

Description of Device Parameters

Micropilot FMR50, FMR51, FMR52, FMR53, FMR54, FMR56, FMR57

FOUNDATION Fieldbus

Free space radar

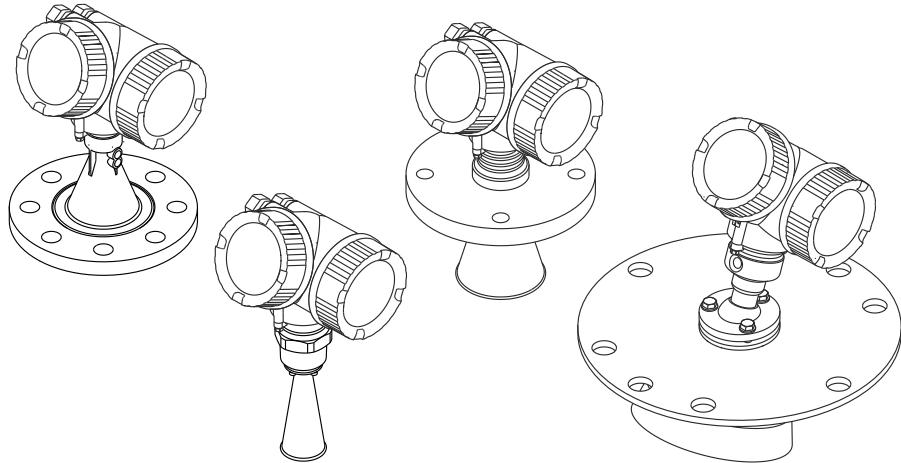


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1 Important document information

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.

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3 "Expert" menu

Das **Expert** menu enthält alle Parameter des Geräts. Es ist nach den Funktionsblöcken des Geräts aufgebaut.

3.1 Aufbau des Menüs

Navigation

Diagram Expert

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Access status tooling (0005)	→  17
Enter access code (0003)	→  18
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3.2 Beschreibung der Parameter

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 (0353-1)
- 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 (0353-2)

 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
- 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 (→  18).

 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 (→  16).

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 (→ [18](#)).

 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 (→ [16](#)).

Enter access code

Navigation

  Expert → Ent. access code (0003)

Description

Enter access code to disable write protection of parameters.

User entry

0 to 9999

Additional information

- For local operation, the customer-specific access code, which has been defined in the **Define access code** parameter (→ [34](#)), 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.

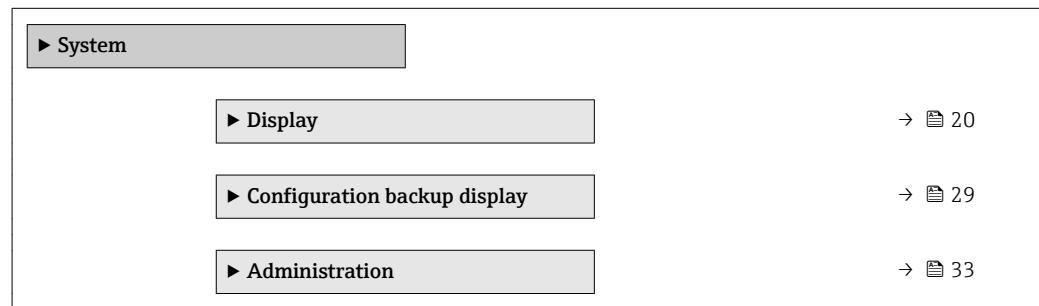
3.3 "System" submenu

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

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Format display	→ ☰ 21
Value 1 to 4 display	→ ☰ 23
Decimal places 1 to 4	→ ☰ 23
Display interval	→ ☰ 23
Display damping	→ ☰ 24
Header	→ ☰ 24
Header text	→ ☰ 25
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Backlight	→ ☰ 26
Access status display	→ ☰ 27

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) *
- العربية (Arabic) *
- Bahasa Indonesia *
- ภาษาไทย (Thai) *
- tiếng Việt (Vietnamese) *
- čeština (Czech)

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

Additional information The **English** option can be selected in every device. One additional operating language can be selected in the product structure when ordering a device (feature 500 "Additional Operation Language") and will be selectable in the **Language** parameter.

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

* Visibility depends on order options or device settings

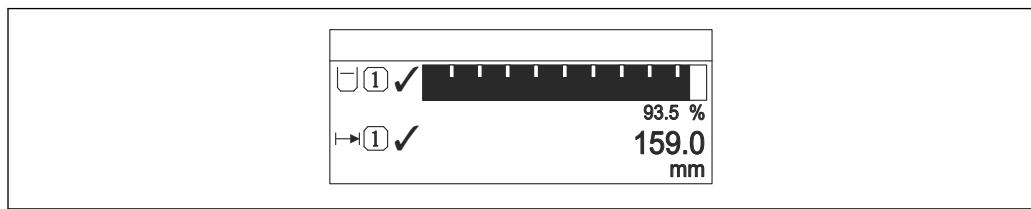
Factory setting

1 value, max. size

Additional information

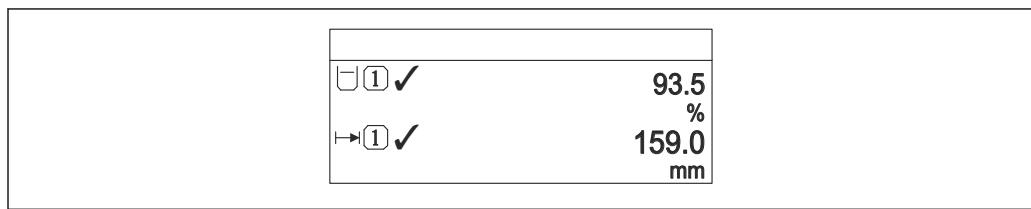
■ 1 "Format display" = "1 value, max. size"

A0019963



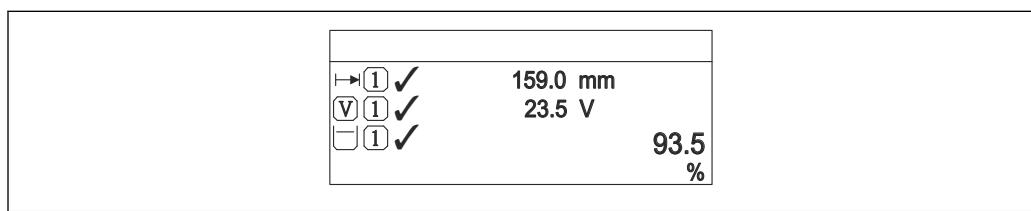
■ 2 "Format display" = "1 bargraph + 1 value"

A0019964



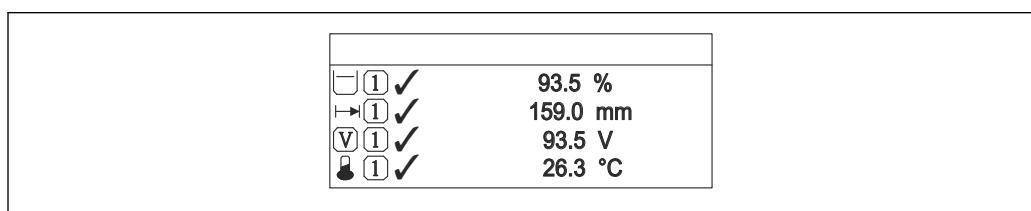
■ 3 "Format display" = "2 values"

A0019965



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

A0019966



■ 5 "Format display" = "4 values"

A0019968



- The **Value 1 to 4 display** → ■ 23 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 (→ ■ 23).

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 ¹⁹⁾
- Level linearized
- Distance
- Current output 1 ²⁰⁾
- 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.

19) can not be selected for the "Value 1 display" parameter.

20) "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



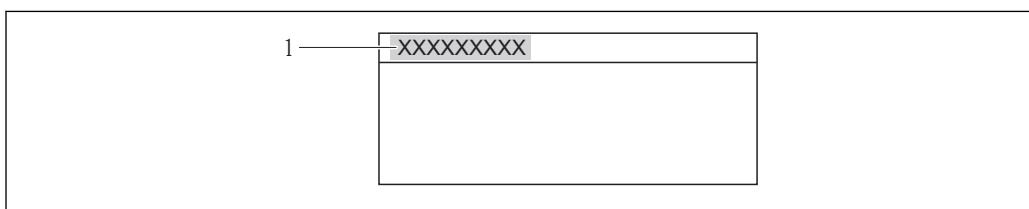
Navigation Expert → System → Display → Header (0097)

Description Select header contents on local display.

- Device tag
- Free text

Factory setting Device tag

Additional information



A0013375

1 Position of the header text on the display

Meaning of the options

- **Device tag**

Is defined in the **Device tag** parameter.

- **Free text**

Is defined in the **Header text** parameter (→ 25).

Header text**Navigation** Expert → System → Display → Header text (0112)**Prerequisite** **Header (→ 24) = 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** → 23 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  buttons simultaneously.
- Brighter: press the  and  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

Diagram 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 (→ [18](#)).

 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 (→ [16](#)).

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 (→ 30). 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.

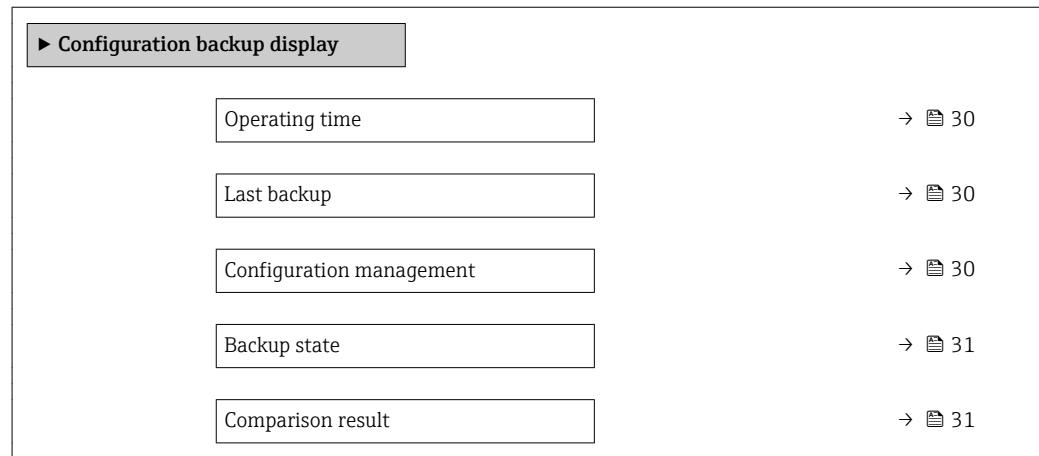
- **Compare**

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

9999 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
- Display incompatible

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:

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 (→ 31).

▪ 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** (→ 30) = **Compare**.

 If the transmitter configuration has been duplicated from a different device by **Configuration management** (→ 30) = **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

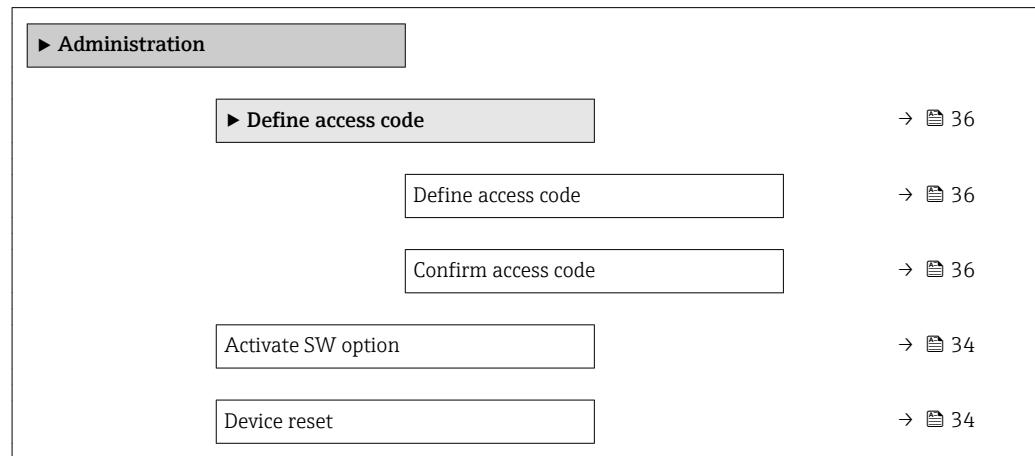
The **Administration** submenu contains all parameters for the management of the device. Its structure depends on the user interface:

Structure of the submenu on the local display

Navigation



Expert → System → Administration

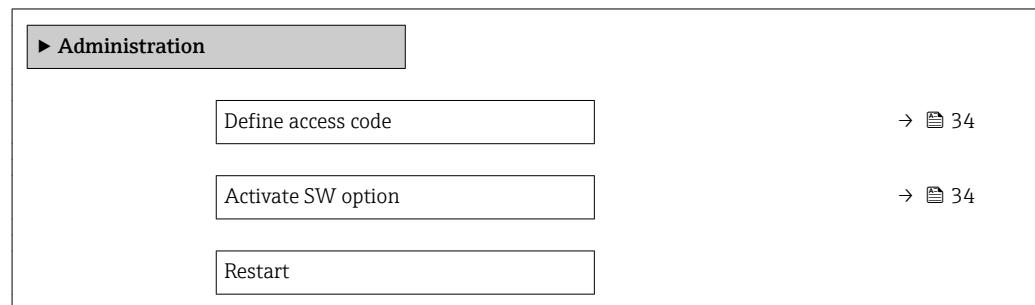


Structure of the submenu in an operating tool

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 (→ 18).
- 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 (→ 36).

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 fieldbus defaults
- To factory defaults

	<ul style="list-style-type: none">■ To delivery settings■ Of customer settings■ To transducer defaults■ Restart device
Factory setting	Cancel
Additional information	Meaning of the options <ul style="list-style-type: none">■ 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 measurement-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



→ 34

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

► Sensor	
Distance unit	→ 39
Temperature unit	→ 39
Tank type	→ 39
Tube diameter	→ 40
Bin type	→ 40
Max. filling speed liquid	→ 40
Max. draining speed liquid	→ 41
Max. filling speed solid	→ 41
Max. draining speed solid	→ 42
Advanced process conditions	→ 42
Application parameter	→ 43
► Medium	→ 44
► Level	→ 48
► Linearization	→ 59
► Information	→ 68
► Sensor properties	→ 74
► Distance	→ 77
► Gas phase compensation	→ 86
► Sensor diagnostics	→ 90
► Safety settings	→ 96

▶ Envelope curve	→ 103
▶ Mapping	→ 109
▶ Echo tracking	→ 119
▶ External input	→ 122
▶ Tank bottom evaluation	→ 127

3.4.2 Description of parameters

Navigation

 Expert → Sensor
Distance unit

Navigation  Expert → Sensor → Distance unit (0551)

Description Select distance unit.

Selection *SI units*

- mm
- m

US units

- ft
- in

Factory setting m

Temperature unit

Navigation  Expert → Sensor → Temperature unit (0557)

Description Select temperature unit.

Selection *SI units*

- °C
- K

US units

- °F
- °R

Factory setting °C

Tank type

Navigation  Expert → Sensor → Tank type (1175)

Prerequisite Medium type (→  45) = 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** (→ 39) = 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** (→ 45) = 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** (→ 45) = 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 (→ 39)

Additional information **Max. filling speed liquid** is preset by **Tank type** (→ 39). It can, however, be adjusted to the process in the vessel at any time. If **Tank type** (→ 39) 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** (→ 45) = **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 (→ 39)

Additional information **Max. draining speed liquid** (→ 41) is preset by **Tank type** (→ 39). It can, however, be adjusted to the process in the vessel at any time. If **Tank type** (→ 39) 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** (→ 45) = **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 (→ 45) = 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 (→ 120) = 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 (→ 120) = Long time history** is only valid for a fixed dielectric constant. The **Changing DC values** option

disables the setting **Evaluation mode** (→  120) = **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 optimizes 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** (→  45) = **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 parameters 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 → Application param. (1126)

Description

Indicates whether settings depending on the application parameters (e.g. **Advanced process conditions** (→  42), **Tank type** (→  39) and **Tube diameter** (→  40)) 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.

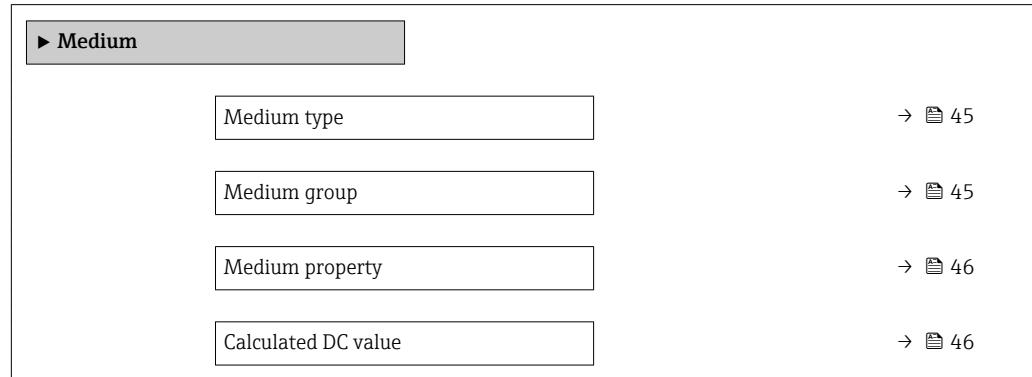
3.4.3 "Medium" submenu

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 (→  45) = **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 (→  46).

The **Medium group** parameter presets the **Medium property** parameter (→  46) as follows:

Medium group	Medium property (→  46)
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** (→ 45) and **Medium group** (→ 45).

Additional information

Dependency on "Medium type" and "Medium group"

Medium type (→ 45)	Medium group (→ 45)	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

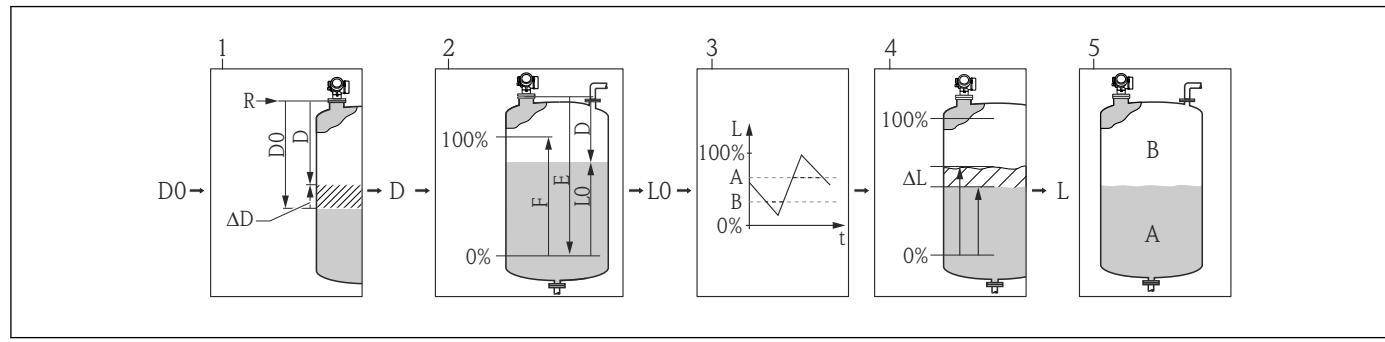
1.0 to 100.0

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 (→ 48) is used to configure the calculation of the level from the measured distance.



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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

► Level	
Distance offset	→  49
Distance	→  50
Empty calibration	→  50
Full calibration	→  51
Level unit	→  52
Level limit mode	→  53
High limit	→  53
Low limit	→  54
Level correction	→  54
Output mode	→  54
Level	→  55
Level linearized	→  56
Tank/silo height	→  56

Description of parameters

Navigation

Diagram Expert → Sensor → Level

Distance offset



Navigation

Diagram 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.

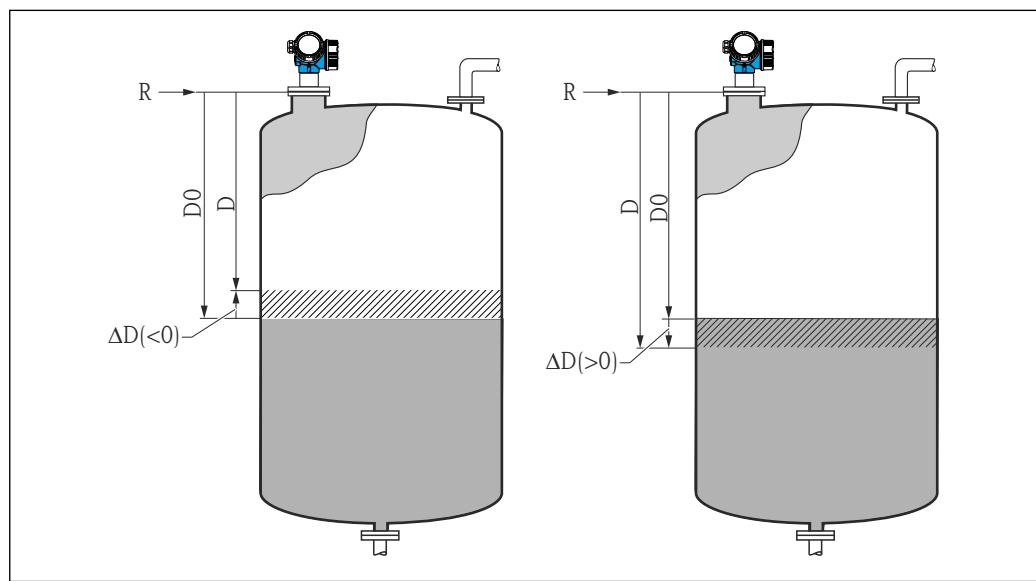


Diagram 7 Effect of "Distance offset" (→ Diagram 49)

ΔD Distance offset

D_0 Measured distance

D Corrected distance (is used to calculate the level)

R Reference point

- i**
- 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

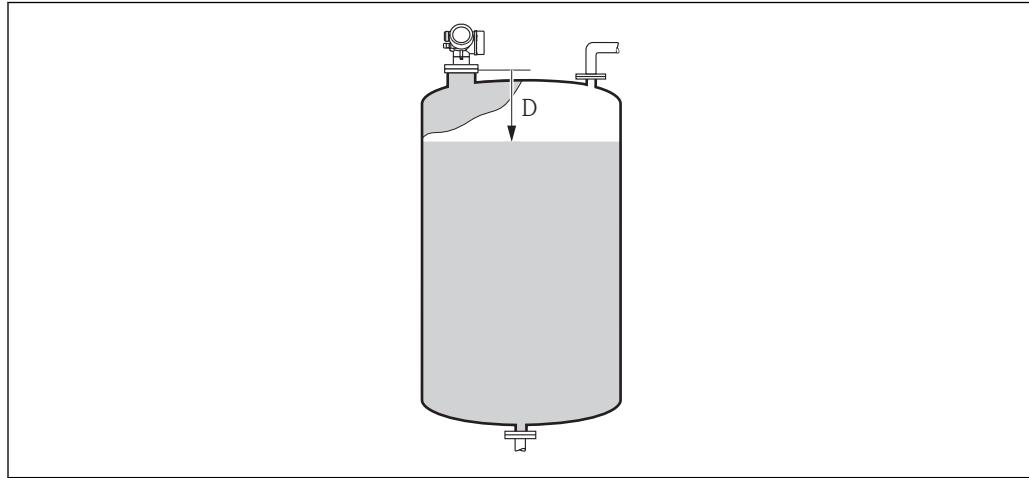
Navigation

④ ⑤ Expert → Sensor → Level → Distance (2231)

Description

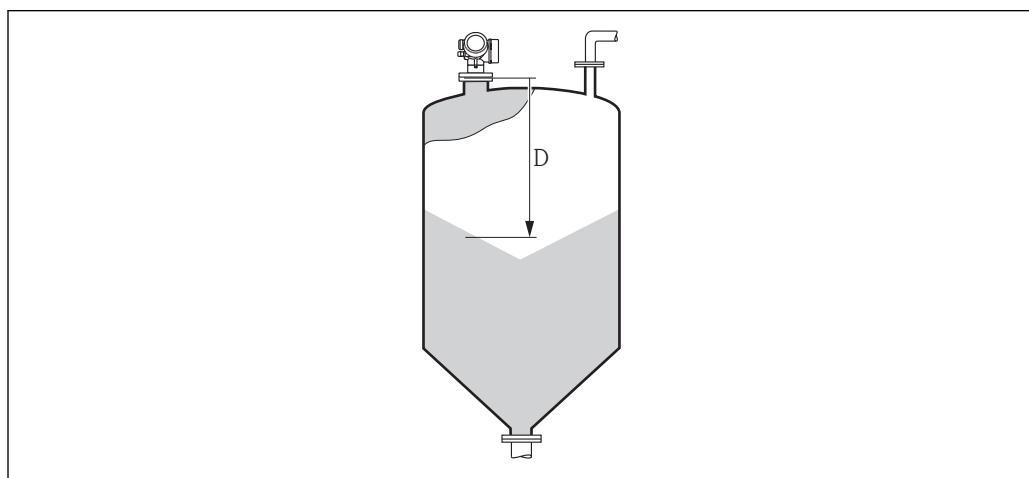
Displays the measured distance D from the reference point (lower edge of the flange or threaded connection) to the level. The **Distance offset** parameter (→ ④ 49) is included in the displayed value.

Additional information



A0019483

④ 8 Distance for level measurements



A0019485

④ 9 Distance for bulk solid measurements

i The unit is defined by the **Distance unit** parameter (→ ④ 39).

Empty calibration



Navigation

④ ⑤ Expert → Sensor → Level → Empty calibr. (2343)

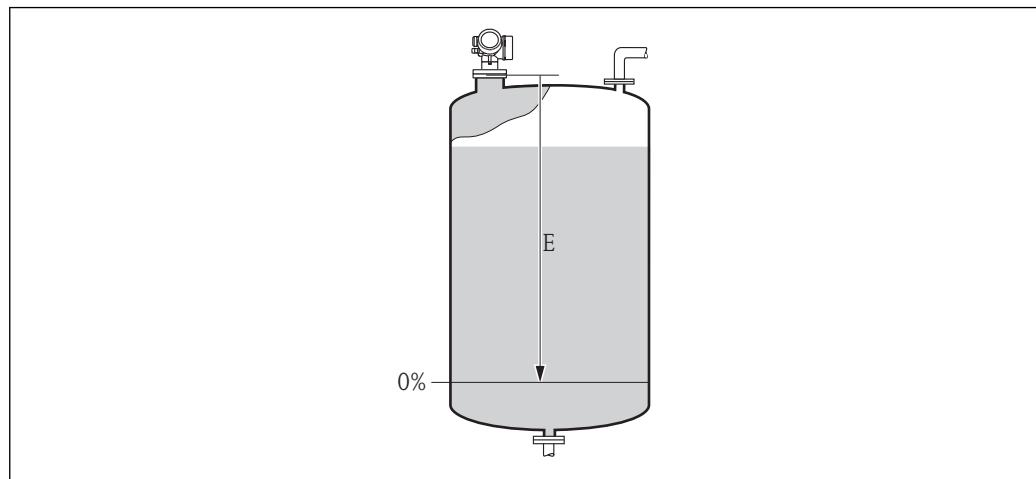
Description

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

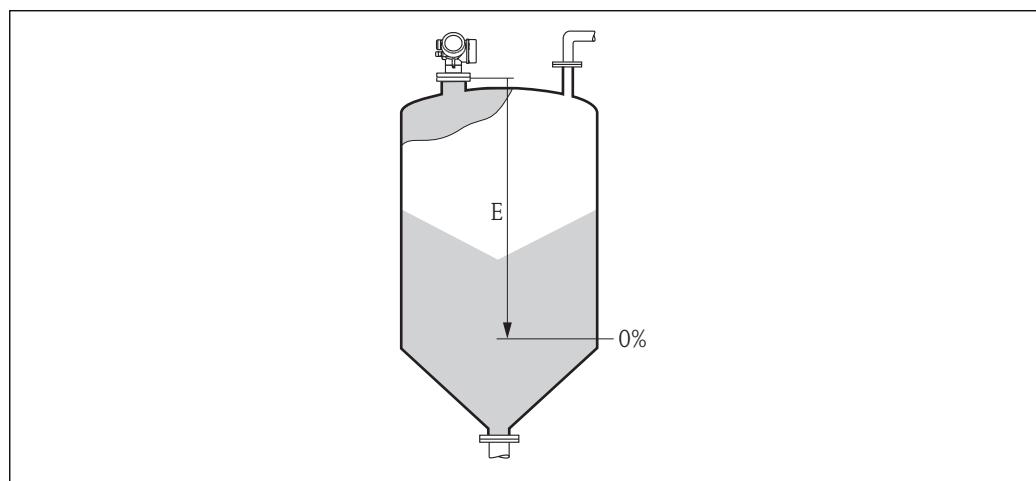
Factory setting Depending on the antenna

Additional information



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



A0019488

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

i 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



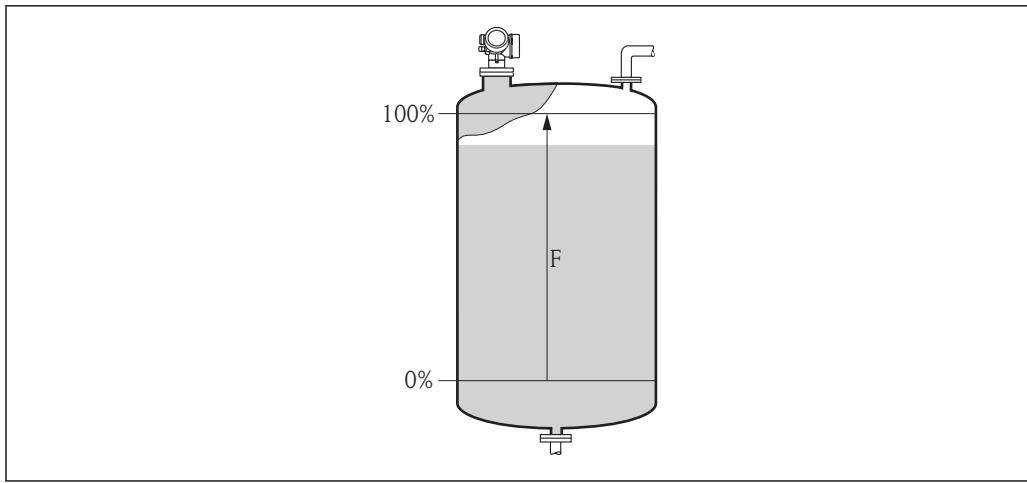
Navigation ■■ Expert → Sensor → Level → Full calibr. (2308)

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

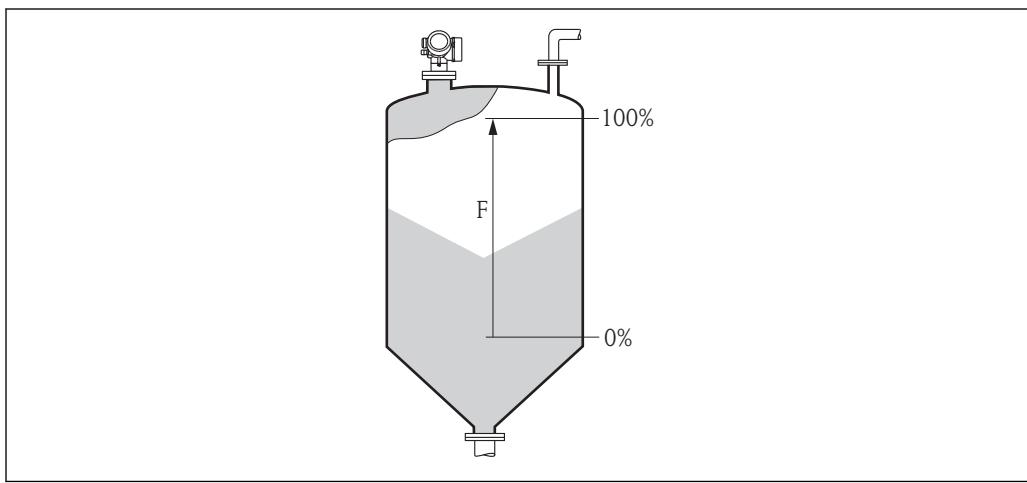
User entry Depending on the antenna

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 (→ ■ 39):

- The unit defined in the **Distance unit** parameter is used for the basic calibration (**Empty calibration** (→ ■ 50) and **Full calibration** (→ ■ 51)).
- 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

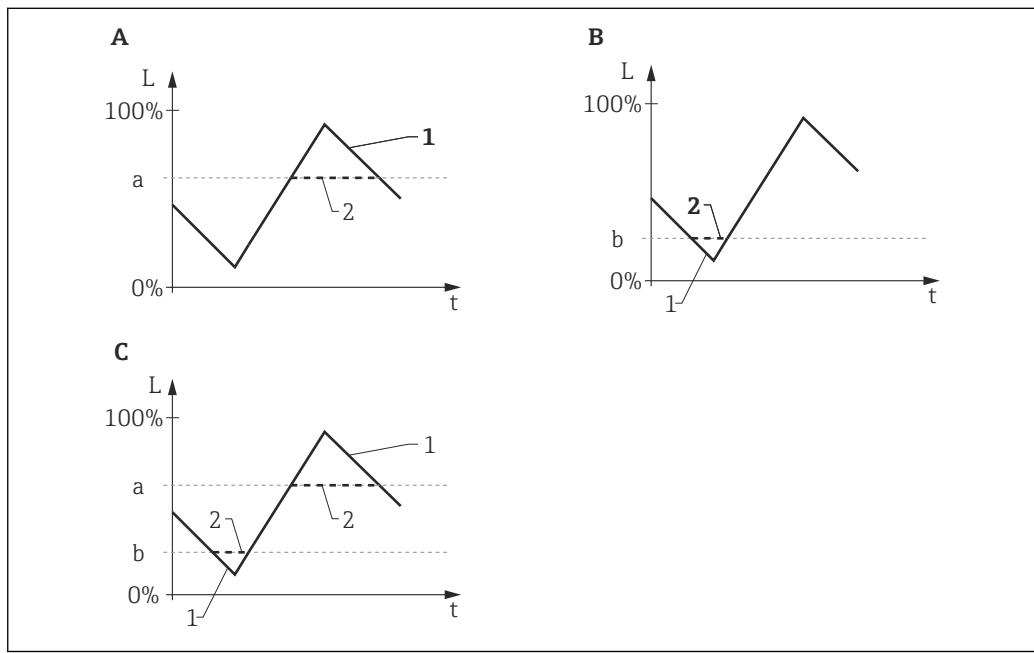
- Off
- Low limit
- High limit
- Low and High Limit

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** (→ 53) und **Low limit** (→ 54) 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 (→ 53) = **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** (→ 53) = **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

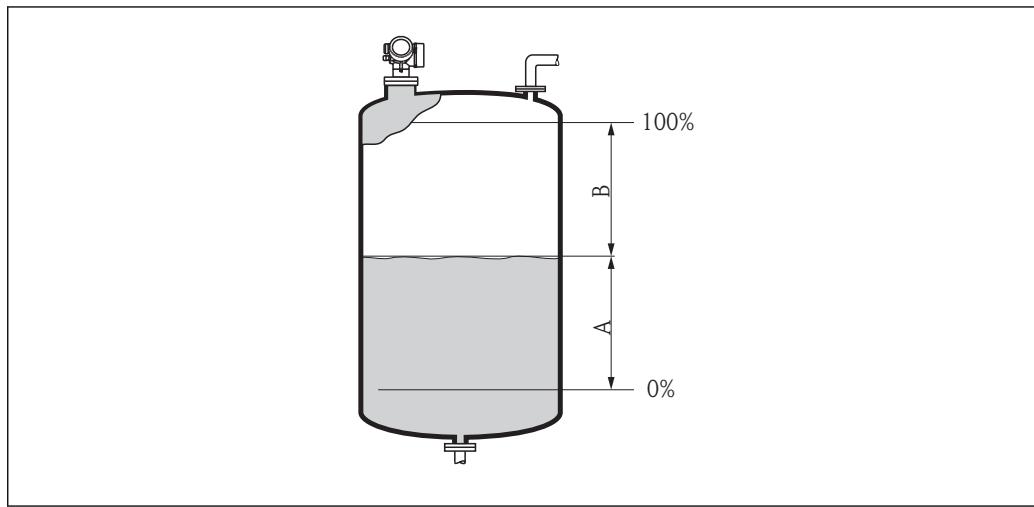
Factory setting Level linearized

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).



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15 Definition of the "Output mode (→ 54)" parameter

A Level linearized

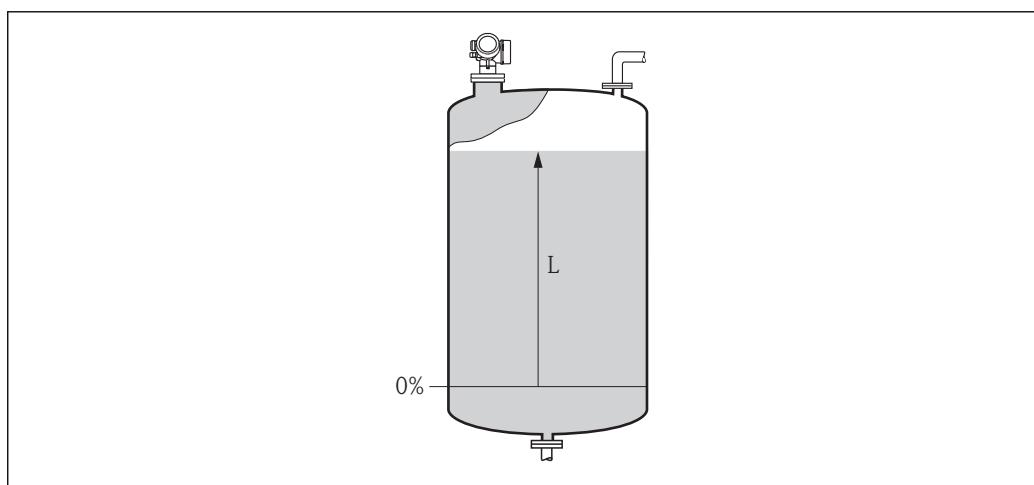
B Ullage

Level**Navigation**

Expert → Sensor → Level → Level (2319)

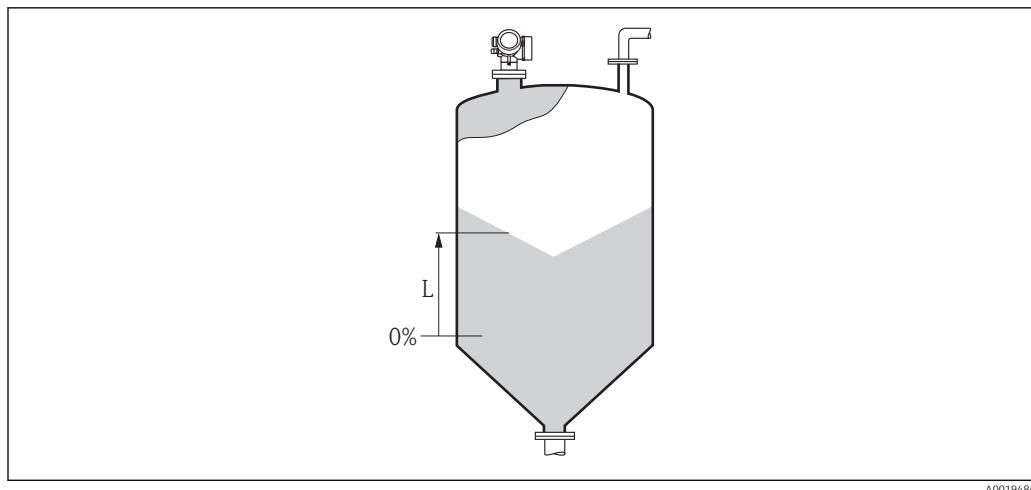
Description

Displays measured level L (before linearization).

Additional information

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16 Level in case of liquid measurements



17 Level in case of bulk solid measurements

The unit is defined in the **Level unit** parameter (→ 52).

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 → 62.

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 (→ 50)

Additional information

If the parametrized measuring range (**Empty calibration** (→ 50)) 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.

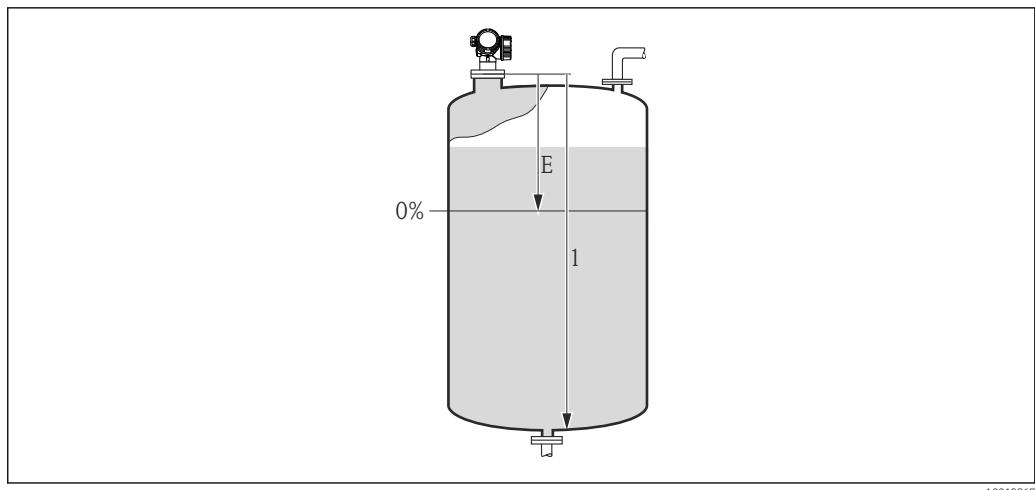


图 18 "Tank/silo height" parameter (→ 图 56)'for measurements in liquids

E Empty calibration (→ 图 50)

1 Tank/silo height (→ 图 56)

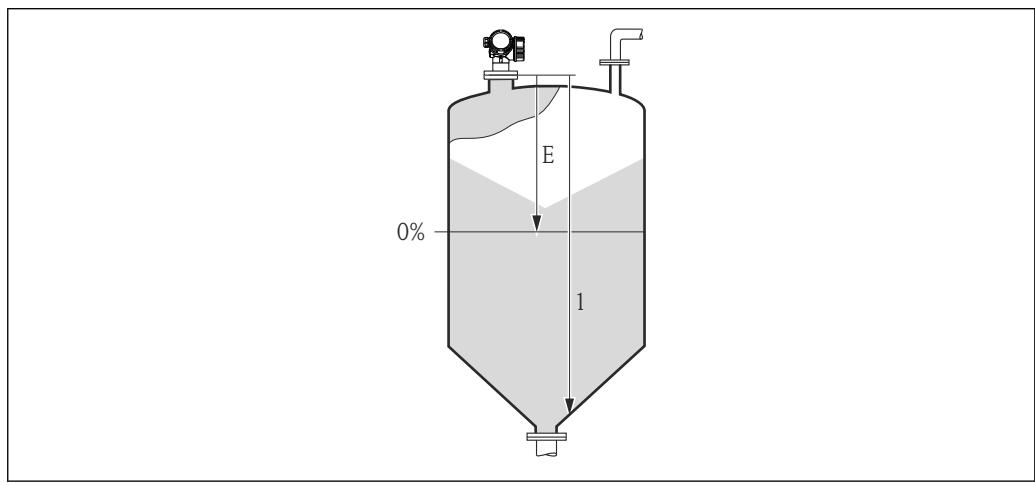


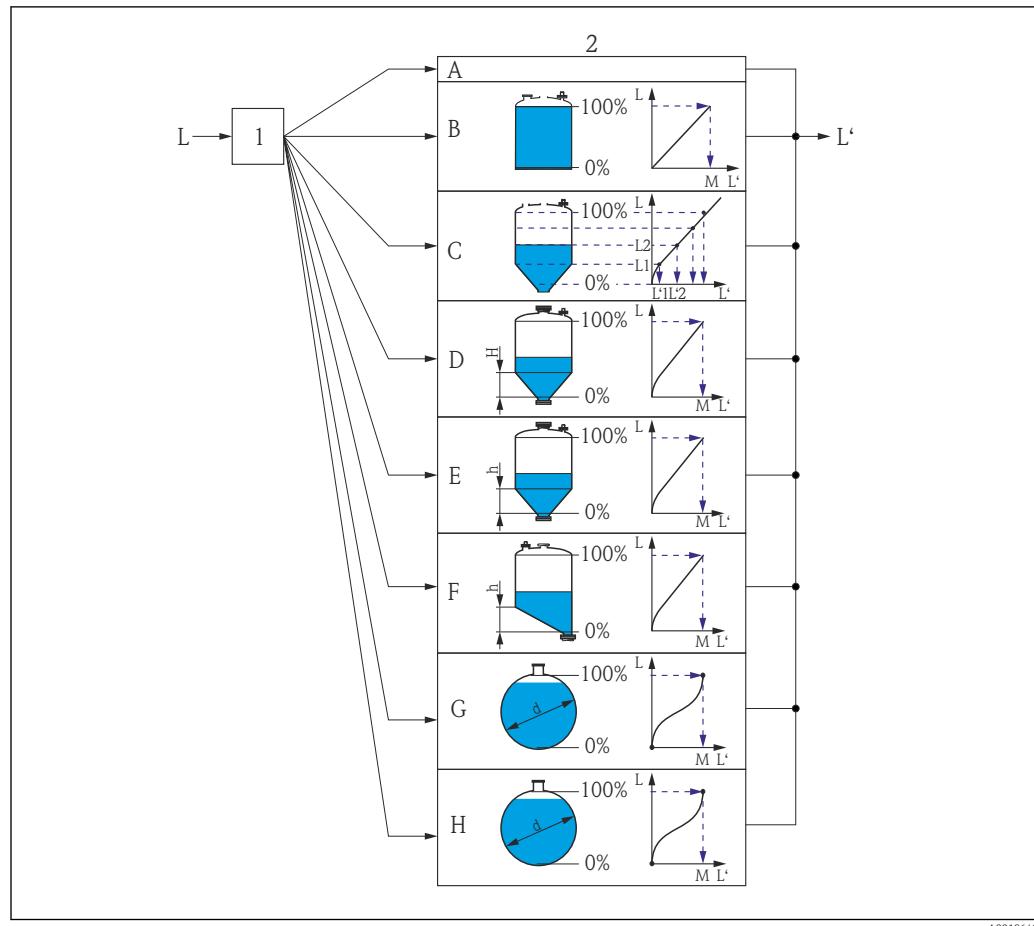
图 19 "Tank/silo height" parameter (→ 图 56)'for measurements in bulk solids

E Empty calibration (→ 图 50)

1 Tank/silo height (→ 图 56)

i For tanks with conical outlet, **Tank/silo height** should not be changed as in this type of applications **Empty calibration** (→ 图 50) is usually **not** << the tank or silo height.

3.4.5 "Linearization" submenu

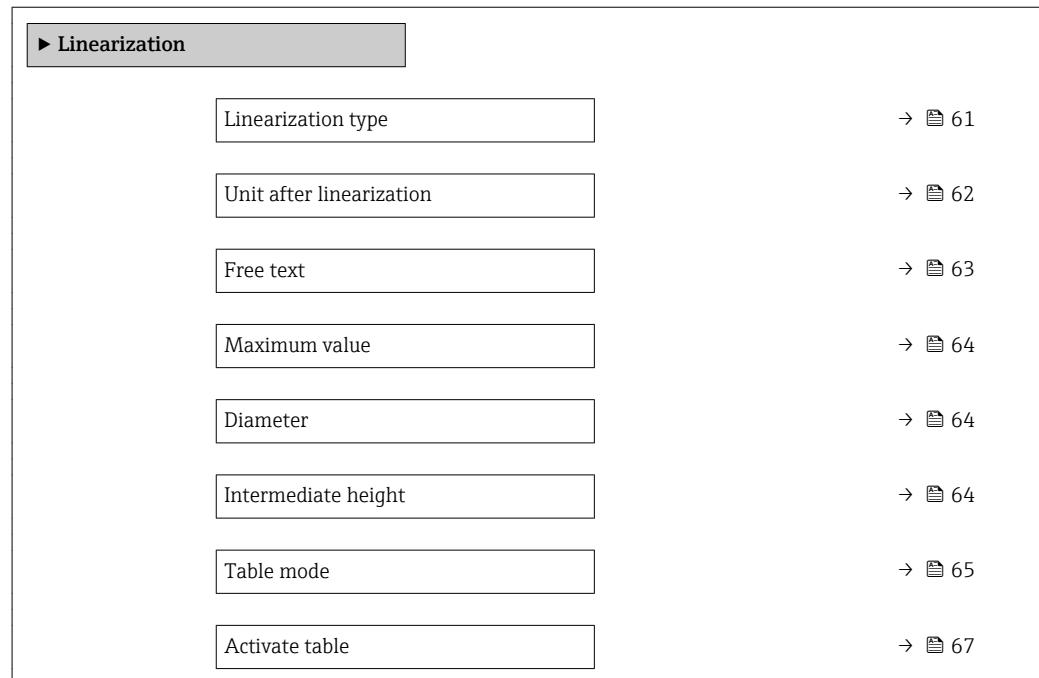


20 Linearization: Transformation of the level into a volume or weight; the transformation is dependent on the shape of the vessel.

- 1 Selection of linearization type and unit
- 2 Configuration of the linearization
- A Linearization type (\rightarrow 61) = None
- B Linearization type (\rightarrow 61) = Linear
- C Linearization type (\rightarrow 61) = Table
- D Linearization type (\rightarrow 61) = Pyramid bottom
- E Linearization type (\rightarrow 61) = Conical bottom
- F Linearization type (\rightarrow 61) = Angled bottom
- G Linearization type (\rightarrow 61) = Horizontal cylinder
- H Linearization type (\rightarrow 61) = Sphere
- L Level before linearization (measured in distance units)
- L' Level linearized (\rightarrow 56) (corresponds to volume or weight)
- M Maximum value (\rightarrow 64)
- d Diameter (\rightarrow 64)
- h Intermediate height (\rightarrow 64)

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

► Linearization	
Linearization type	→  61
Unit after linearization	→  62
Free text	→  63
Level linearized	→  63
Maximum value	→  64
Diameter	→  64
Intermediate height	→  64
Table mode	→  65
Table number	→  66
Level	→  66
Level	→  67
Customer value	→  67
Activate table	→  67

Description of parameters

Navigation

Diagram Expert → Sensor → Linearization

Linearization type



Navigation

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

Description

Select linearization type.

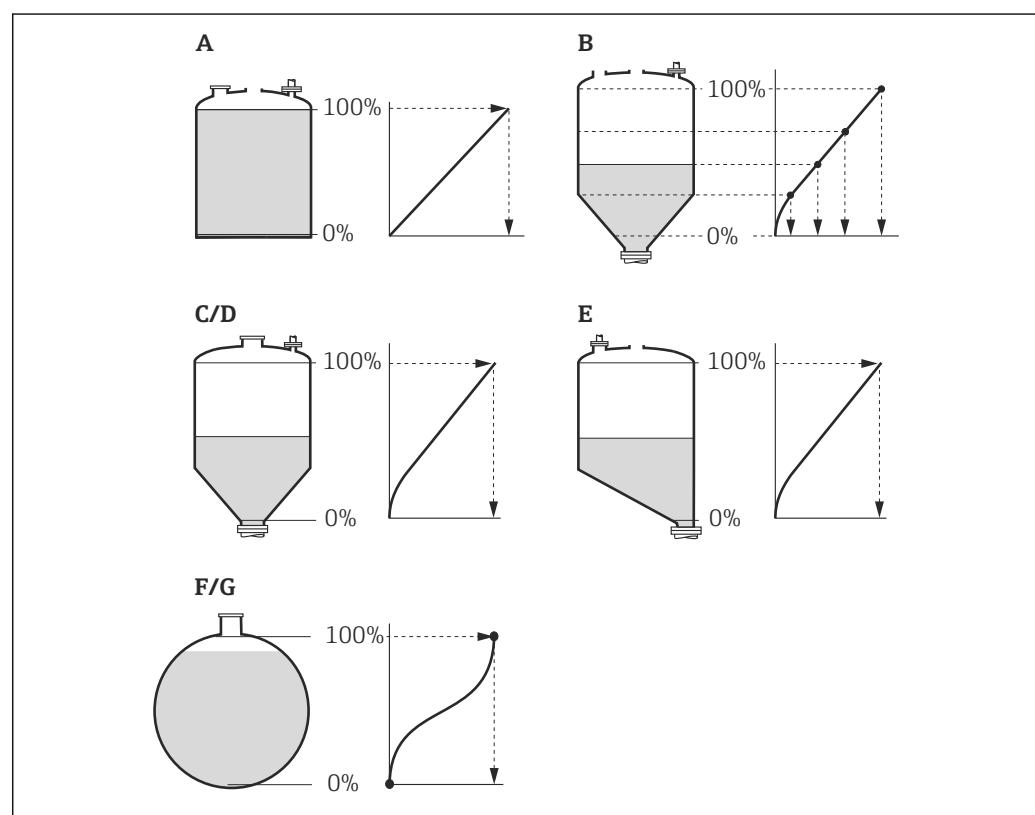
Selection

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

Factory setting

None

Additional information



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Diagram 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** (→ [62](#))

- **Maximum value** (→ [64](#)): 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** (→ [62](#))

- **Table mode** (→ [65](#))

- For each table point: **Level** (→ [66](#))

- For each table point: **Customer value** (→ [67](#))

- **Activate table** (→ [67](#))

- **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** (→ [62](#))

- **Maximum value** (→ [64](#)): Maximum volume or weight

- **Intermediate height** (→ [64](#)): 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** (→ [62](#))

- **Maximum value** (→ [64](#)): Maximum volume or weight

- **Intermediate height** (→ [64](#)): 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** (→ [62](#))

- **Maximum value** (→ [64](#)): Maximum volume or weight

- **Intermediate height** (→ [64](#)): 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** (→ [62](#))

- **Maximum value** (→ [64](#)): Maximum volume or weight

- **Diameter** (→ [64](#))

- **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** (→ [62](#))

- **Maximum value** (→ [64](#)): Maximum volume or weight

- **Diameter** (→ [64](#))

Unit after linearization



Navigation

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

Prerequisite

Linearization type (→ [61](#)) ≠ None

Description

Select unit of the linearized value.

Selection	<i>SI units</i>	<i>US units</i>	<i>Imperial units</i>
	■ STon	■ lb	impGal
	■ t	■ UsGal	
	■ kg	■ ft ³	
	■ cm ³		
	■ dm ³		
	■ m ³		
	■ hl		
	■ l		
	■ %		
	<i>Custom-specific units</i>		
	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 (→ 63).		

Free text



Navigation	 Expert → Sensor → Linearization → Free text (2341)
Prerequisite	Unit after linearization (→ 62) = 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 → 62.

Maximum value**Navigation**

Expert → Sensor → Linearization → Maximum value (2315)

Prerequisite**Linearization type** (→ 61) 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** (→ 61) 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 (→ 39).

Intermediate height**Navigation**

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

Prerequisite**Linearization type** (→ 61) has one of the following values:

- Pyramid bottom
- Conical bottom
- Angled bottom

Description

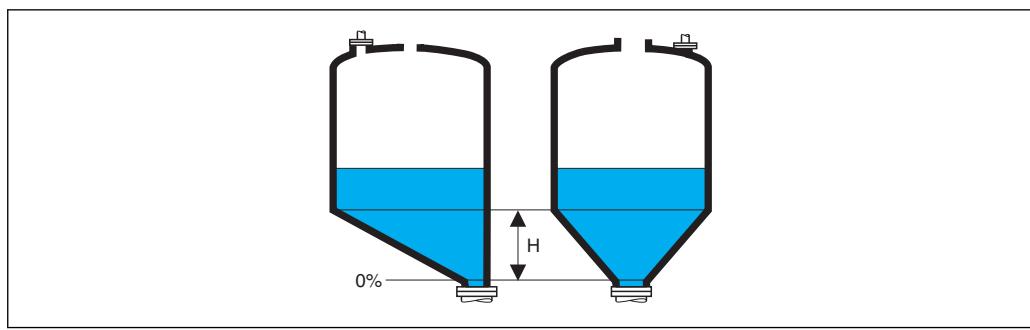
Specify intermediate height H.

User entry

0 to 200 m

Factory setting

0 m

Additional information*H Intermediate height*

The unit is defined in the **Distance unit** parameter (→ 39).

Table mode**Navigation**

Expert → Sensor → Linearization → Table mode (2303)

Prerequisite

Linearization type (→ 61) = **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.

i Before entering a linearization table, the values for **Empty calibration** (→ 50) and **Full calibration** (→ 51) 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** (→ 65) = **Clear table**). Then enter a new table.

How to enter the table

- Via FieldCare

The table points can be entered via the **Table number** (→ 66), **Level** (→ 66) and **Customer value** (→ 67) 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.

i 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 (→ 52) beforehand.

Table number**Navigation**

Expert → Sensor → Linearization → Table number (2370)

Prerequisite

Linearization type (→ 61) = **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** (→ 61) = **Table**
- **Table mode** (→ 65) = **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	<ul style="list-style-type: none"> ▪ Linearization type (→ 61) = Table ▪ Table mode (→ 65) = 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 (→ 61) = 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 (→ 61) = Table
Description	Activate (enable) or deactivate (disable) the linearization table.
Selection	<ul style="list-style-type: none"> ▪ Disable ▪ Enable
Factory setting	Disable
Additional information	<p>Meaning of the options</p> <ul style="list-style-type: none"> ▪ Disable The measured level is not linearized. If Linearization type (→ 61) = Table at the same time, the device issues error message F435. ▪ Enable The measured level is linearized according to the table.
	<p> 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.</p>

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

▶ Information	
Signal quality	→ ☰ 69
Absolute echo amplitude	→ ☰ 69
Relative echo amplitude	→ ☰ 70
Tank bottom echo amplitude	→ ☰ 71
Found echoes	→ ☰ 71
Used calculation	→ ☰ 71
Tank trace state	→ ☰ 72
Measurement frequency	→ ☰ 72
Electronic temperature	→ ☰ 72

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 bottom 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** (→  97) = **Alarm**.
 - S941, if another option has been selected in **Output echo lost** (→  97).

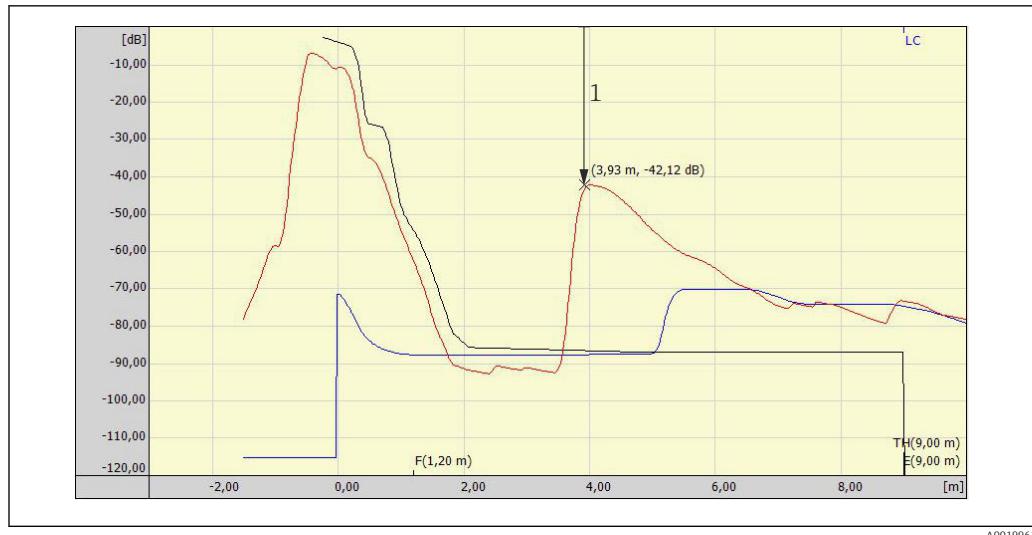
Absolute echo amplitude

Navigation

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

Description

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

Additional information

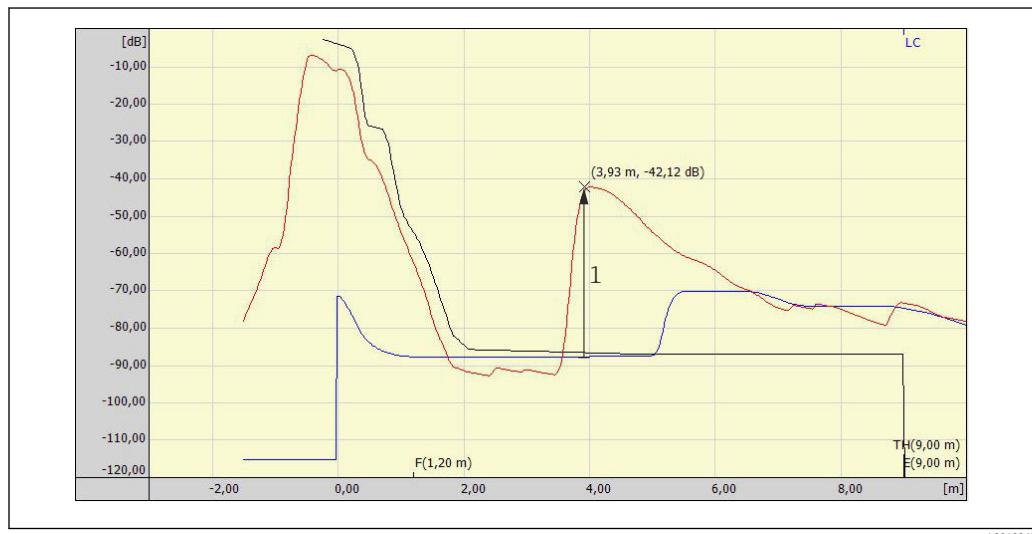
1 Absolute echo amplitude in the envelope curve, measured in dB

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

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

i 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	<ul style="list-style-type: none"> ▪ 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 <ul style="list-style-type: none"> ▪ 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 (→  39).

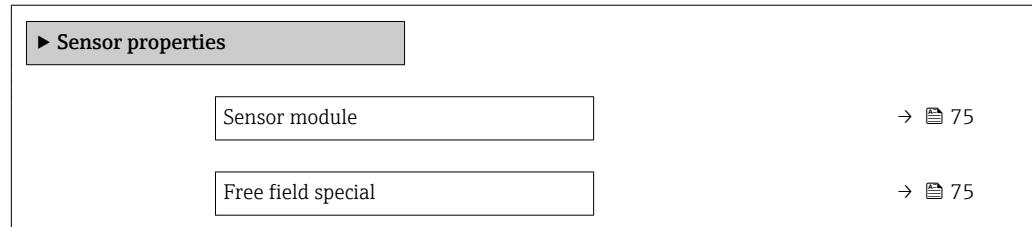
3.4.7 "Sensor properties" submenu

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 (→  75) = **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.

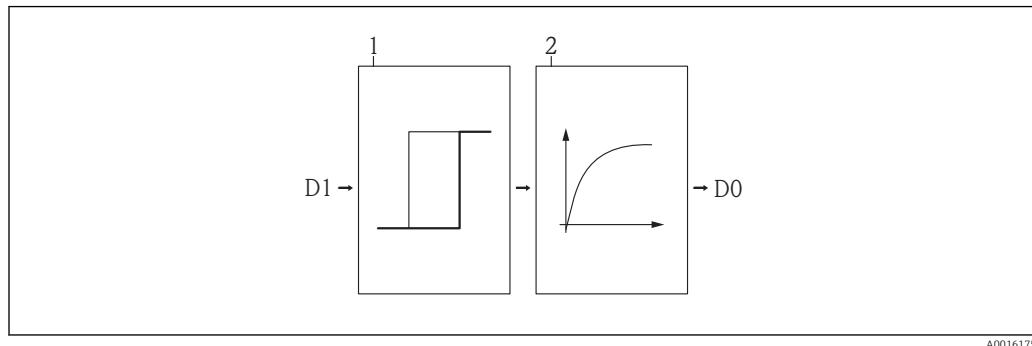


图 22 The configurable distance filters

- 1 Dead time (→ 图 79)
- 2 Integration time (→ 图 80) (low pass filter)

Low pass filter

The low pass filter dampens the distance signal with a user defined integration time τ (**Integration time** parameter (→ 图 80)). After a sudden change of the level, it takes about $5 \times \tau$, until the new measured value is obtained.

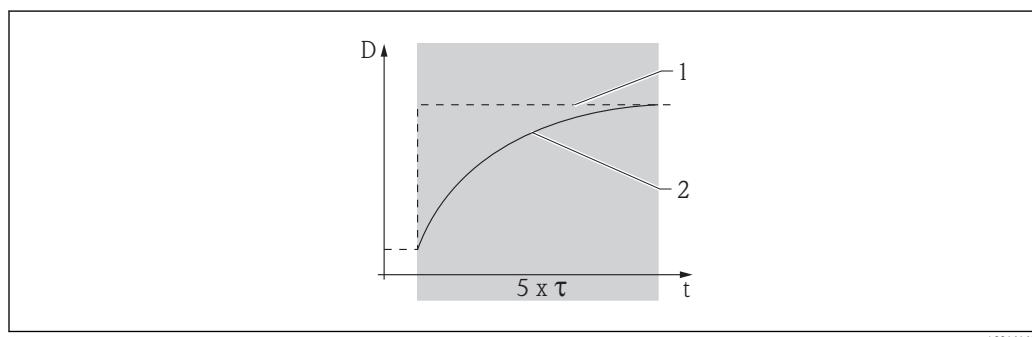
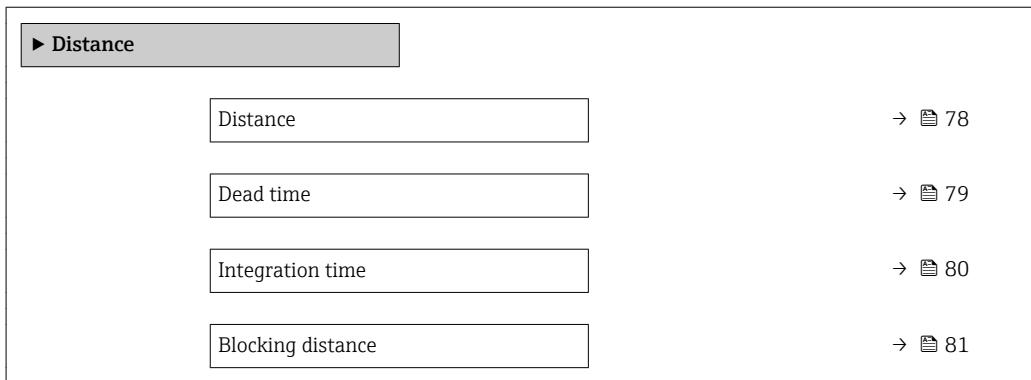


图 23 Low pass filter

- 1 Signal before the low pass filter
- 2 Signal after the low pass filter
- τ Integration time (→ 图 80)

Structure of the submenu*Navigation* Expert → Sensor → Distance

Description of parameters

Navigation

Diagram Expert → Sensor → Distance

Distance

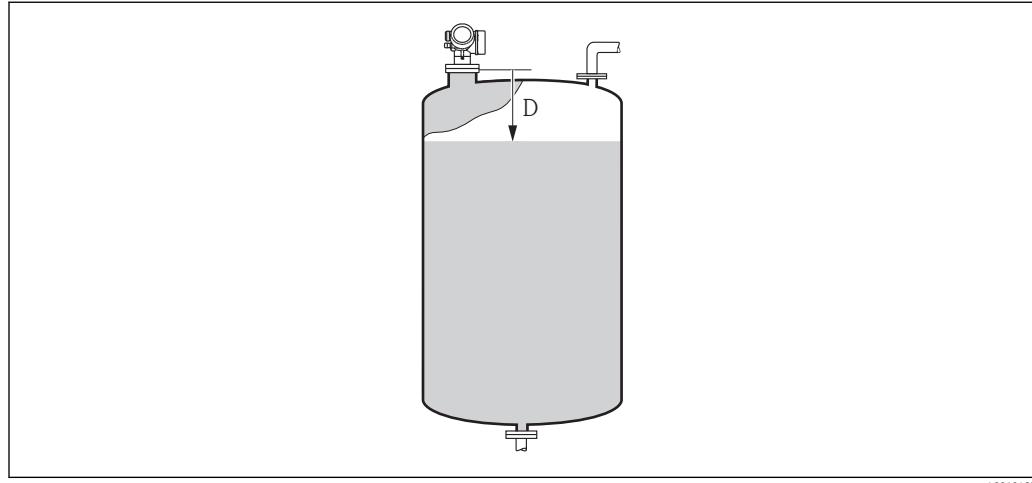
Navigation

Diagram Expert → Sensor → Distance → Distance (1124)

Description

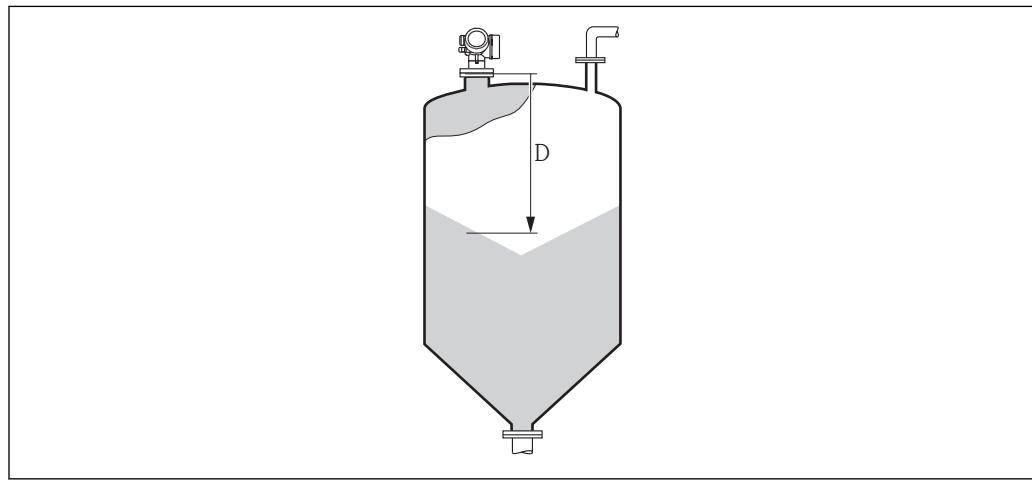
Displays the measured distance D between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



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■ 24 Distance for liquid measurements



A0019485

■ 25 Distance for bulk solid measurements



The unit is defined in the **Distance unit** parameter (→ ■ 39).

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 (→ [45](#))
- Max. filling speed liquid (→ [40](#)) bzw. Max. filling speed solid (→ [41](#))
- Max. draining speed liquid (→ [41](#)) bzw. Max. draining speed solid (→ [42](#))

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

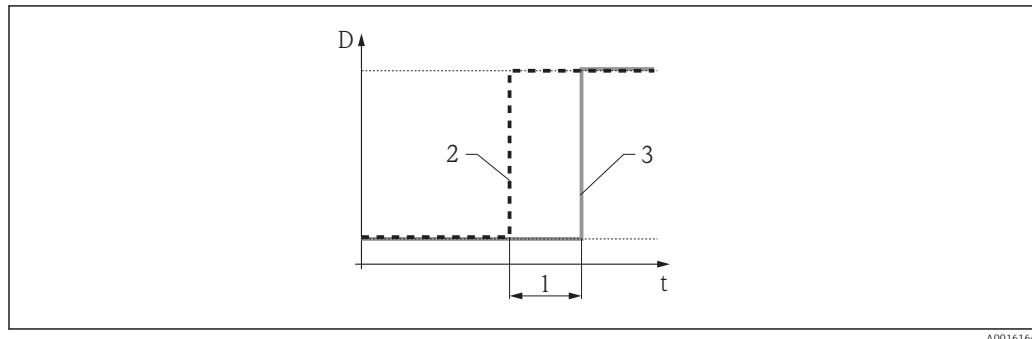
Max. filling speed liquid (→ 40)	Max. draining speed liquid (→ 41)					
	Slow < 1cm (0,4in) /min	Medium < 10cm (4in) /min	Standard < 1m (40in) /min	Fast < 2m (80in) /min	Very fast > 2m (80in) /min	No filter / test
Slow < 1cm (0,4in) /min	8 s	6 s	4 s	2 s	0 s	0 s
Medium < 10cm (4in) /min	6 s	6 s	4 s	2 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 (→ 41)	Max. draining speed solid (→ 42)						
	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 from disturbing the output signal.



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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 (→ 45)
- Max. filling speed liquid (→ 40) bzw. Max. filling speed solid (→ 41)
- Max. draining speed liquid (→ 41) bzw. Max. draining speed solid (→ 42)

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

Max. filling speed liquid (→ 40)	Max. draining speed liquid (→ 41)					
	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 (→ 41)	Max. draining speed solid (→ 42)						
	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

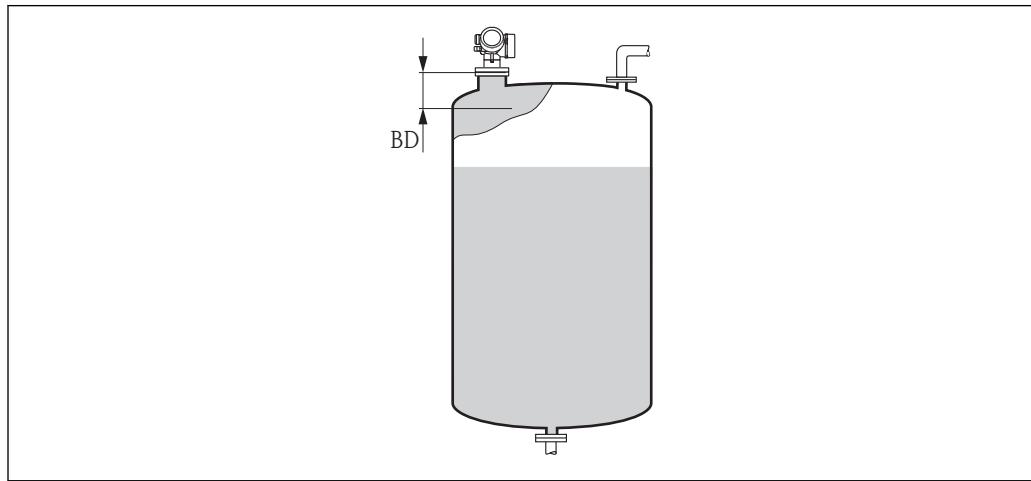
0 to 200 m

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)

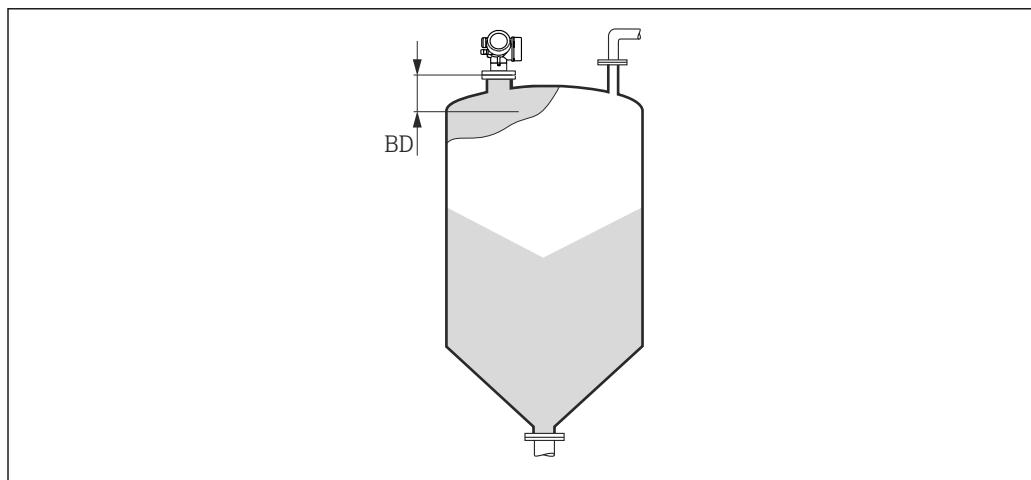
Additional information

No echos are evaluated within the blocking distance BD. Therefore, BD can be used to suppress interference echos in the vicinity of the antenna.



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):

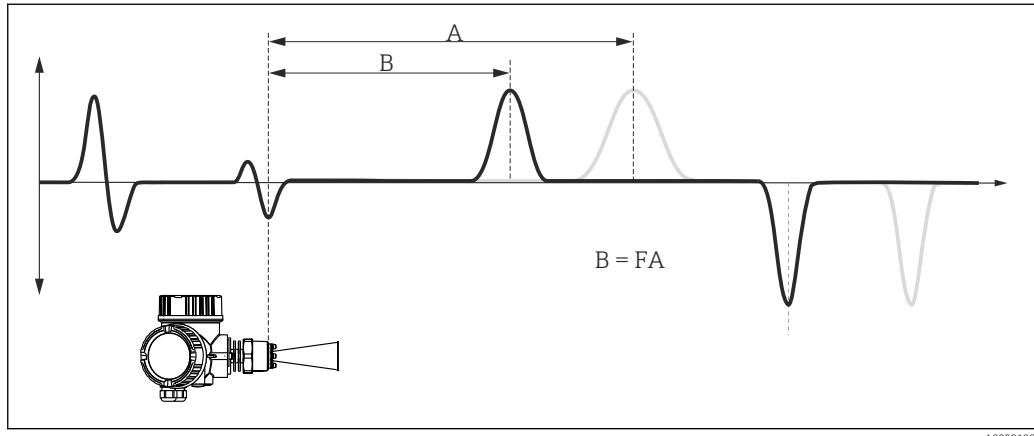
Gas layer	Temperature		Pressure				
	°C	°F	1 bar (14.5 psi)	10 bar (145 psi)	50 bar (725 psi)	100 bar (1450 psi)	160 bar (2320 psi)
Air/ nitrogen	20	68	0.00 %	0.22 %	1.2 %	2.4 %	3.89 %
	200	392	-0.01 %	0.13 %	0.74 %	1.5 %	2.42 %
	400	752	-0.02 %	0.08 %	0.52 %	1.1 %	1.70 %
Hydrogen	20	68	-0.01 %	0.10 %	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.

► Gas phase compensation	
GPC mode	→  87
External pressure selector	→  87
External pressure	→  88
Gas phase compensation factor	→  88
Present reference distance	→  88
Reference distance	→  89
Reference echo threshold	→  89
Const. GPC factor	→  89

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
- External 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.

▪ External correction

The device receives the externally measured pressure through an AO block and uses it together with the gas phase compensation factor F to calculate the gas phase compensation. The displayed envelope curve does already contain the correction.

▪ 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.

External pressure selector



Navigation   Expert → Sensor → Gas phase comp. → Ext. press.input (1073)

Prerequisite **GPC mode (→ 87) = External correction**

Description Allocate an AO block to the gas phase compensation. The externally measured pressure is read via this AO block.

Selection

- None
- Analog output 1
- Analog output 2
- Analog output 3

- Analog output 4
- Analog output 5
- Analog output 6
- Analog output 7
- Analog output 8

Factory setting None

External pressure

Navigation  Expert → Sensor → Gas phase comp. → External press. (1233)

Prerequisite **GPC mode (→  87) = External correction**

Description Indicates the measured pressure which is currently used for the gas phase compensation.

Gas phase compensation factor



Navigation  Expert → Sensor → Gas phase comp. → Gas comp. factor (1209)

Prerequisite **GPC mode (→  87) = External correction**

Description Define gas phase compensation factor F .

User entry Signed floating-point number

Factory setting 0

Additional information Suitable value for saturated steam in the temperature range 100 to 350 °C (212 to 662 °F):
 $F = 0.00505 / \text{bar}$

Present reference distance

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

Prerequisite **GPC mode (→  87) = 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 (→ 87) = 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 artificially 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 (→ 87) = 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 (→ 87) = 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

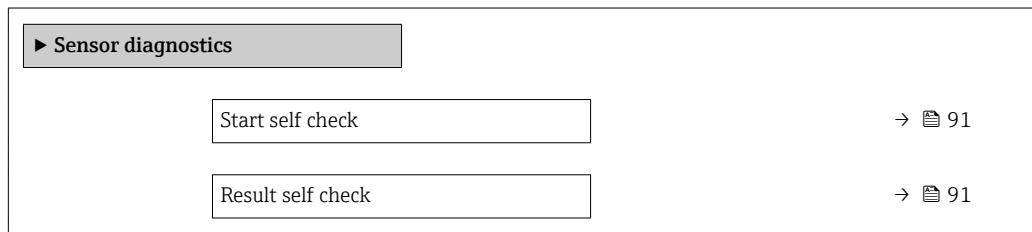
The **Sensor diagnostics** submenu is used for the proof-test which is required for SIL applications in regular intervals. For details refer to the description of the test procedure C in the Functional Safety Manual, SD01087F.

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 (→ [91](#)).

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 (→ 91).



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

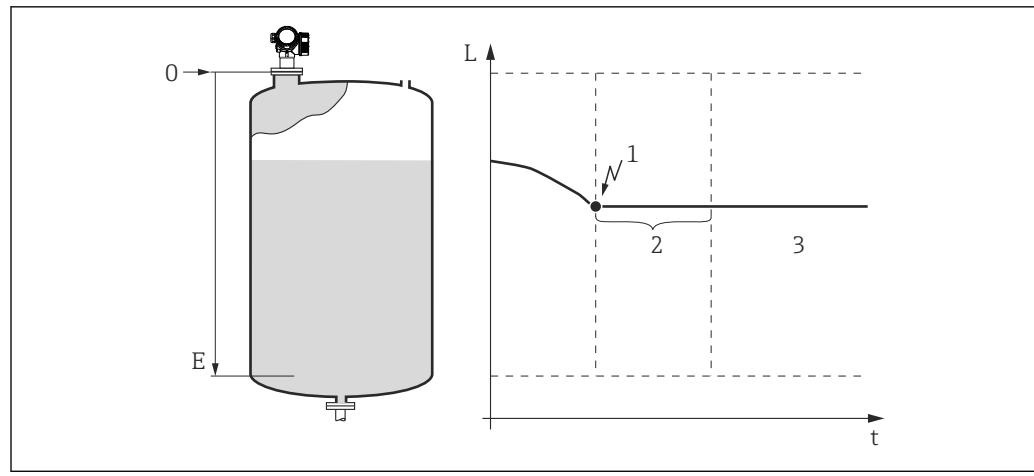
The **Safety settings** submenu contains all parameters which determine the behavior of the device in critical situations such as an echo loss or an undershooting of a user defined safety distance.

Behavior in the case of an echo loss

The behavior in case of an echo loss is defined in the **Output echo lost** parameter (→ 97). Depending on the selected option, suitable values must be selected in a number of additional parameters:

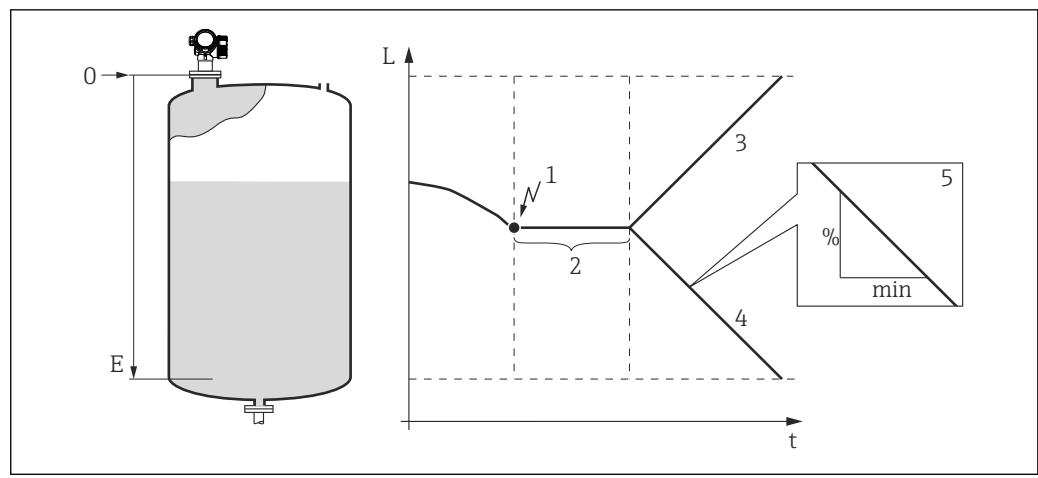
Option selected in "Output echo lost" (→ 97)"	Required additional parameters
Last valid value	Delay time echo lost (→ 99)
Ramp at echo lost	<ul style="list-style-type: none"> ▪ Ramp at echo lost (→ 98) ▪ Delay time echo lost (→ 99)
Value echo lost	<ul style="list-style-type: none"> ▪ Value echo lost (→ 97) ▪ Delay time echo lost (→ 99)
Alarm	1)

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



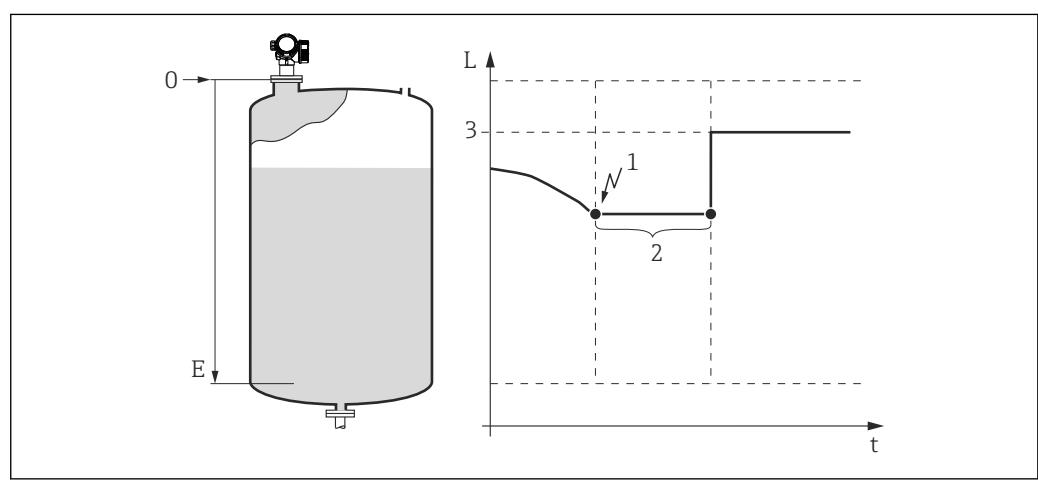
30 "Output echo lost (→ 97)" = "Last valid value"

- 1 Echo loss
- 2 Delay time echo lost (→ 99)
- 3 The last valid measured value is held.



31 "Output echo lost (\rightarrow 97)" = "Ramp at echo lost"

- 1 Echo loss
- 2 Delay time echo lost (\rightarrow 99)"
- 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".

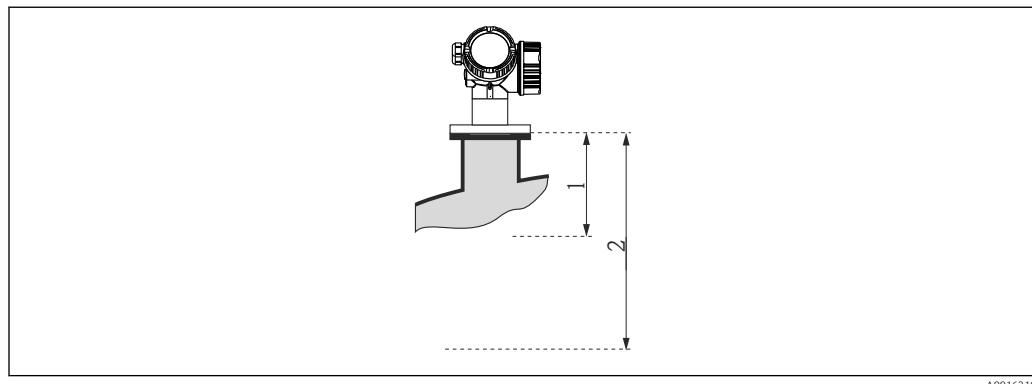


32 "Output echo lost (\rightarrow 97)" = "Value echo lost"

- 1 Echo loss
- 2 Delay time echo lost (\rightarrow 99)
- 3 Value echo lost (\rightarrow 97)

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 (→ 99).



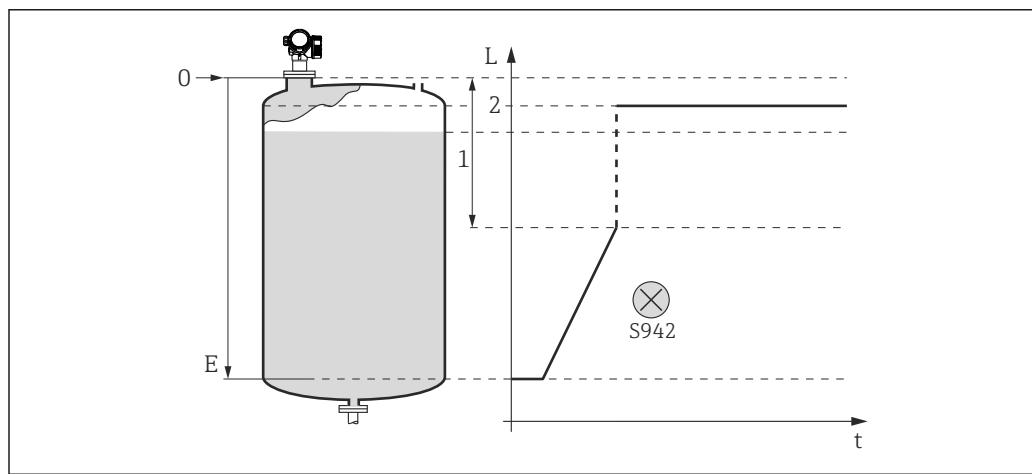
A0016210

■ 33 Definition of the safety distance

- 1 Blocking distance (→ 81)
- 2 Safety distance (→ 99)

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

- In safety distance (→ 100)
- Acknowledge alarm (→ 101)



A0016211

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

- 1 Safety distance (→ 99)
- 2 Value defined in "Failure mode"

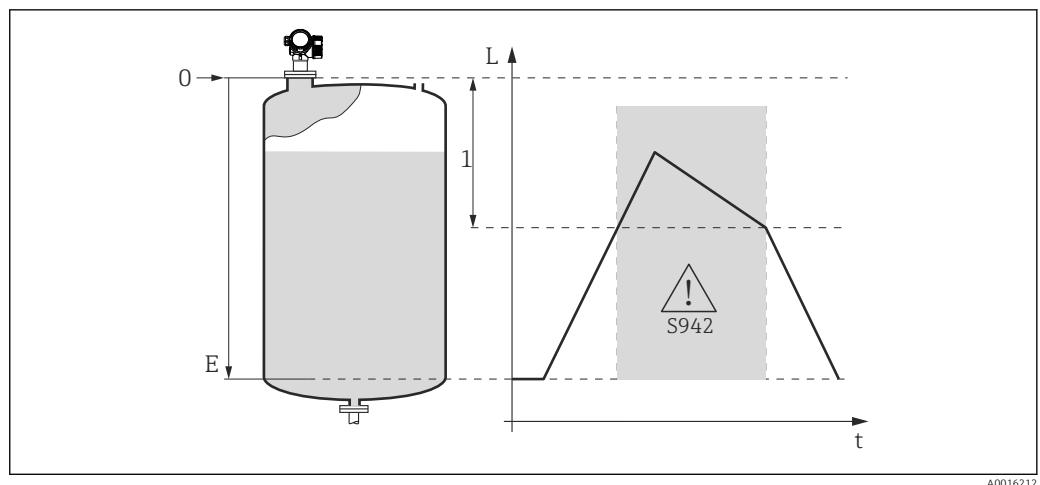


图 35 "In safety distance" = "Warning": If the safety distance is undershot, the device continues measuring but nevertheless generates a warning.

1 Safety distance (→ 图 99)

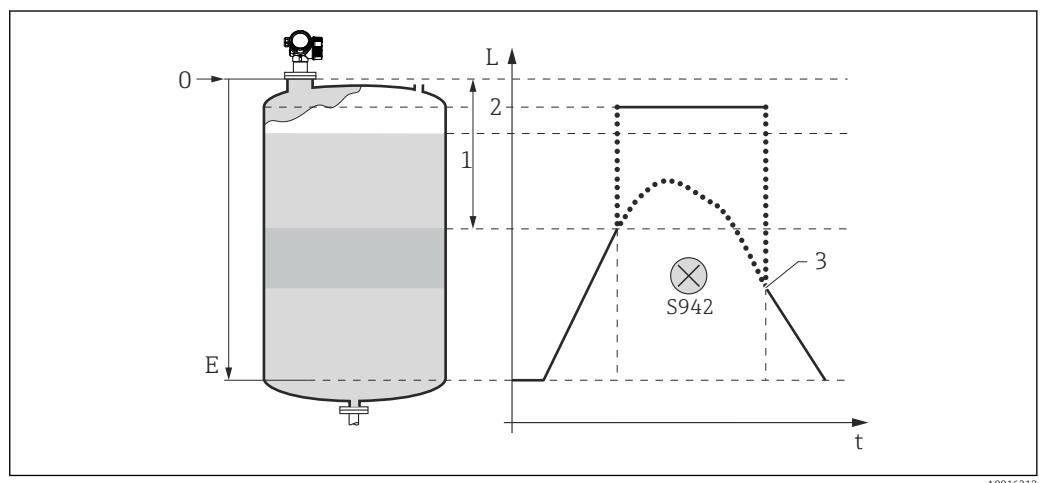


图 36 "In safety distance" = "Self holding": If the safety distance is undershot, the device generates an alarm. The measurement is not resumed until this alarm has been acknowledged by the user.

- 1 Safety distance (→ 图 99)
- 2 Value defined in "Failure mode"
- 3 Acknowledge alarm (→ 图 101)

Structure of the submenu

Navigation

☰ ☰ Expert → Sensor → Safety sett.

▶ Safety settings	
Output echo lost	→ ☰ 97
Value echo lost	→ ☰ 97
Status echo lost	→ ☰ 98
Ramp at echo lost	→ ☰ 98
Delay time echo lost	→ ☰ 99
Safety distance	→ ☰ 99
In safety distance	→ ☰ 100
Status in safety distance	→ ☰ 100
Acknowledge alarm	→ ☰ 101

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 lostIn the case of a lost echo the output value is continuously shifted towards 0% or 100%.
The slope of the ramp is defined in the **Ramp at echo lost** parameter (→  98).**■ Value echo lost**In the case of a lost echo the output assumes the value defined in the **Value echo lost** parameter (→  97).**■ Alarm**In the case of a lost echo the device generates an alarm; see the **Failure mode** parameter**Value echo lost****Navigation**   Expert → Sensor → Safety sett. → Value echo lost (2316)**Prerequisite** **Output echo lost (→  97) = 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** (→  52)
- with linearization: **Unit after linearization** (→  62)

Status echo lost**Navigation** Expert → Sensor → Safety sett. → Status echo lost (1416)**Description**

Define status in case of a lost echo.

Selection

- Good
- Good: Maintenance required (M)
- Good: Maintenance demanded (M)
- Uncertain: Maintenance demanded (M)
- Bad: Maintenance alarm (F)
- Uncertain: Process related/no maint. (S)
- Bad: Process related/no maintenance (F)

Factory settingDepending on the **Output echo lost** parameter (→  97)**Additional information***Dependence on the "Output echo lost" parameter*

Output echo lost (→  97)	Status echo lost (→  98)
Last valid value	Uncertain: Process related/no maint. (S)
Ramp at echo lost	Uncertain: Process related/no maint. (S)
Value echo lost	Uncertain: Process related/no maint. (S)
Alarm	Bad: Process related/no maintenance (F)

Ramp at echo lost**Navigation** Expert → Sensor → Safety sett. → Ramp echo lost (2323)**Prerequisite****Output echo lost (→  97) = Ramp at echo lost****Description**

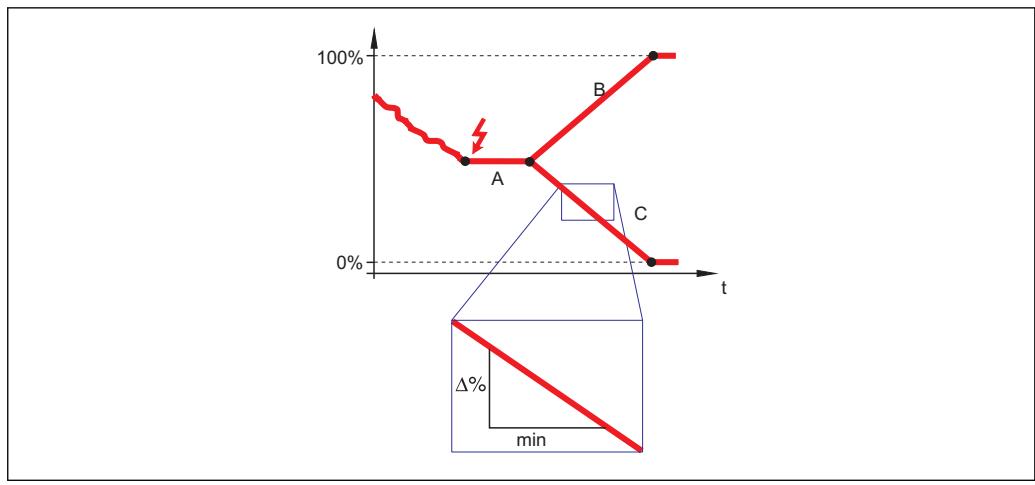
Define the slope of the ramp in the case of a lost echo.

User entry

Signed floating-point number

Factory setting

0.0 %/min

Additional information

- A Delay time echo lost (→ 99)
- B Ramp at echo lost (→ 98) (positive value)
- C Ramp at echo lost (→ 98) (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 continuously 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 (→ 97). 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 (→ 100) 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).

Status in safety distance**Navigation**

Expert → Sensor → Safety sett. → Stat.safety dist (1417)

Description

Define status in case the safety distance is undershot.

Selection

- Good
- Good: Maintenance required (M)
- Good: Maintenance demanded (M)
- Uncertain: Maintenance demanded (M)
- Bad: Maintenance alarm (F)
- Uncertain: Process related/no maint. (S)
- Bad: Process related/no maintenance (F)

Factory setting

Dependent on the **In safety distance** parameter (→ 100)

Additional information

In safety distance (→ 100)	Status in safety distance (→ 100)
Off	-
Alarm	Bad: Process related/no maintenance (F)
Warning	Uncertain: Process related/no maint. (S)
Self holding	Bad: Process related/no maintenance (F)

Acknowledge alarm**Navigation**

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

Prerequisite**In safety distance (→ 100) = 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

i 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

Diagram Expert → Sensor → Env. curve

Envelope curve



Navigation

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

Description

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

Selection

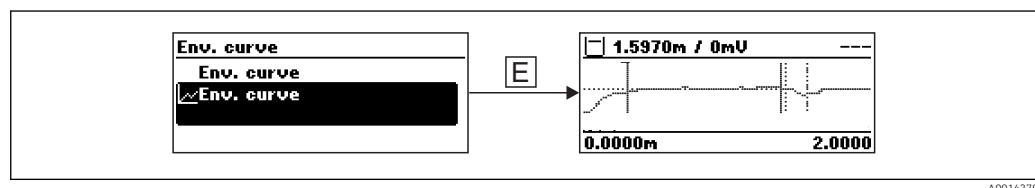
- Envelope curve
- Envelope + Map
- Envelope + Ref.
- Raw envelope curve
- Envelope + EWC

Factory setting

Envelope curve

Additional information

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



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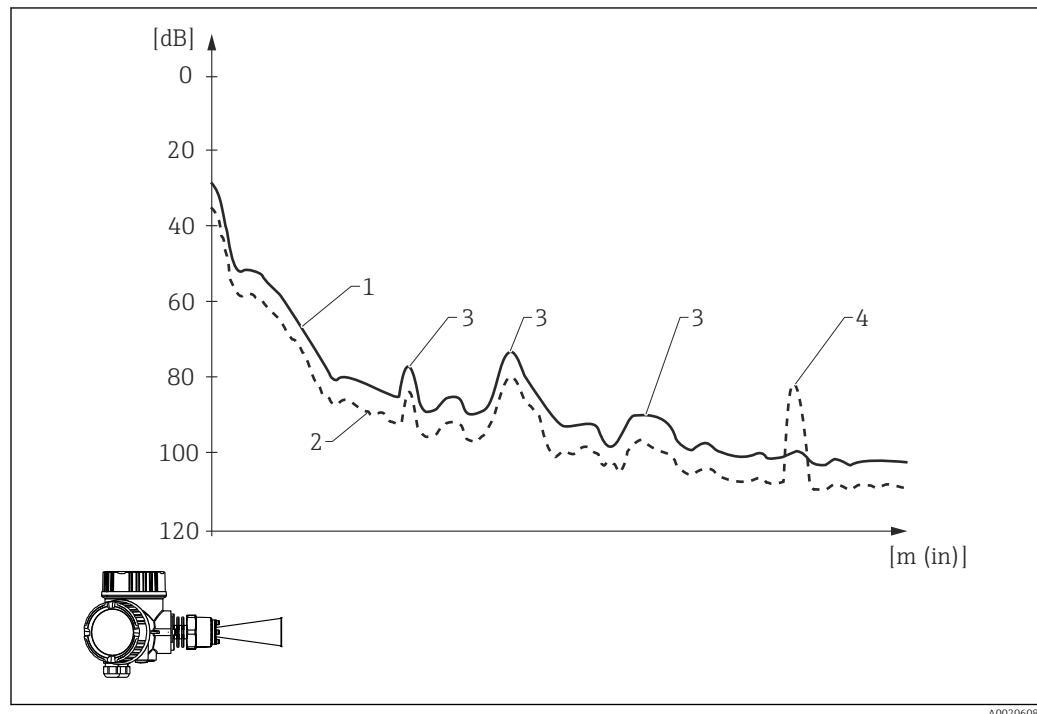
To quit the envelope curve display, press the "+" and "-" keys simultaneously.

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 generated 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**²²⁾ 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**²²⁾ 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.

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

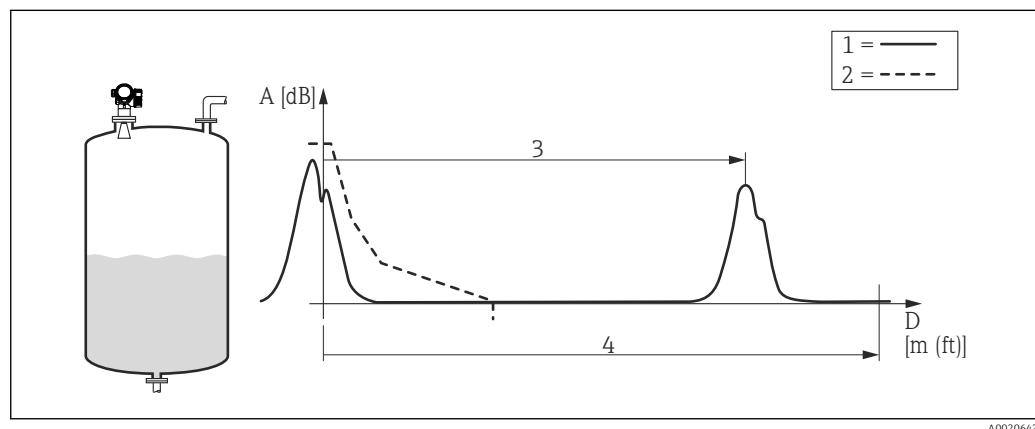
Recording the mapping curve

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 (→ 111).

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 (→ 111).

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 (→ 111) and select the **Manual map** option.
2. Go to the **Record map** parameter (→ 113) 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 (→ 112).

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:

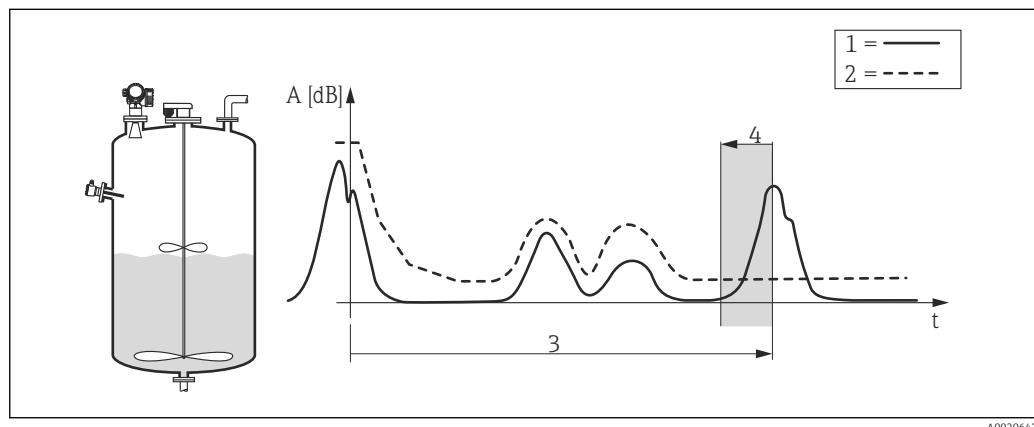
1. Enter the end point of the area to be deleted into the **Mapping end point** parameter (→ 112).
2. Go to the **Record map** parameter (→ 113) and select the **Delete partial map** option.

Mapping in the tank bottom area

Irrespective of the defined mapping range, no mapping is recorded near the end of the measuring range (defined in the **Tank/silo height** parameter (\rightarrow 56)). In this gap the map assumes a constant value as defined by the **End of mapping** (\rightarrow 113) and **End map. ampl.** (\rightarrow 113) parameters.

"End of mapping" = "Last map value"

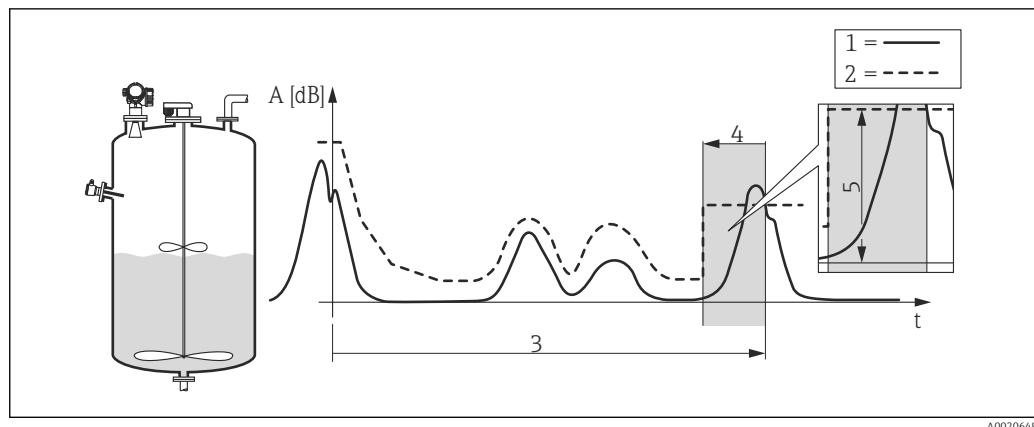
With this setting the last value of the map remains valid within the tank bottom area.



- 1 Envelope curve
- 2 Map
- 3 Tank/silo height (\rightarrow 56)
- 4 Tank bottom area

"End of mapping" = "Adjustable"

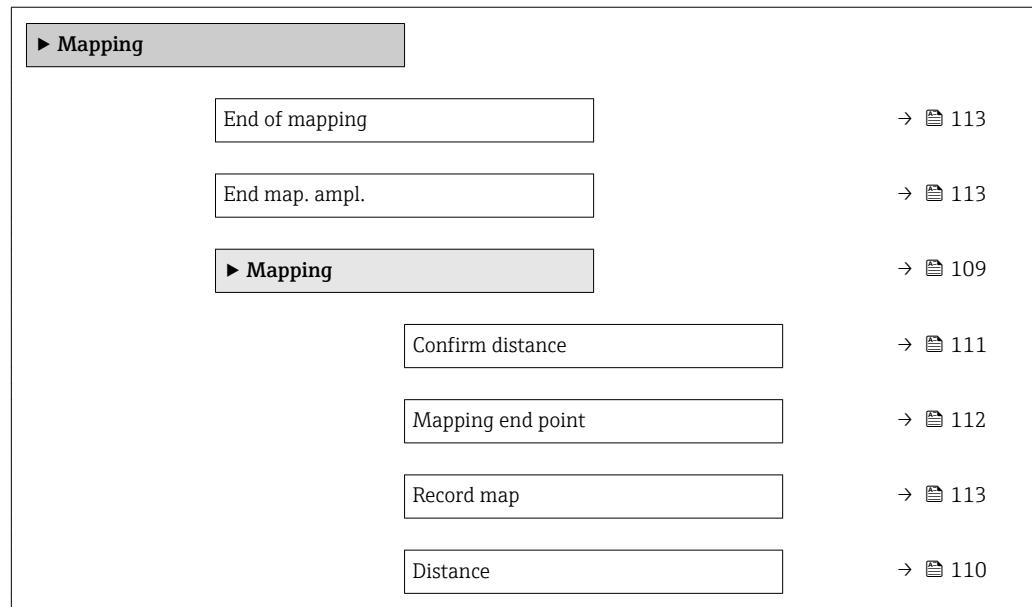
With this setting the value of the mapping curve within the tank bottom area is defined in the **End map. ampl.** parameter (\rightarrow 113)



- 1 Envelope curve
- 2 Map
- 3 Tank/silo height (\rightarrow 56)
- 4 Tank bottom area
- 5 End map. ampl. (\rightarrow 113)

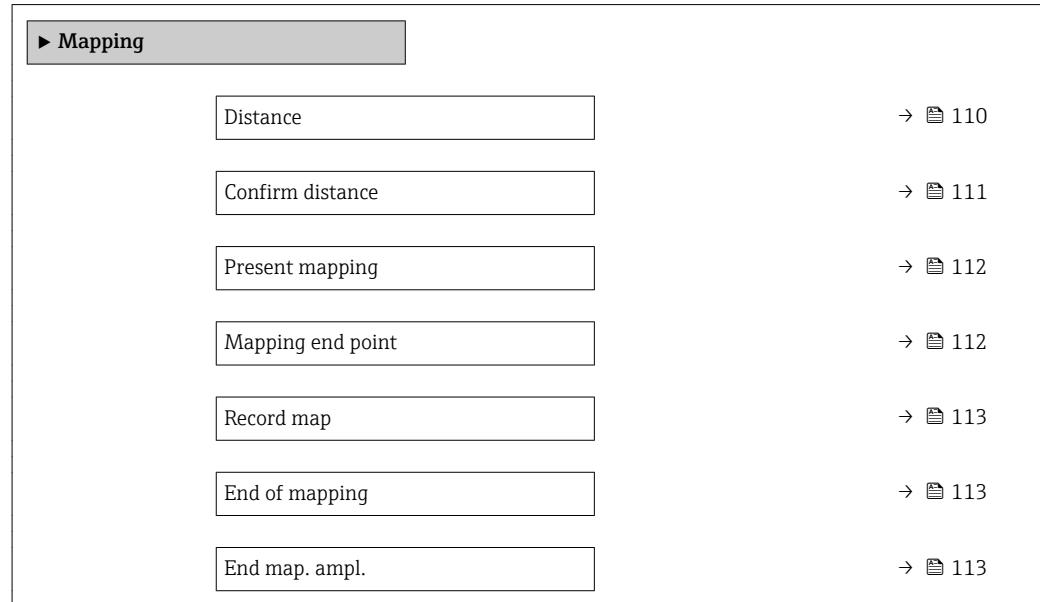
Structure of the submenu on the local display*Navigation*

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

Diagram Expert → Sensor → Mapping

Distance

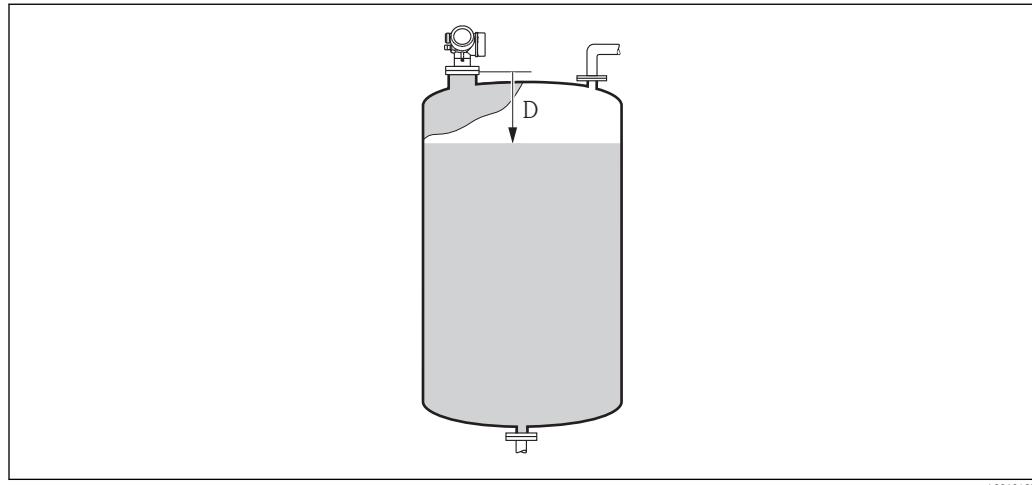
Navigation

Diagram Expert → Sensor → Mapping → Distance (1124)

Description

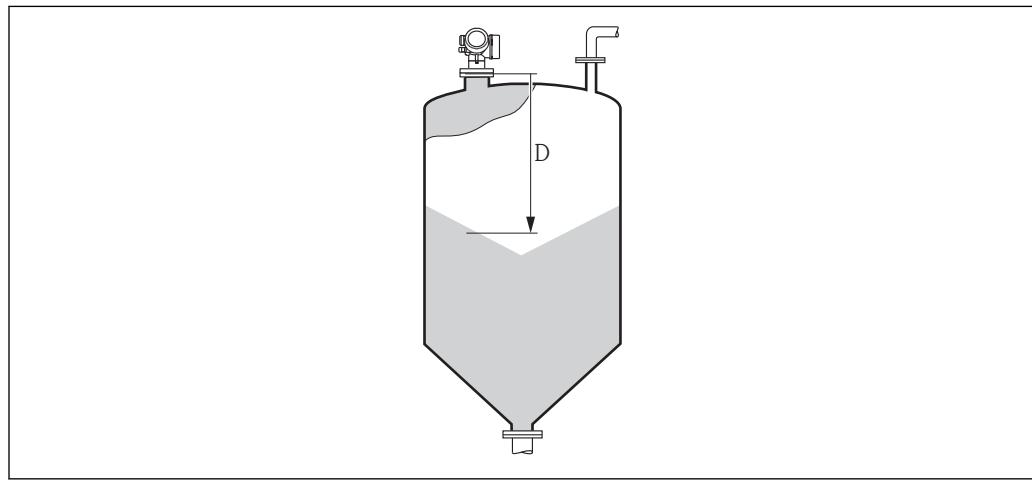
Displays the measured distance D between the reference point (lower edge of the flange or threaded connection) and the level.

Additional information



A0019483

37 Distance for liquid measurements



A0019485

38 Distance for bulk solid measurements



The unit is defined in the **Distance unit** parameter (→ 39).

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 (→ 112). 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**²⁵⁾

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 (→ 56). 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** (→ 50) 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 (→ 111) = **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 (→ 112) is displayed together with this parameter. It indicates up to which distance a mapping has already been recorded.

25) Only available for "Expert → Sensor → Echo tracking → **Evaluation mode** parameter (→ 120)" = "Short time history" or "Long time history"

Record map**Navigation** Expert → Sensor → Mapping → Record map (1069)**Prerequisite** Confirm distance (→ 111) = 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** (→ 112).

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 (→ 120). A number of further parameters is used to configure the echo tracking more precisely.

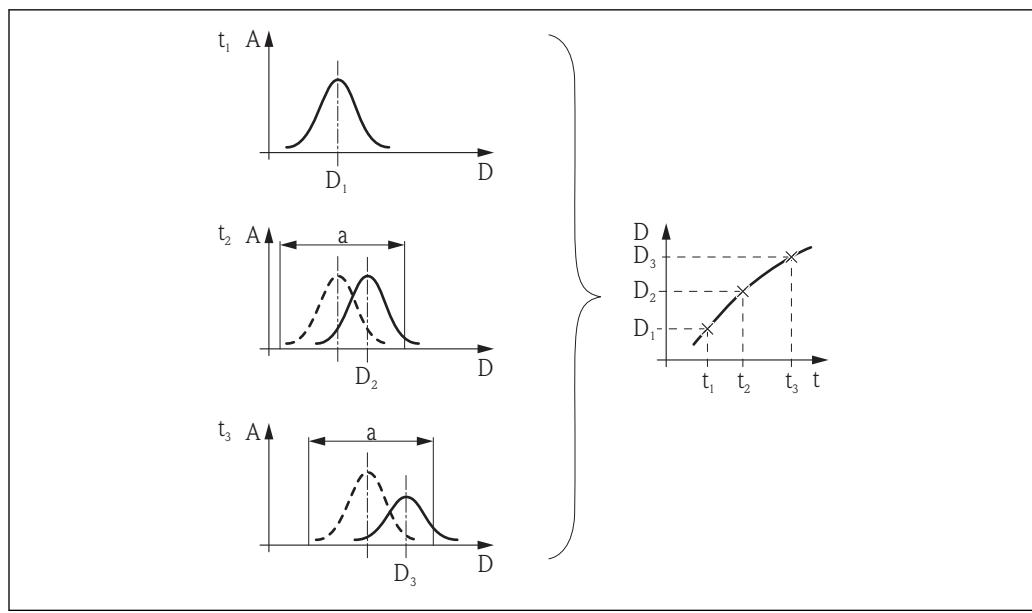
"Evaluation mode" = "History off"

The envelope curve is evaluated statically.

"Evaluation mode" = "Short time history"

The static envelope curve evaluation 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.

i 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.

i 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):

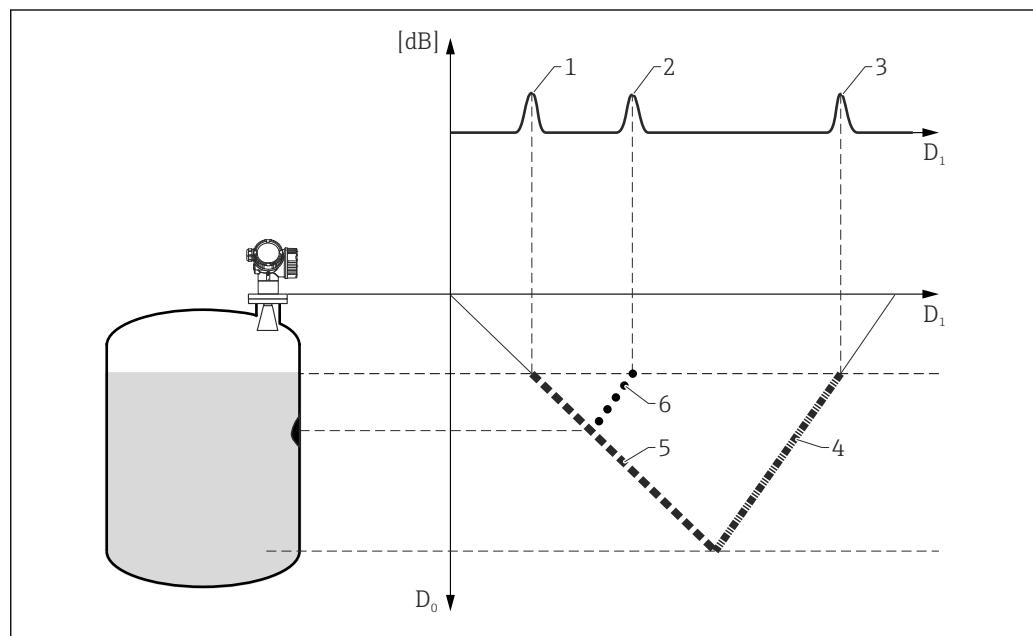
- If the echo is within the tank bottom area (parameter **Tank bottom range** (→ **128**)), the first echon within th search window is allocated to the track.
- If the echo is above the tank bottom area, the largest echo within the search window is allocated to the track.

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.

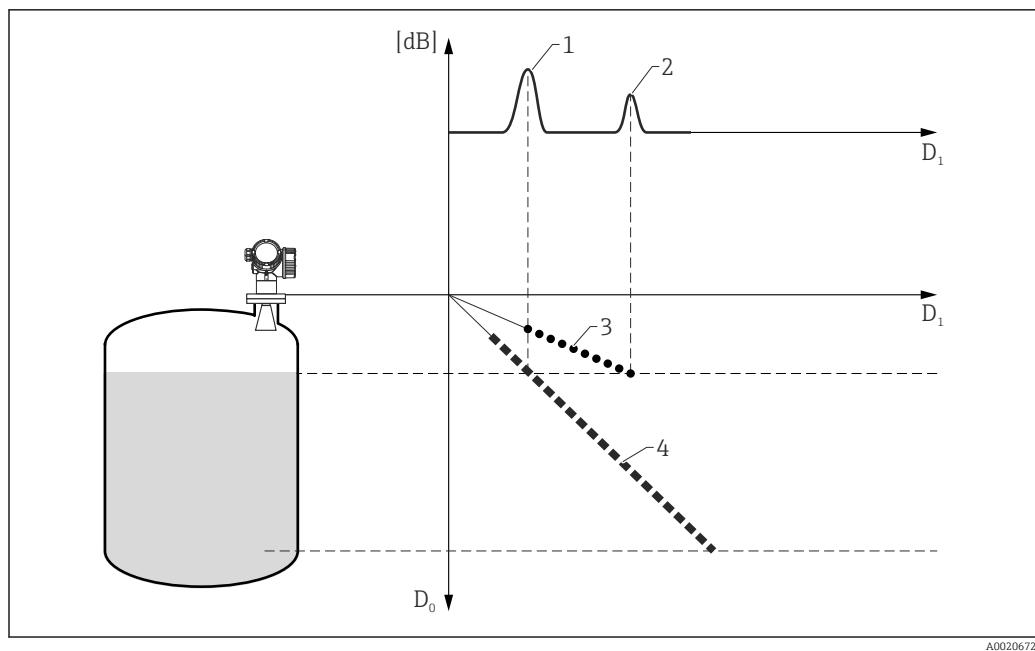
For a given tank with a given medium, the positions of the level, interface, multiple and end-of-probe or tank bottom echoes are in a defined relation to each other. This relationship is recorded during the operation of the device and stored in the tank history. On the basis of this tank history, echoes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

Schematic examples

A0020671

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

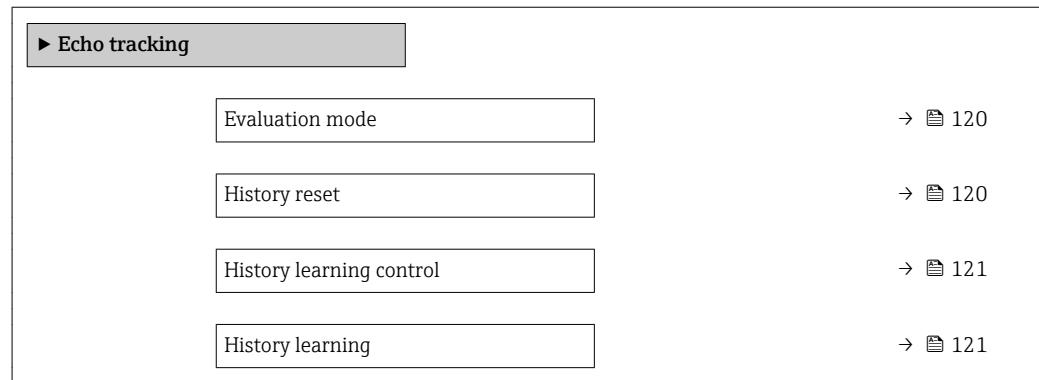
- D_0 Actual level distance
- D_1 Distance of the signal in the envelope curve
- 1 Level echo
- 2 Interference echo
- 3 Tank-bottom echo
- 4 Track "Tank-bottom echo" (stored in the tank history)
- 5 Track "Level echo" (stored in the tank history)
- 6 Track "Interference echo" (stored in the tank history)



41 Example 2: Tank history with a multiple echo

- D_0 Actual level distance
- D_1 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)

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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** (→ 39) or **Bin type** (→ 40) 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 is lost temporarily.

i 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.

History learning control**Navigation**

Expert → Sensor → Echo tracking → Hist. learn.ctrl (1074)

Prerequisite

Device with PROFIBUS PA or FOUNDATION Fieldbus

Description

Select DO block to be used for starting and stopping the recording of the track.

Selection

- None
- Digital output 1
- Digital output 2
- Digital output 3
- Digital output 4
- Digital output 5
- Digital output 6
- Digital output 7
- Digital output 8

Factory setting

None

History learning**Navigation**

Expert → Sensor → Echo tracking → History learning (1094)

Prerequisite

Device with PROFIBUS PA or FOUNDATION Fieldbus

Description

Start or stop the recording of the echo track.

Selection

- Off
- On

Factory setting

On

Additional information

This parameter is only relevant for **History learning control** (→ 121) = **Manual**.

3.4.15 "External input" submenu

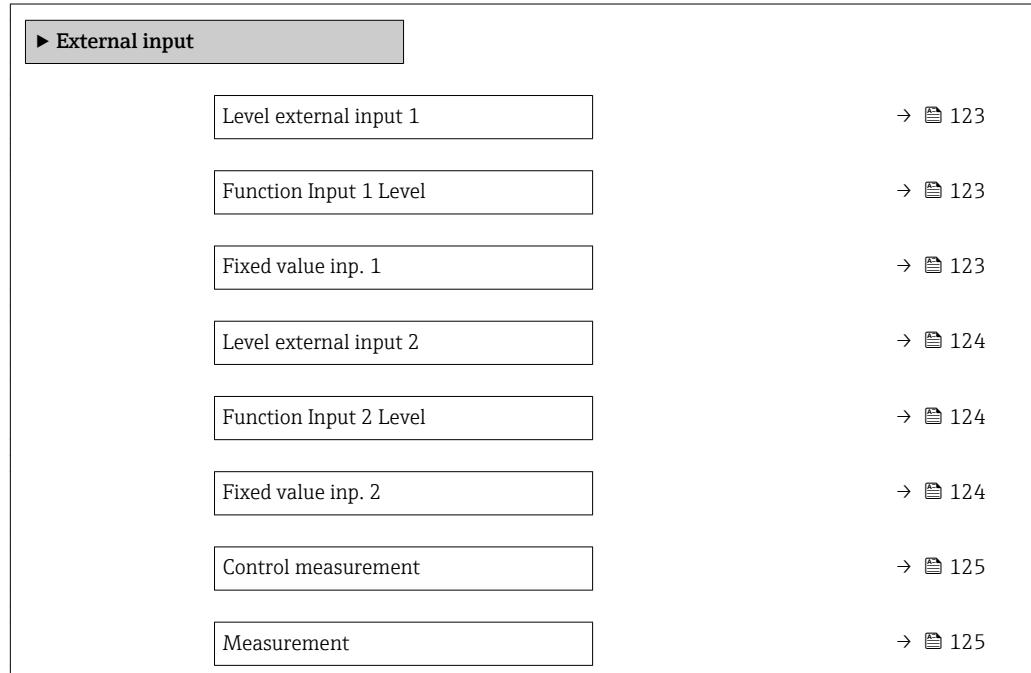
i The **External input** submenu is only available for devices with PROFIBUS PA or FOUNDATION Fieldbus.

The behavior of the sensor can be controlled via two external switch inputs: The measurement can be switched on and off. Furthermore, a specific value can be assigned to the level when the digital switch signal is present, regardless of the actual measured value.

Structure of the submenu

Navigation

Expert → Sensor → External input



Description of parameters**Navigation** Expert → Sensor → External input**Level external input 1****Navigation** Expert → Sensor → External input → Level ext. in. 1 (2305)**Description**

Assign a DO block to the external input. The switch signal is read from this block.

Selection

- None
- Digital output 1
- Digital output 2
- Digital output 3
- Digital output 4
- Digital output 5
- Digital output 6
- Digital output 7
- Digital output 8

Factory setting

None

Function Input 1 Level**Navigation** Expert → Sensor → External input → Fct. Inp. 1 Lvl (2311)**Prerequisite****Level external input 1 (→  123) ≠ None****Description**

Define the reaction of the level signal in case a switching signal is active at the external input.

Selection

- Off
- Low (0%)
- High (100%)
- Hold Last Value
- Fixed Value

Factory setting

Off

Fixed value inp. 1**Navigation** Expert → Sensor → External input → Fix. val. inp. 1 (2332)**Prerequisite****Function Input 1 Level (→  123) = Fixed Value****Description**

Specify the value the level signal assumes if a switch signal is active at the external input.

User entry 0.0 to 200 000.0 %

Factory setting 0.0 %

Level external input 2



Navigation Expert → Sensor → External input → Level ext. in. 2 (2306)

Description Assign a DO block to the external input. The switch signal is read from this block.

Selection

- None
- Digital output 1
- Digital output 2
- Digital output 3
- Digital output 4
- Digital output 5
- Digital output 6
- Digital output 7
- Digital output 8

Factory setting None

Function Input 2 Level



Navigation Expert → Sensor → External input → Fct. Inp. 2 Lvl (2331)

Prerequisite **Level external input 2 (→ 124) ≠ None**

Description Define the reaction of the level signal in case a switching signal is active at the external input.

Selection

- Off
- Low (0%)
- High (100%)
- Hold Last Value
- Fixed Value

Factory setting Off

Fixed value inp. 2



Navigation Expert → Sensor → External input → Fix. val. inp. 2 (2333)

Prerequisite **Function Input 2 Level (→ 124) = Fixed Value**

Description Specify the value the level signal assumes if a switch signal is active at the external input.

User entry 0.0 to 200 000.0 %

Factory setting 1.0 %

Control measurement



Navigation Expert → Sensor → External input → Ctrl. measurem. (1083)

Description Specify the DO block used to switch the measurement on or off.

Selection

- None
- Digital output 1
- Digital output 2
- Digital output 3
- Digital output 4
- Digital output 5
- Digital output 6
- Digital output 7
- Digital output 8

Factory setting None

Measurement



Navigation Expert → Sensor → External input → Measurement (1082)

Description Used to switch the measurement on or off manually.

Selection

- Off
- On

Factory setting On

3.4.16 "Tank bottom evaluation" submenu

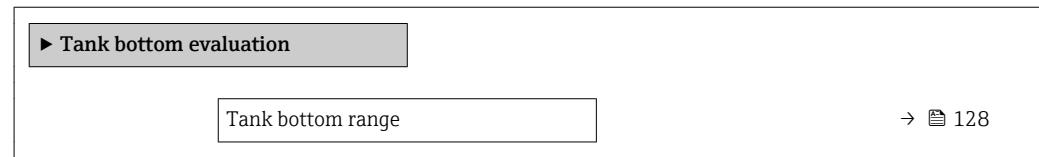
The tank bottom evaluation is intended to prevent an echo loss if the tank is empty.

If no echo is found within the defined tank height (**Tank/silo height** (→ [56](#))) the tank bottom searches beyond this distance in the **Tank bottom range** (→ [128](#)), 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 measuring 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** (→  56)) in which the tank bottom echo is searched for.

User entry

0 to 99.999 m

Factory setting

1 m

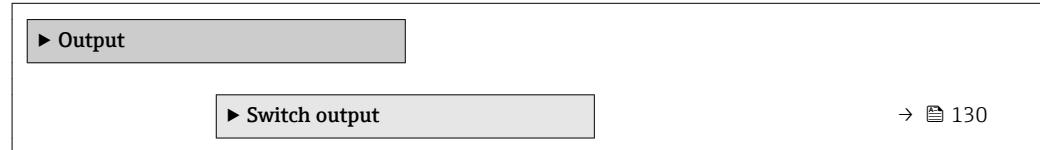
3.5 "Output" submenu

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

3.5.1 Structure of the submenu

Navigation

◀ ▶ Expert → Output



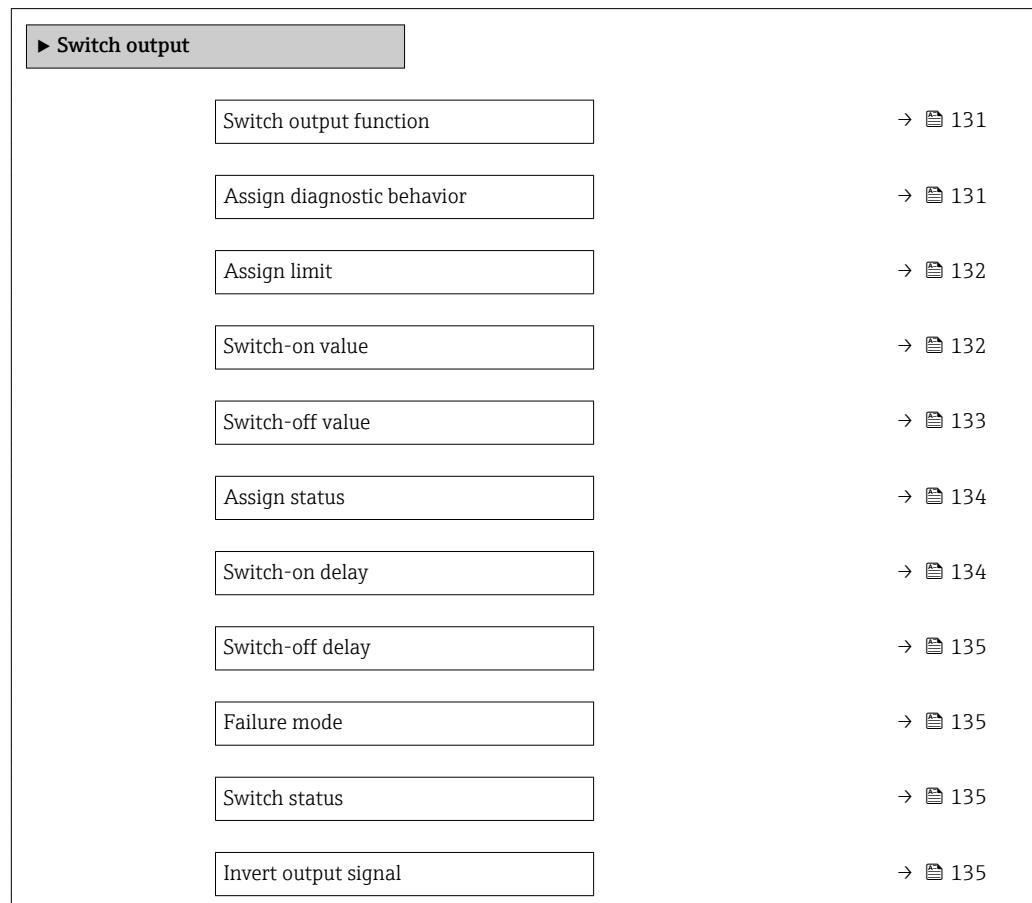
3.5.2 "Switch output" submenu

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 (→ 131) 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** (→ 132)
- **Switch-on value** (→ 132)
- **Switch-off value** (→ 133)

▪ **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 (→ 134).

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** (→ 131) = **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 (→ 131) = 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 (→ 131) = Limit**

Description Enter measured value for the switch-on point.

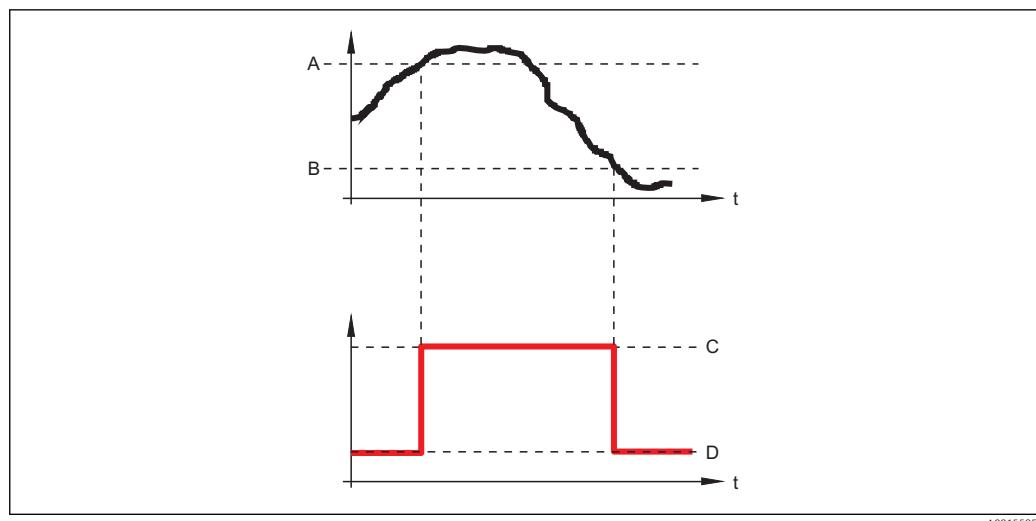
User entry Signed floating-point number

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

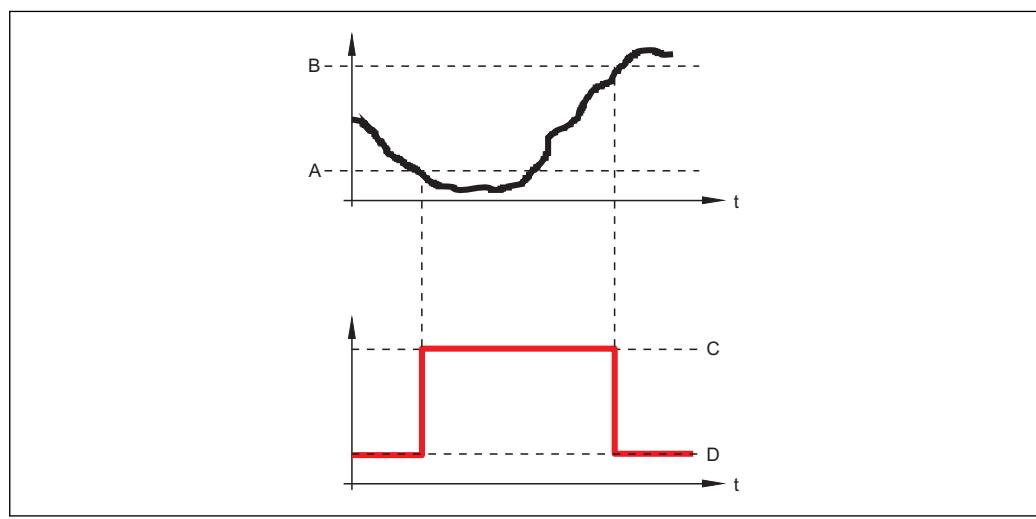
- The output is closed if the measured value is larger than **Switch-on value**.
- The output is opened if the measured value is smaller than **Switch-off value**.



- 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**.



- 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 (→ 131) = 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 (→ 132).

Assign status



Navigation	Expert → Output → Switch output → Assign status (0485)
Prerequisite	Switch output function (→ 131) = Digital Output
Description	Select device status for switch output.
Selection	<ul style="list-style-type: none">▪ Off▪ Digital output AD 1▪ Digital output AD 2▪ Digital output 1▪ Digital output 2▪ Digital output 3▪ Digital output 4▪ Digital output 5▪ Digital output 6▪ Digital output 7▪ Digital output 8
Factory setting	Off
Additional information	The Digital output AD 1 and Digital output AD 2 options refer to the Advanced Diagnostic Blocks → 168 . 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	<ul style="list-style-type: none">▪ Switch output function (→ 131) = Limit▪ Assign limit (→ 132) ≠ 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** (→ 131) = Limit
- **Assign limit** (→ 132) ≠ 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

Navigation

Diagram Expert → Communication

3.6.1 "Resource block" submenu

This submenu contains the parameters of the Resource Block according to the FOUNDATION Fieldbus specification.

 In the case of display operation only the most important parameters of the block are displayed.

The complete block is accessible via FieldCare or a FOUNDATION Fieldbus configuration tool.

Navigation

Diagram Expert → Communication → Resource block

3.7 "Analog inputs" submenu

Navigation

Diagram Expert → Analog inputs

3.7.1 "Analog input 1 to 5" submenu

There is an **Analog input** submenu for each Analog Input block of the device . It contains the parameters of the Analog Input block according to the FOUNDATION Fieldbus specification.

 In the case of display operation only the most important parameters of the block are displayed.

The complete block is accessible via FieldCare or a FOUNDATION Fieldbus configuration tool.

Navigation

Diagram Expert → Analog inputs → Analog input 1 to 5

3.8 "Discrete inputs" submenu

Navigation

Diagram Expert → Discrete inputs

3.8.1 "Discrete input 1 to 3" submenu

There is a **Discrete input** submenu for each Discrete Input block of the device. It contains the parameters of the Discrete Input block according to the FOUNDATION Fieldbus specification.

 In the case of display operation only the most important parameters of the block are displayed.

The complete block is accessible via FieldCare or a FOUNDATION Fieldbus configuration tool.

Navigation Expert → Discrete inputs → Discrete input 1 to 3

3.9 "Analog outputs" submenu

Navigation Expert → Analog outputs

3.9.1 "Multiple analog output" submenu

There is a **Multiple analog output** submenu for each Analog Output block of the device . It contains the parameters of the Analog Output block according to the FOUNDATION Fieldbus specification.

 In the case of display operation only the most important parameters of the block are displayed.

The complete block is accessible via FieldCare or a FOUNDATION Fieldbus configuration tool.

Navigation Expert → Analog outputs → Multiple AO

3.10 "Discrete outputs" submenu

Navigation Expert → Discrete outputs

3.10.1 "Multiple discrete output" submenu

There is a **Multiple discrete output** submenu for each Discrete Output block of the device. It contains the parameters of the Discrete Output block according to the FOUNDATION Fieldbus specification.

 In the case of display operation only the most important parameters of the block are displayed.

The complete block is accessible via FieldCare or a FOUNDATION Fieldbus configuration tool.

Navigation Expert → Discrete outputs → Multiple DO

3.11 "Diagnostics" submenu

3.11.1 Structure of the submenu on the local display

Navigation

Diagram Expert → Diagnostics

► Diagnostics	
Actual diagnostics	→ Diagram 141
Previous diagnostics	→ Diagram 141
Operating time from restart	→ Diagram 142
Operating time	→ Diagram 142
► Diagnostic list	→ Diagram 143
► Event logbook	→ Diagram 145
► Device information	→ Diagram 148
► Data logging	→ Diagram 152
► Min/max values	→ Diagram 156
► Simulation	→ Diagram 162
► Device check	→ Diagram 165
► Advanced diagnostics 1 to 2	→ Diagram 175
► Envelope diagnostics	→ Diagram 184

3.11.2 Structure of the submenu in an operating tool

Navigation

» Expert → Diagnostics

► Diagnostics	
Actual diagnostics	→ 141
Timestamp	→ 141
Previous diagnostics	→ 141
Timestamp	→ 142
Operating time from restart	→ 142
Operating time	→ 142
► Diagnostic list	→ 143
► Event logbook	→ 145
► Device information	→ 148
► Data logging	→ 152
► Min/max values	→ 156
► Simulation	→ 162
► Device check	→ 165
► Advanced diagnostics 1 to 2	→ 175
► Envelope diagnostics	→ 184

3.11.3 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 (→  141).

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 (→  141).

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*

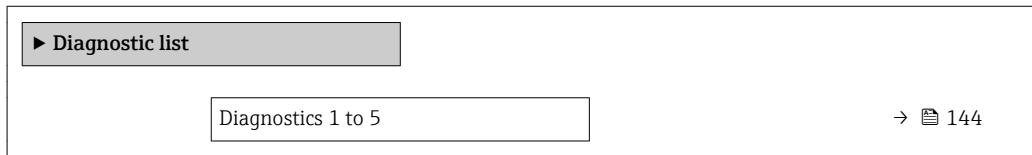
9 999 d (≈ 27 years)

3.11.4 "Diagnostic list" submenu

Structure of the submenu on the local display

Navigation

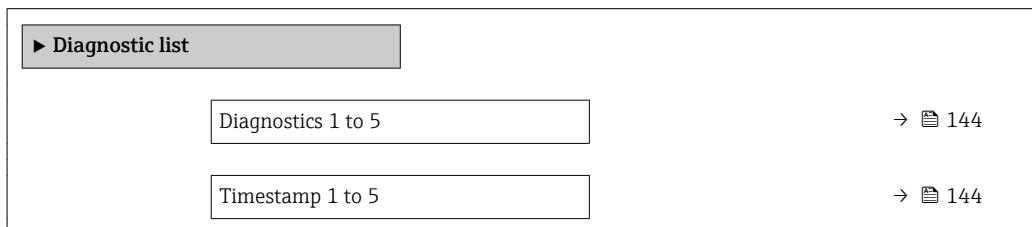
☰ ☰ Expert → Diagnostics → Diagnostic list



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 (→  144).

User interface

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

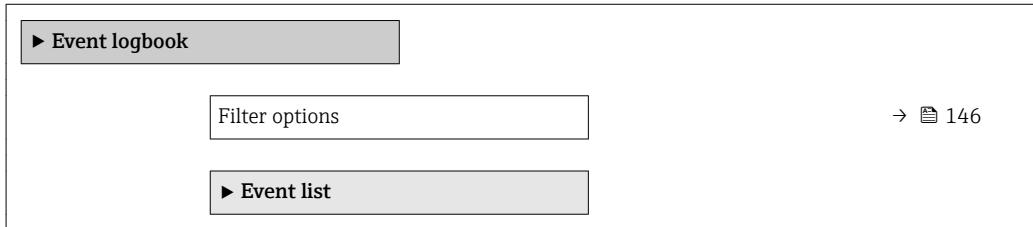
3.11.5 "Event logbook" submenu

Aufbau des Untermenüs auf der Vor-Ort-Anzeige

Navigation



Expert → Diagnostics → Event logbook



Aufbau des Untermenüs im Bedientool

Navigation



Expert → Diagnostics → Event logbook



Beschreibung der Parameter*Navigation*

Expert → Diagnostics → Event logbook

Filter options**Navigation**

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

 **Event list** submenu ist nur vorhanden bei Bedienung über Vor-Ort-Anzeige.

Event list submenu enthält keine Parameter sondern die Anzeige der Historie an aufgetretenen Ereignismeldungen der im **Filter options** parameter (→ 146) ausgewählten Kategorie. Maximal werden 100 Ereignismeldungen chronologisch angezeigt.

Folgende Symbole zeigen an, ob ein Ereignis aufgetreten oder beendet ist (Statussymbole):

- : Auftreten des Ereignisses
- : Ende des Ereignisses

 Behebungsmaßnahmen zur Ursache der Meldung sind über das -Symbol auf der Anzeige abrufbar.

3.11.6 "Device information" submenu

Structure of the submenu

Navigation

☰ ☰ Expert → Diagnostics → Device info

▶ Device information	
Device tag	→ ☰ 149
Serial number	→ ☰ 149
Firmware version	→ ☰ 149
Device name	
Order code	→ ☰ 149
Extended order code 1 to 3	→ ☰ 150
ENP version	→ ☰ 150
Hardware revision	→ ☰ 150
ITK Version	→ ☰ 150
Device Revision	→ ☰ 150
Device Type	→ ☰ 151
DD Revision	→ ☰ 151

Description of parameters

Navigation

  Expert → Diagnostics → Device info

Device tag

Navigation

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

Description

Enter tag for measuring point.

Factory setting

FMP5x

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.

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

Hardware revision

Navigation

  Expert → Diagnostics → Device info → Hardware rev. (10793)

Description

Indicates the hardware revision of the device.

ITK Version

Navigation

  Expert → Diagnostics → Device info → ITK Version (10794)

Description

Indicates the ITK version of the device.

Device Revision

Navigation

  Expert → Diagnostics → Device info → Device Revision (10710)

Description

Indicates the device revision.

Device Type

Navigation  Expert → Diagnostics → Device info → Device Type (10711)

Description Indicates the device type.

DD Revision

Navigation  Expert → Diagnostics → Device info → DD Revision (10709)

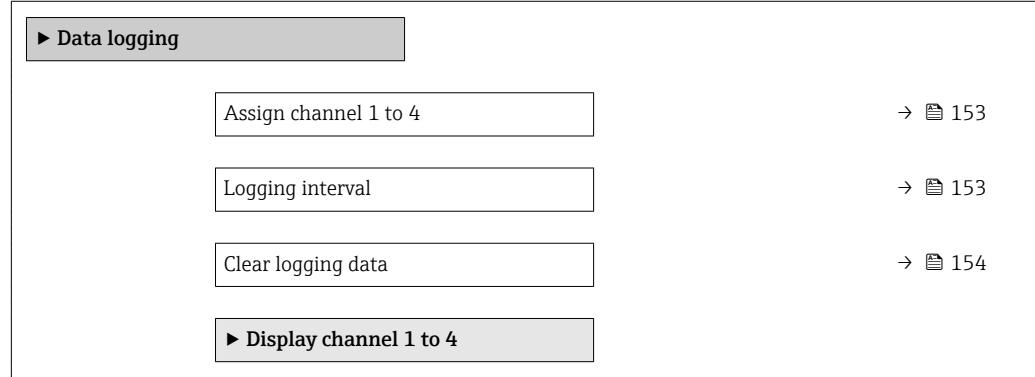
Description Indicates the DD revision.

3.11.7 "Data logging" submenu

Structure of the submenu on the local display

Navigation

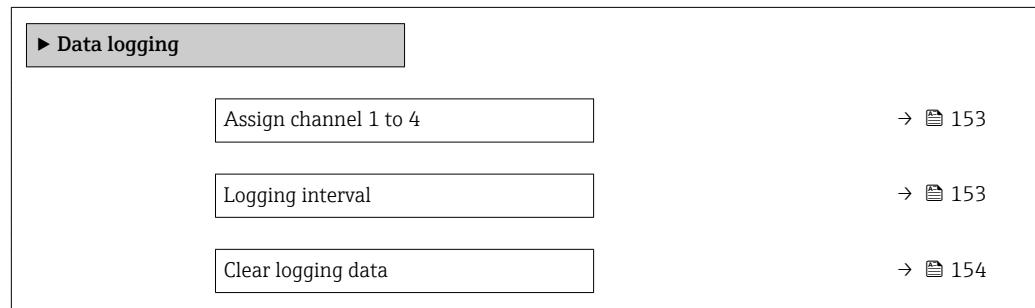
☰ ☰ Expert → Diagnostics → Data logging



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
- Terminal voltage
- Electronic temperature
- Absolute echo amplitude
- Relative echo amplitude
- Analog output adv. diagnostics 1
- Analog output adv. diagnostics 2

Factory setting

Off

Additional information

A total of 500 measured values can be logged. This means:

- 500 data points if 1 logging channel is used
- 250 data points if 2 logging channels are used
- 166 data points if 3 logging channels are used
- 125 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 500, 250, 166 or 125 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)
DescriptionDefine logging interval t_{log} .**User entry**

1.0 to 3 600.0 s

Factory setting

30.0 s

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: $T_{log} = 500 \cdot t_{log}$
- If 2 logging channels are used: $T_{log} = 250 \cdot t_{log}$
- If 3 logging channels are used: $T_{log} = 166 \cdot t_{log}$
- If 4 logging channels are used: $T_{log} = 125 \cdot t_{log}$

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

- $T_{\log} = 500 \cdot 1 \text{ s} = 500 \text{ s} \approx 8.5 \text{ min}$
- $T_{\log} = 500 \cdot 10 \text{ s} = 5000 \text{ s} \approx 1.5 \text{ h}$
- $T_{\log} = 500 \cdot 80 \text{ s} = 40000 \text{ s} \approx 11 \text{ h}$
- $T_{\log} = 500 \cdot 3600 \text{ s} = 1800000 \text{ s} \approx 20 \text{ d}$

Clear logging data



Navigation

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

Description

Initiate a deletion of the complete logging memory.

Selection

- Cancel
- Clear data

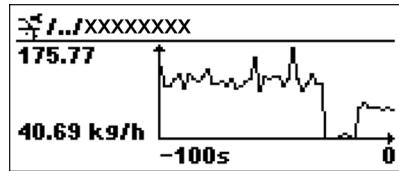
Factory setting

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.

3.11.8 "Min/max values" submenu

Structure of the submenu

Navigation

Expert → Diagnostics → Min/max val.

► Min/max values	
Max. level value	→ 157
Time max. level	→ 157
Min. level value	→ 157
Time min. level	→ 157
Max. draining speed	→ 157
Max. filling speed	→ 158
Reset min./max.	→ 158
Max. electronics temperature	→ 158
Time max. electronics temperature	→ 158
Min. electronics temperature	→ 158
Time min. electronics temperature	→ 159
Reset min./max. temp.	→ 159

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

3.11.9 "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.

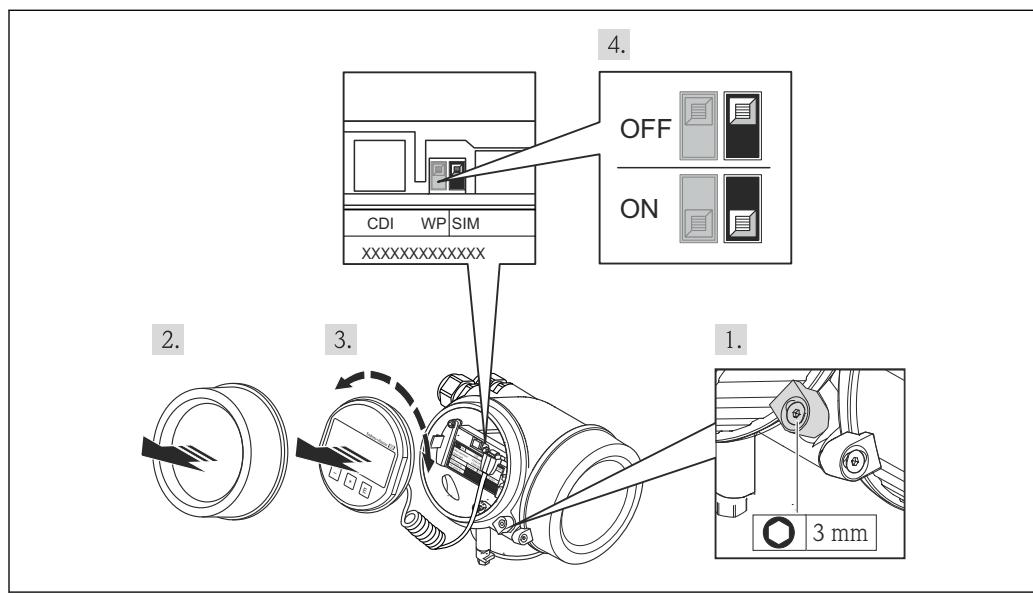
Conditions which can be simulated

Condition to be simulated	Associated parameters
Specific value of a process variable	<ul style="list-style-type: none"> ▪ Assign measurement variable (→ 163) ▪ Value process variable (→ 163)
Specific state of the switch output	<ul style="list-style-type: none"> ▪ Switch output simulation (→ 163) ▪ Switch status (→ 164)
Existence of an alarm	Simulation device alarm (→ 164)

Enable/disable simulation

The simulation of measured values can be enabled or disabled via a hardware switch (SIM switch) at the electronics. Simulating a measured value is only possible if the SIM switch is in the ON position.

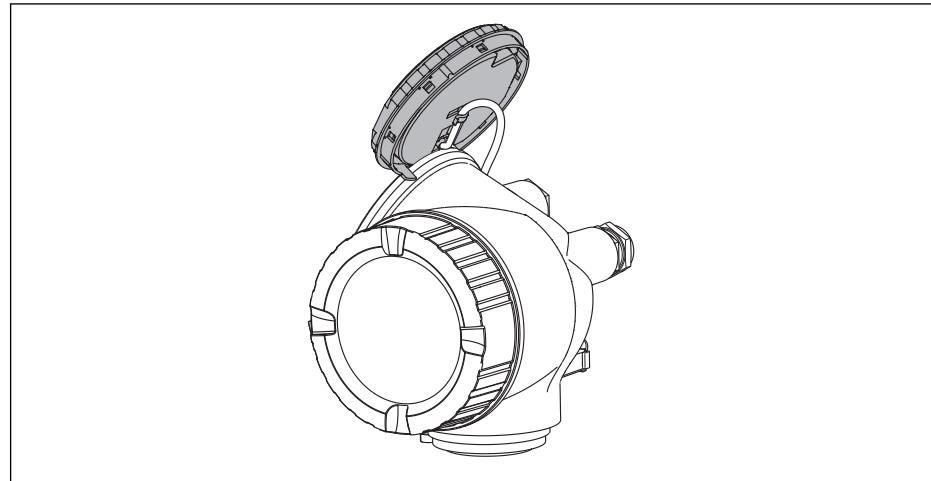
The switch output can always be simulated, irrespective of the position of the SIM switch.



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1. Loosen the securing clamp.
2. Unscrew the housing cover.

3. Pull out the display module with a gentle rotation movement. To make it easier to access the SIM switch, attach the display module to the edge of the electronics compartment.
↳ Display module is attached to the edge of the electronics compartment.



A0013909

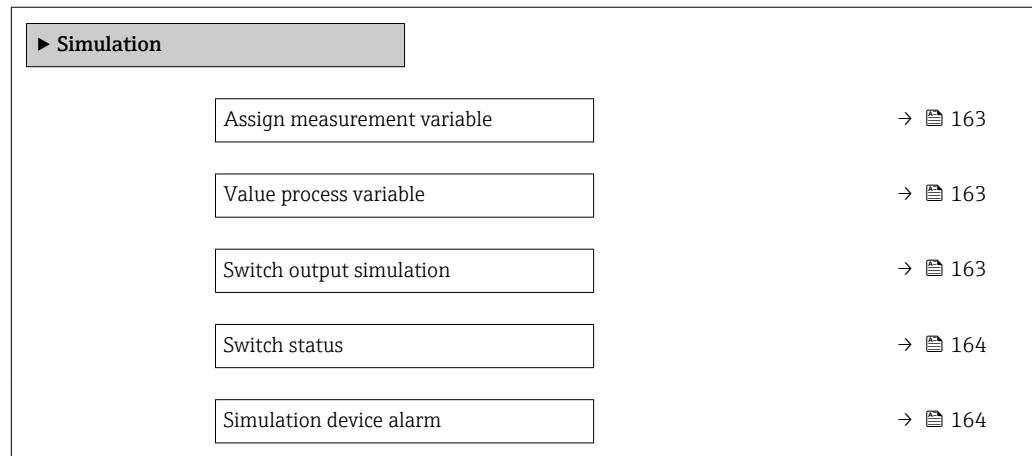
4. SIM switch in the **ON** position: measured values can be simulated. SIM switch in the **OFF** position (factory setting): Simulation of measured values is disabled.
5. Feed the spiral cable into the gap between the housing and main electronics module and plug the display module into the electronics compartment in the desired direction until it engages.
6. Screw the electronics compartment cover closed and tighten the securing clamp.

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

Select 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 (→  163).
- If **Assign measurement variable ≠ Off**, a simulation is active. This is indicated by a diagnostic message of the *Function check (C)* category.

**Value process variable****Navigation**
 Expert → Diagnostics → Simulation → Value proc. var. (2329)
Prerequisite**Assign measurement variable (→  163) ≠ 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.

**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 (→ 163) = 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

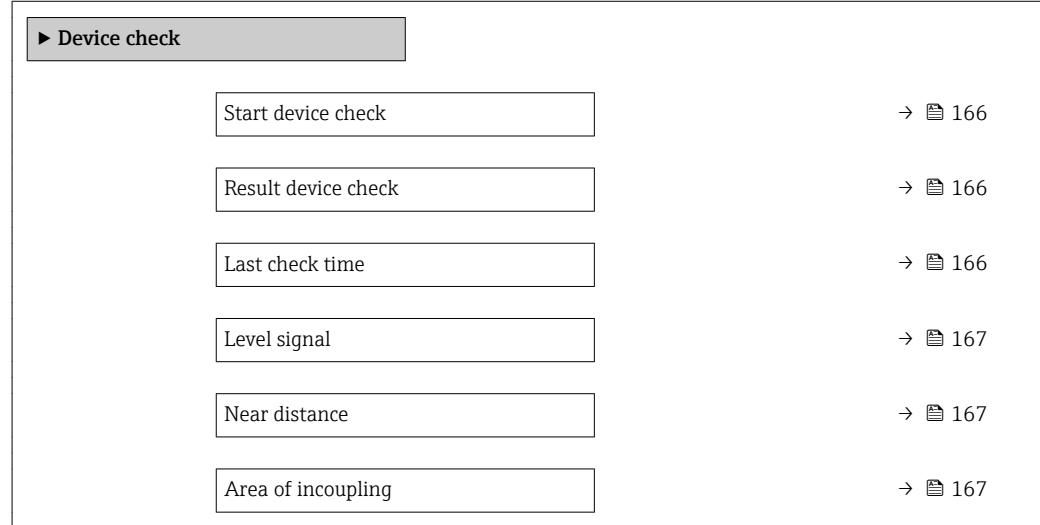
Additional informationWhen selecting the **On** option, the device generates an alarm. This helps to check the correct output behavior of the device in the case of an alarm.An active simulation is indicated by the diagnostic message **☒C484 Simulation failure mode**.

3.11.10 "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. However, 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.

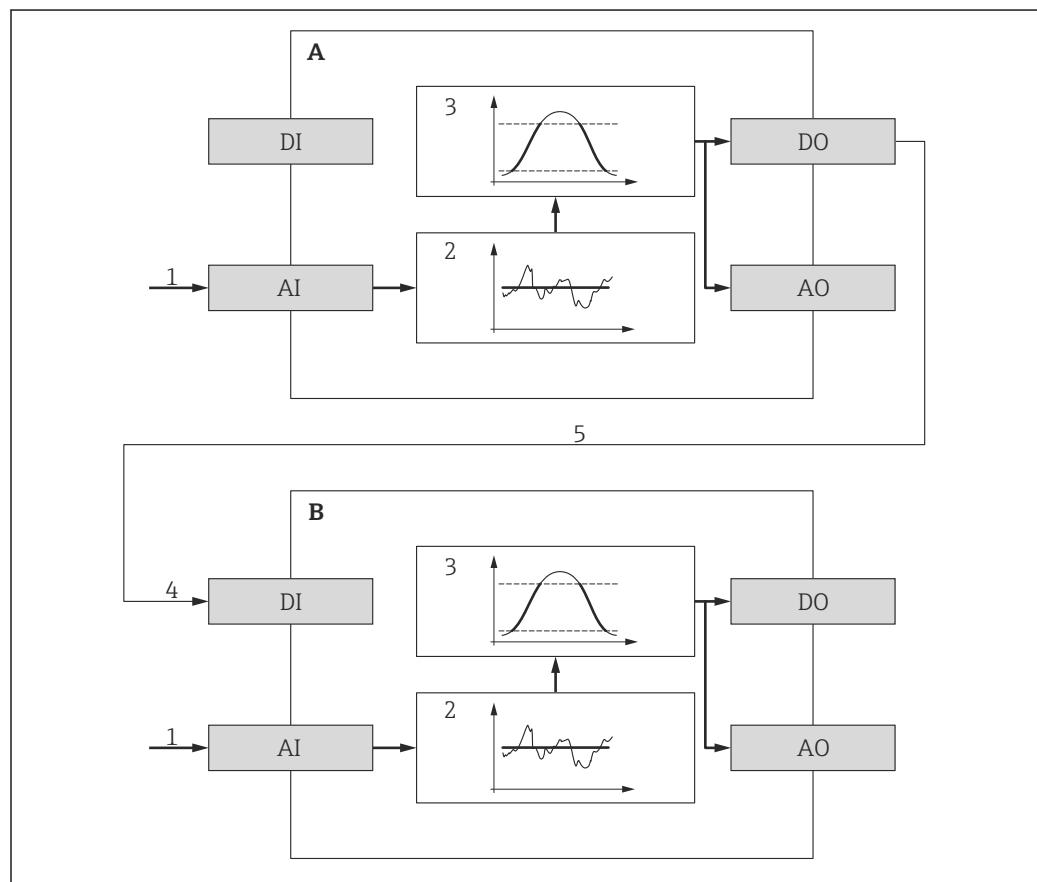
3.11.11 "Advanced diagnostics 1 to 2" submenu

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 Diagnosics 1
- B Advanced Diagnosics 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 (→ 176)
Linking the digital input to the digital output of the other block.	<ul style="list-style-type: none"> ▪ Link AD to (→ 176) ▪ Linking logic AD (→ 177)
Calculation of one of the following quantities for a freely configurable sampling interval: <ul style="list-style-type: none"> ▪ Maximum ▪ Minimum ▪ Mean ▪ Standard deviation ▪ Difference Max. - Min. ▪ Slope 	<ul style="list-style-type: none"> ▪ Sample time (→ 177) ▪ Calculation type (→ 177) ▪ Calculation unit (→ 179)
Drag indicator for the calculated quantity	<ul style="list-style-type: none"> ▪ Maximum value (→ 181) ▪ Minimum value (→ 181) ▪ Reset min./max. (→ 182)
Limit check	<ul style="list-style-type: none"> ▪ Check mode (→ 178) ▪ Upper limit (→ 180) ▪ Lower limit (→ 180) ▪ Hysteresis (→ 181)
Reaction in case of a limit violation	<ul style="list-style-type: none"> ▪ Assign status signal to AD event (→ 182) ▪ Assign event behaviour (→ 182) ▪ Alarm delay (→ 183)

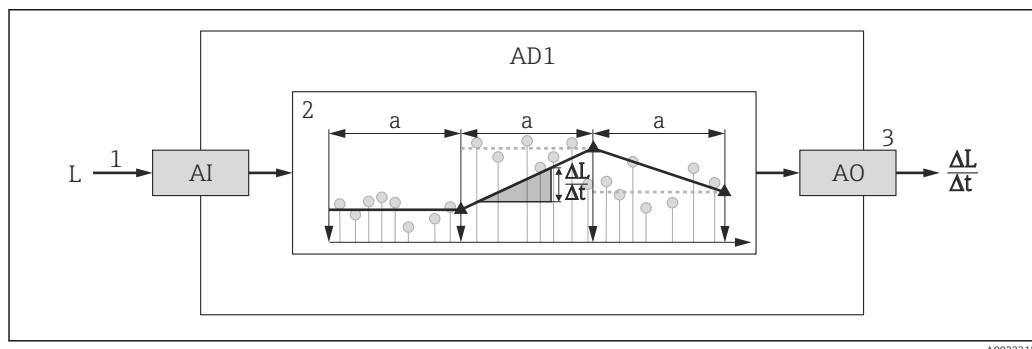
Example 1: Draining/filling speed

i Only one Advanced Diagnostic Block is needed for this application. In the example this is **Advanced diagnostics 1** (\rightarrow [175](#)). However, **Advanced diagnostics 2** (\rightarrow [175](#)) 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 Diagnostic Block AD1
- 2 Calculation of the draining or filling speed $\Delta L/\Delta t$ within the sampling interval a .
- 3 $\Delta L/\Delta t$ 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

i 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** (\rightarrow [182](#))
- **Assign event behaviour** (\rightarrow [182](#))
- **Alarm delay** (\rightarrow [183](#))

i With this configuration, the **Maximum value 1** and **Minimum value 1** drag indicators display the maximum or minimum value the rate of level 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 = Analog output adv. diagnostics 1.**
3. Select **Turn down = On.**
4. Enter maximum expected draining speed (negative value) in **4 mA value**.
5. Enter maximum expected filling speed (positive value) in **20 mA value**.

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:

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

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Where:

- $\Delta L/\Delta t$: Rate of level change²⁷⁾
- W_4 : **4 mA value**
- W_{20} : **20 mA value**
- I: Output current

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

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

A0022343

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 = Analog output adv. diagnostics 1.**

 With this configuration, the **Primary variable (PV)** parameter 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.

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

Example 2: Foam detection

i 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 %.

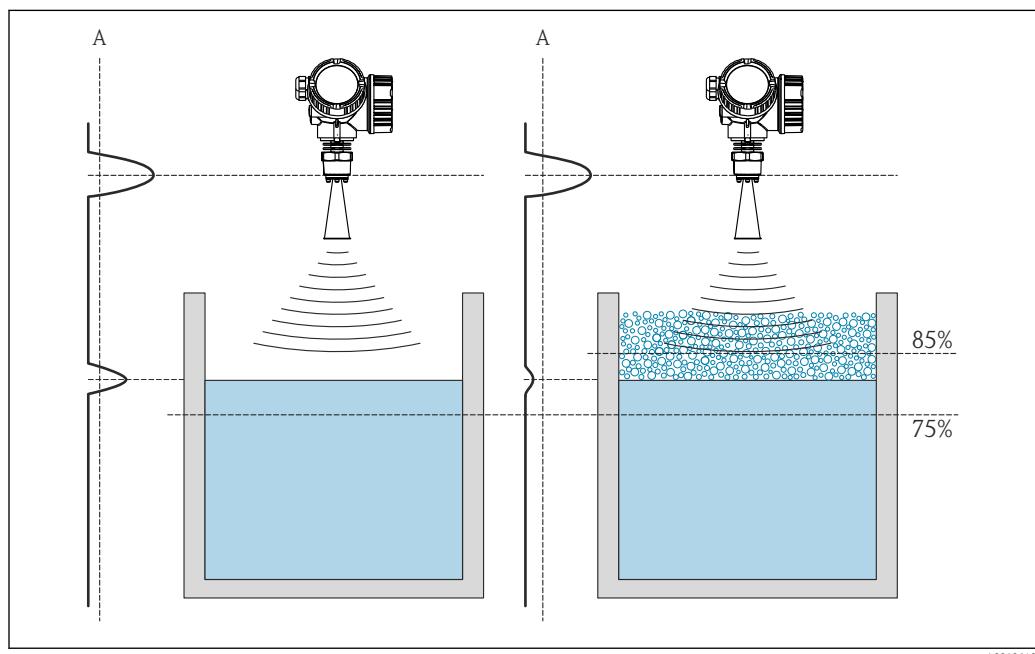


Fig. 44 Decrease of the amplitude in case of foam formation

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 (→ **Fig. 175**) submenu as follows:

1. Navigate to the **Advanced diagnostics 1** submenu (→ **Fig. 175**)
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 %**.

i **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 (→ **Fig. 175**) 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 (→ 175):

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.

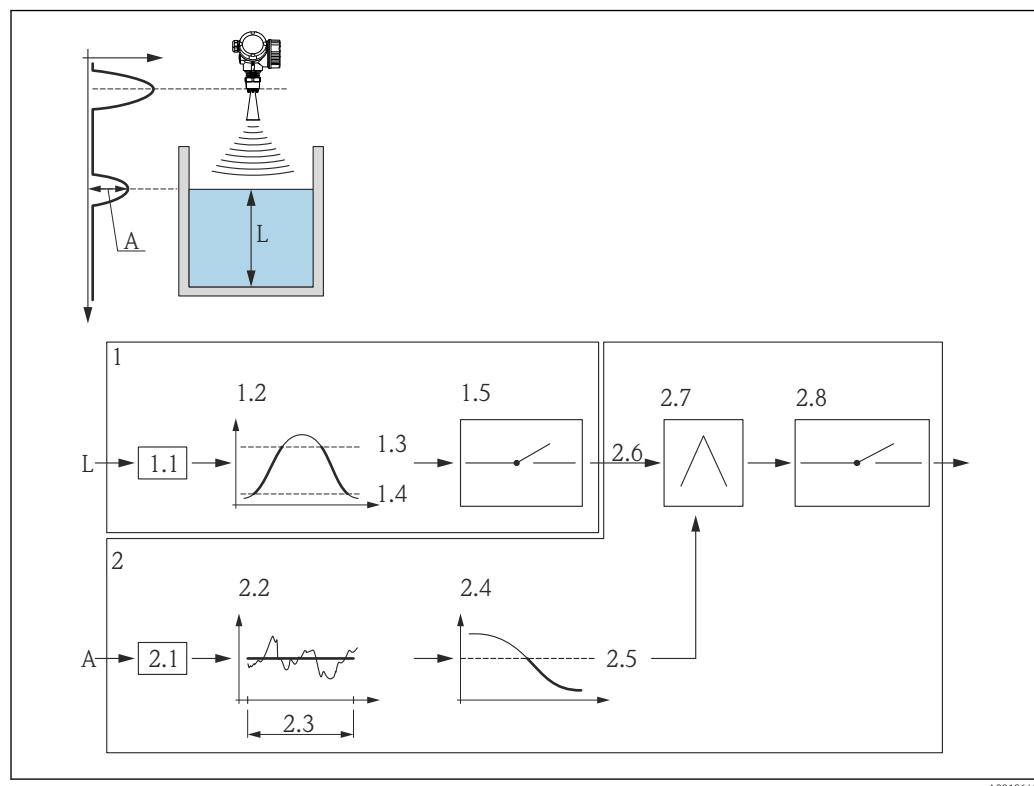
For the example this means:

- 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

A0019641

Fig. 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

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

► Advanced diagnostics 1 to 2	
Assign diagnostic signal 1 to 2	→ 176
Link AD 1 to 2 to	→ 176
Linking logic AD 1 to 2	→ 177
Sample time 1 to 2	→ 177
Calculation type 1 to 2	→ 177
Check mode 1 to 2	→ 178
Calculation unit 1 to 2	→ 179
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Minimum value 1 to 2	→ 181
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Assign status signal to AD event 1 to 2	→ 182
Assign event behaviour 1 to 2	→ 182
Alarm delay 1 to 2	→ 183

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
- Terminal voltage
- Area of incoupling
- Analog output 1
- Analog output 2
- Analog output 3
- Analog output 4
- Analog output 5
- Analog output 6
- Analog output 7
- Analog output 8

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
- Digital output 1
- Digital output 2
- Digital output 3
- Digital output 4
- Digital output 5
- Digital output 6
- Digital output 7
- Digital output 8

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 (→  176) = Digital output AD 1 oder Digital output AD 2
Description	Select linking logic between the two Advanced Diagnostic Blocks.
Selection	<ul style="list-style-type: none"> ■ AND ■ OR
Factory setting	AND

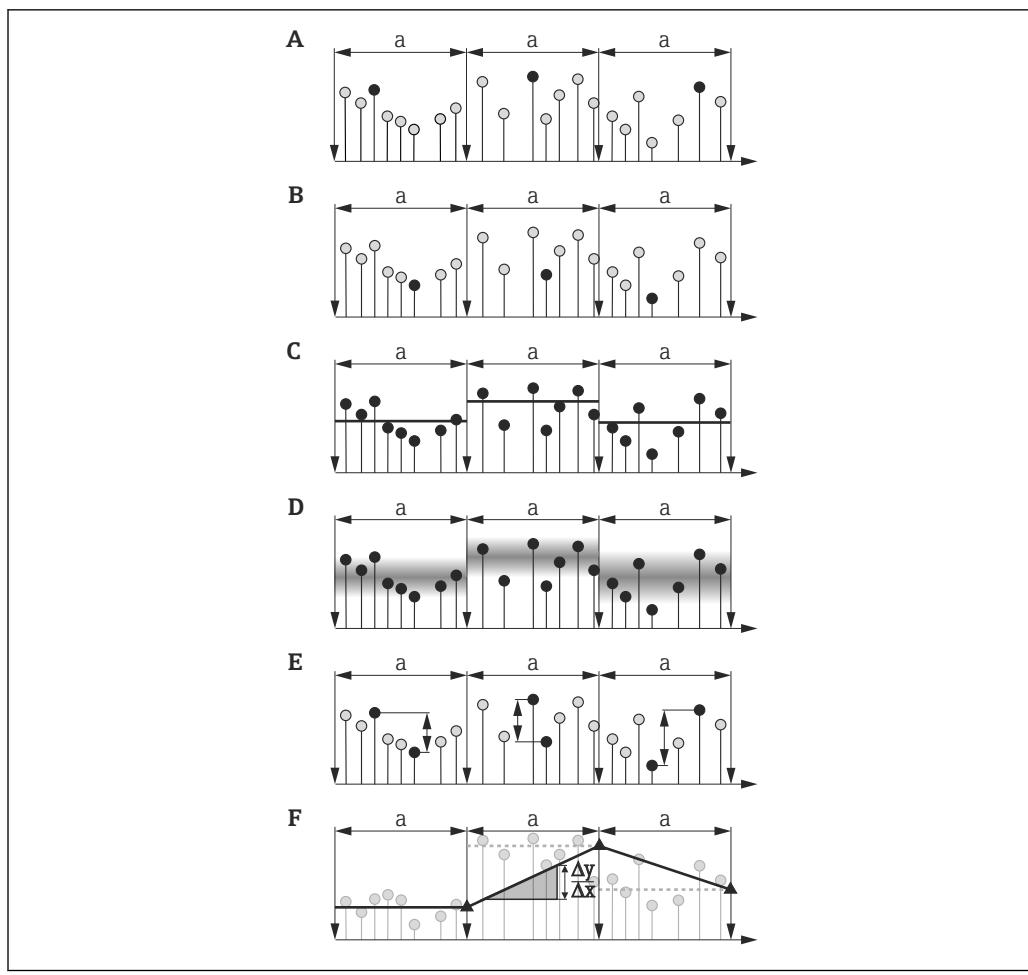
Sample time 1 to 2

Navigation	  Expert → Diagnostics → Adv.diagn. 1 to 2 → Sample time 1 to 2 (11187–1 to 2)
Prerequisite	Assign diagnostic signal (→  176) ≠ 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 (→  176) ≠ None
Description	Select quantity to be calculated from the measured variable.
Selection	<ul style="list-style-type: none"> ■ Off ■ Maximum ■ Minimum ■ Mean ■ Standard deviation ■ Difference Max. - Min. ■ Slope
Factory setting	Off

Additional information



A0021630

46 Options of the "Calculation type" parameter

- a Sample time (→ 177)
- 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"

i The calculation is performed based on the sampling interval defined in the **Sample time** parameter (→ 177).

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 (→ 176) ≠ None

Description

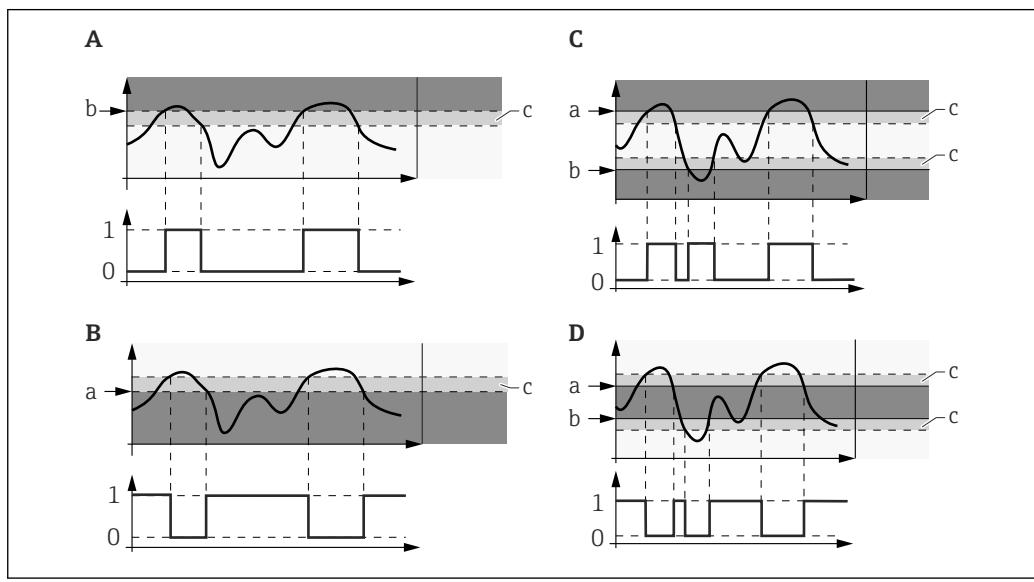
Define check mode for limit monitoring.

Selection

- Off
- Upper limit
- Lower limit
- In range
- Out of range

Factory setting

Off

Additional information

A0021631

图 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 ($\rightarrow \text{图 180}$)
- b Lower limit ($\rightarrow \text{图 180}$)
- c Hysteresis ($\rightarrow \text{图 181}$)
- A "Check mode" = "Lower limit"
- B "Check mode" = "Upper limit"
- C "Check mode" = "In range"
- D "Check mode" = "Out of range"

i If a calculation has been selected in the **Calculation type** parameter ($\rightarrow \text{图 177}$), the check does not refer to the assigned measuring variable but to the quantity calculated from it.

Calculation unit 1 to 2**Navigation**

图 11188 → Expert → Diagnostics → Adv.diagn. 1 to 2 → Calc. unit 1 to 2 (11188-1 to 2)

Prerequisite

Assign diagnostic signal ($\rightarrow \text{图 176}$) ≠ None

Description

Select unit for the calculation.

Selection

Dependent on the following parameters:

- Assign diagnostic signal ($\rightarrow \text{图 176}$)
- Calculation type ($\rightarrow \text{图 177}$)

Factory setting

Dependent on the following parameters:

- Assign diagnostic signal (→ 176)
- Calculation type (→ 177)

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 (→ 178) 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 (→ 176)
- Calculation type (→ 177)

Factory setting

Dependent on the following parameters:

- Assign diagnostic signal (→ 176)
- Calculation type (→ 177)

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 (→ 178) 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 (→ 176)
- Calculation type (→ 177)

Factory setting

Dependent on the following parameters:

- Assign diagnostic signal (→ 176)
- Calculation type (→ 177)

Hysteresis 1 to 2



Navigation	Expert → Diagnostics → Adv.diagn. 1 to 2 → Hysteresis 1 to 2 (11178–1 to 2)
Prerequisite	Check mode parameter (→ 178) 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 (→ 176) ■ Calculation type (→ 177)
Factory setting	Dependent on the following parameters: ■ Assign diagnostic signal (→ 176) ■ Calculation type (→ 177)

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 (→ 176) ≠ 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 (→ 176) ≠ 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 (→ 176) ≠ None
Description	Reset drag indicators (Maximum value (→ 181) and/or Minimum value (→ 181)).
Selection	<ul style="list-style-type: none">■ 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 (→ 176) ≠ None
Description	Assign a category according to NAMUR NE107 to the event of the Advanced Diagnostic Block.
Selection	<ul style="list-style-type: none">■ Failure (F)■ Maintenance required (M)■ Function check (C)■ Out of specification (S)■ Not categorized
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 (→ 176) ≠ None
Description	Assign an event behavior to the event of the Advanced Diagnostic Block.
Selection	<ul style="list-style-type: none">■ 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 (→ 176) ≠ None
Description	Define alarm delay for the Advanced Diagnostic Block.
User entry	0.0 to 3 600.0 s
Factory setting	10.0 s

3.11.12 "Envelope diagnostics" submenu

i 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 (→ [185](#)).

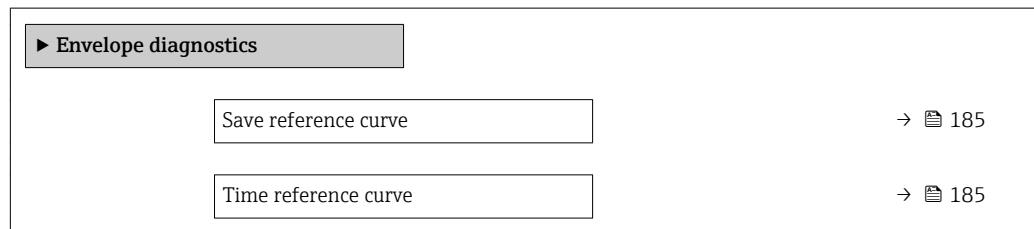
The reference curve can only be displayed in the envelope curve diagram of FieldCare after it has been loaded from the device into FieldCare. This is performed by the "Load Reference Curve" function in FieldCare:



Structure of the submenu

Navigation

Expert → Diagnostics → Envelope diag.



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
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
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished

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
412	Processing Download	Download active, please wait	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
482	Block in OOS	Set Block in AUTO mode	F	Alarm
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
494	Switch output simulation	Deactivate simulation switch output	C	Warning
495	Simulation diagnostic event	Deactivate simulation	C	Warning
497	Simulation block output	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
825	Operating temperature	1. Check ambient temperature 2. Check process 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'	F	Alarm ¹⁾
942	In safety distance	1. Check level 2. Check safety distance 3. Reset self holding	S	Alarm ¹⁾
943	In blocking distance	Reduced accuracy Check level	S	Warning
950	Advanced diagnostic 1 to 2 occurred	Maintain your diagnostic event	M	Warning ¹⁾

1) Diagnostic status is changeable.

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