

7200 Series Radar Tank Gauges

Smart Transmitter for continuous and non-contact level measurement. Cost-effective 4...20 mA 2-wire technology. Suitable for hazardous locations.

Varec[®]



FuelsManager[®]
Compatibility

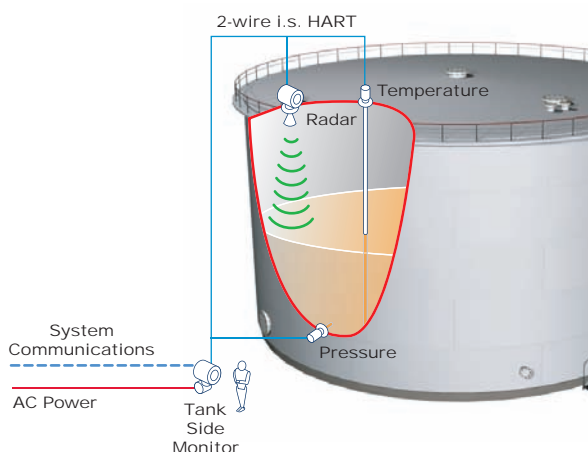


Your benefits

- 2-wire technology, low price: A real alternative to differential pressure, floats and displacers. 2-wire technology reduces wiring costs and allows easy implementation into existing systems.
- Non-contact measurement: Measurement is almost independent from product properties.
- Easy on-site operation via menu-driven alphanumeric display.
- Easy commissioning, documentation and diagnostics via operating software (ToF Tool).
- 2 frequency ranges – 7230/7231 RTG in the C-band and 7240/7244/7245 RTG in the K-band: No compromises, the right frequency for every application.
- HART or PROFIBUS PA respectively FOUNDATION Fieldbus protocol.
- High temperatures: Suitable for process temperatures up to 200 °C (392 °F), up to 400 °C (752 °F) with high-temperature antenna.
- Rod antenna with inactive length: Reliable measurement in narrow nozzles, with condensation and build-up in the nozzle.
- Application in safety related systems (overspill protection) with requirements for functional safety up to SIL 2 in accordance to IEC 61508/IEC 61511-1.

Application

The 7200 Series Radar Tank Gauges is used for continuous, non-contact level measurement of bulk liquid inventories. The measurement is not affected by changing media, temperature changes, gas blankets or vapours.



Function and system design

Measuring Principle

The Radar Tank Gauge is a "downward-looking" measuring system, operating based on the time-of-flight method. It measures the distance from the reference point (process connection) to the product surface. Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system.

Antenna Selection

It is essential for each and every application and installation to evaluate the right antenna type. The antenna selection depends on the following criteria:

- Type of application (i.e. free space vs. stilling well)
- Installation possibilities (size, location and height of nozzle)
- Properties of the product stored in the tank (radar reflectivity, vapor pressure, temperature, etc.)
- Accuracy requirements

The 7200 Series Radar Tank Gauge comes with 5 basic antenna forms.

Horn antenna

The 7230 with horn antenna is suitable for free space applications that disallow the use of a parabolic antenna due to tank/nozzle geometry. It is essential that the horn extends below the nozzle. The general rule for diameter selection is "the larger, the better," as a larger aperture of the antenna generates a narrower beam and has a better gain – signal to noise (S/N) ratio.



Rod antenna

The 7231 with rod antenna is used for measurements where only small diameter nozzles are available and tanks containing condensing products (or heavy water condensation) or corrosive products, such as sulphur, as the rod is easy to clean and has good "drip-off" properties. The "inactive" length of the antenna should extend below the nozzle.



Small horn & wave guide antenna

The 7240 with the small (1½") horn antenna is ideally suited for small vessels. Additionally, it provides an accuracy of ± 3 mm. The Wave Guide version provides an ideal solution for horizontal cylindrical tanks.



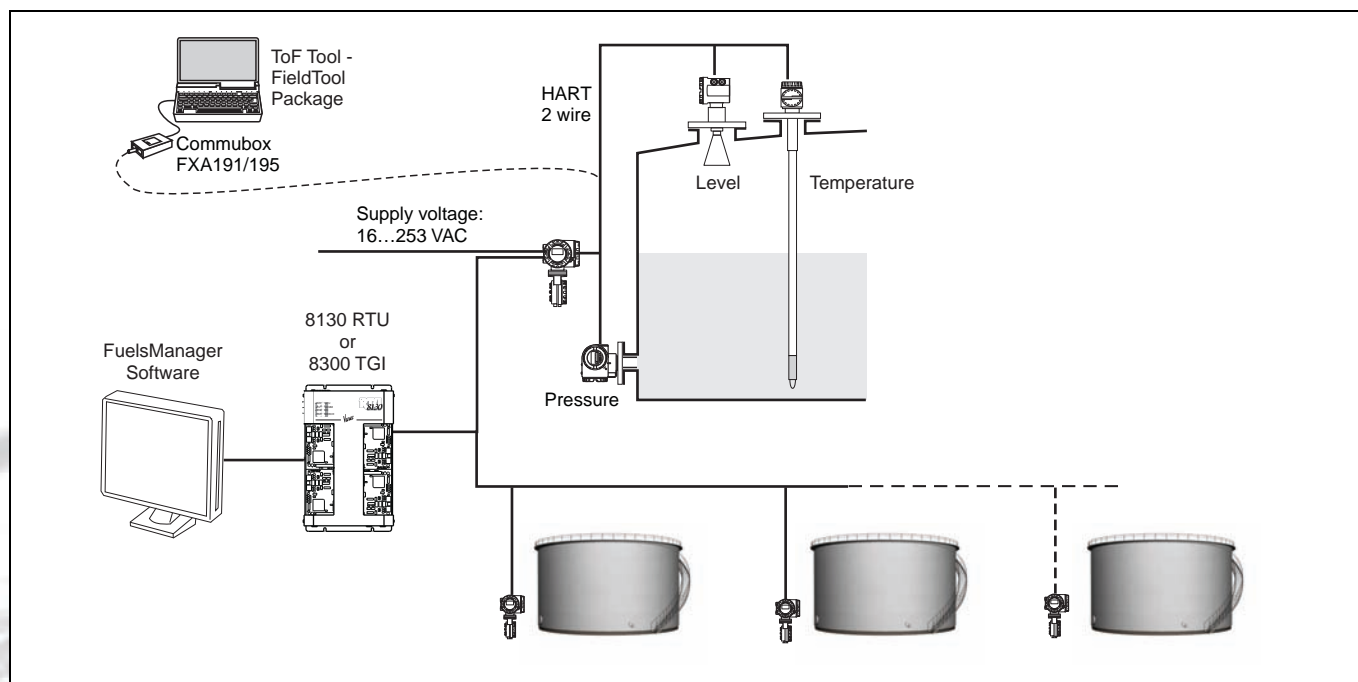
Process antennas

The 7244 and 7245 combines the advantages of the horn antenna with high chemical resistance while being easy to clean.

Tank Gauging System

The Varec 4590 Tank Side Monitor provides integrated communications for sites with multiple tanks, each with one or more sensors on the tank, such as radar, spot or average temperature, capacitive probe for water detection and/or pressure sensors. Multiple protocols out of the Tank Side Monitor guarantee connectivity to nearly any of the existing industry standard tank gauging protocols. Optional connectivity of analog 4...20 mA sensors, digital I/O and analog output simplify full tank sensor integration. Use of the proven concept of the intrinsically safe HART bus (HART multidrop) for all on-tank sensors yields extremely low wiring costs, while at the same time providing maximum safety, reliability and data availability.





Example System Diagram

Installation Guidelines

Configuration

The 7200 Radar Tank Gauge is commissioned by entering an empty distance E (=zero) and a full distance F (=span) that correspond with 4mA and 20mA current output.

A linearization table (max. 32 points) which can be configured locally or remotely provides engineering units and a linear output signal for spheres, horizontal cylindrical tanks and vessels with conical outlet.

On-site operation and configuration is performed using:

- The built in display and operating module VU331
- A Personal Computer, service adaptor (FXA193) and "ToF Tool – FieldTool Package" operating software.

Remote operation and configuration can be performed using:

- A Personal Computer, Commubox FXA191/195 and "ToF Tool – FieldTool Package" operating software.

Measuring Range

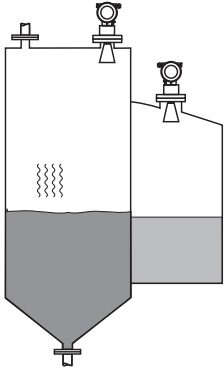
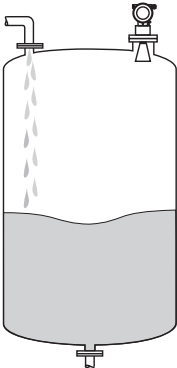
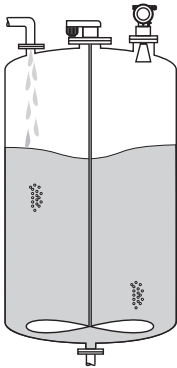
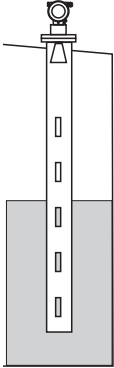
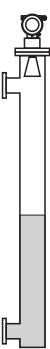
The usable measuring range depends on the size of the antenna, the reflectivity of the medium, the mounting location and eventual interference reflections.

The maximum configurable range is:

- 20 m (65 ft) for 7200 Series Radar Tank Gauges FMR23x/24x (larger ranges up to 35 m (114 ft) on request),
- 70 m (229 ft) for 7200 Series Radar Tank Gauges FMR250 (further informations see TI390F/00/en).

The following tables describe the groups of media as well as the achievable measuring range as a function of application and media group. If the dielectric constant of a medium is unknown, it is recommended to assume media group B to ensure a reliable measurement.

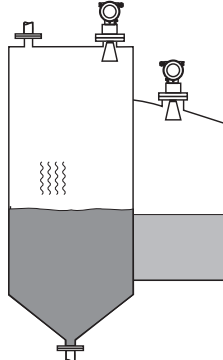
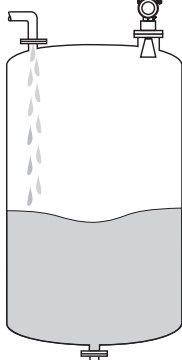
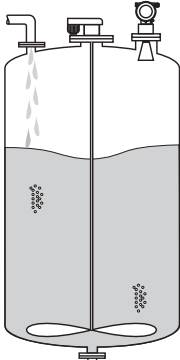
Media group	DC (ϵ_r)	Examples
A	1.4... 1.9	non-conducting liquids, e.g. liquefied gas (LPG). For more information please contact your Varec representative.
B	1.9... 4	non-conducting liquids, e.g. benzene, oil, toluene, white products, black products, crudes, bitumen/asphalts, ...
C	4...10	e.g. concentrated acids, organic solvents, esters, aniline, alcohol, acetone, ...
D	> 10	conducting liquids, e.g. aqueous solutions, dilute acids and alkalis

Measuring range depending on vessel type, conditions and product for 7230 and 7231 RTG									
Product class		Storage tank Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes).		Buffer tank Moving surfaces (e.g. continuous filling, from above, mixing jets).		Process tank with agitator Turbulent surface. Single stage agitator <60 RPM.		Stilling well	Bypass
									
		Measuring range		Measuring range		Measuring range		Measuring range	Measuring range
7230 (horn diameter):		150 mm / 6"	200 mm / 8" 250 mm / 10"	150 mm / 6"	200 mm / 8" 250 mm / 10"	150 mm / 6"	200 mm / 8" 250 mm / 10"	80...250 mm / 3"...10"	80...250 mm / 3"...10"
7231:		Rod antenna	—	Rod antenna	—	Rod antenna	—	—	—
A	DC (ϵ_r)=1,4...1,9	to use a stilling well (20 m / 65 ft) or 7240 with Wave Guide antenna ^{a)} (3.8 m / 12.5 ft)						20 m/65 ft	possible, i.e. with stilling well in bypass.
B	DC (ϵ_r)=1,9...4	10 m/33 ft	15 m/49 ft	5 m/16 ft	7,5 m/24 ft	4 m/13 ft	6 m/20 ft	20 m/65 ft	
C	DC (ϵ_r)=4...10	15 m/49 ft	20 m/65 ft	7,5 m/24 ft	10 m/33 ft	6 m/20 ft	8 m/27 ft	20 m/65 ft	
D	DC (ϵ_r)>10	20 m/65 ft	20 m/65 ft	10 m/33 ft	12,5 m	8 m/27 ft	10 m/33 ft	20 m/65 ft	

a. In the event of horizontal stress (e.g. agitators), mechanical support is required or provide the Wave Guide antenna with a protective pipe (maximum lateral load 100 Nm).

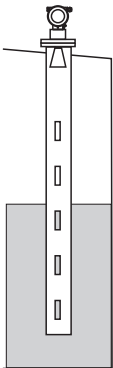

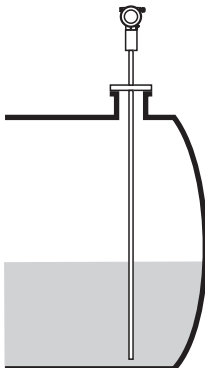
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**Measuring range depending on vessel type, conditions, and product for Radar Tank Gauge M
7240, 7244, 7245:**

Product class		Storage tank Calm product surface (e.g. intermittent filling, filling from bottom, immersion tubes).				Buffer tank Moving surfaces (e.g. continuous filling, from above, mixing jets).				Process tank with agitator Turbulent surface. Single stage agitator <60 RPM.			
													
		Measuring range				Measuring range				Measuring range			
7240 (horn diameter):		40 mm / 1½"	50 mm / 2"	80 mm / 3"	100mm / 4"	40 mm / 1½"	50 mm / 2"	80 mm / 3"	100mm / 4"	40 mm / 1½"	50 mm / 2"	80 mm / 3"	100mm / 4"
7244 (horn diameter):		40 mm / 1½"	—	—	—	40 mm / 1½"	—	—	—	40 mm / 1½"	—	—	—
7245 (horn diameter):		—	50 mm / 2"	80 mm / 3"	—	—	50 mm / 2"	80 mm / 3"	—	—	50 mm / 2"	80 mm / 3"	—
A	DC (εr)=1,4...1,9	to use a stilling well (20 m / 65 ft) or 7240 with Wave Guide antenna ^{a)} (3.8 m / 12.5 ft)											
B	DC (εr)=1,9...4	3 m/ 10 ft	5 m/ 16 ft	10 m/ 33 ft	15 m/ 49 ft	2 m/ 7 ft	2.5 m/ 8 ft	5 m/ 16 ft	7.5 m/ 24 ft	1 m/ 3 ft	1.5 m/ 5 ft	2 m/ 7 ft	3 m/ 10 ft
C	DC (εr)=4...10	6 m/ 20 ft	10 m/ 33 ft	15 m/ 49 ft	20 m/ 65 ft	3 m/ 10 ft	5 m/ 16 ft	7.5 m/ 24 ft	10 m/ 33 ft	1.5 m/ 5 ft	2 m/ 7 ft	3 m/ 10 ft	5 m/ 16 ft
D	DC (εr)>10	9 m/ 30 ft	15 m/ 49 ft	20 m/ 65 ft	20 m/ 65 ft	5 m/ 16 ft	7.5 m/ 24 ft	10 m/ 33 ft	12.5 m/ 42 ft	2 m/ 7 ft	3 m/ 10 ft	5 m/ 16 ft	7 m/ 23 ft

a. In the event of horizontal stress (e.g. agitators), mechanical support is required or provide the Wave Guide antenna with a protective pipe (maximum lateral load 100 Nm).

Measuring range depending on vessel type, conditions, and product for Radar Tank Gauge M 7240, 7244, 7245 (continued)

Product class		Stilling well	Bypass	Wave Guide antenna
				
		Measuring range	Measuring range	Measuring range
7240 (horn diameter):		40mm/1½" ... 100mm/4"	50mm/2" ... 100mm/4"	Wave Guide antenna ^{a)}
7244 (horn diameter):		40mm/1½"	—	—
7245 (horn diameter):		50mm/2" ... 80mm/3"	50mm/2" ... 80mm/3"	—
A	DC (εr)=1,4...1,9	20 m / 65 ft	to use the Wave Guide antenna	depending on pipe length, max. 3.8 m (12.5 ft)
B	DC (εr)=1,9...4	20 m / 65 ft	to use the Wave Guide antenna	
C	DC (εr)=4...10	20 m / 65 ft	20 m / 65 ft	
D	DC (εr)>10	20 m / 65 ft	20 m / 65 ft	

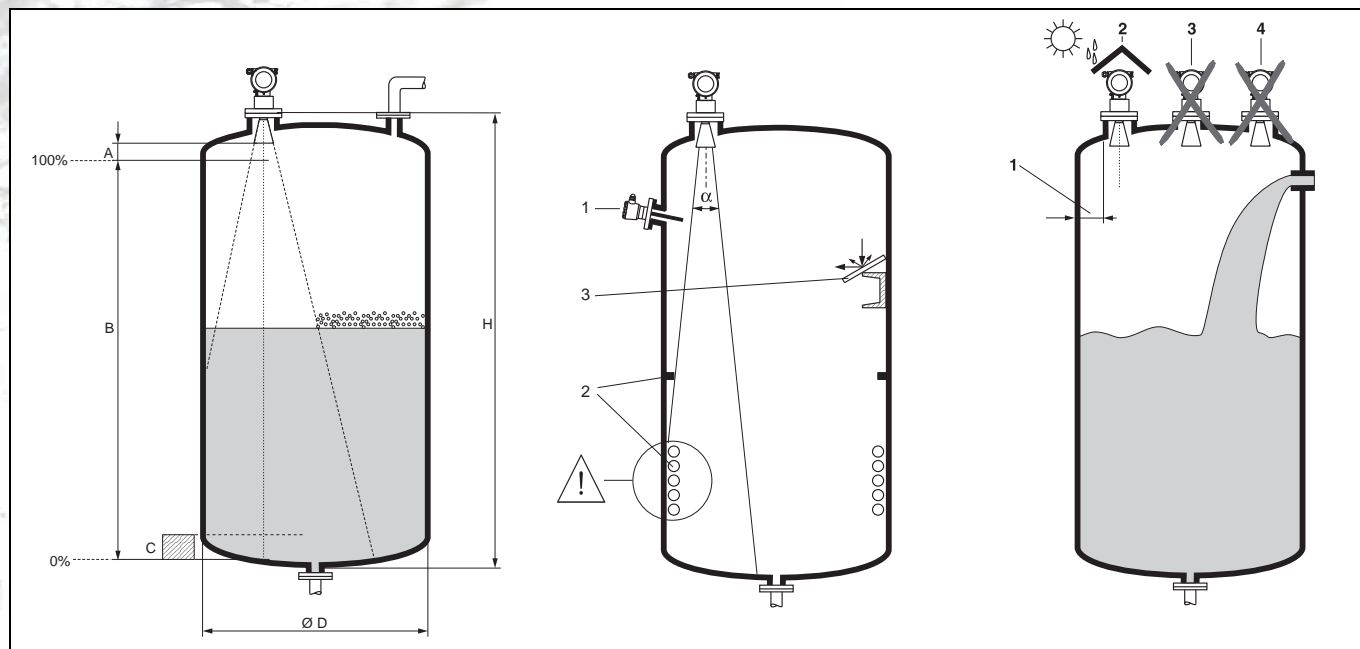
a. In the event of horizontal stress (e.g. agitators), mechanical support is required or provide the Wave Guide antenna with a protective pipe (maximum lateral load 100 Nm).

Measuring Conditions

Note!

- In case of **boiling surfaces, bubbling** or tendency for **foaming**, use 7230 or 7231. Depending on its consistence, foam can either absorb microwaves or reflect them off the foam surface. Measurement is possible under certain conditions.
- In case of heavy **steam development** or **condensate** the max. measuring range of 7240 may decrease depending on density, temperature and composition of the steam → use 7230 or 7231.
- For the measurement of absorbing gases such as **ammonia** or some **fluorocarbons*** please use 7230 in a stilling well.
- *Affected compounds are e.g. R134a, R227, Dymel 152a.
- The measuring range begins, where the beam hits the tank bottom. Particularly with dish bottoms or conical outlets the level cannot be detected below this point.
- For Wave Guide antennas, the end of the pipe is the begin of the measuring range.
- In case of media with a low dielectric constant (groups A and B), the tank bottom can be visible through the medium at low levels (low height **C**). Reduced accuracy has to be expected in this range. If this is not acceptable, we recommend positioning the zero point at a distance **C** above the tank bottom in these applications.
- In principle it is possible to measure up to the tip of the antenna with 7230/231/240. However, due to considerations regarding corrosion and build-up, the end of the measuring range should not be chosen any closer than **A** to the tip of the antenna.
- For 7244/245, the end of measuring range should not be chosen closer than **A** to the tip of the antenna, especially if there is development of condensate.
- The smallest possible measuring range **B** depends on the antenna version.

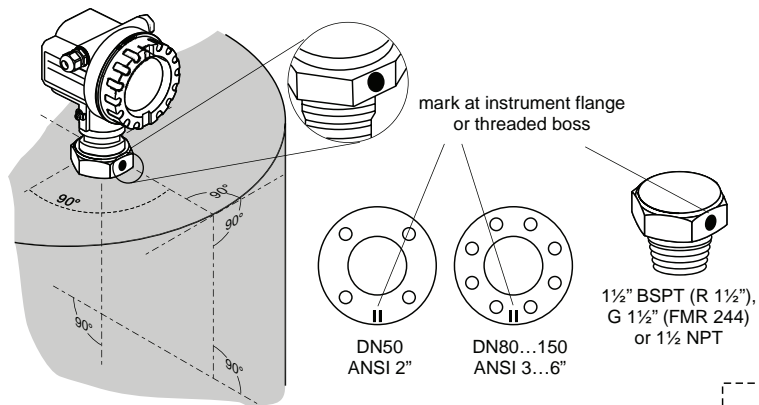
The tank diameter should be greater than **D**, the tank height at least **H**.



• Measuring conditions, tank installation & gauge orientation

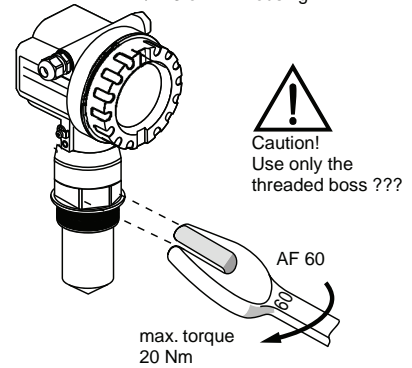
	A [mm/inch]	B [m/inch]	C [mm/inch]	D [m/inch]	H [m/inch]
7230/231	50 / 2	> 0,5 / > 20	150...300 / 6...12	> 1 / > 40	> 1,5 / > 60
7240	50 / 2	> 0,2 / > 8	50...150 / 2...6	> 0,2 / > 8	> 0,3 / > 12
7244	150 / 6	> 0,2 / > 8	50...150 / 2...6	> 0,2 / > 8	> 0,3 / > 12
7245	200 / 8	> 0,2 / > 8	50...150 / 2...6	> 0,2 / > 8	> 0,3 / > 12

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

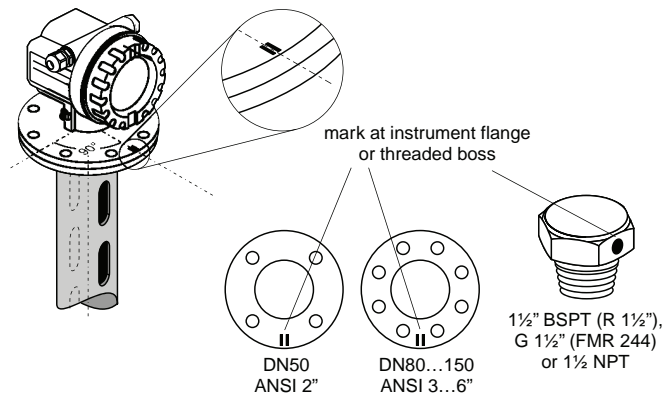


7244

F12/F23 or T12 housing



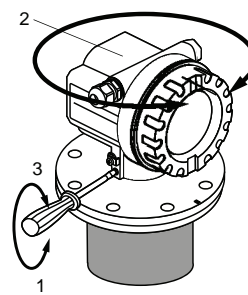
Installation in stilling well:
Mark on process connector pointed towards the slots or vent holes!



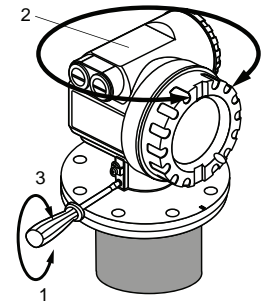
Turn housing

The housing can be turned 350° in order to simplify access to the display and the terminal compartment

F12/F23 housing

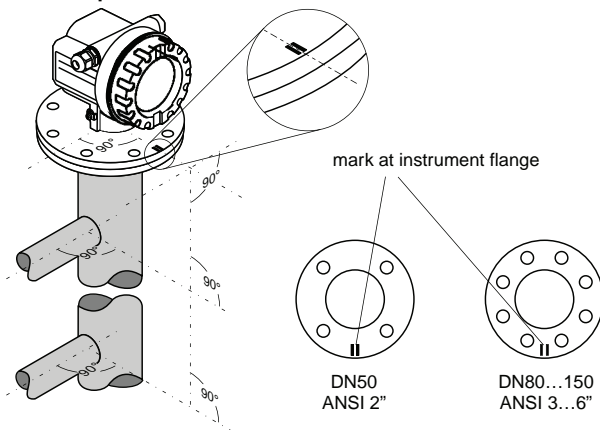


T12 housing



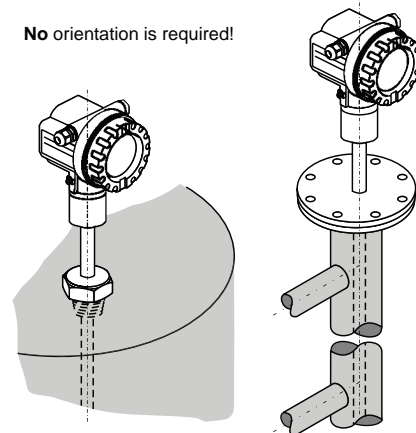
Allen key 4 mm / 0.1"
 FMR 244: max. torque 0.5 Nm

Installation in bypass:
Mark on process connector 90° offset from the tank connections!



Installation with Wave Guide antenna:

No orientation is required!



Installation Examples

Note! Please refer to the specific instrument's Installation & Operation Manual for complete installation instructions

Tank Installations

Avoid any installations (1), like limit switches, temperature sensors, etc., inside the signal beam (see Beam angle on Page 22).

Symmetrical installations (2), i.e. vacuum rings, heating coils, baffles, etc., can also interfere with the measurement.

Optimization options

- Antenna size: the bigger the antenna, the smaller the beam angle, the less interference echoes.
- Mapping: the measurement can be optimized by means of electronic suppression of interference echoes.
- Antenna alignment: refer to "optimum mounting position"
- Stilling well: a stilling well respectively a Wave Guide antenna can always be used to avoid interference.
- Metallic screens (3) mounted at a slope spread the radar signals and can, therefore, reduce interference echoes.

Gauge orientation

- Recommended distance (1) wall – **outer edge** of nozzle: $\sim 1/6$ of tank diameter. Nevertheless the device should not be installed closer than 30 cm/12" (7230/231) resp. 15 cm/6" (7240/244/245) to the tank wall.
- Not in the centre (3), interference can cause signal loss.
- Not above the fill stream (4).

It is recommended to use a weather protection cover (2) in order to protect the transmitter from direct sun or rain. Assembly and disassembly is simply done by means of a tension clamp.

Mounting in a stilling well

- The stilling well should be constructed from metal (no enamel coating, plastic on request) with a constant diameter.
- Diameter of stilling well not larger than antenna diameter.
- Any rectangular increase of the pipe diameter has to be avoided.
- Welding seam as smooth as possible and on the same axis as the slots.
- Slots offset 180° (not 90°).
- Slot width respectively diameter of holes max. $1/10$ of pipe diameter, de-burred. Length and number do not have any influence on the measurement.
- At any transition (e.g. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04").
- The stilling well must be smooth on the inside (average roughness $R_z \leq 6.3 \mu\text{m}$). Use extruded or parallel welded stainless steel pipe. An extension of the pipe is possible with welded flanges or pipe

sleeves. Flange and pipe have to be properly aligned at the inside.

- Do not weld through the pipe wall. The inside of the stilling well must remain smooth. In case of unintentional welding through the pipe, the weld seam and any unevenness on the inside need to be carefully removed and smoothed. Otherwise, strong interference echoes will be generated and material build-up will be promoted.
- Slot width respectively diameter of holes max. $1/10$ of pipe diameter, de-burred. Length and number do not have any influence on the measurement.
- Select horn antenna as big as possible. For intermediate sizes (i.e. 180 mm) select next larger antenna and adapt it mechanically (7230/7240 only).
- Particularly on smaller nominal widths it needs to be observed that flanges are welded to the pipe such that they allow for a correct orientation (marker aligned toward slots).

Recommendations for the bypass pipe

Metal (no plastic or enamel coating)

Constant diameter

Select horn antenna as big as possible. For intermediate sizes (i.e. 95 mm) select next larger antenna and adapt it mechanically (7230/7240 only).

At any transition (i.e. when using a ball valve or mending pipe segments), no gap may be created exceeding 1 mm (0.04").

In the area of the tank connections ($\sim \pm 20 \text{ cm} / 8"$) a reduced accuracy of the measurement has to be expected.

Note! Please refer to the specific instrument's Installation & Operation Manual for complete installation instructions

Special Installations

Measurement through plastic tank walls

It is also possible to measure the contents of a tank by installing the gauge on the outside of the tank and measuring through the wall of the tank.

Measurement in plastic tanks

If the outer wall of the tank is made of a non-conductive material (e.g. Plastic or GRP), microwaves can also be reflected off objects outside the tank (e.g. metallic pipes, ladders, grates, etc.). Therefore, these objects should be considered as interfering installations if they are within the signal beam.

Enamelled antenna

Do not hit or chip the enamelled antenna as the coating may be damaged and effect the measurement accuracy.

Antenna extensions

- An antenna extension needs to be selected to allow the antenna to extend below the nozzle – See FAR10 Accessory

- If the antenna has to be mounted on a sloping or vertical vessel wall, an extension with a 45° respectively 90° bend is available. The smallest possible radius R for the bend is 300 mm (12").

Installation with heat insulation

The 7200 RTG can be installed on a tank with heat insulation.

Please contact Varec for further information about all special installations.

Effect of gas phase

High pressures reduce the propagation velocity of the measuring signals in the gas/vapor above the fluid. This effect depends on the gas/vapor and is particularly large for low temperatures. This results in a measuring error that gets bigger as the distance increases between the device zero point (flange) and product surface. The following table illustrates this measured error for a few typical gases/vapors (with regard to the distance; a positive value means that too large a distance is being measured):

Gas phase	Temperature		Pressure				
	°C	°F	1 bar/14.5 psi	10 bar/145 psi	50 bar/725 psi	100 bar/1450 psi	160 bar/2320 psi
Air Nitrogen	20	68	0.00 %	0.22 %	1.2 %	2.4 %	3.89 %
	200	392	-0.01 %	0.13 %	0.74 %	1.5 %	2.42 %
	400	752	-0.02 %	0.08 %	0.52 %	1.1 %	1.70 %
Hydrogen	20	68	-0.01 %	0.10 %	0.61 %	1.2 %	2.00 %
	200	392	-0.02 %	0.05 %	0.37 %	0.76 %	1.23 %
	400	752	-0.02 %	0.03 %	0.25 %	0.53 %	0.86 %

Gas phase	Temperature		Pressure				
	°C	°F	1 bar/14.5 psi	10 bar/145 psi	50 bar/725 psi	100 bar/1450 psi	160 bar/2320 psi
Water (saturated steam)	100	212	0.20 %	—	—	—	—
	180	356	—	2.1 %	—	—	—
	263	505.4	—	—	8.6 %	—	—
	310	590	—	—	—	22 %	—
	364	687.2	—	—	—	—	41.8 %

Note! When the pressure is known and constant, this measured error can, for example, be compensated by means of linearization.

Inputs & Outputs

Output Signal

4...20 mA with HART protocol

PROFIBUS PA

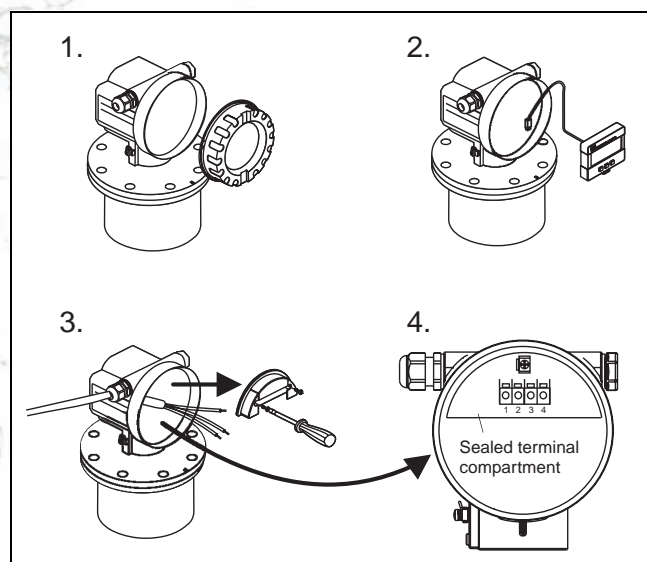
FOUNDATION Fieldbus (FF)

Terminal Compartment

Three housings are available:

- Aluminium housing F12 with additionally sealed terminal compartment for:
 - standard,
 - EEx ia.
- Aluminium housing T12 with separate terminal compartment for:
 - standard,
 - EEx e,
 - EEx d,
 - EEx ia (with overvoltage protection).
- 316L housing F23 for:
 - standard,
 - EEx ia.

The electronics and current output are galvanically isolated from the antenna circuit.



Accessing the Terminal Compartment

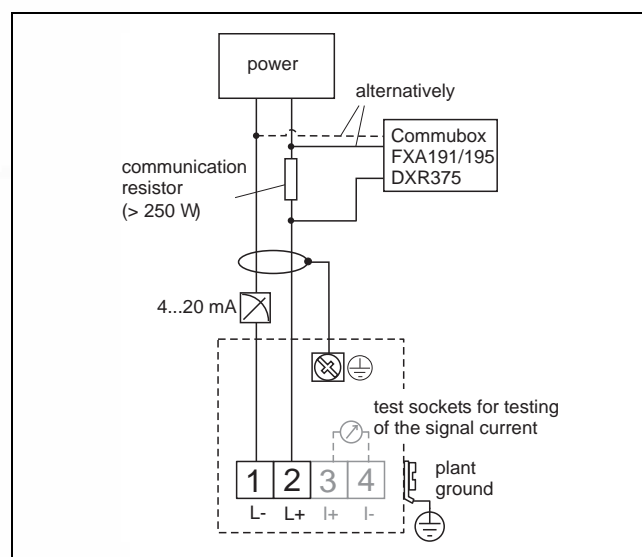
Field Communications

4...20 mA with HART

The 2-wire cable is connected to the screw terminals in the terminal compartment.

Note! A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).

Note! Protective circuitry against reverse polarity, RFI, and over-voltage peaks is built into the device (refer to TI241F »basics for EMC-tests«).

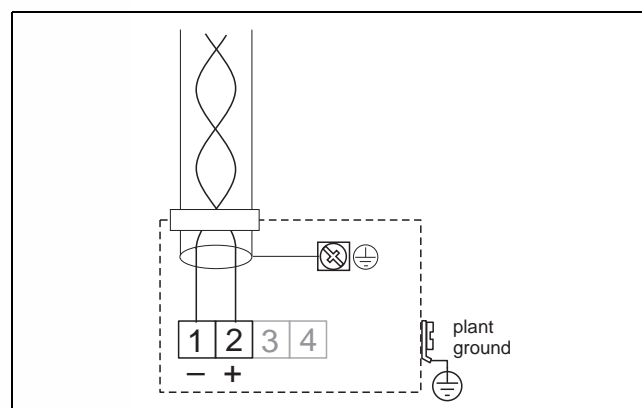


4-20 mA with HART Terminal Wiring Diagram

System integration via PROFIBUS PA

A maximum of 32 transmitters (8 if mounted in an explosion hazardous location EEx ia IIC according to FISCO-model) can be connected to the bus. The segment coupler provides the operating voltage to the bus. Both on-site as well as remote operation are possible.

The complete measuring system consists of:



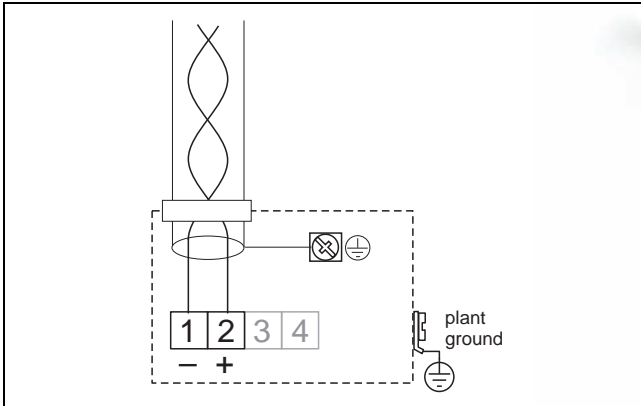
Profibus PA Wiring Diagram

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the auxiliary energy.

Note! Use a twisted, screened two-wire cable, preferably cable type A

Foundation Fieldbus

A maximum of 32 transmitters (standard, EEx em or EEx d) can be connected to the bus. For protection class EEx ia IIC: the max. number of transmitters depends on the established rules and standards for intrinsically safe circuits (EN 60079-14), proof of intrinsically safety. Both on-site as well as remote operation are possible.



Foundation Fieldbus Wiring Diagram

The complete measuring system consists of:

The digital communication signal is transmitted to the bus via a 2-wire connection. The bus also provides the auxiliary energy.

For further information on the network structure and earthing and for further bus system components such as bus cables, contact Varec.

Note! Use a twisted, screened two-wire cable, preferably cable type A

Note! For further information on the cable specifications, see Operating Instructions BA013S "FOUNDATION Fieldbus Overview", FONDATION Fieldbus Guideline and IEC 61158-2 (MBP).

Fieldbus Plug Connectors

For the versions with fieldbus plug connector (M12 or 7/8"), the signal line can be connected without opening the housing.

Pin assignment of the M12 plug connector (PROFIBUS PA plug)

	Pin	Meaning
	1	Ground
	2	Signal +
	3	Signal -
	4	not connected

Pin assignment of the 7/8" plug connector (FOUNDATION Fieldbus plug)

	Pin	Meaning
	1	Signal -
	2	Signal +
	3	not connected
	4	ground

Overvoltage Protector

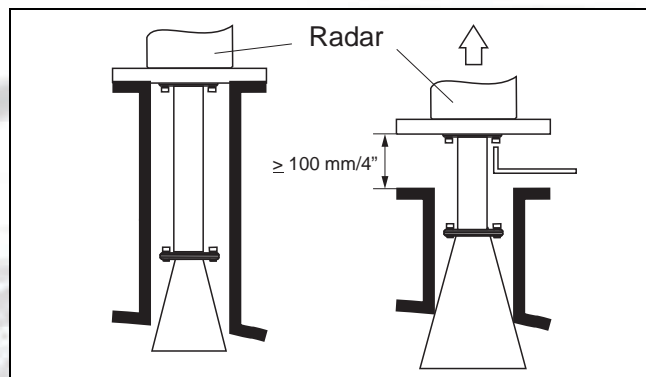
The level transmitter 7200 Series Radar Tank Gauges with T12-housing (housing version "D", see ordering information on page 52-63) is equipped with an internal overvoltage protector (600 Vrms surge arrester) according to DIN EN 60079-14 or IEC 60060-1 (impulse current test 8/20 μ s, $I = 10$ kA, 10 pulses). Connect the metallic housing of the 7200 Series Radar Tank Gauges to the tank wall or screen directly with an electrically conductive lead to ensure reliable potential matching.

Accessories

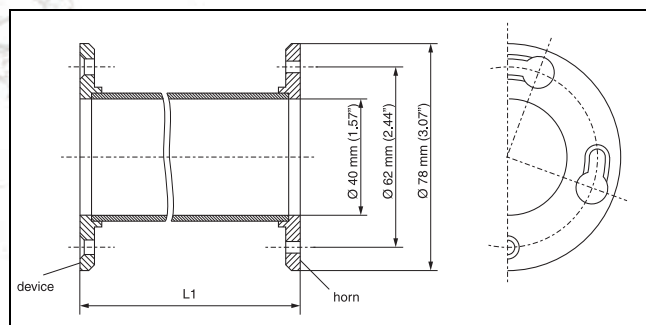
Antenna Extension for 7230 RTG

The antenna extension has to be selected such that the horn extends below the nozzle.

If the horn diameter is greater than the nominal width of the nozzle, the antenna including the extension is mounted from inside the vessel. The bolts are tightened from outside, with the instrument lifted up. The extension has to be selected such that the instrument can be lifted by at least 100 mm (4").



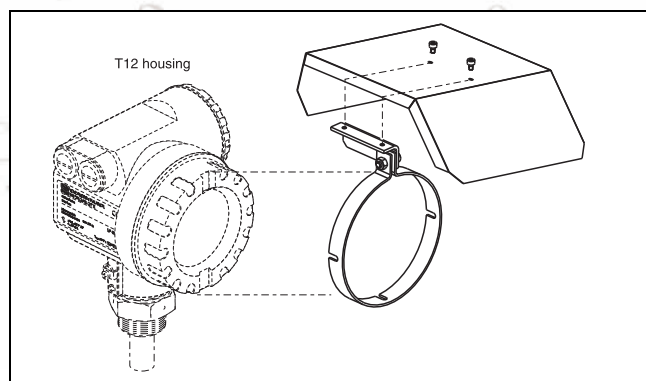
Antenna Extension



Antenna Extension Dimensions

Weather Protection Cover

A weather protective cover made of stainless steel is available for outdoor mounting (order code: 543199-0001). The shipment includes the protective cover and tension clamp.



Weather Protection Cover

Commubox FXA191 HART

For intrinsically safe communication with ToF Tool/FieldCare via the RS232C interface. For details refer to TI237F/00/en.

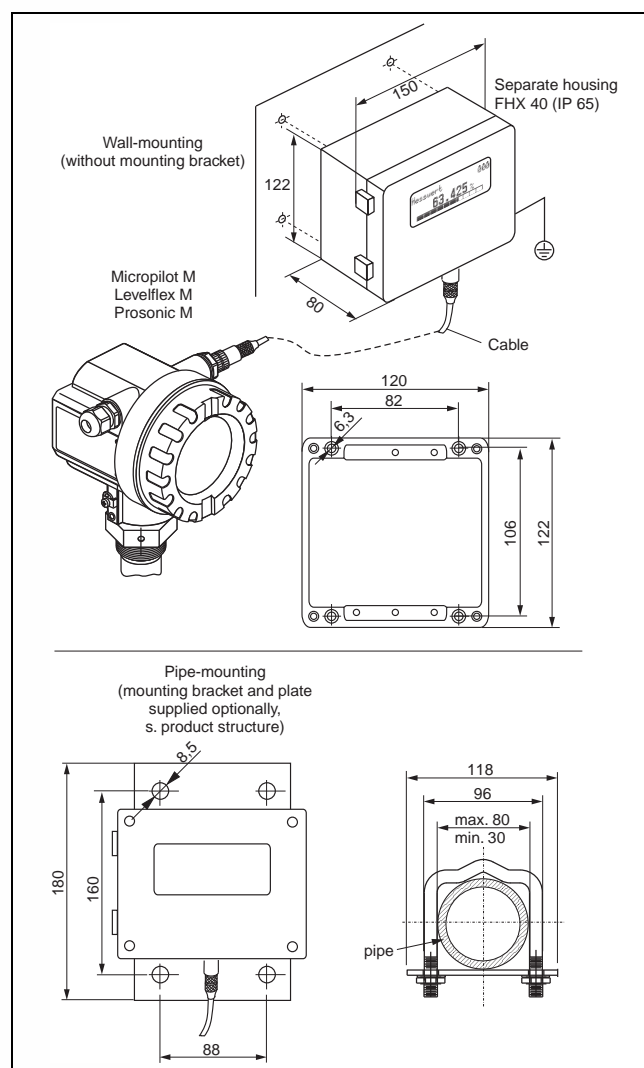
Commubox FXA195 HART

For intrinsically safe communication with ToF Tool/FieldCare via the USB interface. For details refer to TI404F/00/en.

Service Interface FXA193

The Service-Interface connects the Service plug of Proline and ToF instruments with the 9 pin RS 232C interface of a PC. (USB connectors must be equipped with a usual commercial USB/Serial adapter.)

Remote display 4400

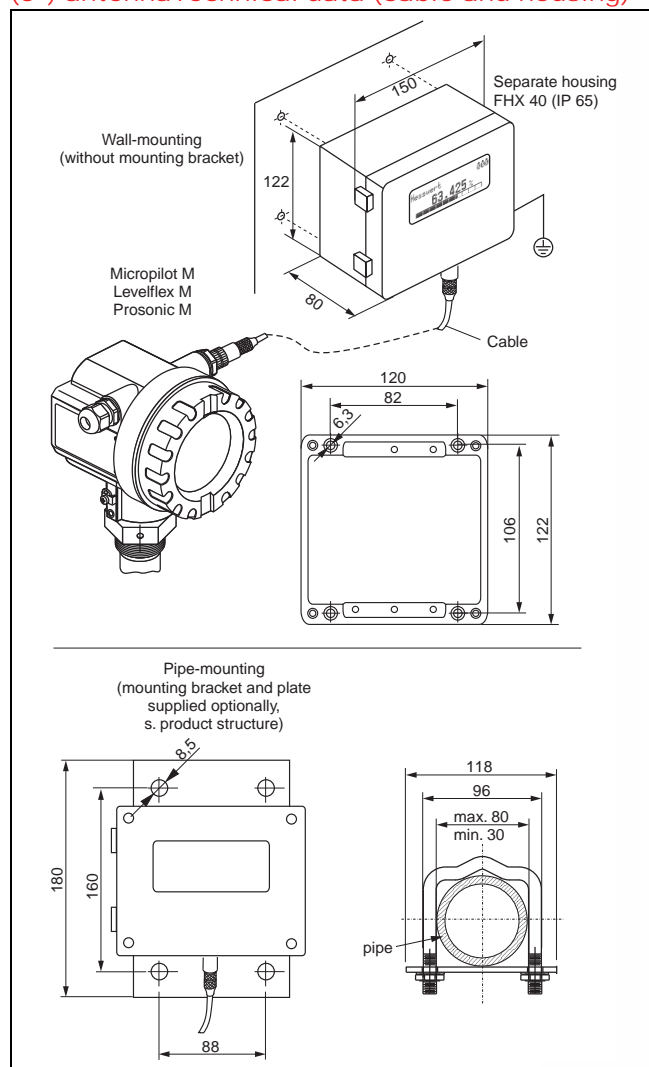


Technical data (cable and housing)

Max. cable length	20 m (65 ft)
Temperature range	-30 °C...+70 °C (-22 °F...158 °F)
Degree of protection	IP65 acc. to EN 60529 (NEMA 4)
Materials	Housing: AISi12; cable glands: nickle plated brass
Dimensions [mm] / [inch]	122x150x80 (HxWxD) / 4.8x5.9x3.2

For connection of the remote display 4400 use the cable which fits the communication version of the respective instrument.

Variable flange seal for 7244 RTG with 80 mm (3") antenna



Variable flange seal	DN80	DN100	DN150
D [mm (inch)]	142 (5.59)	162 (6.38)	218 (8.58)
d [mm (inch)]	89 (3.50)	115 (4.53)	169 (6.65)
h [mm (inch)]	22 (0.87)	23.5 (0.93)	26.5 (1.04)
hmin [mm (inch)]	14 (0.55)	14 (0.55)	14 (0.55)
hmax [mm (inch)]	30 (1.18)	33 (1.30)	39 (1.54)

Technical data and order codes

Variable flange seal	DN80	DN100	DN150
compatible with	DN80 PN10-40 ANSI 3" 150lbs JIS 10K 80A	DN100 PN10-40 ANSI 4" 150lbs JIS 10K 100A	DN150 PN10-40 ANSI 6" 150lbs JIS 10K 150A
Material	EPDM		
Process pressure	-0.1 bar ... 0.1 bar (-1.45 psi ... 1.45 psi)		
Process temperature	-40 °C ... +80 °C (-40 °F ... +176 °F)		
Order code	71074263	71074264	71074265

Technical Specifications

The following specifications apply to the 7200 Series Radar Tank Gauge 7230, 7231, 7240, 7244 and 7245 RTG over the following reference operating conditions

- Temperatur = +20 °C (68 °F) ±5 °C (9 °F)
- Pressure = 1013 mbar abs. (14.7 psia) ±20 mbar (0.3 psi)
- Relative humidity (air) = 65 % ±20%
- Ideal reflector
- With no major interference reflections inside the signal beam

General

Manufacturer	Varec, Inc.
Designation	7200 Series Radar Tank Gauge 7230/7231/7240/7244/7245 RTG
Function	Level-Radar Smart Transmitter for continuous and non-contact precision level measurement.

Performance

Reaction time	The reaction time depends on the parameter settings (min. 1 s). In case of fast level changes, the instrument needs the reaction time to indicate the new value.
Resolution	Digital / analog in % 4...20 mA 0.03 % of measuring range 7230: 1 mm 7231: 1 mm 7240: 1 mm 7244: 1 mm 7245: 1 mm

Physical

Weight for F12 or T12 housing (weight of flange additional)	7230 Approx. 6 kg 7231 Approx. 4 kg 7240 Approx. 4 kg 7244 Approx. 2.5 kg 7245 Approx. 4 kg
Weight for F23 housing (weight of flange additional)	7230 Approx. 9.4 kg 7231 Approx. 7.4 kg 7240 Approx. 7.4 kg 7244 Approx. 5.9 kg 7245 Approx. 7.4 kg
Enclosure	IP 65, NEMA 4X (open housing and removed liquid crystal display: IP20, NEMA 1 housing F23: 316L, corrosion-resistant steel Housing F12/T12: separate terminal compartment for increased safety respectively explosion proof. Material: aluminium, seawater repellent, chromate, powder coated Sight window: glass (all Housings)

Antenna	IP 68 (NEMA 6P)	
Conduit entries	Cable gland: M20x1.5 (for EEx d: cable entry) Cable entry: G ½ or ½ NPT PROFIBUS PA M12 plug Fieldbus Foundation 7/8" plug	
Cable gland	Type	Clamping area
Standard, EEx ia, IS	Plastic M20x1.5	5...10 mm
EEx em, EEx nA	Metal M20x1.5	7...10.5 mm

Influence of Ambient Temperature

Digital output (HART, PROFIBUS PA, FOUNDATION Fieldbus)	7240 – average T_K : 2 mm/10 K, max. 5 mm over the entire temperature range -40 °C...+80 °C 7230 – average T_K : 3 mm/10 K, max. 10 mm over the entire temperature range -40 °C...+80 °C 7231 – average T_K : 5 mm/10 K, max. 15 mm over the entire temperature range -40 °C...+80 °C
Current output (additional error, in reference to the span of 16 mA)	Zero point (4 mA) – average T_K : 0,03 %/10 K, max. 0,45 % over the entire temperature range -40 °C...+80 °C Span (20 mA)

Supply voltage

The following values are the voltages across the terminals directly at the instrument:

Communication		Current Consumption	Terminal voltage	
			min	max
HART	standard	4 mA	16 V	36 V
		20 mA	7.5 V	36 V
	EEx ia	4 mA	16 V	30 V
		20 mA	7.5 V	30 V
	EEx em	4 mA	16 V	30 V
	EEx d	20 mA	11 V	30 V
Fixed current, adjustable e.g. for solar power operation (measured value transferred at HART)	standard	11 mA	10 V*	36 V
	EEx ia	11 mA	10 V*	30 V
Fixed current for HART Multidrop mode	standard	4 mA**	16 V	36 V
	EEx ia	4 mA**	16 V	30 V

*Short-term min. start-up voltage: 11.4 V

**Start-up current 11 mA.

Environmental

Ambient Temperature	-40 °F and +185 °F (-40 °C and +85 °C) -50 °C (-58 °F) on request. For calibration to regulatory standards: -25 °C ... +55 °C (-30 °F...+140 °F) With $T_u < -20$ °C and $T_u > +60$ °C the operability of the LC-display is reduced. A weather protection cover should be used for outdoor operation if the instrument is exposed to direct sunlight.
Storage Temperature	-40 °F and +176 °F (-40 °C and +88 °C) -50 °C (-58 °F) on request.
Viscosity	7240 : 500 cst. (Max. Allowable)
Climate class	DIN EN 60068-2-38 (test Z/AD)
Electromagnetic compatibility (EMC)	Interference Emission to EN 61326, Electrical Equipment Class B. Interference Immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC) A standard installation cable is sufficient if only the analogue signal is used. Use a screened cable when working with a superimposed communications signal (HART).
Vibration shock	DIN EN 60068-2-64 / IEC 68-2-64: 20...2000 Hz, 1 (m/s ²) ² /Hz This value can be reduced for Wave Guide antennas, depending on the length. In the event of horizontal stress, mechanical support is required or provide the Wave Guide antenna with a protective pipe.
Operating frequency	7230/231: C-band 7240/244/245: K-band Up to 8 7200 Series Radar Tank Gauges transmitters can be installed in the same tank because the transmitter pulses are statistically coded.

Maximum Measured Error

Type of device	to 10 m	ex 10 m
7230	± 10 mm	± 0.1 % of measuring range
7231	± 10 mm	± 0.1 % of measuring range
7240	± 3 mm	± 0.03 % of measuring range
7244	± 3 mm	± 0.03 % of measuring range
7245	± 3 mm	± 0.03 % of measuring range

HART Field Communications

Min Load	250 Ω
Cable	Four (4) wire, twisted pairs (wire diameter 0.5...2.5 mm)
Ripple HART	47...125 Hz: U _{ss} = 200 mV (at 500 Ω)
Max. Noise HART	500 Hz...10 kHz: U _{eff} = 2.2 mV (at 500 Ω)

Power Consumption

min. 60 mW, max. 900 mW

Current Consumption

Communication	Current consumption
HART	3,6...22 mA ^{a)}
PROFIBUS PA	max. 13 mA
FOUNDATION Fieldbus	max. 15 mA

a. for HART Multidrop: start up current is 11 mA.

Certifications & Approvals

CE approval – The measuring system meets the legal requirements of the EC-guidelines. Varec confirms the instrument passing the required tests by attaching the CE-mark.
Sanitary compatibility MR231 with PTFE-antenna made of FDA-listed TFM 1600. 7245 with flange cladding made of FDA-listed TFM 1600 3A/EHEDG approval with Tri-clamp process connection The leak-tight connections can be cleaned with the cleaning methods usually used in this industry without leaving residues.
External standards and guidelines EN 60529 – Protection class of housing (IP-code) EN 61010 – Safety regulations for electrical devices for measurement, control, regulation and laboratory use. EN 61326 – Emissions (equipment class B), compatibility (appendix A – industrial area) NAMUR – Standards committee for measurement and control in the chemical industry
Overspill protection – German WHG and SIL 2, for 4...20 mA output signal
RF approvals – R&TTE, FCC
Marine certificate – GL (Germanisch Lloyd), ABS, NK HART, PROFIBUS PA not Wave Guide antenna, not HT antenna
Pressure measuring device guideline The 7240 with Wave Guide antenna complies with article 3 (3) of EC guide-line 97/23/EC (pressure measuring device guideline) and has been designed and manufactured according to good engineering practice.

Process Temperature/Pressure Limits

	Type of antenna		Seal	Temperature	Pressure	Wetted parts
7230	V	Standard	FKM Viton GLT	-40 °C ... +200 °C ^{a)} (-40 °F ... +392 °F)	-1 ... 64 bar (... 928 psi)	PTFE, seal, 316L/1.4435 resp. Alloy C4
	E	Standard	EPDM	-40 °C ... +150 °C (-40 °F ... +302 °F)		
	K	Standard	Kalrez (Spectrum 6375)	-20 °C ... +200 °C ¹⁾ (-4 °F ... +392 °F)		
	L	Extended temperature	Graphit	-60 °C ... +280 °C (-76 °F ... +536 °F)	-1 ... 100 bar (... 1450 psi)	Ceramic (Al ₂ O ₃ : 99,7%), Graphit, 316L/1.4435
	M	High temperature	Graphit	-60 °C ... +400 °C (-76 °F ... +752 °F)	-1 ... 160 bar (... 2320 psi)	
	H	Enamel	PTFE	-40 °C ... +200 °C (-40 °F ... +392 °F)	-1 ... 16 bar (... 232 psi)	PTFE, Enamel
7240	V	Standard	FKM Viton	-20 °C ... +150 °C (-4 °F ... +302 °F)	-1 ... 40 bar (... 580 psi)	PTFE, seal, 316L/1.4435 resp. Alloy C22
	E	Standard	FKM Viton GLT	-40 °C ... +150 °C (-40 °F ... +302 °F)		
	K	Standard	Kalrez (Spectrum 6375)	-20 °C ... +150 °C (-4 °F ... +302 °F)		
7244	V	Standard, completely PTFE encapsulated	FKM Viton GLT	-40 °C ... +130 °C (-40 °F ... +266 °F)	-1 ... 3 bar (... 43.5 psi)	PTFE (TFM1600), Viton, PVDF
7245	3, 4	Standard, PTFE clad	none	-40 °C ... +150 °C (-40 °F ... +302 °F)	-1 ... 16 bar (... 232 psi)	PTFE (TFM1600, FDA-listed) ^{b)}

a.max. +150 °C (+302 °F) for conductive media

b.3A-, EHEDG approval for Tri-Clamp process connection.

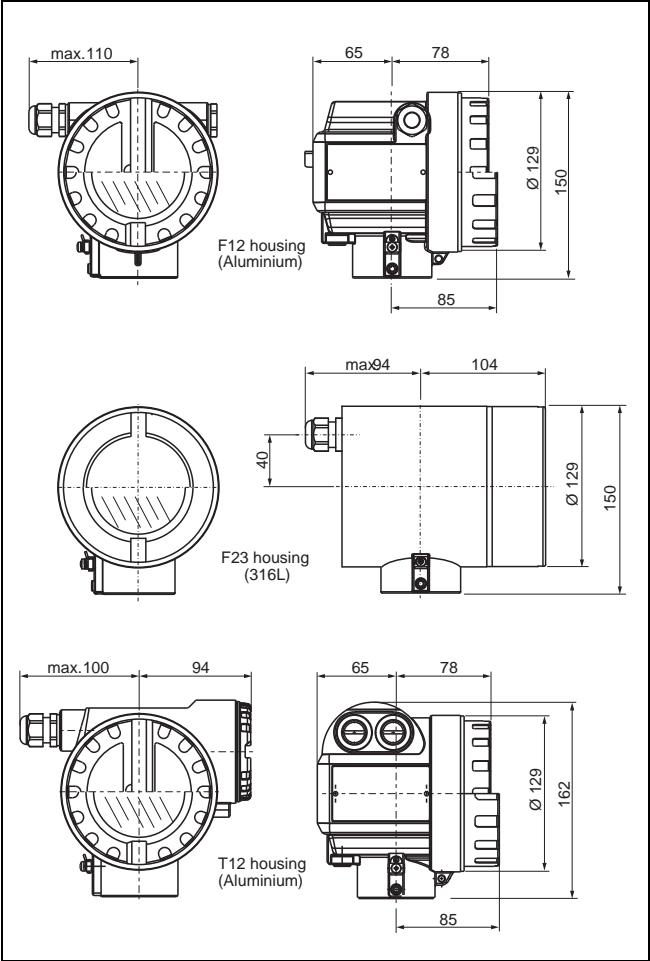
	Type of antenna		Process connection	Temperature	Pressure	Wetted parts
7231	A, B	PPS	-	-20 °C ... +120 °C (-4 °F ... +248 °F)	-1 ... 16 bar (... 232 psi)	316L/1.4435, Viton, PPS
	C, D	PTFE (TFM1600)	PVDF threaded connection	-40 °C ... +80 °C (-40 °F ... +176 °F)	-1 ... 3 bar (... 43.5 psi)	PVDF, PTFE
			Metal threaded connection	-40 °C ... +150 °C (-40 °F ... +302 °F)	-1 ... 40 bar (... 580 psi)	316L/1.4435, PTFE (TFM1600)
			Flange unclad		-1 ... 16 bar (... 232 psi)	PTFE (TFM1600)
			Flange clad ²⁾			
			Tri-Clamp 2"		-1 ... 16 bar (... 232 psi)	316L/1.4435, PTFE (TFM1600) ^{a)}
			Tri-Clamp 3"		-1 ... 10 bar (... 145 psi)	
			Aseptic, Dairy		-1 ... 25 bar (... 362 psi)	
	E, F	PTFE antistatic (TFM4220, 2% conductive additives)	Metal threaded connection	-40 °C ... +150 °C (-40 °F ... +302 °F)	-1 ... 40 bar (... 580 psi)	316L/1.4435, PTFE (TFM4220)
			Flange unclad		-1 ... 16 bar (... 232 psi)	PTFE (TFM4220)
			Flange clad ^{b)}			

a.FDA-listed material

b.on DN150, 6" ANSI, JIS 150A the disc is made of antistatic PTFE (=black)

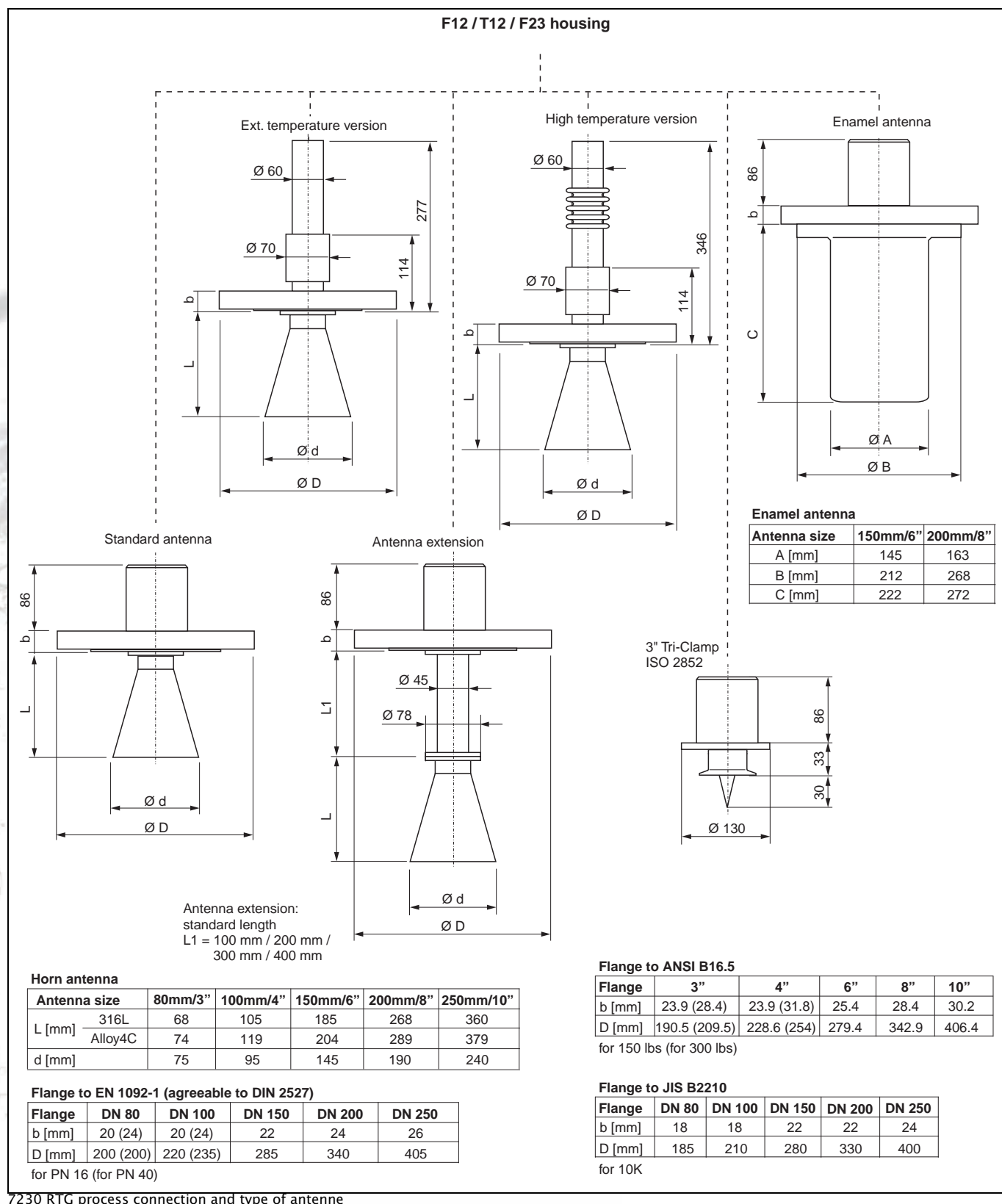
Product Dimensions

Housings

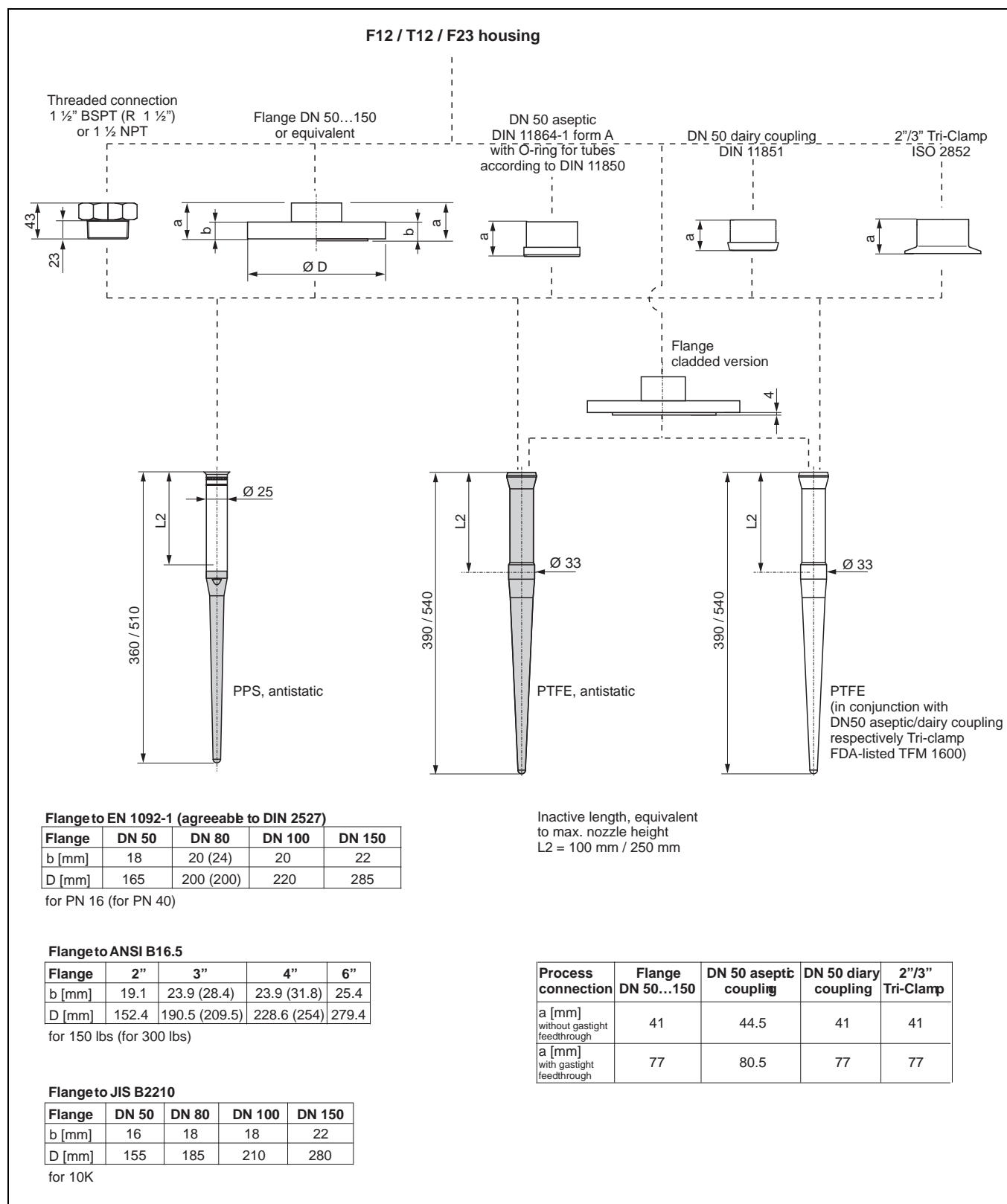


F12, F23, & T12 Housing dimensions

7230 RTG antenna dimensions

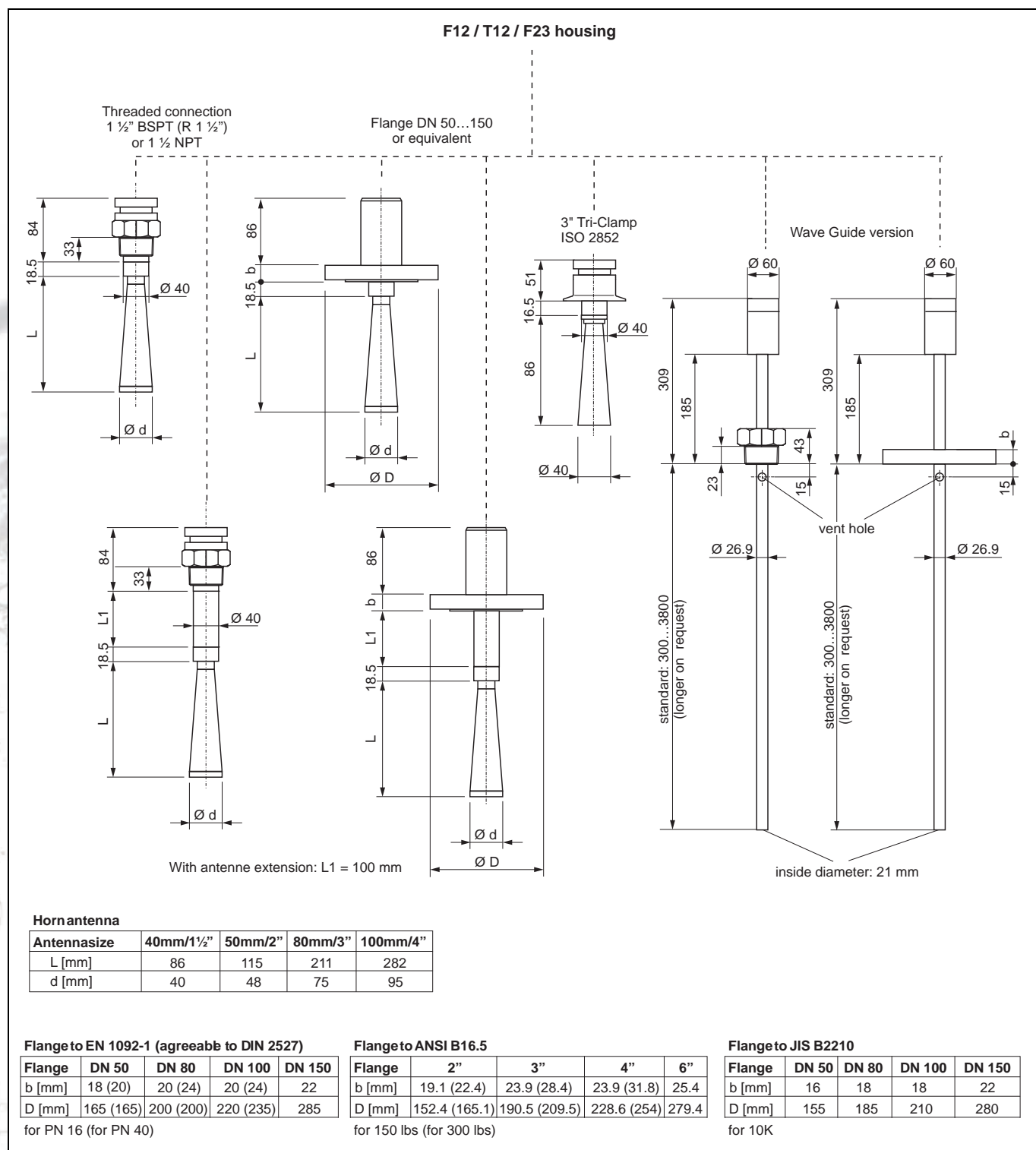


7231 RTG antenna dimensions



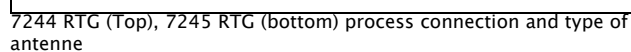
7231 RTG process connection and type of antenna

7240 RTG antenna dimensions



7240 RTG process connection and type of antennae

Varec, Inc.



Operation

Operation Concept

The display of the process value and the configuration of the Radar Tank Gauge occur locally by means of a large 4-line alphanumeric display with plain text information. The guided menu system with integrated help texts ensures a quick and safe commissioning.

Display and operation can occur in one out of six languages (English, German, French, Italian, Dutch, and Spanish). During the first start-up, the instrument explicitly asks for the desired unit / language.

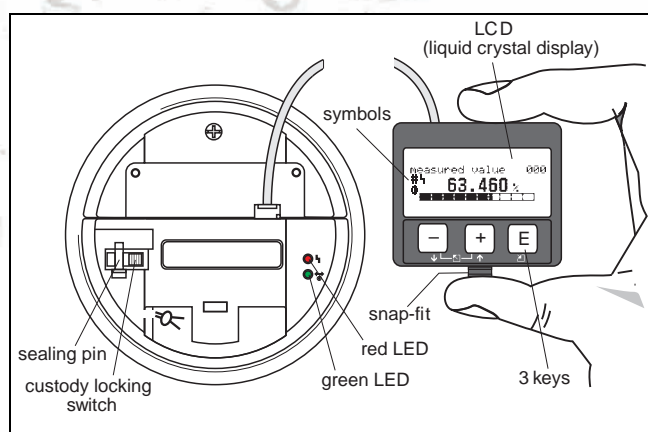
Remote commissioning, including documentation of the measuring point and in-depth analysis functions, is supported via the ToF Tool, the graphical operating software for Varec instruments.

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

On-site Operation

The LC-Display VU331 (Four lines with 20 characters each.) allows configuration via 3 keys directly at the instrument. It can be removed to ease operation by simply pressing the snap-fit. It is connected to the device by means of a 500 mm cable.

All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration procedure.



LC-Display VU331

To access the display, it is possible to open the cover of the electronics compartment even in an explosion hazardous area.

Remote Operation

The ToF Tool is a graphical operation software for instruments from Varec that operate based on the time-of-flight principle. It is used to support commissioning, securing of data, signal analysis, and documentation of the instruments. It is compatible with the following

operating systems: Win95, Win98, WinNT4.0, Win2000 and Windows XP.

The ToF Tool supports the following functions:

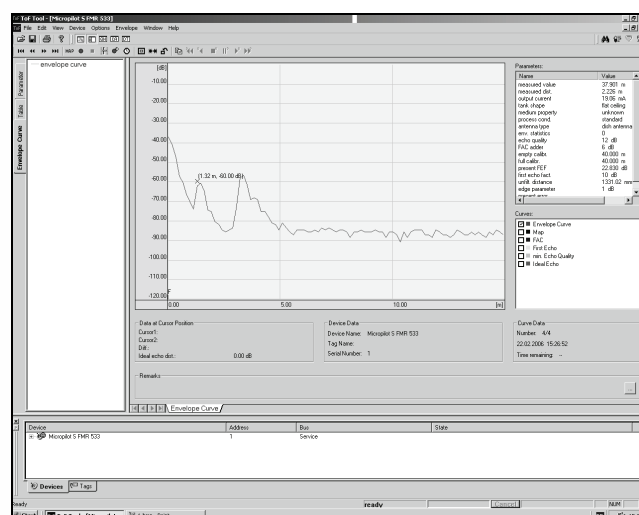
- Online configuration of transmitters
- Signal analysis via envelope curve
- Loading and saving of instrument data (Upload/Download))
- Documentation of measuring point

Note! More information on the ToF Tool can be found on the CD-ROM which is supplied with the instrument.

Menu-guided commissioning:

Signal analysis via envelope curve:

- Connection options:
- HART with Commubox FXA191/195
- Service-interface with adapter FXA193 (RS232C) or FXA291 and ToF Adapter FXA291 (USB)



ToF Tool Operating screen shots

Software Reliability

The software used in the radar instrument 7500 Series Radar Tank Gauge fulfills the requirements of OIML R85. This particularly includes:

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

The radar instrument 7500 Series Radar Tank Gauge continuously monitor the compliance with accuracy requirements for custody transfer measurements according to OIML R85. If the accuracy cannot be maintained, a specific alarm is generated on the local display and via the digital communication.

Signal on Alarm

Error information can be accessed via the following interfaces:

- Local display:
 - Error symbol
 - Plain text display
 - LED's: red LED continuously on = alarm, red LED flashes = warning
- Current output
- Digital interface

Linearization

The linearization function of the 7500 Series Radar Tank Gauge allows the conversion of the measured value into any unit of length or volume. Linearization tables for calculating the volume in cylindrical tanks are pre-programmed. Other tables of up to 32 value pairs can be entered manually or semi-automatically.

Maintenance

Spare Parts and Maintenance Kits

The 7200 series RTG is designed and manufactured to provide accurate and reliable operation without an intensive maintenance schedule.

Varec can provide spare parts, preventive maintenance advice, training and warranties. Please consult your Installation and maintenance manual or a representative for more details.

Cleaning the Antenna

The antenna can get contaminated, depending on the application. The emission and reception of microwaves can thus eventually be hindered. The degree of contamination leading to an error depends on the medium and the reflectivity, mainly determined by the dielectric constant ϵ_r . If the medium tends to cause contamination and deposits, cleaning on a regular basis is recommended. Care has to be taken not to damage the antenna in the process of a mechanical or hose-down cleaning. The material compatibility has to be considered if cleaning agents are used! The maximum permitted temperature at the flange should not be exceeded

Order Codes

Please consult your local sales representative for product options.



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Your Official Representative

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