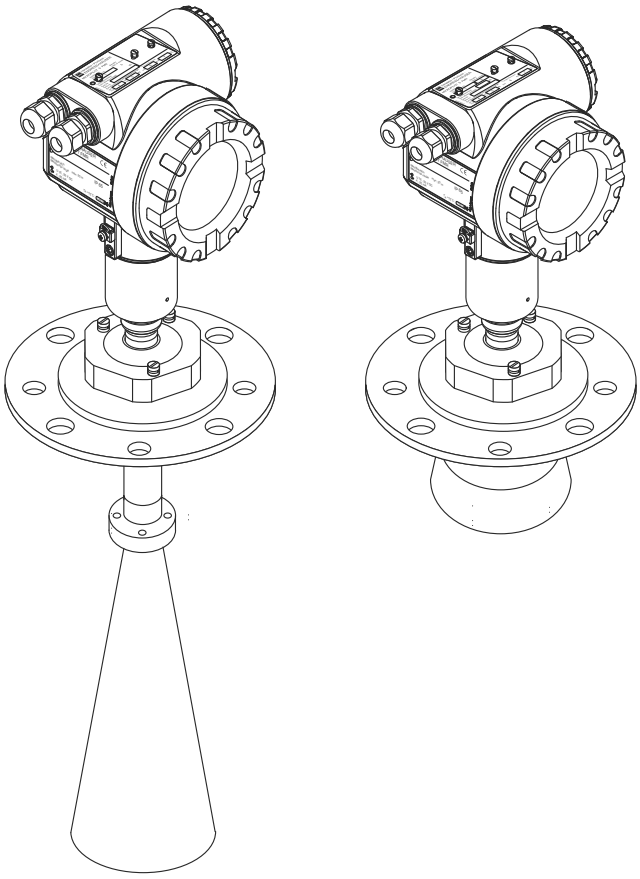
BA00341F/00/EN/14.14
71263405
Valid as of software version:
V 01.01.zz (amplifier)
V 01.01.zz (communication)

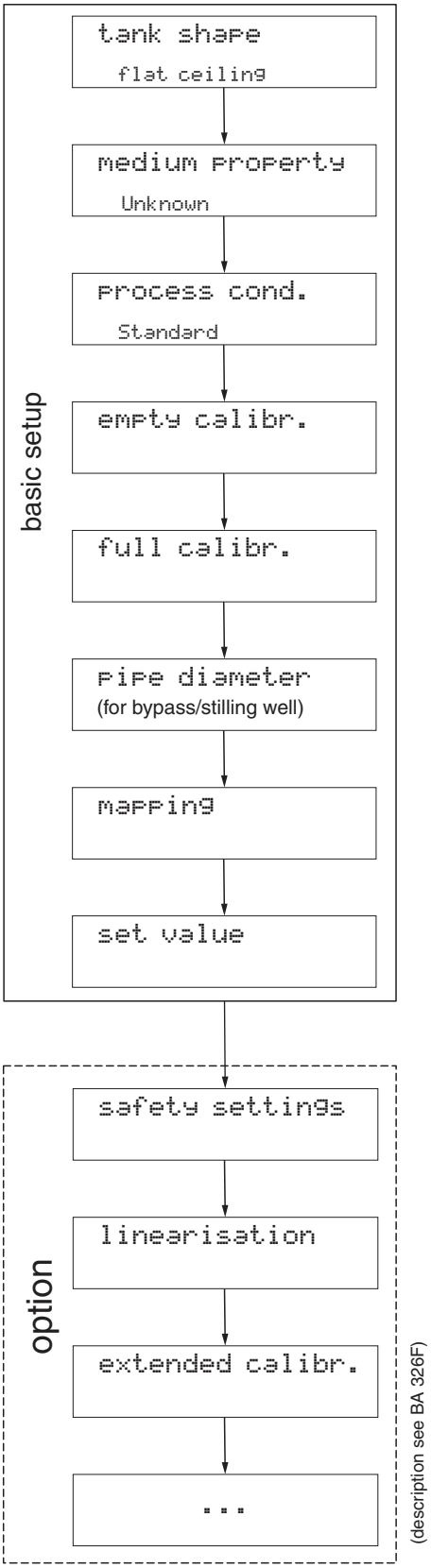
Description of Instrument Functions
Micropilot S FMR540
Level Radar

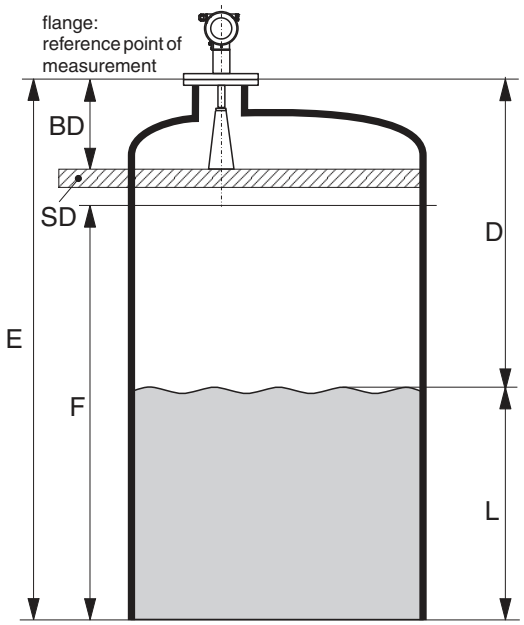
HART®
FIELD COMMUNICATION PROTOCOL



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
BD = blocking distance, setting in

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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 → 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 (→ 13). 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 (→ 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:

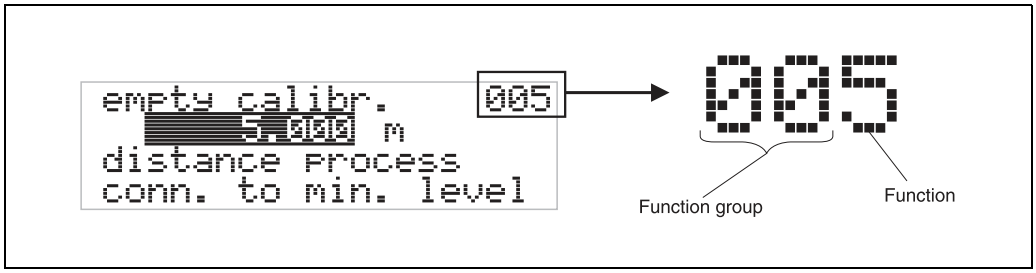
- **Function groups (00, 01, 03, …, 0C, 0D):**
  The individual operating Selection of the instrument are split up roughly into different function groups. The function groups that are available include, e.g.: "**basic setup**", "**safety settings**", "**output**", "**display**", etc.
- **Functions (001, 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 (→ 13), 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**

…

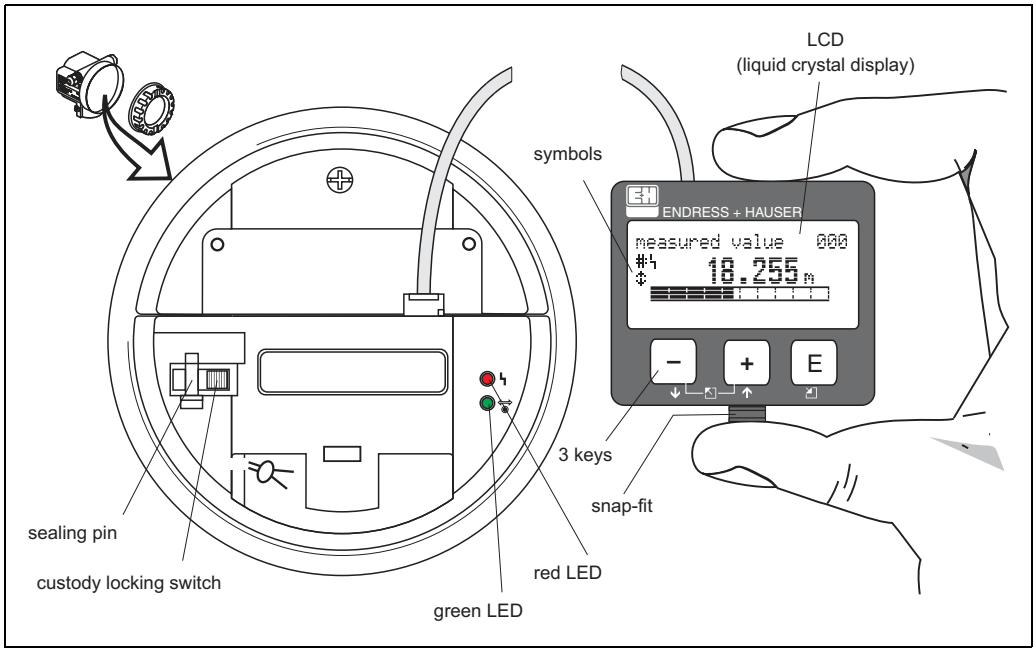
The third digit numbers the individual functions within the function group:

- **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



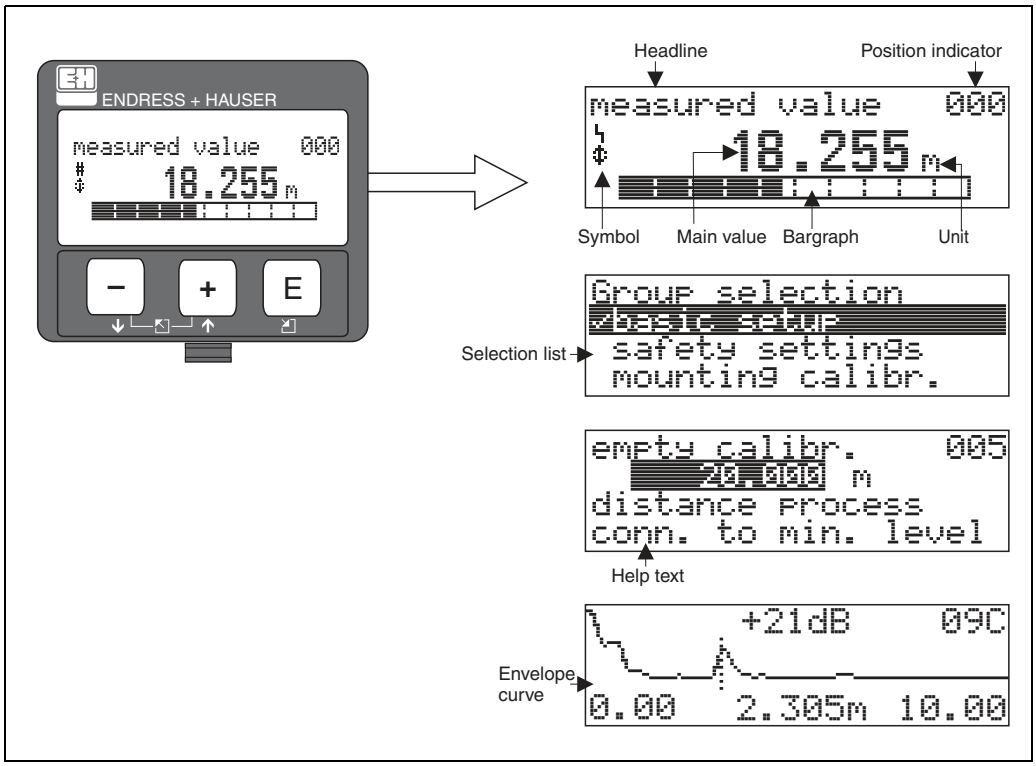
Note!

To access the display the cover of the electronic compartment may be removed even in hazardous area.

1.5.1 Display

Liquid crystal display (LCD):

Four lines with 20 characters each. Display contrast adjustable through key combination.



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 is in progress.
	**Calibration to regulatory standards disturbed** If the instrument is not locked or it cannot guarantee the calibration to regulatory standards, the situation will be indicated on the display via the symbol.

Light emitting diods (LEDs):

There is a green and a red LED besides the Liquid Crystal Display.

LED	Meaning
red LED continuously on	Alarm
red LED flashes	Warning
red LED off	No alarm
green LED continuously on	Operation
Green LED flashes	Communication with external device

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
[Esc] [−] [+] 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.

Custody locking switch

Access to the electronics can be prevented by means of a custody locking switch that locks the device settings. The custody locking switch can be sealed for custody transfer applications.

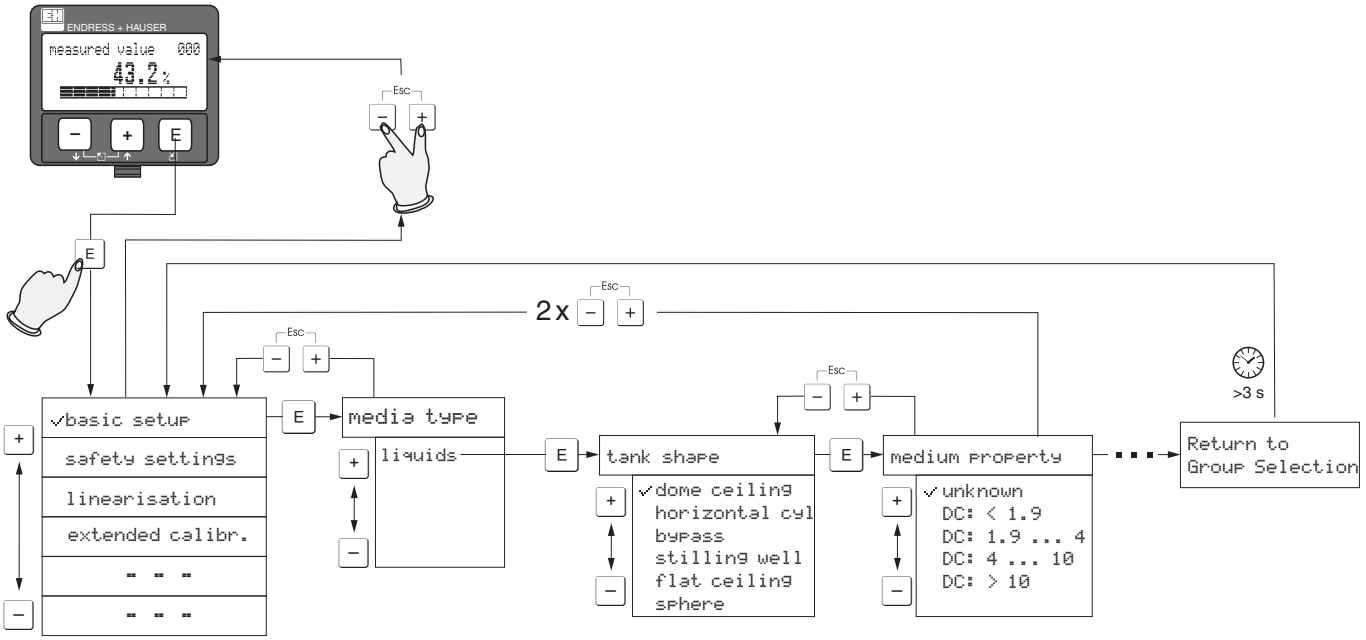
Software reliability

The software used in the radar instruments Micropilot S fulfills the requirements of OIML R85. This particularly includes:

- cyclical test of data consistency
- non-volatile memory
- segmented data storage

The radar instruments Micropilot S continuously monitor the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If the accuracy cannot be maintained, a specific alarm is generated on the local display and via the digital communication.

1.5.4 Operation with the VU331



Example - 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) + + − (= Esc) 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) + + − (= Esc) interrupts the input, system quits Edit mode

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

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

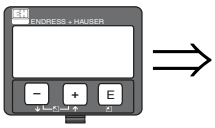
6) Press + + − (= Esc) to return to **Measured value display**

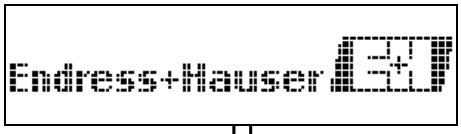
1 Selection and configuration in operation menu

1.6 Commissioning

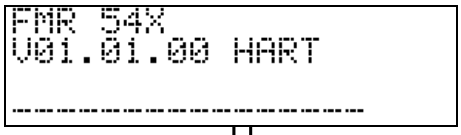
1.6.1 Switching on the measuring device

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

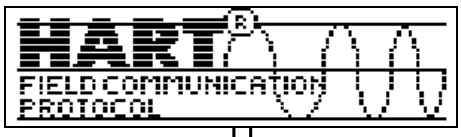




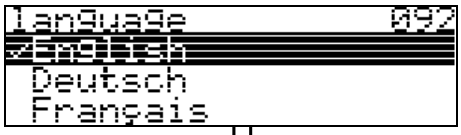
After 5 s, the following message appears



After 5 s, the following message appears



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



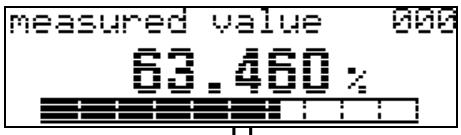
Select the language

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



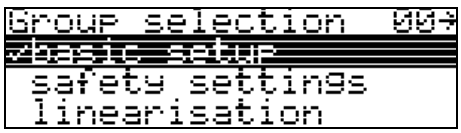
Select the basic unit

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



The current measured value is displayed

After E is pressed, you reach the group selection.



This selection enables you to perform the basic setup

2 Function menu Micropilot S

Basic Setup in liquids

Function group		Function		Description
basic setup (→ 16)	**00** ⇒	measured value	000 →	→ 16
⇓		tank shape	002 →	→ 16
		medium property	003 →	→ 17
		process cond.	004 →	→ 18
		empty calibr.	005 →	→ 19
		full calibr.	006 →	→ 20
		pipe diameter	007 →	→ 21
		check distance	051 →	→ 22
		range of mapping	052 →	→ 23
		start mapping	053 →	→ 23
		set value	009 →	→ 24

Further Functions

Function group		Function		Description
safety settings (→ 26)	**01** ⇒	output on alarm	010 →	→ 26
⇓		outp. echo loss	012 →	→ 28
		ramp %span/min	013 →	→ 29
		delay time	014 →	→ 29
		safety distance	015 →	→ 30
		in safety dist.	016 →	→ 31
		ackn. alarm	017 →	→ 32
		overspill prot.	018 →	→ 32
diptable (→ 35)	**03** ⇒	diptable state	030	→ 35
⇓		dip table mode	033 →	→ 35
		dip table	034 →	→ 38
		view handling	036 →	→ 39
		store point	037	→ 38
		add next point	038 →	→ 38
		delete handling	039 →	→ 40
linearisation (→ 41)	**04** ⇒	level/ullage	040 →	→ 41
⇓		linearisation	041 →	→ 42
		customer unit	042 →	→ 45
		table no.	043 →	→ 47
		input level	044 →	→ 47
		input volume	045 →	→ 48
		max. scale	046 →	→ 48
		diameter vessel	047 →	→ 48

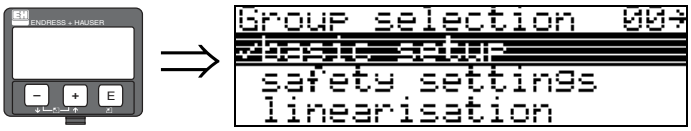
Further Functions

Function group		Function			Description
extended calibr.	**05**	selection	050	→	→ 49
(→ 49)		check distance	051	→	→ 49
⇓		range of mapping	052	→	→ 50
		start mapping	053	→	→ 50
		pres. map dist.	054	→	→ 51
		cust. tank map	055	→	→ 51
		echo quality	056	→	→ 52
		offset	057	→	→ 52
		antenna extens.	C9	→	→ 52
		output damping	058	→	→ 53
		blocking dist.	059	→	→ 53
output	**06**	commun. address	060	→	→ 54
(→ 54)		no. of preambels	061	→	→ 54
⇓		low output limit	062	→	→ 55
		curr.output mode	063	→	→ 55
		fixed cur. value	064	→	→ 56
		simulation	065	→	→ 56
		simulation value	066	→	→ 57
		output current	067	→	→ 56
		4mA value	068	→	→ 59
		20mA value	069	→	→ 59
envelope curve	**0E**	plot settings	0E1	→	→ 60
(→ 60)		recording curve	0E2	→	→ 60
⇓		envelope curve display	0E3	→	→ 61
display	**09**	language	092	→	→ 63
(→ 63)		back to home	093	→	→ 63
⇓		format display	094	→	→ 64
		no.of decimals	095	→	→ 64
		sep. character	096	→	→ 64
		display test	097	→	→ 65

Further Functions

Function group			Function			Description
diagnostics (→ 66)	**0A**	⇒	present error	0A0	→	→ 67
			previous error	0A1	→	→ 67
			clear last error	0A2	→	→ 67
			reset	0A3	→	→ 68
			unlock parameter	0A4	→	→ 70
			measured dist.	0A5	→	→ 71
			measured level	0A6	→	→ 72
			detection window	0A7		→ 72
			application par.	0A8	→	→ 73
system parameters (→ **74**)	**0C**	⇒	tag no.	0C0	→	→ 74
			protocol+sw-no.	0C2	→	→ 74
			software no.	0C2	→	→ 74
			serial no.	0C3	→	→ 74
			distance unit	0C5	→	→ 75
			download mode	0C8	→	→ 75
service (→ **76**)	**D00**	⇒	service level	D00		→ 76

3 Function group "basic setup" (00)

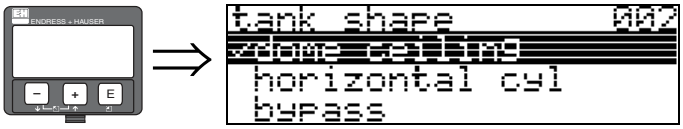


3.1 Function "measured value" (000)



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. The lenght of bargraph corresponds to the percentage value of the present measured value with regards to the span.

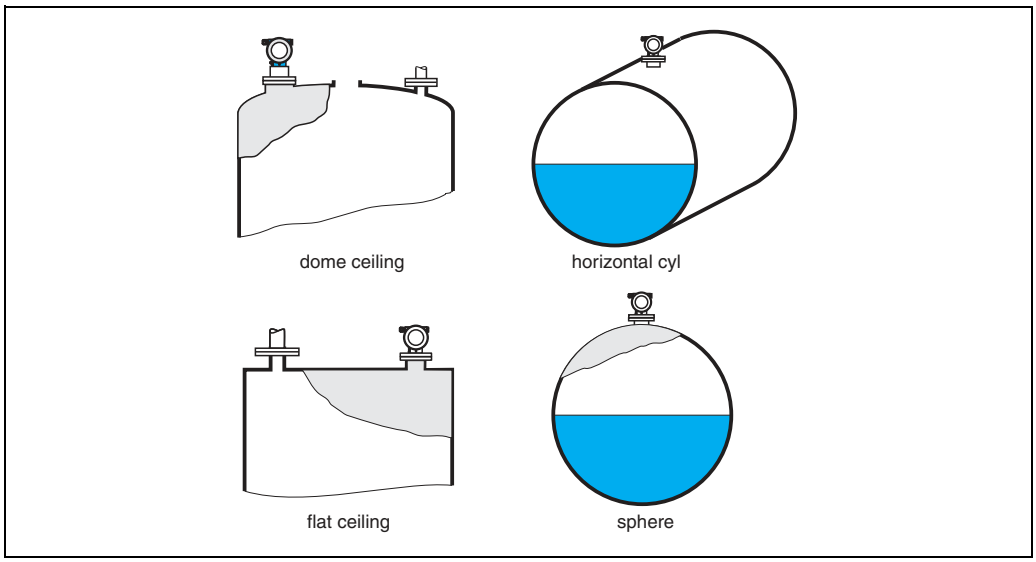
3.2 Function "tank shape" (002)



This function is used to select the tank shape.

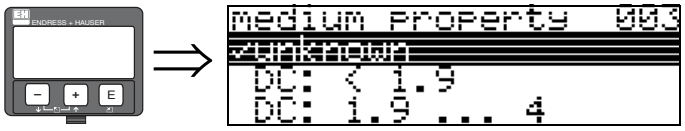
Selection:

- dome ceiling
- horizontal cyl
- bypass
- stilling well
- flat ceiling
- sphere



Note!
For the best measuring performance of FMR540. it is recommended to install the sensor to the free-space application. Use in bypass/stilling well is not recommended.

3.3 Function "medium property" (003)



This function is used to select the dielectric constant.

Note!
It is recommended that Micropilot S FMR540 is used in Application with calm surface for maximum measuring accuracy.

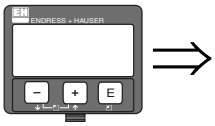
Selection:

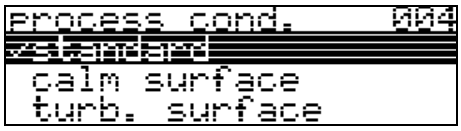
- **unknown**
- DC: < 1.9
- DC: 1.9 ... 4
- DC: 4 ... 10
- DC: > 10

Product class	DC (εr)	Examples
A	1,4 ... 1,9	non-conducting liquids, e.g. liquefied gas [1] For more information please contact your Endress+Hauser representative.
B	1,9 ... 4	non-conducting liquids, e.g. benzene, oil, toluene, white products, black products, crudes, bitumen, asphalts...
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

1) Treat Ammonia NH_3 as a medium of group A.

3.4 Function "process cond." (004)

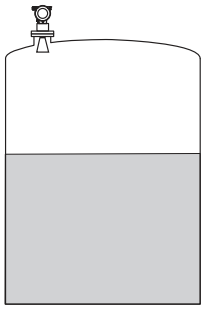
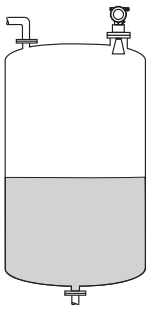




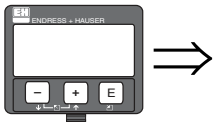
This function is used to select the process conditions.

Selection:

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

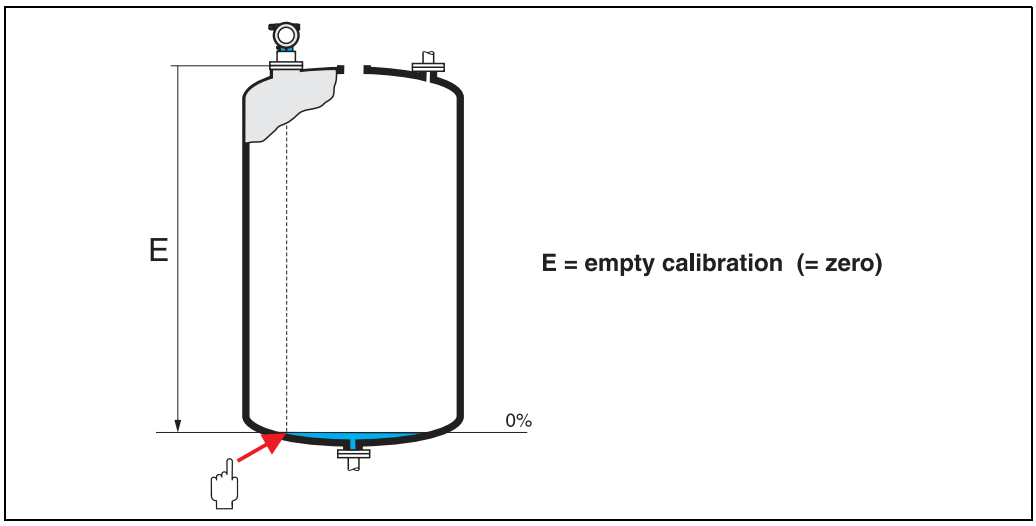
standard	**calm surface**
For all applications that do not fit into any of the following groups.	Storage tanks with immersion tube or bottom filling
	
The filter and output damping are set to average values.	The averaging filters and output damping are set to high values. -> steady meas. value -> precise measurement -> slower reaction time

3.5 Function "empty calibr." (005)



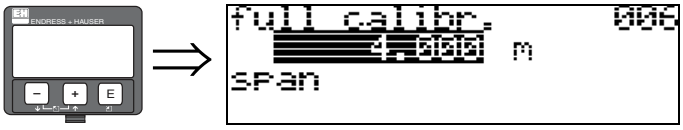


This function is used to enter the distance from the flange (reference point of the measurement) to the minimum level (=zero).

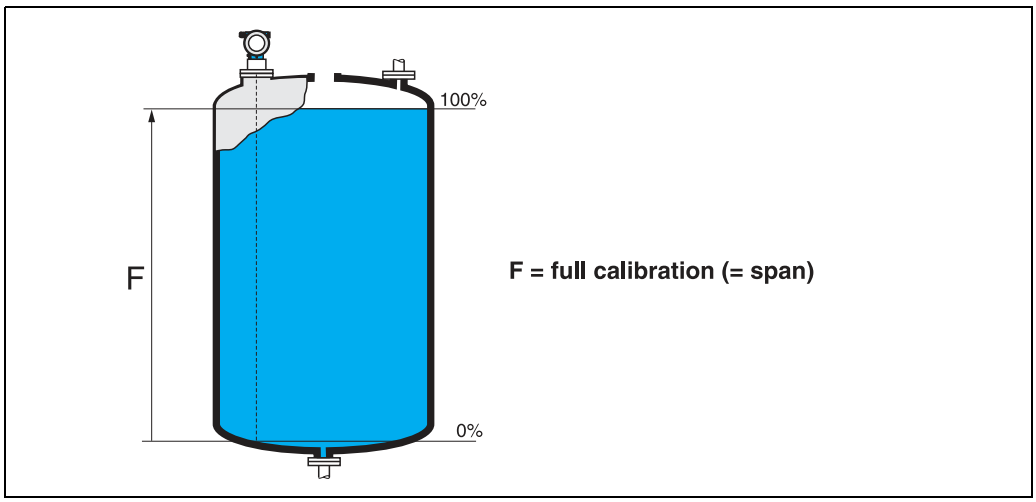


Caution!
For dish bottoms or conical outlets, the zero point should be no lower than the point at which the radar beam hits the bottom of the vessel.

3.6 Function "full calibr." (006)



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

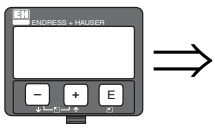


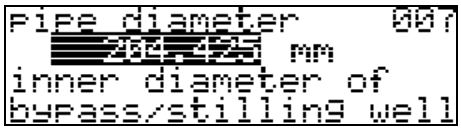
In principle, it is possible to measure up to the tip of the antenna. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than 50 mm (2") to the tip of the antenna.

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

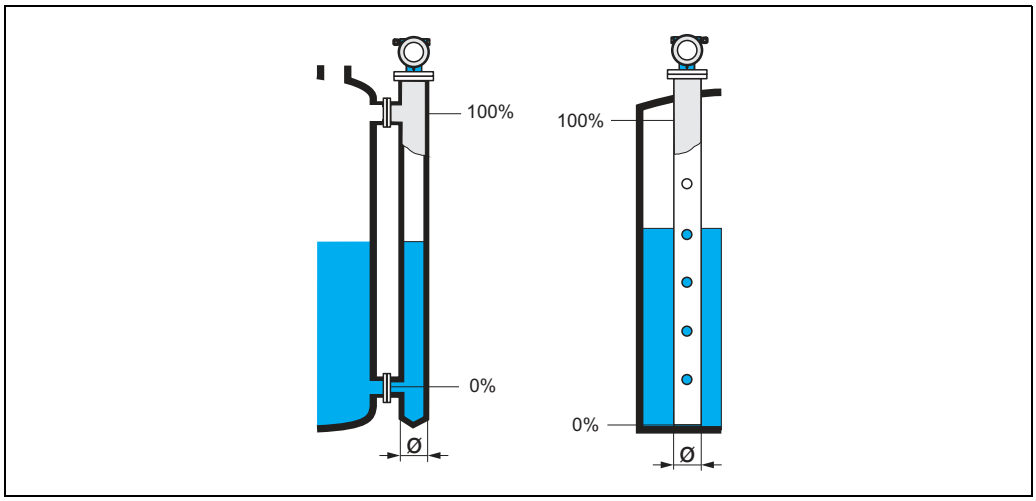
3.7 Function "pipe diameter" (007)

Note!
FMR540 is best suitable for "free-space" application. The use of FMR540 in bypass/stilling well is not recommended.



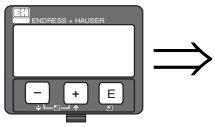


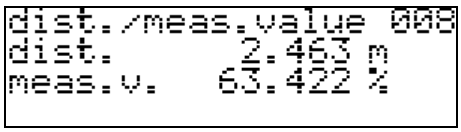
This function is used to enter the pipe diameter of the stilling well or bypass pipe.



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 "dist./meas.value" (008)





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)**

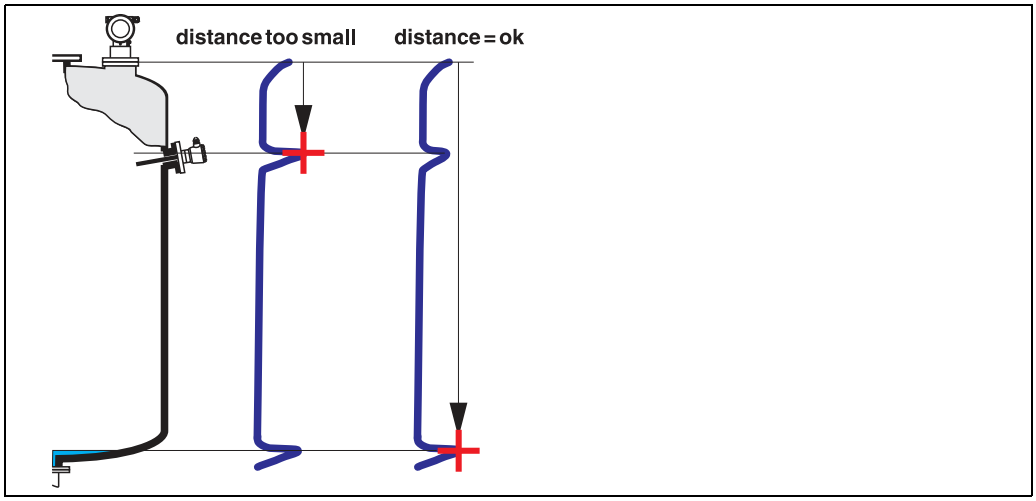
3.9 Function "check distance" (051)



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.

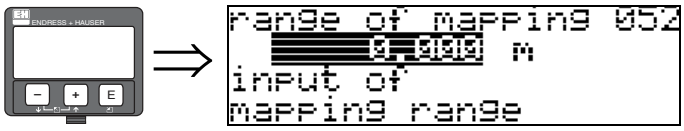
manual

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 vessel, 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.

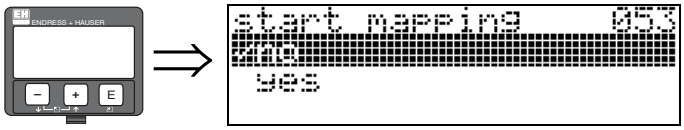
3.10 Function "range of mapping" (052)



This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (→ 2). This value can be edited by the operator.

For manual mapping, the default value is 0 m.

3.11 Function "start mapping" (053)



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

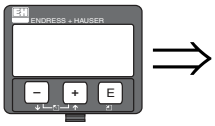
Selection:

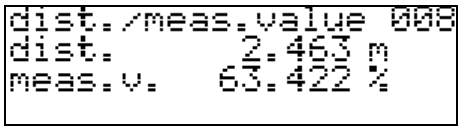
- off: no mapping is carried out
- on: mapping is started

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 "dist./meas.value" (008)

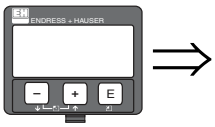




The distance measured from the reference point to the product surface and the level calculated with the aid of the empty alignment are displayed again. Check whether the values correspond to the actual level or the actual distance. The following cases can occur:

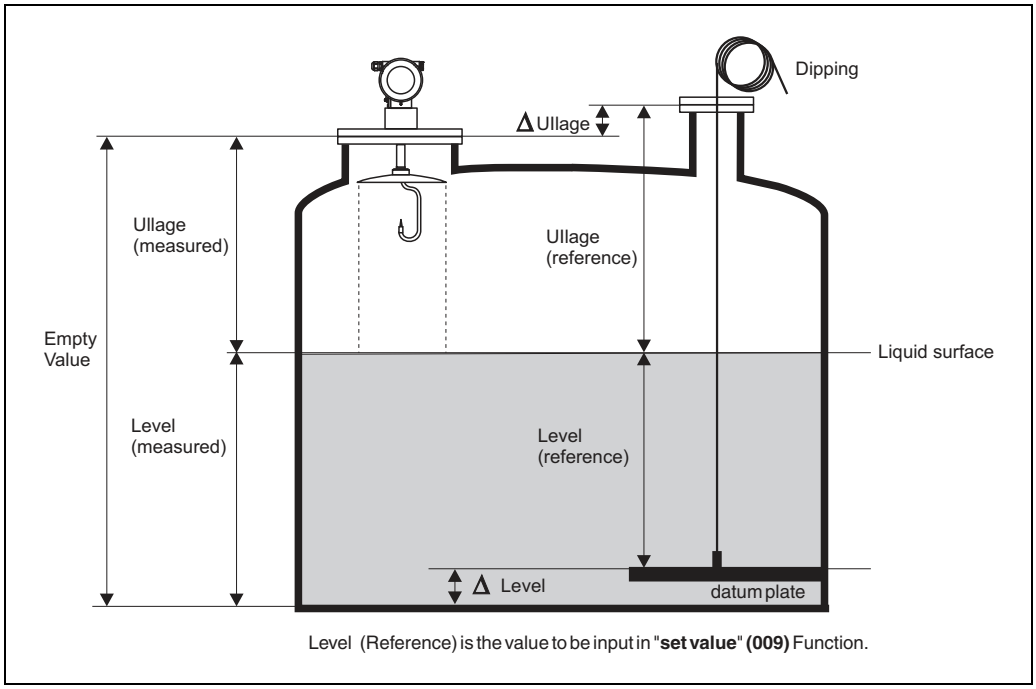
- Distance correct – level correct -> basic setup completed
- Distance incorrect – level incorrect -> a further interference echo mapping must be carried out "**check distance**" (**051**).

3.13 Function "set value" (009)

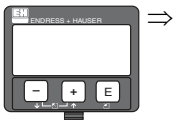




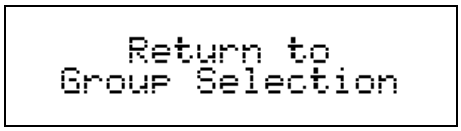
This function enables the user to offset the difference between the reference level and the measured level (or between ullage value and measured distance). To make an offset effective, input the reference level measured by the dip measurement by using key buttons. The software offsets the dist./meas value with the difference between reference level and measured value.



Level (Reference) is the value to be input in "**set value**" **(009)** Function.

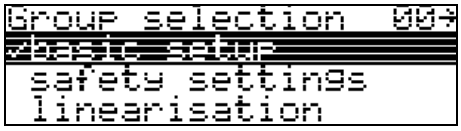


⇒





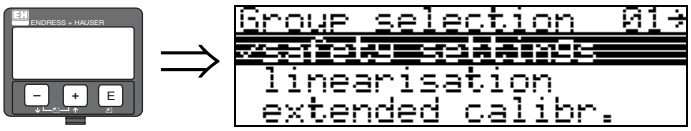
After 3 s, the following message appears



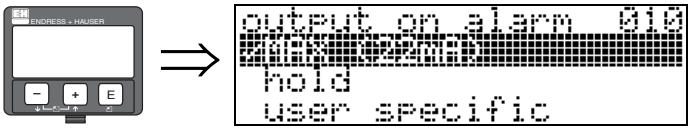


Note!
After the basic setup, an evaluation of the measurement with the aid of the envelope curve ("**Envelope curve**" **(0E)** function group) is recommended.

4 Function group "safety settings" (01)



4.1 Function "output on alarm" (010)

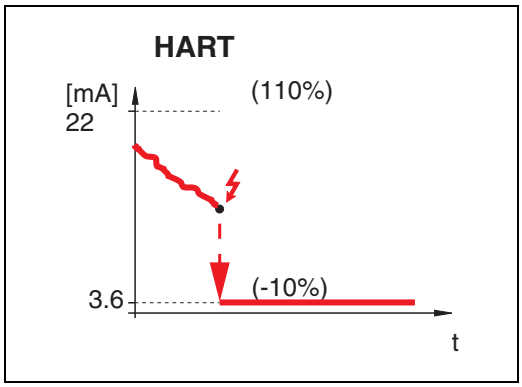


This function is used to select the reaction of the output on an alarm.

Selection:

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

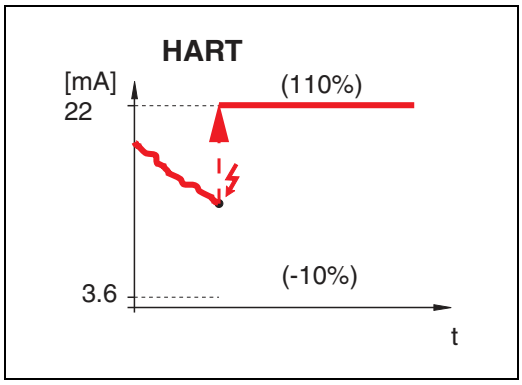
MIN (<= 3.6mA)



If the instrument is in alarm state, the output changes as follows:

- HART:MIN-Alarm 3.6 mA

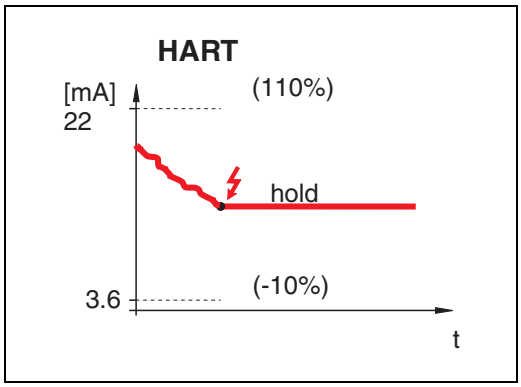
MAX (22mA)



If the instrument is in alarm state, the output changes as follows:

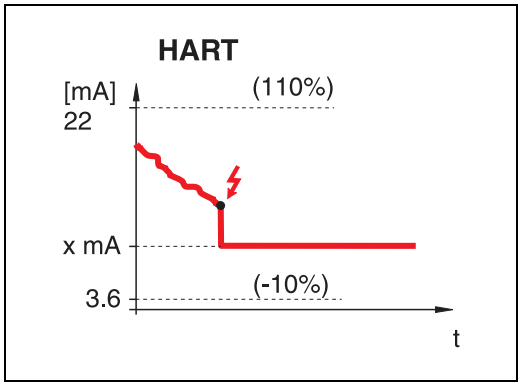
- HART:MAX-Alarm 22 mA

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).

4.2 Function "outp. echo loss" (012)

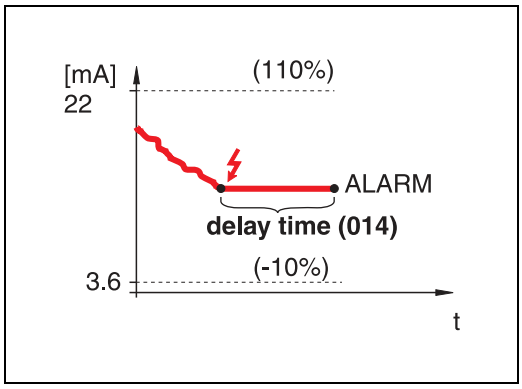


Use this function to set the output response on echo loss.

Selection:

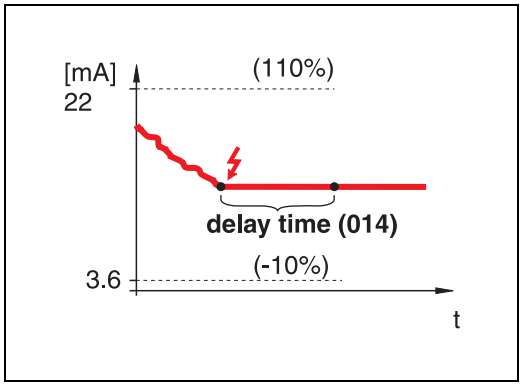
- alarm
- **hold**
- ramp %/min

alarm



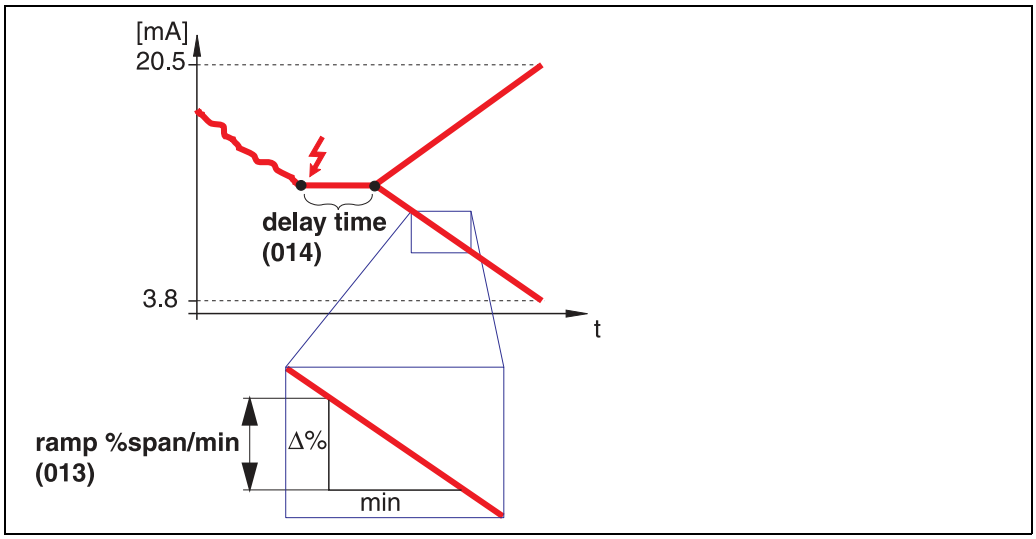
On echo loss, the instrument switches to alarm state after an adjustable "**delay time**" **(014)**. The output response depends on the configuration set in "**output on alarm**" **(010)**.

hold



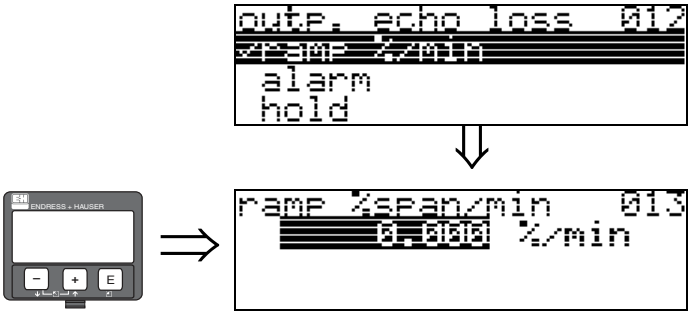
On echo loss, a warning is generated after a definable "**delay time**" **(014)**. Output is held.

ramp %/min



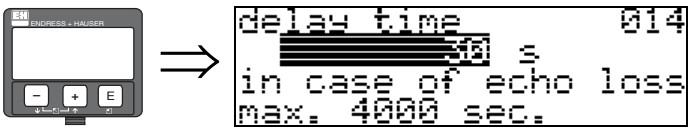
On echo loss, a warning is generated after a definable "**delay time**" **(014)**. The output is changed towards 0% or 100% depending on the slope defined in "**ramp %span/min**" **(013)**.

4.3 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.

4.4 Function "delay time" (014)



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.

4.5 Function "safety distance" (015)

A configurable safety distance is placed before the "**blocking dist.**" **(059)** (→ 53). This distance warns you that any further level increase would make the measurement invalid, for example, when touching the antenna area.

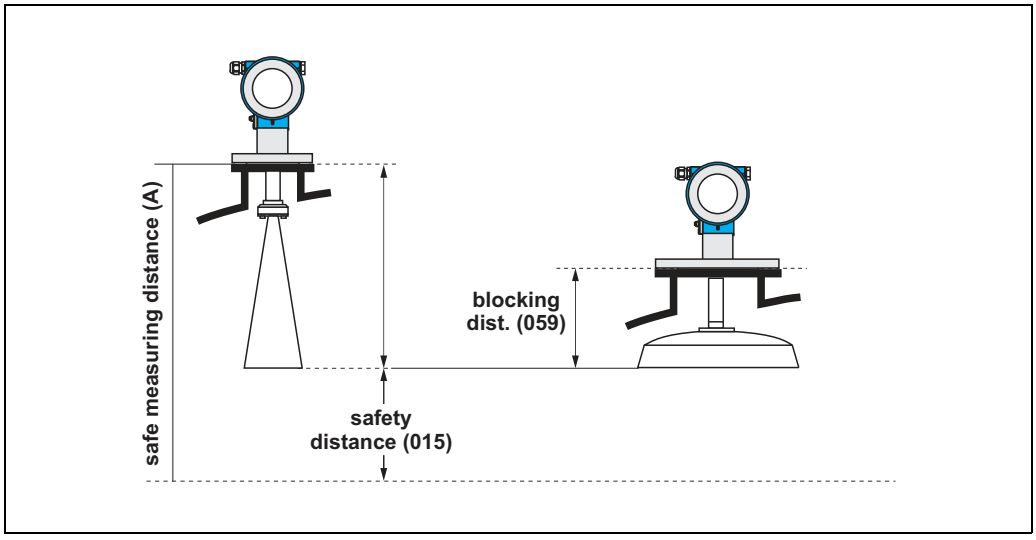
It is recommended the sum of blocking distance and safety distance exceed the distance shown on the table below.



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

blocking dist. (BD) + safety distance ≥ min. measuring distance

	Extension mm (in)	4" Horn Antenna mm (in)	8" Parabolic Antenna mm (in)	10" Parabolic Antenna mm (in)
blocking distance (095)	-	470 (18,5)	102 (4,0)	130 (5,1)
safety distance (015)	-	100 (3,9)	100 (3,9)	100 (3,9)
safe measuring distance "A"	-	870 (34,3)	502 (19,8)	530 (20,9)
safe measuring distance "A" 150 mm (5.9 in)	150 (5,9)	1020 (40,2)	652 (25,7)	680 (26,8)
safe measuring distance "A" 250 mm (9.8 in)	250 (9,8)	1120 (44,1)	752 (29,6)	780 (30,7)
safe measuring distance "A" 450 mm (18 in)	450 (18,0)	1320 (52,0)	952 (37,5)	980 (38,6)



4.6 Function "in safety dist." (016)

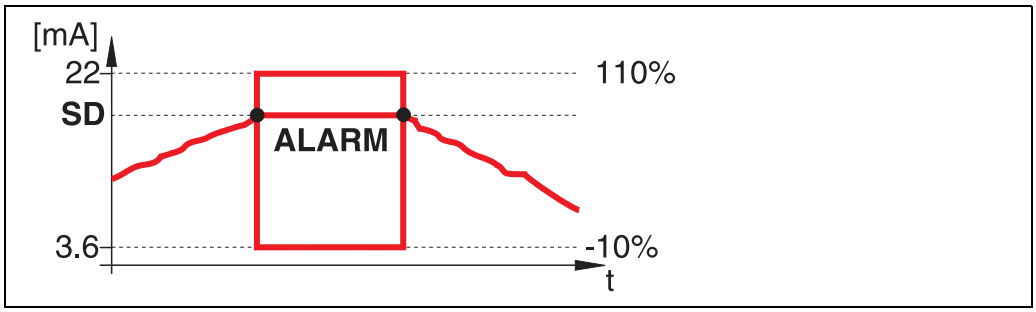


This function defines the response when the level enters the safety distance .

Selection:

- **alarm**
- warning
- self holding

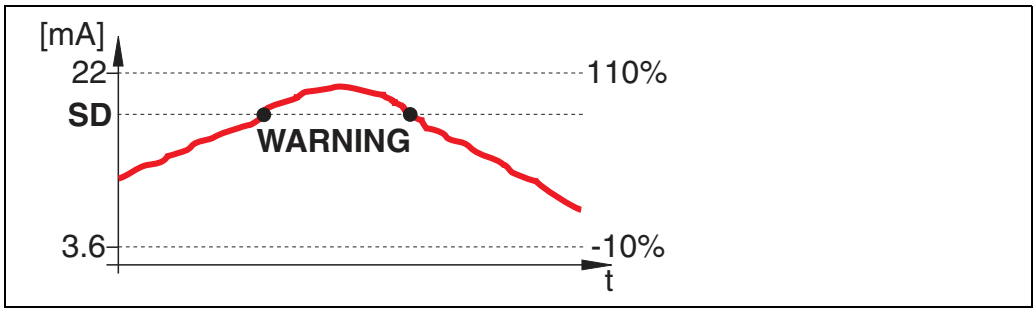
alarm



Instrument enters the defined alarm state ("**output on alarm**" **(011)**). The alarm message **E651** - "**level in safety distance** - **risk of overspill**" is displayed.

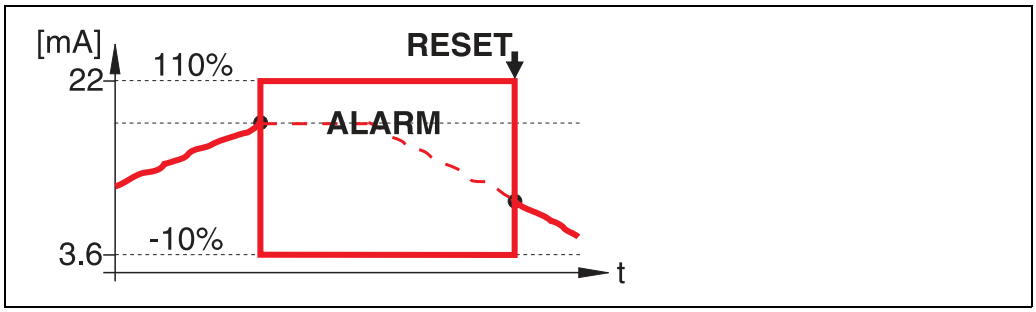
If the level drops out of the safety distance, the alarm warning disappears and the instrument starts to measure again.

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)**).

4.7 Function "ackn. alarm" (017)



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

Selection:

- **no**
- yes

no

The alarm is not acknowledged.

yes

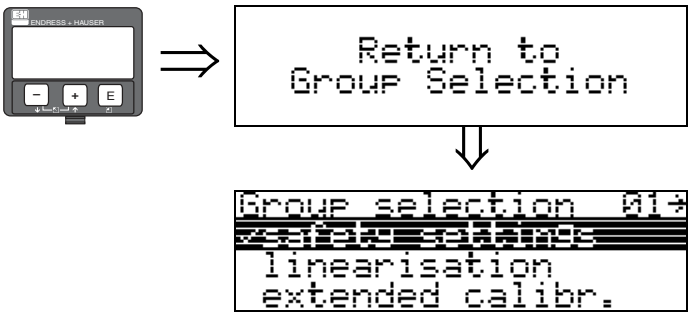
Acknowledgement takes place.

4.8 Function "overspill prot." (018)



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 (→ 68).

Caution!
The FMR540 must not be used for applications requiring an approval according WHG (in preparation)/SIL!



After 3 s, the following message appears

5 Function Group "diptable" (03)



5.1 Function "dip table state" (030)



Selection:

- **table off** (the dip table is switched off)
- table on (the dip table is switched on)

5.2 Function "dip table mode" (031)



The dip table can be switched on or off using this function.

Selection:

- view points
- add manually
- add semi.autom
- delete point
- del all points

view points
The value pairs in the dip table can **only** be read. You can still select this menu option, even if there is no dip table available. In this case, the number of free table entries is at maximum value (**= 32**).

add manually

The value pairs in the dip table can be read and written. You can enter the measured value and the dip value.

- uncorrected measured value:
  This is the measured value supplied by the instrument, **NOT** corrected by the dip table. The choice of measured value, level or remaining fill height is dependent on the instrument setting.
- Dip value:
  This is the level or distance to flange respectively, given by the hand dip. This value should be used to correct the measured value.
  The "manual mode" of the dip table can be used to enter collected data after a series of data pairs taken at different tank levels.

Note!
The bigger the distance between the different levels while taking hand dips, the more accurate the linearisation of the dip table will be.

add semi.autom

The value pairs in the dip table can be read. You can enter the dip value only. When there are new value pairs, the current level or distance is accepted as the measured value.

delete point

A value pair is deleted.

del all points

The complete dip table is deleted. The table is switched off. The number of free table entries is set to the maximum value (**= 32**).

5.2.1 Dip table

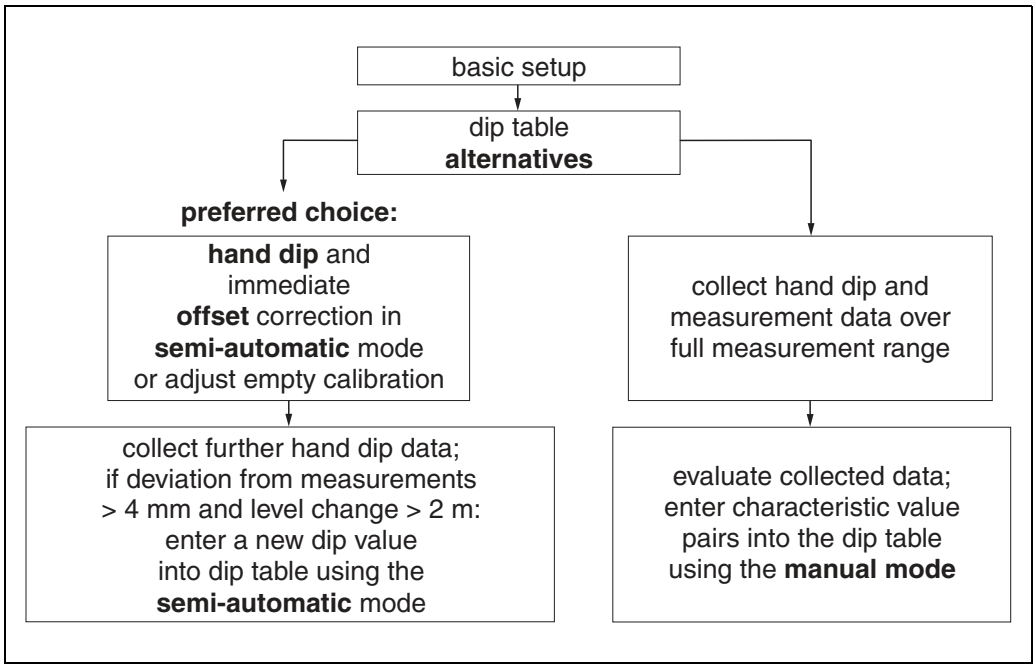
The dip table is used to correct the level readings of the Micropilot S using independently taken hand dips. The dip table is used in particular to adapt the level gauge to the specific application conditions as mechanical offset and tank/stilling well design.

Depending on national regulations, national inspectors will dip the tank at one to three levels during a calibration run and check the level readings.

Only one value pair must be entered into the dip table to correct the measurement **offset**.

If a second value pair is entered into the dip table, the Micropilot S accepts the corrected measured values identically for both value pairs. All other measured values are determined by linear interpolation.

If you enter two value pairs, the system carries out a linear interpolation between adjacent value pairs. Outside these value pairs, extrapolation is also linear.



To collect and enter data into the dip table, two alternative procedures may be carried out. In order not to mix up measurement values corrected by the offset or linearisation of the dip table with uncorrected measurement values, it is recommended to use the semi-automatic mode of the dip table to enter new data pairs. In this case, the first dip value should be entered immediately after the basic calibration. Further linearization points should be entered only after a level change of at least 2 m (cf. upper figure, preferred choice) and a deviation between the "uncorrected measurement value" and the hand dip value of at least 4mm. If this procedure can not be followed, then NO value pair should be entered into the dip table after basic calibration. Measurement data and hand dip values should be collected over the full measurement range and be evaluated with regard to a good linear fit. Only then characteristic value pairs should be entered into the dip table using the "manual mode" (cf. upper figure, right side). If further linearisation is needed, further hand dip values should be entered using only the "semi-automatic" mode.

Note!

The offset should NOT be determined and entered within the close range of the antenna (conf. definition of the safety distance) or immediately in the range of the tank bottom, because within these ranges interferences of the radar signal may occur.

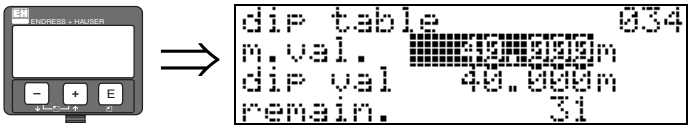
The dip table can be printed out using the ToF-Tool. Before doing this, the ToF Tool must be reconnected to the instrument in order to update the values within the ToF Tool.

Make your inputs into the dip table in semi-automatic mode.

Caution!

After entering one or more points into the dip table, make sure that the dip table is activated and left in the "table on" dip table mode.

5.3 Function "dip table" (034)



This function edits the measured variable. "m. val. (measured value)" indicates the measured value from FMR540.

"dip val (dipped value)" indicates measured value from dip measurement.

You can edit both value from display VU331 or ToF tool.

The number behind the entry "**remain**" indicates the current number of remaining free value pairs. The maximum number of value pairs is 32; after each entry, the remaining number is decremented. When deleting the dip table points by selecting"delete point" at "**dip table mode**" **(031)**

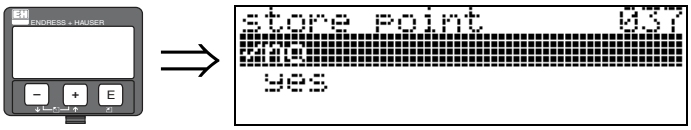
"remain." indication is replaced by "tab. no (tab number)"

in order to indicate which dip table point is to be deleted.

Caution!

The uncorrected measured value is displayed in the "**dip table**" (034) function. This may differ considerably from the measured values when a dip table is activated.

5.4 Function "store point" (037)



This function is to confirm point is written for the dip table.

5.5 Function "add next point" (038)



This function is to select if further addition of dippoint is required.

5.6 Function "view handling" (036)



This function will appear when "view points" is selected at "dip table state" (030).

Selection:

- return - go to "dip table state" (030)
- next point - go to next dippoint
- previous point - go to previous dippoint

Return able you to go back to "**dip table state**" **(030)**.

return

By selecting this point, you return to the function "**dip table mode**" **(033)**.

next point

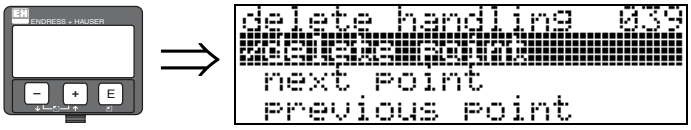
This scrolls down in the table. If the table is empty, you can still select this option. However, the displayed value does not change.

previous point
This scrolls up in the table. If the table is empty, you can still select this option. However, the displayed value does not change.

Caution!

After entering one or more points into the dip table, make sure that the dip table is activated in the "**table on**" dip table mode.

5.7 Function "delete handling" (039)



This fucntion appears after selecting "delete point" at "**dip table mode**" **(031)**

The list of selections gives the required handling of deleting the values recorded on the previously shown tab number,

move to the next tab number, going back to the previous tab number or just to return to the group selection.

Selection:
- delete point
- next point
- previous point
- return

delete point

to detele a dip table point (recorded on a specific tab. number in the dip table) which is previously shown on function "**dip table**" **(034)**

next point

to select next dip table point to be deleted for example, to move from tab. no. 1 to tab. no. 2

previous point

to select a dip table point previously displayed

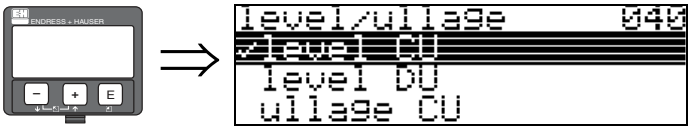
return

to go to function "**diptable state**" **(030)** to activate or de activate the diptable

6 Function group "linearisation" (04)



6.1 Function "level/ullage" (040)



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

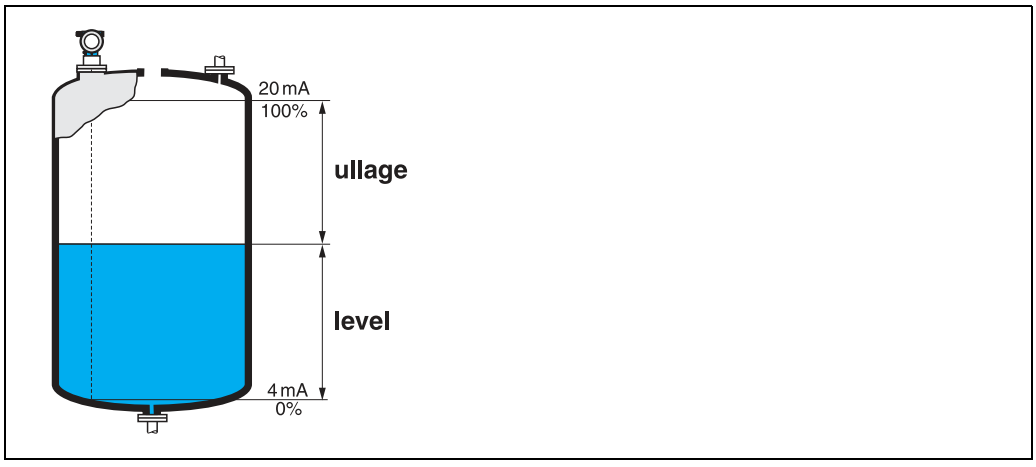
Ullage in customer units. The value can be linearised.

The "**linearisation**" **(041)** default value is set to a linear 0...100%.

ullage DU

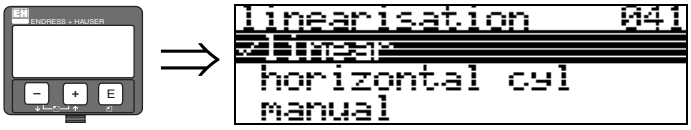
Ullage in the selected "**distance unit**" **(0C5)**.

Note!
Reference point for the ullage is "full calibr." (=span).



6.2 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.



This function is used to select the linearisation modes.

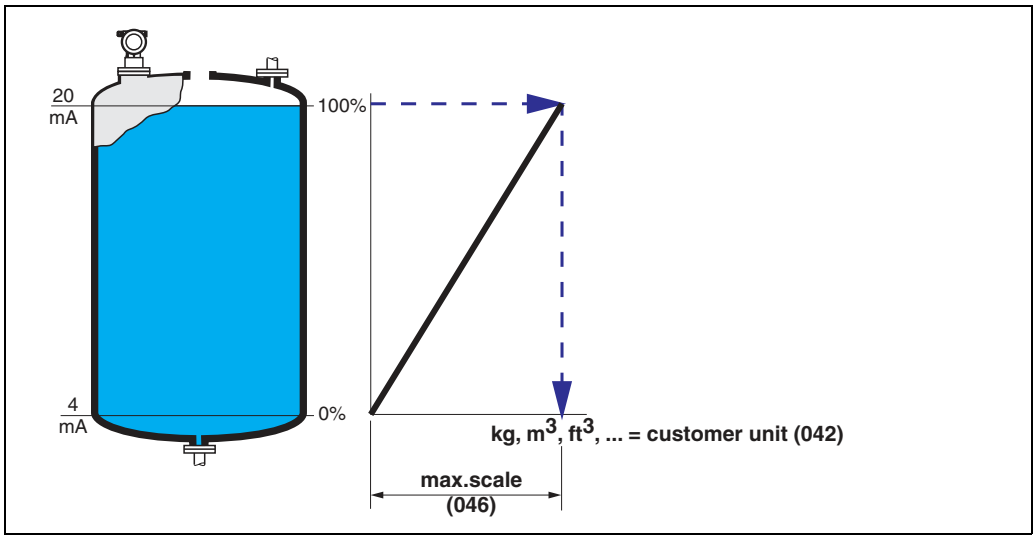
Selection:

- **linear**
- horizontal cyl
- manual
- semi-automatic
- table on
- clear table

linear

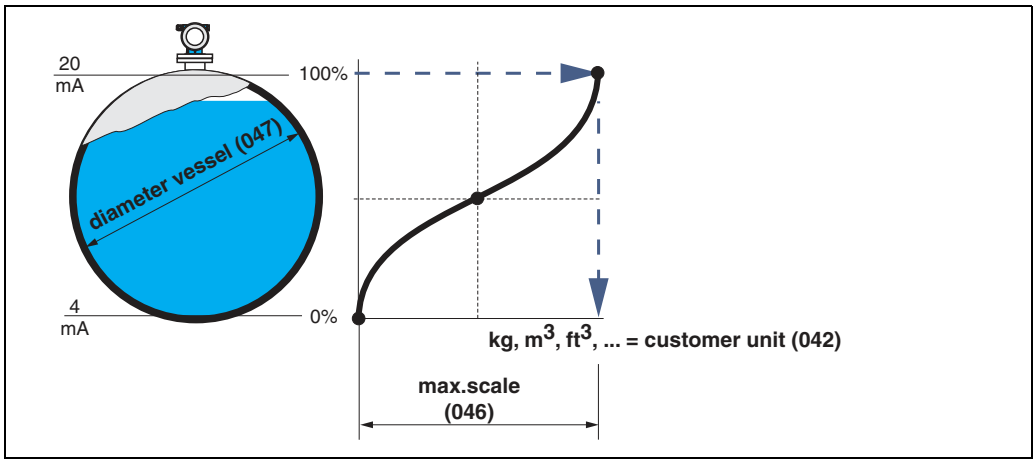
The tank is linear e.g. a cylindrical vertical tank. You can measure in customer units by entering a maximum volume/weight.

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

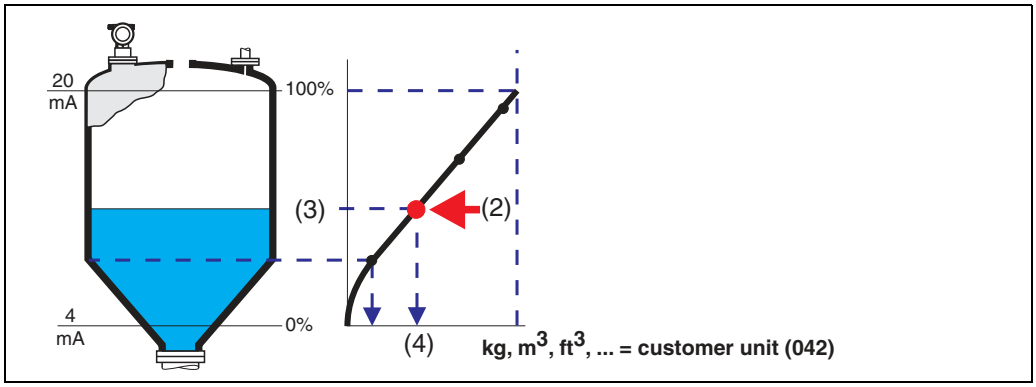
The volume, mass etc. are calculated automatically in cylindrical horizontal tanks by entering the "**diameter vessel**" **(047)**, the "**customer unit**" **(042)** and the "**max. scale**" **(046)**. The "**max. scale**" **(046)** corresponds to an output of 100% (= 20 mA for HART).



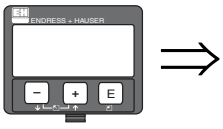
manual

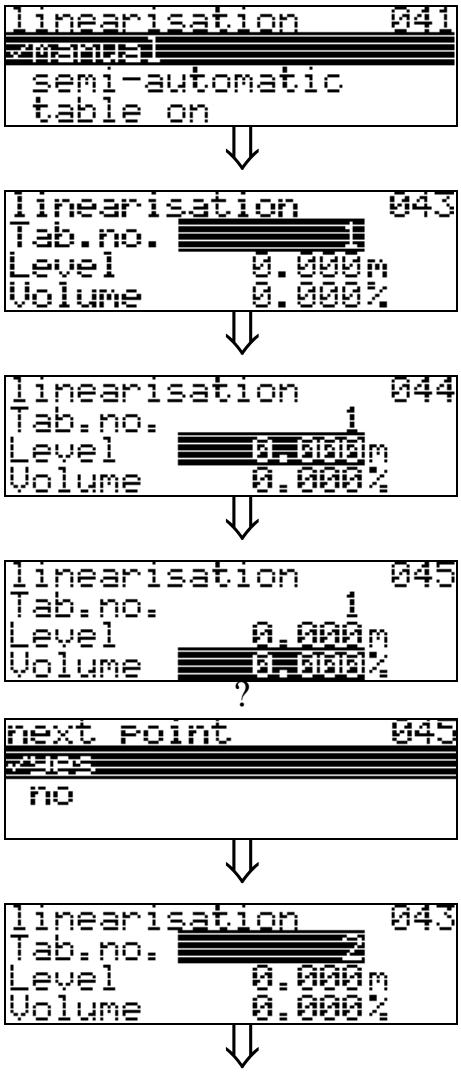
If the level is not proportional to the volume or weight within the set measuring range, you can enter a linearisation table in order to measure in customer units. The requirements are as follows:

- 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).





Select the table point (Point 1).

Enter the level belonging to Point 1.

Enter the corresponding volume.

Enter a further table point?

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.

semi-automatic

The vessel 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**".

6.3 Function "customer unit" (042)



You can select the customer unit with this function.

Selection:

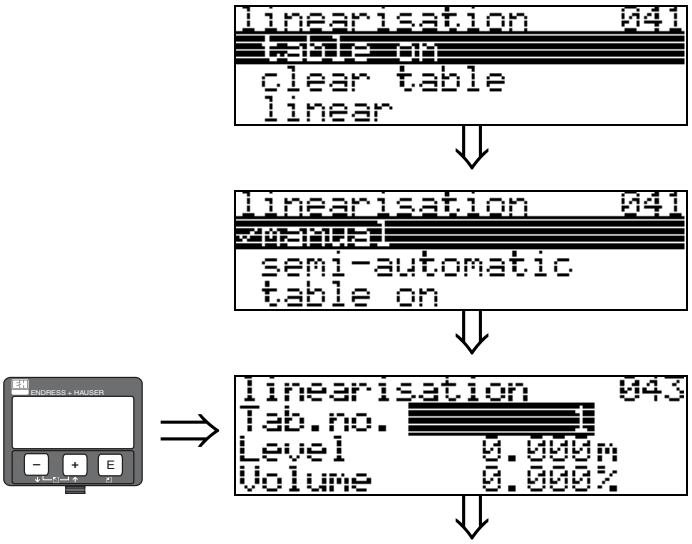
- %
- l
- hl
- m3
- dm3
- cm3
- ft3
- usgal
- i gal
- kg
- t
- lb
- ton
- m
- ft
- mm
- inch

Dependence

The units of the following parameters are changed:

- measured value (000)
- input volume (045)
- max. scale (046)
- simulation value (066)

6.4 Function "table no." (043)

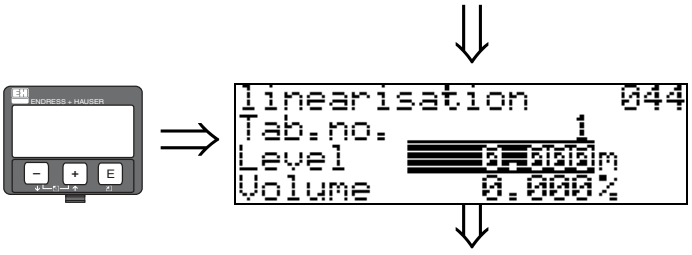


Position of the value pair in the linearisation table.

Dependence

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

6.5 Function "input level" (044)

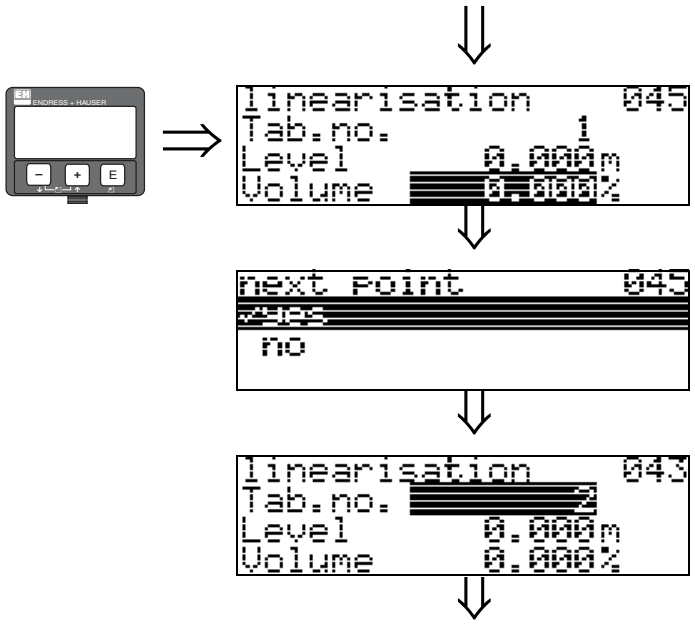


You can enter the level for each point of the linearisation curve with this function. When the linearisation curve is entered semi-automatically, Micropilot detects the level automatically.

User input:

Level in "**distance unit**" **(0C5)**.

6.6 Function "input volume" (045)

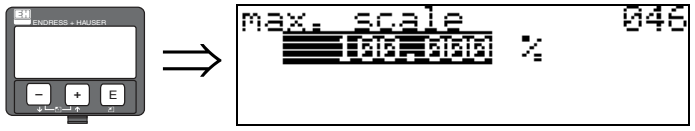


Specify the volume for each point of the linearisation curve with this function.

User input:

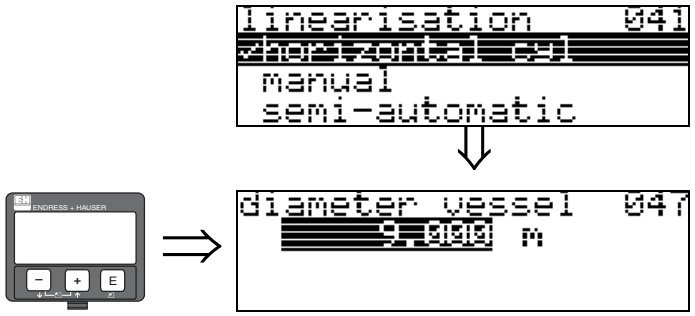
Volume in "**customer unit**" **(042)**.

6.7 Function "max. scale" (046)



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.

6.8 Function "diameter vessel" (047)

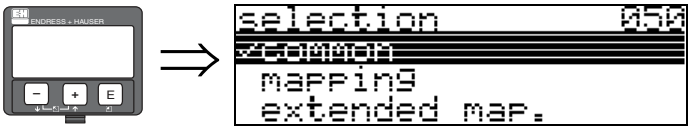


Enter the vessel diameter with this function. This entry is necessary if you selected "**horizontal cyl**" in the "**linearisation**" **(041)** function.

7 Function group "extended calibr." (05)



7.1 Function "selection" (050)



Select the function of the extended calibration.

Selection:

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

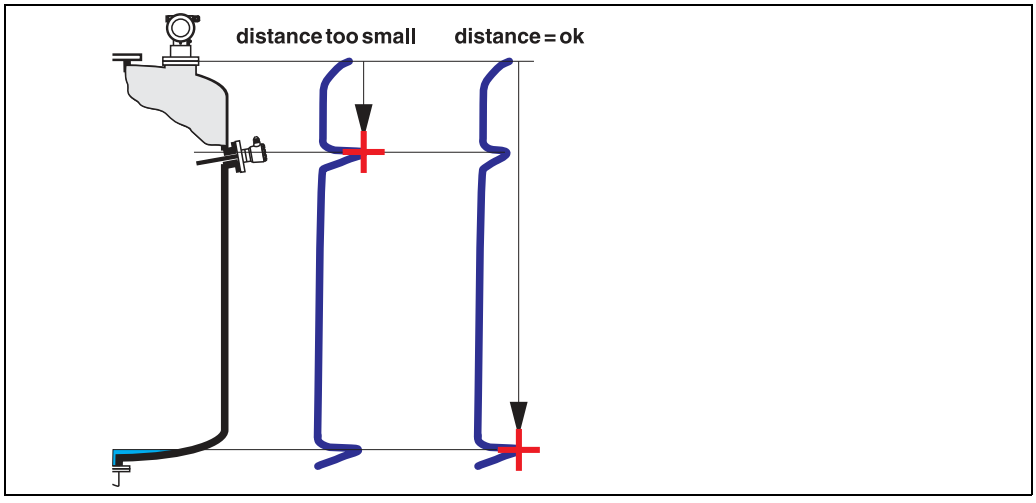
7.2 Function "check distance" (051)



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.

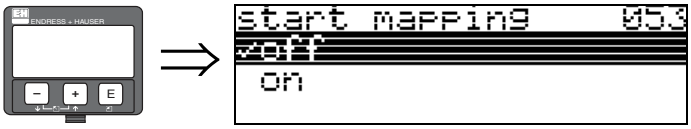
7.3 Function "range of mapping" (052)



This function displays the suggested range of mapping. The reference point is always the reference point of the measurement (→ 2). This value can be edited by the operator.

For manual mapping, the default value is 0 m.

7.4 Function "start mapping" (053)



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

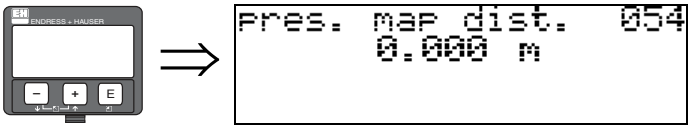
Selection:

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

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

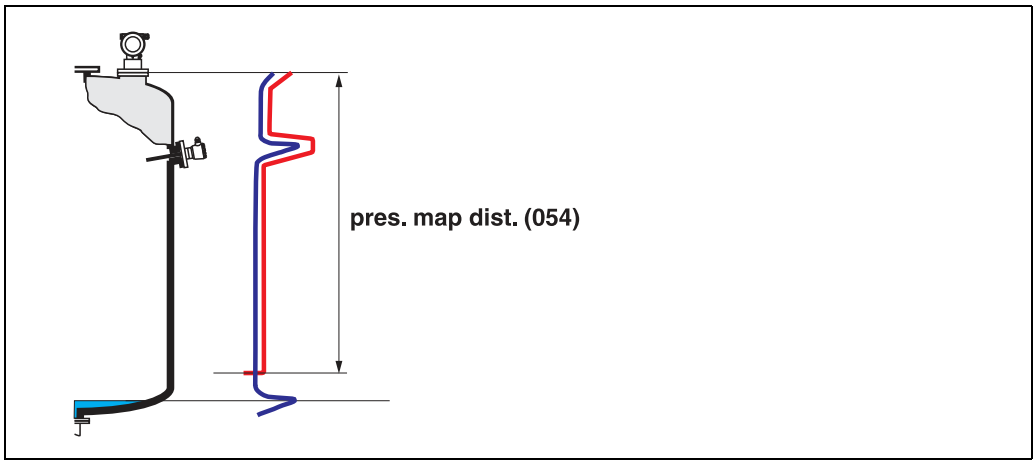
Caution!
A mapping will be recorded only, if the device is not in error state.

7.5 Function "pres. map dist." (054)

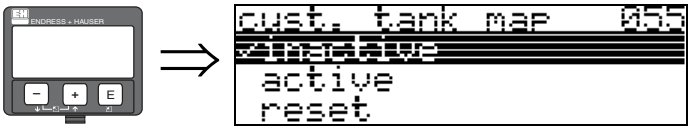


Displays the distance up to which a mapping has been recorded.

A value of 0 indicates that no mapping was recorded so far.



7.6 Function "cust. tank map" (055)



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 (→ 80).

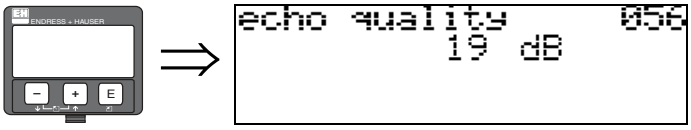
active

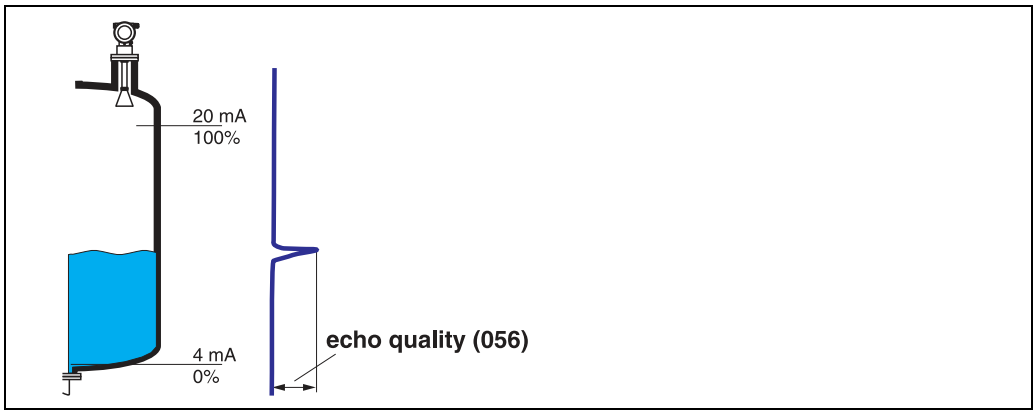
Evaluation is using the customer tank map (→ 79).

reset

Deletes the complete tank map.

7.7 Function "echo quality" (056)





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 (→ 86).

7.8 Function "offset" (057)



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

7.9 Function "antenna extens." (0C9)



This function indicates the antenna extension length, depending on sensor option at the time of order. It is recommended to keep the value as delivered.

7.10 Function "output damping" (058)



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)**.

7.11 Function "blocking dist." (059)



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 → 30).
- 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 → 30).
- The customer can set the Micropilot to respond to circumstances when the product is within this zone (safety distance) (→ 30).

8 Function group "output" (06)

8.1 Function "commun. address" (060)



Enter the communication address for the instrument with this function.

- Standard: 1
- 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)**.

8.2 Function "no. of preambels" (061)



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.

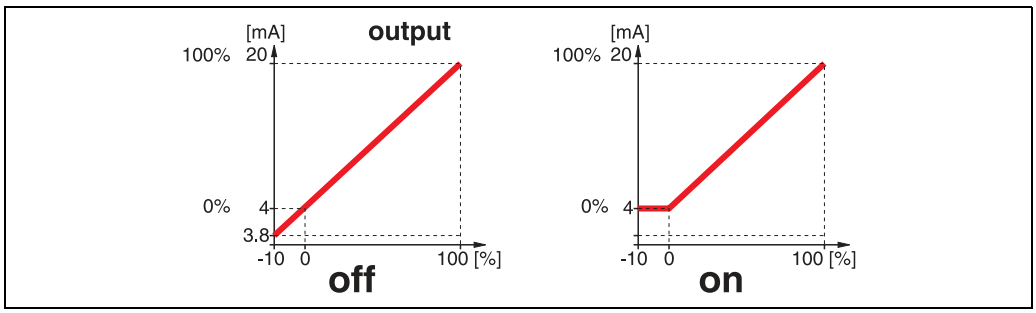
8.3 Function "low output limit" (062)



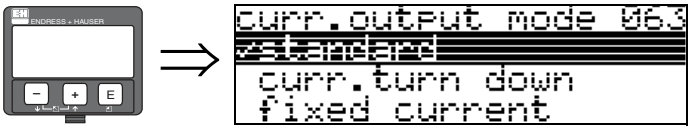
The output of negative level values can be suppressed with this function.

Selection:

- off minimum output -10% (3.8 mA for HART)
- on minimum output 0% (4 mA for HART)



8.4 Funktion "curr.output mode" (063)



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).

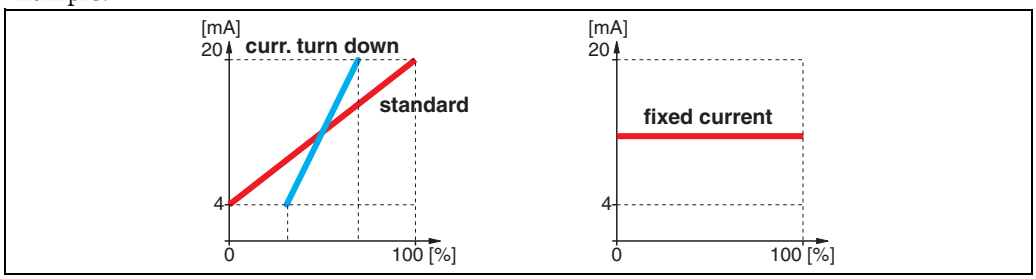
curr.turn down

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.

Example:



8.5 Function "fixed cur. value" (064)

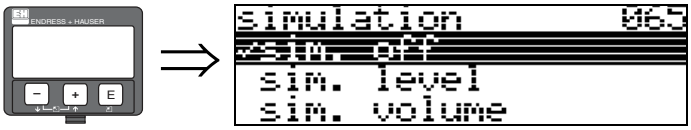


Set the fixed current value with this function. This entry is necessary when you have switched on the "**curr. output mode**" **(063)** function.

User input:

3,8...20,5 mA

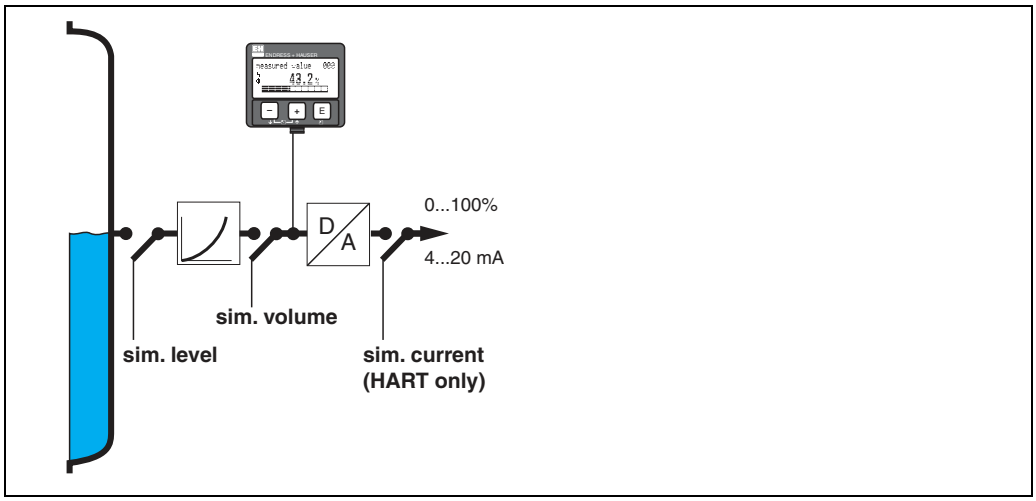
8.6 Function "simulation" (065)



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



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)

follow the entered values.

sim. volume

Enter the volume value in "**simulation value**" **(066)**.

The functions

- measured value (000)
- output current" (067)

follow the entered values.

sim. current

Enter the current value in "**simulation value**" **(066)**.

The function

- output current" (067)

follows the entered values.

8.7 Function "simulation value" (066)

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



The level can be entered.

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

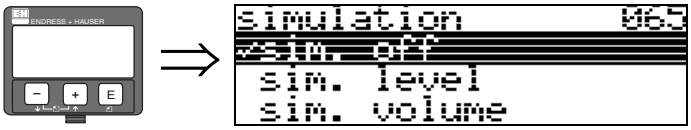


The volume can be entered.

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

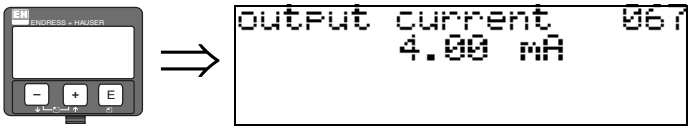


Enter the output current.



Please make sure to select "off" at the end of simulation activities.

8.8 Function "output current" (067)



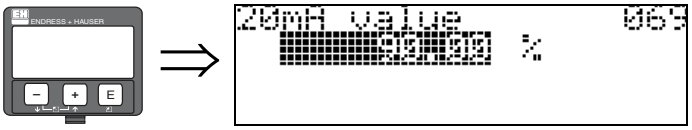
Displays the output current in mA.

8.9 Function "4mA value" (068)



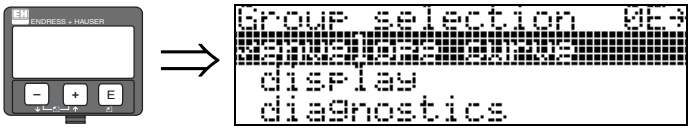
In this function specify the level (or volume, weight, flow resp.), at which the output current should be 4 mA. This value will be used if you choose the option "curr. turn down" in the **"current output mode" (063)** function.

8.10 Function "20mA value" (069)



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.

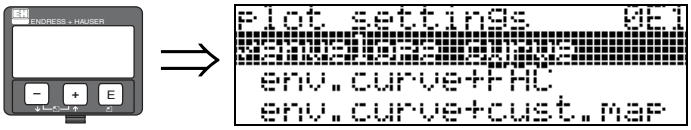
9 Function group "envelope curve" (0E)



Caution!

This function can be performed on the display only!

9.1 Function "plot settings" (0E1)



Select which information will be displayed in the LCD:

- **envelope curve**
- env.curve+FAC (on FAC → 80)
- env.curve+cust.map (i.e. customer tank map is also displayed)

9.2 Function "recording curve" (0E2)

This function defines whether the envelope curve is read as a

- **single curve**
  or
- cyclic.

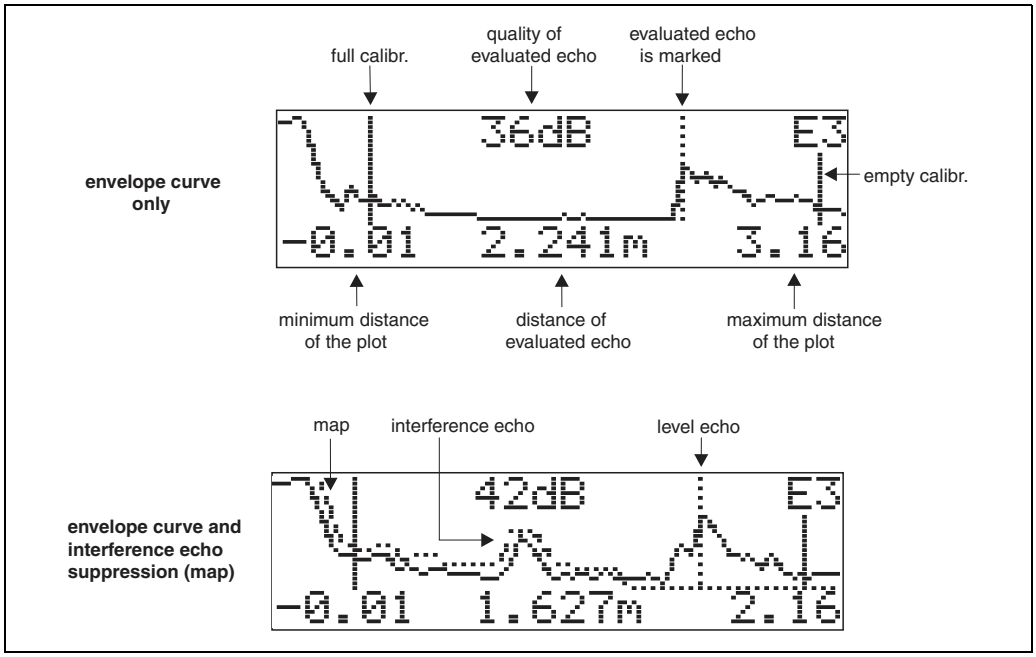


Note!
If the cyclical envelope curve is active in the display, the measured variable is refreshed in a slower cycle time. It is therefore recommended to exit the envelope curve display after optimising the measuring point.

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 (→ 86).

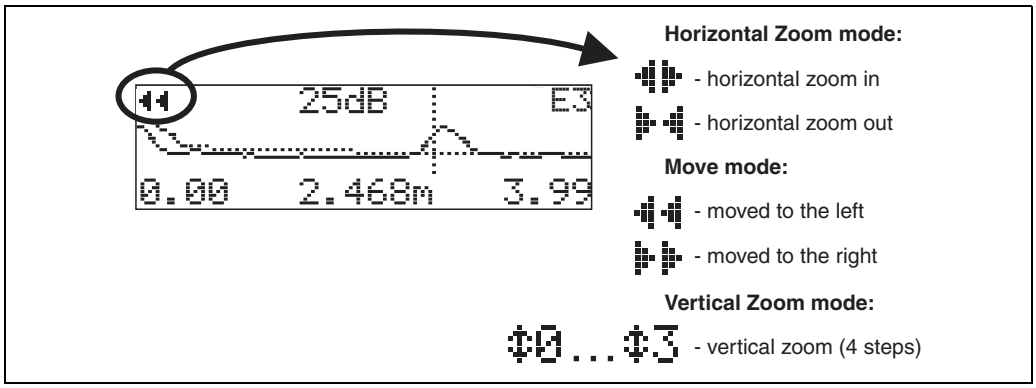
9.3 Function "envelope curve display" (E3)

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.

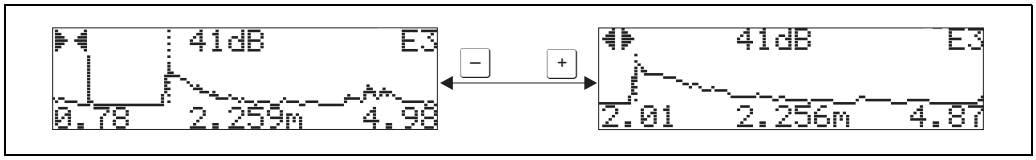


Horizontal Zoom mode

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.

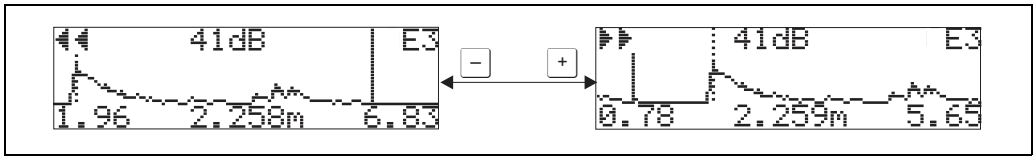


Move mode

Then press [E] to switch to Move mode. Either ⇉ or ⇇ is displayed.

You now have the following options:

- [+] shifts the curve to the right.
- [−] shifts the curve to the left.



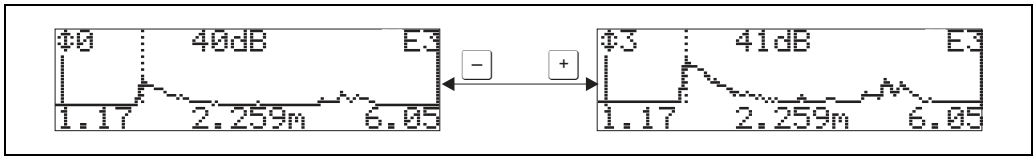
Vertical Zoom mode

Press [E] once more to switch to Vertical Zoom mode. ⇳ is displayed.

You now have the following options:

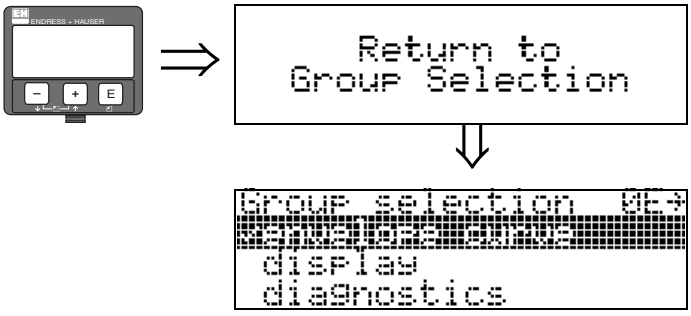
- [+] increases the vertical scale.
- [−] reduces the vertical scale.

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



Exiting the navigation

- Press [E] again to run through the different modes of the envelope curve navigation.
- Press [+] and [−] 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.



After 3 s, the following message appears

10 Function group "display" (09)



10.1 Function "language" (092)



Selects the display language.

Selection:

- English
- Deutsch
- Français
- Español
- Italiano
- Nederlands
- □□□ (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!

10.2 Function "back to home" (093)



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

factory setting = 100 s

Cautio!

This function is not visualised in Commuwin II!

10.3 Function "format display" (094)



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"

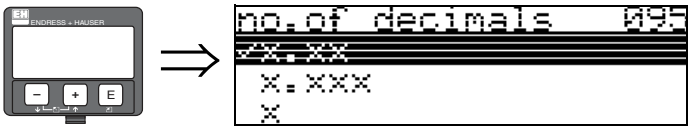
The measured value is displayed in the following format (e.g 5'05-14/16").

This option is only possible for "**distance unit**" **(0C5)** - "**ft**" and "**in**"!

Caution!

This function is not visualised in Commuwin II!

10.4 Function "no.of decimals" (095)



Selection:

- x
- **x.x**
- x.xx
- x.xxx

10.5 Function "sep. character" (096)



Selection:

- **.**
- ,

.

The decimal place is separated by a point.

,

The decimal place is separated by a comma.

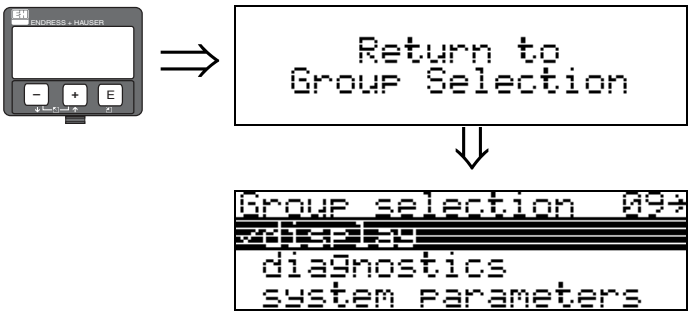
10.6 Function "display test" (097)



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!



After 3 s, the following message appears

11 Function group "diagnostics" (0A)



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:

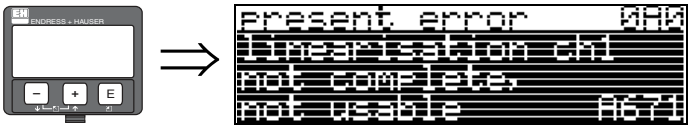
- **A (Alarm):**
  Instrument goes into a defined state (e.g. MAX)
  Indicated by a constant ϟ symbol.
  (For a description of the codes, → 82)
- **W (Warning):**
  Instrument continue measuring, error message is displayed.
  Indicated by a flashing ϟ symbol.
  (For a description of the codes, → 82)
- **E (Alarm / Warning):**
  Configurable (e.g. loss of echo, level within the safety distance)
  Indicated by a constant/flashing ϟ symbol.
  (For a description of the codes, → 82)

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 → 82.

- 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)**.

11.1 Function "present error" (0A0)



The present error is shown using this function.

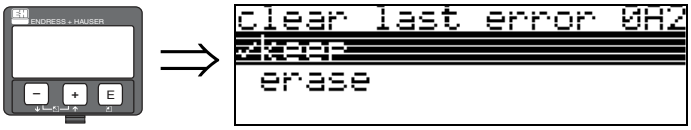
If several current errors occur, use ⊞ or ⊟ to page through the error messages.

11.2 Function "previous error" (0A1)



The last error presented is shown with this function.

11.3 Function "clear last error" (0A2)



Selection:

- **keep**
- erase

11.4 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



Entry ("reset" (0A3)):

333 = customer parameters (HART)

333 = reset customer parameters for HART

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)
- vessel / silo (00A)
- empty calibr. (005)
- full calibr. (006)
- pipe diameter (007)
- set value (009)
- 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)
- dip table (03)
- 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)
- curr.output mode (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.

11.5 Function "unlock parameter" (0A4)



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

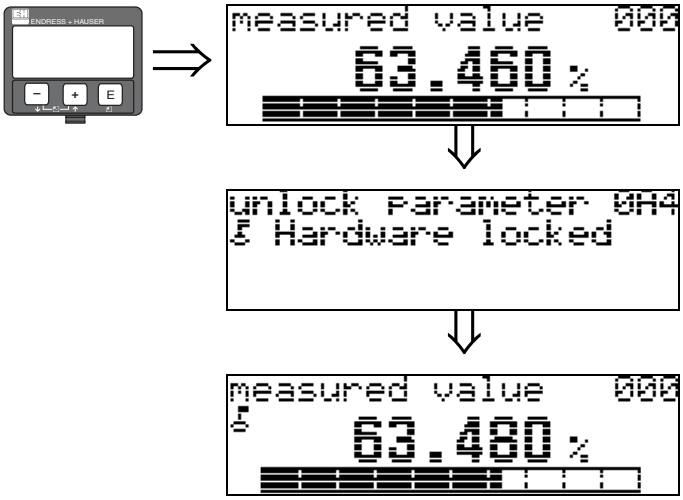
11.5.1 Locking of the configuration mode

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) 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 E 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 E 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.



+ and − and E press simultaneous

The LOCK_SYMBOL appears on the LCD.

11.5.2 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:

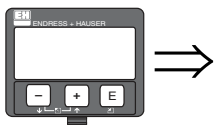
"**unlock parameter**" **(0A4):**
By entering the unlock parameter (on the display or via communication)

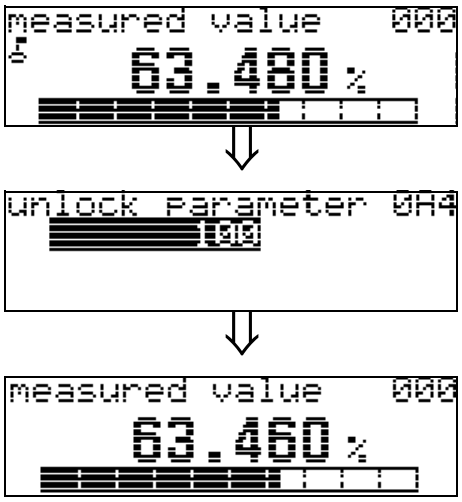
100 = for HART devices

the Micropilot is released for operation.

Hardware lock:
After pressing the [+] and [−] and [E] keys at the same time, the user is asked to enter the unlock parameter

100 = for HART devices





[+] and [−] and [E] press simultaneous

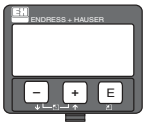
Please enter unlock code and confirm with [E].

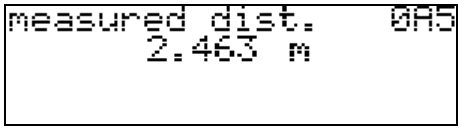


Caution!

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 Endress+Hauser service organization. Please contact Endress+Hauser if you have any questions.

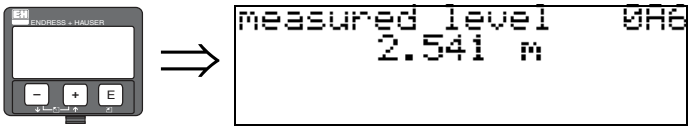
11.6 Function "measured dist." (0A5)



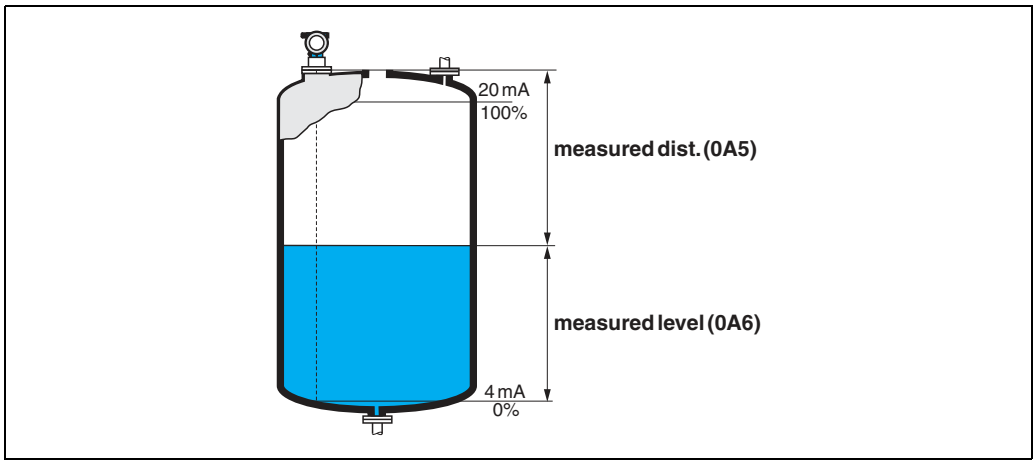


Display of measured distance in the selected "**distance unit**" **(0C5)**.

11.7 Function "measured level" (0A6)



Display of measured level in the selected "**distance unit**" **(0C5)**.



11.8 Function "detection window" (0A7)



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).

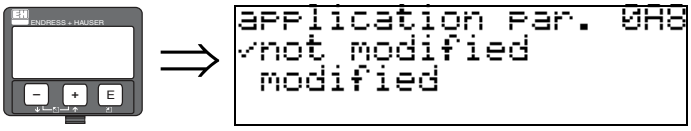
The window always moves togehter with a rising a falling echo.

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.

11.9 Function "application par." (0A8)



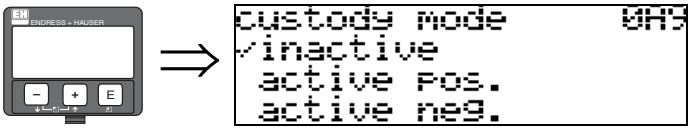
Displays whether or not one of the settings dependent on the "**tank shape**" **(002)**, "**medium property**" **(003)** and "**process cond.**" **(004)** application parameters has been changed.

If, for example, the "**output damping**" **(058)** is changed, the "**application par.**" shows "**modified**".

Selection:

- **not modified**
- modified

11.10 Function "custody mode" (0A9)



This indicates the instrument calibration mode. The calibration mode (active) can be set using the hardware security lock on the electronics (∅ ⓘ 8).

Selection:

- **inactive**
- active pos.
- active neg.

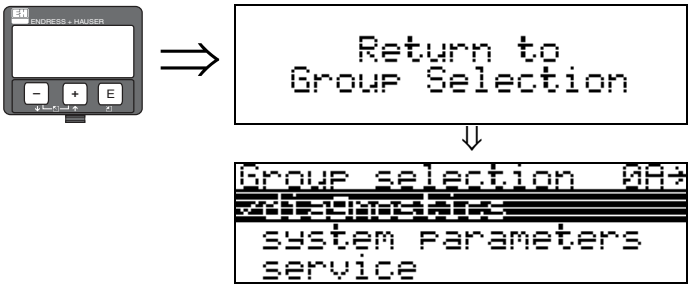
inactive

The custody mode is not activated (switch for custody mode is open, → 10)

active pos.

The custody mode (instrument is lead-sealed and accurate to the nearest mm) is active and is held.

active neg.
Custody mode (instrument is lead-sealed and accurate to the nearest mm) is activated and not held, e.g. because the signal-to-noise ratio is less than 10 dB (refer to "**echo quality**" **(056)** function in the "**extended calibr.**" **(05)** function group).



After 3 s, the following message appears

12 Function group "system parameters" (0C)



12.1 Function "tag no." (0C0)

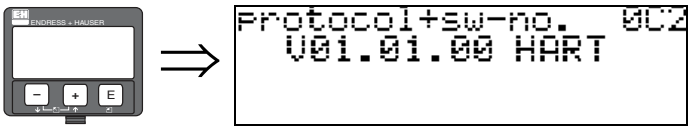


You can define the tag number with this function.

User input:

- 16 alphanumeric characters for HART instruments (8 using the HART universal command)

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

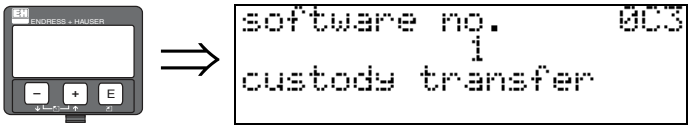


This function shows the protocol and the hardware and software version: Vxx.yy.zz.prot.

Display:

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

12.3 Function "software no." (0C3)



This function shows the software number of the device.

12.4 Function "serial no." (0C4)



This function displays the instrument serial number.

12.5 Function "distance unit" (0C5)



You can select the basic distance unit with this function.

Selection:

- m
- ft
- **mm**
- inch

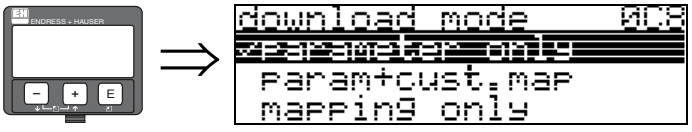
Dependence

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) - liquids only
- 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)

12.6 Function "download mode" (0C8)



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.

13 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 (in preparation) for Micropilot S.

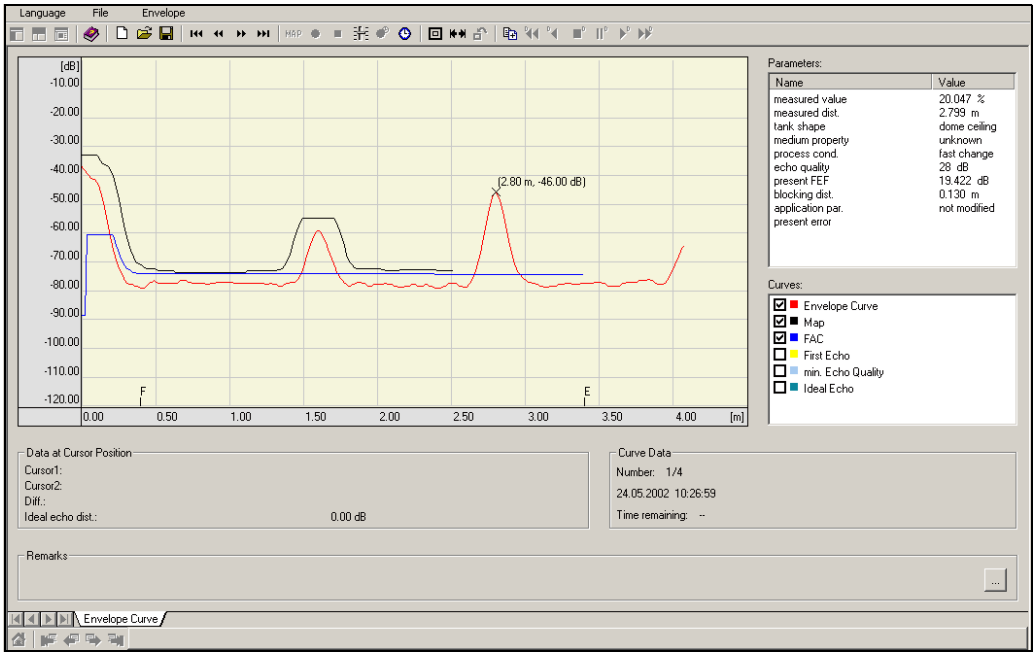
13.1 Software history

Software version / Date	Software changes	Documentation changes
V 01.01.00 / 10.2006	Original software. Operated via: – ToF Tool from version 4.6 – HART communicator DXR375 with Rev. 1, DD 1.	
V 01.01.02 / 07.2009	Adaptation parabolic antenna	

14 Envelope curve

14.0.1 Envelope curve with FieldCare

Signal analysis via envelope curve



See → 60 ff. for the envelope curve in the local display.

14.0.2 Tank mapping

Generation of an envelope curve

Depending on the distance, the electromagnetic wave with a frequency of approx. 26 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 44 ms.

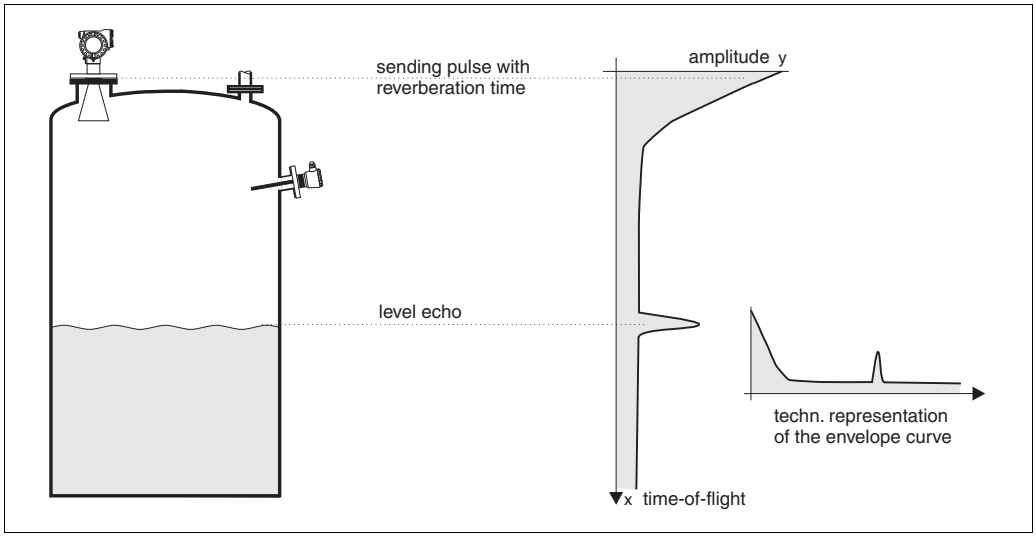
The sampling factor is 164 660 for 26 GHz. The resulting carrier frequency 158 kHz at 26 GHz, respectively.

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 Endress+Hauser software “FieldCare” and an interface adapter can be used for display and evaluation of an envelope curve. Hardware and software requirements you can find on the internet: www.endress.com » select your country » Search: FieldCare » FieldCare » Technical Data.



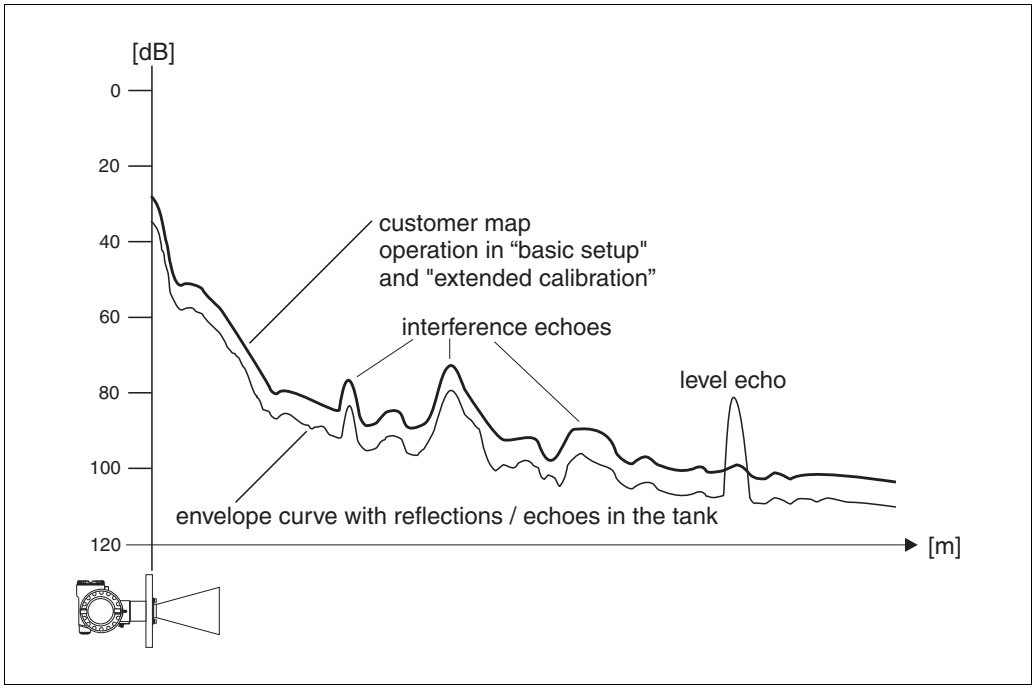
1 Example of a tank with a schematic envelope curve

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.

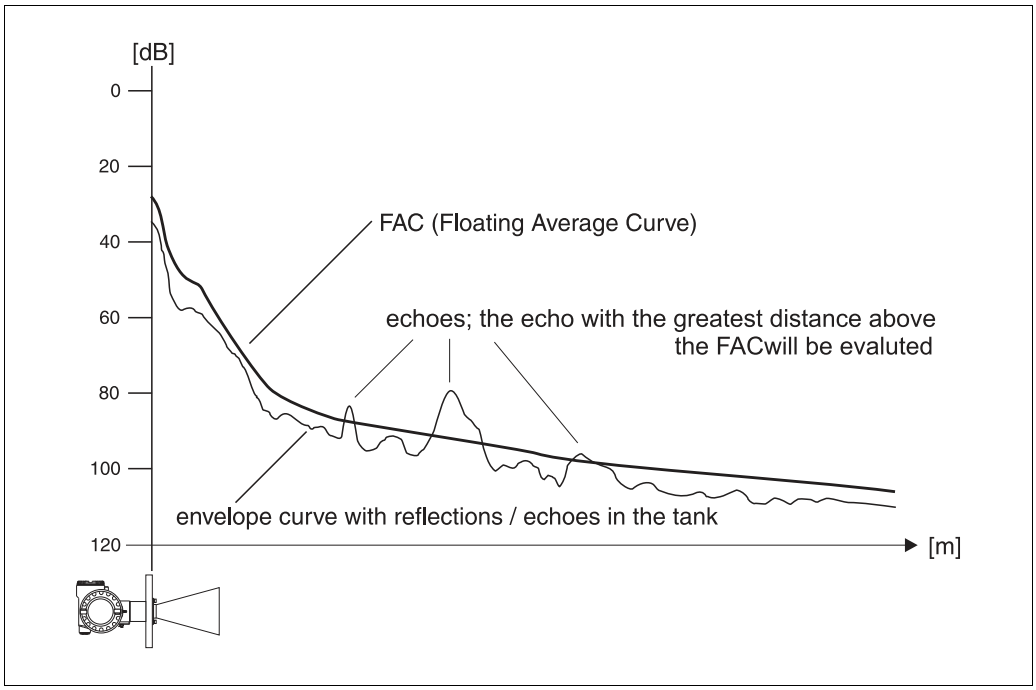


The FAC (Floating Average Curve)

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.

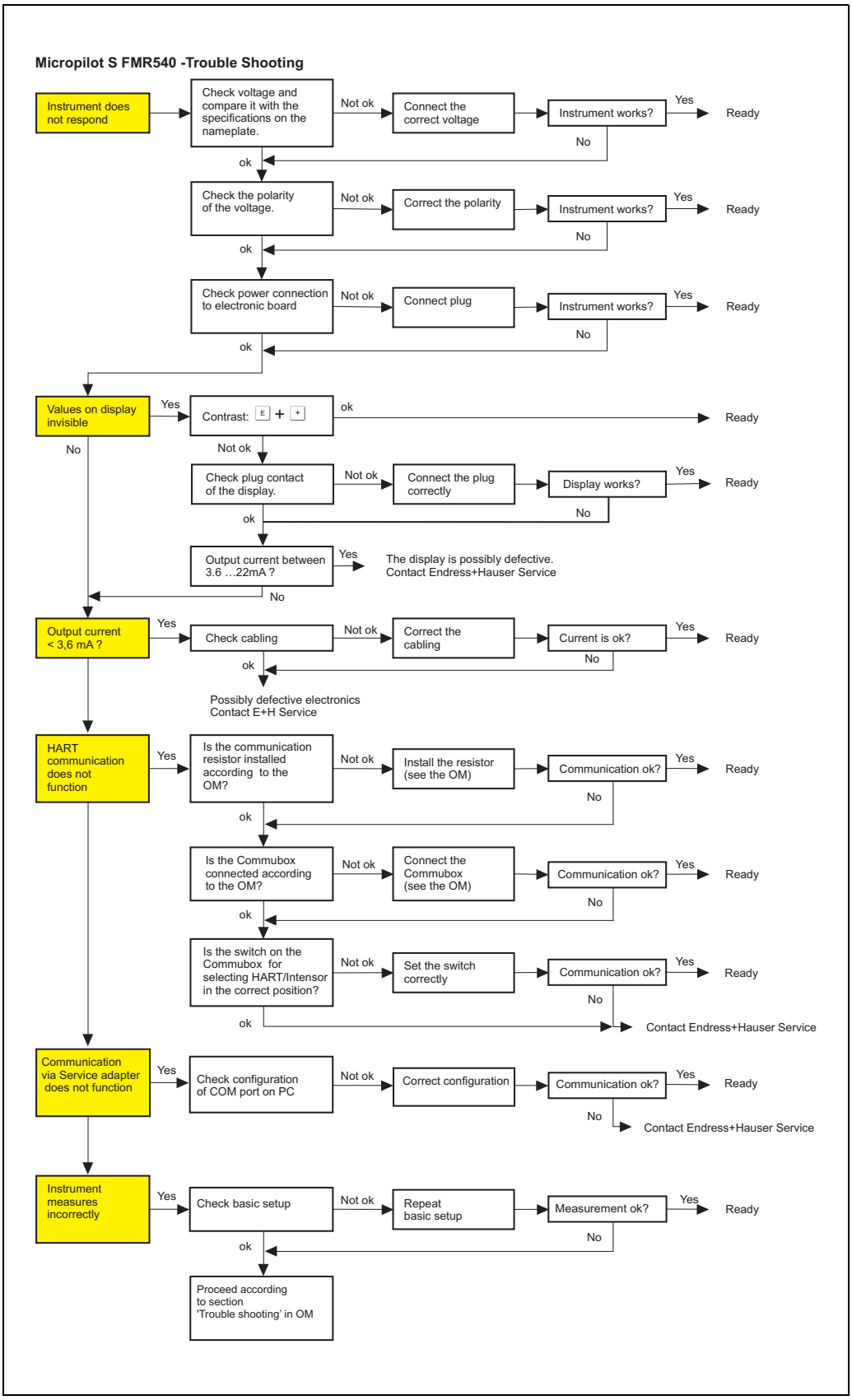


15 Trouble-shooting

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 → 81 ff. or in the appropriate instrument operating manual.

15.1 Trouble-shooting instructions



15.2 System error messages

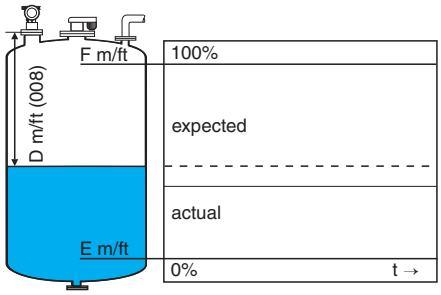
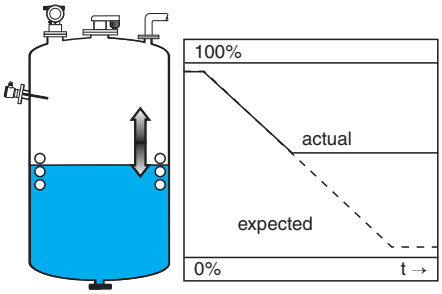
Code	Description	Possible cause	Remedy
A102	checksum error general reset & new calibr.required	device has been powered off before data could be stored; emc problem; E^2PROM defect	reset; avoid emc problem; if alarm prevails after reset, exchange electronics
W103	initialising - please wait	E^2PROM storage 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; E^2PROM 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	RAM defective	reset; if alarm prevails after reset, exchange electronics
A114	electronics defect	E2PROM defective	reset; if alarm prevails after reset, exchange electronics
A115	fault power supply	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; E^2PROM 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; E^2PROM 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 and electronics
A270	Custody switch out of check position	Switch for custody transfer may be defective	check position of custody switch; exchange electronics
W511	no factory calibration ch1	factory calibration has been deleted	record new factory calibration

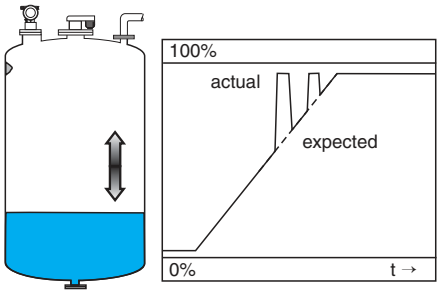
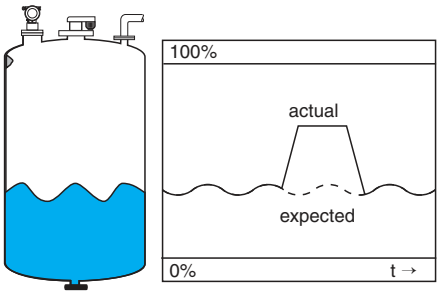
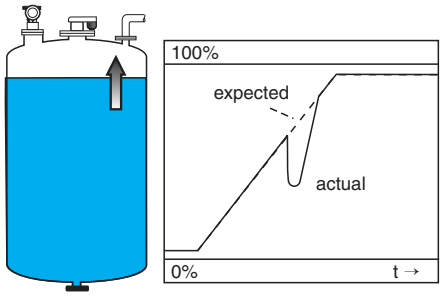
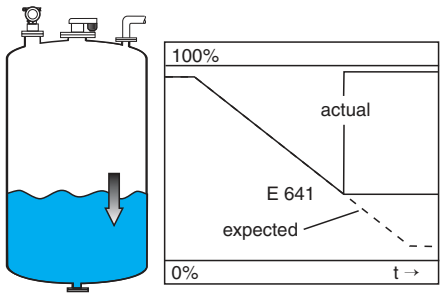
Tab. 15-1

Code	Description	Possible cause	Remedy
W512	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
E641	no usable echo channel 1 check calibr.	echo lost due to application conditions or 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

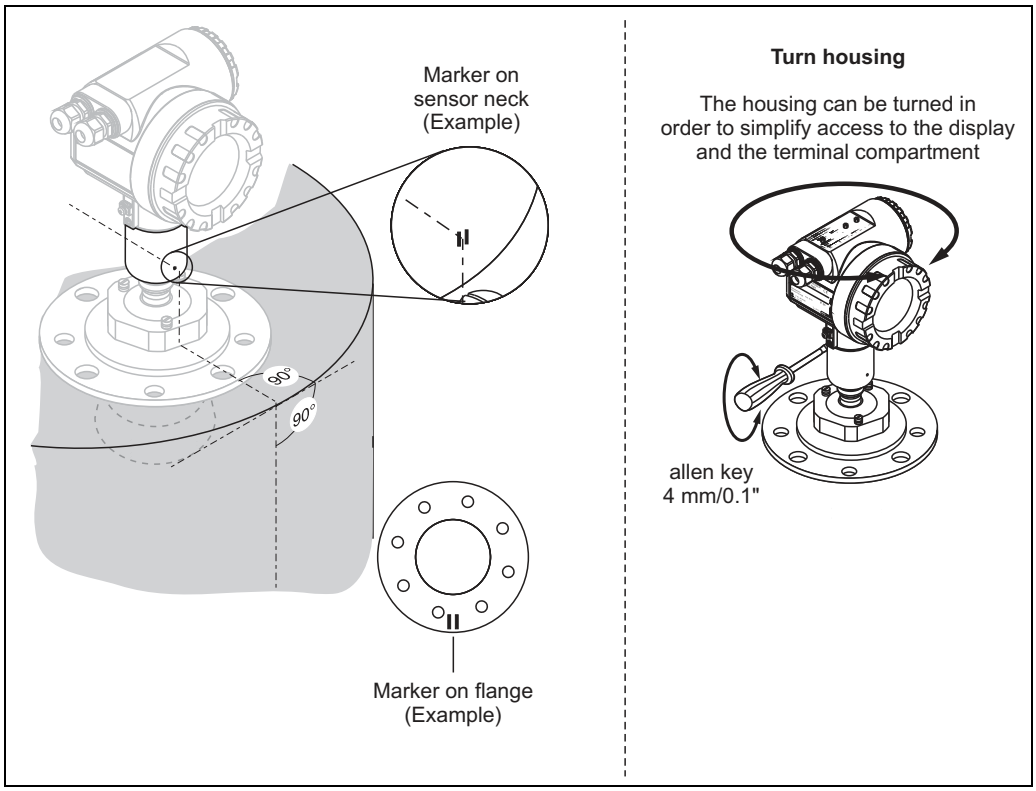
Tab. 15-1

15.3 Application errors

Error	Output	Possible cause		Remedy
A warning or alarm has occurred.	Depending on the configuration	See table of error messages (→ 82)		1. See table of error messages (→ 82)
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 3. Check dip table
		no ↓		
		An interference echo may have been evaluated.	yes →	1. Carry out tank mapping → basic setup
		no ↓		
		→	→	Customise the measurement with help of dip table
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

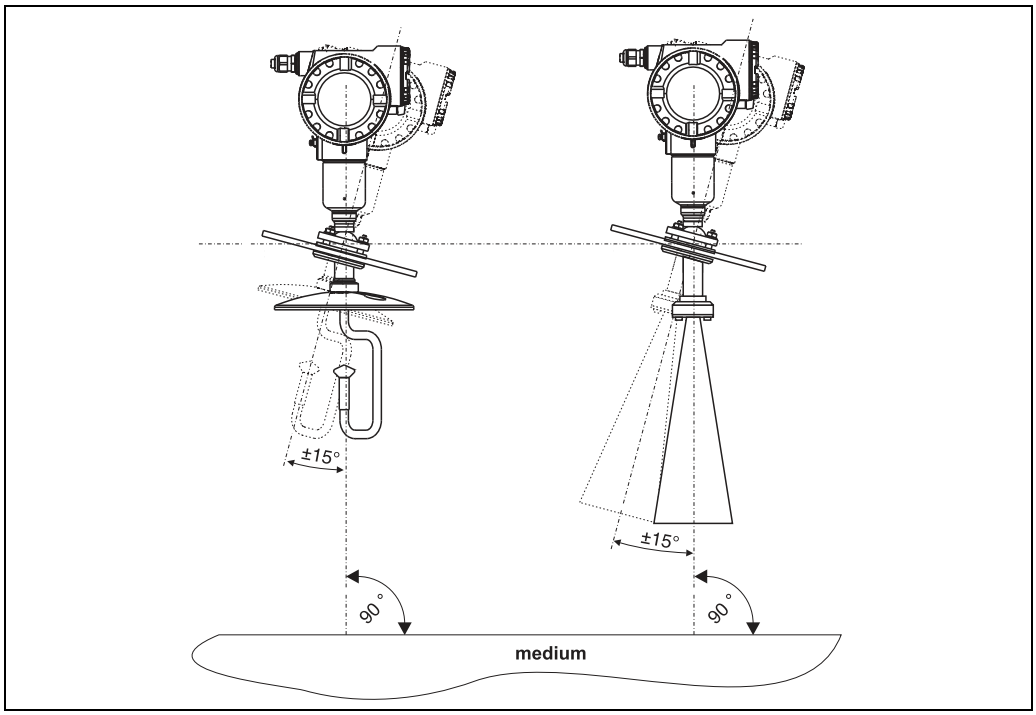
Error	Output	Possible cause		Remedy
If the surface is not calm (e.g. filling, emptying, agitator running), the measured value jumps sporadically to a higher level	 	Signal is weakened by the rough surface – the interference echoes are sometimes stronger		1. Carry out tank mapping → basic setup 2. Set the process cond. (004) to "turb. surface" or "agitator" 3. Increase the output damping (058) 4. Optimise the orientation (→ 86) 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
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 (→ 86) 3. If necessary, select a better installation position and/or larger antenna

15.4 Orientation of the Micropilot



Alignment unit - optional

Micropilot S should be installed vertically towards the liquid surface for best measuring performance of ±1 mm. Using the alignment unit it is possible to tilt the antenna axis by up to 15° in all directions. The alignment unit is used for the optimum alignment of the radar beam to the liquid surface. The Sensor should be positioned vertical to the liquid surface in inclination of 0° for the parabolic antenna and 3° for the horn antenna.



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