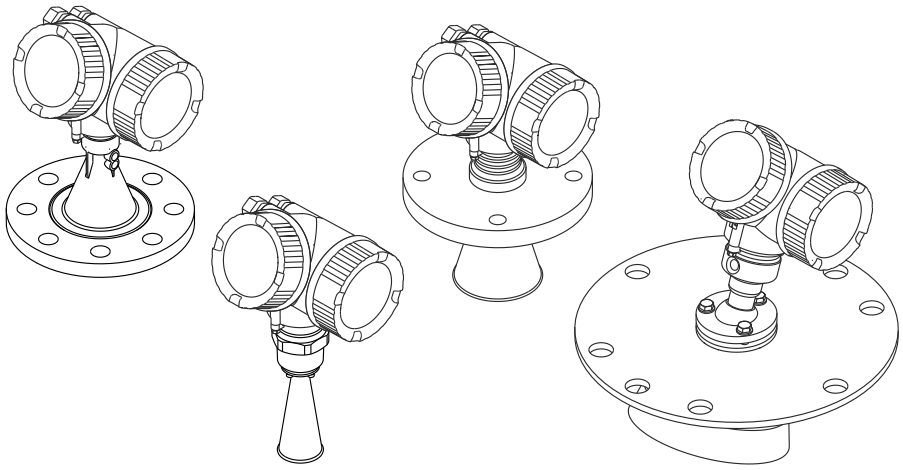
GP01014F/00/EN/05.16
71320301
01.02.zz (Device firmware)

Description of Device Parameters
Micropilot FMR5x
HART

Free space radar



Endress+Hauser
People for Process Automation

Table of contents

1 Important document information

1.1 Document function

The document is part of the Operating Instructions and serves as a reference for parameters, providing a detailed explanation of each individual parameter of the operating menu.

1.2 Symbols

1.2.1 Symbols for certain types of information

Symbol	Meaning
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Operation via local display
	Operation via operating tool
	Write-protected parameter

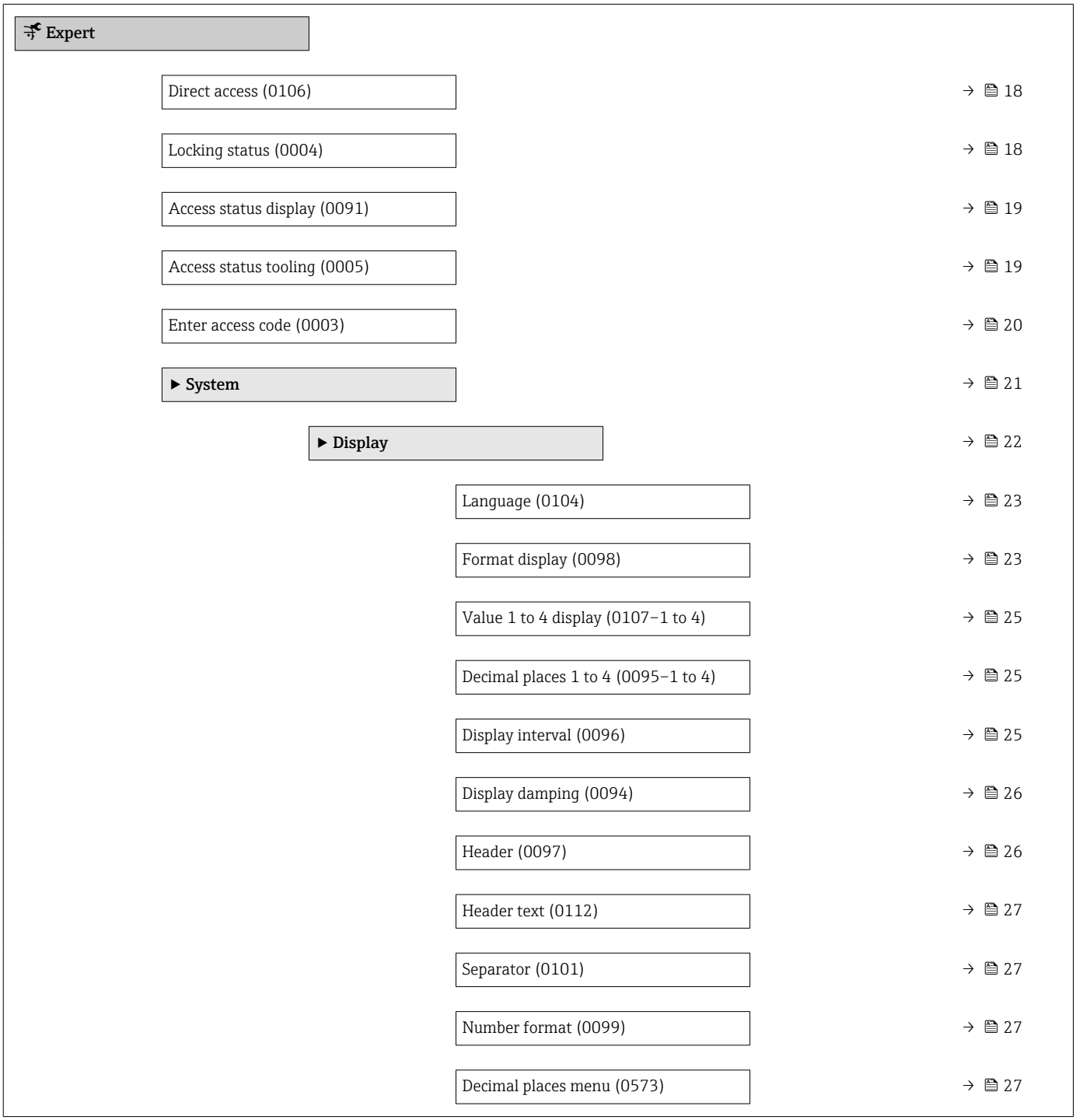
1.2.2 Symbols in graphics

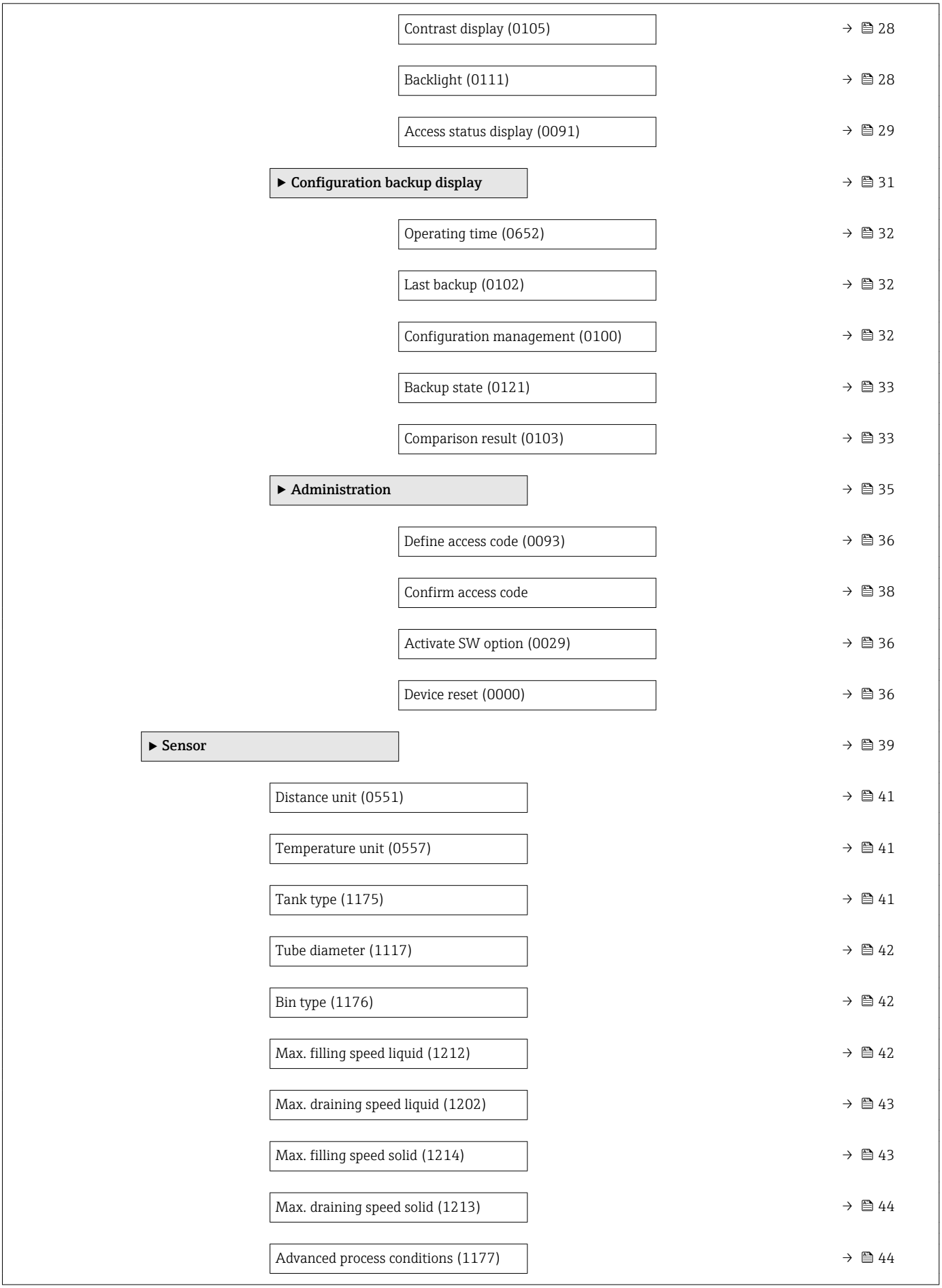
Symbol	Meaning	Symbol	Meaning
1, 2, 3 ...	Item numbers	A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections		

2 Overview of the operating menu

- The following table lists all parameters the "Expert" menu may contain. The page number refers to where a description of the parameter can be found.
- Depending on the device version and parametrization some parameters will not be available in a given situation. For details on the conditions refer to the "Prerequisite" category in the description of the respective parameter.
- The representation essentially corresponds to the menu seen when using an operating tool (e.g. FieldCare). On the local display there may be minor differences in the menu structure. Details are mentioned in the description of the respective submenu.

Navigation Expert

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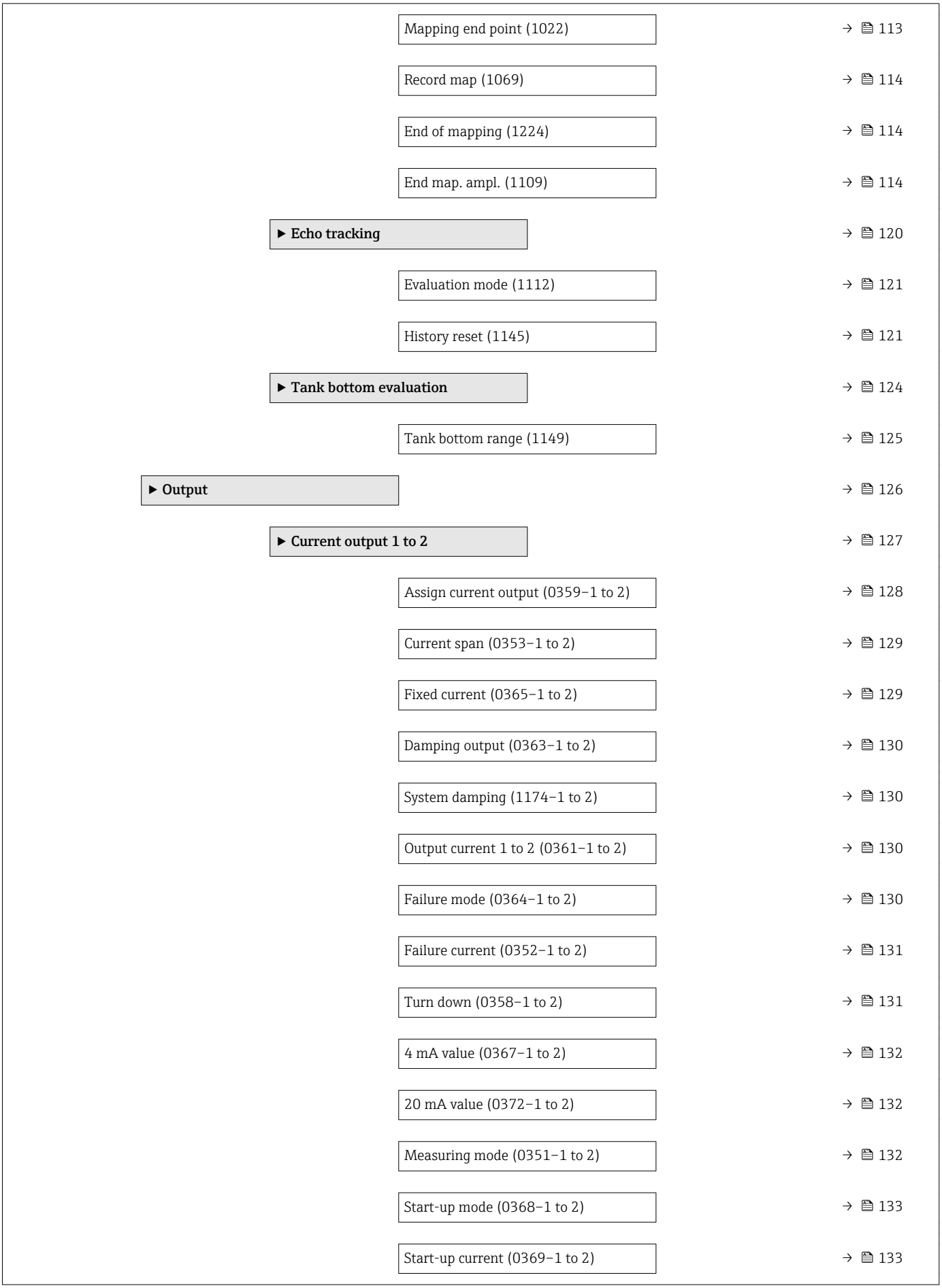
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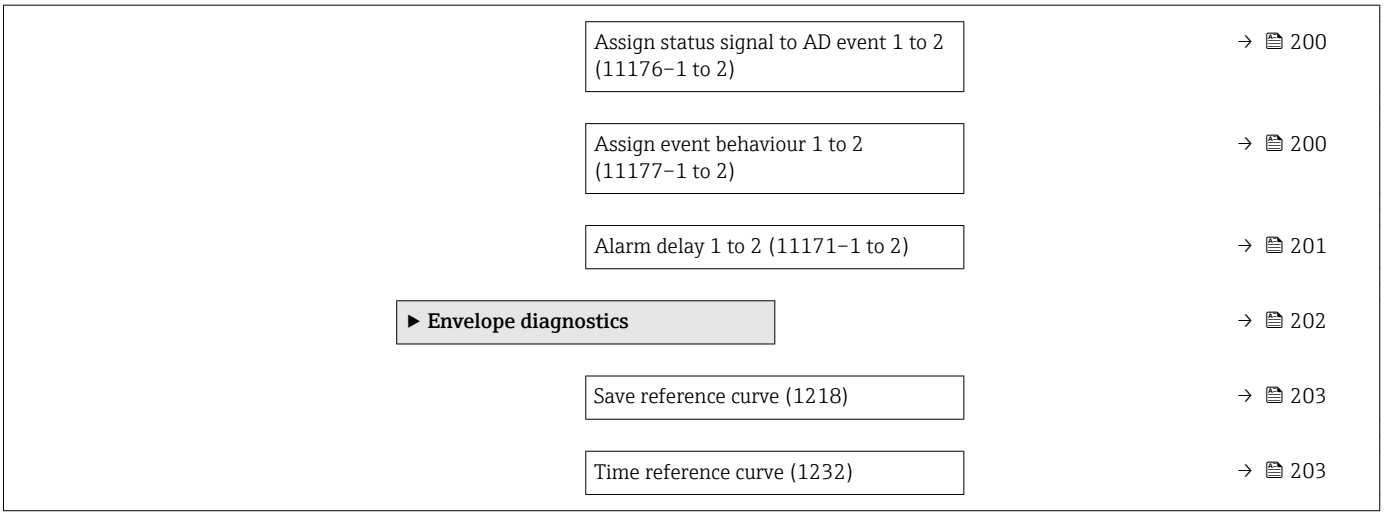
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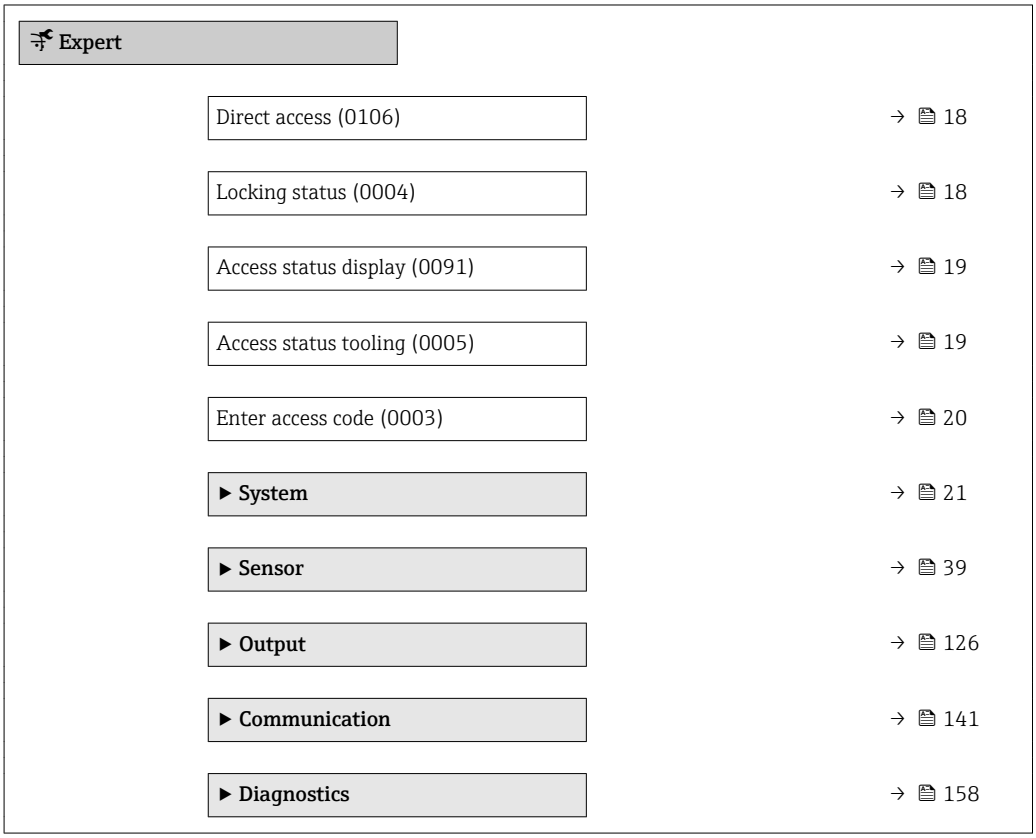
3 "Expert" menu

The **Expert** menu contains all parameters of the device. It is structured according to the function blocks of the device.

3.1 Structure of the menu

Navigation Expert



3.2 Description of parameters

Navigation Expert

Direct access

Navigation Expert → Direct access (0106)

Description Enter the access code of a parameter in order to access this parameter directly (i.e. without navigation).

User entry 0 to 65 535

Factory setting 0

Additional information The direct access code consists of a five digit number and an optional channel code, which specifies an input or output channel, e.g. 00353-2

- Leading zeros need not to be entered.
  Example: You may enter "353" instead of "00353"
- If the channel code is not entered, channel 1 is automatically selected.
  Example: By entering "353" you access the following parameter: Curr.output 1 → Current span (0353)
- In order to access a different channel: Enter the direct access code with the channel code.
  Example: By entering "353-2" you access the following parameter: Curr.output 2 → Current span (0353)

In this document, the direct access code is added in brackets after the parameter name in the *Navigation* category.

Locking status

Navigation Expert → Locking status (0004)

Description Indicates the write protection with the highest priority that is currently active.

User interface

- Hardware locked
- SIL locked
- WHG locked
- Temporarily locked

Additional information

Meaning and priorities of the types of write protection

- **Hardware locked (priority 1)**
  The DIP switch for hardware locking is activated on the main electronics module. This locks write access to the parameters.
- **SIL locked (priority 2)**
  The SIL mode is activated. Writing access to the relevant parameters is denied.
- **WHG locked (priority 3)**
  The WHG mode is activated. Writing access to the relevant parameters is denied.
- **Temporarily locked (priority 4)**
  Write access to the parameters is temporarily locked on account of internal processes in progress in the device (e.g. data upload/download, reset etc.). The parameters can be modified as soon as the processes are complete.

On the display module, the 🔒-symbol appears in front of parameters that cannot be modified since they are write-protected.

Access status display

Navigation Expert → Access stat.disp (0091)

Prerequisite The device has a local display.

Description Indicates access authorization to parameters via local display.

User interface

- Operator
- Maintenance
- Service

Additional information

If a 🔒 symbol appears in front of a parameter, the parameter cannot be changed via the local display with the current access authorization.

The access authorization can be changed via the **Enter access code** parameter (→ 20).

If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the **Locking status** parameter (→ 18).

Access status tooling

Navigation Expert → Access stat.tool (0005)

Description Indicates access authorization to parameters via operating tool (e.g. FieldCare).

User interface

- Operator
- Maintenance
- Service

Additional information

The access authorization can be changed via the **Enter access code** parameter (→ 20).

If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the **Locking status** parameter (→ 18).

Enter access code

Navigation

Expert → Ent. access code (0003)

Description

Enter access code to disable write protection of parameters.

User entry

0 to 9 999

Additional information

- For local operation, the customer-specific access code, which has been defined in the **Define access code** parameter (→ 36), has to be entered.
- If an incorrect access code is entered, the user retains his current access authorization.
- The write protection affects all parameters marked with the -symbol in this document. On the local display, the -symbol in front of a parameter indicates that the parameter is write-protected.
- If no key is pressed for 10 min, or the user switches from the navigation and editing mode back to the measured value display mode, the device automatically locks the write-protected parameters after another 60 s.

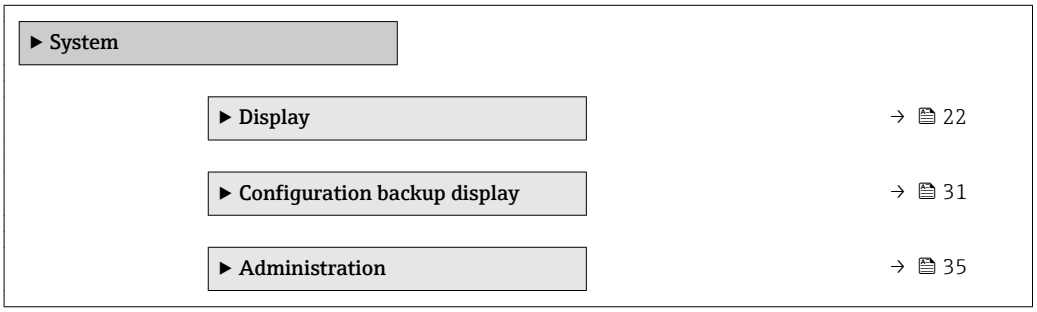
Please contact your Endress+Hauser Sales Center if you lose your access code.

3.3 "System" submenu

The **System** submenu contains all general parameters which affect neither the measurement nor the measured value communication.

3.3.1 Structure of the submenu

Navigation Expert → System



3.3.2 "Display" submenu

The **Display** submenu is used to configure the representation of measured values on the local display module. Up to four measured values can be allocated to the local display module. Additionally, display characteristics such as the format of numbers, the associated texts or the display contrast can be configured.

This submenu is only visible if a display module is connected to the device.

Structure of the submenu

Navigation Expert → System → Display

▶ **Display**	
Language	→ 23
Format display	→ 23
Value 1 to 4 display	→ 25
Decimal places 1 to 4	→ 25
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Display damping	→ 26
Header	→ 26
Header text	→ 27
Separator	→ 27
Number format	→ 27
Decimal places menu	→ 27
Contrast display	→ 28
Backlight	→ 28
Access status display	→ 29

Description of parameters

Navigation Expert → System → Display

Language

Navigation Expert → System → Display → Language (0104)

Description Set display language.

Selection
- English
- Deutsch *
- Français *
- Español *
- Italiano *
- Nederlands *
- Portuguesa *
- Polski *
- русский язык (Russian) *
- Svenska *
- Türkçe *
- 中文 (Chinese) *
- 日本語 (Japanese) *
- 한국어 (Korean) *
- Bahasa Indonesia *
- tiếng Việt (Vietnamese) *
- čeština (Czech) *

Factory setting The language selected in feature 500 of the product structure.
If no language has been selected: **English**

Format display

Navigation Expert → System → Display → Format display (0098)

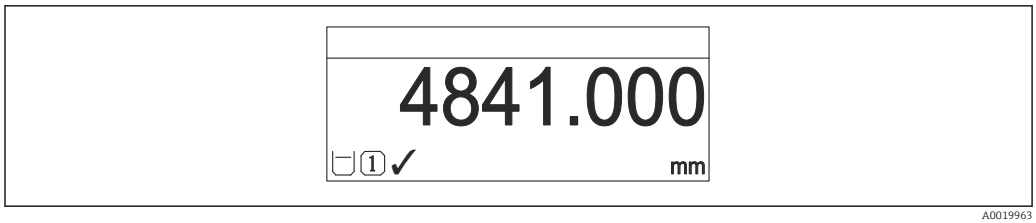
Description Select how measured values are shown on the display.

Selection
- 1 value, max. size
- 1 bargraph + 1 value
- 2 values
- 1 value large + 2 values
- 4 values

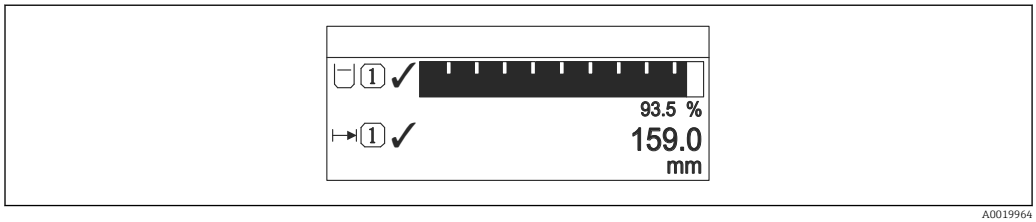
Factory setting 1 value, max. size

* Visibility depends on order options or device settings

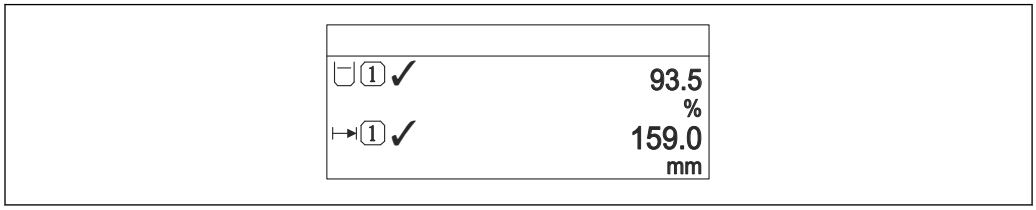
Additional information



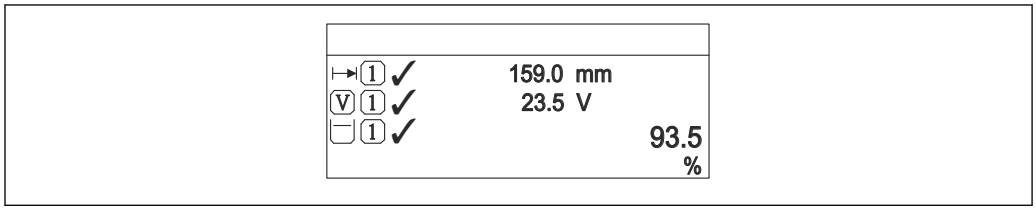
1 *"Format display" = "1 value, max. size"*



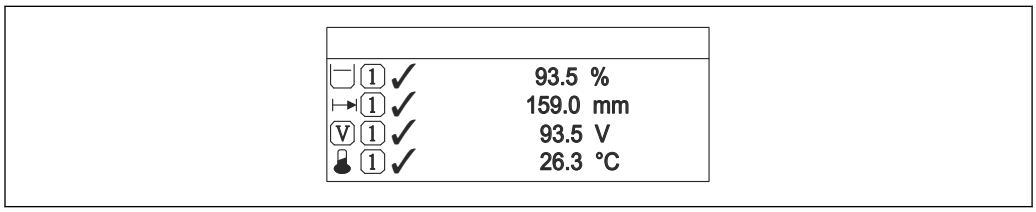
2 *"Format display" = "1 bargraph + 1 value"*



3 *"Format display" = "2 values"*



4 *"Format display" = "1 value large + 2 values"*



5 *"Format display" = "4 values"*

- The **Value 1 to 4 display** → 25 parameters specify which measured values are shown on the display and in which order.
- If more measured values are specified than the current display mode permits, the values alternate on the device display. The display time until the next change is configured in the **Display interval** parameter (→ 25).

Value 1 to 4 display

Navigation Expert → System → Display → Value 1 display (0107)

Description Select the measured value that is shown on the local display.

Selection
- None [1]
- Level linearized
- Distance
- Current output 1 [2]
- Measured current
- Current output 2
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2
- Area of incoupling

Factory setting
- Value 1 display: Level linearized
- Value 2 display: None
- Value 3 display: None
- Value 4 display: None

Decimal places 1 to 4

Navigation Expert → System → Display → Decimal places 1 to 4 (0095–1 to 4)

Description Select the number of decimal places for the display value.

Selection
- x
- x.x
- x.xx
- x.xxx
- x.xxxx

Factory setting x.xx

Additional information The setting does not affect the measuring or computational accuracy of the device.

Display interval

Navigation Expert → System → Display → Display interval (0096)

Description Set time measured values are shown on display if display alternates between values.

1) can not be selected for the "Value 1 display" parameter.
2) Visibility depends on order options or device settings

User entry 1 to 10 s

Factory setting 5 s

Additional information This parameter is only relevant if the number of selected measuring values exceeds the number of values the selected display format can display simultaneously.

Display damping

Navigation Expert → System → Display → Display damping (0094)

Description Define display reaction time to fluctuations in the measured value.

User entry 0.0 to 999.9 s

Factory setting 0.0 s

Header

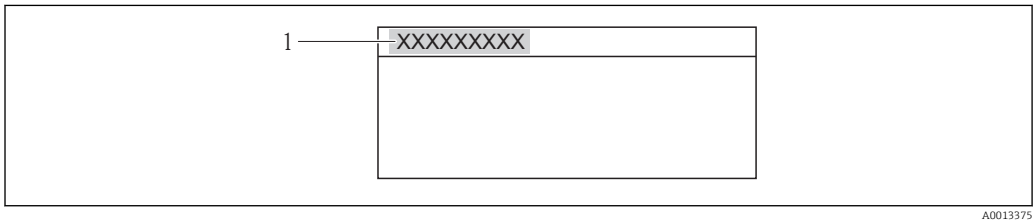
Navigation Expert → System → Display → Header (0097)

Description Select header contents on local display.

Selection
- Device tag
- Free text

Factory setting Device tag

Additional information



1 Position of the header text on the display

Meaning of the options

- **Device tag**
  Is defined in the **Device tag** parameter (→ 145).
- **Free text**
  Is defined in the **Header text** parameter (→ 27).

Header text

Navigation Expert → System → Display → Header text (0112)

Prerequisite **Header (→ 26) = Free text**

Description Enter display header text.

Factory setting ----------

Additional information The number of characters which can be displayed depends on the characters used.

Separator

Navigation Expert → System → Display → Separator (0101)

Description Select decimal separator for displaying numerical values.

Selection
- .
- ,

Factory setting .

Number format

Navigation Expert → System → Display → Number format (0099)

Description Choose number format for the display.

Selection
- Decimal
- ft-in-1/16"

Factory setting Decimal

Additional information The **ft-in-1/16"** option is only valid for distance units.

Decimal places menu

Navigation Expert → System → Display → Dec. places menu (0573)

Description Select number of decimal places for the representation of numbers within the operating menu.

Selection
- x
- x.x
- x.xx
- x.xxx
- x.xxxx

Factory setting
x.xxxx

Additional information
- Is only valid for numbers in the operating menu (e.g. **Empty calibration**, **Full calibration**), but not for the measured value display. The number of decimal places for the measured value display is defined in the **Decimal places 1 to 4** → 25 parameters.
- The setting does not affect the accuracy of the measurement or the calculations.

Contrast display

Navigation
Expert → System → Display → Contrast display (0105)

Description
Adjust local display contrast setting to ambient conditions (e.g. lighting or reading angle).

User entry
20 to 80 %

Factory setting
Dependent on the display.

Additional information
Setting the contrast via push-buttons:
- Darker: press the ⊖ and E buttons simultaneously.
- Brighter: press the ⊕ and E buttons simultaneously.

Backlight

Navigation
Expert → System → Display → Backlight (0111)

Prerequisite
The device has the SD03 local display (with optical keys).

Description
Switch the local display backlight on and off.

Selection
- Disable
- Enable

Factory setting
Disable

Additional information
Meaning of the options
- **Disable**
  Switches the backlight off.
- **Enable**
  Switches the backlight on.

Regardless of the setting in this parameter the backlight may be automatically switched off by the device if the supply voltage is too low.

Access status display

Navigation Expert → System → Display → Access stat.disp (0091)

Prerequisite The device has a local display.

Description Indicates access authorization to parameters via local display.

User interface
- Operator
- Maintenance
- Service

Additional information

If a symbol appears in front of a parameter, the parameter cannot be changed via the local display with the current access authorization.

The access authorization can be changed via the **Enter access code** parameter (→ 20).

If additional write protection is active, this restricts the current access authorization even further. The write protection status can be viewed via the **Locking status** parameter (→ 18).

3.3.3 "Configuration backup display" submenu

This submenu is only visible if a display module is connected to the device.

All software configurations are initially stored in a memory module (HistoROM) in the housing and are thus permanently connected with the device. As an additional option, the display module contains a backup memory for the device configuration. The transmission of configuration data between these two memory modules is controlled by the **Configuration management** parameter (→ 32). It provides the following options:

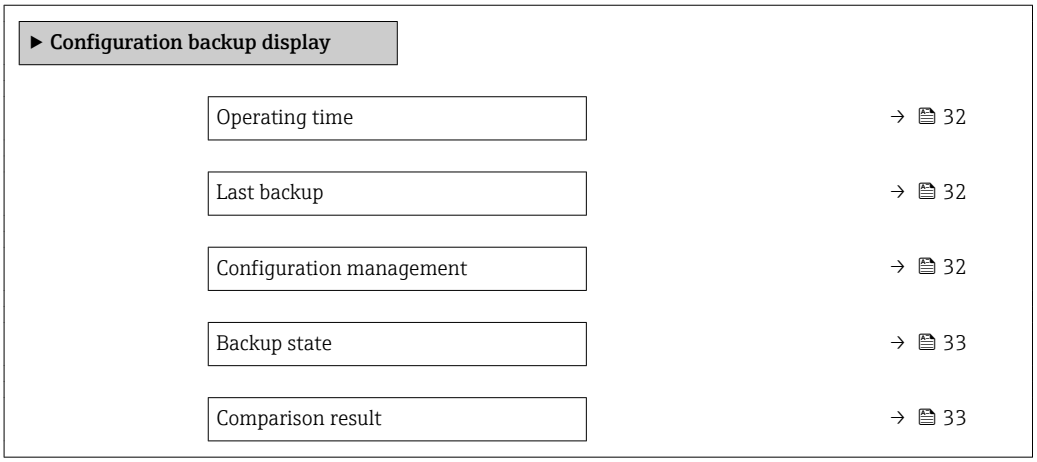
- **Execute backup**
  Saves the current device configuration in the display module.
- **Restore**
  This option can be used to restore a configuration back into the device which has previously been saved in the display module.
- **Duplicate**
  If the configuration has been saved into the display module, the module can be connected to a different device and the configuration can be duplicated to this device. This allows to efficiently configure a number of devices in the same way.
- **Compare**
  The comparison result indicates whether the device configuration has been changed since the last backup.

If an existing backup is restored to a different device using the **Restore** option, it may occur that some device functionalities are no longer available. Even a reset to the delivery state won't restore the original state in some cases.

In order to transfer the configuration to a different device only the **Duplicate** option should be used.

Structure of the submenu

Navigation Expert → System → Conf.backup disp



Description of parameters

Navigation Expert → System → Conf.backup disp

Operating time

Navigation Expert → System → Conf.backup disp → Operating time (0652)

Description Indicates how long the device has been in operation.

User interface Days (d), hours (h), minutes (m), seconds (s)

Additional information *Maximum time*
9 999 d (≈ 27 years)

Last backup

Navigation Expert → System → Conf.backup disp → Last backup (0102)

Description Indicates when the last data backup was saved to the display module.

User interface Days (d), hours (h), minutes (m), seconds (s)

Configuration management

Navigation Expert → System → Conf.backup disp → Config. managem. (0100)

Description Select action for managing the device data in the display module.

Selection
- Cancel
- Execute backup
- Restore
- Duplicate
- Compare
- Clear backup data

Factory setting Cancel

Additional information **Meaning of the options**
- **Cancel**
  No action is executed and the user exits the parameter.
- **Execute backup**
  A backup copy of the current device configuration in the HistoROM (built-in in the device) is saved to the display module of the device.
- **Restore**
  The last backup copy of the device configuration is copied from the display module to the HistoROM of the device.

- **Duplicate**
  The transmitter configuration is duplicated to another device using the transmitter display module. The following parameters, which characterize the individual measuring point are **not** included in the transmitted configuration:
  – HART date code
  – HART short tag
  – HART message
  – HART descriptor
  – HART address
  – Device tag
  – Medium type
- **Compare**
  The device configuration saved in the display module is compared to the current device configuration of the HistoROM. The result of this comparison is displayed in the **Comparison result** parameter (→ 33).
- **Clear backup data**
  The backup copy of the device configuration is deleted from the display module of the device.

While this action is in progress, the configuration cannot be edited via the local display and a message on the processing status appears on the display.

If an existing backup is restored to a different device using the **Restore** option, it may occur that some device functionalities are no longer available. In some cases even a device reset will not restore the original status.

In order to transmit a configuration to a different device, the **Duplicate** option should always be used.

Backup state

Navigation Expert → System → Conf.backup disp → Backup state (0121)

Description Displays which backup action is currently in progress.

Comparison result

Navigation Expert → System → Conf.backup disp → Compar. result (0103)

Description Displays the comparison result between the device and the display.

Additional information

Meaning of the display options
- **Settings identical**
  The current device configuration of the HistoROM is identical to the backup copy in the display module.
- **Settings not identical**
  The current device configuration of the HistoROM is not identical to the backup copy in the display module.
- **No backup available**
  There is no backup copy of the device configuration of the HistoROM in the display module.

- **Backup settings corrupt**
  The current device configuration of the HistoROM is corrupt or not compatible with the backup copy in the display module.
- **Check not done**
  The device configuration of the HistoROM has not yet been compared to the backup copy in the display module.
- **Dataset incompatible**
  The data sets are incompatible and can not be compared.

To start the comparison, set **Configuration management (→ 32)** = **Compare**.

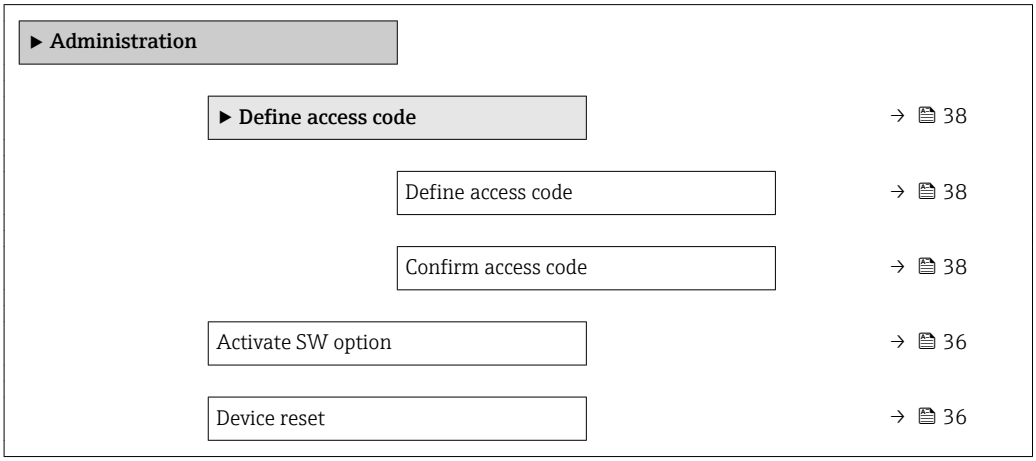
If the transmitter configuration has been duplicated from a different device by **Configuration management (→ 32)** = **Duplicate**, the new device configuration in the HistoROM is only partially identical to the configuration stored in the display module: Sensor specific properties (e.g. the mapping curve) are not duplicated. Thus, the result of the comparison will be **Settings not identical**.

3.3.4 "Administration" submenu

The **Administration** submenu contains all parameters for the management of the device. Its structure depends on the user interface:

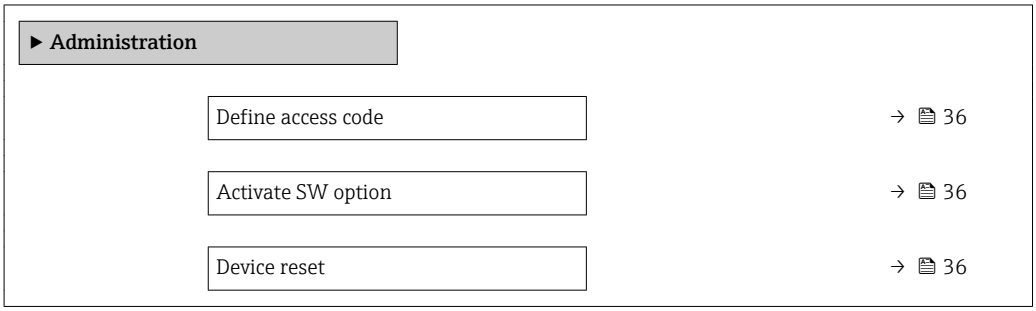
Structure of the submenu on the local display

Navigation Expert → System → Administration



Structure of the submenu in an operating tool

Navigation Expert → System → Administration



Description of parameters

Navigation Expert → System → Administration

Define access code

Navigation Expert → System → Administration → Def. access code (0093)

Description Define release code for write access to parameters.

User entry 0 to 9 999

Factory setting 0

Additional information

If the factory setting is not changed or 0 is defined as the access code, the parameters are not write-protected and the configuration data of the device can then always be modified. The user is logged on in the *Maintenance* role.

The write protection affects all parameters marked with the symbol in this document. On the local display, the symbol in front of a parameter indicates that the parameter is write-protected.

Once the access code has been defined, write-protected parameters can only be modified if the access code is entered in the **Enter access code** parameter (→ 20).

Please contact your Endress+Hauser Sales Center if you lose your access code.

For display operation: The new access code is only valid after it has been confirmed in the **Confirm access code** parameter (→ 38).

Activate SW option

Navigation Expert → System → Administration → Activate SW opt. (0029)

Description Enter code to unlock specific software options.

User entry Positive integer

Factory setting 0

Device reset

Navigation Expert → System → Administration → Device reset (0000)

Description Select to which state the device is to be reset.

Selection

- Cancel
- To factory defaults
- To delivery settings

- Of customer settings
- To transducer defaults
- Restart device

Factory setting Cancel

Additional information

Meaning of the options

- **Cancel**
  No action
- **To factory defaults**
  All parameters are reset to the order-code specific factory setting.
- **To delivery settings**
  All parameters are reset to the delivery setting. The delivery setting may differ from the factory default if customer specific settings have been ordered.
  This option is only visible if customer specific settings have been ordered.
- **Of customer settings**
  All customer parameters are reset to their factory setting. Service parameters, however, remain unchanged.
- **To transducer defaults**
  Every measurment-related parameter is reset to its factory setting. Service parameters and communication-related parameters, however, remain unchanged.
- **Restart device**
  The restart resets every parameter which is stored in the volatile memory (RAM) to the factory setting (e.g. measured value data). The device configuration remains unchanged.

"Define access code" wizard

Navigation Expert → System → Administration → Def. access code

Define access code	
Navigation	Expert → System → Administration → Def. access code → Def. access code
Description	→ 36

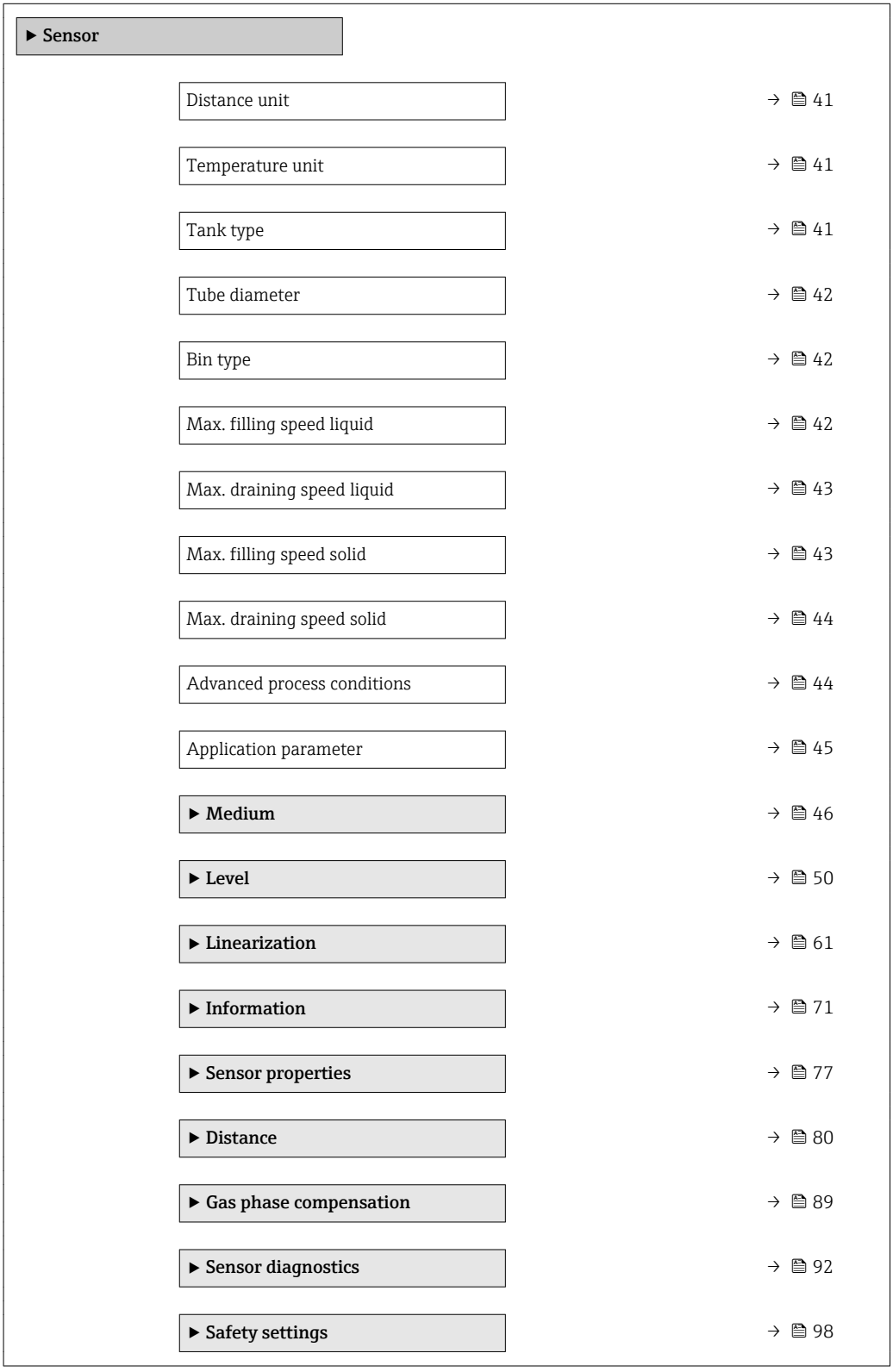
Confirm access code	
Navigation	Expert → System → Administration → Def. access code → Confirm code
Description	Confirm the entered access code.
User entry	0 to 9 999
Factory setting	0

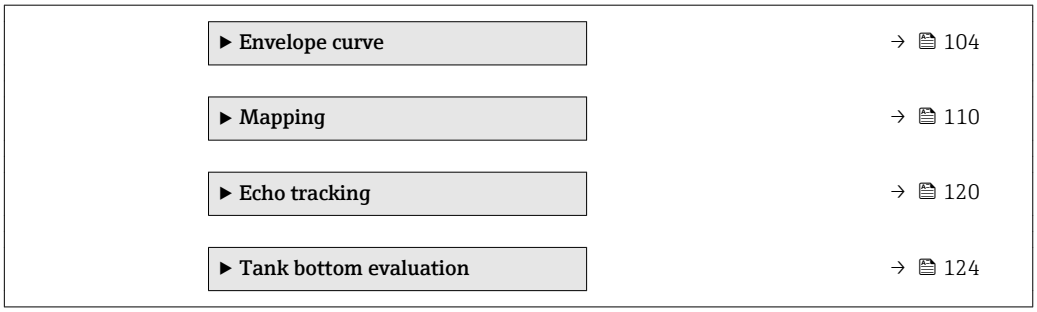
3.4 "Sensor" submenu

The **Sensor** submenu contains all parameters related to the measurement and the sensor settings.

3.4.1 Structure of the submenu

Navigation Expert → Sensor




▶ Envelope curve
→ 104
▶ Mapping
→ 110
▶ Echo tracking
→ 120
▶ Tank bottom evaluation
→ 124

3.4.2 Description of parameters

Navigation Expert → Sensor

Distance unit

Navigation Expert → Sensor → Distance unit (0551)

Description Select distance unit.

Selection

SI units	*US units*
▪ mm	▪ ft
▪ m	▪ in

Factory setting m

Temperature unit

Navigation Expert → Sensor → Temperature unit (0557)

Description Select temperature unit.

Selection

SI units	*US units*
▪ °C	▪ °F
▪ K	▪ °R

Factory setting °C

Tank type

Navigation Expert → Sensor → Tank type (1175)

Prerequisite **Medium type (→ 47) = Liquid**

Description Select tank type.

Selection
- Bypass / pipe
- Stilling well
- Workbench test
- Open channel
- Sphere
- Storage vessel
- Process vessel standard
- Process vessel with agitator
- Wave guide antenna

Factory setting Depending on the antenna

Additional information Depending on the antenna some of the options mentioned above may not be available or there may be additional options.

Tube diameter

Navigation Expert → Sensor → Tube diameter (1117)

Prerequisite **Tank type (→ 41)** = **Bypass / pipe**

Description Specify diameter of bypass or stilling well.

User entry 0 to 9.999 m

Factory setting 0 m

Bin type

Navigation Expert → Sensor → Bin type (1176)

Prerequisite **Medium type (→ 47)** = **Solid**

Description Specify bin type.

Selection
- Buffer silo (fast)
- Bin / Pile
- Crusher / belt
- Silo
- Workbench test

Factory setting Silo

Max. filling speed liquid

Navigation Expert → Sensor → Max. fill liquid (1212)

Prerequisite **Medium type (→ 47)** = **Liquid**

Description Select expected maximum filling speed.

Selection
- Slow < 1cm (0,4in) /min
- Medium < 10cm (4in) /min
- Standard < 1m (40in) /min

- Fast < 2m (80in) /min
- Very fast > 2m (80in) /min
- No filter / test

Factory setting Depending on the **Tank type** parameter (→ 41)

Additional information **Max. filling speed liquid** is preset by **Tank type (→ 41)**. It can, however, be adjusted to the process in the vessel at any time. If **Tank type (→ 41)** is changed again at a later point of time, it may be necessary to repeat the fine adjustment.

Max. draining speed liquid

Navigation Expert → Sensor → Max drain liquid (1202)

Prerequisite **Medium type (→ 47)** = **Liquid**

Description Select expected maximum draining speed.

Selection
- Slow < 1cm (0,4in) /min
- Medium < 10cm (4in) /min
- Standard < 1m (40in) /min
- Fast < 2m (80in) /min
- Very fast > 2m (80in) /min
- No filter / test

Factory setting Depending on the **Tank type** parameter (→ 41)

Additional information **Max. draining speed liquid (→ 43)** is preset by **Tank type (→ 41)**. It can, however, be adjusted to the process in the vessel at any time. If **Tank type (→ 41)** is changed again at a later point of time, it may be necessary to repeat the fine adjustment.

Max. filling speed solid

Navigation Expert → Sensor → Max. fill. solid (1214)

Prerequisite **Medium type (→ 47)** = **Solid**

Description Select expected maximum filling speed.

Selection
- Very slow < 0,5m (1,6ft) /h
- Slow < 1m (3,3ft) /h
- Standard < 2m (6,5ft) /h
- Medium < 4m (13ft) /h
- Fast < 8m (26ft) /h
- Very fast > 8m (26ft) /h
- No filter / test

Factory setting Standard < 2m (6,5ft) /h

Additional information It is strongly recommended to adjust this parameter to the actual maximum filling speed of the process.

Max. draining speed solid

Navigation Expert → Sensor → Max.drain solid (1213)

Prerequisite **Medium type (→ 47) = Solid**

Description Select expected maximum draining speed.

Selection
- Very slow < 0,5m (1,6ft) /h
- Slow < 1m (3,3ft) /h
- Standard < 2m (6,5ft) /h
- Medium < 4m (13ft) /h
- Fast < 8m (26ft) /h
- Very fast > 8m (26ft) /h
- No filter / test

Factory setting Standard < 2m (6,5ft) /h

Additional information It is strongly recommended to adjust this parameter to the actual maximum draining speed of the process.

Advanced process conditions

Navigation Expert → Sensor → Adv. conditions (1177)

Description Specify additional process conditions (if required).

Selection
- Foam (>5cm/0,16ft)
- Changing DC values
- Many obstacles
- Small tanks (< 1m/3ft)
- Weak signal

Factory setting None

Additional information *"Foam (>5cm/0,16ft)" option*

This option makes sure that no tank history is used which has been recorded while foam was present at the surface and thus is no reliable map of the tank property. To achieve this, the setting **Evaluation mode (→ 121) = Long time history** is deactivated.

The **Foam (>5cm/0,16ft)** option is only available for liquid applications (FMR50, FMR51, FMR52, FMR53, FMR54).

"Changing DC values" option

A tank history which has been recorded with **Evaluation mode (→ 121) = Long time history** is only valid for a fixed dielectric constant. The **Changing DC values** option

disables the setting **Evaluation mode (→ 121)** = **Long time history** and thus avoids wrong measuring values in the case of a changing dielectric constant.

The **Changing DC values** option is only available for liquid applications (FMR50, FMR51, FMR52, FMR53, FMR54).

"Many obstacles" option

This option otimizes the signal evaluation for bulk solid applications with a large measuring range where obstacles generate many interference echos. With this selection the last echo in the envelope curve will always be evaluated. For strongly damping media this is always the level echo.

The **Many obstacles** option is only available for bulk solid applications (FMR56, FMR57).

Preconditions for the application of the "Many obstacles" option
- **Medium type (→ 47)** = **Solid**
- Strongly damping medium (e.g. flour, wheat, cereals, ...)
- No multiple echos if the tank is full
- Interference echo suppression only in the near field (ringing area)
- Expert → Sensor → Echo tracking → Evaluation mode (1112) = Short time history

"Small tanks (< 1m/3ft)" option

This option provides a simple possibility to reduce the echo width of the sensor module. This enables an improved detection of superimposed echos - especially in the near field. Internally, all paramters related to the echo width are adjusted by this option.

The **Small tanks (< 1m/3ft)** option is only available for liquid measurements with 26 GHz HF module (FMR50, FMR51, FMR52).

"Weak signal" option

This option improves the detectability of small level echos in bulk solid applications with very weak signal amplitudes.

The **Weak signal** option is only available for bulk solid measurements (FMR56, FMR57).

Application parameter

Navigation Expert → Sensor → Applicat. param. (1126)

Description Indicates whether settings depending on the application parameters (e.g. **Advanced process conditions (→ 44)**, **Tank type (→ 41)** and **Tube diameter (→ 42)**) have been changed after the basic setup.

User interface
- Changed
- Not changed

Additional information

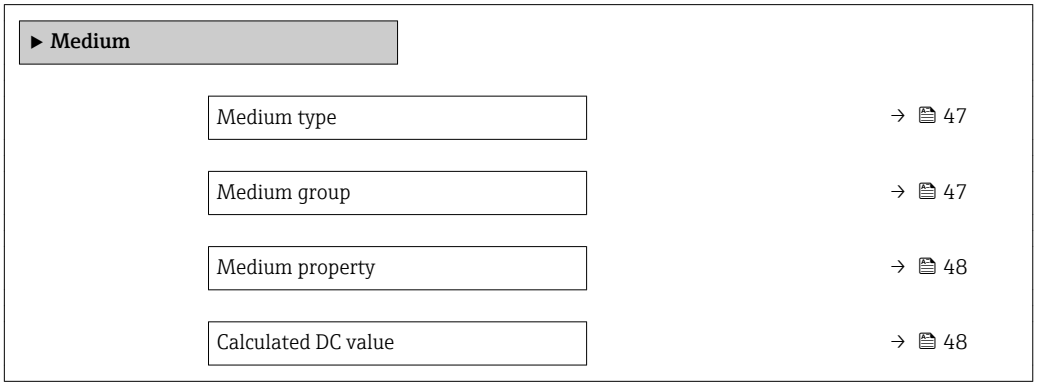
Meaning of the options
- **Changed**
  Parameters have been changed. The device is no longer in the state defined by the application parameters.
- **Not changed**
  There have been no changes. The device is still in the state defined by the application parameters.

3.4.3 "Medium" submenu

The **Medium** submenu is used to specify the relevant properties of the measured medium, especially the dielectric constant (DC).

Structure of the submenu

Navigation Expert → Sensor → Medium



Description of parameters

Navigation Expert → Sensor → Medium

Medium type

Navigation Expert → Sensor → Medium → Medium type (1049)

Description Specify type of medium.

User interface
- Liquid
- Solid

Factory setting
- FMR50, FMR51, FMR52, FMR53, FMR54: **Liquid**
- FMR56, FMR57: **Solid**

Additional information This parameter determines the value of several other parameters and strongly influences the complete signal evaluation. Therefore, it is strongly recommended **not to change** the factory setting.

Medium group

Navigation Expert → Sensor → Medium → Medium group (1208)

Prerequisite **Medium type (→ 47) = Liquid**

Description Select medium group.

Selection
- Others
- Water based (DC >= 4)

Factory setting Others

Additional information This parameter roughly specifies the dielectric constant (DC) of the medium. For a more detailed definition of the DC use the **Medium property** parameter (→ 48).

The **Medium group** parameter presets the **Medium property** parameter (→ 48) as follows:

Medium group	Medium property (→ 48)
Others	Unknown
Water based (DC >= 4)	DC 4 … 7

The **Medium property** parameter can be changed at a later point of time. However, when doing so, the **Medium group** parameter retains its value. Only the **Medium property** parameter is relevant for the signal evaluation.

The measuring range may be reduced for small dielectric constants. For details refer to the Technical Information (TI) of the respective device.

Medium property

Navigation Expert → Sensor → Medium → Medium property (1165)

Description Specify relative dielectric constant ε_r of the medium.

Selection
- Unknown
- DC 1.4 ... 1.6
- DC 1.6 ... 1.9
- DC 1.9 ... 2.5
- DC 2.5 ... 4
- DC 4 ... 7
- DC 7 ... 15
- DC > 15

Factory setting Dependent on **Medium type (→ 47)** and **Medium group (→ 47)**.

Additional information *Dependency on "Medium type" and "Medium group"*

Medium type (→ 47)	Medium group (→ 47)	Medium property
Solid		Unknown
Liquid	Water based (DC >= 4)	DC 4 ... 7
	Others	Unknown

For dielectric constants (DC values) of many media commonly used in various industries refer to:
- the Endress+Hauser DC manual (CP01076F)
- the Endress+Hauser "DC Values App" (available for Android and iOS)

Calculated DC value

Navigation Expert → Sensor → Medium → Calc. DC value (1118)

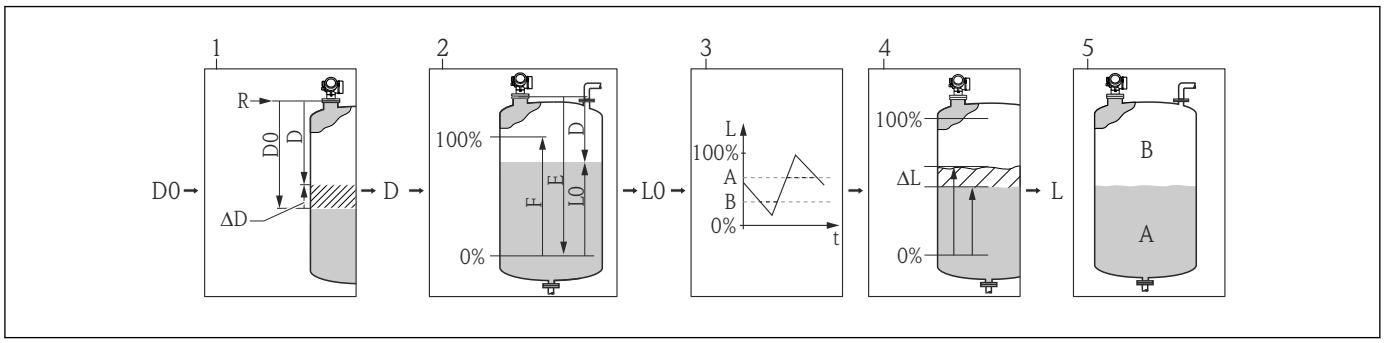
Description Displays the dielectric constant calculated by the device.

User interface 1.0 to 100.0

Additional information The calculation is only possible for small DC values as it requires the tank bottom signal.

3.4.4 "Level" submenu

The **Level** submenu (→ 50) is used to configure the calculation of the level from the measured distance.

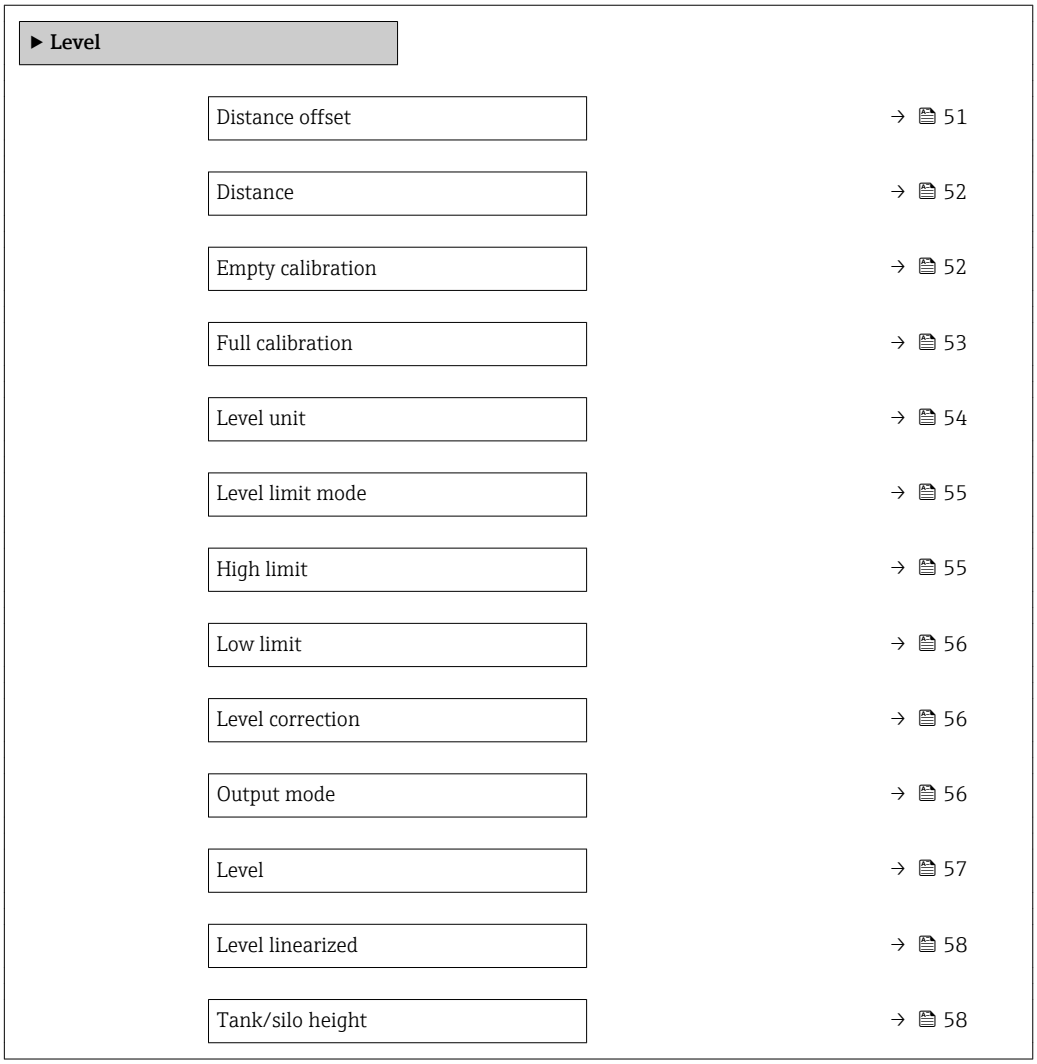


6 *Calculation of the level from the measured distance*

1 *Correction of the measured distance*
2 *Level calculation*
3 *Level limitation*
4 *Correction of the level*
5 *Definition of the output value: Level (A) or Ullage (B)*

Structure of the submenu

Navigation Expert → Sensor → Level



Description of parameters

Navigation Expert → Sensor → Level

Distance offset

Navigation Expert → Sensor → Level → Distance offset (2309)

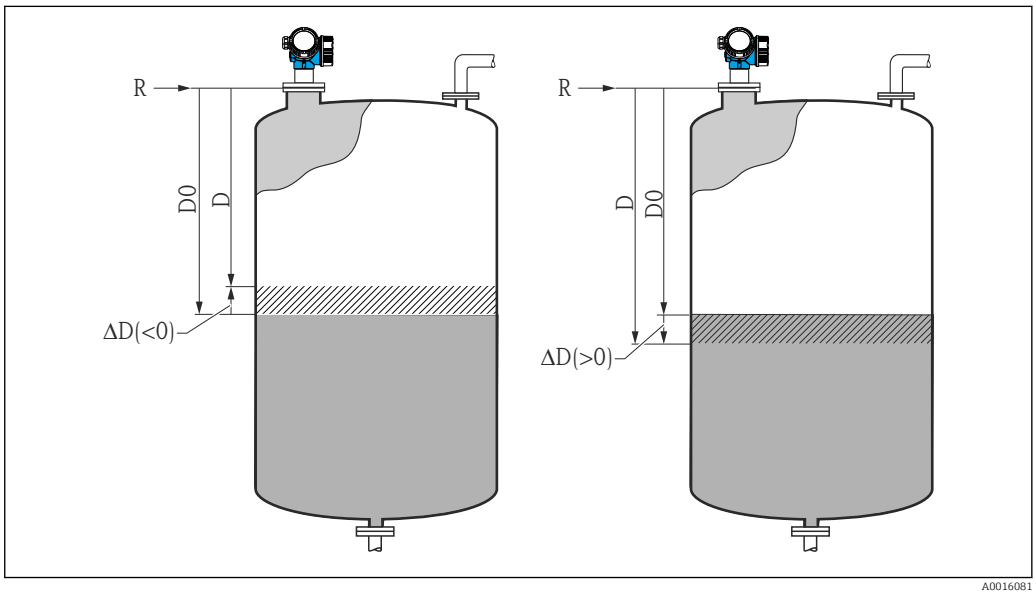
Description Specify distance offset.

User entry −200 to 200 m

Factory setting 0 m

Additional information The value specified in this parameter is added to the measured distance between the reference point of the measurement and the level echo.

- Positive values increase the distance and thus decrease the level.
- Negative values decrease the distance and thus increase the level.



7 *Effect of "Distance offset (→ 51)"*

ΔD Distance offset
D0 Measured distance
D Corrected distance (is used to calculate the level)
R Reference point

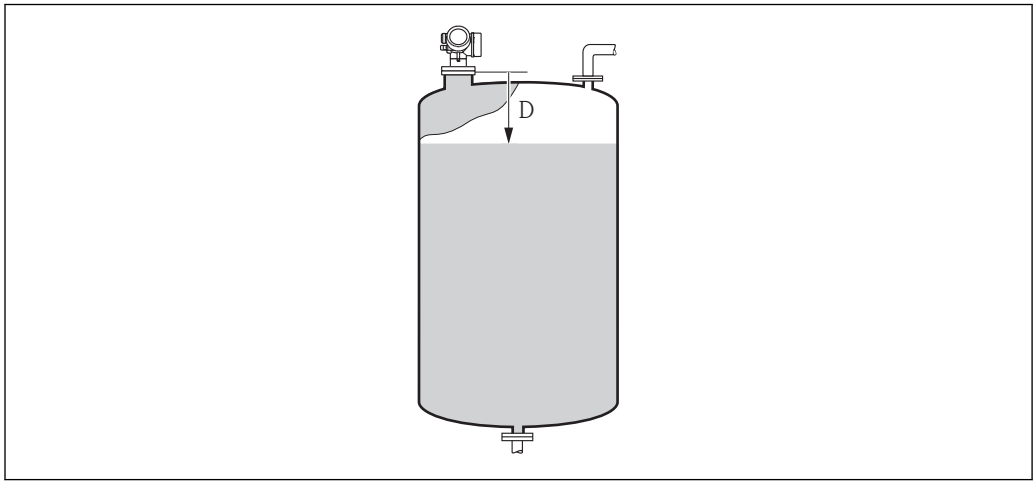
- The value entered in this parameter changes the distance input into the level block and thus influences the measured level.
- The distance without offset is displayed in the following parameters:
  – Setup → Distance (1124)
  – Expert → Sensor → Distance → Distance (1124)
  – Expert → Sensor → Mapping → Distance (1124)
- The distance with offset is displayed in the following parameters:
  Expert → Sensor → Level → Distance (2231)

Distance

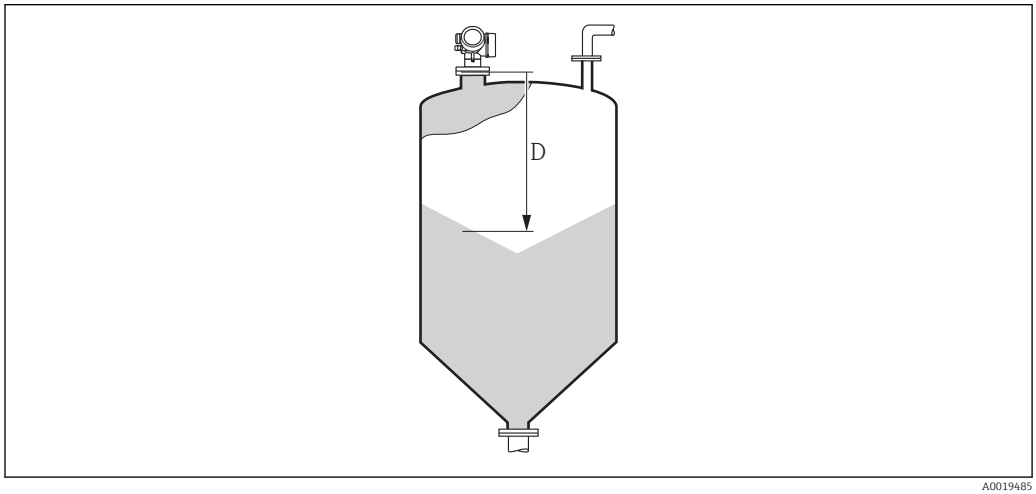
Navigation Expert → Sensor → Level → Distance (2231)

Description Displays the measured distance D from the reference point (lower edge of the flange or threaded connection) to the level. The **Distance offset** parameter (→ 51) is included in the displayed value.

Additional information



8 *Distance for level measurements*



9 *Distance for bulk solid measurements*

The unit is defined by the **Distance unit** parameter (→ 41).

Empty calibration

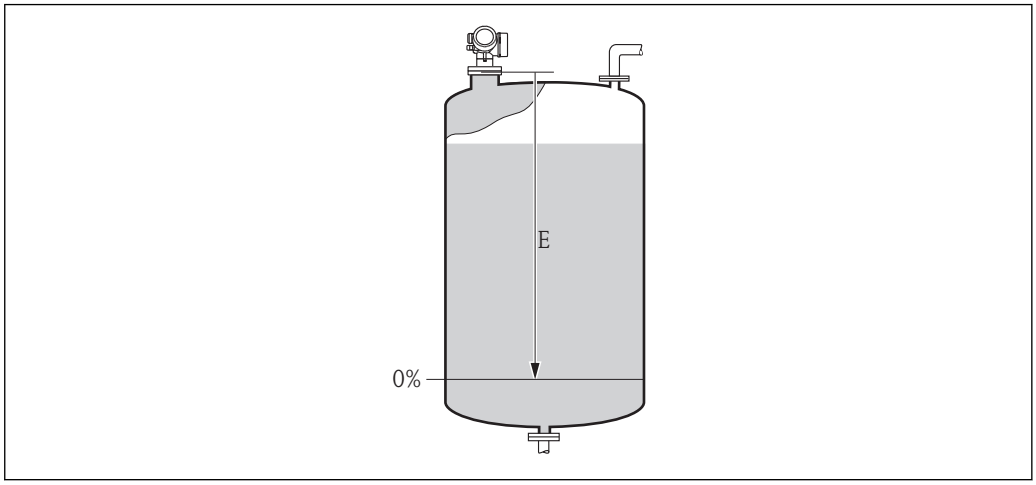
Navigation Expert → Sensor → Level → Empty calibr. (2343)

Description Specify the distance E between the process connection and the minimum level (0%). This defines the starting point of the measuring range.

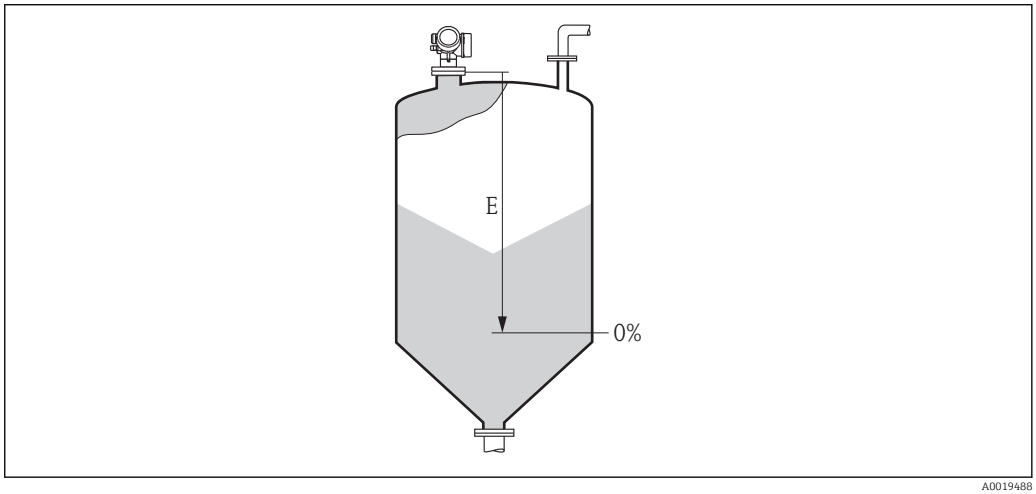
User entry Depending on the antenna

Factory setting Depending on the antenna

Additional information



10 *Empty calibration (E) for level measurements in liquids*



11 *Empty calibration (E) for level measurements in bulk solids.*

The measuring range starts at the point at which the radar beam hits the tank or silo bottom. In the case of dished boiler ends or conical outlets levels below this point can not be measured.

Full calibration

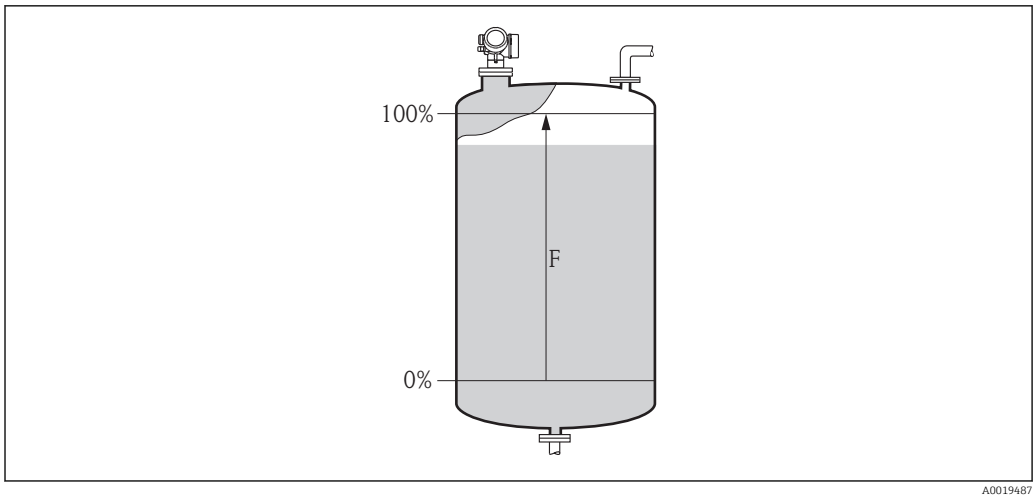
Navigation Expert → Sensor → Level → Full calibr. (2308)

Description Specify the distance F between the minimum level (0%) and the maximum level (100%).

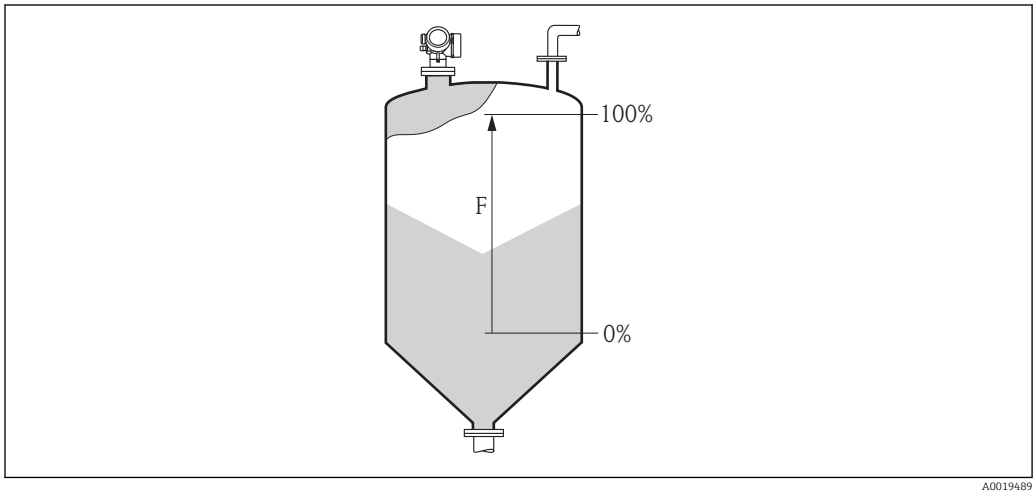
User entry Depending on the antenna

Factory setting Depending on the antenna

Additional information



12 *Full calibration (F) for level measurements in liquids*



13 *Full calibration (F) for level measurements in bulk solids*

Level unit

Navigation Expert → Sensor → Level → Level unit (0576)

Description Select level unit.

Selection

SI units
- %
- m
- mm

US units
- ft
- in

Factory setting %

Additional information The level unit may differ from the distance unit defined in the **Distance unit** parameter (→ 41):

- The unit defined in the **Distance unit** parameter is used for the basic calibration (**Empty calibration (→ 52)** and **Full calibration (→ 53)**).
- The unit defined in the **Level unit** parameter is used to display the (unlinearized) level.

Level limit mode

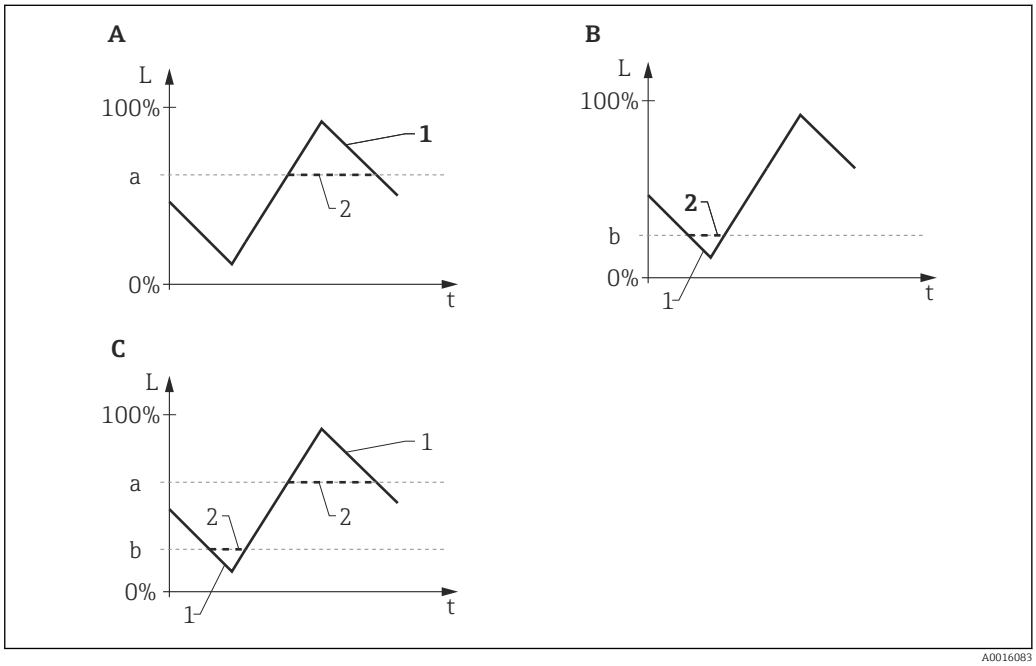
Navigation Expert → Sensor → Level → Level limit mode (2314)

Description Select the type of level limitation.

Selection
- Off
- Low limit
- High limit
- Low and High Limit

Factory setting Low limit

Additional information The parameter determines to which direction the level is limited. The exact limits are defined in the **High limit (→ 55)** und **Low limit (→ 56)** parameters.



14 *Effect of the "Level limit mode", "High limit" and "Low limit" parameters*

A "Level limit mode" = "High limit"
B "Level limit mode" = "Low limit"
C "Level limit mode" = "Low and High Limit"
a "High limit"
b "Low limit"
1 Level before limitation
2 Level after limitation

High limit

Navigation Expert → Sensor → Level → High limit (2312)

Prerequisite **Level limit mode (→ 55)** = **High limit** or **Low and High Limit**

Description Specify upper limit.

User entry Signed floating-point number

Factory setting 0 %

Additional information Levels exceeding the value specified in this parameter will be ignored. Instead, the device uses the maximum level specified in this parameter (for measured value transformation and output).

Low limit

Navigation Expert → Sensor → Level → Low limit (2313)

Prerequisite **Level limit mode (→ 55)** = **Low limit** or **Low and High Limit**

Description Specify lower level limit.

User entry −200 000.0 to 200 000.0 %

Factory setting 0.0 %

Additional information Levels falling below the value specified in this parameter will be ignored. Instead, the device uses the minimum level specified in this parameter (for measured value transformation and output).

Level correction

Navigation Expert → Sensor → Level → Level correction (2325)

Description Specify level correction (if required).

User entry −200 000.0 to 200 000.0 %

Factory setting 0.0 %

Additional information The value specified in this parameter is added to the measured level (before linearization).

Output mode

Navigation Expert → Sensor → Level → Output mode (2317)

Description Select output mode.

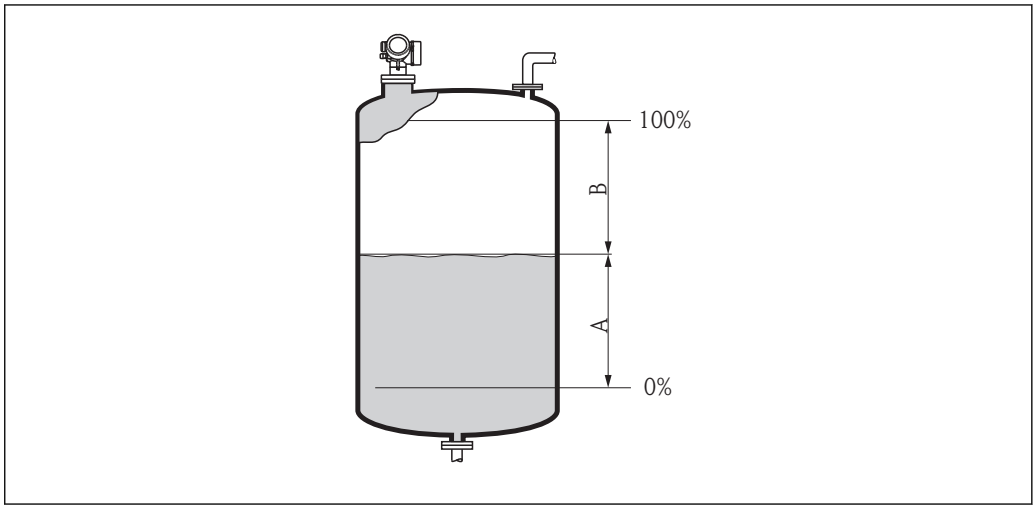
Selection
- Ullage
- Level linearized

Factory setting Level linearized

Additional information

Meaning of the options

- **Ullage**
  The remaining space in the tank or silo is indicated.
- **Level linearized**
  The level is indicated (more precisely: the linearized value if a linearization has been activated).



15 Definition of the "Output mode (→ 56)" parameter

A Level linearized
B Ullage

The **Ullage** option is not available for **Linearization type (→ 63)** = **Table**.

Level

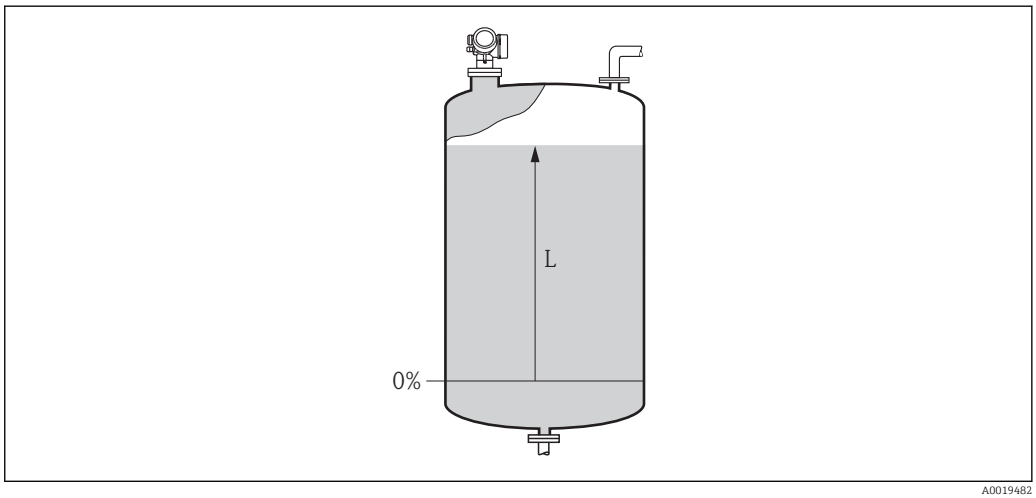
Navigation

Expert → Sensor → Level → Level (2319)

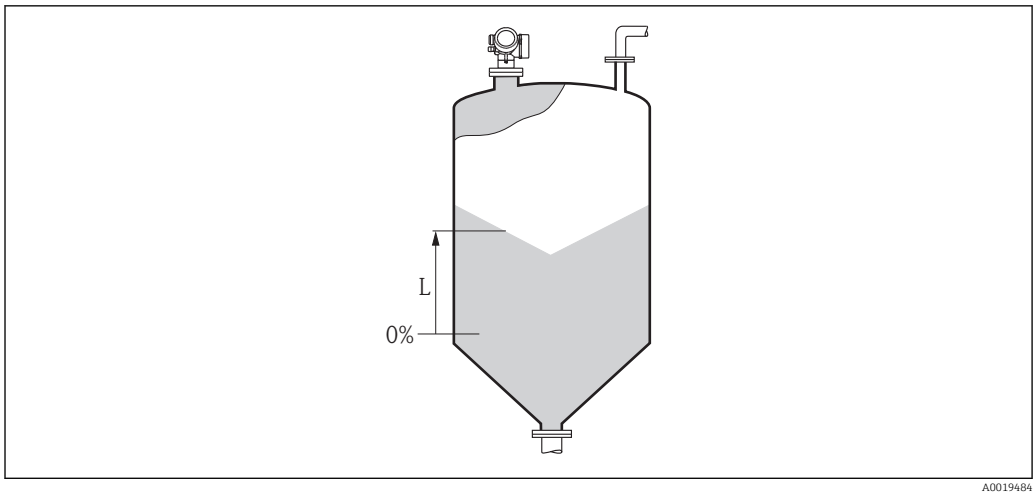
Description

Displays measured level L (before linearization).

Additional information



16 Level in case of liquid measurements



17 *Level in case of bulk solid measurements*

The unit is defined in the **Level unit** parameter (→ 54).

Level linearized

Navigation Expert → Sensor → Level → Level linearized (2318)

Description Displays linearized level.

Additional information The unit is defined by the **Unit after linearization** parameter → 64.

Tank/silo height

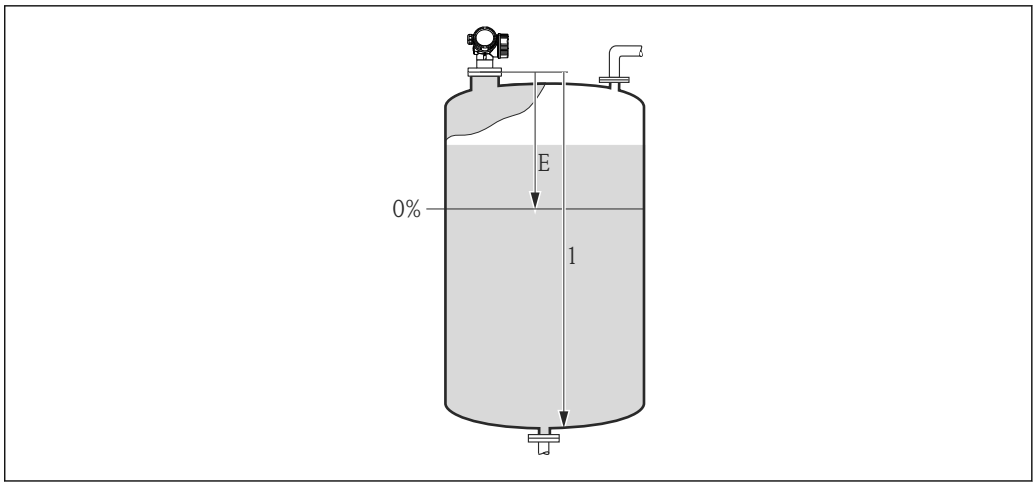
Navigation Expert → Sensor → Level → Tank/silo height (1148)

Description Specify total height of the tank or silo as measured from the process connection.

User entry –999.9999 to 999.9999 m

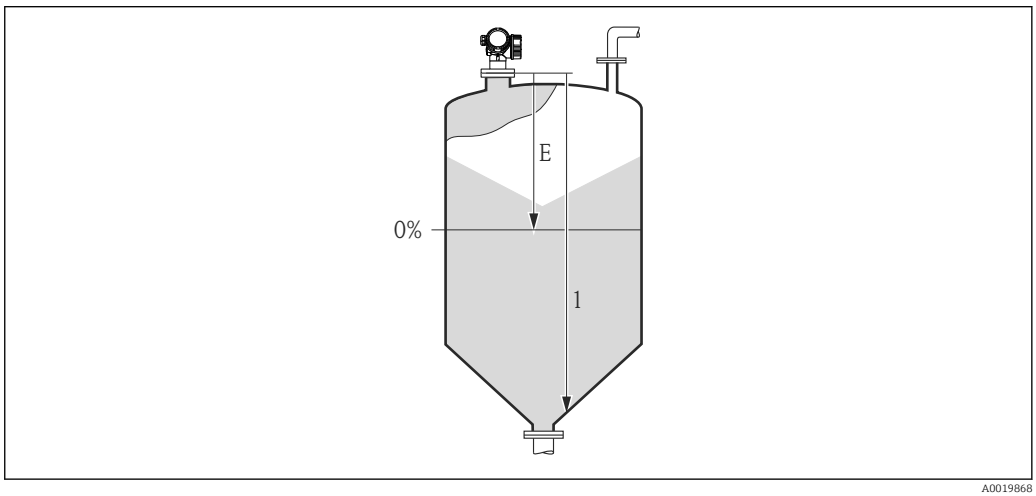
Factory setting **Empty calibration (→ 52)**

Additional information If the parametrized measuring range (**Empty calibration (→ 52)**) differs significantly from the tank or silo height, it is recommended to enter the tank or silo height. Example: Continuous level monitoring in the upper third of a tank or silo.



18 *"Tank/silo height" parameter (→ 58)' for measurements in liquids*

E Empty calibration (→ 52)
1 Tank/silo height (→ 58)

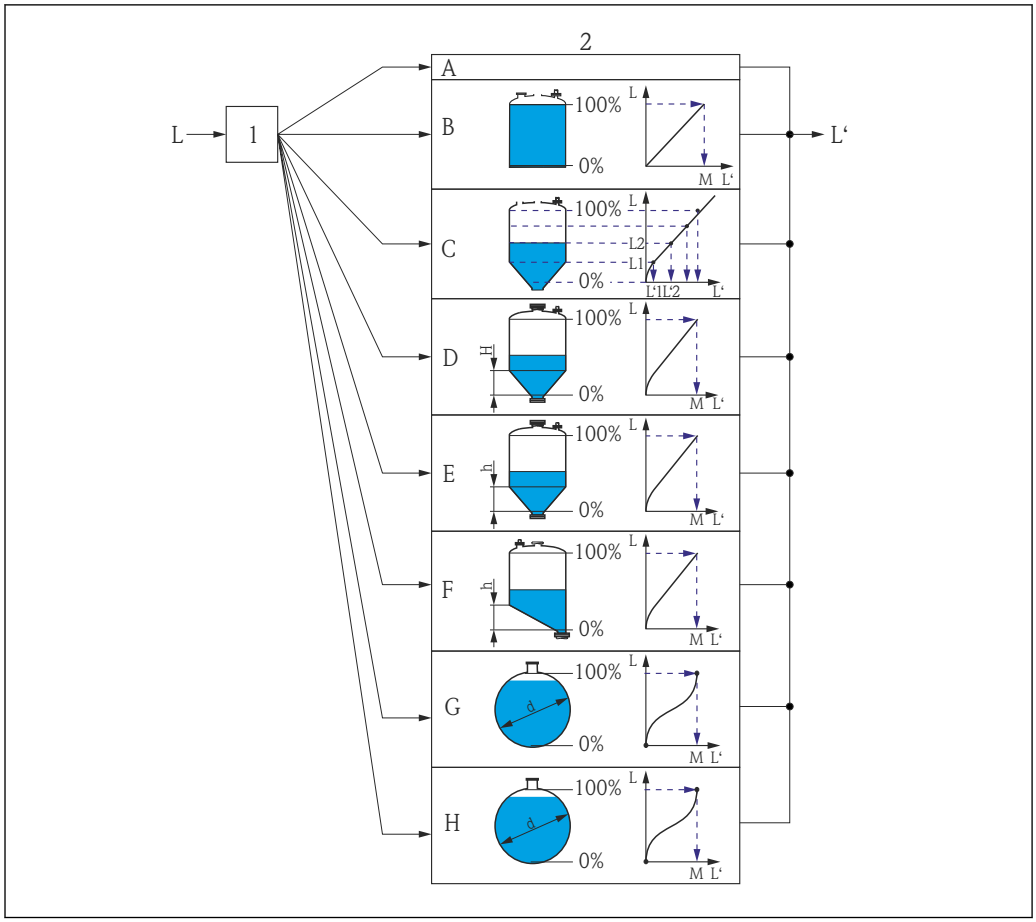


19 *"Tank/silo height" parameter (→ 58)' for measurements in bulk solids*

E Empty calibration (→ 52)
1 Tank/silo height (→ 58)

For tanks with conical outlet, **Tank/silo height** should not be changed as in this type of applications **Empty calibration (→ 52)** is usually **not** << the tank or silo height.

3.4.5 "Linearization" submenu

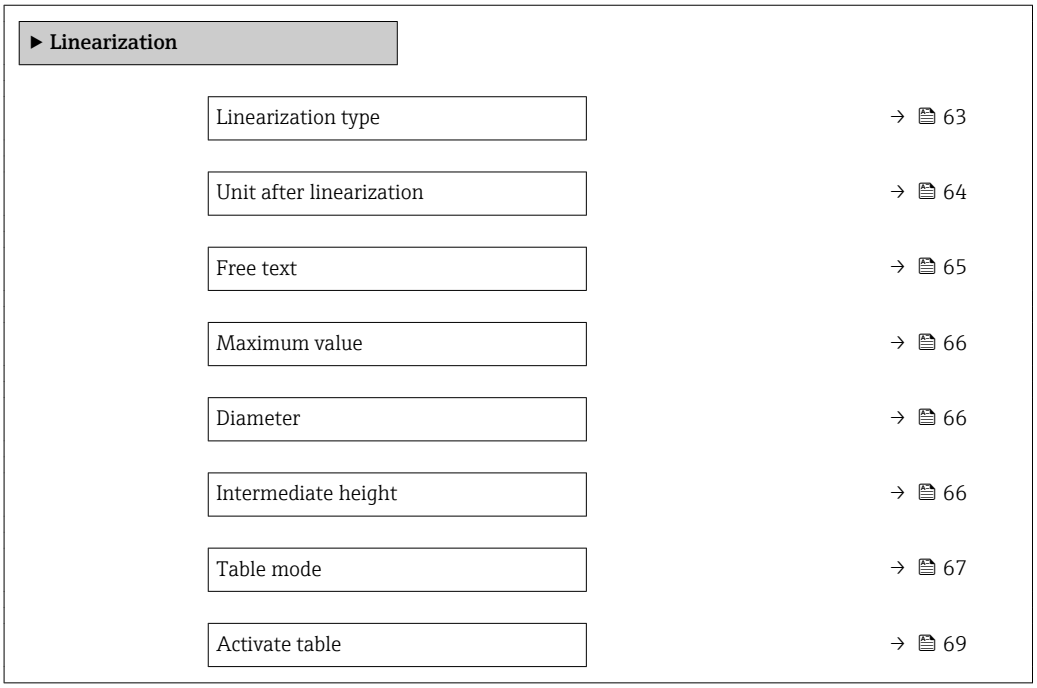


20 *Linearization: Transformation of the level into a volume or weight; the transformation is dependent on the shape of the vessel.*

1 Selection of linearization type and unit
2 Configuration of the linearization
A Linearization type (→ 63) = None
B Linearization type (→ 63) = Linear
C Linearization type (→ 63) = Table
D Linearization type (→ 63) = Pyramid bottom
E Linearization type (→ 63) = Conical bottom
F Linearization type (→ 63) = Angled bottom
G Linearization type (→ 63) = Horizontal cylinder
H Linearization type (→ 63) = Sphere
L Level before linearization (measured in distance units)
L' Level linearized (→ 58) (corresponds to volume or weight)
M Maximum value (→ 66)
d Diameter (→ 66)
h Intermediate height (→ 66)

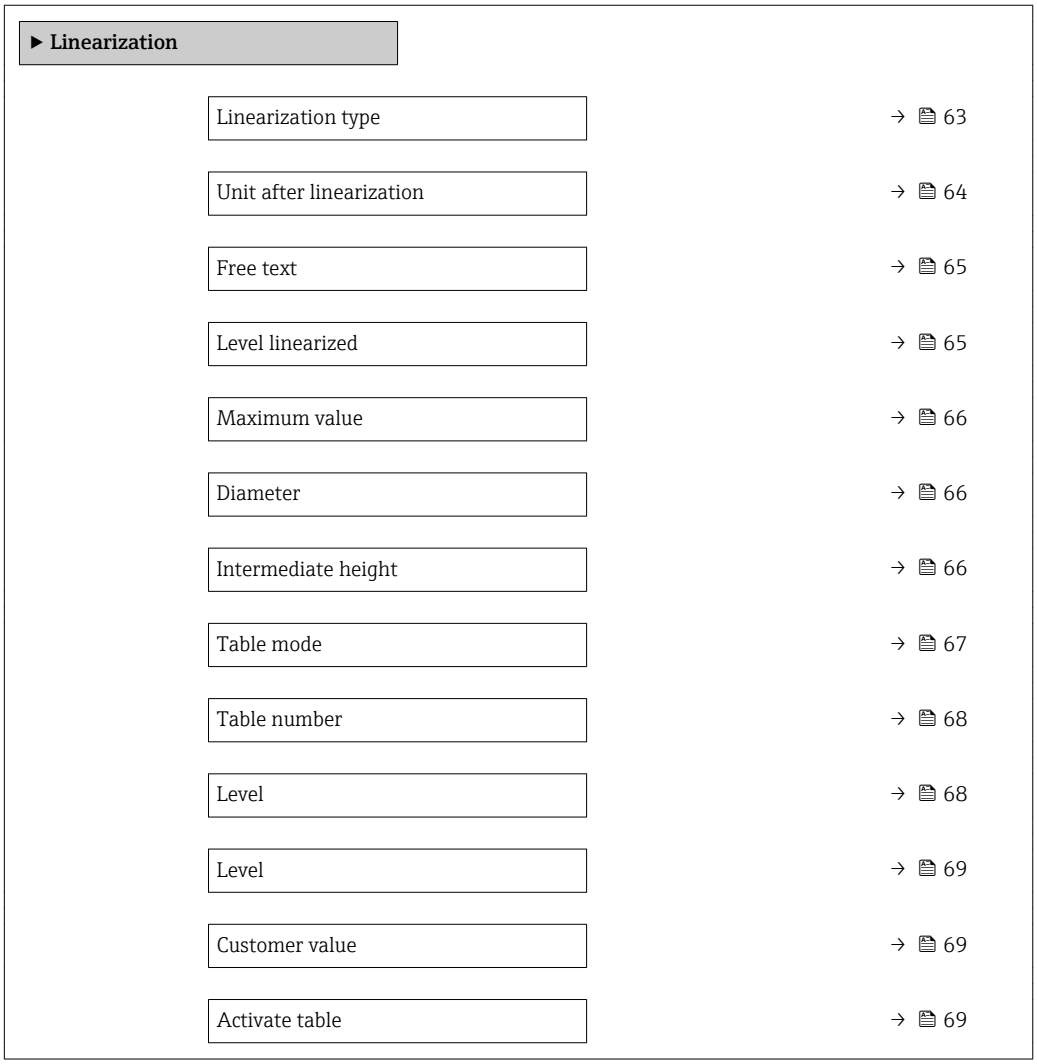
Structure of the submenu on the local display

Navigation Expert → Sensor → Linearization



Structure of the submenu in an operating tool (e.g. FieldCare)

Navigation Expert → Sensor → Linearization



Description of parameters

Navigation Expert → Sensor → Linearization

Linearization type

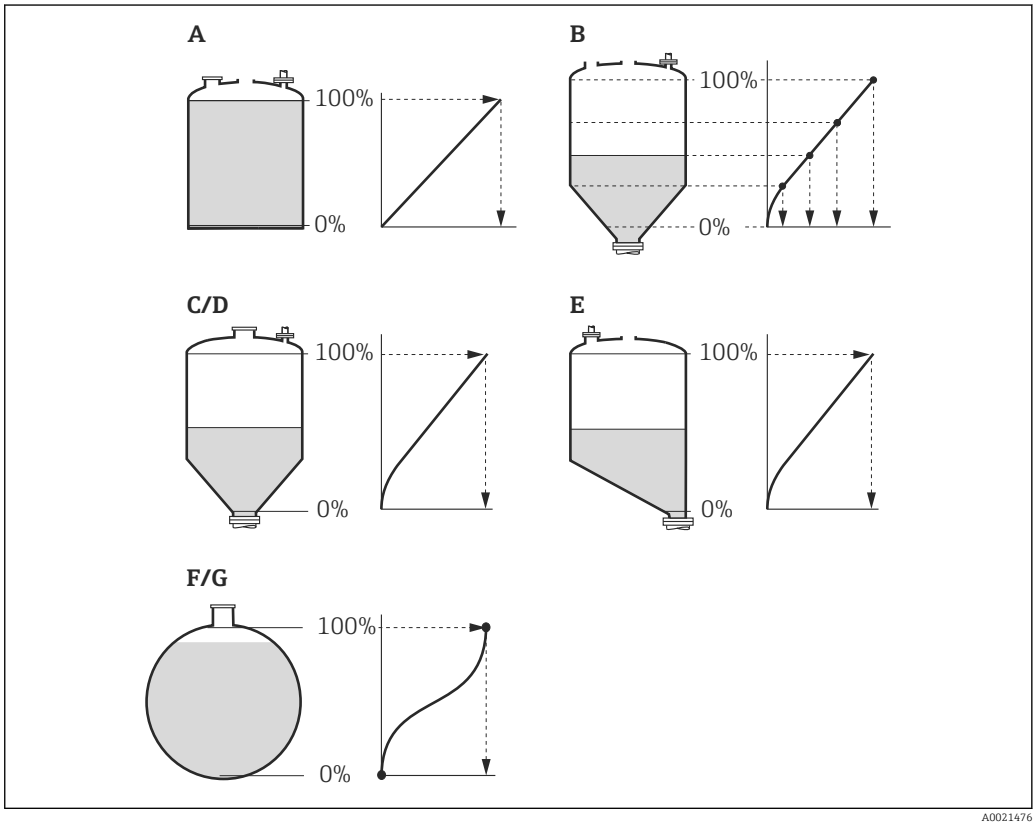
Navigation Expert → Sensor → Linearization → Lineariz. type (2339)

Description Select linearization type.

Selection
- None
- Linear
- Table
- Pyramid bottom
- Conical bottom
- Angled bottom
- Horizontal cylinder
- Sphere

Factory setting None

Additional information



21 Linearization types

A None
B Table
C Pyramid bottom
D Conical bottom
E Angled bottom
F Sphere
G Horizontal cylinder

Meaning of the options

- **None**
  The level is transmitted in the level unit without linearization.
- **Linear**
  The output value (volume/weight) is directly proportional to the level L. This is valid, for example, for vertical cylinders. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
- **Table**
  The relationship between the measured level L and the output value (volume/weight) is given by a linearization table consisting of up to 32 pairs of values "level - volume" or "level - weight", respectively. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Table mode (→ 67)**
  – For each table point: **Level (→ 68)**
  – For each table point: **Customer value (→ 69)**
  – **Activate table (→ 69)**
- **Pyramid bottom**
  The output value corresponds to the volume or weight in a silo with pyramid bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
  – **Intermediate height (→ 66)**: The height of the pyramid
- **Conical bottom**
  The output value corresponds to the volume or weight in a tank with conical bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
  – **Intermediate height (→ 66)**: The height of the conical part of the tank
- **Angled bottom**
  The output value corresponds to the volume or weight in a silo with an angled bottom. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
  – **Intermediate height (→ 66)**: Height of the angled bottom
- **Horizontal cylinder**
  The output value corresponds to the volume or weight in a horizontal cylinder. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
  – **Diameter (→ 66)**
- **Sphere**
  The output value corresponds to the volume or weight in a spherical tank. The following additional parameters have to be specified:
  – **Unit after linearization (→ 64)**
  – **Maximum value (→ 66)**: Maximum volume or weight
  – **Diameter (→ 66)**

Unit after linearization

Navigation Expert → Sensor → Linearization → Unit lineariz. (2340)

Prerequisite **Linearization type (→ 63)** ≠ None

Description Select unit of the lineaized value.

Selection

SI units
- STon
- t
- kg
- cm^3
- dm^3
- m^3
- hl
- l
- %

US units
- lb
- UsGal
- ft^3

Imperial units
impGal

Custom-specific units
Free text

Factory setting

%

Additional information

The selected unit is only used to be indicated on the display. The measured value is **not** transformed according to the selected unit.

It is also possible to configure a distance-to-distance linearization, i.e. a transformation from the level unit to a different distance unit. To do so, select the **Linear** linearization mode. In order to define the new level unit, select the **Free text** option in the **Unit after linearization** parameter and enter the required unit into the **Free text** parameter (→ 65).

Free text

Navigation

Expert → Sensor → Linearization → Free text (2341)

Prerequisite

Unit after linearization (→ 64) = **Free text**

Description

Enter unit symbol.

User entry

Up to 32 alphanumerical characters (letters, numbers, special characters)

Factory setting

Free text

Level linearized

Navigation

Expert → Sensor → Linearization → Level linearized (2318)

Description

Displays linearized level.

Additional information

The unit is defined by the **Unit after linearization** parameter → 64.

Maximum value

Navigation Expert → Sensor → Linearization → Maximum value (2315)

Prerequisite **Linearization type (→ 63)** has one of the following values:
- Linear
- Pyramid bottom
- Conical bottom
- Angled bottom
- Horizontal cylinder
- Sphere

Description Specify the maximum content of the vessel (100%) measured in the units after linearization.

User entry −50 000.0 to 50 000.0 %

Factory setting 100.0 %

Diameter

Navigation Expert → Sensor → Linearization → Diameter (2342)

Prerequisite **Linearization type (→ 63)** has one of the following values:
- Horizontal cylinder
- Sphere

Description Specify tank diameter.

User entry 0 to 9 999.999 m

Factory setting 2 m

Additional information The unit is defined in the **Distance unit** parameter (→ 41).

Intermediate height

Navigation Expert → Sensor → Linearization → Intermed. height (2310)

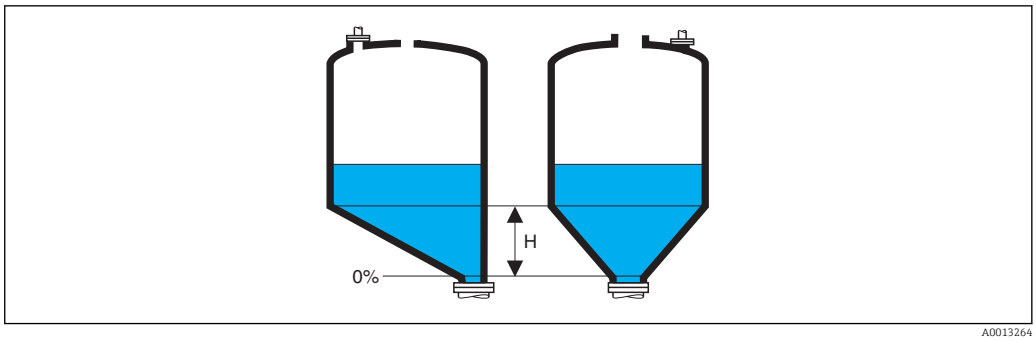
Prerequisite **Linearization type (→ 63)** has one of the following values:
- Pyramid bottom
- Conical bottom
- Angled bottom

Description Specify intermediate height H.

User entry 0 to 200 m

Factory setting 0 m

Additional information



H Intermediate height

The unit is defined in the **Distance unit** parameter (→ 🖹 41).

Table mode

Navigation Expert → Sensor → Linearization → Table mode (2303)

Prerequisite **Linearization type (→ 🖹 63) = Table**

Description Select editing mode of the linearization table.

Selection
- Manual
- Semiautomatic *
- Clear table
- Sort table

Factory setting Manual

Additional information

Meaning of the options
- **Manual**
  The level and the associated linearized value are entered manually for each linearization point.
- **Semiautomatic**
  The level is measured by the device for each linearization point. The associated linearized value is entered manually.
- **Clear table**
  Deletes the existing linearization table.
- **Sort table**
  Rearranges the linerization points into an ascending order.

* Visibility depends on order options or device settings

Conditions the linearization table must meet:
- The table may consist of up to 32 pairs of values "Level - Linearized Value".
- The table must be monotonic (monotonically increasing or decreasing).
- The first linearization point must refer to the minimum level.
- The last linearization point must refer to the maximum level.

Before entering a linearization table, the values for **Empty calibration (→ 52)** and **Full calibration (→ 53)** must be set correctly.

If values of the table need to be changed after the full or empty calibration have been changed, a correct evaluation is only ensured if the existing table is deleted and the complete table is entered again. To do so delete the existing table (**Table mode (→ 67)** = **Clear table**). Then enter a new table.

How to enter the table
- Via FieldCare
  The table points can be entered via the **Table number (→ 68)**, **Level (→ 68)** and **Customer value (→ 69)** parameters. As an alternative, the graphic table editor may be used: Device Operation → Device Functions → Additional Functions → Linearization (Online/Offline)
- Via local display
  Select the **Edit table** submenu to call up the graphic table editor. The table is displayed and can be edited line by line.

The factory setting for the level unit is "%". If you want to enter the linearization table in physical units, you must select the appropriate unit in the **Level unit** parameter (→ 54) beforehand.

If a decreasing table is entered, the values for 20 mA and 4 mA of the current output are interchanged. That means: 20 mA refers to the lowest level, whereas 4 mA refers to the highest level. If required, the current output can be inverted in the **Measuring mode** parameter (→ 132).

Table number

Navigation Expert → Sensor → Linearization → Table number (2370)

Prerequisite **Linearization type (→ 63)** = **Table**

Description Select table point you are going to enter or change.

User entry 1 to 32

Factory setting 1

Level (Manual)

Navigation Expert → Sensor → Linearization → Level (2383)

Prerequisite
- **Linearization type (→ 63)** = **Table**
- **Table mode (→ 67)** = **Manual**

Description Enter level value of the table point (value before linearization).

User entry Signed floating-point number

Factory setting 0 %

Level (Semiautomatic)

Navigation Expert → Sensor → Linearization → Level (2389)

Prerequisite
- **Linearization type (→ 63)** = **Table**
- **Table mode (→ 67)** = **Semiautomatic**

Description Displays measured level (value before linearization). This value is transmitted to the table.

Customer value

Navigation Expert → Sensor → Linearization → Customer value (2384)

Prerequisite **Linearization type (→ 63)** = **Table**

Description Enter linearized value for the table point.

User entry Signed floating-point number

Factory setting 0 %

Activate table

Navigation Expert → Sensor → Linearization → Activate table (2304)

Prerequisite **Linearization type (→ 63)** = **Table**

Description Activate (enable) or deactivate (disable) the linearization table.

Selection
- Disable
- Enable

Factory setting Disable

Additional information

Meaning of the options

- **Disable**
  The measured level is not linearized.
  If **Linearization type (→ 63)** = **Table** at the same time, the device issues error message F435.
- **Enable**
  The measured level is linearized according to the table.

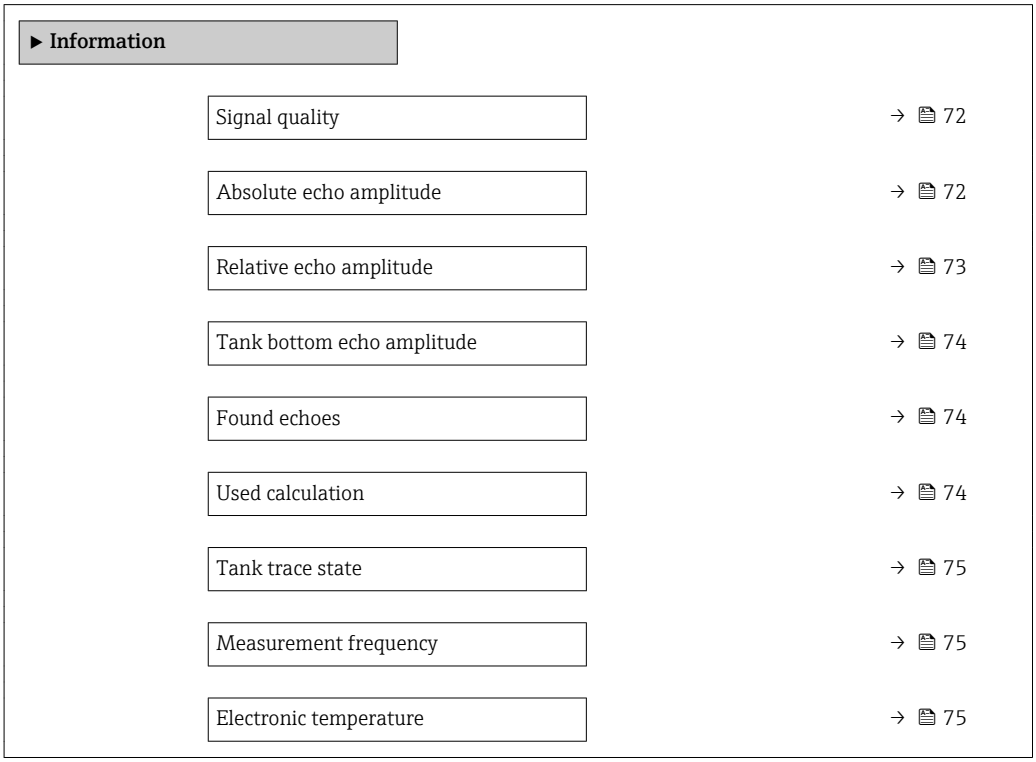
When editing the table, the **Activate table** parameter is automatically reset to **Disable** and must be reset to **Enable** after the table has been entered.

3.4.6 "Information" submenu

The **Information** submenu comprises all display parameters which give information about the current state of the measurement.

Structure of the submenu

Navigation Expert → Sensor → Information



Description of parameters

Navigation Expert → Sensor → Information

Signal quality

Navigation Expert → Sensor → Information → Signal quality (1047)

Description Displays the signal quality of the level echo.

Additional information

Meaning of the display options

- **Strong**
  The evaluated echo exceeds the threshold by at least 10 dB.
- **Medium**
  The evaluated echo exceeds the threshold by at least 5 dB.
- **Weak**
  The evaluated echo exceeds the threshold by less than 5 dB.
- **No signal**
  The device does not find a usable echo.

The signal quality indicated in this parameter always refers to the currently evaluated echo: either the level echo or the tank bottome echo. To differentiate between these two, the quality of the tank bottom echo echo is always displayed in brackets.

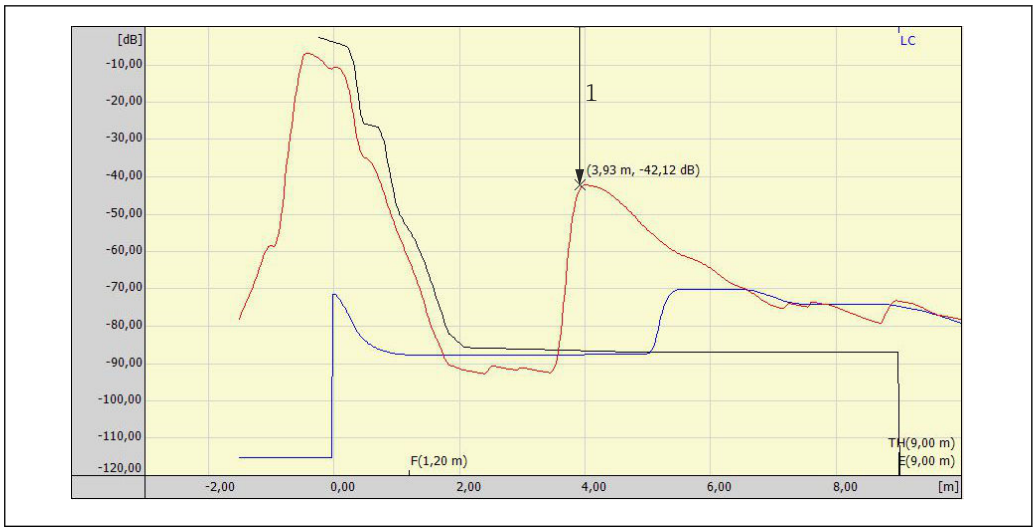
In case of a lost echo (**Signal quality = No signal**) the device generates the following error message:
- F941, for **Output echo lost (→ 99) = Alarm**.
- S941, if another option has been selected in **Output echo lost (→ 99)**.

Absolute echo amplitude

Navigation Expert → Sensor → Information → Abs. echo ampl. (1127)

Description Displays the absolute amplitude of the level echo in the envelope curve.

Additional information



A0019961

1 Absolute echo amplitude in the envelope curve, measured in dB

Relative echo amplitude

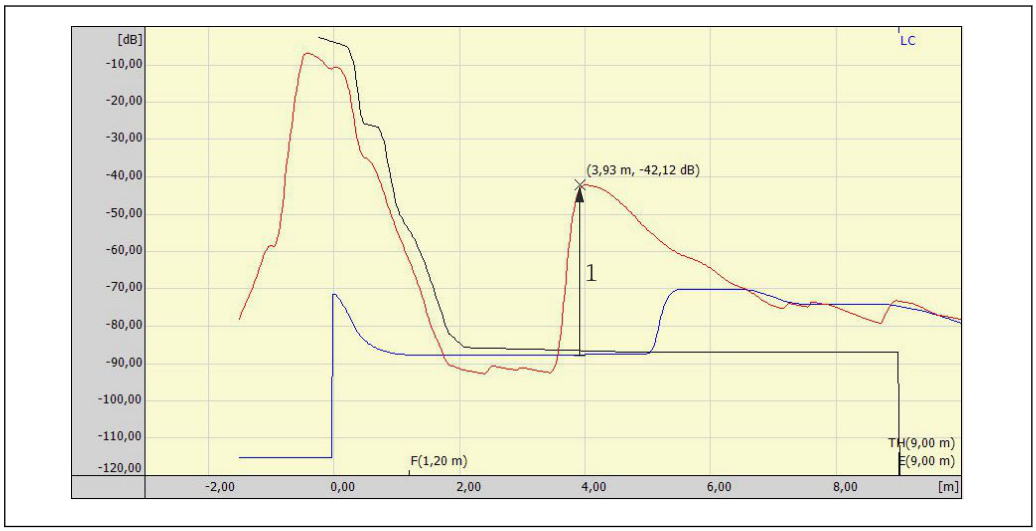
Navigation

Expert → Sensor → Information → Relat.echo ampl. (1089)

Description

Displays the relative amplitude of the level echo, i.e. the distance between the level echo and the weighting curve.

Additional information



A0019962

1 The relative echo amplitude is the difference between the weighting curve (blue) and the peak in the envelope curve (red).

In the envelope curve display of FieldCare, the absolute echo amplitude is indicated instead of the relative amplitude (see the number on the top right of the echo peak in the example).

Tank bottom echo amplitude

Navigation Expert → Sensor → Information → Tank bottom ampl (1128)

Description Indicates the amplitude of the tank bottom echo.

Additional information The tank bottom echo amplitude is only evaluated for media with a small DC value.

Found echoes

Navigation Expert → Sensor → Information → Found echoes (1068)

Description Indicates which echoes have been found.

User interface
- None
- Level
- Level and TB
- EOP
- EOP (TT)
- EOP (LN)
- Level and EOP
- Multiple echo (TT)

Used calculation

Navigation Expert → Sensor → Information → Used calculation (1115)

Description Indicates which echoes are used for the calculation of the measured value.

Additional information

Meaning of the options
- **None**
  The measured value is not calculated (e.g. due to a lost echo)
- **Level**
  The level is calculated from the direct level echo.
- **Tank bottom**
  The level is calculated from the tank bottom echo.
- **TB (TT)**
  The level is calculated from the tank bottom echo taking into account the tank table (TT).
- **Multiple echo (TT)**
  The level is calculated from the multiple echo, taking into account the tank table (TT).
- **Level and TB**
  The level is calculated from the direct level echo. Its plausibility is checked by the tank bottom echo.

Tank trace state

Navigation Expert → Sensor → Information → Tank trace state (1206)

Description Indicates the current state of the tank trace.

Additional information

Meaning of the options
- **Not active**
  A valid tank trace is not available.
- **EOP (TT)**
  A valid EOP tank trace is available.
- **Multiple echo (TT)**
  A valid multiple echo tank trace is available.
- **EOP + Multiple echo (TT)**
  A valid EOP and multiple echo tank trace are available.

Measurement frequency

Navigation Expert → Sensor → Information → Measurm. freq. (1180)

Description Displays the current measurement frequency (number of pulses per second).

Electronic temperature

Navigation Expert → Sensor → Information → Electronic temp. (1062)

Description Displays the current temperature of the electronics.

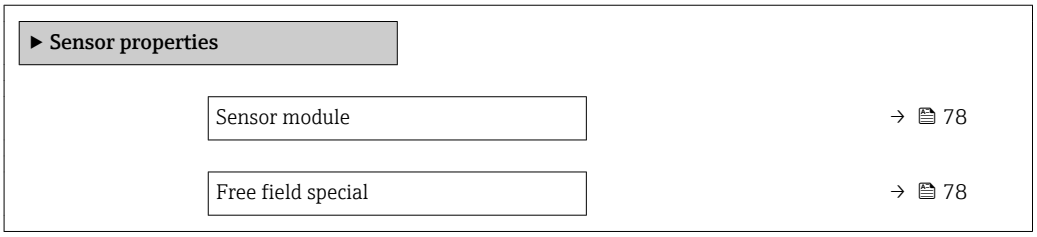
Additional information The unit is defined in the **Temperature unit** parameter (→ 41).

3.4.7 "Sensor properties" submenu

The **Sensor properties** submenu comprises all parameters which describe the measurement-related properties of the probe and the envelope curve.

Structure of the submenu

Navigation Expert → Sensor → Sensor prop.



Description of parameters

Navigation Expert → Sensor → Sensor prop.

Sensor module

Navigation Expert → Sensor → Sensor prop. → Sensor module (1101)

Description Displays the type of sensor module.

Free field special

Navigation Expert → Sensor → Sensor prop. → Free field spec. (1150)

Prerequisite **Sensor module (→ 78)** = **SMR26L** or **SMR26S**

Description Switch the free field option on or off.

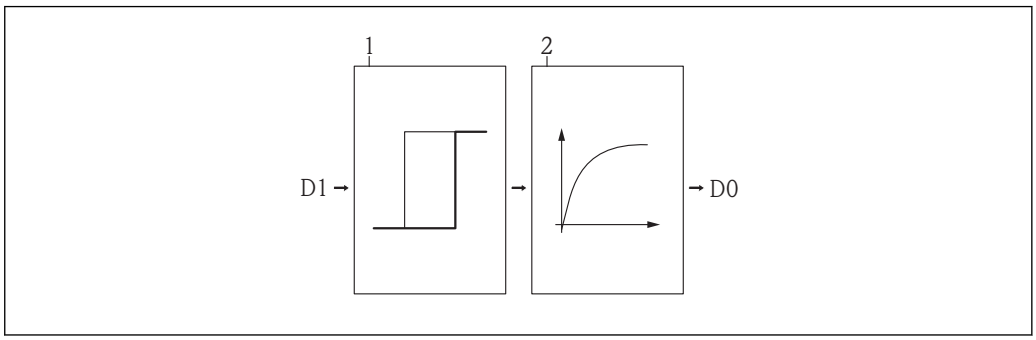
Selection
- No
- Yes

Factory setting No

Additional information This parameter can be switched on for free field applications (e.g. below bridges).

3.4.8 "Distance" submenu

The **Distance** submenu contains all parameters which control the filtering of the raw distance D1. The resulting distance D0 is used for the subsequent calculation of the level.

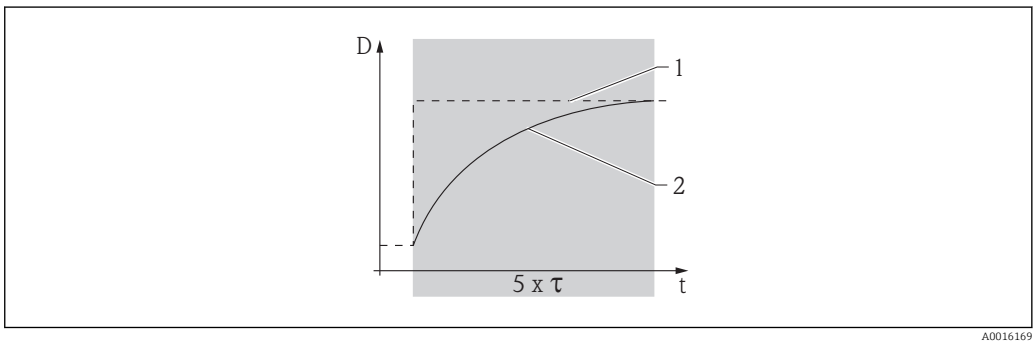


22 *The configurable distance filters*

1 Dead time (→ 82)
2 Integration time (→ 83) (low pass filter)

Low pass filter

The low pass filter dampens the distance signal with a user defined integration time τ (**Integration time** parameter (→ 83)). After a sudden change of the level, it takes about 5 x τ, until the new measured value is obtained.

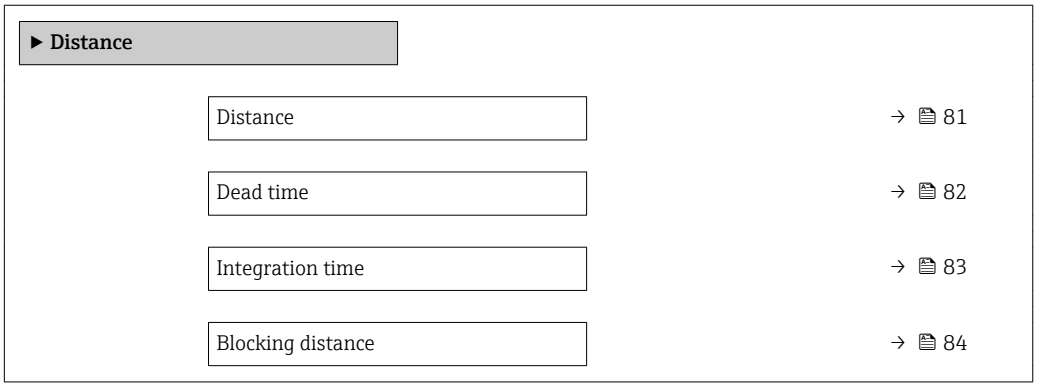


23 *Low pass filter*

1 Signal before the low pass filter
2 Signal after the low pass filter
τ Integration time (→ 83)

Structure of the submenu

Navigation Expert → Sensor → Distance



Description of parameters

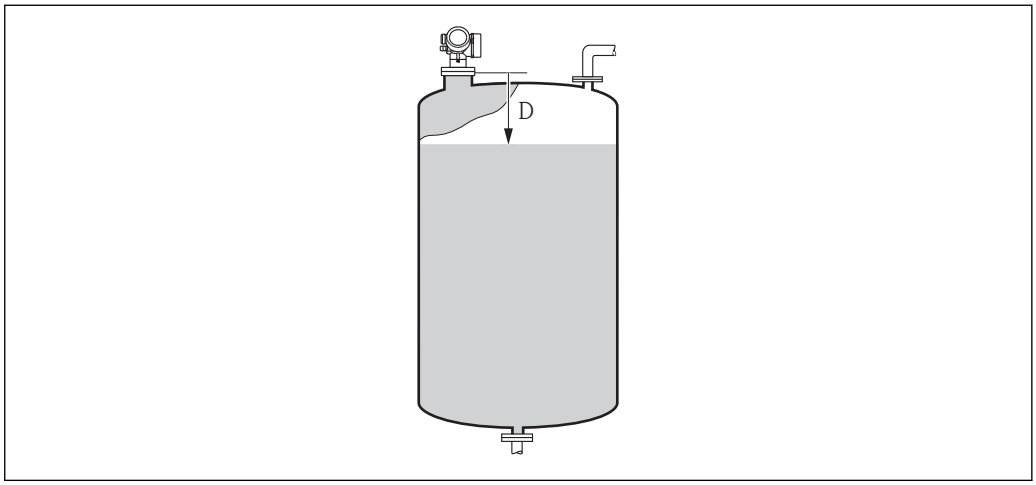
Navigation Expert → Sensor → Distance

Distance

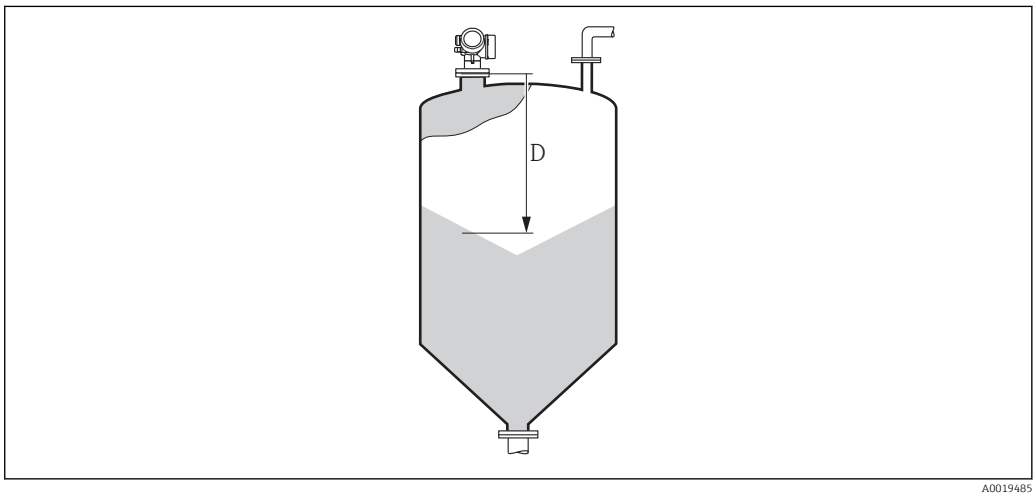
Navigation Expert → Sensor → Distance → Distance (1124)

Description Displays the measured distance D between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



24 *Distance for liquid measurements*



25 *Distance for bulk solid measurements*

The unit is defined in the **Distance unit** parameter (→ 41).

Dead time

Navigation Expert → Sensor → Distance → Dead time (1199)

Description Define the dead time (in seconds).

User entry 0 to 600 s

Factory setting **Dependent on the following parameters:**
- **Medium type (→ 47)**
- **Max. filling speed liquid (→ 42)** bzw. **Max. filling speed solid (→ 43)**
- **Max. draining speed liquid (→ 43)** bzw. **Max. draining speed solid (→ 44)**

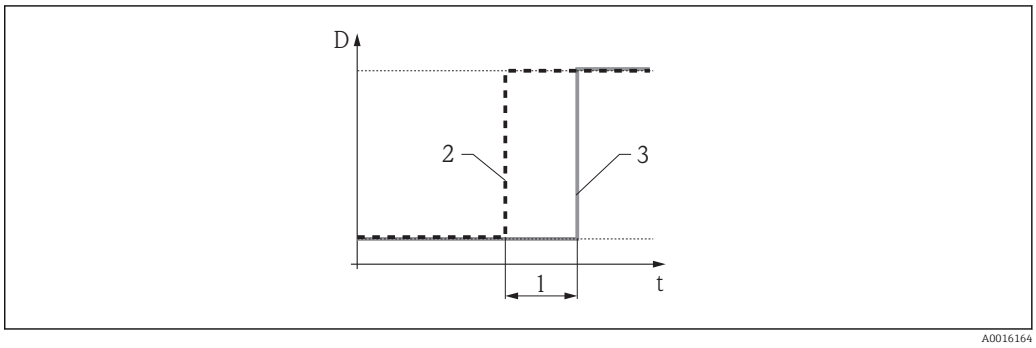
Additional information *Factory setting for "Medium type" = "Liquid"*

Max. filling speed liquid (→ 42)	Max. draining speed liquid (→ 43)					
	Slow < 1cm (0,4in) /min	Medium < 10cm (4in) /min	Standard < 1m (40in) /min	Fast < 2m (80in) /min	Very fast > 2m (80in) /min	No filter / test
Slow < 1cm (0,4in) /min	8 s	6 s	4 s	2 s	0 s	0 s
Medium < 10cm (4in) /min	6 s	6 s	4 s	2 s	0 s	0 s
Standard < 1m (40in) /min	4 s	4 s	4 s	2 s	0 s	0 s
Fast < 2m (80in) /min	2 s	2 s	2 s	2 s	0 s	0 s
Very fast > 2m (80in) /min	0 s	0 s	0 s	0 s	0 s	0 s
No filter / test	0 s	0 s	0 s	0 s	0 s	0 s

Factory setting for "Medium type" = "Solid"

Max. filling speed solid (→ 43)	Max. draining speed solid (→ 44)						
	Very slow < 0,5m (1,6ft) /h	Slow < 1m (3,3ft) /h	Standard < 2m (6,5ft) /h	Medium < 4m (13ft) /h	Fast < 8m (26ft) /h	Very fast > 8m (26ft) /h	No filter / test
Very slow < 0,5m (1,6ft) /h	180 s	180 s	120 s	60 s	40 s	0 s	0 s
Slow < 1m (3,3ft) /h	180 s	180 s	120 s	60 s	40 s	0 s	0 s
Standard < 2m (6,5ft) /h	120 s	120 s	60 s	60 s	40 s	0 s	0 s
Medium < 4m (13ft) /h	60 s	60 s	60 s	40 s	40 s	0 s	0 s
Fast < 8m (26ft) /h	40 s	40 s	40 s	40 s	20 s	0 s	0 s
Very fast > 8m (26ft) /h	0 s	0 s	0 s	0 s	0 s	0 s	0 s
No filter / test	0 s	0 s	0 s	0 s	0 s	0 s	0 s

Application
Sudden changes of the measured distance are ignored during the time span defined in this parameter. In this way it is possible to prevent short-term interferences form disturbing the output signal.



26 Effect of the dead time

1 Dead time
2 Signal before the dead time filter
3 Signal after the dead time filter

Disadvantages
- The device slows down.
- Fast level changes are registered with a delay.

Integration time

Navigation	Expert → Sensor → Distance → Integration time (1092)
Description	Define the integration time (in seconds).
User entry	0.0 to 200 000.0 s
Factory setting	**Dependent on the following parameters:** ▪ **Medium type (→ 47)** ▪ **Max. filling speed liquid (→ 42)** bzw. **Max. filling speed solid (→ 43)** ▪ **Max. draining speed liquid (→ 43)** bzw. **Max. draining speed solid (→ 44)**

Additional information

Factory setting for "Medium type" = "Liquid"

Max. filling speed liquid (→ 🖹 42)	Max. draining speed liquid (→ 🖹 43)					
	Slow < 1cm (0,4in) /min	Medium < 10cm (4in) /min	Standard < 1m (40in) /min	Fast < 2m (80in) /min	Very fast > 2m (80in) /min	No filter / test
Slow < 1cm (0,4in) /min	30 s	15 s	5 s	1 s	0 s	0 s
Medium < 10cm (4in) /min	15 s	15 s	5 s	1 s	0 s	0 s
Standard < 1m (40in) /min	5 s	5 s	5 s	1 s	0 s	0 s
Fast < 2m (80in) /min	1 s	1 s	1 s	1 s	0 s	0 s
Very fast > 2m (80in) /min	0 s	0 s	0 s	0 s	0 s	0 s
No filter / test	0 s	0 s	0 s	0 s	0 s	0 s

Factory setting for "Medium type" = "Solid"

Max. filling speed solid (→ 🖹 43)	Max. draining speed solid (→ 🖹 44)						
	Very slow < 0,5m (1,6ft) /h	Slow < 1m (3,3ft) /h	Standard < 2m (6,5ft) /h	Medium < 4m (13ft) /h	Fast < 8m (26ft) /h	Very fast > 8m (26ft) /h	No filter / test
Very slow < 0,5m (1,6ft) /h	250 s	200 s	200 s	100 s	50 s	1 s	0 s
Slow < 1m (3,3ft) /h	200 s	200 s	200 s	100 s	50 s	1 s	0 s
Standard < 2m (6,5ft) /h	200 s	200 s	100 s	100 s	50 s	1 s	0 s
Medium < 4m (13ft) /h	100 s	100 s	100 s	50 s	50 s	1 s	0 s
Fast < 8m (26ft) /h	50 s	50 s	50 s	50 s	20 s	1 s	0 s
Very fast > 8m (26ft) /h	1 s	1 s	1 s	1 s	1 s	1 s	0 s
No filter / test	0 s	0 s	0 s	0 s	0 s	0 s	0 s

Increasing the integration time results in a calmer measuring signal. However, it also causes a delayed reaction to level changes.

Blocking distance

Navigation Expert → Sensor → Distance → Blocking dist. (1144)

Description Specify blocking distance BD.

User entry

0 to 200 m

Factory setting

- FMR50, FMR51, FMR53, FMR54: antenna length
- FMR52: antenna length + 200 mm (7.9 in)
- FMR56, FMR57: antenna length + 400 mm (15.7 in)

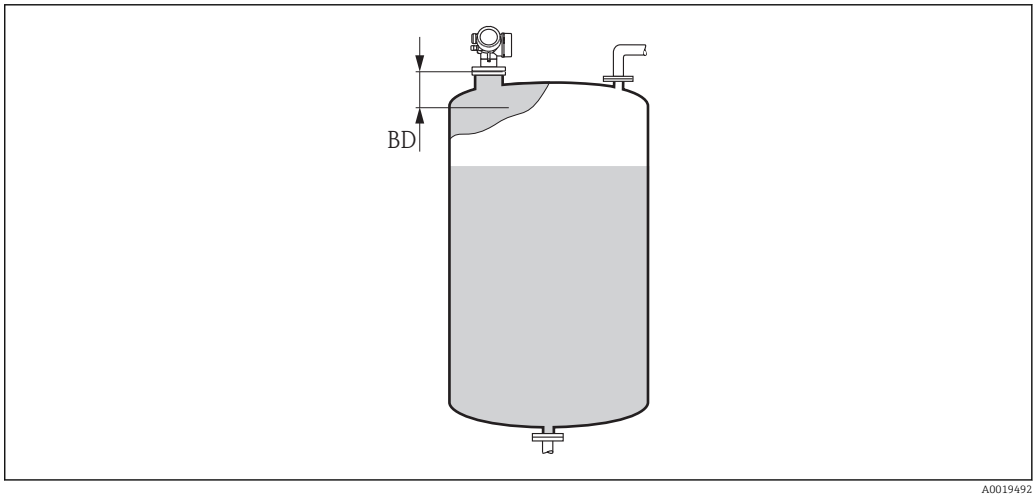
Additional information

Signals in the blocking distance are only evaluated if they have been outside the blocking distance when the device was switched on and move into the blocking distance due to a level change during operation. Signals which are already in the blocking distance when the device is switched on, are ignored.

This behavior is only valid if the following two conditions are met:
- Expert → Sensor → Echo tracking → Evaluation mode (1112) = **Short time history** or **Long time history**)
- Expert → Sensor → Gas phase comp. → GPC mode (1034)= **On**, **Without correction** or **External correction**

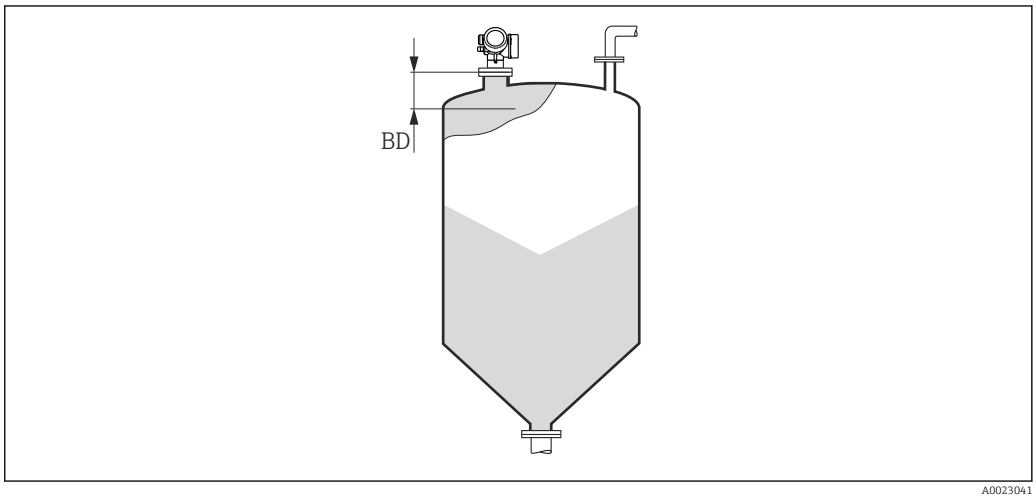
If one of these conditions is not met, signals in the blocking distance will always be ignored.

If required, a different behavior for signals in the blocking distance can be defined by the Endress+Hauser service.



A0019492

27 Blocking distance (BD) for liquid measurements



A0023041

28 Blocking distance (BD) for bulk solid measurements

3.4.9 "Gas phase compensation" submenu

Einfluss der Gasphase

High pressures reduce the propagation velocity of the measuring signals in the gas/vapor above the fluid. This effect depends on the kind of gas/vapor and of its temperature. This results in a systematic measuring error that gets bigger as the distance increases between the reference point of the measurement (flange) and the product surface.

The following table illustrates this measured error for a few typical gases/vapors (with regard to distance; a positive value means that too large a distance is being measured):

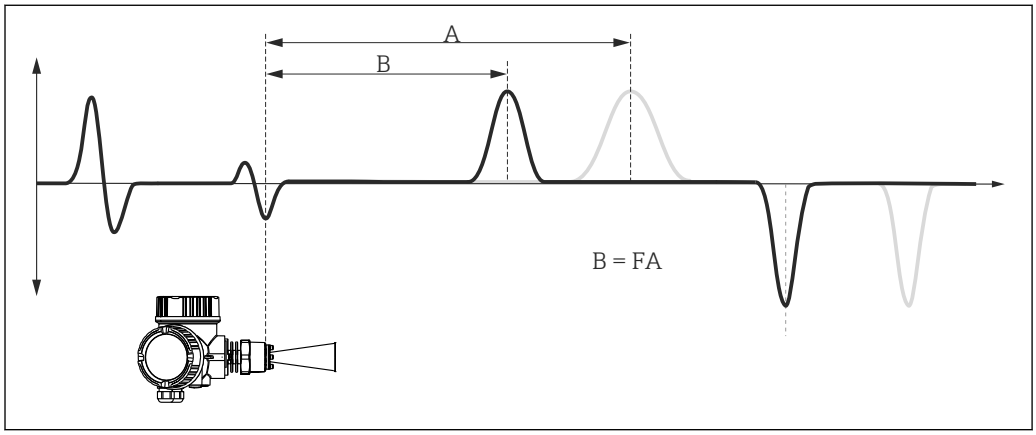
Gas layer	Temperature		Pressure				
	°C	°F	1 bar (14.5 psi)	10 bar (145 psi)	50 bar (725 psi)	100 bar (1450 psi)	160 bar (2320 psi)
Air/ nitrogen	20	68	0.00 %	0.22 %	1.2 %	2.4 %	3.89 %
	200	392	–0.01 %	0.13 %	0.74 %	1.5 %	2.42 %
	400	752	–0.02 %	0.08 %	0.52 %	1.1 %	1.70 %
Hydrogen	20	68	–0.01 %	0.10 %	0.61 %	1.2 %	2.00 %
	200	392	–0.02 %	0.05 %	0.37 %	0.76 %	1.23 %
	400	752	–0.02 %	0.03 %	0.25 %	0.53 %	0.86 %
Water (saturated steam)	100	212	0.02 %	-	-	-	-
	180	356	-	2.1 %	-	-	-
	263	505.4	-	-	8.6 %	-	-
	310	590	-	-	-	22 %	-
	364	687	-	-	-	-	41.8 %

Gas phase compensation with reference signal

This type of gas phase compensation requires a reference signal at a defined distance from the process connection which must be above the maximum level. The current speed of propagation is determined from the shift of this reference signal The envelope curve can be scaled accordingly.

Constant gas phase compensation factor

If the properties of the gas phase (pressure, temperature, composition) do not change over the time and are known, a gas phase compensation can also be performed without a reference signal. Instead, a constant, user-defined correction factor is applied in this case. This factor is used to scale the envelope curve (and thus the measured echo distance).

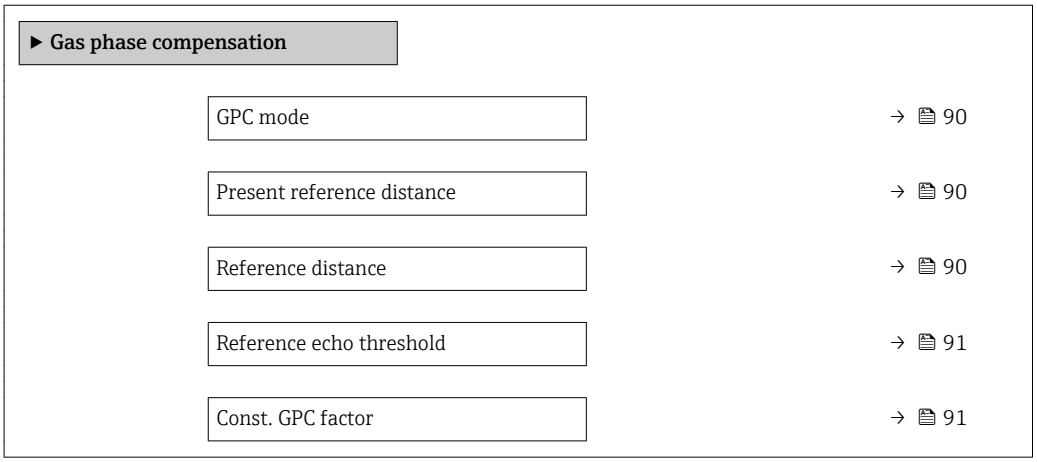


29 Gas phase compensation with a constant correction factor F

A Position of the level echo in the original envelope curve
B Position of the level echo in the corrected envelope curve.

Structure of the submenu

Navigation Expert → Sensor → Gas phase comp.



Description of parameters

Navigation Expert → Sensor → Gas phase comp.

GPC mode

Navigation Expert → Sensor → Gas phase comp. → GPC mode (1034)

Description Select gas phase compensation mode.

Selection
- Off
- On
- Without correction
- Const. GPC factor

Factory setting Off

Additional information

Meaning of the options
- **Off**
  The gas phase compensation is deactivated.
- **On**
  This option can only be selected for probes with reference echo. The gas phase compensation is calculated from the position of this reference echo. In FieldCare, the displayed envelope curve does already contain the correction.
- **Without correction**
  The correction factor is calculated from the reference echo but not applied to the measurement. In FieldCare, the envelope curve is displayed without the correction. This option is only used for diagnostic purposes and should not be selected in normal applications.
- **Const. GPC factor**
  The correction factor is a constant defined by the user. A reference echo is not needed. In FieldCare, the displayed envelope curve does already contain the correction.

Present reference distance

Navigation Expert → Sensor → Gas phase comp. → Pres. ref. dist. (1076)

Prerequisite **GPC mode (→ 90)** = **On** or **Without correction**

Description Displays the currently measured distance of the reference echo.

Reference distance

Navigation Expert → Sensor → Gas phase comp. → Reference dist. (1033)

Prerequisite **GPC mode (→ 90)** = **On** or **Without correction**

Description Enter actual distance of the reference echo.

User entry 0 to 200 m

Factory setting 0.3 m

Additional information The distance of the aritificially generated reference echo has to be entered into this parameter. The reference echo must always be in the gas phase; the level must never rise above the reference echo.

Reference echo threshold

Navigation Expert → Sensor → Gas phase comp. → Ref. echo thresh (1168)

Prerequisite **GPC mode (→ 90)** = **On** or **Without correction**

Description Define threshold for the reference echo.

User entry −999.0 to 999.0 dB

Factory setting −80 dB

Additional information Only echoes exceeding the defined threshold are accepted as reference echo.

Const. GPC factor

Navigation Expert → Sensor → Gas phase comp. → Const.GPC factor (1217)

Prerequisite **GPC mode (→ 90)** = **Const. GPC factor**

Description Specify constant correction factor for the measured distance.

User entry 0.5 to 1.5

Factory setting 1

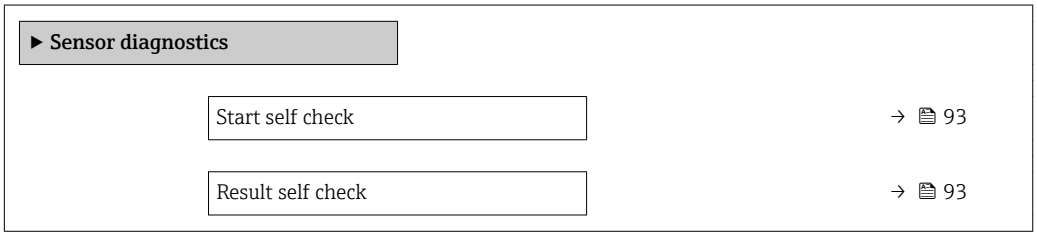
3.4.10 "Sensor diagnostics" submenu

The **Sensor diagnostics** submenu is used for the proof-test which is required for SIL applications in regular intervals. For details refer to the description of the test procedure C in the Functional Safety Manual, SD01087F.

For the self check, a test signal is generated in the sensor module and fed onto the analog signal path. The device software checks whether this test signal is within the admissible amplitude and distance ranges. The result of the self check is displayed in the **Result self check** parameter (→ 🖹 93).

Structure of the submenu

Navigation Expert → Sensor → Sensor diag.



Description of parameters

Navigation Expert → Sensor → Sensor diag.

Start self check

Navigation Expert → Sensor → Sensor diag. → Start self check (1133)

Description Start a self check of the device.

Selection
- No
- Yes

Factory setting No

Additional information For the self check, a test signal is generated in the sensor module and fed onto the analog signal path. The device software checks whether this test signal is within the admissible amplitude and distance ranges. The result of the self check is displayed in the **Result self check** parameter (→ 93).

The self check is used for the proof-test which is required for SIL applications in regular intervals. For details refer to the description of the test procedure C in the Functional Safety Manual SD01087F.

Result self check

Navigation Expert → Sensor → Sensor diag. → Result selfcheck (1134)

Description Displays the result of the self check.

Additional information

Meaning of the options
- **Ok**
  The self check has been passed.
- **Not ok**
  The self check failed.
- **Check not done**
  A self check has not been performed.

3.4.11 "Safety settings" submenu

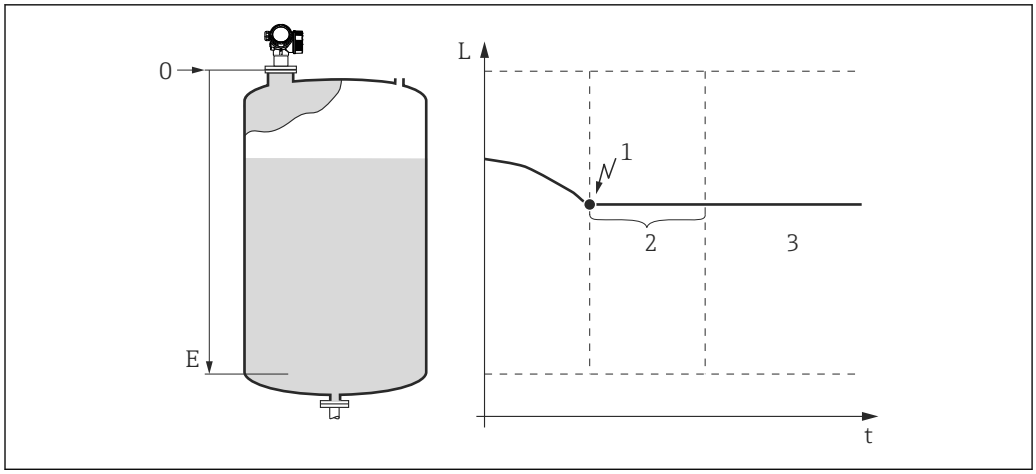
The **Safety settings** submenu contains all parameters which determnine the behavior of the device in critical situations such as an echo loss or an undershooting of a user defined safety distance.

Behavior in the case of an echo loss

The bahavior in case of an echo loss is defined in the **Output echo lost** parameter (→ 🖹 99). Depending on the selected option, suitable values must be selected in a number of additional parameters:

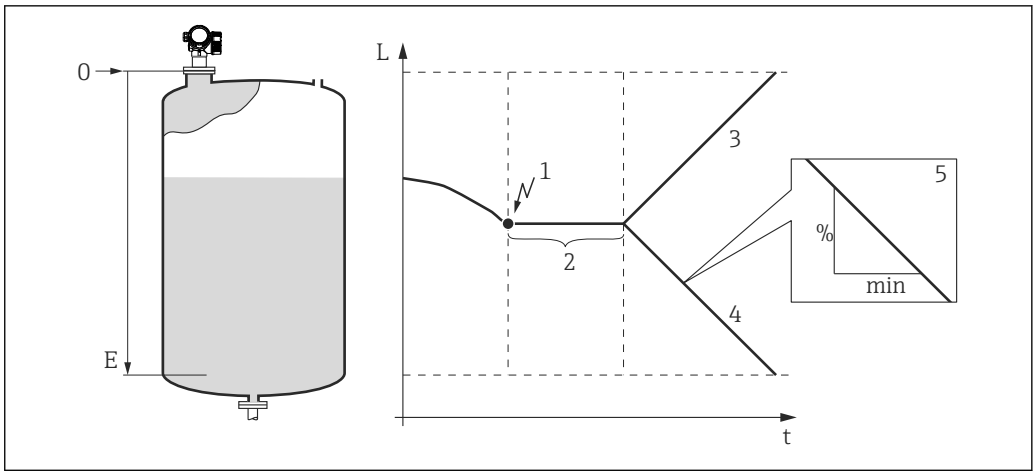
Option selected in in "Output echo lost (→ 🖹 99)"	Required additional parameters
Last valid value	Delay time echo lost (→ 🖹 100)
Ramp at echo lost	▪ Ramp at echo lost (→ 🖹 100) ▪ Delay time echo lost (→ 🖹 100)
Value echo lost	▪ Value echo lost (→ 🖹 99) ▪ Delay time echo lost (→ 🖹 100)
Alarm	1)

1) The alarm bahavior ist defined in the submenus "Current output" (HART) or "Analog input" (PROFIBUS PA, FOUNDATION Fieldbus).



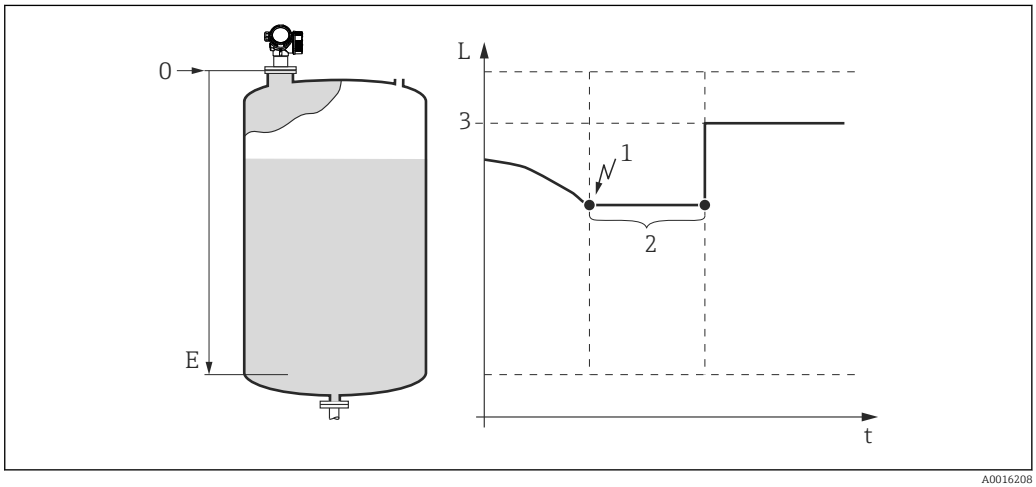
30 "Output echo lost (→ 🖹 99)" = "Last valid value"

1 Echo loss
2 Delay time echo lost (→ 🖹 100)
3 The last valid measured value is held.



31 *"Output echo lost (→ 99)" = "Ramp at echo lost"*

1 *Echo loss*
2 *"Delay time echo lost (→ 100)"*
3 *For a positive ramp: The measured value is increased with a constant rate until it reaches the maximum value (100%).*
4 *For a negative ramp: The measured value is decreased with a constant rate until it reaches the minimum value (0%).*
5 *The ramp is specified as "percentage of the defined measuring span per minute".*

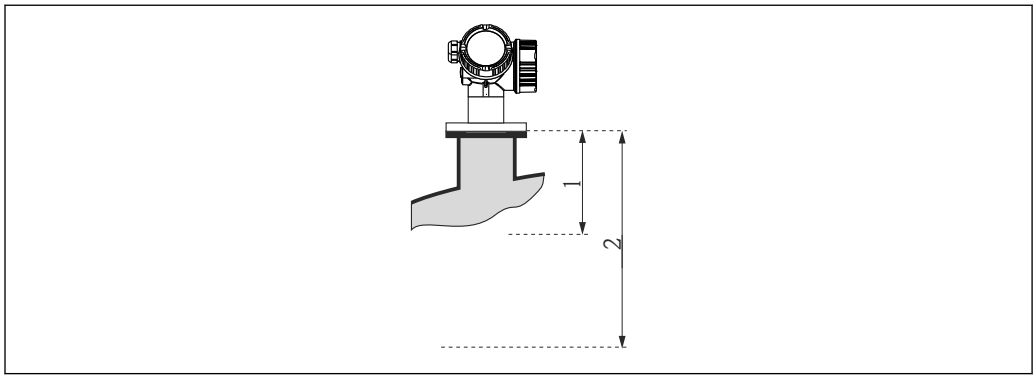


32 *"Output echo lost (→ 99)" = "Value echo lost"*

1 *Echo loss*
2 *Delay time echo lost (→ 100)*
3 *Value echo lost (→ 99)*

Safety distance

In order to get a warning message if the level rises into the proximity of the upper blocking distance, a safety distance can be defined in the **Safety distance** parameter (→ 101).

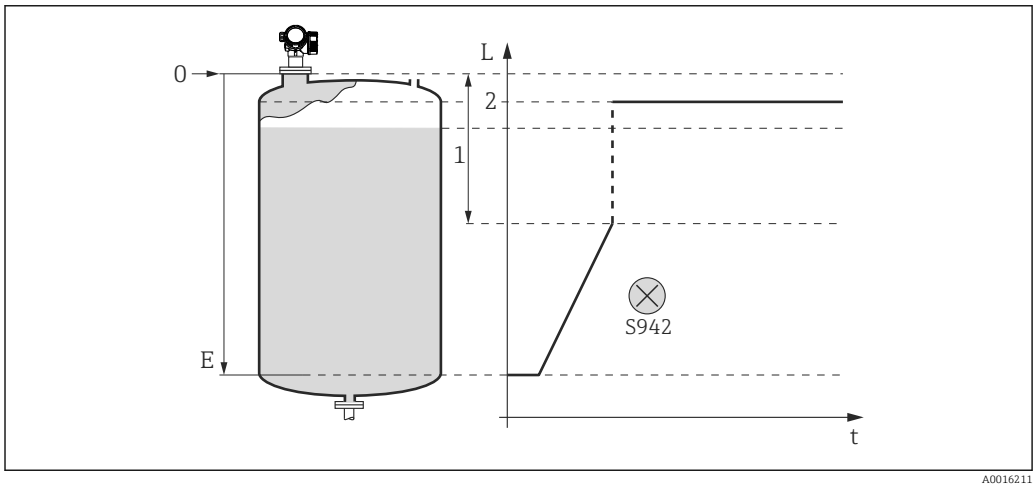


33 *Definition of the safety distance*

1 *Blocking distance (→ 84)*
2 *Safety distance (→ 101)*

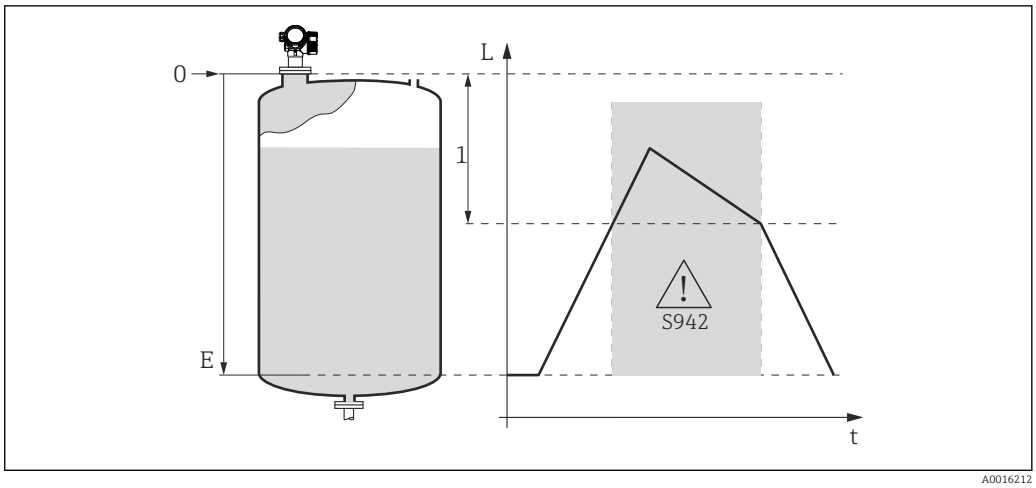
The behavior of the device in case the level rises into the safety distance is defined in the following parameters:

- **In safety distance (→ 101)**
- **Acknowledge alarm (→ 101)**



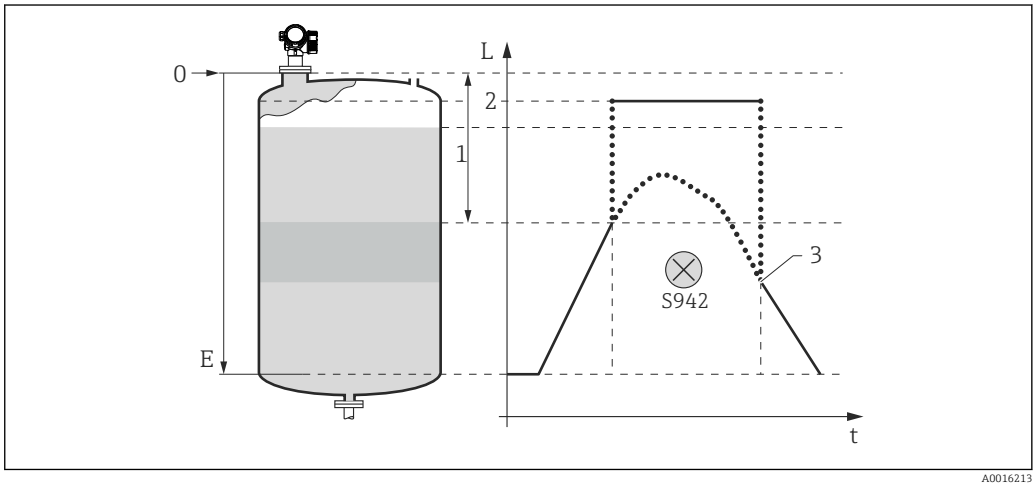
34 *"In safety distance" = "Alarm": If the safety distance is undershot, the device generates an alarm.*

1 *Safety distance (→ 101)*
2 *Value defined in "Failure mode (→ 130)"*



35 *"In safety distance" = "Warning": If the safety distance is undershot, the device continues measuring but nevertheless generates a warning.*

1 Safety distance (→ 101)

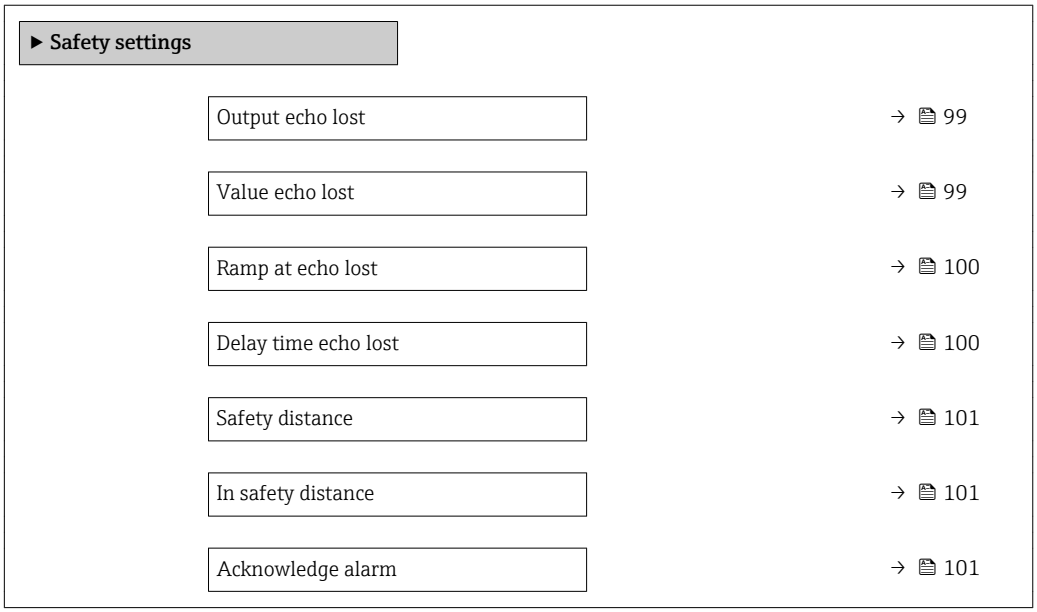


36 *"In safety distance" = "Self holding": If the safety distance is undershot, the device generates an alarm. The measurement is not resumed until this alarm has been acknowledged by the user.*

1 Safety distance (→ 101)
2 Value defined in "Failure mode (→ 130)"
3 Acknowledge alarm (→ 101)

Structure of the submenu

Navigation Expert → Sensor → Safety sett.



Description of parameters

Navigation Expert → Sensor → Safety sett.

Output echo lost

Navigation Expert → Sensor → Safety sett. → Output echo lost (2307)

Description Define the behavior of the output signal in case of a lost echo.

Selection
- Last valid value
- Ramp at echo lost
- Value echo lost
- Alarm

Factory setting Last valid value

Additional information

Meaning of the options
- **Last valid value**
  The last valid value is kept in the case of a lost echo.
- **Ramp at echo lost**
  In the case of a lost echo the output value is continously shifted towards 0% or 100%. The slope of the ramp is defined in the **Ramp at echo lost** parameter (→ 100).
- **Value echo lost**
  In the case of a lost echo the output assumes the value defined in the **Value echo lost** parameter (→ 99).
- **Alarm**
  In the case of a lost echo the device generates an alarm; see the **Failure mode** parameter (→ 130)

Value echo lost

Navigation Expert → Sensor → Safety sett. → Value echo lost (2316)

Prerequisite **Output echo lost (→ 99)** = **Value echo lost**

Description Define output value in case of a lost echo.

User entry 0 to 200 000.0 %

Factory setting 0.0 %

Additional information Use the unit which has been defined for the measured value output:
- without linearization: **Level unit (→ 54)**
- with linearization: **Unit after linearization (→ 64)**

Ramp at echo lost

Navigation Expert → Sensor → Safety sett. → Ramp echo lost (2323)

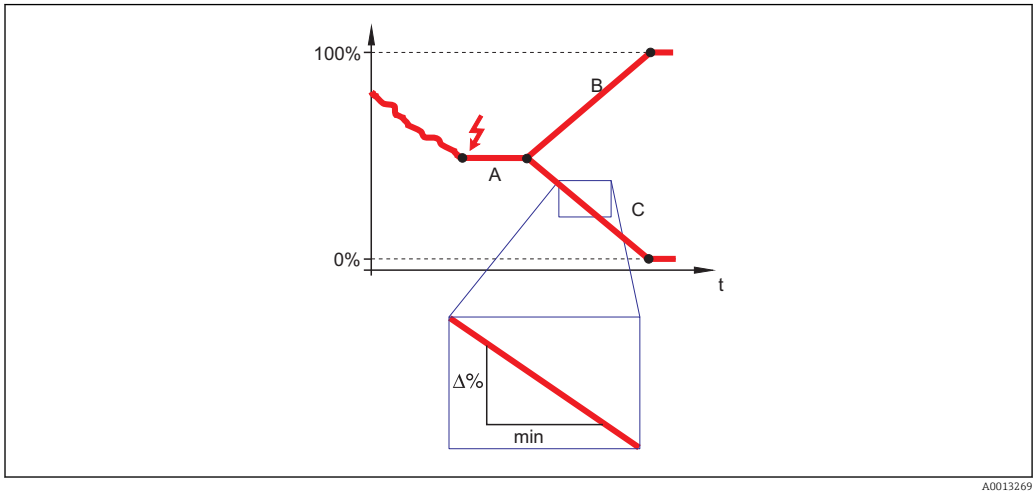
Prerequisite **Output echo lost (→ 99) = Ramp at echo lost**

Description Define the slope of the ramp in the case of a lost echo.

User entry Signed floating-point number

Factory setting 0.0 %/min

Additional information



A Delay time echo lost (→ 100)
B Ramp at echo lost (→ 100) (positive value)
C Ramp at echo lost (→ 100) (negative value)

- The unit for the slope of the ramp is "percentage of the measuring range per minute" (%/min).
- For a negative slope of the ramp: The measured value is continuously decreased until it reaches 0%.
- For a positive slope of the ramp: The measured value is continuosly increased until it reaches 100%.

Delay time echo lost

Navigation Expert → Sensor → Safety sett. → Delay echo lost (1193)

Description Define the delay in the case of an echo loss.

User entry 0 to 99 999.9 s

Factory setting 60.0 s

Additional information After an echo loss, the device waits for the time specified in this parameter before reacting as specified in the **Output echo lost** parameter (→ 99). This helps to avoid interruptions of the measurement by short-term interferences.

Safety distance

Navigation Expert → Sensor → Safety sett. → Safety distance (1093)

Description Define safety distance.

User entry −200 to 200 m

Factory setting 0 m

Additional information The safety distance is measured from the reference point of the measurement (lower edge of the flange or threaded connection). The safety distance can be used to generate a warning before the level rises into the blocking distance. The **In safety distance** parameter (→ 101) defines the reaction of the device if the level rises into the safety distance.

In safety distance

Navigation Expert → Sensor → Safety sett. → In safety dist. (1018)

Description Define reaction if the level rises into the safety distance.

Selection
- Off
- Alarm
- Warning
- Self holding

Factory setting Warning

Additional information

Meaning of the options
- **Off**
  No reaction if the level rises into the safety distance
- **Alarm**
  The device assumes the alarm state and generates the diagnostic message **In safety distance**.
- **Warning**
  The device assumes the warning state and generates the diagnostic message **In safety distance**.
- **Self holding**
  The device assumes the defined alarm state. Additionally, the diagnostic message **In safety distance** is generated. If the level drops out of the safety distance, the alarm remains active. The measurement is continued only after a reset of the self holding via the **Acknowledge alarm** parameter (→ 101).

Acknowledge alarm

Navigation Expert → Sensor → Safety sett. → Acknowl. alarm (1130)

Prerequisite **In safety distance (→ 101) = Self holding**

Description Reset the self holding alarm of the device.

Selection
- No
- Yes

Factory setting No

Additional information

Meaning of the options
- **No**
  The alarm is **not** rest.
- **Yes**
  The alarm is reset. The measurement is resumed.

3.4.12 "Envelope curve" submenu

The **Envelope curve** submenu is only available on the display module (not in FieldCare). It is used to display the envelope curve on the display module. When operating via FieldCare, the envelope curve can be displayed in the envelope curve editor (**Device Operation → Device Functions → Additional Functions → Envelope Curve**).

Description of parameters

Navigation Expert → Sensor → Env. curve

Envelope curve

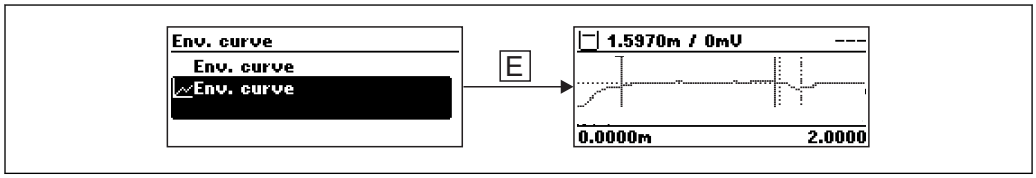
Navigation Expert → Sensor → Env. curve → Env. curve (1207)

Description Define which curves are included in the envelope curve display on the display module.

Selection
- Envelope curve
- Envelope + Map
- Envelope + Ref.
- Raw envelope curve
- Envelope + EWC

Factory setting Envelope curve

Additional information The display of the selected curve is called up as follows:



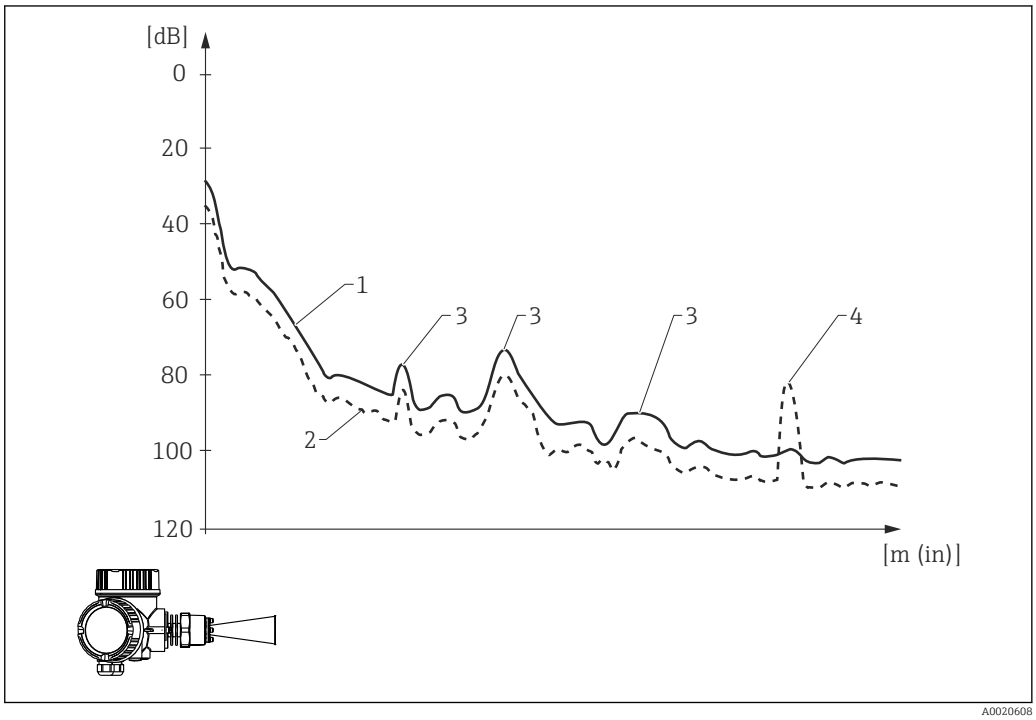
To quit the envelope curve display, press the "+" and "-" keys simultaneously.

When operating via FieldCare, the envelope curve can be displayed in the envelope curve editor (**Device Operation → Device Functions → Additional Functions → Envelope Curve**).

3.4.13 "Mapping" submenu

The mapping is used to suppress static interference signals which may be generatet by internal tank or silo fittings. A **mapping curve**, representing the **envelope curve** of an empty tank or silo as precisely as possible, is used for the mapping.

In the case of a **static envelope curve evaluation** [3] all echos below the mapping curve are ignored in the signal evaluation.



1 Mapping curve
2 Envelope curve
3 Interference echos; covered by the mapping curve
4 Level echo; exceeds the envelope curve

In the case of a **dynamic envelope curve evaluation** [3] echoes from below the map can also be taken into account. In this case the static envelope curve evaluation serves as a starting point as long as enough history information is not yet available.

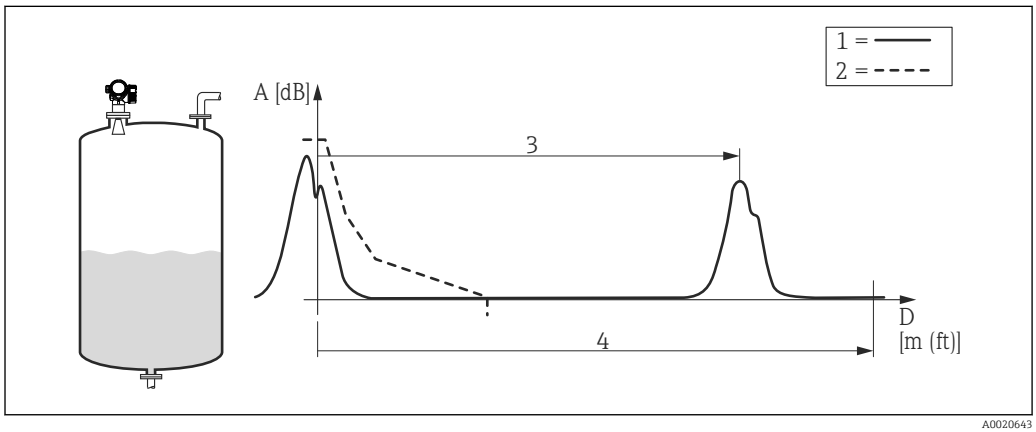
3) For the difference between static and dynamic envelope curve evaluation refer to the "Expert → Sensor → Echo tracking" submenu.

Recording the mapping curve

There are different methods of recording the mapping curve:
- Factory map
- Overlay map
- Record new map

Factory map

The factory map is adapted to the individual antenna and is therefore permanently stored in the device and not recorded by the user. It covers the near field of the antenna (ringing area).



1 Envelope curve
2 Factory map
3 Level distance
4 Empty distance

If a new mapping is recorded, the factory map nevertheless remains in the device and can be reactivated when required by selecting the **Factory map** option in the **Confirm distance** parameter (→ 112).

Overlaying the map

In this case the existing mapping curve (i.e. the factory map or a previously recorded map) initially remains valid.

The envelope curve is observed during the defined **Mapping overlay time**. At each position the highest value reached during the mapping overlay time is used for the new mapping curve. Depending on the circumstances this may be the amplitude of the old mapping curve or an amplitude obtained during the **Mapping overlay time**.

With the help of the overlay mapping it is possible to map not only static but also dynamic signals (e.g. from an agitator).

Map overlaying will be used if one of the options **Distance ok** or **Tank empty** has been selected in the **Confirm distance** parameter (→ 112).

New recording of the mapping curve

In this case the existing map is deleted and a new map is recorded.

In contrast to the overlaying, only the current envelope curve is used here and there is no mapping overlay time. Therefore the new recording is faster than the overlaying. However, dynamic interference echoes can not be suppressed in this way.

A new recording of the map is started in the following way:

1. Go to the **Confirm distance** parameter (→ 112) and select the **Manual map** option.
2. Go to the **Record map** parameter (→ 114) and select the **Record map** option.

Partial mapping / Deleting a map partially

The overlaying or new recording of the map does not necessarily cover the complete measuring range. Instead a partial mapping can be performed.

- The mapping starts at −0.25 m (−0.8 ft), i.e. above the reference point.
- The end point of the mapping range can be defined in the **Mapping end point** parameter (→ 🖹 113).

After these settings, the recording of the mapping curve is started as described above.

The map can also be partially deleted. This is performed as follows:

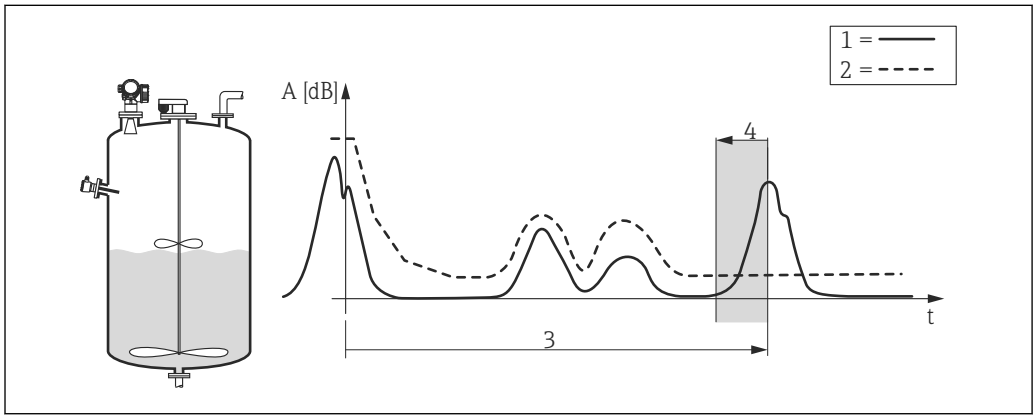
1. Enter the end point of the area to be deleted into the **Mapping end point** parameter (→ 🖹 113).
2. Go to the **Record map** parameter (→ 🖹 114) and select the **Delete partial map** option.

Mapping in the tank bottom area

Irrespective of the definded mapping range, no mapping is recorded near the end of the measuring range (defined in the **Tank/silo height** parameter (→ 58)). In this gap the map assumes a constant value as defined by the **End of mapping (→ 114)** and **End map. ampl. (→ 114)** parameters.

"End of mapping" = "Last map value"

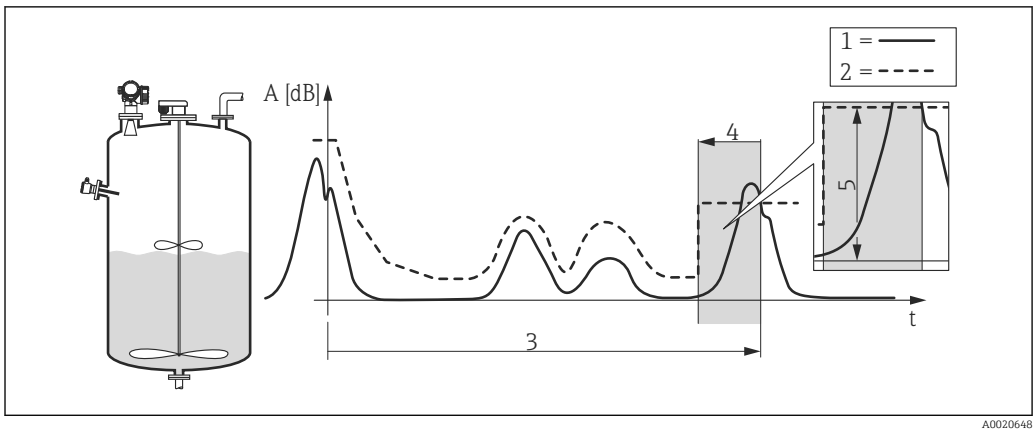
With this setting the last value of the map remains valid within the tank bottom area.



1 *Envelope curve*
2 *Map*
3 *Tank/silo height (→ 58)*
4 *Tank bottom area*

"End of mapping" = "Adjustable"

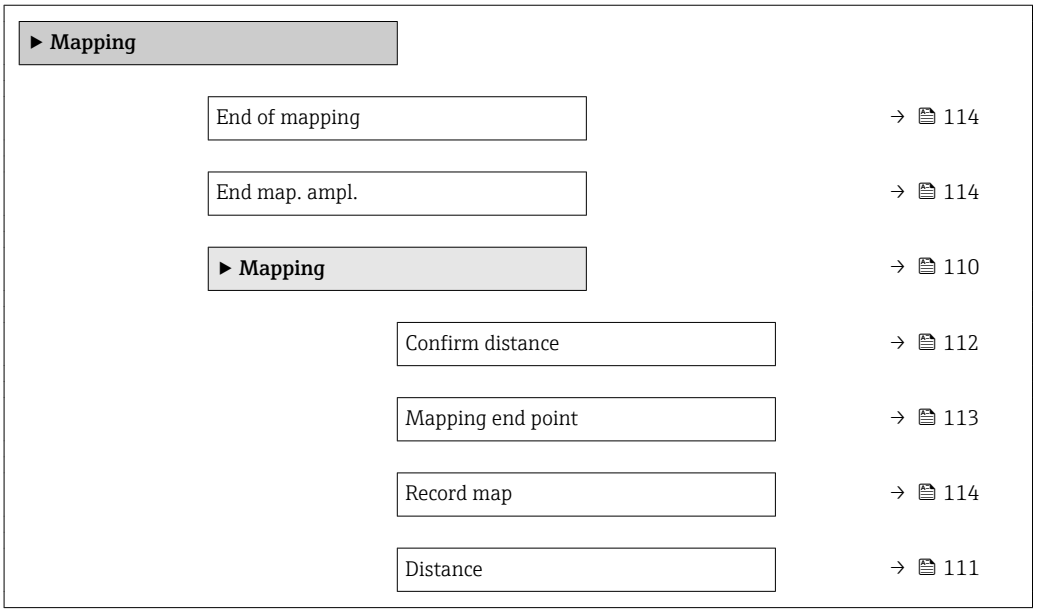
With this setting the value of the mapping curve within the tank bottom area is defined in the **End map. ampl.** parameter (→ 114)



1 *Envelope curve*
2 *Map*
3 *Tank/silo height (→ 58)*
4 *Tank bottom area*
5 *End map. ampl. (→ 114)*

Structure of the submenu on the local display

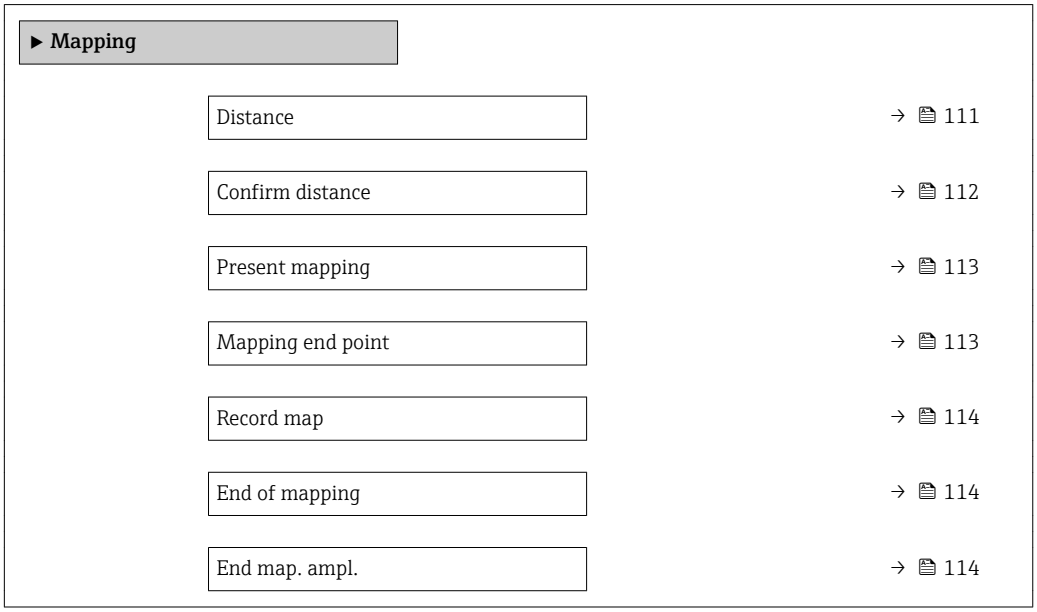
Navigation Expert → Sensor → Mapping



Structure of the submenu in an operating tool

Navigation Expert → Sensor → Mapping

"Mapping" submenu in an operating tool



Description of parameters

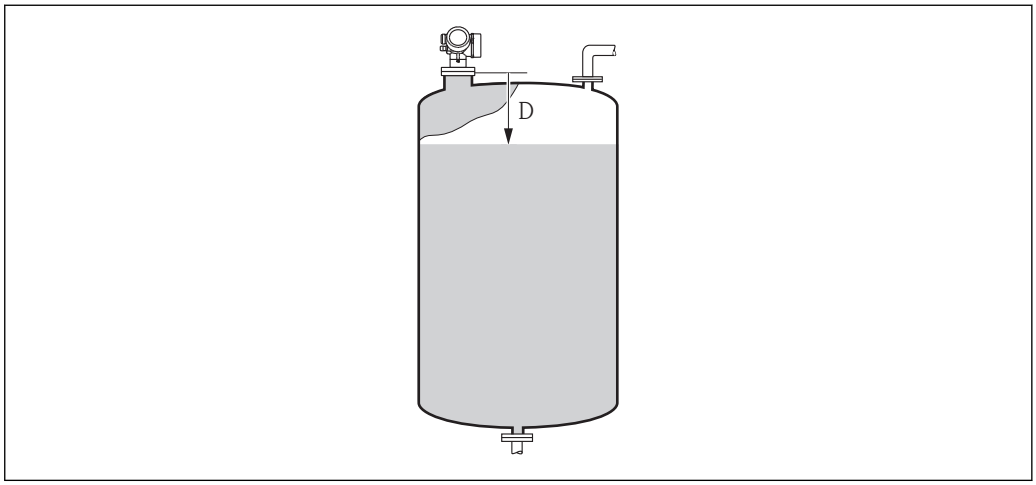
Navigation Expert → Sensor → Mapping

Distance

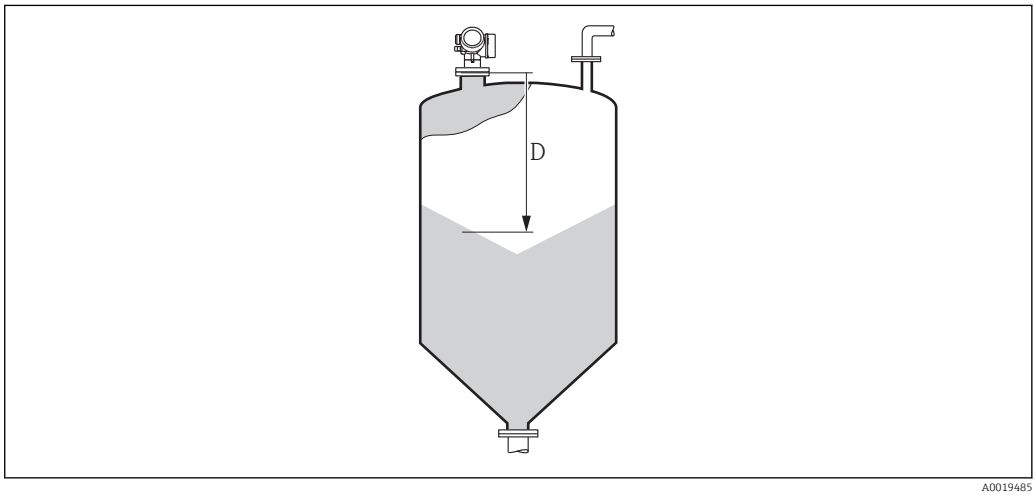
Navigation Expert → Sensor → Mapping → Distance (1124)

Description Displays the measured distance D between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



37 *Distance for liquid measurements*



38 *Distance for bulk solid measurements*

The unit is defined in the **Distance unit** parameter (→ 41).

Confirm distance

Navigation Expert → Sensor → Mapping → Confirm distance (1045)

Description Specify, whether the measured distance matches the real distance.

Depending on the selection the device automatically sets the range of mapping.

Selection
- Manual map
- Distance ok
- Distance unknown
- Distance too small *
- Distance too big *
- Tank empty
- Factory map

Factory setting Distance unknown

Additional information

Meaning of the options
- **Manual map**
  To be selected if the range of mapping is to be defined manually in the **Mapping end point** parameter (→ 113). In this case it is not necessary to confirm the distance.
- **Distance ok**
  To be selected if the measured distance matches the actual distance. The device performs a mapping.
- **Distance unknown**
  To be selected if the actual distance is unknown. A mapping can not be performed in this case.
- **Distance too small**
  To be selected if the measured distance is smaller than the actual distance. The device searches for the next echo and returns to the **Confirm distance** parameter. The distance is recalculated and displayed. The comparison must be repeated until the displayed distance matches the actual distance. After this, the recording of the map can be started by selecting **Distance ok**.

* Visibility depends on order options or device settings

- **Distance too big** [4]
  To be selected if the measured distance exceeds the actual distance. The device adjusts the signal evaluation and returns to the **Confirm distance** parameter. The distance is recalculated and displayed. The comparison must be repeated until the displayed distance matches the actual distance. After this, the recording of the map can be started by selecting **Distance ok**.
- **Tank empty**
  To be selected if the tank is completely empty. The device records a mapping covering the complete measuring range as defined by the **Tank/silo height** parameter (→ 58). By default, **Tank/silo height** = **Empty calibration**.
  Take into account that in case of conical outlets, for example, a measurement is only possible up to the point at which the radar hits the bottom of the tank or silo. If the **Tank empty** option is used, **Empty calibration (→ 52)** and **Tank/silo height** may not reach below this point as otherwise the empty signal is suppressed.
- **Factory map**
  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.

When operating via the display module, the measured distance is displayed together with this parameter for reference purposes.

If the teaching procedure with the **Distance too small** option or the **Distance too big** option is quit before the distance has been confirmed, a map is **not** recorded and the teaching procedure is reset after 60 s.

Present mapping

Navigation Expert → Sensor → Mapping → Present mapping (1182)

Description Indicates up to which distance a mapping has already been recorded.

Mapping end point

Navigation Expert → Sensor → Mapping → Map. end point (1022)

Prerequisite **Confirm distance (→ 112)** = **Manual map** or **Distance too small**

Description Specify new end of the mapping.

User entry 0.1 to 999 999.9 m

Factory setting 0.1 m

Additional information This parameter defines up to which distance the new mapping is to be recorded. The distance is measured from the reference point, i.e. from the lower edge of the mounting flange or the threaded connection.

For reference purposes the **Present mapping** parameter (→ 113) is displayed together with this parameter. It indicates up to which distance a mapping has already been recorded.

4) Only available for "Expert → Sensor → Echo tracking → **Evaluation mode** parameter (→ 121)" = "Short time history" or "Long time history"

Record map

Navigation Expert → Sensor → Mapping → Record map (1069)

Prerequisite **Confirm distance (→ 112)** = **Manual map** or **Distance too small**

Description Start recording of the map.

Selection
- No
- Record map
- Overlay map
- Factory map
- Delete partial map

Factory setting No

Additional information

Meaning of the options
- **No**
  The map is not recorded.
- **Record map**
  The map is recorded. After the recording is completed, the new measured distance and the new mapping range appear on the display. When operating via the local display, these values must be confirmed by pressing ☑.
- **Overlay map**
  The new mapping curve is generated by overlaying the old and the current envelope curves.
- **Factory map**
  The factory map stored in the ROM of the device is used.
- **Delete partial map**
  The mapping curve is deleted up to **Mapping end point (→ 113)**.

End of mapping

Navigation Expert → Sensor → Mapping → End of mapping (1224)

Description Define behavior of the mapping curve in the tank bottom area.

Selection
- Adjustable
- Last map value

Factory setting Adjustable

End map. ampl.

Navigation Expert → Sensor → Mapping → End map. ampl. (1109)

Description Specify the amplitude of the mapping curve in the tank bottom area.

User entry −99 999.0 to 99 999.0 dB

Factory setting −90 dB

3.4.14 "Echo tracking" submenu

The echo tracking algorithm takes into account the change in time of the individual echoes when evaluating the envelope curve. This improves the allocation of the echoes to the level or interface signal. Different types of echo tracking can be selected in the **Evaluation mode** parameter (→ 121). A number of further parameters is used to configure the echo tracking more precisely.

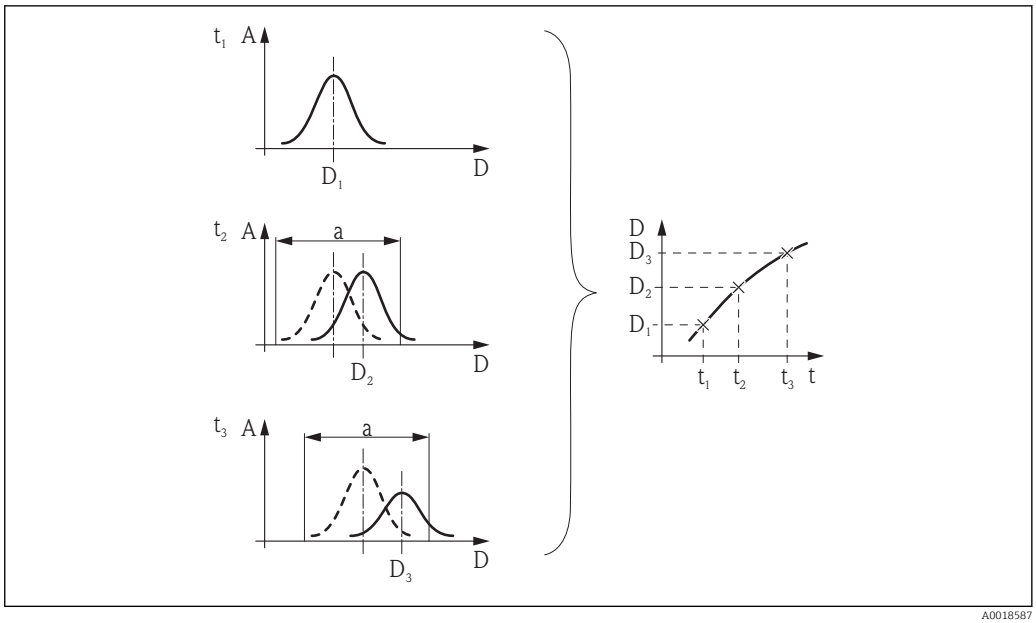
"Evaluation mode" = "History off"

The envelope curve is evaluated statically.

"Evaluation mode" = "Short time history"

The static envelope curve evalauation is taken as a starting point.

The position of the individual echoes is tracked. The track contains the position, the velocity, the relative and the absolute echo amplitude. Normally the strongest echo within a search window is selected and allocated to the track.



39 *Definition of a track: In a new envelope curve, the echo is searched for in a window of width "a" centered around the echo position in the previous envelope curve. The change of the echo position in the course of time defines the track.*

In this evaluation mode it is possible to activate the moving track recognition (**Moving track recognition** parameter).

The moving track recognition is used to distinguish the level echo from interference echoes. It makes use of the fact that an echo which moves in one direction for a certain time is likely to be the level echo. Interference echoes, on the other hand, normally stay at the same position within the envelope curve.

If the moving track recognition is switched on, this distinction is used as an additional criterion to identify the level echo.

In firmware version 01.00.zz the allocation of the echoes to the track depends on the current position of the echo (for details refer to SI01373F-3):

- If the echo is within the tank bottom area (parameter **Tank bottom range (→ 125)**), the first echon within th search window is allocated to the track.
- If the echo is above the tank bottom area, the largest echo within the search window is allocated to the track.

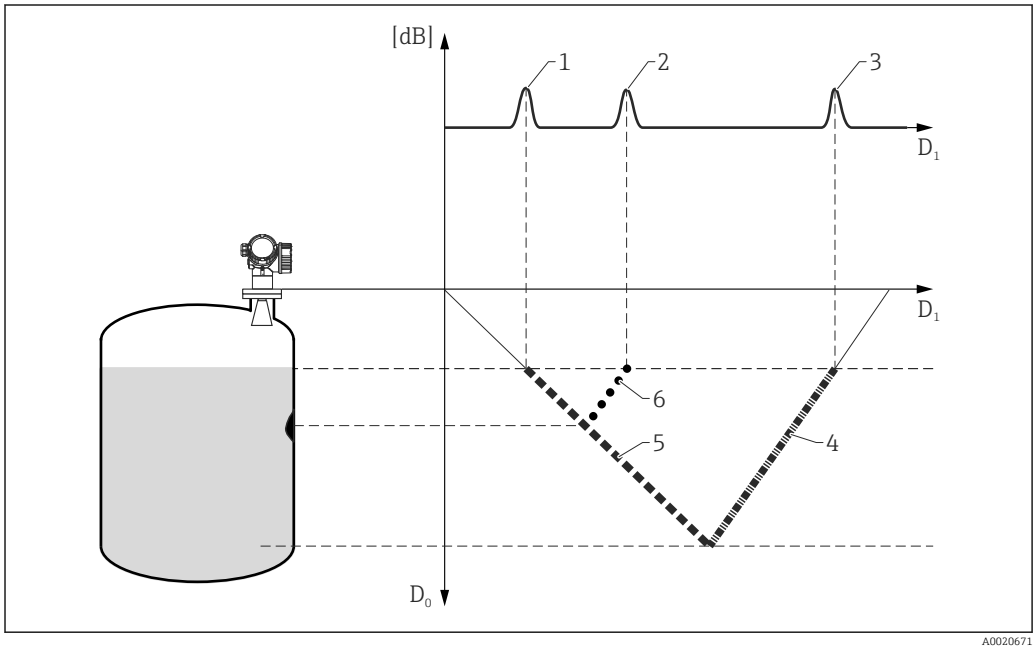
From firmware version 01.01.zz the largest echo within the search window is allocated to the track in any case.

"Evaluation mode" = "Long time history"

A so-called tank history is used for the determination of the level and a consistency check of the echoes.

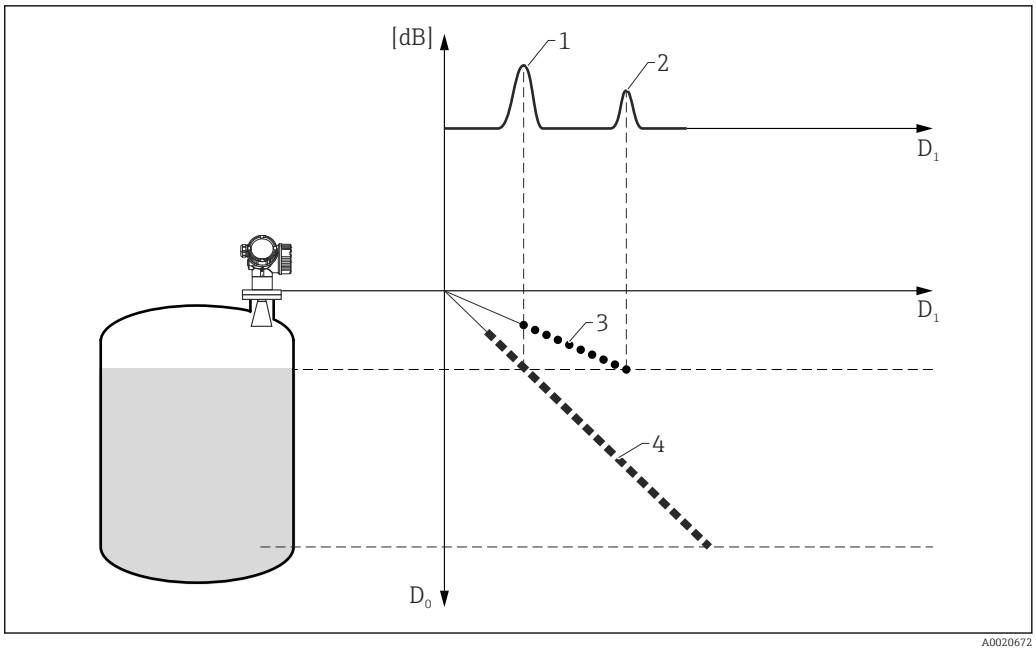
For a given tank with a given medium, the positions of the level, interface, multiple and end-of-probe or tank bottom echoes are in a defined relation to each other. This relationship is recorded during the operation of the device and stored in the tank history. On the basis of this tank history, echoes can be reliably allocated, even if one echo is lost temporarily or if the device was switched off for a while.

Schematic exmaples



40 Example 1: Tank history with interference echo and tank-bottom echo

D0 Actual level distance
D1 Distance of the signal in the envelope curve
1 Level echo
2 Interference echo
3 Tank-bottom echo
4 Track "Tank-bottom echo" (stored in the tank history)
5 Track "Level echo" (stored in the tank history)
6 Track "Interference echo" (stored in the tank history)

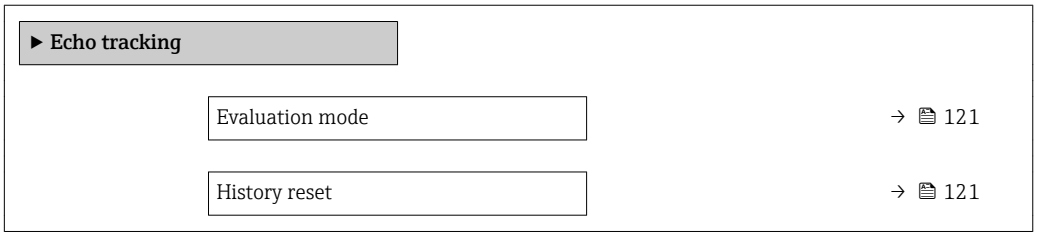


41 Example 2: Tank history with a multiple echo

D0 Actual level distance
D1 Distance of the signal in the envelope curve
1 Level echo
2 Multiple echo
3 Track "Multiple echo" (stored in the tank history)
4 Track "Level echo" (stored in the tank history)

Structure of the submenu

Navigation Expert → Sensor → Echo tracking



Description of parameters

Navigation Expert → Sensor → Echo tracking

Evaluation mode

Navigation Expert → Sensor → Echo tracking → Evaluation mode (1112)

Description Select evaluation mode for echo tracking.

Selection
- History off
- Short time history
- Long time history *

Factory setting Dependent on the **Tank type (→ 41)** or **Bin type (→ 42)** parameter, respectively.

Additional information

Meaning of the options
- **History off**
  The envelope curve is evaluated only statically.
- **Short time history**
  In addition to the static algorithms a dynamic echo trace is continuously created.
- **Long time history**
  (Only available for level measurements)
  In addition to the static algorithms and the dynamic echo trace a tank trace is continuously generated. Using the tank trace the device can determine the level even if the level echo ist lost temporarily.

The **Long time history** option is not recommended if there are substantial changes of the medium or process conditions within a short period of time (e.g. in the case of changing dielectric constants or boiling media).

History reset

Navigation Expert → Sensor → Echo tracking → History reset (1145)

Description Reset history of the echo and tank tracking.

Selection
- Reset done
- Restart echo tracking
- Delete history

Factory setting Reset done

* Visibility depends on order options or device settings

Additional information

Meaning of the options

- **Reset done**
  Does not initiate an action but is only a display option. It is displayed as soon as the reset operation has been accomplished.
- **Restart echo tracking**
  The echo tracking is reset. The tank trace, however, is maintained.
- **Delete history**
  The echo tracking and tank trace are reset.

3.4.15 "Tank bottom evaluation" submenu

The tank bottom evaluation is intended to prevent an echo loss if the tank is empty.

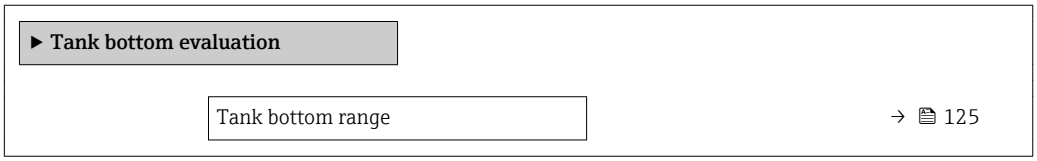
If no echo is found within the defined tank height (**Tank/silo height (→ 58)**) the tank bottom searches beyond this distance in the **Tank bottom range (→ 125)**, to see whether an echo from the tank bottom exists.

If a tank bottom echo has been found, a level of 0% is assumed. If neither a direct level echo nor a tank bottom echo has been found, an echo loss is reported (error message S941).

- Level echoes from within the measruing range always have a higher priority than the tank bottom echo.
- The first echo factor is not applied to the tank bottom echo.

Structure of the "Tank bottom evaluation" submenu

Navigation Expert → Sensor → Tank bottom eval



Description of parameters

Navigation Expert → Sensor → Tank bottom eval

Tank bottom range

Navigation Expert → Sensor → Tank bottom eval → TB range (1149)

Description Define range (starting from **Tank/silo height (→ 58)**) in which the tank bottom echo is searched for.

User entry 0 to 99.999 m

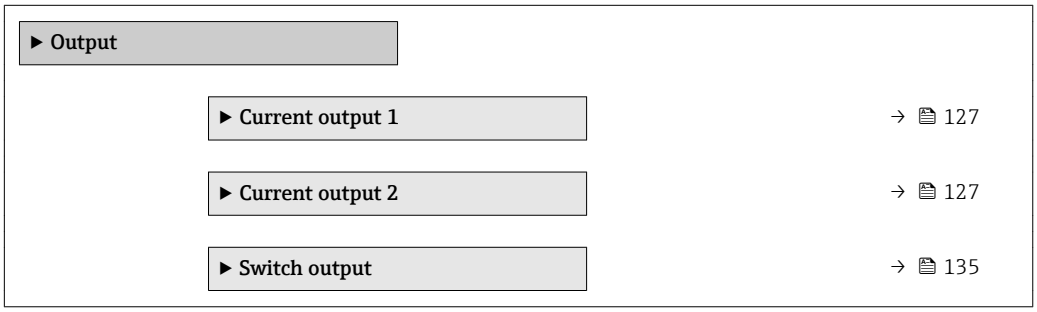
Factory setting 1 m

3.5 "Output" submenu

The **Output** submenu contains all parameters needed to configure the current and switch outputs.

3.5.1 Structure of the submenu

Navigation Expert → Output

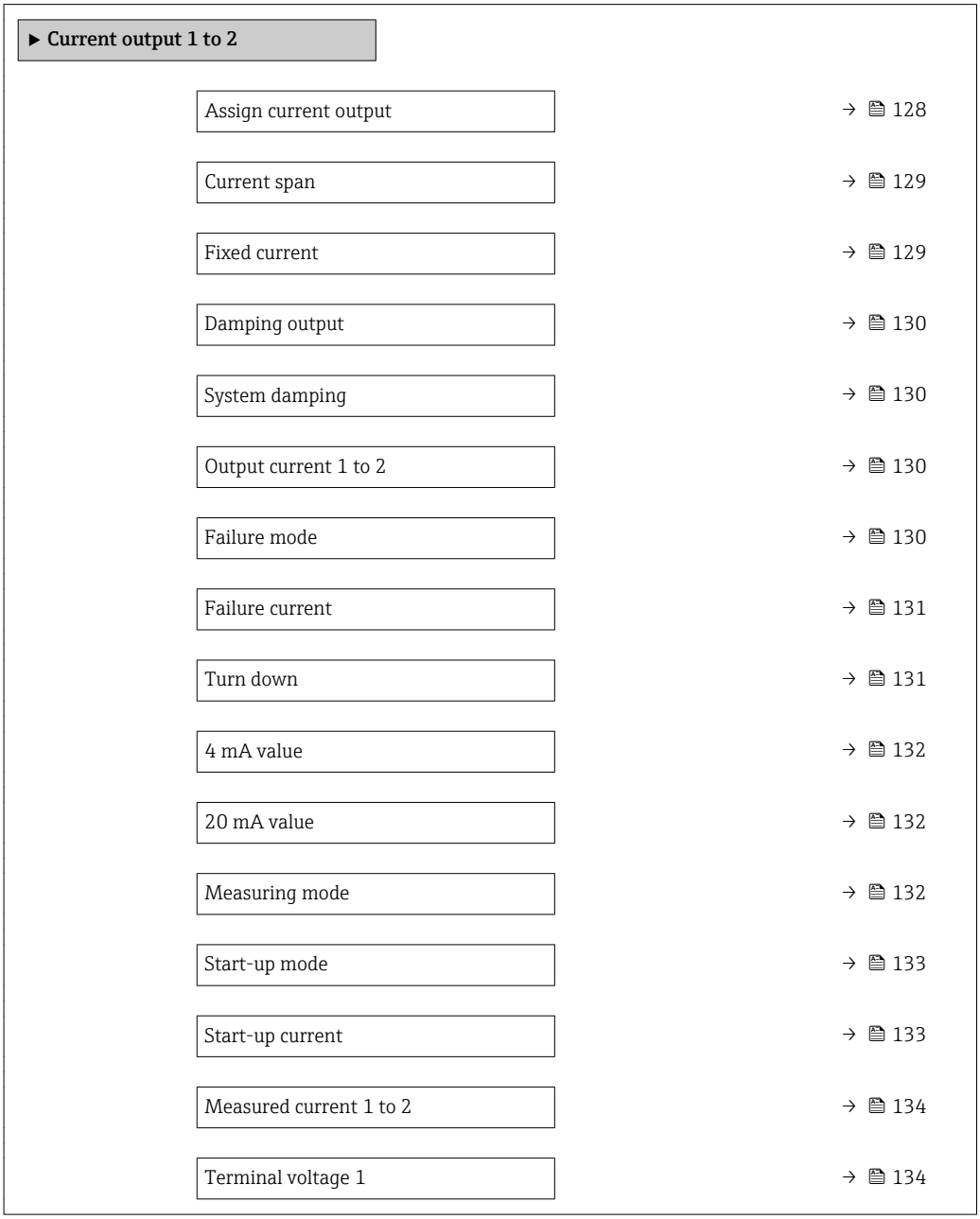


3.5.2 "Current output 1 to 2" submenu

There is a **Current output** submenu for each current output of the device (1 or 2 depending on the device version).

Structure of the submenu

Navigation Expert → Output → Curr.output 1 to 2



Description of parameters

Navigation Expert → Output → Curr.output 1 to 2

Assign current output 1 to 2

Navigation Expert → Output → Curr.output 1 to 2 → Assign curr. (0359–1 to 2)

Description Select process variable for current output.

Selection
- Level linearized
- Distance
- Electronic temperature
- Relative echo amplitude
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2
- Area of incoupling

Factory setting
- Current output 1: Level linearized
- Current output 2 [5]: Relative echo amplitude

Additional information *Definition of the current range for the process variables*

Process variable	4 mA value	20 mA value
Level linearized	0 % [1] or the associated linearized value	100 % [2] or the associated linearized value
Distance	0 (i.e. level is at the reference point)	**Empty calibration (→ 52)** (i.e. level is at 0 %)
Electronic temperature	−50 °C (−58 °F)	100 °C (212 °F)
Relative echo amplitude	0 dB	150 dB
Analog output adv. diagnostics 1/2	depending on the parametrization of the Advanced Diagnostics	
Area of incoupling	0	100

1) the 0% level is defined by **Empty calibration** parameter (→ 52)
2) The 100% level is defined by **Full calibration** parameter (→ 53)

It may be necessary to adjust the 4mA and 20mA values to the application (especially in the case of the **Analog output adv. diagnostics 1/2** and **Area of incoupling** options).

This can be done by the following parameters:
- Expert → Output → Curr.output 1 to 2 → Turn down (0358–1 to 2)
- Expert → Output → Curr.output 1 to 2 → 4 mA value (0367–1 to 2)
- Expert → Output → Curr.output 1 to 2 → 20 mA value (0372–1 to 2)

5) only for devices with two current outputs

Current span

Navigation Expert → Output → Curr.output 1 to 2 → Current span (0353–1 to 2)

Description Select current range for process variable and alarm signal.

Selection
- 4...20 mA
- 4...20 mA NAMUR
- 4...20 mA US
- Fixed current

Factory setting 4...20 mA NAMUR

Additional information *Meaning of the options*

Option	Current range for process variable	Lower alarm signal level	Upper alarm signal level
4...20 mA	4 to 20.5 mA	< 3.6 mA	> 21.95 mA
4...20 mA NAMUR	3.8 to 20.5 mA	< 3.6 mA	> 21.95 mA
4...20 mA US	3.9 to 20.8 mA	< 3.6 mA	> 21.95 mA
Fixed current	Constant current, defined in the **Fixed current** parameter (→ 129).		

- In the case of an error, the output current assumes the value defined in the **Failure mode** parameter (→ 130).
- If the meausred value is out of the measuring range, diagnostic message **Current output** is issued.

In a HART multidrop loop only one device can use the analog current to transmit a signal. For all other devices one must set:
- **Current span** = **Fixed current**
- **Fixed current (→ 129)** = **4 mA**

Fixed current

Navigation Expert → Output → Curr.output 1 to 2 → Fixed current (0365–1 to 2)

Prerequisite **Current span (→ 129)** = **Fixed current**

Description Define constant value of the current.

User entry 4 to 22.5 mA

Factory setting 4 mA

Damping output

Navigation Expert → Output → Curr.output 1 to 2 → Damping out. (0363–1 to 2)

Description Define time constant τ for the damping of the output current.

User entry 0.0 to 999.9 s

Factory setting 0.0 s

Additional information Fluctuations of the measured value affect the output current with an exponential delay, the time constant τ of which is defined in this parameter. With a small time constant the output reacts immediately to changes of the measrued value. With a big time constant the reaction of the output is more delayed. For τ = 0 (factory setting) there is no damping.

System damping

Navigation Expert → Output → Curr.output 1 → System damping (1174–1)

Prerequisite Only for current output 1

Description Indicates the global sum of all damping values.

Additional information If the velocity is limited by the draining or filling filter [6], this is not taken into account in the indicated system damping.

Output current 1 to 2

Navigation Expert → Output → Curr.output 1 to 2 → Output curr. 1 to 2 (0361–1 to 2)

Description Displays calculated output current.

Failure mode

Navigation Expert → Output → Curr.output 1 to 2 → Failure mode (0364–1 to 2)

Prerequisite **Current span (→ 129) ≠ Fixed current**

Description Select behavior of the output current in case of an error.

6) to be defined in the "Process property", "Draining speed" and "Filling speed" parameters

Selection
- Min.
- Max.
- Last valid value
- Actual value
- Defined value

Factory setting
Max.

Additional information

Meaning of the options
- **Min.**
  The current output adopts the value of the lower alarm level according to the **Current span** parameter (→ 129).
- **Max.**
  The current output adopts the value of the upper alarm level according to the **Current span** parameter (→ 129).
- **Last valid value**
  The current remains constant at the last value it hat before the error occurred.
- **Actual value**
  The output current follows the actual measured value; the error is ignored.
- **Defined value**
  The output current assumes the value defined in the **Failure current** parameter (→ 131).

The error behavior of other output channels is not influenced by these settings but is defined in separate parameters.

Failure current

Navigation
Expert → Output → Curr.output 1 to 2 → Failure current (0352–1 to 2)

Prerequisite
Failure mode (→ 130) = Defined value

Description
Enter current output value in alarm condition.

User entry
3.59 to 22.5 mA

Factory setting
22.5 mA

Turn down

Navigation
Expert → Output → Curr.output 1 to 2 → Turn down (0358–1 to 2)

Prerequisite
Current span (→ 129) ≠ Fixed current

Description
Switch the current turn down functionality on or off.

Selection
- Off
- On

Factory setting
Off

Additional information Using the turn down functionality it is possible to map a section of the measuring range to the total range of the output current (4-20mA). The section is defined by the 4 mA value (→ 🖹 132) and 20 mA value (→ 🖹 132) parameters.

Without the turn down, the complete measuring range (0 to 100%) is mapped to the current output (4 to 20mA).

4 mA value

Navigation Expert → Output → Curr.output 1 to 2 → 4 mA value (0367–1 to 2)

Prerequisite **Turn down (→ 🖹 131)** = **On**

Description Enter value of the process variable for 4 mA.

User entry Signed floating-point number

Factory setting 0.0 %

20 mA value

Navigation Expert → Output → Curr.output 1 to 2 → 20 mA value (0372–1 to 2)

Prerequisite **Turn down** parameter (→ 🖹 131) = **On**

Description Enter value of the process variable for 20 mA.

User entry Signed floating-point number

Factory setting 0.0 %

Additional information If **20 mA value** is smaller than **4 mA value (→ 🖹 132)**, the current output is inverted, which means that an increase of the process variable results in a decrease of the output current.

Measuring mode

Navigation Expert → Output → Curr.output 1 to 2 → Measuring mode (0351–1 to 2)

Prerequisite **Current span (→ 🖹 129)** ≠ **Fixed current**

Description Select measuring mode of the current output.

Selection
- Standard
- Inverse

Factory setting Standard

Additional information

Meaning of the options
- **Standard**
  If the level increases, the output current increases as well.
- **Inverse**
  If the level increases, the output current decreases.

Start-up mode

Navigation Expert → Output → Curr.output 1 → Start-up mode (0368–1)

Prerequisite
- **Current span (→ 129) ≠ Fixed current**
- Only for current output 1

Description Select behavior of the current output during start-up.

Selection
- Min.
- Max.
- Defined value

Factory setting Min.

Additional information

Meaning of the options
- **Min.**
  The start-sup current corresponds to the lower edge of the range selected in the **Current span** parameter (→ 129).
- **Max.**
  The start-up current corresponds to the upper edge of the range selected in the **Current span** parameter (→ 129).
- **Defined value**
  The value of the start-up current is defined in the **Start-up current** parameter (→ 133).

Start-up current

Navigation Expert → Output → Curr.output 1 → Start-up current (0369–1)

Prerequisite
- **Start-up mode (→ 133) = Defined value**
- Only for current output 1

Description Define value the current output assumes during start-up.

User entry 3.59 to 22.5 mA

Factory setting 3.6 mA

Measured current 1

Navigation Expert → Output → Curr.output 1 → Measur. curr. 1 (0366–1)

Prerequisite Only available for current output 1

Description Displays the measured value of the output current.

Terminal voltage 1

Navigation Expert → Output → Curr.output 1 → Terminal volt. 1 (0662)

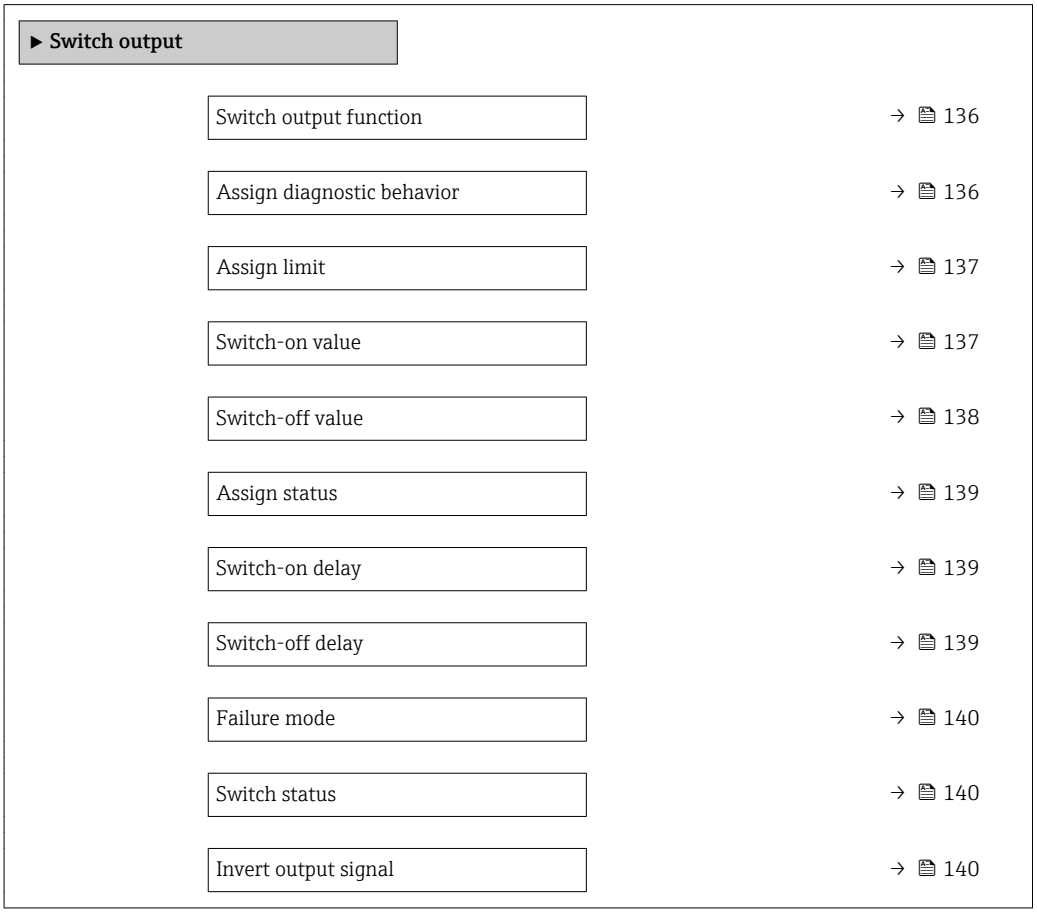
Description Dipslays terminal voltage at the current output.

3.5.3 "Switch output" submenu

The **Switch output** submenu is used to configure the switch output of the device.

Structure of the submenu

Navigation Expert → Output → Switch output



Description of parameters

Navigation Expert → Output → Switch output

Switch output function

Navigation Expert → Output → Switch output → Switch out funct (0481)

Description Select function for switch output.

Selection
- Off
- On
- Diagnostic behavior
- Limit
- Digital Output

Factory setting Off

Additional information

Meaning of the options
- **Off**
  The output is always open (non-conductive).
- **On**
  The output is always closed (conductive).
- **Diagnostic behavior**
  The output is normally closed and is only opened if a diagnostic event is present. The **Assign diagnostic behavior** parameter (→ 136) determines for which type of event the output is opened.
- **Limit**
  The output is normally closed and is only opened if a measured variable exceeds or falls below a defined limit. The limit values are defined by the following parameters:
  – **Assign limit (→ 137)**
  – **Switch-on value (→ 137)**
  – **Switch-off value (→ 138)**
- **Digital Output**
  The switching state of the output tracks the output value of a DI function block. The function block is selected in the **Assign status** parameter (→ 139).

The **Off** and **On** options can be used to simulate the switch output.

Assign diagnostic behavior

Navigation Expert → Output → Switch output → Assign diag. beh (0482)

Prerequisite **Switch output function (→ 136)** = **Diagnostic behavior**

Description Select diagnostic behavior for switch output.

Selection
- Alarm
- Alarm or warning
- Warning

Factory setting Alarm

Assign limit

Navigation Expert → Output → Switch output → Assign limit (0483)

Prerequisite **Switch output function (→ 136) = Limit**

Description Select process variable for limit monitoring.

Selection
- Off
- Level linearized
- Distance
- Terminal voltage
- Electronic temperature
- Relative echo amplitude
- Area of incoupling

Factory setting Off

Switch-on value

Navigation Expert → Output → Switch output → Switch-on value (0466)

Prerequisite **Switch output function (→ 136) = Limit**

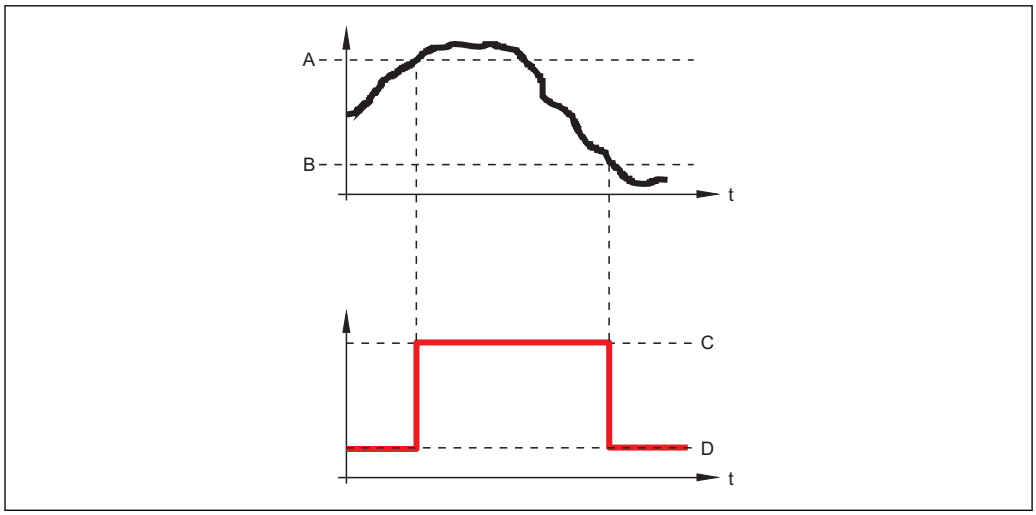
Description Enter measured value for the switch-on point.

User entry Signed floating-point number

Factory setting 0

Additional information The switching behavior depends on the relative position of the **Switch-on value** and **Switch-off value** parameters:

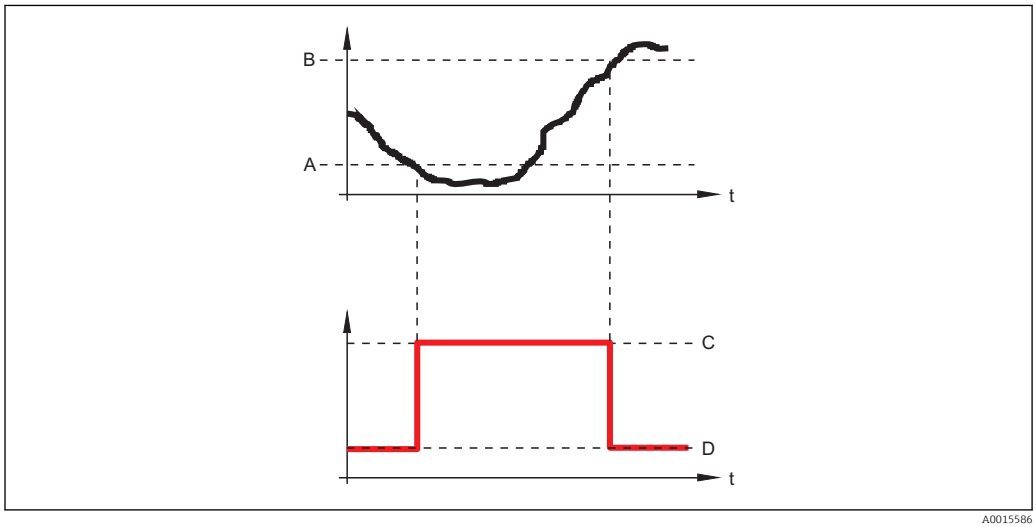
Switch-on value > Switch-off value
– The output is closed if the measured value is larger than **Switch-on value**.
– The output is opened if the measured value is smaller than **Switch-off value**.



A0015585

A Switch-on value
B Switch-off value
C Output closed (conductive)
D Output opened (non-conductive)

Switch-on value < Switch-off value
– The output is closed if the measured value is smaller than **Switch-on value**.
– The output is opened if the measured value is larger than **Switch-off value**.



A0015586

A Switch-on value
B Switch-off value
C Output closed (conductive)
D Output opened (non-conductive)

Switch-off value

Navigation Expert → Output → Switch output → Switch-off value (0464)

Prerequisite **Switch output function (→ 136) = Limit**

Description Enter measured value for the switch-off point.

User entry Signed floating-point number

Factory setting 0

Additional information The switching behavior depends on the relative position of the **Switch-on value** and **Switch-off value** parameters; description: see the **Switch-on value** parameter (→ 137).

Assign status

Navigation Expert → Output → Switch output → Assign status (0485)

Prerequisite **Switch output function (→ 136)** = **Digital Output**

Description Select device status for switch output.

Selection
- Off
- Digital output AD 1
- Digital output AD 2

Factory setting Off

Additional information The **Digital output AD 1** and **Digital output AD 2** options refer to the Advanced Diagnostic Blocks → 186. A switch signal generated in these blocks can be transmitted via the switch output.

Switch-on delay

Navigation Expert → Output → Switch output → Switch-on delay (0467)

Prerequisite
- **Switch output function (→ 136)** = **Limit**
- **Assign limit (→ 137)** ≠ **Off**

Description Define switch-on delay.

User entry 0.0 to 100.0 s

Factory setting 0.0 s

Switch-off delay

Navigation Expert → Output → Switch output → Switch-off delay (0465)

Prerequisite
- **Switch output function (→ 136)** = **Limit**
- **Assign limit (→ 137)** ≠ **Off**

Description Define switch-off delay.

User entry 0.0 to 100.0 s

Factory setting 0.0 s

Failure mode

Navigation Expert → Output → Switch output → Failure mode (0486)

Description Define output behavior in alarm condition.

Selection
- Actual status
- Open
- Closed

Factory setting Open

Switch status

Navigation Expert → Output → Switch output → Switch status (0461)

Description Displays the current state of the switch output.

Invert output signal

Navigation Expert → Output → Switch output → Invert outp.sig. (0470)

Description Specify whether the output signal is to be inverted.

Selection
- No
- Yes

Factory setting No

Additional information

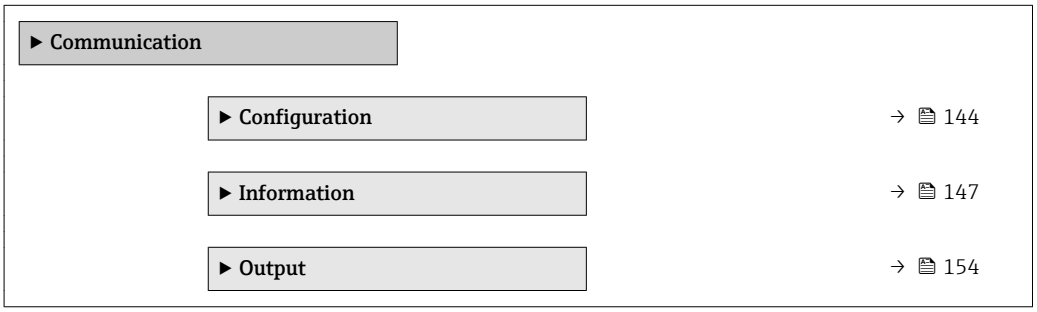
Meaning of the options
- **No**
  The behavior of the switch output is as described above.
- **Yes**
  The states **Open** and **Closed** are inverted as compared to the description above.

3.6 "Communication" submenu

The **Communication** submenu (→ 141) contains all parameters needed to configure the HART communication interface.

3.6.1 Structure of the submenu

Navigation Expert → Communication



3.6.2 "Diagnostic configuration" submenu

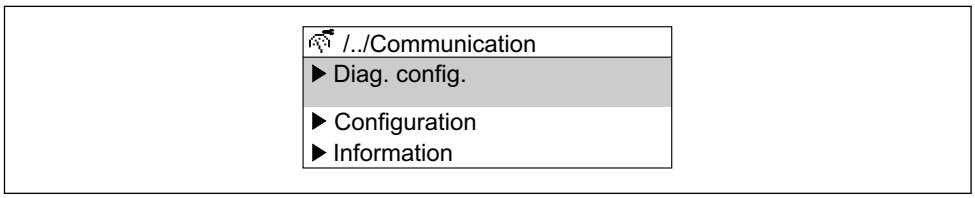
This submenu is used to allocate a status according to NAMUR recommendation NE107 to individual error messages. This applies to the following error messages:

- **In safety distance**
- **Echo lost**
- **Advanced diagnostic occured** (if an advanced diagnostics has been activated.)

Navigation Expert → Communication → Diag. config.

Configuration via local display

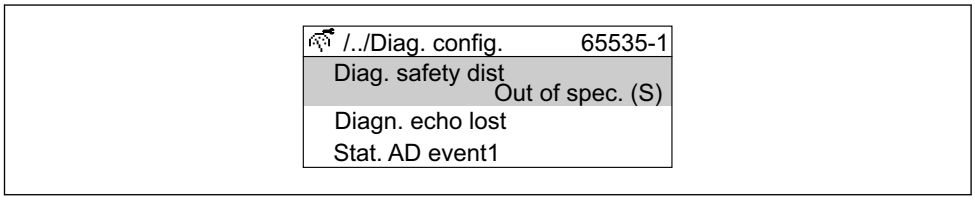
1.



A0030197-EN

Go to the **Diagnostic configuration** submenu.

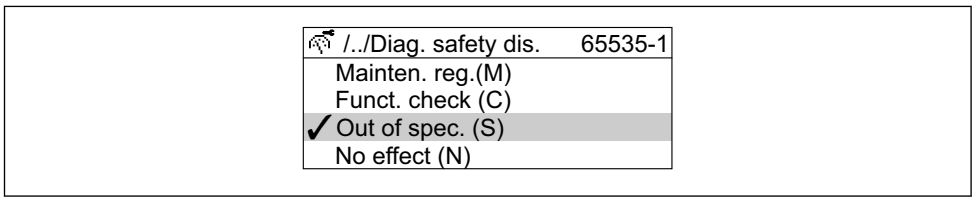
2.



A0030198-EN

Select an error message.

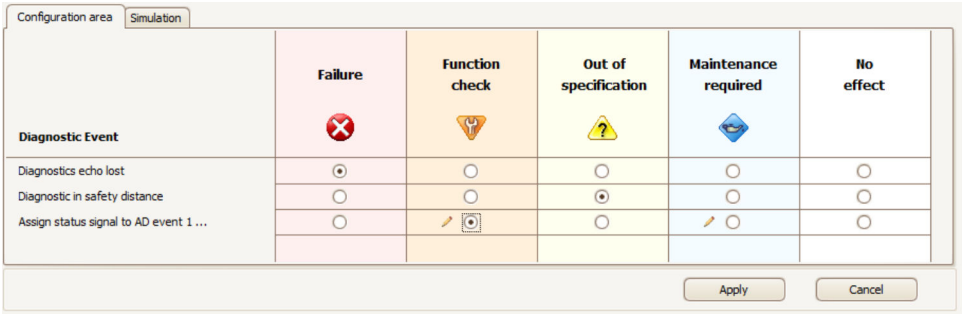
3.



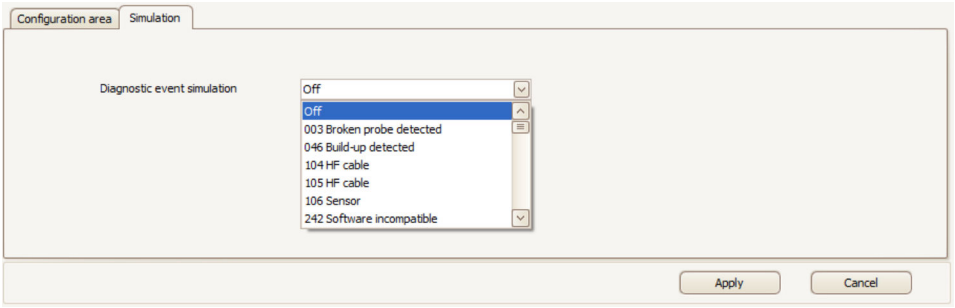
A0030199-EN

Select a status according to NE107.

Configuration via FieldCare

1. Go to the **Diagnostic configuration** submenu.
2. 

   Mark the desired behavior of the individual error messages in the table and click "Apply" to confirm your selection.

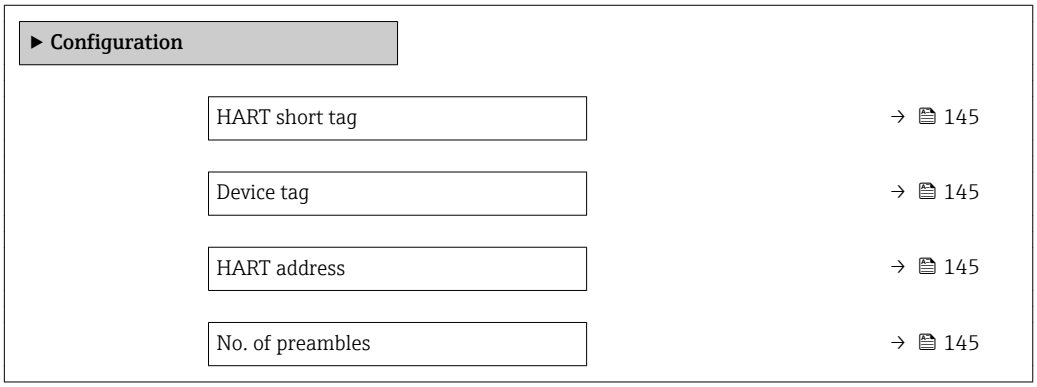
3. 

   Error messages can be simulated in the "Simulation" dialog in order to check the correct behavior.

3.6.3 "Configuration" submenu

Structure of the submenu

Navigation Expert → Communication → Configuration



Description of parameters

Navigation Expert → Communication → Configuration

HART short tag

Navigation Expert → Communication → Configuration → HART short tag (0220)

Description Define short tag for the measuring point.

Factory setting SHORTTAG

Device tag

Navigation Expert → Communication → Configuration → Device tag (0215)

Description Enter the name for the measuring point.

Factory setting FMR5x

HART address

Navigation Expert → Communication → Configuration → HART address (0219)

Description Define HART address of the device.

User entry 0 to 63

Factory setting 0

Additional information
- Measured value transmission via the current value is only possible for address "0". For any other address the current is fixed at 4.0 mA (multidrop mode).
- For a system according to HART 5.0 possible addresses are 0 to 15.
- For a system according to HART 6.0 possible addresses are 0 to 63.

No. of preambles

Navigation Expert → Communication → Configuration → No. of preambles (0217)

Description Define number of preambles within the HART telegram.

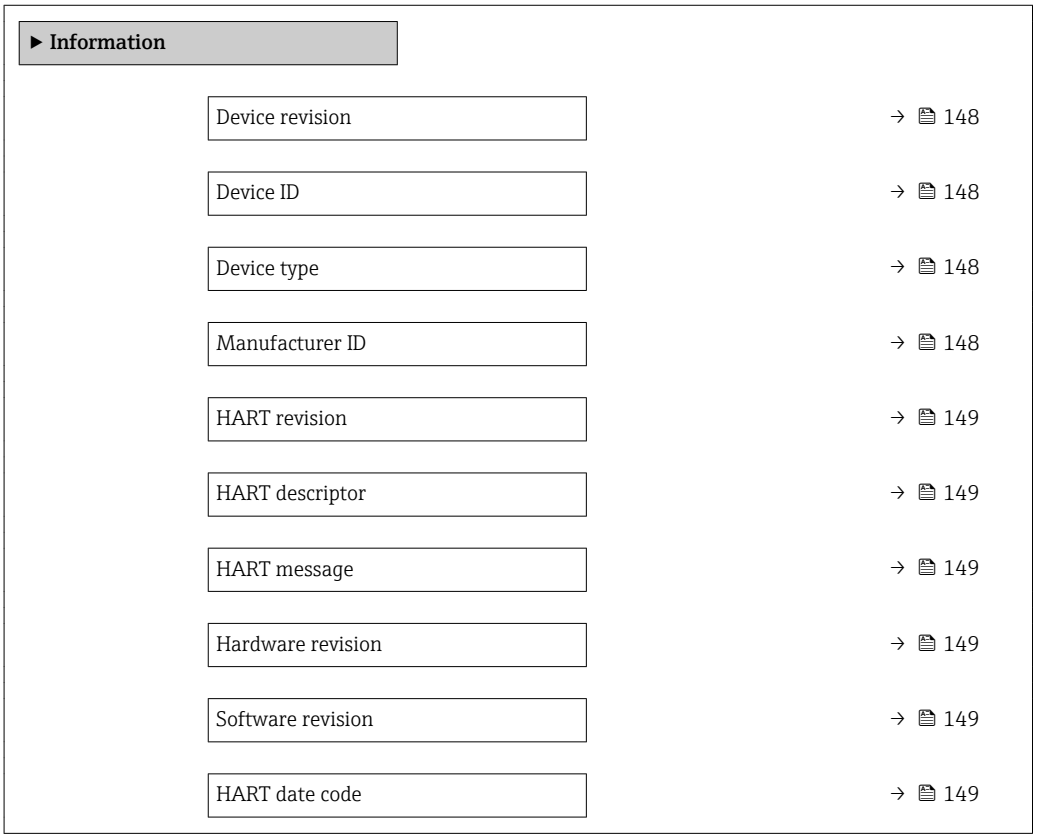
User entry 2 to 20

Factory setting 5

3.6.4 "Information" submenu

Structure of the submenu

Navigation Expert → Communication → Information



Description of parameters

Navigation Expert → Communication → Information

Device revision

Navigation Expert → Communication → Information → Device revision (0204)

Description Displays the device revision registered for this device at the HART Communication Foundation.

Additional information The device revision is used to allocate the correct Device Description file (DD) to the device.

Device ID

Navigation Expert → Communication → Information → Device ID (0221)

Description Displays Device ID.

Additional information In addition to the Device type and Manufacturer ID, the Device ID is part of the unique device identification (Unique ID) which characterizes each HART device unambiguously.

Device type

Navigation Expert → Communication → Information → Device type (0222)

Description Displays the device type with which the device is registered with the the HART Communication Foundation.

Additional information The device type is needed to allocate the correct Device Description file (DD) to the device.

Manufacturer ID

Navigation Expert → Communication → Information → Manufacturer ID (0223)

Description Displays the manufactured ID with which the device is registered with the HART Communication Foundation.

HART revision

Navigation Expert → Communication → Information → HART revision (0205)

Description Indicates HART revision of the device.

HART descriptor

Navigation Expert → Communication → Information → HART descriptor (0212)

Description Enter descriptor for the measuring point.

Factory setting FMR5x

HART message

Navigation Expert → Communication → Information → HART message (0216)

Description Define HART message which is sent via the HART protocol if requested by the master.

Factory setting FMR5x

Hardware revision

Navigation Expert → Communication → Information → Hardware rev. (0206)

Description Indicates hardware revision of the device.

Software revision

Navigation Expert → Communication → Information → Software rev. (0224)

Description Indicates software revision of the device.

HART date code

Navigation Expert → Communication → Information → HART date code (0202)

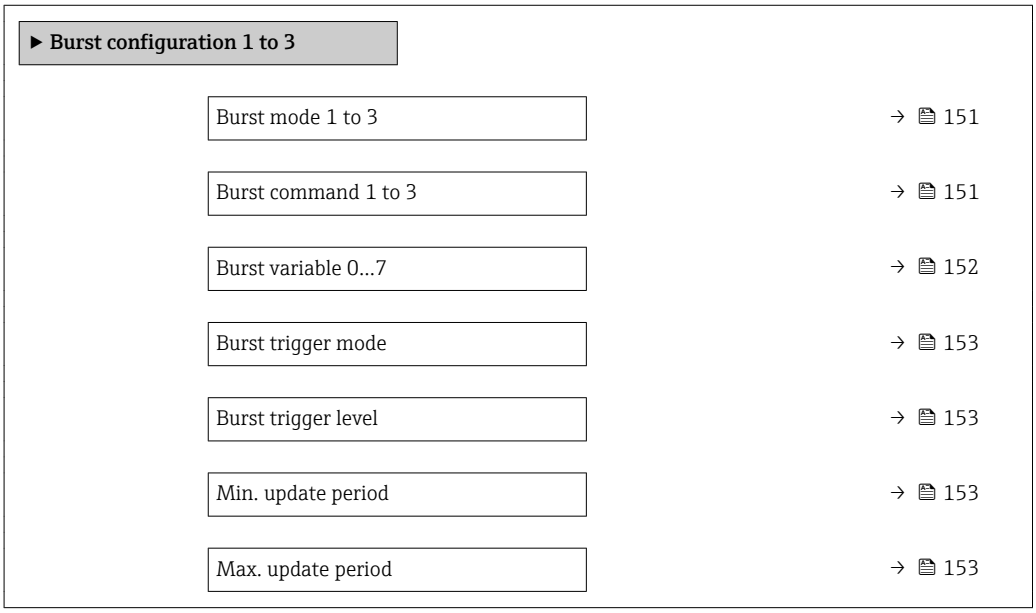
Description Enter date of the last configuration change.

Additional information Format: YYYY-MM-DD

3.6.5 "Burst configuration 1 to 3" submenu

Structure of the submenu

Navigation Expert → Communication → Burst config. 1 to 3



Description of parameters

Navigation Expert → Communication → Burst config. 1 to 3

Burst mode 1 to 3

Navigation Expert → Communication → Burst config. 1 to 3 → Burst mode 1 to 3 (2032–1 to 3)

Description Switch HART burst mode for burst message on.

Selection
- Off
- On

Factory setting Off

Burst command 1 to 3

Navigation Expert → Communication → Burst config. 1 to 3 → Burst command 1 to 3 (2031–1 to 3)

Description Select the HART command that is sent to the HART master.

Selection
- Command 1
- Command 2
- Command 3
- Command 9
- Command 33
- Command 48

Factory setting Command 2

Burst variable 0...7

Navigation Expert → Communication → Burst config. 1 to 3 → Burst variable 0 (2033)

Description For HART command 9 and 33, assign a HART device variable or process variable to burst variable.

Selection
- Level linearized
- Distance
- Unfiltered distance
- Interface *
- Interface distance *
- Unfiltered interface distance *
- Thickness upper layer *
- Terminal voltage
- Electronic temperature
- Measured capacitance *
- Absolute echo amplitude
- Relative echo amplitude
- Absolute interface amplitude *
- Relative interface amplitude *
- Absolute EOP amplitude
- Noise of signal
- EOP shift
- Calculated DC value *
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2
- Not used
- Percent of range
- Measured current
- Primary variable (PV)
- Secondary variable (SV)
- Tertiary variable (TV)
- Quaternary variable (QV)

Factory setting Not used

* Visibility depends on order options or device settings

Burst trigger mode

Navigation Expert → Communication → Burst config. 1 to 3 → Trigger mode (2044–1 to 3)

Description Select the event that triggers the burst message.

Selection
- Continuous
- Window
- Rising
- Falling
- On change

Factory setting Continuous

Burst trigger level

Navigation Expert → Communication → Burst config. 1 to 3 → Trigger level (2043–1 to 3)

Description Enter the burst trigger value that determines together with the option selected in 'Burst trigger mode' parameter the time of burst message.

User entry Positive floating-point number

Factory setting 2.0E-38

Min. update period

Navigation Expert → Communication → Burst config. 1 to 3 → Min. upd. per. (2042–1 to 3)

Description Enter the minimum time span between two burst responses of one burst message.

User entry Positive integer

Factory setting 1 000 ms

Max. update period

Navigation Expert → Communication → Burst config. 1 to 3 → Max. upd. per. (2041–1 to 3)

Description Enter the maximum time span between two burst responses of one burst message.

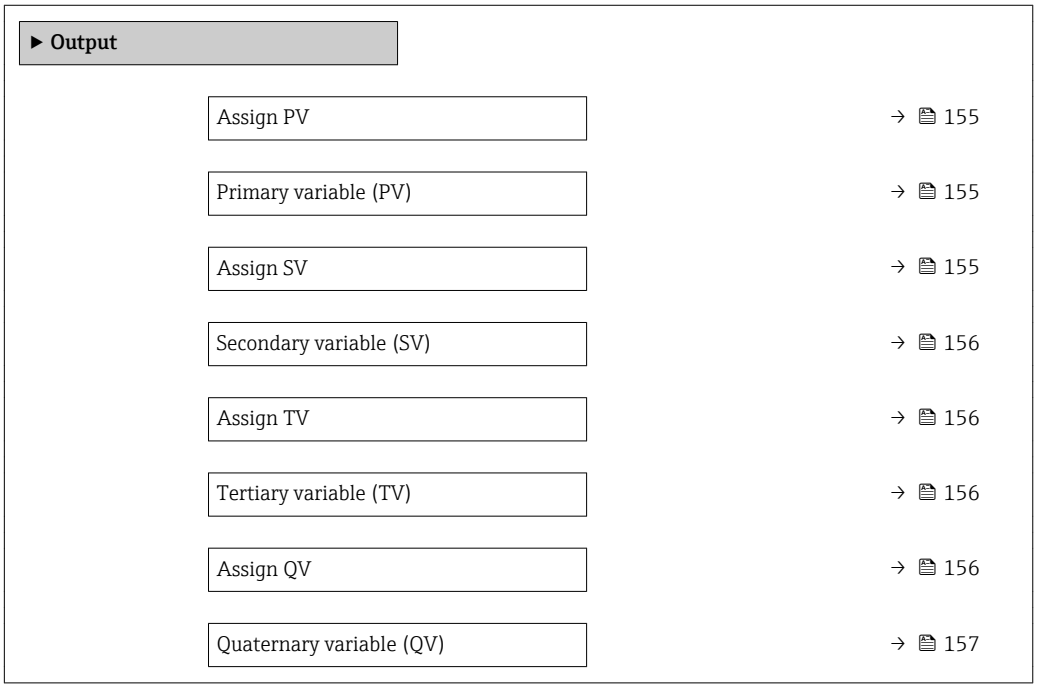
User entry Positive integer

Factory setting 2 000 ms

3.6.6 "Output" submenu

Structure of the submenu

Navigation Expert → Communication → Output



Description of parameters

Navigation Expert → Communication → Output

Assign PV

Navigation Expert → Communication → Output → Assign PV (0234)

Description Select measuring variable for primary HART variable (PV).

Selection
- Level linearized
- Distance
- Electronic temperature
- Relative echo amplitude
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2
- Area of incoupling

Factory setting Level linearized

Primary variable (PV)

Navigation Expert → Communication → Output → Primary var (PV) (0201)

Description Displays primary HART variable (PV).

Assign SV

Navigation Expert → Communication → Output → Assign SV (0235)

Description Select measuring variable for secondary HART variable (SV).

Selection
- None
- Level linearized
- Distance
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Area of incoupling
- Sensor debug
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting Distance

Secondary variable (SV)

Navigation Expert → Communication → Output → Second.var(SV) (0226)

Description Displays secondary HART variable (SV).

Assign TV

Navigation Expert → Communication → Output → Assign TV (0236)

Description Select measuring variable for third HART variable (TV).

Selection
- None
- Level linearized
- Distance
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Area of incoupling
- Sensor debug
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting Absolute echo amplitude

Tertiary variable (TV)

Navigation Expert → Communication → Output → Tertiary var(TV) (0228)

Description Displays third HART variable (TV).

Assign QV

Navigation Expert → Communication → Output → Assign QV (0237)

Description Select measuring variable for fourth HART variable (QV).

Selection
- None
- Level linearized
- Distance
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Area of incoupling

- Sensor debug
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting Relative echo amplitude

Quaternary variable (QV)

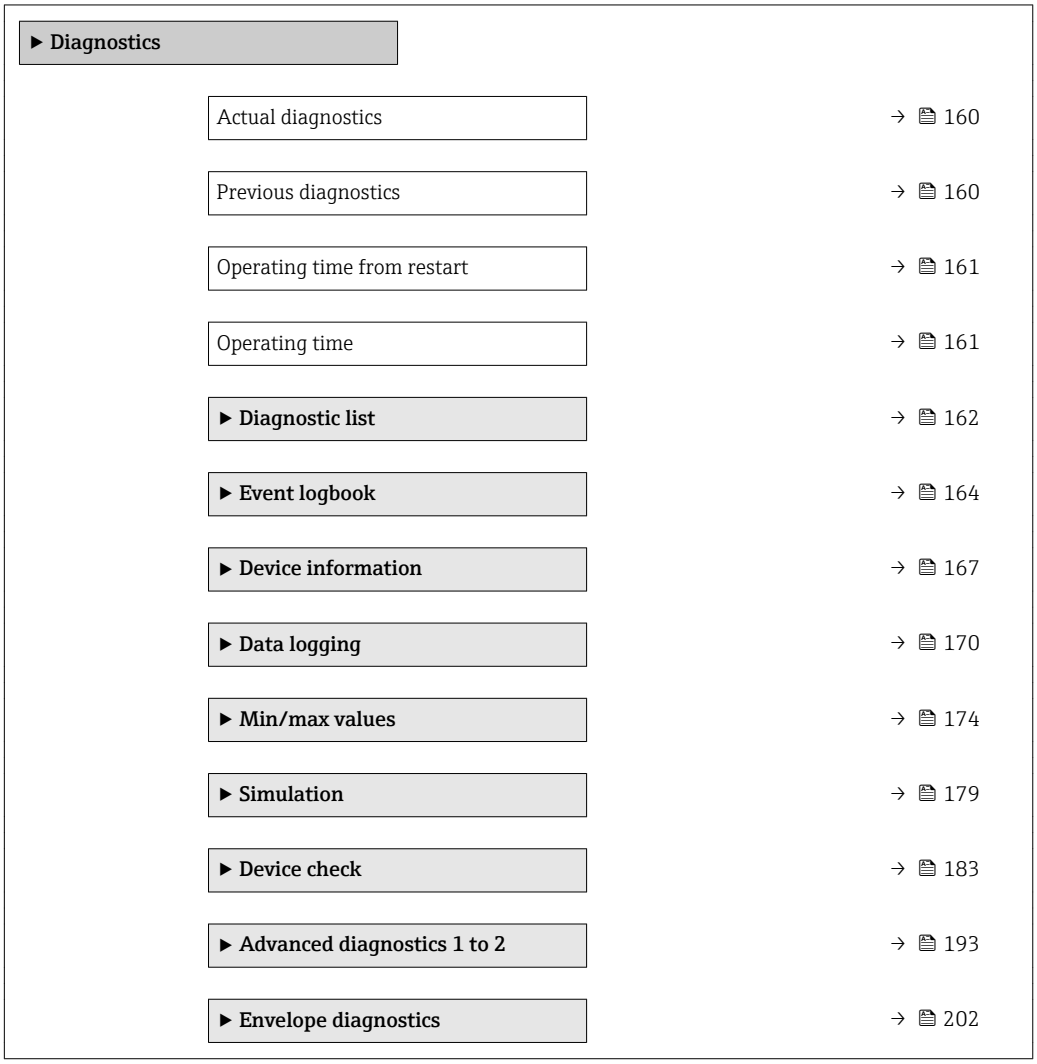
Navigation Expert → Communication → Output → Quaterna.var(QV) (0203)

Description Displays fourth HART variable (QV).

3.7 "Diagnostics" submenu

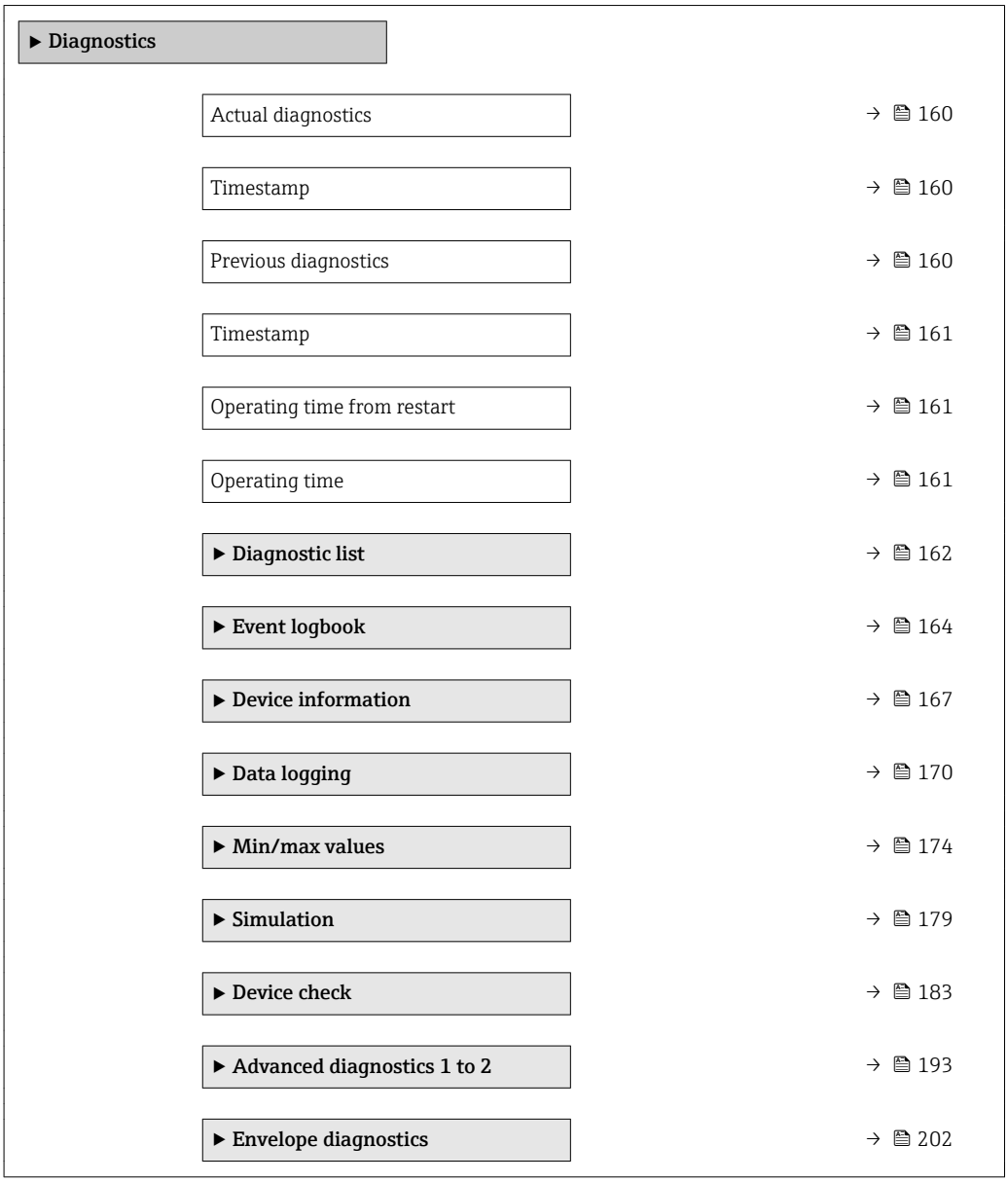
3.7.1 Structure of the submenu on the local display

Navigation Expert → Diagnostics



3.7.2 Structure of the submenu in an operating tool

Navigation Expert → Diagnostics



3.7.3 Description of parameters

Navigation Expert → Diagnostics

Actual diagnostics

Navigation Expert → Diagnostics → Actual diagnos. (0691)

Description Displays current diagnostic message.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

If several messages are active at the same time, the messages with the highest priority is displayed.

Information on what is causing the message, and remedy measures, can be viewed via the ⓘ symbol on the display.

Timestamp

Navigation Expert → Diagnostics → Timestamp (0667)

Description Displays timestamp for the **Actual diagnostics** parameter (→ 160).

User interface Days (d), hours (h), minutes (m), seconds (s)

Previous diagnostics

Navigation Expert → Diagnostics → Prev.diagnostics (0690)

Description Displays the last diagnostic message which has been active before the current message.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

The condition displayed may still apply. Information on what is causing the message, and remedy measures, can be viewed via the ⓘ symbol on the display.

Timestamp

Navigation Expert → Diagnostics → Timestamp (0672)

Description Displays timestamp for the **Previous diagnostics** parameter (→ 160).

User interface Days (d), hours (h), minutes (m), seconds (s)

Operating time from restart

Navigation Expert → Diagnostics → Time fr. restart (0653)

Description Displays the time the device has been in operation since the last device restart.

User interface Days (d), hours (h), minutes (m), seconds (s)

Operating time

Navigation Expert → Diagnostics → Operating time (0652)

Description Indicates how long the device has been in operation.

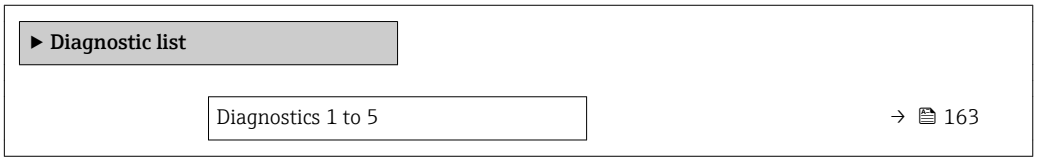
User interface Days (d), hours (h), minutes (m), seconds (s)

Additional information *Maximum time*
9 999 d (≈ 27 years)

3.7.4 "Diagnostic list" submenu

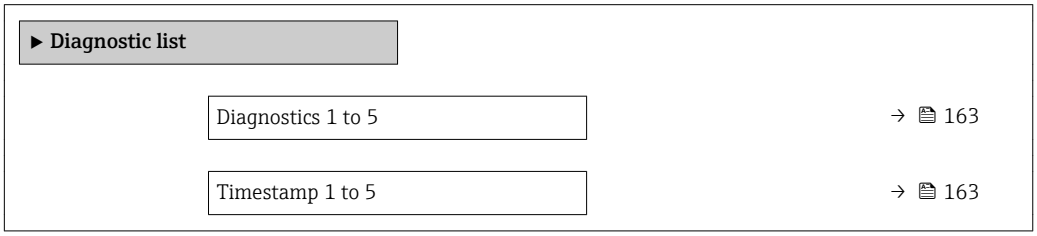
Structure of the submenu on the local display

Navigation Expert → Diagnostics → Diagnostic list



Structure of the submenu in an operating tool

Navigation Expert → Diagnostics → Diagnostic list



Description of parameters

Navigation Expert → Diagnostics → Diagnostic list

Diagnostics 1 to 5

Navigation Expert → Diagnostics → Diagnostic list → Diagnostics 1 to 5 (0692–1 to 5)

Description Display the current diagnostics messages with the highest to fifth-highest priority.

Additional information The display consists of:
- Symbol for event behavior
- Code for diagnostic behavior
- Operating time of occurrence
- Event text

Timestamp 1 to 5

Navigation Expert → Diagnostics → Diagnostic list → Timestamp (0683)

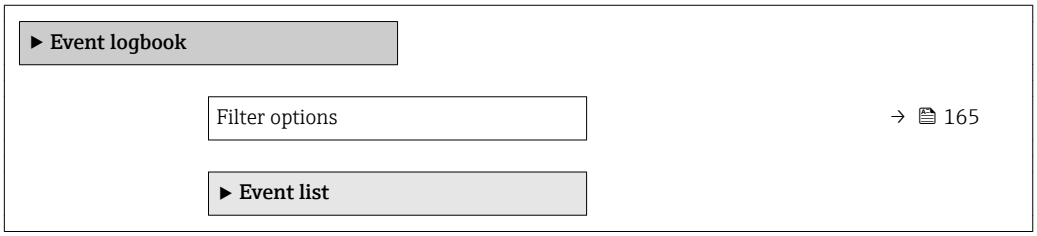
Description Displays timestamp for the **Diagnostics 1 to 5** parameter (→ 163).

User interface Days (d), hours (h), minutes (m), seconds (s)

3.7.5 "Event logbook" submenu

Structure of the submenu on the local display

Navigation Expert → Diagnostics → Event logbook



Structure of the submenu in an operating tool

Navigation Expert → Diagnostics → Event logbook

Description of parameters

Navigation Expert → Diagnostics → Event logbook

Filter options

Navigation Expert → Diagnostics → Event logbook → Filter options (0705)

Description Select category (status signal) whose event messages are displayed in the events list.

Selection
- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information (I)

Factory setting All

Additional information
- This parameter is only used for operation via the local display.
- The status signals are categorized according to NAMUR NE 107.

"Event list" submenu

The **Event list** submenu (→ 166) is only available when operating via the local display.

The **Event list** submenu doesn't contain any parameters but only the list of events of the category selected in the **Filter options** parameter. A maximum of 100 event messages is displayed in chronological order.

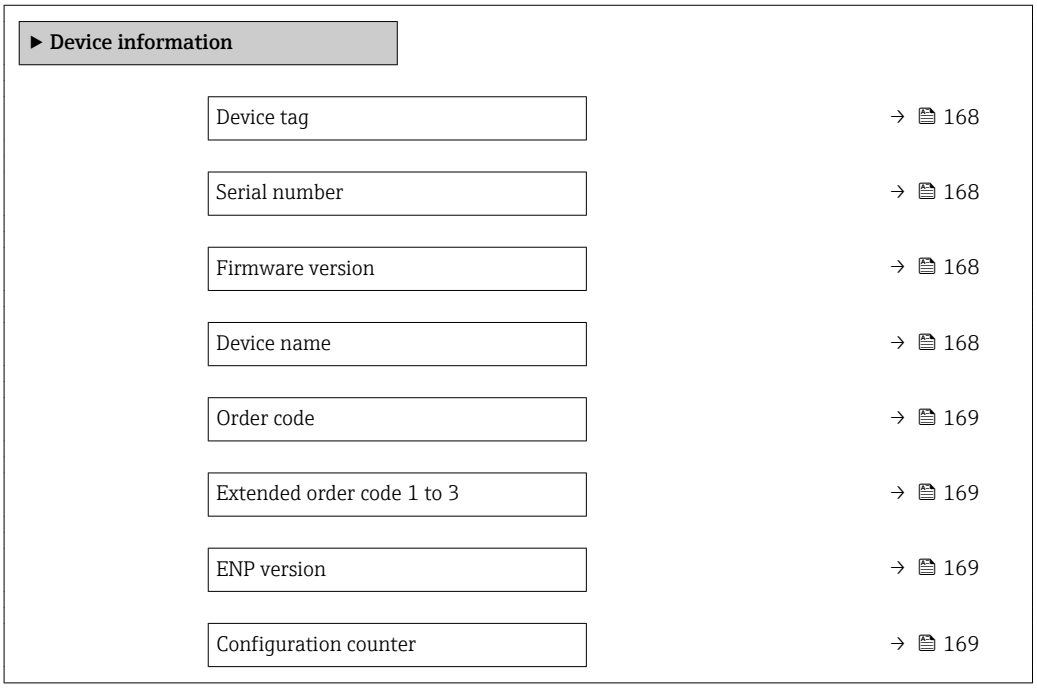
The following status symbols indicate, whether an event has appeared or disappeared at the time stated:
- : Event appeared
- : Event disappeared

Remedy measures concerning the cause of the message can be called up via the symbol on the display.

3.7.6 "Device information" submenu

Structure of the submenu

Navigation Expert → Diagnostics → Device info



Description of parameters

Navigation Expert → Diagnostics → Device info

Device tag

Navigation Expert → Diagnostics → Device info → Device tag (0011)

Description Enter the name for the measuring point.

Factory setting FMR5x

Serial number

Navigation Expert → Diagnostics → Device info → Serial number (0009)

Description Displays serial number of the device.

Additional information

Uses of the serial number
- To identify the device quickly, e.g. when contacting Endress+Hauser.
- To obtain specific information on the device using the Device Viewer: www.endress.com/deviceviewer

The serial number is also indicated on the nameplate.

Firmware version

Navigation Expert → Diagnostics → Device info → Firmware version (0010)

Description Indicates the installed Firmware version.

User interface xx.yy.zz

Additional information For firmware versions differing only in the last two digits ("zz") there is no difference concerning functionality or operation.

Device name

Navigation Expert → Diagnostics → Device info → Device name (0013)

Description Displays device name.

Order code

Navigation Expert → Diagnostics → Device info → Order code (0008)

Description Displays order code of the device.

Additional information The order code is generated from the extended roder code, which defines all device features of the product structure. In contrast, the device features can not be read directly from the order code.

Extended order code 1 to 3

Navigation Expert → Diagnostics → Device info → Ext. order cd. 1 to 3 (0023–1 to 3)

Description Displays the three parts of the extended order code.

Additional information The extended order code indicates the version of all the features of the product structure and thus uniquely identifies the device.

ENP version

Navigation Expert → Diagnostics → Device info → ENP version (0012)

Description Displays version of the electronic nameplate (ENP).

User interface xx.yy.zz

Configuration counter

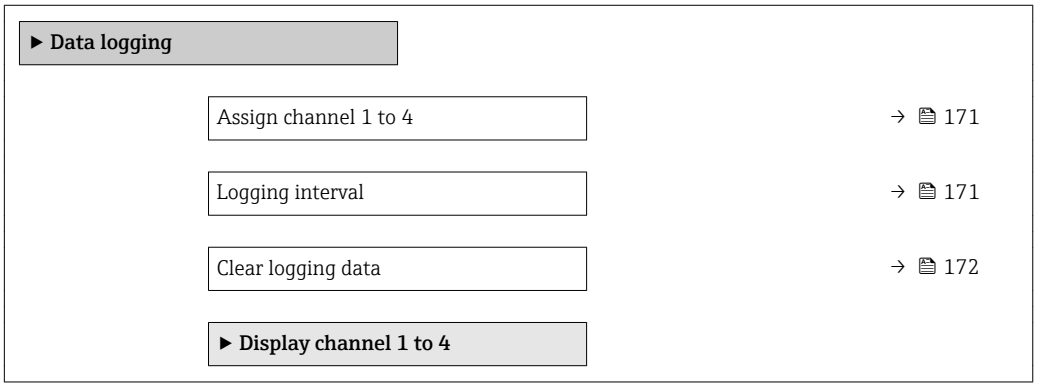
Navigation Expert → Diagnostics → Device info → Config. counter (0233)

Description Displays configuration counter.

3.7.7 "Data logging" submenu

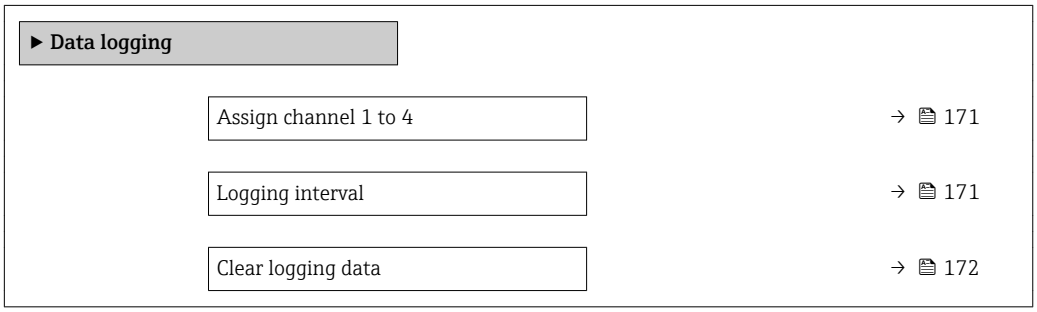
Structure of the submenu on the local display

Navigation Expert → Diagnostics → Data logging



Structure of the submenu in an operating tool

Navigation Expert → Diagnostics → Data logging



Description of parameters

Navigation Expert → Diagnostics → Data logging

Assign channel 1 to 4

Navigation Expert → Diagnostics → Data logging → Assign chan. 1 (0851)

Description Allocate a process variable to the respective data logging channel.

Selection
- Off
- Level linearized
- Distance
- Current output 1
- Measured current
- Current output 2 *
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Area of incoupling
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting Off

Additional information A total of 1000 measured values can be logged. This means:
- 1000 data points if 1 logging channel is used
- 500 data points if 2 logging channels are used
- 333 data points if 3 logging channels are used
- 250 data points if 4 logging channels are used

If the maximum number of data points is reached, the oldest data points in the data log are cyclically overwritten in such a way that the last 1000, 500, 333 or 250 measured values are always in the log (ring memory principle).

The logged data are deleted if a new option is selected in this parameter.

Logging interval

Navigation Expert → Diagnostics → Data logging → Logging interval (0856)

Description Define logging interval t_{log}.

User entry 1.0 to 3 600.0 s

Factory setting 30.0 s

* Visibility depends on order options or device settings

Additional information

This parameter defines the interval between the individual data points in the data log, and thus the maximum loggable process time T_{log}:

- If 1 logging channel is used: $T_{log} = 1000 \cdot t_{log}$
- If 2 logging channels are used: $T_{log} = 500 \cdot t_{log}$
- If 3 logging channels are used: $T_{log} = 333 \cdot t_{log}$
- If 4 logging channels are used: $T_{log} = 250 \cdot t_{log}$

Once this time elapses, the oldest data points in the data log are cyclically overwritten such that a time of T_{log} always remains in the memory (ring memory principle).

The logged data are deleted if this parameter is changed.

Example

When using 1 logging channel
- $T_{log} = 1000 \cdot 1$ s = 1 000 s ≈ 16.5 min
- $T_{log} = 1000 \cdot 10$ s = 1 000 s ≈ 2.75 h
- $T_{log} = 1000 \cdot 80$ s = 80 000 s ≈ 22 h
- $T_{log} = 1000 \cdot 3\,600$ s = 3 600 000 s ≈ 41 d

Clear logging data

Navigation Expert → Diagnostics → Data logging → Clear logging (0855)

Description Initiate a deletion of the complete logging memory.

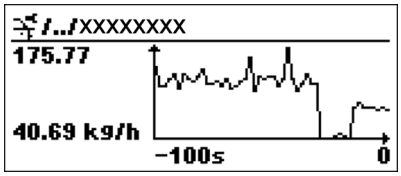
Selection
- Cancel
- Clear data

Factory setting Cancel

"Display channel 1 to 4" submenu

The **Display channel 1 to 4** submenu is only available when operating via the local display. When operating via FieldCare, the diagram can be displayed in the "Event List / HistoROM" function.

The **Display channel 1 to 4** submenu displays the measured value trend of the respective logging channel.



- x-axis: displays 125 to 500 measured values of a process variable (the number of values depending on the number of selected channels).
- y-axis: displays the approximate measured value span and constantly adapts this to the ongoing measurement.

To quit the diagram and to return to the operating menu, press ⊞ and ⊟ simultaneously.

3.7.8 "Min/max values" submenu

Structure of the submenu

Navigation Expert → Diagnostics → Min/max val.

Description of parameters

Navigation Expert → Diagnostics → Min/max val.

Max. level value

Navigation Expert → Diagnostics → Min/max val. → Max. level value (2357)

Description Displays maximum level measured in the past.

Time max. level

Navigation Expert → Diagnostics → Min/max val. → Time max. level (2385)

Description Displays operating time at which the maximum level has been obtained.

Min. level value

Navigation Expert → Diagnostics → Min/max val. → Min. level value (2358)

Description Displays minimum level measured in the past.

Time min. level

Navigation Expert → Diagnostics → Min/max val. → Time min. level (2386)

Description Displays operating time at which the minimum level has been obtained.

Max. draining speed

Navigation Expert → Diagnostics → Min/max val. → Max.drain.speed (2320)

Description Displays maximum draining speed measured in the past.

Max. filling speed

Navigation Expert → Diagnostics → Min/max val. → Max. fill. speed (2360)

Description Displays maximum filling speed measured in the past.

Reset min./max.

Navigation Expert → Diagnostics → Min/max val. → Reset min/max (2324)

Description Select which min/max values are to be reset.

Selection
- None
- Drain/fill speed
- Level
- Reset all

Factory setting None

Max. electronics temperature

Navigation Expert → Diagnostics → Min/max val. → Max.electr.temp. (1031)

Description Displays maximum electronics temperature measured in the past.

Time max. electronics temperature

Navigation Expert → Diagnostics → Min/max val. → Time max.el.temp (1204)

Description Displays operating time at which the maximum electronics temperature has been obtained.

Min. electronics temperature

Navigation Expert → Diagnostics → Min/max val. → Min.electr.temp. (1040)

Description Displays minimum electronics temperature measured in the past.

Time min. electronics temperature

Navigation Expert → Diagnostics → Min/max val. → Time min.el.temp (1205)

Description Displays operating time at which the minimum electronics temperature has been obtained.

Reset min./max. temp.

Navigation Expert → Diagnostics → Min/max val. → Res.min/max temp (1173)

Description Select which min/max values are to be reset.

User interface
- None
- Electronic temperature
- Reset all

Factory setting None

3.7.9 "Simulation" submenu

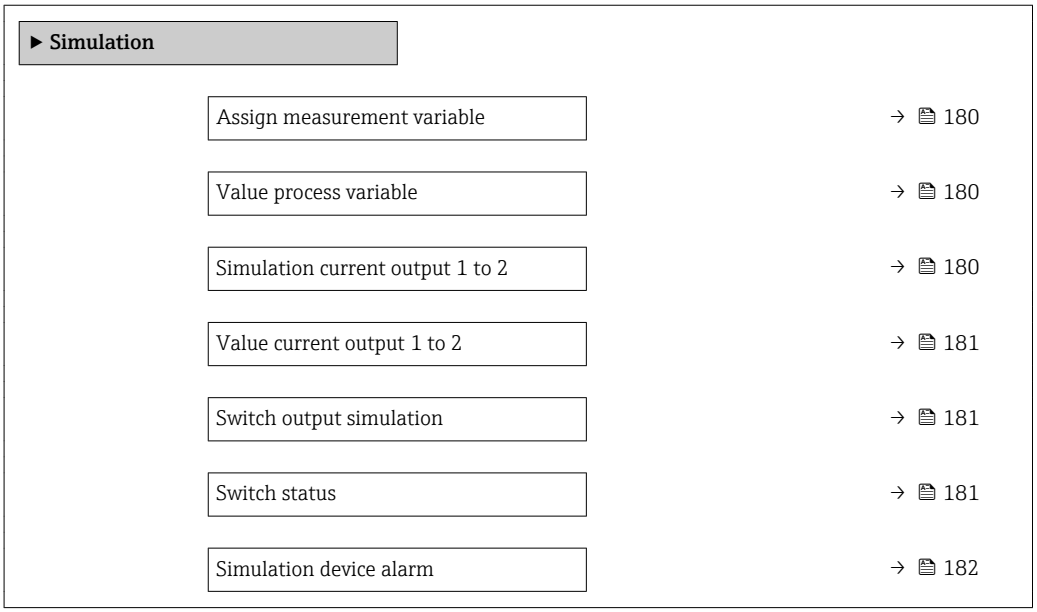
The **Simulation** submenu is used to simulate specific measuring values or other conditions. This helps to check the correct configuration of the device and connected control units.

Conditions which can be simulated

Condition to be simulated	Associated parameters
Specific value of a process variable	▪ Assign measurement variable (→ 🖹 180) ▪ Value process variable (→ 🖹 180)
Specific value of the output current	▪ Simulation current output (→ 🖹 180) ▪ Value current output (→ 🖹 181)
Specific state of the switch output	▪ Switch output simulation (→ 🖹 181) ▪ Switch status (→ 🖹 181)
Existence of an alarm	Simulation device alarm (→ 🖹 182)

Structure of the submenu

Navigation Expert → Diagnostics → Simulation



Description of parameters

Navigation Expert → Diagnostics → Simulation

Assign measurement variable

Navigation Expert → Diagnostics → Simulation → Assign meas.var. (2328)

Description Selct process variable to be simulated.

Selection
- Off
- Level
- Level linearized

Factory setting Off

Additional information
- The value of the variable to be simulated is defined in the **Value process variable** parameter (→ 180).
- If **Assign measurement variable ≠ Off**, a simulation is active. This is indicated by a diagnotic message of the *Function check (C)* category.

Value process variable

Navigation Expert → Diagnostics → Simulation → Value proc. var. (2329)

Prerequisite **Assign measurement variable (→ 180) ≠ Off**

Description Specify value of the process value being simulated.

User entry Signed floating-point number

Factory setting 0

Additional information Downstream measured value processing and the signal output use this simulation value. In this way, users can verify whether the measuring device has been configured correctly.

Simulation current output 1 to 2

Navigation Expert → Diagnostics → Simulation → Sim.curr.out. 1 to 2 (0354–1 to 2)

Description Switch the simulation of the current output on or off.

Selection
- Off
- On

Factory setting Off

Additional information An active simulation is indicated by a diagnostic message of the *Function check (C)* category.

Value current output 1 to 2

Navigation Expert → Diagnostics → Simulation → Value curr.out 1 to 2 (0355–1 to 2)

Prerequisite **Simulation current output (→ 180) = On**

Description Enter current value for the simulation

User entry 3.59 to 22.5 mA

Factory setting 3.59 mA

Additional information The current output assumes the value specified in this parameter. In this way, users can verify the correct adjustment of the current output and the correct function of connected control units.

Switch output simulation

Navigation Expert → Diagnostics → Simulation → Switch sim. (0462)

Description Switch the simulation of the switch output on or off.

Selection
- Off
- On

Factory setting Off

Switch status

Navigation Expert → Diagnostics → Simulation → Switch status (0463)

Prerequisite **Switch output simulation (→ 181) = On**

Description Define the switch state to be simulated.

Selection
- Open
- Closed

Factory setting Open

Additional information The switch status assumes the value defined in this parameter. This helps to check correct operation of connected control units.

Simulation device alarm

Navigation Expert → Diagnostics → Simulation → Sim. alarm (0654)

Description Switch alarm simulation on or off.

Selection
- Off
- On

Factory setting Off

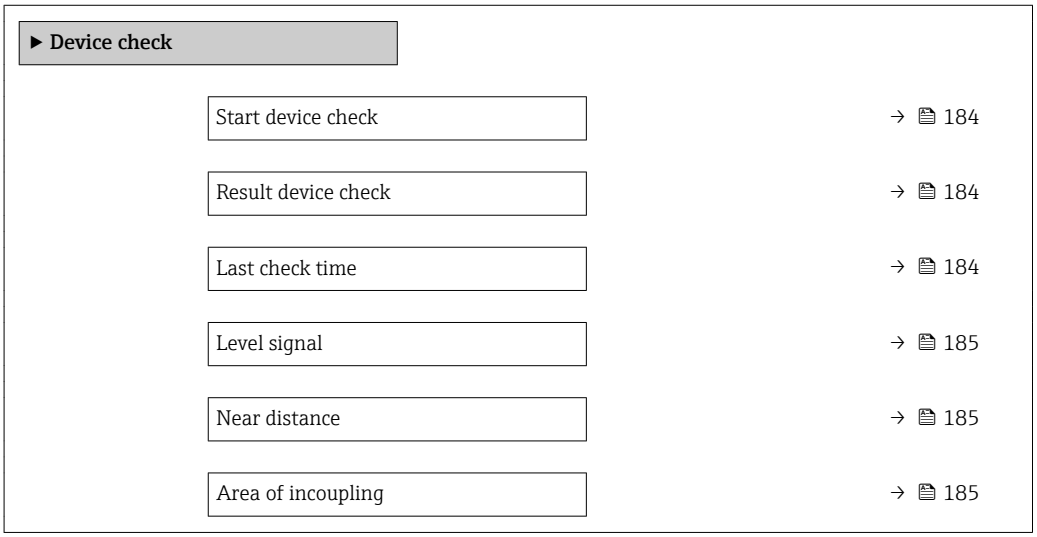
Additional information When selecting the **On** option, the device generates an alarm. This helps to check the correct output behavior of the device in the case of an alarm.

An active simulation is indicated by the diagnostic message **C484 Simulation failure mode**.

3.7.10 "Device check" submenu

Structure of the submenu

Navigation Expert → Diagnostics → Device check



Description of parameters

Navigation Expert → Diagnostics → Device check

Start device check

Navigation Expert → Diagnostics → Device check → Start dev. check (1013)

Description Start a device check.

Selection
- No
- Yes

Factory setting No

Additional information In the case of a lost echo a device check can not be performed.

Result device check

Navigation Expert → Diagnostics → Device check → Result dev.check (1014)

Description Displays the result of the device check.

Additional information

Meaning of the display options
- **Installation ok**
  Measurement possible without restrictions.
- **Accuracy reduced**
  A measurement is possible. However, the measuring accuracy may be reduced due to the signal amplitudes.
- **Measurement capability reduced**
  A measurement is currently possible. Howerver, there is the risk of an echo loss. Check the mounting position of the device and the dielectric constant of the medium.
- **Check not done**
  No device check has been performed.

Last check time

Navigation Expert → Diagnostics → Device check → Last check time (1203)

Description Displays the operating time at which the last device check has been performed.

Level signal

Navigation Expert → Diagnostics → Device check → Level signal (1016)

Prerequisite Device check has been performed.

Description Displays result of the device check for the level signal.

User interface
- Check not done
- Check not OK
- Check OK

Additional information For **Level signal** = **Check not OK**: Check the mounting position of the device and the dielectric constant of the medium.

Near distance

Navigation Expert → Diagnostics → Device check → Near distance (1157)

Description Displays result of the device check for the near distance.

User interface
- Check not done
- Check not OK
- Check OK

Factory setting Check not done

Area of incoupling

Navigation Expert → Diagnostics → Device check → Area incoupling (1169)

Description Indicates the area of ringing zone.

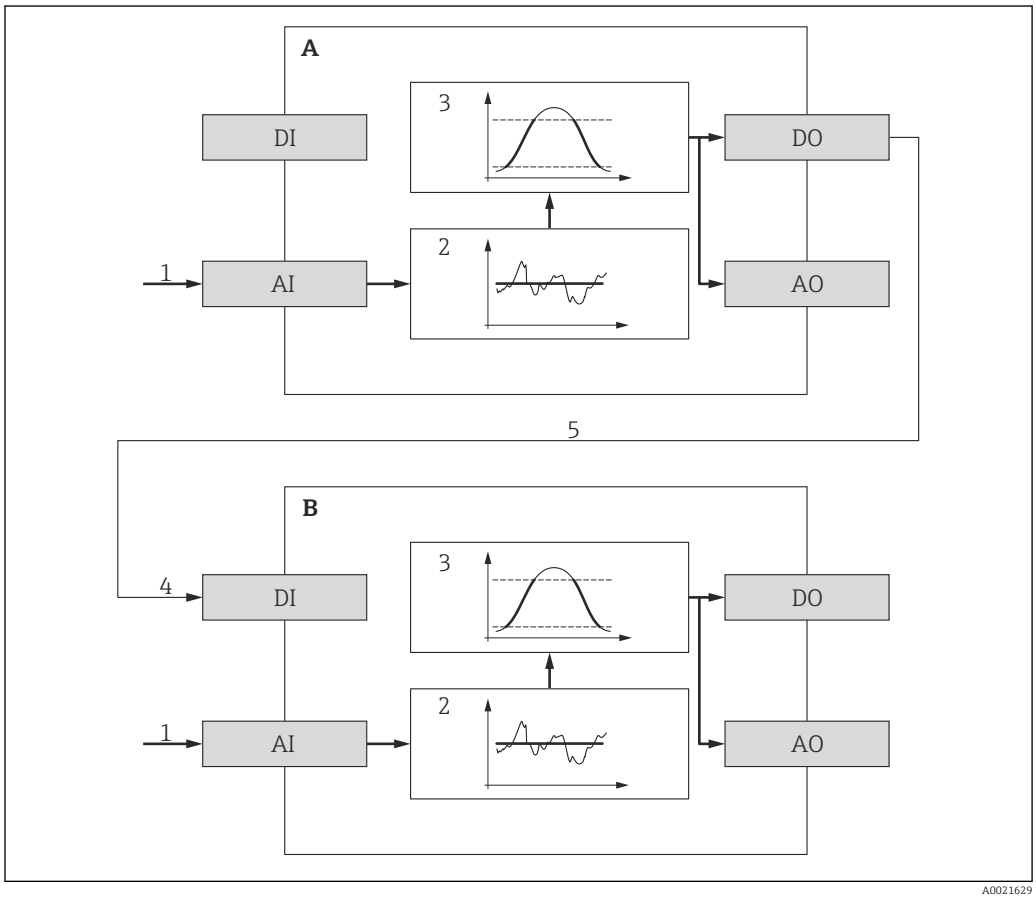
3.7.11 "Advanced diagnostics 1 to 2" submenu

Mode of operation

The Advanced Diagnostics offers additional options to monitor the process. The device contains two Advanced Diagnostic Blocks which can be used separately or in combination.

A measuring variable can be assigned to the input of each Advanced Diagnostic Block. Based on a freely configurable time interval, the variable can be submitted to a statistical function (e.g. maximum, minimum, mean, slope). Finally, a limit detection can be parametrized and its result can be transmitted to a digital output.

The result can be displayed and evaluated by a DCS or PLC. If required, it can also be linked to the second Advanced Diagnostic block and thus it is possible to combine the two results by the logical operators AND or OR.



42 *Combined Advanced Diagnostic blocks*

A Advanced Diagnsotics 1
B Advanced Diagnsotics 2
AI Analog input of the respective block
DI Digital input of the respective block
AO Analog output of the respective block
DO Digital output of the respective block
1 Analog process variable
2 Statistical calculation (maximum, minimum, mean, slope)
3 Limit check
4 Digital input of AD2
5 Digital output of AD1 is linked to digital input of AD2

Overview of the Advanced Diagnostic functionalities

Task	Associated parameters
Allocation of a process variable to the analog input of the block.	Assign diagnostic signal (→ 194)
Linking the digital input to the digital output of the other block.	▪ Link AD to (→ 194) ▪ Linking logic AD (→ 194)
Calculation of one of the following quantities for a freely configurable sampling interval: ▪ Maximum ▪ Minimum ▪ Mean ▪ Standard deviation ▪ Difference Max. - Min. ▪ Slope	▪ Sample time (→ 195) ▪ Calculation type (→ 195) ▪ Calculation unit (→ 197)
Drag indicator for the calculated quantity	▪ Maximum value (→ 199) ▪ Minimum value (→ 199) ▪ Reset min./max. (→ 200)
Limit check	▪ Check mode (→ 196) ▪ Upper limit (→ 198) ▪ Lower limit (→ 198) ▪ Hysteresis (→ 199)
Reaction in case of a limit violation	▪ Assign status signal to AD event (→ 200) ▪ Assign event behaviour (→ 200) ▪ Alarm delay (→ 201)

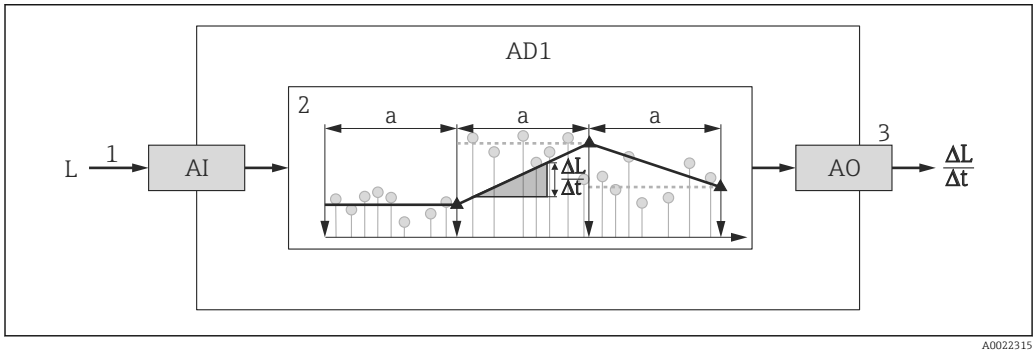
Example 1: Draining/filling speed

Only one Advanced Diagnostic Block is needed for this application. In the example this is **Advanced diagnostics 1 (→ 193)**. However, **Advanced diagnostics 2 (→ 193)** could be used just as well.

The level change rate (i.e. draining or filling speed) allows the customer to instantly realize whether or not the level is changing, and at which rate. The rate at which the level is changing must be observed as powerful pumps can create significant over and underpressure in a tank. Pressure relieve valves can only operate properly up to a certain level change rate. This is in particular valid for almost emptied tanks. The level change rate is also an intermediate result for calculating transfer estimates, such as time to fill, time to empty, time to target, etc.

Basic idea

The Advanced Diagnostics is used to calculate the draining or filling speed from the measured level. The result can be transmitted via the current output or the HART communication interface.



43 *Calculation of the draining or filling speed*

1 *Allocation of the (linearized) level to Advanced Diagnsotic Block AD1*
2 *Calculation of the draining or filling speed ΔL/Δt within the sampling interval a.*
3 *ΔL/Δt can be transmitted via the current output or the HART communication interface.*

Configuration of the calculation

The calculation of the rate of level change is configured as follows:

1. Select **Assign diagnostic signal 1** = **Level linearized**.
2. Select **Link AD 1 to** = **None** (= factory setting)
3. Define **Sample time 1** in accordance with the expected draining or filling speed.
4. Select **Calculation type 1** = **Slope**.
5. Select a suitable option in **Calculation unit 1**, e.g.: **"Level unit" / s**

As the rate of level change is not to be checked for limit violation, the following parameters may retain their factory settings:
- **Check mode 1**
- **Assign status signal to AD event (→ 200)**
- **Assign event behaviour (→ 200)**
- **Alarm delay (→ 201)**

With this configuration, the **Maximum value 1** and **Minimum value 1** drag indicators display the maximum or minimum value the rate of lavel change has obtained. Positive values indicate filling (rising level), negative values indicate draining (falling level). If required, the drag indicators can be reset by the **Reset min./ max. 1** parameter.

Allocation of the calculated rate of level change to the current output

1. Navigate to the following submenu: Expert → Output → Curr.output 1.
2. Select **Assign current output (→ 🖹 128)** = **Analog output adv. diagnostics 1**.
3. Select **Turn down (→ 🖹 131)** = **On**.
4. Enter maximum expected draining speed (negative value) in **4 mA value (→ 🖹 132)**.
5. Enter maximum expected filling speed (positive value) in **20 mA value (→ 🖹 132)**.

With this configuration, the rate of level change is transmitted via the current output. The relationship between the rate of level change and the output current is as follows:

$$\frac{\Delta L}{\Delta t} = \frac{5W_4 - W_{20}}{4} + \frac{W_{20} - W_4}{16\ mA}\ I$$

A0022342

Where:
- $\Delta L/\Delta t$: Rate of level change [7)]
- W_4 : **4 mA value (→ 🖹 132)**
- W_{20} : **20 mA value (→ 🖹 132)**
- I: Output current

In the case of a constant level ($\Delta L/\Delta t = 0$) the current is:

$$I_0 = 4\ mA - \frac{W_4}{W_{20} - W_4}\ 16\ mA$$

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Allocation of the calculated rate of level change to the HART output

1. Navigate to the following submenu: Expert → Communication → Output
2. Select **Assign PV (→ 🖹 155)** = **Analog output adv. diagnostics 1**.

With this configuration, the **Primary variable (PV)** parameter (→ 🖹 155) displays the calculated filling or draining speed. Positive values indicate filling; negative values indicate draining.

Instead of PV, it is also possible to allocate the rate of level change to SV, TV or QV.

7) Negative values: draining speed; Positive values: filling speed

Example 2: Foam detection

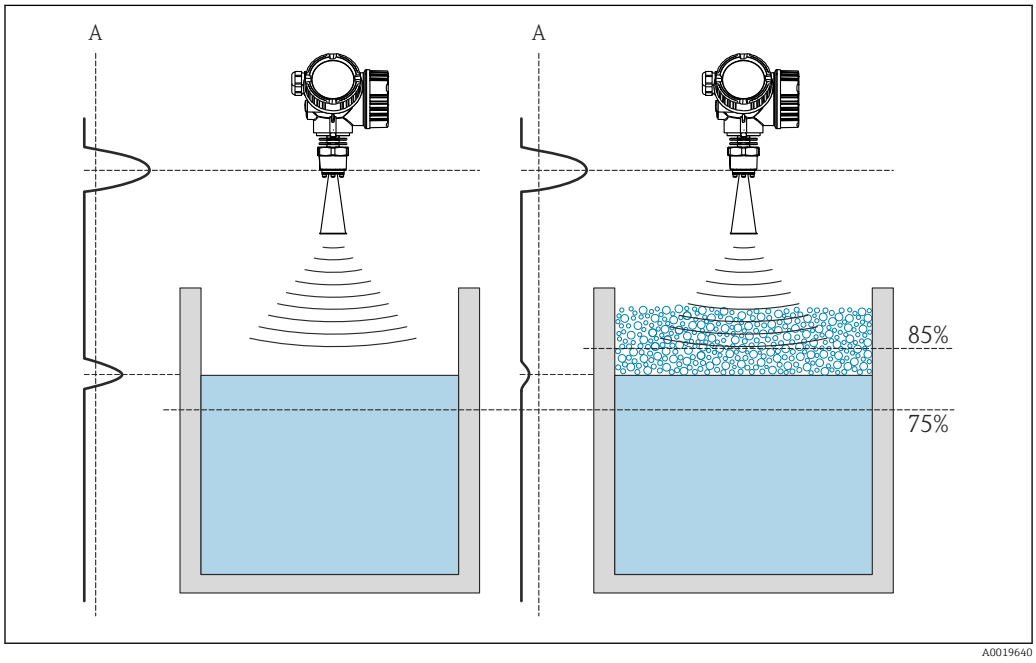
In this example, both Advance Diagnostic Blocks are used.

Preconditions

- The process runs at a fixed level (in the example: 80 %)
- If foam occurs during the operation, the vessel should automatically be sprinkled with water from the top or an antifoam agent should be added to dissolve the foam.

Basic idea

The echo amplitude decreases in the case of foam formation. This can be used by the Advanced Diagnostics to detect the foam. The foam detection, however, should only be active as long as the level is between 75 % and 85 %.



44 *Decrease of the amplitude in case of foam formation*

A Amplitude threshold for foam detection

Configuration of the level monitoring

In order to ensure that the level is within the correct range, configure the **Advanced diagnostics 1** submenu (→ 193) submenu as follows:

1. Navigate to the **Advanced diagnostics 1** submenu (→ 193)
2. Select **Assign diagnostic signal 1** = **Level linearized**.
3. Select **Check mode 1** = **Out of range**
4. Set **Upper limit 1** = 85 %.
5. Set **Lower limit 1** = 75 %.

Check mode 1 = **Out of range** checks whether the level is outside a defined range. As long as this is the case, the block outputs "0" (INACTIVE). If the level gets into the defined range, the block outputs "1" (ACTIVE).

Configuration of the foam detection

For the foam detection, configure the **Advanced diagnostics 2** submenu (→ 193) as follows:

1. Select **Assign diagnostic signal 2** = **Relative echo amplitude**.

2. Use the **Minimum value 2** parameter to observe the echo amplitude for the specified level (80 % in the example) for a while and determine a suitable lower limit for the amplitude (10 dB in the example).
3. Select **Calculation type 2** = **Mean**.
4. Enter **Sample time 2** = "60 s".
5. Select **Check mode 2** = **Lower limit**.
6. Enter the amplitude limit determined in step 2 into the **Lower limit 2** parameter (10 dB in the example).

With these settings, the Advanced Diagnostic Block behaves as follows:
- If the amplitude is above 10 dB (i.e.: no foam), the block assumes the digital value "0" (INACTIVE).
- If the amplitude is below 10 dB (i.e.: foam present), the block assumes the digital value "1" (ACTIVE).

Configuration of the block linking

The linking logic is configured in the **Advanced diagnostics 2** submenu (→ 193):

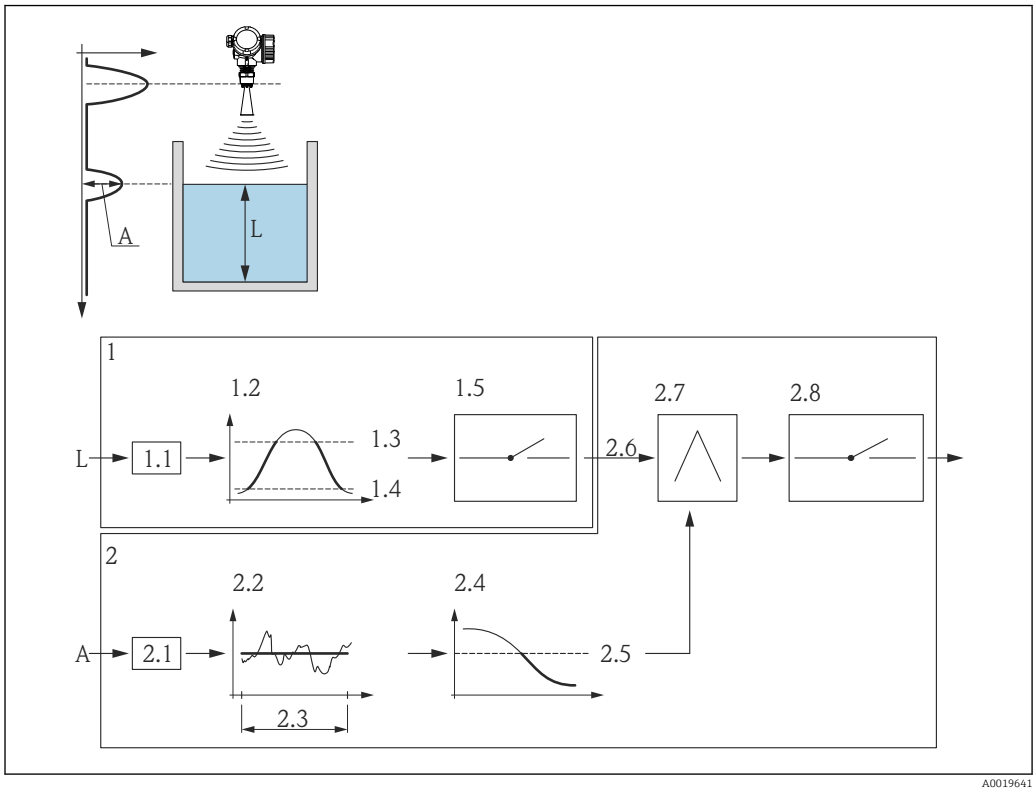
1. Select **Link AD 2 to** = **Digital output AD 1**.
2. **Select Linking logic AD 2** = **AND**.

With this configuration the output of **Advanced Diagnostics 2** assumes the following value:
- 0 (INACTIVE) - if at least one of the two blocks is in the "0" (INACTIVE) status.
- 1 (ACTIVE) - if both blocks are in the "1" (ACTIVE) status.
  For the example this means:
  - A diagnostic signal is output, if the level is within the defined range and the signal amplitude is below the threshold (i.e. foam is present).
  - If, on the other hand, the level is out of the defined range or if the signal amplitude exceeds the threshold (i.e. no foam), **no** diagnostic signal is transmitted via the switch output.

The digital output signal of **Advanced diagnostics 2** can be linked to the switch output of the device:

Expert → Output → Switch output → Assign status (0485) = Digital output AD 2

Overview: Foam detection with the advanced diagnostics



45 *Configuration of the Advanced Diagnostics for foam detection*

L Level
A Amplitude
1 Advanced diagnostics 1: Monitoring the level
1.1 "Assign diagnostic signal 1" = "Relative echo amplitude"
1.2 "Check mode 1" = "Out of range"
1.3 "Upper limit 1" = 85 %
1.4 "Lower limit 1" = 75 %
1.5 Digital output of Advanced Diagnostics 1
2 Advanced Diagnostics 2: Monitoring the amplitude
2.1 "Assign diagnostic signal 2" = "Relative echo amplitude"
2.2 "Calculation type 2" = "Mean"
2.3 "Sample time 2" = 60 s
2.4 "Check mode 2" = "Lower limit"
2.5 "Lower limit 2" = 10 dB
2.6 "Link AD 2 to" = "Digital output AD 1"
2.7 "Linking logic AD 2" = "AND"
2.8 Digital output of Advanced Diagnostics 2

Structure of the submenu

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2

► **Advanced diagnostics 1 to 2**		
	Assign diagnostic signal 1 to 2	→ 194
	Link AD 1 to 2 to	→ 194
	Linking logic AD 1 to 2	→ 194
	Sample time 1 to 2	→ 195
	Calculation type 1 to 2	→ 195
	Check mode 1 to 2	→ 196
	Calculation unit 1 to 2	→ 197
	Upper limit 1 to 2	→ 198
	Lower limit 1 to 2	→ 198
	Hysteresis 1 to 2	→ 199
	Value	→ 199
	Maximum value 1 to 2	→ 199
	Minimum value 1 to 2	→ 199
	Reset min./max. 1 to 2	→ 200
	Assign status signal to AD event 1 to 2	→ 200
	Assign event behaviour 1 to 2	→ 200
	Alarm delay 1 to 2	→ 201

Description of parameters

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2

Assign diagnostic signal 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Assign signal 1 to 2 (11179–1 to 2)

Description Allocate a measuring variable to the Advanced Diagnostic Block.

Selection
- None
- Level linearized
- Unfiltered distance
- Relative echo amplitude
- Sensor debug
- Electronic temperature
- Measured current
- Terminal voltage
- Area of incoupling

Factory setting None

Link AD 1 to 2 to

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Link AD 1 to 2 to (11180–1 to 2)

Description Link the digital input (DI) of the Advanced Diagnostic Block to the digital output (DO) of the other Advanced Diagnostic Block.

Selection
- None
- Digital output AD 1
- Digital output AD 2

Factory setting None

Linking logic AD 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Link. logic AD 1 to 2 (11181–1 to 2)

Prerequisite **Link AD to (→ 194)** = **Digital output AD 1** oder **Digital output AD 2**

Description Select linking logic between the two Advanced Diagnostic Blocks.

Selection
- AND
- OR

Factory setting AND

Sample time 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Sample time 1 to 2 (11187–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Specify sampling interval for the calculation.

User entry 1 to 3 600 s

Factory setting 10 s

Calculation type 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Calc. type 1 to 2 (11174–1 to 2)

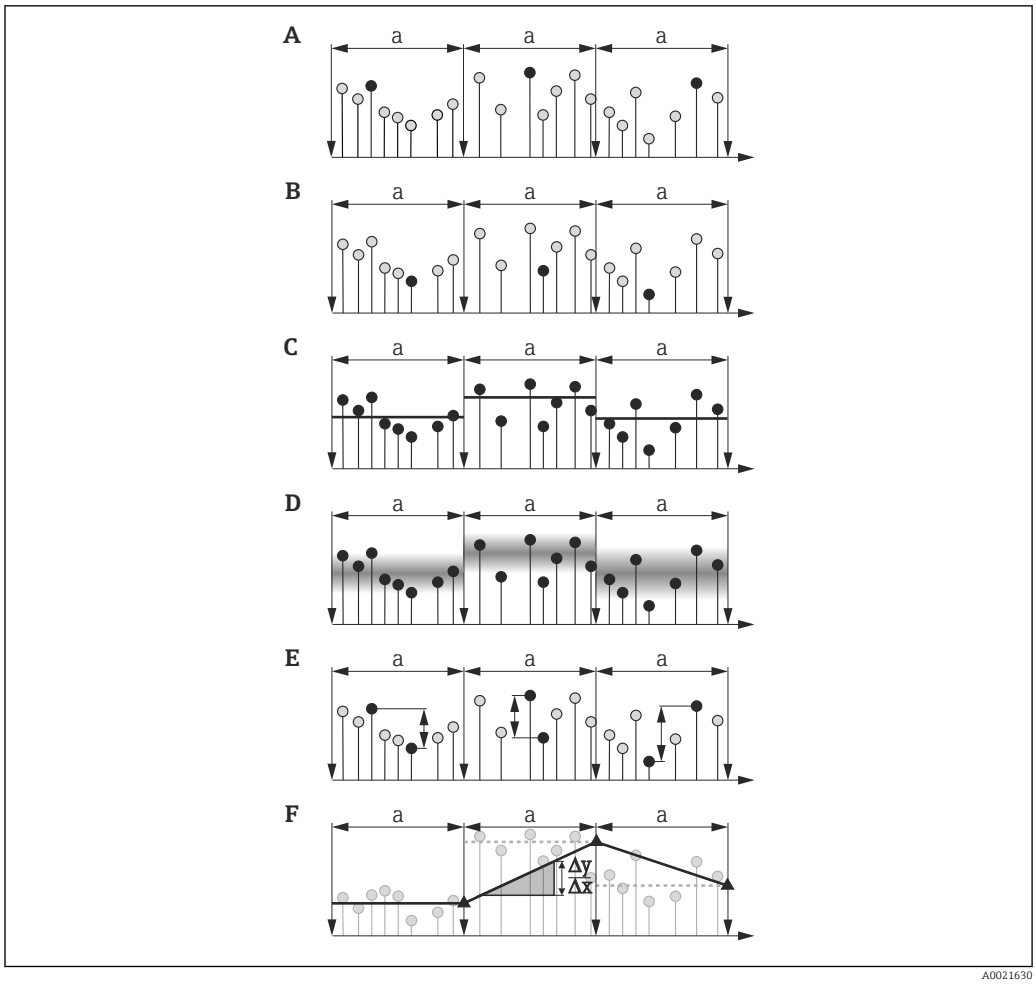
Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Select quantity to be calculated from the measured variable.

Selection
- Off
- Maximum
- Minimum
- Mean
- Standard deviation
- Difference Max. - Min.
- Slope

Factory setting Off

Additional information



46 Options of the "Calculation type " parameter

a Sample time (→ 195)
A "Calculation type " = "Maximum"
B "Calculation type " = "Minimum"
C "Calculation type " = "Mean"
D "Calculation type " = "Standard deviation"
E "Calculation type " = "Difference Max. - Min."
F "Calculation type " = "Slope"

The calculation is performed based on the sampling interval defined in the **Sample time** parameter (→ 195).

Check mode 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Check mode 1 to 2 (11175–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Define check mode for limit monitoring.

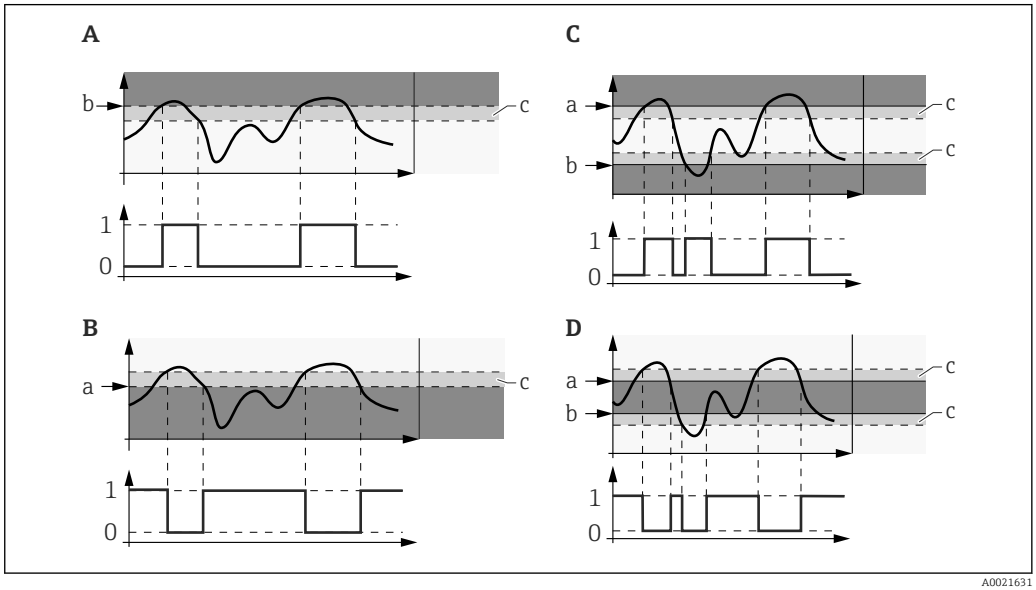
Selection

- Off
- Upper limit
- Lower limit
- In range
- Out of range

Factory setting

Off

Additional information



47 *Limit monitoring in the Advanced Diagnostic Block*

0 Status of digital output: 0 ("INACTIVE")
1 Status of digital output: 1 ("ACTIVE")
a Upper limit (→ 198)
b Lower limit (→ 198)
c Hysteresis (→ 199)
A "Check mode " = "Lower limit"
B "Check mode " = "Upper limit"
C "Check mode " = "In range"
D "Check mode " = "Out of range"

If a calculation has been selected in the **Calculation type** parameter (→ 195), the check does not refer to the assigned measuring variable but to the quantity calculated from it.

Calculation unit 1 to 2

Navigation

Expert → Diagnostics → Adv.diagn. 1 to 2 → Calc. unit 1 to 2 (11188–1 to 2)

Prerequisite

Assign diagnostic signal (→ 194) ≠ None

Description

Select unit for the calculation.

Selection

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Factory setting

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Upper limit 1 to 2

Navigation

Expert → Diagnostics → Adv.diagn. 1 to 2 → Upper limit 1 to 2 (11182–1 to 2)

Prerequisite

Check mode parameter (→ 196) has one of the following values:
- Upper limit
- In range
- Out of range

Description

Specify upper limit for the limit monitoring.

User entry

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Factory setting

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Lower limit 1 to 2

Navigation

Expert → Diagnostics → Adv.diagn. 1 to 2 → Lower limit 1 to 2 (11184–1 to 2)

Prerequisite

Check mode parameter (→ 196) has one of the following values:
- Lower limit
- In range
- Out of range

Description

Define lower limit for the limit monitoring.

User entry

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Factory setting

Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Hysteresis 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Hysteresis 1 to 2 (11178–1 to 2)

Prerequisite **Check mode** parameter (→ 196) has one of the following values:
- Upper limit
- Lower limit
- In range
- Out of range

Description Select hysteresis for the limit monitoring.

User entry Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Factory setting Dependent on the following parameters:
- Assign diagnostic signal (→ 194)
- Calculation type (→ 195)

Value

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Value (11172–1 to 2)

Description Displays the current value of the calculated process variable.

Maximum value 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Maximum value 1 to 2 (11183–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Indicates the maximum value the assigned measuring variable has obtained in the past (drag indicator).

Minimum value 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Minimum value 1 to 2 (11185–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Indicates minimum value the assigned measuring variable has obtained in the past (drag indicator).

Reset min./max. 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Reset min/max 1 to 2 (11186–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Reset drag indicators (**Maximum value (→ 199)** and/or **Minimum value (→ 199)**).

Selection
- Off
- Reset max.
- Reset min.
- Reset min./max.

Factory setting Off

Assign status signal to AD event 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Stat. AD event 1 to 2 (11176–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Assign a category according to NAMUR NE107 to the event of the Advanced Diagnostic Block.

Selection
- Failure (F)
- Maintenance required (M)
- Function check (C)
- Out of specification (S)

Factory setting Maintenance required (M)

Assign event behaviour 1 to 2

Navigation Expert → Diagnostics → Adv.diagn. 1 to 2 → Evt behaviour 1 to 2 (11177–1 to 2)

Prerequisite **Assign diagnostic signal (→ 194) ≠ None**

Description Assign an event behavior to the event of the Advanced Diagnostic Block.

Selection
- Off
- Alarm
- Warning
- Logbook entry only

Factory setting Warning

Alarm delay 1 to 2

Navigation	Expert → Diagnostics → Adv.diagn. 1 to 2 → Alarm delay 1 to 2 (11171–1 to 2)
Prerequisite	**Assign diagnostic signal (→ 194) ≠ None**
Description	Define alarm delay for the Advanced Diagnostic Block.
User entry	0.0 to 3 600.0 s
Factory setting	10.0 s

3.7.12 "Envelope diagnostics" submenu

In devices which have been delivered with software version 01.00.zz, this submenu is only visible for the "Service" user role.

After the configuration of the measurement it is recommended to record the current envelope curve as a reference curve. The reference curve can be used later for diagnostic purposes. To record the reference curve use the **Save reference curve** parameter (→ 🖹 203).

The reference curve can only be displayed in the envelope curve diagram of FieldCare after it has been loaded from the device into FieldCare. This is performed by the "Load Reference Curve" function in FieldCare:

Structure of the submenu

Navigation Expert → Diagnostics → Envelope diag.

▶ **Envelope diagnostics**		
	Save reference curve	→ 🖹 203
	Time reference curve	→ 🖹 203

Description of parameters

Navigation Expert → Diagnostics → Envelope diag.

Save reference curve

Navigation Expert → Diagnostics → Envelope diag. → Save ref. curve (1218)

Description Save current envelope curve as reference curve.

Selection
- No
- Yes

Factory setting No

Additional information

Meaning of the options
- No
  No action
- Yes
  The current envelope curve is saved as reference curve.

Time reference curve

Navigation Expert → Diagnostics → Envelope diag. → Time ref. curve (1232)

Description Indicates at which time the existing reference curve has been recorded.

4 Overview of information events

Info number	Info name
I1000	--------(Device ok)
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed
I1092	Trend data deleted
I1110	Write protection switch changed
I1137	Electronic changed
I1151	History reset
I1154	Reset terminal voltage min/max
I1155	Reset electronic temperature
I1156	Memory error trend
I1157	Memory error event list
I1184	Display connected
I1185	Display backup done
I1186	Restore via display done
I1187	Settings downloaded with display
I1188	Display data cleared
I1189	Backup compared
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed

5 Overview of diagnostic events

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of electronic				
242	Software incompatible	1. Check software 2. Flash or change main electronics module	F	Alarm
252	Modules incompatible	1. Check electronic modules 2. Change I/O or main electronic module	F	Alarm
261	Electronic modules	1. Restart device 2. Check electronic modules 3. Change I/O Modul or main electronics	F	Alarm
262	Module connection	1. Check module connections 2. Change electronic modules	F	Alarm
270	Main electronic failure	Change main electronic module	F	Alarm
271	Main electronic failure	1. Restart device 2. Change main electronic module	F	Alarm
272	Main electronic failure	1. Restart device 2. Contact service	F	Alarm
273	Main electronic failure	1. Emergency operation via display 2. Change main electronics	F	Alarm
275	I/O module failure	Change I/O module	F	Alarm
276	I/O module failure	1. Restart device 2. Change I/O module	F	Alarm
282	Data storage	1. Restart device 2. Contact service	F	Alarm
283	Memory content	1. Transfer data or reset device 2. Contact service	F	Alarm
311	Electronic failure	1. Transfer data or reset device 2. Contact service	F	Alarm
311	Electronic failure	Maintenance required! 1. Do not perform reset 2. Contact service	M	Warning
Diagnostic of configuration				
410	Data transfer	1. Check connection 2. Retry data transfer	F	Alarm
411	Up-/download active	Up-/download active, please wait	C	Warning
431	Trim 1 to 2	Carry out trim	C	Warning
435	Linearization	Check linearization table	F	Alarm
437	Configuration incompatible	1. Restart device 2. Contact service	F	Alarm
438	Dataset	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
441	Current output 1 to 2	1. Check process 2. Check current output settings	S	Warning
484	Simulation failure mode	Deactivate simulation	C	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
485	Simulation measured value	Deactivate simulation	C	Warning
491	Simulation current output 1 to 2	Deactivate simulation	C	Warning
494	Switch output simulation	Deactivate simulation switch output	C	Warning
495	Simulation diagnostic event	Deactivate simulation	C	Warning
585	Simulation distance	Deactivate simulation	C	Warning
586	Record map	Recording of mapping please wait	C	Warning
Diagnostic of process				
801	Energy too low	Increase supply voltage	S	Warning
803	Current loop	1. Check wiring 2. Change I/O module	F	Alarm
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
825	Operating temperature		F	Alarm
921	Change of reference	1. Check reference configuration 2. Check pressure 3. Check sensor	S	Warning
941	Echo lost	Check parameter 'DC value'	S	Warning
941	Echo lost		F	Alarm
942	In safety distance	1. Check level 2. Check safety distance 3. Reset self holding	S	Warning
942	In safety distance		S	Alarm
943	In blocking distance	Reduced accuracy Check level	S	Warning
950	Advanced diagnostic 1 to 2 occured	Maintain your diagnostic event	M	Warning [1]

1) Diagnostic behavior can be changed.

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