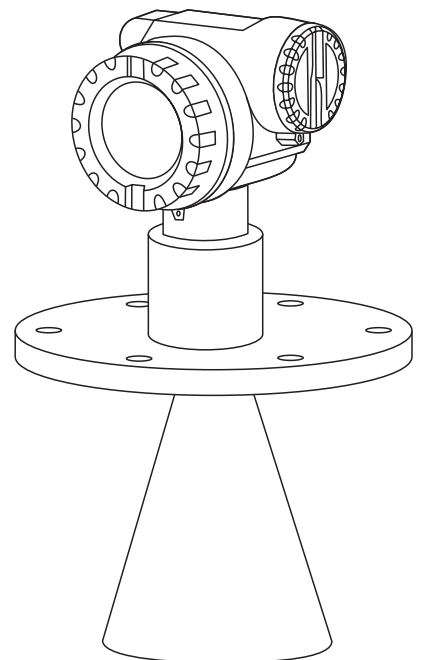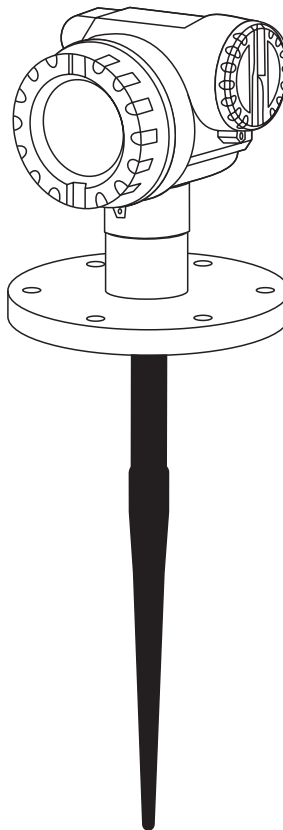Description of Instrument Functions

Micropilot M
FMR230, FMR231

Level–Radar

HART®
FIELD COMMUNICATION PROTOCOL

PROFI®
PROCESS FIELD BUS
BUS

Fieldbus™
Foundation

Endress+Hauser

People for Process Automation

Basic Setup
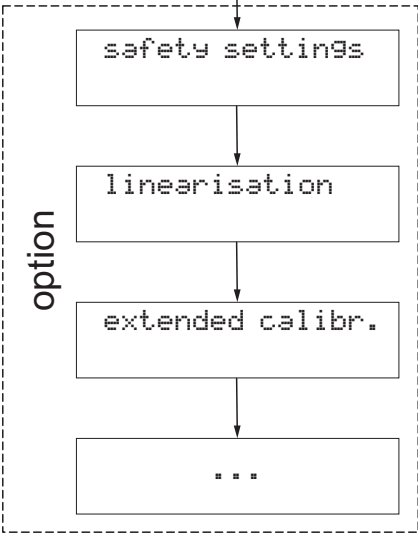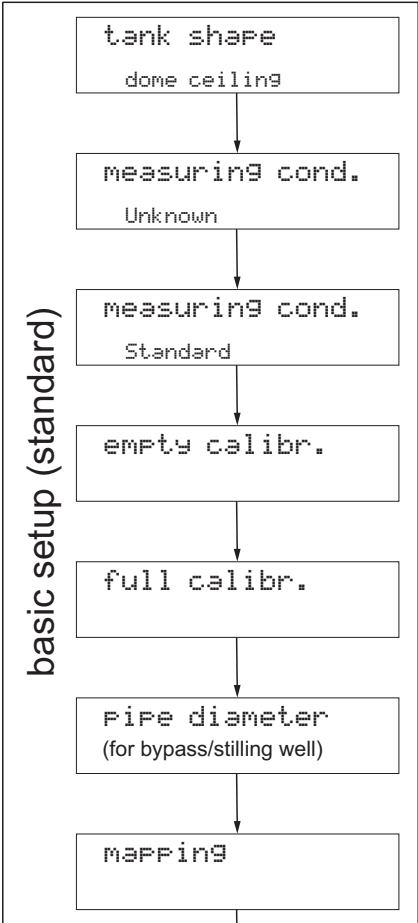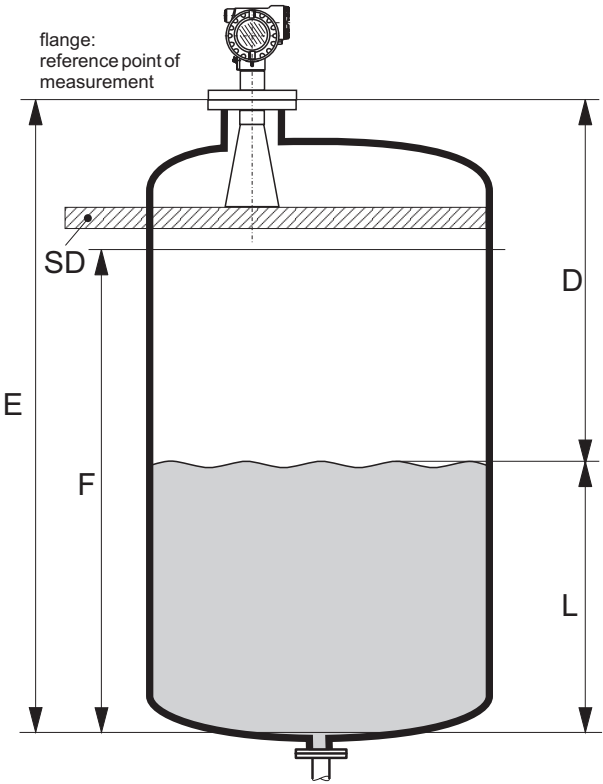
E = empty calibr. (= zero)
    setting in 005
F = full calibr. (= span)
    setting in 006
D = distance (distance flange / product)
    display in 0A5
L = level
    display in 0A6
SD = safety distance
     setting in 015

Table of contents

1   Notes on use

You have various options for accessing the descriptions of instrument functions or how to enter parameters.

1.1   Using the table of contents to locate a function description

All the functions are listed in the table of contents sorted by function group (e.g. basic setup, safety settings, etc.). You can access a more detailed description of a function by using a page reference / link.
The table of contents is on page 3.

1.2   Using the graphic of the function menu to locate a function description

This guides you step by step from the highest level, the function groups, to the exact function description you require.

All the available function groups and instrument functions are listed in the table (see page 11). Select your required function group or function. You can access an exact description of the function group or function by using a page reference / link.

1.3   Using the index of the function menu to locate a function description

To simply navigation within the function menu, each function has a position which is shown in the display. You can access each function via a page reference/link in the function menu index (see page 87) which lists all the function names alphabetically and numerically.

✎   Note!
The default values of the parameters are typed in **boldface**.

1.4   General structure of the operating menu

The operating menu is made up of two levels:

- **Function groups (00, 01, 03, …, 0C, 0D):**
  The individual operating Selection of the instrument are split up roughly into different function groups. The function groups that are available include, e.g.: "**basic setup**", "**safety settings**", "**output**", "**display**", etc.
- **Functions (001, 002, 003, …, 0D8, 0D9):**
  Each function group consists of one or more functions. The functions perform the actual operation or parameterisation of the instrument. Numerical values can be entered here and parameters can be selected and saved. The available functions of the "**basic setup (00)**" function group include, e.g.: "**tank shape (002)**",
  "**medium property (003)**", "**process cond. (004)**", "**empty calibr. (005)**", etc.

If, for example, the application of the instrument is to be changed, carry out the following procedure:

1.   Select the "**basic setup (00)**" function group.
2.   Select the "**tank shape (002)**" function (where the existing tank shape is selected).

1.4.1   Identifying the functions

For simple orientation within the function menus (see Page 11 ff.), for each function a position is shown on the display.
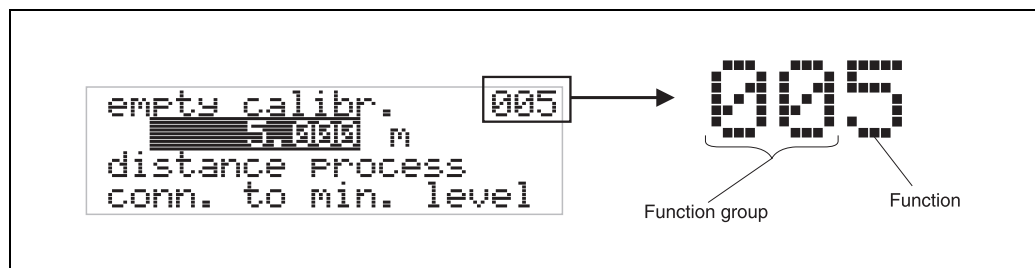
The first two digits identify the function group:

- **basic setup**   00
- **safety settings**   01
- **linearisation**   04

…

The third digit numbers the individual functions within the function group:

- **basic setup**   00   →   - **tank shape**   002
                                   - **medium property**   003
                                   - **process cond.**   004

                                       …

Hereafter the position is always given in brackets (e.g. "**tank shape**" **(002)**) after the described function.

1.5   Display and operating elements
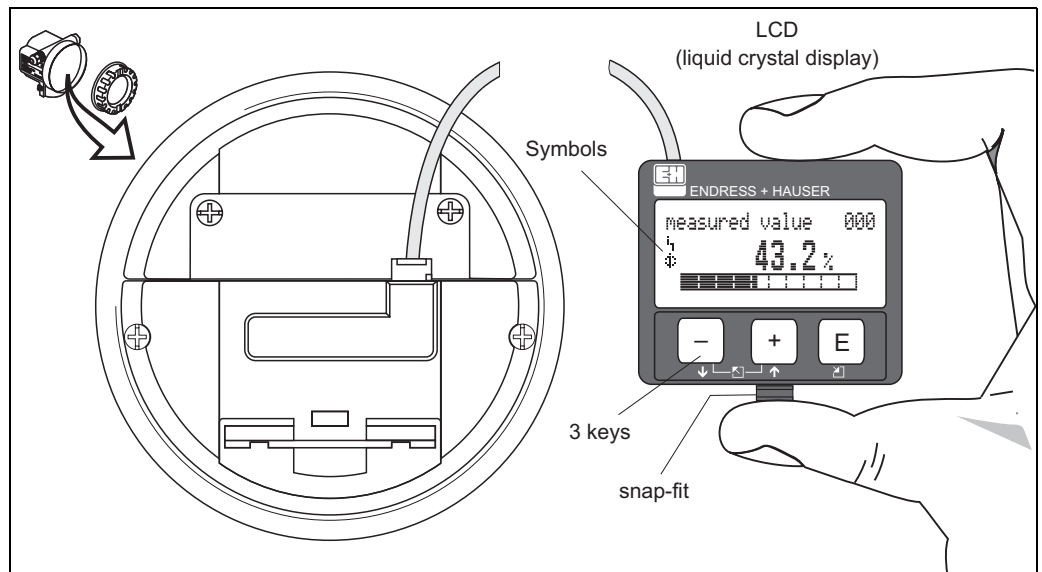
Fig. 1:   *Layout of the display and operating elements*

1.5.1   Display

Liquid crystal display (LCD):
Four lines with 20 characters each. Display contrast adjustable through key combination.
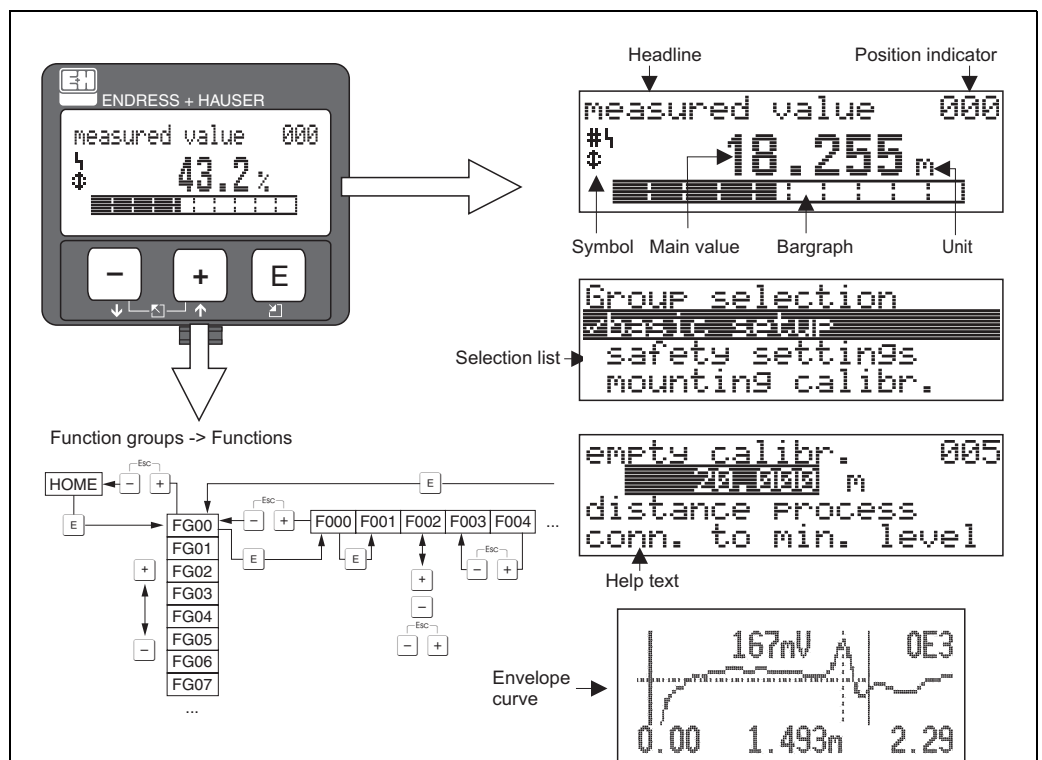
Fig. 2:   *Display*

1.5.2   Display symbols

The following table describes the symbols that appear on the liquid crystal display:

Symbols	Meaning
	ALARM_SYMBOL This alarm symbol appears when the instrument is in an alarm state. If the symbol flashes, this indicates a warning.
	LOCK_SYMBOL This lock symbol appears when the instrument is locked,i.e. if no input is possible.
	COM_SYMBOL This communication symbol appears when a data transmission via e.g. HART, PFOFIBUS PA or FOUNDATION Fieldbus is in progress.
	SIMULATION_SWITCH_ENABLE This communication symbol appears when simulation in FF is enabled via the DIP switch.

Tab. 1–1Meaning of Symbols

1.5.3   Key assignment

The operating elements are located inside the housing and are accessible for operation by opening the lid of the housing.

Function of the keys

Key(s)	Meaning
+ or ↑	Navigate upwards in the selection list Edit numeric value within a function
− or ↓	Navigate downwards in the selection list Edit numeric value within a function
− + or ←	Navigate to the left within a function group
E or E	Navigate to the right within a function group, confirmation.
+ and E or − and E	Contrast settings of the LCD
+ and − and E	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so.

Tab. 1–2Function of the keys

1.5.4   Operation with the VU 331

Fig. 3:   Selection and configuration in operation menu

Selection and configuration in Operation menu:

1.) Change from Measured Value Display to **Group Selection** by pressing E

2.) Press – or + to select the required **Function Group** (e.g.. "basic setup (00)") and confirm by pressing
   E ➜ First f**unction** (e.g. "tank shape (002)") is selected.
   Note!
   The active selection is marked by a ✓ in front of the menu text.

3.) Activate Edit mode with + or –.
   Selection menus:
   a) Select the required **Parameter** in selected **function** (e.g. "tank shape (002)") with – or +.
   b) E confirms selection ➜ ✓ appears in front of the selected parameter
   c) E confirms the edited value ➜ system quits Edit mode
   d) + + – (= ⊟⊞) interrupts selection ➜ system quits Edit mode
   Typing in numerals and text:
   a) Press + or – to edit the first character of the **numeral / text** (e.g. "empty calibr. (005)")
   b) E positions the cursor at the next character ➜ continue with (a) until you have completed your input
   c) if a ↵ symbol appears at the cursor, press E to accept the value entered
      ➜ system quits Edit mode
   d) + + – (= ⊟⊞) interrupts the input, system quits Edit mode

4) Press E to select the next **function** (e.g. "medium property (003)")

5) Press + + – (= ⊟⊞) once ➜ return to previous **function** (e.g. "tank shape (002)")
   Press + + – (= ⊟⊞) twice ➜ return to **Group selection**

6) Press + + – (= ⊟⊞) to return to **Measured value display**

1.6   Commissioning

1.6.1   Switching on the measuring device

When the instrument is switched on for the first time, the following messages appear on the display:
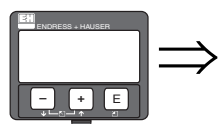
```
initialization        /


VU 331 01.01.02
```

After 5 s, the following message appears

```
FMR2XX
V01.04.00 HART
```

After 5 s, the following message appears

```
HART
FIELD COMMUNICATION
PROTOCOL
```

After 5 s or after you have pressed E the following message appears

```
language           092
English
 Deutsch
 Français
```

Select the language
(this message appears the first time the instrument is switched on)

```
distance unit      0C5
m
 ft
 mm
```

Select the basic unit
(this message appears the first time the instrument is switched on)

```
measured value     000
     63.460 %
```

⟹ The current measured value is displayed

After E is pressed, you reach the group selection.

```
Group selection    00→
basic setup
 safety settings
 linearisation
```

This selection enables you to perform the basic setup

2   Function menu Micropilot M

Function group			Function			Description
basic setup **00**		⇒	measured value	000	→	Page 14
(siehe Seite 14)			tank shape	002	→	Page 14
⇓			medium property	003	→	Page 15
			process cond.	004	→	Page 15
			empty calibr.	005	→	Page 17
			full calibr.	006	→	Page 18
			pipe diameter	007	→	Page 19
			check distance	051	→	Page 20
			range of mapping	052	→	Page 21
			start mapping	053	→	Page 21
safety settings **01**		⇒	output on alarm	010	→	Page 23
(siehe Seite 23)			output on alarm (HART only)	011	→	Page 25
⇓			outp. echo loss	012	→	Page 25
			ramp %span/min	013	→	Page 26
			delay time	014	→	Page 27
			safety distance	015	→	Page 27
			in safety dist.	016	→	Page 27
			ackn. alarm	017	→	Page 29
			overspill prot.	018	→	Page 29
linearisation **04**		⇒	level/ullage	040	→	Page 30
(siehe Seite 30)			linearisation	041	→	Page 31
⇓			customer unit	042	→	Page 35
			table no.	043	→	Page 36
			input level	044	→	Page 36
			input volume	045	→	Page 37
			max. scale	046	→	Page 37
			diameter vessel	047	→	Page 37
extended calibr. **05**		⇒	selection	050	→	Page 38
(siehe Seite 38)			check distance	051	→	Page 38
⇓			range of mapping	052	→	Page 39
			start mapping	053	→	Page 40
			pres. map dist.	054	→	Page 41
			cust. tank map	055	→	Page 41
			echo quality	056	→	Page 42
			offset	057	→	Page 42
			antenna extens.	0C9	→	Page 42
			output damping	058	→	Page 43
			blocking dist.	059	→	Page 43

Function group			Function			Description
output	**06**	⇒	commun. address (HART only)	060	→	Page 44
profibus param.	**06**		instrument addr. (PROFIBUS PA only)	060	→	Page 44
PROFIBUS PA only			no. of preambels (HART only)	061	→	Page 45
(siehe Seite 44)			ident number (PROFIBUS PA only)	061	→	Page 45
⇓			low output limit (HART only)	062	→	Page 46
			set unit to bus (PROFIBUS PA only)	062	→	Page 46
			curr.output mode (HART only)	063	→	Page 47
			out value (PROFIBUS PA only)	063	→	Page 47
			fixed cur. value (HART only)	064	→	Page 48
			out status (PROFIBUS PA only)	064	→	Page 48
			simulation	065	→	Page 49
			simulation value	066	→	Page 49
			output current (HART only)	067	→	Page 49
			2nd cyclic value (PROFIBUS PA only)	067	→	Page 51
			4mA value	068	→	Page 52
			select v0h0 (PROFIBUS PA only)	068	→	Page 53
			20mA value	069	→	Page 53
			display value (PROFIBUS PA only)	069	→	Page 53
envelope curve	**0E**	⇒	plot settings	0E1	→	Page 54
(siehe Seite 54)			recording curve	0E2	→	Page 54
⇓			envelope curve display	0E3	→	Page 55
display	**09**	⇒	language	092	→	Page 57
(siehe Seite 57)			back to home	093	→	Page 57
⇓			format display	094	→	Page 58
			no.of decimals	095	→	Page 58
			sep. character	096	→	Page 58
			display test	097	→	Page 59
diagnostics	**0A**	⇒	present error	0A0	→	Page 61
(siehe Seite 60)			previous error	0A1	→	Page 61
⇓			clear last error	0A2	→	Page 61
			reset	0A3	→	Page 62
			unlock parameter	0A4	→	Page 63
			measured dist.	0A5	→	Page 64
			measured level	0A6	→	Page 65
			detection window	0A7	→	Page 65
			application par.	0A8	→	Page 66

Function group			Function			Description
system parameters	**0C**	⇒	tag no.	0C0	→	Page 67
(siehe Seite 67)			device tag (FOUNDATION Fieldbus only)	0C0	→	Page 67
⇓			Profile Version (PROFIBUS PA only)	0C1	→	Page 67
			protocol+sw–no.	0C2	→	Page 67
			serial no.	0C4	→	Page 68
			device id (FOUNDATION Fieldbus only)	0C4	→	Page 68
			distance unit	0C5	→	Page 68
			download mode	0C8	→	Page 69
			antenna extens.	0C9	→	Page 69
service	**D00**	⇒	service level	D00		Page 70

3 Function group "basic setup" (00)

```
Group selection    00→
▓basic setup▓▓▓▓▓▓▓
  safety settings
  linearisation
```

3.1 Function "measured value" (000)
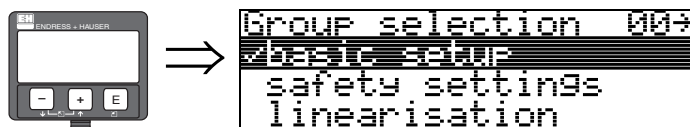
```
measured value    000
   63.460 %
▓▓▓▓▓▓▓▓▓▓▓▓
```

This function displays the current measured value in the selected unit
(see "**customer unit**" **(042)** function). The number of digits after decimal point can be selected in the "**no.of decimals**" **(095)** function.

Caution!
When using an FAR10 antenna extension, carry out an correction before the basic setup. The length of the FAR10 is to be entered in the function "**antenna extens**" **(0C9)** (see Page 42 or Page 69).

3.2 Function "tank shape" (002)

```
tank shape        002
▓dome ceiling▓▓▓▓▓▓
  horizontal cyl
  bypass
```
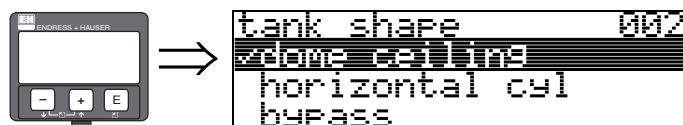
This function is used to select the tank shape.

Selection:
- **dome ceiling**
- horizontal cyl
- bypass
- stilling well
- flat ceiling
- sphere

dome ceiling   horizontal cyl

bypass   stilling well

flat ceiling   sphere
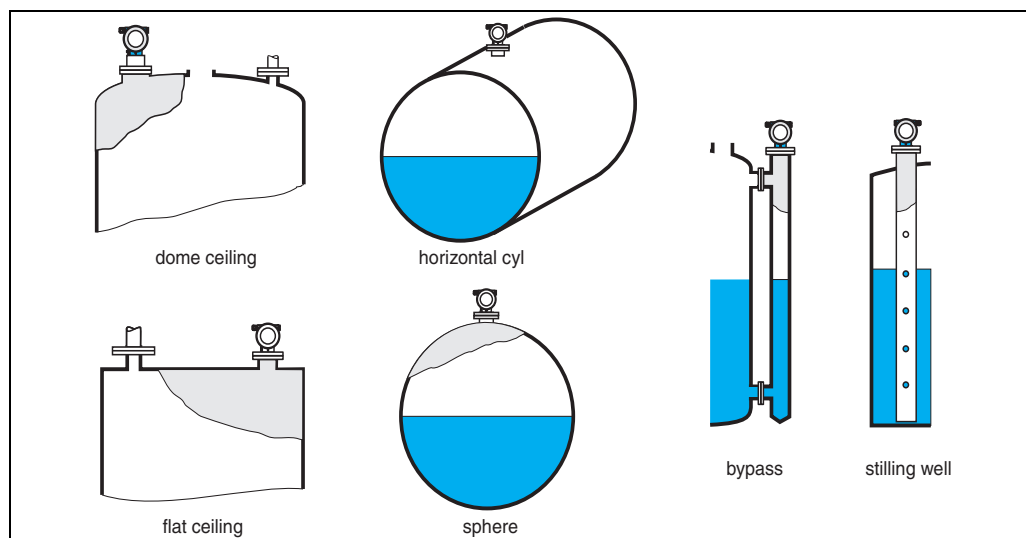
3.3   Function "medium property" (003)

```
medium property   003
unknown
DC: < 1.9
DC: 1.9 ... 4
```

This function is used to select the dielectric constant.

Selection:
- **unknown**
- < 1.9
- 1.9 ... 4
- 4 ... 10
- > 10

Product class	DK (εr)	Examples
A	1,4 … 1,9	non-conducting liquids, e.g. liquefied gas [1]
B	1,9 … 4	non-conducting liquids, e.g. benzene, oil, toluene, …
C	4 … 10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, …
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

Treat Ammonia NH3 as a medium of group A, i.e. use FMR230 in a stilling well.
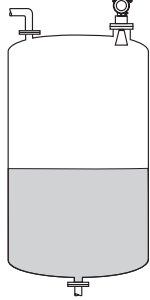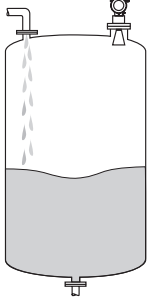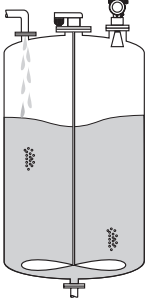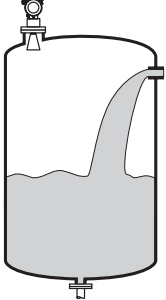
3.4   Function "process cond." (004)

```
process cond.    004
standard
calm surface
turb. surface
```
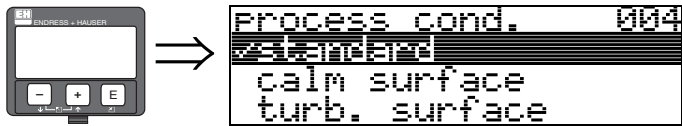
This function is used to select the process conditions.

Selection:
- **standard**
- calm surface
- turb. surface
- add. agitator
- fast change
- test:no filter

standard	calm surface	turb. surface
For all applications that do not fit into any of the following groups.	Storage tanks with immersion tube or bottom filling	Storage / buffer tanks with rough surface due to free filling or mixer nozzles
The filter and output damping are set to average values.	The averaging filters and output damping are set to high values. -> steady meas. value -> precise measurement -> slower reaction time	Special filters to smooth the input signals are emphasised. -> smoothed meas. value -> medium fast reaction time

add. agitator	fast change	test:no filter
Agitated surfaces (with possible vortex) due to agitators	Fast change of level, particularly in small tanks	All filters can be switched off for service / diagnostic purposes.
Special filters to smooth the input signals are set to high values. ->smoothed meas. value ->medium fast reaction time ->minimization of effects by agitator blades	The averaging filters are set to low values. The output damping is set to 0. -> rapid reaction time -> possibly unsteady meas. value	All filters off.

3.5   Function "empty calibr." (005)
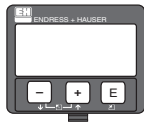
```
empty calibr.      005
     5.000  m
distance process
conn. to min. level
```

This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (=zero).
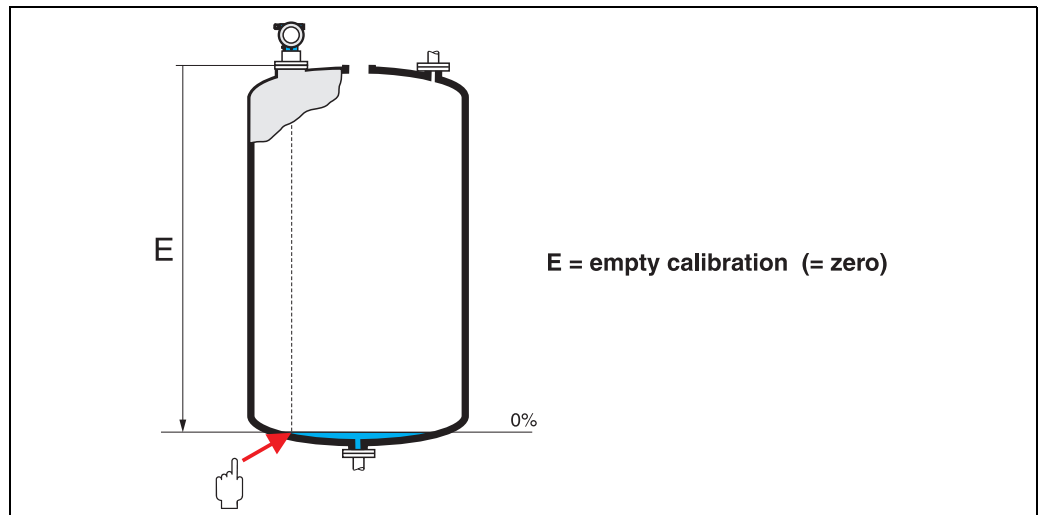
E = empty calibration (= zero)

Caution!
For dish bottoms or conical outlets, the zero point should be no lower than the point at which the radar beam hits the bottom of the tank.

3.6 Function "full calibr." (006)
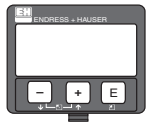

```
full calibr.        006
▇▇▇▇4.000 m
span
```

This function is used to enter the distance from the minimum level to the maximum level (=span).

F = full calibration (= span)
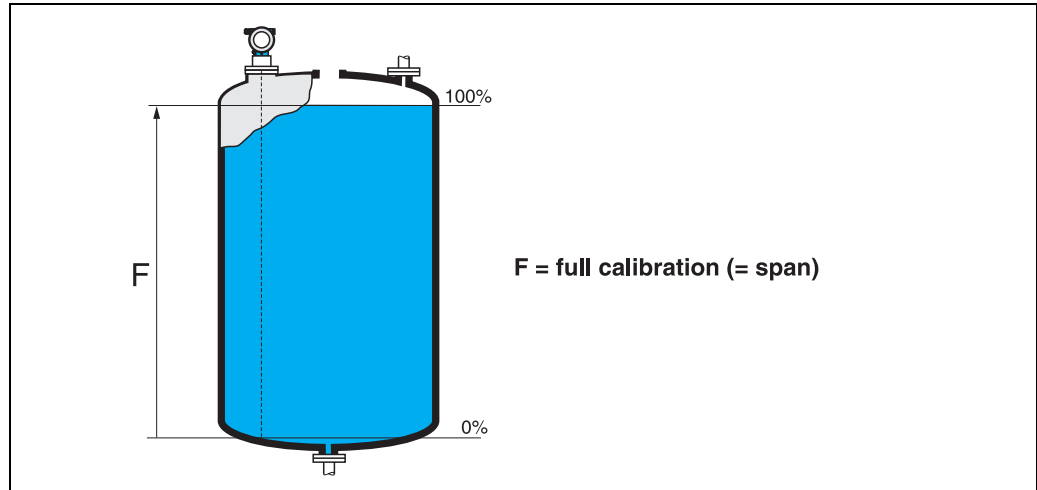
In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 50 mm (2") to the tip of the antenna.

✎ Note!
If **bypass** or **stilling well** was selected in the "**tank shape**" **(002)** function, the pipe diameter is requested in the following step.

3.7   Function "pipe diameter" (007)

```
Pipe diameter    007
▓▓▓▓▓▓▓ mm
inner diameter of
bypass/stilling well
```

This function is used to enter the pipe diameter of the stilling well or bypass pipe.
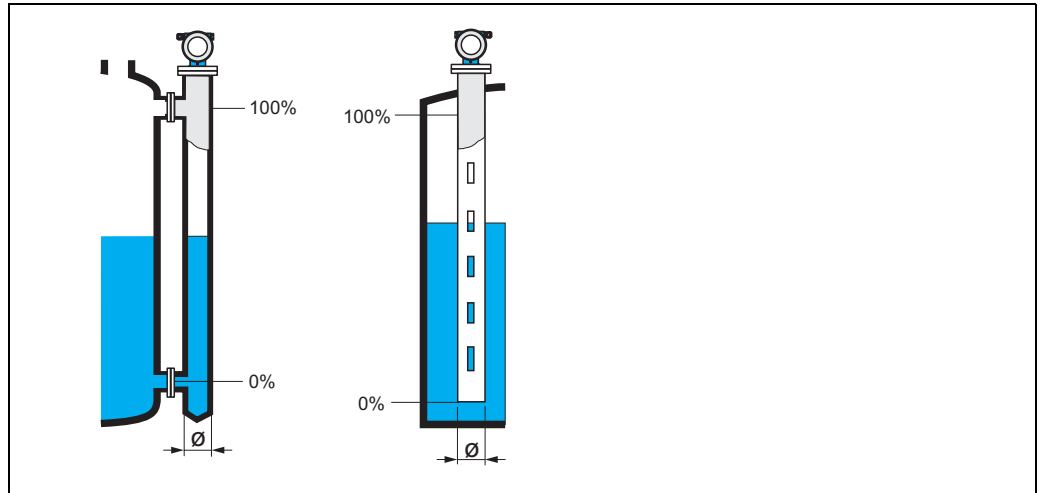
Microwaves propagate more slowly in pipes than in free space. This effect depends on the inside diameter of the pipe and is automatically taken into account by the Micropilot. It is only necessary to enter the pipe diameter for applications in a bypass or stilling well.

3.8   Display (008)
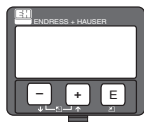
```
dist./meas.value 008
dist.      2.463 m
meas.v.   63.422 %
```

The **distance** measured from the reference point to the product surface and the **level** calculated with the aid of the empty adjustment are displayed. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

- Distance correct – level correct -> continue with the next function, "**check distance**" (051)
- Distance correct – level incorrect -> Check "**empty calibr.**" (005)
- Distance incorrect – level incorrect -> continue with the next function, "**check distance**" (051)

3.9   Function "check distance" (051)
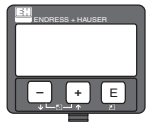
```
check distance    051
dist. unknown
 manual
 distance = ok
```

This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

Selection:

- distance = ok
- dist. too small
- dist. too big
- **dist. unknown**
- manual
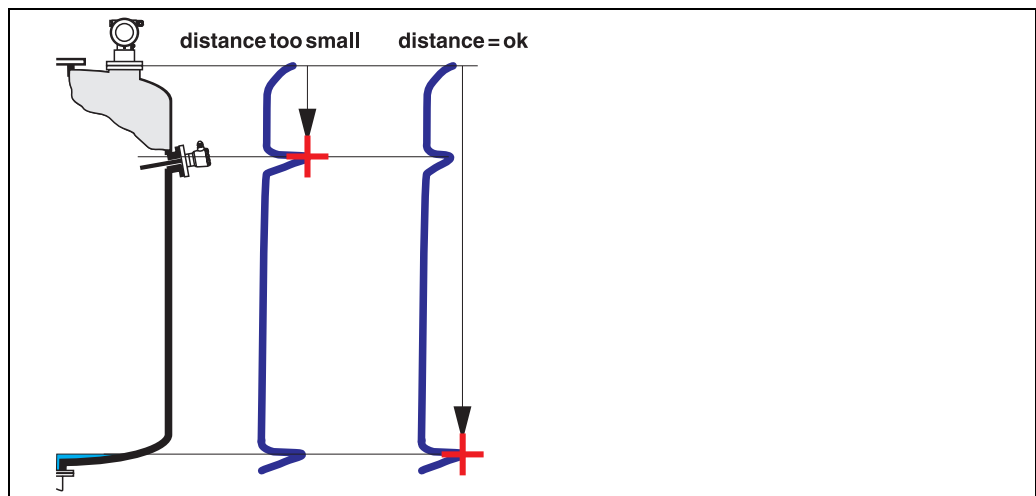
distance = ok

- Mapping is carried out up to the currently measured echo.
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

Anyway, it is suggested to carry out a mapping in this case as well.

dist. too small

- At the moment, an interference is being evaluated.
- Therefore, a mapping is carried out including the presently measured interference echoe.
- The range to be suppressed is suggested in the "**range of mapping (052)**" function.

dist. too big

- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002), (003), (004)** and "**empty calibr.**" **(005)**

dist. unknown

If the actual distance is not known, no mapping can be carried out.

manual

A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the "**range of mapping (052)**" function.

☝ Caution!
The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20").
If a mapping already exists, it is overwriten up to the distance specified in
"**range of mapping**" **(052)**. Beyond this value the existing mapping remains unchanged.

3.10   Function "range of mapping" (052)
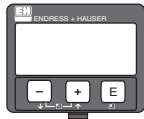
```
range of mapping 052
        0.000  m
input of
mapping range
```

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (see Page 2 ff.). This value can be edited by the operator.
For manual mapping, the default value is 0 m.

3.11   Function "start mapping" (053)
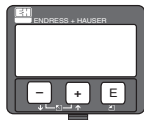
```
start mapping    053
✓off
 on
```

This function is used to start the interference echo mapping up to the distance given in "**range of mapping**" **(052)**.

Selection:
■ **off:** no mapping is carried out
■ on: mapping is started

During the mapping process the message "**record mapping**" is displayed.

☝ Caution!
A mapping will be recorded only, if the device is not in error state.

3.12   Display (008)
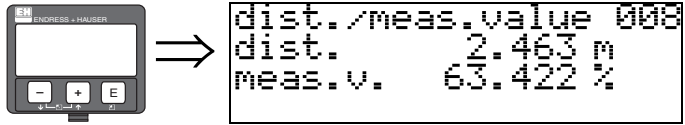
```
dist./meas.value 008
dist.       2.463 m
meas.v.    63.422 %
```

The distance measured from the reference point to the product surface and the level calculated with the aid of the empty alignment are displayed again. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

- Distance correct – level correct -> basic setup completed
- Distance incorrect – level incorrect -> a further interference echo mapping must be carried out "**check distance**" (**051**).
- Distance correct – level incorrect -> check "**empty calibr.**" (**005**)

```
     Return to
  Group Selection
```

⇩

After 3 s, the following message appears

```
Group selection  00→
✓basic setup
 safety settings
 linearisation
```
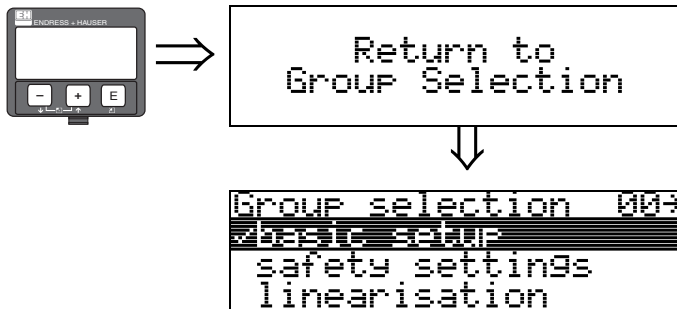
✎   Note!
After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**display**" (**09**) function group) is recommended.

4   Function group "safety settings" (01)

```
Group selection   01→
 safety settings
 linearisation
 extended calibr.
```

4.1   Function "output on alarm" (010)

```
output on alarm   010
 MIN (<=3.6mA)
✓MAX (22mA)
 hold
```
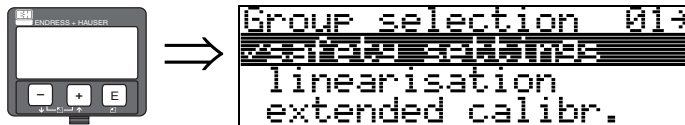
This function is used to select the reaction of the output on an alarm.

Selection:
- MIN (<= 3.6mA)
- **MAX (22mA)**
- hold
- user specific

MIN (<= 3.6mA)
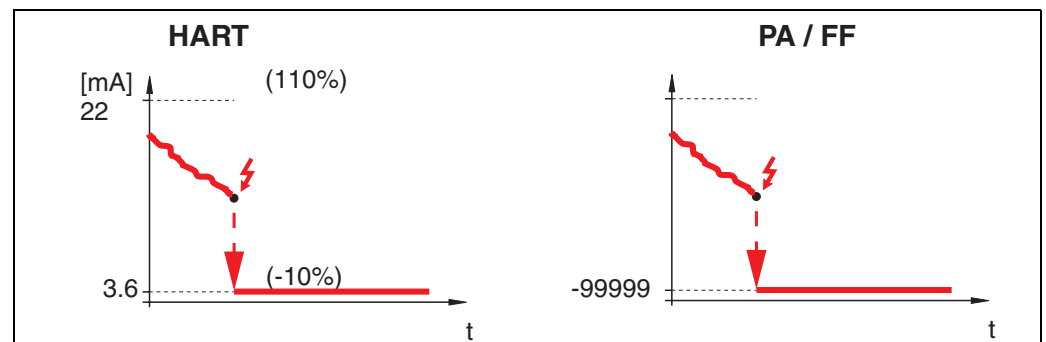
If the instrument is in alarm state, the output changes as follows:
- HART: MIN-Alarm 3.6 mA
- PROFIBUS PA: MIN-Alarm -99999
- FOUNDATION Fieldbus: MIN-Alarm -99999

MAX (22mA)
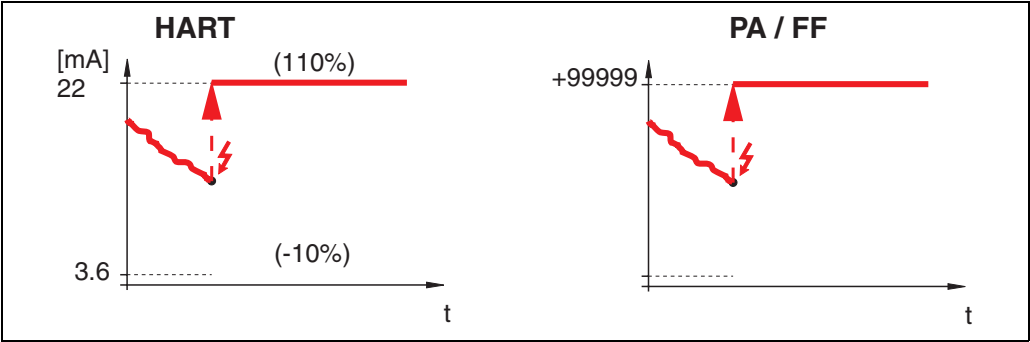
If the instrument is in alarm state, the output changes as follows:
- HART: MAX-Alarm 22 mA
- PROFIBUS PA: MAX-Alarm +99999
- FOUNDATION Fieldbus: MAX-Alarm +99999

hold
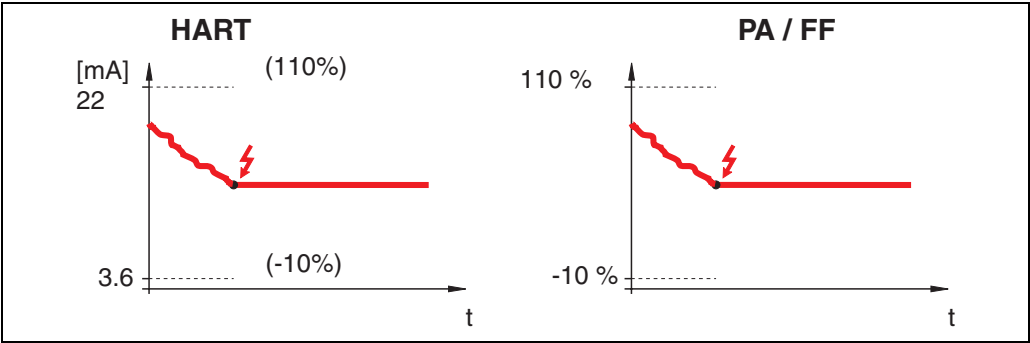
If the instrument is in alarm state, the last measured value is held.

user specific
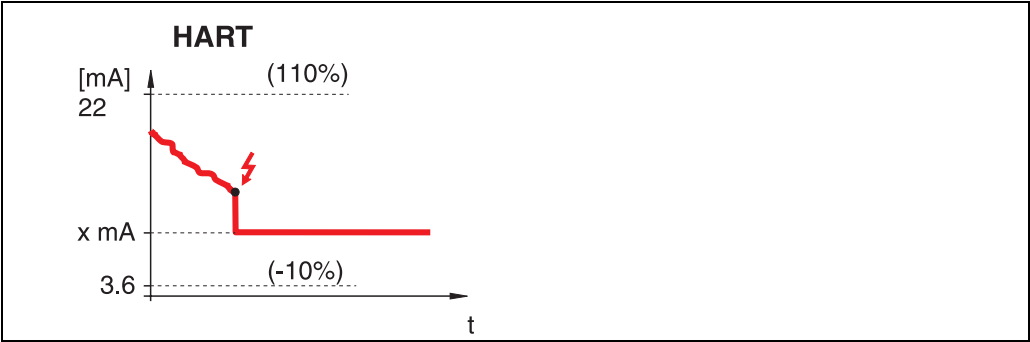
If the instrument is in alarm state, the output is set to the value configured in "**output on alarm**" **(011)** (x mA).

Caution!
This selection is available for HART devices only!

4.2 Function "output on alarm" (011), HART only

```
output on alarm   010
user specific
  MIN (<=3.6mA)
  MAX (22mA)
```

⇓

```
output on alarm   011
      22.00  mA
```
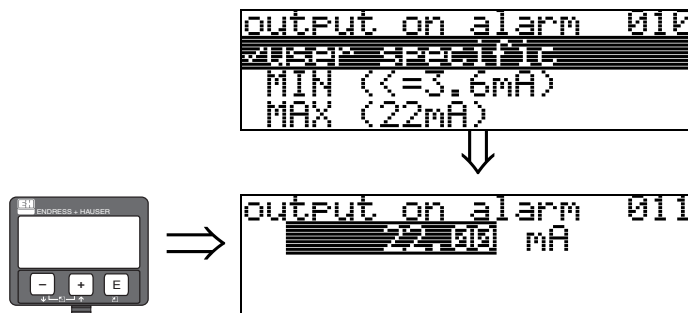
On alarm, the output current is set to the entered value in mA. This function is active when you selected "**user specific**" in the "**output on alarm**" **(010)** function.

Caution!
This function is available for HART devices only!

4.3 Function "outp. echo loss" (012)

```
outp. echo loss   012
hold
  ramp %/min
  alarm
```

Use this function to set the output response on echo loss.

Selection:
- alarm
- **hold**
- ramp %/min

alarm
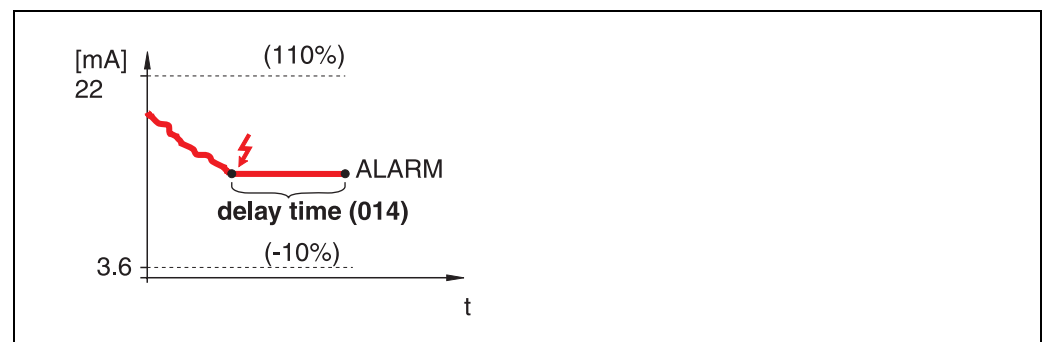
On echo loss, the instrument switches to alarm state after an adjustable "**delay time**" **(014)**. The output response depends on the configuration set in "**output on alarm**" **(010)**.

hold
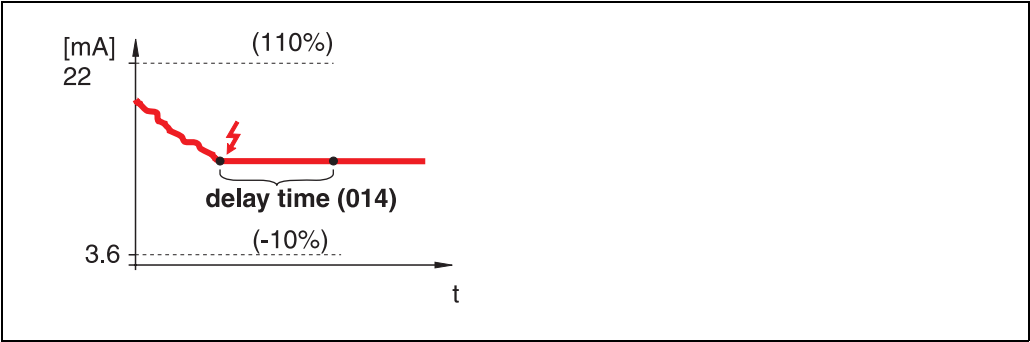
On echo loss, a warning is generated after a definable "**delay time**" **(014)**. Output is held.

ramp %/min
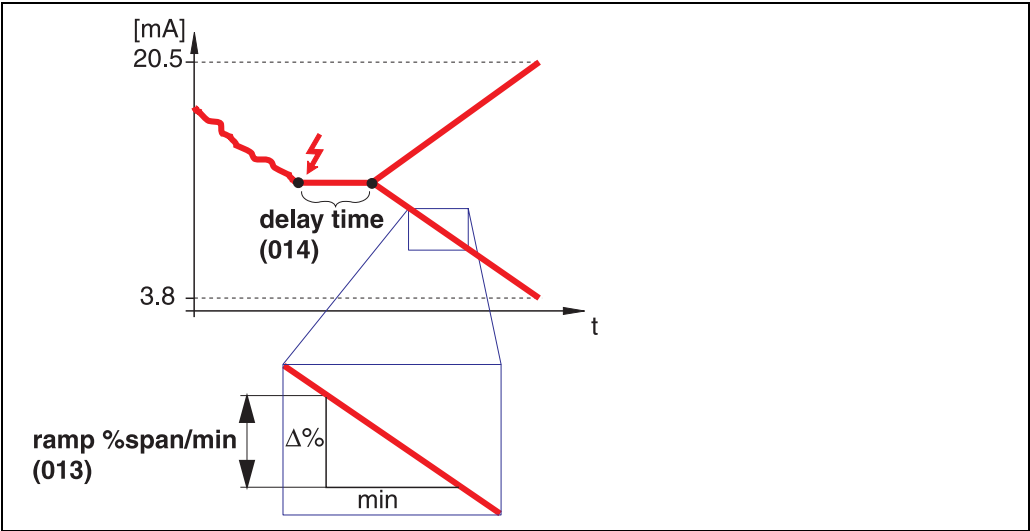
On echo loss, a warning is generated after a definable "**delay time**" **(014)**. The output is changed towards 0% or 100% depending on the slope defined in "**ramp %span/min**" **(013)**.

4.4   Function "ramp %span/min" (013)
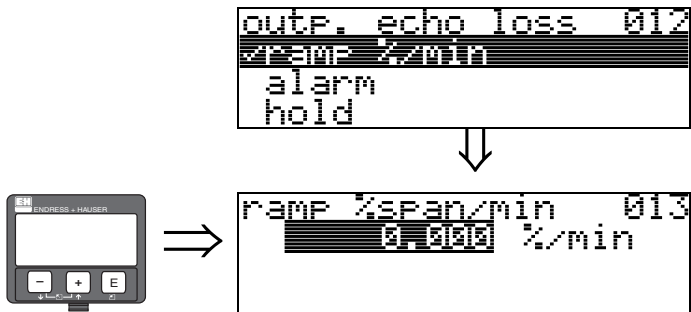
Ramp slope which defines the output value on echo loss. This value is used if "**ramp %span/min**" is selected in "**outp. echo loss**" **(012)**. The slope is given in % of the measuring range per minute.

4.5   Function "delay time" (014)

```
delay time        014
          30  s
in case of echo loss
max. 4000 sec.
```

Use this function to enter the delay time (Default = 30 s) after which a warning is generated on echo loss, or after which the instrument switches to alarm state.

4.6   Function "safety distance" (015)

A configurable safety distance is placed before the "**blocking dist.**" **(059)** (see page 43). This distance warns you that any further level increase would make the measurement invalid, for example, when touching the antenna area.
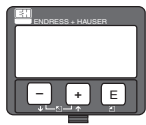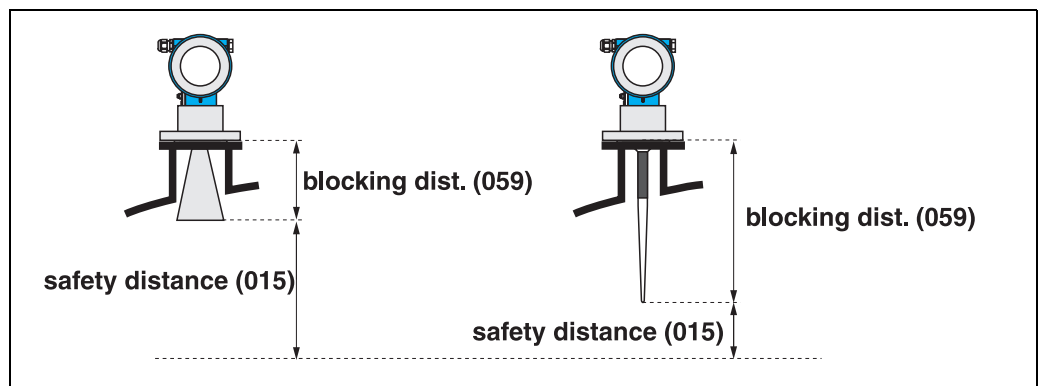

```
safety distance   015
         0.100  m
from antenna tip/
lower edge of horn
```

Enter the size of the safety distance here. The default value is 0.1 m.

4.7   Function "in safety dist." (016)
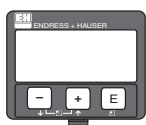
```
in safety dist.   016
warning
 self holding
 alarm
```

This function defines the response when the level enters the safety distance .

Selection:
- alarm
- **warning**
- self holding
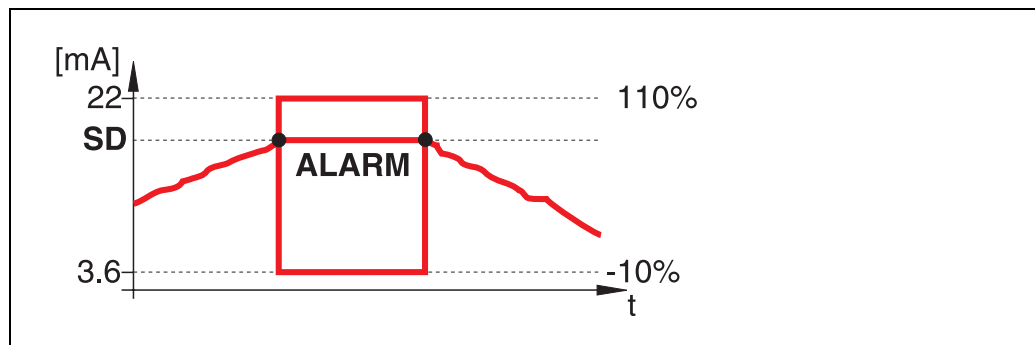
alarm

Instrument enters the defined alarm state ("**output on alarm**" **(011)**). The alarm message **E651** – "**level in safety distance** – **risk of overspill**" is displayed.
If the level drops out of the safety distance, the alarm warning disappears and the instrument starts to measure again.

warning
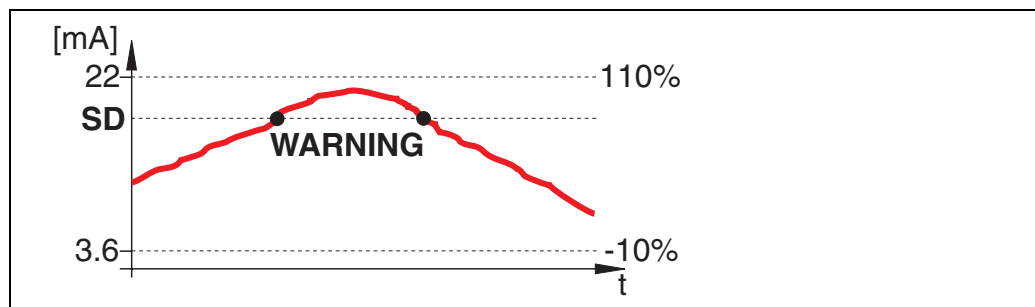
Instrument displays a warning **E651** – "**level in safety distance** – **risk of overspill**", but continues to measure. If the level leaves the safety distance, the warning disappears.

self holding
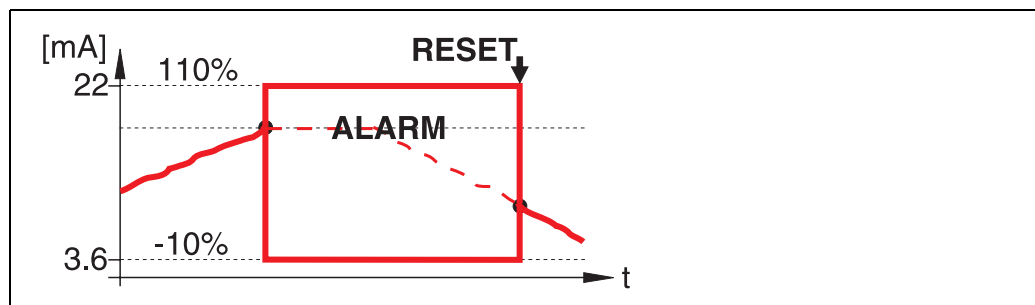
Instrument switches to defined alarm state ("**output on alarm**" **(011)**). The alarm message **E651** – "**level in safety distance** – **risk of overspill**" is displayed.
If the level leaves the safety distance, the measurement continues only after a reset of the self holding (function: "**ackn. alarm**" **(017)**).

4.8   Function "ackn. alarm" (017)

```
ackn. alarm       017
✓no
 yes
```

This function acknowledges an alarm in case of "**self holding**".

Selection:
▪ **no**
▪ yes

no
The alarm is not acknowledged.

yes
Acknowledgement takes place.

4.9   Function "overspill prot." (018)

```
overspill prot.  018
✓standard
 german WHG
```

When "**german WHG**" is selected, various parameters relating to WHG overspill protection/SIL are modified and the instrument is locked against further operation. Select "**Standard**" to unlock. Thereby the WHG parameter adjustment is preserved. In order to reset the WHG–specific parameters it is recommended to carry out a reset of the instrument (see Page 62). For further information see ZE 244F/00/de (for german WHG) or SD 150F/00/en (for SIL).

```
     Return to
   Group Selection
```

After 3 s, the following message appears

```
Group selection  01→
✓safety settings
 linearisation
 extended calibr.
```
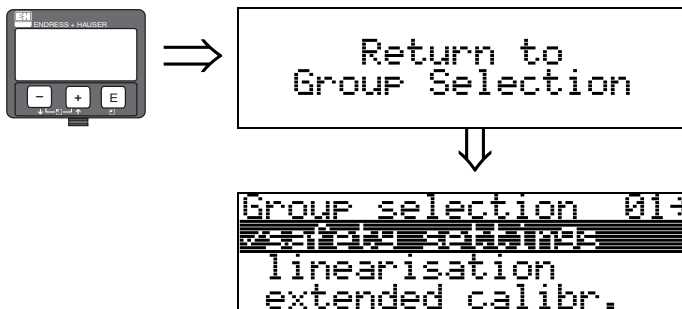
5　Function group "linearisation" (04)

```
Group selection   04→
✓linearisation
 extended calibr.
 output
```

5.1　Function "level/ullage" (040)

```
level/ullage      040
✓level CU
 level DU
 ullage CU
```

Selection:
- **level CU**
- level DU
- ullage CU
- ullage DU

level CU
Level in customer units. The measured value can be linearised.
The "**linearisation**" **(041)** default value is set to a linear 0...100%.

level DU
Level in the selected "**distance unit**" **(0C5)**.

ullage CU
Ullage in customer units. The value can be linearised.
The "**linearisation**" **(041)** default value is set to a linear 0...100%.

ullage DU
Ullage in the selected "**distance unit**" **(0C5)**.

✎　Note!
Reference point for the ullage is "full calibr." (=span).
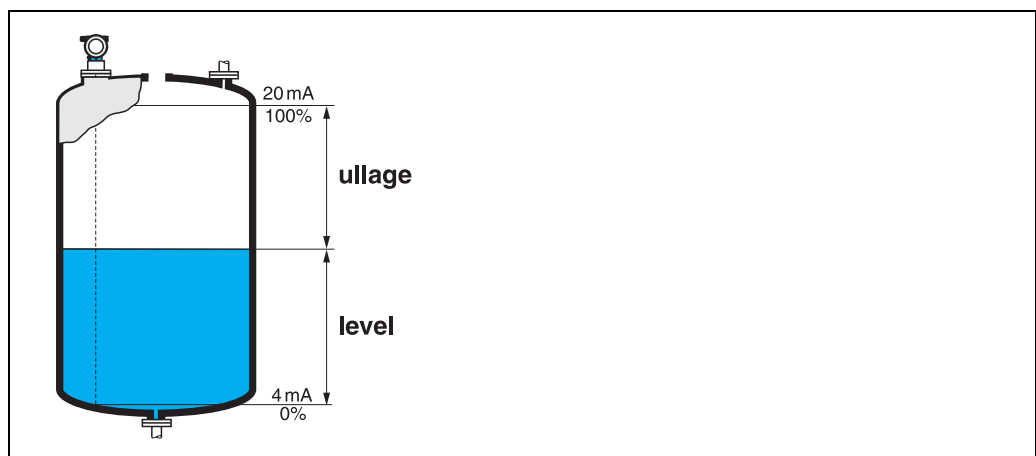
5.2   Function "linearisation" (041)

Linearisation defines the ratio of level to container volume or product weight and allows a measurement in customer units, e.g. metres, hectolitres etc. The measured value in (000) is then displayed in the selected unit.

```
linearisation      041
linear
 horizontal cyl
 manual
```
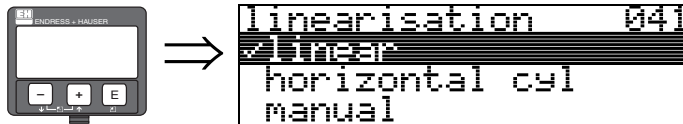
This function is used to select the linearisation modes.

Selection:
■ **linear**
■ horizontal cyl
■ manual
■ semi–automatic
■ table on
■ clear table

linear
The tank is linear e.g. a cylindrical vertical tank. You can measure in customer units by entering a maximum volume/weight.
You can select the "**customer unit**" **(042)**. Define the volume value corresponding to the calibration in "**max. scale**" **(046)**. This value corresponds to an output of 100% (= 20 mA for HART).
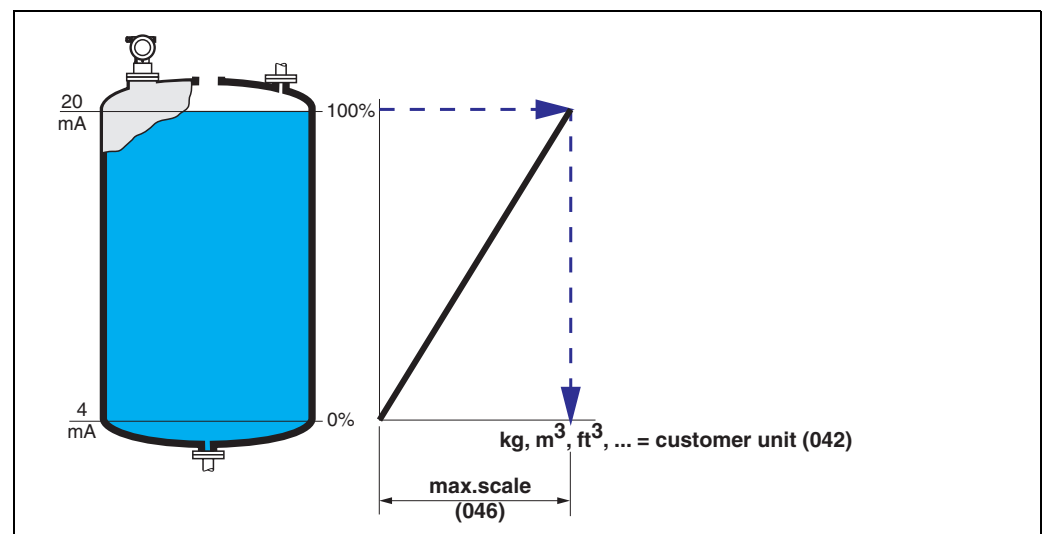
horizontal cyl

The volume, mass etc. are calculated automatically in cylindrical horizontal tanks by entering the "**diameter vessel**" **(047)**, the "**customer unit**" **(042)** and the "**max. scale**" **(046)**. The "**max. scale**" **(046)** corresponds to an output of 100% (= 20 mA for HART).
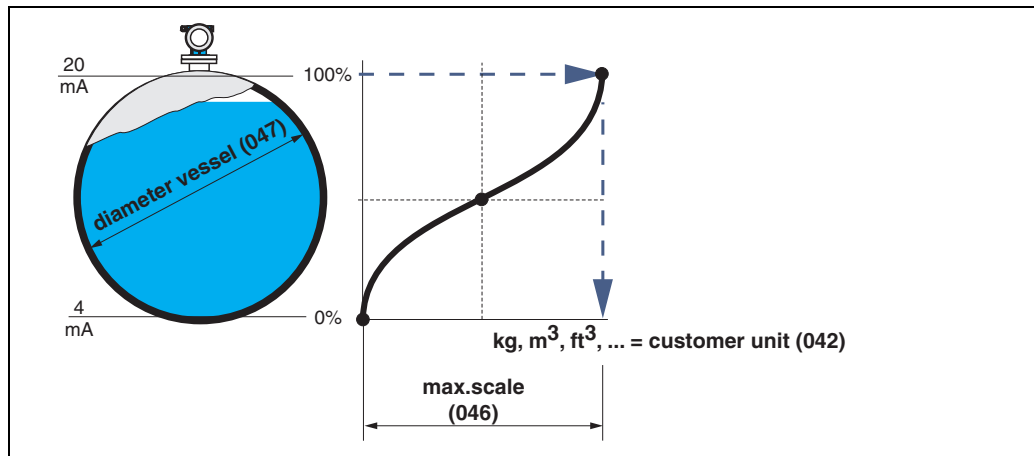
manual

If the level is not proportional to the volume or weight within the set measuring range, you can enter a linearisation table in order to measure in customer units. The requirements are as follows:

- The 32 (max.) value pairs for the linearisation curve points are known.
- The level values must be given in ascending order. The curve is monotonously increasing.
- The level heights for the first and last points on the linearisation curve correspond to empty and full calibration respectively.
- The linearisation takes place in the basic setup unit ("**distance unit**" **(0C5)**).
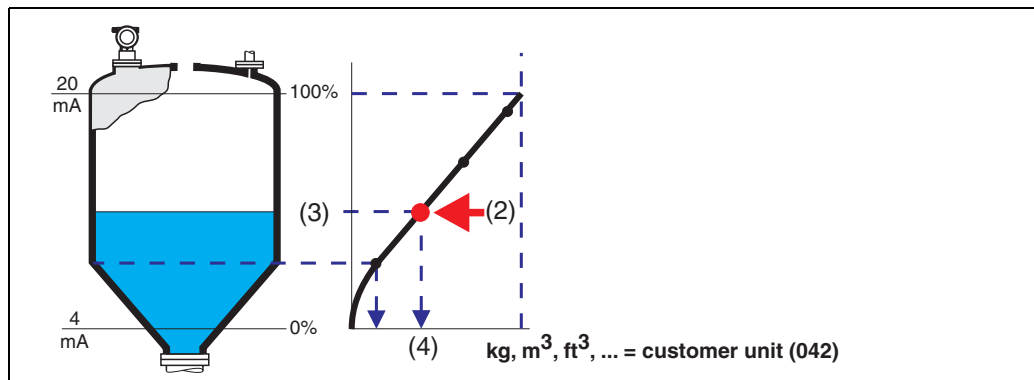
Each point (2) in the table is described by a value pair: level (3) and, for example, volume (4). The last value pair defines the 100% output (= 20 mA for HART).

```
linearisation      041
manual
 semi-automatic
 table on
```

```
linearisation      043
Tab.no.              1
Level          0.000m
Volume         0.000%
```
Select the table point (Point 1).

```
linearisation      044
Tab.no.              1
Level          0.000m
Volume         0.000%
```
Enter the level belonging to Point 1.

```
linearisation      045
Tab.no.              1
Level          0.000m
Volume         0.000%
```
Enter the corresponding volume.

```
next point         045
yes
 no
```
Enter a further table point?

```
linearisation      043
Tab.no.              2
Level          0.000m
Volume         0.000%
```
Next table point.

...
Continue until "**next point**" **(045)** is answered with no.

✎ Note!
After making entries into the table, activate it with "**table on**".
The 100% value (=20 mA for HART) is defined by the last point in the table.

✎ Note!
Before confirming 0.00 m as the level or 0.00% as the volume, activate the Edit mode with ⊞ or ⊟.

Entries can be made into the linearisation table in ToF Tool using the table editor.
You can also display the contents graphically.
Linearization curves for any tank forms can be calculated additionally.

semi–automatic
The tank is filled in stages when the linearisation curve is entered semi–automatically. The Micropilot automatically detects the level and the corresponding volume/weight has to be entered. The procedure is similar to manual table entry, where the level value for each table point is given automatically by the instrument.

✎   Note!
If the tank is emptied, pay attention to the following points:
- The number of points must be known in advance.
- The first table number = (32 – number of points).
- Entries in "**Tab. no.**" **(043)** are made in reverse order (last entry = 1).

table on
An entered linearisation table only becomes effective when activated.

clear table
Before making entries into the linearisation table, any existing tables must be deleted. The linearisation mode automatically switches to linear.

✎   Note!
A linearisation table can be deactivated by selecting "**linear**" or "**horizontal cyl**" (or the "**level/ullage**" **(040)** function = "**level DU**", "**ullage DU**"). It is not deleted and can be reactivated at any time by selecting "**table on**".

5.3 Function "customer unit" (042)

```
customer unit     042
%
l
hl
```

You can select the customer unit with this function.

Selection:
- %
- l
- hl
- m3
- dm3
- cm3
- ft3
- usgal
- i gal
- kg
- t
- lb
- ton
- m
- ft
- mm
- inch

Dependence
The units of the following parameters are changed:
- measured value (000)
- input volume (045)
- max. scale (046)
- simulation value (066)

5.4 Function "table no." (043)

```
linearisation    041
 table on
 clear table
 linear
```

⇓

```
linearisation    041
 manual
 semi-automatic
 table on
```

⇓

```
linearisation    043
Tab.no.          1
Level        0.000m
Volume       0.000%
```

⇓
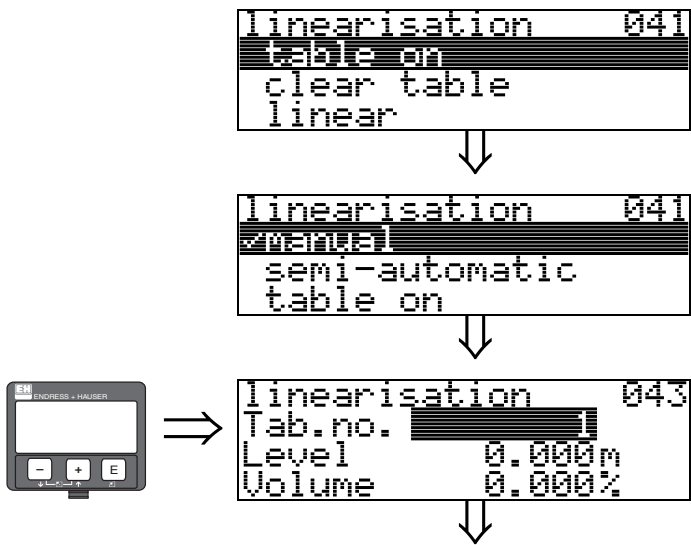
Position of the value pair in the linearisation table.

Dependence
Updates "**input level**" **(044)** , "**input volume**" **(045)**.

5.5 Function "input level" (044)

⇓

```
linearisation    044
Tab.no.          1
Level        0.000m
Volume       0.000%
```

⇓

You can enter the level for each point of the linearisation curve with this function. When the linearisation curve is entered semi-automatically, Micropilot detects the level automatically.

User input:
Level in "**distance unit**" **(0C5)**.

5.6   Function "input volume" (045)

```
⇓
```

```
linearisation        045
Tab.no.                 1
Level           0.000m
Volume          0.000%
```

```
⇓
```

```
next point            045
▓yes▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓
  no
```

```
⇓
```

```
linearisation        043
Tab.no.              ▓2▓
Level           0.000m
Volume          0.000%
```

```
⇓
```
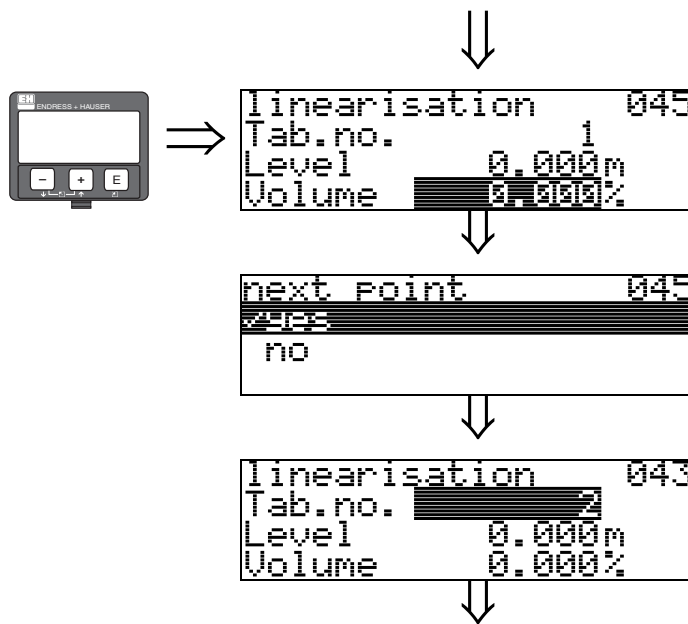
Specify the volume for each point of the linearisation curve with this function.

User input:
Volume in "**customer unit**" **(042)**.

5.7   Function "max. scale" (046)

```
max. scale            046
   ▓100.000▓  %
```

You can enter the end value of the measuring range with this function. This input is necessary if you selected "**linear**" or "**horizontal cyl**" in the "**linearisation**" **(041)** function.

5.8   Function "diameter vessel" (047)

```
linearisation        041
▓horizontal cyl▓▓▓▓▓
  manual
  semi-automatic
```

```
⇓
```

```
diameter vessel      047
   ▓9.000▓  m
```
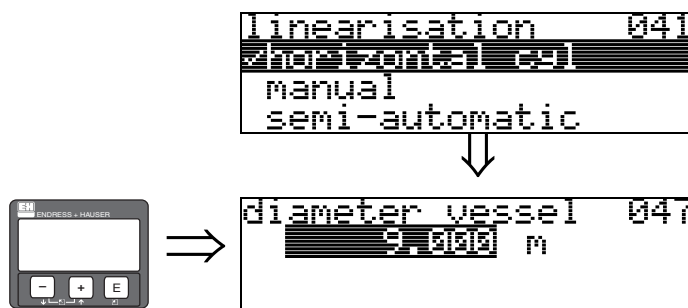
Enter the tank diameter with this function. This entry is necessary if you selected "**horizontal cyl**" in the "**linearisation**" **(041)** function.

6　　Function group "extended calibr." (05)

```
Group selection   05→
↗extended calibr.
 output
 display
```

6.1　　Function "selection" (050)

```
selection        050
↗common
 mapping
 extended map.
```
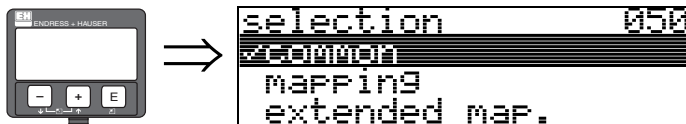
Select the function of the extended calibration.

Selection:
- **common** (e.g. "Level correction", "Output damping", "Antenna extension", ...)
- mapping
- extended map.

6.2　　Function "check distance" (051)

```
check distance   051
↗dist. unknown
 manual
 distance = ok
```

This function triggers the mapping of interference echoes. To do so, the measured distance must be compared with the actual distance to the product surface. The following options are available for selection:

Selection:
- distance = ok
- dist. too small
- dist. too big
- **dist. unknown**
- manual
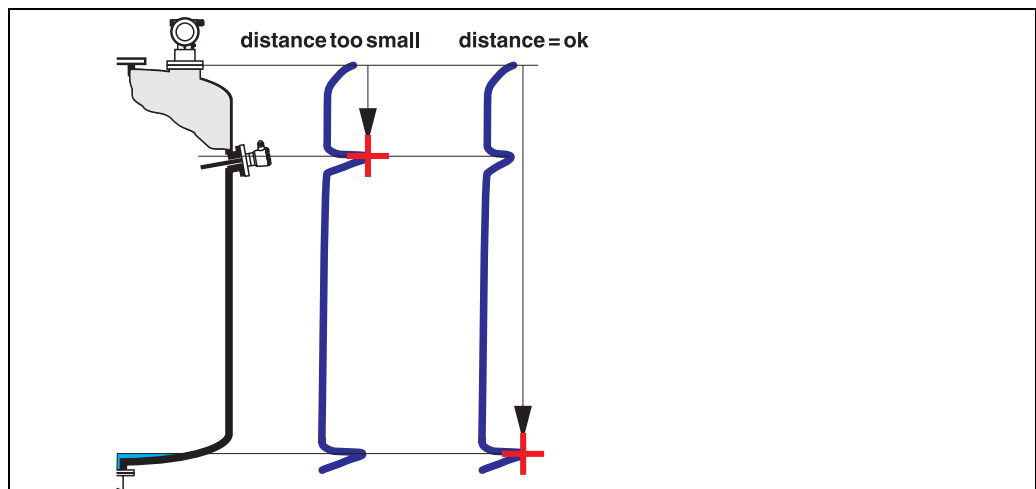
distance = ok
- mapping is carried out up to the currently measured echo
- The range to be suppressed is suggested in the "**range of mapping (052)**" function
Anyway, it is wise to carry out a mapping even in this case.

dist. too small
- At the moment, an interference is being evaluated
- Therefore, a mapping is carried out including the presently measured echoes
- The range to be suppressed is suggested in the "**range of mapping (052)**" function

dist. too big
- This error cannot be remedied by interference echo mapping
- Check the application parameters **(002), (003), (004)** and "**empty calibr.**" **(005)**

dist. unknown
If the actual distance is not known, no mapping can be carried out.

manual
A mapping is also possible by manual entry of the range to be suppressed. This entry is made in the "**range of mapping (052)**" function.

Caution!
The range of mapping must end 0.5 m (20") before the echo of the actual level. For an empty tank, do not enter E, but E – 0.5 m (20").
If a mapping already exists, it is overwriten up to the distance specified in
"**range of mapping**" **(052)**. Beyond this value the existing mapping remains unchanged.

6.3   Function "range of mapping" (052)

This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (see Page 2 ff.). This value can be edited by the operator.
For manual mapping, the default value is 0 m.

6.4   Function "start mapping" (053)

```
start mapping    053
▼off
  on
```

This function is used to start the interference echo mapping up to the distance given in "**range of mapping**" **(052)**.

Selection:
- **off:** no mapping is carried out
- on: mapping is started

During the mapping process the message "**record mapping**" is displayed.

Caution!
A mapping will be recorded only, if the device is not in error state.

6.5 Function "pres. map dist." (054)
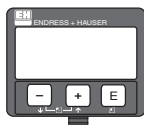
```
pres. map dist.   054
        0.000  m
```

Displays the distance up to which a mapping has been recorded.
A value of 0 indicates that no mapping was recorded so far.

pres. map dist. (054)
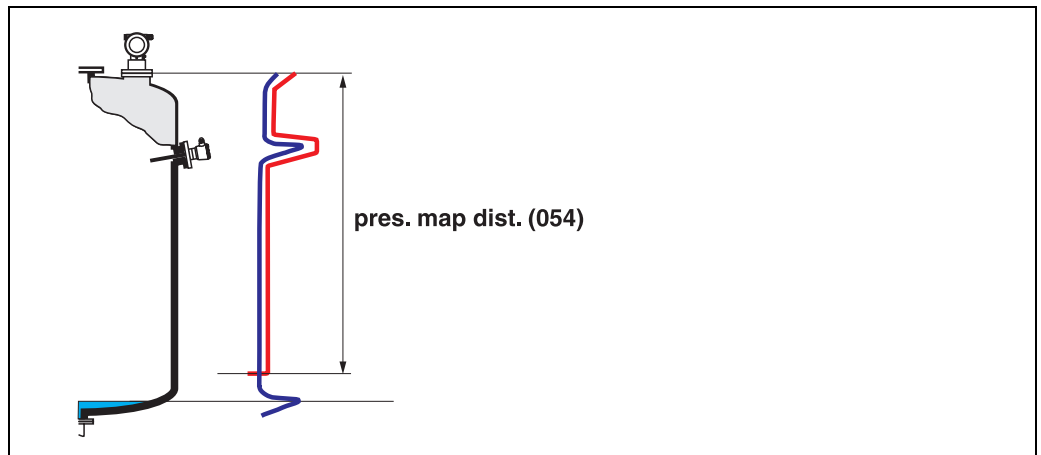
6.6 Function "cust. tank map" (055)
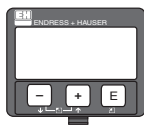
```
cust. tank map    055
inactive
 active
 reset
```

This function displays the evaluation mode using the customer tank map.

Selection:
- inactive
- active
- reset

inactive
No tank mapping has been recorded, or map is switched off. Evaluation is only using FAC (see page 74).

active
Evaluation is using the customer tank map (see page 73).

reset
Deletes the complete tank map.

6.7   Function "echo quality" (056)

```
echo quality      056
        19 dB
```
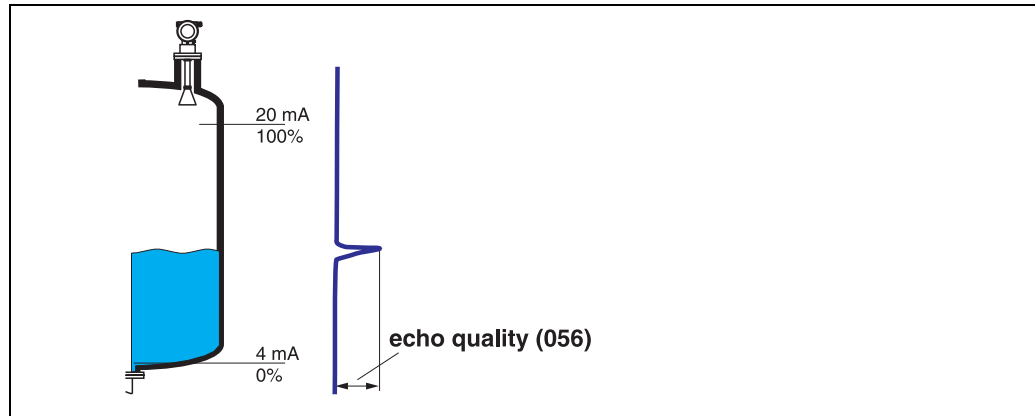

The echo quality is the benchmark for measurement reliability. It describes the amount of reflected energy and depends primarily on the following conditions:
- Dielectric constant of the medium
- Surface characteristics (waves, foam etc.)
- Distance between sensor and product

Low values increase the probability that the echo is lost through a change in measurement conditions, e.g. turbulent surface, foam, large measuring distance.

Caution!
Echo quality can be improved by orientation of the Micropilot (see page 81).

6.8   Function "offset" (057)
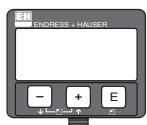
```
offset            057
     0.000 m
will be added to the
measured level
```

This function corrects the measured level by a constant value. The entered value is added to the measured level.

6.9   Function "antenna extens." (0C9)
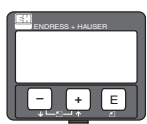
```
antenna extens.   0C9
     0.000 m
length FAR10 –
for FMR230 only
```

With this function, the length of the antenna extension FAR10 can be entered (FMR230 only). The influence of slower speed of propagation of the microwaves within the FAR10 is corrected automatically.

6.10 Function "output damping" (058)

```
output damping     058
▆▆▆▆▆▆▆5.0 s
```

Influences the time an output requires to react to a sudden level jump (63% of steady state). A high value attenuates, for example, the influences of rapid changes on the measured variable.

User input:
0...255 s

The default value depends on the selected application parameters "**tank shape**" **(002)**, "**medium property**" **(003)** and "**process cond.**" **(004)**.

6.11 Function "blocking dist." (059)

```
blocking dist.     059
▆▆▆▆▆▆▆0.500 m
```

A window below the antenna tip can be suppressed when there are strong reflections of structures, welding joints or struts near the antenna.
- The blocking distance is measured from the bottom edge of the process connection. Usually, the suppression reaches up to the tip of the antenna (see diagram on page 27).
- All echos are suppressed within this blocking distance.
- As the level echo could possibly be suppressed (and there is no guarantee that no other significant echo is available), a 10 cm long safety distance is placed in front of the suppression (see "**safety distance**" **(015)** function on page 27).
- The customer can set the Micropilot to respond to circumstances when the product is within this zone (safety distance) (see page 27).

```
      Return to
   Group Selection
```

After 3 s, the following message appears

```
Group selection   05+
▆extended calibr.▆
 output
 display
```
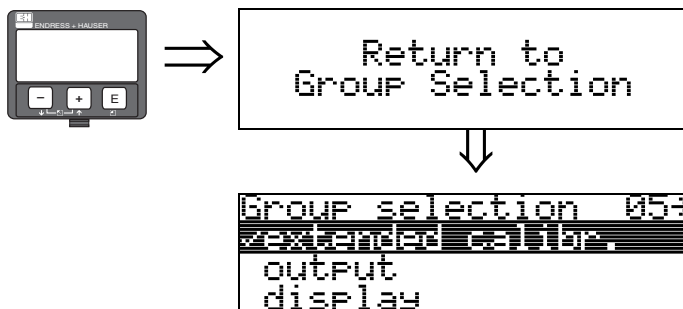
7   Function group "output" (06),
– "profibus param." (06), PROFIBUS PA only
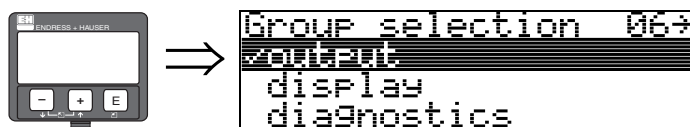
Display at HART and FOUNDATION Fieldbus instrument
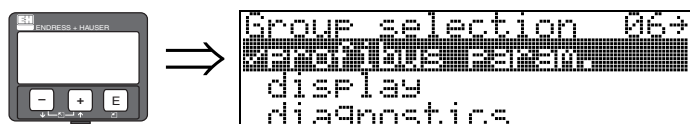
Display at PROFIBUS PA instrument

7.1   Function "commun. address" (060), HART only

Enter the communication address for the instrument with this function.
- Standard: 0
- Multidrop: 1–15
In multidrop mode the default value of the output current is 4 mA. It can be modified in the function **"fixed cur. value" (064)**.

Caution!
This function is available for HART devices only!

7.2   Function "instrument addr." (060), PROFIBUS PA only
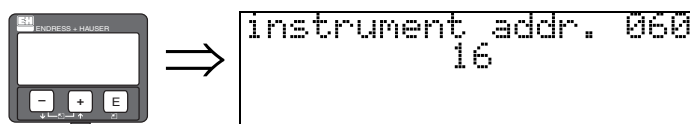
The PA bus address is displayed in this field. The address is set either directly on the instrument using DIP switches (see instrument operating instructions) or using a special SetSlaveAddress command via the bus, e.g. by the ToF Tool.

Caution!
This function is available for PROFIBUS PA devices only!

7.3   Function "no. of preambels" (061), HART only

```
no. of preambels 061
████████████5
```

Enter the number of preambles for the HART protocol with this function.
An increase in the value is advisable for "bad" lines with communications problems.

Caution!
This user input is available for HART devices only!

7.4   Function "ident number" (061), PROFIBUS PA only

```
ident number    061
manufacturer
 profile
```
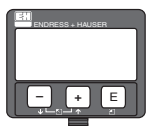
- manufacturer
- profile

manufacturer
Set to1522 hex according to manufacturer (PNO registered).

profile
Setting defined as in PA Profile 3.0: 9700 hex – instrument with one AI block.

Caution!
This function is available for PROFIBUS PA devices only!

7.5   Function "low output limit" (062), HART only

```
low output limit 062
✔on
 off
```

The output of negative level values can be suppressed with this function.

Selection:
- offminimum output –10% (3.8 mA for HART)
- onminimum output 0% (4 mA for HART)
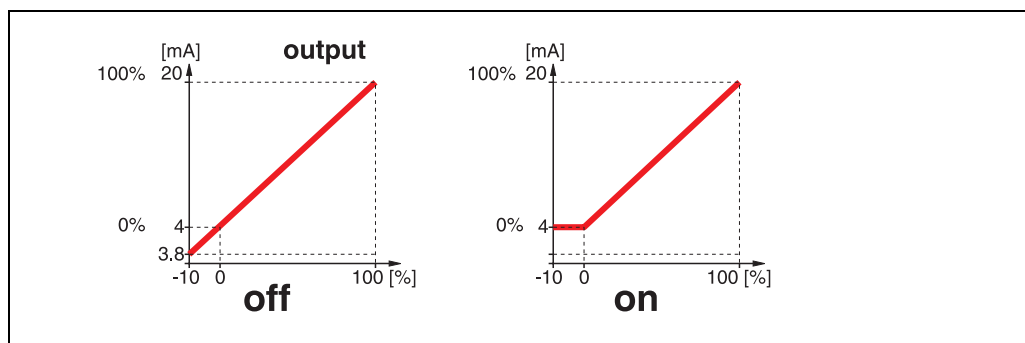
Caution!
This user input is available for HART devices only!

7.6   Function "set unit to bus" (062), PROFIBUS PA only

```
set unit to bus  062
✔confirm
```
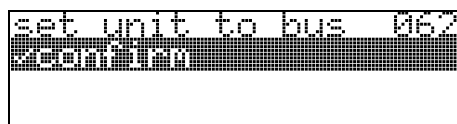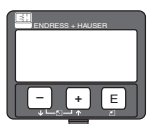
- confirm

After confirming this function, the unit of the measured variable is taken over in
the AI block (PV scale –> Out scale).
This function must always be executed after changing the unit.

Caution!
This function is available for PROFIBUS PA devices only!

7.7 Funktion "curr.output mode" (063), HART only

```
curr.output mode 063
standard
 curr.turn down
 fixed current
```

With this function you specify the mode of the current output with HART devices.

Selection:
- **standard**
- curr.turn down
- fixed current

standard
The total measuring range (0 ... 100%) will be mapped to the current intervall
(4 ... 20 mA).

curr.turn down
Only a part of the measuring range will be mapped to the current intervall
(4 ... 20 mA). Use the functions **"4mA value" (068)** and **"20mA value" (069)** to define the
concerning range.

fixed current
The current is fixed. The actual measured value is transmitted by the HART signal only. The value
of the current is defined in the **"fixed current" (064)** function.

Caution!
This function is available for HART devices only!

Example:
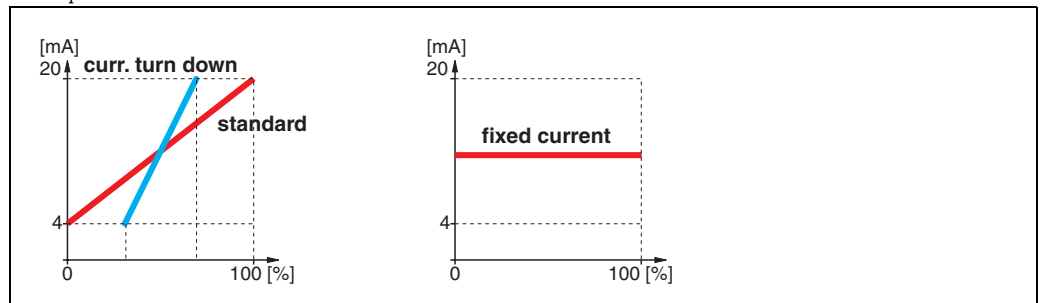
7.8 Function "out value" (063), PROFIBUS PA only
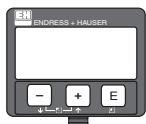
```
out value       063
r
     0.000
```

This displays the AI block output.

Caution!
This function is available for PROFIBUS PA devices only!

7.9   Function "fixed cur. value" (064), HART only

```
fixed cur. value 064
▌▌▌▌▌▌▌▌4.00 mA
```

Set the fixed current value with this function. This entry is necessary when you have switched on the "**fixed current**" **(063)** function.

User input:
3,8...20,5 mA

Caution!
This user input is available for HART devices only!

7.10   Function "out status" (064), PROFIBUS PA only

```
out status        064
                  79
```
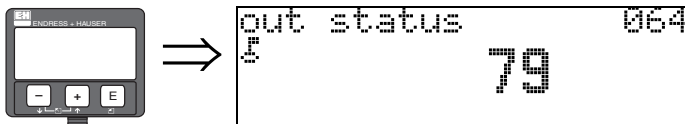
Displays the current output status (for value, see operating instructions of relevant instrument).

Caution!
This function is available for PROFIBUS PA devices only!

7.11 Function "simulation" (065)

```
simulation        065
✓sim. off
  sim. level
  sim. volume
```

If necessary, linearisation, the output signal and the current output can be tested with the simulation function. You have the following simulation options:

Selection:
- **sim. off**
- sim. level
- sim. volume
- sim. current (HART only)
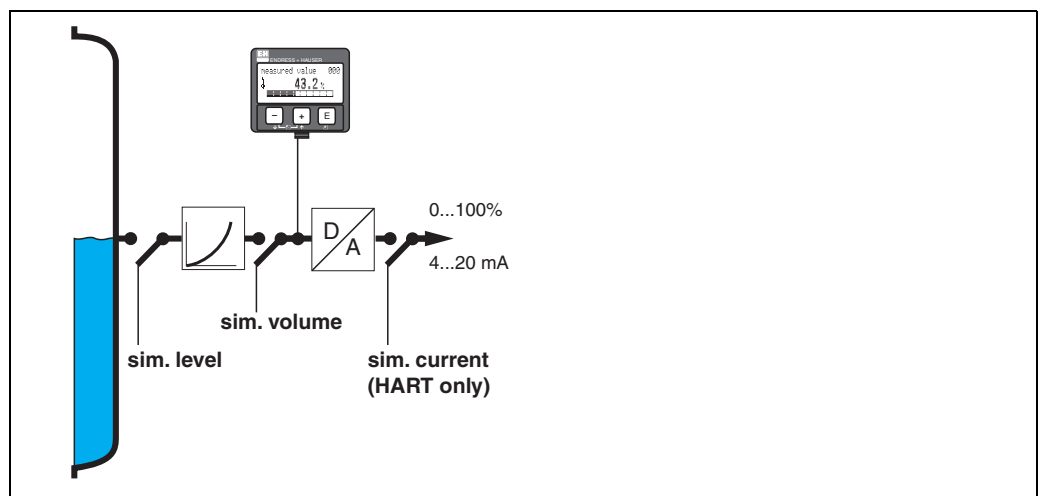
sim. off
Simulation is switched off.

sim. level
Enter the level value in "**simulation value**" **(066)**.
The functions
- measured value (000)
- measured level (0A6)
- output current" (067) – only with HART instruments!
follow the entered values.

sim. volume
Enter the volume value in "**simulation value**" **(066)**.
The functions
- measured value (000)
- output current" (067) – only with HART instruments!
follow the entered values.

sim. current (HART only)
Enter the current value in "**simulation value**" **(066)**.
The function
- output current" (067) – only with HART instruments!
follows the entered values.

7.12   Function "simulation value" (066)

After selecting the "**sim. level**" option in the "**simulation**" **(065)** function, the following message appears in the display:

```
simulation value 066
        2.54  m
```

The level can be entered.

After selecting the "**sim. volume**" option in the "**simulation**" **(065)** function, the following message appears in the display:

```
simulation value 066
        25.56  %
```

The volume can be entered.

After selecting the "**sim. current**" option in the "**simulation**" **(065)** function, the following message appears in the display:

```
simulation value 066
        8.00  mA
```

Enter the output current (only for HART instruments).

7.13   Function "output current" (067), HART only
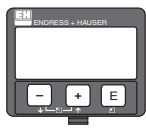
```
output current    067
        4.00  mA
```

Displays the output current in mA.

Caution!
This function is available for HART devices only!

7.14   Function "2nd cyclic value" (067), PROFIBUS PA only
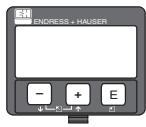
```
2nd cyclic value 067
height/dist.
```

Selects the second cyclical value.

- height/dist.

Micropilot always transmits the distance as the second cyclical value.

Caution!
This function is available for PROFIBUS PA devices only!

7.15   Function "4mA value" (068), HART only
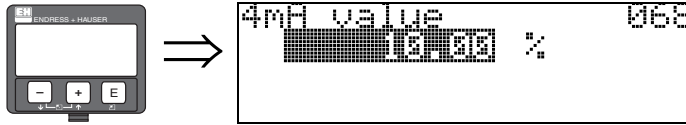
In this function specify the level (or volume, weight, flow resp.), at which the output current should be 4 mA. This value will be used if you choose the option "curr. turn down" in the **"current output mode" (063)** function.

7.16   Function "select v0h0" (068), PROFIBUS PA only

Selects the value displayed in "**measured value**" **(000)**.

Selection:
- **measured value**
- display value

measured value
The configured measured value is displayed in the "**measured value**" **(000)** function.

display value
The value in "**display value**" **(069)** is displayed in the "**measured value**" **(000)** function.

Caution!
This function is available for PROFIBUS PA devices only!

7.17   Function "20mA value" (069), HART only
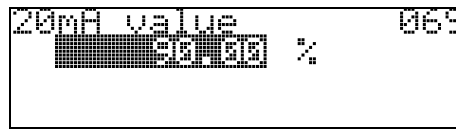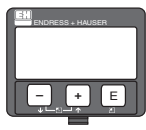
```
20mA value          069
▓▓▓▓▓▓▓80.00 %
```

In this function specify the level (or volume, weight, flow resp.), at which the output current should be 20 mA. This value will be used if you choose the option "curr. turn down" in the **"current output mode" (063)** function.

7.18   Function "display value" (069), PROFIBUS PA only

```
display value       069
┋ NOT AVAILABLE
```
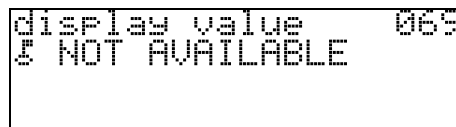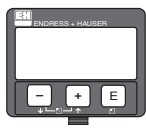
This field can be set externally, e.g. from a PLC. The value is then displayed as the main measured variable in the display by selecting the "**select v0h0**" **(068)** = "**display value**" function.

Caution!
This function is available for PROFIBUS PA devices only!

8   Function group "envelope curve" (0E)

⟹
```
Group selection   0E→
 envelope curve
  display
  diagnostics
```
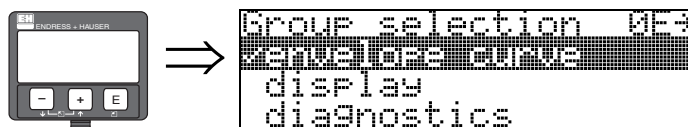
☝ Caution!
This function can be performed on the display only!

8.1   Function "plot settings" (0E1)

⟹
```
plot settings     0E1
 envelope curve
  env.curve+FAC
  env.curve+cust.map
```
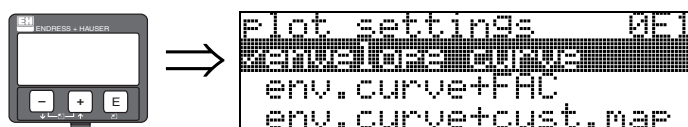
Select which information will be displayed in the LCD:
- **envelope curve**
- env.curve+FAC (on FAC see page 74)
- env.curve+cust.map (i.e. customer tank map is also displayed)

8.2   Function "recording curve" (0E2)

This function defines whether the envelope curve is read as a
- **single curve**
  or
- cyclic.

⟹
```
recording curve   0E2
 single curve
  cyclic
```

✎ Note!
If the cyclical envelope curve is active in the display, the measured variable is refreshed in a slower
cycle time. It is therefore recommended to exit the envelope curve display after optimising the
measuring point.

✎ Note!
An **orientation** of the Micropilot can help to optimise measurement in applications with very weak
level echos or strong interference echos by increasing the useful echo/reducing the interference
echo (see»Orientation of the Micropilot« on page 81).

8.3   Function "envelope curve display" (0E3)

The envelope curve is displayed in this function. You can use it to obtain the following information:
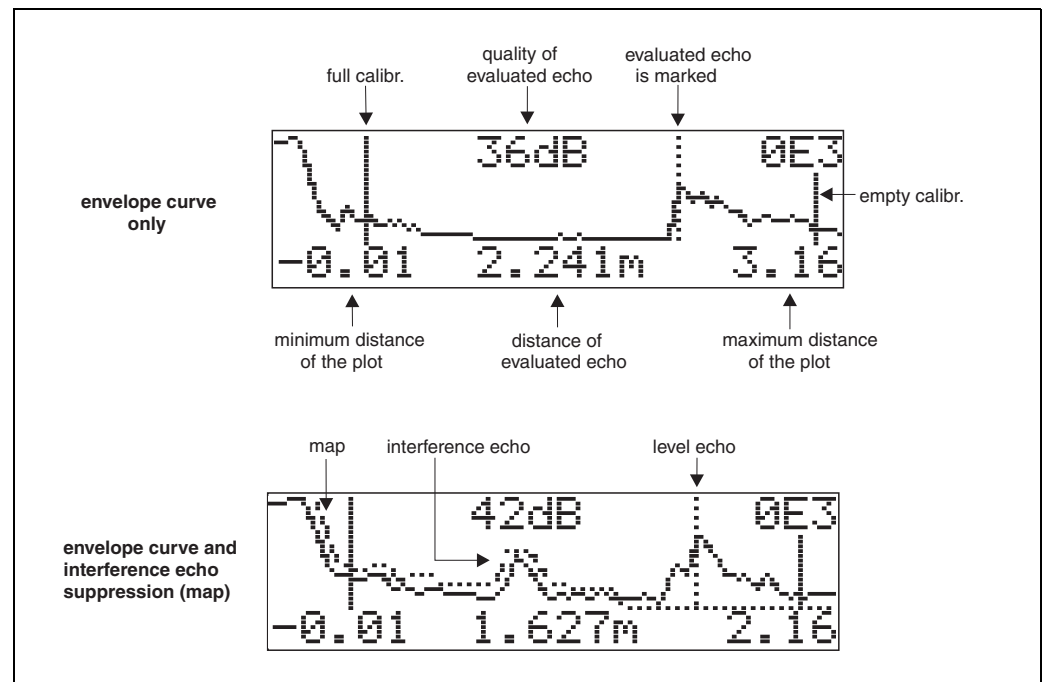
Navigating in the envelope curve display
Using navigation, the envelope curve can be scaled horizontally and vertically and shifted to the left or the right. The active navigation mode is indicated by a symbol in the top left hand corner of the display.
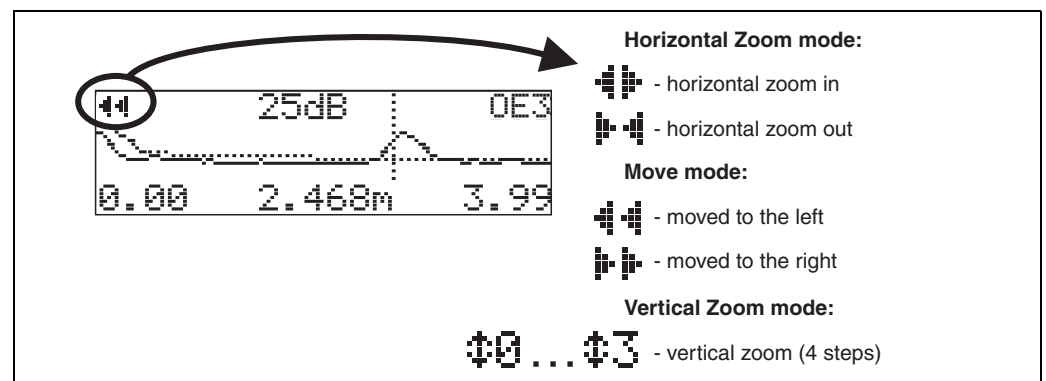
Horizontal Zoom mode
Firstly, go into the envelope curve display. Then press ⊞ or ⊟ to switch to the envelope curve navigation. You are then in Horizontal Zoom mode. Either ◄╟► or ╟►◄ is displayed.
You now have the following options:
- ⊞ increases the horizontal scale.
- ⊟ reduces the horizontal scale.
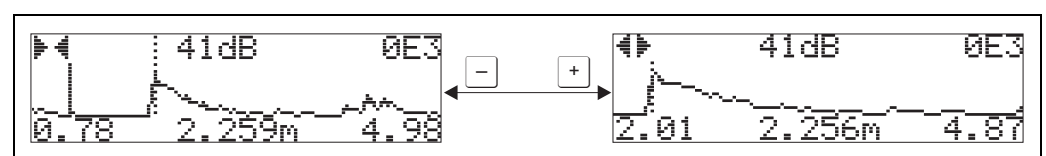
Move mode

Then press $\boxed{\text{E}}$ to switch to Move mode. Either ▐▐ or ◀◀ is displayed.

You now have the following options:

- $\boxed{+}$ shifts the curve to the right.
- $\boxed{-}$ shifts the curve to the left.

```
┌──────────────────────┐         ┌──────────────────────┐
│◀◀    41dB      0E3│         │▐▐    41dB      0E3│
│                      │ ◀─┐ ┌─▶ │                      │
│1.96   2.258m   6.83│  └─┘     │0.78   2.259m   5.65│
└──────────────────────┘         └──────────────────────┘
```
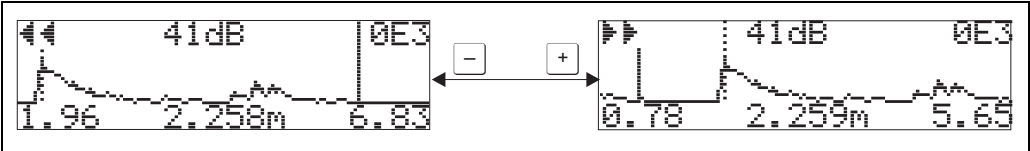
Vertical Zoom mode

Press $\boxed{\text{E}}$ once more to switch to Vertical Zoom mode. ↕1 is displayed.

You now have the following options:

- $\boxed{+}$ increases the vertical scale.
- $\boxed{-}$ reduces the vertical scale.

The display icon shows the current zoom factor (↕0 to ↕3).

```
┌──────────────────────┐         ┌──────────────────────┐
│↕0    40dB      0E3│         │↕3    41dB      0E3│
│                      │ ◀─┐ ┌─▶ │                      │
│1.17   2.259m   6.05│  └─┘     │1.17   2.259m   6.05│
└──────────────────────┘         └──────────────────────┘
```
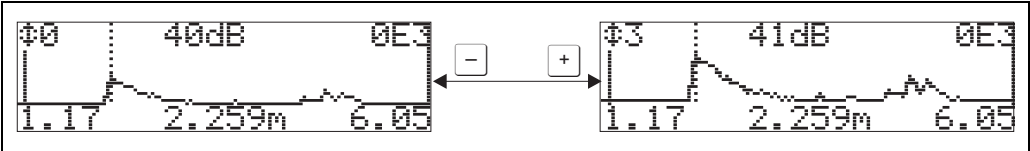
Exiting the navigation

- Press $\boxed{\text{E}}$ again to run through the different modes of the envelope curve navigation.
- Press $\boxed{+}$ and $\boxed{-}$ to exit the navigation. The set increases and shifts are retained. Only when you reactivate the **"recording curve" (0E2)** function does the Micropilot use the standard display again.

```
┌──────────────────────────┐
│       Return to          │
│   Group Selection        │
│                          │
└──────────────────────────┘
```

After 3 s, the following message appears
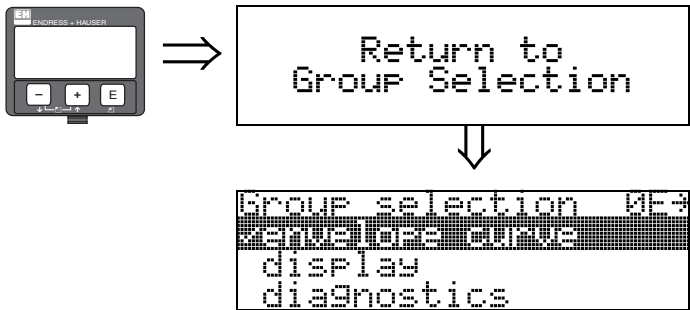
```
┌──────────────────────────┐
│Group selection    0E→│
│envelope curve            │
│ display                  │
│ diagnostics              │
└──────────────────────────┘
```

9   Function group "display" (09)

```
Group selection   09┤
☑display
  diagnostics
  system parameters
```
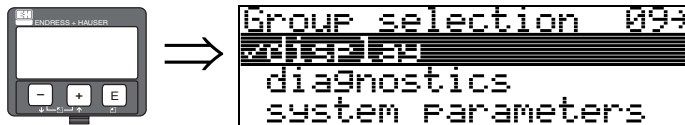
9.1   Function "language" (092)

```
language           092
☑English
  Deutsch
  Français
```

Selects the display language.

Selection:
- English
- Deutsch
- Français
- Español
- Italiano
- Nederlands
- ｺﾞﾄ (Katakana, Japanese)

  Note!
  When using tools on operating systems without Japanese language support "????." will be displayed only.

Dependence
All texts will be changed.

Caution!
This function is not visualised in Commuwin II!

9.2   Function "back to home" (093)

```
back to home       093
▇▇▇▇▇▇▇▇900 s
```

If no entry is made using the display during the specified time period, the display returns to the measured value display.
9999 s means that there is no return.

User input:
3...9999 s

Caution!
This function is not visualised in Commuwin II!

9.3   Function "format display" (094)

```
format display    094
decimal
 ft-in-1/16''
```

Selects the display format.

Selection:
- **decimal**
- ft-in-1/16"

decimal
The measured value is given in decimal form in the display (e.g. 10.70%).

ft-in-1/16"
The measured value is displayed in the following format (e.g 5'05-14/16").
This option is only possible for "**distance unit**" **(0C5)** – "**ft**" and "**in**"!

Caution!
This function is not visualised in Commuwin II!

9.4   Function "no.of decimals" (095)

```
no.of decimals    095
x.xx
 x.xxx
 x
```
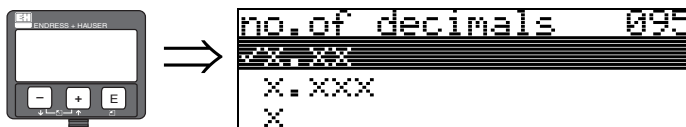
Selection:
- x
- x.x
- **x.xx**
- x.xxx

9.5   Function "sep. character" (096)

```
sep. character    096
.
 ,
```

Selection:
- **.**
- ,

.
The decimal place is separated by a point.

,
The decimal place is separated by a comma.

9.6   Function "display test" (097)

```
display test      097
off
 on
```

All display pixels are switched on. If the whole LCD is dark, it is working correctly.

Caution!
This function can be performed on the display only!

```
      Return to
   Group Selection
```

After 3 s, the following message appears

```
Group selection  09
display
 diagnostics
 system parameters
```

10   Function group "diagnostics" (0A)

```
Group selection   0A→
▓diagnostics▓▓▓▓▓▓▓▓▓
  system parameters
  service
```
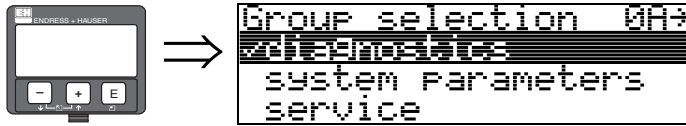
In the "**diagnostics**" function group, you can display and confirm error messages.

Type of error
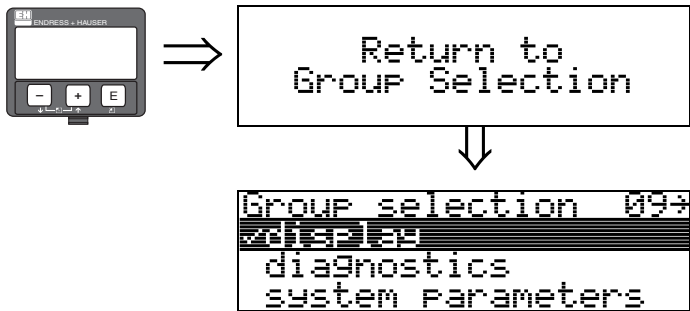Errors that occur during commissioning or measuring are displayed immediately on the local display. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:

- **A (Alarm):**
  Instrument goes into a defined state (e.g. MAX)
  Indicated by a constant ⌐ symbol.
  (For a description of the codes, see Table 14.2 on Page 77)
- **W (Warning):**
  Instrument continue measuring, error message is displayed.
  Indicated by a flashing ⌐ symbol.
  (For a description of the codes, see Table 14.2 on Page 77)
- **E (Alarm / Warning):**
  Configurable (e.g. loss of echo, level within the safety distance)
  Indicated by a constant/flashing ⌐ symbol.
  (For a description of the codes, see Table 14.2 on Page 77)

Error messages
Error messages appear as four lines of plain text on the display. In addition, a unique error code is also output. A description of the error codes is given on Page 77.

- The "**diagnostics (0A)**" function group can display current errors as well as the last errors that occurred.
- If several current errors occur, use ⊞ or ⊟ to page through the error messages.
- The last occurring error can be deleted in the "**diagnostics (0A)**" function group
  with the funktion"**clear last error**" **(0A2).**

10.1   Function "present error" (0A0)

```
present error    0A0
linearisation ch1
not complete,
not usable        A671
```

The present error is shown using this function.
If several current errors occur, use ⊞ or ⊟ to page through the error messages.

10.2   Function "previous error" (0A1)

```
previous error   0A1
simulation ch. 1
on
                 W621
```

The last error presented is shown with this function.
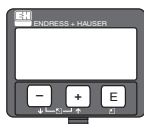
10.3   Function "clear last error" (0A2)

```
clear last error 0A2
keep
 erase
```

Selection:
▪ **keep**
▪ erase

10.4   Function "reset" (0A3)

Caution!
A reset sets the instrument back to the factory settings. This can lead to an impairment of the measurement. Generally, you should perform a basic setup again following a reset.

A reset is only necessary:
- if the instrument no longer functions
- if the instrument must be moved from one measuring point to another
- if the instrument is being de-installed /put into storage/installed
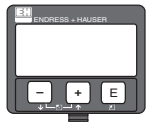
```
reset                0A3
▓▓▓▓▓▓▓▓▓0
for reset code
see manual
```

Entry ("reset" (0A3)):
- 333 = customer parameters (HART)
- 33333 = customer parameters (PROFIBUS PA and FOUNDATION Fieldbus)

333 = reset customer parameters for HART
33333 = reset customer parameters for PROFIBUS PA and FOUNDATION Fieldbus
This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application:
- The Micropilot is reset to the default values.
- The customer specific tank map is not deleted.
- A linearisation is switched to "**linear**" although the table values are retained. The table can be reactivated in the "**linearisation**" **(04)** function group.

List of functions that are affected by a reset:

- tank shape (002)
- empty calibr. (005)
- full calibr. (006)
- pipe diameter (007)
- output on alarm (010)
- output on alarm (011)
- outp. echo loss (012)
- ramp %span/min (013)
- delay time (014)
- safety distance (015)
- in safety dist. (016)
- level/ullage (040)
- linearisation (041)
- customer unit (042)

- diameter vessel (047)
- range of mapping (052)
- pres. Map dist (054)
- offset (057)
- low output limit (062)
- fixed current (063)
- fixed cur. value (064)
- simulation (065)
- simulation value (066)
- 4mA value (068)
- 20mA value (069)
- format display (094)
- distance unit (0C5)
- download mode (0C8)

The tank map can also be reset in the "**cust. tank map**" **(055)** function of the "**extended calibr.**" **(05)** function group.

This reset is recommended whenever an instrument with an unknown 'history' is to be used in an application or if a faulty mapping was started:
- The tank map is deleted. The mapping must be recommenced.

10.5   Function "unlock parameter" (0A4)

```
unlock parameter 0A4
🔒 Hardware locked
```

Set-up can be locked and unlocked with this function.

10.5.1   Locking of the configuration mode

The Micropilot can be protected in two ways against unauthorised changing of instrument data, numerical values or factory settings:

"unlock parameter" (0A4):
A value **<> 100 for HART** (e.g. 99) or **<> 2457 for PROFIBUS PA and FOUNDATION Fieldbus** (e.g. 2456) must be entered in "**unlock parameter**" **(0A4)** in the "**diagnostics**" **(0A)** function group. The lock is shown on the display by the 🔒 symbol and can be released again either via the display or by communication.

Hardware lock:
The instrument is locked by pressing the ⊕ and ⊖ and Ⓔ keys at the same time.
The lock is shown on the display by the 🔒 symbol and can **only** be unlocked again via the display by pressing the ⊕ and ⊖ and Ⓔ keys at the same time again. It is **not** possible to unlock the hardware by communication.
All parameters can de displayed even if the instrument is locked.

```
measured value    000
   63.460 %
▮▮▮▮▮▮▮▯▯▯▯
```

⊕ and ⊖ and Ⓔ press simultaneous

```
unlock parameter 0A4
🔒 Hardware locked
```

```
measured value    000
🔒
   63.480 %
▮▮▮▮▮▮▮▯▯▯▯
```

The LOCK_SYMBOL appears on the LCD.

10.5.2   Unlocking of configuration mode

If an attempt is made to change parameters when the instrument is locked, the user is automatically requested to unlock the instrument:

"**unlock parameter**" **(0A4):**
By entering the unlock parameter (on the display or via communication)

    100 = for HART devices
    2457 = for PROFIBUS PA and FOUNDATION Fieldbus devices

the Micropilot is released for operation.

Hardware-Verriegelung:
After pressing the ⊞ and ⊟ and Ⓔ keys at the same time, the user is asked to enter the unlock parameter

    100 = for HART devices
    2457 = for PROFIBUS PA and FOUNDATION Fieldbus devices.

⊞ and ⊟ and Ⓔ press simultaneous

Please enter unlock code and confirm with Ⓔ.
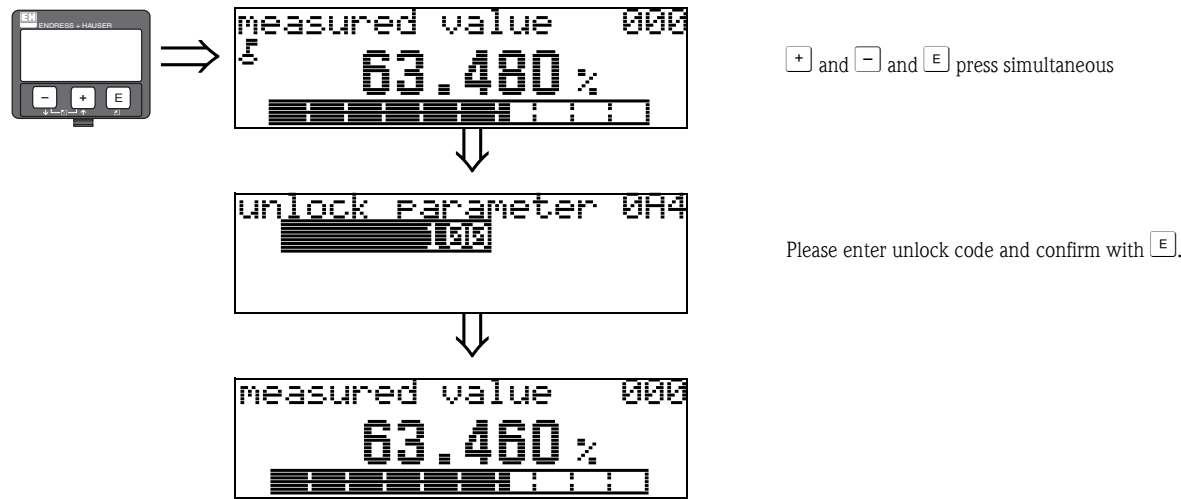
☝ Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy. There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the E+H service organization. Please contact Endress+Hauser if you have any questions.

10.6   Function "measured dist." (0A5)
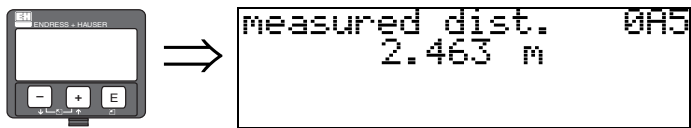
Display of measured distance in the selected "**distance unit**" **(0C5)**.

10.7   Function "measured level" (0A6)

```
measured level    0A6
        2.541  m
```

Display of measured level in the selected "**distance unit**" (**0C5**).
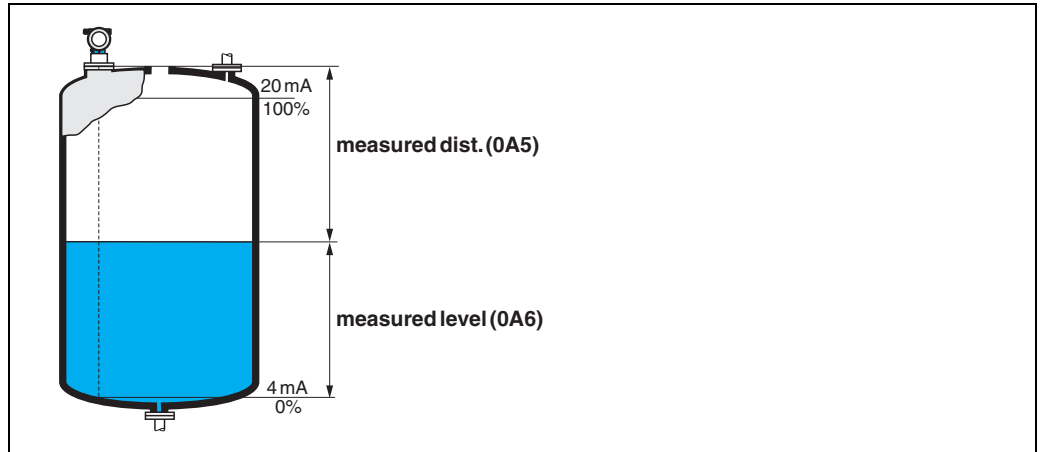
10.8   Function "detection window" (0A7)
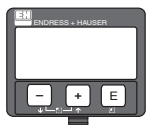
```
detection window 0A7
✓off
 on
 reset
```

Is used to switch the detection window on and off and to reset an existing detection window.
If this function is switched on, a window is defined surrounding the current level echo (typical
width: 1 to 2.5 m; depending on the application parameters).
The window always moves togehter with a rising a falling echo.
Echos beyond the limits of the window are ignored for a certain time.

Selection:
- **off**
- on
- reset
  After selection of this option, the current window is reset, the level echo is looked for in the
  complete measuring range and a new window is defined surrounding the current level echo.

10.9   Function "application par." (0A8)

```
application par. 0A8
✓not modified
 modified
```
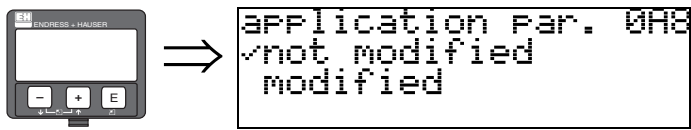
Displays whether or not one of the settings dependent on the "**tank shape**" **(002)**,
"**medium property**" **(003)** and "**process cond.**" **(004)** application parameters has been changed.
If, for example, the "**output damping**" **(058)** is changed, the
"**application par.**" shows "**modified**".

Selection:
- **not modified**
- modified

```
     Return to
  Group Selection
```

After 3 s, the following message appears

```
Group selection  0A→
✓diagnostics
 system parameters
 service
```
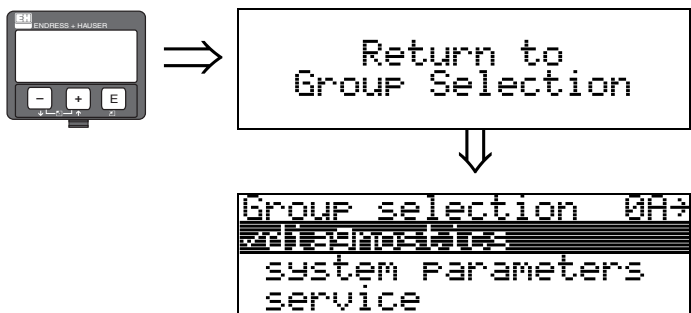
11   Function group "system parameters" (0C)


```
Group selection  0C→
▓System parameters
  service
  basic setup
```

11.1   Function "tag no." (0C0)


```
tag no.          0C0
▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓
```

You can define the tag number with this function.

User input:
- 16 alphanumeric characters for HART instruments (8 using the HART universal command)
- 32 alphanumeric characteristics for PROFIBUS PA instruments

11.2   Function "device tag" (0C0), FOUNDATION Fieldbus only

This function displays the tag number.

11.3   Function "Profile Version" (0C1), PROFIBUS PA only


```
Profile Version  0C1
        3.0
```
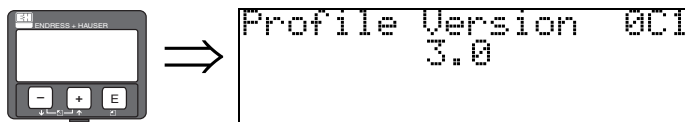
The PA Profile version is shown using this function (Profile 3.0).

Caution!
This function is available for PROFIBUS PA devices only!

11.4   Function "protocol+sw-no." (0C2)


```
Protocol+sw-no.  0C2
   V01.01.00 HART
```

This function shows the protocol and the hardware and software version: Vxx.yy.zz.prot.

Display:
xx: hw-version
yy: sw-version
zz: sw-revision
prot: protocoll type (e.g. HART)

11.5   Function "serial no." (0C4)

```
serial no.          0C4
┌ YMLNR 0IID ▓▓▓▓▓▓▓▓▓
```

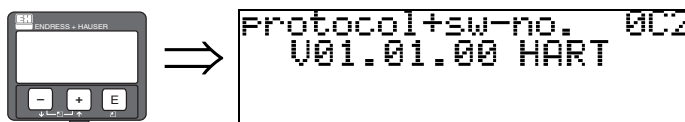This function displays the instrument serial number.

11.6   Function "device id" (0C4), FOUNDATION Fieldbus only

This function displays the instrument serial number.

11.7   Function "distance unit" (0C5)

```
distance unit       0C5
▓m
 ft
 mm
```

You can select the basic distance unit with this function.

Selection:
- **m**
- ft
- mm
- inch

Dependence
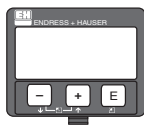m, mm: "**format display**" **(094)** can only be "**decimal**".

The units are changed for the following parameters:
- empty calibr. (005)
- full calibr. (006)
- pipe diameter (007)
- safety distance (015)
- input level (044)
- diameter vessel (047)
- range of mapping (052)
- cust. tank map (055)
- offset (057)
- simulation value (066)
- measured dist. (0A5)
- measured level (0A6)
- antenna extens. (0C9)

11.8   Function "download mode" (0C8)

```
download mode      0C8
▓parameter only▓▓▓▓▓
 param+cust.map
 mapping only
```

This parameter defines which values are written to the instrument during a ToF Tool or Commuwinn II configuration download.
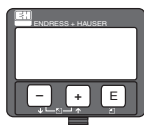
Selection:
- **parameter only**
- param+cust.map
- mapping only

✎ Note!
This parameter must not be set explicitly in ToF Tool. The various possibilities can be selected from the download dialog.

11.9   Function "antenna extens." (0C9)

```
antenna extens.   0C9
▓▓▓▓▓0.000▓ m
length FAR10 –
for FMR230 only
```

With this function, the length of the antenna extension FAR10 can be entered (FMR230 only). The influence of slower speed of propagation of the microwaves within the FAR10 is corrected automatically.

✎ Note!
This function can only be edited in the "**extended calibr.**" **(05)** function group
(see Chap. 6.9 on Page 42).
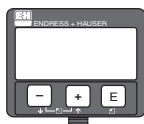
```
      Return to
   Group Selection
```

⇓

```
Group selection   0C→
▓system parameters▓▓
 service
 basic setup
```

12 Function group "service" (0D)

You can find a detailed description of the "Service" function group as well as a detailed overview of the function menu in the Service Manual: SM 07F for Micropilot M.

12.1 Software history

Micropilot M FMR230, FMR231

| Date	Software version	Changes to software	Documentation
12.2000	01.01.00	Original software. Operated via: – ToF Tool from version 1.5 – Commuwin II (from version 2.07–3) – HART communicator DXR275 (from OS 4.6) withRev. 1, DD 1.	BA221F/00/en/01.01 52006323
05.2002 03.2003	01.02.00 01.02.02	▪ Function group: envelope curve display ▪ Katakana (japanese) ▪ current turn down (HART only) ▪ the customer tank map can be edited ▪ length of antenna extension FAR10 can be entered directly Operated via: – ToF Tool from version 3.1 – Commuwin II (from version 2.08–1) – HART communicator DXR375 with Rev. 1, DD 1.	BA221F/00/en/03.03 52006323
01.2005	01.02.04	Function "echo lost" improved	
03.2006	01.04.00	▪ Function: detection windowg Operated via: – ToF Tool from version 4.2 – FieldCare from version 2.02.00 – HART–Communicator DXR375 with Rev. 1, DD 1.	BA221F/00/en/12.05 52006322

13 Envelope curve

13.0.1 Envelope curve with the ToF Tool

Signal analysis via envelope curve
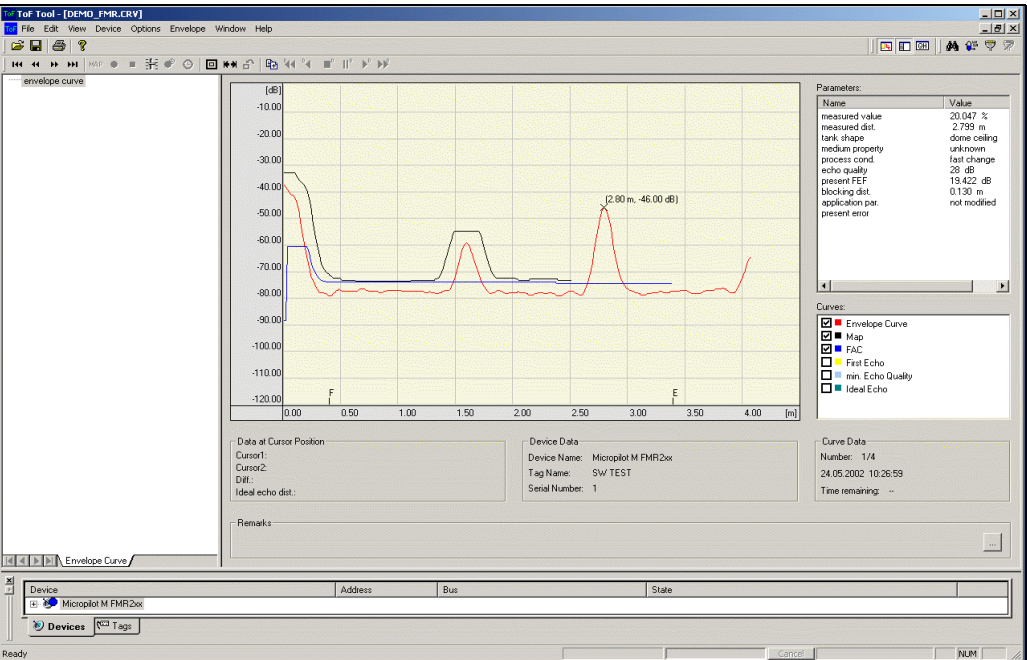
See page 54 ff. for the envelope curve in the local display.

13.0.2   Tank mapping

Generation of an envelope curve

Depending on the distance, the electromagnetic wave with a frequency of approx. 6 GHz requires a time-of-flight between 1 ns and 270 ns. The reflected signal is expanded by means of a sampling process to approximately 0.3 ms to 20 ms.

The sampling factor for 6 GHz is 81920; it is 163 840 for 26 GHz. The resulting carrier frequency is approx. 70 kHz, and 140 kHz at 26 GHz, respectively.

The envelope curve generated such is then demodulated, processed to a logarithmic scale, amplified and finally digitalized and evaluated by a microprocessor.

In chronological order, an envelope curve consistes of the sending pulse, the electrical reverberation and one or more echoes.

The maximum measuring time depends on the maximum measuring distance. Afterwards, the next cycle starts with the sending pulse.

The envelope curve can be viewed on the local display. In order to do that, the function 09C must be selected in the operation menu. The display can be configured in function 09A and 09B. In addition, a laptop computer or PC in combination

with the E+H software "ToF Tool" and an interface adapter can be used for display and evaluation of an evelope curve. (see BA 224F – Operating Instructions for ToF Tool).
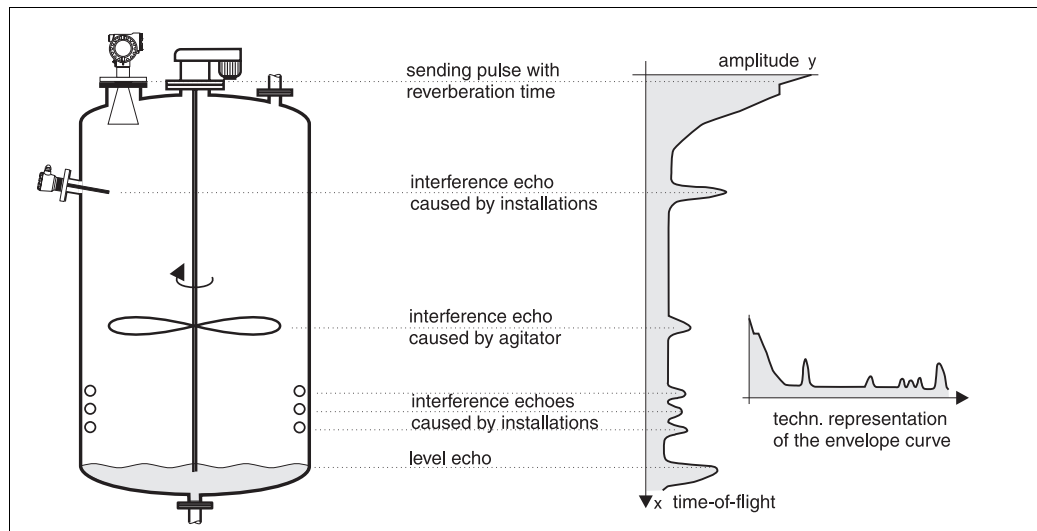

Fig. 4:   Example of a tank with a schematic envelope curve

Tank mapping

It may be required to map interference reflections inside the tank. This map is preferrably done with an empty tank. This way, all eventual interference reflections caused by installations in the tank are detected and stored in memory.

Only significant echoes will then exceed the tank map and be evaluated.

The mapping can also be performed up to the level or a defined distance, even if the tank is not empty. However, if the level drops below the mapping distance, additional reflections can interfere with the measurement.
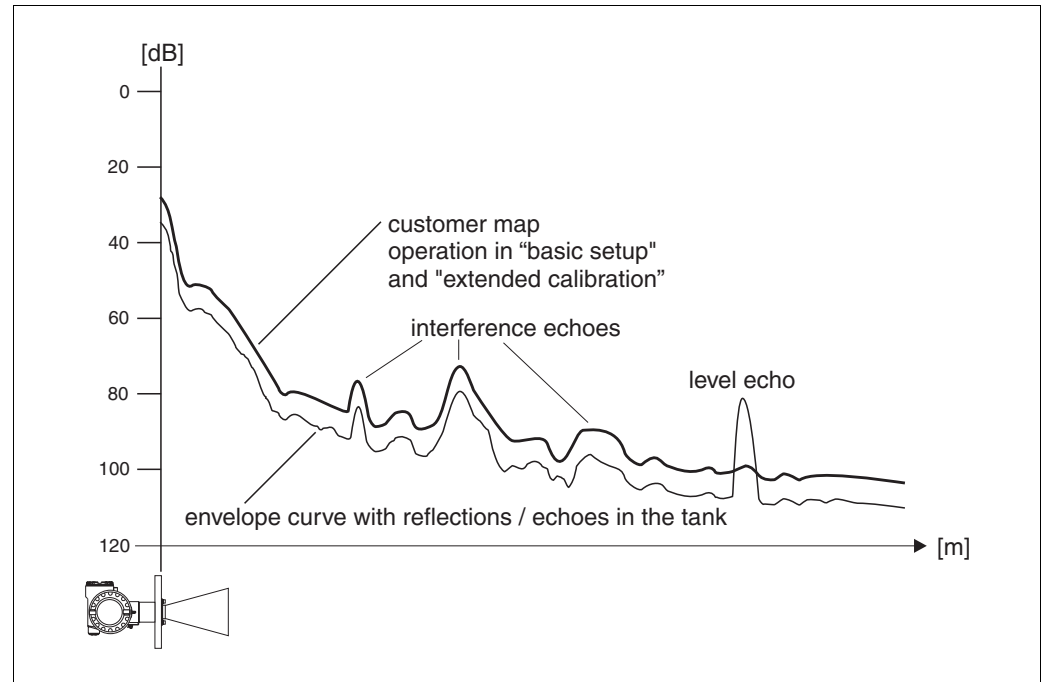
The FAC (Floating Average Curve)
The FAC is similar to the tank map, but automatically adapts itself to changing interference echoes in the tank, i.e. caused by buildup and turbulences. The FAC only covers small interference reflections, all signals below this curve are ignored.
The echo signal with the greatest distance to the FAC will be evaluated.
The FAC is not only recorded once, but newly calculated with every envelope curve. Thus, it continuously adapts itself to the conditions in the tank.
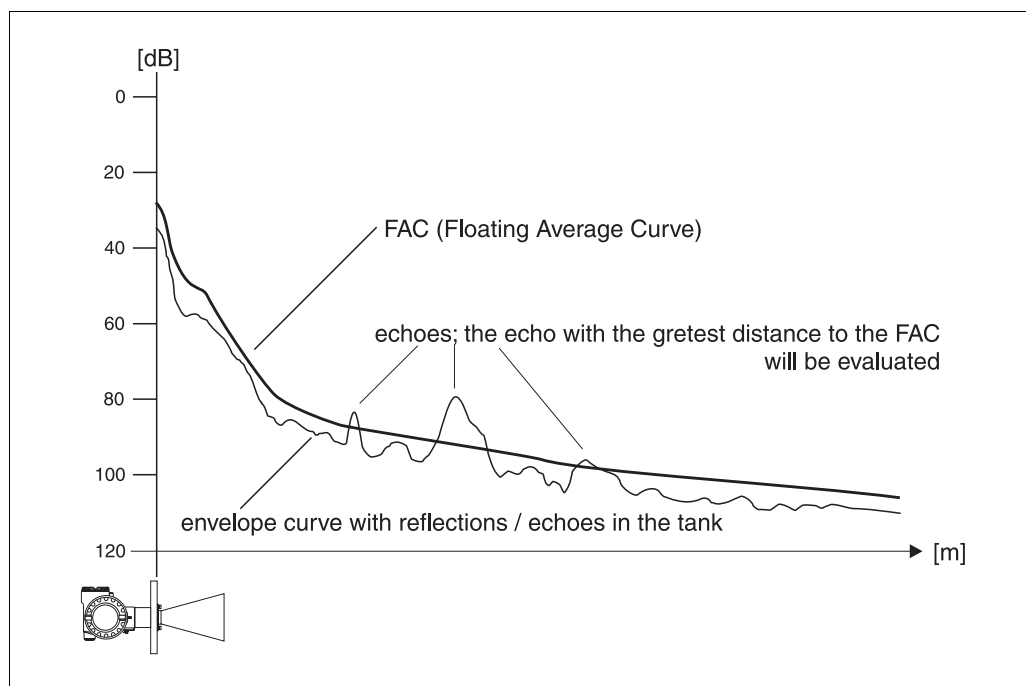
14   Trouble-shooting

If you have followed the instructions in this operating manual, the Micropilot should work correctly.
If this is not the case, Micropilot has facilities for analysing and correcting errors.
You can find a structured approach for locating errors on page 76 ff. or in the appropriate instrument operating manual.

14.1 Trouble-shooting instructions

Micropilot M FMR 2xx -Trouble Shooting

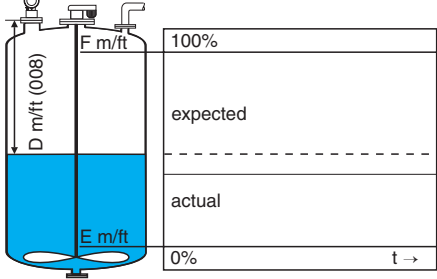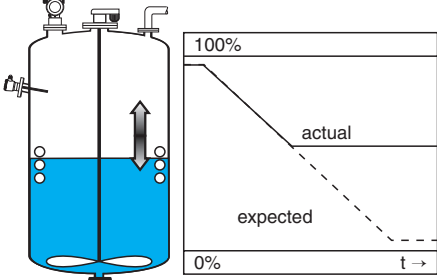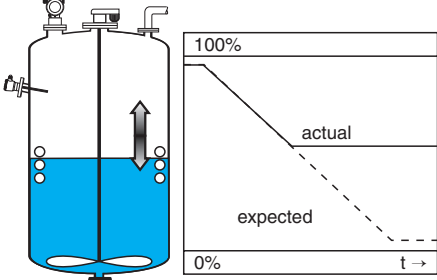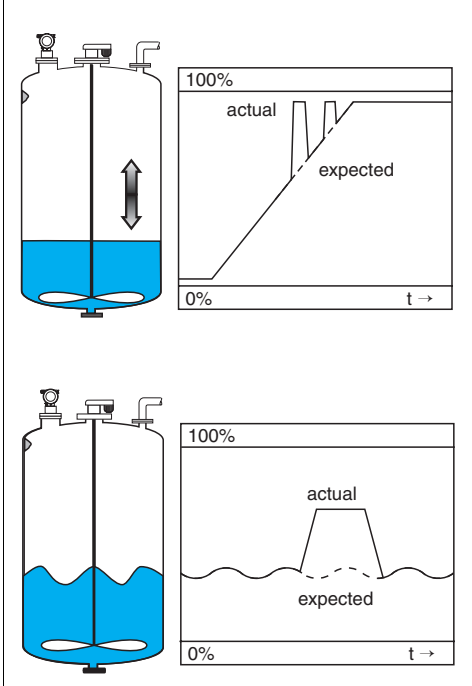|			
Instrument does not respond	Check voltage and compare it with the specifications on the nameplate.	Not ok → Connect the correct voltage → Instrument works?	Yes → Ready / No
	ok		
	Check the polarity of the voltage.	Not ok → Correct the polarity → Instrument works?	Yes → Ready / No
	ok		
	Check power connection to electronic board	Not ok → Connect plug → Instrument works?	Yes → Ready / No
	ok		
Values on display invisible	Yes → Contrast: E + +	ok → Ready	
No	Not ok		
	Check plug contact of the display.	Not ok → Connect the plug correctly → Display works?	Yes → Ready / No
	ok		
	Output current between 3.6 …22mA ?	Yes → The display is possibly defective. Contact E+H Service	
	No		
Output current < 3,6 mA ?	Yes → Check cabling	Not ok → Correct the cabling → Current is ok?	Yes → Ready / No
	ok		
	Possibly defective electronics Contact E+H Service		
HART communication does not function	Yes → Is the communication resistor installed according to the OM?	Not ok → Install the resistor (see the OM) → Communication ok?	Yes → Ready / No
	ok		
	Is the Commubox connected according to the OM?	Not ok → Connect the Commubox (see the OM) → Communication ok?	Yes → Ready / No
	ok		
	Is the switch on the Commubox for selecting HART/Intensor in the correct position?	Not ok → Set the switch correctly → Communication ok?	Yes → Ready / No
	ok → Contact E+H Service		
Communication PA does not function	Yes → Check cabling + terminator	Not ok → Correct cabling + terminator → Communication ok?	Yes → Ready / No
	ok		
	EMC interference?	Yes → Check screening (see OM Section 'Connection') → Communication ok?	Yes → Ready / No
	No → Contact E+H Service		
Communication via Service adapter does not function	Yes → Check configuration of COM port on PC	Not ok → Correct configuration → Communication ok?	Yes → Ready / No → Contact E+H Service
Instrument measures incorrectly	Yes → Check basic setup	Not ok → Repeat basic setup → Measurement ok?	Yes → Ready / No
	ok		
	Proceed according to section 'Trouble shooting' in OM		

14.2   System error messages

Code	Description	Possible cause	Remedy
A102	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
W103	initialising – please wait	E²PROM storage not yet finished	wait some seconds; if warning prevails, exchange electronics
A106	downloading please wait	processing data download	wait until warning disappears
A110	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A111	electronics defect	RAM defective	reset; if alarm prevails after reset, exchange electronics
A113	electronics defect	ROM defective	reset; if alarm prevails after reset, exchange electronics
A114	electronics defect	E2PROM defective	reset; if alarm prevails after reset, exchange electronics
A115	electronics defect	general hardware problem	reset; if alarm prevails after reset, exchange electronics
A116	download error repeat download	checksum of stored data not correct	restart download of data
A121	electronics defect	no factory calibration existant; E²PROM defective	contact service
W153	initialising – please wait	initialisation of electronics	wait some seconds; if warning prevails, power off device and power on again
A155	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A160	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E²PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
A164	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A171	electronics defect	hardware problem	reset; if alarm prevails after reset, exchange electronics
A231	sensor 1 defect check connection	HF module or electronics defective	exchange HF module or electronics
W511	no factory calibration ch1	factory calibration has been deleted	record new factory calibration
A512	recording of mapping please wait	mapping active	wait some seconds until alarm disappears
W601	linearisation ch1 curve not monotone	linearization not monotonously increasing	correct linearisation table
W611	less than 2 linearisation points for channel 1	number of entered linearization points < 2	correct linearisation table
W621	simulation ch. 1 on	simulation mode is active	switch off simulation mode

Code	Description	Possible cause	Remedy
E641	no usable echo channel 1 check calibr.	echo lost due to application conditions of built up on antenna	check installation; optimize orientation of antenna; clean antenna (cf. Operating Instructions)
E651	level in safety distance – risk of overspill	level in safety distance	alarm will disappear as soon as level leaves safety distance;
A671	linearisation ch1 not complete, not usable	linearisation table is in edit mode	activate linearisation table
W681	current ch1 out of range	current out of range (3,8 mA ... 21,5 mA)	check calibration and linearisation

14.3   Application errors

Error	Output	Possible cause		Remedy
A warning or alarm has occurred.	Depending on the configuration	See table of error messages (see page 77)		1. See table of error messages (see page 77)
Measured value (00) is incorrect		Measured distance (008) OK?	yes →	1. Check empty calibr. (005) and full calibr. (006). 2. Check linearisation: → level/ullage (040) → max. scale (046) → diameter vessel (047) → Check table
		no ↓		
		Measurement in bypass or stilling well?	yes →	1. Is bypass or stilling well selected in tank shape (002)? 2. Is the pipe diameter (007) correct?
		no ↓		
		Is an FAR10 antenna extension being used?	yes →	1. offset (057) correctly set? (see page 42)
		no ↓		
		An interference echo may have been evaluated.	yes →	1. Carry out tank mapping → basic setup
No change off measured value on filling/emptying		Interference echo from installations, nozzle or extension on the antenna		1. Carry out tank mapping → basic setup 2. If necessary, clean antenna 3. If necessary, select better mounting position 4. If necessary due to wide interference echos set function detection window (0A7) to "off"

Error	Output	Possible cause	Remedy
If the surface is not calm (e.g. filling, emptying, agitator running), the measured value jumps sporadically to a higher level		Signal is weakened by the rough surface — the interference echoes are sometimes stronger	1. Carry out tank mapping → basic setup 2. Set the process cond. (004) to "turb. surface" or "agitator" 3. Increase the output damping (058) 4. Optimise the orientation (see page 81) 5. If necessary, select a better mounting position and/or larger antenna
During filling/emptying the measured value jumps downwards		Multiple echoes yes →	1. Check the tank shape (002), e.g. "dome ceiling" or "horizontal cyl" 2. In the range of the blocking dist. (059) there is no echo evaluation → Adapt the value 3. If possible, do not select central installation position 4. Perhaps use a stilling well
E 641 (loss of echo)		Level echo is too weak. Possible causes: ■ Rough surface due to filling/ emptying ■ Agitator running ■ Foam yes →	1. Check application parameters (002), (003) and (004) 2. Optimise alignment (see page 81) 3. If necessary, select a better installation position and/or larger antenna
E 641 (loss of echo) after turn on the power supply	**If the instrument is configured to Hold by loss of echo the output is set to any value/current.**	noise level during the initialisation phase to high.	Repeat once more empty calibr. (005). Caution! Before conformation change with ⊞ or ⊟ to the edit mode.

14.4   Orientation of the Micropilot

⚠ **At mounting adjust the marking at the instrument flange!**

Installation in tank (free space):
Mark on process connector facing the nearest tank wall!

mark at instrument flange
or threaded boss

1½" BSPT (R 1½")
or 1½ NPT

DN150
ANSI 6"

DN200…250
ANSI 8…10"
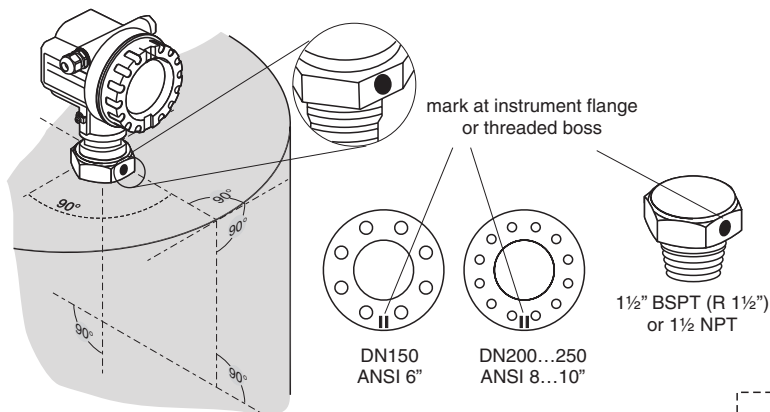
Installation in stilling well:
Mark on process connector pointed towards the slots or vent holes!

mark at instrument flange
or threaded boss

1½" BSPT (R 1½"),
G 1½" (FMR 244)
or 1½ NPT

DN50
ANSI 2"

DN80…150
ANSI 3…6"
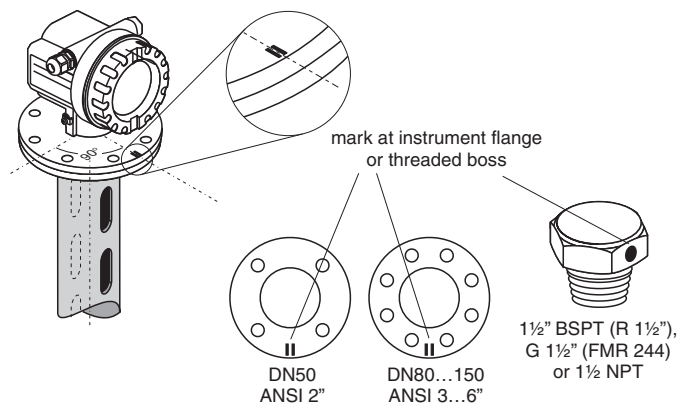
Installation in bypass:
Mark on process connector 90° offset from the tank connections!

mark at instrument flange

DN50
ANSI 2"

DN80…150
ANSI 3…6"
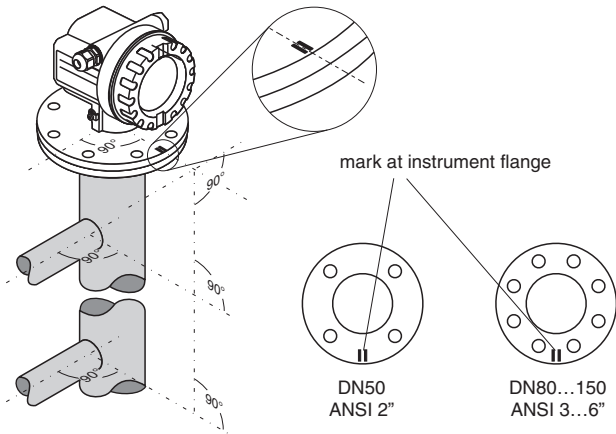
Turn housing
The housing can be turned 350° in order to simplify access to the display and the terminal compartment

F12/F23 housing

T12 housing

Allen key 4 mm / 0.1"
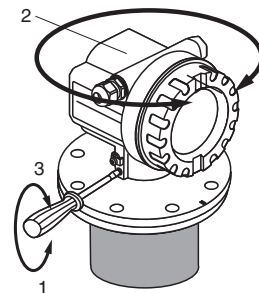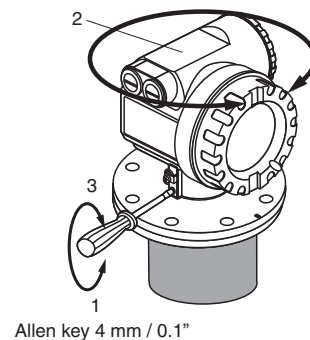
For orientation a marker is found on the flange or threaded boss of the Micropilot. During installation this must be oriented as follows (see page 81):

- In tanks: to the vessel wall
- In stilling wells: to the slots
- In bypass pipes: vertical to the tank connectors

After commissioning the Micropilot, the echo quality indicates whether a sufficiently large measuring signal is obtained. If necessary, the quality can be optimised later. Vice versa, the presence of an interference echo can be used to minimise this by optimum orientation. The advantage of this is that the subsequent tank mapping uses a somewhat lower level that causes an increase in the strength of the measuring signal.

Proceed as follows:

⚠ Warning!
Subsequent alignment can lead to personal injury. Before you unscrew or loosen the process connection, make sure that the vessel is not under pressure and does not contain any injurious substances.

1. It is best to empty the container so that the bottom is just covered. However, alignment can be carried out even if the vessel is empty.
2. Optimisation is best carried out with the aid of the envelope graph in the display or the ToF Tool.
3. Unscrew the flange or loosen the threaded boss by a half a turn.
4. Turn the flange by one hole or screw the threaded boss by one eighth of a turn. Note the echo quality.
5. Continue to turn until 360° is reached.
6. Optimum alignment:
   a) Vessel partly full, no interference echo obtained:

level echo: highest value

level echo
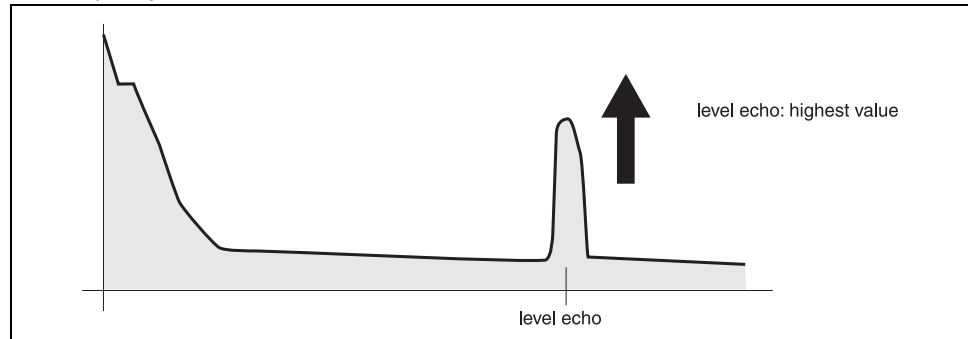
   b) Vessel partly full, interference echo obtained:

level echo: highest value
false echo: smallest value

false echo   level echo
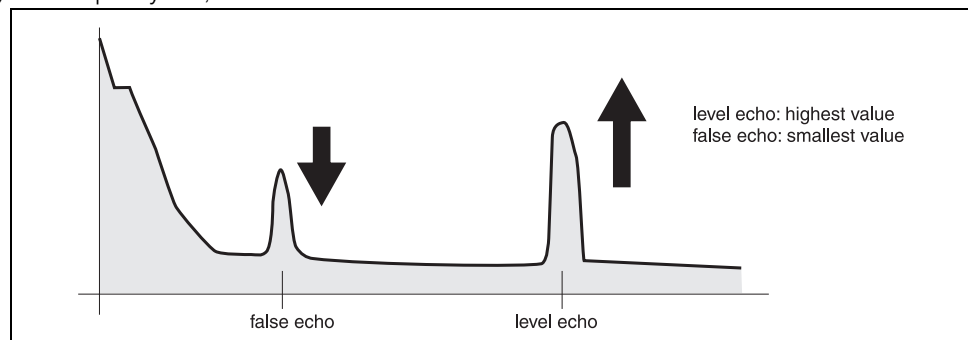
c) Vessel empty, no interference echo:

echo: highest value

echo tank bottom
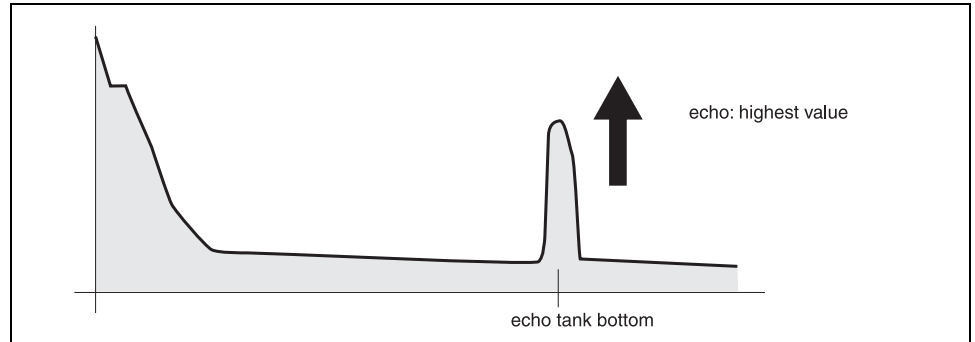
d) Vessel empty, interference echo obtained:

false echo: smallest value

false echo   echo tank bottom
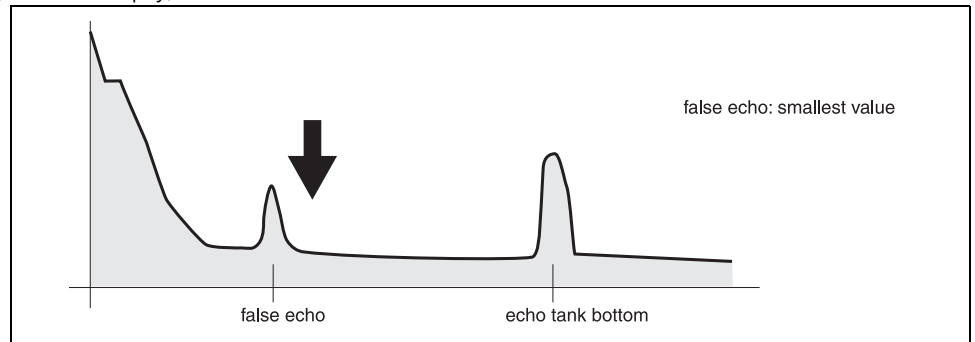
7. Fix the flange or threaded boss in this position.
    If necessary, replace the seal.
8. Carry out tank mapping, see page 19 ff.

Index function menu

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