for use in a panel.

Required panel cutout 45x92 mm (1.77x3.62 in)

Field housing

The field housing version is designed for use in the field. The unit is mounted directly on a wall, or on a pipe with a diameter of up to 2 " with the aid of an optional mounting bracket. An optional weather protection cover protects the device from the effects of weather conditions.

Orientation

Panel housing

The orientation is horizontal.

Field housing

The device must be mounted in such a way that the cable entries point downwards.

13.5 Environment

Ambient temperature range

−40 to 60 °C (−40 to 140 °F)

At temperatures below −25 °C (−13 °F) the readability of the display can no longer be guaranteed.

Storage temperature

−40 to 85 °C (−40 to 185 °F)

Climate class

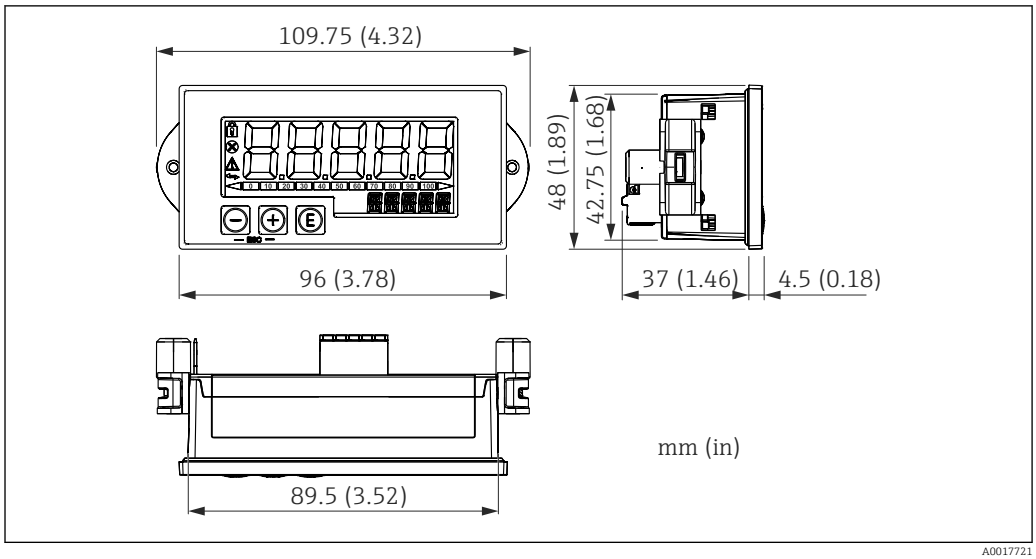
IEC 60654-1, Class B2

Operating altitude	Up to 5 000 m (16 400 ft) above MSL in accordance with IEC61010-1
Degree of protection	**Panel housing** IP65 at front, IP20 at rear **Field housing** Aluminum housing: degree of protection IP66/67, NEMA 4x Plastic housing: degree of protection IP66/67
Electromagnetic compatibility	▪ Interference immunity: As per IEC61326 (Industrial Environments) / NAMUR NE 21 Maximum measured error < 1 % o. MR ▪ Interference emission: As per IEC61326, Class B
Electrical safety	Class III, overvoltage protection category II, pollution degree 2

13.6 Mechanical construction

Design, dimensions

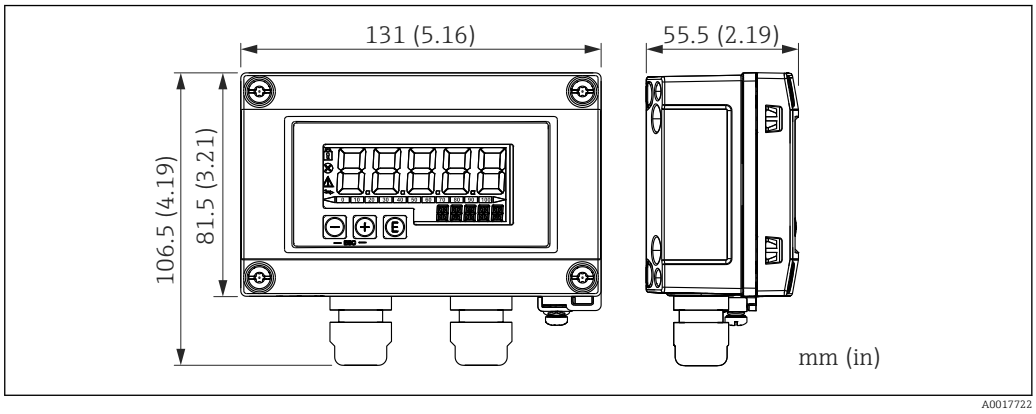
Panel-mount housing



26 Dimensions of the panel housing

Required panel cutout 45x92 mm (1.77x3.62 in), max. panel thickness 13 mm (0.51 in).

Field housing



27 *Dimensions of the field housing incl. cable entries (M16)*

Weight

Panel-mount housing

115 g (0.25 lb.)

Field housing

- Aluminum: 520 g (1.15 lb)
- Plastic: 300 g (0.66 lb)

Materials

Panel-mount housing

Front: aluminum

Rear panel: polycarbonate PC

Field housing

Aluminum or plastic (PBT with steel fibers, antistatic)

13.7 Operability

On-site operation

The device is operated with the 3 operating keys on the front of the housing. The device setup can be disabled with a 4-digit user code. If the setup is disabled, a padlock symbol appears on the display when an operating parameter is selected.

 A0017716	Enter key; for calling up the operating menu, confirming the selection/configuration of parameters in the operating menu
 A0017714	Selecting and setting values in the operating menu; pressing the - and + keys simultaneously takes the user back up a menu level. The configured value is not saved (ESC)
 A0017715	

13.8 Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

14 HART communication

HART (Highway Addressable Remote Transducer) is an established global industry standard, which has been tried and tested in the field and has an installed base of over 14 million devices.

HART is a "smart" technology which enables 4 to 20 mA analog transmission and digital communication to occur simultaneously along the same wire pair. With HART, transmission is based on the Bell 202 Frequency-shift keying (FSK). A high-frequency wave (±0.5 mA) is superimposed on the low-frequency analog signal (4 to 20 mA). Maximum transmission distances depend on the network structure and ambient conditions.

In many applications, the HART signal is used only for configuration purposes. However, with the appropriate tools, HART can be used for device monitoring, device diagnosis and for recording multivariable process information.

The HART protocol is based on the master/slave principle. This means that during normal operation, all communication is initiated by the master. Unlike other master-slave communication types, HART permits two masters in one loop/network: a primary master, e.g. the distributed control system, and a secondary master, e.g. a handheld terminal. However, two masters of the same type are not permitted simultaneously. Secondary master devices can be used without affecting communication to and from the primary master. The field devices are generally the HART slaves and respond to HART commands from the master that are addressed directly to them or to all devices.

The HART specification stipulates that the masters transmit a voltage signal, while the sensors/actuators (slaves) convey their messages using load-independent currents. The current signals are converted to voltage signals at the internal resistor of the receiver (load).

To ensure reliable signal reception, the HART protocol specifies that the total load of the current loop - including cable resistance - must be between a minimum of 230 Ω and a maximum of 600 Ω. If the resistance is less than 230 Ω, the digital signal is greatly attenuated or short-circuited. Therefore, a HART communication resistor is always required in the 4 to 20 mA cable in the case of a low-impedance power supply.

14.1 HART protocol command classes

Each command is assigned to one of the following three classes:
- Universal commands
  are supported by all devices using the HART protocol (e.g. device tag, firmware no. etc.).)
- Common practice commands
  offer functions that are supported by many but not by all HART instruments (e.g. read out value, set parameter etc.)
- Device-specific commands
  provide access to device data that are not HART standard but are unique to a particular device model (e.g. linearization, advanced diagnostic functions)

Since the HART protocol is an open communication protocol between the control device and the field device, it can be implemented by any manufacturer and freely applied by the user. The necessary technical support is provided by the HART Communication Foundation (HCF).

14.2 HART commands used

The process indicator uses the following HART universal commands:

Universal command number	Response data used
0 Unique device identifier	The device identifier provides information on the device and manufacturer; it cannot be changed. The response comprises a 12-byte device ID. The following bytes are used by the process indicator: ▪ Byte 0: fixed value 254 ▪ Byte 2: device type ID, for slave addressing with long address format ▪ Byte 3: number of preambles ▪ Byte 9-11: device identification, for slave addressing with long address format
2 Read the primary process variable as current in mA and the percentage value based on the current range	The response comprises 8 bytes: ▪ Byte 0-3: current in mA ▪ Byte 4-7: percentage value
3 Read the primary process variable as current in mA and four dynamic process variables	The response comprises 24 bytes: The following bytes are used by the process indicator: ▪ Byte 4: HART unit code of the primary process variable ▪ Byte 5-8: primary process variable ▪ Byte 9: HART unit code of the secondary process variable ▪ Byte 10-13: secondary process variable ▪ Byte 14: HART unit code of the third process variable ▪ Byte 15-18: third process variable ▪ Byte 19: HART unit code of the fourth process variable ▪ Byte 20-23: fourth process variable

The universal commands used by the process indicator must be supported by the slaves to guarantee proper communication.

14.3 Field device status

The field device status is contained in the second data byte of a slave/actuator response.

The following bits are analyzed by the process indicator and displayed as a diagnostic message:

Bit mask	Definition	Used in the process indicator
0x80	Device error function – The device has detected a serious error or an error function which affects the operation of the device.	Diagnostic F911
0x40	Configuration changed – A function was executed which has changed the device configuration.	No
0x20	Cold start – The supply voltage has failed or a device reset has occurred.	No
0x10	Additional status available – Additional status information is available via command #48.	No
0x08	Loop current fixed – The loop current is maintained at a fixed value and does not react to changes in the process.	No

Bit mask	Definition	Used in the process indicator
0x04	Loop current saturated – The loop current has reached its upper (or lower) limit point and cannot increase (decrease) further.	Diagnostic S913
0x02	Non-primary variable out of limits.	Diagnostic S915
0x01	Primary variable out of limits.	Diagnostic S915

14.4 Supported units

If "HART" is configured in the UNIT1-4 parameter, the units are automatically read out and displayed by the transmitter.

However, if the transmitted unit cannot be clearly displayed, the HART-UnitCode "UCxxx" is displayed instead, with xxx standing for the unit code number.

In this case, a self-defined text can be specified for the unit via the TEXT1-4 parameter.

Unit code	Description	Display text
1	Inches of water at 68 °F	inH2O
2	Inches of mercury at 0 °C	inHG
3	Feet of water at 68 °F	FTH2O
4	Millimeters of water at 68 °F	mmH2O
5	Millimeters of mercury at 0 °C	mmHG
6	Pounds per square inch	PSI
7	Bar	BAR
8	Millibars	mBAR
9	Grams per square centimeter	g/cm2
10	Kilograms per square centimeter	UC010
11	Pascal	Pa
12	Kilopascals	kPa
13	Torr	TORR
14	Atmospheres	ATM
15	Cubic feet per minute	FT3/m
16	Gallons per minute	gal/m
17	Liters per minute	l/min
18	Imperial gallons per minute	UC018
19	Cubic meters per hour	m3/h
20	Feet per second	FT/S
21	Meters per second	m/S
22	Gallons per second	gal/S
23	Million gallons per day	MGD
24	Liters per second	l/S
25	Million liters per day	Ml/d
26	Cubic feet per second	FT3/S
27	Cubic feet per day	FT3/d
28	Cubic meters per second	m3/S
29	Cubic meters per day	m3/d
30	Imperial gallons per hour	UC030

Unit code	Description	Display text
31	Imperial gallons per day	UC031
32	Degrees Celsius	°C
33	Degrees Fahrenheit	°F
34	Degrees Rankine	°R
35	Kelvin	K
36	Millivolts	mV
37	Ohm	Ohm
38	Hertz	HZ
39	Milliamperes	mA
40	Gallons	gal
41	Liters	LITERS
42	Imperial gallons	Igal
43	Cubic meters	m3
44	Feet	FEET
45	Meters	METER
46	Barrels	bbl
47	Inches	inch
48	Centimeters	cm
49	Millimeters	mm
50	Minutes	min
51	Seconds	SEC
52	Hours	HOUR
53	Days	DAY
54	Centistokes	cST
55	Centipoises	cP
56	Microsiemens	uS
57	Percent	%
58	Volts	VOLT
59	pH	PH
60	Grams	g
61	Kilograms	Kg
62	Metric tons	T
63	Pounds	lb
64	American tons	TN SH
65	British tons	TN L
66	Millisiemens per centimeter	mS/cm
67	Microsiemens per centimeter	uS/cm
68	Newton	N
69	Newton meters	Nm
70	Grams per second	g/S
71	Grams per minute	g/min
72	Grams per hour	g/h
73	Kilograms per second	Kg/S

Unit code	Description	Display text
74	Kilograms per minute	Kg/mi
75	Kilograms per hour	Kg/h
76	Kilograms per day	Kg/d
77	Metric tons per minute	T/min
78	Metric tons per hour	T/h
79	Metric tons per day	T/d
80	Pounds per second	lb/S
81	Pounds per minute	lb/mi
82	Pounds per hour	lb/h
83	Pounds per day	lb/d
84	American tons per minute	TnS/m
85	American tons per hour	TnS/h
86	American tons per day	TnS/d
87	British tons per hour	Tnl/h
88	British tons per day	Tnl/d
89	Deka therm	dTh
90	Specific gravity units	UC090
91	Grams per cubic centimeter	g/cm3
92	Kilograms per cubic meter	Kg/m3
93	Pounds per gallon	lb/ga
94	Pounds per cubic feet	lb/F3
95	Grams per milliliter	g/ml
96	Kilograms per liter	Kg/l
97	Grams per liter	g/l
98	Pounds per cubic inch	lb/ci
99	American tons per cubic yard	UC099
100	Degrees Twaddell	°Tw
101	Degrees Brix	°BX
102	Degrees Baumé heavy	UC102
103	Degrees Baumé light	UC103
104	Degrees API	°API
105	Percent solids per weight	%wT
106	Volume percent	%VOL
107	Degrees Balling	°bal
108	Proof per volume	P/VOL
109	Proof per mass	P/MAS
110	Bushels	bSh
111	Cubic yards	YARD3
112	Cubic feet	FEET3
113	Cubic inches	inch3
114	Inches per second	in/S
115	Inches per minute	in/mi
116	Feet per minute	F/min

Unit code	Description	Display text
117	Degrees per second	DEG/S
118	Revolutions per second	RPS
119	Revolutions per minute	RPM
120	Meters per hour	m/h
121	Normal cubic meters per hour	Nm3/h
122	Normal liters per hour	Nl/h
123	Normal cubic feet per minute	F3/mi
124	Fluid barrel (1 barrel = 31.5 U.S. gallons)	UC124
125	Ounce	Oz
126	Foot Pound Force	FTLBF
127	Kilowatts	kW
128	Kilowatt hours	kWh
129	Horse power	HP
130	Cubic feet per hour	FT3/h
131	Cubic meters per minute	m3/mi
132	Barrels per second	bbl/S
133	Barrels per minute	bbl/m
134	Barrels per hour	bbl/h
135	Barrels per day	bbl/d
136	Gallons per hour	gal/h
137	Imperial gallons per second	UC137
138	Liters per hour	l/h
139	Parts per million	PPm
140	Mega calories per hour	UC140
141	Mega joules per hour	mJ/h
142	British Thermal Units per hour	BTU/h
143	Degrees	DEG
144	Radian	rad
145	Millimeters of water at 60 °F	inH2O
146	Micrograms per liter	ug/l
147	Micrograms per cubic meter	ug/m3
148	Percent consistency	%con
149	Volume percent	VOL%
150	Percent steam quality	%SQ
151	Feet inch sixteenths	UC151
152	Cubic feet per pound	F3/lb
153	Picofarads	PF
154	Milliliters per liter	ml/l
155	Microliters per liter	ul/l
156-159	Unit Code Expansion Tables	UC156 - UC159
160	Percent Plato	%P
161	Percent lower explosion level	%LEL

Unit code	Description	Display text
162	Mega calories	Mcal
163	Kilo ohms	KOHM
164	Mega joules	MJ
165	British Thermal Unit	BTU
166	Standard cubic meters	Nm3
167	Normal liters	Nl
168	Normal cubic feet	SCF
169	Parts per billion	PPb
170 - 219	Unit Code Expansion Tables See Operating Instructions of connected transmitter/sensor. For CM82: see Section "Troubleshooting"	UC170 - UC219
220 - 234	not defined	UC220 - UC234
235	Gallons per day	gal/d
236	Hectoliters	hl
237	Megapascals	MPa
238	Inches of water at 4 °C	inH2O
239	Millimeters of water at 4 °C	mmH2O
240 - 249	Manufacturer-specific	UC240 - UC249
250	Not used	-----
251	None	
252	Unknown	UC252
253	Special	UC253

14.5 HART® protocol connection types

The HART protocol can be used for point-to-point and Multidrop connections:

Point to point (TYPICAL)

In a point-to-point connection, the HART® master communicates with precisely one HART® slave.

A point-to-point connection should always be the preferred option where possible.

Multidrop (measurement not by current, slower)

In Multidrop mode, several HART® devices are incorporated in a single current loop. Analog signal transmission is disabled in this case and the data and measured values are exchanged exclusively via the HART® protocol. The current output of each connected device is set to a fixed value of 4 mA and is used only to supply power to the two-wire devices.

Using Multidrop, several sensors/actuators can be connected in parallel to one wire pair. The master then differentiates between devices based on the configured addresses. Each device must have a different address. When more than seven sensors/actuators are connected in parallel, an increased voltage drop occurs.

The loop must not include a mixture of devices with an active current output (e.g. four-wire devices) and devices with a passive current output (e.g. two-wire devices).

The HART® protocol is a form of communication that is not susceptible to interference. This means that, during operation, communication devices can be connected or removed without putting components of the other devices at risk or interrupting their communication.

14.6 Device variables for multivariable measuring instruments

Multivariable measuring instruments can transmit up to four device variables via HART®: the primary variable (PV), the secondary variable (SV), the tertiary variable (TV) and the quarternary variable (QV).

Below you will find some examples of what default values can be set for these variables for various sensors/actuators:

Flowmeter, e.g. Promass:

- Primary process variable (PV) → Mass flow
- Secondary process variable (SV) → Totalizer 1
- Third process variable (TV) → Density
- Fourth process variable (QV) → Temperature

Temperature transmitter, e.g. TMT82:

- Primary process variable (PV) → Sensor 1
- Secondary process variable (SV) → Device temperature
- Third process variable (TV) → Sensor 1
- Fourth process variable (QV) → Sensor 1

For a level measuring instrument such as the Levelflex FMP5x, these four values can be as follows:

Level measurement:
- Primary process variable (PV) → Level linearized
- Secondary process variable (SV) → Distance
- Third process variable (TV) → Absolute echo amplitude
- Fourth process variable (QV) → Relative echo amplitude

Interface measurement:
- Primary process variable (PV) → Interface
- Secondary process variable (SV) → Level linearized
- Third process variable (TV) → Upper interface thickness
- Fourth process variable (QV) → Relative interface amplitude

HART® actuator, e.g. positioner:

- Primary process variable (PV) → Actuating value
- Secondary process variable (SV) → Valve set point
- Third process variable (TV) → Target position
- Fourth process variable (QV) → Valve position

Index

www.addresses.endress.com

Endress+Hauser

People for Process Automation