**Reference Manual**
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# TankRadar® Pro

## Radar Level Gauge

ROSEMOUNT®
Tank Gauging

www.rosemount-tg.com

EMERSON™
Process Management

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# 1. Introduction



TankRadar Pro is a powerful radar level gauge suitable for non-contact level measurements in storage tanks and other types of tanks. It is designed for easy installation and maintenance free operation.

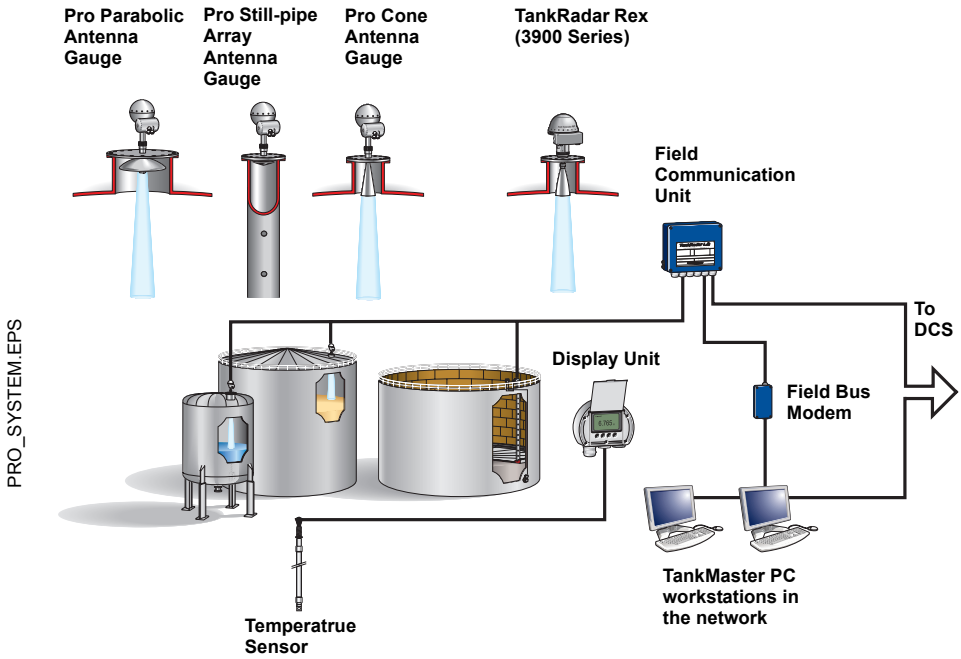
The modular hardware and software design makes it possible to specify a TankRadar Pro gauge that will meet your requirements now and in the future. This manual covers all models of the TankRadar Pro family.

## 1.1 THE TANKRADAR PRO SYSTEM

The TankRadar Pro gauge offers a high degree of flexibility. It can be used as a stand-alone unit, or it can be connected to various control systems.

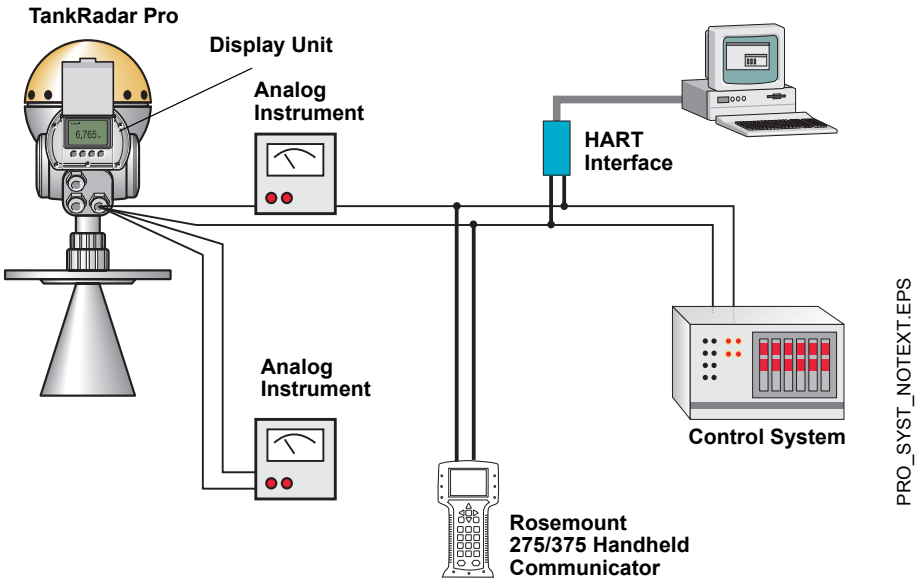
You can integrate TankRadar Pro in your own Local Area Network (LAN). By using the TRL/2 Bus interface you can easily connect Pro gauges to a TankRadar Rex system.

Figure 1-1. TankRadar Pro system.




Various types of software offer configuration and service capabilities for the TankRadar Pro gauge. They also include functions for presentation of measurement data.

Figure 1-2. TankRadar Pro HART® system.




If HART technology is used you can configure and monitor measurement data via a Handheld Communicator or a PC.

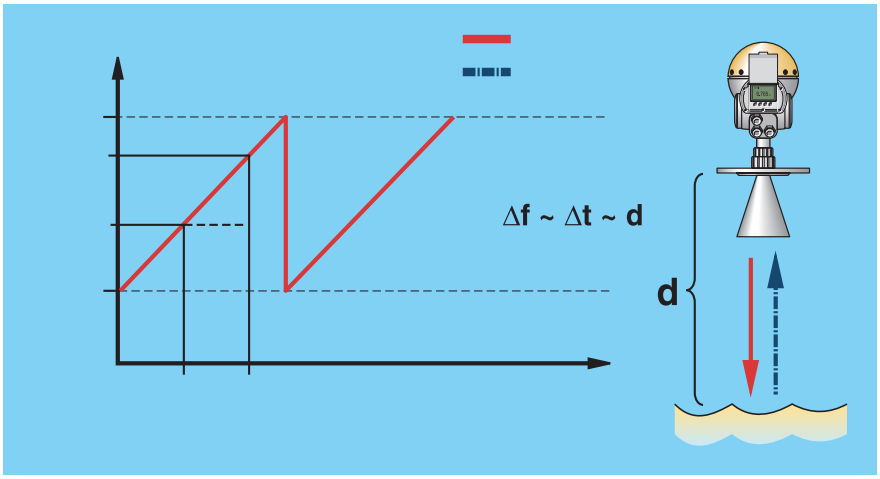
For stand-alone systems, or as a complement to a PC or a control system, you can monitor level data using one or two analog outputs depending on the particular hardware configuration.

As an option, your TankRadar Pro gauge can be equipped with an easy-to-use display unit. It offers basically the same functionality as the Pro Setup software package. Four sturdy softkeys give you access to configuration routines, service functions and level monitoring.

## 1.2 MEASUREMENT PRINCIPLE

The TankRadar Pro gauge sends a microwave signal with a continuously varying frequency towards the liquid surface. When the reflected signal returns to the antenna, it is mixed with the outgoing signal.

Figure 1-3. Measurement principle.




Since the gauge continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals.

The gauge mixes the two signals, resulting in a low frequency signal which is proportional to the distance to the liquid surface. This signal can be measured very accurately allowing fast, reliable and accurate level measurements.

TankRadar Pro uses an optimum microwave frequency, which reduces sensitivity to vapor, foam and contamination of the antenna, and keeps the radar beam narrow in order to minimize influence from walls and disturbing objects.

TankRadar Pro uses Fast Fourier Transformation (FFT), which is a well established signal processing technique, to obtain a frequency spectrum of all echoes in the tank. From this frequency spectrum the surface level is extracted. In combination with Rosemount´s echofixer, FFT allows high accuracy measurements also in demanding applications. Rosemount´s echofixer provides a technique to adapt measurements to various situations, by using information from previous measurements.

To further improve measurement accuracy, TankRadar Pro can utilize the benefits of Rosemount´s Fast High Accuracy Signal Technique™ (FHAST™).

Multiple Echo Tracking™ (MET™) is another advanced TankRadar Pro feature, which provides increased resolution in tanks with disturbing objects. MET™ facilitates the separation of disturbances from the actual product surface echo.

## 1.3 MEASURING RANGE

The following diagrams show how the measuring range is influenced by the antenna type, dielectric constant of the liquid ($\varepsilon_r$) and the process conditions.

Values are valid for free propagation measurement without still-pipes.

Use the diagrams to confirm that you have chosen the correct antenna type and size for your application.

For optimum performance, the maximum measuring distance should be kept within the range indicated with darker colour in the diagrams. To increase the measuring range further in turbulent tanks, a still-pipe can be used.

**Product cathegories:**

- a. $1.9 < \varepsilon_r < 4$. Oil, petrochemicals, gasoline and other hydrocarbons.
- b. $4 < \varepsilon_r < 10$. Alcohols, concentrated acids, organic solvents, oil/water mixtures and acetone.
- c. $\varepsilon_r > 10$. Conductive liquids e.g. water based solutions, dilute acids and alkalis.

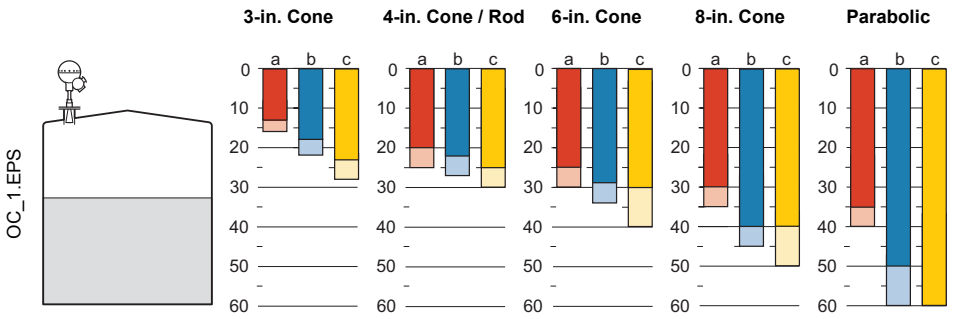



Figure 1-4.
Measuring Range in tanks with calm surface.

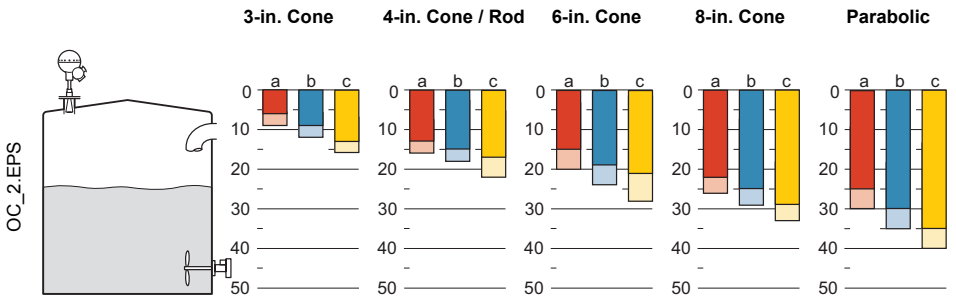



Figure 1-5.
Measuring Range in gently stirred tanks.

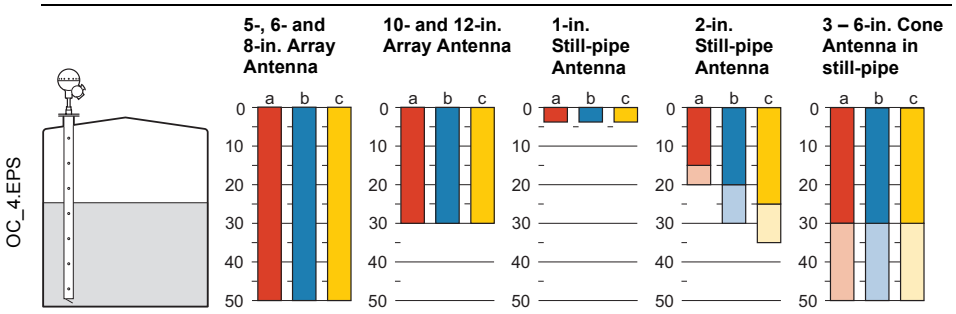
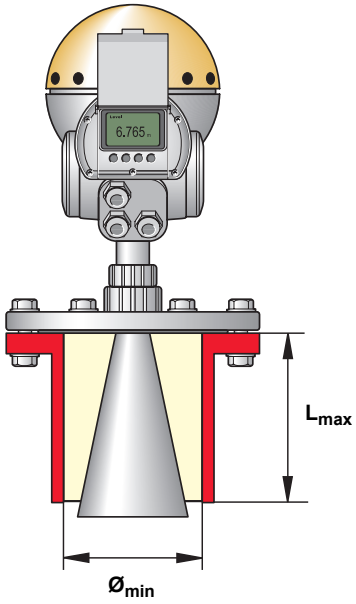



Figure 1-6.
Measuring Range in still-pipe tanks.

# 2. Mechanical Installation

## 2.1 NOZZLE REQUIREMENTS

In order to allow the microwaves to propagate undisturbed, the socket dimensions should be kept within the specified limits for the different antennas.

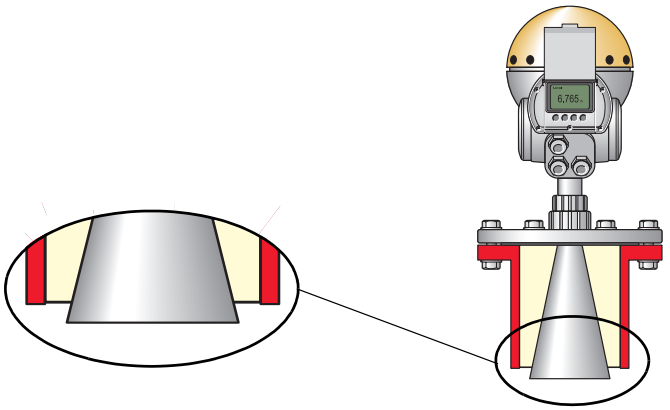



SOCKET_REQUIREMENT.EPS

Table 2-1. Nozzle Requirements in mm (inches)

| Antenna | $L_{recommended}$ | $L_{max}$ | Ø$_{min}$ |
|---|---|---|---|
| 3 in. Cone | 95 (3.7) or less | 245 (9.6) | 75 (3.0) |
| 4 in. Cone | 150 (5.9 or less) | 300 (11.8) | 98 (3.9) |
| 6 in. Cone | 260 (10.2) or less | 410 (16.1) | 146 (5.7) |
| 8 in. Cone | 370 (14.6) or less | 525 (20.6) | 194 (7.6) |
| Parabolic | 160 (6.3) or less | 600 (23.6) | 500 (20.0) |
| 5 in. Still-pipe Array | NA | NA | 126 (5.0) |
| 6 in. Still-pipe Array | NA | NA | 151 (6.0) |
| 8 in. Still-pipe Array | NA | NA | 194 (7.7) |
| 10 in. Still-pipe Array | NA | NA | 248 (9.8) |
| 12 in. Still-pipe Array | NA | NA | 299 (11.8) |
| 4 in. Process Seal | as short as possible | 300 (11.8) | 100 (3.9) |
| 6 in. Process Seal | as short as possible | 300 (11.8) | 150 (5.9) |
| Rod100 | 100 (3.9) or less | 3.9 (100) or less | 43 (1.6) |
| Rod250 | 250 (9.8) or less | 9.8 (250) or less | 43 (1.6) |

NA= Not applicable




SOCKET_REQ.EPS

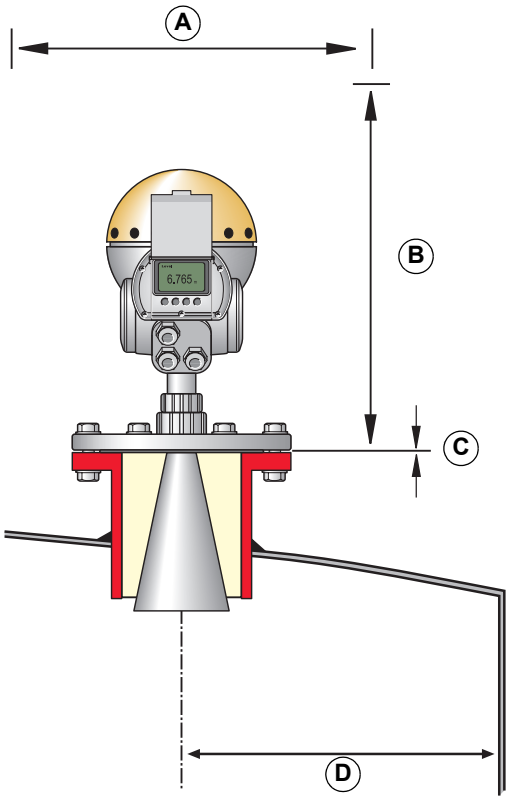
Figure 2-1. For best measurement performance it is recommended that the antenna tip ends outside the nozzle

## 2.2 FREE SPACE REQUIREMENTS

Position the gauge in a way that allows the microwaves to propagate without disturbance from the tank wall, according to the illustration below. In order to achieve optimum performance you should consider the following recommendations:

- Try to avoid obstacles in the radar beam.
- Mount the gauge away from pipe inlets which cause turbulent conditions.
- Choose as large antenna as possible to ensure maximum antenna gain.

FREESPACE_V2.EPS




**A. Service space 550 mm (21.7 in.)**

**B. Service space**

| Antenna | Distance, mm (in.) |
|---|---|
| Cone | 400 (15.7) |
| Process seal | 800 (31.5) |
| Parabolic | 400 (15.7) |
| Still-pipe Array, fixed | 400 (15.7) |
| Still-pipe Array, hinged-lid | 740 (29.1) |
| Rod | 400 (15.7) |

**C. Nozzle Inclination**

| Antenna | Maximum angle |
|---|---|
| Cone | 1° |
| Process seal | 3° |
| Parabolic | 3° |
| Still-pipe Array | 2° |
| Rod | 2° |

**D.Minimum distance to tank wall(1)**

| Antenna | Distance, m (ft) |
|---|---|
| Cone | 0.6 (2.0) |
| Process seal | 0.6 (2.0) |
| Parabolic | 0.6 (2.0) |
| Still-pipe Array | Not applicable |
| Rod | 0.6 (2.0) |

*(1) Mounting closer to the tank wall may be allowed if reduced accuracy is accepted.*

## 2.3 STILL-PIPE REQUIREMENTS FOR ARRAY ANTENNA

The Still-pipe Array antenna fits 5, 6, 8, 10 and 12 in. flanges and pipes. The adaption is accomplished by selecting a suitable Still-pipe Array antenna.

The still-pipe must be vertical within 0.5° (0.2 m over 20 m) to obtain highest measurement accuracy.

Table 2-2 shows the wide range of schedules and pipe inner diameters that the Still-pipe Array antenna can be mounted in.

Table 2-2. Antenna size and the corresponding pipe inner diameter.

| Antenna Size, mm (in.) | Pipe | |
|---|---|---|
| | Size | Inner Diameter mm (in.) |
| 120.2 (4.73) | 5 in. SCH10-SCH60 | 134.5 - 125.3 (5.30-4.93) |
| 145.2 (5.72) | 6 in. SCH10-SCH60 | 161.5 - 150.3 (6.36-5.92) |
| 189 (7.44) | 8 in. SCH20-SCH80 | 206.3 - 193.7 (8.12-7.63) |
| 243 (9.57) | 10 in. SCH10-SCH60 | 264.7 - 247.7 (10.42-9.75) |
| 293.5 (11.56) | 12in. SCH 10-40-XS | 314.7-298.5 (12.39-11.75) |

When constructing new tanks, an 8 in. still-pipe or larger is recommended. This is especially relevant in tanks with sticky, viscous products. Before manufacturing a new still-pipe, we recommend that you contact Emerson Process Management / Rosemount Tank Gauging for advice.

For highest performance, the total area of the slots or holes in the still-pipe must not exceed the values shown in Table 2-3 below. The listed values refer to the total area of the holes over the entire length of the pipe, regardless of its length. In some cases it is possible to allow a larger total area. If the limits are exceeded, please contact Emerson Process Management / Rosemount Tank Gauging for advice.

Table 2-3. Maximum area of the still-pipe slots or holes.

| Pipe Dimension mm (in) | 6 | 8 | 10 | 12 |
|---|---|---|---|---|
| Max area of slots / holes $m^2$ ($ft^2$) | 0.1 | 0.4 | 0.8 | 1.2 |

## 2.4 BEAM WIDTH

BILD_24.EPS

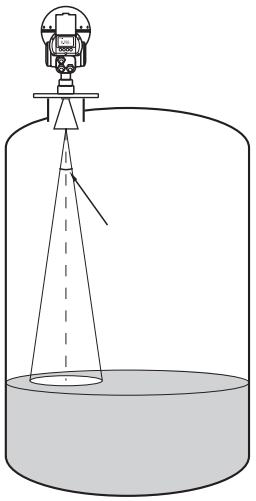


Table 2-4. Beam Width for different antennas.

| Antenna | Half Power Beam Width |
|---|---|
| 3 in. Cone | 25° |
| 4 in Cone / Process Seal / Rod | 21° |
| 6 in Cone / Process Seal | 18° |
| 8 in. Cone | 15° |
| Parabolic | 10° |

BEAMAREA.EPS

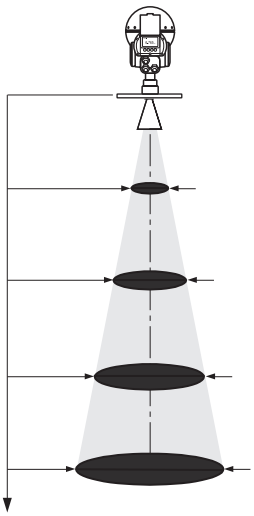


Table 2-5. Diameter of the radiated area for different antennas.

| Antenna | Diameter of radiated area at different distances from flange, m/(ft) | | | |
|---|---|---|---|---|
| | 5 m (16 ft) | 10 m (33 ft) | 15 m (49 ft) | 20 m (66 ft) |
| 3 in. Cone | 2.2/(7.2) | 4.4/(14) | 6.7/(22) | 8.9/(29) |
| 4 in. Cone / Process Seal | 1.9/(6.2) | 3.7/(12) | 5.6/(18) | 7.4/(24) |
| 6 in. Cone / Process Seal | 1.6/(5.2) | 3.1/(10) | 4.7/(15) | 6.3/(21) |
| 8 in.Cone | 1.3/(4.3) | 2.6/(8.5) | 3.9/(13) | 5.3/(17) |
| Parabolic | 0.9/(3.0) | 1.7/(5.6) | 2.6/(8.5) | 3.5/(11) |

## 2.5 DIMENSIONS

Figure 2-2. Pro Parabolic antenna gauge.

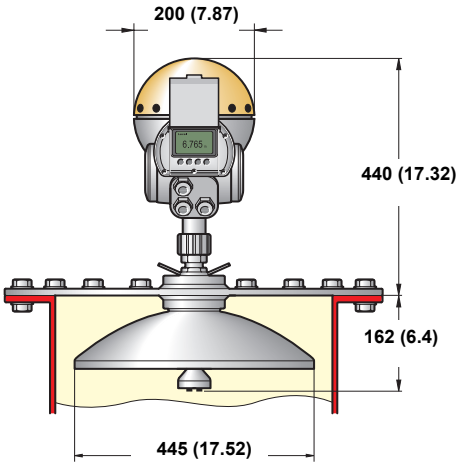



Figure 2-3. Pro Cone antenna gauge.

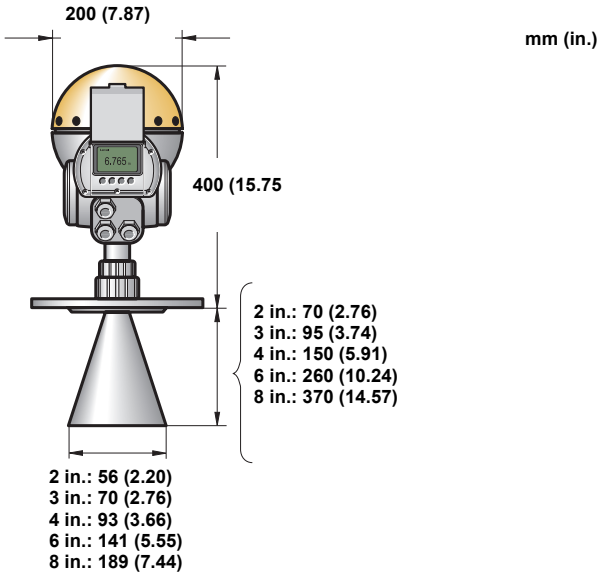


Figure 2-4. Pro Still-pipe Array antenna gauge.

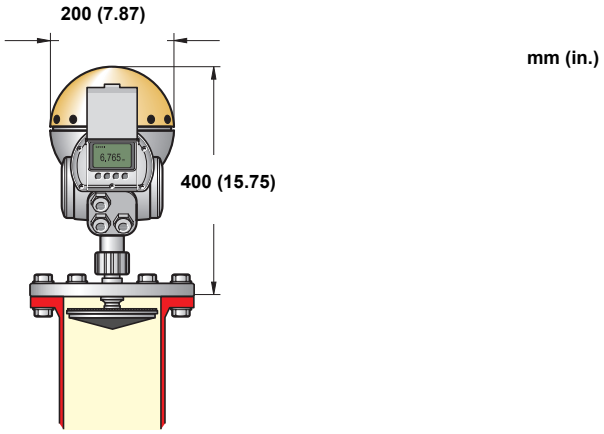



Figure 2-5. Pro Process Seal antenna gauge.

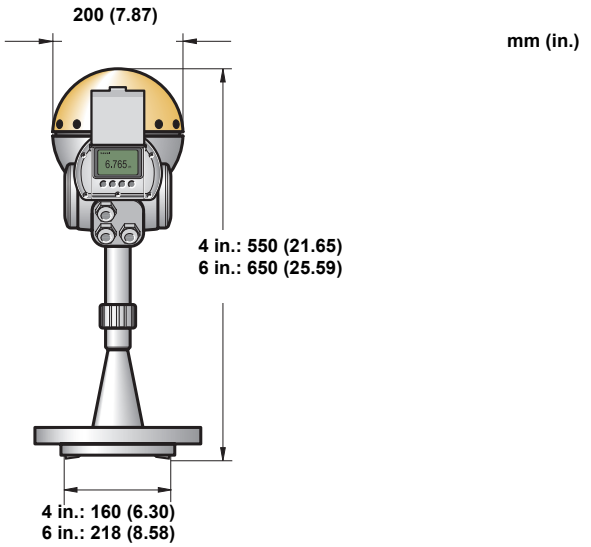
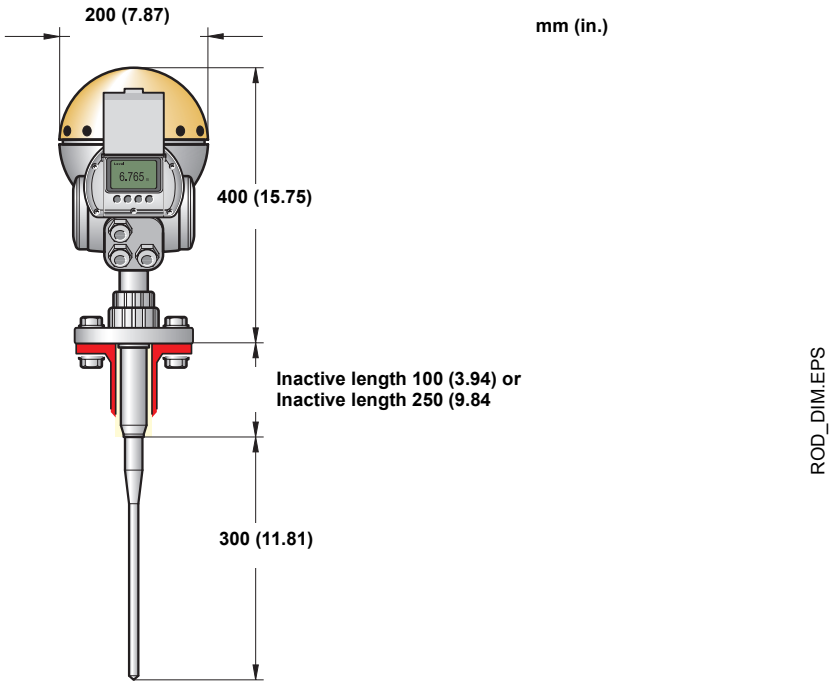


Figure 2-6. Pro Rod antenna gauge.




## 2.6 TOOLS

The following set of tools is needed for installation of a TankRadar Pro gauge:

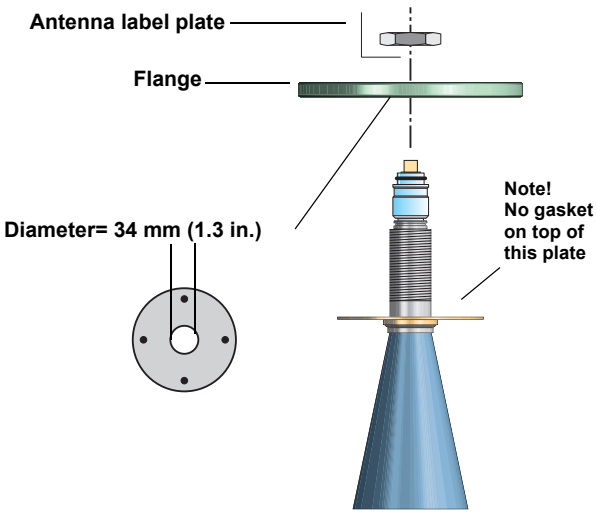
- Screw driver
- Adjustable wrench
- Allen key
- Circlip plier (snap ring plier)
- Hook spanner

## 2.7 CUSTOMER SUPPLIED FLANGES

The simple design of the antenna tank connection allows usage of customer supplied flanges. Note that if a hole is drilled in a standard blind flange the pressure performance is reduced. In such a case the flange should be marked with new rating for Maximum Allowed Working Pressure (MAWP).

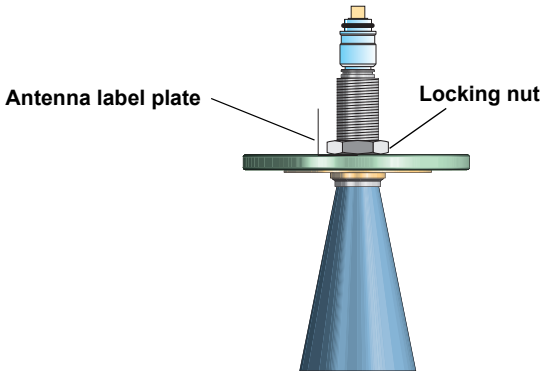
## 2.8 MOUNTING THE CONE ANTENNA - PTFE SEALING

FLANGE_MOUNT_PTFE_50%.EPS



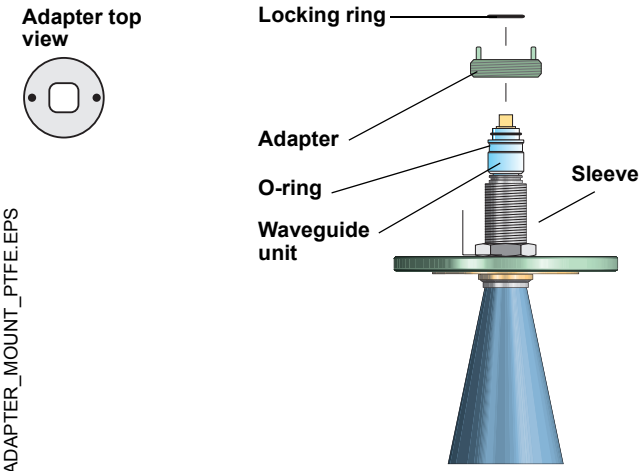

1. Remove the locking ring and the adapter from the antenna.
   Mount the flange on top of the cone plate.
   Make sure that the bottom side of the flange is flat and all parts are clean and dry.
   For customer supplied flanges, see page 2-8.

CONE_FLANGE_ASSY_PTFE_50%.



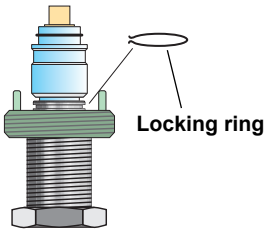

2. Place the antenna label plate and secure the flange with the locking nut.
   Make sure that the nut fits tightly to the flange.

ADAPTER_MOUNT_PTFE.EPS



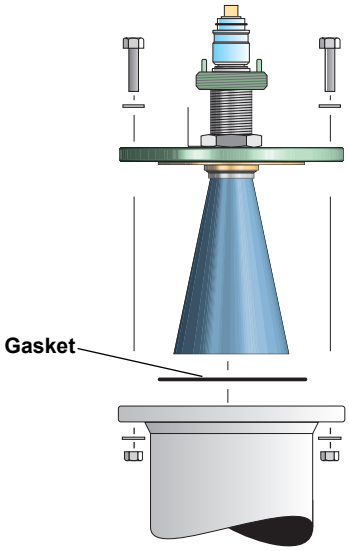

3. Mount the adapter on top of the sleeve.

ADAPTER_LOCKRING_PTFE.E



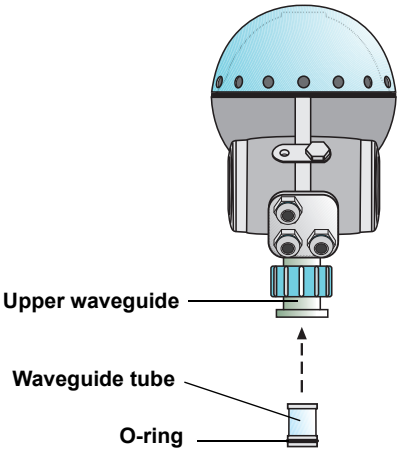

4. Secure the adapter with the locking ring.

CONETANK_PTFE_ED3.EPS



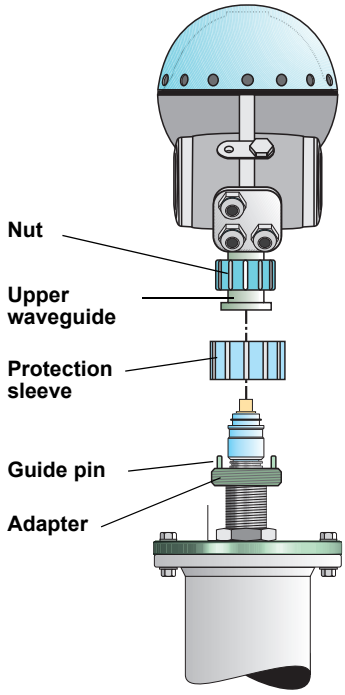

5. Carefully fit the flange and the cone antenna on the tank nozzle.
   Tighten with screws and nuts.

WAVEGUIDE_TUBE.EPS



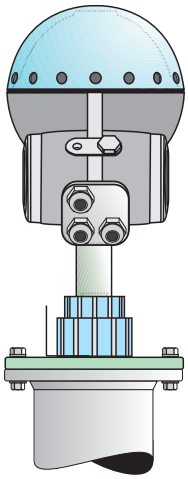

6. Insert the waveguide tube into the upper waveguide.
   Make sure that the gasket at the lower end of the waveguide tube is in place.

HEAD_MOUNT_PTFE.EPS




7. Place the protection sleeve on the flange. Mount the transmitter head and tighten the nut. Check that the guide pins on the adapter enter the corresponding grooves on the upper waveguide

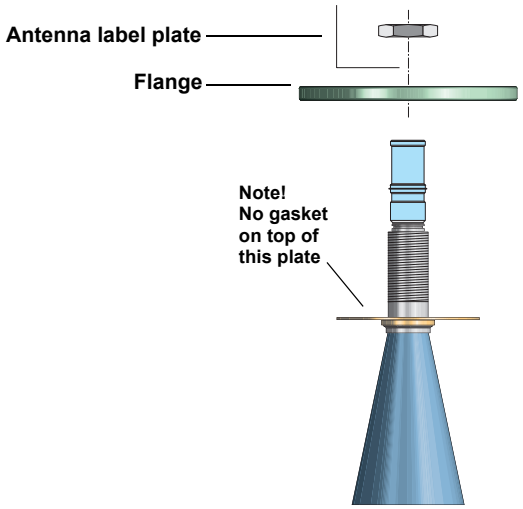
TH40HEAD_NOZZLE.EPS



8. Proceed with the electrical installation.

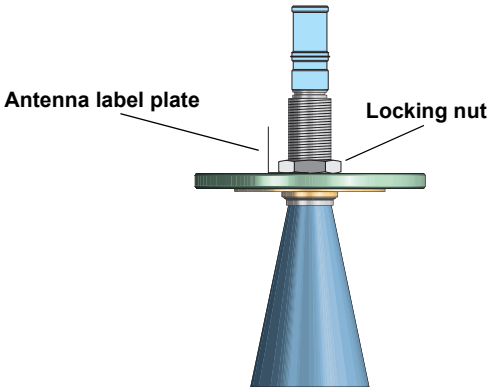
## 2.9 MOUNTING THE CONE ANTENNA - QUARTZ SEALING

FLANGE_MOUNT_QUARTZ_REV.EPS



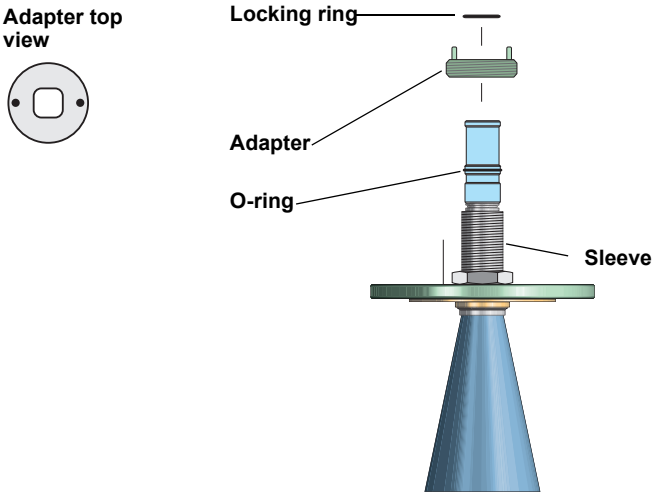

1. Remove the locking ring and the adapter from the antenna.
   Mount the flange on top of the cone plate.
   Make sure that the bottom side of the flange is flat and all parts are clean and dry.

CONE_FLANGE_ASSY_QUARTZ_REV.EPS



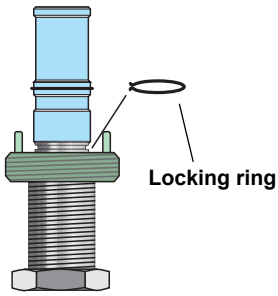

2. Place the antenna label plate and secure the flange with the locking nut.
   Make sure that the locking nut fits tightly to the flange.

ADAPTER_MOUNT_QUARTZ_REV.EPS



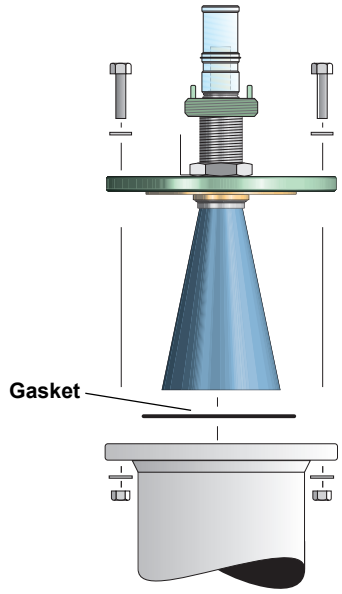

3. Mount the adapter on the sleeve.

ADAPTER_LOCKRING_QUARTZ.EPS



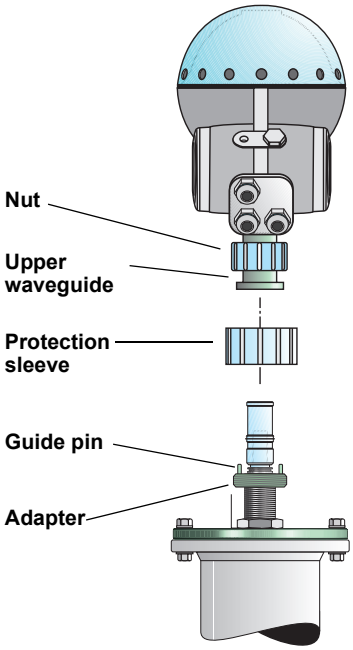

4. Secure the adapter with the locking ring.

CONETANK_QUARTZ_ED3_REV.EPS



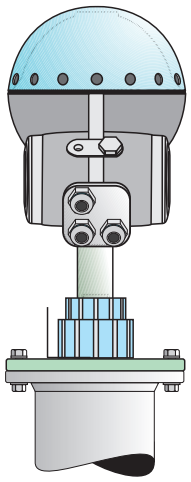

5. Carefully fit the flange and the cone antenna on the tank nozzle.
   Tighten with screws and nuts.

HEAD_MOUNT_QUARTZ.EPS




6. Place the protection sleeve on the flange. Mount the transmitter head and tighten the nut. Check that the guide pins on the adapter enter the corresponding grooves on the upper waveguide.

TH40HEAD_NOZZLE.EPS



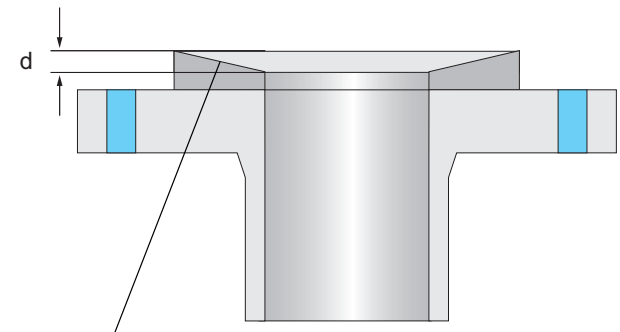
7. Proceed with the electrical installation.

## 2.10 MOUNTING THE PROCESS SEAL ANTENNA

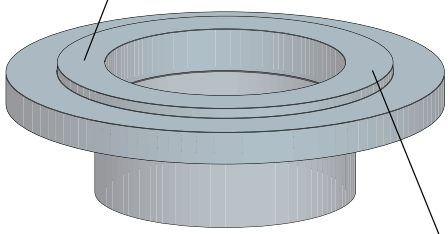
### 2.10.1 Preparations

It is very important that the nozzle surface is flat. The maximum deviation must be within the specifications as illustrated below (see *Installation Instruction Process Seal Doc. no. 9240007-985*):

**Concave:**
**Ceramic window:**
**d<0.1 mm (0.004 in.)**
**PTFE window:**
**d<0.5 mm (0.020 in.)**

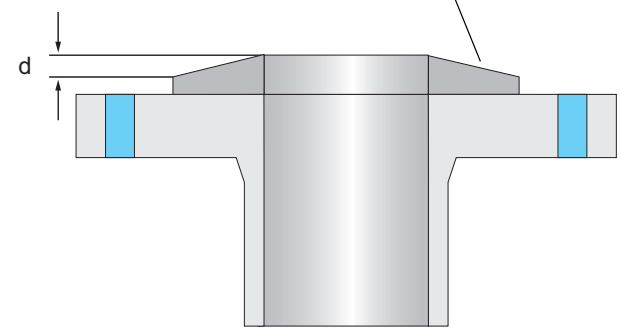



NOZZLE_FLATNESS_CONCAVE_V2.EPS



NOZZLE.EPS.EPS

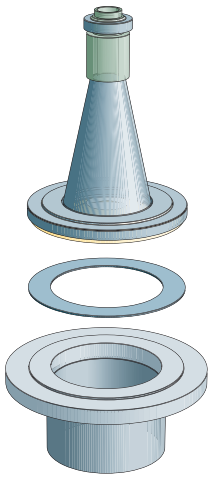
**Convex:**
**Ceramic window:**
**d<0.1 mm (0.004 in.)**
**PTFE window:**
**d<0.5 mm (0.020 in.)**




NOZZLE_FLATNESS_CONVEX_V2.EPS

To mount the antenna do the following:

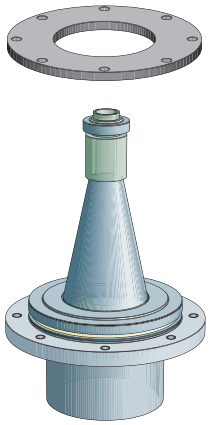
GASKET_WADAPTER_MOUNT_V3.EPS



1. Place a gasket on top of the nozzle and mount the antenna.
   Use one of the two delivered gaskets:
   - Teflon® or
   - Graphite for temperatures above 250 °C.

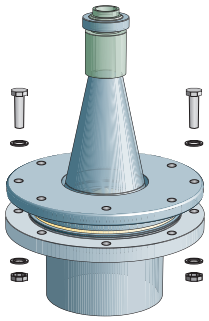
**NOTE!**
These gaskets are optimized for use with microwave emitting equipment. No other gaskets than the original may be used for Process Seal antennas.

FLANGE_MOUNT_PS.EPS



2. Put the loose flange on top of the antenna.

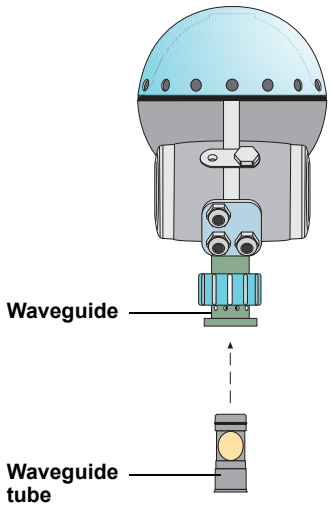
ANTENNA_FLANGE_SCREW_ASSY.EPS



3. Tighten the flange to the antenna by using screws and nuts. Use lubricating grease to minimize friction when the screws are tightened.

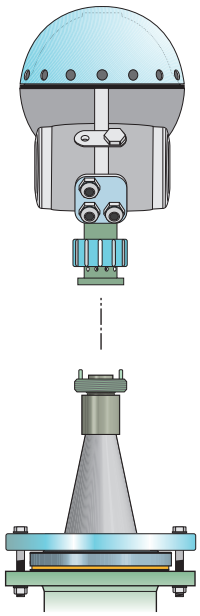
**NOTE!**
Tighten the screws carefully to the recommended torque according to Table 2-6. Tighten opposite screws in pair.

PS_FIG2.EPS



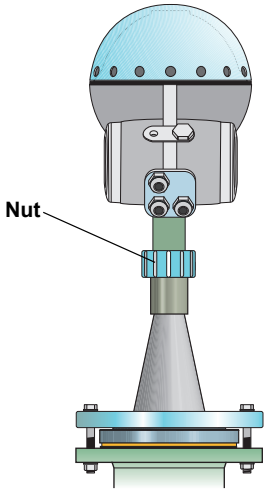

4. Insert the waveguide tube into the upper waveguide.

PS_FIG3.EPS



5. Mount the transmitter head onto the adapter.

PS_FIG4.EPS




6. Tighten the nut and make sure that the transmitter head fits tightly to the antenna.

## 2.10.2 Torque

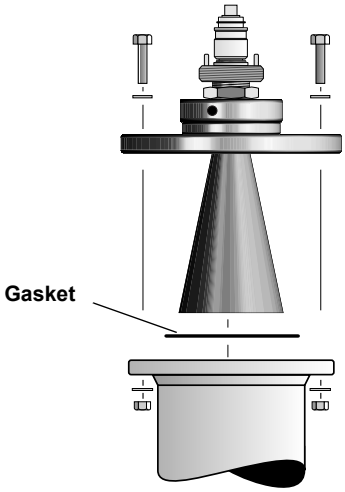
Tighten the flange screws to the following torque:

Table 2-6. Recommended torque for flange screws.

| **Recommended Torque (Nm)** | | | | | |
|---|---|---|---|---|---|
| **PTFE** | | | | | |
| **DIN Flange** | PN6 | PN10 | PN16 | PN25 | PN40 |
| DN100 | 23 | 11 | 11 | 15 | 15 |
| DN150 | 12 | 15 | 15 | | |
| **ANSI Flange** | 150 Psi | 300 Psi | | | |
| 4 in. | 11 | 15 | | | |
| 6 in. | 15 | 10 | | | |
| **Ceramic** | | | | | |
| **DIN Flange** | PN6 | PN10 | PN16 | PN25 | PN40 |
| DN100 | 69 | 35 | 35 | 45 | 45 |
| DN150 | 36 | 46 | 46 | | |
| **ANSI Flange** | 150 Psi | 300 Psi | | | |
| 4 in. | 35 | 45 | | | |
| 6 in. | 46 | 31 | | | |

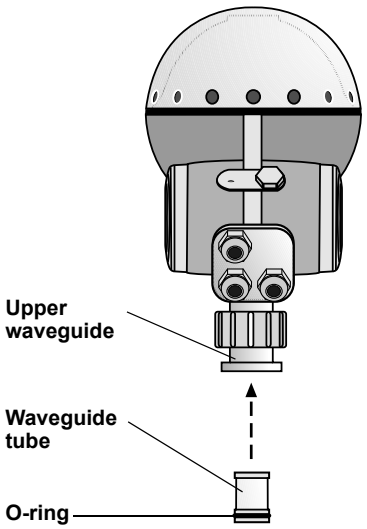
## 2.11 MOUNTING THE CONE ANTENNA - INTEGRATED FLUSHING CONNECTION

FLUSHING_CONE_ANTENNA.EPS



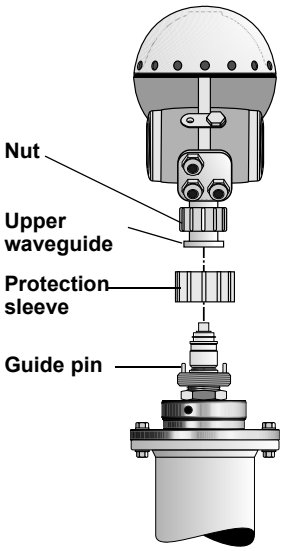

1. The flange, which is a part of the antenna assembly, is welded to the cone antenna. Carefully fit the antenna assembly and the appropriate gasket on the tank nozzle.

FLUSHING_WAVEGUIDE_TUBE.EPS



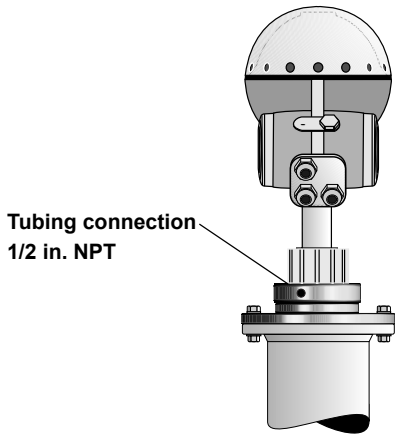

2. Insert the waveguide tube into the upper waveguide. Make sure that the o-ring at the lower end of the waveguide tube is in place.

FLUSHING_ANTENNA_HEAD.EPS




3. Mount the transmitter head and tighten the nut. Check that the guide pins on the adapter enter the corresponding grooves on the upper waveguide

FLUSHING_ANTENNA_CONNECT.EPS

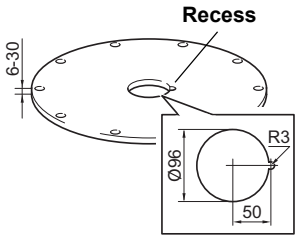



4. Connect your tubing to the antenna for cleaning, purging or cooling purposes. Use a tube or pipe of minimum 10 mm (0.4 in) size. Typical media to use are:
   - nitrogen
   - air
   - water
   - steam

## 2.12 MOUNTING THE PARABOLIC ANTENNA

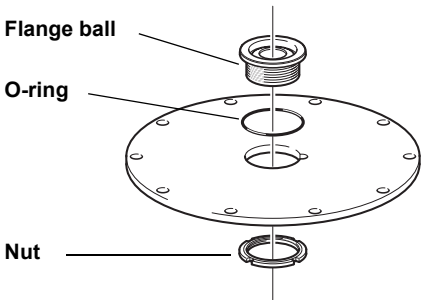
### 2.12.1 Mounting the Flange Ball

PARANT_FLANGE.EPS



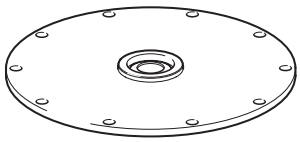

1. The flange should be between 6 and 30 mm (0.2 and 1.2 in.) thick. Make sure that the diameter of the hole is 96 mm (3.8 in.). Make a small recess in the flange hole.

PARANT_FLANGEBALL.EPS



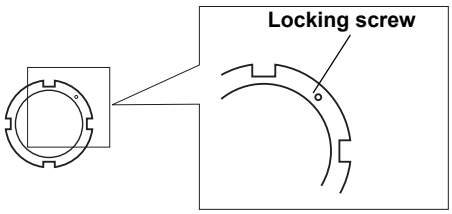

2. Put the O-ring on the flange and insert the flange ball into the hole. Make sure that the pin on the side of the flange ball fits into the corresponding recess on the flange.

PARANT_TIGHTENNUT.E



3. Tighten the nut. Make sure that the flange ball fits tightly to the flange.

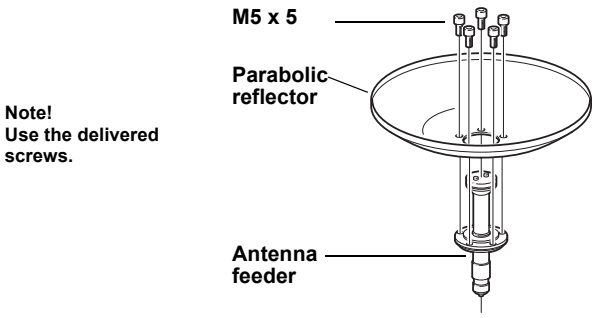
PARANT_NUT_LOCKSCREW.EPS




4. Secure the nut by tightening the locking screw.

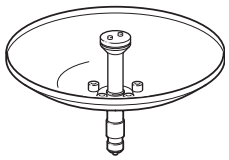
## 2.12.2 Mounting the Antenna

PARANT_PARABOLICREFLECTOR.EPS



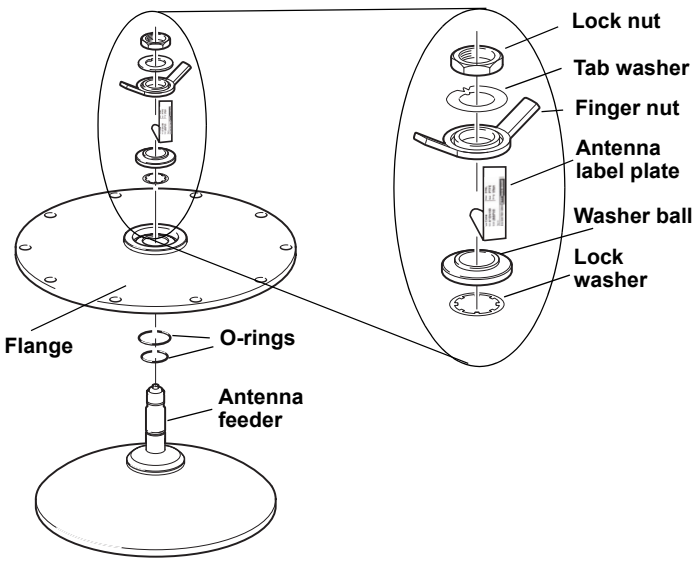

1. Fit the parabolic reflector to the antenna feeder and mount the five M5 screws.

PARANT_PARABOLICTIGHTEN.EPS



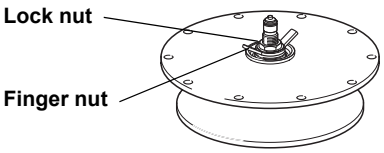
2. Tighten the screws.

PARANT_LABEL_REV.EPS



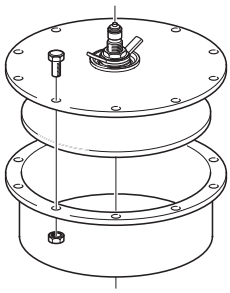

3. Put the two O-rings in the grooves on the upper surface of the flange ball.
4. Turn the flange around and mount the antenna feeder on the flange. Mount the washers and nuts.

PARANT_FINGERNUT_T30.E



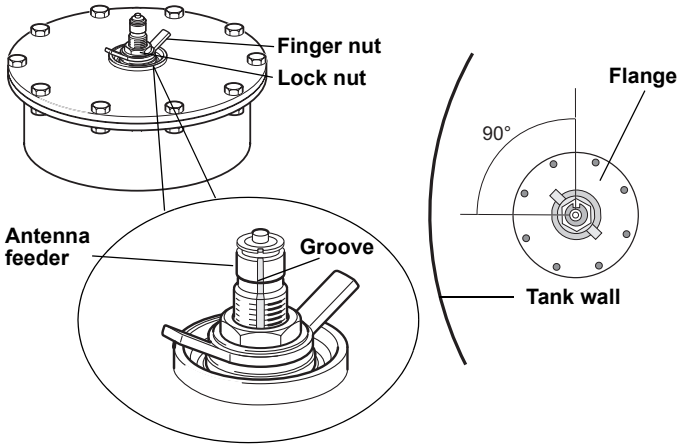

5. Tighten the finger nut and the lock nut loosely.

PARANT_TANKNOZZLE_T30.EPS



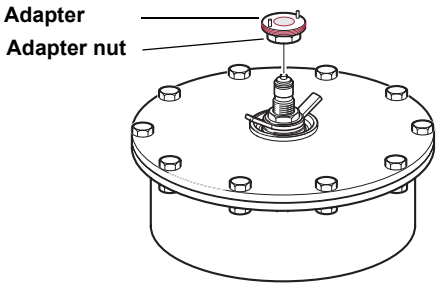
6. Place the antenna on the tank nozzle and tighten the flange screws.

PARANT_TANKNOZZLE_T30.EPS



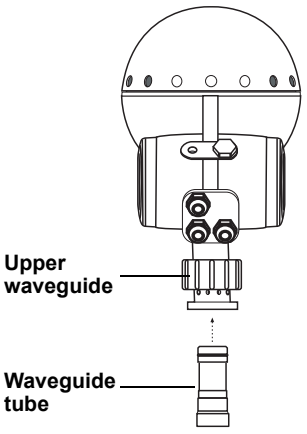

7. Rotate the antenna so that the groove on the antenna feeder is directed 90° to the tank wall.
8. Tighten the finger nut and the lock nut.

PARANT_PROADAPTER_T30.EPS



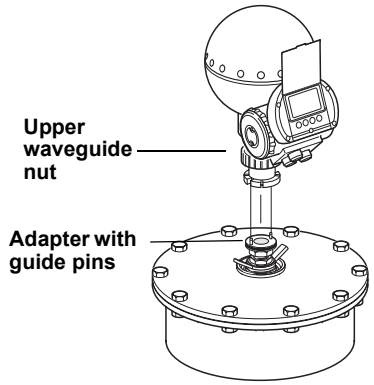

9. Mount the adapter on top of the antenna feeder. Tighten the adapter nut loosely so the transmitter head can be properly aligned. Normally the antenna should be mounted with 0° inclination. However, in some applications, for example solid products, a small inclination of the antenna may improve the performance. This may also be the case if there are disturbing echoes from objects in the tank.

PA_WAVEGUIDETUBE.EPS



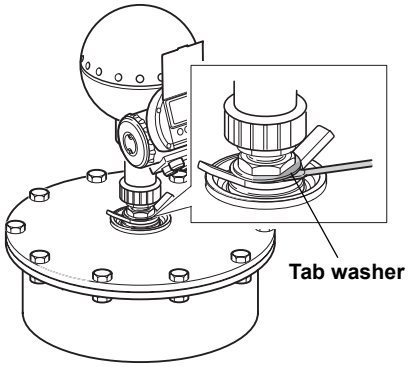

10. Insert the waveguide tube into the upper waveguide.

PARANT_PRO_THMOUNT_T30_REV.EPS




11. Carefully mount the transmitter head onto the adapter and tighten the upper waveguide nut by hand. Make sure that the guide pins on the adapter fit into the holes on the upper waveguide.

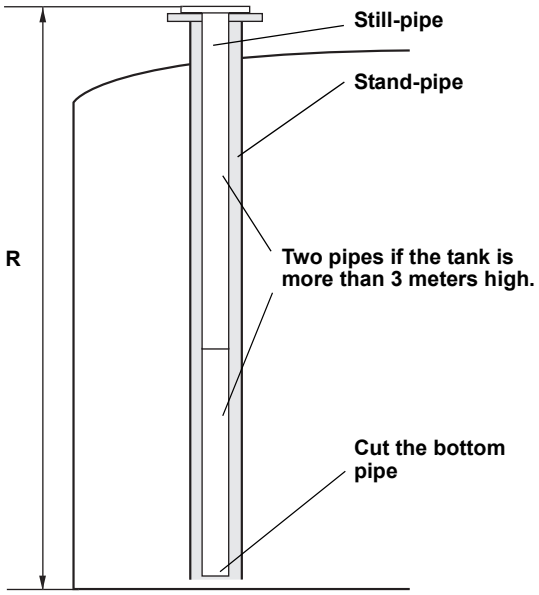
PARANT_TABWASHER_T30.EPS




12. When the antenna inclination is adjusted to obtain optimum performance, (see pt. 9), tighten the finger nut and the lock nut firmly. Secure by folding the tab washer over the lock nut.

## 2.13 MOUNTING THE 2-IN. STILL-PIPE ANTENNA

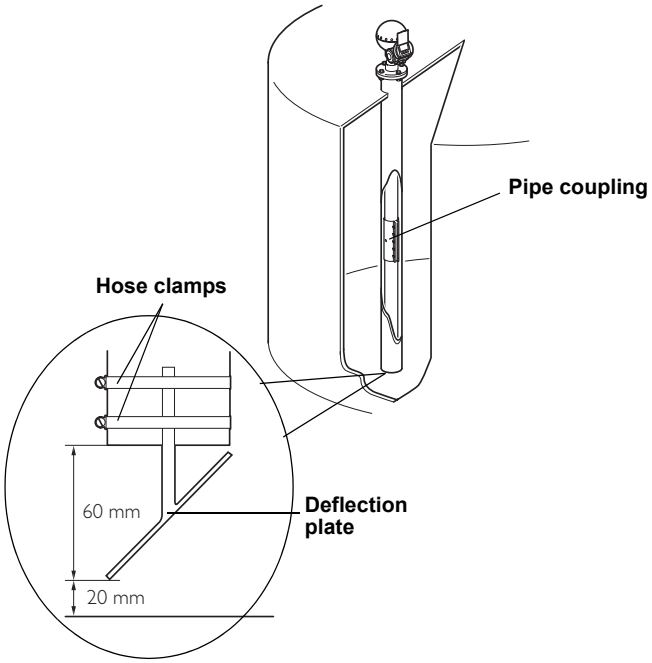
STILLPIPE_TANK.EPS



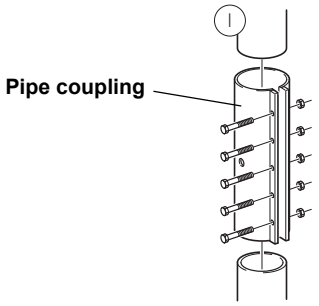

1. Measure the tank height R. The tank height is measured from the top of the still-pipe flange to the bottom of the tank.
2. If the tank is more than 3 m (9.8 ft) high, connect two pipes by using a pipe coupling.
3. Attach the deflection plate to the bottom pipe by using two hose clamps. The deflection plate allows you to measure down to the bottom of an empty tank. Make sure that the lower pipe is cut to leave room for the deflection plate and about 20 mm (0.8 in.) free space between the tank bottom and the deflection plate.

**NOTE!**
7 m (23 ft) or longer still-pipes might require anchoring to better withstand tank movements.

22,06.EPS

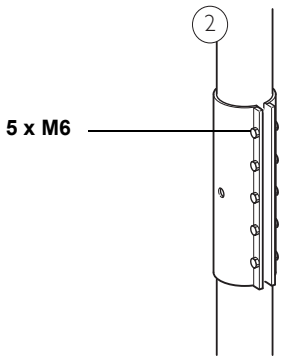


20,01_STEP1.EPS



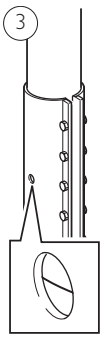

4. Put the pipes together by using a pipe coupling.

20,01_STEP2.EPS



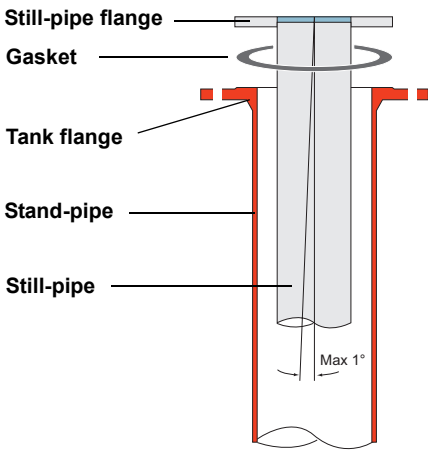

5. Tighten the five M6 nuts.

20,01_STEP3.EPS




6. Inspect the pipe ends by looking through the slots on the side of the pipe coupling. Make sure that there is no gap between the pipe ends.

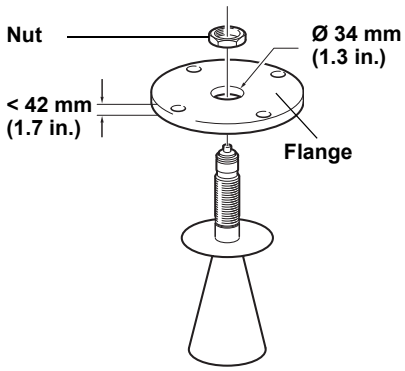
STILLPIPE2INCH_MOUNT_V3.EPS




7. Insert the still-pipe into the stand-pipe. Put a gasket between the tank flange and the pipe flange. The minimum diameter of the stand-pipe is 86 mm (3.39 in.) without pipe coupling and 99 mm (3.90 in.) with pipe coupling. Make sure that the inclination of the still-pipe is less than 1°.

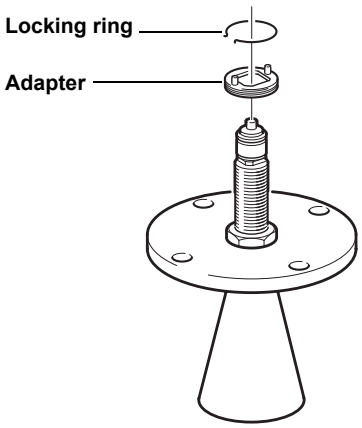
## 2.13.1 Mounting the Antenna and Transmitter Head

21,01_V2.EPS



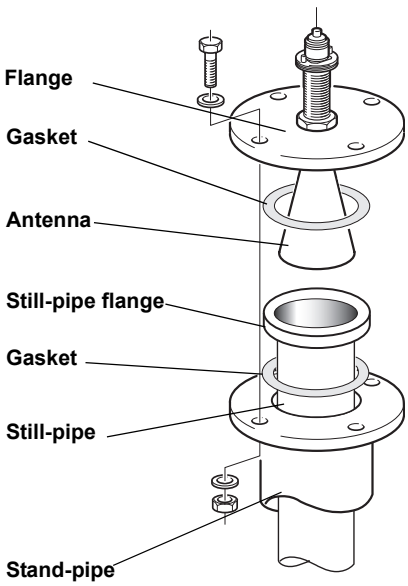

1. Remove the locking ring and the adapter from the antenna.
   Mount the flange on the antenna and tighten the nut.
   Use a flange with center hole diameter 34 mm (1.3 in.) and maximum thickness of 42 mm (1.7 in.).

21,02.EPS



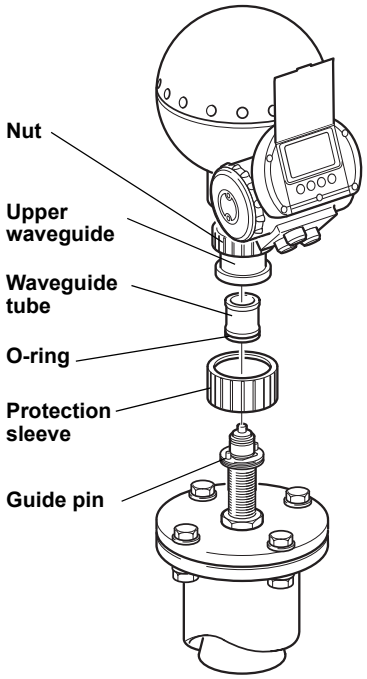

2. Mount the adapter and secure with the locking ring.

21,03_C.EPS




3. Fit the flange and antenna assembly on the tank. Put a gasket between the flange and the still-pipe. Tighten with screws and nuts.

21,04.EPS




**NOTE!**
Measure the pipe inner diameter before closing the still-pipe. This value should be entered during the configuration.

4. If PTFE is used as tank sealing material, insert the waveguide tube into the upper waveguide. Put the protection sleeve on the flange. (When Quartz is used as tank sealing material, the waveguide tube is integrated with the antenna).

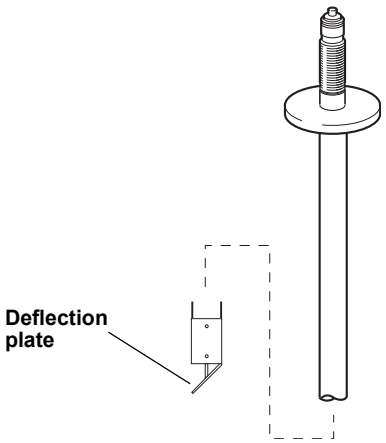
5. Mount the transmitter head. Check that the guide pins on the adapter fit the corresponding grooves on the upper waveguide.

6. Tighten the nut.

## 2.14 MOUNTING THE 1-IN. STILL-PIPE ANTENNA

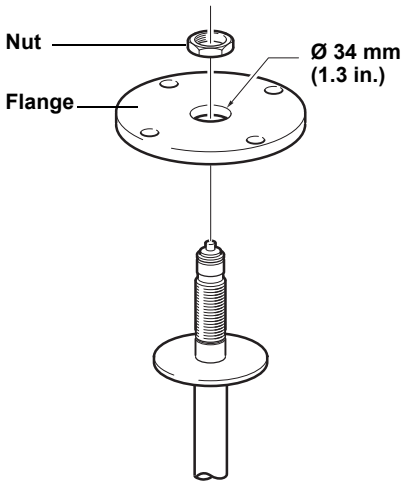
The 1-in. still-pipe antenna is suitable for measurements in tanks with small nozzles and turbulent tanks with clean products. The software configuration is simple since objects in the tank have no influence on the measurement performance. The 1-in. still-pipe antenna is used for small tanks and clean liquids.

1INCH_PIPE_DEFLPLATE.EPS



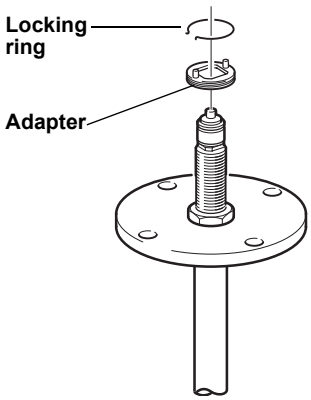

1. Cut the pipe so that there is about 20 mm (0.8 in.) left to the tank bottom. Use a deflection plate to ensure reliable measurements also when the tank is empty.

22,01_1INCH.EPS



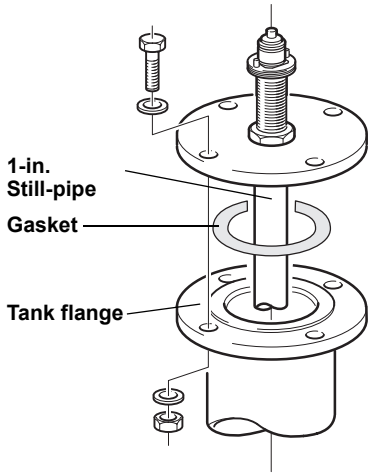

2. Remove the locking ring and the adapter from the antenna.
   Mount a flange on the pipe and tighten the nut. Use a flange with a hole diameter of 34 mm (1.3 in.).

22,02_1INCH.EPS



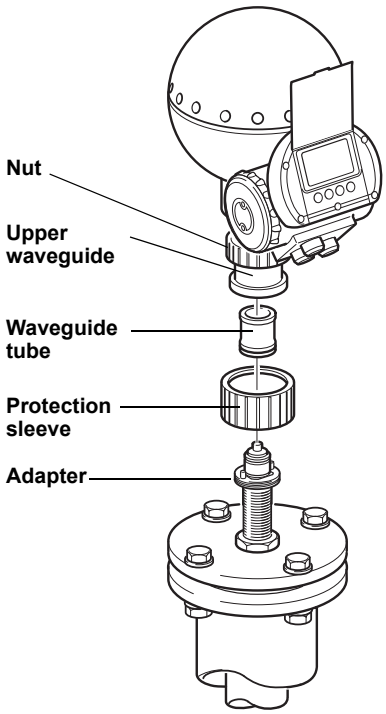

3. Mount the adapter and secure with the locking ring.

22,03_V3.EPS




4. Insert the 1-in. still-pipe in the nozzle. Put a gasket between the still-pipe and the tank flange.

22,04.EPS




5. Insert the waveguide tube into the gauge upper waveguide and put the protection sleeve on the flange.

6. Mount the transmitter head. Check that the guide pins on the adapter enter the corresponding grooves on the upper waveguide.

7. Tighten the nut.

## 2.15 MOUNTING THE CONE ANTENNA IN A STILL-PIPE/BRIDLE

The TankRadar Pro gauge is very suitable for measurements in bridles. The high signal processing capacity allows measurements even when there are several pipe inlets.

20,03.EPS

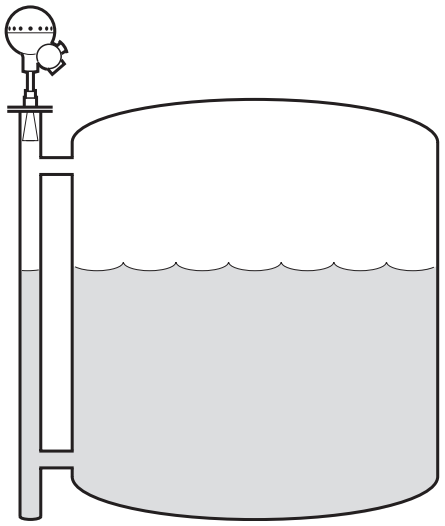
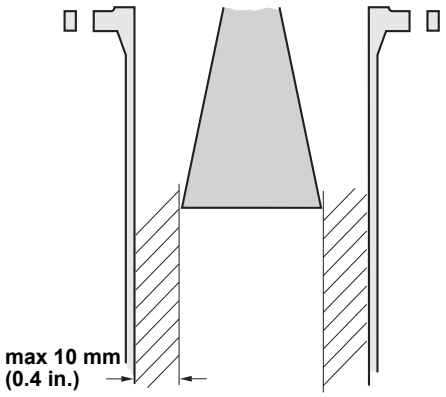


Figure 2-7. TankRadar Pro is suitable for measurements in bridles.

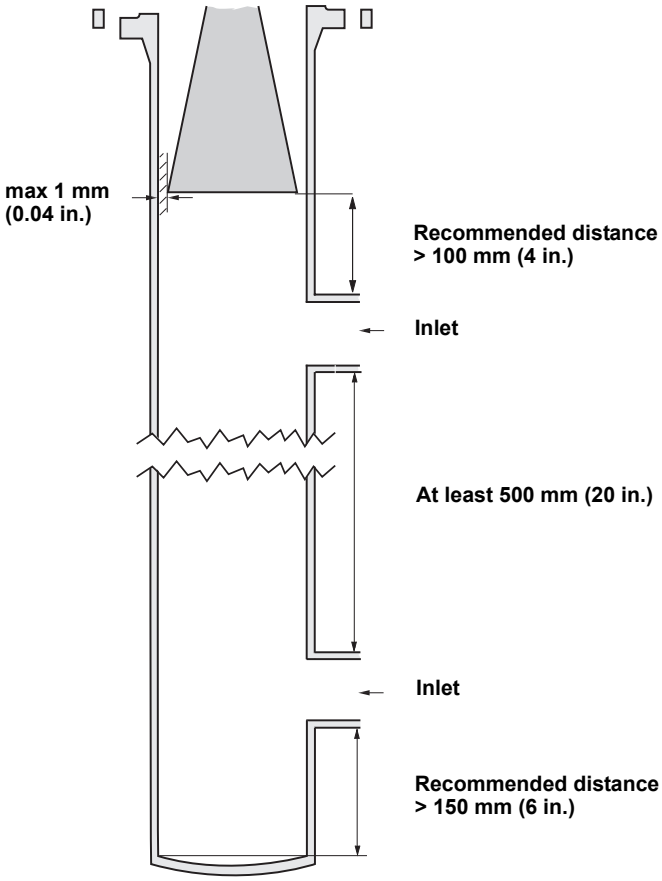
Still-pipe or bridle mounting is recommended for LPG tanks and other applications where surface conditions may be extremely turbulent. By using a pipe, the influence of foam and turbulence is reduced. Accuracy may, however, be reduced in bridle and still-pipe applications.

### 2.15.1 To Mount the Gauge

20,07_MAX10MM_01.EPS



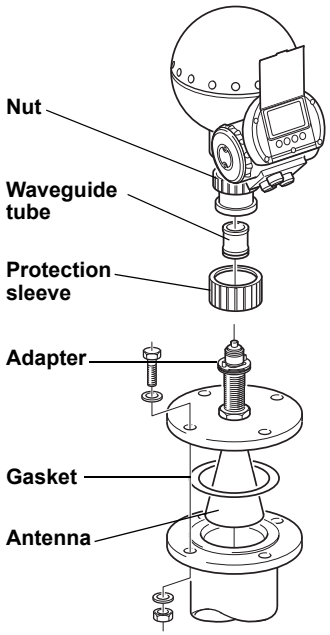

1. The 3-, 4-, 6- and 8-in. antennas are designed to fit into new or existing still-pipes with the corresponding size. A gap between the antenna opening and the pipe of up to 10 mm (0.4 in.) may occur. In still-pipes with small inlet pipes or no inlet pipes at all, the gap has no influence on the measuring performance. It is always recommended to have the gap as small as possible, since larger gaps cause larger inaccuracies.




PRO_07_AB.EPS

2. In pipes with inlets in the order of 2 in. or larger, or in pipes where severe contimanation can be expected, the antenna should be customized in order to achieve optimum performance. In this case do the following:
   a. Measure the inner diameter of the pipe.
   b. Cut the cone antenna so that it fits inside the still-pipe.
   c. Make sure that the gap between the pipe and the antenna is smaller than 1 mm (0.04 in.).

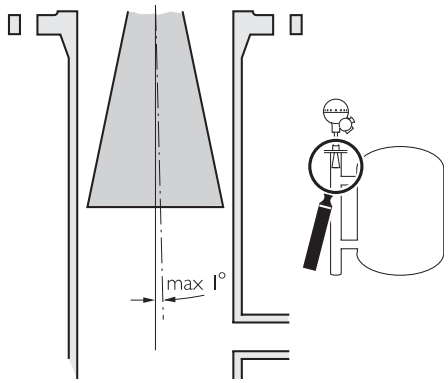
**NOTE!**
Measure the pipe inner diameter before closing the still-pipe. This value should be entered during the configuration.




ANTENNA_HEAD_MOUNT.EPS

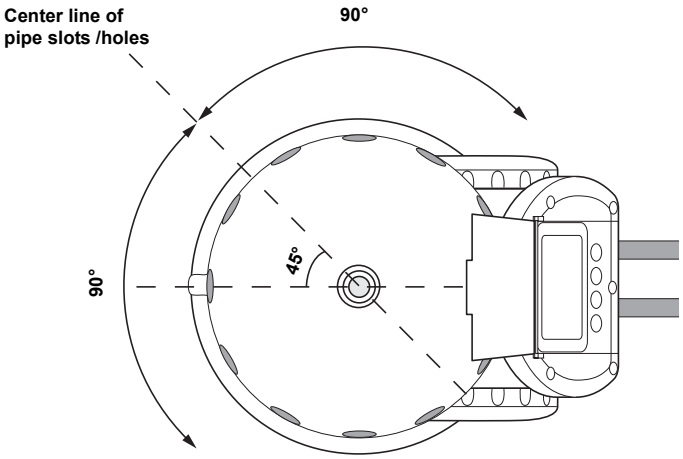
3. Mount the antenna and the transmitter head in the same way as a standard cone antenna.

20,07_INCLINATION.EPS




4. Make sure that the inclination of the gauge is less than 1°.

BRIDLE_HEADROTATE.EPS




5. In order to minimize the influence of disturbing echoes from inlet and outlet pipes you may need to rotate the transmitter head 90°.

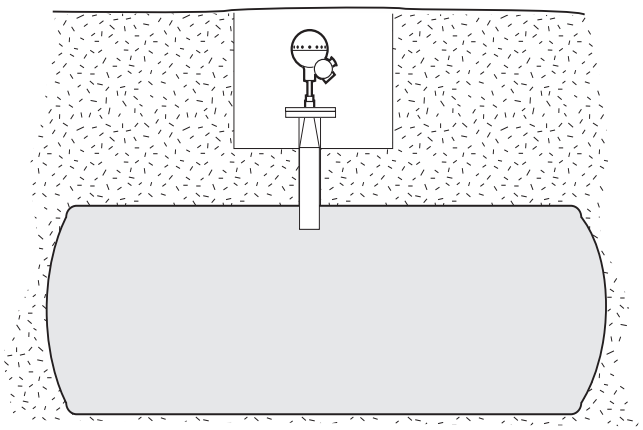
## 2.16 MOUNTING AN EXTENDED CONE ANTENNA

The Extended Cone antenna is suitable for tanks with long nozzles or tanks where measurements should be avoided in the region close to the nozzle.

Use the Extended Cone antenna if:

- the nozzle is high:

Figure 2-8. Underground tank with high nozzle.



TANK_UNDERGROUND.EPS

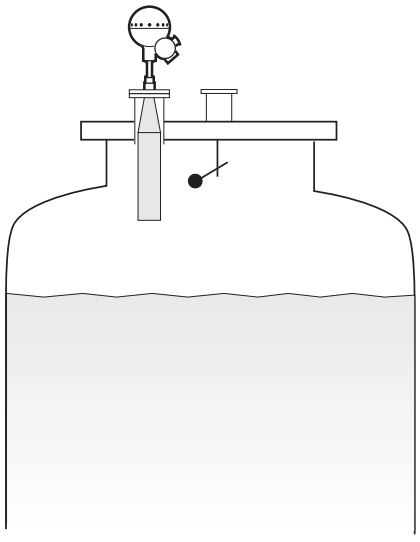
**ANSI 3-in. antenna for nozzles higher than 250 mm (9.8 in.),**

**ANSI 4-in. antenna for nozzles higher than 300 mm (11.8 in.),**

**ANSI 6-in. antenna for nozzles higher than 400 mm (15.8 in.),**

- there are disturbing objects close to the tank opening, or

Figure 2-9. Disturbing objects close to the tank nozzle.



TANK_INSULATED.EPS

- there is a rough surface at the inside of the nozzle.

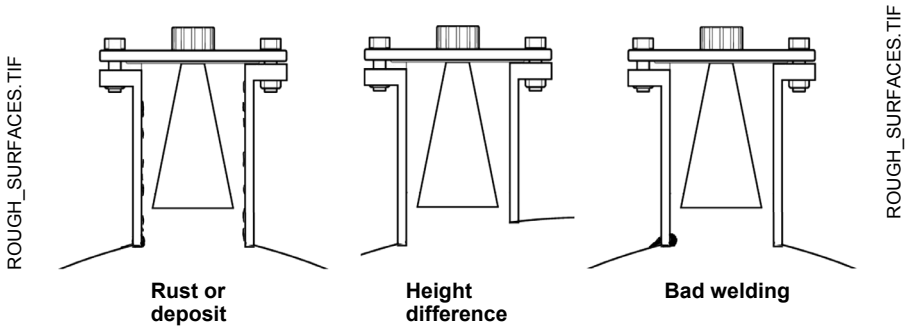
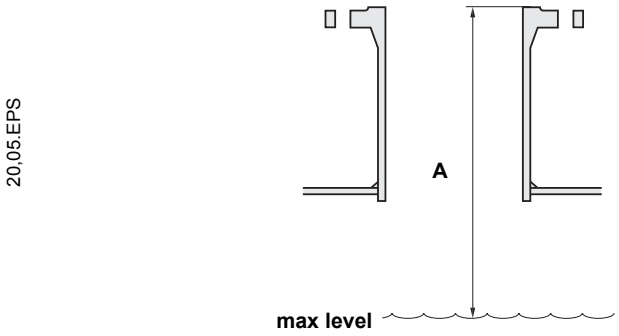
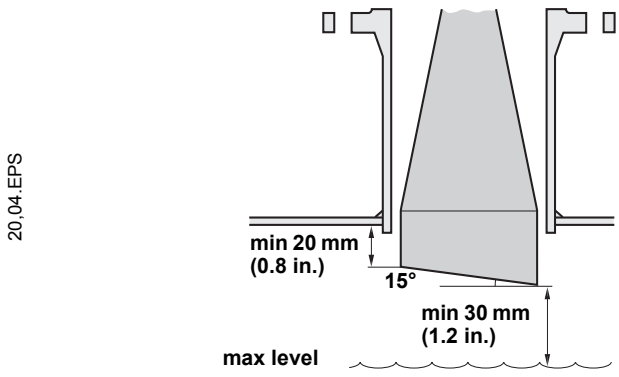



Figure 2-10. An extended cone antenna can be used if the nozzle has irregularities or a height diffrence.

## 2.16.1 To Mount the Gauge



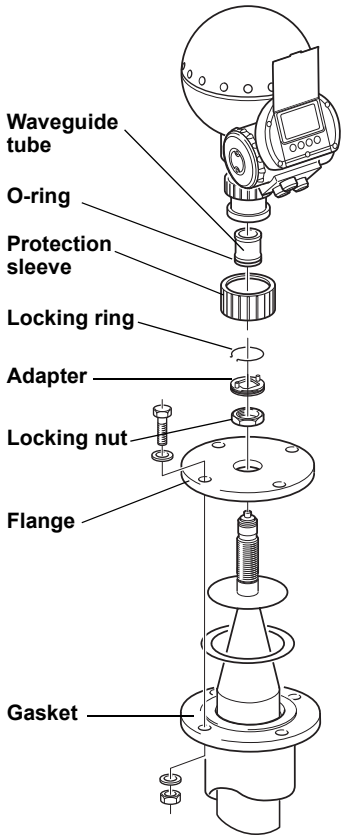

1. Measure the total distance **A** between the flange and the maximum product level.




2. The standard length of the Extended Cone antenna is 500 mm (20 in.). If the distance **A** between the flange and the maximum product level is smaller, the antenna must be cut to meet the following specifications:
   - the distance between the antenna and the tank roof is > 20 mm (0.8 in.),
   - the distance between the maximum product level and the antenna is > 30 mm (1.2 in.),
   - the antenna is cut with a slant opening of 15°.

Due to the slanting opening of the antenna, the direction of the radar beam is slightly changed towards the short end of the antenna opening. If objects are present which may cause disturbing radar echoes, the antenna should be oriented in such a way that the disturbing objects do not interfere with the radar signal.

CONEEXTENSION_MOUNT_B.EPS




3. Mount the antenna and transmitter head in the same way as a gauge with a standard cone antenna.
4. When the gauge is mounted, the following antenna parameters must be adjusted by using the configuration tool of your choice:
   - **Tank Connection Length** (TCL). See "*Setting the Tank Connection Length (TCL)"* on page 2-36
   - **Hold Off** (H) distance. See "*Setting the Hold Off Distance"* on page 2-37.

See also chapter 4 Gauge Configuration for more information on how to configure TankRadar Pro.

## 2.16.2 Setting the Tank Connection Length (TCL)

To adjust the TCL value using the RadarMaster software do the following (other configuration tools use other procedures):

1. Start the *RadarMaster* configuration software.
2. Select the **Start Radar** tab.
3. From the **Antenna Type** drop down list choose **User Defined**.
4. Enter the new TCL value.

Use the following formula to calculate the appropriate Tank Connection Length (TCL):

$$TCL_{ext} = TCL_{cone} + K \times (L_{ext} - L_{antenna}) \quad (1)$$

where:

| | | |
|---|---|---|
| $TCL_{ext}$ | = | the TCL adjusted to the extended cone antenna. |
| $TCL_{cone}$ | = | the default TCL for a standard cone antenna without extension. Note that there are different TCL values for tank sealing PTFE and Quartz, see the table below. |
| $L_{ext}$ | = | the length of the extended cone antenna (in metres). |
| $L_{antenna}$ | = | the length of the standard cone antenna without extension (in metres). |
| K | = | a constant related to the antenna diameter. |

Table 2-7. Antenna parameter values for different sizes. Diameter in mm (in.)

| Antenna type | 3 in. Diameter=68 (2.7) | 4 in. Diameter=90 (3.5) | 6 in. Diameter=138 (5.4) |
|---|---|---|---|
| **K** | 0.035 | 0.020 | 0.008 |
| **$L_{antenna}$** | 0.094 | 0.148 | 0.261 |
| **$TCL_{cone\ /PTFE}$** | 0.475 | 0.475 | 0.475 |
| **$TCL_{cone\ /Quartz}$** | 0.515 | 0.515 | 0.515 |

### 2.16.3 Setting the Hold Off Distance

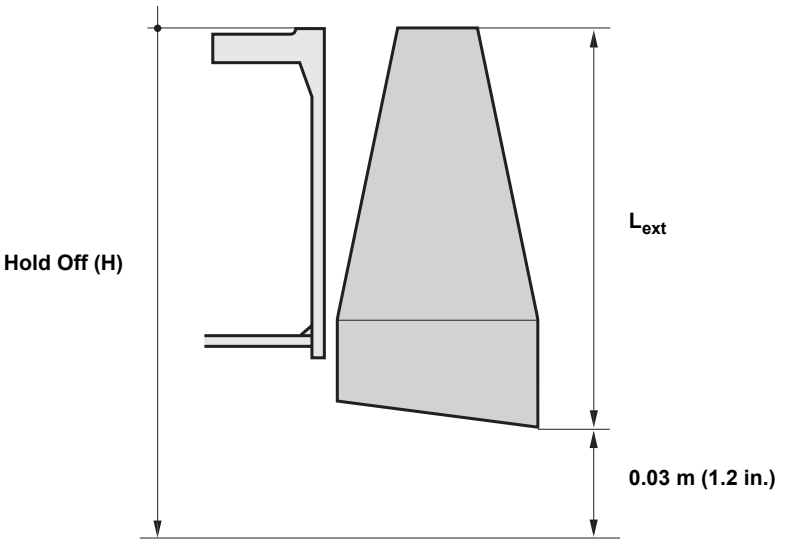
To set a new Hold Off distance do the following:

1. Start the *Pro Setup* configuration software.
2. In *Pro Setup* choose the **Configuration** tab.
3. In the **Hold Off/New** input field type the desired Hold Off distance.

Use the following formula in order to calculate the appropriate Hold Off (H) distance:

$$H = 0.03 + L_{ext} \qquad (2)$$

where $L_{ext}$ is the length of the extended cone antenna (in metres).



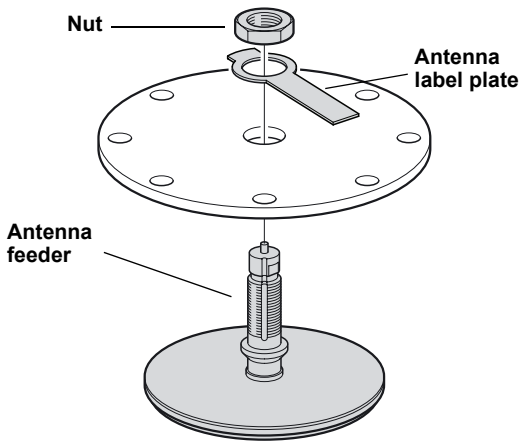
## 2.17 MOUNTING THE STILL-PIPE ARRAY ANTENNA

The small-sized Still-pipe Array antenna is designed for mounting on existing 5-, 6-, 8-, 10- and 12 in. still-pipes. It is available in two models, the flanged-mounted fixed version and the hinged-lid mounted version.

### 2.17.1 Fixed Version

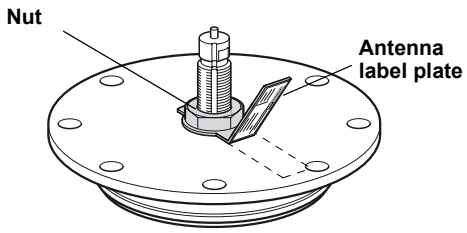
Follow the instructions below. See also installation drawing 9150070-944.

PRO_ARRAY_FLANGE_STEP1.EPS



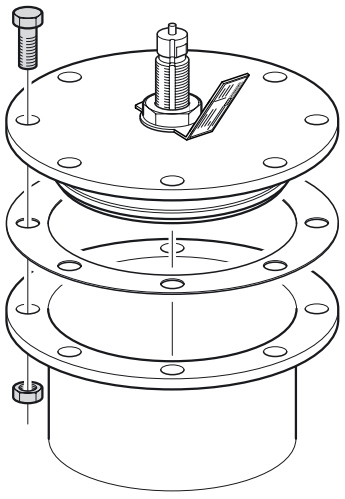

1. Insert the antenna feeder into the flange hole and place the antenna label into position, with the text down.

PRO_ARRAY_FLANGE_STEP2.EPS




2. Tighten the nut and bend the antenna label plate at the slot mark to a position with the text clearly visible.

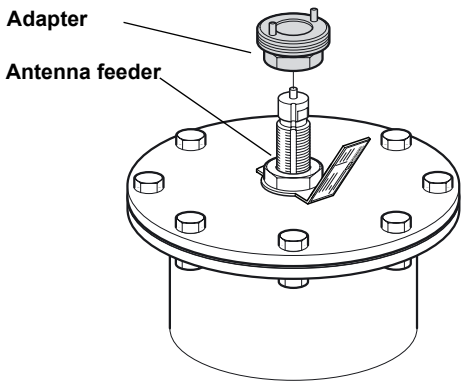
PRO_ARRAY_FLANGE_STEP3.EPS



3. Put the antenna and flange assembly on the tank nozzle and tighten the flange screws.

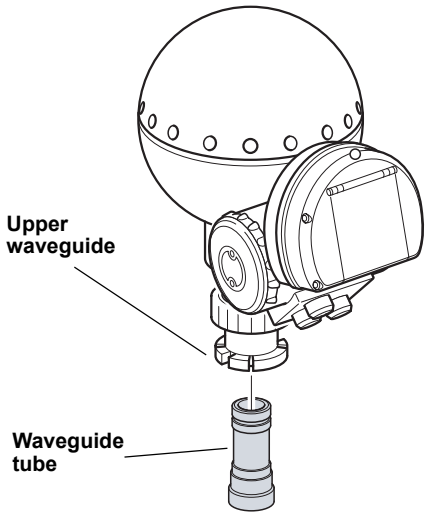
**NOTE!**
Measure the pipe inner diameter before closing the still-pipe. This value should be entered during the configuration.

PRO_ARRAY_FLANGE_STEP4.EPS



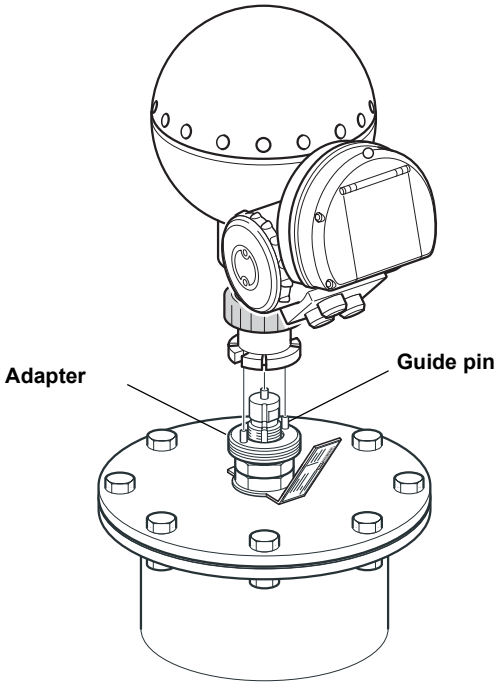

4. Put the adapter on top of the antenna feeder. Tighten the adapter nut.

PRO_ARRAY_FLANGE_STEP5.EPS




5. Insert the waveguide tube into the upper waveguide.

PRO_ARRAY_FLANGE_STEP6.EPS

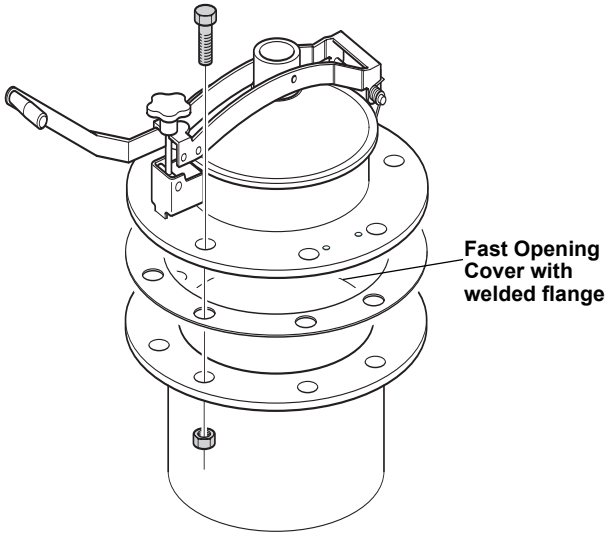



6. Carefully mount the Transmitter Head onto the adapter. Make sure that the guide pins on the adapter fit into the holes on the base of the upper waveguide.
   Tighten the upper waveguide nut by hand.

## 2.17.2 Hinged-lid Version

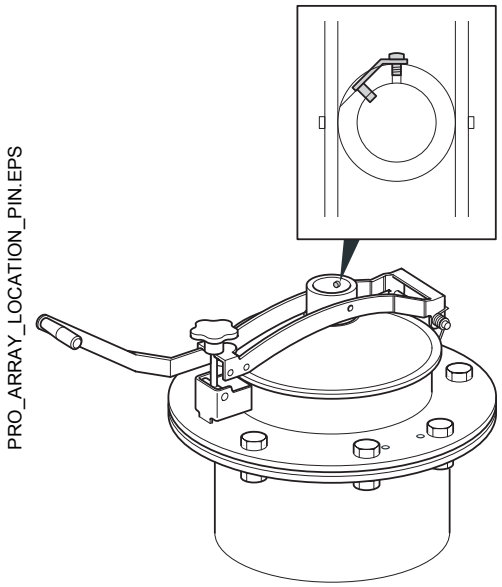
Follow the instructions below. See also installation drawing 9150070-945.

PRO_ARRAY_COVER_FLANGE_MOUNT.EPS



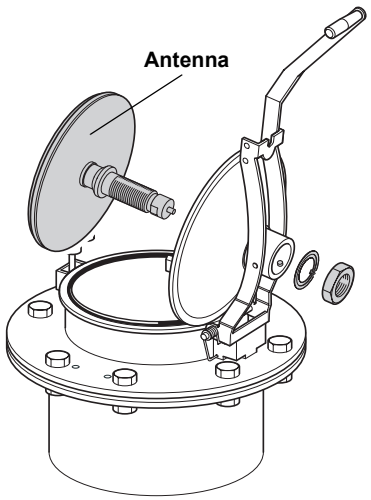

1. Mount the Fast Opening Cover and flange on the nozzle.
   Tighten the flange screws (5, 6 and 10-in. flanges have four welded screws).

PRO_ARRAY_LOCATION_PIN.EPS



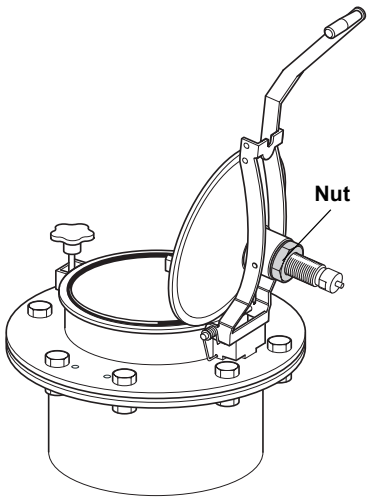
2. Check that the guide pin is mounted. The guide pin is used to make sure that the antenna is properly oriented towards the transmitter head.

PRO_ARRAY_ANTENNA_MOUNT.EPS



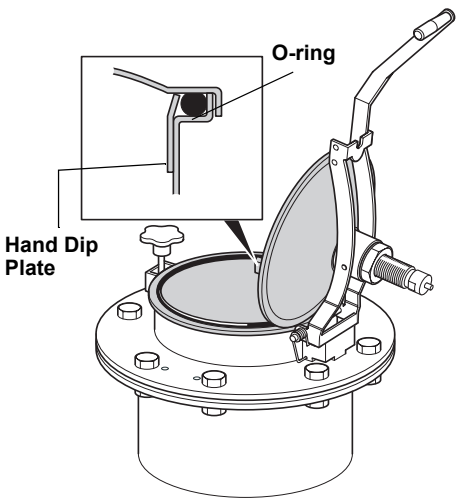

3. Mount the antenna on the lid.

PRO_ARRAY_ANTENNA_TIGHTEN_NUT.EPS

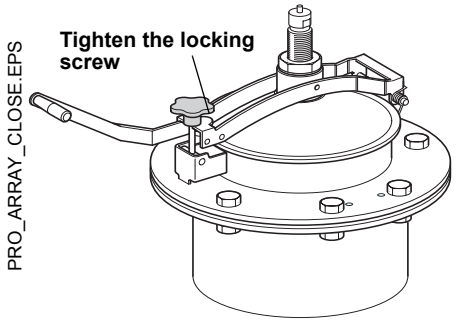



4. Tighten the nut.

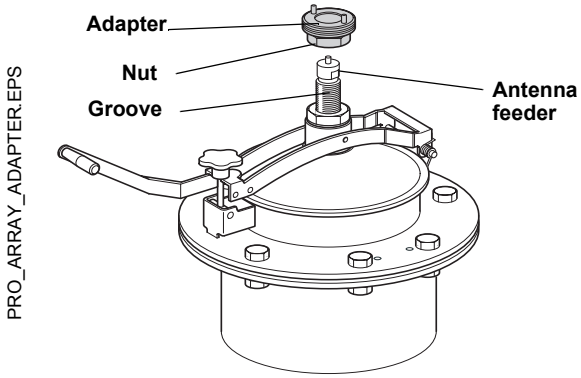
PRO_ARRAY_ORING_CHECK.EPS



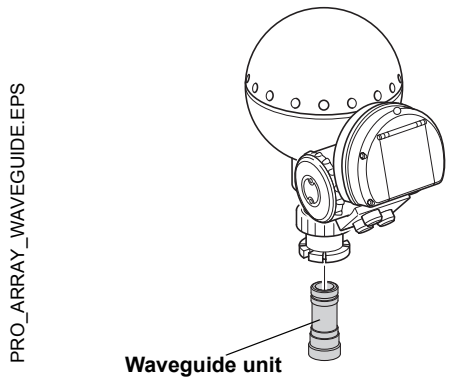

5. Check that the O-ring is properly seated all around the cover and is pressed down behind the Hand Dip Plate.




6. Close the lid and tighten the locking screw.

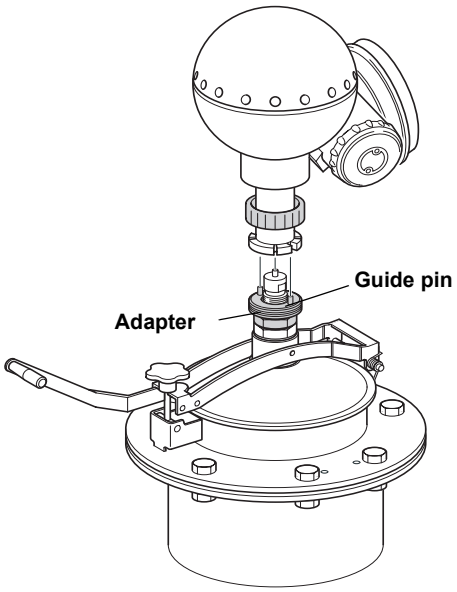



7. Put the adapter on top of the antenna feeder. Tighten the adapter nut.



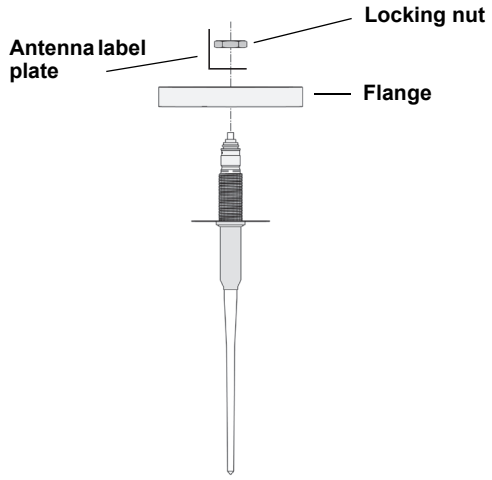

8. Insert the waveguide tube into the upper waveguide.

PRO_ARRAY_HEAD.EPS



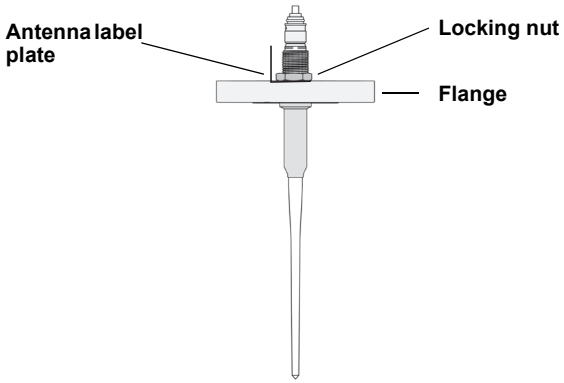

9. Carefully mount the Transmitter Head onto the adapter. Make sure that the guide pins on the adapter fit into the holes on the base of the upper waveguide.
   Tighten the upper waveguide nut by hand.

## 2.18 MOUNTING THE ROD ANTENNA, FLANGED VERSION



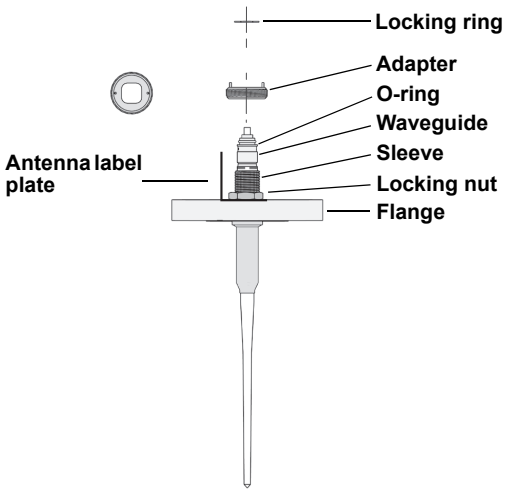

ROD_MOUNT_FLANGE.EPS

1. Mount the flange on top of the rod plate. Make sure the bottom side of the flange is flat and all parts are clean and dry.




ROD_MOUNT_NUT.EPS

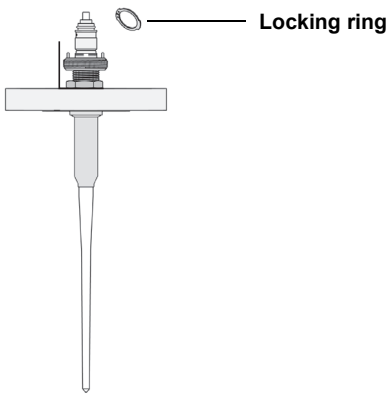
2. Secure the flange and label plate with the locking nut. Make sure the nut fits tightly to the flange.




ROD_MOUNT_ADAPTER.EPS

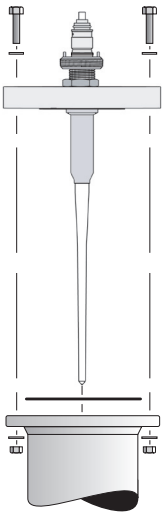
3. Mount the adapter on top of the sleeve.

ROD_MOUNT_RING.EPS



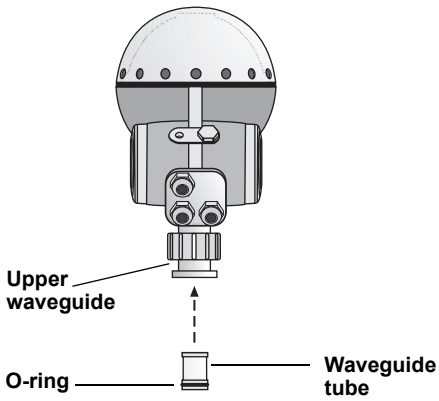

4. Secure the adapter with the locking ring.

ROD_MOUNT.EPS



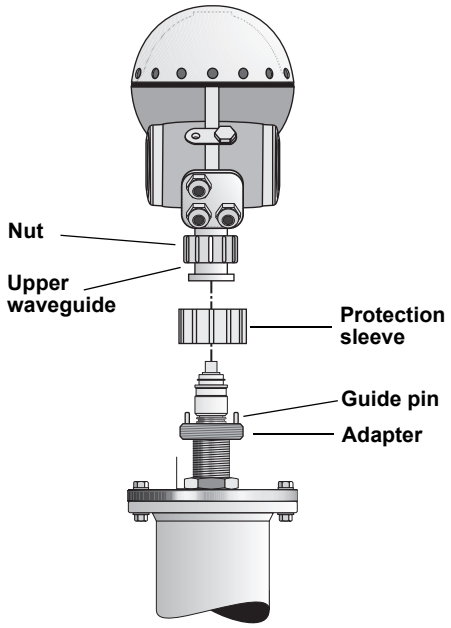
5. Carefully fit the flange and the rod antenna on the tank nozzle with an appropriate gasket in between. Tighten with screws and nuts.

WAVEGUIDE_TUBE_REV.EPS



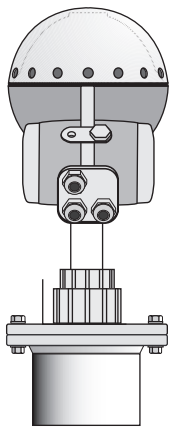

6. Insert the waveguide tube into the upper waveguide. Make sure the o-ring at the lower end of the waveguide tube is in place.

ROD_HEAD_MOUNT.EPS




7. Place the protection sleeve on the flange. Mount the transmitter head and tighten the nut. Check that the guide pins on the adapter enter the corresponding grooves on the upper waveguide.

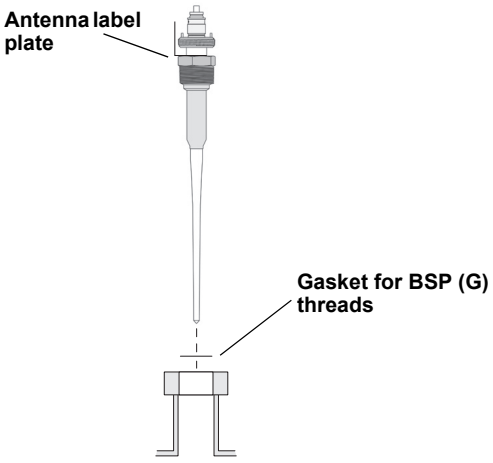
TH40HEAD_NOZZLE1.EPS



8. Proceed with the electrical installation.

## 2.19 MOUNTING THE ROD ANTENNA, THREADED VERSION

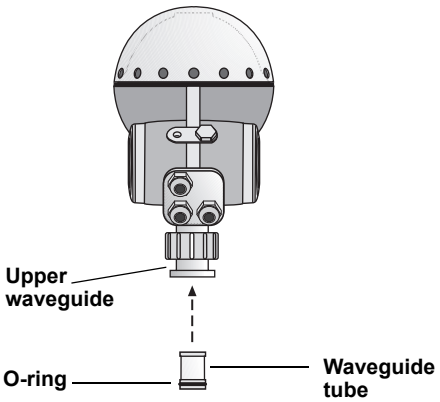
ROD_MOUNT_BSP.EPS




1. Carefully fit the rod antenna into the threaded nozzle and screw it in place.

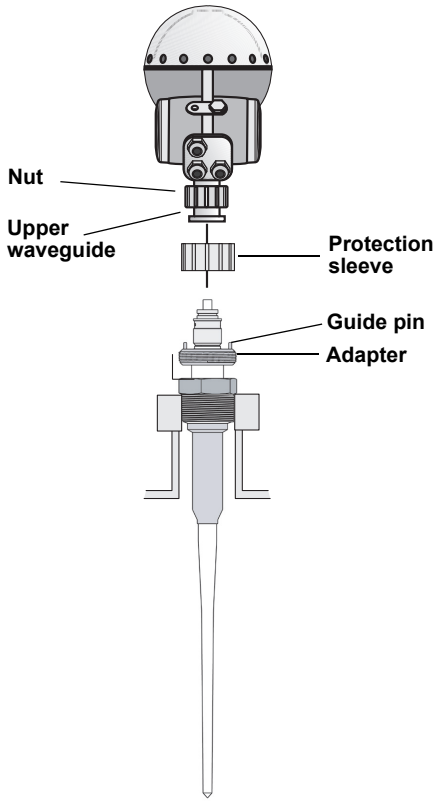
**NOTE!**
For adapters with NPT threads, pressure-tight joints may require a sealant.

WAVEGUIDE_TUBE_REV.EPS



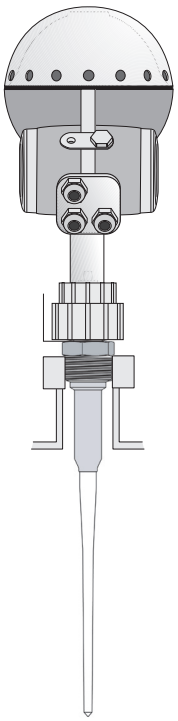

2. Insert the waveguide tube into the upper waveguide. Make sure the o-ring at the lower end of the waveguide tube is in place.

ROD_HEAD_MOUNT_BSP.EPS




3. Place the protection sleeve on the flange. Mount the transmitter head and tighten the nut. Check that the guide pins on the adapter enter the corresponding grooves on the upper wave guide.

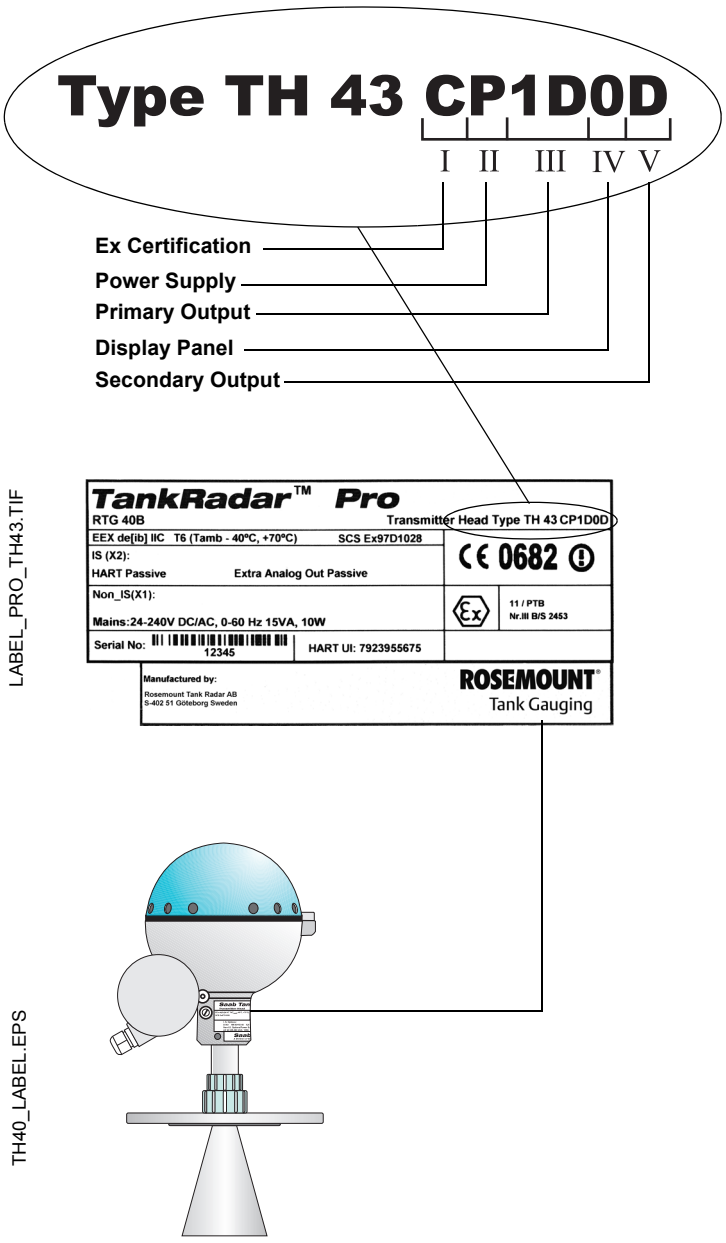
TH40HEAD_NOZZLE_BSP1.EPS



4. Proceed with the electrical installation.

# 3. Electrical Installation

## 3.1 IDENTIFICATION OF INSTALLED OPTIONS




| | |
|---|---|
| **I** | **Ex Certification** |
| C | ATEX |
| F | FM |
| I | IECEx |
| S | CSA |
| **II** | **Power Supply** |
| P | Ultra Wide 24-240 V |
| **III** | **Primary Output** |
| 1A | Non-IS HART®/4-20 mA, active. |
| 1B | IS HART®/4-20 mA, active. |
| 1C | Non-IS HART/4-20 mA, passive. |
| 1D | IS HART®/4-20 mA, passive. |
| 2A | TRL/2 Bus, Modbus protocol |
| 3A | Profibus DP |
| 4A | FOUNDATION™ fieldbus, non-intrinsic safety. |
| 4B | FOUNDATION™ fieldbus, intrinsic safety. |
| **IV** | **Display Panel** |
| 0 | No Display Unit |
| P | Display Unit mounted on gauge |
| R | Remote Display Unit |
| T | Remote Display Unit with temperature sensors |
| **V** | **Secondary Output** |
| 0 | No secondary output |
| A | Non-intrinsically safe 4-20 mA, active. |
| B | Intrinsically safe 4-20 mA, active. |
| C | Non-intrinsically safe 4-20 mA, passive. |
| D | Intrinsically safe 4-20 mA, passive. |

**NOTE!**
If you change optional circuit boards the label must be exchanged to show the current inputs and outputs.

Figure 3-1. The transmitter head label includes important information on gauge type and the installed options.

## 3.2 SYMBOLS

The CE marking symbolises the conformity of the product with the applicable Community requirements.

The Ex Certificate is a statement of an independent Certification Body declaring that this product meets the requirement of the applicable European Intrinsic Safety directives.


The FM symbol indicates that the marked equipment is certified by FM - Factory Mutual Research Corporation according to FMRC standards and are applicable for installation in hazardous loactions.

The device uses non-harmonized radio frequencies.

Protective Earth.

Ground.

Power Supply.

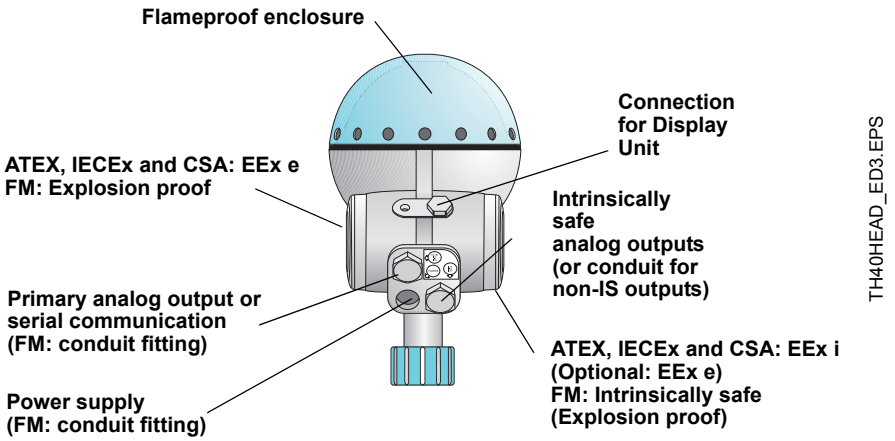

External cabling must be approved for use in min. 75 °C.

## 3.3 SYSTEM OVERVIEW

### Transmitter Head

The transmitter head enclosure consists of a separate flameproof compartment for electronics and two isolated junction boxes.

Figure 3-2. Transmitter head overview.




### Junction Box

As standard the Pro gauge is equipped with a junction box which has separated compartments for non-intrinsically safe and intrinsically safe connections. As an option, the gauge can be equipped with two non-intrinsically safe compartments.

### Display Panel

Connect the intrinsically safe Remote Display Unit to terminals 5, 6, 7 and ground in the intrinsically safe (*EEx i*) junction box.

### Analog Outputs

There are two analog outputs which can be of passive or active type (external or internal loop supply). The primary output has a HART® interface.

Connect the primary analog output to terminals **1** and **2**.

Use the *EEx e* junction box for non-intrinsically safe applications, and the *EEx i* junction box for intrinsically safe applications.

### Digital Communication

TankRadar Pro can be equipped with HART® interface, TRL/2 Bus interface, Profibus DP or FOUNDATION™ fieldbus.

The TRL/2 Bus and Profibus DP may only be connected to the non-intrinsically safe (*EEx e*) junction box. FOUNDATION™ fieldbus and HART® can be connected to either the intrinsically safe (*EEx i*) or the non-intrinsically safe (*EEx e*) junction box.

Connect the serial data transmission cables to terminals **1** and **2**.

### Power Supply

Connect the power supply to terminals **3** and **4** in the non-intrinsically safe Junction Box (*EEx e*).

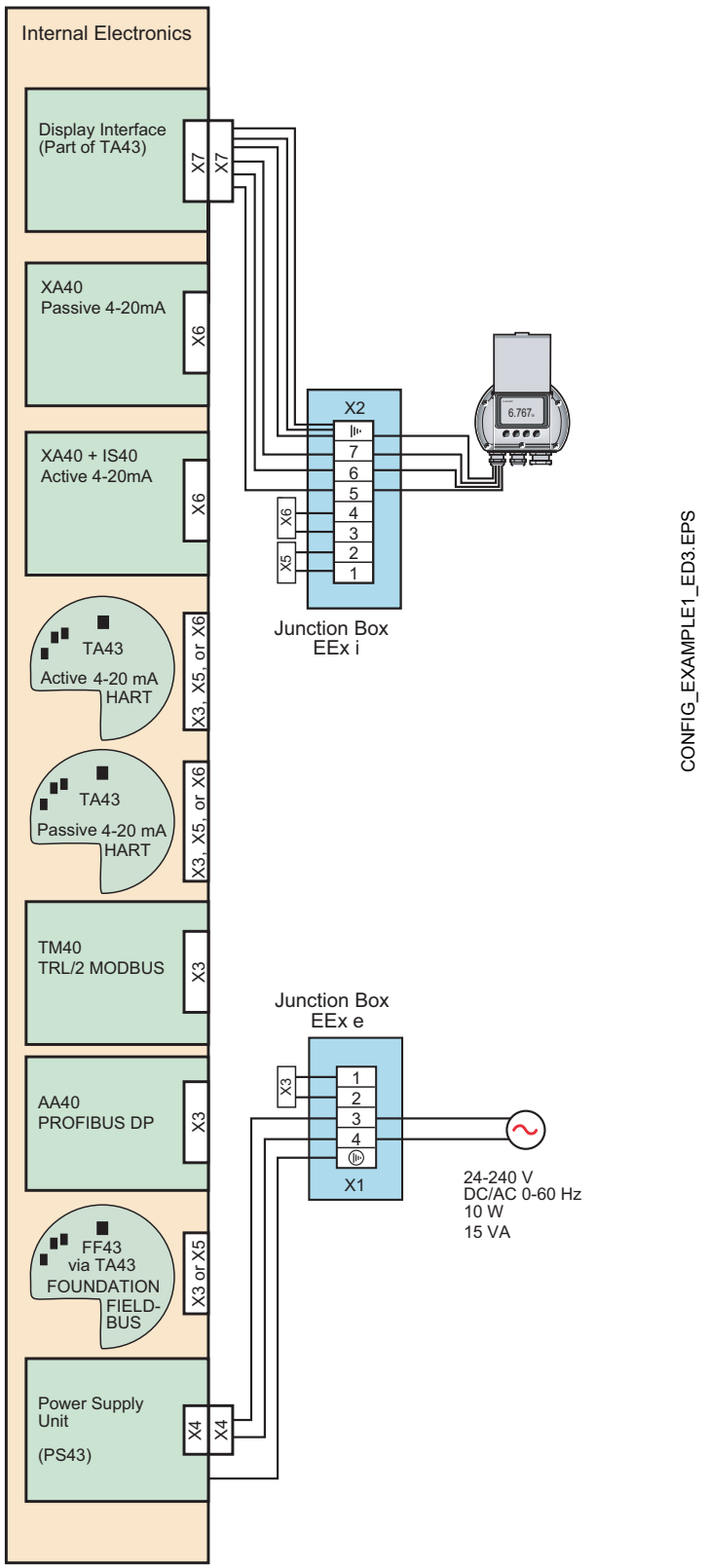



Figure 3-3. Schematic illustration of the TankRadar Pro gauge connections.

## 3.4 GENERAL SAFETY INSTRUCTIONS FOR ATEX

1. This product is an electrical apparatus and must be installed in the hazardous area in accordance with the requirements of the EC Type Examination Certificate.
   The installation and maintenance must be carried out in accordance with all appropriate international, national and local standard codes of practice and site regulations for intrinsically safe apparatus and in accordance with the instructions contained within this manual. Access to the circuitry must not be made during operation.
2. The equipment must only be installed, operated and maintained by trained competent personnel.
3. The essential information from the Certification Label will be included in the instruction documentation.
4. The product has been designed such that the protection afforded will not be reduced due to the corrosion of materials, electrical conductivity, impact strength, ageing resistance and the affects of temperature variation.
5. The product can not be repaired by the user and must be replaced by an equivalent certified product. Repairs should only be carried out by the manufacturer or approved repairer.
6. The product must be protected from excessive dust by an enclosure etc.
7. The product must not be subjected to mechanical and thermal stresses in excess of those permitted in the certification documentation and the instruction manual. If necessary the product must be protected by an enclosure to prevent mechanical damage.
8. There are no exposed parts of the apparatus which produce excessive surface temperature, infrared, electromagnetic, ionising radiation or non electrical dangers.
9. The product must not be installed in a position where it may be attacked by aggressive substances.
10. All externally connected equipment must comply with the relevant electrical safety standard, or have isolation from mains.

The TankRadar Pro enclosure is flameproof and may not be opened while the gauge is energized and a flammable atmosphere is present.
Rosemount Tank Radar AB will not take any responsibility for local regulations defining conditions when flameproof enclosures are allowed to be opened when energized.

**NOTE!**
Make sure that you do not mix up intrinsically safe and non-intrincisally safe wires.

## 3.5 CABLES

Depending on local requirements, cable glands or explosion proof conduits must be used for connection to the non-intrinsically safe junction box (*EEx e*). For the connection to the instrinsically safe junction box (*EEx i*) use cable glands with integral shield connection for cable diameter 6-12 mm or conduit.

Use shielded instrument cable 0.5 $mm^2$ (*AWG 20*) for analog outputs and serical communication. Use min. 0.5 $mm^2$ cable for power supply.

## 3.6 POWER SUPPLY

You can use either DC or AC as the built-in power supply has a wide input range. The following specification is valid for the power supply:

- 24-240 V
- DC/AC 0-60 Hz
- 10 W
- 15 VA

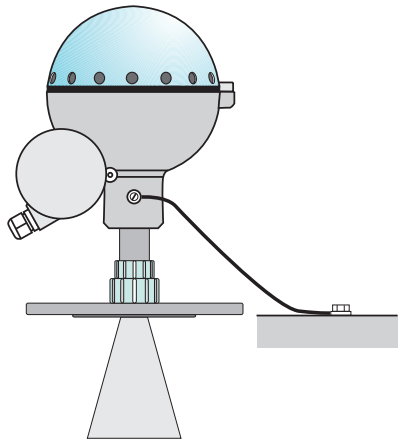
There is no voltage selector in the electronics compartment since the gauge power supply unit automatically adapts to the available voltage within specified limits.

## 3.7 GROUNDING

### 3.7.1 ATEX

The flameproof enclosure must be connected to a potential equalizing network or the tank shell or according to national code of practice.

Figure 3-4. The gauge enclosure must be grounded according to national code of pactice.



GRNDLUG.EPS

This grounding also serves as electrical safety ground. Additional connection to the protective ground terminal of terminal X1 in Junction Box EEx e is not recommended except where required according to national code of practice. A ground loop with circulating current may occur. See also the *Special Safety Instruction*.

### 3.7.2 FM

Grounding is accomplished through the conduit pipes.

## 3.8 EXTERNAL CONNECTIONS

### 3.8.1 Non-Intrinsically Safe Junction Box - EEx e

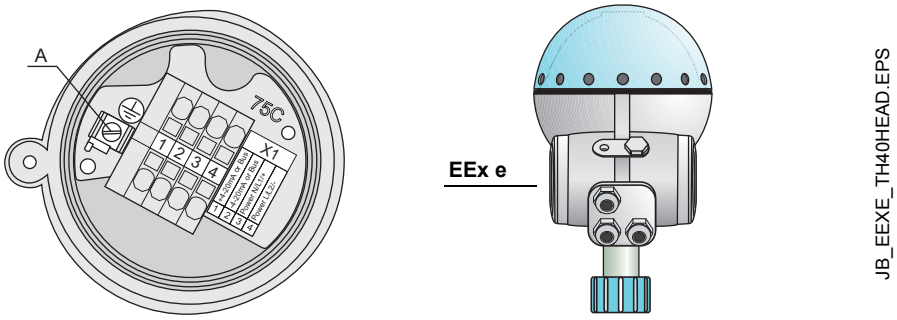



Figure 3-5. Junction Box for non-intrinsically safe connections and power supply.

**1-2** Non-intrinsically safe HART®/4-20 mA primary analog output, or
TRL/2 Bus, Profibus DP or non-intrinsically safe FOUNDATION™ fieldbus

**3-4** Power supply input

**A** Electrical safety ground terminal

**NOTE:**
Redundant when the gauge is grounded according to ATEX.

Table 3-1. X1 connections.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **PO +**<br>+ 4-20 mA:<br>code 1A or 1C<br>(polarity sensitive)<br>or Bus:<br>code 2A, 3A<br>(polarity sensitive)<br>or 4A | **PO-**<br>- 4-20 mA:<br>code 1A or 1C<br>(polarity sensitive)<br>or Bus:<br>code 2A, 3A<br>(polarity sensitive)<br>or 4A | **Power**<br>N/L1/+ | **Power**<br>L/L2/- |

### Cable shield

Connect the shield to the cable glands.
If conduit fittings are used no cable shield is used.

## 3.8.2 Intrinsically Safe Junction Box - EEx i

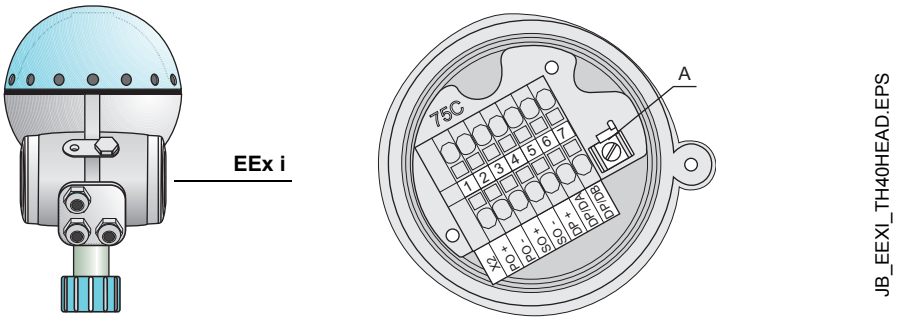



Figure 3-6. Junction Box for intrinsically safe connections and for connection of the Display Unit.

**1-2** Intrinsically safe HART®/4-20 mA primary analog output or intrinsically safe FOUNDATION™ fieldbus.

**3-4** Secondary analog output.

**5-7** Display Unit .

**A** Ground terminal for Display Unit.

Table 3-2. X2 connections.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| PO +<br>+ 4-20 mA: code 1B or 1D (polarity sensitive) or Bus: code 4B | PO -<br>- 4-20 mA: code 1B or 1D (polarity sensitive) or Bus: code 4B | SO +<br>+ 4-20 mA: code B or D (polarity sensitive) | SO -<br>- 4-20 mA: code B or D (polarity sensitive) | DP + | DP/DA | DP/DB |

## Cable shield

Connect the shield to the cable glands.
If conduit fittings are used no cable shield is used.

### 3.8.3 Alternative Non-intrinsically Safe Junction Box

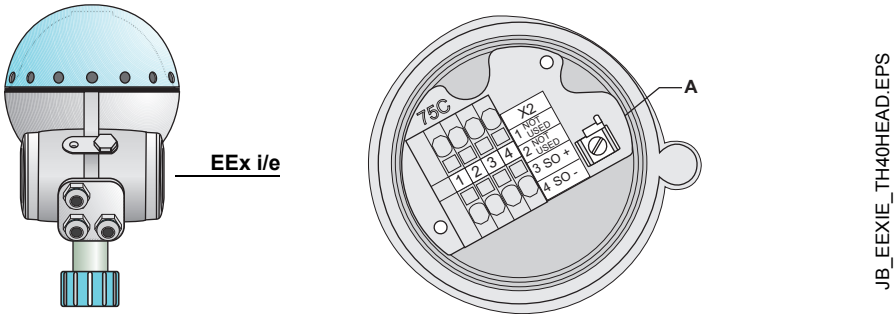



Figure 3-7. Standard intrinsically safe Junction Box (EEx i) fitted with an alternative connector for non-IS output.

**1-2** Not used

**3-4** Non-intrinsically safe Secondary Analog Output

**A** Ground terminal (not used)

**X2**

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| **NOT USED** | **NOT USED** | **SO +**<br><br>+ 4-20 mA:<br>code A or C (polarity sensitive) | **SO -**<br><br>- 4-20 mA:<br>code A or C (polarity sensitive) |

## Cable shield

Connect the shield to the cable glands.
If conduit fittings are used no cable shield is used.

## 3.9 CONNECTING TO A TRL/2 BUS INTERFACE

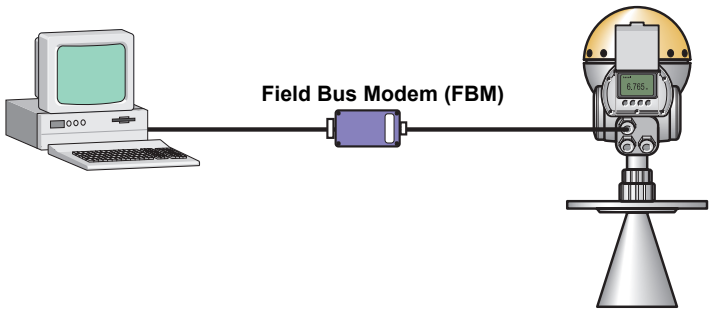



Figure 3-8. Connect a Field Bus Modem (FBM) to a Pro gauge equipped with a TRL/2 interface.

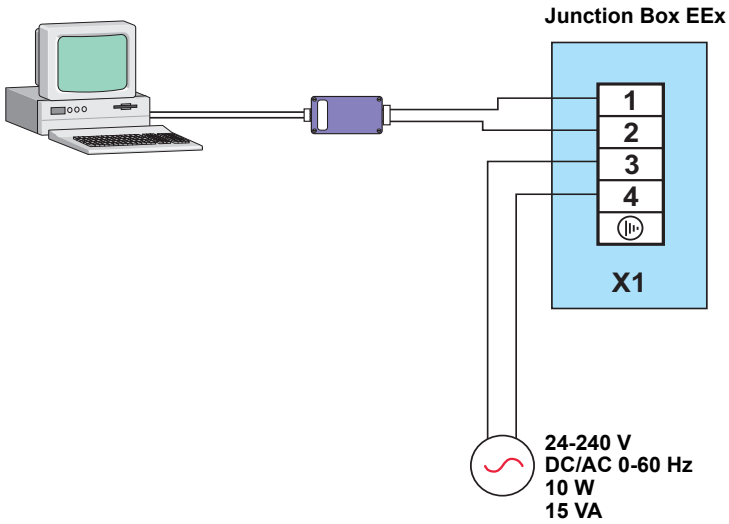



Figure 3-9. Connect the Field Bus Modem (FBM) to the non-intrinsically safe junction box (EEx e).

## 3.10 CONNECTING HART DEVICES

### 3.10.1 Active Output (internal loop supply)

For Pro gauges with active output, a Handheld Communicator or a HART® modem can be connected as follows:

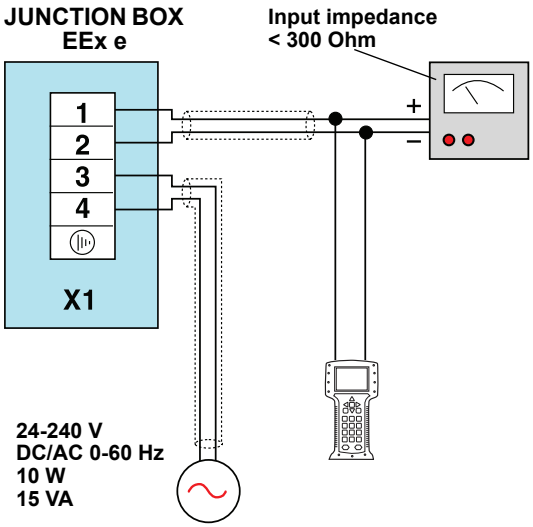



Figure 3-10. Connection of a HART device to a Pro gauge with active output.

### 3.10.2 Passive Output (external loop supply)

A Handheld Communicator or a HART® modem should not be connected directly across an external power supply. Instead, it should be connected across a load resistor of about 250 Ω.

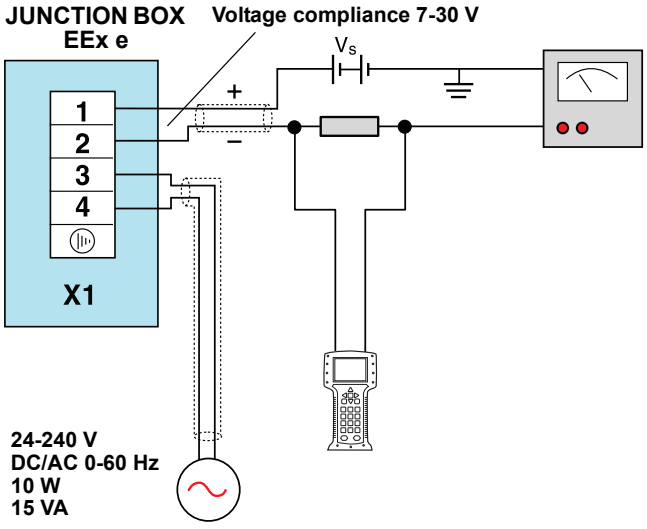



Figure 3-11. The HART device should be connected across a load resistor for a Pro gauge with passive output.

### 3.10.3 Intrinsically Safe Conditions

A Handheld Communicator can be connected in the hazardous area. The HART® interface must be connected via a zener barrier in the safe area. It is also possible to use an intrinsically safe Ex classed HART® interface which has a built-in Zener barrier.

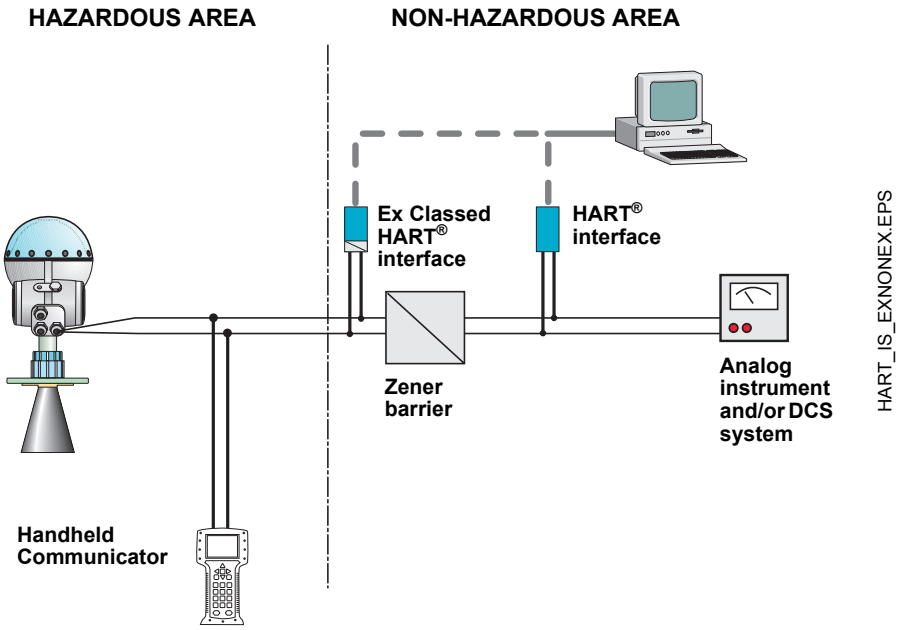



Figure 3-12. IS Connections of HART devices.

### 3.10.4 Non-Intrinsically Safe Conditions

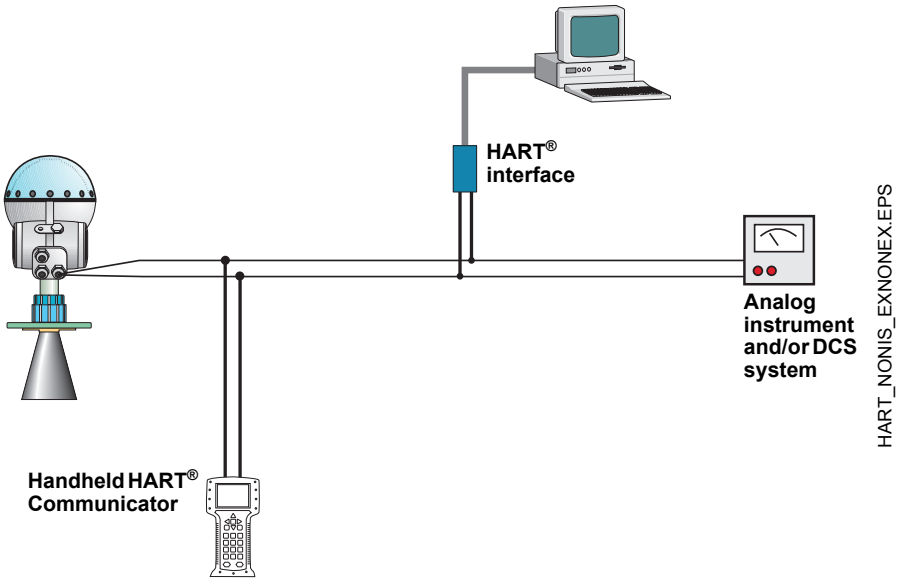



Figure 3-13. Non-IS Connections of HART devices.

## 3.11 CONNECTING THE MODEL 2210 DISPLAY UNIT

The Model 2210 Display Unit can be factory mounted on the TankRadar Pro's enclosure or remotely mounted. The Display Unit can be used for configuration of the Pro gauge as well as for displaying tank data (see Section 7: Using the 2210 Display Unit for information on how to operate the gauge by using the Display Unit).

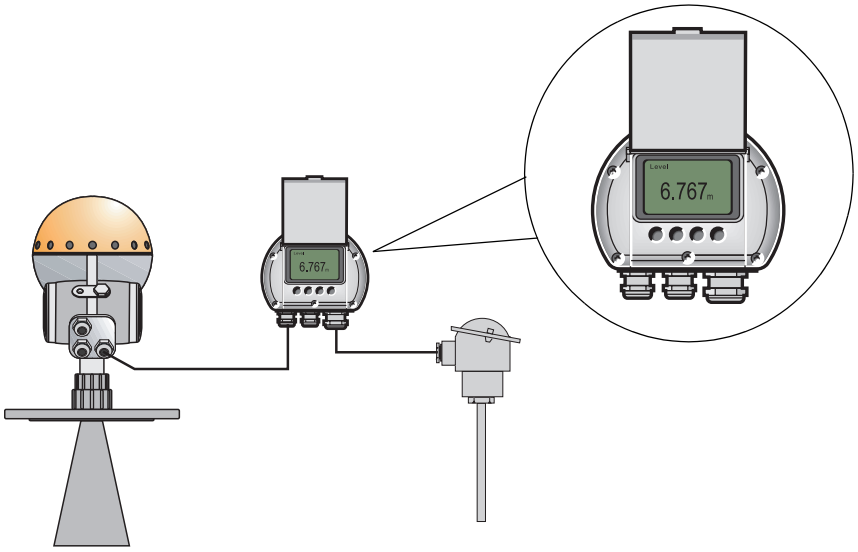



Figure 3-14. When equipped with the optional TP40 board, the Display Unit can also be used for temperature measurements.

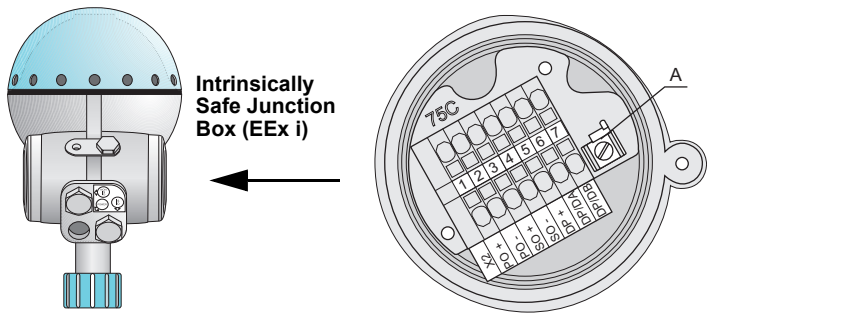



Figure 3-15. The Display Unit is connected to the Intrinsically Safe Junction Box on the front of the Pro gauge head.

The Display Unit is offered in two versions:

- the Standard version, or
- with the optional TP 40 board for connection of up to six PT 100 temperature elements.

Connect the Display Unit to the X2 terminal in the Intrinsically Safe Junction Box by the following four wires:

| | |
|---|---|
| Grounding wire | ground terminal |
| Signal wires | terminal 6 and 7 |
| Supply voltage | terminal 5 |

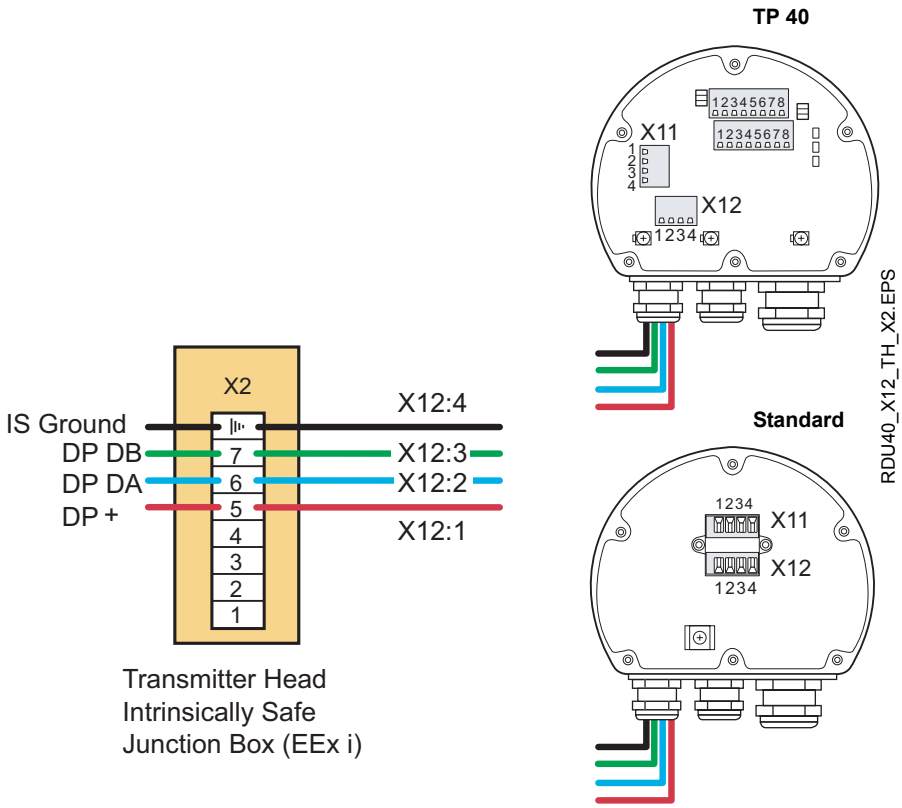



Figure 3-16. The Display Unit is connected to the X2 terminal in the Intrinsically Safe Junction Box.

## 3.12 TEMPERATURE MEASUREMENT

For temperature measurements you can use 1-3 spot elements or 1-6 multiple spot elements. The sensors are connected to socket X17 and X18 on the optional TP40 board. Depending on the type of sensor that is used, different jumpers must be set on sockets X24, X25, X26, X27 and X28, see next page for detailed instructions.

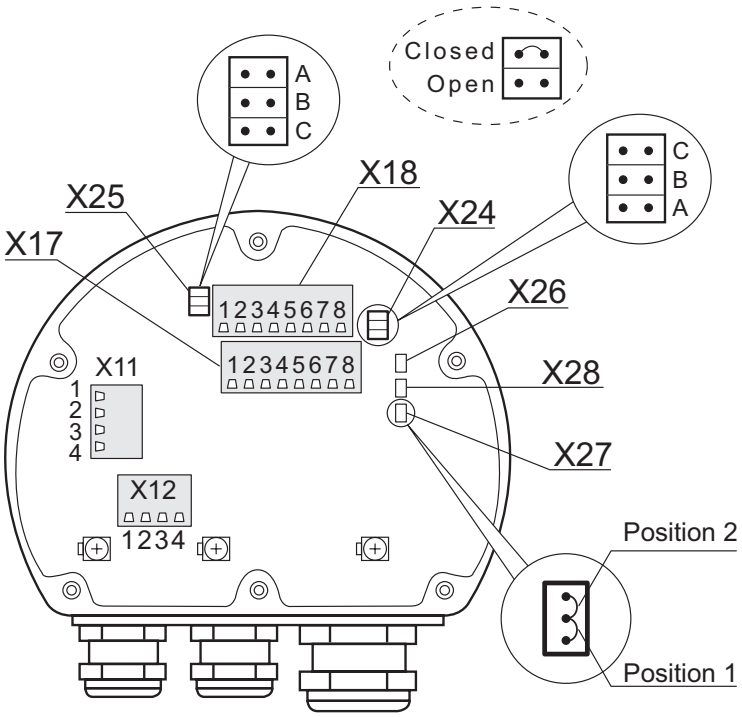



Figure 3-17. Temperature measurements are enabled by jumper settings. The sensors are connected to the X17 and X18 sockets on the optional TP40 board.

### 3.12.1 Spot Elements 3-wire Independent

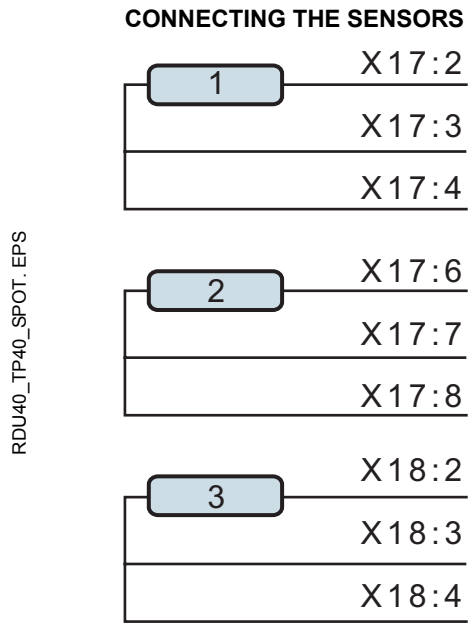



Table 3-3. Jumper settings, 3-wire independant.

| Jumper settings | |
|---|---|
| X24 | A, B, C open |
| X25 | A, B, C closed |
| X26 | position 1 |
| X27 | position 1 |
| X28 | position 1 |

Figure 3-18. Connection of sensors and jumper settings for 3-wire Multispot with independent return.

### 3.12.2 Multiple Spot Elements 3-wire Common Return

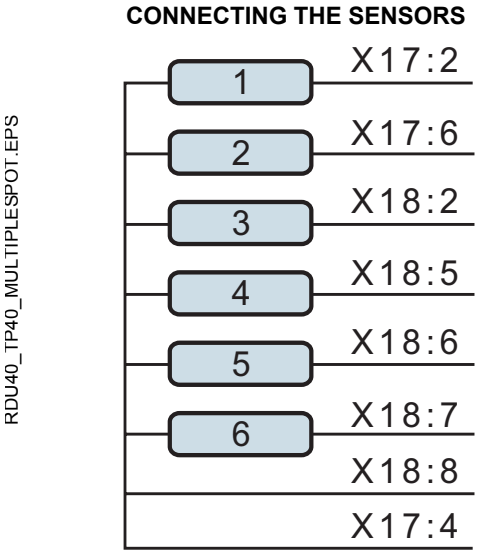



Table 3-4. Jumper settings, 3-wire independant

| Jumper settings | |
|---|---|
| X24 | A, B, C closed |
| X25 | A, B, C closed |
| X26 | position 2 |
| X27 | position 2 |
| X28 | position 2 |

Figure 3-19. Connection of sensors and jumper settings for 3-wire Multispot with common return.

## 3.13 INTERNAL CONNECTIONS

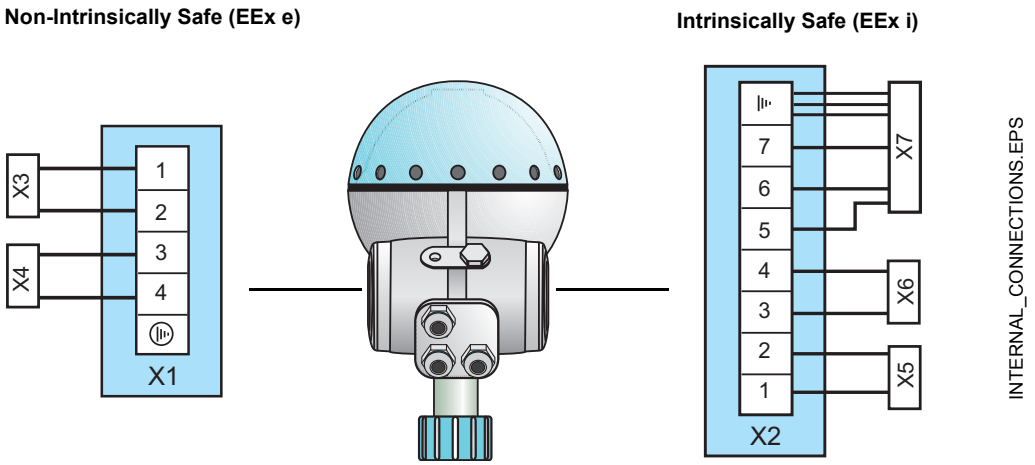
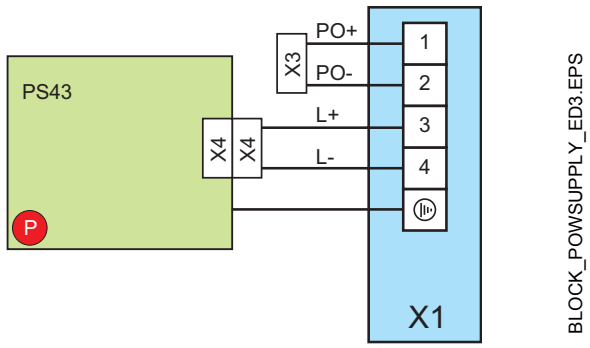



Figure 3-20. IS and Non-IS Internal Connections.

### 3.13.1 Power Supply

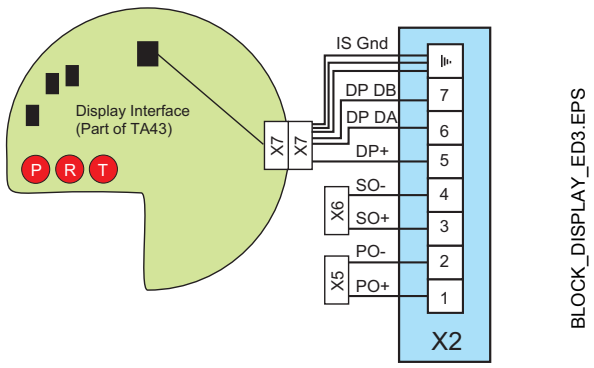
Table 3-5. Circuit board

| Option | Description | Board |
|---|---|---|
| P | Ultra Wide<br>24-240 VAC/DC | PS43 |




### 3.13.2 2210 Display Unit

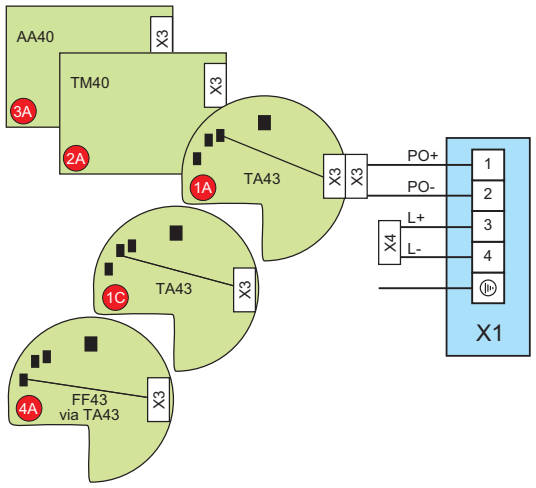
| Option | Description | Board |
|---|---|---|
| 0 | No Display Unit | TA43 |
| P | Display Unit mounted on gauge | TA43 |
| R | Remote Display Unit | TA43 |
| T | Remote Display Unit with temperature input | TA43 |



## 3.13.3 Primary Output

### NON-INTRINSIC SAFETY (EEx e)

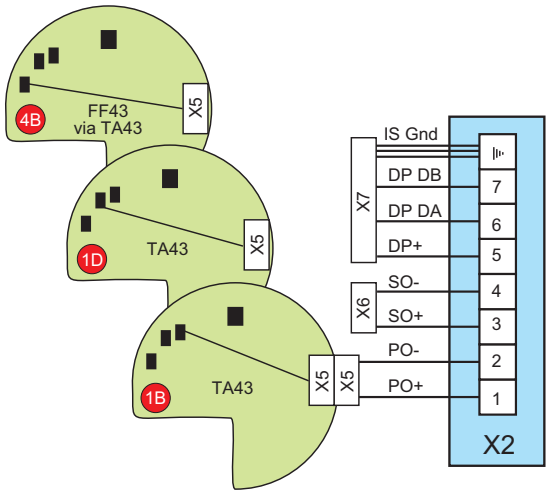
| Option | Description | Board |
|---|---|---|
| 1A | Non-intrinsically safe HART®/4-20 mA, active | TA43 |
| 1C | Non-intrinsically safe HART®/4-20 mA, passive | TA43 |
| 2A | TRL/2 Bus | TM40 |
| 3A | Profibus DP | AA40 |
| 4A | FOUNDATION™ fieldbus | TA43 |




BLOCK_1C1A2A_ED3.EPS

### INTRINSIC SAFETY (EEx i)

| Option | Description | Board |
|---|---|---|
| 1B | Intrinsically safe HART®/4-20 mA, active | TA43 |
| 1D | Intrinsically safe HART®/4-20 mA, passive | TA43 |
| 4B | FOUNDATION™ fieldbus | TA43 |

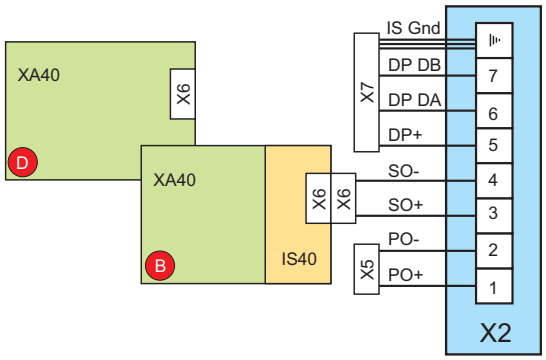



BLOCK_1D1B_ED3.EPS

## 3.13.4 Secondary Output, Intrinsic Safety (EEx i)

**Alt.1: Secondary Output option B or D when Primary Output option is 1A, 1B, 1C or 1D.**

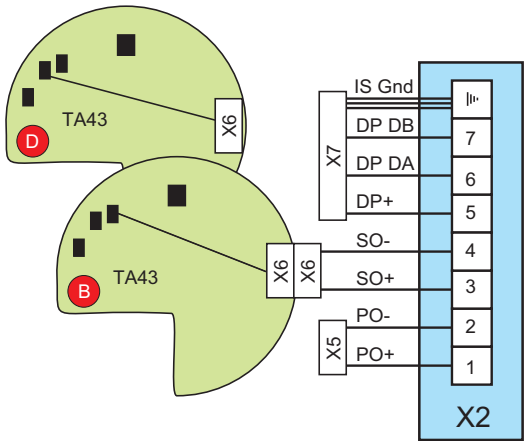
| Option | Description | Board |
|---|---|---|
| B | Intrinsically safe<br>4-20 mA active | XA40+IS40 |
| D | Intrinsically safe<br>4-20 mA passive | XA40 |




BLOCK_XA40BD_ED3_HART.EPS

**Alt.2: Secondary Output option B or D when Primary Output option is 2A, 3A, 4A or 4B.**

| Option | Description | Board |
|---|---|---|
| B | Intrinsically safe<br>4-20 mA active | TA43 |
| D | Intrinsically safe<br>4-20 mA passive | TA43 |

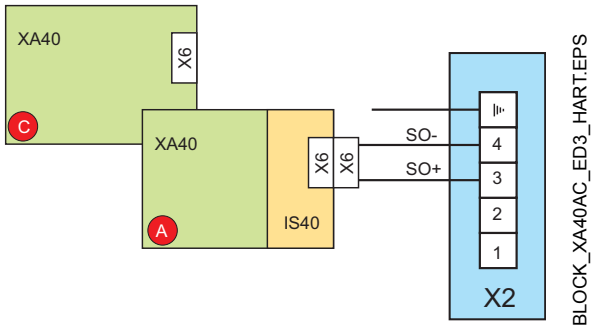



BLOCK_XA40BD_ED3_BUS.EPS

## 3.13.5 Secondary Output, Non-Intrinsic Safety (EEx e)

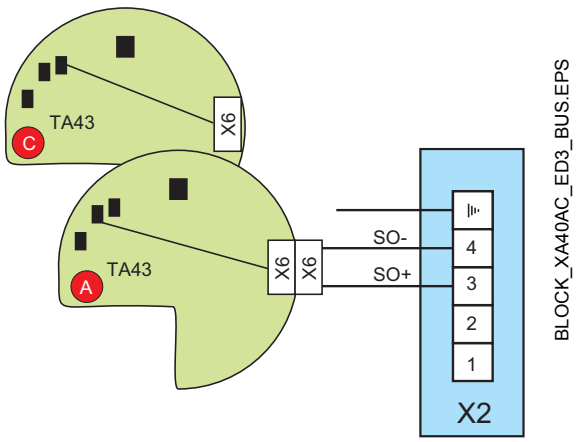
Alt.1: Secondary Output option A or C when Primary Output option is 1A or 1C.

| Option | Description | Board |
|---|---|---|
| A | Non-intrinsically safe 4-20 mA active | XA40+IS40 |
| C | Non-intrinsically safe 4-20 mA passive | XA40 |




Alt.2: Secondary Output option A or C when Primary Output option is 2A, 3A or 4A.

| Option | Description | Board |
|---|---|---|
| A | Non-intrinsically safe 4-20 mA active | TA43 |
| C | Non-intrinsically safe 4-20 mA passive | TA43 |




**NOTE!**
This junction box is normally used for intrinsically safe connections. This version is a non-intrinsically safe option equipped with an alternative connector for non-intrinsically safe output.

# 4. Gauge Configuration



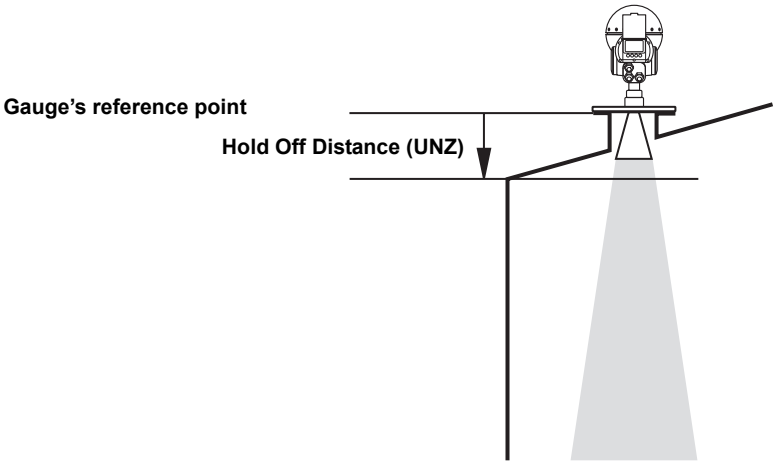
To be able to fully utilize the TankRadar Pro, the gauge has to be properly configured. This is done by accessing configuration parameters and assigning them appropriate values. In this chapter you will find the parameters and how they affect your application. The preferred user interface for the configuration is the Rosemount RadarMaster software. Configuration can also be performed using the WinSetup software, 2210 Display Unit, Rosemount 275/375 Handheld Communicator, AMS, DeltaV or others. In these cases there may be a limited support for various configuration parameters.

When the basic configuration is done the gauge will be optimized for your application. However, in some cases the gauge must be further configured using the Advanced Functions. Please note that this may affect the previous basic configuration by updating some parameters already set.

## 4.1 ANTENNA PARAMETERS

For the antenna, a few choices are available. The type of antenna must always be selected and, if applicable, also the corresponding type of tank sealing. The type of antenna and tank sealing can be obtained from the ordering information. See also the TankRadar Pro Technical Description (501026).

Figure 4-1. Reference Point and Hold-off Distance




TANK FULL TANK DETECT.EPS

**Antenna Type**

Table 4-1. Pre-configured antennas and Hold Off Distance, default values. Units are in mm (in.)

| Antenna Type | TCL | Hold Off |
|---|---|---|
| User Defined | 0.000 (0.000) | 0.000 (0.000) |
| Rod 100 | 600 (23.62) | 595 (23.43) |
| Rod 250 | 780 (30.83) | 738 (29.06) |
| Cone 3 in. PTFE | 475 (18.70) | 120 (4.72) |
| Cone 4 in. PTFE | 475 (18.70) | 170 (6.69 ) |
| Cone 6 in. PTFE | 475 (18.70) | 280 (11.02) |
| Cone 8 in. PTFE | 475 (18.70) | 400 (15.75) |
| Cone 3 in. Quartz | 515 (20.28) | 120 (4.72) |
| Cone 4 in. Quartz | 515 (20.28) | 170 (6.69) |
| Cone 6 in. Quartz | 515 (20.28) | 280 (11.02) |
| Cone 8 in. Quartz | 515 (20.28) | 400 (15.75) |
| Pipe with Cone PTFE | 475 (18.70) | 60 (2.36) |
| Pipe with Cone Quartz | 515 (20.28) | 60 (2.36) |
| Still-pipe Array, 5 in. Fixed. | 926 (36.46) | 500 (19.69) |
| Still-pipe Array, 6 in. Fixed. | 926 (36.46) | 500 (19.69) |
| Still-pipe Array, 8 in. Fixed. | 926 (36.46) | 500 (19.69) |
| Still-pipe Array, 10 in. Fixed. | 926 (36.46) | 500 (19.69) |
| Still-pipe Array, 12 in. Fixed. | 926 (36.46) | 500 (19.69) |
| Still-pipe Array, 5 in. Hinged lid. | 1000 (39.37) | 500 (19.69) |
| Still-pipe Array, 6 in. Hinged lid. | 1000 (39.37) | 500 (19.69) |
| Still-pipe Array, 8 in. Hinged lid. | 1000 (39.37) | 500 (19.69) |
| Still-pipe Array, 10 in. Hinged lid. | 1000 (39.37) | 500 (19.69) |
| Still-pipe Array, 12 in. Hinged lid. | 1000 (39.37) | 500 (19.69) |
| Parabolic | 793 (31.22) | 200 (7.87) |
| Process Seal 4 in. PTFE | 563 (22.17) | 200 (7.87) |
| Process Seal 6 in. PTFE | 623 (24.53) | 200 (7.87) |

**Hold Off Distance (UNZ)**

The **Hold Off Distance** (UNZ) defines how close to the gauge's reference point a level value is accepted (see illustration on page 4-2). Normally, the **Hold Off Distance** is set automatically and does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the **Hold Off Distance** in order to avoid measurements in the region close to the antenna. See also "*Setting the Hold Off Distance"* on page 2-37.

## 4.1.1 Installation in Pipe

**Pipe Inner Diameter**

Enter the **Pipe Inner Diameter** (only valid for pipe antennas or cone antennas in existing still-pipe). The figure is used to compensate for the lower microwave propagation speed inside the pipe. An incorrect value will give a scale factor error. Only valid for pipe antennas or cone antennas in existing still-pipe. The 2-in. still-pipe has a Pipe Inner Diameter of 56 mm (2.2 in.) and the 1-in. still-pipe has a Pipe Inner Diameter of 28 mm (1.1 in.).
If locally supplied still-pipes are used, make sure that the inner diameter is noted before the installation of the pipe.

## 4.1.2 User Defined Antenna

**TCL**

The **Tank Connection Length** (TCL) parameter is entered for antenna type *User Defined* only. See also "*Setting the Tank Connection Length (TCL)"* on page 2-36)

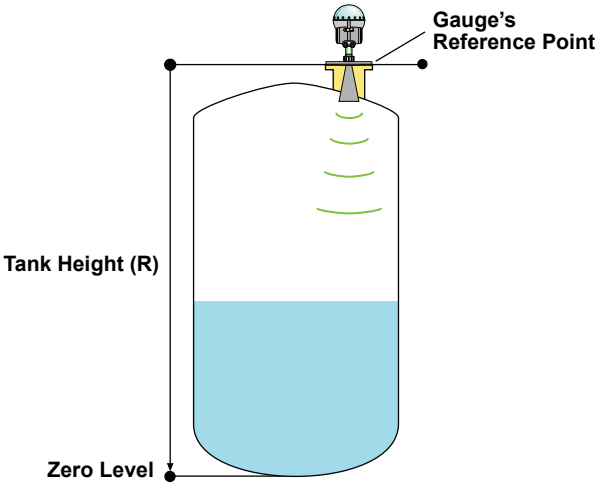
Table 4-2. $TCL_{ext}$ values for the 500 mm (20 in.) extended cone. Units are mm (in.)

| Sealing | 3 in. Cone | 4 in. Cone | 6 in. Cone |
|---|---|---|---|
| PTFE | 0.489 (0.019) | 0.482 (1.90) | 0.477 (1.88) |
| Quartz | 0.529 (2.08) | 0.522 (2.06) | 0.517 (2.04) |

## 4.2 TANK GEOMETRY PARAMETERS

Configuration of the following parameters must be performed for the tank:

### Tank Height (R)




TANKDISTANCE_GRCH_V3_ED3_BASIC.EPS

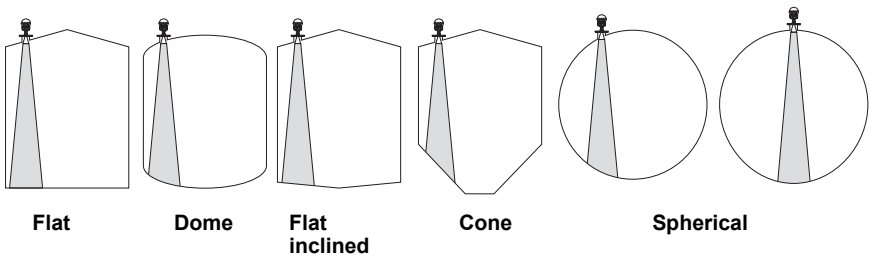
Figure 4-2. The Tank Height (R) is defined as the distance between the upper reference point and the lower reference point (Zero Level).

### Tank Type / Tank Bottom Type

By defining **Tank Type** and **Tank Bottom Type,** some parameters are set to default values in order to optimize the gauge.

For tank types vertical cylinder and cubical, all tank bottom types are valid. For tank types horizontal cylinder and spherical, the parameter **Tank Bottom Type** is not used.

Select **Tank Bottom Type** flat inclined if the bottom inclination is between 10 and 30 degrees or if the inclination is less than 10 degrees, but there are disturbing objects on the tank floor right beneath the gauge (such as heating coils). See also *"Bottom Echo Visible" on page 4-14*.



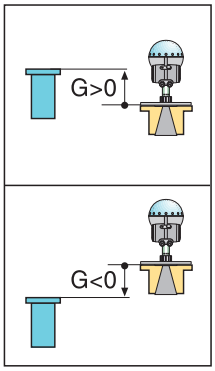

ITTOM EXAMPLES_GEOM.EPS

Figure 4-3. Examples of Tank Types and Tank Bottom Types.

Advanced tank geometry configuration is done through the following parameters:

**Distance Offset (G)**

The **Distance Offset** (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Gauge's Reference Point*). You can use the **Distance Offset** to specify your own reference point at the top of the tank. Set the **Distance Offset** to zero if you want the flange as upper reference point. The **Distance Offset** is defined as positive if you use an upper reference point above the *Gauge's Reference Point*. The **Distance Offset** is used when the measured level by the gauge should correspond with the level value obtained by hand-dipping.



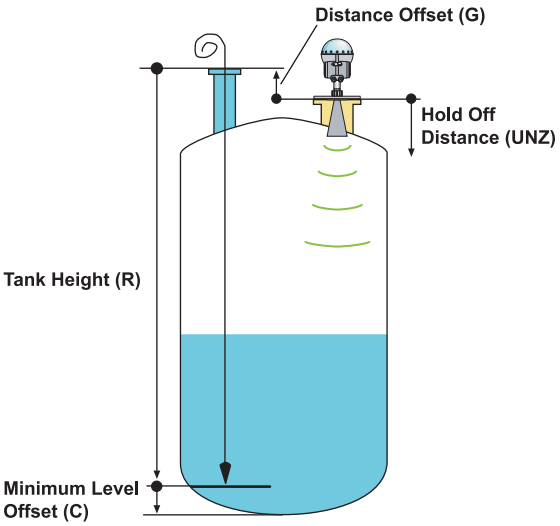

G_DISTANCE.EPS

Figure 4-4. The Distance Offset, G, is the distance between the Upper Reference Point and the gauge's reference point.

**Minimum Level Offset (C)**

The **Minimum Level Offset** (C) defines a lower null zone which extends the measurement range beyond the Zero Level Reference Point down to the tank bottom.The **Minimum Level Offset** is defined as the distance between the zero level (*Tank Level Reference Point*) and the minimum accepted level, i.e. the tank bottom. Set the **Minimum Level Offset** to zero if you use the tank bottom as zero level reference point.

If the zero level is at an elevated point (for example the datum plate) and not at the tank bottom, you need to define the **Minimum Level Offset**. Note that the **Minimum Level Offset** can not be negative.




TANKDISTANCE_GRCH_ED4_2.EPS

Figure 4-5. The Minimum Level Offset is the distance from the Zero level to the tank bottom.

**Show Negative Values as Zero**

Set this parameter if you want levels below the reference point at the bottom of the tank to be displayed as zero. This parameter can only be used if you have set a *Minimum Level Offset* distance in the tank geometry configuration.

**Calibration Distance**

The **Calibration Distance** is by default set to zero. It is used to adjust the gauge so that measured levels match hand-dipped product levels or other reference level values. Normally, the **Calibration Distance** does not need to be changed. However, in some rare cases a fine tuning of the gauge has to be performed after installation. This could for instance be due to a high nozzle. To be able to enter a correct **Calibration Distance,** thorough hand-dipping results or other reference measurements must be available.

## 4.3 ANALOG OUTPUT

TankRadar Pro has the possibility to handle two analog outputs which can be separately configured.

Analog Output 1 is not available for primary out when using other bus communication protocols than HART®.

**Output Source**

Select the source to control the analog output.

**Upper Range Value**
**Lower Range Value**

Enter the range values that correspond to the analog output values 4 and 20 mA. You can specify any value as long as the **Upper Range Value** is above the **Lower Range Value**. If the measured value goes outside the range values, the gauge enters alarm mode.

**Alarm Mode**

Choose the desired **Alarm Mode**. The Alarm Mode specifies the analog output state when a measurement or internal error occurs or when the measured value is out of range.

**High:** the output current is set to 22 mA.

**Low:** the output current is set to 3.8 mA.

**Freeze Current:** the output current is set to the value at the time when the error occurs.

**Binary High:** the output current is 4 mA under normal conditions. If there is a measurement error, or when the source signal is out of range, the output current is set to 20 mA.

**Binary Low:** the output current is 20 mA under normal conditions. If there is a measurement error, or when the source signal is out of range, the output current is set to 4 mA.

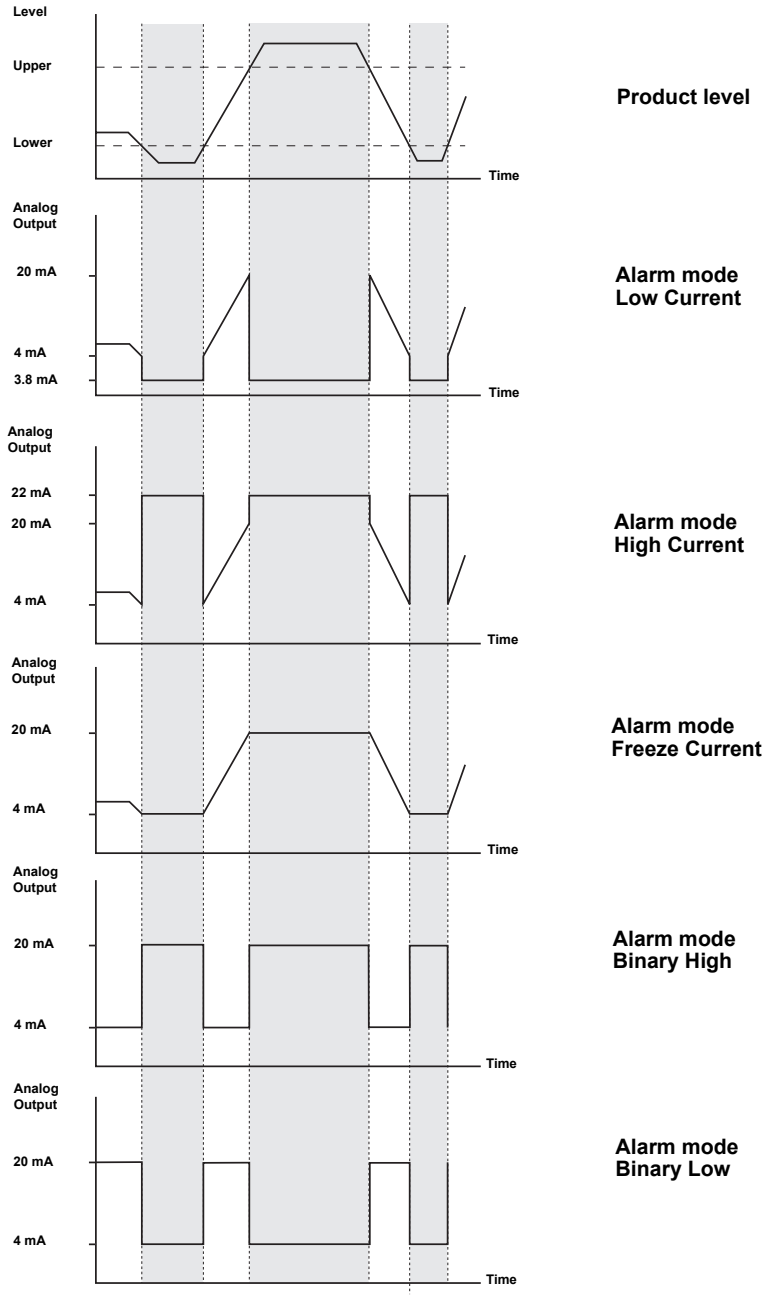
**Disable Limit Alarm if Out of Range**

If the detected level is above the upper or below the lower limit, setting this parameter suppresses the analog output from going into alarm mode. The output current is set to 4 mA if the level is below the lower limit, and 20 mA if the level is above the upper limit

The examples below illustrate how the analog output signal is related to the actual measured product level and the specified upper and lower limits. If the source signal exceeds the Upper limit or falls below the Lower limit, the output current is set according to the specified Alarm Mode setting.

If your gauge is equipped with an optional analog output (Analog Out 2), configure it the same way as Analog Out 1.

Figure 4-6. Analog Output current as a function of product level for different alarm mode settings. The shaded area indicates analog output in Alarm mode. The graphs are valid when Disable Limit Alarm if Out of Range is not set.



## 4.4 PROCESS CONDITION PARAMETERS

To describe the **Process Conditions,** mark the check boxes that correspond to the conditions in your tank (see list below) in order to optimize the gauge for such measurements:

**Rapid level changes**

For measurement conditions where the level changes quickly due to filling and emptying of the tank. A standard configured gauge is able to track level changes of up to 100 mm/s (4 in./s). When the Rapid Level Changes check box is marked, the gauge can track level changes of up to 200 mm/s (8 in./s).

**Turbulent Surface**

For tanks with turbulent surface. The reason for the turbulence might be splash loading, agitators, mixers or boiling product. Turbulence and waves may attenuate the microwave signals.

**Foam**

For conditions with weak and varying surface echo amplitudes, which is typical for foam.

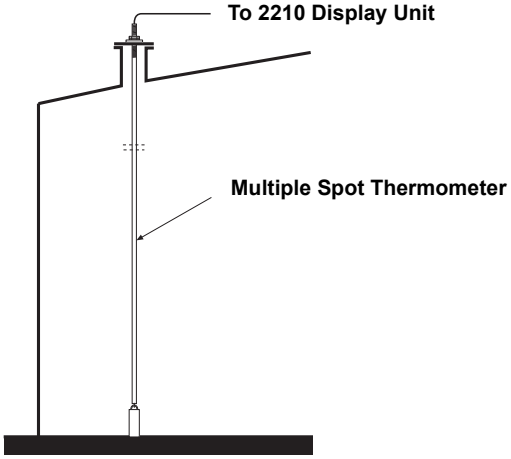
**Solid Products**

For solid products, such as concrete or grains. This parameter can be used when the application is a silo where there is product pile-up.

**NOTE!**
For best performance choose only if applicable and not more than two options.

## 4.5 TEMPERATURE MEASUREMENT

Up to six temperature sensors can be connected to the 2210 Display Unit. You can use 1-3 spot elements or 1-6 multiple spot elements with common return. All temperature sensors must be of the same type, for example Pt100 or CU90. See Section 3: Electrical Installation for information on how to connect the temperature sensors.




MST_INSTALL.EPS

Figure 4-7. Up to six temperature sensors of the same type can be connected to the 2210 Display Unit.

Use one of the following temperature measurement conversion methods:

- PT100 and CU90
- User Defined Linearization Table. The sensor characteristics is specified in a table of corresponding resistance and temperature values.
- User Defined Formula. The sensor characteristics is specified in a mathematical formula: $R=R_0*(1+A*T+B*T^2)$ where R is the resistance at temperature T, $R_0$ is the resistance at zero degrees Centigrade and A and B are constants.

**Sensor Mounting Level 1-6**

Enter the level (from the tank bottom) at which each sensor is mounted. The first sensor must be mounted in the lowest position in the tank, the second above the first and so on.

**Number of Sensors**

Enter the number of temperature sensors connected to the Display Unit. You can have up to 6 sensors connected. If you choose 0 sensors, temperature measurement is disabled.

## 4.6 VOLUME CALCULATION

The **Volume Calculation** is performed by using one of two methods: pre-defined tank shape or strapping table. The strapping table is an optional function. If this function is required, please contact Emerson Process Management / Rosemount Tank Gauging.

To configure the Pro gauge for volume calculations you have to choose a **Volume Calculation method.**

Select one of the volume calculation methods. Choose one of the ideal tank shape options if approximation of your tank with an ideal tank shape provides sufficient accuracy. The strapping table option can be used for an arbitrary tank shape. You can enter levels and corresponding volumes to obtain a close match between the actual and the calculated volume. This option should be used in cases where the tank shape deviates significantly from an ideal sphere or cylinder, or when you require high accuracy.

**NOTE!**
The gauge is delivered with a start code that enables the ordered software options. The strapping table software is optional and must be ordered and included in the start code to be functional. If you wish to change the set of available options, contact your local representative for a new start code.

### Ideal tank

Use this option if approximation of your tank with an ideal tank shape (assuming no dished ends) provides sufficient accuracy. Enter the following parameters:

- Tank diameter (and the length if it is a horizontal tank).
- Volume Offset: use this parameter if you do not want zero volume and zero level to match (for example if you want to include volume below the zero level).

### Strapping table

- Enter levels and corresponding volumes starting at the bottom of the tank. These figures can typically be obtained from tank drawings or from a certificate from the tank manufacturer. If the level/volume table is based on a reference point that is different from your reference point, you can use **Level Offset** and **Volume Offset**. The **Volume Offset** is added to every value in the corresponding column.
- Select which **interpolation** method to use for calculating volumes between the strapping points. Normally, linear interpolation is the preferred method. For spherical tanks, quadratic interpolation may result in a smaller error. By using linear interpolation and a sufficient number of values in the strapping table, the interpolation error can normally be reduced to a minimum.

## 4.7 ADVANCED FUNCTIONS

The previous sections in this chapter have dealt with basic configuration. However, in some cases the gauge must be further configured using the Advanced Functions. Please note that this may affect the previous basic configuration by updating some parameters already set.

Several parameters are used for the **Advanced Functions** settings and they are described in:

- "*Disturbance Echo Handling"* on page 4-11
- "*Bottom Echo Handling"* on page 4-14
- "*Full Tank Handling"* on page 4-15
- "*Empty Tank Handling"* on page 4-15
- "*Surface Tracking"* on page 4-16
- "*Filtering"* on page 4-20

### 4.7.1 Disturbance Echo Handling

There are three different methods available for Disturbance Echo Handling:

- General Amplitude Threshold
- Customized Noise Threshold Table (Amplitude Threshold Points (ATP) table)
- Registration of False Echoes

These methods will be described in the following sections. Also, there are guidelines on when to register a false echo.

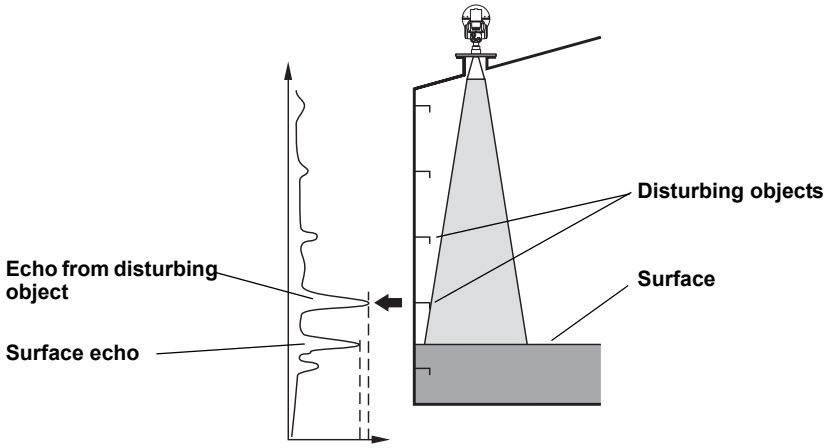


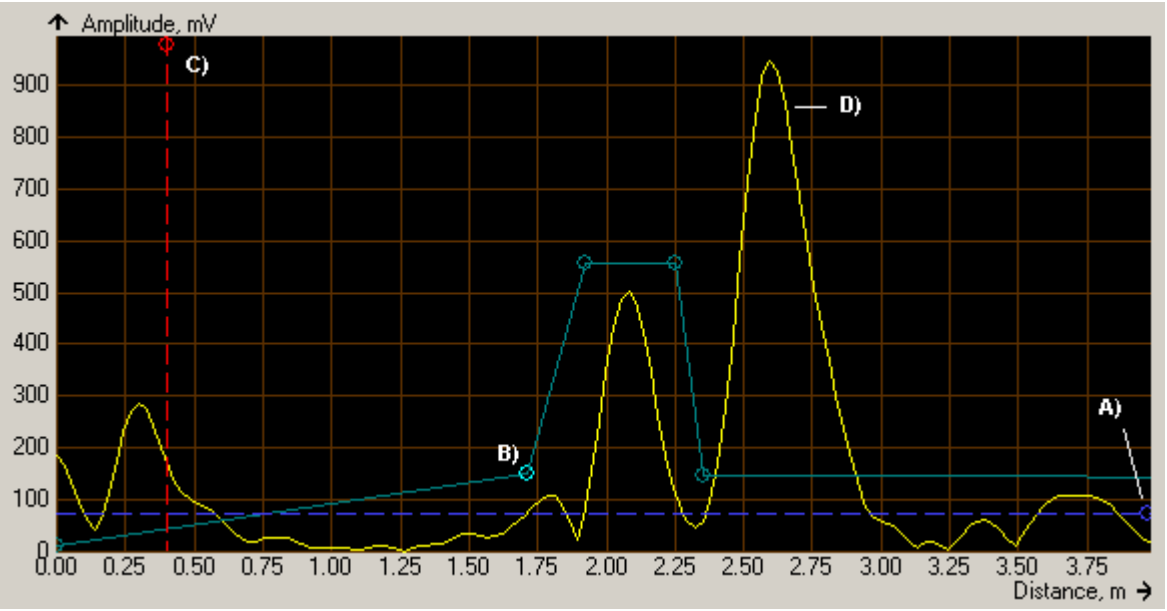

Figure 4-8. Registration of false echoes improves measurements when the surface is close to the disturbing objects.

The False Echo function is used to improve the performance of the gauge when the surface is close to a horizontal surface of a stationary object in the tank. The object causes an echo when it is above the surface. When the echoes from the surface and the object are close to eachother, they might interfere and cause a decrease in performance.

It is possible to store the positions of the disturbing objects in the memory of the gauge. When the surface is passing by a disturbing object, the gauge can measure with a higher reliability, when the position of the object is registered.

Use a spectrum plot to find your disturbance echoes. Remember to update it several times to get the whole picture of disturbance echoes in the tank. Do not base your false echo registration on only one updated spectrum plot.

Figure 4-9. Spectrum plot.
A: General amplitude threshold.
B: Amplitude threshold point (ATP)
C: Hold Off Distance (UNZ)
D: Echo curve.




SPECTRUM.TIF

## General amplitude threshold

Echoes with amplitudes below the general amplitude threshold will be disregarded. Recommended threshold values are:

- Calm conditions: no turbulence, foam or condensation. Set amplitude threshold to approximately 20% of surface echo amplitude.
- Foam, agitators or low product DC: the surface echo signal may drop to 200-300 mV during processing in tank. A threshold value of about 150 mV is recommended.

**NOTE!**
These figures are estimations. Significantly different figures may have to be used in many cases.

Some further considerations are:

- If a water test is performed before the product enters the tank, there is probably a difference in signal amplitude between the water and the product. Use the signal amplitude for the product to set the amplitude threshold.
- A moving surface may cause a decrease in signal amplitude.

## Customized noise threshold table (ATP-table)

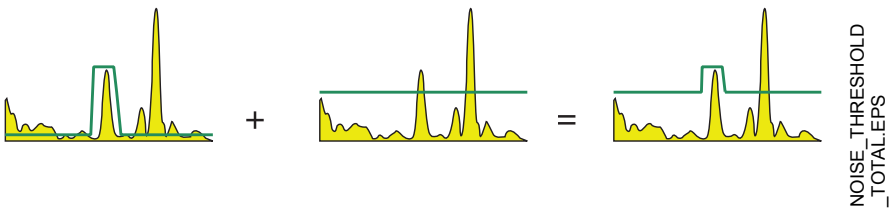
You can filter out weak disturbing echoes by creating a noise threshold table. This technique should only be used in special situations, for example at the bottom of tanks with weak disturbing echoes. In such tanks the gauge may lock at disturbances close to the bottom when the tank is empty. Setting up a noise threshold in this region will guarantee that the gauge starts following the surface when the tank is filled again. Make sure that the surface echo amplitude in the bottom region is always stronger than the noise threshold.

This function can also be used in areas where there occasionally are strong echoes present, i.e. to block the device from tracking "wall bounce echoes", moving cleaning gun, wide mixer blades and product mist from spray nozzles. For those large areas registering a False Echo may not be sufficient.

Furthermore, the ATP-table can be used to remove the influence from the tank nozzle or a still-pipe inlet at the top of the tank. You can also use the *Hold Off Distance* (UNZ) to manage such cases.

Do not create noise thresholds around echoes which are already registered as interfering echoes. The general amplitude threshold is the lower limit of the noise threshold table.

Figure 4-10. Disturbing objects can be filtered out by using a noise threshold table.




## Registration of False Echoes

The False Echo function allows you to let the gauge register disturbing echoes caused by objects in the tank. This makes it possible to detect a product surface close to a disturbance echo even if the surface echo is weaker than the disturbing echo.

**NOTE!**
Registration of disturbance echoes requires that the echofixer software is enabled.

### When should I register?

See the recommendations below before you register new interfering echoes:

- Make sure that a correct **amplitude threshold** is set before you register any disturbance echoes. See description of the Spectra Threshold window.
- Keep the number of registered echoes to a minimum.
- Compare the list of interfering echoes with the tank drawing or by visible inspection of the tank. Note if there are objects like beams, heating coils, agitators etc. which correspond to the found echoes. Only register echoes which can be clearly identified as objects in the tank.
- Make sure that the level is stable before you register a disturbance echo. A fluctuating level may indicate a temporary disturbance which is not due to an interfering object.
- Do not register a disturbance echo if the amplitude is below the general amplitude threshold.
- Do not register a disturbance echo if the amplitude is significantly smaller than the amplitude of the surface echo when the surface is at the same level as the disturbance. (In some cases weak disturbance echoes can be filtered out by creating a noise threshold table.
- It may be necessary to register new disturbance echoes at a later stage when objects have become visible due to surface movement.

## 4.7.2 Bottom Echo Handling

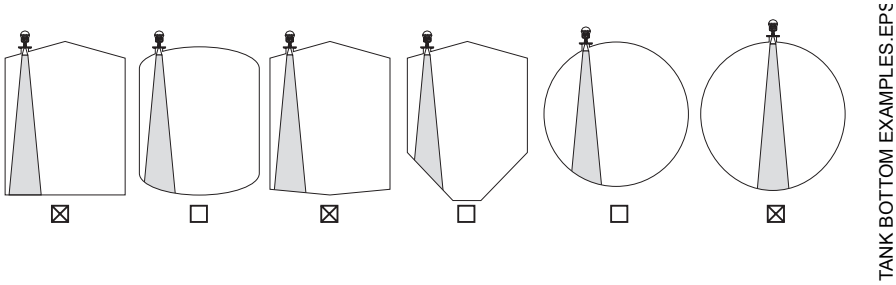
**Bottom Echo Visible**

This parameter is automatically set depending on tank type and tank bottom type. By setting this parameter the bottom echo will be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom. If this parameter is not set, searching for a lost surface echo is restricted to a region close to the tank bottom.

Only set this parameter if the bottom echo is visible.

The figure shows scenarios where the bottom echo could be visible. Always check if the gauge shows a value for the bottom at empty tank before marking the checkbox. Only flat bottom tanks have the checkbox marked as default. You may manually set this parameter in Advanced Service.

Figure 4-11. The Bottom Echo Visible means that the bottom is treated as a disturbance.



If *Empty Tank Handling* is set to automatic, the choice of *Tank Bottom Type* controls the setting of **Bottom Echo Visible**. For *Tank Bottom Type* flat, the **Bottom Echo Visible** parameter is always set.

If the *Empty Tank Handling* function is not set to automatic, the **Bottom Echo Visible** parameter is set manually for all tank types. However, the *Tank Bottom Type* flat has always **Bottom Echo Visible** set.

**Invalid Level Alarm Is Not Set If Tank Is Empty**

If the surface echo is lost close to the bottom of the tank, setting this parameter suppresses the “invalid” display.

## 4.7.3 Full Tank Handling

**Invalid Level Alarm Is Not Set If Tank Is Full**

If the surface echo is lost close to the top of the tank, the level value will normally be displayed as “invalid”. Set this parameter to suppress the “invalid“ display.

**NOTE!**
By setting this parameter the analog output will not enter alarm mode for invalid levels close to the tank bottom or close to the antenna.

## 4.7.4 Empty Tank Handling

**Empty Tank Detection Area**

The Empty tank handling is a function for handling situations when the surface echo is lost close to the bottom. If the surface echo is lost the function makes the gauge present a zero-level measurement, and an alarm is created, unless this alarm has been blocked.

This function is activated by default if you have selected one of the following *Tank Bottom Types*:

- Cone
- Dome
- Flat inclined
- Unknown

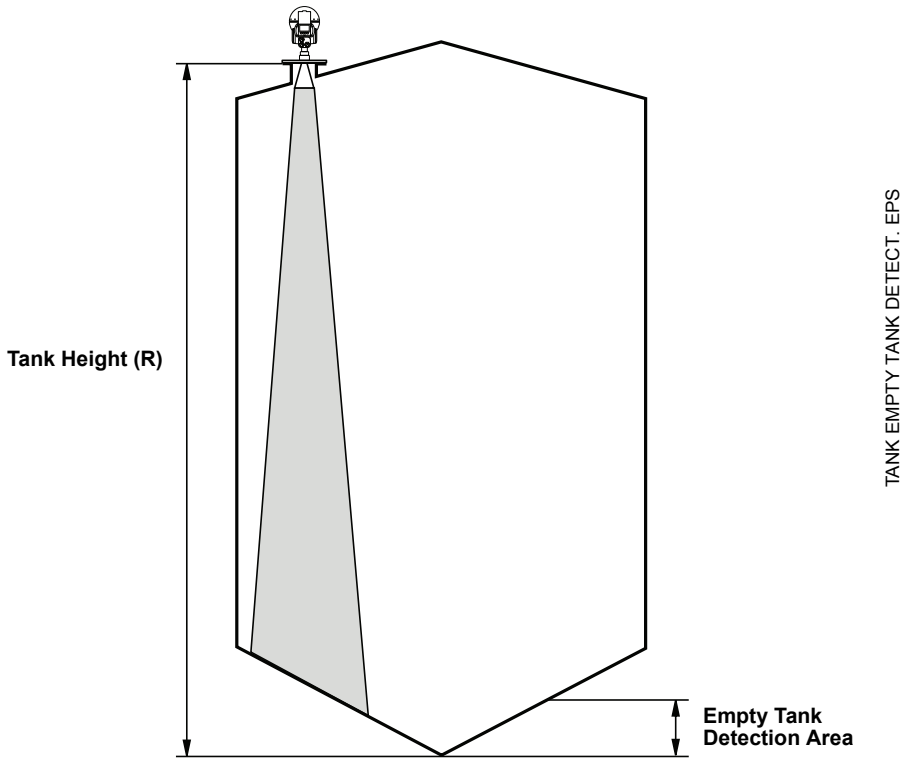
This function also requires that the *Bottom Echo visible* checkbox is not marked. If it is marked, the function is disabled.

The gauge will search for the surface echo within the **Empty Tank Detection Area**.

The **Empty Tank Detection Area** is calculated as a percentage of *Tank Height (R) + Minimum Level Offset (C) - Distance Offset (G)*. It has a lower limit of 400 mm (16 in.) and a higher limit of 1000 mm (39 in.).
The used Empty Tank Detection Area is shown in the Advanced Setup and can be adjusted manually if required.

Since the gauge will search for the surface echo in the **Empty Tank Detection Area,** it is very important that there are no disturbances in this area. If there are they might need to be filtered out. See *"Disturbance Echo Handling"* on page 4-11 *and* "*Tank Type / Tank Bottom Type"* on page 4-4.

Figure 4-12. The Empty Tank Detection Area is useful for situations when the echo is lost close to the bottom.




## 4.7.5 Surface Tracking

**Slow Search**

This variable controls how to search for the surface if a surface echo is lost. With this parameter set, the gauge starts searching for the surface at the last known position, and gradually increases the width of the search region until the surface is found. If this variable is not set the gauge searches through the whole tank. This parameter may typically be used for tanks with turbulent conditions.

**Slow Search Speed**

If the surface echo is lost, the gauge starts to search around the last known level to find the surface echo again. This parameter indicates how fast it should expand the search window.

**Level above min distance possible**

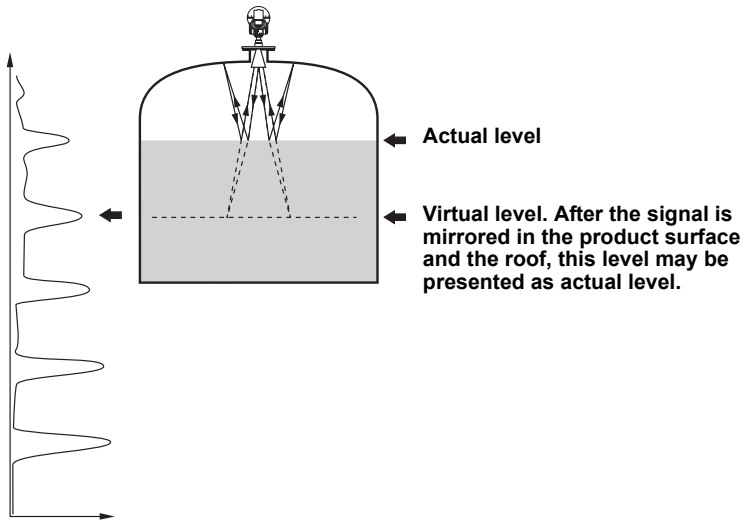
If this parameter is set and the surface echo is lost above the *Hold Off Distance* (UNZ), full tank is indicated and searching for the surface echo is limited to a region close to the antenna. When this parameter is not set and the surface is lost at the top of the tank the device searches for a surface echo within the whole tank.

**Double Bounce Possible(1)**

Some radar waves are reflected against the tank roof and back to the surface before they are detected by the gauge. Normally, these signals have a low amplitude and are therefore neglected by the gauge. For spherical and horizontal cylinder tanks, in some cases the amplitude may be strong enough to lead the gauge to interpret the double bounce as the surface echo. By setting the **Double Bounce Possible** parameter this type of measurement situation may be improved.

**NOTE!**
This function should only be used if the problem of double bounces can not be solved by changing the mounting position

Figure 4-13. Detected Radar waves might sometimes be the result of multiple reflections. By setting Double Bounce Possible, the risk of detecting the wrong surface is reduced.




*(1) For gauge software version 2B5 and higher:*
- *The Double Bounce function is enabled by default*
- *The Double Bounce Offset is automatically calculated if its value is less than 800 mm. See "Double Bounce Offset" on page 4-18.*

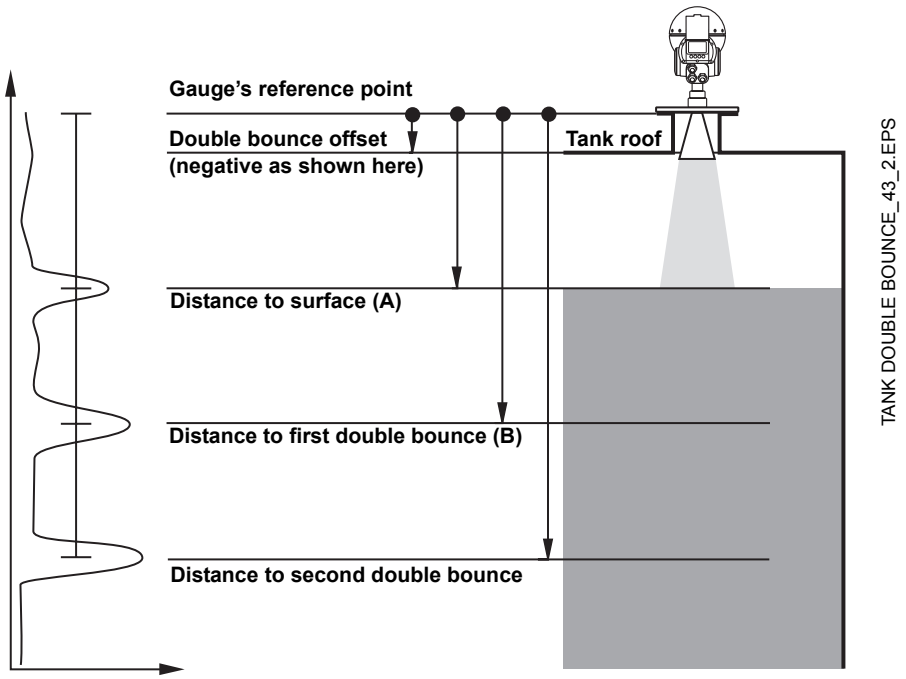
**Double Bounce Offset**

Use the Double Bounce Offset to define the distance between detected double bounces. In order to determine the *Double Bounce Offset,* you need to check the spectra of signal amplitude vs. distance to echo or read the detected echoes from the display. The distance between double bounces is constant. By subtracting two times the distance to the surface (2A) from the distance to the first double bounce (B) you will get the *Double Bounce Offset* (DBO). The *Double Bounce Offset* is negative if the reflection point (normally the tank roof) is below the gauge´s reference point.

$$DBO = B - 2A$$

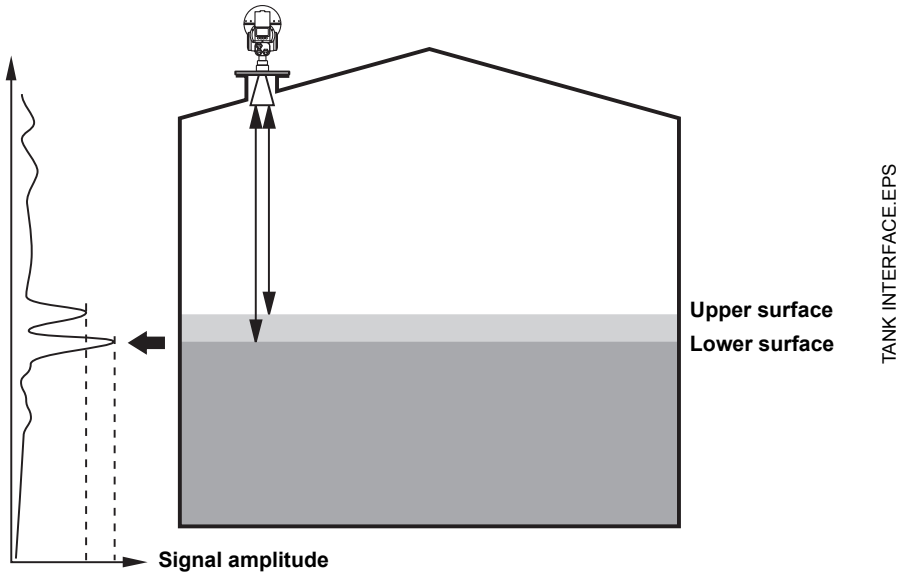
DBO: Double Bounce Offset
B: Distance to first double bounce
A: Distance to surface

Figure 4-14. The Double Bounce Offset is used to define the distance between detected double bounces.



**Double Surface** Indicates that there are two liquids or foam in the tank resulting in two reflecting surfaces. The upper liquid or foam layer must be partly transparent to the radar signal.

Figure 4-15. If Double Surface is activated you can specify which surface to select.




If this function is activated, you can specify which surface to select by using the *Select Lower Surface* parameter.

**Upper Product DC** This is the dielectrical constant for the upper product. A more precise value results in better accuracy for the lower surface level.

**Select Lower Surface** This function should only be used if *Double Surface* is set. If *Select Lower Surface* is set the lower surface will be presented as the product surface. If not set, the upper surface is tracked.

**Echo Timeout** Use *Echo Timeout* to define the time in seconds before the gauge will start to search for a surface echo if it has been lost. After an echo has been lost, the gauge will not start searching or set Invalid Level until this time has elapsed.

**Close Distance Window** This parameter defines a window centered at the current surface position in which new surface echo candidates can be selected. The size of the window is ± CloseDist. Echoes outside this window will not be considered as possible surface echoes. The gauge will without delay jump to the strongest echo inside this window.

If there are rapid level changes in the tank, the value of the *Close Distance Window* could be increased to prevent the gauge from missing level changes. On the other hand, a too large value might cause the gauge to select an invalid echo as the surface echo.

## 4.7.6 Filtering

**Distance Filter Factor**

The *Distance Filter* Factor defines how much the level value should be filtered. A low factor setting will give the new level value by adding a small portion (for instance 1%) of the level change to the previous level value. A high factor setting typically takes the latest measurement and presents it as the new level. This implies that a low factor setting makes the level value steady but the gauge reacts slowly to level changes in the tank. A high factor setting makes the gauge react quickly to level changes but the presented level value can be somewhat jumpy.

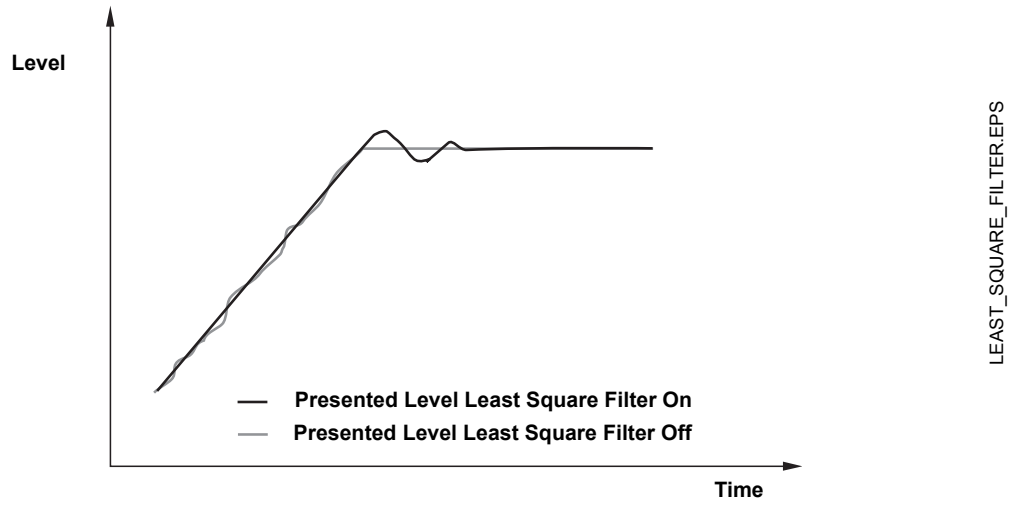
**Activate Jump Filter**

If the surface echo is lost and a new surface echo is found, the *Jump Filter* tells the gauge to wait for some time before it jumps to the new echo. During that time the new echo has to be a valid echo. The *Jump Filter* does not use the *Distance Filter Factor* and can be used in parallel to the *Least Square Filter* or the *Adaptive Filter*. The *Jump Filter* is typically used for applications with turbulent surface and makes the echo tracking work smoother as the level passes the agitator.

**Activate Least Square Filter**

This filter calculates the new level value according to the least square method and will give increased accuracy for slow filling or emptying of tanks. The level value will follow the surface with high accuracy and without delay as the level changes. When the level stabilizes at a certain level, the *Least Square Filter* makes the level move somewhat further before it aligns to the correct level value, see picture.

Figure 4-16. The least square filter gives increased accuracy for slow filling or emptying of tanks.




**Activate Adaptive Filter**

The adaptive filter is tracking the level fluctuations, and is continuously adjusting the filter grade accordingly. The filter can preferably be used in tanks where fast tracking of level changes are important, but where turbulence occasionally cause unstable level values.

# 5. FOUNDATION™ fieldbus Configuration

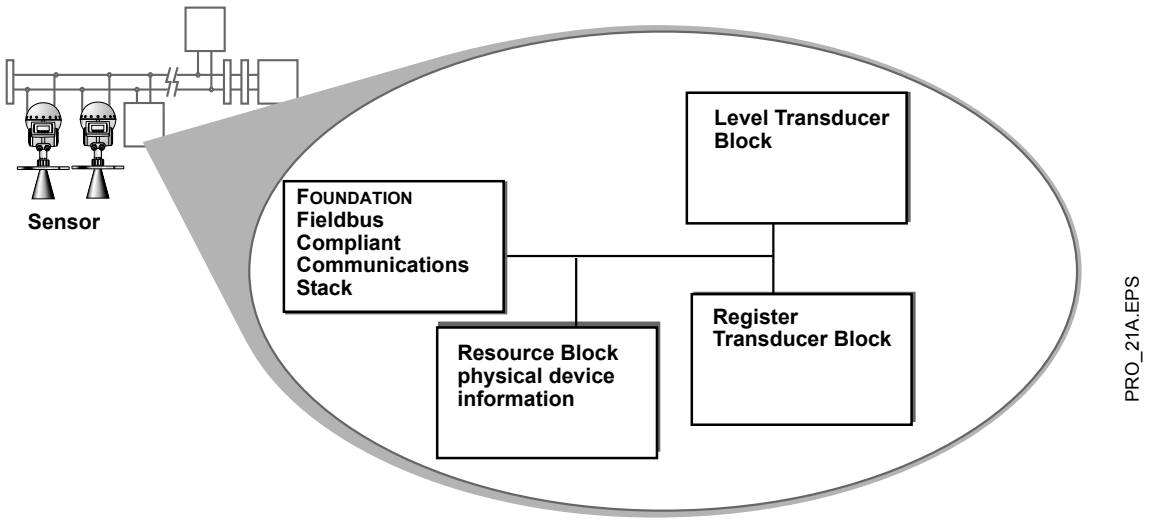


## 5.1 INTRODUCTION

The TankRadar Pro gauge with FOUNDATION™ fieldbus software is designed to permit configuration using any FOUNDATION™ fieldbus host (see page 5-3 for an example of configuration with Emerson Process Management DeltaV™).

Figure 5-1 illustrates how the signals are channelled through the gauge.

Figure 5-1. Function Block Diagram for the TankRadar Pro gauge with FOUNDATION™ fieldbus



### 5.1.1 Overview

Each FOUNDATION™ fieldbus configuration tool or host device has a different way of displaying and performing configurations. Some will use Device Descriptions (DD) and DD Methods to make configuration and displaying of data consistent across host platforms. Since there is no requirement that a configuration tool or host support these features, this section will describe how to re-configure the device manually.

This section covers basic operation, software functionality, and basic configuration procedures for TankRadar Pro with FOUNDATION™ fieldbus (Device Revision 1). For detailed information about FOUNDATION™ fieldbus technology and the function blocks used in the TankRadar Pro gauge, refer to the Rosemount FOUNDATION™ fieldbus Block manual (00809-0100-4783).

### 5.1.2 FOUNDATION™ fieldbus Function Blocks

#### Resource Block

The Resource block contains diagnostic, hardware, electronics, and mode handling information. There are no linkable inputs or outputs to the Resource Block. See *"Resource Block"* on page 5-25 for additional information.

#### Transducer Block

The Transducer block allows a user to view the different parameters, errors, and diagnostics in the gauge. It also includes information to configure the gauge for the application it is used in.

#### Level Transducer Block

The Level Transducer block contains gauge information including diagnostics and the ability to configure the radar gauge, set to factory defaults, and restart the gauge. See *"Level Transducer Block"* on page 5-18 for additional information.

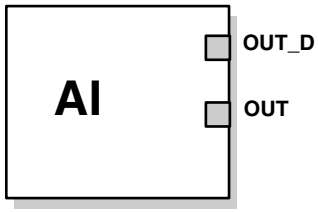
#### Register Transducer Block

The Register Transducer Block allows a service engineer to access all database registers in the device. See *"Register Transducer Block"* on page 5-28 for additional information.

### Analog Input (AI) Block

The Analog Input (AI) function block processes field device measurements and makes them available to other function blocks. The output value from the AI block is in engineering units and contains a status indicating the quality of the measurement. The measuring device may have several measurements or derived values available in different channels. Use the channel number to define the variable that the AI block processes and passes on to linked blocks. See "*Configure the AI Block"* on page 5-8 for additional information.

Figure 5-2. Analog Input Block




**OUT=The block output value and status**
**OUT_D=Discrete output that signals a selected alarm condition**

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## 5.2 ASSIGNING DEVICE TAG AND NODE ADDRESS

TankRadar Pro is shipped with a blank tag and a temporary address (unless specifically ordered with both) to allow a host to automatically assign an address and a tag. If the tag or address need to be changed, use the features of the configuration tool. The tools basically do the following:

1. Change the address to a temporary address (248-251).
2. Change tag to new value.
3. Change address to new address.

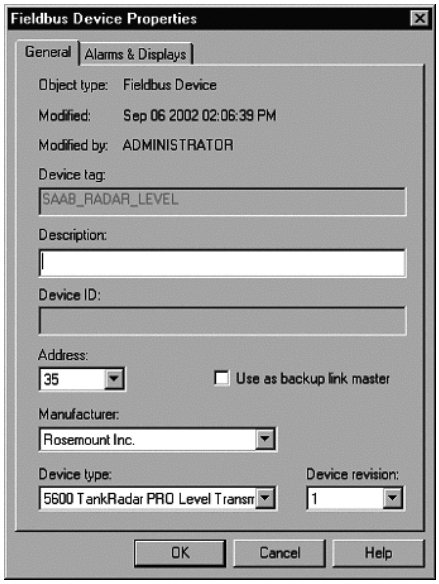
When the device is at a temporary address, only the tag and address can be changed or written to. The resource, transducer, and function blocks are all disabled.

## 5.3 CONFIGURE GAUGE USING DELTA V

**NOTE**
Device support files for the TankRadar Pro gauge with FOUNDATION™ fieldbus are available on www.rosemount.com. Correct revision of Device Support Files must be loaded into DeltaV to provide proper functionality.

1. Select **DeltaV > Engineering > DeltaV Explorer** from the Start menu.
2. Navigate through the file structure to find the gauge you wish to configure.
3. Double-click the gauge you wish to configure/calibrate.
4. The **Fieldbus Device Properties** window appears (see Figure 5-3).

Figure 5-3. Fieldbus device properties

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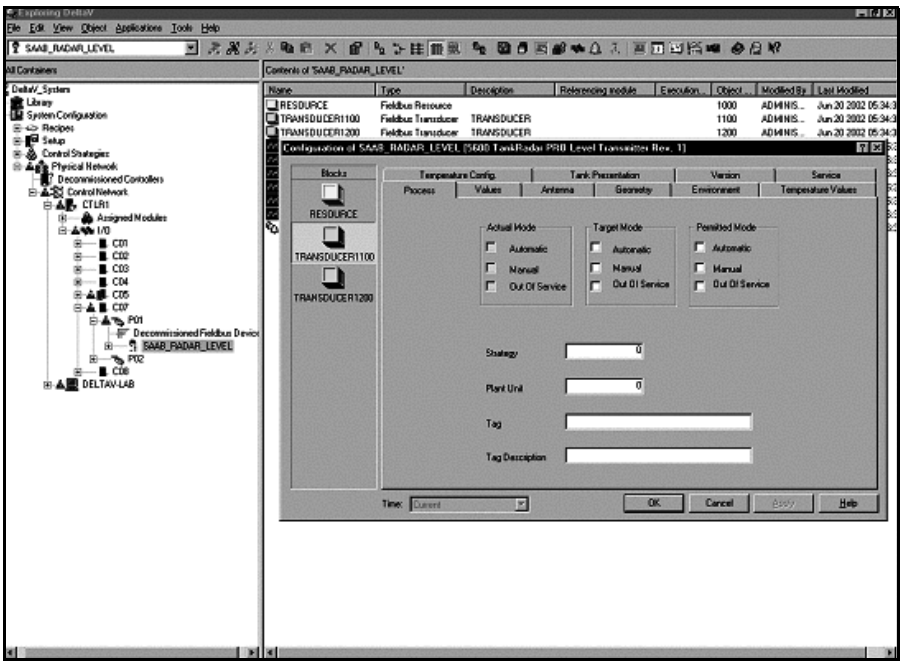
5. Enter a description of the device properties information in the window.

## 5.4 CONFIGURE THE PARAMETERS

The wizard is used to do a standard configuration of the device. The function blocks within the gauge appear in the right half of the DeltaV Explorer window (see Figure 5-4). All settings that are made from this method can also be made manually from the DD information, through the parameters listed below.

Figure 5-4. List of Function Blocks in **DeltaV Explorer**

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1. Double-click on the TRANSDUCER1100 block icon.
   The transducer block properties window appears.
2. Select the **Mode** tab.
3. Select Out of Service (**OOS**) and deselect **Auto** in the **Target Mode** region of the window.

The parameters you change in the properties window remain highlighted so you can easily track changes.

4. Click the **Apply** button to apply the changes you made.

**NOTE**
As you make changes to the configuration parameters, the software warns you that the changes you made may upset the process and create a dangerous situation in your plant. Before you select **OK**, verify that the control loop is in manual control.

The **Actual Mode** region changes to **OOS**.

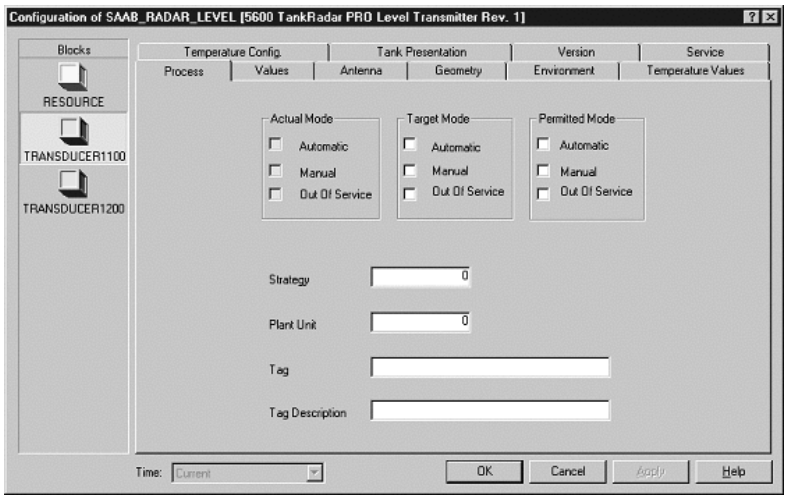
5. A warning window will pop up, click **OK** to return to the DeltaV Explorer.
6. Right-click on the TRANSDUCER block icon to access the configuration parameters menu.
7. Select the parameter you wish to configure, and follow the on-line instructions to complete the configuration.

See "*Level Transducer Block"* on page 5-18 to change the sensor type and to calibrate the sensors.

8. Repeat Steps 1 through 5 to return the mode of the transducer block to **Auto**.

**Process**

Figure 5-5. Configuring the TankRadar Pro Transducer Block (Process Tab)

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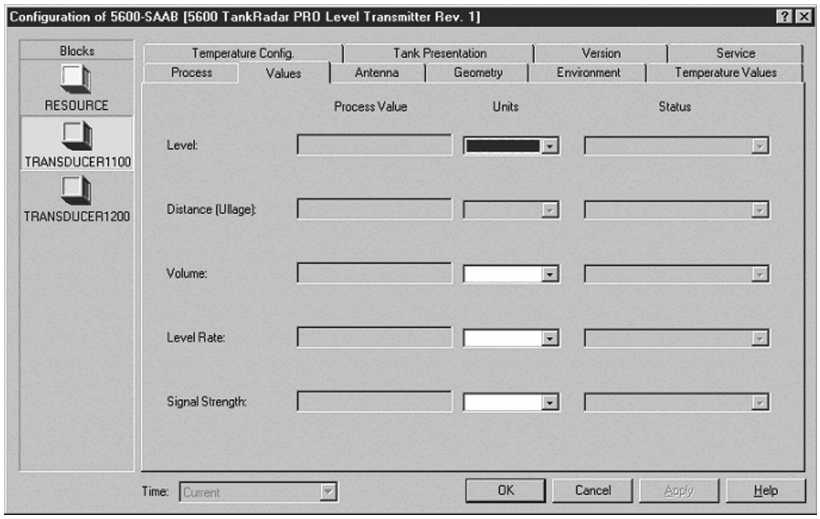
**Values**

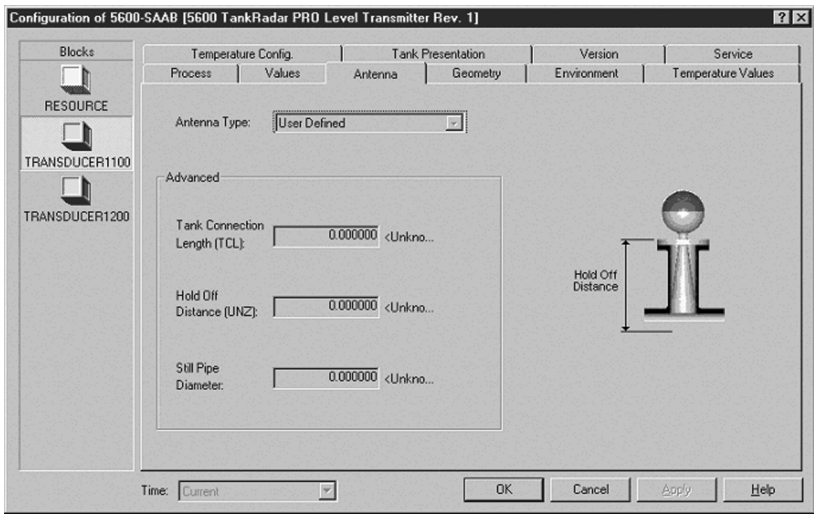
Figure 5-6. Configuring the TankRadar Pro Transducer Block (Values Tab)




PRO_J_01A.TIF

**Antenna**

Figure 5-7. Configuring the TankRadar Pro Transducer Block (Antenna Tab)

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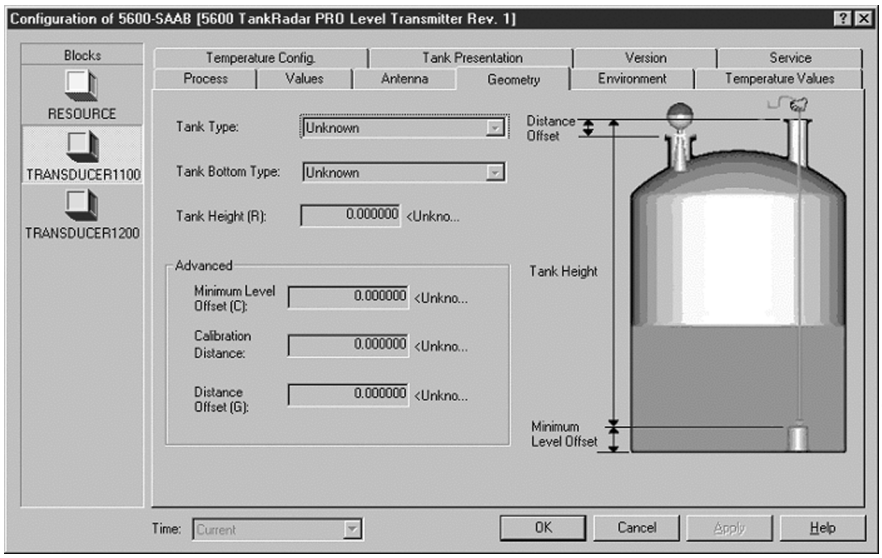
1. Choice of **Antenna Type** (ANTENNA_TYPE).
2. Based on antenna type choice, the different antenna related configuration parameters will be available for configuration. See "*Antenna Parameters"* on page 4-2. for Tank Connection Length (ANTENNA_TCL), and Antenna Pipe Diameter (ANTENNA_PIPE_DIAMETER).

### Geometry

Figure 5-8. Configuring the TankRadar Pro Transducer Block (Geometry Tab)

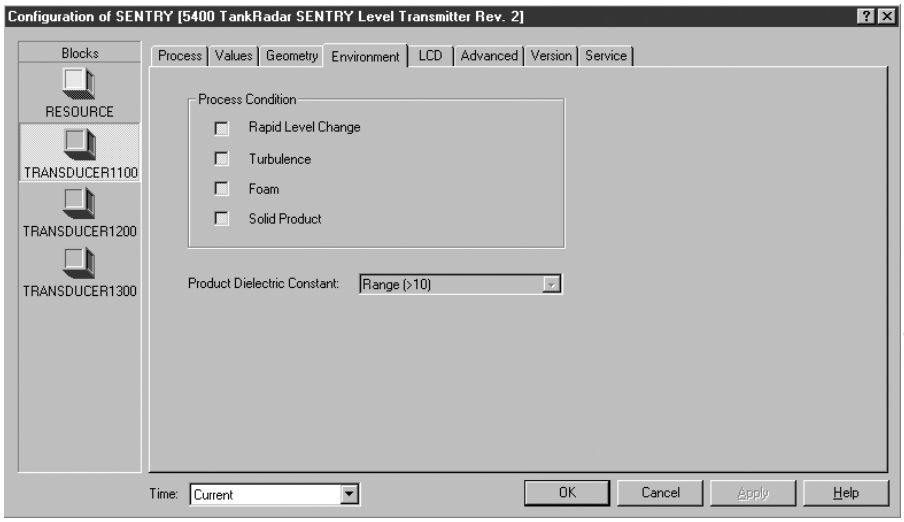



1. Setup the **tank type** (GEOM_TANK_TYPE) and tank geometry parameters (GEOM_TANK_BOTTOM_TYPE).
   See“*Tank Type / Tank Bottom Type”* on page 4-4
2. Set **Tank Height** (GEOM_TANK_HIGH). The tank height is defined by the difference between the Upper Reference Point (gauge point) and the Lower Reference Point (zero level). See “*Tank Height (R)”* on page 4-4.

For more information about the tank parameters, see“*Tank Geometry Parameters”* on page 4-4.

**Environment**

Figure 5-9. Configuring the TankRadar Pro Transducer Block (Environment Tab)




1. Select the Environment tab.
2. Set the process conditions:
   a. Process dielectric constants (ENV_DICECTR_CONST)
   b. Process conditions (ENV_ENVIRONMENT)

See "*Process Condition Parameters"* on page 4-8.

## 5.5 CONFIGURE THE AI BLOCK

A minimum of four parameters are required to configure the AI Block; CHANNEL, L_TYPE, XD_SCALE and OUT_SCALE.

The parameters are described with "*Application Examples"* on page 5-11.

**CHANNEL**

Table 5-1. AI Block and Process variables for the CHANNEL.

.

| AI Block | TB Channel Value | Process Variable |
|---|---|---|
| Level | 1 | CHANNEL_RADAR_LEVEL |
| Ullage | 2 | CHANNEL_RADAR_ULLAGE |
| Level Rate | 3 | CHANNEL_RADAR_LEVELRATE |
| Signal Strength | 4 | CHANNEL_RADAR_SIGNAL_STRENGTH |
| Volume | 5 | CHANNEL_RADAR_VOLUME |
| Average Temperature | 6 | CHANNEL_RADAR_AVG_TEMP |

### L_TYPE

The L_TYPE parameter defines the relationship of the gauge measurement (Level, Distance, Level Rate, Signal Strength, Volume, and Average Temperature) to the desired output of the AI Block. The relationship can be direct or indirect.

**Direct**
Select direct when the desired output will be the same as the gauge measurement (Level, Distance, Level Rate, and Signal Strength).

**Indirect**
Select indirect when the desired output is a calculated measurement based on the gauge measurement. The relationship between the gauge measurement and the calculated measurement will be linear.

**Indirect Square Root**
Select indirect square root when the desired output is an inferred measurement based on the gauge measurement and the relationship between the sensor measurement and the inferred measurement is square root (e.g. level).

### XD_SCALE and OUT_SCALE

The XD_SCALE and OUT_SCALE each include three parameters: 0%, 100%, and engineering units. Set these based on the L_TYPE:

**L_TYPE is Direct**
When the desired output is the measured variable, set the XD_SCALE to match the OUT_SCALE value.

**L_TYPE is Indirect**
When an inferred measurement is made based on the sensor measurement, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

**L_TYPE is Indirect Square Root**
When an inferred measurement is made based on the gauge measurement and the relationship between the inferred measurement and sensor measurement is square root, set the XD_SCALE to represent the operating range that the sensor will see in the process. Determine the inferred measurement values that correspond to the XD_SCALE 0 and 100% points and set these for the OUT_SCALE.

**NOTE**
To avoid configuration errors, only select Engineering Units for XD_SCALE that are supported by the device. For supported units, see page 5-10.

Table 5-2. Length

| Display | Description |
|---|---|
| m | meter |
| ft | feet |
| in | inch |
| mm | millimeter |

Table 5-3. Level Rate

| Display | Description |
|---|---|
| ft/s | feet per second |
| m/s | meter per second |
| m/h | meter per hour |

Table 5-4. Temperature

| Display | Description |
|---|---|
| K | Kelvin |
| °C | Degree Celsius |
| °F | Degree Fahrenheit |

Table 5-5. Signal Strength

| Display | Description |
|---|---|
| mV | Millivolt |

Table 5-6. Volume

| Display | Description |
|---|---|
| $m^3$ | Cubic meter |
| Gallon | US gallon |
| bbl | barrel |
| $ft^3$ | Cubic feet |

**NOTE**
It is important to use the units exactly as specified in the tables above.

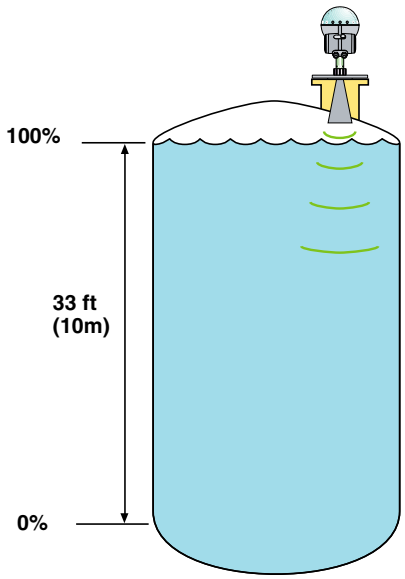
## 5.6 APPLICATION EXAMPLES

### Radar Level Gauge, Level Value

**Situation #1**

A level gauge is measuring the level in a 10 m (33 ft) high tank.

Figure 5-10. Situation #1 Diagram

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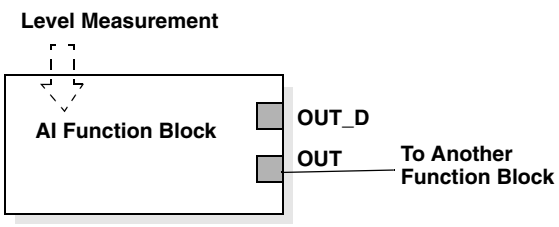
**Solution #1**

Table 5-7 lists the appropriate configuration settings, and Figure 5-11 illustrates the correct function block configuration.

Table 5-7. Analog Input Function Block Configuration for a typical level gauge.

| Parameter | Configured Values |
|---|---|
| L_TYPE | Direct |
| XD_SCALE | Not Used |
| OUT_SCALE | Not Used |
| CHANNEL | 1 Level |

Figure 5-11. Analog Input Function Block Diagram for a typical level gauge.

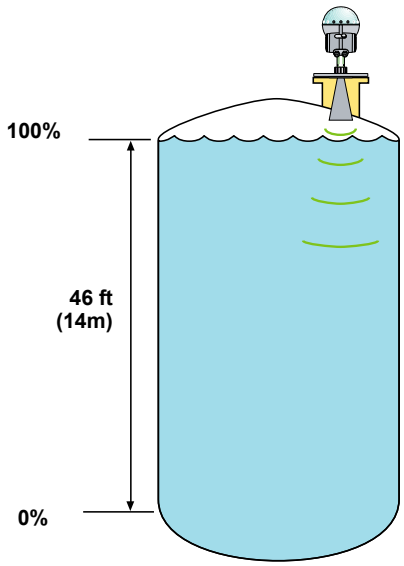


## Radar Level Gauge, Level value in percent (%)

### Situation #2

The level of a tank is to be measured using the radar level gauge mounted on a nozzle on the top of the tank. The maximum level in the tank is 14 m (46 ft). The level value shall be displayed in percentage of the full span (see Figure 5-12).

Figure 5-12. Situation #2 Diagram



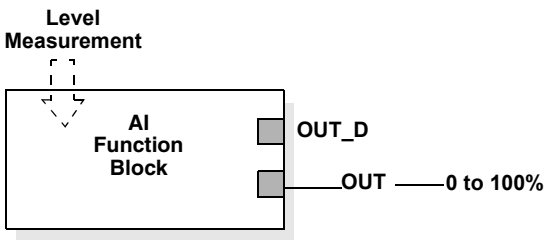

### Solution #2

Table 5-8 lists the appropriate configuration settings, and Figure 5-13 illustrates the correct function block configuration.

Table 5-8. Analog Input Function Block Configuration for a level gauge where level output is sealed between 0-100%

| Parameter | Configured Values |
|---|---|
| L_TYPE | Indirect |
| XD_SCALE | 0 to 14 m |
| OUT_SCALE | 0 to 100% |
| CHANNEL | 1 Level |

Figure 5-13. Function Block Diagram for a level gauge where level output is sealed between 0-100%

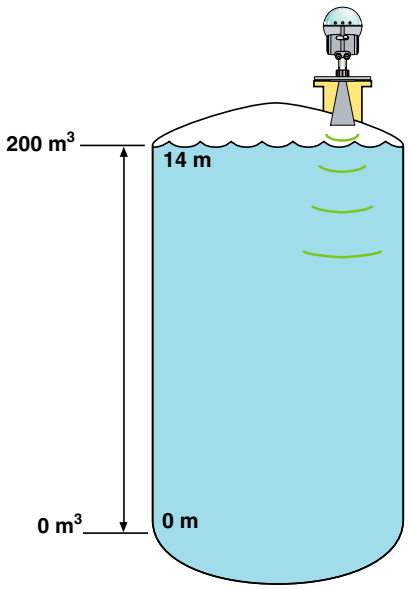


## Radar Level Gauge used to Display Volume

### Situation #3

The volume of the tank is to be calculated using the radar level gauge.

Figure 5-14. Situation #3 Diagram



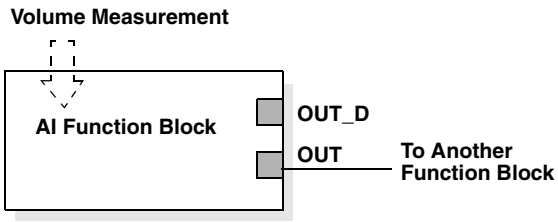

### Solution 3.1

In this solution the volume channel in the analog input block is used to obtain the volume.

Table 5-9. Analog Input Function Block Configuration for a radar level gauge used in level measurement (Situation #3)

| Parameter | Configured Values |
|---|---|
| L_TYPE | Direct |
| XD_SCALE | Not Used |
| OUT_SCALE | Not Used |
| Channel | 5 Volume |

Figure 5-15. Analog Input Function Block Diagram for a typical level gauge



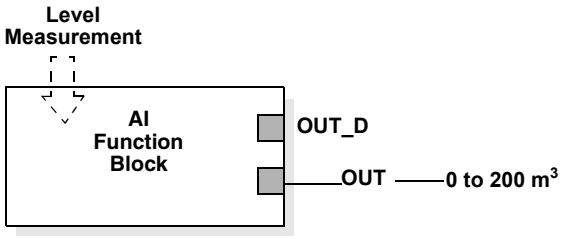
**Solution #3.2**

In this solution the level channel in the analog input block is used to obtain the volume.

Table 5-10. Analog Input Function Block Configuration for a radar level gauge used in level measurement (Situation #3)

| Parameter | Configured Values |
|---|---|
| L_TYPE | Indirect |
| XD_SCALE | 0 to 14 m |
| OUT_SCALE | 0 to 200 $m^3$ |
| Channel | 1 Level |

Figure 5-16. Function Block Diagram for a level gauge where level output is sealed between 0-100%




## 5.7 CONFIGURATION USING THE SENSOR BUS PORT

When using a TankRadar Pro with FOUNDATION Fieldbus the configuration of the gauge is done via DeltaV or other Fieldbus Host. With the help of Device descriptors these hosts are able to present, read, and write necessary information and data within the gauge and assist the user to a successful configuration of the gauge.

In some cases, there could be a need for a more advanced service access to the gauge. This is done by using the Radar Master and accessing the data from the Sensor Bus Port, which is always readily available. Below are instructions of how to connect this port and how to use it.

### 5.7.1 Electrical Connection

The electrical interface is RS485 (2-wire) and the language spoken (protocol) is Modbus.

To be able to connect to the Sensor Bus, you must have an RS232/485 converter. Below you find two models of such RS232/485 modems which have been successfully used to communicate with TankRadar Pro on the Sensor Bus. Basically any type of RS232/485 converter can be used but different models use different switches/settings etc., and therefore they are not listed here. The recommended type for field use is the K2.

The converter is to be connected on the Sensor Bus Port which is normally used by the Rosemount 2210 Display Unit. Disconnect the communication wires (X2: 6 & 7) to the Display Unit.

### Connecting the K2 ADE Modem

Once the Rosemount 2210 Display Unit has been disconnected, connect the K2 ADE modem to terminals 6 and 7 on the TankRadar Pro gauge according to Figure 5-17.

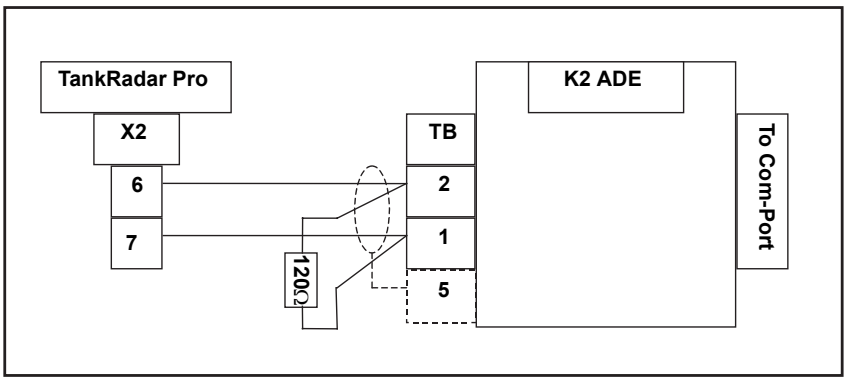
**NOTE**
The K2 can not be used in an Intrinsically Safe area.
The part number for the K2 ADE modem is 6853500-572.

The K2 ADE is a small and handy converter which is connected directly to the COM-port. It will take the power from the COM-port of the computer.

**NOTE**
Some computers can not supply enough power and in such cases you can try the 'intelligent' mode. This means you set a fixed Baud rate on the converter (using the DIP-switches) and it will control the RS485 dataflow direction automatically (without the need for any control signals (i.e. RTS) from Radar Master Software).

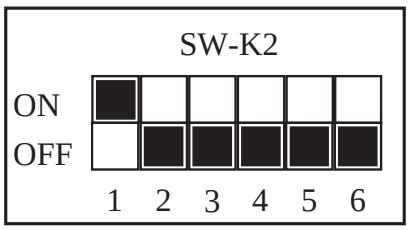
For best communication performance, a 120 ohm resistor must be connected on the K2 1 & 2 terminal.

Figure 5-17. Connection of the K2 Modem




Set the K2 converter per Figure 5-18 to be controlled by the RTS signal from the Radar Master software.

Figure 5-18. DIP-switch setting on the K2 converter.



### 5.7.2 Switching to Sensor Bus Mode

By using the “Sensor Bus method(1)” in DeltaV or applicable Fieldbus host the user is automatically setting the gauge in “Out Of Service” mode. Then it sets the gauge in the Sensor Bus Mode.

**Connection and configuration description**

1. Make the electrical connection, as described in Figure 5-17 and Figure 5-18.
2. When you start Radar Master you will get a ‘RRM Startup’ window with some options. Press Cancel. Go to: Open View\Communication Preferences\ and set the communication as below:
   - Disable the HART communication before Enabling the Modbus Communication (Only necessary if the same Communication Port is used).
   - Modem: RS485
   - Baud Rate: 4800
   - Stop bit: 1
   - Handshake: RTS/CTS/DTR/DSR
   - Retries: 10
   - The rest are left as default
3. Search for the gauge by selecting New Device in the Device menu. The default unit has Modbus address 246.
4. Once the gauge is found, select it and press OK.
5. Enter any Configuration or Service window within Radar Master and perform the configuration and setup as normally done.

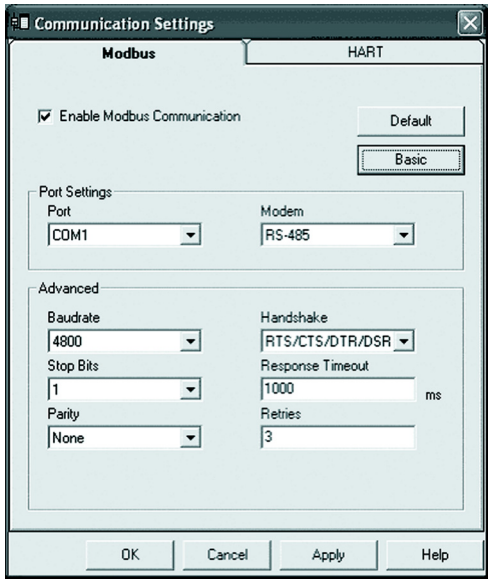
**NOTE**
Do not enter any Rosemount 2210 Display Unit configuration windows since the display unit is disconnected. This will result in a software halt in the gauge. Should this happen, please cycle the gauge power and restart the unit. Go back to Step 3 and continue from there.

6. When finished press “Disconnect” by right-clicking on the gauge in the Device explorer in Rosemount Radar Master.

Use the Online Help in Radar Master for further instructions of how to configure the gauge.

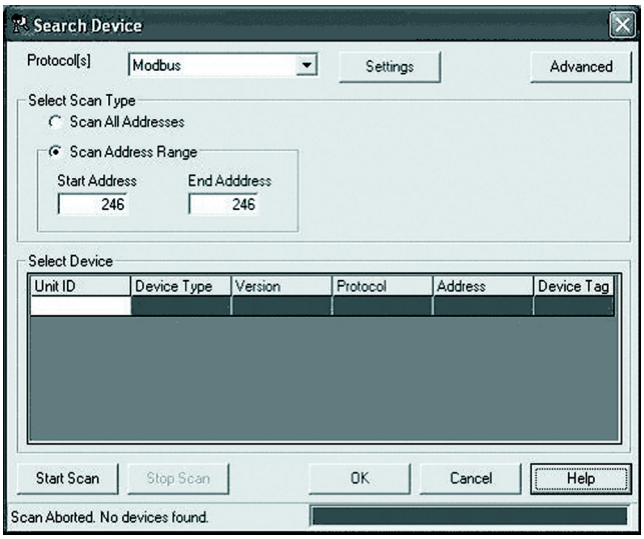
*(1) Some host systems do not support “methods”. For such systems, the gauge must be set in Sensor Bus mode from RadarMaster. See the on-line help for further instructions.*

Figure 5-19. Setting Modbus communication using the Radar Master




PRO_COMMUNICATION.TIF

Figure 5-20. Search for gauge using the Radar Master



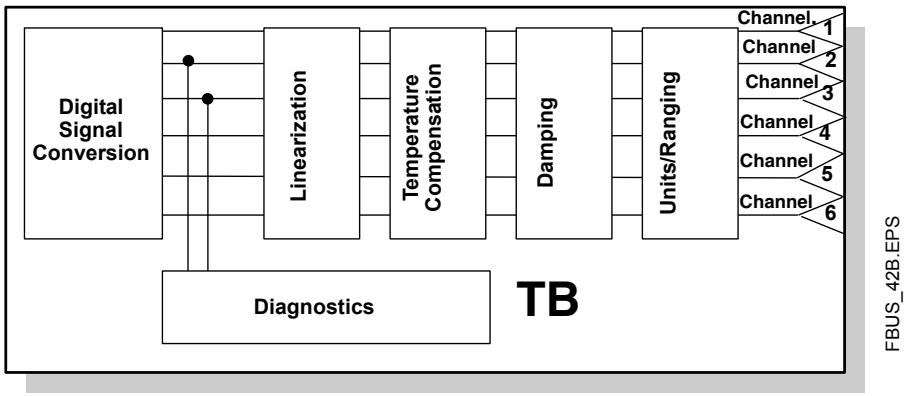

PRO_SEARCH.TIF

# 5.8 LEVEL TRANSDUCER BLOCK

## 5.8.1 Overview

This section contains information on the TankRadar Pro Transducer Block (TB). Descriptions of all Transducer Block parameters, errors, and diagnostics are listed. Also, the modes, alarm detection, status handling, application information, and troubleshooting are discussed.

Figure 5-21. Transducer Block Diagram




### Definition

The transducer block contains the actual measurement data, including a level and distance reading. Channels 1–6 are assigned to these measurements (see Figure 5-21). The transducer block includes information about sensor type, engineering units, and all parameters needed to configure the radar gauge.

### Channel Definitions

Each input has a channel assigned to it allowing the AI block to link to it. The channels for TankRadar Pro are the following:

Table 5-11. Channel Assignments

| AI-block | TB channel Value | Process variable |
|---|---|---|
| Level | 1 | CHANNEL_RADAR_LEVEL |
| Ullage | 2 | CHANNEL_RADAR_ULLAGE |
| Level Rate | 3 | CHANNEL_RADAR_LEVELRATE |
| Signal Strength | 4 | CHANNEL_RADAR_SIGNAL_STRENGTH |
| Volume | 5 | CHANNEL_RADAR_VOLUME |
| Average Temperature | 6 | CHANNEL_RADAR_AVG_TEMP |

## 5.8.2 Parameters and Descriptions

Table 5-12. Level Transducer Block Parameters and Descriptions

| Parameter | Index Number | Description |
|---|---|---|
| ST_REV | 1 | The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed. |
| TAG_DESC | 2 | The user description of the intended application of the block. |
| STRATEGY | 3 | The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. |
| ALERT_KEY | 4 | The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. |
| MODE_BLK | 5 | The actual, target, permitted, and normal modes of the block.<br>Target: The mode to “go to”<br>Actual: The mode the “block is currently in”<br>Permitted: Allowed modes that target may take on<br>Normal: Most common mode for target |
| BLOCK_ERR | 6 | This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. |
| UPDATE_EVT | 7 | This alert is generated by any change to the static data. |
| BLOCK_ALM | 8 | The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The fist alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |
| TRANSDUCER_DIRECTORY | 9 | Directory that specifies the number and starting indices of the transducers in the transducer block. |
| TRANSDUCER_TYPE | 10 | Identifies the transducer. |
| XD_ERROR | 11 | A transducer block alarm subcode. |
| COLLECTION_DIRECTORY | 12 | A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block. |
| RADAR_LEVEL_TYPE | 13 | |
| RADAR_LEVEL | 14 | Level Value |
| RADAR_LEVEL_RANGE | 15 | See Table 5-2 on page 5-10 |
| RADAR_ULLAGE | 16 | Ullage value |
| RADAR_LEVELRATE | 17 | Level Rate value |
| RADAR_LEVELRATE_RANGE | 18 | See Table 5-3 on page 5-10 |
| RADAR_SIGNAL_STRENGTH | 19 | Signal strength valve |
| RADAR_SIGNAL_STRENGTH_RANGE | 20 | See Table 5-5 on page 5-10 |
| RADAR_VOLUME | 21 | Volume valve |
| RADAR_VOLUME_RANGE | 22 | See Table 5-6 on page 5-10 |
| RADAR_AVG_TEMP | 23 | Average Temperature |
| RADAR_TEMP_1 | 24 | Spot temperature 1 |
| RADAR_TEMP_RANGE | 25 | See Table 5-4 on page 5-10 |
| RADAR_TEMP_2 | 26 | Spot temperature 2 |
| RADAR_TEMP_3 | 27 | Spot temperature 3 |
| RADAR_TEMP_4 | 28 | Spot temperature 4 |
| RADAR_TEMP_5 | 29 | Spot temperature 5 |
| RADAR_TEMP_6 | 30 | Spot temperature 6 |
| ANTENNA_TYPE | 31 | Antenna Type, see page 4-2 and Table 5-13 on page 5-21 |

| Parameter | Index Number | Description |
|---|---|---|
| ANTENNA_TCL | 32 | TCL (Tank connection Length), see page 4-2 and page 4-3 |
| ANTENNA_PIPE_DIAM | 33 | Pipe Diameter, see page 4-3 |
| GEOM_DIST_OFFSET | 34 | Distance offset, see page 4-5 |
| GEOM_TANK_HEIGHT | 35 | Tank Height, see page 4-4 |
| GEOM_MIN_LEVEL_OFFSET | 36 | Minimum distance offset, see page 4-5 |
| GEOM_HOLD_OFF | 37 | Hold Off, see page 4-3 |
| GEOM_CAL_DISTANCE | 38 | Calibration Distance, see page 4-6 |
| GEOM_TANK_TYPE | 39 | Tank Type, see page 4-4 and Table 5-17 on page 5-22 |
| GEOM_TANK_BOTTOM_TYPE | 40 | Tank Bottom Type, see page 4-4 and Table 5-18 on page 5-22 |
| ENV_ENVIRONMENT | 41 | |
| ENV_PRESENTATION | 42 | |
| ENV_DEVICE_MODE | 43 | Switch to sensor bus |
| ENV_TANK_TYPE_OPTIONS | 44 | Tank Type Options, see page 4-4 and Table 5-17 on page 5-22 |
| ENV_DIELECTR_CONST | 45 | Dielectrical Constant |
| DIAGN_DEV_ERR | 46 | |
| DIAGN_VERSION | 47 | Gauge SW version |
| DIAGN_REVISION | 48 | P1451 revision (NOTE: This version must be checked by the Output Board in order to verify that the software is compatible.) |
| DIAGN_DEVICE_ID | 49 | Device ID for the gauge |
| TEMP_NUM_SENSORS | 50 | Num Temp Spots |
| TEMP_SENSOR_TYPE | 51 | Sensor Type |
| TEMP_INSERT_DIST | 52 | Insertion distance |
| TEMP_EXCL_AVG_CALC | 53 | Exclude from Avg. Temp. calculation |
| TEMP_POS_1 | 54 | Position sensor 1 |
| TEMP_POS_2 | 55 | Position sensor 2 |
| TEMP_POS_3 | 56 | Position sensor 3 |
| TEMP_POS_4 | 57 | Position sensor 4 |
| TEMP_POS_5 | 58 | Position sensor 5 |
| TEMP_POS_6 | 59 | Position sensor 6 |
| STATS_ATTEMPTS | 60 | Ref 3 |
| STATS_FAILURES | 61 | Ref 3 |
| STATS_TIMEOUTS | 62 | Ref 3 |

Table 5-13. Antenna Type

| VALUE | ANTENNNA_TYPE |
|---|---|
| 0 | User Defined |
| 1 | Cone 4, PTFE |
| 2 | Cone 4, QUARTZ |
| 3 | Reserved |
| 4 | Reserved |
| 5 | Cone 6, PTFE |
| 6 | Cone 6, QUARTZ |
| 7 | Reserved |
| 8 | Reserved |
| 9 | Cone 8, PTFE |
| 10 | Cone 8, QUARTZ |
| 11 | Reserved |
| 12 | Reserved |
| 13 | Pipe, PTFE |
| 14 | Pipe, QUARTZ |
| 15 | Rod |
| 16 | Parabolic |
| 17 | Process Seal 4 PTFE |
| 18 | Process Seal 4 Ceramic |
| 19 | Process Seal 6 PTFE |
| 20 | Process Seal 6 Ceramic |
| 21 | Cone 3, PTFE |
| 22 | Cone 3, QUARTZ |
| 23 | Pipe ITG 6, PTFE |
| 24 | Pipe ITG 8, PTFE |
| 25 | Pipe ITG 10, PTFE |
| 26 | Pipe ITG 12, PTFE |

Table 5-14. Device Mode

| Value | ENV_DEVICE_MODE |
|---|---|
| 0 | FF bus |
| 1 | Sensorbus |
| 2 | Restart device |
| 3 | Set to factory default database |

Table 5-15. Environment

| Bit Number | Value of ENV_ENVIRONMENT | Description |
|---|---|---|
| 0 | 0 | - |
| 1 | 0X00000001 | Reserved |
| 2 | 0x00000002 | Rapid Changes |
| 3 | 0x00000004 | Reserved |
| 4 | 0x00000008 | Turbulent Surface |
| 5 | 0x00000010 | Foam |
| 6 | 0x00000020 | Solid Product |

Table 5-16. Presentation

| Bit Number | Value of Env_Presentation | Description |
|---|---|---|
| 0 | 0 | - |
| 1 | 0x00000001 | Reserved |
| 2 | 0x00000002 | Reserved |
| 3 | 0x00000004 | Reserved |
| 4 | 0x00000008 | Bottom echo visible |
| 5 | 0x00000010 | Tank contains double bounce |
| 6 | 0x00000020 | Slow Search |
| 7 | 0x00000040 | Double Surfaces |
| 8 | 0x00000080 | Select lower surface |
| 9 | 0x00000100 | - |
| 10 | 0x00000200 | Show negative levels as zero |
| 11 | 0x00000400 | Reserved |
| 12 | 0x00000800 | Reserved |
| 13 | 0x00001000 | Reserved |
| 14 | 0x00002000 | Reserved |
| 15 | 0x00004000 | Invalid level is NOT set if tank is empty |
| 16 | 0x00008000 | If set and if bit 12 not set, Invalid level is NOT set if tank is full |
| 17 | 0x00010000 | - |
| 18 | 0x00020000 | Reserved |
| 19 | 0x00040000 | Reserved |

Table 5-17. Tank Type

| Value | GEOM_TANK_TYPE |
|---|---|
| 0 | Unknown |
| 1 | Vertical Cylinder |
| 3 | Horizontal Cylinder |
| 4 | Spherical |
| 5 | Cubical |

Table 5-18. Tank Bottom Type

| Value | GEOM_TANK_BOTTOM_TYPE |
|---|---|
| 0 | Unknown |
| 1 | Flat |
| 2 | Dome |
| 3 | Cone |
| 4 | Flat Inclined |

Table 5-19. Dielectrical Constant

| Value | ENV_DIELECTR_CONST |
|---|---|
| 0 | Unknown |
| 1 | Range (1-2, 5) |
| 2 | Range (2, 4-5) |
| 3 | Range (4-10) |
| 4 | Range (>10) |

### 5.8.3 Diagnostics Device Errors

In addition to the BLOCK_ERR and XD_ERROR parameters, more detailed information on the measurement status can be obtained via DIAGN_DEV_ERR. Table 5-20 on page 5-23 lists the potential errors and the possible corrective actions for the given values. The corrective actions are in order of increasing system level compromises. The first step should always be to reset the gauge and then if the error persists, try the steps in Table 5-20. Start with the first corrective action and then try the second.

Table 5-20. Device Errors Diagnostics

| Bit Number | Value of DIAGN_DEV_ERR | Description |
|---|---|---|
| 0 | 0 | No alarm active |
| 1 | 0x00000001 | Reserved |
| 2 | 0x00000002 | FF card to gauge comm fault |
| 3 | 0x00000004 | Level Measurement Failure |
| 4 | 0x00000008 | Temperature Measurement Failure |
| 5 | 0x00000010 | Volume Measurement Failure |
| 6 | 0x00000020 | Invalid ATP |
| 7 | 0x00000040 | No surface echo |
| 8 | 0x00000080 | Tank signal clip warning |
| 9 | 0x00000100 | Empty Tank |
| 10 | 0x00000200 | Full Tank |
| 11 | 0x00000400 | Conf. Reg. Pwd. Enabled |
| 12 | 0x00000800 | DB Error |
| 13 | 0x00001000 | Microwave unit error |
| 14 | 0x00002000 | Display error |
| 15 | 0x00004000 | Analog out error |
| 16 | 0x00008000 | Other HW error |
| 17 | 0x00010000 | Configuration error |
| 18 | 0x00020000 | SW error |
| 19 | 0x00040000 | DB Warning |
| 20 | 0x00080000 | Microwave unit Warning |
| 21 | 0x00100000 | Display Warning |
| 22 | 0x00200000 | Analog out Warning |
| 23 | 0x00400000 | Other HW Warning |
| 24 | 0x00800000 | Configuration Warning |
| 25 | 0x01000000 | SW Warning |

Table 5-21. Temperature sensor type

| Value | TEMP_CONV_METHOD Description |
|---|---|
| 0 | User defined linearization table |
| 1 | User defined formula |
| 2 | DIN PT 100 |
| 3 | CU90 |

Table 5-22. Exclude from average temperature calculation

| Bit Number | Value of TEMP_EXCL_AVG_CALC | Description |
|---|---|---|
| 0 | 0 | - |
| 1 | 0x00000001 | Reserved |
| 2 | 0x00000002 | Exclude nbr. 1 |
| 3 | 0x00000004 | Exclude nbr. 2 |
| 4 | 0x00000008 | Exclude nbr. 3 |
| 5 | 0x00000010 | Exclude nbr. 4 |
| 6 | 0x00000020 | Exclude nbr. 5 |
| 7 | 0x00000040 | Exclude nbr. 6 |

### 5.8.4 Supported Units

Table 5-23. Length

| Value | Display | Description |
|---|---|---|
| 1010 | m | meter |
| 1018 | ft | feet |
| 1019 | in | inch |
| 1013 | mm | millimeter |

Table 5-24. Level Rate

| Value | Display | Description |
|---|---|---|
| 1067 | ft/s | feet per second |
| 1061 | m/s | meter per second |
| 1063 | m/h | meter per hour |

Table 5-25. Temperature

| Value | Display | Description |
|---|---|---|
| 1000 | K | Kelvin |
| 1001 | °C | Degree Celsius |
| 1002 | °F | Degree Fahrenheit |

Table 5-26. Signal Strength

| Value | Display | Description |
|---|---|---|
| 1243 | mV | Millivolt |

Table 5-27. Volume

| Value | Display | Description |
|---|---|---|
| 1034 | $m^3$ | Cubic meter |
| 1048 | Gallon | US gallon |
| 1051 | bbl | barrel |
| 1043 | $ft^3$ | Cubic feet |

## 5.9 RESOURCE BLOCK

### 5.9.1 Overview

This section contains information on the TankRadar Pro Resource Block. Descriptions of all Resource Block Parameters, errors, and diagnostics are included. Also the modes, alarm detection, status handling, and troubleshooting are discussed.

#### Definition

The resource block defines the physical resources of the device. The resource block also handles functionality that is common across multiple blocks. The block has no linkable inputs or outputs.

### 5.9.2 Parameters and Descriptions

The table below lists all of the configurable parameters of the Resource Block, including the descriptions and index numbers for each.

Table 5-28. Resource Block parameters.

| Parameter | Index Number | Description |
|---|---|---|
| ACK_OPTION | 38 | Selection of whether alarms associated with the function block will be automatically acknowledged. |
| ADVISE_ACTIVE | 82 | Enumerated list of advisory conditions within a device. |
| ADVISE_ALM | 83 | Alarm indicating advisory alarms. These conditions do not have a direct impact on the process or device integrity. |
| ADVISE_ENABLE | 80 | Enabled ADVISE_ALM alarm conditions. Corresponds bit for bit to the ADVISE_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. |
| ADVISE_MASK | 81 | Mask of ADVISE_ALM. Corresponds bit of bit to ADVISE_ACTIVE. A bit on means that the condition is masked out from alarming. |
| ADVISE_PRI | 79 | Designates the alarming priority of the ADVISE_ALM |
| ALARM_SUM | 37 | The current alert status, unacknowledged states, unreported states, and disabled states of the alarms associated with the function block. |
| ALERT_KEY | 04 | The identification number of the plant unit. |
| BLOCK_ALM | 36 | The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The first alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |
| BLOCK_ERR | 06 | This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. |
| CLR_FSAFE | 30 | Writing a Clear to this parameter will clear the device FAIL_SAFE if the field condition has cleared. |
| CONFIRM_TIME | 33 | The time the resource will wait for confirmation of receipt of a report before trying again. Retry will not happen when CONFIRM_TIME=0. |
| CYCLE_SEL | 20 | Used to select the block execution method for this resource. TankRadar Pro supports the following:<br>Scheduled: Blocks are only executed based on the function block schedule.<br>Block Execution: A block may be executed by linking to another blocks completion. |

| Parameter | Index Number | Description |
|---|---|---|
| CYCLE_TYPE | 19 | Identifies the block execution methods available for this resource. |
| DD_RESOURCE | 09 | String identifying the tag of the resource which contains the Device Description for this resource. |
| DD_REV | 13 | Revision of the DD associated with the resource - used by an interface device to locate the DD file for the resource. |
| DEFINE_WRITE_LOCK | 60 | Allows the operator to select how WRITE_LOCK behaves. The initial value is “lock everything”. If the value is set to “lock only physical device” then the resource and transducer blocks of the device will be locked but changes to function blocks will be allowed. |
| DETAILED_STATUS | 55 | Indicates the state of the gauge. See Resource Block detailed status codes. |
| DEV_REV | 12 | Manufacturer revision number associated with the resource - used by an interface device to locate the DD file for the resource. |
| DEV_STRING | 43 | This is used to load new licensing into the device. The value can be written but will always read back with a value of 0. |
| DEV_TYPE | 11 | Manufacturer’s model number associated with the resource - used by interface devices to locate the DD file for the resource. |
| DIAG_OPTION | 46 | Indicates which diagnostics licensing options are enabled. |
| DISTRIBUTOR | 42 | Reserved for use as distributor ID. No Foundation enumerations defined at this time. |
| DOWNLOAD_MODE | 67 | Gives access to the boot block code for over-the-wire downloads.<br>0 = Uninitialized<br>1 = Run mode<br>2 = Download mode |
| FAIL_SAFE | 28 | Condition set by loss of communication to an output block, fault promoted to an output block or physical contact. When FAIL_SAFE condition is set, then output function blocks will perform their FAIL_SAFE actions. |
| FAILED_ACTIVE | 72 | Enumerated list of failure conditions within a device. |
| FAILED_ALM | 73 | Alarm indicating a failure within a device which makes the device non-operational. |
| FAILED_ENABLE | 70 | Enabled FAILED_ALM alarm conditions. Corresponds bit for bit to the FAILED_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. |
| FAILED_MASK | 71 | Mask of FAILED_ALM. Corresponds bit of bit to FAILED_ACTIVE. A bit on means that the condition is masked out from alarming. |
| FAILED_PRI | 69 | Designates the alarming priority of the FAILED_ALM. |
| FB_OPTION | 45 | Indicates which function block licensing options are enabled. |
| FEATURES | 17 | Used to show supported resource block options. See Error! Reference source not found. The supported features are: SOFT_WRITE_LOCK_SUPPORT, HARD_WRITE_LOCK_SUPPORT, REPORTS, and UNICODE |
| FEATURES_SEL | 18 | Used to select resource block options. |
| FINAL_ASSY_NUM | 54 | The same final assembly number placed on the neck label. |
| FREE_SPACE | 24 | Percent of memory available for further configuration. Zero in a preconfigured device. |
| FREE_TIME | 25 | Percent of the block processing time that is free to process additional blocks. |
| GRANT_DENY | 14 | Options for controlling access of host computers and local control panels to operating, tuning, and alarm parameters of the block. Not used by device. |
| HARD_TYPES | 15 | The types of hardware available as channel numbers. |
| HARDWARE_REV | 52 | Hardware revision of the hardware that has the resource block in it. |
| ITK_VER | 41 | Major revision number of the inter operability test case used in certifying this device as interoperable. The format and range are controlled by the Fieldbus Foundation. |
| LIM_NOTIFY | 32 | Maximum number of unconfirmed alert notify messages allowed. |
| MAINT_ACTIVE | 77 | Enumerated list of maintenance conditions within a device. |
| MAINT_ALM | 78 | Alarm indicating the device needs maintenance soon. If the condition is ignored, the device will eventually fail. |
| MAINT_ENABLE | 75 | Enabled MAINT_ALM alarm conditions. Corresponds bit for bit to the MAINT_ACTIVE. A bit on means that the corresponding alarm condition is enabled and will be detected. A bit off means the corresponding alarm condition is disabled and will not be detected. |
| MAINT_MASK | 76 | Mask of MAINT_ALM. Corresponds bit of bit to MAINT_ACTIVE. A bit on means that the condition is masked out from alarming. |

| Parameter | Index Number | Description |
|---|---|---|
| MAINT_PRI | 74 | Designates the alarming priority of the MAINT_ALM |
| MANUFAC_ID | 10 | Manufacturer identification number – used by an interface device to locate the DD file for the resource. |
| MAX_NOTIFY | 31 | Maximum number of unconfirmed notify messages possible. |
| MEMORY_SIZE | 22 | Available configuration memory in the empty resource. To be checked before attempting a download. |
| MESSAGE_DATE | 57 | Date associated with the MESSAGE_TEXT parameter. |
| MESSAGE_TEXT | 58 | Used to indicate changes made by the user to the device's installation, configuration, or calibration. |
| MIN_CYCLE_T | 21 | Time duration of the shortest cycle interval of which the resource is capable. |
| MISC_OPTION | 47 | Indicates which miscellaneous licensing options are enabled. |
| MODE_BLK | 05 | The actual, target, permitted, and normal modes of the block:<br>Target: The mode to “go to”<br>Actual: The mode the “block is currently in”<br>Permitted: Allowed modes that target may take on<br>Normal: Most common mode for actual |
| NV_CYCLE_T | 23 | Minimum time interval specified by the manufacturer for writing copies of NV parameters to non-volatile memory. Zero means it will never be automatically copied. At the end of NV_CYCLE_T, only those parameters which have changed need to be updated in NVRAM. |
| OUTPUT_BOARD_SN | 53 | Output board serial number. |
| RB_SFTWR_REV_ALL | 51 | The string will contains the following fields:<br>Major rev: 1-3 characters, decimal number 0-255<br>Minor rev: 1-3 characters, decimal number 0-255<br>Build rev: 1-5 characters, decimal number 0-255<br>Time of build: 8 characters, xx:xx:xx, military time<br>Day of week of build: 3 characters, Sun, Mon,...<br>Month of build: 3 characters, Jan, Feb.<br>Day of month of build: 1-2 characters, decimal number 1-31<br>Year of build: 4 characters, decimal<br>Builder: 7 characters, login name of builder |
| RB_SFTWR_REV_BUILD | 50 | Build of software that the resource block was created with. |
| RB_SFTWR_REV_MAJOR | 48 | Major revision of software that the resource block was created with. |
| RB_SFTWR_REV_MINOR | 49 | Minor revision of software that the resource block was created with. |
| RECOMMENDED_ACTION | 68 | Enumerated list of recommended actions displayed with a device alert. |
| RESTART | 16 | Allows a manual restart to be initiated. Several degrees of restart are possible. They are the following:<br>1 Run – nominal state when not restarting<br>2 Restart resource – not used<br>3 Restart with defaults – set parameters to default values. See START_WITH_DEFAULTS below for which parameters are set.<br>4 Restart processor – does a warm start of CPU. |
| RS_STATE | 07 | State of the function block application state machine. |
| SAVE_CONFIG_BLOCKS | 62 | Number of EEPROM blocks that have been modified since last burn. This value will count down to zero when the configuration is saved. |
| SAVE_CONFIG_NOW | 61 | Allows the user to optionally save all non-volatile information immediately. |
| SECURITY_IO | 65 | Status of security switch. |
| SELF_TEST | 59 | Instructs resource block to perform self-test. Tests are device specific. |
| SET_FSAFE | 29 | Allows the FAIL_SAFE condition to be manually initiated by selecting Set. |
| SHED_RCAS | 26 | Time duration at which to give up on computer writes to function block RCas locations. Shed from RCas shall never happen when SHED_ROUT = 0 |
| SHED_ROUT | 27 | Time duration at which to give up on computer writes to function block ROut locations. Shed from ROut shall never happen when SHED_ROUT = 0 |
| SIMULATE_IO | 64 | Status of simulate switch. |

| Parameter | Index Number | Description |
|---|---|---|
| SIMULATE_STATE | 66 | The state of the simulate switch:<br>0 = Uninitialized<br>1 = Switch off, simulation not allowed<br>2 = Switch on, simulation not allowed (need to cycle jumper/switch)<br>3 = Switch on, simulation allowed |
| ST_REV | 01 | The revision level of the static data associated with the function block. |
| START_WITH_DEFAULTS | 63 | 0 = Uninitialized<br>1 = do not power-up with NV defaults<br>2 = power-up with default node address<br>3 = power-up with default pd_tag and node address<br>4 = power-up with default data for the entire communications stack (no application data) |
| STRATEGY | 03 | The strategy field can be used to identify grouping of blocks. |
| SUMMARY_STATUS | 56 | An enumerated value of repair analysis. |
| TAG_DESC | 02 | The user description of the intended application of the block. |
| TEST_RW | 08 | Read/write test parameter - used only for conformance testing. |
| UPDATE_EVT | 35 | This alert is generated by any change to the static data. |
| WRITE_ALM | 40 | This alert is generated if the write lock parameter is cleared. |
| WRITE_LOCK | 34 | If set, no writes from anywhere are allowed, except to clear WRITE_LOCK. Block inputs will continue to be updated. |
| WRITE_PRI | 39 | Priority of the alarm generated by clearing the write lock. |
| XD_OPTION | 44 | Indicates which transducer block licensing options are enabled. |

## 5.10 REGISTER TRANSDUCER BLOCK

### 5.10.1 Overview

The Register Transducer Block allows access to Database registers and Input registers of the TankRadar Pro gauge. This makes it possible to read a selected set of register directly by accessing the memory location.

The Register Transducer Block is only available with advanced service.

**WARNING!**
Since this Register Transducer Block allows access to most registers in the gauge, which includes the registers set by the Methods and Configuration screens, in the Level Transducer Block (see "*Level Transducer Block"* on page 5-18) it should be handled with care and ONLY to be changed by trained and certified service personnel.

## 5.10.2 Register Access Transducer Block Parameters

Table 5-29. Register Transducer Block parameters.

| Parameter | Index Number | Description |
|---|---|---|
| ST_REV | 1 | The revision level of the static data associated with the function block. The revision value increments each time a static parameter value in the block is changed. |
| TAG_DESC | 2 | The user description of the intended application of the block. |
| STRATEGY | 3 | The strategy field can be used to identify grouping of blocks. This data is not checked or processed by the block. |
| ALERT_KEY | 4 | The identification number of the plant unit. This information may be used in the host for sorting alarms, etc. |
| MODE_BLK | 5 | The actual, target, permitted, and normal modes of the block.<br>Target: The mode to “go to”<br>Actual: The mode the “block is currently in”<br>Permitted: Allowed modes that target may take on<br>Normal: Most common mode for target |
| BLOCK_ERR | 6 | This parameter reflects the error status associated with the hardware or software components associated with a block. It is a bit string, so that multiple errors may be shown. |
| UPDATE_EVT | 7 | This alert is generated by any change to the static data. |
| BLOCK_ALM | 8 | The block alarm is used for all configuration, hardware, connection failure or system problems in the block. The cause of the alert is entered in the subcode field. The fist alert to become active will set the Active status in the Status parameter. As soon as the Unreported status is cleared by the alert reporting task, another block alert may be reported without clearing the Active status, if the subcode has changed. |
| TRANSDUCER_DIRECTORY | 9 | Directory that specifies the number and starting indices of the transducers in the transducer block. |
| TRANSDUCER_TYPE | 10 | Identifies the transducer.<br>100 = Standard pressure with calibration |
| XD_ERROR | 11 | A transducer block alarm subcode. |
| COLLECTION_DIRECTORY | 12 | A directory that specifies the number, starting indices, and DD Item ID’s of the data collections in each transducer within a transducer block. |
| INP_SEARCH_START_NBR | 13 | Search start number for input registers |
| DB_SEARCH_START_NBR | 14 | Search start number for holding registers |
| INP_REG_1_NAME | 16 | Name of the register |
| INP_REG_1_FLOAT | 17 | If the register contains a float value it shall be displayed here |
| INP_REG_1_INT_DEC | 18 | If the register contains a DWORD value and *dec* is chosen, it shall be displayed here |
| INP_REG_2_NAME | 20 | |
| INP_REG_2_FLOAT | 21 | |
| INP_REG_2_INT_DEC | 22 | |
| INP_REG_3_NAME | 24 | |
| INP_REG_3_FLOAT | 25 | |
| INP_REG_3_INT_DEC | 26 | |
| INP_REG_4_NAME | 28 | |
| INP_REG_4_FLOAT | 29 | |
| INP_REG_4_INT_DEC | 30 | |
| INP_REG_5_NAME | 32 | |
| INP_REG_5_FLOAT | 33 | |
| INP_REG_5_INT_DEC | 34 | |
| INP_REG_6_NAME | 36 | |

| Parameter | Index Number | Description |
|---|---|---|
| INP_REG_6_FLOAT | 37 | |
| INP_REG_6_INT_DEC | 38 | |
| INP_REG_7_NAME | 40 | |
| INP_REG_7_FLOAT | 41 | |
| INP_REG_7_INT_DEC | 42 | |
| INP_REG_8_NAME | 44 | |
| INP_REG_8_FLOAT | 45 | |
| INP_REG_8_INT_DEC | 46 | |
| INP_REG_9_NAME | 48 | |
| INP_REG_9_FLOAT | 49 | |
| INP_REG_9_INT_DEC | 50 | |
| INP_REG_10_NAME | 52 | |
| INP_REG_10_FLOAT | 53 | |
| INP_REG_10_INT_DEC | 54 | |
| DB_REG_1_NAME | 57 | Name of the register |
| DB_REG_1_FLOAT | 58 | If the register contains a float value it shall be displayed here |
| DB_REG_1_INT_DEC | 59 | If the register contains a DWORD value and *dec* is chosen, it shall be displayed here |
| DB_REG_2_NAME | 61 | |
| DB_REG_2_FLOAT | 62 | |
| DB_REG_2_INT_DEC | 63 | |
| DB_REG_3_NAME | 65 | |
| DB_REG_3_FLOAT | 66 | |
| DB_REG_3_INT_DEC | 67 | |
| DB_REG_4_NAME | 69 | |
| DB_REG_4_FLOAT | 70 | |
| DB_REG_4_INT_DEC | 71 | |
| DB_REG_4_NAME | 73 | |
| DB_REG_4_FLOAT | 74 | |
| DB_REG_4_INT_DEC | 75 | |
| DB_REG_5_NAME | 77 | |
| DB_REG_5_FLOAT | 78 | |
| DB_REG_5_INT_DEC | 79 | |
| DB_REG_6_NAME | 81 | |
| DB_REG_6_FLOAT | 82 | |
| DB_REG_6_INT_DEC | 83 | |
| DB_REG_7_NAME | 85 | |
| DB_REG_7_FLOAT | 86 | |
| DB_REG_7_INT_DEC | 87 | |
| DB_REG_8_NAME | 89 | |
| DB_REG_8_FLOAT | 90 | |
| DB_REG_8_INT_DEC | 91 | |
| DB_REG_9_NAME | 93 | |
| DB_REG_9_FLOAT | 94 | |
| DB_REG_9_INT_DEC | 95 | |
| DB_REG_10_NAME | 97 | |
| DB_REG_10_FLOAT | 98 | |
| DB_REG_10_INT_DEC | 99 | |
| INP_SEARCH_CHOICE | 101 | Search for register by name or by number. |
| INP_SEARCH_START_GROUP | 102 | Available when searching by name |
| INP_SEARCH_START_NAME | 103 | Available when searching by name |
| DB_SEARCH_CHOICE | 104 | Search for register by name or by number |
| DB_SEARCH_START_GROUP | 105 | Available when searching by name |
| DB_SEARCH_START_NAME | 106 | Available when searching by name |

# 6. HART Configuration

Commissioning consists of testing the gauge and verifying gauge configuration data. TankRadar Pro can be commissioned either before or after installation.

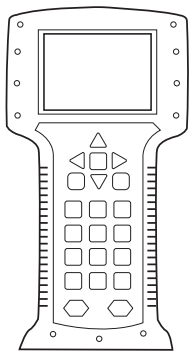
To commission, connect the gauge and the Handheld Communicator according to intrinsically safe or non-incendive field wiring practices in an explosive atmosphere. Connect the Communicator leads at any termination point in the signal loop.

To enable communication, a resistance of at least 250 ohms must be present between the Communicator loop connection and the power supply. Do not use inductive-based transient protectors with TankRadar Pro.

When using a Handheld Communicator, any configuration changes made must be sent to the gauge by using the “Send” key (F2). AMS configuration changes are implemented when the “Apply” button is clicked. See “*Connecting HART Devices”* on page 3-12 on how to connect the Communicator.

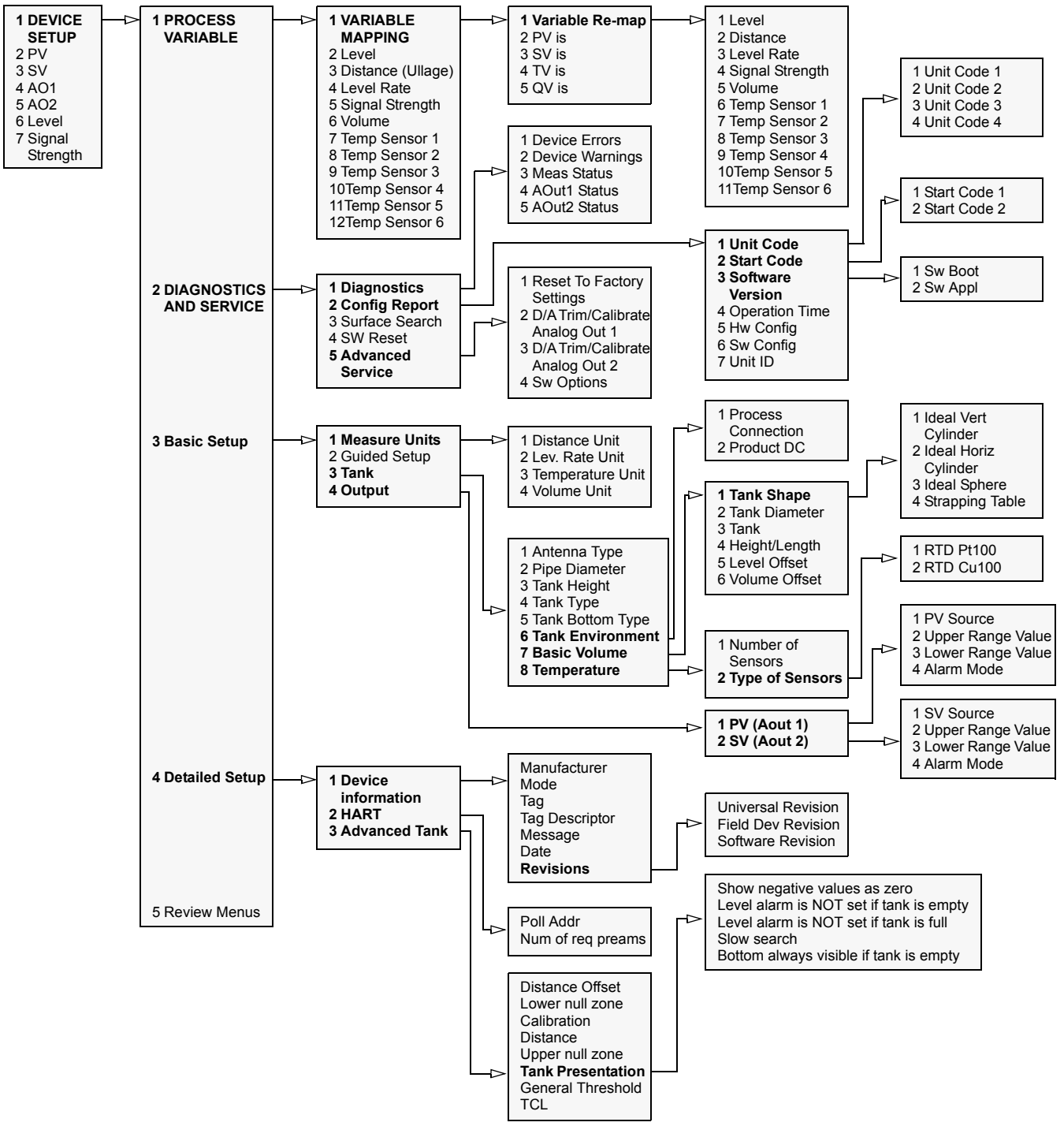
For more information on the 275 /375 Handheld Communicator, see Rosemount document 00275-8026-0002.

Figure 6-1. Rosemount 375 Handheld Communicator



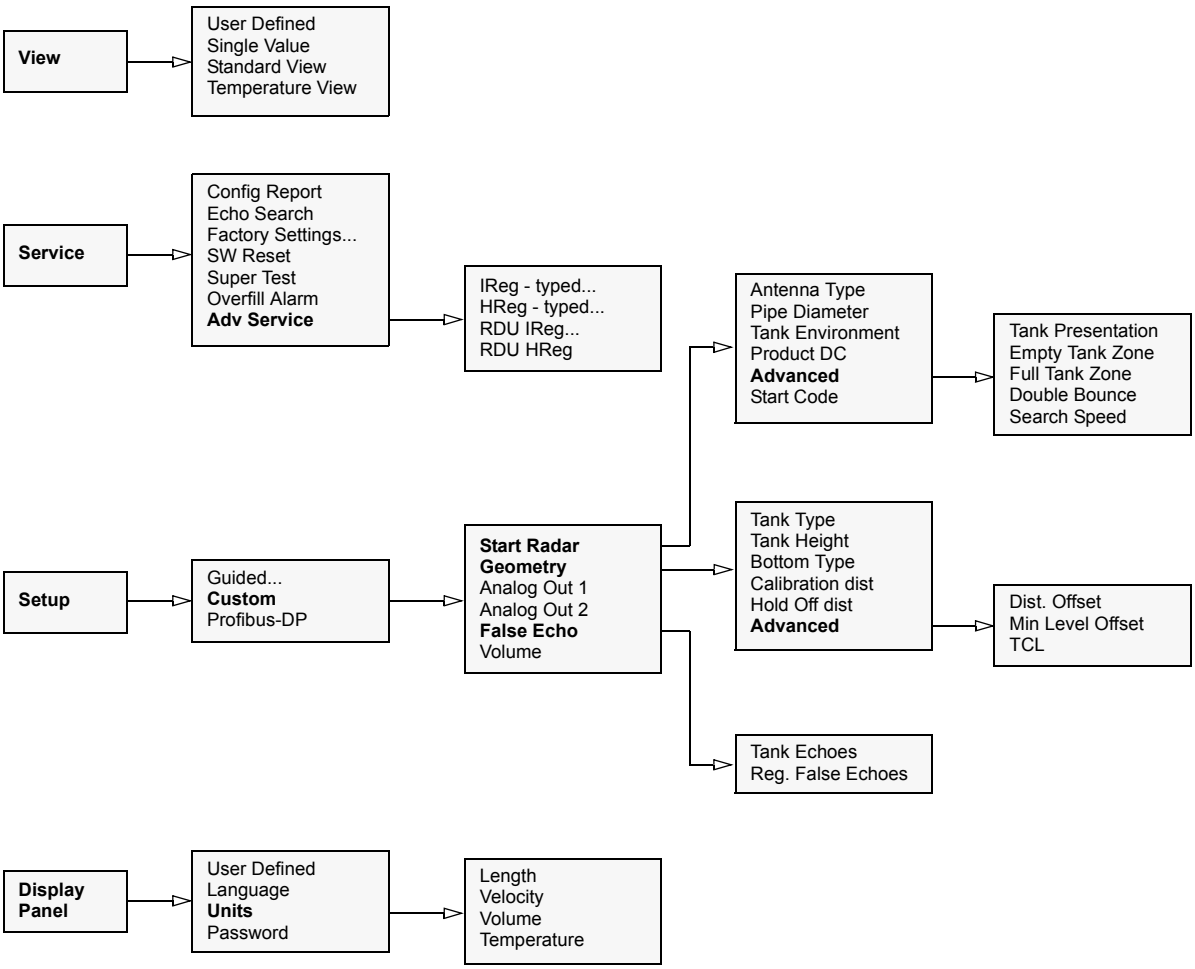
375_FRONT.EPS

Figure 6-2. HART Menu Tree for the TankRadar Pro Radar Level Gauge



# 7. Using the 2210 Display Unit

## 7.1 MENU OVERVIEW

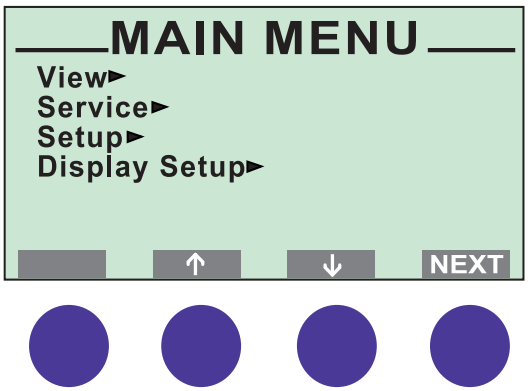


## 7.2 OPERATION

You can use the 2210 Display Unit for configuration as well as for viewing tank data. The four softkeys allow you to navigate through the different menus, and to select various functions for service and configuration. (See Section 3: Electrical Installation for information on how to connect the 2210 Display Unit).

If you leave the Display Unit in Service or Setup mode without pushing any button for 10 minutes (set in User Defined), it is automatically switched to View mode, presenting the same measurement variable that was displayed last time View mode was open.

Figure 7-1. Main menu options.




MAINMENU_43.EPS

The **Main menu** contains the following options:

- The **View** option allows you to view level data and signal strength.
- The **Service** option allows you to view configuration status, edit holding registers, reset holding registers to factory values, do a software reset or to start a search for the surface echo.
- The **Setup** option allows you to configure a *TankRadar Pro* gauge.
- The **Display Setup** option allows you to set units for displayed values, to set language and to change the user password.

### 7.2.1 Adjusting the LCD Contrast

The LCD contrast can be increased by simultaneously pressing the two buttons on the right-hand side. Press the two left-hand buttons to decrease the contrast. It takes approximately 10 seconds to adjust from minimum to maximum display panel contrast.

Figure 7-2. 2210 Display Unit.


DISPLAY_ILL.TIF

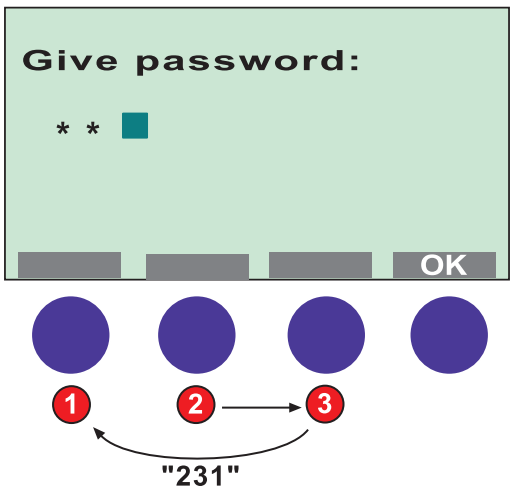
### 7.2.2 Entering a Password

Some windows are protected by a password. The password is entered by pressing the three blank softkeys in a certain order (maximum 12 characters). Each figure refers to a particular softkey, as illustrated below.

As default the password is blank, i.e. you can open a password protected window merely by pressing the OK button. In order to use the password protection you have to set the password as described in *"Display Setup" on page 7-10* and below.

If, for example, the password is "231", you start by pressing the second key, then the third key and finally the first softkey. You can change password at any time by opening the **Display Setup** menu.

Figure 7-3. The three softkeys to the left can be used to enter a password.

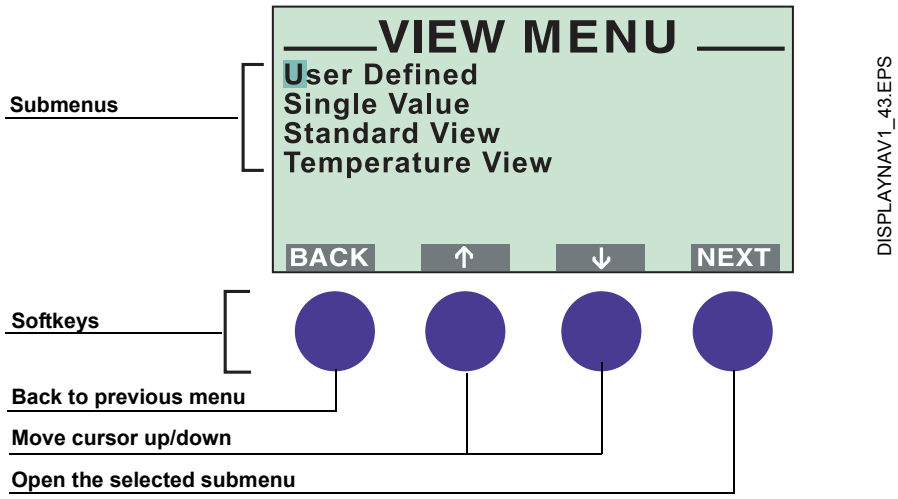



PSSWDENT_43.EPS

### 7.2.3 Softkeys

The softkeys have different meanings depending on which window that is open. Use the arrow buttons to move the cursor up and down (or sideways in some windows). These buttons are also used for changing figures when you are asked to enter a value.

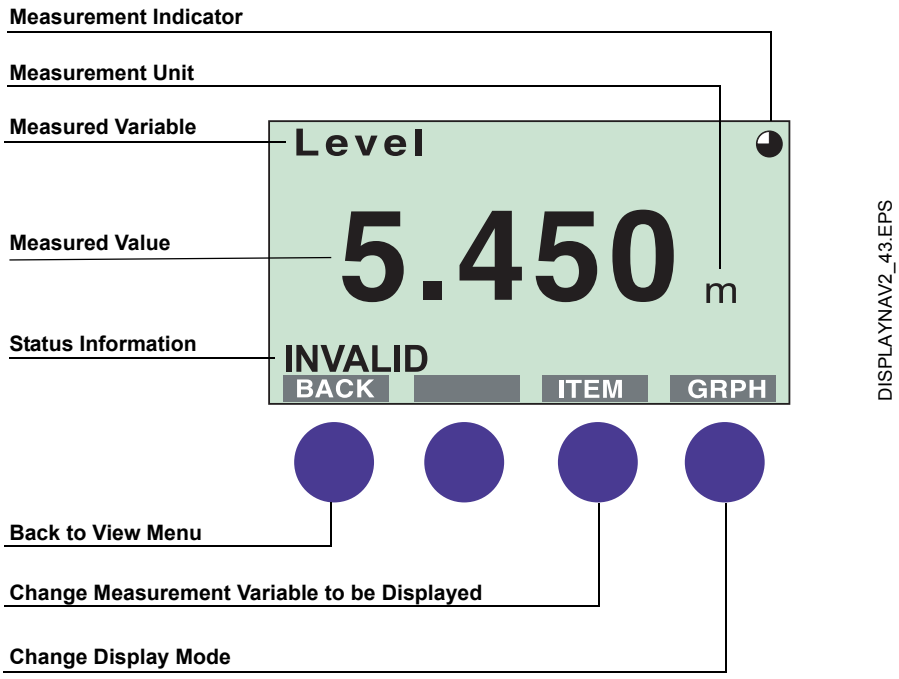
Figure 7-4. The softkeys have different meanings depending on which window is open.




### 7.2.4 Presentation of Measured Data

When viewing measurement data, you can use the softkeys to move between different views as illustrated below. There are also status indicators showing you that measurements are performed, and whether these measurements are valid or not.

Figure 7-5. Measurement data and software key functions.

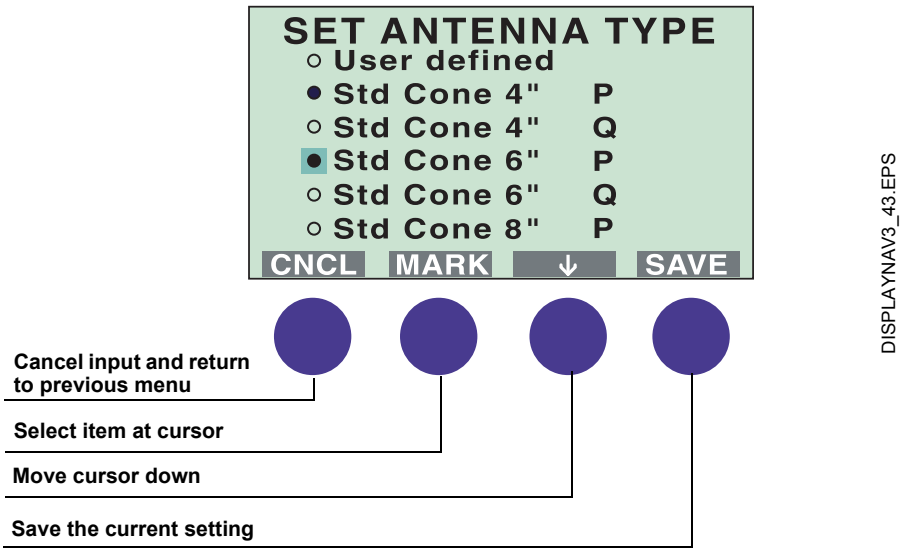


### 7.2.5 Selecting Between Different Alternatives

When you configure TankRadar Pro, the softkeys will take on definitions which allow you to select specific items and to save the current settings.

When the cursor has reached the last item, it jumps back to the first item by pressing the ↓ button.

Figure 7-6. Selecting options and saving settings.

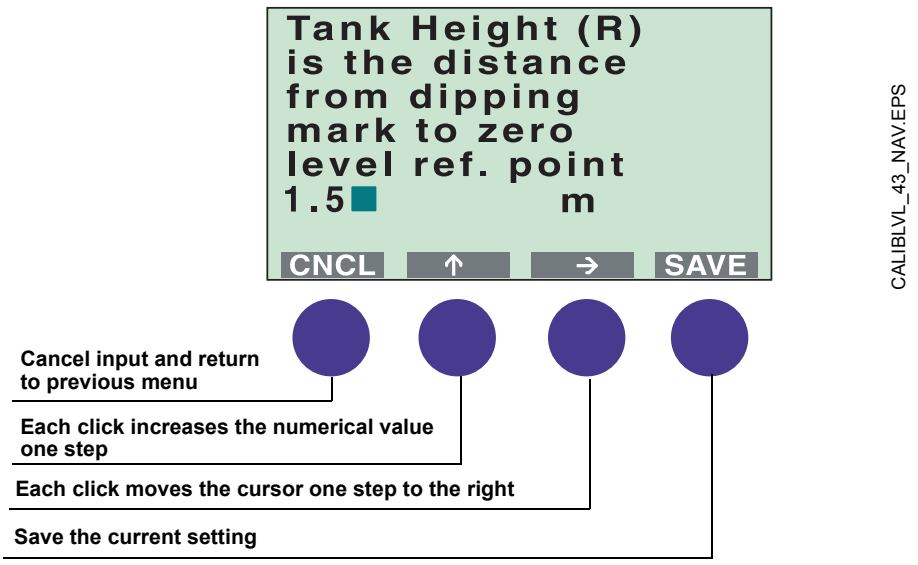



### 7.2.6 Entering Numerical Values

Use the ↑ button to enter the desired value. Each click increases the digit value one step from zero to nine.

Use the → button to move the cursor to the next digit. When the cursor reaches the last digit, select the → button to move back to the first digit again.

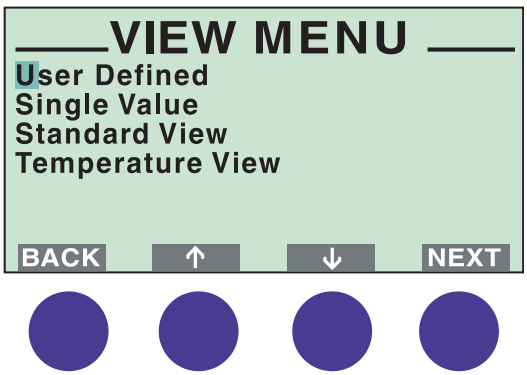
Figure 7-7. How to enter numerical values with the softkey arrow buttons.



## 7.3 VIEWING LEVEL DATA

### 7.3.1 The View Menu

Figure 7-8. The **View Menu** includes options for viewing tank and gauge related data.




VIEWMENU_43.EPS

- Press the BACK button to return to the Main menu.
- Use the ↑ or the ↓ button to move the cursor up or down.
- Press the NEXT button to open the selected submenu.

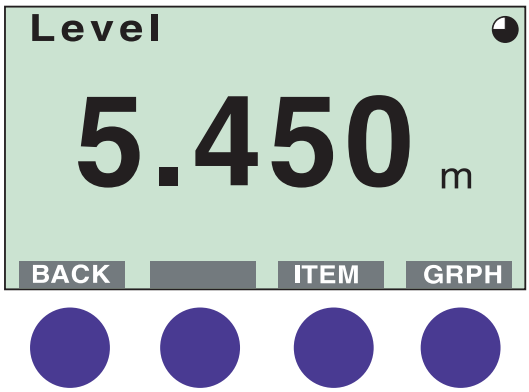
#### User Defined

Select the User Defined submenu to view measured data according to defined settings. The first time this submenu is accessed you will be asked to define your preferred settings, see *"Display Setup" on page 7-10*. These settings can of course be changed later on.

## Single Value

Select the **Single Value** submenu to view measured data.

Figure 7-9. The Single Value menu shows one variable. It is possible to switch between variables with the softkeys.




VIEWDISP_43.EPS

Press the ITEM button to choose between the different options:

- Level
- Distance
- Level Rate
- Signal Strength
- Volume
- Average Temperature
- Temperature spots 1-6

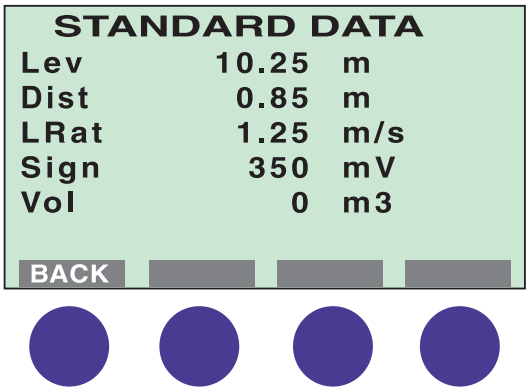
The GRPH button allows you to switch between display modes:

| | |
|---|---|
| Numerical | measured data is presented as a value. |
| Bar graph | the measured value is presented in a bar graph showing the current Level, Distance or Volume value. |

## Standard View

Select the **Standard View** option from the **View** menu to view a list of measured variables.

Figure 7-10. The Standard View lists all gauge variables.

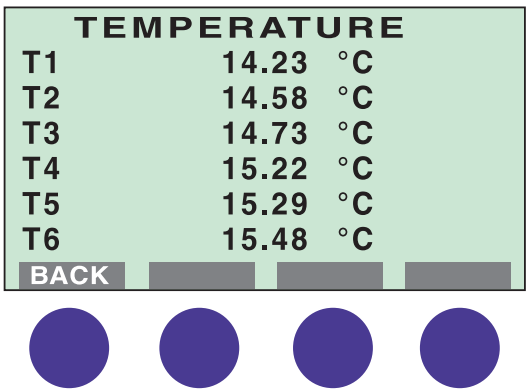



VIEWSTANDARD_43.EPS

## Temperature View

Select the **Temperature View** option to view measured temperatures from the connected temperature sensors.

Figure 7-11. The Temperature View lists measurements from the connected temperature sensors.



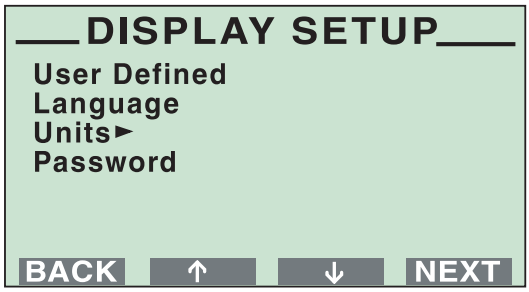

VIEWTEMP_43.EPS

## 7.4 DISPLAY SETUP

Use this option to set presentation units, language and password. If you do not want to change the default settings, you can skip this step and go to Guided or Custom Setup.

To configure the display panel, you need to access the Display Setup Window. This is done by selecting the Display Setup option from the Main Menu and pressing the NEXT button.

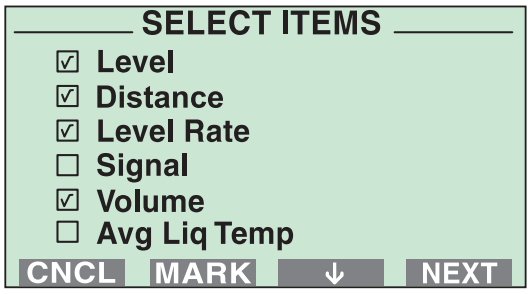
Figure 7-12. The Display Setup is used for various settings such as units, language and password.



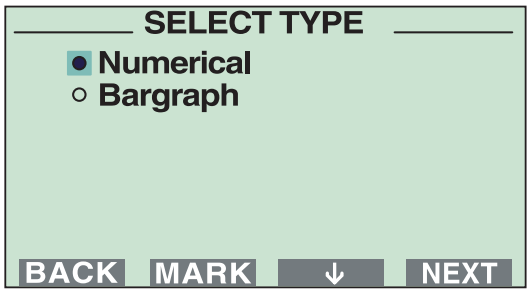

DISPLAYSETUP_43.EPS

## 7.4.1 User Defined View

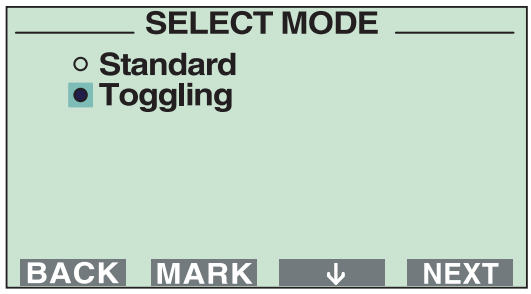
TRPRO_USER_DEFINED_SELECT.EPS TRPRO_USER_DEFINED_TYPE.EPS TRPRO_USER_DEFINED_MODE.EPS TRPRO_USER_DEFINED_EACH_ITEM.EPS



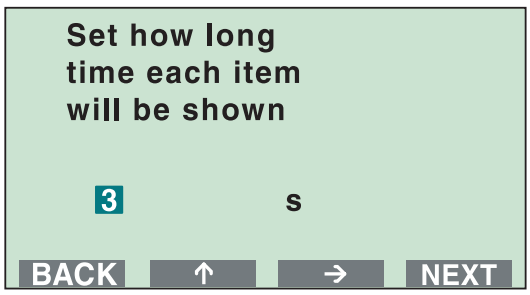

1. Select **User Defined** and press the NEXT button.



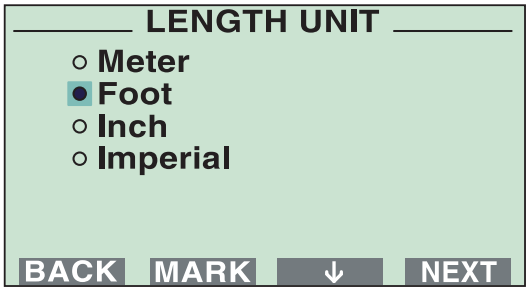

2. The number of selections above decides if the next choice is to select type or mode. If one item was selected, select type and press the NEXT button.




If two or more items were selected, select mode and press the NEXT button. For the toggling mode also select how long each item will be shown and press the NEXT button.



TRPRO_USER_DEFINED_UNIT.EPS




3. Select units for the selected items and press the NEXT button.

TRPRO_USER_DEFINED_TIMEOUT.EPS


4. Set timeout in minutes for the display to return to default view and press the SAVE button.

### 7.4.2 Language

1. Select **Language** and press the NEXT button.
2. Move the cursor to the preferred language and press the MARK button.
3. Save your choice by pressing the SAVE button

   ***Response**: the display returns to view mode.*

### 7.4.3 Units

1. Select the **Units** menu and press the NEXT button.
2. Select **Length**, **Velocity**, **Volume** or **Temperature** and press the NEXT button. MARK the measurement unit to be used for presentation of data and click the SAVE button.

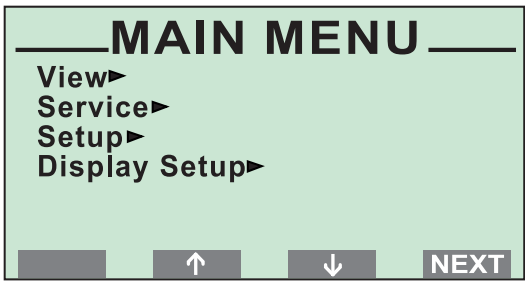
### 7.4.4 Password

To change your display panel password select the **Password** option and press the NEXT button. This password must be entered in order to be able to change the gauge configuration. Follow the procedure "*Entering a Password*" on page 7-4.

## 7.5 INSTALLING A PRO GAUGE

Select **Setup** from the Main Menu and choose one of the options to configure the gauge.

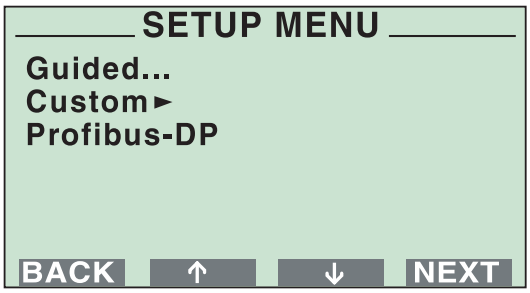
Figure 7-13. Select Setup from the Main Menu to install a gauge.




MAINMENU_43.EPS

**NOTE!**
Not all menu functions are supported by the different software configuration tools.

Figure 7-14. Choose how to configure the gauge.




STP_MENU_43.EPS

### Guided Setup

The Guided Setup option contains the basic steps for configuration of the Pro gauge.

### Custom Setup

Use the Custom Setup option if you for example want to include options for volume calculations and disturbance echo handling.

### Profibus DP

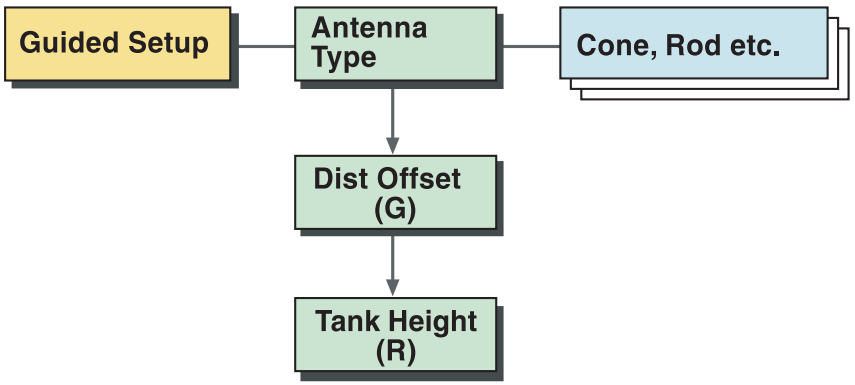
Profibus DP communication parameters, number of gauge variables and Profibus address are set here.

## 7.5.1 Guided Setup

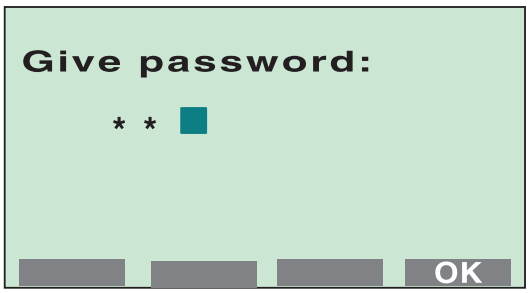
The **Guided Setup** includes the basic steps to start the gauge.

By using this option you are guided step by step through a sequence of configuration windows. The windows are automatically opened in a pre-defined order.

Figure 7-15. The Guided Setup helps the user to step-by-step enter all necessary information to configure a gauge.



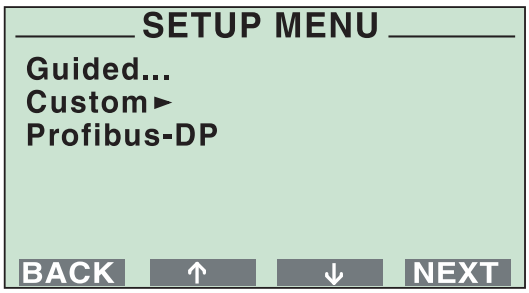

To configure a new radar gauge using the **Guided Setup** option do the following:




1. Choose Setup from the Main Menu.

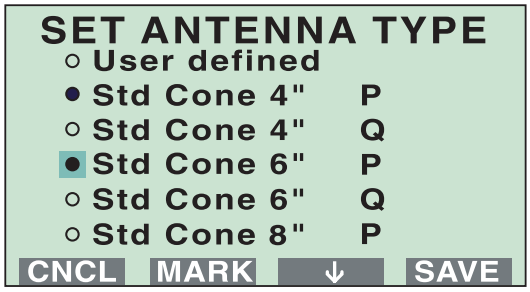
   ***Response**: a request for password is displayed*.
2. Enter your password and press the NEXT button.

   The password is defined by clicking the first three softkeys in a given order. An asterisk is shown for each key that is pressed. See "*Entering a Password*" on page 7-4.




3. Select "Guided..." from the Setup Menu and press the NEXT button.

ANTTYPE_43.EPS



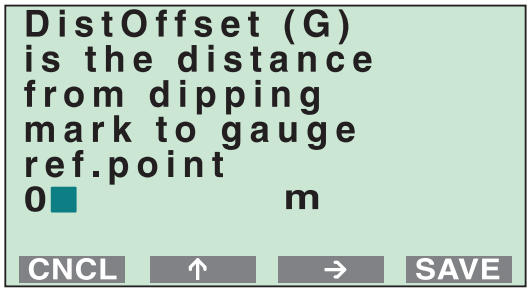

4. Set the Antenna Type.

   Press the ↓ button to move the cursor to the desired antenna, and click the MARK button to select it.

   Std = standard
   P = PTFE tank sealing
   Q = Quartz sealing
   C = Ceramic

   Finish by pressing the SAVE button. Note that you have to scroll the list using the ↓ button to find all available antenna types.

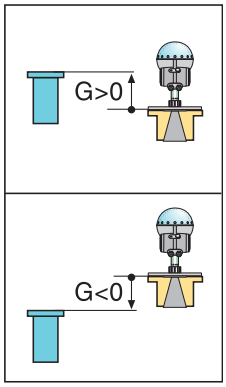
CALIBULL_43.EPS



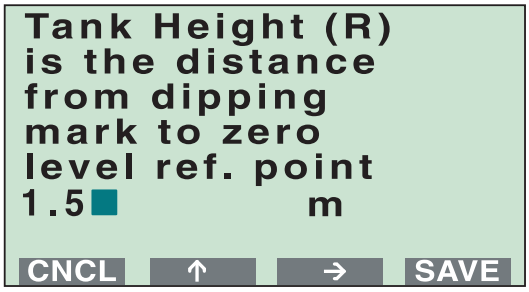

5. Set the **Distance Offset** (G)

   The **Distance Offset** (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Gauge's Reference Point*). You can use the **Distance Offset** to specify your own reference point at the top of the tank. Set the **Distance Offset** to zero if you want the flange as upper reference point. The **Distance Offset** is defined as positive if you use an upper reference point above the *Gauge's Reference Point*. The **Distance Offset** is used when the measured level by the gauge should correspond with the level value obtained by hand-dipping. Finish by pressing the SAVE button.

G_DISTANCE.EPS



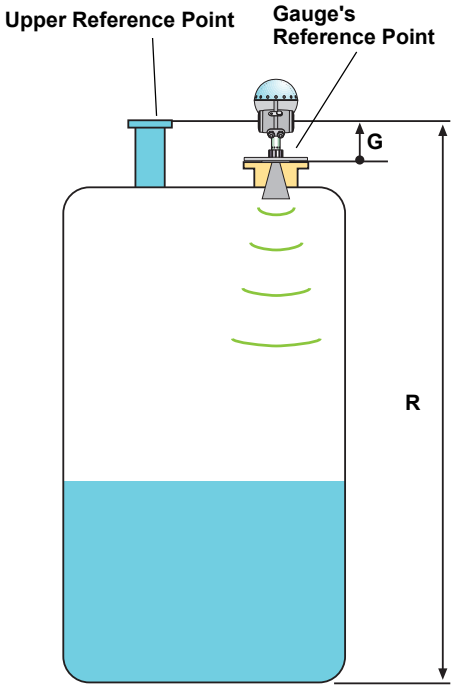
CALIBLVL_43.EPS




6. Calibrate the **Tank Height** (R).

   The **Tank Height** (R) is defined as the distance between the upper reference point (specified by the Distance Offset G) and the lower reference point (zero level). Finish by pressing the SAVE button.

TANKDISTANCE_GR.EPS

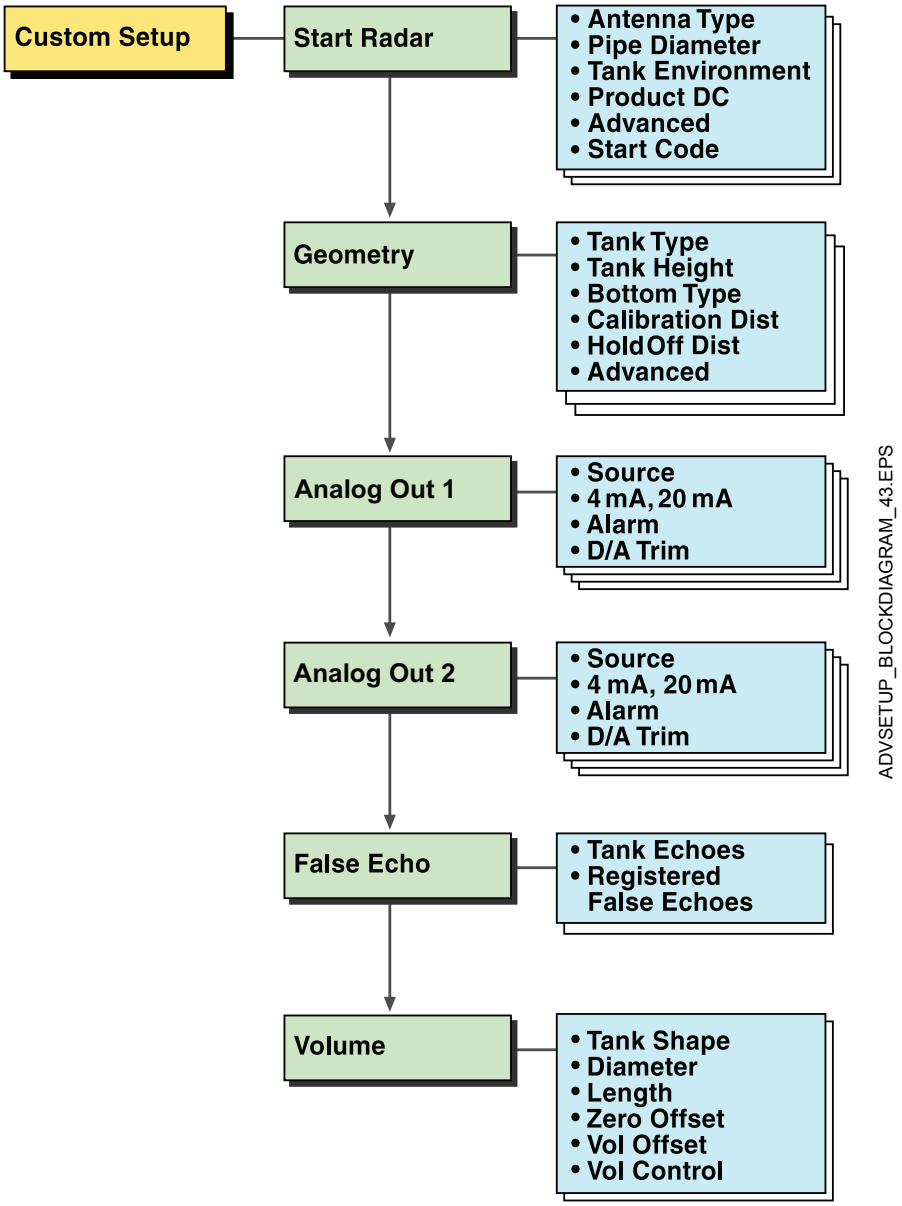



**NOTE!**
See Section 4: Gauge Configuration for further information on how to set the tank geometry parameters.

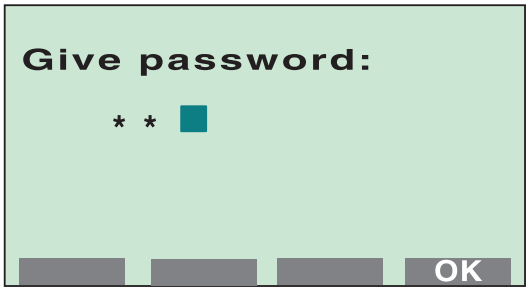
### 7.5.2 Custom Setup

Use the **Custom Setup** if you want to make a complete configuration of the gauge:

Figure 7-16. Custom Setup procedure.



PASSWORD.EPS

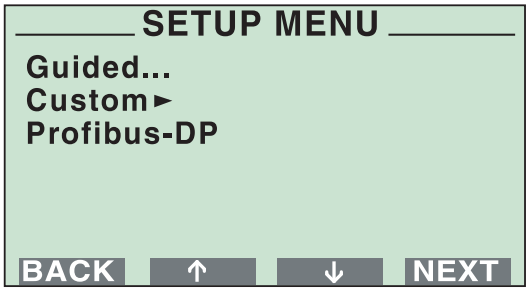



To configure a radar gauge using the **Custom Setup** option, do the following:

1. Choose **Setup** from the Main Menu.

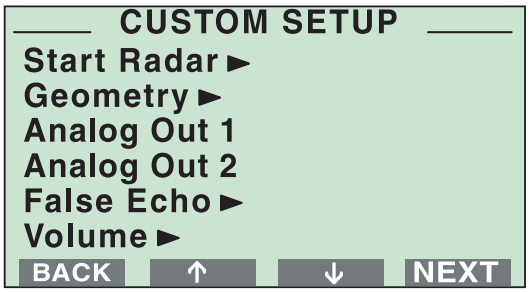
   ***Response**: a request for password is displayed.*
2. Enter your password and press the OK button.

STP_MENU_43.EPS



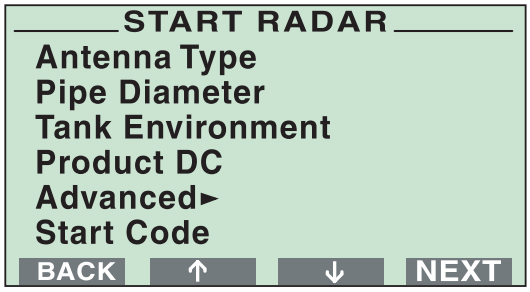

3. Select **Custom** from the Setup Menu and press the NEXT button.

ADVANCED_SETUP_43.EPS

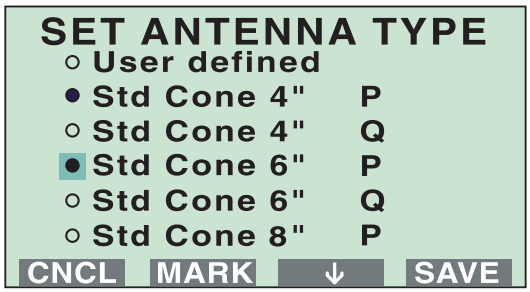



4. Select the **Start Radar** option from the Custom Setup menu.

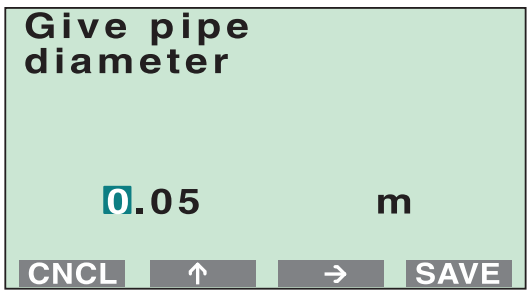
STARTRADAR_43.EPS



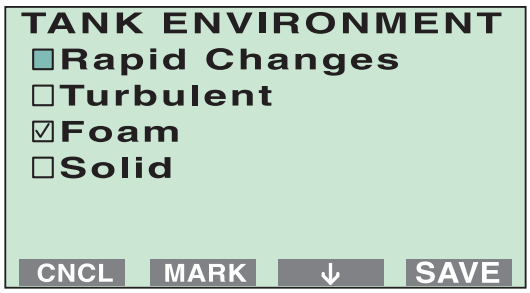

ANTTYPE_43.EPS




PIPE_DIAM_43.EPS




TANKENVIRONMENT.EPS




a. Choose the **Antenna Type** option from the **Start Radar** menu. The following main groups are available:

- User defined
- Cone
- Still-pipe
- Still-pipe Array
- Rod
- Parabolic
- Process Seal

Most antenna types are available in different versions and sizes:

Std = standard
P = PTFE tank sealing
Q = Quartz tank sealing
C = Ceramic

Select the type of antenna that is mounted on the gauge and click the SAVE button.
***Response:*** *the Start Radar menu is opened.*

b. Choose the **Pipe Diameter** option if you are using a still-pipe.

Enter the still-pipe diameter by using the → and ↑ buttons.

Note that the default value is -0.1 (negative). This means that no pipe correction is done.

Press the SAVE button to store the entered value.

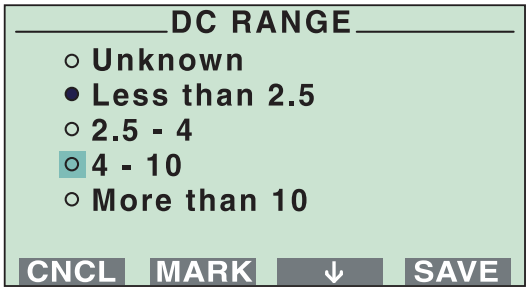
***Response****: the Start Radar menu is opened.*

c. Choose the **Tank Environment** option.

Select appropriate surface conditions. Mark the options that describe the conditions in your tank by using the MARK button. You should not choose more than two options for best performance. Press the SAVE button to store the current setting

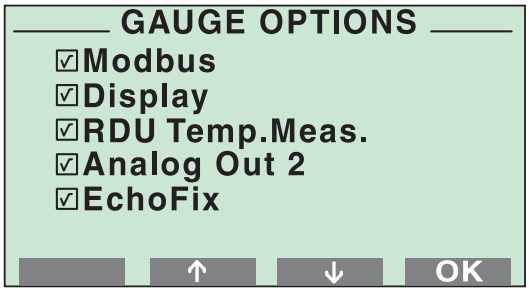
***Response****: the display returns to the Start Radar menu.*

PRODUCT_DC_43.EPS

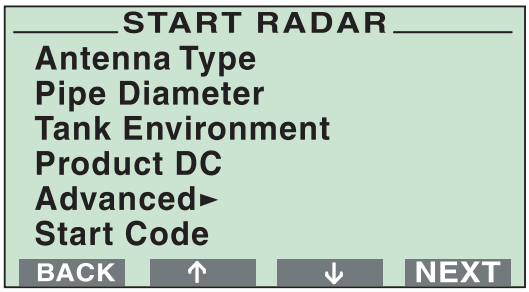



STARTCODE_43.EPS


TRPRO_OPTIONS_43.EPS




STARTRADAR_43.EPS




d. Choose the **Product DC** option.

   The product dielectric constant defines how well the product reflects microwaves. See your product specification sheet for the correct value. When *Unknown* is used, the gauge can not be optimized for the product. Mark the appropriate range and press the SAVE button.

   ***Response**: the Start Radar menu is opened.*

e. Choose the **Start Code** option.

   Confirm your **Start Code** by selecting the SAVE button.

   The gauge is delivered with a start code that enables the ordered software options. If you wish to change the set of available options, (Rosemount´s echofixer, Multiple Echo Tracking™ (MET), Fast High Accuracy Signal Technique™ (FHAST) and strapping table volume calculation), contact your local representative for a new start code.

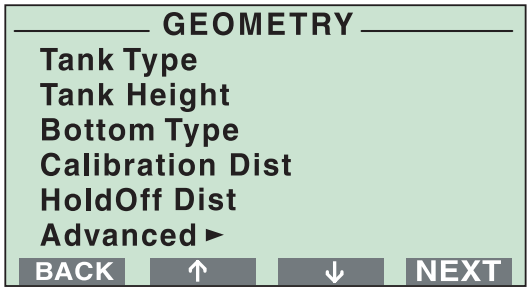
   Check the list of enabled options.
   Contact your local representative if you like to add one or more software options. If the list is correct confirm by pressing the OK button.

   ***Response**: the Start Radar menu is opened.*

f. Press the BACK button to return to the **Custom Setup** menu.

   The **Advanced** option allows you to make advanced setup of Tank Environment database registers. For trained personnel only.

ADVSETUP_CALIBRATION_43.EPS



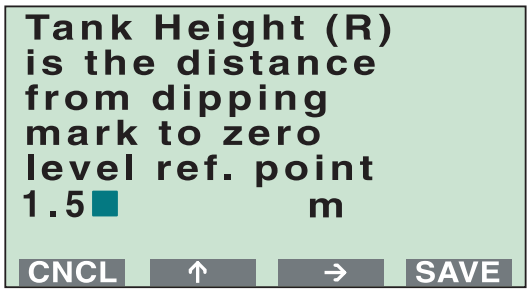

5. Select the **Geometry** option from the Custom Setup menu.

GEOM_TANK_TYPE_43.EPS


a. Select **Tank Type** and press the NEXT button.

   Select Tank Shape option and press the SAVE button.

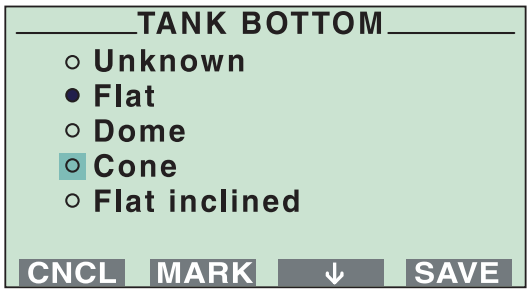
CALIBLVL_43.EPS




b. Select **Tank Height** and press the NEXT button.

   The **Tank Height** (R) is defined as the distance between the upper reference point and the lower reference point (zero level). Set the **Tank Height** and press the SAVE button.

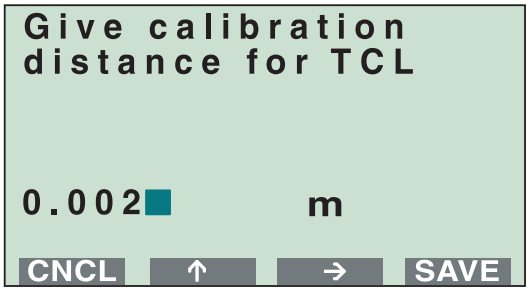
GEOM_BOTTOM_TYPE_43.EPS




c. Select **Bottom Type** and press the NEXT button.

   Select Tank Bottom option and press the SAVE button.

GEOM_CALIB_DIST_43.EPS

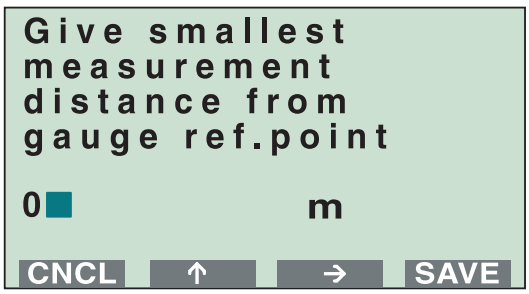



d. Select **Calibration Dist** and press the NEXT button.

The **Calibration Distance** is by default set to zero. It is used to adjust the gauge so that measured levels match hand-dipped product levels or other reference level values. Normally, the **Calibration Distance** does not need to be changed. However, in some rare cases a fine tuning of the gauge has to be performed after the installation. Set the **Calibration Distance** and press the SAVE button.

**NOTE!**
See Gauge Configuration (Chapter 4) for further information on how to set the tank geometry parameters.

GEOM_HOLDOFF_DIST_43.EPS

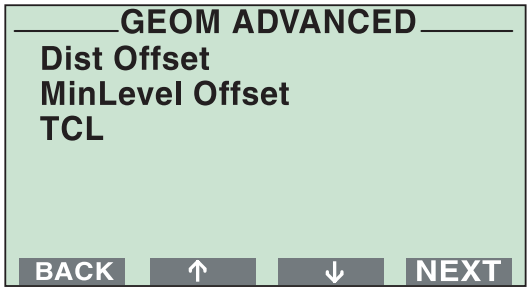



e. Select **HoldOff Dist** and press the NEXT button.

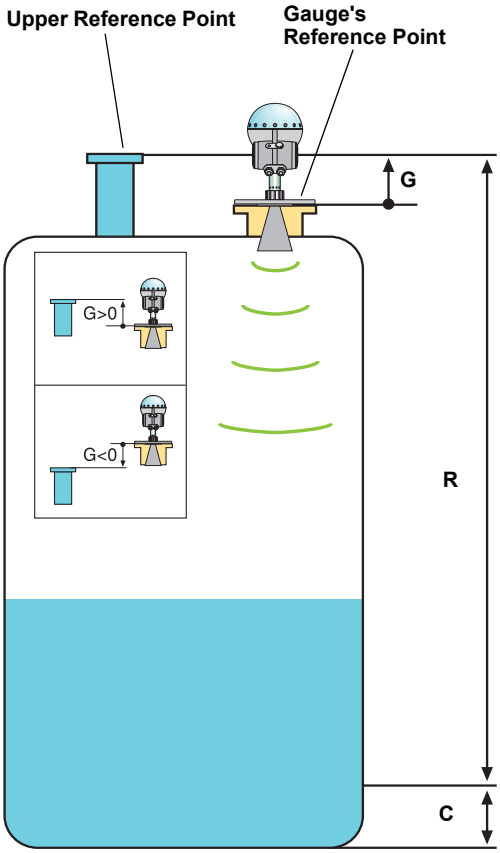
Set the **Hold Off Distance** (UNZ). The **Hold Off Distance** defines how close to the gauge´s reference point a level value is accepted. Normally, the **Hold Off Distance** is set automatically and does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the **Hold Off Distance** in order to avoid measurements in the region close to the antenna. Set the **Hold Off Distance** and press the SAVE button.

**NOTE!**
The default Hold Off Distance value for a non-standard antenna is zero and must be set accordingly during the installation.

GEOM_ADVANCED_43.EPS




TANKDISTANCE_GRC.EPS




f. Select the **Advanced** menu and press the NEXT button.

Set the **Distance Offset** (G).

The **Distance Offset** (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the Gauge´s Reference Point). You can use the **Distance Offset** to specify your own reference point at the top of the tank. Set the **Distance Offset** to zero if you want the flange as upper reference point. The **Distance Offset** is defined as positive if you use an upper reference point above the Gauge´s Reference Point. The **Distance Offset** is used when the measured level by the gauge should correspond with the level value obtained by hand-dipping.

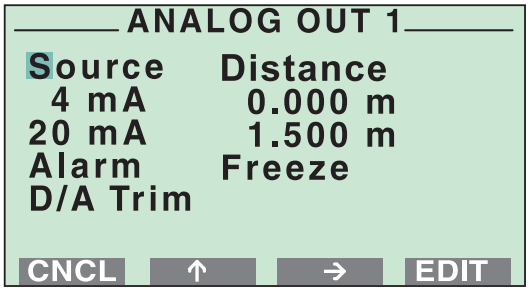
Set the **Minimum Level Offset** (C).

The **Minimum Level Offset** (C) defines a lower null zone which extends the measurement range beyond the Zero Level Reference Point down to the tank bottom.The **Minimum Level Offset** is defined as the distance between the zero level (Tank Level Reference Point) and the minimum accepted level, i.e. the tank bottom. Set the **Minimum Level Offset** to zero if you use the tank bottom as zero level reference point. If the zero level is at an elevated point (for example the datum plate) and not at the tank bottom, you need to define the **Minimum Level Offset**. Note that the **Minimum Level Offset** can not be negative.

Set the **Tank Connection Length** (TCL).

The **Tank Connection Length** (TCL) parameter is entered for antenna type User Defined only. For standard antennas the TCL value is set automatically. See also page 2-36.

CNFAOUT1_43.EPS



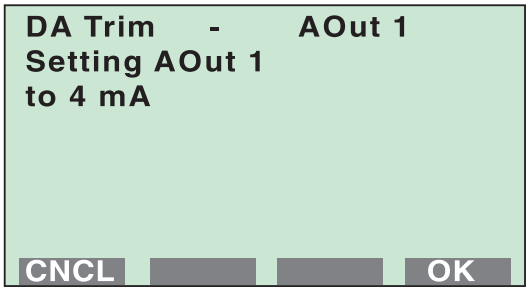

6. Select the **Analog Out 1** option from the Custom Setup menu (Optional).

   If the gauge is equipped with an analog output, the range of the output is automatically calibrated to match the tank calibration (Distance Offset and Tank Height). If you want to change this setting, do the following:

   - Place the cursor on **Source** and press EDIT. Available options are: level, distance, level rate, signal strength and volume (T1-T6 and Average Liquid Temp. optional).
   - Enter the analog output values that correspond to **4 mA** and **20 mA**, respectively.
   - Select **Alarm mode** (see Chapter 4 for description):
     - Low Current
     - High Current
     - Freeze
     - Bin Low
     - Bin High
   - **D/A Trim**. Use this option to calibrate the Digital/Analog Converter to correspond to the nominal values, 4 mA and 20 mA.

**NOTE!**
The analog output is set to fixed current mode during the calibration procedure.

DA_TRIM1.EPS



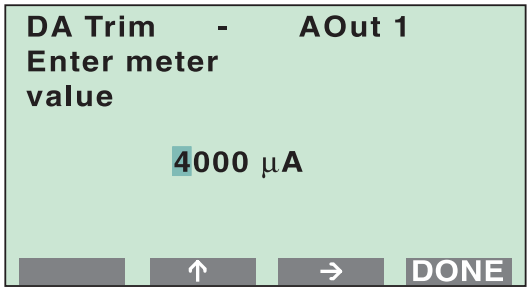

To calibrate the DAC do the following:

a. Choose the **D/A Trim** option.

b. Click the **OK** button if you want to continue, (or click the **CNCL** button to quit without calibrating the D/A converter).

   ***Response**: the analog output is set to 4 mA.*

DATR1_VA.EPS




c. Enter the measured value that corresponds to the 4 mA setting.
d. Click the **DONE** button.

   ***Response:*** *the analog output is set to 20 mA.*
e. Enter the measured value that corresponds to the 20 mA setting.
f. Click the **DONE** button.

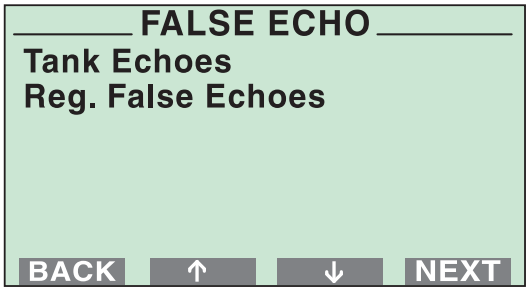
Now the D/A calibration is finished, and the analog output is no longer in fixed current mode.

7. Select the **Analog Out 2** option from the Custom Setup menu (optional).

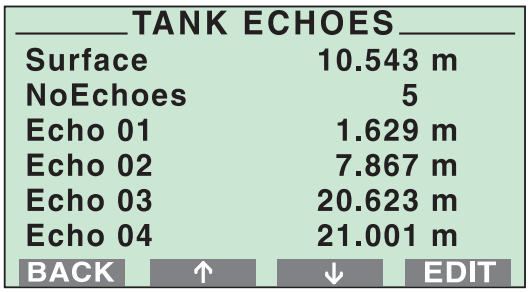
   If the gauge is equipped with an extra analog output, follow the same configuration procedure as for Analog Out 1.

   Configuration of the extra analog output is identical to configuration of analog output 1. See step 6 above.

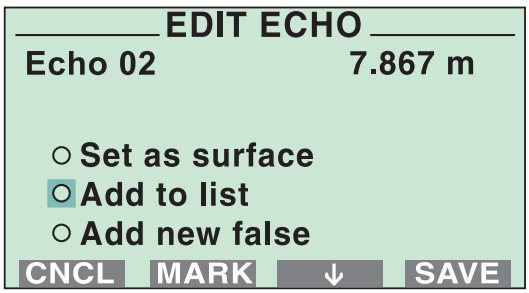
FLSEECHO_43.EPS




TANKECHS_43.EPS




EDITECHO_ADD_TO_LIST_43.EPS




8. Select the **False Echo** option from the Custom Setup menu (optional).

   In normal operation the gauge compares detected echoes with a list of **registered** disturbance echoes, in order to decide wich one is the actual product surface.

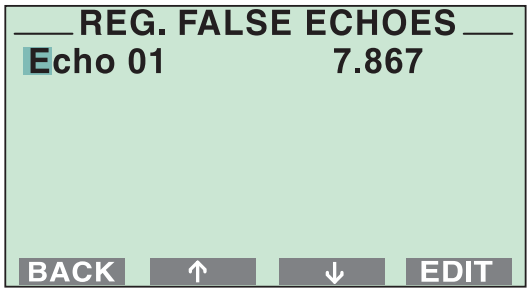
   To view a list of echoes that the gauge has detected select the **Tank Echoes** option.

   You can select echoes from this list and add to the list of registered echoes. You should only register disturbing echoes which can be identified as caused by an object in the tank. See Section 4: Gauge Configuration for further information on when to register disturbance echoes.

   To register a disturbance echo, do the following:

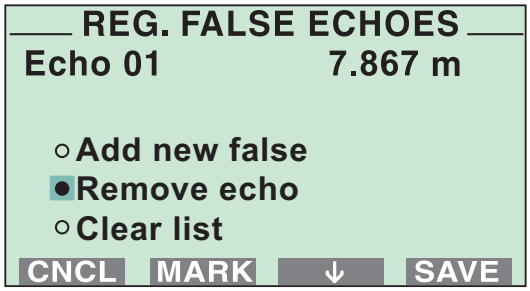
   a. Move the cursor to the echo you want to add to the list.
   b. Click the EDIT button.
   c. Move the cursor to **Add to list**, and click the MARK button.
   d. Click the SAVE button to register the marked echo.
   e. Repeat steps 1 to 4 if you wish to register more disturbance echoes.
      The **Set as surface** option allows you to define an echo as the product surface.
      Mark the **Add new false** option if you want to manually add echoes. This may be a useful option if, for example, there are known disturbances below the product surface which can not be detected by the gauge at the time of installation.
   f. Click the CNCL button to return to the False Echo menu.

RGFALSEC_43.EPS




To view the current list of registered disturbing echoes select the **Reg. False Echoes** option:

EDITREGECHOES_REMOVE_43.EPS

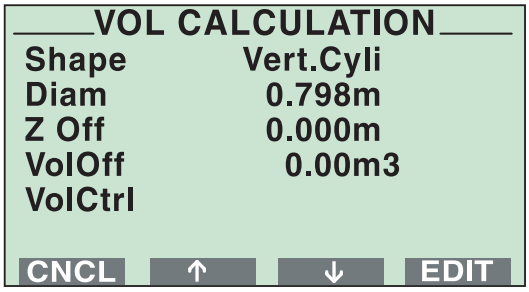



To remove a registered disturbance echo, do the following:

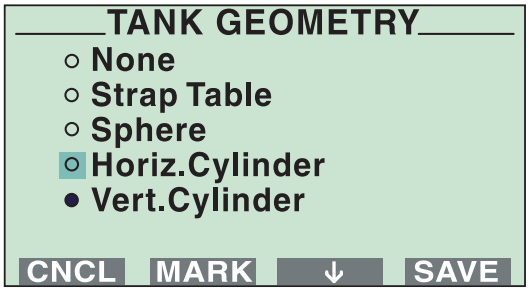
a. Move the cursor to the echo you want to remove.
b. Click the EDIT button.
c. Select the **Remove echo** option and click the MARK button.
d. Click the SAVE button to remove the selected echo.
   Mark the **Add new false** option if you want to manually add a false echo to the list of registered disturbance echoes.
   Mark the **Clear list** option if you want to remove the whole list of registered disturbance echoes. This option may be useful if you want to create a completely new list.

   See Section 4: Gauge Configuration for further information on disturbance echo handling. We recommend that the RadarMaster software is used for configuration of tanks with several disturbance echoes.

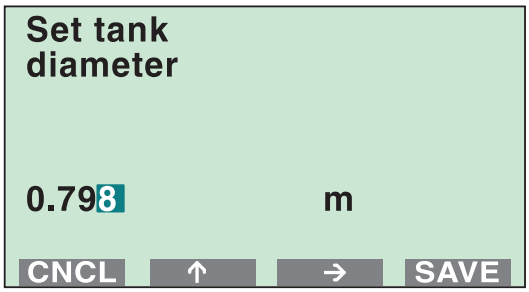
VOLUME_43_NEW.EPS



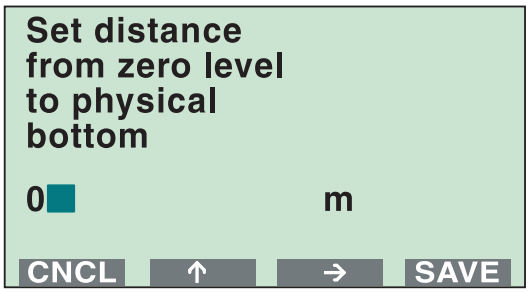

VOLUME_SHAPE_43.EPS




VOLUME_DIAM_43.EPS




VOLUME_ZOFF_43.EPS




9. Select the **Volume** option from the Custom Setup menu.

   The **Volume** option allows you to configure the Pro gauge for volume calculations. You can choose between using either a pre-defined tank shape like a sphere or a horizontal or vertical cylinder, or entering level and volume values into a strapping table. The following procedure varies with the selected tank shape.

   a. Select **Shape** and press the EDIT button.

      Choose the Tank Geometry to be used for volume calculation and press the SAVE button.

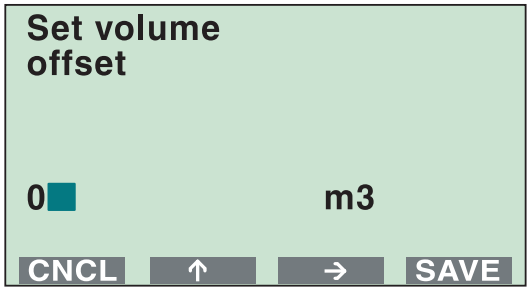
   b. Select **Diam** and press the EDIT button.

      Set the tank diameter and press the SAVE button.

   c. Select **Zero Level Offset** and press the EDIT button.

      Set the distance from zero level to the tank bottom and press the SAVE button.

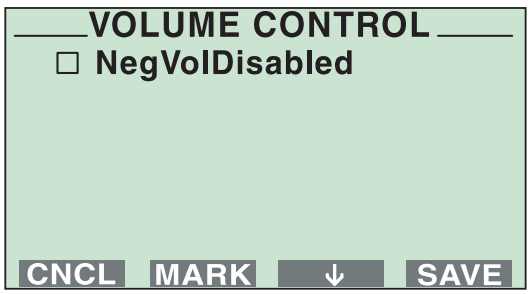
VOLUME_VOLOFF_43.EPS




d. Select **Volume Offset** and press the EDIT button.

   Set the volume offset and press the SAVE button.

VOLUME_VOLCTRL_43.EPS




e. Select Volume Control and press the EDIT button.

   When the NegVolDisabled option is marked, calculated negative volumes will be shown as zero (the product level is below the zero level e.g. the datum plate). Choose whether or not to display negative volumes. When done, press the SAVE button.

## 7.6 SERVICE

The **Service** Menu allows you to view the configuration status, edit holding registers, reset holding registers to factory values, do a software reset or to start a search for the surface echo. Information about antenna type, software versions, operation time, error status and unit code is available. You can also start a search for the surface echo and reset some of the holding registers to factory settings.

The service functions should only be used if you are familiar with the advanced functionality of *TankRadar Pro*.

| | |
|---|---|
| Config Report | Shows information on antenna type, software versions, software and hardware configuration, operation time, error status and unit code. Please provide this information if you contact Emerson Process Management / Rosemount Tank Gauging for troubleshooting. |
| Echo Search | Starts a search for the surface echo. |
| Factory Settings | Resets selected holding registers to factory settings. |
| Software Reset | Use this option to trigger the software start-up procedure. |
| Super Test | Enables all software options (Echofixer, MET, FHAST, Strap Table) for one week. Use this option if you want to test options not available in your gauge. |
| Overfill Alarm | Use this menu to activate or de-activate the overfill alarm. |
| Advanced Service | Use this option to view input registers and to view and edit holding registers. The Advanced Service window is protected by a special password which is valid for this window only. Contact your local representative for this password if you need to use the Advance Service option. |

# 8. Tank Geometry Examples



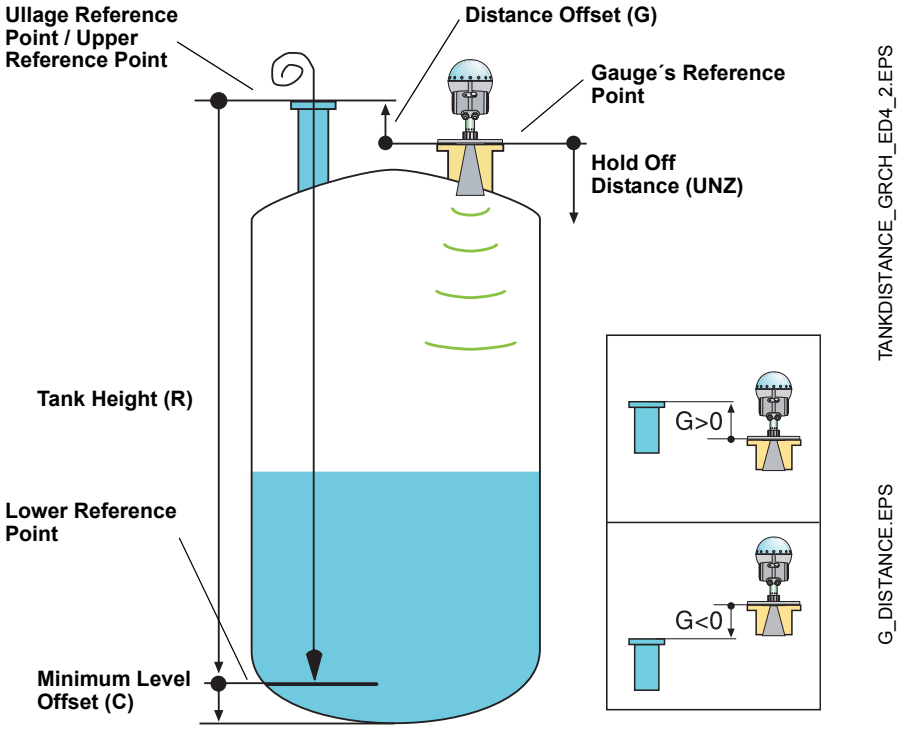
## 8.1 DEFINITIONS

The **Tank Height** (R) is defined as the distance between the upper reference point and the lower reference point (zero level).

The **Minimum Level Offset** (C) defines a lower null zone which extends the measurement range beyond the Zero Level Reference Point down to the tank bottom.The **Minimum Level Offset** is defined as the distance between the zero level (Tank Level Reference Point) and the minimum accepted level, i.e. the tank bottom. Set the **Minimum Level Offset** to zero if you use the tank bottom as zero level reference point.

If the zero level is at an elevated point (for example the datum plate) and not at the tank bottom, you need to define the **Minimum Level Offset**. Note that the **Minimum Level Offset** can not be negative.

Figure 8-1. Overview of the different tank parameters.



The **Distance Offset** (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the Gauge´s Reference Point). You can use the **Distance Offset** to specify your own reference point at the top of the tank. Set the **Distance Offset** to zero if you want the flange as upper reference point. The **Distance Offset** is defined as positive if you use an upper reference point above the Gauge´s Reference Point. The **Distance Offset** is used when the measured level by the gauge should correspond with the level value obtained by hand-dipping.

The **Hold Off Distance** (UNZ) defines how close to the gauge's reference point a level value is accepted. Normally, the **Hold Off Distance** is set automatically and does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the **Hold Off Distance** in order to avoid measurements in the region close to the antenna.

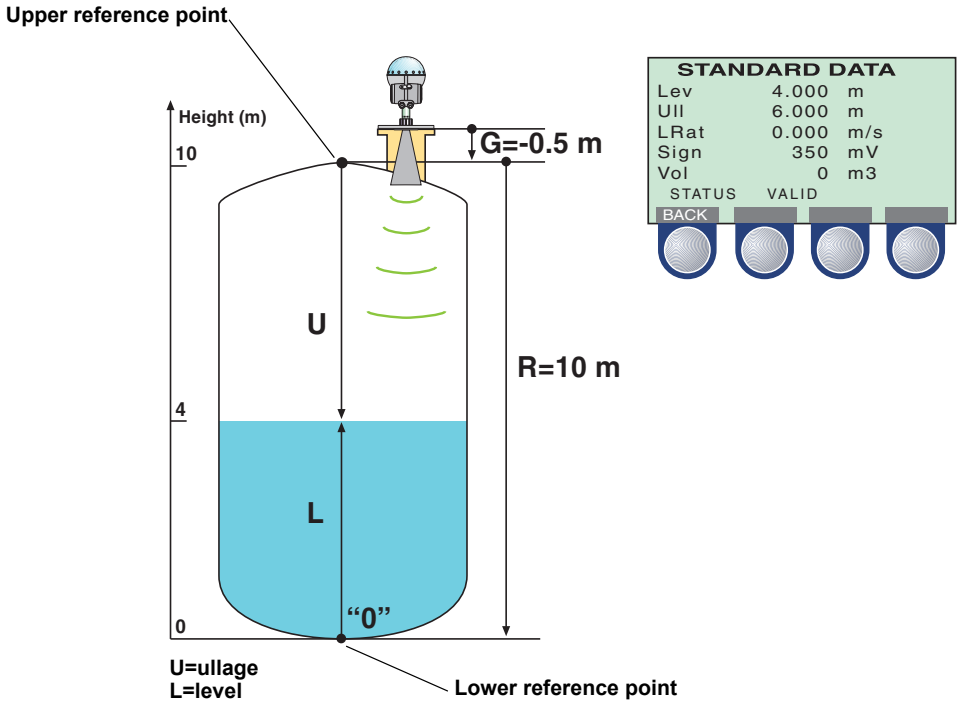
## 8.2 EXAMPLES

The following examples illustrate how you can set the various tank distance parameters to suit your own preferred reference point settings.

### 8.2.1 Example 1

| If you want | set |
|---|---|
| Upper reference point at the tank roof | G=distance between flange and tank roof (G<0). |
| Lower reference point at the bottom of the tank | R=distance between upper reference point and the bottom of the tank.<br>C=0. |

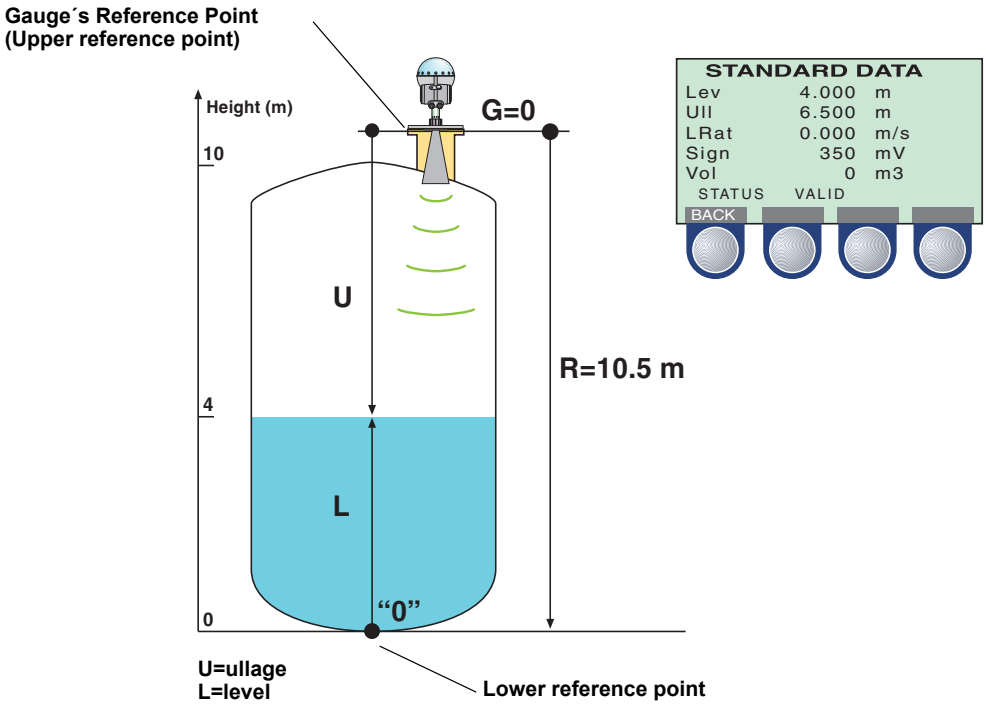
Figure 8-2. The Gauge's Reference Point is above the Upper Reference Point of the tank. The Lower Reference Point is at the tank bottom.



### 8.2.2 Example 2

| If you want | set |
|---|---|
| Upper reference point equal to the TR Pro reference point | G=0 |
| Lower reference point at the bottom of the tank | R=distance between TR Pro reference point and the bottom of the tank.<br>C=0. |

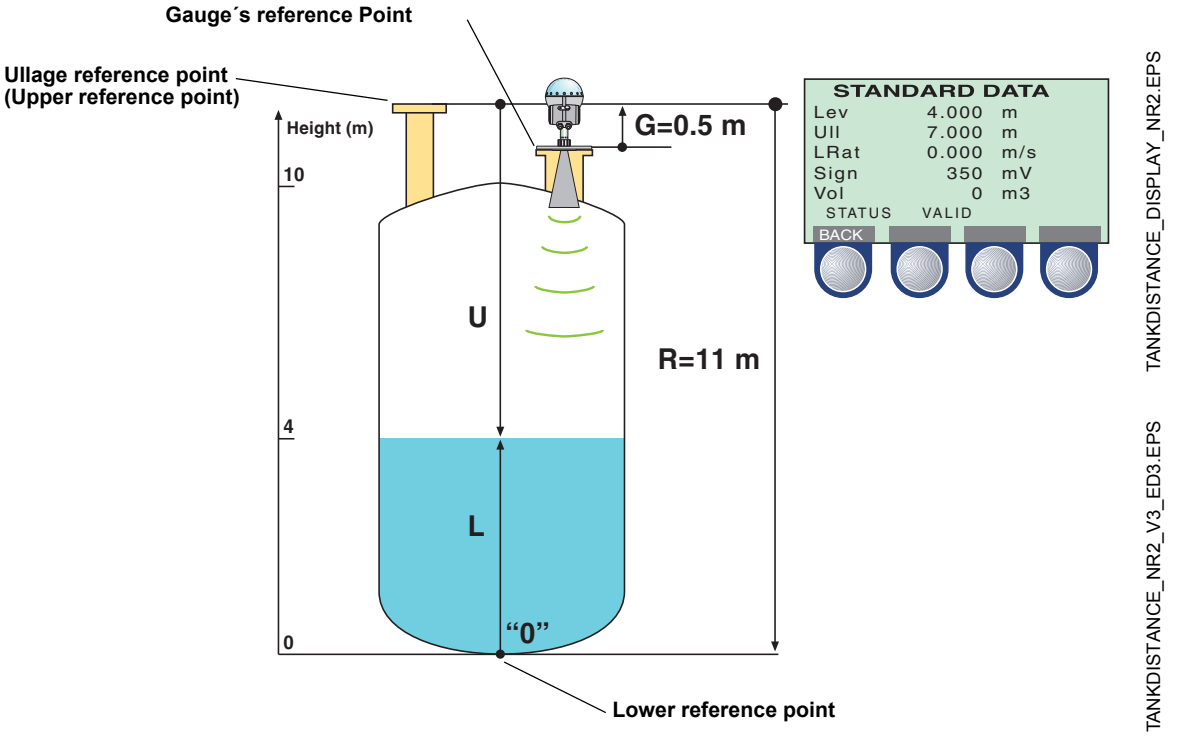
Figure 8-3. The Gauge's Reference Point is at the same level as the Upper Reference Point of the tank. The Lower Reference Point is at the tank bottom.



### 8.2.3 Example 3

| If you want | set |
|---|---|
| Upper reference point at the ullage reference point | G=distance between ullage and RTG reference points. |
| Lower reference point at the tank bottom | R=distance between ullage reference point and tank bottom.<br>C=0. |

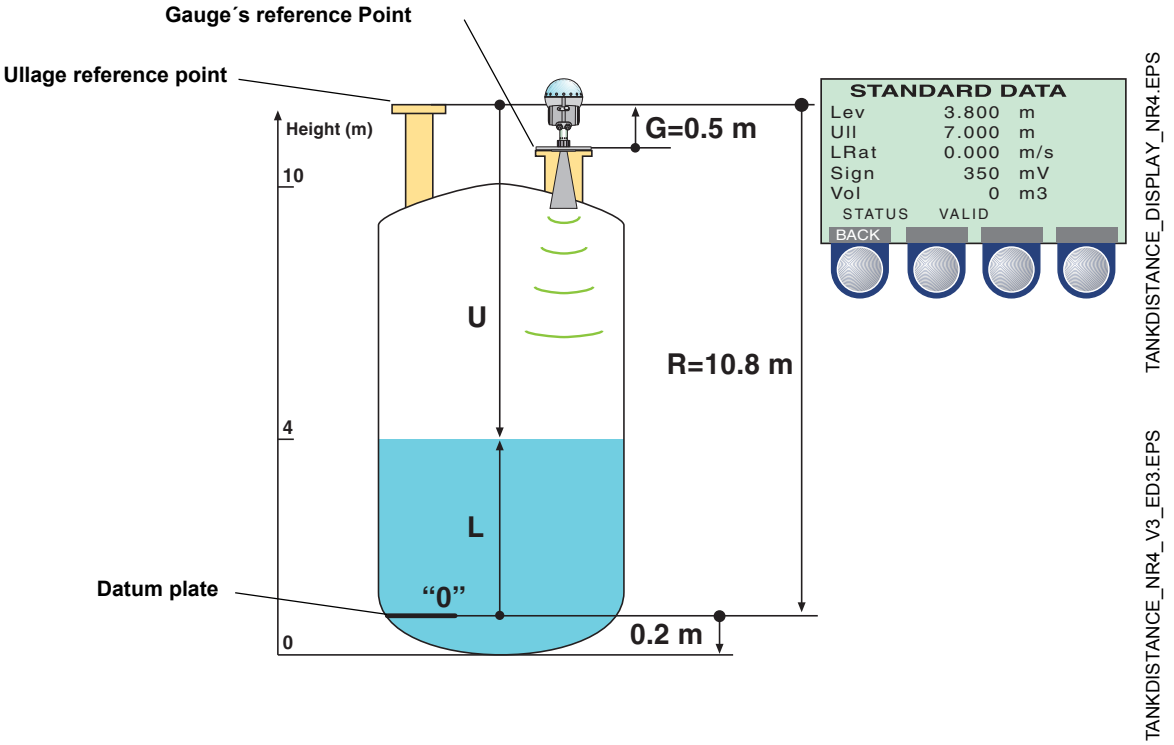
Figure 8-4. The Gauge's Reference Point is below the Upper Reference Point of the tank. The Lower Reference Point is at the tank bottom.



### 8.2.4 Example 4

| If you want | set |
|---|---|
| Upper reference point at ullage reference point | G=distance between ullage and RTG reference points. |
| Lower reference point at datum plate | R=distance from ullage reference point to datum plate.<br>C=distance between datum plate and tank bottom. |

Figure 8-5. The Gauge's Reference Point is below the Upper Reference Point of the tank.
The Lower Reference Point is above the tank bottom, at the datum plate.



# 9. Technical Specifications

| | |
|---|---|
| **General** | |
| Product designation | TankRadar Pro: Lite, Standard, Gold or Platinum. |
| Operating principle | 10 GHz FMCW radar. |
| Beam angle | See "*Beam Width"* on page 2-5 |
| Microwave output power | Max. 1.0 mW. |
| Internal calibration | Integrated digital reference for automatic compensation of radar sweep. |
| Signal processing | Digital signal processing using Fast Fourier Transformation (FFT), FHAST™, MET™ and Echofixer (depending on Pro model). |
| Temperature measurement (Requires 2210 Display Unit) | 1-3 spot elements PT100 or CU 100, or 1-6 spot elements with common return.<br>Input accuracy ± 0.5 °C (± 0.9 °F). |
| **Display / Configuration** | |
| Display (factory mounted on gauge) | • 6-digit graphical LCD display, 128 x 64 pixels.<br>• For display and confi guration.<br>• 4 control soft-keys.<br>• 7 text lines with 16 characters/line<br>• Weather/dirt protection cover. Protection class IP67. |
| Display (mounted separately) | Same as above, mounted in separate enclosure, Protection class IP 67<br>Max cable length, display - radar gauge: 100 m (330 ft)<br>Cable type: 4-wire shielded instrument cable, min 0.5 mm², (AWG 20)<br>Optional: Temperature measurement 1-3 spot elements PT100 or CU100 (see above) |
| HART® device | Rosemount 275/375 handheld communicator.<br>Rosemount Asset Management Solutions software (AMS™). |
| FOUNDATION™ fieldbus | All FOUNDATION™ fieldbus host systems (DeltaV® provides enhanced graphics). |
| PC/remote configuration | RadarMaster, Windows based configuration software.<br>RadarSetup, Windows based configuration software.<br>WinSetup, setup software for terminals and refineries. |

| **Mechanical** | | |
|---|---|---|
| Antennas | Cone, Parabolic, Still-pipe Array, Process Seal and Rod antennas. | |
| Materials exposed to tank atmosphere | Cone Antenna (PTFE sealing) | Antenna Material, alt 1: Stainless Steel 316L, alt 2: Hastelloy® C-22, alt 3: Tantalum, alt 4: Monel® 400<br>O-rings: Viton® fluoroelastomer or Kalrez® perfluoroelastomer<br>Sealing: PTFE fluoropolymer |
| | Cone Antenna (Quartz sealing) | Antenna Material, alt 1: Stainless Steel 316L, alt 2: Hastelloy® C-22, alt 3: Tantalum, alt 4: Monel® 400<br>O-rings: Viton® fluoroelastomer or Kalrez® perfluoroelastomer<br>Sealing: Quartz |
| | Parabolic Antenna | Stainless Steel 316L, Teflon® FEP fluoropolymer |
| | Process Seal Antenna | PTFE fluoropolymer or $Al_2O_3$ (Aluminium oxide) |
| | 1- and 2 in. Still-pipe Antennas | Antenna Material: Stainless Steel 316L<br>O-rings: Viton® fluoroelastomer or Kalrez® perfluoroelastomer<br>Sealing: PTFE fluoropolymer or Quartz |
| | Still-pipe Array Antenna | Antenna Material: Polyphenylensulfid (PPS).<br>O-ring: Fluorosilicone.<br>Sealing: PTFE fluoropolymer. |
| | Rod Antenna | Antenna Material: Stainless Steel 316L and PTFE fluoropolymer<br>O-rings: Viton® fluoroelastomer or Kalrez® perfluoroelastomer<br>Sealing: PTFE fluoropolymer |
| Antenna dimensions | See “*Dimensions”* on page 2-6. | |
| Antenna extension | Extended cone antennas available in Stainless steel 316L. | |
| Flushing connection | 1/2-in. NPT (cone antenna, see page 2-19) | |
| Housing/Enclosure | Permanent mould cast aluminium, chromed and 120 µm powder painted. | |
| Flanges | DIN, ANSI and JIS standard.<br>Material: Hot-galvanized carbon steel, Fe/Zn Class A 553589 or<br>Stainless steel A182 Gr. F 316L and EN 10222-5-1.4404 | |
| Weight, excl. flange | Approximately 8 kg (18 lbs), depending on antenna selection. | |
| Height above flange | 400 mm (15 in.) | |

| **Electrical** | | |
|---|---|---|
| Power supply | Ultra wide 24-240 V DC or AC 0-60 Hz. | |
| Power consumption | Maximum 10 W, nominal 5 W. | |
| Primary output<br>(for level, volume etc) | Alt. 1: HART® 4–20 mA current loop (IS option)<br>Alt. 2: TRL/2 Bus (FSK with Modbus protocol)<br>Alt. 3: Profibus® DP<br>Alt. 4: FOUNDATION™ fieldbus (IS option) | |
| Secondary output<br>(optional, for volume, signal quality, temperature etc.) | Analog 4–20 mA current loop, active or passive. Optional: IS version. | |
| Analog output characteristics | Type | Analog 4–20 mA Current Loop, active (with) or passive (without loop supply). |
| | Galvanic isolation | > 1500 V RMS or DC |
| | Accuracy | ± 300 µA at 4 mA<br>± 600 µA at 20 mA |
| | Range | 4-20 mA |
| | Alarm level | 3.8 mA, 22 mA or freeze; software selectable |
| | Resolution | 0.5 µA (0.003%) |
| | Linearity | ± 0.01% |
| | Temperature drift | ± 50 ppm/°C (± 28 ppm/°F) |
| | Output impedance | > 10 MΩ |
| | Voltage compliance | 7-30 V (passive output) |
| | External loop resistance | < 700 Ω (passive output with 24 V external supply)<br>< 300 Ω (active output) |
| FOUNDATION™ fieldbus characteristics | Polarity sensitive | No |
| | Quiescent current draw | 12.5 mA |
| | Lift-off minimum voltage | 9.0 V |
| | Device capacitance / inductance | $C_i$=0 µF / $L_i$=0 mH |
| | Class | Link Master (LAS) |
| | Number of available VCRs | 20 |
| | VCR Statistics | Yes |
| | Slot time / Response delay / Inter message delay | Min 6 ms / Max 4 ms / Min 7 ms |
| | Function blocks | 6 analog input, 2 transducer, 1 resource |
| | Execution time | 60 ms for AI-block |
| | Instantiation | Yes (all activated) |
| | Available Menus and Methods | Transducer Block: Configure Gauge, Restart Device, Set to Factory Defaults, Sensor Bus.<br>Resource Function Block: Master Reset |
| | Conforming FOUNDATION™ fieldbus | ITK 4.6 |
| | Advanced diagnostics | Failures: Level, Temperature and Volume measurement failure<br>Warnings: Empty tank, Full tank, Database, Hardware, Software and Configuration warnings<br>Errors: Database, Hardware, Software and Configuration warnings |
| Output cabling | Twisted and shielded pair, min. 0.5 $mm^2$ (AWG20). | |
| Cable entries | 3×½-in. NPT for cable glands or conduit entries.<br>Optional: Cable gland kit, including 3 x EEx e approved (ATEX) ½-in. NPT cable glands.<br>Optional: 3 x EEx e approved, including 3 x EEx e (ATEX) adapters ½-in. NPT/M20 | |
| Relay output | Optional equipment, mounted in separate enclosure. Potential free contacts, normally open or normally closed, selectable. Switching capacity: 100-260 VAC 3 A or 24-48 VDC 3 A<br>Function: alarm limits and hysteresis set at Radar gauge. | |

| **Measuring performance** | |
|---|---|
| Instrument accuracy | ± 3 mm (± 0.12 in.), ± 5 mm (± 0.2 in.) or ± 10 mm (± 0.4 in.) depending on model |
| Resolution | 1 mm (0.04 in.) |
| Temperature stability | ± 500 ppm of measured distance within the ambient temperature range |
| Repeatability | ± 1 mm (± 0.04 in.) |
| Measuring range | 0-50 m (0-165 ft) default, 0-99 m (0-325 ft) special configuration |
| Update time | 100 ms |
| Optional disturbance echo handling | Rosemount's Echofixer and Multiple Echo Tracking (MET™). |
| Ex approval Transmitter Head (Platinum, Standard and Gold versions) | See TankRadar Pro Technical Description (501026En) |
| Overfill protection | TÜV approval, BPG-US 99/6001 |
| **Environment** | |
| Ambient temperature | -40 ºC to 70 ºC (-40 ºF to 158 ºF) |
| Tank temperature | -40 ºC to 400 ºC (-40 ºF to 752 ºF) |
| Pressure | -1 to 55 Bar (Vacuum to 790 Psi) depending on antenna choice. |
| Pressure / Temperature at antenna | See diagrams in TankRadar Pro Technical Description (501026En) |
| Emission approvals | FCC: K8CPRO, K8CPROX. R&TTE: E813268O-CC |
| Humidity | IEC 60068-2-3 |
| Climatic class / Corrosion class | IEC 68-2-1, IEC 60068-2-52 test KB severity 2 |
| Ingress protection | IP66, IP67, NEMA 4 |
| Vibration | IEC 721-3-4 class 4M4 |
| UV protection | ISO 4892-2 |
| Electromagnetic compatibility | EN61326-1:1997 incl. A1:1998 and A2:2001, Immunity EN50081-2, Emission EN50081-1 |
| Lightning protection | EN61326, EN61000-4-5, IEC801-5, level 2 kV |
| Power supply fluctuation | IEC 92 Part 504 sec 3.5 |
| Boiler Approval | CSA B51-97: Compliance |

# 10. Troubleshooting

Table 10-1. List of Errors.

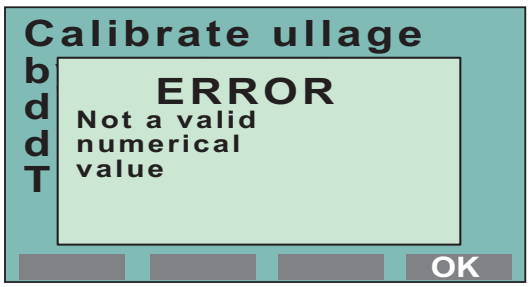
| Symptom | Action |
|---|---|
| No level reading | • Check the power supply.<br>• Check the cables for serial data communication. |
| Incorrect level reading | • Check the gauge calibration.<br>• Check that the gauge has not locked on an interfering object.<br>• Check that the mechanical installation is correct. |
| Serial communication failure | • Check the COM port setting in the Pro Setup program.<br>• Check the serial communication address.<br>• Check the cable connections and that the correct cables are used.<br>• Insufficient power supply to Field Bus Modem. |
| Display Unit window is blank | • Check the power supply. |
| Poor Display Unit contrast | • Press the two right-hand buttons to increase the LCD contrast. |

## 10.1 DISPLAY UNIT ERROR MESSAGES

### 10.1.1 User Input Errors

This message appears if you try to enter an unvalid value into a holding register.

Figure 10-1. Holding Register input error message.

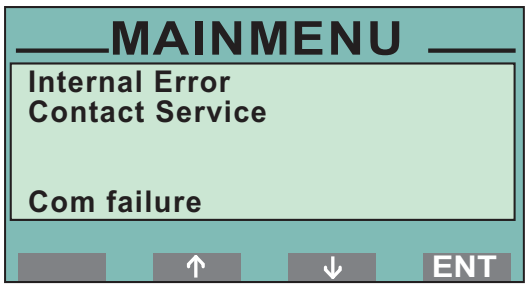



ERRHLDRG.EPS

### 10.1.2 Internal Software Errors

This message indicates an error in the Display Unit software.

Figure 10-2. Internal software error message.




ERR_INT.EPS

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