Issue 3 March 2017

HYCONTROL
LEVEL MEASUREMENT SOLUTIONS

VG4

VG4 2-WIRE RADAR (FMCW) LEVEL TRANSMITTERS

USER AND PROGRAMMING MANUAL

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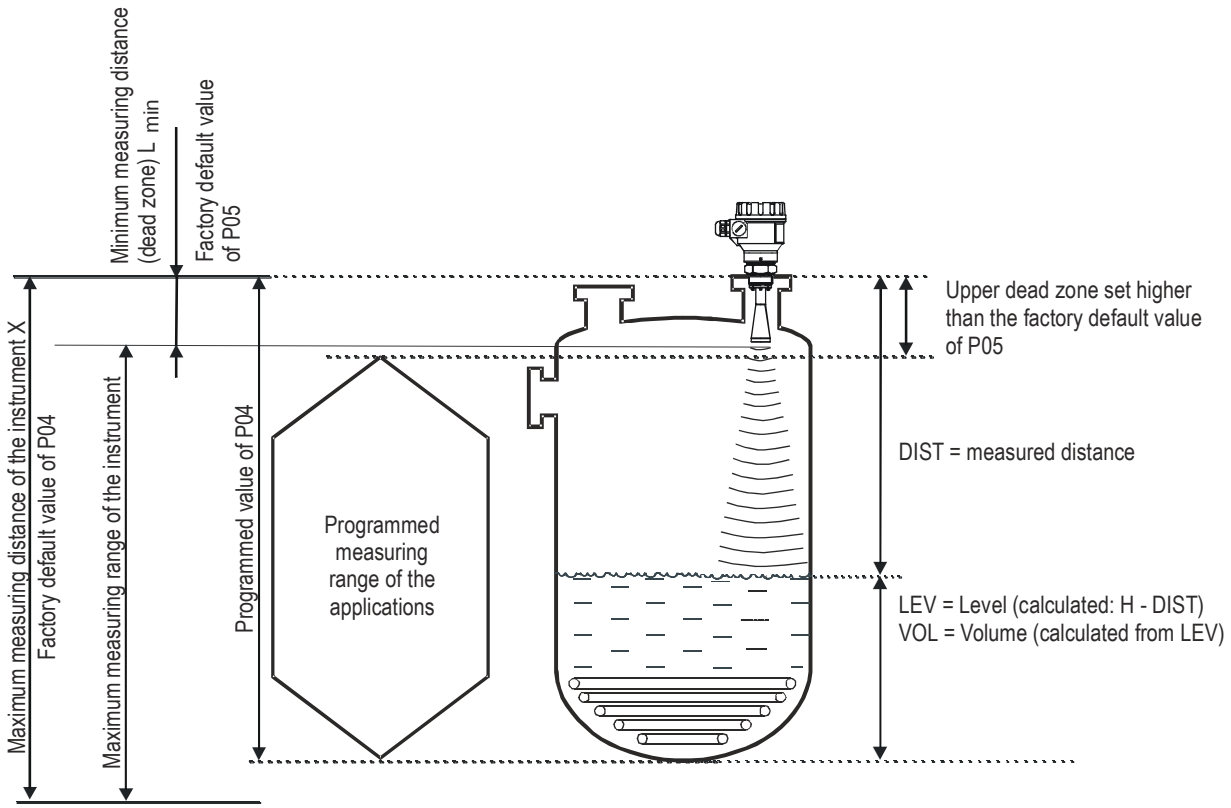
BASIC CONCEPTS OF RADAR LEVEL MEASUREMENT



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Thank you for choosing a HYCONTROL instrument.
We are sure that you will be satisfied throughout its use!

1. INTRODUCTION

Application

The **VG4** non-contact radar level transmitters provide the most advanced, new generation measurement technique of the industrial process automation field. **VG4** is an ideal solution of high precision level transmitting of liquids, slurries, pastes, emulsions and other chemicals in a wide range of application area, such as food industry, energy industry, pharmaceutical industry, chemical industry, and even in naval applications with mm accuracy range and high measuring stability.

VG4 is able to provide an excellent non-contact measurement solution for those substances which tend to steam, or for liquids with a gas layer. Since there is no need for a defined propagation medium in the case of microwaves, the **VG4** operates in a vacuum.

Operation principle

The reflection of the emitted microwave impulses depend on the relative dielectric constant of the measured medium. It is essential for the radar level measurement to operate correctly that the relative dielectric constant (ε_r) of the medium should be more than 1.9.

The operation of the non-contact radar level transmitters is based on the measurement of the time of flight of the reflected signals, called the Time Domain Reflectometry (TDR) method.

The propagation speed of microwave impulses is practically the same in air, gases and in a vacuum, is independent of the process temperature and pressure, so the measured distance is not affected by the physical parameters of medium to be measured.

The **VG4** level transmitter is a Pulse Burst Radar operating at 25 GHz (K-band) microwave frequency.

The 25 GHz models' most noticeable advantage over the lower frequency (5-12 GHz) radars are the smaller antenna size, better focusing, lower dead-band and smaller beam angle.

The level transmitter induces a few nanosecond length microwave impulses in the antenna and a part of the energy of the emitted signals reflects back from the measurement surface depending on the measured media. The time of flight of the reflected signal is measured and processed by the electronics and then this is converted to distance, level or volume proportional data.

2. ORDER CODES

Not all combinations are possible!

VG4 ☐ ☐ – **1** ☐ ☐ – ☐ *

FUNCTION	CODE
Compact transmitter	**E**
Transmitter + display	**G**
High temperature transmitter	**H**
High temperature transmitter + display	**J**

ANTENNA / HOUSING MATERIAL	CODE
316Ti / Aluminium housing	**S**
316Ti / Stainless steel housing	**K**

ANTENNA / DIAMETER	CODE
DN40 Horn / 1½"	**4**
DN50 Horn / 2"	**5**
DN80 Horn / Flange	**8**

PROCESS CONNECTION	CODE
BSP	**0**
NPT	**N**
DN 80 PN25	**2**
DN 100 PN25	**3**
DN 125 PN25	**4**
DN 150 PN25	**5**
DN 80, PP	**6**
DN 100, PP	**7**
DN 125, PP	**8**
DN 150, PP	**9**
3" RF 150 psi	**A**
4" RF 150 psi	**B**
5" RF 150 psi	**C**
6" RF 150 psi	**D**
3" RF, PP	**E**
4" RF, PP	**F**
5" RF, PP	**G**
6" RF, PP	**H**
JIS 10K80A	**J**
JIS 10K100A	**K**
JIS 10K125A	**L**
JIS 10K 150A	**M**
JIS 80A, PP	**P**
JIS100A, PP	**R**
JIS125A, PP	**S**
JIS150A, PP	**T**

OUTPUT / EX	CODE
4 - 20 mA + HART	**4**
4 - 20 mA + HART / Ex	**8**

* The order code of an Ex version Should end in 'Ex'

ACCESSORIES TO BE ORDERED NON-SEPARATELY	ORDER CODES
PP antenna enclosure with 1½" BSP threaded process connection	**VG4AP-140-0**
PP antenna enclosure with 1½" NPT threaded process connection	**VG4AP-14N-0**
PTFE antenna enclosure with 1½" BSP threaded process connection	**VG4AT-140-0**
PTFE antenna enclosure with 1½" NPT threaded process connection	**VG4AT-14N-0**
PP antenna enclosure with 2" BSP threaded process connection	**VG4AP-150-0**
PP antenna enclosure with 2" NPT threaded process connection	**VG4AP-15N-0**
PTFE antenna enclosure with 2" BSP threaded process connection	**VG4AT-150-0**
PTFE antenna enclosure with 2" NPT threaded process connection	**VG4AT-15N-0**

3. TECHNICAL DATA

TYPE		METAL HOUSING VG4□S-1□□-□ VG4□K-1□□-□	HIGH TEMPERATURE VERSION VG4H□-1□□-□, VG4J□-1□□-□
Measured and calculated values		Level, distance, volume and mass	
Measured media		Liquids	
Frequency of the measuring signal		~25 GHz (K-band)	
Minimum and maximum measuring range[1]		See chapter 3.2	
Material of wetted parts			
Process connection			
Beam angle			
Minimum ε_r of the medium[1]			
Maximum medium pressure (depending on the antenna)		25 bar (at 120 ºC) with plastic antenna enclosure: 3 bar (at 25 ºC)	
Medium temperature		-30 … + 100 ºC (up to max. 2 min.: 120 ºC) with PP antenna enclosure: max.: 80 ºC	-30 … + 180 ºC
Ambient temperature		-20 … +60 ºC	
Resolution		1 mm	
Typical linearity error (as per EN 61298-2)[1]		< 0.5 m: ±25 mm, 0.5 - 1m: ±15 mm, 1 – 1.5 m: ±10 mm, 1.5 – 8 m: ±3 mm, > 8 m: ±0.04% of the measured distance	
Temperature error (as per EN 61298-3)		0,05% FSK / 10 °C (-20 ... +60 °C)	
Output	Analogue	4 - 20 mA (3.9 – 20.5 mA)	
	Digital communication	HART (minimum terminal resistor: 250 Ohm)	
	Display	VGF-DISPLAY graphical display unit	
Damping time		Selectable: 0 …99 sec	
Measuring frequency		10…60 sec as per the application settings	
Error indication		Output = 22 mA or 3.8 mA	
Output load		$R_t = (U_t\text{-}20V) / 0.022$ A, U_t = power supply voltage	
Power supply voltage		20 V … 36 V DC, Ex: 20 V … 30 V DC	
Electrical protection		Class III.	
Ingress protection		IP 67	
Electrical connection		2x M 20 x1.5 cable glands + internal thread for 2x ½" NPT cable protective pipe, cable outer diameter: ∅ 7…13 mm, cross section: max.1.5 mm^2	
Housing material		Paint coated aluminium (EN AC 4200), Stainless steel	
Sealing		Viton, EPDM	
Mass		2 - 2.6 kg	2.7 - 3.3 kg

[1] Based on proper application settings at 95% sample rate level at constant temperature. The environment should be free from EMI noise and power supply voltage fluctuations in accordance with the standard. The reflector should be a plane plate reflector with ideal material, surface and dimensions (min. 3m x 3m). The largest false echo should be 20 dB smaller than the useful echo.

3.1. ATEX, EXPLOSION PROTECTION, EX MARKINGS, EX LIMIT DATA

Ex markings

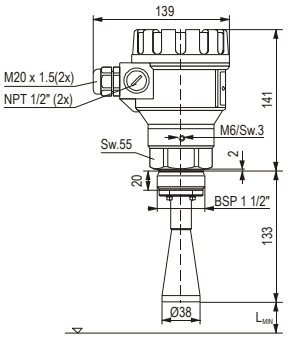
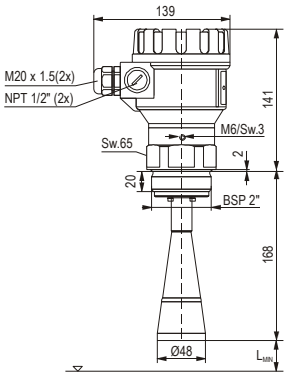
TYPE	METAL HOUSING TYPE VG4□S-1□□-8Ex VG4□K-1□□-8Ex	HIGH TEMPERATURE VERSION WITH METAL HOUSING VG4H□-1□□-8Ex, VG4J□-1□□-8Ex
ATEX (ia)	⟨Ex⟩ II 1G Ex ia IIB T6…T3 Ga Li: 200µH Ci: 16nF Ui:30V Ii:140mA Pi:1W	

Temperature limit data for hazardous atmospheres:

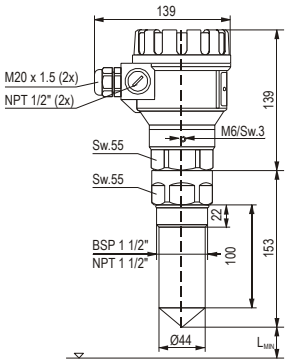
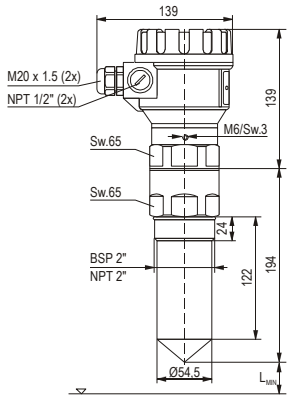
TEMPERATURE DATA FOR HAZARDOUS GAS ATMOSPHERES (II B GROUP)	METAL HOUSING TYPE VG4□S-1□□-8Ex, VG4□K-1□□-8Ex			HIGH TEMPERATURE VERSION WITH METAL HOUSING VG4H□-1□□-8Ex, VG4J□-1□□-8Ex
Maximum permissible medium temperature at the antenna	+80°C	+90°C	+100°C	+180°C
Maximum permissible surface temperature at the process connection	+75°C	+90°C	+100°C	+175°C
Temperature class	**T6**	**T5**	**T4**	**T3**

See 'Appendix 1 ⟨Ex⟩ATEX Safety Guidelines' for futher ATEX installation information.

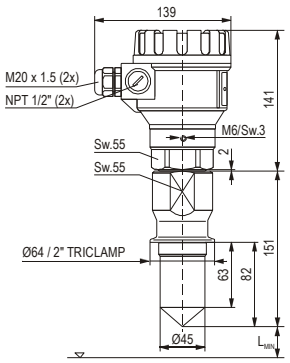
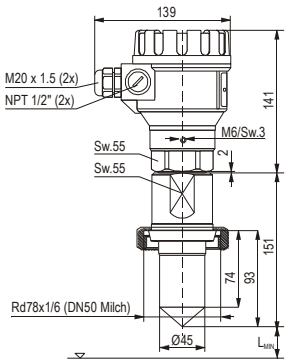
3.2. DIMENSIONS AND SPECIAL DATA OF THE ANTENNA VARIATIONS

	ALUMINIUM HOUSING, *1½" HORN ANTENNA* **VG4ES-140-☐, VG4GS-140-☐,** **VG4ES-14N-☐, VG4GS-14N-☐**	*ALUMINIUM HOUSING,* *2" HORN ANTENNA* **VG4ES-150-☐, VG4GS-150-☐** **VG4ES-15N-☐, VG4ES-15N-☐**
		
Material of wetted parts	316Ti, PTFE	316Ti, PTFE
Process connection	1½" BSP, 1½" NPT	2" BSP, 2" NPT
Beam angle (-3dB)	19°	16°
Minimum measuring distance (L_{MIN})*	200 mm	200 mm

* Value L_{MIN} based on reference conditions as described in Chapter 3 Technical data.

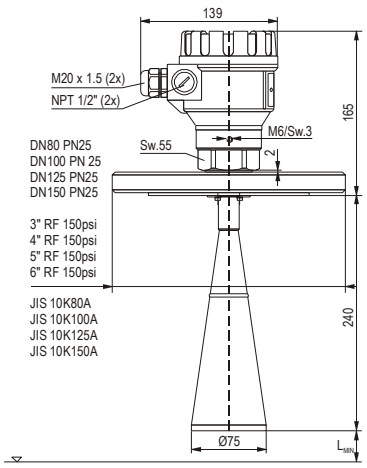
	ALUMINIUM HOUSING, *1½" ANTENNA WITH PLASTIC ENCLOSURE* **VG4ES-140-☐, VG4GS-140-☐** **+ VG4AP-140-0, VG4AP-14N-0**	*ALUMINIUM HOUSING,* *2" ANTENNA WITH PLASTIC ENCLOSURE* **VG4ES-150-☐, VG4GS-150-☐** **+ VG4AP-150-0, VG4AP-15N-0**
		
Material of wetted parts	PP	PP
Process connection	1½" BSP, 1½" NPT	2" BSP, 2" NPT
Minimum measuring distance (L_{MIN})*	300 mm	300 mm

* Value L_{MIN} based on reference conditions as described in Chapter 3 Technical data.

ALUMINIUM HOUSING, 2" TRICLAMP ANTENNA WITH PTFE ENCLOSURE, HYGIENIC VERSION **VG4ES-140-□, VG4GS-140-□ + VG4AT-14T-0**	*ALUMINIUM HOUSING, DN50 PIPE COUPLING ANTENNA WITH PTFE ENCLOSURE, HYGIENIC VERSION* **VG4ES-140-□, VG4GS-140-□ + VG4AT-14R-0**
	

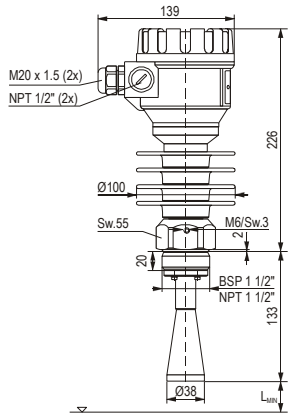
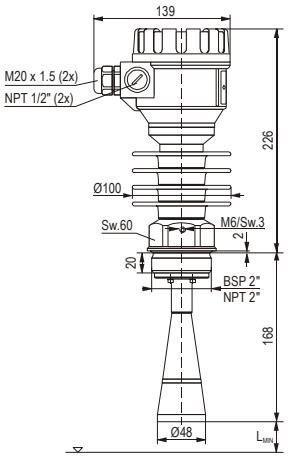
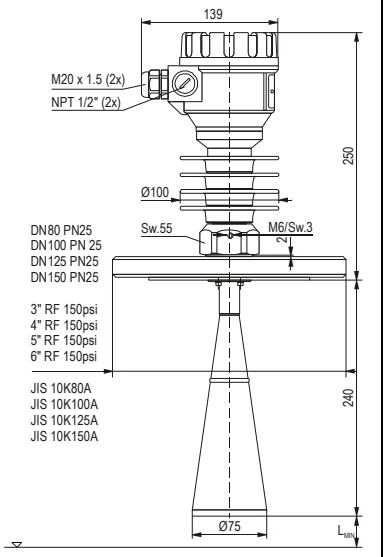
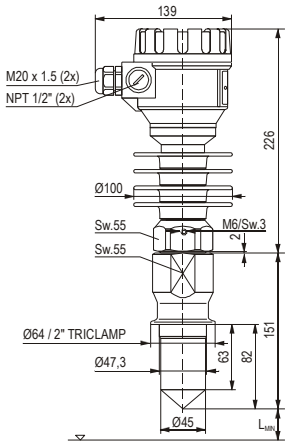
Material of wetted parts	316Ti, PTFE	316Ti, PTFE
Process connection	2" TRICLAMP	DN50 MILCH
Minimum measuring distance (L_{MIN})*	300 mm	300 mm

* Value L_{MIN} based on reference conditions as described in Chapter 3 Technical data.

ALUMINIUM HOUSING, HORN ANTENNA WITH FLANGE VG4ES-18□-□, VG4GS-18□-□


Material of wetted parts	316Ti, PTFE
Process connection	Flange
Beam angle (-3dB)	11°
Minimal measuring distance (L_{MIN})*	200 mm

* Value L_{MIN} based on reference conditions as described in Chapter 3 Technical data.

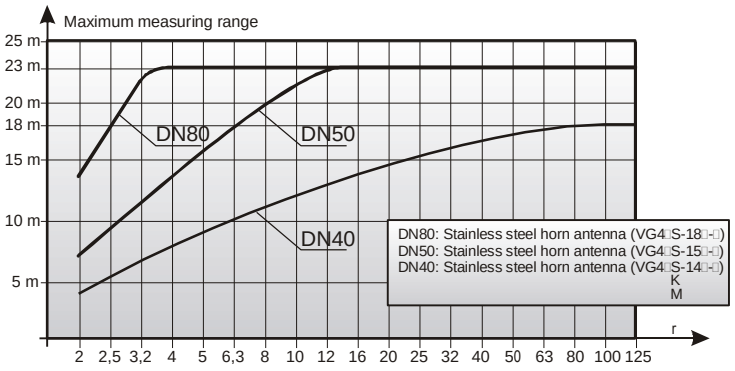
HIGH TEMPERATURE VERSION, ALUMINIUM HOUSING, 1½" HORN ANTENNA **VG4HS-140-□, VG4JS-140-□, VG4HS-14N-□, VG4JS-14N-□**	*HIGH TEMPERATURE VERSION, ALUMINIUM HOUSING, 2" HORN ANTENNA* **VG4HS-150-□, VG4JS-150-□, VG4HS-15N-□, VG4JS-15N-□**	*HIGH TEMPERATURE VERSION, ALUMINIUM HOUSING, HORN ANTENNA WITH FLANGE* **VG4HS-18□-□, VG4JS-18□-□**	*HIGH TEMPERATURE VERSION, ALUMINIUM HOUSING, 2" TRICLAMP ANTENNA WITH PTFE ENCLOSURE, HYGIENIC VERSION* **VG4HS-140-□, VG4JS-140-□ + VG4AT-14T-0**
			
Material of wetted parts	316Ti, PTFE	316Ti, PTFE	316Ti, PTFE	316Ti, PTFE
Process connection	1½" BSP, 1½" NPT	2" BSP, 2"NPT	Flange	2" TRICLAMP
Beam angle (-3dB)	19°	16°	11°	
Minimal measuring distance (L_{MIN})*	200 mm	200 mm	200 mm	300 mm

* Value L_{MIN} based on reference conditions as described in Chapter 3 Technical data.

3.2.1. DETERMINE THE MAXIMUM MEASURING RANGE

The maximum measuring range of the VG4 radars is significantly affected by the circumstances of the application environment and on the selected device type. Depending on the relative dielectric constant of the measuring medium and the process conditions the maximum measurement range (achievable under the reference conditions) may decrease by up to 85% (reduce to one-sixth!).

The maximum measuring distance is illustrated in the diagram on the right for materials with different relative dielectric constant. The diagram is valid for horn antenna, for liquids with still surface not tending to foaming, vapouring or steaming and an ideal case of slow (<5m/h) rate of level change.



Depending on the process conditions or the plastic antenna enclosure the following typical reducing factors are recommended to be considered in order to calculate the maximal measuring range. When more than one reducing factor occurs at the same time then all the factors should be considered for the calculation:

Process Condition	Reflection reduction in Amplitude	Max. measuring distance decrease by	Reducing Factor
Slow mixing or slightly waving	2…6 dB	20-50%	0.8…0.5
Foaming	2…6 dB	20-50%	0.8…0.5
Fast mixing, vortex	8…10 dB	60-70% (the measurement might be completely terminated)	0.4…0.3
Steaming, condensation	3…10 dB	30-70% (the measurement might be completely terminated)	0.7…0.3
PP antenna enclosure	2 dB	20%	0.8
PTFE antenna enclosure	1 dB	10%	0.9

For example: Measurement medium is Styrene (ε_r=2.4) at 25ºC process temperature and slowly mixed. The device type is VG4GS-150-4 with VG4AT-150-0 antenna enclosure. The maximal measuring range is (9 m * 0.5 * 0.9) = 4 m.

3.3. ACCESSORIES

- User's and Programming Manual
- Warrant Card
- Declaration of Conformity
- 2 pcs M20x1.5 cable glands
- Sealing (Klinger® Oilit) only for BSP threaded process connections

3.4. CONDITIONS OF SAFE OPERATION

To avoid the danger of electrostatic charge accumulation, in case of the plastic antenna enclosure, the following safety rule shall be observed:

- The measured medium should be an electrostatic conductor, and the electrical resistivity of the measured medium cannot exceed 10^4 Ω.
- The speed and the method of the filling and emptying process should be chosen properly according to the measured medium.
- The material of the plastic antenna enclosures can produce static electricity. The antenna enclosure should only be cleaned by a wet rag.

Meeting the requirements of the technological process
Please consider carefully that all parts of the instrument that could possibly come in contact with the measured medium – including the transducer, the sealing and any other mechanical parts – should meet all requirements of the applied technological process, such as the process pressure, temperature and chemical effects from the used technologies.

FCC Radio license
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must withstand any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

3.5. REPAIR AND MAINTENANCE

The VG4 does not require maintenance on a regular basis.
Repairs during or after the warranty period are carried out exclusively by the Manufacturer.
The equipment sent back for repair should be cleaned or disinfected by the User!

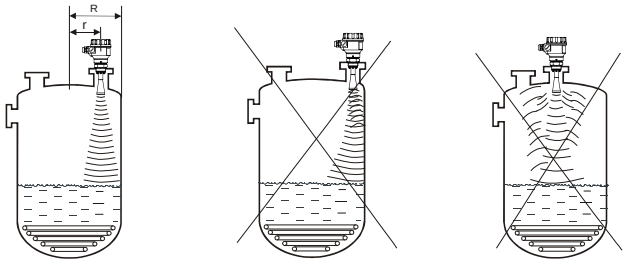
4. INSTALLATION

4.1. MOUNTING

When choosing the installation location please ensure proper space for later calibrations, verification or maintenance service.

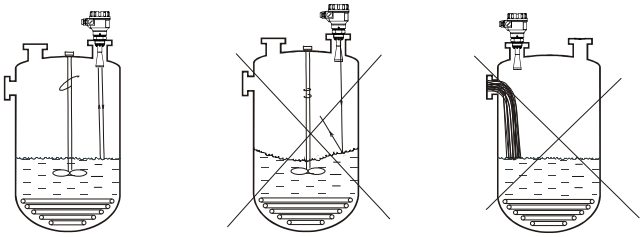
PLACEMENT

The ideal position for the VG4 is when r = (0.3 … 0.5)R (in case of a cylindrical tank).
It is highly recommended to consider the beam cone on the page 2 drawing. The distance between the sensor and the tank wall should be at least 200 mm. If the unit is installed into a dome top or spherical tank, unwanted multiple reflections may appear, which can cancel each other and the measuring signal out, this can interfere the measurement.



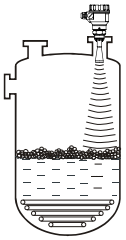
MOVING LIQUID SURFACE

Waves, vortex or strong vibration effects can have a negative influence on the measurement accuracy and the maximum measuring range. To avoid these effects, the mounting placement should be as far as possible from the sources of the disturbing effects. It is possible that the maximum measuring distance may decrease by 50-70% when the liquid surface is vortexing (see chapter 3.2). For this reason the device should be mounted as far as possible from the filling stream or the tank outlet.



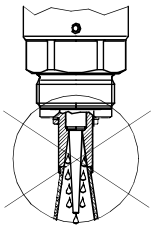
FOAMING

Filling, stirring or any other processes in the tank can generate dense foam on the liquid surface, which may considerably damp the reflected signals.
This can reduce the maximum measuring distance by approximately 50%.



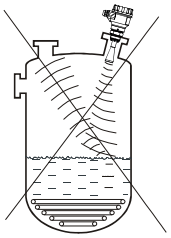
FUMES, VAPOURS

If the measured medium or its foam can reach the antenna or the measured medium is highly volatile, build-up can form on the sensor which may result in unreliable level measurement.



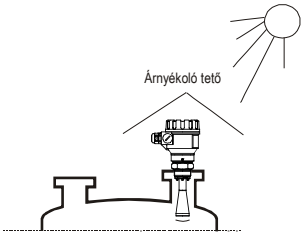
SENSOR ALIGNMENT

The antenna face should be parallel to the medium surface within ± 2-3°.



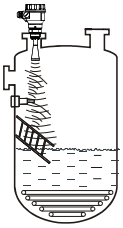
TEMPERATURE

To avoid overheating the instrument should be protected against direct sunshine.



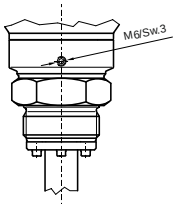
OBSTACLES

Prior to the installation make sure that no objects (cooling pipes, bracing elements, thermometers, etc.) cross the microwave signals, especially in case of extraordinary large silos. Bracing elements and other structural obstacles may cause false reflections the effects of which can be reduced in most cases: a small bent metal deflector plate mounted above the obstacle can help to reduce the unwanted false reflections which affect reliable measurement.
If there is no possible mechanical solution to reduce / avoid these kinds of false reflections, then the instrument can be programmed to block out the obstacles. (see: 5.3.4.5)



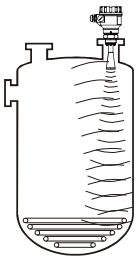
POLARIZATION PLANE

The emitted radar impulses of VG4 are electromagnetic waves. The orientation of the polarization plane is the same as for the electric wave component of the electro-magnetic wave. The rotation of the polarization plane compared to the tank position could be useful (for example to avoid disturbing reflections) in certain applications. To rotate the polarization plane loosen the M6 hex socket set screw above the process connection and rotate the instrument. Then tighten the unit by the screw.



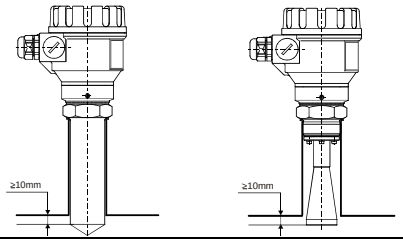
EMPTY TANK

Especially in case of standing tanks with hemispherical bottom and in the case of tanks which have equipment inside at the bottom (e.g. heating element, stirrer) wrong level measurement may occur when the tank is totally emptied. The reason for this measurement error is that the tank bottom or the objects at the bottom disperse or reflect the emitted microwave signals. Also the lower signal-level deflected radar impulses may interfere with itself inside the tank.
In order to perform reliable level measurement there should be at least 100 mm liquid level above the disturbing objects at the bottom or above the hemispherical tank bottom.



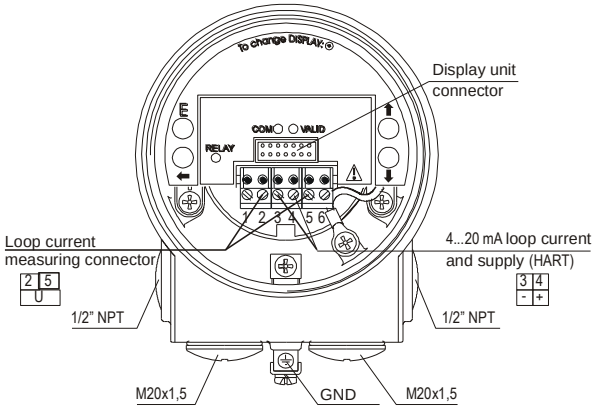
SOCKET, NOZZLE

The process connection should be fitted so that the antenna end protrudes at least 10 mm out of the socket.



4.2. WIRING

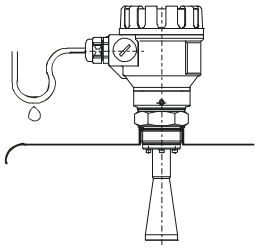
The instrument operates from a 20 … 36 V galvanic isolated and not grounded DC power supply in a two-wire system. (For Ex version: 20 … 30 V DC!)
The voltage value measured on the terminal of the instrument should be a minimum of 20 V (at 4mA)! If you are using the HART interface, to ensure proper communication between the transmitter's interface and the power-supply a minimum 250 Ohm resistance should be maintained within the network. The instrument should be wired with shielded cable fed through the cable gland. The wiring of the cables can be done after removing the cover of the instrument and the VGF display unit.



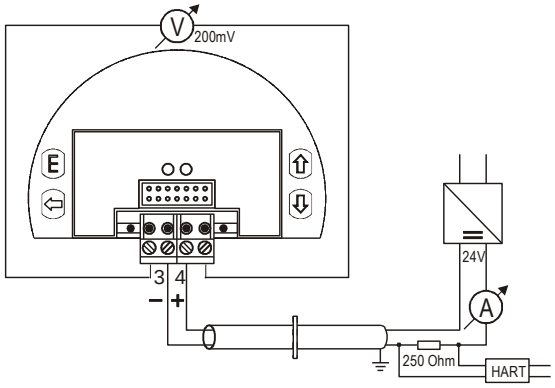
IMPORTANT: The grounding screw on the housing of the transmitter should be connected to the equipotential network. Resistance of the EP network should be R ≤ 2 Ohm measured from the neutral point. Shielding of the cable should be grounded at the control room side to the EP network. To avoid disturbing noises, keep wiring away from high-voltage cables, especially inverters because even cable shielding does not supply effective protection against this interference.

The instrument may be damaged by electrostatic discharge (ESD) via its terminal, thus apply the precautions commonly used to avoid electrostatic discharge e.g. by touching a properly grounded point before removing the cover of the enclosure. A possible electrostatic discharge can cause damage for the instrument. Do not touch the internal terminals!

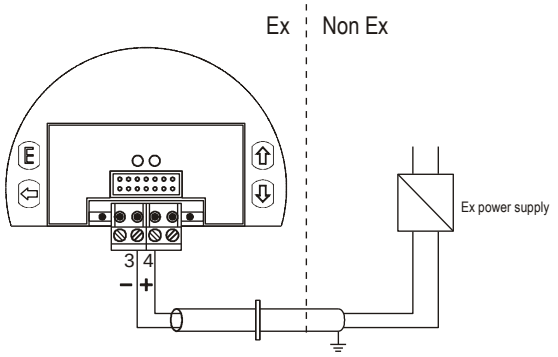
WATER / VAPOUR
To achieve suitable ingress protection HYCONTROL recommends using the suggested cable outer diameter (see technical data table in chapter 3) and secure the cable gland properly.
HYCONTROL also recommends running the connecting cables downwards to lead any rain water or condensed water aside. This is needed in case of outside installations and special applications where there is very high humidity or the possibility of water condensation is quite high (for example in cleaning, purification processes or in cooled and / or heated tanks).



4.2.1. WIRING OF THE DEVICES



Using HART communication in non-Ex environment



Using Ex approved instrument in hazardous environment

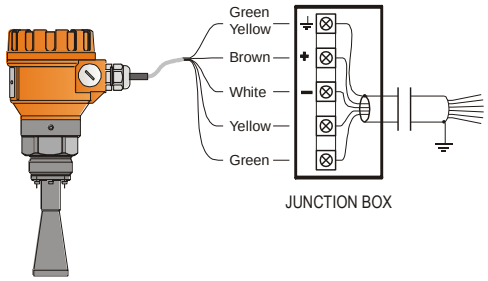
In case of integrated version:

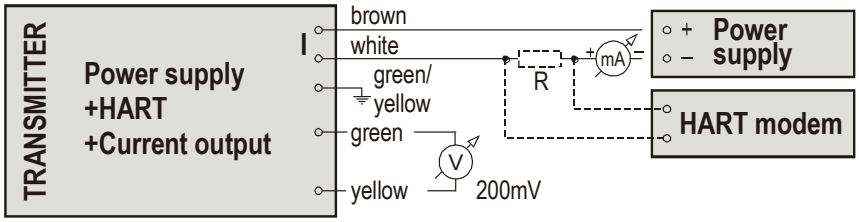
Prior to wiring ensure that the power supply is turned off at the source.
(For wiring the unit 6 x 0.5 mm² cross section or greater cable is recommended).

The necessary programming can be made after energizing the unit.

Colour codes of the wires:

Green	–		(+) Positive point of current loop measurement
Yellow	–		(-) Negative point of current loop measurement
White	–	I	(-) Negative point of current loop, power supply and HART
Brown	–	I	(+) Positive point of current loop, power supply and HART
Green/Yellow	–	GND	Grounding and shielding point



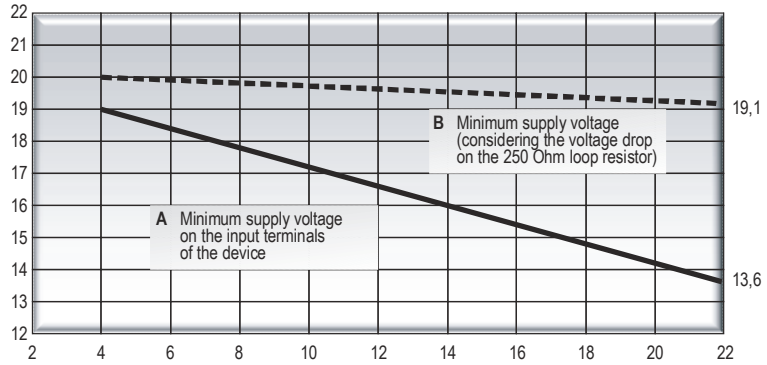


Extension of the integrated cable:

The use of a junction box is recommended for extending the cable.
The shield of the two cables should be connected and grounded at the signal processing device.

4.2.2. DETERMINE THE APPROPRIATE POWER SUPPLY VOLTAGE

The minimum power supply voltage required by the VG4 devices is depending on the load impedance in accordance to the below diagram:



A: Minimum supply voltage on the input terminals of the device

B: Minimum supply voltage (considering the voltage drop across the 250 Ohm loop resistor)

Calculation example: Voltage drop calculated with 22 mA:

$U_{\text{minimum supply voltage (22 mA)}}$ = 22 mA x load resistance+ $U_{\text{input minimum (22 mA)}}$

$U_{\text{minimum supply voltage (22 mA)}}$ = 22 mA x 250 Ohm + 9 V = 5.5 V + 13.6 V = 19.1 V

In order to provide operation in the total current loop range the calculation should be also checked with 4 mA:

$U_{\text{minimum supply voltage (4 mA)}}$ = 4 mA x load resistance + $U_{\text{input minimum (4 mA)}}$

$U_{\text{minimum supply voltage (4 mA)}}$ = 4 mA x 250 Ohm + 19 V = 1 V + 19 V = 20 V

Therefore in the case of a 250 Ohm load resistance a 20 V power supply voltage is just enough voltage to provide for the total 4-20 mA measuring range.

4.3. LOOP CURRENT CHECKING WITH HAND INSTRUMENT

After removing the cover and the Display Module, the actual loop current can be measured throughout an internal 1 Ohm shunt resistor by connecting a voltmeter (set to the 200mV range) to points 2 and 5 indicated on the wiring drawing in 4.2.1.

5. PROGRAMMING

The VG4 transmitters can be programmed (basically) using the following two methods:

- **Programming with the VGF-DISPLAY display unit** (see 5.2)

  All features of the unit can be accessed and all parameters can be set, such as measurement configuration and optimisation, outputs, dimensions for 11 tanks with different shape, 99-point linearization.

- **Programming with HyView PC configuration software**

The **VG4G□** and **VG4J□** types include the VGF-DISPLAY display unit.

The VG4 transmitters are fully operational without the VGF-DISPLAY display as well, it is only needed for local programming and / or local measurement displaying.

FACTORY DEFAULT SETTING

The VG4 series level transmitters are factory programmed in the following manner:

- ⇒ Measurement mode: Level (LEV). The displayed value is the measured level.
- ⇒ The current output and the bargraph on the right are proportional to the measured level.
- ⇒ 4 mA and 0% are assigned to zero level.
- ⇒ 20 mA and 100% are assigned to the maximum level.
- ⇒ Error indication by the current output: holds the last current value.
- ⇒ Level tracking time constant: 15 sec.

The instrument regards the distance (DIST) measured from the antenna end as the basic measurement value. This distance is handled and displayed in one of the selected dimensions: m, cm, mm, feet, or inch. Since the maximum measurement distance is given (entered in P04) the instrument can calculate the actual level (LEV) value. If the proper mechanical dimensions of the mounting – distance between the sealing and the tank bottom – is known, the measured level values can be more accurate by adding this data. The level values calculated that way are the base for volume (VOL) calculation and the 99-point linearization table (VMT) also uses these values as input data.

5.1. THE VGF-DISPLAY DISPLAY UNIT

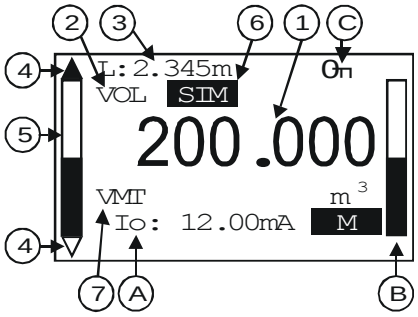
5.1.1. PRIMARY MEASUREMENT SCREEN

The VGF-DISPLAY is a 64x128 dot-matrix LCD display which can be plugged into the transmitter. (It is universal – usable in other HYCONTROL devices as well – provided that the system software supports VGF-DISPLAY.)

Warning!

The VGF-DISPLAY module is based on LCD technology, so please make sure it is not exposed to permanent heat or direct sunlight, in order to avoid damage of the display unit. If the instrument cannot be protected against direct sunlight or high temperature that is beyond the standard operating temperature range of the VGF-DISPLAY, please do not leave the VGF display in the instrument.

Displaying a measurement with the VGF-DISPLAY display unit



Display elements

1. Primary (Measured) Value (PV) based on BASIC SETUP / PV. MODE.
2. Calculation mode of Primary Value (PV) based on BASIC SETUP / PV. MODE.
3. Type and value of the initial quantity used for calculating the Primary Value (PV):
   - if PV is Level measurement (LEV) then item 3 is a Distance (DIST),
   - if PV is Volume measurement (VOL) then item 3 is a Level (LEV).
4. Trend direction arrows. An empty triangle shows when the measured value change is small and the filled triangle shows when the measured change is large. If none of the arrows are shown then the measured value hasn't changed.
5. Distance Value for primary measurement in relation to the measurement range (Sensor range) displayed in a bargraph.
6. Indication whether the display and output show the values from the simulation and not the measured values.
7. Indication of active (**V**olume / **M**ass **T**able - VMT) calculation mode.

During active simulation any critical measurement errors will be displayed to give information to the user.

A, Output current - calculated value

On the display after the mA current value, current output mode is indicated by the inverse text:

M

Indicates Manual mode (see 5.3.2.1)

H

Indicates HART address is not 0, so output current has become set to 4 mA (see 5.3.2.1)

E!

Indicates that the analogue transmission has reacted to a programmed failure condition
e.g. if an upper or lower fault current is programmed (see 5.3.2.4)

B, Output range (4-20 mA) indicated in a bargraph.

The bottom of the bargraph is assigned to 4 mA and the top is assigned to 20 mA.

C, Indication of Menu Lock:

- If the key symbol is visible, the unit is protected with a password. When entering the menu, the instrument asks for the correct password (see 5.3.6.1).
- If REM message is visible, the instrument is in remote programming mode and the main menu cannot be accessed.

Errors occurred during the measurement can be seen on the bottom line of the display.

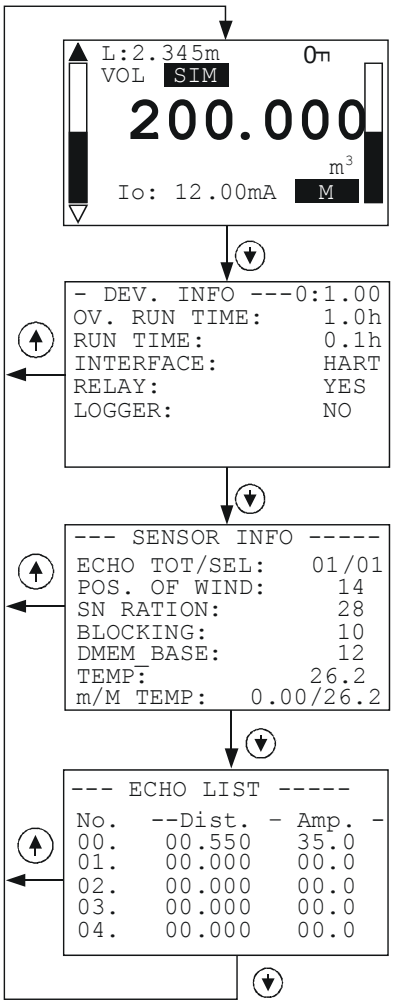
5.1.2. INFORMATION SCREENS

Press ⓓ button to cycle between the main measurement screen and the information display screen:

1. General information screen (DEV. INFO)
   Overall running time (OV. RUN TIME)
   Run time after power on (RUN TIME)
   Type of interface (INTERFACE) in the instrument.
   Type of instrument (TYPE)
2. Sensor information screen: (SENSOR INFO)
   Number of echoes (ECHO TOT/SEL)
   Blocking (BLOCKING)
   Signal-to-noise ratio (SN)
   Temperature (TEMP)
3. Echo table: (ECHO TABLE)

   The location (distance) and the amplitude of the echoes (Dist. / Amp.) are listed

   The listed items are the reflections detected by the VG4 (measured in dB) and the approximate distance from the process connection. The listed values are not accurate measurement values, since around the selected echo (measurement window) there are further measurements and signal processing procedures in order to provide accurate measurement display and level transmission.



The information screen returns back to main screen after 30 seconds.
By pressing the ⓤ button the user can return to the main screen any time.
Pressing the Ⓔ button in any of the screens allows the user to enter the main menu.
After exiting the menu the main screen will always be shown.

5.1.3. ECHO MAP

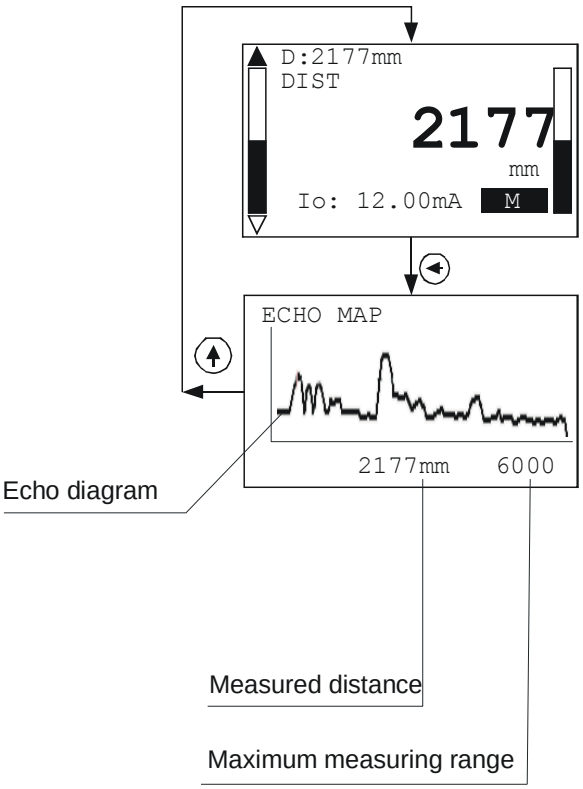
Pressing the ◄ button in the measurement screen will cause the echo map screen to appear. This screen shows the following information:

1. Echo diagram
2. Actual measured distance
3. Maximum measuring range

The echo map screen returns back to the main screen after 30 seconds.

By pressing the ▲ button the user can return to the main screen at any time. Pressing the E button in any of the screens allows the user to enter the main menu.

After exiting the menu the main screen will always be shown.



Echo diagram

Measured distance

Maximum measuring range

5.2. PROGRAMMING WITH THE VGF-DISPLAY DISPLAY MODULE

When entering the menu the instrument makes a copy of the actual parameters and all changes are done to this duplicated parameter set. During programming the instrument keeps measuring and transmitting with the current (and intact) parameter set. After exiting the menu the instrument replaces the original parameters with the new parameter set and will measure according to the new parameters. This means that the change of the parameters does not become immediately effective when pressing the Ⓔ button!

Entering the menu can be done by pressing the Ⓔ button, while exiting the menu can be done by pressing the ◄ button.
If the instrument is left in programming mode after 30 minutes it will automatically return to measuring mode. If the VGF-DISPLAY display is removed during programming the instrument immediately returns to measuring mode.

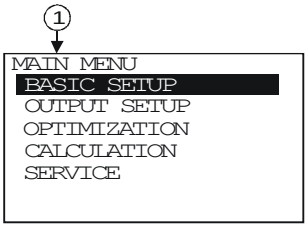
As programming with VGF-DISPLAY (manual programming) and HART (remote mode) programming is not possible at the same time, only one programming method can be chosen. Measured values can be read out through HART at any time.

5.2.1. COMPONENTS OF THE PROGRAMMING INTERFACE

The parameters of the instrument are grouped according to their functions. The programming interface consists of lists, dialog windows, edit windows and report windows.

Lists

Navigation between the lines of a list can be done by pressing the ▲ / ▼ buttons. Pressing the Ⓔ button activates a list item. The selected list item is marked with inverse colour. Exit from a list by pressing the ◄ button.



Menu list

The Menu list is a specialized list. Its characteristic is that upon selecting a list item we directly get into another list, and these lists are opening from each other in different levels.

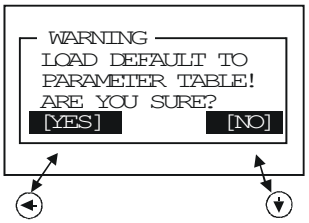
The menu header (1) helps to navigate.

Entering the main menu can be done by pressing the Ⓔ button. Navigation between the menu items can be done by pressing the ▲ / ▼ buttons. Enter to the selected menu by pressing the Ⓔ button. The selected list item is marked with inverse colour.

Exit from a submenu by pressing the ◄ button. Pressing the ◄ button in the main menu will quit from the programming mode and the instrument will return to measuring mode.

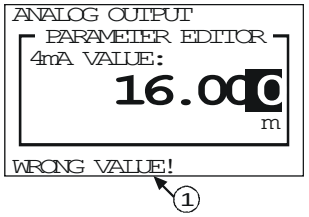
Dialog window

During the programming the system sends messages or warnings to the users by dialog windows. These usually can be acknowledged by pressing the ◄ button or the user can choose between two options (usually YES or NO) by pressing the ◄ / ▼ buttons. In some cases one of the parameters has to be changed to correct an error.



Edit window

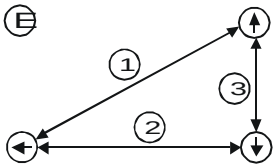
An edit window is used for modifying a numeric parameter value. The selected character can be changed by pressing the ▲ / ▼ buttons. The cursor can be moved to left, by pressing the ◄ button.
The direction of the cursor movement through the digits is right to left. The changed value can be validated by pressing the Ⓔ button. The software checks if the entered value is appropriate, exiting from the edit window is only possible after entering a correct value. If the entered value is uninterpretable the software sends an error message in the bottom line (1) of the display.



Edit window – button combinations

In the edit window the following button combinations are available:

1. Recalling the parameters to the state seen before editing (◄ + ▲, pressed for 3 sec.)
2. Recalling default parameters (◄ + ▼, pressed for 3 sec.)
3. Inserting (currently) measured value to the edit window (▲ + ▼, pressed for 3 sec.)
   Only for certain parameters!



5.2.2. MENU STRUCTURE

Main menu

BASIC SETUP	Parameter group of the basic measurement parameters
OUTPUT SETUP	Parameter group of the output parameters
OPTIMIZATION	Parameter group for measurement optimization settings
CALCULATION	Calculations
SERVICE	Service functions, calibration, test and simulation

5.3. PROGRAMMABLE FEATURES DESCRIPTION

5.3.1. BASIC MEASUREMENT SETTINGS

5.3.1.1 Default system units

Parameter: P00: c, where c: 0, 1. *(see VG4 parameter table)* Default value: EU
Path: BASIC SETUP / UNITS / ENGINEERING SYSTEM
Description: This should be configured as the first step of the programming.
Here you can choose the default unit system:

- EU Metric units (European unit system)
- US Imperial Units (American unit system)

5.3.1.2 Default engineering units

Parameter: P00:b, and P02:b, or P02:c *(see VG4 parameter table)* Default value: mm, m^3, t
Path: BASIC SETUP / UNITS / ENGINEERING UNITS
Description: The dimension of the selected default unit system can be specified in this menu. The measurement mode selected here will define the primary measured value and the displayed value, furthermore it will be the source for the current output:

- BASIC UNITS (m, cm, mm, ft, inch)
- VOLUME / FLOW UNITS (m^3, l, ft^3, gallon)
- MASS UNITS (t, t)

If the dimension is modified, the device resets all the parameters after a warning message.

5.3.1.3 Measurement mode / Process Variable (PV)

Parameter: P01: b a *(see VG4 parameter table)* Default value: DIST
Path: BASIC SETUP / PV MODE
Description: This mode determines the primary value and the displayed value. It also determines the value which will be proportional to the output current.

- DISTANCE
- LEVEL
- VOLUME
- MASS

5.3.1.4 Maximum Measuring Distance

Parameter: P04 — Default value: 16000 - 23000
Path: BASIC SETUP / MAX. MEAS.DIST — *See section 3.2.1*
Description: This parameter should be entered in all cases, except distance measurement mode. But it is best programmed in the case of distance measurements in order to avoid detecting the possible unwanted effects of multiple reflections.

5.3.1.5 Damping Time

Parameter: P20 — Default value: 15 sec
Path: BASIC SETUP / DAMPING TIME
Description: Damping time is used to damp the unwanted fluctuations of the output and display.
If the measured value changes rapidly the new value will settle with 1% accuracy after this set time. (Damping is calculated using the exponential function).

5.3.1.6 Demo Mode

Parameter: P00: d *(see VG4 parameter table)* — Default value: OFF
Path: BASIC SETUP / DEMO MODE
Description:

- OFF: The operation is performed taking all the application parameters into consideration (such as filling, emptying speed, echo selection, etc.)
- ON: This fast operation mode ignores the application parameters. The demo mode uses a fast evaluation algorithm independent of P25, P26 and P27 parameters. *Please note: - Measurement accuracy and reliable operation in the process environment are not guaranteed in Demo mode.*
-

5.3.2. ANALOGUE OUTPUT

5.3.2.1 Output Current Mode

Parameter: P12:b, where b: 0, 1. *(see VG4 parameter table)* — Default value: AUTO
Path: OUTPUT SETUP / ANALOG OUTPUT / CURRENT MODE
Description: Transmission mode of the current output.

- AUTO The output current is calculated from the measured value, output is active.
- MANUAL The output current is set to whatever value has been programmed by the user in parameter 5.3.2.6. That value overrides any measurement value, error current value or even the 4mA value set when selecting HART in multidrop mode.

5.3.2.2

5.3.2.3 Output Current Value assigned to 4 mA

Parameter: P10 — Default value: 0 mm
Path: OUTPUT SETUP / ANALOG OUTPUT / 4mA VALUE
Description: Measured value in mm that corresponds to the 4 mA current value.
The value is measured in agreement with the Measurement Mode setting (P01:a). Assignment can be done so that the change in measured value and the change in the output value are in the same (normal) direction, or opposite direction (inverse operation). e.g. 1m level is 4 mA and 10m level is 20 mA or 1m level is 20 mA and 10m level is 4 mA.

5.3.2.4 Output Current Value assigned to 20 mA

Parameter: P11 — Default value:
Path: OUTPUT SETUP / ANALOG OUTPUT / 20mA VALUE — Maximum measurement distance (mm)
Description: Measured value in mm that corresponds to the 20 mA current value.
The value is measured in agreement with the Measurement Mode setting (P01:a). Assignment can be done so that the change in measured value and the change in the output value are in the same (normal) direction, or opposite direction (inverse operation). e.g. 1m level is 4 mA and 10m level is 20 mA or 1m level is 20 mA and 10m level is 4 mA.

5.3.2.5 Output Current Error Mode

Parameter: P12:a, where a: 0, 1, 2 *(see VG4 parameter table)* — Default value: HOLD
Path: OUTPUT SETUP / ANALOG OUTPUT / ERROR MODE
Description: Error indication by the Current output:

- HOLD Error indication has no effect on the output current.
- 3.8mA Error indication: the output current gets is set to 3.8mA.
- 22mA Error indication: the output current gets is set to 22mA.

Warning: This error indication is active unless the failure is fixed, or until the failure clears.

5.3.2.6 Fixed Output Current

Parameter: P08 — Default value: 4 mA
Path: OUTPUT SETUP / ANALOG OUTPUT / MANUAL VALUE
Description: Parameter for setting the fixed output current:
Values between 3.8 and 20.5 can be entered. The output current will be fixed at the entered value and will override the processes calculated current (see: 5.3.2.1). This error indication overrides all other error indication.

5.3.3. DIGITAL OUTPUT

5.3.3.1 HART Polling Address

Parameter: P19 — Default value: 0
Path: OUTPUT SETUP / SERIAL OUTPUT / ADDRESS
Description: HART Polling Address
The polling address can be set between 0 and 15. For a single instrument the polling address is 0 and the output is 4-20 mA (analogue output). If multiple units are used in HART Multidrop mode (max. 15 pcs.) the polling addresses should differ from 0 (1-15), in this case the output current will be fixed at 4 mA.

5.3.4. MEASUREMENT OPTIMIZATION

5.3.4.1 Blocking, Dead Zone

Parameter: P05 — Default value: 300 mm
Path: OPTIMIZATION / DEAD ZONE
Description: The instrument ignores all reflections within the dead zone and the close in blocking distance. Minor obstructions and false reflections which are close to the sensor can be eliminated by increasing the dead zone value manually.

5.3.4.2 Echo Selection

Parameter: P25:a, where a: 0, 1, 2, 3 *(see VG4 parameter table)* — Default value: AUTO
Path: OPTIMIZATION / ECHO SELECTION
Description: Determines how the echo (true reflection) is selected within the measuring window. In order to avoid disturbing reflections the instrument forms a so-called measuring window around the reflected signal. The distance measurement is performed with the echo signal within the measurement window.

- AUTO
- FIRST
- HIGHEST AMPLITUDE
- LAST

5.3.4.3 Emptying Speed

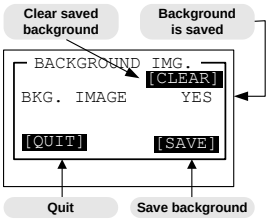
Parameter: P27 — Default value: 50 m/h
Path: OPTIMIZATION / EMPTYING SPEED
Description: The parameter must not be smaller than the fastest possible emptying rate of the actual process.

5.3.4.4 Filling Speed

Parameter: P26 — Default value: 50 m/h
Path: OPTIMIZATION / FILLING SPEED
Description: The parameter must not be smaller than the fastest possible filling rate of the actual technology.

5.3.4.5 Background Image

Parameter: OPTIMIZATION / BACKG.ECHO IMAGE / SAVE BACKG. IMAGE
Path: The fixed disturbing objects inside the tank which generates unwanted false reflections can be blocked out from the measurement range. For this purpose the instrument needs to map the totally empty tank to create a “background image”. After this procedure the software will automatically recognise and ignore the reflections coming from the disturbing objects crossing the microwave beam (see 4.1 - Obstacles).
Warning! The background image should be saved only when the tank does not contain the measurement medium but the disturbing objects inside the tank remain. The background image is not recommended to be saved when the tank is filled with the measurement medium since it might result in the wrong level measurement.



5.3.4.6 Using saved background image

Parameter: P35: a, where a: 0, 1 *(see VG4 parameter table)* — Default value: OFF
Path: OPTIMIZATION / BACKG.ECHO IMAGE / SAVE BACKG: IMAGE
Description: Turning ON or OFF the usage of saved background image during the calculations as per the above 5.3.4.5 point described.

- OFF: Ignoring the saved background image.
- ON: Uses background image, damping reflections coming from the disturbing objects.

5.3.4.7 Threshold value

Parameter: P29 — Default value: 4 dB
Path: OPTIMIZATION / TRESHOLD VALUE
Description: Defining an upper limit value above the saved background image described in 5.3.4.5. The instrument will evaluate the measurement result as a real echo when the reflected signal exceeds the saved background level by the threshold value entered here. Setting the threshold value is useful when the level in the tank and the position of the (small surface) stationary object are at the same point. In this case the instrument will not process the object as a false reflection.

5.3.5. CALCULATIONS

5.3.5.1 Specific gravity

Parameter: P32 — Default value: 0
Path: CALCULATION / SPECIFIC GRAVITY
Description: Entering a value (other than "0") for specific gravity in this parameter causes a MASS value to be displayed instead of Volume (VOL), in tonne or lb/tonne units depending on P00 (c) and P02 (b).

5.3.5.2 Volume / Mass Calculation Mode

Parameter: P47: a *(see VG4 parameter table)* — Default value: 0
Path: CALCULATION / V/M CALC. MODE
Description: Calculation of the volume and mass can be performed in two ways:

- TANK FUNCTION/SHAPE – volume and mass calculation with a tank shape formula. Entering this option automatically turns the table OFF.
- V/M TABLE – volume and mass calculation with a table. Entering this option automatically turns the table ON.

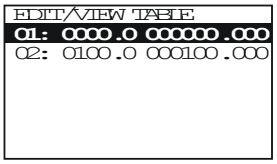
5.3.5.3 Volume / Mass Table

Parameter: -
Path: CALCULATION / V/M CALC. MODE / V/M TABLE
Description:

- VIEW/EDIT TABLE
- ADD ITEM
- DELETE ITEM

If none of the formulas match perfectly to the characteristics of the required tank, there is a possibility of using a custom table. The device can handle a 99-point table and counts values between the neighbouring point pairs using linear interpolation.
The input (left) side of the table contains the level data, the output (right) side contains the volume or mass data.
The first data point pair of the table should be 0,0. If a long table needs to be shortened, enter 0,0 point pair into the last item of the table, the device will modify the following unused data point pairs automatically changing them to 0,0.
The status (ACTIVE or OFF) of the table is shown on a warning message (1) on the bottom line of the display.

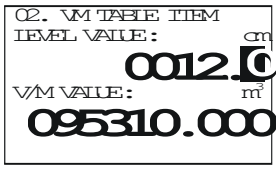
All modifications are done on a temporary table. This temporary table becomes valid after exiting.
Modifications during the programming procedure have no effect on the measurement and the transmitting.



Entering the data point pairs can be done in arbitrary order, because the device sorts according to ascending order. Both sides of the table have to increase in value or stay the same. In case of any error, a warning message (see chapter 6) will appear. When entering the table again the highlighted text indicates the first wrong line.

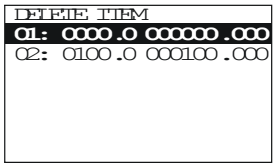
View table:

In EDIT /VIEW TABLE menu data values in the ordered table can be checked. To move through the list use the ⓓ and ⓤ buttons, to edit the selected item use the Ⓔ button. Exiting from the list can be done by pressing the ⓛ button.



Edit table:

Adding a data point pair (ADD ITEM) to the list or pressing Ⓔ button on an existing items causes an edit screen to appear. In this edit screen there are two editing fields. Both editing field works the same as editing a parameter. To move from the first field to the second field press the Ⓔ button. Pressing Ⓔ button in the second field will return the cursor back to the previous menu point. When exiting from the last field, the device re- orders the table.



Delete item

Moving through the list can be done with ⓓ and ⓤ buttons, to delete an item press the Ⓔ button on the selected item. To exit the list press the ⓛ button. The table should contain at least 2 items.

5.3.5.4 Tank Function / Profile

Parameter: P40:a, where a: 0,1, 2, 3, 4. *(see VG4 parameter table)* Default value: 0
Path: CALCULATION / V/M CALC. MODE / TANK FUNCTION/SHAPE
Description:

- STANDING CYL. - Standing cylindrical tank
- STD. CYL. CON. BOT. - Standing cylindrical tank with conical bottom
- STD. RECT. W/CHUTE - Standing rectangular tank with or without chute
- LYING CYLINDRICAL - Horizontal cylindrical tank
- SPHERICAL - Spherical tank

5.3.5.5 Tank Bottom Shape

Parameter: P40:b, where b: 0,1, 2, 3 *(see VG4 parameter table)* Default value: 0
Path: CALCULATION / V/M CALC. MODE / TANK FUNCTION/SHAPE
Description: This menu only appears, if it is required for the selected tank shape type

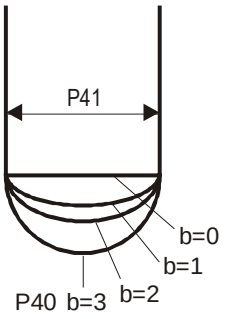
- SHAPE0
- SHAPE1
- SHAPE2
- SHAPE3

5.3.5.6 Tank Dimensions

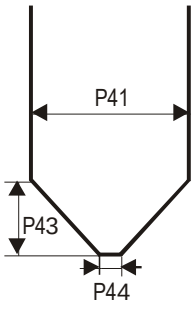
Parameter: P41- P45 Default value: 0
Path: CALCULATION / V/M CALC. MODE / TANK FUNCTION/SHAPE
Description:

- DIM1 (P41)
- DIM2 (P42)
- DIM3 (P43)
- DIM4 (P44)
- DIM5 (P45)

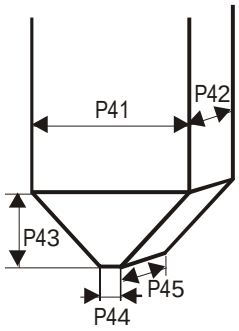
Vertical cylindrical tank with hemispherical bottom a = 0



Vertical cylindrical tank with conical bottom a = 1 ; b = 0

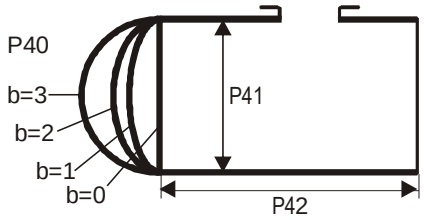


Vertical rectangular tank with or without chute a = 2 ; b = 1

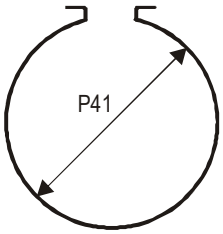


If no chute: P43, P44 and P45 = 0

Horizontal cylindrical tank a = 3



Spherical tank a = 4 ; b = 0



5.3.6. SERVICE FUNCTIONS

5.3.6.1 Security Codes

User codes

Path: SERVICE / SECURITY / USER LOCK
Description: Setting or unlocking the user security code.
The instrument can be protected against unauthorized programming with a 4 digit PIN (Personal Identification Number) code. If either of the digits differs from 0 the code is active. If zero is specified, then the secret code has been deleted!
If a security code is set this code is requested at menu entry.

Service code

Path: SERVICE / SECURITY / SERVICE LOCK
Description: Setting of the service code.
Only for trained personnel

5.3.6.2 Current Output Test

Parameter: P80
Path: SERVICE / OUTPUT TEST / ANALOG OUTPUT / CURRENT VALUE
Description: Loop current test (mA)
When entering this Parameter the current value which is proportional to the actual measurement value will appear on the display and at the output. In loop current test mode, values between 3.9 and 20.5 can be entered. The output current will be set to the entered value. The measured current on the output should be equal to the set value.
In test mode a dialog window warns the user that there is a fixed output current set until the user exits the warning message window. Exiting can be done by pressing the Ⓔ button.

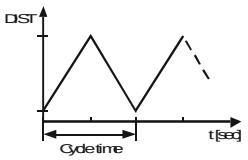
5.3.6.3 Distance Simulation

This function facilitates the user to be able to check the calculations (tank formula, table), outputs, and the additional processing instruments connected to the output. VG4 transmitters can perform simulation on the value of a constant or a variable. To start simulation the instrument must return to Measurement mode. In Measurement mode if simulation is in progress, an inverse SIM caption appears on the display.

Simulation mode

Parameter: P84:a, where a: 0,1, 2, 3, 4 — Default value: OFF
Path: SERVICE / DIST SIMULATION / MODE
Description: Simulation mode:

OFF	No simulation
FIX VALUE	Value of the simulated distance is set according to the lowest value of the simulation.
MANUAL VALUE	. . . .
TRIANGLE WAVE	Value of the simulated distance changes linearly between the lowest and highest values with an adjustable cycle time.
SQUARE WAVE	The simulated value jumps between the lowest and highest values with an adjustable cycle time.



Simulation cycle

Parameter: P85 — Default value: 60 sec
Path: SERVICE / DIST. SIMULATION / TIME
Description: Cycle time of the simulation

Bottom value of the simulation

Parameter: P86 — Default value: 0 mm
Path: SERVICE / DIST. SIMULATION / BOTTOM VALUE
Description: Lowest value of the simulation

Upper value of the simulation

Parameter: P87 — Default value: Programmed measurement range
Path: SERVICE / SIMULATION / UPPER VALUE
Description: Highest value of the simulation

5.3.6.4 Load Default Values

Path: SERVICE / DEFAULTS / LOAD DEFAULT
Description: This command loads all default values of the instrument.
After loading the default values the parameters can freely be changed, the effect of the changes does not affect the measurement until the user exits from the Programming mode and returns to Measurement mode. Before loading the defaults the software asks for a confirmation from the user because all user parameters will be lost!

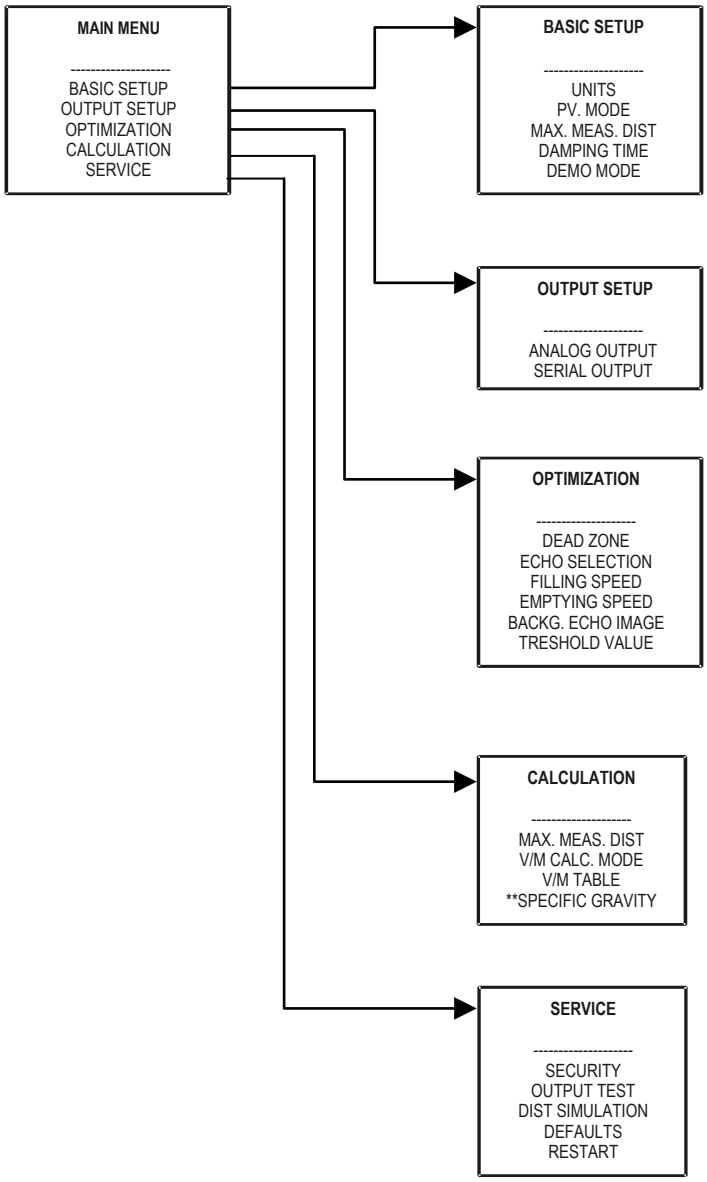
6. ERROR CODES

MESSAGE ON THE SCREEN	ERROR DESCRIPTION	PROCEDURE TO DO	CODE
MEMORY ERROR	Memory error	Contact service department.	1
NO ECHO	Sensor error	Contact service department.	2
EE COM. ERROR	Hardware error (EEPROM communication error)	Contact service department.	3
MATH. OVERLOAD	Calculation overflow	Check instrument program.	4
SIGNAL IN N.D.B.	Sensor or calibration error (Measured value is in the close-end dead-zone)	Contact service department.	5
SIGNAL IN F.D.B.	Sensor or calibration error (Measured value is in the far-blocking zone)	Check the installation conditions.	7
VMT SIZE ERROR	Linearization error: Less than two items are in the table.	Check the content of the VMT. See: 5.3.5.3.	12
VMT INPUT ERROR	Linearization table error: monotonicity error in the input (level) side of the table.	Check the content of the VMT. See: 5.3.5.3.	13
VMT OUTPUT ERROR	Linearization table error: monotonicity error in the output (volume or mass) side of the table.	Check the content of the VMT. See: 5.3.5.3.	14
VMT INPUT OV.RNG.	Linearization table error: The measured level is greater than the highest level of the table's input side.	Check the content of the VMT. See: 5.3.5.3. Device performs extrapolation according to the last point pairs.	15
EE CHK ERROR	Parameter checksum error.	Check instrument program To recalculate the checksum modify a parameter and return to Measurement mode. If this error still remains, contact service department.	16
INTEGRITY ERROR	Parameter integrity error (Automatically corrected internal error). Only WARNING message.	Check instrument program.	17
AC COM. ERROR	Hardware error	Contact service department.	18
CALIBRATION ERROR	Sensor calibration error	Contact service department.	

7. VG4 PARAMETER TABLE

Pxx	Parameter name	d	c	b	a
00	**Engineering system, dimensions**	DEMO mode 0 = Normal mode 1 = Demo mode	Engineering system: 0 = EU 1 = US	Dimension: (EU) 0 = m, 1 = cm, 2 = mm (US) 0 = ft,1 = inch	
01	**Measurement Mode / Process Variable (PV)**				0 = DIST, 1 = LEVEL, 2 = VOLUME, 3 = MASS
02	**Selectable dimensions**		Time units: 0= sec 1= min 2= hour 3=day	(VOL/F-EU) 0 = m^3, 1=litre (VOL/F-US) 0 = ft^3, 1 = US gallon (MASS-EU) 0 = tonne, 1= US tonne (MASS-US) 0 = tonne, 1 =lb(pound)	Temperature unit: 0= °C 1= °F
04	**Max. measuring distance**	Maximum measuring distance of the level transmitter can be defined			
05	**Blocking / DEAD ZONE**	Minimum distance in within which all measurement values are ignored			
08	**Fix current output**	Fix forced value on the output current between 3.8 and 20.5 mA for loop current measuring purposes (operation mode = manual)			
10	**4 mA**	Measured and transmitted value (PV) assigned to 4 mA current value			
11	**20 mA**	Measured and transmitted value (PV) assigned to 20 mA current value			
12	**Output current mode**			Operation mode: 0= AUTO 1= MANUAL	Current output - Error indication 0= HOLD 1= 3.8mA 2= 22mA
19	**HART polling address**	HART Short Address of the level transmitter (0-15)			
20	**Damping time**	Damping value in seconds applied to the measured value			
25	**Echo selection in the measuring window**				0 = AUTO 1= FIRST 2= HIGHEST AMPLITUDE 3= LAST
26	**Filling speed [m/h, ft/h]**	Rate of change of the measured value (when distance is decreasing) which can be just followed with the level transmitter			
27	**Emptying speed [m/h, ft/h]**	Rate of change of the measured value (when distance is increasing) which can be just followed with the level transmitter			
29	**Threshold value**	Threshold limit value (0 - 6 dB) for the received echo evaluation			
32	**Specific gravity of the medium**	Data for mass calculation			
35	**Background mode**				Calculating with the saved background image: 0= OFF 1= ON
40	**Tank shape**				0 = Standing cylindrical tank with dome bottom 1 = Standing cylindrical tank with conical bottom 2 = Standing rectangular tank with or without chute 3 = Horizontal cylindrical tank 4 = Spherical tank
41-45	**Tank dimensions**				
47	**VMT mode**				Operation of the linearization: 0 = OFF, 1 = ON
60	**Overall runtime**	Overall elapsed operating hours of the level transmitter (working time) with 0.1 hour accuracy. Service data			
61	**Runtime after last reset**	Elapsed operating hours of the level transmitter since the last power ON with 0.1 hour accuracy. Service data			
70	**Number of echoes**	Service data			
71	**Position of the measuring window**	Service data			
74	**Signal-to-noise ratio**	Service data			
75	**Blocking distance value**	Service data			
80	**Current output test**	Fix forced value on the output current between 3.8 and 20.5 mA for checking the accuracy of the current generator			
84	**Simulation**				Distance simulation mode: 0 = No simulation 1 = Fix value 2 = Simulation with a manual value: PV=a entered in P86 3= Simulation between P86 and P87 levels with P85 cycle time (triangle wave) 4= Simulation between P86 and P87 levels with P85 cycle time (square wave)
85	**Cycle time of DIST simulation**	Cycle time of the distance simulation in seconds. Default value: 60 sec			
86	**Bottom value of the simulation**	Initial value of the distance simulation in the selected units (e.g.: mm). Default value: 0 (mm)			
87	**Upper value of the simulation**	Final value of the distance simulation in the selected units (e.g.: mm). Its default value is the same as the programmed maximum measurement range.			

8. MENU MAP


MAIN MENU

BASIC SETUP
OUTPUT SETUP
OPTIMIZATION
CALCULATION
SERVICE
BASIC SETUP

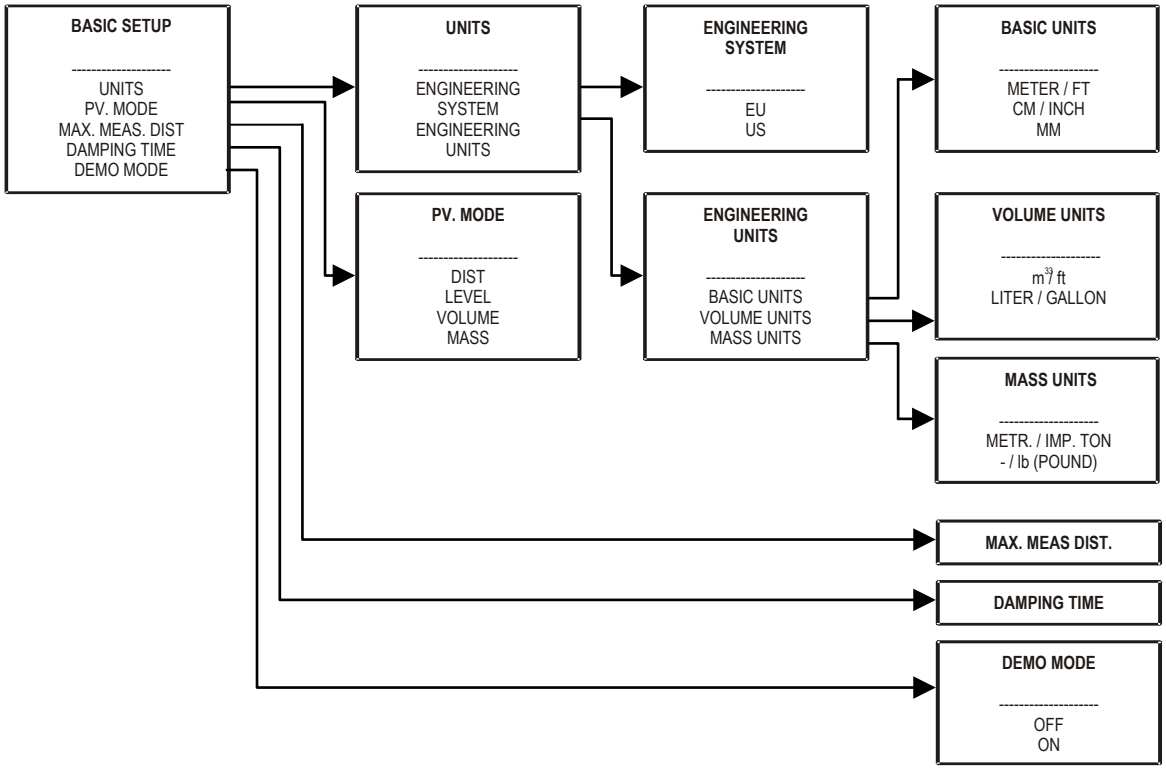
UNITS
PV. MODE
MAX. MEAS. DIST
DAMPING TIME
DEMO MODE
OUTPUT SETUP

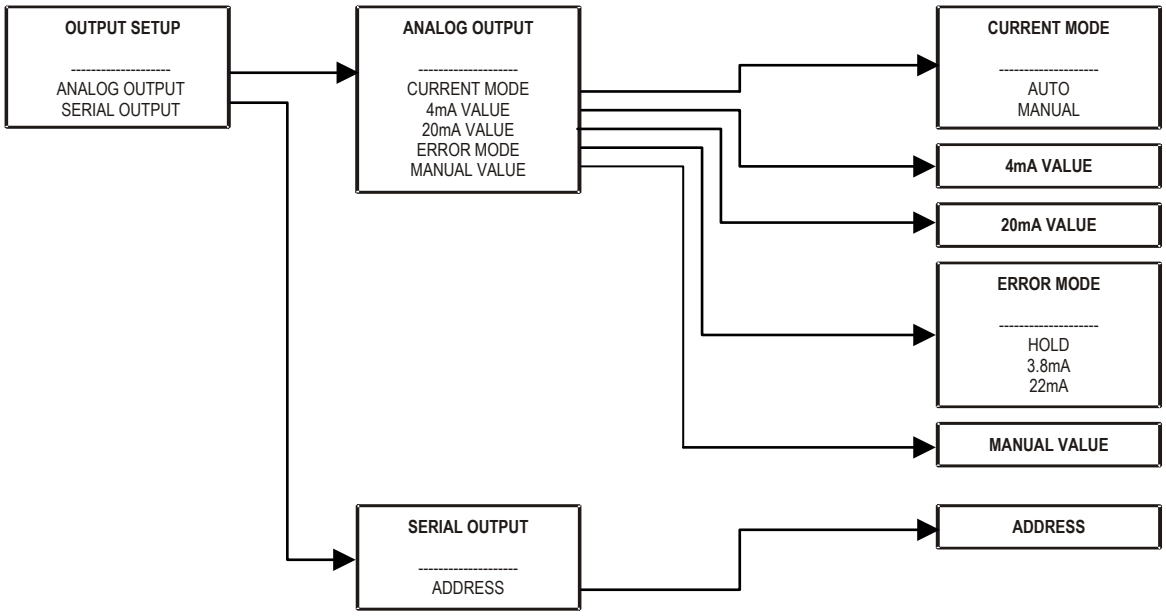
ANALOG OUTPUT
SERIAL OUTPUT
OPTIMIZATION

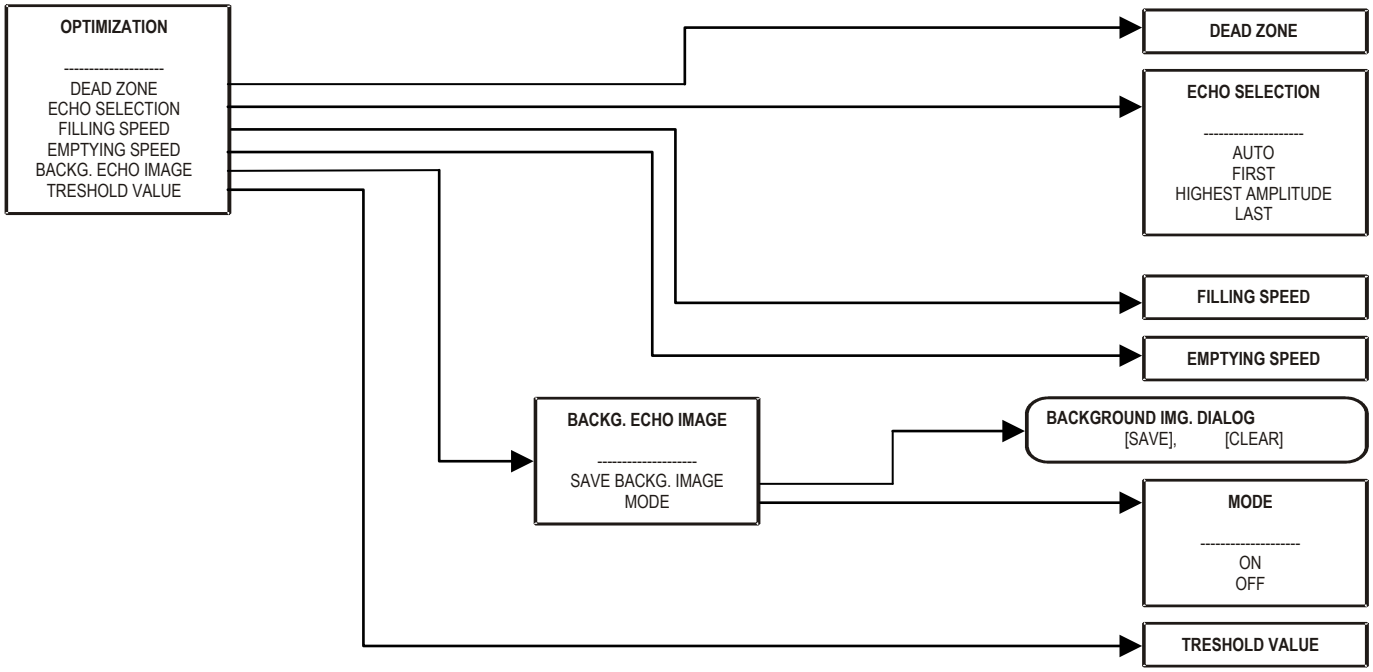
DEAD ZONE
ECHO SELECTION
FILLING SPEED
EMPTYING SPEED
BACKG. ECHO IMAGE
TRESHOLD VALUE
CALCULATION

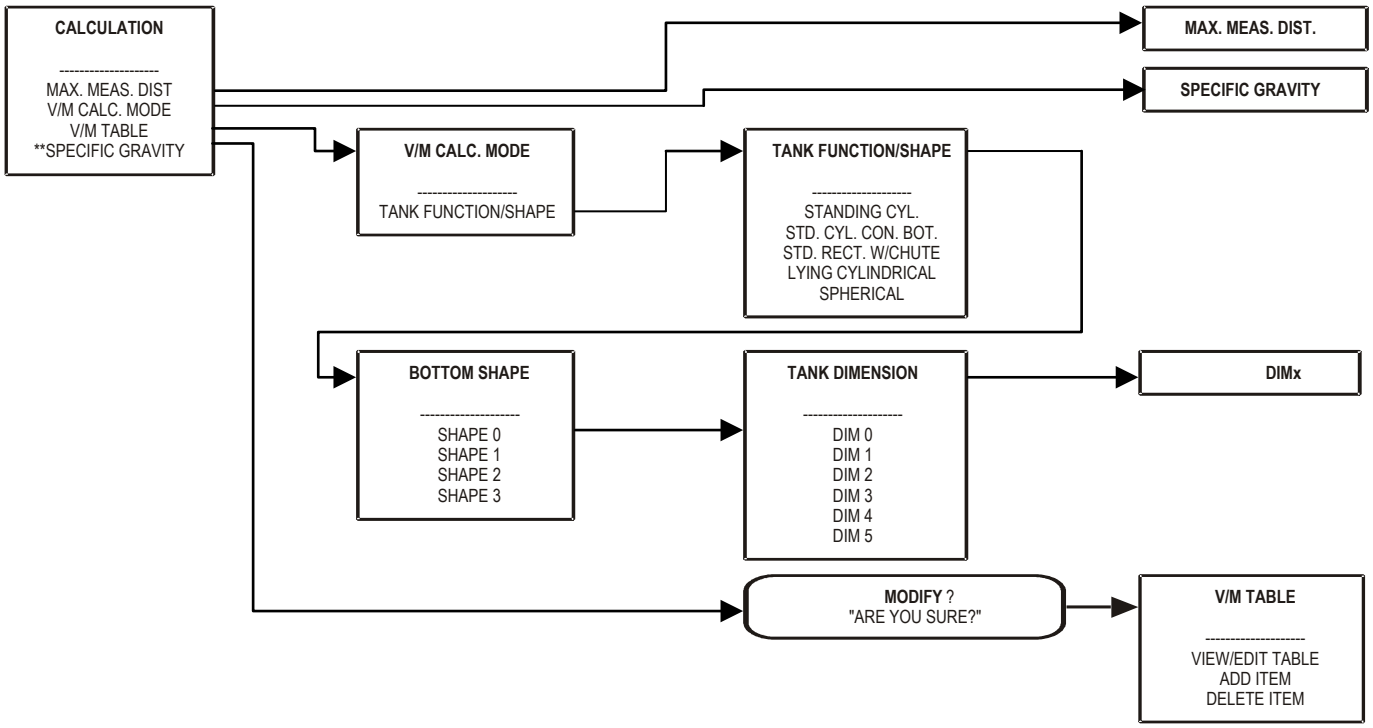
MAX. MEAS. DIST
V/M CALC. MODE
V/M TABLE
**SPECIFIC GRAVITY
SERVICE

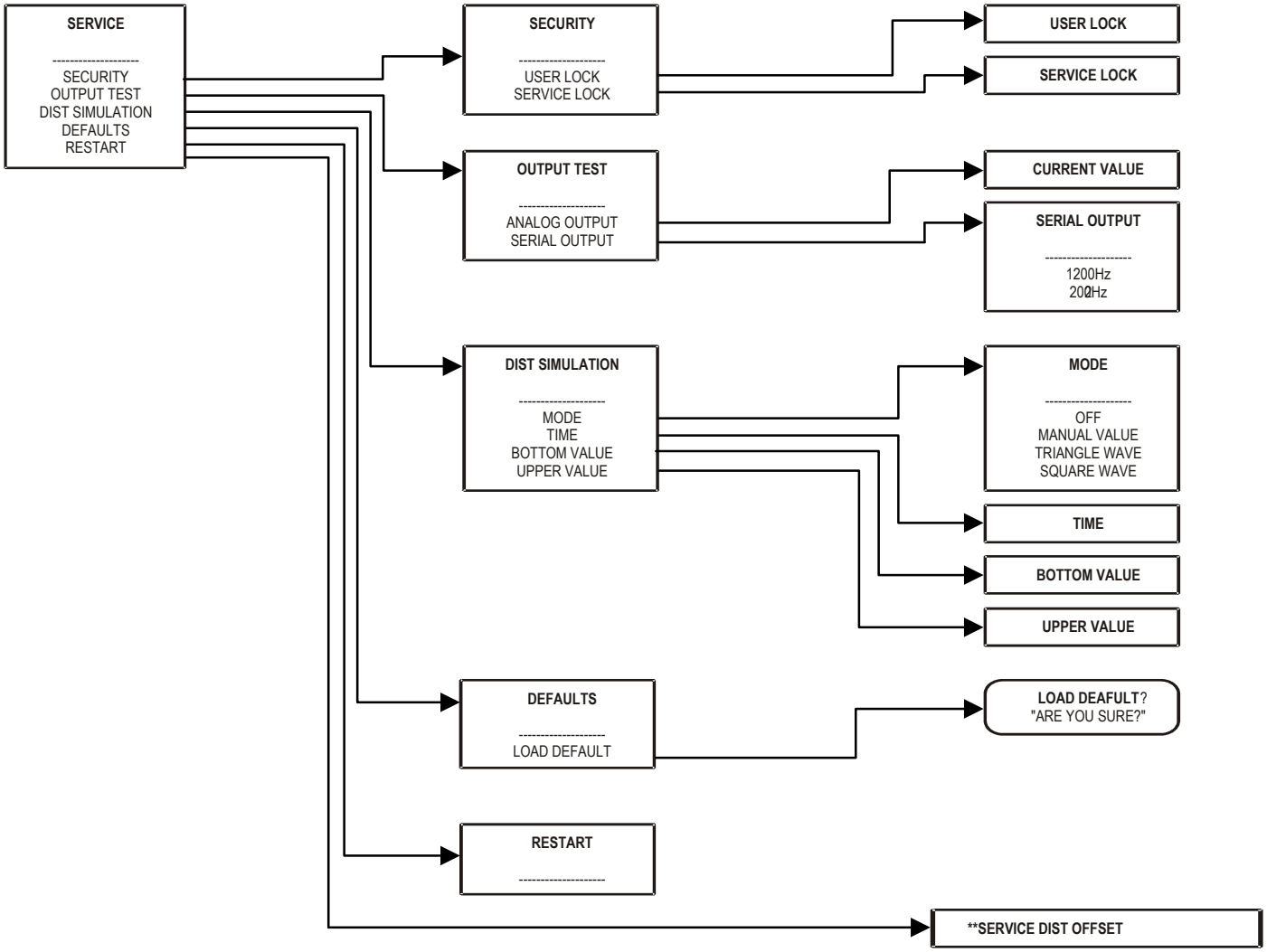
SECURITY
OUTPUT TEST
DIST SIMULATION
DEFAULTS
RESTART


BASIC SETUP
UNITS
PV. MODE
MAX. MEAS. DIST
DAMPING TIME
DEMO MODE
UNITS
ENGINEERING SYSTEM
ENGINEERING UNITS
PV. MODE
DIST
LEVEL
VOLUME
MASS
ENGINEERING SYSTEM
EU
US
ENGINEERING UNITS
BASIC UNITS
VOLUME UNITS
MASS UNITS
BASIC UNITS
METER / FT
CM / INCH
MM
VOLUME UNITS
m3 ft
LITER / GALLON
MASS UNITS
METR. / IMP. TON
- / lb (POUND)
MAX. MEAS DIST.
DAMPING TIME
DEMO MODE
OFF
ON


OUTPUT SETUP
ANALOG OUTPUT
SERIAL OUTPUT
ANALOG OUTPUT
CURRENT MODE
4mA VALUE
20mA VALUE
ERROR MODE
MANUAL VALUE
SERIAL OUTPUT
ADDRESS
CURRENT MODE
AUTO
MANUAL
4mA VALUE
20mA VALUE
ERROR MODE
HOLD
3.8mA
22mA
MANUAL VALUE
ADDRESS


OPTIMIZATION
DEAD ZONE
ECHO SELECTION
FILLING SPEED
EMPTYING SPEED
BACKG. ECHO IMAGE
TRESHOLD VALUE
DEAD ZONE
ECHO SELECTION
AUTO
FIRST
HIGHEST AMPLITUDE
LAST
FILLING SPEED
EMPTYING SPEED
BACKG. ECHO IMAGE
SAVE BACKG. IMAGE
MODE
BACKGROUND IMG. DIALOG
[SAVE], [CLEAR]
MODE
ON
OFF
TRESHOLD VALUE


CALCULATION
MAX. MEAS. DIST
V/M CALC. MODE
V/M TABLE
**SPECIFIC GRAVITY
MAX. MEAS. DIST.
SPECIFIC GRAVITY
V/M CALC. MODE
TANK FUNCTION/SHAPE
TANK FUNCTION/SHAPE
STANDING CYL.
STD. CYL. CON. BOT.
STD. RECT. W/CHUTE
LYING CYLINDRICAL
SPHERICAL
BOTTOM SHAPE
SHAPE 0
SHAPE 1
SHAPE 2
SHAPE 3
TANK DIMENSION
DIM 0
DIM 1
DIM 2
DIM 3
DIM 4
DIM 5
DIMx
MODIFY ?
"ARE YOU SURE?"
V/M TABLE
VIEW/EDIT TABLE
ADD ITEM
DELETE ITEM


SERVICE
SECURITY
OUTPUT TEST
DIST SIMULATION
DEFAULTS
RESTART
SECURITY
USER LOCK
SERVICE LOCK
USER LOCK
SERVICE LOCK
OUTPUT TEST
ANALOG OUTPUT
SERIAL OUTPUT
CURRENT VALUE
SERIAL OUTPUT
1200Hz
2002Hz
DIST SIMULATION
MODE
TIME
BOTTOM VALUE
UPPER VALUE
MODE
OFF
MANUAL VALUE
TRIANGLE WAVE
SQUARE WAVE
TIME
BOTTOM VALUE
UPPER VALUE
DEFAULTS
LOAD DEFAULT
LOAD DEAFULT?
"ARE YOU SURE?"
RESTART
**SERVICE DIST OFFSET

APPENDIX 1. ⟨Ex⟩ ATEX SAFETY GUIDELINES

ATEX Safety guidelines for the use of the VG4 2-wire Non-contact radar compact transmitter

General:
The **VG4□□-1□□-8Ex** can be used in the presence of combustible gas according to ATEX directive 2014/34/EU: equipment group II, category 1G.

Marking of approved instrument according to directive 2014/34/EU:

e.g. VG4ES-140-8Ex nameplate

Guidance for installation, setup and repair
Installation, setup and maintenance must be in accordance with the applicable codes of practice and harmonised standards for Ex ia (intrinsic safe) equipment and by qualified technical personnel only.

User repairs are not permitted; in case of faults return the unit to Hycontrol.

Because the enclosure of the electronic circuits is made of aluminium, if it is mounted in an area where the apparatus has an equipment protection level Ga, it must be installed so as to avoid the occurrence of rare events and ignition sources due to impact and friction sparks.

Periodically inspect the body and wiring for damage.

To avoid electrostatic hazard, in case of the plastic antenna enclosure, the following safety rule shall be observed:

- The measured medium should be an electrostatic conductor, and the electrical resistivity of the measured medium cannot exceed $10^4\ \Omega$.
- The speed and the method of the filling and emptying process should be chosen properly according to the measured medium.
- The material of the plastic antenna enclosures can produce static electricity. The antenna enclosure should only be cleaned by a wet rag.

Ex markings

TYPE	METAL HOUSING TYPE VG4□S-1□□-8Ex VG4□K-1□□-8Ex	HIGH TEMPERATURE VERSION WITH METAL HOUSING VG4H□-1□□-8Ex, VG4J□-1□□-8Ex
ATEX (ia)	⟨Ex⟩ II 1G Ex ia IIB T6…T3 Ga Li: 200µH Ci: 16nF Ui:30V Ii:140mA Pi:1W	

Maximum surface temperature data for hazardous atmospheres:

TEMPERATURE DATA FOR HAZARDOUS GAS ATMOSPHERES (II B GROUP)	METAL HOUSING TYPE VG4□S-1□□-8Ex, VG4□K-1□□-8Ex			HIGH TEMPERATURE VERSION WITH METAL HOUSING VG4H□-1□□-8Ex, VG4J□-1□□-8Ex
Maximum permissible medium temperature at the antenna	+80°C	+90°C	+100°C	+180°C
Maximum permissible surface temperature at the process connection	+75°C	+90°C	+100°C	+175°C
Temperature class	**T6**	**T5**	**T4**	**T3**