

MicroTREK

H-700

2-wire Guided Wave Radar
Level Transmitters

Programming Manual
5th Edition



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Thank you for purchasing a NIVELCO product.

1. INTRODUCTION

Application

The **MicroTREK** 2-wire guided wave radar level transmitter measures the distance to the surface of liquids, solids, and granules, from which the device calculates and transmits the level, volume, or mass values as required. The device can be used in storage and reaction tanks, bypass chambers, rigid pipelines of suitable diameter, and level reference vessels. The device can also be used with HART® compliant EView2, PACTware and MultiCONT universal process controller.

1.1 Local display / menu handling

1.1.1 SAP-300 display unit (optional)

MicroTREK H-700 type compact guided wave radar transmitters can be equipped with an SAP-300 display unit. The display shows the actual measurement value and status information by default. The display can also be used to program most of MicroTREK's parameters with the four buttons.

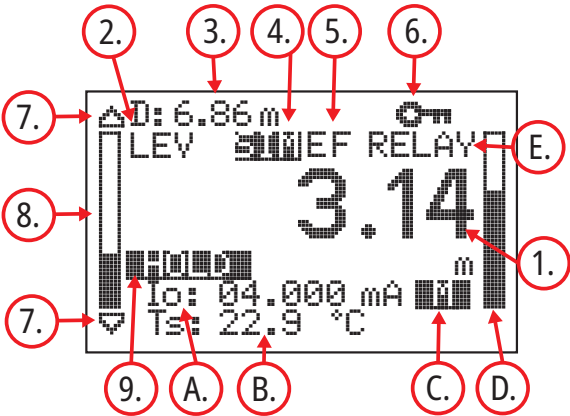
SAP-300 display unit – technical data		Warning!
Display	64 × 128 dot matrix LCD	 Do not expose the SAP-300 to prolonged heat or sunlight as the display may be damaged.
Operating temperature:	–20...+65 °C (–4...+149 °F)	

Do not leave the SAP-300 in the MicroTREK, if it is not possible to protect the MicroTREK from sunlight or if the **MicroTREK** is to be used outside the operating temperature range of the SAP-300.



1.1.2 Elements of the display

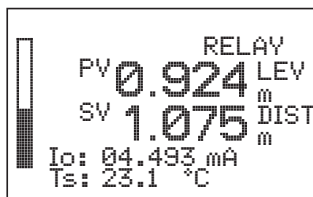
1	Measured Primary Value (PV), with unit indication below (5 digit)		
2	Measured quantity (PV mode): LEV – Level, VOL – Volume...		
3	Raw value for PV calculation: ' D: ' – Distance, ' L: ' – Level,		
4	SIM – indicator: Simulation mode active. Warning! PV is simulated, not measured.		
5	Empty/Full marker: ' E ' – Tank Empty, ' F ' – Tank Full		
6	Menu locked by: ' key ' – Security code, ' REM ' – Remote access active		
7	Trend indicator: ' △ ' – slow increase, ' ▲ ' – fast increase, ' ▽ ' – slow decrease, ' ▼ ' – fast decrease		
8/D	Bar-graph: <i>left</i> – Level % (full range), <i>right</i> – Output % of 4–20 mA output range		
9	Output status indicator: ' OCT ' – Output Conversion Table active		
	speed Level change speed exceeds limit, output holding last valid		
	hold Echo loss, output holding last valid value		
	F/EE Echo loss, output continuing last valid trend		
A	Output current value	B	Transmitter temperature
C	Output mode: ' M ' – Manual, ' H ' – HART multi-drop, ' E ' – Error current		
E	' RELAY ' – Relay On (C2 state)		



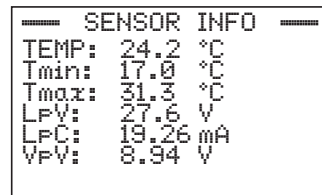
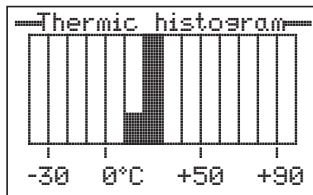
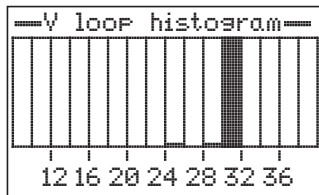
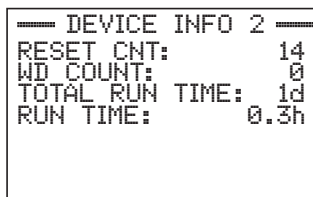
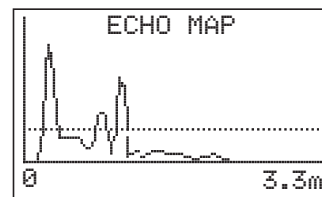
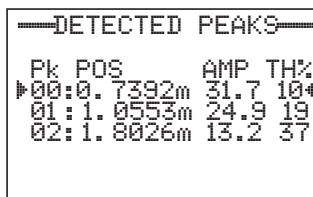
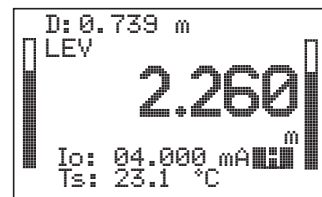
1.1.3 Info screens

You can switch between info screens using the   and  buttons.

- Value display: single display mode
- Echo map: dotted line indicates threshold level
- Peak list: Peak no., Position, Amplitude [dB], Threshold relative to peak amplitude
- Device info 1: Type and version info
- Device info 2: Run time info (only for advanced diagnostic purposes)
- Sensor Info: (TEMP) Electronics temperature, (LpV) Loop voltage, (LpC) Loop current, (VpV) Internal buffer voltage.
- Histogram: Thermic histogram, Loop voltage histogram



 3 sec



1.1.4 Menu handling

Navigating in the menu	Button	Value input	Checkbox setting
Entering the selected menu		Accepting the setting	Accepting the setting
Selecting a menu item		Modifying digit value	Selecting an item
Going back to the previous menu		Next digit	Switching checked/unchecked

Menu properties

Enter the main menu from any info screen by pressing the  button.

Menu TOP row: left – MENU TITLE, right –  or  indicates that menu can be scrolled in given direction.

Menu BOTTOM row: left – **<Menu ID>** (M-ID), right – **Parameter-ID** (P-ID), only if relevant

Changes take effect only after you exit the menu. Until then, the transmitter continues to operate with the previous settings.

After 30 seconds of inactivity (or if SAP-300 is unplugged) MicroTREK will automatically exit the menu, discard-ing all changes.

Local display access and remote programming (**REM**) through Bluetooth®, HART or MODBUS block each other. Whichever is first will have priority.

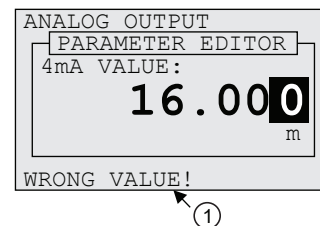
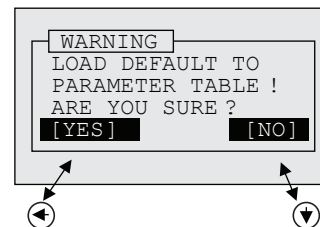
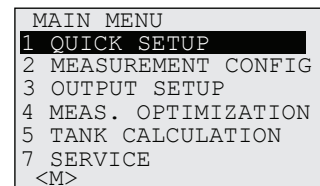
Dialog BOX:  or  buttons perform the function displayed on the screen, e.g., [Yes], [No].

Value input – special key combinations (press simultaneously)

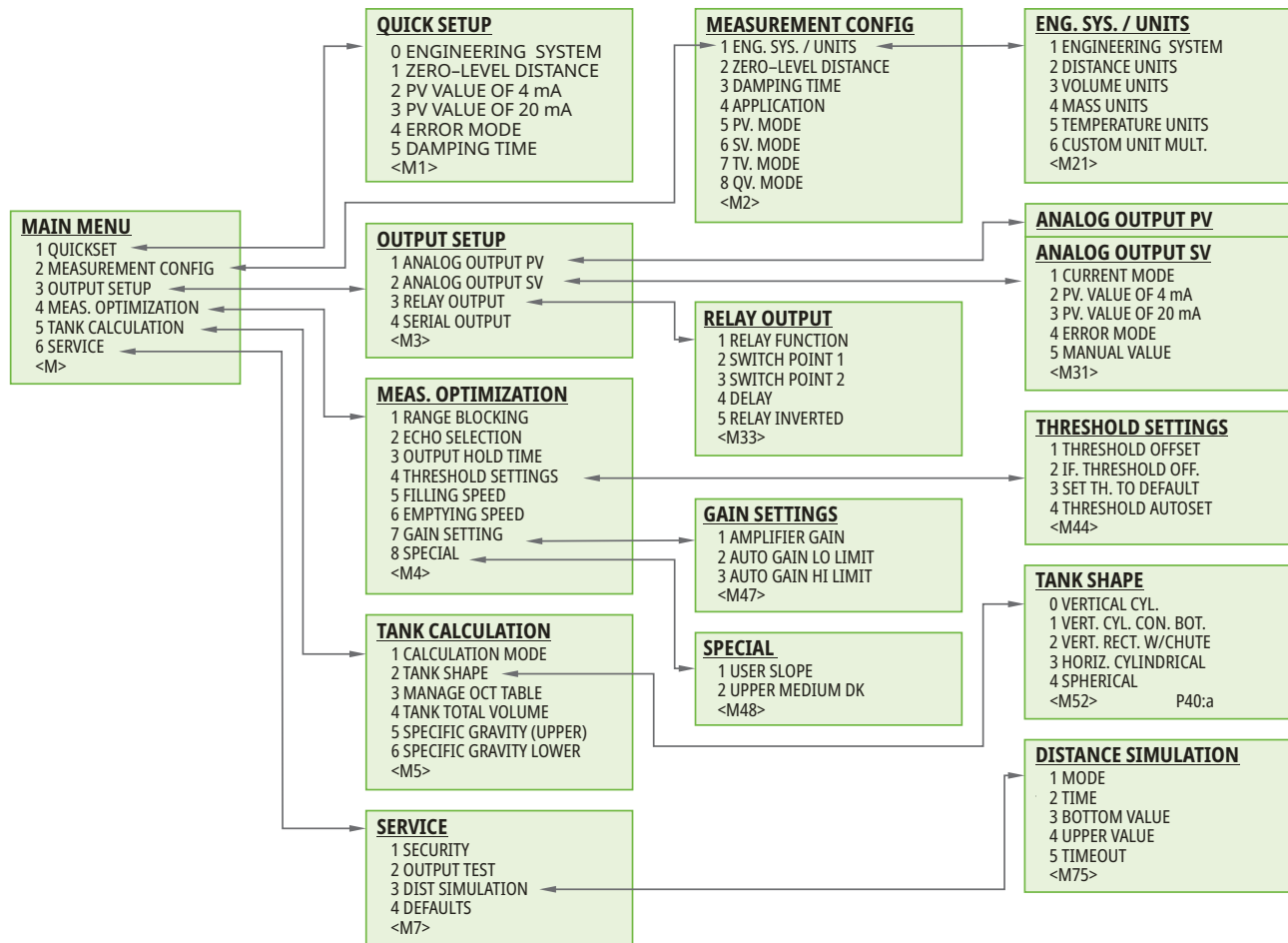
 +  → Return to original value.

 +  → Set to default value.

 +  → Set to actually measured value. (Supported only for some parameters.)



1.1.5 Menu map



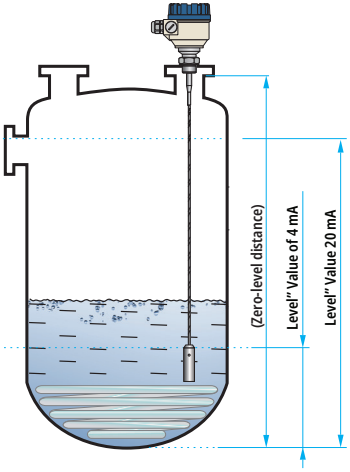
2. MicroTREK SETTINGS

2.1 Quick setup

Local display menu	M-ID	EView2	MonoCONT	P-ID	MultiCONT	MODBUS
QUICKSET	Q	—	—	—	—	—

MicroTREK H-700 offers a built-in Quick Setup feature for simple LEVEL measurement applications.

Quick Setup guides you sequentially through the following basic settings. Press  button for 3 seconds to exit Quick Setup any time.

#		Description	
0	ENGINEERING SYSTEM	Defines RF compliance and the unit system (Metric/Imperial) to be used. For USA select "US / Imperial". See chapter 2.2.1 Engineering System / Units for more information.	
1	ZERO-LEVEL DISTANCE	Defines the zero point for level measurement. Enter the distance between the sealing plane of the process connection and the designated zero level. See chapter 2.2.2 Measurement Configuration / Zero-level distance for more information.	
2	PV VALUE OF 4 mA	Defines the LEVEL value assigned to 4 mA current output, by default the zero-level. See chapter 2.3.1 Output setup / PV Value of 4 mA for more information.	
3	PV VALUE OF 20 mA	Defines the LEVEL value assigned to 20 mA current output, by default the maximum measurable level. The analog output automatically scales the set level range to the 4...20 mA current output range. See chapter 2.3.1 Output setup / PV Value of 20 mA for more information	
4	ERROR MODE	Defines the behavior of the current output in case of "No echo error", i.e. while no up-to-date LEVEL value is available. See chapter 2.3.1. Output setup / Error Mode for more information. Options: – HOLD Keeps last valid value on output (default). Recommended setting. – 3.8 mA Outputs "Low error current". – 22 mA Outputs "High error current". Use an "Error current" mode only when the control system can unambiguously distinguish it from the valid 4 mA and 20 mA endpoints.	
5	DAMPING TIME	The delay in seconds before the output reaches 98% of the new value. Larger values smooth the output (e.g., to suppress ripples); smaller values allow a faster reaction to sudden changes. Default is 20 s. See chapter 2.2.3 Measurement Configuration / Damping for more information.	

2.2 Measurement Config

2.2.1 Eng. Sys. / Units

a. Engineering System

P00:c

M211

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Eng. Sys. / Units → Engineering System	Application → Calculation system	Transmitter → P00 Region/Mode → Engineering system	Devices → Remote Program → App. parameters → P00 Application	800 → ☐ ☒ ☐ ☐
<M211>	P00 → ☐ ☒ ☐ ☐	<T42>	☐ ☐ ☒ ☐	—

The units that can be used (length, volume, weight) will change according to the Region set by this parameter.



Changing this parameter will reset all parameters to the factory default of the selected unit system. Always set this parameter first.

#	Value	Description	Default
0	EU / Metric	EU, United Kingdom, Switzerland, Canada, Australia, Albania, Andorra, Azerbaijan, Belarus, Bosnia and Herzegovina, Liechtenstein, Moldova, Monaco, Montenegro, New Zealand, North Macedonia, Norway, San Marino, Saudi Arabia, Serbia, Turkey, Ukraine	EU / Metric
1	US / Imperial	United States	

b. Distance Units

P00:b

M212

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Distance Units	Application → Engineering units	Transmitter → P00 Region/Mode → Distance units	Devices → Remote Program → App. parameters → P00 Application	800 → ☐ ☐ ☒ ☐
<M212>	P00 → ☐ ☐ ☒ ☐	<T43>	☐ ☐ ☒ ☐	—

⁽¹⁾ Appears only if PV, SV, TV, or QV is set to MASS.

#	Metric	Imperial	Description	Default (Metric/Imperial)
0	m	ft	This setting defines the level or distance unit used on digital outputs, such as local display, HART, or Modbus. Additionally, the configuration parameters also require the value given in the unit set here. If “custom unit” is selected, the unit uses the unit of length as the distance unit based on the value specified in “User Unit.”	m / ft
1	cm	inch		
2	mm	inch		
3	custom unit		 Changing the ‘Distance Unit’ parameter will reset all other parameters to the default of the selected unit system, except the ‘Region’ setting. All user parameters must be set again.	

c. Volume Units

P02:b

M213

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Volume Units ⁽¹⁾	Measurement config. → Volume unit	Transmitter → Transmitter setup → P02 Output unit → Volume units	Devices → Remote Program → Parameters → P02 Output unit	804 → ☐ ☐ ☒ ☐
<M213>	P02 → ☐ ☐ ☒ ☐	<T1021>	☐ ☐ ☒ ☐	—

⁽¹⁾ Appears only if PV, SV, TV, or QV is set to VOLUME.

#	Metric	Imperial	Description	Default (Metric/Imperial)
0	liter	gallon	Defines the unit used for digital Volume value output. The unit of the transmitted number when set to volume measurement. The device converts the measured level into volume by calculation. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the “Output” column in the VM table (OC).	m ³ / barrel
1	hl	ft ³		
2	m ³	barrel		
3	million liters	million gallons		

d. Mass Units

P02:a

M214

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Mass Unit ⁽¹⁾	Measurement config. → Mass unit	Transmitter → Transmitter setup → P02 Output unit > Mass Unit	Devices → Remote Program → Parameters → P02 Output unit	804 → □□□■
<M214>	P02 → □□□■	<T1022>	□□□□■	—

⁽¹⁾ Appears only if PV, SV, TV, or QV is set to MASS.

#	Metrikus	Imperial	Leírás	Default (Metric/Imperial)
0	kg	lb	The unit of the transmitted number if the device is set for weight measurement. The device converts the measured level into mass. It is done by using a level-dependent (non-linear) function. It also gives the unit of measure for the "Output" column in the VM table (OC).	ton / US ton
1	ton	US ton		
2	US ton	metric ton		

e. Temperature Units

P00:d

M215

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Temperature Units	Measurement config. → Temperature	Transmitter → P00 Region/Mode → Temperature Unit	Devices → Remote Program → Parameters → P00 Application	800 → ■□□□
<M215>	P00 → ■□□□	<T44>	□■□□□	—

#	Metric	Imperial	Description	Default
0		°C	Defines the unit used for digital Temperature output.	°C
1		°F		

f. Custom Unit Multiplier

P07

M216

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → Region / Units → Custom Unit Mult.	Application. → Conversion factor	—	—	—
<M216>	P07	—	—	—

This setting is only available when “Distance Units (M212, P00:b)” is set to “3: custom unit”.

The distance in “custom unit” equals the distance in meters multiplied by P07.

This field is only visible and active when “custom unit” is selected as the unit system.

The multiplier is referenced to the meter; the conversion factor must always be specified relative to one meter.

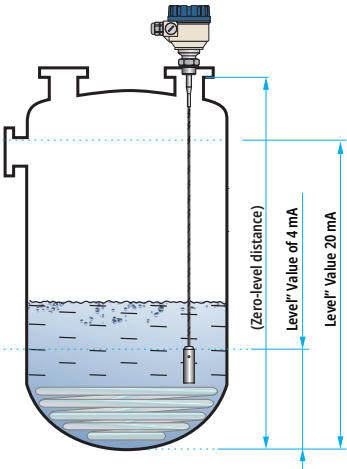
For example, a conversion factor of 10 yields a unit of 10 m (33 ft) while a factor of 0.1 yields a unit of 0.1 m (0.33 ft).

	Value range	Unit	Default
Custom Unit Multiplier	0.001...100	meter	1.000

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Zero-Level Distance	Measurement config. → Zero-Level Dist.	Transmitter → Transmitter setup → P04 Zero-level distance	Devices → Remote Program → Parameters → P04 Zero-level distance	808 → float
<M22>	P04	<T104>	—	—

The “Zero-level distance” (or “Tank Height” – 'A') is the distance between the “reference plane” of the process connection and the designated “zero level” of the application, typically the bottom of the tank. The device calculates the level by subtracting the measured “Level Distance” ('DIST') from the “Zero-level distance”. Level = P04 (A) – Distance

This parameter shall always be set, except for distance measurement.



	Value range	Unit	Default
Zero-level distance	60 m (0...200 ft)	“Distance Unit”	Maximum measuring range of the probe See User’s Manual, “Maximum measuring range” in Probe properties table

2.2.3 Damping Time

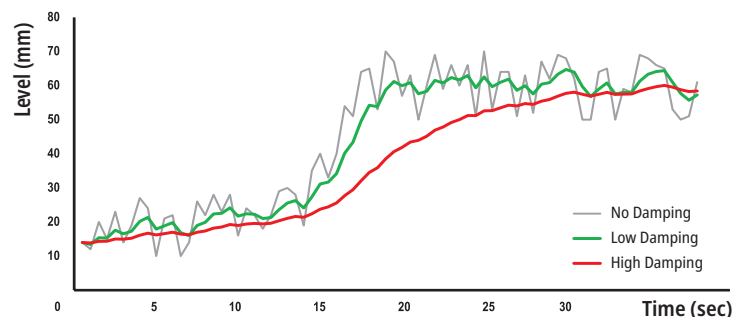
P20

M23

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Damping Time	Measurement optimization → Damping time	Transmitter → Transmitter Setup → P20 Damping time	Devices → Remote Program → Parameters → P20 Damping Time	840 → float
<M23>	P20	<T120>	—	—

Damping time reduces unwanted fluctuations in the display of measured data (e.g., ripples). It slows down the reaction of the output. Within the set time, the output reaches 98% of the new value.

	Value range	Unit	Default
Damping Time	0...999	s	20 s



2.2.4 Application

P00:a

M24

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → Application	Application → Operation mode	Transmitter → P00 Region/Mode → Application	Devices → Remote Program → App. parameters → P00 Application	800 → ☐ ☐ ☐ ☒
<M24>	P00 → ☐ ☐ ☐ ☒	<T41>	☐ ☐ ☐ ☒	—

#	Value	Description	Default
0	Liquid	Measured medium property. The basic characteristic of the measured medium is set here. The measuring capabilities of the device vary significantly depending on this characteristic of the medium (see specification).	Liquid medium
1	Granular solid		
2	Liquid If. (Two interfacing liquids)		

2.2.5 PV Mode (Primary Output Value)

M25

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → PV Mode	Measurement configuration → Measurement Mode (PV source)	Transmitter → Transmitter setup → P01 PVSV mode → PV mode	Devices → Remote Program → Parameters → P01 Output function	802 → □□■ ■
<M25>	P01 → □□■ ■	<T1011>	□□□■ ■	—

Defines the Value transmitted on the Primary Output (PV), including the analogue output (4...20 mA loop current), as well as the value shown on local display.
Default: "Level"

#	Value	#		Description	Default
10	Distance	20	Distance 2	Distance (DIST) of the level as measured by the Transmitter.	Level
11	Level	21	Level 2	Level (LEV) is calculated from "Distance" based on "Zero-level distance" (See "2.2.2 Zero-Level Distance").	
12	Volume	22	Volume 2	Volume (VOL) is calculated from "Level" based on tank shape settings. (See "2.5. Tank Calculation")	
15	Ullage Volume			Empty Volume (UL.VOL) is calculated from "Volume" based on "Total Volume" setting. (See "2.5. Tank Calculation")	
13	Mass	23	Mass 2	Weight (MASS) is calculated from "Volume" based on "Specific Gravity" setting. (See "2.5. Tank Calculation")	
16	Level%			Level% is the relative level in a 0% to 100% range. (100% is defined by "Min. Measuring Distance" setting.)	
17	Volume%			Volume% is the relative volume in a 0% to 100% range.	
31	Δ Level			The difference between Level 1 and Level 2.	
32	Δ Volume			The difference between Volume 1 and Volume 2.	
33	Δ Mass			The difference between Mass 1 and Mass 2.	
40	Device Temperature			Temperature of transmitter. (Indicative for ambient temperature.)	

2.2.6 SV Mode (Secondary Output Value)

M26

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → SV Mode	Measurement configuration → Secondary value source (SV)	Transmitter → Transmitter setup → P01 PVSV mode → SV mode	Devices → Remote Program → Parameters → P01 Output function	802 → ■■■□
<M26>	P01 → ■■■□	<T1012>	□■■■□	—

Defines the Value transmitted on the Secondary Output (SV), which is available on the digital output channels like HART® or MODBUS. See “PV Mode” concerning the selectable values. **Default: “Distance”**

2.2.7 TV Mode (Third Output Value)

M27

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config. → TV Mode	Measurement configuration 2 → Third value source (TV)	Transmitter → Transmitter setup → P30 TVQV mode → TV mode	—	860 → □□■■■
<M27>	P30 → □□■■■	<T1301>	—	—

Defines the Value transmitted on the Third Output (TV), which is available on the digital output channels like HART® or MODBUS. See “PV Mode” concerning the selectable values. **Default: “Volume”**

2.2.8 QV Mode (Fourth Output Value)

M28

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Config → QV Mode	Measurement configuration 2 → Forth value source (QV)	Transmitter → Transmitter setup → P30 TVQV mode → QV mode	—	860 → ■■■□□
<M28>	P30 → ■■■□□	<T1302>	—	—

Defines the Value transmitted on the Fourth Output (QV), which is available on the digital output channels like HART® or MODBUS. See “PV Mode” concerning the selectable values. **Default: “Ullage volume”**

2.3 Output setup

2.3.1 Analog Output PV

M31

a. Current Mode

M311

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output PV → Current Mode	Outputs → Current output → Current generator mode	Transmitter → Transmitter setup → P12 Errorcurrent mode → Current Mode	Devices → Remote Program → Parameters → P12 current output	824 → ☐ ☐ ☒ ☐
<M311>	P12 → ☐ ☐ ☒ ☐	<T1122>	☐ ☐ ☒ ☐	—

Selects the current loop output mode when transmitting current.

Analog current output mode:

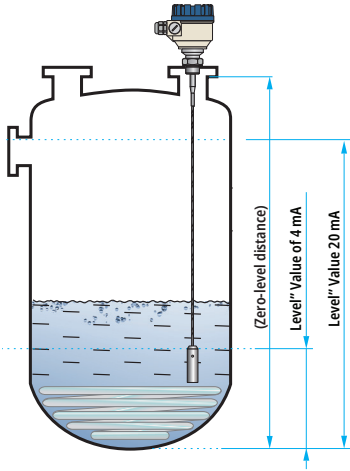
#	Value	Description	Default
0	Auto (current transmission)	The value of the output current is calculated from the measured value using the parameters P10 and P11. The output of the transmitter is active. The value of the output current is not calculated from the measured value. Instead, a fixed output current (P08) is sent to the output. In this mode, the setting of the fault current mode is irrelevant. Multi-drop HART communication mode 4 mA "HART Address" (P19) override.	AUTO
1	Manual		

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output PV → PV Value of 4 mA	Outputs → Current output → Assignment of 4 mA - PV	Transmitter → Transmitter setup → P10 PV Assign 4 mA	Devices → Remote Program → Parameters → P10 PV assign 4 mA	820 → float
<M312>	P10	<T110>	—	—

The value of the transmitted quantity assigned to 4 mA output current. Default: "0.0".

In "Automatic" mode of the analog current output, the PV value assigned to 4 mA (usually the lower limit of the measuring range for level measurement). The device scales the (HART – PV, see P01 PV/SV mode) output value to the analog current output 4...20 mA range using the values specified in parameters P10 and P11.

	Value range	Unit	Default
PV Value of 4 mA	0...99.999	"Distance Unit"	0



c. PV Value of 20 mA

P11

M313

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output PV → PV Value of 4 mA	Outputs → Current output → Assignment of 20 mA - PV	Transmitter → Transmitter setup → P11 PV Assign 20mA	Devices → Remote Program → Parameters → P11 PV assign 20 mA	822 → float
<M313>	P11	<T111>	—	—

The value of the transmitted quantity assigned to 20 mA output current.

In the case of “Automatic” (current transmission) mode of the analog current output, it is the PV assigned to 20 mA (usually the upper limit of the measurement range in the case of level measurement). The device scales the (HART – PV, see P01 PV/SV mode) output value to the analog current output 4...20 mA range using the values specified in parameters “PV Value of 4 mA” and “PV Value of 20 mA”. The values can be assigned inversely. (For example, 4 mA to 1 m [3.3 ft] level and 20 mA to 10 m [33 ft] level, or vice versa 20 mA to 1 m [3.3 ft] level and 4 mA to 10 m [33 ft] level.)

d. Error Mode

P12:a

M314

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output PV → Error Mode	Outputs → Current output → Error indication by the current output	Transmitter → Transmitter setup → P12 Errorcurrent mode → Error Mode	Devices → Remote Program → Parameters → P12 current output	824 → □□□■
<M314>	P12 → □□□■	<T1121>	□□□□■	—

Error current mode: the device indicates the error state on the current output according to the setting below. The error indication set as below persists until the error is cleared.

#	Value	Default
0	HOLD (holding last valid value)	HOLD
1	3.8 mA	
2	22 mA	

e. Manual Value

M315

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Analog Output PV → Manual Value	Outputs → Current output → Fix output current (P08)	Transmitter → Transmitter setup → P08 Fix output current	Devices → Remote Program → Parameters → P08 Fix current	816 → float
<M315>	P08	<T108>	—	—

If the “Current Mode” (P12:b) is set to “Manual” the output current takes the value specified here, and the analog transmission switches off. A value between 3.8...20.5 mA is specified in this parameter. Caution: the device automatically switches to “Fix” current output mode when a new value is set in parameter “Manual Value” (P08). When 0 is entered, the device switches to “Auto” current transmission mode (“Current Mode” P12:b = 0) and resets the value of parameter P08 to the factory setting. In HART multi-drop mode (see parameter P19 Short Address), the current loop output is fixed at 4 mA, as per standard, and the manual output current value “Manual value” (P08) does not apply. Default: 4.0 mA

	Value range	Unit	Default
Manual value	3.8...22	mA	4 mA

2.3.2 Analog Output SV

M32

This function is identical to the 6.3.1. Analog Output PV function, but is available only in the dual-current-generator version.

2.3.3 Relay Output (optional)

a. Relay Function

P13:ba

M331

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Relay Function	Outputs → Relay output → Relay mode	Transmitter → Transmitter setup → P13 Relay Function → Relay mode	Devices → Remote Program → Parameters → P13 Relay function	826 → □□■ ■
<M331>	P13 → □□■ ■	<T1131>	□□□■ ■	—

This parameter can set the operating mode of the RELAY, which is optionally built into the device. If it is set to “by PV,” the RELAY operates based on the triggering “Switch Point 1” (P14) and releasing “Switch Point 2” (P15) values set. The “No ECHO” setting enables a switched (relay contact) error signal to the process controller.

Caution: when the device is de-energized, the relay releases, so C1 is ON.

#	Value	Default
00	PV Hysteresis (see below for function)	Hysteresis
01	PV Window (see below for function)	
04	C1 if Error	
09	Relay OFF	

Function		Programmable parameters	Description
Hysteresis		Switch Point 1 and 2 At least 1 mm (0.039") hysteresis is required between Switch Points 1 and 2. Switch Point 1 > Switch Point 2 – normal operation Switch Point 1 < Switch Point 2 – inverted operation	The basic switching method of the RELAY set to "PV" mode can be adjusted.
Window comparator		Switch Point 1 and 2 At least 1 mm (0.039") hysteresis required between Switch Points 1 and 2. Switch Point 1 > Switch Point 2 – normal operation Switch Point 1 < Switch Point 2 – inverted operation	The basic switching method of the RELAY set to "PV" mode can be adjusted.

b. Switch Point 1

P14

M332

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Switch Point 1	Outputs → Relay output → Relay parameters → Energized value	Transmitter → Transmitter Setup → P14 Relay on state value	Devices → Remote Program → Parameters → P14 Relay on value	828 → float
<M332>	P14	<T114>	—	—

The measured PV value at which reaching the upper limit value is indicated on the RELAY output. Adjustable value range: Value is adjustable according to PV setting range.

	Value range	Unit	Default
Switch Point 1	0...99.999	"Distance Unit"	1.000 m (3.300 ft)

c. Switch Point 2

M333

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Switch Point 2	Outputs → Relay output → Relay parameters → De-energized value	Transmitter → Transmitter Setup → P15 Relay off state value	Devices → Remote Program → Parameters → P15 Relay off value	830 → float
<M333>	P15	<T115>	—	—

The measured PV value at which reaching the lower limit value is indicated on the RELAY output. Adjustable value range: Value is adjustable according to PV setting range.

	Value range	Unit	Default
Switch Point 2	0...99.999	"Distance Unit"	5.000 m (16.400 ft)

d. Delay P16 M334

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Delay	Outputs → Relay output → Relay delay time	Transmitter → Transmitter Setup → P16 Relay delay	Devices → Remote Program → Parameters → P16 Relay delay	832 → float
<M334>	P16	<T116>	—	—

If the PV measurement value reaches the lower or upper switching value, or an error signal occurs, the actual RELAY operation — or the corresponding change on the output — is activated only after this delay time has elapsed.

	Value range	Unit	Default
Delay	0 ... 999	s	0

e. Relay Inverted P13:d M335

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Relay Output → Relay Inverted	Outputs → Relay output → Inverting	Transmitter → Transmitter setup → P13 Relay Function → Relay Inverted	Devices → Remote Program → Parameters → P13 Relay function	826 → ☒ ☐ ☐ ☐
<M335>	P13 → ☒ ☐ ☐ ☐	<T1132>	☐ ☒ ☐ ☐	—

If the setting is non-inverted, the RELAY closes its contacts when the trigger value is reached, otherwise (inversion), it opens these contacts.

#	Value	Default
0	Not inverted	Not inverted
1	Inverted	

2.3.4 Serial Output

a. Address

P19M341

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Output setup → Serial Output → Address	Device Identification → HART Device Short Address	Transmitter → Transmitter setup → P19 Short Address	Devices → Remote Program → Parameters → P19 Polling addr.	838 → float
<M341>	P19	<T119>	—	—

Unique device address based on which the device can be identified and managed via the HART® bus.

Value range	Unit	Default
0	Analog current loop output is active (current transmission via 4...20 mA)	0
1...15	Analog current loop inactive (no current transmission, fixed 4 mA), multi-drop	

2.4 Measurement Optimization

2.4.1 Range Blocking

a. Min. Measuring Distance (Dead Zone)

P05M411

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Min. Meas. Dist.	Measurement configuration → Minimum (P05)	Transmitter → Transmitter setup → P05 Near blocking	Devices → Remote Program → Parameters → P05 Near Blocking	810 → float
<M411>	P05	<T105>	—	—

“Min. Measuring Distance” defines the minimum measuring distance and as such the maximum measurable level. This parameter creates a dead zone within the set distance from the transmitter. Any signal within this range will be ignored. Thus, it can be used to block disturbing echo signals in the near zone.

Warning: critical parameter.

	Value range	Unit	Default
Min. Measuring Distance	Cannot be less than “Minimum measuring range” according to the Probe properties table	“Distance Unit”	See “Minimum measuring range” according to the Probe properties table

b. Max. Measuring Distance (Far-end Blocking)

P06

M412

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Max. Meas. Dist.	Measurement configuration → Far end (P06)	Transmitter → Transmitter setup → P06 Far blocking	Devices → Remote Program → Parameters → P06 Far Blocking	812 → float
<M412>	P06	<T106>	—	—

This parameter limits the maximum measuring range of the device. Signals received beyond the set distance will not be processed. Its value is calculated from the plane of the lower sealing surface of the mechanical connector (in the case of a flanged version, from the lower plane of the flange).

Far-end blocking can be turned off by setting the parameter to 0. In this case, the device will give a valid result along the entire length of the sensor.

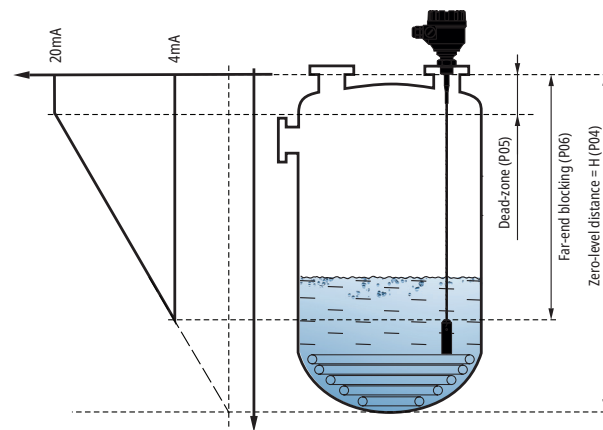
	Value range	Unit	Default
Far-Blocking Level	0 (limiter off) or the minimum measuring distance. The distance between (P05) +5 cm (1.97") and the probe length (P03)	"Distance Unit"	0.0(off) (Off)

Level or volume measurement

- If the level drops below the value of "Max. distance/Far blocking" (P06): It keeps a level value corresponding to P06 on the output and calculates the derived values from it.
- If the level goes above the far-end blocking limit:

When the level is in this zone, the output is fixed at the value corresponding to the Maximum measuring distance.

The display shows "E" for "Empty" or "Echo in far blocking". The "Echo in far blocking" signal is also detected when EView2 is consulted.



A typical setup

c. Probe Length P03 M413

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Probe Length	Measurement configuration → Sensing Distance	Transmitter → Transmitter setup → P03 Sensing distance	Devices → Remote Program → Parameters → P03 Sensing distance	806 → float
<M413>	P03	<T103>	—	—

The set value is the nominal probe length. This value should only be changed if the probe length is changed or the probe is replaced. Its value must be set in distance unit (P00:b). For special applications, the length of the probe may be greater than the height of the tank but may not exceed 30 m (98.5 ft).

	Value range	Unit	Default
Probe Length	0.1...30 m (0.33...100 ft)	"Distance Unit"	Default probe length as per order

d. Tank Full Limit P29 M414

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Range Blocking → Tank Full Limit	Advanced mode → Parameters → P29 Tank Full Limit	Transmitter → Transmitter setup → P29 Tank Full Limit	Devices → Remote Program → Parameters → P29 Tank Full Limit	858 → float
<M414>	P29	<T129>	—	—

The distance between the plane of the lower sealing surface of the process connection (or the lower plane of the flange for the flanged version) and the highest defined level in the tank. It must be set to a value equal to or greater than the value set in the "dead zone". When the measured level reaches this threshold, the instrument stops and displays the message "Tank Full" on the information output. The instrument continues to measure the level above the full tank threshold in the background, without displaying it, until the dead zone is reached.

	Value range	Unit	Default
Tank Full Limit	Minimum measurement distance ... Probe Length (P03)	"Distance Unit"	"Minimum measuring distance" according to the Probe properties table

2.4.2 Echo Selection

P25:a

M42

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Echo Selection	Measurement optimization → Echo selection → Selection of Echo...	Transmitter → Transmitter setup → P25 Echo selection	Devices → Remote Program → Parameters → P25 Echo Selection	850 → ☐ ☐ ☐ ☒
<M42>	P25 → ☐ ☐ ☐ ☒	<T125>	☐ ☐ ☐ ☒	—

The parameter “Echo Selection” (P25:a) sets the echo selection strategy. Automatic operating mode is suitable for most applications. For special application requirements, a specific echo selection can be set as required.

#	Value	Default
0	Automatic	Automatic
1	First	
2	Second	
3	Largest	
4	Last	

2.4.3 Output Hold Time

P28:b

M44

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Output Hold Time	Measurement optimization → Measurement loss management → Error delay	Transmitter → Transmitter setup → P28 Echo loss	Devices → Remote Program → Parameters → P28 Echo Loss	856 → ☐ ☐ ☒ ☐
<M441>	P28 → ☐ ☐ ☒	<T128>	☐ ☐ ☒ ☐	—

This parameter defines the time elapsed between the occurrence of the error and the issued error signal (error current). During the delay, the output holds the last valid measured value. The function is available for current output only if the error signal is set to a lower (3.8 mA) or upper (22 mA) error current.

Echo loss handling:

#	Hold (time limit)	Default	Notes	
0	No delay	10 s		During a short echo loss, the last value is held in transmission for a period set in “Hold (time limit)” (P28:b). After that, it is transmitted via HART on bit 0 of DSE(1) according to P12:a on the current loop output.
1	10 s			
2	20 s			
3	30 s			
4	1 min			
5	2 min			
6	5 min			
7	15 min			

2.4.4 Threshold Settings

a. Threshold Offset

P34

M441

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Threshold Settings → Threshold offset	Measurement optimization → Threshold offset	Transmitter → Transmitter setup → P34 Threshold offset	Devices → Remote Program → Parameters → P34 Thresh. offs.	868 → float
<M441>	P34	<T134>	—	—

It is used for simple relative modification of the acceptance threshold value set in the Echo diagram, the value range of which is $-4095...+4095$. It can increase (positive value) or decrease (negative value) the device's noise suppression ability compared to the default setting. If the value is 0, there is no change compared to the set threshold value. (See Chapter 4.3 Level Threshold settings).

Caution: a “No echo” error message may appear if the set value is too high.

	Value range	Unit	Default
Threshold offset	$-4095...+4095$	“ADC value”	0

b. Interface Threshold Offset

P35

M442

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Threshold Settings → If. Threshold offset	Measurement optimization → Threshold offset	Transmitter → Transmitter setup → P35 If. Threshold offset	Devices → Remote Program → Parameters → P35 If. Thresh. offs.	869 → float
<M442>	P35	<T135>	—	—

Interface measurement parameter that helps to detect the second level. If an echo exceeds this increased level, it is considered a second echo. The shift value should be specified in the “AD increments” indicated on the vertical (amplitude) axis of the echo diagram (its value depends on the gain).

Caution: this setting requires a high level of expertise.

	Value range	Unit	Default
Interface Threshold offset	$-4095...+4095$	“ADC value”	220

c. Set Threshold To Default

—

M443

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Threshold Settings → Set Th. To Default	Advanced → Threshold settings → Reset Threshold settings	—	—	—
<M443>	—	—	—	—

Set threshold to default.

d. Threshold Autose

—

M444

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Threshold Settings → Threshold Autose	—	—	—	—
<M444>	—	—	—	—

Threshold autose.

#	Value	Default
1	Autose	Autose
2	Autose If. Offset	
3	Autose Low	
4	Autose High	
5	Mask Current	
6	Mask Mounting	
7	Mask Probe End	
8	Force Previous	
9	Reset Threshold	

2.4.5 Filling Speed

M45

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Filling Speed	Measurement optimization → Level elevation rate (filling speed)	Transmitter → Transmitter setup → P26 Filling speed	Devices → Remote Program → Parameters → P26 Filling speed	852 → float
<M45>	P26	<T126>	—	—

The level tracking speed is the fastest level change speed the device can continuously track. The device will only follow a level change slower than the set value. If the device senses a level signal change faster than this value, it assumes this is the result of a measurement error (e.g., condensation); it will not accept the reading, and the outputs will show the last valid value.

If this was caused by an incorrect measurement and the next measurement is plausible given the set maximum speed, the hold is canceled and the actual measured level takes effect. If the rapid change in level is genuine, the device recalculates with each measurement whether the currently measured level falls within the range defined by the tracking speed multiplied by the elapsed time. If it is within the range, it cancels the hold, and the output adjusts to the new value according to the set damping parameter.

Setting the level tracking speed is important when process conditions, especially during filling or emptying, can produce interference (e.g., ripples, foaming) that affects measurement stability. The set level tracking speed must be higher than the maximum filling/discharging speed required by the process. By entering it correctly, measurements during filling and discharging become more reliable. Caution: in tanks with a conical or pyramidal bottom, the level change rate at the bottom of the tank increases significantly due to the shape of the tank. The parameter's unit of measure: metric: [m/h]; US: [ft/h].

	Value range	Unit	Default
Filling speed	0...2000 (0...6561) 0: Filling speed limit disabled	m/h (ft/h)	200 m/h (656 ft / h)

2.4.6 Emptying Speed

M46

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Emptying Speed	Measurement optimization → Level descent rate (Emptying speed)	Transmitter → Transmitter setup → P27 Emptying speed	Devices → Remote Program → Parameters → P27 Emptying speed	854 → float
<M46>	P27	<T127>	—	—

	Value range	Unit	Default
Emptying speed	0...2000 (0...6561) 0: Emptying speed limit disabled	m/h (ft/h)	200 m/h (656 ft / h)

2.4.7 Gain Settings

a. Amplifier Gain

P24:a

M471

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Gain Settings → Amplifier Gain	Device Settings → Advanced mode → Parameters	Transmitter → Transmitter setup → P24 Amplifier Gain	Devices → Remote Program → Parameters → P24 Amplifier Gain	852 → □□□■
<M471>	P24 → □□□■	<T124>	□□□□■	—

#	Value	Default	
0	Automatic	Automatic	Sets the sensitivity of the analog amplifier that processes the echo signal from the measured level. In "Auto" mode(0), the instrument searches for and sets the optimal gain level based on the measured signal levels without any user intervention. In special cases (e.g. when measuring a medium with lower in a noisy environment), it may be necessary to turn off the "Auto" mode and set a fixed gain. Caution: this setting requires a high level of expertise.
1	Stage 1		
2	Stage 2		
3	Stage 3		
4	Stage 4		

b. Auto Gain Low Limit

M472

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Gain Settings → Auto Gain Lo Limit	Device Settings → Advanced mode → Parameters	Transmitter → Transmitter setup → P24 Amplifier Gain	Devices → Remote Program → Parameters → P24 Amplifier Gain	852 → □□■□
<M472>	P24 → □□■□	<T124>	□□□■□	—

#	Value	Default	
0	Automatic	Automatic	Here, you can set the lower and upper limits for the "Auto" adjustment of the sensitivity of the analog amplifier that processes the echo signal coming from the measured level. Important: This setting is only valid when the P24a parameter (see above) is set to "Auto" mode. Caution: this setting requires a high level of expertise.
1	Stage 1		
2	Stage 2		
3	Stage 3		
4	Stage 4		

c. Auto Gain High Limit

M473

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Gain Settings → Auto Gain Hi Limit	Device Settings → Advanced mode → Parameters	Transmitter → Transmitter setup → P24 Amplifier Gain	Devices → Remote Program → Parameters → P24 Amplifier Gain	852 → ☐ ☒ ☐ ☐
<M473>	P24 → ☐ ☒ ☐ ☐	<T124>	☐ ☐ ☒ ☐	—

2.4.8 Special

a. User Slope

M481

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Special → User Slope	Measurement optimization → Velocity user correction factor	—	—	—
<M481>	P22	—	—	—

User-defined multiplier (P22), Correction factor (measured/actual)

Applies a correction factor to the distance measurement result. If the value measured by the device differs from the value under real conditions, this multiplier can be used to adjust the result. The output value is multiplied by the number set here. The default multiplier is 1, which does not change the output.

	Value range	Unit	Default
User Slope	0.7...10	—	1

b. Upper Medium DK

M482

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Measurement Optimization → Special → Upper Medium DK	Measurement optimization → Velocity user correction factor	—	—	—
<M482>	P09	—	—	—

Dielectric constant, ϵ_r (P09), “Upper Medium DK” appears only when the ‘Application’ (P00:a, M24) parameter is set to “2: Liquid If.”

The dielectric constant of the measured substance used for liquid and solid media measurements. In interface measurement applications, it refers to the dielectric constant of the upper medium. The measurement algorithm adjusts its operation according to the configured dielectric constant. In interface measurement, it also influences the calculated distance to the lower medium; therefore, correct configuration of this parameter is essential.

	Value range	Unit	Default
Upper Medium DK	1.0 ... 80.0	—	80.0

2.5 Tank Calculation

The Calculation mode is available only when one of the outputs (PV, SV, TV, or QV) is configured to Volume, Ullage Volume, or Volume %. In the case of the OCT setting, the tank shape must be specified in a table.

2.5.1 Calculation Mode M51

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Calculation Mode	Tank/Silo parameters → Calculation Mode	Transmitter → Transmitter setup → P40 Tank Calculation	Devices → Remote Program → Parameters → P40 Tank type	880 → ■□□□
<M51>	P40 → ■□□□	<T140>	□■□□□	—

#	Value	Default
0	OCT Table	Formula
1	Formula	

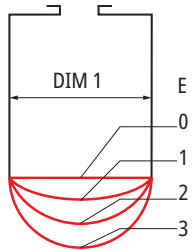
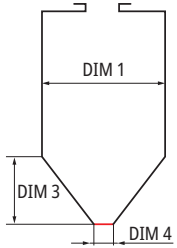
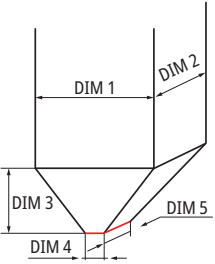
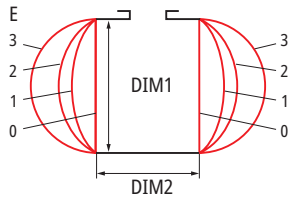
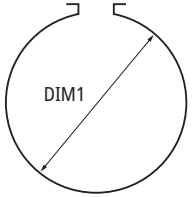
2.5.2 Tank Shape (DIM1...DIM5)

M52

A selection of typical tank shapes for volume measurement. The tank dimensions can be set using parameters “Dimensions 1...5” (P41 ... P45) (see figures below). In the case of the OCT setting, the tank shape must be specified in a table. For proper operation, it is important to specify these dimensions accurately.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Shape	Tank/Silo parameters → Tank shape	Transmitter → Transmitter setup → P40 Tank Calculation → Tank Shape	Devices → Remote Program → Parameters → P40 Tank type	880 → ☐ ☐ ☐ ☒
<M52>	P40 → ☐ ☐ ☐ ☒	<T1401>	☐ ☐ ☐ ☒	—

#	Value	Default
1	Vertical cylindrical tank with a planar or convex bottom (see tank bottom/side shape table for value)	Vertical cylindrical tank with a planar bottom
2	Vertical cylindrical tank with a conical bottom	
3	Vertical rectangular tank with or without chute	
4	Horizontal cylindrical tank (see tank bottom/side shape table for value)	
5	Spherical tank	

M521 P40:a = 0	M522 P40:a = 1, P40:b = 0	M523 P40:a = 2, P40:b = 1	M524 P40:a = 3	M525 P40:a = 4, P40:b = 0
Vertical cylindrical tank with a planar or convex bottom	Vertical cylindrical tank with a conical bottom	Vertical rectangular tank with or without chute DIM3 (P43), DIM4 (P44) and DIM5 (P45) = 0	Horizontal cylindrical tank	Spherical tank
 E = Tank Bottom Shape (P40:b)			 E = Tank bottom / side shape (P40)	

a. Tank bottom/side shape

M521/M524

In case of Vertical and Horizontal cylindrical tank.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Shape → Vertical cylindrical tank	Tank/Silo parameters → Tank shape	Transmitter → Transmitter setup → P40 Tank Calculation → 1 Tank Shape → Vertical cylindrical tank	Devices → Remote Program → Parameters → P40 Tank type	880 → □□■□
<M521>	P40 → □□■□	<T14011>	□□□■□	—

#	Tank bottom shape for Vertical cylindrical tank Tank side shape for Horizontal cylindrical tank	Associates typical tank bottom shapes with the specific tank type for accurate volume calculation. The exact form of the setting code can be seen in the drawings under parameters "Dimensions 1...5" (P41 ... P45).
0	Planar	
1	Slightly convex	
2	Strongly convex	
3	Hemispherical	

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Manage OCT Table	OC-Table (See Chapter 4.5)	Transmitter → OCT	Devices → Remote Program → Parameters → Linear Table	880 → float
<M53>	P40	<T3>	—	—

An output signal of any characteristic can be assigned to the level values measured by the device. The unit of the output signal is the unit set in parameter “Unit system, default unit, region parameter” P00 or “Output Units” P02 of the output data type assigned to the “HART - PV” output in parameter “PV/SV Mode” P01. The characteristic can be specified with a maximum of 100 points. Between the points, the device calculates the output signal from the measured level by linear interpolation and after the last point by linear extrapolation. The OCT can assign the measured level to an arbitrary output signal. Its typical application is level-to-volume conversion for tanks not included in the standard tank shape list (e.g., irregularly shaped tanks).

#	Value
1	View/Edit Table
2	Add Item
3	Delete Item

Conditions for correct programming of data pairs

- The table must start with L(1)= 0 and R(1) is the output quantity assigned to it.
- Column “L” may not contain identical values.
- Columns “L” and “R” can only have increasing values from top to bottom.
- If the table contains fewer than 100 points, column “L”, in the row following the last valid data pair, must be 0.

i	L (left column) Measured Level	R (right column) Output Value
1	0	R(1)
2	L(2)	R(2)
	L(i)	R(i)
nn	L(nn)	R(nn)
nn+1	0	
100		

2.5.4 Tank Total Volume

M54

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Tank Total Volume	Tank/Silo parameters → Total tank volume	Transmitter → Transmitter Setup → P47 Total Volume	Devices → Remote Program → Parameters → P47 Total Volume	894 → float
<M54>	P47	<T3>	—	—

The total tank volume is required for empty volume calculation (see “PV/SV Mode” P01).

If one of the outputs (PV, SV, TV, or QV) is set to transmit “Ullage volume,” then the total volume can be entered in this parameter to calculate the actual transmitted value. In this case, the transmitted data is the difference between the total volume and the actual medium volume. Its unit is the volume unit set in the “PV/SV Mode” P01:b field.

	Value range	Unit	Default
Tank Total Volume	0...999,999.999	“Volume Unit”	0.0

2.5.5 Specific Gravity (Upper)

M55

If the device is set to weight transmission, the specific gravity of the material (medium) stored in the tank must be entered here for the weight calculation. The value is a dimensionless ratio relative to the density of water, i.e., 1 g/cm³.

In case of interface measurement, it refers to the upper medium.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Specific Gravity	Measurement optimization → Specific gravity	Transmitter → Transmitter setup → P32 Specific Gravity	Devices → Remote Program → Parameters → P32 Spec. gravity.	864 → float
<M55>	P32	<T132>	—	—

	Value range	Default
Specific Gravity	0.01...100	1.0

2.5.6 Specific Gravity Lower

M56

This parameter is used only in the case of interface measurement; it refers to the lower medium.

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Tank Calculation → Specific Gravity Lower	Measurement optimization → Specific gravity	Transmitter → Transmitter setup → P33 If. Specific Gravity	Devices → Remote Program → Parameters → P33 If. Spec. gravity.	865 → float
<M56>	P33	<T133>	—	—

	Value range	Default
Specific Gravity Lower	0.01...100	1.0

2.6 Service

2.6.1 Security

—

M61

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Security	Advanced → Special → Security code	Security code → Transmitter	Devices → Remote Program → Secret unlock	2900 → float
<M61>	—	<S2>	—	—

Enter and unlock the user or service code. The unit can be protected against unauthorized reprogramming by a four-digit PIN code. If a value other than zero is entered, the code is active. Entering a zero will clear the user code. When the code is active, the unit will prompt for the code when entering the menu.

#	Value range	Default
1	User Lock (0000...9999)	0000
2	Service Lock (0000...9999)	

2.6.2 Output Test

M62

a. Analog Output PV Test

—

M621

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Output Test → Analog Output PV	Basic → Outputs → Current generator mode=Manual	—	—	—
<M621>	—	—	—	—

When the function is entered, the current corresponding to the measured value is displayed at the output. In test mode, any value between 3.9 and 20.5 mA can be entered in this edit window. The output should then display the same current as the set value. A dialog box reminds you of the test condition. The test value will remain at the output until the warning window is exited. To exit the warning window, press **E**. The analog current output test can only be performed if the device's short HART address is set to 0. For other HART addresses, the output current is fixed at 4 mA.

b. Analog Output SV Test

—

M622

This function is identical to the Analog Output PV Test function, but is available only in the dual-current-generator version.

c. Relay Output Test

—

M623

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Output Test → Relay Output	—	—	—	—
<M623>	—	—	—	—

2.6.3 Distance Simulation

M63

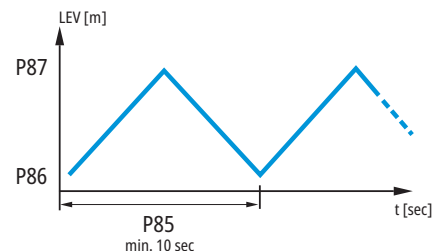
This function helps the user to check the outputs and the processing device connected to it. MicroTREK can simulate a constant or variable level value. The simulation level values must be within the measurement range defined by P04 and P05. To start the simulation, return to the Measurement mode. During simulation, the SIM symbol will flash. To end the simulation, set “Mode” (P84)= OFF.

a. Mode P84:a M631

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Mode	—	Transmitter → Simulation → Settings → Mode	Devices → Remote Program → Parameters → P84 Simulation mode	968 → ☐ ☐ ☐ ☒
<M631>	P84 → ☐ ☐ ☐ ☒	<T612>	☒	—

#	Simulation mode	Default
0	OFF	OFF
1	Fix value: PV = value given in “Bottom Value” (P86)	
2	Triangle Wave ⁽¹⁾	
3	Square Wave ⁽¹⁾	

⁽¹⁾ Simulation between levels “Bottom Value” (P86), “Upper Value” P87 with “Time” (P85).



b. Time P85 M632

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Time	Advanced → Special → Cycle Time (P85)	Transmitter → Simulation → Settings → Cycle time	Devices → Remote Program → Parameters → P85 Sim Cycle Time	970 → float
<M632>	P85	<T612>	—	—

Simulation cycle time. Unit of measurement: seconds [s].

	Value range	Unit	Default
Cycle Time	0...999	s	60 s

c. Bottom Value P86 M633

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Bottom Value	Advanced → Special → Sim Lower Value (P86)	Transmitter → Simulation → Settings → Bottom Value	Devices → Remote Program → Parameters → P86 Sim Lower Value	972 → float
<M633>	P86	<T613>	—	—

	Value range	Unit	Default
Bottom Value	0...99,999	"Distance unit"	20% of Zero-level distance

d. Upper Value P87 M634

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Upper Value	Advanced → Special → Sim Upper Value (P87)	Transmitter → Simulation → Settings → Upper Value	Devices → Remote Program → Parameters → P87 Sim Upper Value	974 → float
<M634>	P87	<T614>	—	—

	Value range	Unit	Default
Upper Value	0...99,999	"Distance unit"	80% of Zero-level distance

e. Timeout P88 M635

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Dist. Simulation → Timeout	Advanced → Special → Timeout (P88)	Transmitter → Simulation → Settings → Timeout	Devices → Remote Program → Parameters → P88 Timeout	976 → float
<M635>	P88	<T615>	—	—

The simulation mode is automatically switched off after the value set here has elapsed.

	Value range	Unit	Default
Timeout	0...9999	min	10 min

2.6.4 Defaults

a.Load Default

—

M641

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Defaults → Load Default	Advanced → Parameters → Load default	Transmitter → Reset → Load Defaults	Devices → Remote Program → Default	—
<M641>	—	<T93>	—	—

Restores the factory settings of the unit. The values can then be modified. Loading the factory settings does not affect the measurement running in the background (it continues with the parameters set before entering the programming). Before loading the factory settings, the instrument displays a dialog box asking if you are sure you want to do this, because all user settings will be lost.

2.6.5 Restart

—

M65

Local menu	EView2	MonoCONT	MultiCONT	Modbus
Service → Restart	Advanced → Special → Device Restart	Transmitter → Reset → Software Reset	—	—
<M65>	—	<T91>	—	—

Restarts the device (warm start) by reloading parameters from non-volatile memory.

2.6.6 Additional settings required for the correct use of the application modes ("Output function"):

Code	Application mode	Programmable parameters	Note
10	Distance	–	
11	Level	P04	It should be adjusted to the tank height, Level = P04 – Distance.
12	Volume	P04, P40...45	In special cases, the "OC" table should be filled out.
13	Mass	P04, P32, P40...45	The medium density (specific gravity) (P32) should be given relative to water (1).
15	Ullage Volume	P04, P40...45, P47	Providing the total volume is important, Empty volume = P47 – Volume.
16	Level %	P04, P29	Level relative to the full tank, Level % = $100 * \text{Level} / (\text{P04} - \text{P29})$.
17	Volume %	P04, P40...45, P47	Volume relative to the total volume, Volume % = $100 * \text{Volume} / \text{P47}$.
For interface measurement			
20	Distance 2	P09	Distance from the reference to the lower medium level.
21	Level 2	P04, P09	Lower medium level, Level 2 = P04 – Distance 2.
22	Volume 2	P04, P09, P40...45	The volume of the lower medium.
23	Mass 2	P04, P09, P33, P40...45	Mass of the lower medium, medium density: P33.
31	Δ Level	(P04), P09	Thickness of the upper medium layer, Δ Level = Level – Level 2.
32	Δ Volume	P04, P09, P40...45	The volume of the upper medium (layer), Δ Volume = Volume – Volume 2.
33	Δ Mass	P04, P09, P32, P40...45	Mass of the upper medium (layer), medium density (specific gravity): P32.**

2.7 Service diagnostic parameters (read only)

P60: - - - - The number of operating hours since factory dispatch [h]

P61: - - - - The number of operating hours since the last power-on [h]

P62: - - - - The number of operating hours of the relay (closed time of contact C2) [h]

P63: - - - - The number of switching cycles of the relay

P64: - - - - The current temperature of the device's electronics [°C / °F]

P65: - - - - The maximum temperature of the device ever measured [°C / °F]

P66: - - - - The minimum temperature of the device ever measured [°C / °F]

P70: - - - - Number of detected peaks (current)

P71: - - - - Magnitude of selected echo (raw value)

P72: - - - - The amplitude of the selected echo [dB]

P73: The distance of the selected echo [m]

P74: Echo loss/shot ratio

2.8 Output control parameters (read only)

P79: - - - - Current generator measured output current [μA]

P80: - - - - Current generator calculated output current [mA]

P81: - - - - Relay output status

2.9 Hardware / Software versions (read only)

P94/95: - - - - Software code 2 / 3 (SLAVE MCUs)

P96: - - - - Software code 3 (MAIN MCU)

P97/98: - - - - Hardware identification code

3. TROUBLESHOOTING

Event	Fault	Solution
Error messages ⁽¹⁾		
“Echo in near blocking” state display freezes at maximum or minimum value	Not a fault. The level has reached (and may have exceeded) the entered max. limit value. It then displays the maximum (for level) or the minimum (for distance).	There is none. The measurement will be normal within the programmed limits.
“Echo in far blocking” state display freezes at maximum or minimum value	Not a fault. The level has dropped to the lower dead zone so no further signal detected. It then displays the maximum (for distance) or minimum (for level).	There is none. The measurement will be normal within the programmed limits.
“No echo” state display freezes at maximum or minimum value.	Not a fault. The level has risen to the upper dead zone so no further signal detected.	Empty the tank below the upper level and check its functioning.
“No echo” state display freezes.	The device has lost the signal it is looking for but has not yet found the reflected signal. This can occur if the signal has dropped below the threshold and parasitic signals from the flange or tank internals prevent the true signal from being found.	Ensure that the level in the tank drops below the maximum and check the measurement. If no signal is detected, change the threshold value manually as described in the “Threshold curve”. Use the oscilloscope chart and threshold setting functions (EView2).

⁽¹⁾ The device is connected to the EView2 software and listed in the “Device Status” window (or the “Markers” window) or the “SAP-300” screen on the lower row with active polling.

Event	Fault	Solution
General operation		
The device is inaccurate for measuring materials with high dielectric constants (ϵ_r). There is a constant offset when measuring.	The Zero-level distance (tank height) setting is incorrect.	Check the tank height and the parameters. If the device has been replaced, check that the factory parameters are the same as the original. Contact NIVELCO to access the factory menu.
The device indicates an inaccurate level value.	The device does not detect the actual measurement signal.	Check for components inside the tank that may cause interference. If the received signal is close to the tank connection, increase the ratio of the detection delay to the dead zone equally, or increase the threshold over the entire measuring range if the full measuring range is important. In all cases, visualize the phenomena using the "Echo Diagram" function of EView2. The threshold should be set to obscure interference but with sufficient margin to detect the useful signal. The reflected pulse image (same as the start signal) may be too large if the probe touches the tank wall or neck. Eliminate the contact.
The device does not measure accurately when there are two or more layers in the tank.	The device may not be properly programmed for this application and will measure the interface layer instead of the level.	Make sure that the correct setting is selected in the "Operating mode" field on the "Application" tab of the "Device Programming" window. Also check that the top layer is at least 0.12 m (0.39 ft) from the measured material. Contact NIVELCO for the correct setting.
Electrical connection and communication output		
Current output value < 3.5 mA	No power supply	Check the power supply.
	The device is not connected properly.	Check the connection between the device and the power supply.
	The output current setting is incorrect.	Perform the calibration if you have permission to do so, or contact NIVELCO.
Current output value is 22 mA (or 3.8 mA, depending on the configured error current mode)	There is an error.	This occurs when 4...20 mA / error 22 (3.8) mA are programmed. Check the status of the device during polling in the "Device status" window.
The status of the current output is not the same as the value on the display or the EView2.	The output current setting is incorrect.	Check the current loop and connections. Set the output as described in the User Manual and try to change the threshold using EView2 – Echo diagram / Threshold settings or the HHC communicator.
Data transmission via the digital interface does not work. The device is in the process of being set up, wait 20 seconds and try again.	The communication parameters are not set correctly on the computer.	Check the computer settings (address / device number).
	Bad connection to interface.	Check the connection.
	Device current < 3.5 mA	If the problem persists, contact NIVELCO.
	Device current = 22 mA	

4. EView2 INSTRUCTIONS

If necessary, install the EView2 HART configuration software (hereafter EView2) as described in Chapter 3 of the program's manual. The software can be downloaded from www.nivelco.com. Electrical connections: Start the program and search for the transmitter (for more information, see also the EView2 user manual, Chapter 4). From the devices found during the scan, select the device you want to configure or program, then open the device's "device programming" window (see Chapters 4.4 and 4.5 of the EView2 user manual). All the necessary parameters and function settings can be changed with EView2. This chapter describes only the functions specific to the MicroTREK, together with two programming examples. For assistance with connection issues to your PC, please refer to the EView2 User Manual for further information.



4.1 Device status window

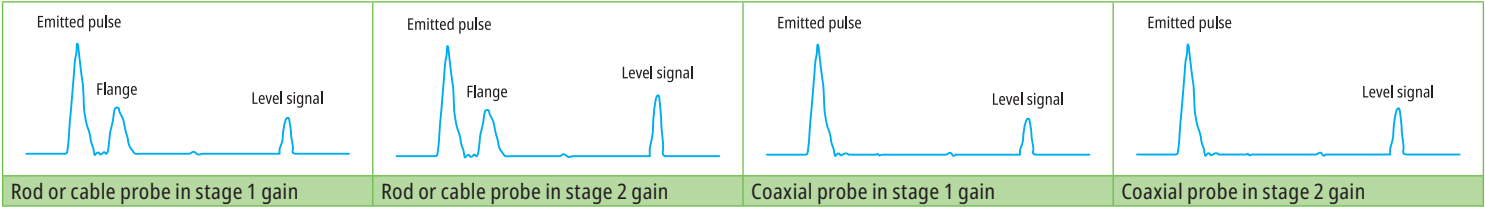
To turn on the "Device status window" in EView2, right-click on the device line in the "Device list" in the main window and select "Show Device Status Window" in the popup window. (See also section 6.3 of the EView2 User's manual.)

4.2 Device "Echo Diagram" (Oscilloscope Function)

Open the "Echo Diagram" window to display the device echo diagram. The "Device Echo map" window will appear. The diagram shows the reflection curve measured by the device. Press the "Refresh" button in the bottom row of the window (or press the F4 button while in the window) to refresh the chart or read the data. After a successful reading, a curve corresponding to the images below will appear on the graph. If there is an evaluable level signal, it will also appear on the graph ("Selected peak" text bubble) along with other additional information. In addition, you can use this window to set any "Threshold" level.

4.2.1 Interpreting Echo Maps

The following diagrams show typical waveforms recorded in Echo diagram mode.

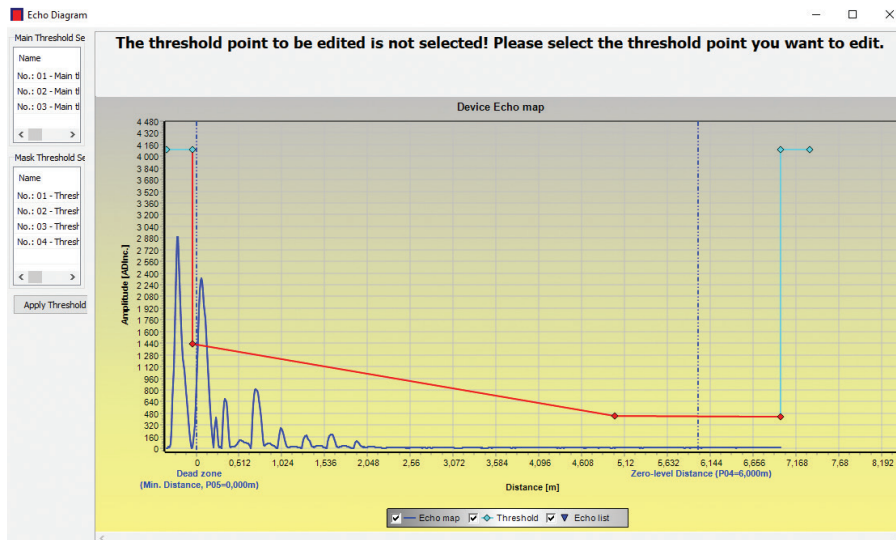


There is no flange reflection in the coaxial probe diagram because the mechanical design does not cause an impedance change along the probe at the flange. The amplitude of the signal reflected from the surface of the measured substance increases as the level increases and decreases as the level decreases. Note for the measurement of solids: for most solids measurements, the measurement is made at a gain factor of 4 (except for powders and granules with a high dielectric constant (ϵ_r), such as carbon dust). If there are difficulties with the level measurement between the device's gain factor 2 and 4 at a certain point in the level measurement, there is usually some interfering object (protruding part, etc.) in the tank in the path of the electromagnetic measuring pulse. Thus, the device gives a false level value when it detects the largest signal reflected there.

4.3 Level Threshold Settings

The level threshold of the device can be changed in the echo diagram window, i.e., the value of “Threshold.”

This may be necessary if the device does not find the level signal (e.g., the set level threshold is too high or too low and the gain is already at the highest level). To change the “Threshold” value, access the “Threshold settings” → “Threshold edit enable” function from the pop-up menu triggered by a right-click. The corner points of the threshold curve on the echo diagram can then be adjusted with the mouse. Pressing the “Apply Threshold” button on the left help panel will apply the set threshold value. To refresh the chart, press the “Refresh” button (or press the F4 button in the window).



Caution: the “Cursor On” function does not give an exact value, it only recalculates the value of the given point based on the graphical representation.

4.3.1 Programming Example 1 (using EView2)

Changing the actual tank height (10.000 m [33.000 ft]) to the probe (cable) length L2 (9.000 m [29.500 ft]), factory-set by the manufacturer), then saving the modified parameter value.

Step	Operation	Entered data / value
1	Open the "Device Setup" window for that device in EView2	The program will read and display the device settings
2	Select "Measurement configuration."	
3	Click on "Zero-level dist." (Zero-level distance)	The data in the field: 10.000 [m] (33.000 [ft])
4	Enter the new value	9.000 [m] (29.500 [ft])
5	Press the button labeled "Send" in the lower right row of the window to download the new value to the device.	
6	Press the "X" close button to exit the device settings window.	

4.3.2 Programming Example 2 (using EView2)

Setting custom scale: Select the "Level" measurement mode as the current loop output parameter to set the scale from the bottom of the tank.
Set the current range from 4...20 mA with 22 mA as an error signal.
Select the appropriate minimum and maximum values for the measurement scale.

Step	Operation	Entered data / value
1	Open the "Device Setup" window in EView2 for the level transmitter to be set up.	The program will read and display the device settings
2	Select "Measurement configuration."	
3	Within the "Measurement mode PV" section, select the new setting value (Level) from the drop-down list. the drop-down list	This field will read "Level".
4	Select "Outputs".	
5	Select "Error indication ..." drop-down list.	The field will say "Hold".
6	Select "New setting" from the drop-down list	The field will say "22 mA"
7	Select the data field named "Assignment of 4 mA – PV".	The field will say "0.000 [m]" ("0.000 [ft]").

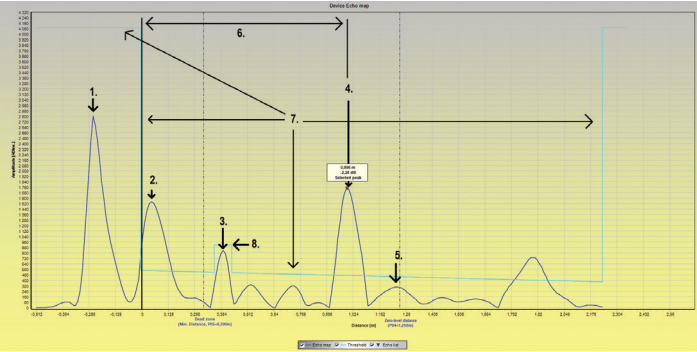
Step	Operation	Entered data / value
8	Enter the new value. This gives the level corresponding to a minimum output of 4 mA.	The field will say "1.000 [m]" ("3.300 [ft]").
9	Select the data field named "Assignment of 20 mA – PV"	The field will say "6.000 [m]" ("19.700 [ft]") (default: 6.000 [m]).
10	Enter 8.600 [m] (28.2 [ft]). This gives the level corresponding to the maximum output of 20 mA (and sets the maximum output to the upper limit of the dead zone).	The field will say "8.600 [m]" ("28.2 [ft]").
11	Press the button labeled "Send" in the lower right row of the window to download the new values to the device.	
12	Press the "X" close button to exit the device settings window.	

4.4 Level Measurement – Level reflection and Automatic Gain Adjustment

After connecting the power supply, the device will start operating:

1. It measures the reflected signals above the threshold line with the gain amplitude determined by the voltage amplitude and adjusted by cyclic repetition.
2. Determines the signal with the maximum amplitude that corresponds to the level reflection.

The following figure is a snapshot of the EView2 – "Echo Diagram" function, typically for a measured material. – The ADC values of the radar digitizer are located on the vertical axis. The ADC value of 4095 corresponds to a radar signal with an amplitude of 3 V. The horizontal axis shows the distance.



1. Radar reference pulse emitted (transmitter signal or ping)
2. Flange reflection / flange pulse (does not occur with coaxial probe)
3. Non-material level reflection (parasitic, such as stirrer)
4. Reflection of measured medium's level
5. Zero-level distance (in this case coincides with the echo of the probe end)
6. Measured distance
7. Main threshold line. For setting up, refer to "4.3 Level Threshold settings"
8. Threshold mask (to mask disturbances that cross the main threshold line).

4.5 The output conversion table (OCT) – (EView2 OC-Table)

The conversion table is usually used for volume measurement but can also be used for weight measurement in cases of non-standard tank shapes. This table assigns different PV output values to the measured levels. The value on the left is always the measured level (relative to the Zero-level distance (P04) setting), and the value on the right is the output value for the output converted level. The unit associated with the output value is determined by the setting of the “Output source” (P01, PV) and “Output unit” (P02) parameters. The output value is determined by linear interpolation between two value pairs, so the accuracy of the conversion depends on the density of the associated value pairs. After the last pair of points, the output value is calculated by linear extrapolation. The maximum number of value pairs is 100.

More information:

- Each new level value entered must be greater than the previous one.
- Note that the units in the table are always interpreted by the device according to the currently set units of measure. Therefore, the OCT must always be filled in with values corresponding to the set units.
- Caution: when using the conversion table, the setting of the current output (P10/P11) is also interpreted according to the value range (and measurement unit) defined on the left side of the table. Accordingly, the appropriate setting of the P10/P11 parameters is recommended after uploading the table.
- If the conversion table is filled in incorrectly, the output (transmitted) value will not be correct either.

The output conversion table (OCT) is active when a table correction is selected in parameter P40. A user-defined conversion table (e.g., “level - volume”) can be created using EView2. To fill in or set the output conversion (OC) table of the device, go to the “Device Settings” → “OC-Table” tab in EView2. Upload or modify the table according to “EView2 User’s Manual – Chapter 6.4.” If the appropriate changes have been made in the table and it has been filled in correctly, press the “Send” button on this page (“OC-Table” tab) on the right side under the “Get” button to download the table to the device.

4.5.1 In the following example, five-point programming is presented, for example: “Level - Volume” conversion

Step	Action	Entered data / chosen value
1	In EView2, open the “Device Settings” window of the given device.	
2	Go to the point called “Application” and select the unit system (“Calculation system”).	Metric (EU), Imperial (US), Optional Uni
3	Select a length unit (Engineering Unit).	m (ft)
4	Go to “Measurement configuration” and select “Measurement mode (PV source): volume transmission” from the list.	Volume
5	Select a volume unit in the “Volume Units” section.	m ³ (ft ³)
6	Go to “Measuring distances” and enter the tank height in the field named “Zero-level dist.” (Click on the field and enter the value).	6.00 m (20 ft)
7	Go to “Probe length” and enter the value for probe length.	5.80 m (19 ft)
8	Go to the “Minimum (P5)” field and enter the dead zone value (forbidden distance).	0.40 m (1.3 ft)
9	Press the “Send” button in the lower right corner of the window to download the new values to the device.	Wait until the download process is complete.
10	Go to the point called “OC-Table.” Fill in the table called “OCT list” with the appropriate values. A maximum of 100 points can be entered. Each level and volume point must be entered. Each subsequent point must be larger than the previous one. New lines can be created by pressing the “Ctrl + Insert” key combination or selecting “Add new item” in the popup menu of the right mouse button. A line can be deleted by pressing the “Ctrl + D” keys together.	See the following table (Example for completing OCT)
11	To download the table to the device, press the “Send” button located on this page (“OC-Table” tab) on the right side under the “Get” button.	

Example of filling out the OCT

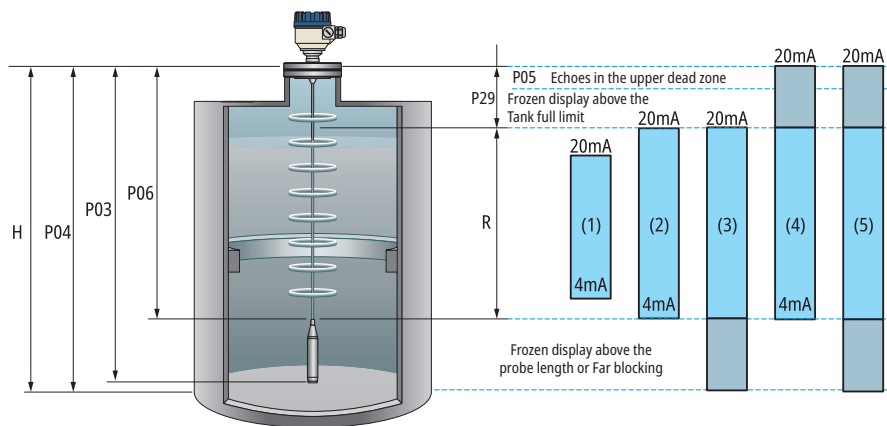
Point	Level (Source column)	Volume (Output column)
1	0.0 m (0.0 ft)	0.0 m ³ (0.0 ft ³)
2	0.20 m (0.66 ft)	0.5 m ³ (17.6 ft ³)
3	0.75 m (2.46 ft)	1.0 m ³ (35.3 ft ³)
4	1.00 m (3.30 ft)	1.5 m ³ (53 ft ³)
5	5.60 m (18.37 ft)	16.8 m ³ (593.3 ft ³)

Example of setting 4...20 mA current output (using EView2)

Step	Action	Entered data / value
1	Go to "Outputs" and set "Current generator mode" to "Auto" (default setting).	Auto
2	In the "Error indication ..." field, set the error status to the appropriate mode (default setting).	Hold
3	Select "Assignment of 4 mA – PV (P10)" and enter the volume value corresponding to the output current value of 4 mA.	0.5 m ³ (17.6 ft ³)
4	Select "Assignment of 20 mA – PV (P11)" and enter the volume value corresponding to the output current value of 20 mA.	16.80 m ³ (593.3 ft ³)
5	Press the "Send" button in the lower right line of the window to download the new values to the device.	
6	Press the "X" close button to exit the device settings window.	

4.6 The measurement scale: five possible configurations on the analog current output

- To illustrate the five possible configurations, the following fluid level measurement settings are assumed:
(EView2 → "Device Settings" → "Application" → "Operating mode: Liquid level measurement")
(EView2 → "Device Settings" → "Measurement Configuration" → "PV source: Level")
- Thus, the HART® **"PV"** of the transmitter, its primary digital output, will be a level value. The level is calculated from the parameter values below:



P03 –Probe length

P04 – “Zero-level distance”

P05 – Min. distance/Near blocking

Echoes within this zone are suppressed from the measurement to improve flange ringdown rejection.

P06 – Max. distance/Far blocking

Echoes within this zone are suppressed from the measurement to improve stability in noisy conditions.

P29 – Tank full limit

Other markings in the figure:

R –Measurement range

H –Tank height



Note: The reference point for distance measurement “0” is the sealing flange of the device (bottom of hexagon), the lower surface of the flange for flanged devices. If max. distance is set to 0, the probe length is the maximum measuring distance.

The 4...20 mA current output of the level transmitter can be assigned to the measured value, HART® **"PV"** with two parameters:

P10: Lower level value: EView2 → "Device Settings" → "Outputs" → "Assignment of 4-mA")

P11: Upper level value: EView2 → "Device Settings" → "Outputs" → "Assignment of 20-mA")

The cases outlined on the right side of the figure above:

1. The “current output” range is shorter than the max. possible measuring range:
 - The 4 and 20 mA adjusters are located inside the near and far dead zone on the probe, within the limits
2. The range of the 'current output' is equal to the measuring range:
 - Assignment of 4-mA (P10): = “0 level” distance – maximum measuring distance.
 - Assignment of 20-mA (P11): = “0 level” distance – minimum measuring distance.
3. The “current output” range is longer than the measuring range:
 - Assignment of 4-mA (P10): shorter than “0 level” distance – maximum measuring distance.
 - Assignment of 20-mA (P11): = “0 level” distance – minimum measuring distance.
4. The “current output” range is longer than the measuring range:
 - Assignment of 4-mA (P10): = “0 level” distance – maximum measuring distance.
 - Assignment of 20-mA (P11): distance longer than “level 0” – minimum measuring distance.
5. The “current output” range is longer than the measuring range:
 - Assignment of 4-mA (P10): shorter than “0 level” distance – maximum measuring distance.
 - Assignment of 20-mA (P11): distance longer than “level 0” – minimum measuring distance.

4.6.1 Echo Loss Handling

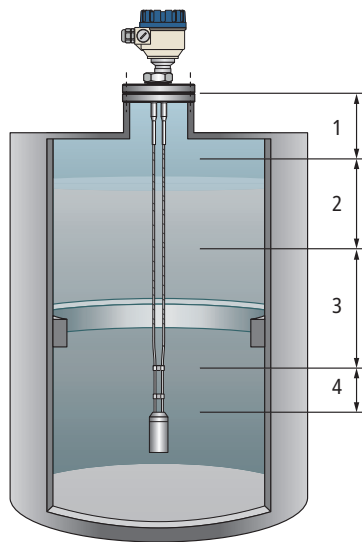
By default, the device searches for the strongest (largest amplitude) reflected signal along the probe length. The reflected signal typically disappears when the level is in the upper dead zone or near the bottom of the tank. In the case of echo loss, the device holds the value for 10 seconds by default. After this, the output either holds the last value or, if configured differently, switches to an error current (3.8 or 22 mA) in the case of an error signal. On the display and HART remote transmission, the transmitted measured value is 'NaN', meaning 'Not a Number' (the display depends on the device). This is accompanied by the 'No echo' indication and display.

Note: Do not process error current 3.8 or 22 mA as measured values in data acquisition or plant control systems. Ensure proper error handling is implemented, and always use plant safety devices and backup level switches.

Other indications:

“E” for “Empty”, “F” for “Full”, “Echo in near blocking”: echo in the near zone, “Echo in far blocking”: echo in the far zone. (During EView2 polling, use the “Device Status” window to monitor the instrument's measurement status on a PC. The status indications can also be tracked on the SAP-300 display.)

The echo processing zones that can be programmed are shown in the following figure.



Zone 1: Close-end blocking (P05):

It can be used to detect unwanted interference. No reflections are detected in this zone. When the level is reached, a "No echo" signal is displayed.

Caution: multiple echoes of the level outside this zone may be picked up by the instrument.

Zone 2: Tank full limit (P29)

If the level is above the Tank full limit, measurement is still active up to the Minimum measurement distance (P05). In this case, the device returns the value of the Tank full limit or the values calculated from it, and displays "F" as "Full" and "Echo in near blocking" on the screen and in the EView2 polling window.

Zone 3: Actual measuring zone

The distance from the Tank full limit (P29) to the Zero-level distance (P04) or the valid Maximum measuring distance (P06).

Zone 4: Far-end blocking (P06)

By default, it is set to "0" when off. When set to valid, this zone will be kept below the Maximum measuring distance (P06) until the Zero-level distance (P04) is reached. When the level is in this zone, the output is fixed at the value corresponding to the Maximum measuring distance. The display shows "E" for "Empty" or "Echo in far blocking". The "Echo in far blocking" signal is also detected when EView2 is consulted.

4.6.2 Gain and Voltage Amplitude

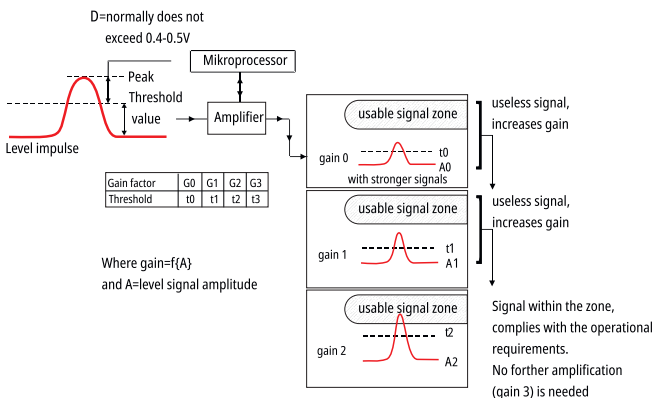
Based on the principle of measurement, the TDR guided radar emits a radar pulse and then samples the returning reflections over time, recording them as a time-varying voltage. It then calculates the distance from the time and the propagation speed of the radar signal. The key challenge is identifying which reflection originates from the measurement target.

This decision is made by an echo-selection algorithm running on the transmitter microcontroller. Its behavior depends on the threshold curve, the gain settings and the dielectric constant (P09), so these parameters must be configured correctly.

Ideally, such a reflection with the largest voltage amplitude comes from the level of the material in the container. However, reflections from many other objects and the background noise of the electronics also interfere with the measurement. Interference reflections can easily match or exceed the amplitude of the target level echo.

- For strong, high-amplitude signals, the “Threshold” line is used to help differentiate between level echo and interference.
- For weak signals, amplification helps to separate the target echo from background noise, improving measurement reliability. However, automatic gain switching has its limits.

Signal gain example (automatic by default):



Gain factor

The gain is automatically set by default to make the measured signal as ideal as possible. In addition, a custom value or gain range can be set with parameter P24. The amplitude of the signal is proportional to the dielectric factor (ϵ_r) of the measured substance. For small amplitudes, gain must be used. The applicable gain depends on the dielectric constant (ϵ_r) and the type of probe.

Stage	Gain factor
1	1.00
2	2.111
3	4.4
4	8.927

4.6.3 Interface measurement

Optional advanced feature. For devices equipped with this feature. If the conditions are met, it is possible to measure the levels of two superimposed materials simultaneously.

In industry terminology, the interface between the upper gaseous layer and the material below is referred to as the **level**. This is also referred to as the first or level/product level/upper interface or distance, abbreviated as **IF1**. The measured and calculated values derived from this are: DIST1 (Distance 1), LEV1 (Level 1), MASS1 (Mass 1), VOL1 (Volume 1). By default, this is transmitted by the instrument as HART PV, analog 4...20 mA current transmission, or HART digital value.

The second contact surface between the two materials below IF1, is called the **interface**. This will be further referred to as the second or lower interface/level/distance, abbreviated as **IF2**. The measured and calculated values derived from it are: DIST2 (distance 2), LEV2 (level 2), MASS2 (mass 2), VOL2 (volume 2). By default, this value is transmitted by the device as a HART SV (Secondary Value). However, IF2 can also be set as PV (current transmission), or TV (Third Value), and QV (Fourth Value).

To enable interface measurement, the device's operating mode must be set to **“Liquid Interface Measurement”** (Liquid interface – optional, P00a=2). This can be found in the “Device settings” menu under “Application” in the EView2 configuration program.

It is essential to specify the relative dielectric constant of the upper measured medium (P09= ϵ_r) to accurately determine the "second" distance. If the dielectric constant is not precisely known, the difference in distance between the measured and actual values of the first and second interfaces can be used as an estimate. The following formula provides a reliable approximation for the ϵ_r value:

$$\epsilon_r = \left(\frac{\text{Measured layer thickness}}{\text{Actual layer thickness}} \right)^2$$

Additionally, the **threshold curve** must be adjusted to suit the specific application. The factory-default threshold curve is optimized for a dielectric constant of 80 and ideal, interference-free measurement conditions. The problem is that low-amplitude echoes are received from both interfaces, which is a characteristic feature of interface measurement requirements.

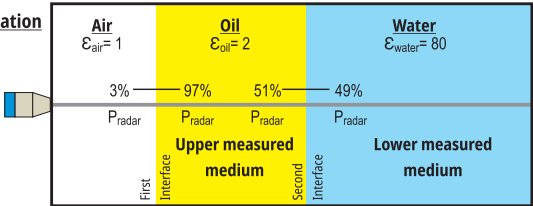
When only one of the two media is present in the tank, the **Interface Threshold Offset** (P35) is used to identify the source of the echo. The value set for this parameter, when multiplied by the current amplification gain (1x, 2.111x, 4.4x, 8.927x), generates a second, parallel threshold curve at a higher level. The original lower threshold curve remains unaffected. If the echo surpasses both the lower threshold curve and the offset-adjusted threshold curve, it originates from the interface of the lower material with the higher dielectric constant. If the signal only crosses the original lower threshold curve, it is likely the echo from the upper material with a lower dielectric constant. By default, the interface threshold offset is set to 220 [ADC value], which is ideal for oil ($\epsilon_r \approx 2$) and water ($\epsilon_r \approx 80$) interface measurements.

For setups designed for interface measurement, the upper material should have a low dielectric constant (ideally <3, with a maximum of 5...10, depending on the probe type), while the lower material should have a high dielectric constant (ideally >20). The difference in dielectric constants between the two measured materials must be at least 10. Under optimal conditions, the minimum measurable material layer thickness is 0.12 m (0.39 ft).

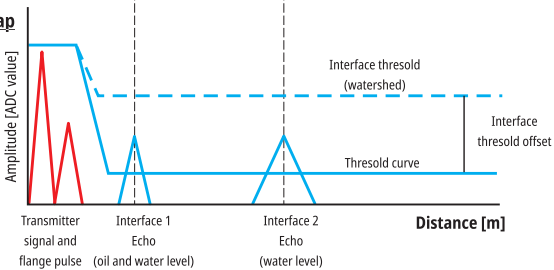
The maximum measurable layer thickness is primarily determined by the dielectric constant of the upper material. The upper material reaches its maximum measurable thickness at a dielectric constant of approximately 2.

Illustration of interface measurement

Typical application



Echo map



5. PARAMETER LIST

[illegible]

Pr.	Page	Name	Pr.	Page	Name
P60	49	The number of operating hours since factory dispatch [h]	P80	49	Current generator calculated output current [mA]
P61	49	The number of operating hours since the last power-on [h]	P81	49	Status of relay outputs
P62	49	The number of operating hours of the relay (closed time of contact C2) [h]	P82	—	—
P63	49	The number of switching cycles of the relay	P83	—	—
P64	49	The current temperature of the electronics [°C / °F]	P84	45	Distance Simulation
P65	49	The maximum temperature of the device ever measured [°C / °F]	P85	45	Cycle time
P66	49	The minimum temperature of the device ever measured [°C / °F]	P86	46	Bottom Value
P67	—	—	P87	46	Upper Value
P68	—	—	P88	46	Timeout
P69	—	—	P89	—	—
P70	49	Number of detected peaks (current)	P90	—	—
P71	49	Magnitude of selected echo [raw value]	P91	—	—
P72	49	Amplitude of selected echo [dB]	P92	—	—
P73	49	Distance of selected echo [m]	P93	—	—
P74	49	Echo lost / shot rate	P94	49	Software code 2 (SLAVE MCU)
P75	—	—	P95	49	Software code 3 (SLAVE MCU)
P76	—	—	P96	49	Software code (MAIN MCU)
P77	—	—	P97	49	Special config mode (read only)
P78	—	—	P98	49	Hardware code (read only)
P79	49	Current generator measured output current [μA]	P99	—	—

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