

Saab TankRadar® Pro

User's Guide



SAAB

Saab Tank Control

Saab TankRadar® Pro

User's Guide

Second edition

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Saab TankRadar Pro generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with the manufacturer's instructions, it may violate FCC regulations on radio frequency emission.

Saab TankRadar Pro has been Part 15 certified under test conditions which assume a closed metallic tank.

Installation on non-metallic tanks, tanks with open manholes, external-floating-roof tanks without stillpipes etc. are not covered by this certificate, and require a Part 90 site-license. If you have an installation like this, contact your Saab Tank Control representative for help with the necessary license application.

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About this manual

This User's Guide provides information about mechanical and electrical installation of a Saab TankRadar Pro gauge. It also describes how to start up and configure the gauge.

The main purpose of the book is to act as guide to installing and operating a TankRadar Pro gauge. It is not intended to cover service tasks such as changing circuit boards or internal software.

- *Chapter 1* reviews some basic concepts of radar based level gauging.
- *Chapter 2* describes how to assemble a gauge and how to mount it on the tank.
- *Chapter 3* describes the electrical installation.
- *Chapter 4* describes how to use the Pro Setup software.
- *Chapter 5* describes how to use the Display Panel.
- *Chapter 6* describes the definitions of tank distances to use when configuring a Pro transmitter.
- *Chapter 7* provides some technical information about TankRadar Pro.
- *Chapter 8* lists some typical problems that might occur and suggestions on how to solve them.



1 Introduction

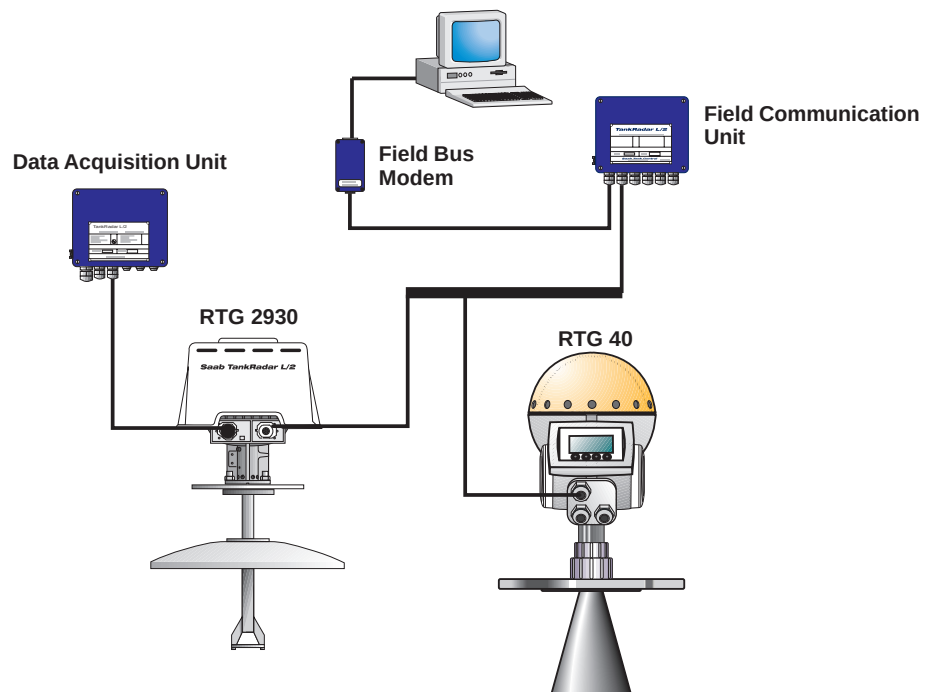
Saab TankRadar Pro is a powerful radar level gauge suitable for non-contact level measurements in process tanks, storage tanks and other types of tanks. It is designed for easy installation and maintenance free operation.

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.

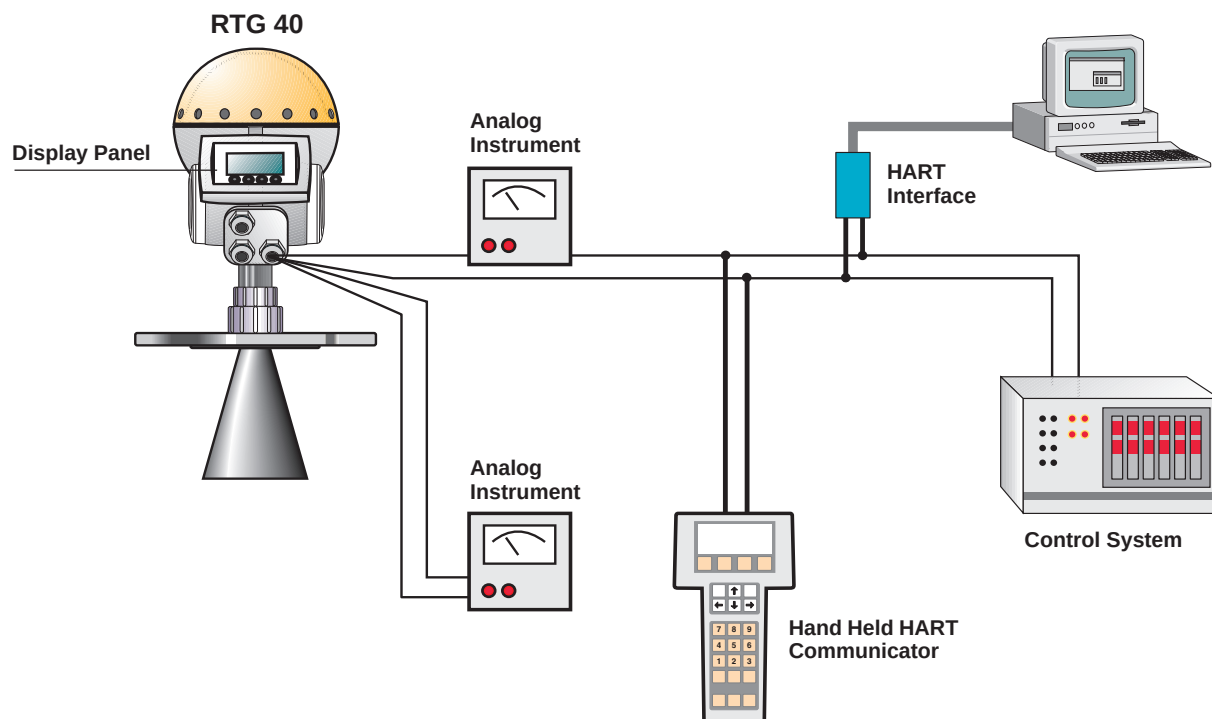
The TankRadar Pro System

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 Saab TRL/2 Bus interface you can easily connect Pro gauges to a Saab TankRadar L/2 system.



A specially designed software package, Pro Setup, offers configuration and service capabilities. It also includes functions for presentation of measurement data.



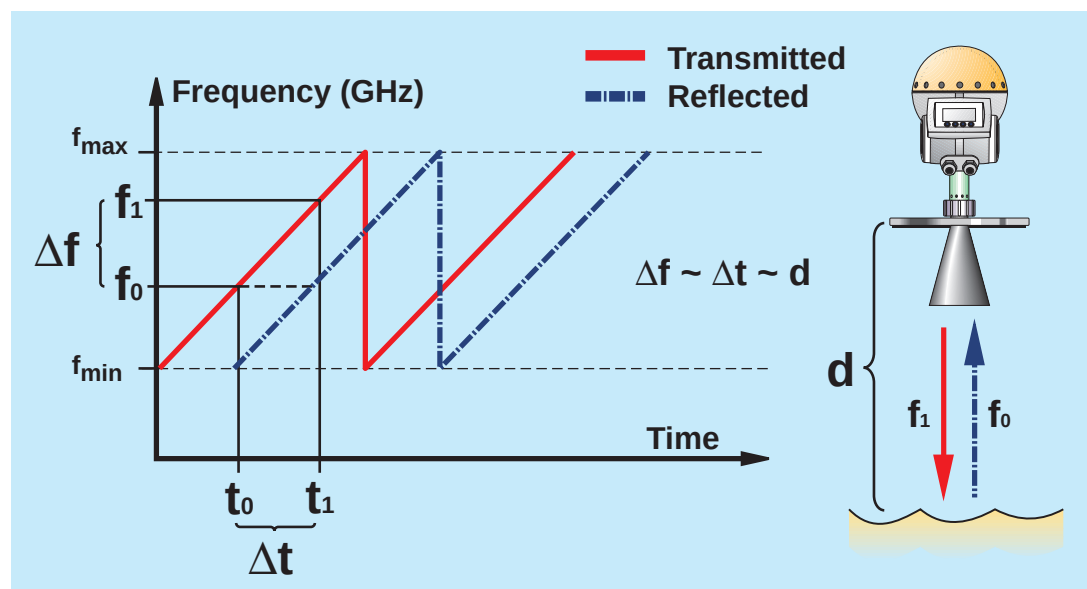
If HART technology is used you can configure and monitor measurement data via a hand held communicator or a PC.

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 panel. It offers basically the same functionality as the Pro Setup software package. Four sturdy softkeys gives you access to configuration routines, service functions and level monitoring.

Measurement Principle

The Saab TankRadar Pro transmitter 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.



Since the transmitter 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.

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

Saab 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 Saab's echofixer, FFT allows meas-

urements in tanks with agitators, mixers and other disturbing objects.

Saab's echofixer provides a technique to adapt measurements to various situations, by using information from previous measurements.

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

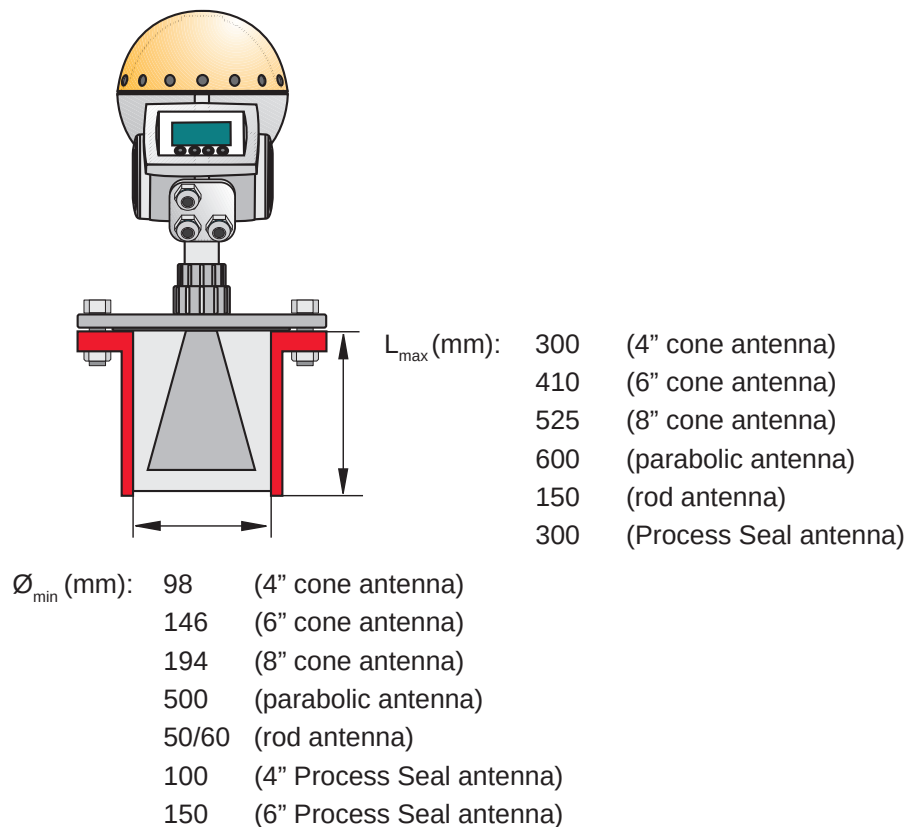
Multiple Echo Tracking™ (MET™) is another advanced Saab TankRadar Pro feature, which provides increased resolution in tanks with disturbing objects. MET™ facilitates the separation of disturbances from the actual product surface echo.

2 Mechanical Installation

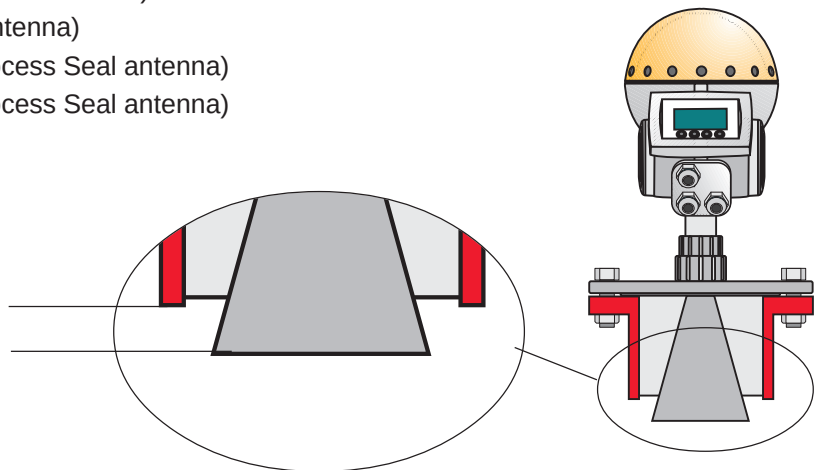
For optimum measurement performance the TR Pro gauge should be mounted according to the socket requirements and the free space requirements illustrated below.

Socket Requirements

In order to allow the microwaves to propagate freely, the socket dimensions should be kept within the specified limits for different antenna sizes.

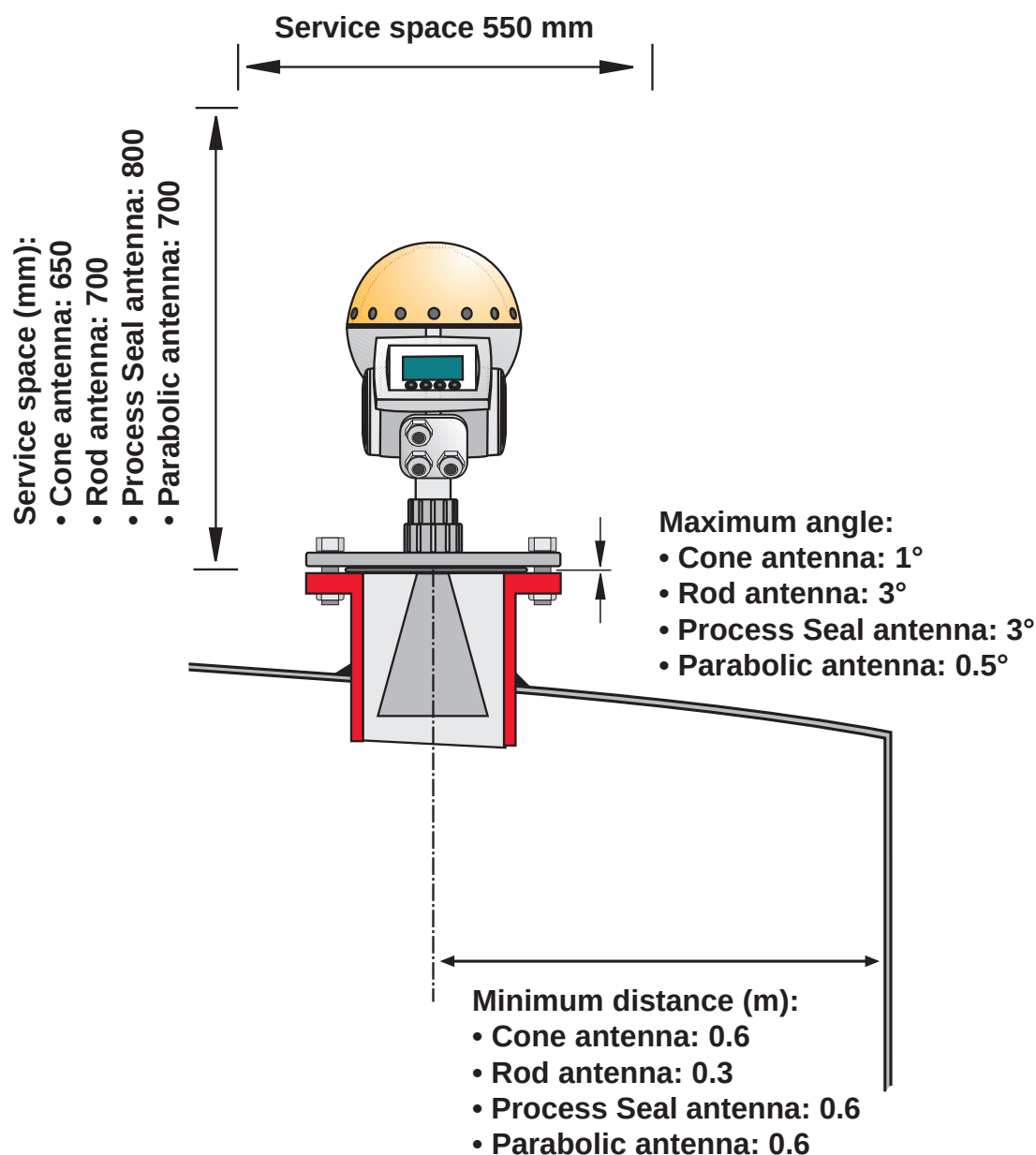


For best measurement performance we recommend that the nozzle is shorter than the antenna.

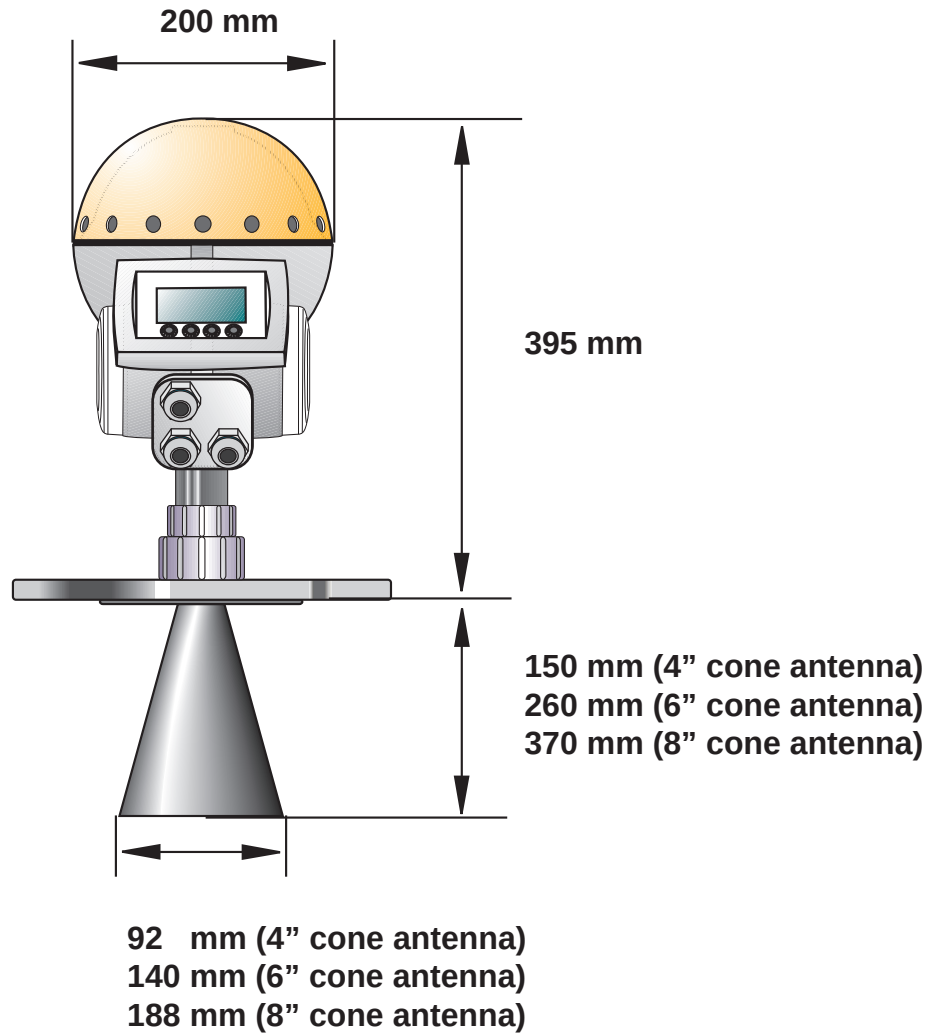


Free Space Requirements

Position the gauge in a way that allows the microwaves to propagate without disturbance from the tank wall, according to the illustration below.



Dimensions



Tools

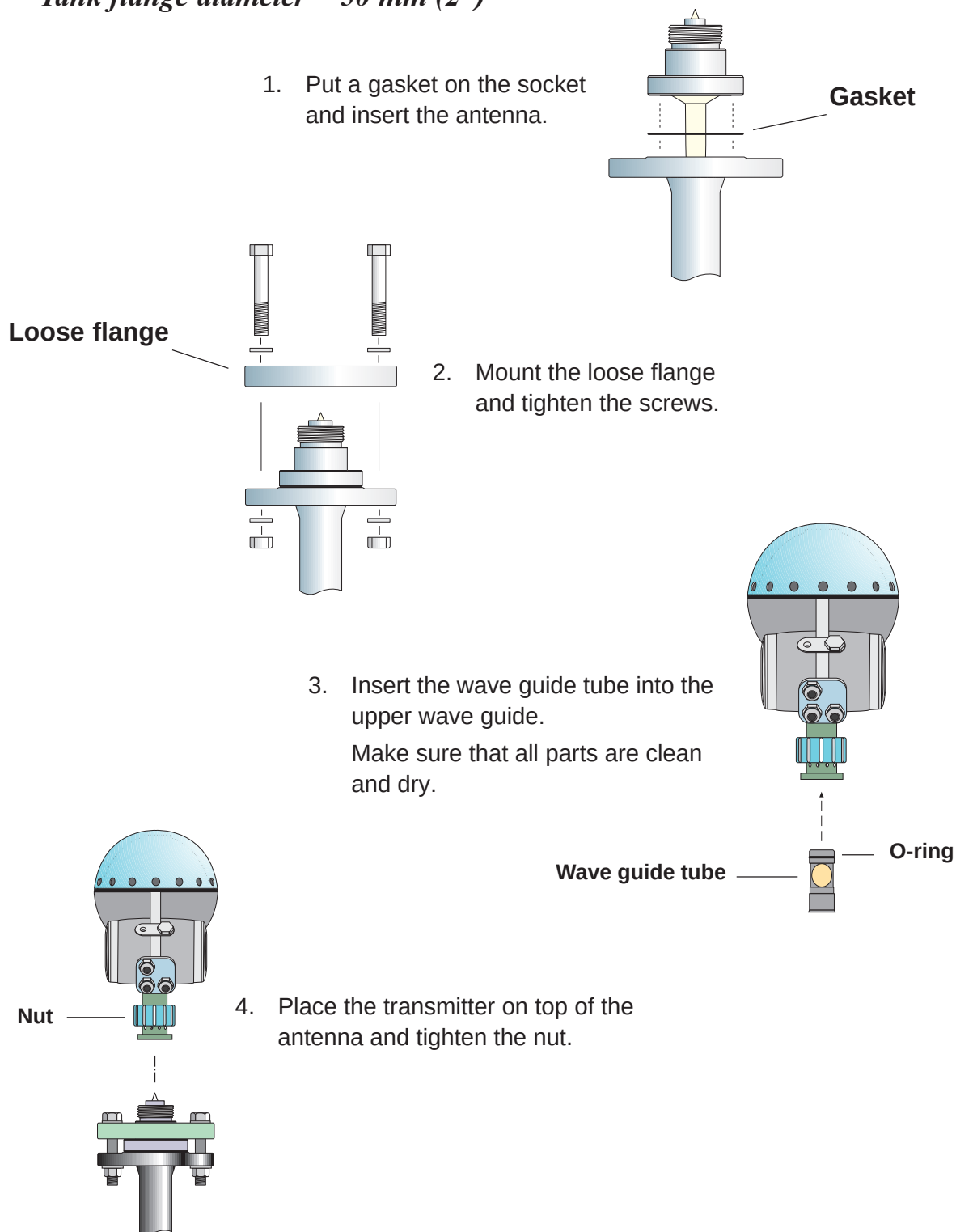
The following set of tools is needed for installation of a TankRadar Pro gauge:

- Screw driver
- Adjustable wrench
- Dispenser for retaining rings
- Allen key
- Circlip pliers
- Pro multipurpose key

Mounting the Rod Antenna

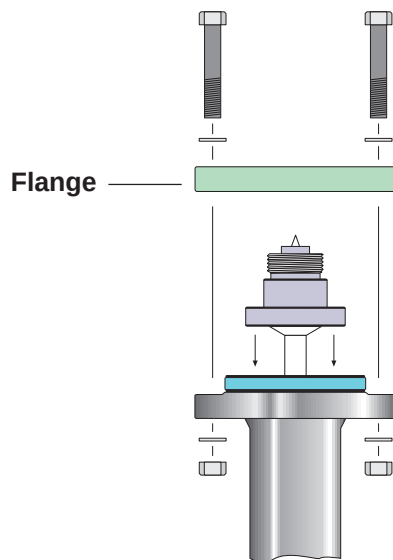
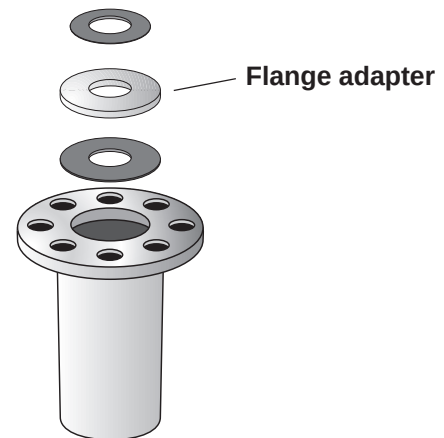
Make sure that all parts are clean and dry when mounted.

Tank flange diameter = 50 mm (2")

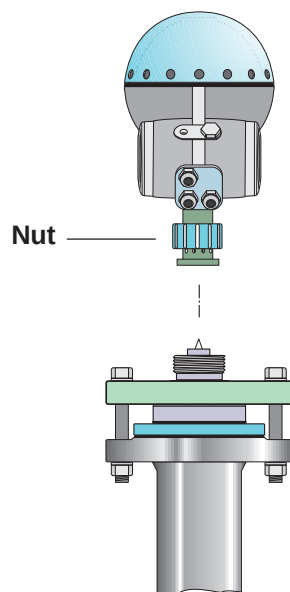


Tank flange diameter = 65 mm (3")

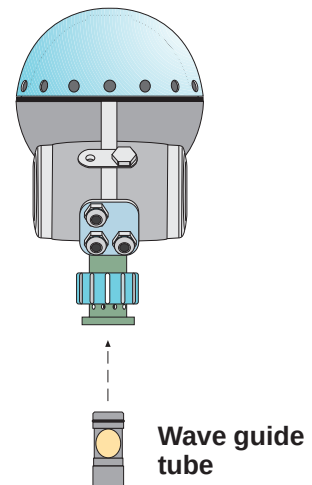
1. Carefully center the flange adapter on top of the tank flange.
Use gaskets under and above the flange adapter.



2. Insert the antenna into the socket.
Mount the loose flange and tighten the screws.



3. Insert the wave guide tube into the upper wave guide.
Make sure that all parts are clean and dry.



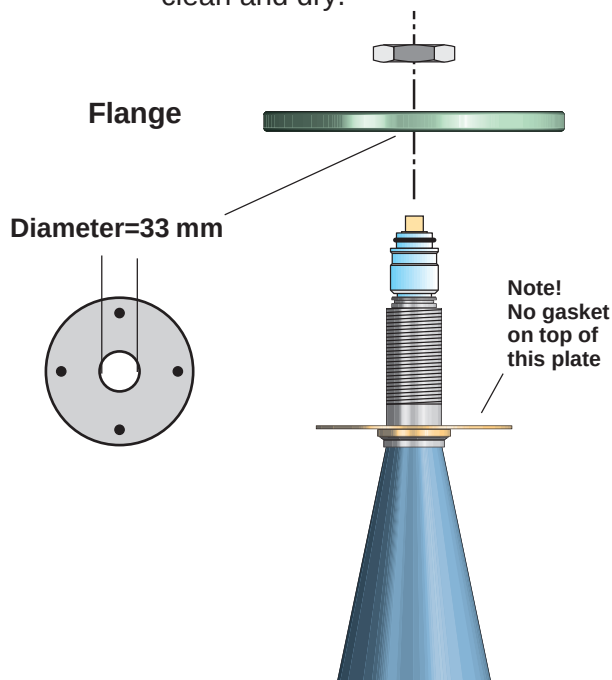
4. Place the transmitter on top of the antenna and tighten the nut.

5. Make sure that all nuts and bolts are tightened.
Proceed with the electrical installation as described in chapter 3.

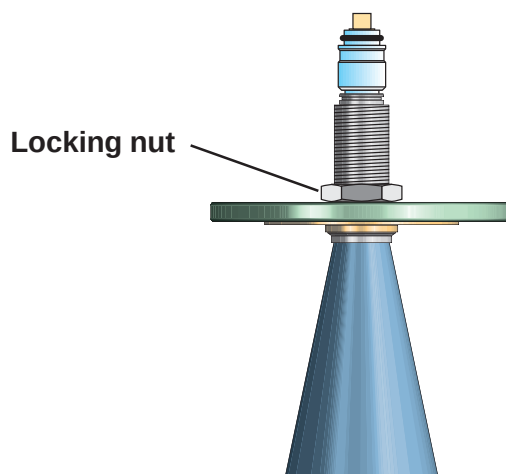
Mounting the Cone Antenna - PTFE sealing

1. Mount the flange on top of the cone plate.

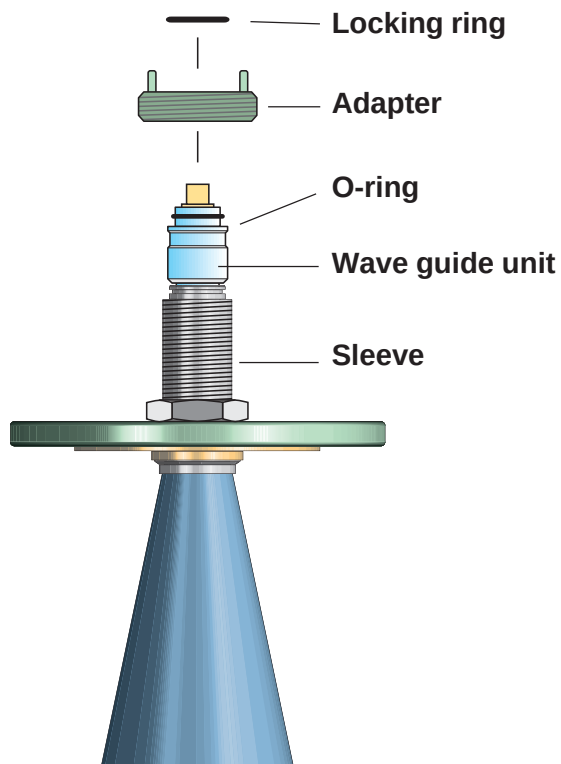
Make sure that the bottom side of the flange is flat and all parts are clean and dry.



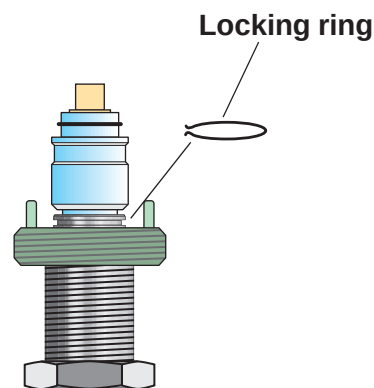
2. Secure the flange with the locking nut.
- Make sure that the nut fits tightly to the flange.



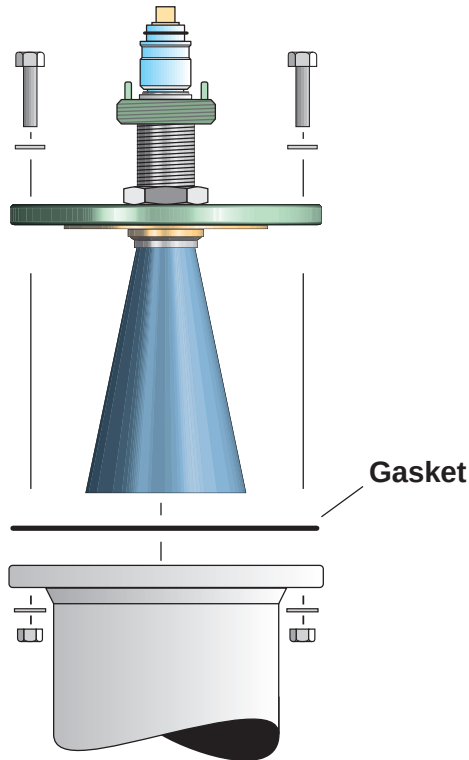
3. Mount the adapter on top of the sleeve.



4. Secure the adapter with the locking ring.

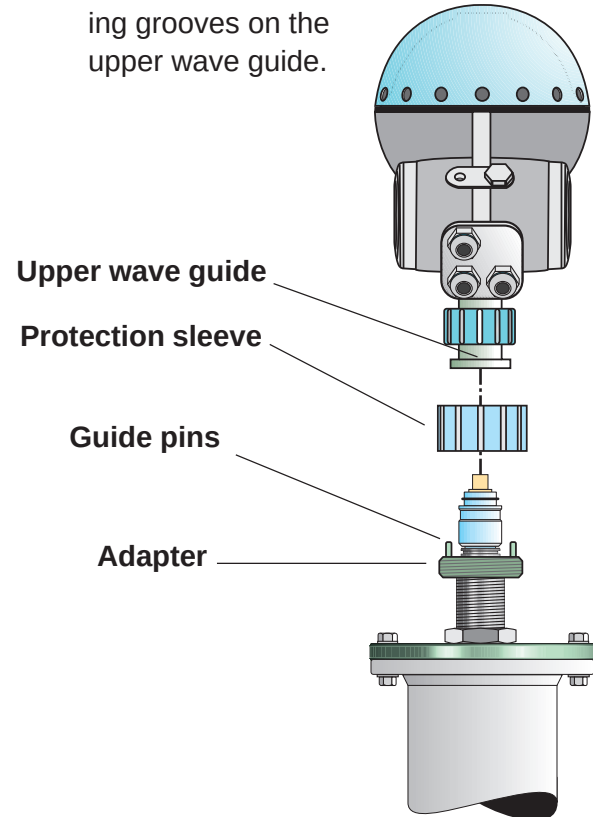


5. Carefully fit the flange and the cone antenna on the tank nozzle.
Tighten with screws and nuts.

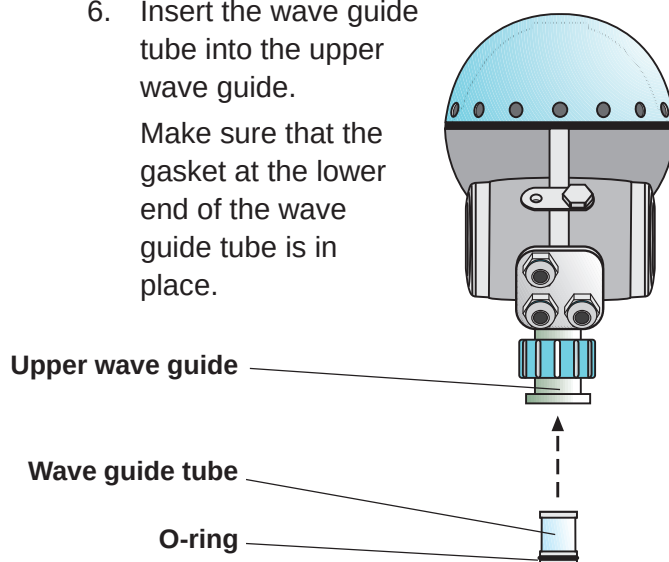


7. Place the protection sleeve on the flange.

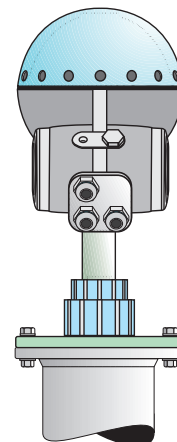
Mount the transmitter head. Check that the guide pins on the adapter enter the corresponding grooves on the upper wave guide.



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



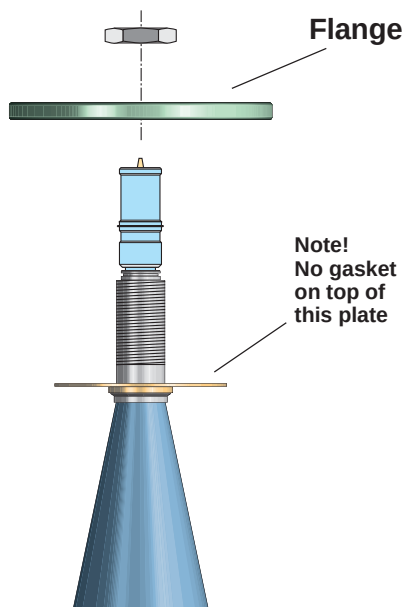
8. Proceed with the electrical installation.



Mounting the Cone Antenna - Quartz Sealing

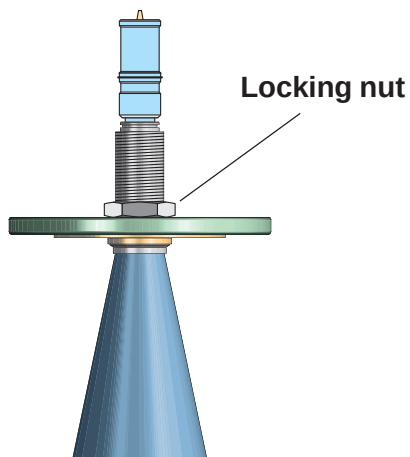
1. Mount the flange on top of the cone plate.

Make sure that the bottom side of the flange is flat and all parts are clean and dry.

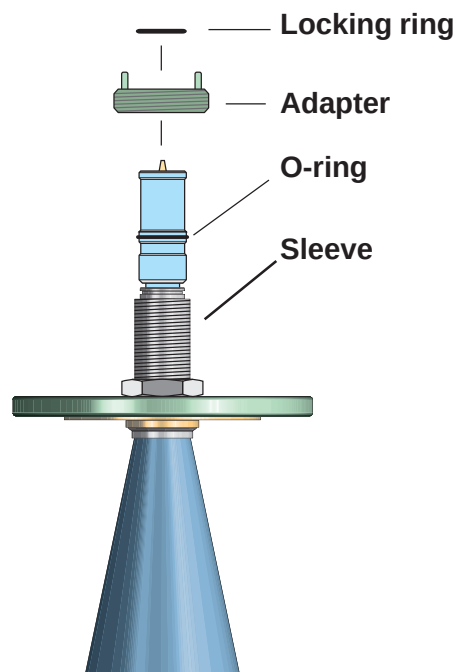


2. Secure the flange with the locking nut.

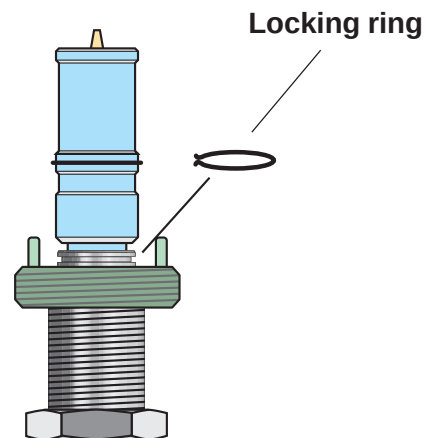
Make sure that the locking nut fits tightly to the flange.



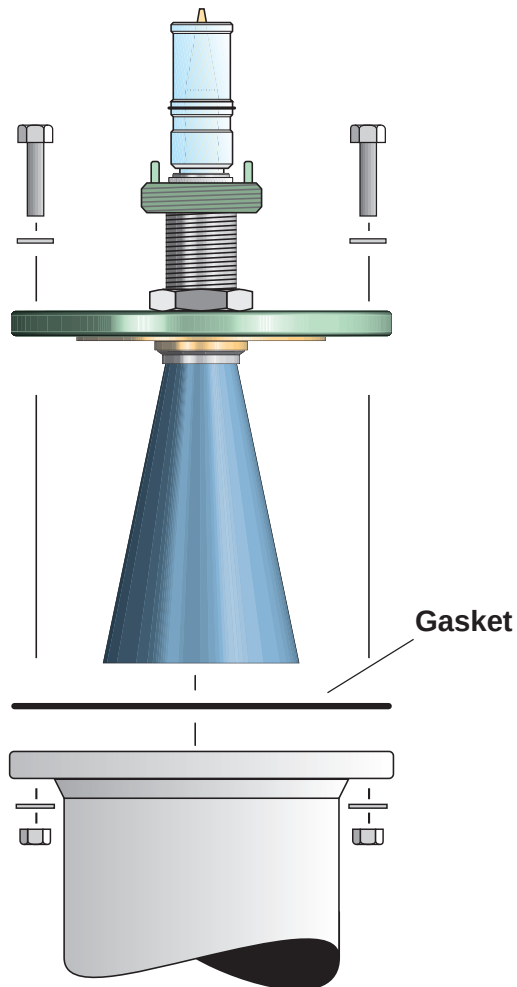
3. Mount the adapter on the sleeve.



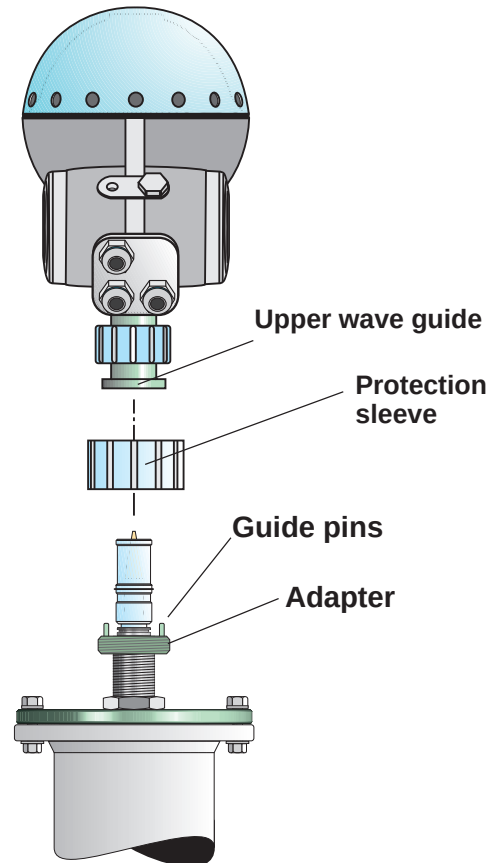
4. Secure the adapter with the locking ring.



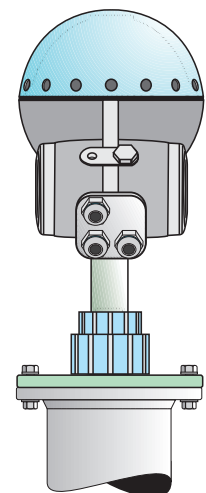
5. Carefully fit the flange and the cone antenna on the tank flange. Tighten with screws and nuts.



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



7. Proceed with the electrical installation.

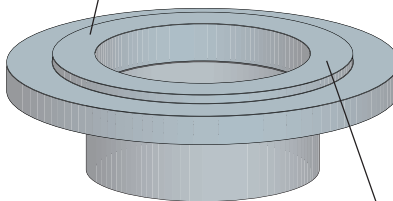
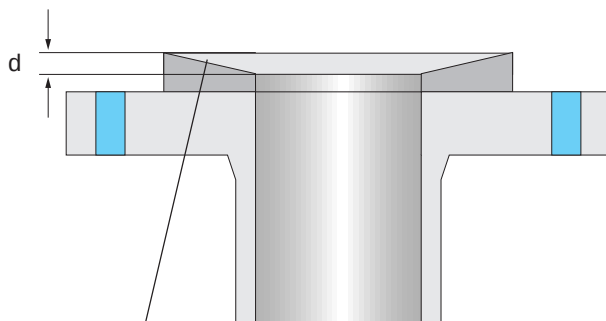


Mounting the Cone Antenna - Process Seal

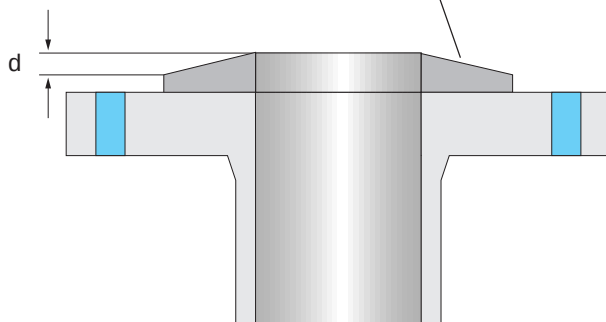
Preparations

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

Concave:
Ceramic window: $d < 0.1 \text{ mm}$
PTFE window: $d < 0.5 \text{ mm}$



Convex:
Ceramic window: $d < 0.1 \text{ mm}$
PTFE window: $d < 0.5 \text{ mm}$

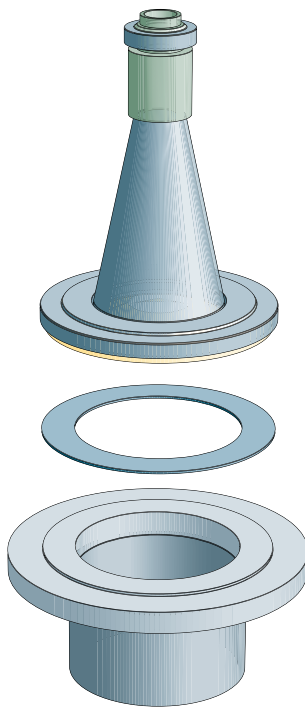


To mount the antenna do the following:

1. Place a gasket on top of the socket and mount the antenna.

Use one of the two gaskets delivered by Saab:

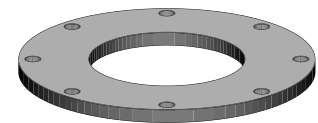
- Teflon
- or
- Graphite for temperatures above 250 ° C.



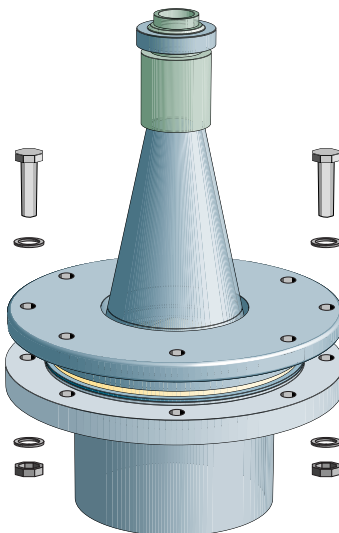
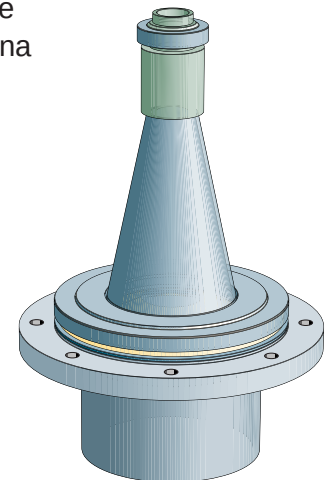
Note!

Use gaskets delivered by Saab. These gaskets are optimized for use with microwave emitting equipment. No other gaskets than Saab original may be used for Process Seal antennas!

2. Put the loose flange on top of the antenna



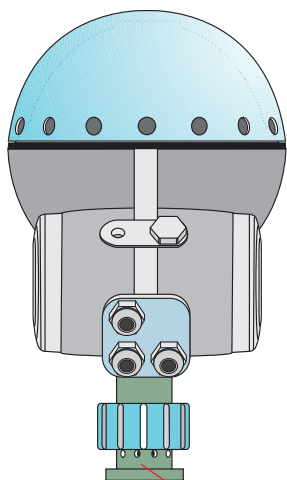
3. Tighten the flange to the antenna by using screws and nuts. Use lubricating grease to minimize friction when the screws are tightened.



Note!

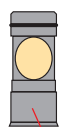
Tighten the screws carefully to a torque according to the recommended values in table 1.

Tighten opposite screws in pair.

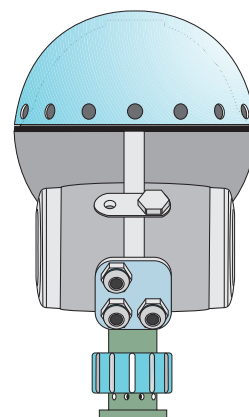


4. Insert the wave guide tube into the upper wave guide.

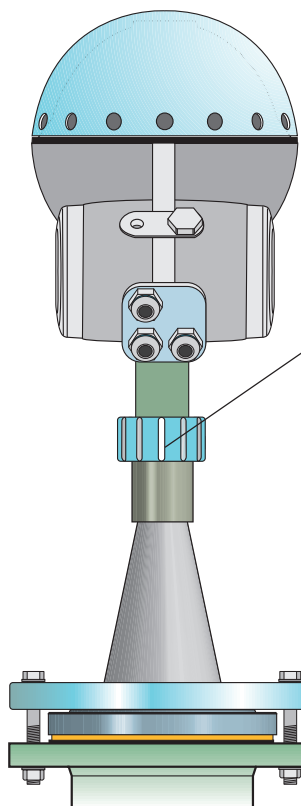
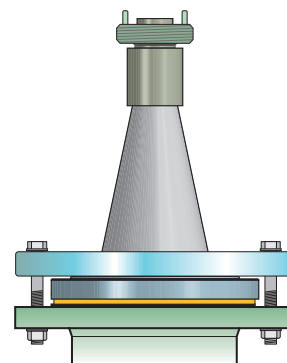
Wave guide



Wave guide tube



5. Mount the transmitter head onto the adapter.



Nut

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

Torque

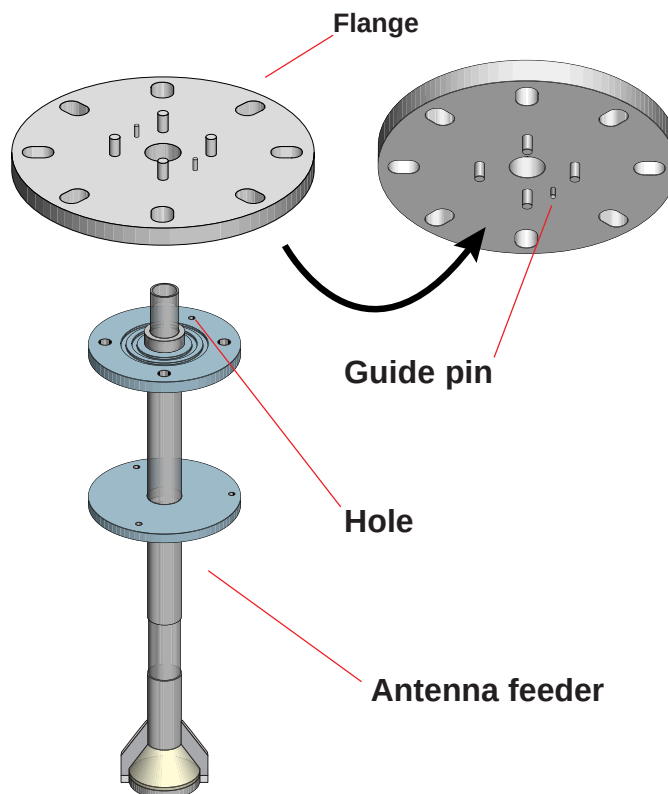
Attach the flange screws by using the following recommended torque values:

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"	11	15			
6"	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"	35	45			
6"	46	31			

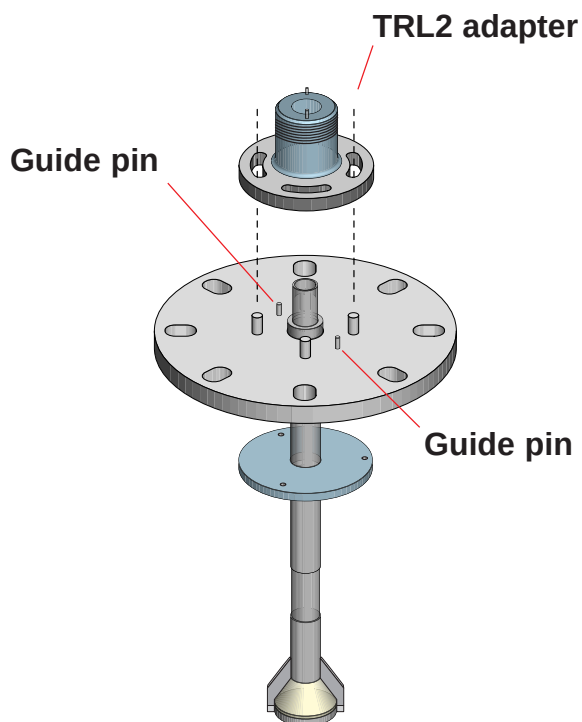
Table 1. Recommended torque for flange screws.

Mounting the Parabolic Antenna

1. Mount the flange on top of the antenna feeder. Use the screws and nuts delivered with the unit. Make sure that the guide pin at the bottom side of the flange fits into the corresponding hole on the feeder. See illustration.

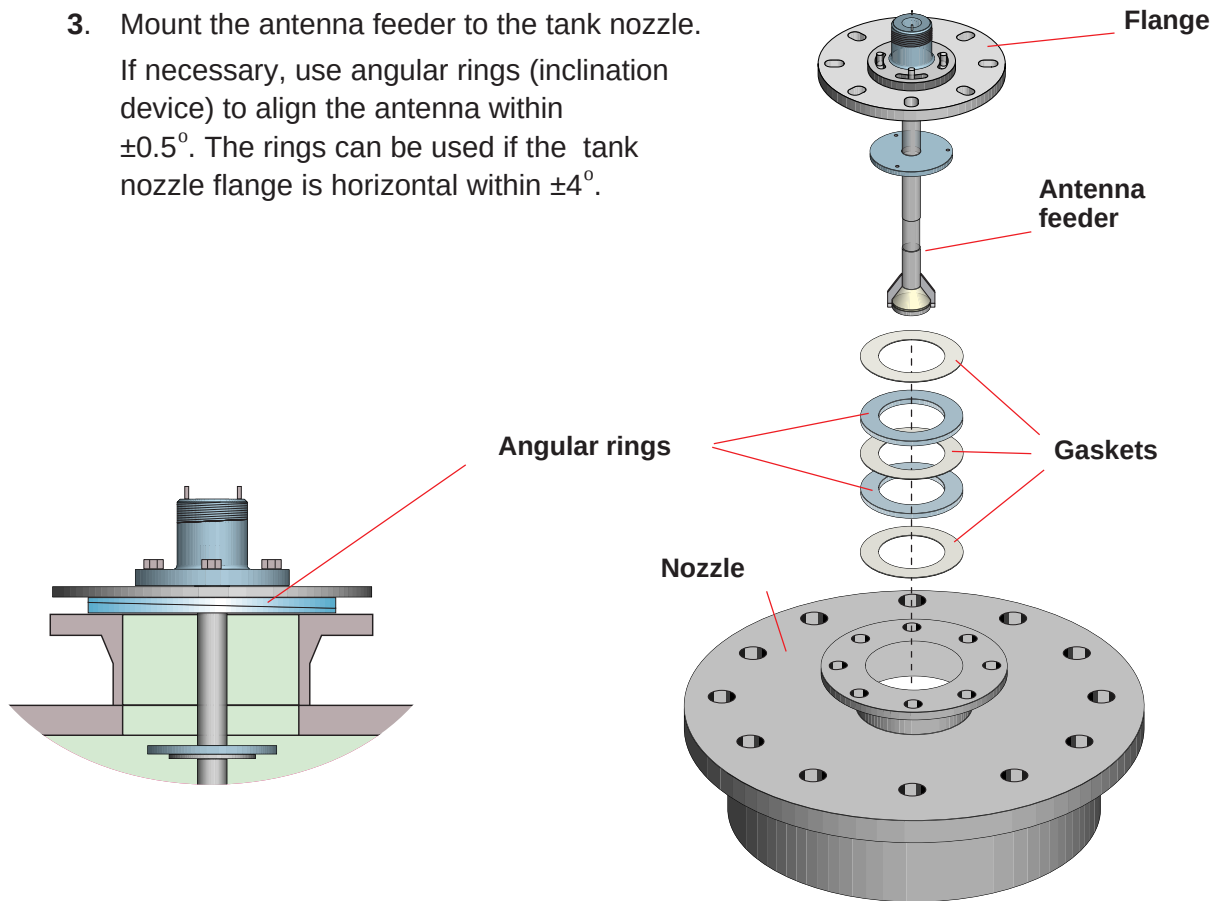


2. Mount the TRL2 adapter on top of the flange and tighten the nuts loosely in order to allow the TRL2 adapter to be rotated. The antenna feeder will be aligned to the transmitter head by using the two guide pins. Note the positions of the guide pins by for example putting a mark at the holes in line with the guide pins.

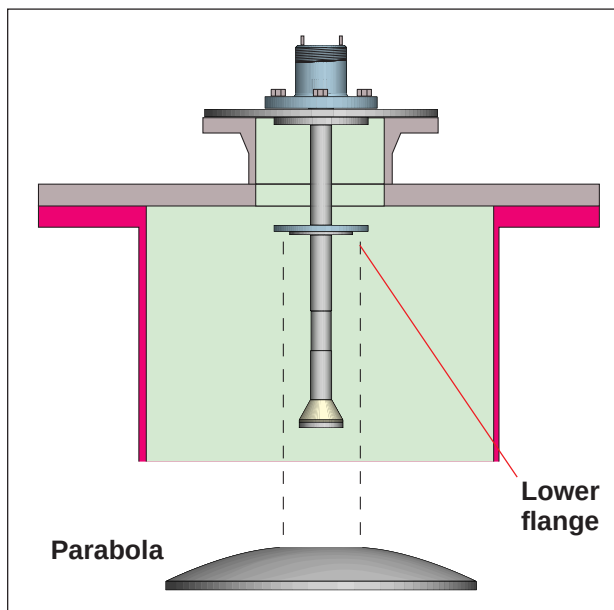


3. Mount the antenna feeder to the tank nozzle.

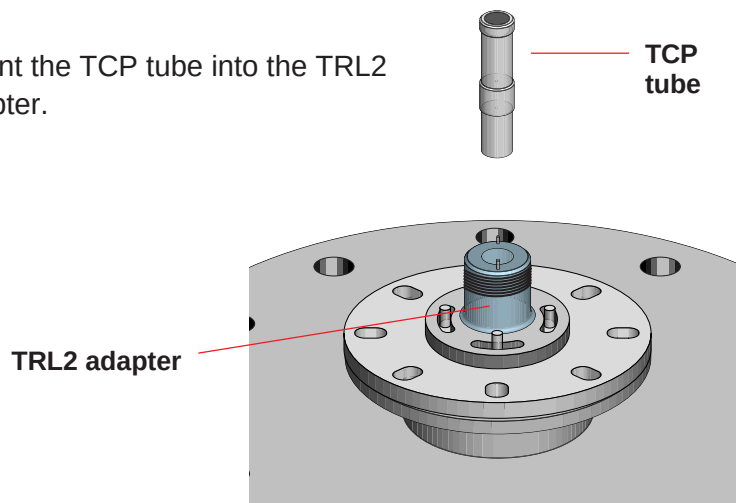
If necessary, use angular rings (inclination device) to align the antenna within $\pm 0.5^\circ$. The rings can be used if the tank nozzle flange is horizontal within $\pm 4^\circ$.



4. Mount the parabola onto the lower flange on the antenna feeder.

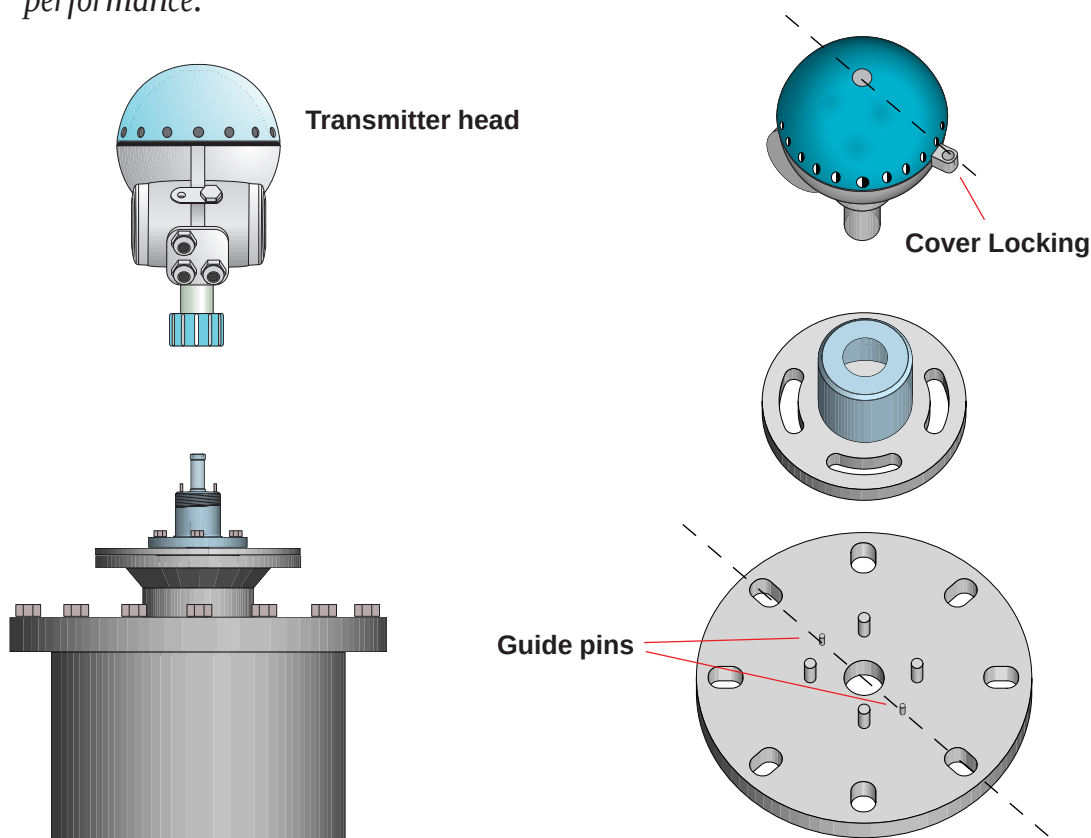


5. Mount the TCP tube into the TRL2 adapter.



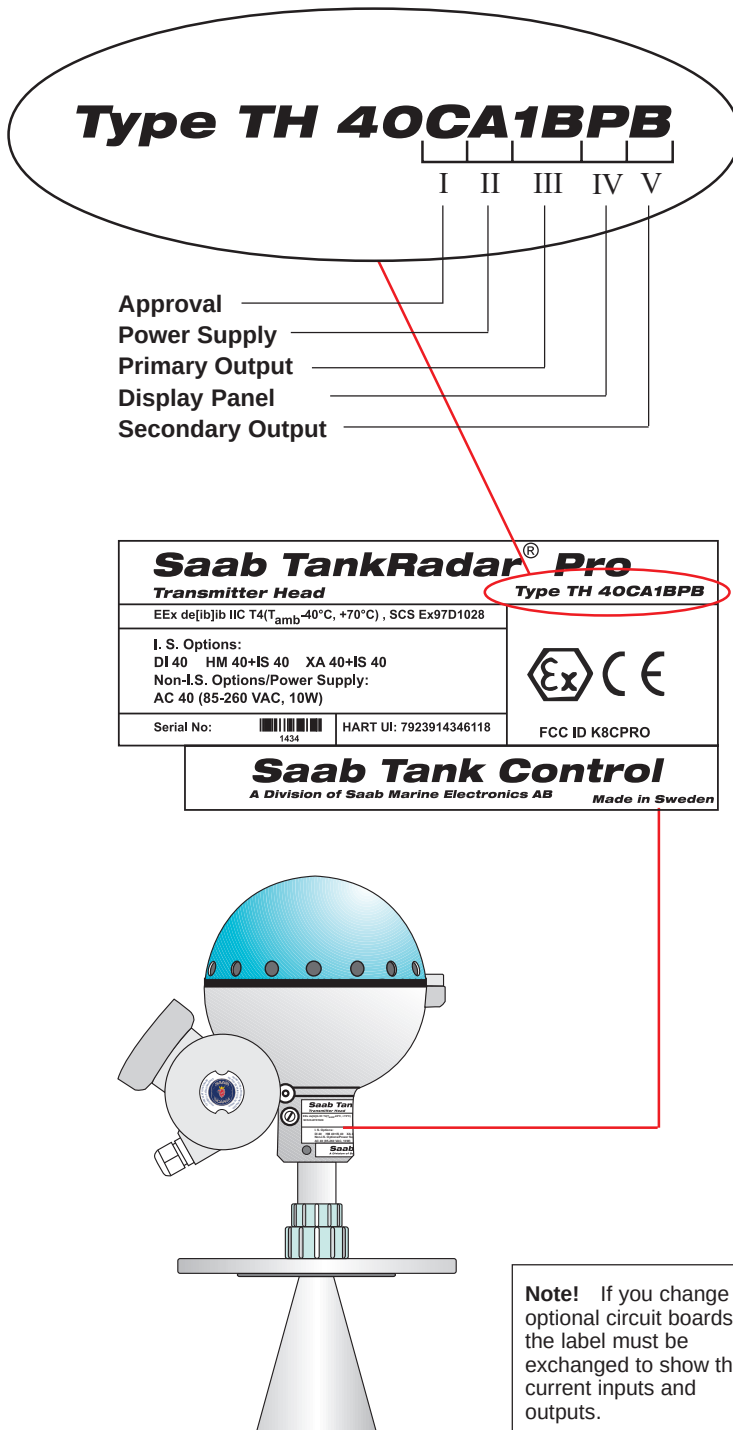
6. Mount the transmitter head.
Rotate the head and the TRL2 adapter to align the cover locking at the back of the transmitter head with the guide pins.

Note! It is very important that the transmitter head is properly aligned to the guide pins. Improper alignment may cause poor measurement performance.



3 Electrical Installation

Identification of Installed Options



I Approval

- C Cenelec
- F FM
- P PTB
- X Other certificates

II Power Supply

- A 100 - 240 VAC nominal power
- D 24 -48 VDC nominal power

III Primary Output

- 1A Non-IS HART/4-20 mA, active.
- 1C Non-IS HART/4-20 mA, passive.
- 1B IS HART/4-20 mA, active.
- 1D IS HART/4-20 mA, passive.
- 2A TRL2 Bus

IV Display Panel

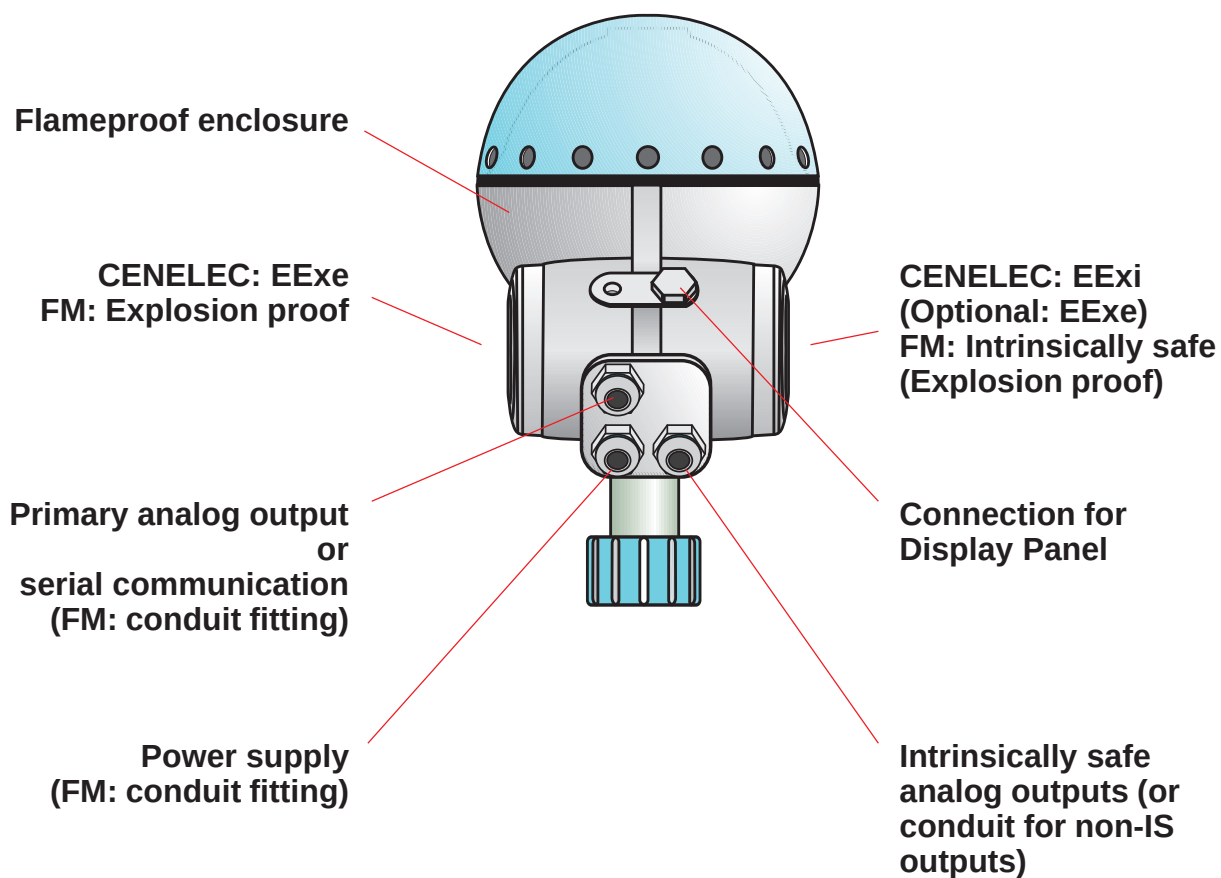
- 0 No display panel
- P Display panel

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.

Junction Box

The standard version is equipped with a junction box that consists of a non-intrinsically safe and an intrinsically safe part. There is also an optional version with two non-intrinsically safe compartments.



External Connections

Non-Intrinsically Safe Junction Box -EEx e

This Junction Box is for non-intrinsically safe connections and power supply.



1-2 Non-intrinsically safe HART/4-20 mA primary analog output,
or
TRL/2 Bus

3-4 Power supply input

5 Not connected

A Electrical safety ground terminal

Note: redundant when the transmitter is grounded according to CENELEC.

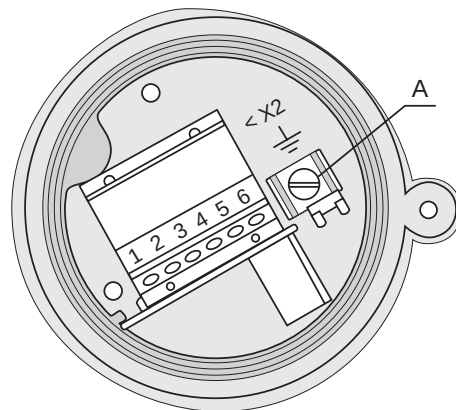
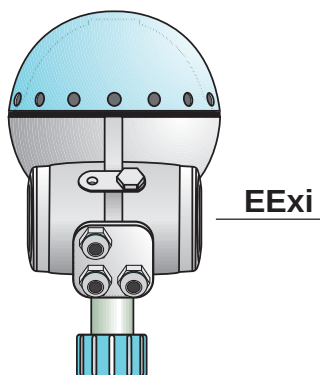
1	2	3	4	5
Out + (Primary)	Out - (Primary)	Power L/L1/+	Power N/L2/-	Not connected

Cable shield

Connect the shield to the cable glands.

Intrinsically Safe Junction Box - EEx i

This Junction Box is for intrinsically safe connections and for connection of the Display Panel.



1-2 Intrinsically safe HART/4-20 mA primary analog output.

3-4 Secondary analog output.

5-6 Display panel.

A Ground terminal for Display Panel.

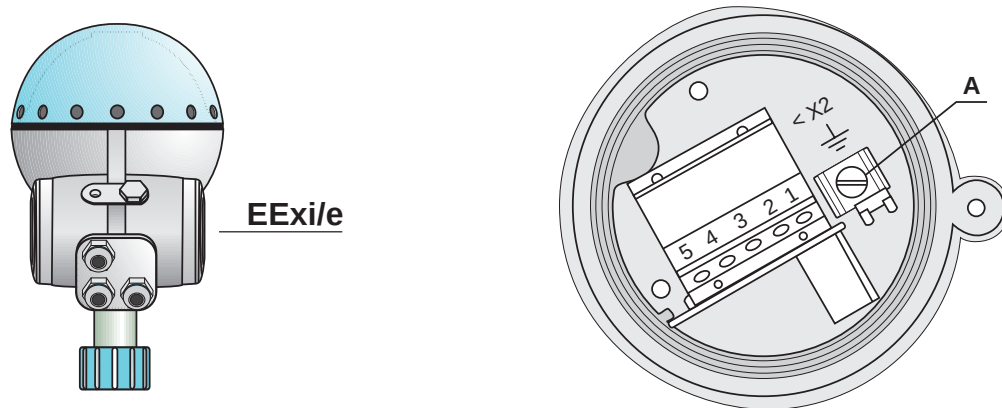
1	2	3	4	5	6
Out + (Primary)	Out - (Primary)	Out + (Secondary)	Out - (Secondary)	DP +	DP S

Cable shield

Connect the shield to the cable glands.

Alternative Non-intrinsically Safe Junction Box

This is the standard intrinsically safe Junction Box (EExi) fitted with an alternative connector for connection of non-IS output if required.



- 1-2 Not used
- 3-4 Non-intrinsically safe Secondary Analog Output
- 5 Not connected
- A Ground terminal (not used)

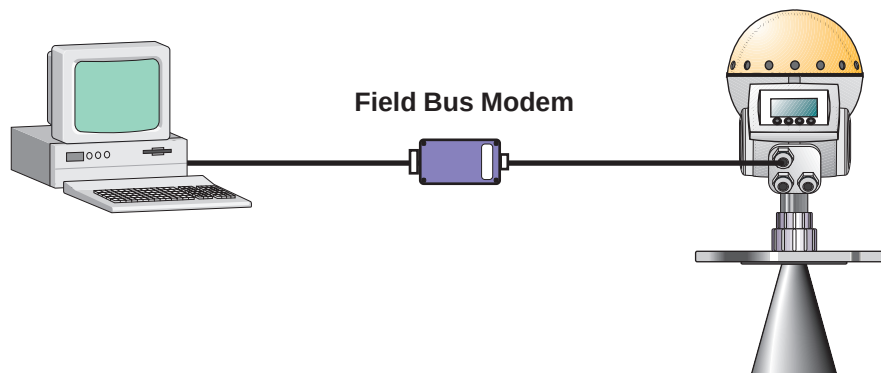
1	2	3	4	5
Not used	Not used	Out + (Secondary)	Out - (Secondary)	Not connected

Cable shield

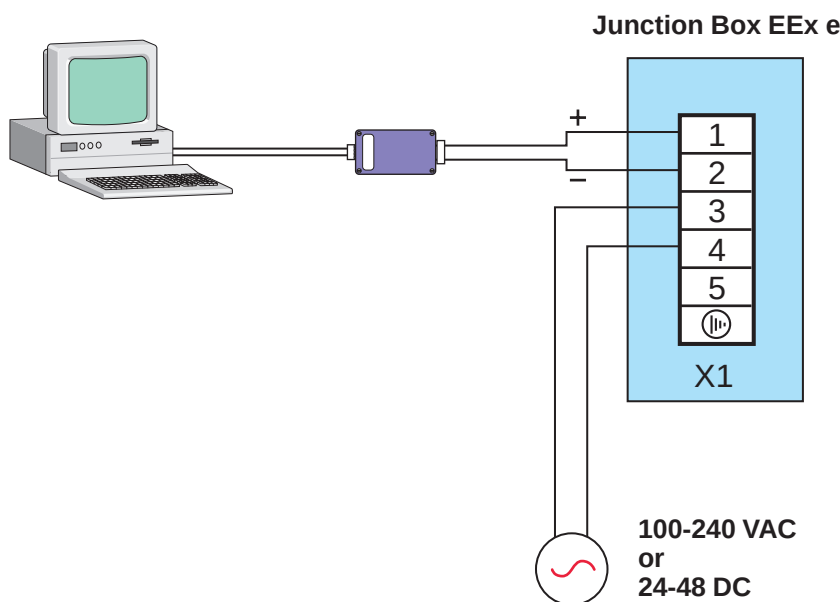
Connect the shield to the cable glands.

Connecting to a TRL2 Bus Interface

Use a Field Bus Modem (FBM) for a Pro transmitter equipped with a TRL2 interface.



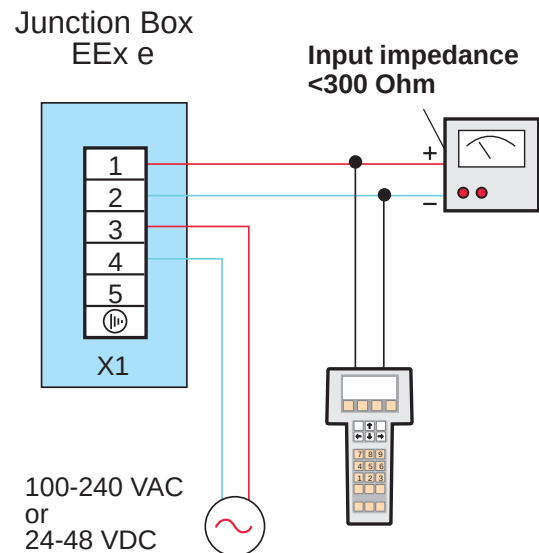
Connect to the non-intrinsically safe junction box (EEx e).



Connecting HART devices

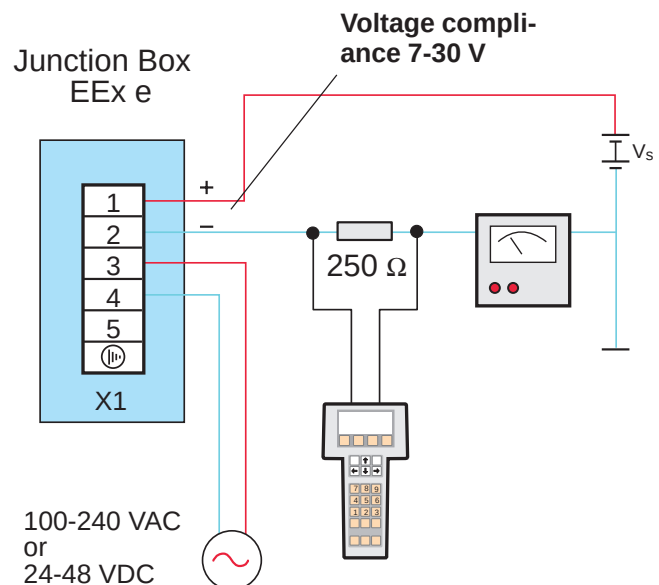
Active output (internal loop supply)

For Pro gauges with active output a hand-held terminal or a HART modem can be connected as follows:



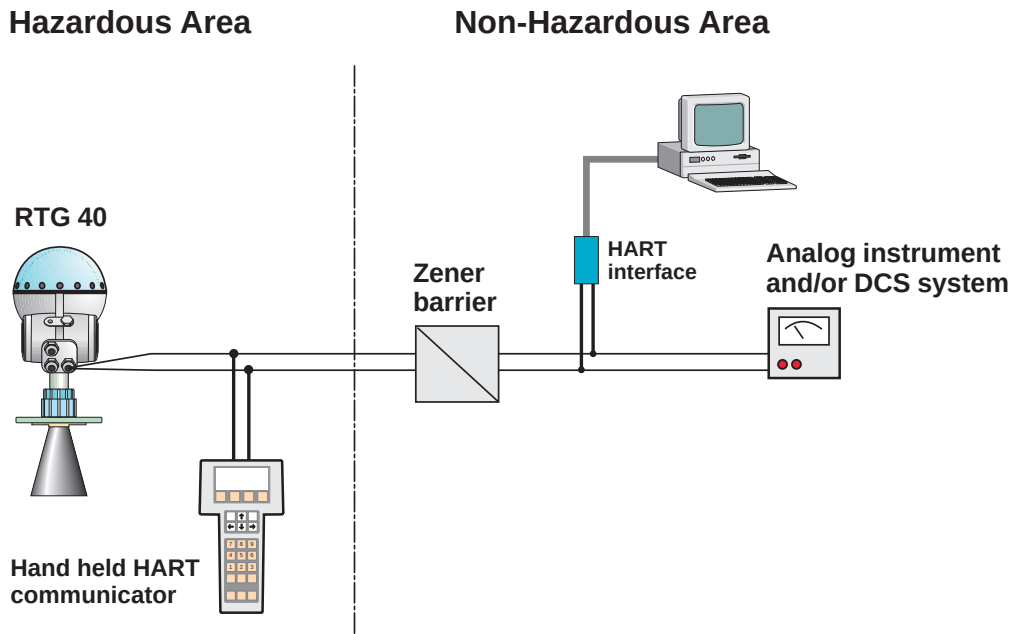
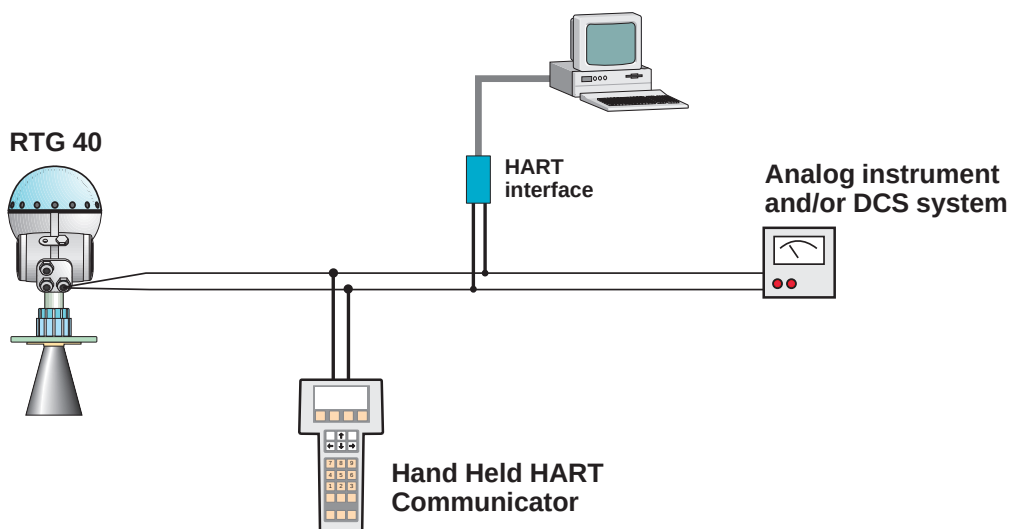
Passive output (external loop supply)

A hand-held terminal 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 .



Intrinsically safe conditions

A hand-held HART communicator can be connected in the hazardous area. The HART interface must be connected via a zener barrier in the safe area.

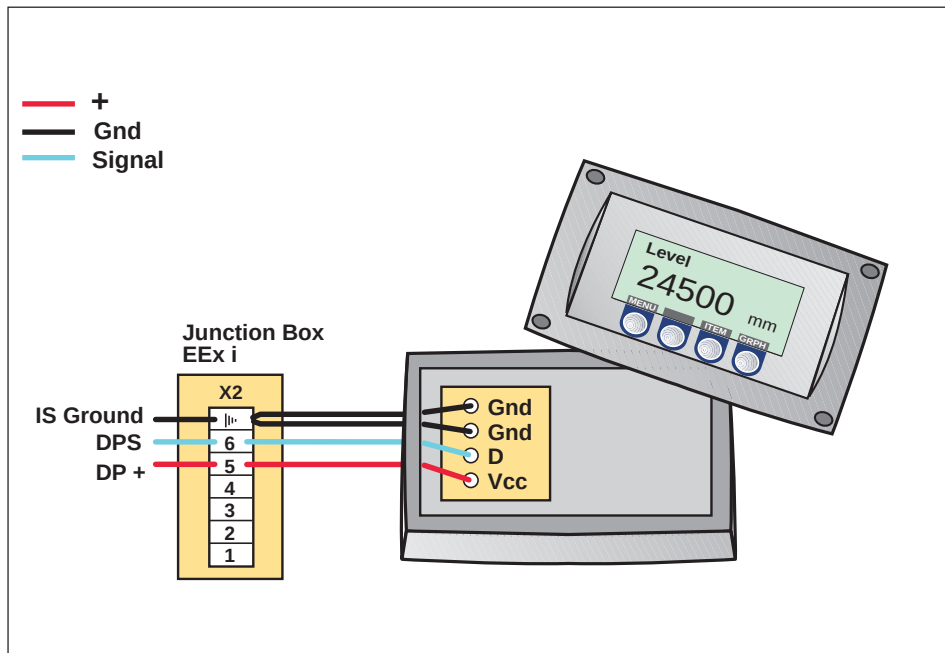
***Non-Intrinsically safe conditions***

Connecting the Display Panel

The Display Panel is intrinsically safe and may only be used when permanently mounted directly on the enclosure with two separate grounding wires.

There are four wires to be connected to the X2 terminal:

- two grounding wires X2 ground terminal
- signal wire terminal 6
- Display Panel supply voltage terminal 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 intrinsically 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 mm² (AWG 20) for analog outputs and serial communication.

Safety

The TankRadar Pro enclosure is flameproof and may not be opened while the transmitter is energized and a flammable atmosphere is present. Saab Tank Control 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-intrinsically safe wires.*

Power Supply

You can use either DC or AC, depending on what type power supply unit that is installed in the transmitter. Nominal supply voltage is:

- 24-48 VDC,
- 100-240 VAC, 50/60 Hz.

See label on the transmitter housing for information on which supply voltage to use.

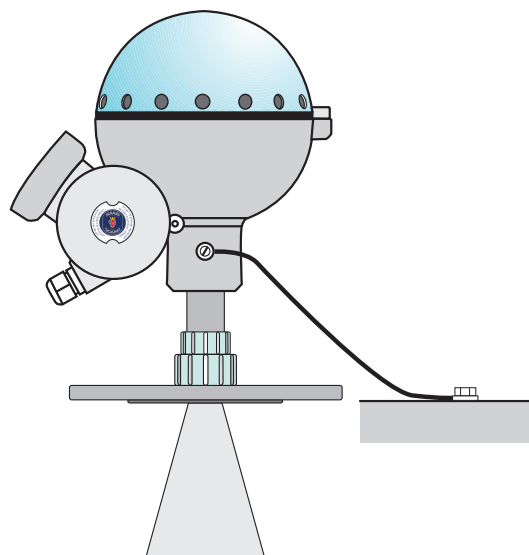
There is no voltage selector in the

electronics compartment since the transmitter power supply unit automatically adapts to the available voltage within specified limits.

Grounding

CENELEC

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



This grounding also serves as electrical safety ground. Additional connection to the protective ground terminal of terminal X1 in Junction Box EExe 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*.

FM

Grounding is accomplished through the conduit pipes.

System Overview

Display Panel

Connect the intrinsically safe Display Panel to terminals 5, 6 and ground in the intrinsically safe (*EExi*) 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 *EExe* junction box for non-intrinsically safe applications, and the *EExi* junction box for intrinsically safe applications.

Digital Communication

Saab TankRadar Pro can be equipped with HART interface or Saab TRL/2 Bus interface.

The Saab TRL/2 Bus may only be connected to the non-intrinsically safe (*EExe*) junction box.

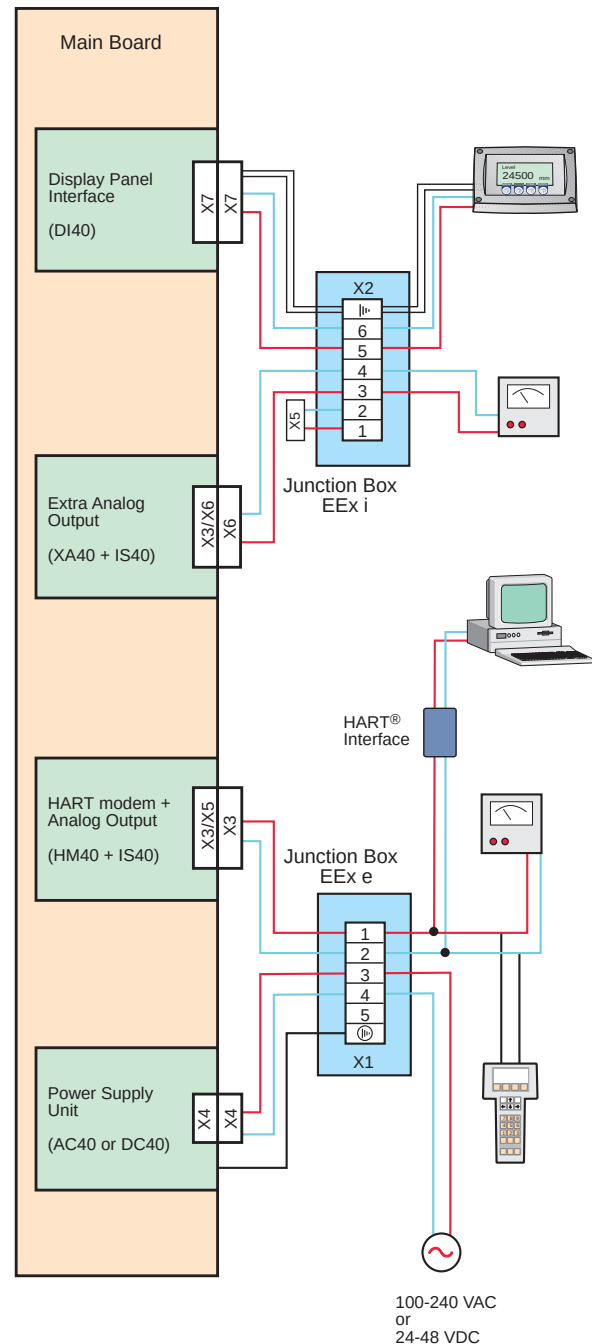
Connect the serial data transmission cables to terminals 1 and 2.

Power Supply

Saab TankRadar Pro operates on 100-240 V AC or 24-48 V DC. Check the label on the transmitter housing that the correct power supply board is installed.

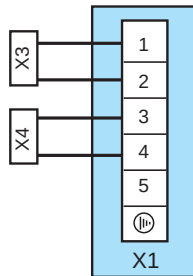
Connect the power supply to terminals 3 and 4 in the non-intrinsically safe Junction Box (*EExe*).

Schematic illustration of Pro transmitter connections

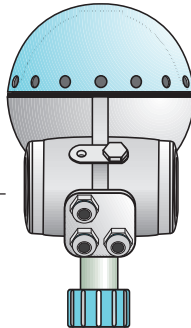
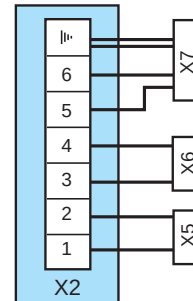


Internal Connections

Non-Intrinsically Safe (EEx e)

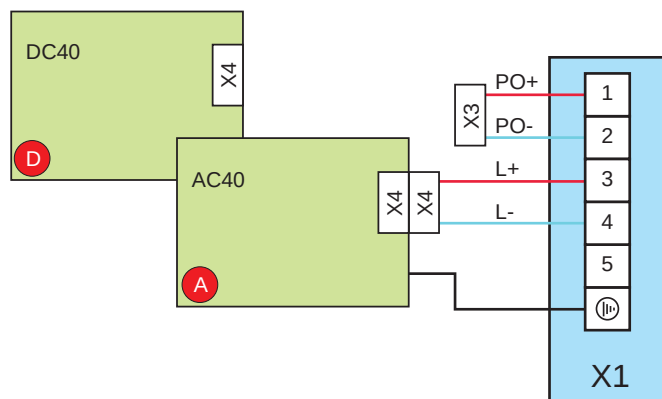


Intrinsically Safe (EEx i)



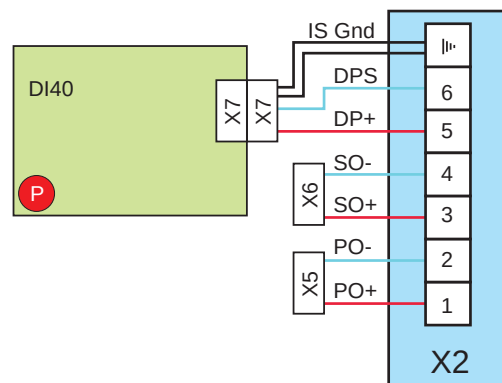
Power Supply

Option	Description	Board
A	100 - 240 VAC	AC40
D	24 - 48 VDC	DC40



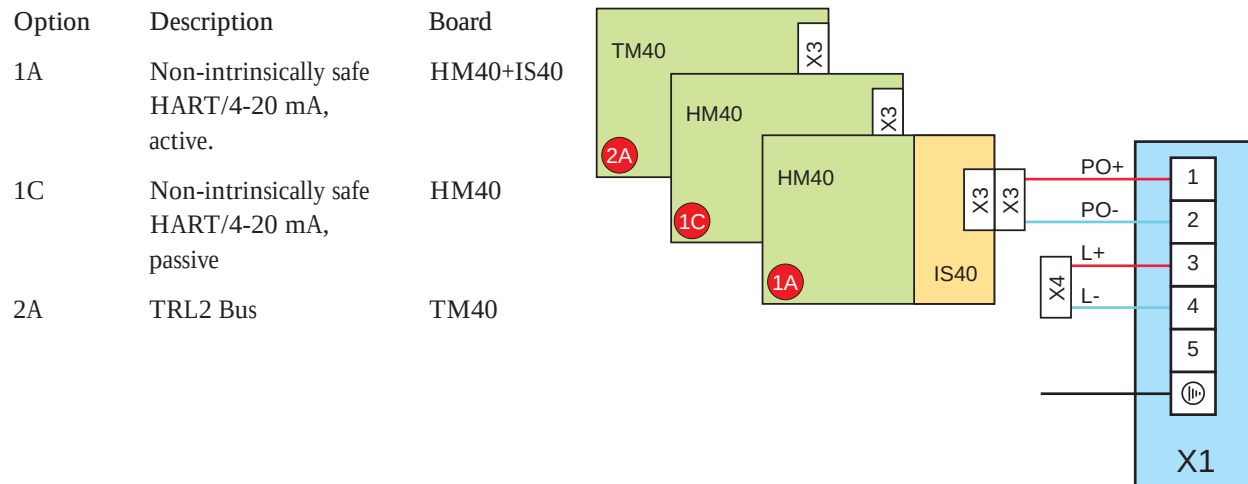
Display Panel

Option	Description	Board
0	No Display Panel	NA
P	Display Panel	DI40

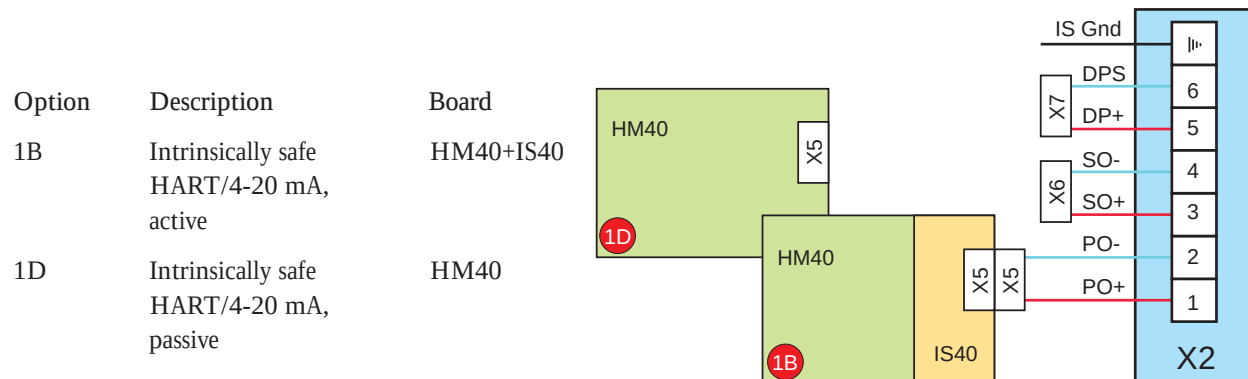


Primary Output

Non-Intrinsic Safety (EEx e)

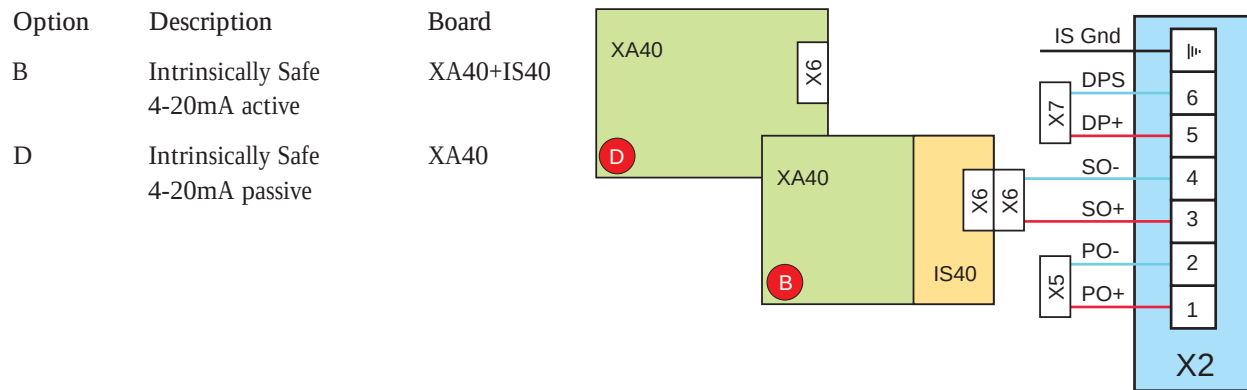


Intrinsic Safety (EEx i)

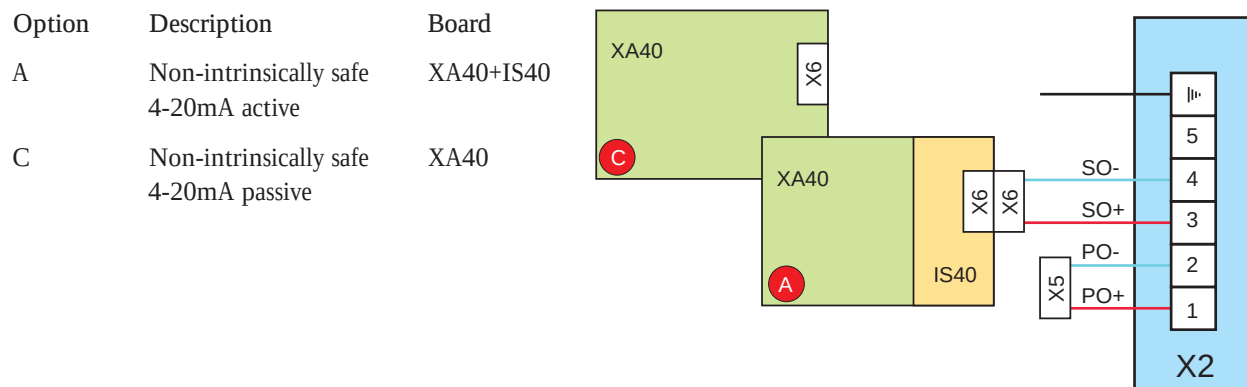


Secondary Output

Intrinsic Safety (EEx i)



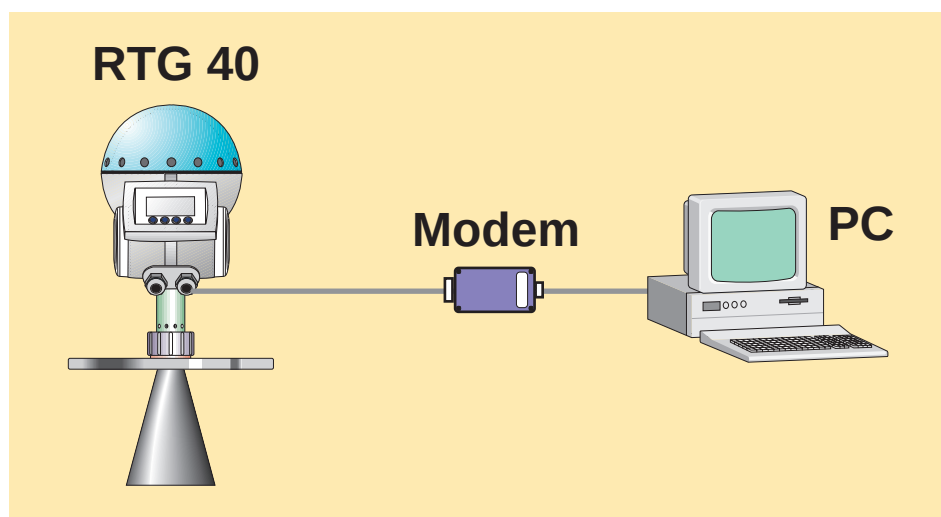
Non-Intrinsic Safety (EEx e)



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 Pro Setup Software

The Pro Setup software is an easy to use PC program for configuration of the Saab *TankRadar Pro* transmitter. It is designed to run under Windows95/NT4.0. It also includes options for viewing tank data as well as options for advanced service.



It is a simple task to start and configure the TankRadar Pro transmitter. When the gauge is mounted on the tank flange, and the cables are properly connected you only need to run through a straightforward configuration procedure to start the transmitter. In this procedure you will set a few parameters to optimize the performance of the gauge for your particular application:

- Tank dimensions
- Type of application.
- Analog out: source, range and alarm mode.
- Volume calculations (optional).
- Tank environment (for the disturbance echo handling).

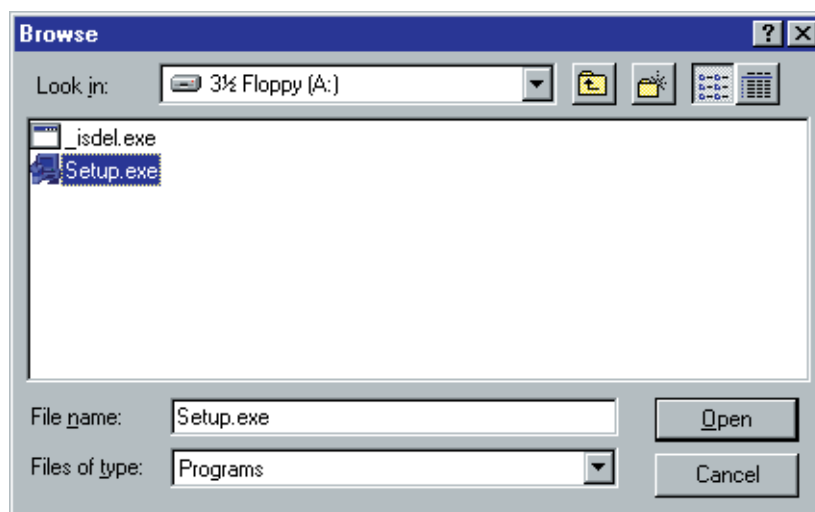
System Requirements

Processor:	Pentium
Operating system:	Windows95/NT 4.0
Memory:	16 MB
Hard disk space:	5 MB

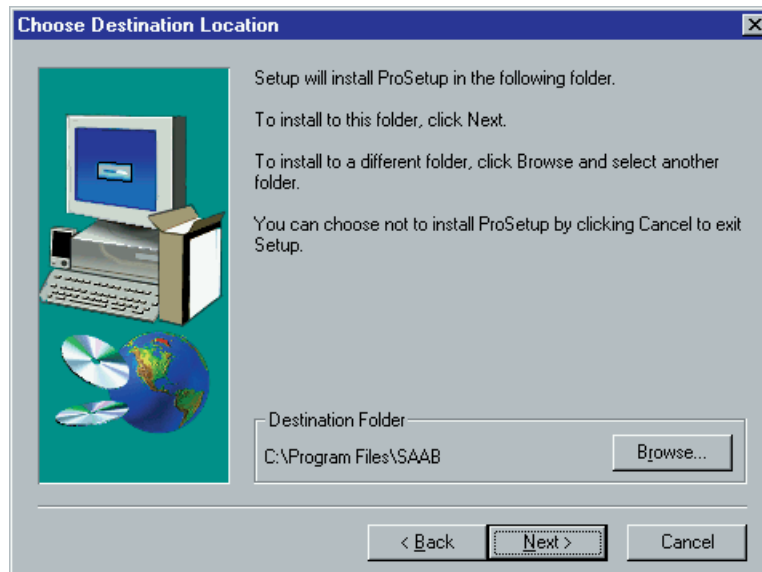
Installing the Pro setup software

To install *TankRadar Pro* configuration software on your computer do the following:

- 1 Start Windows and make sure that no applications are running.
If you run Pro Setup under Windows 95, upgrade Windows 95 by running the Dcom95.exe upgrade kit.
- 2 Insert the TankRadar Pro setup disk.
- 3 Select the Run command on the Start menu.



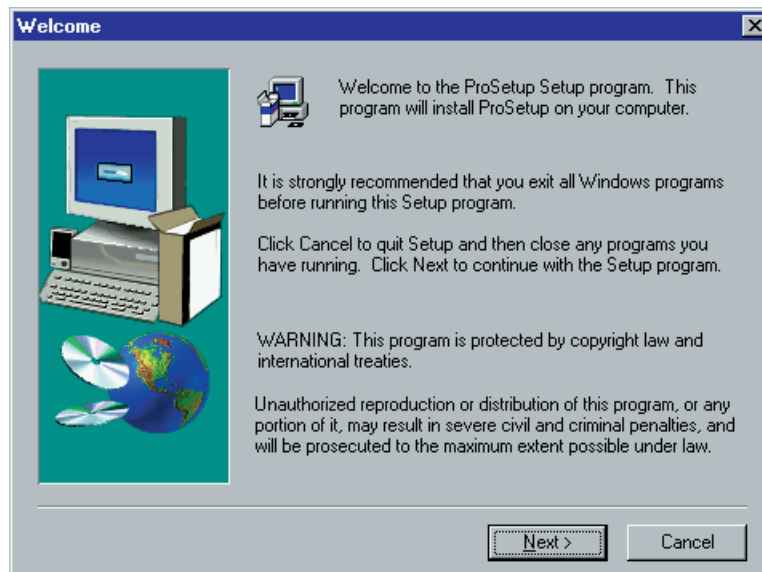
Browse to the diskett drive and select the **setup** file. Follow the instructions.



4 Choose installation directory.

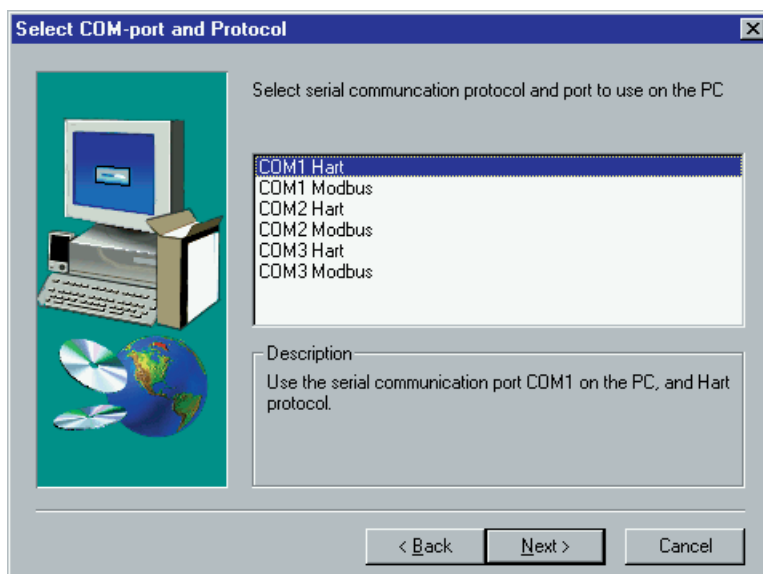
Program Files\Saab is the default directory. Click the **Browse** button if you want to specify another installation directory.

Click the **Next** button.

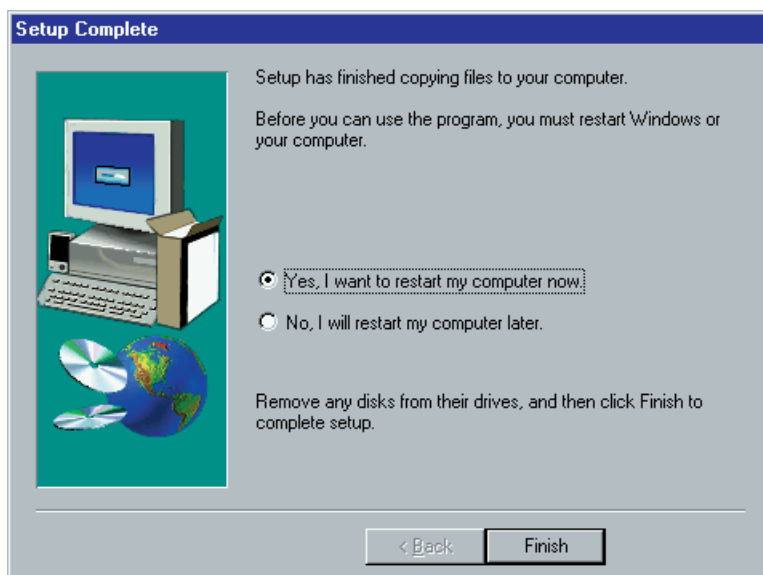


5 Follow the instructions in the installation wizard.

Click the **Next** button.



- 6 Specify the Com port and communication protocol you will use to connect the gauge. Com port and protocol can be changed later.



- 7 Finish the installation.

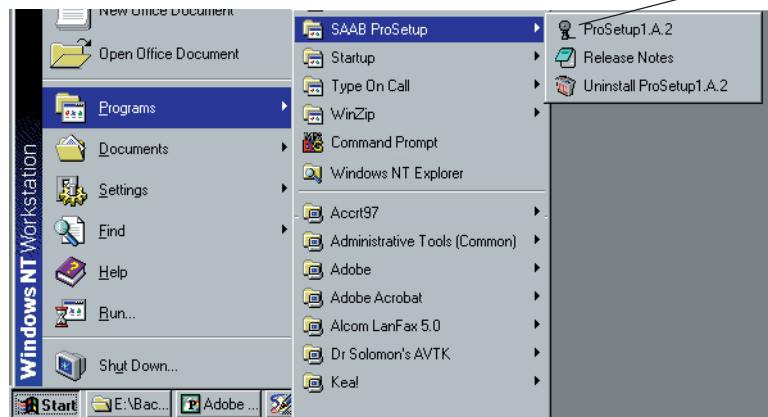
Starting the Pro Setup Program

Do the following to start Pro Setup:

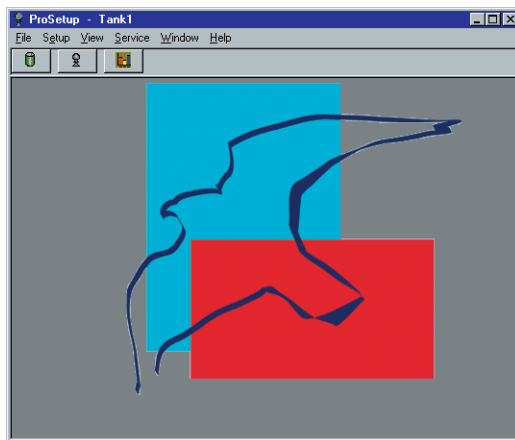
- 1 Click the Start button in the Windows95 Task bar.

Programs menu

Start button



- 2 Open the Programs menu.
- 3 Open the Saab ProSetup folder.
- 4 Click the Pro Setup icon.



Note! While Pro Setup is running, the Win95 Task Bar contains two buttons named “Pro Setup” and “Saab TankRadar IO Master Server”. The last button refers to a communication program supporting Pro Setup. Normally, you do not need to open this window unless you need to change communication parameters. It can also be used to view communication on screen.

Setting a Password

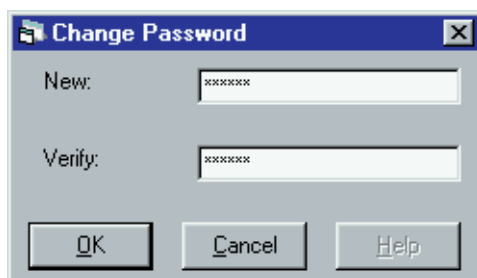
You can set a password to prevent unauthorized changes of the transmitter configuration. Then you will have to enter the password in order to obtain access to configuration and service options. You do not need to enter a password for viewing tank data.

To set a password do the following:

- 1 Select Password from the **Setup** menu.



- 2 Leave the **Password** input field blank if no password has been set.



- 3 Click the **Change** button.
- 4 Enter a new password in the **New** input field.
- 5 Verify the new password and click the **OK** button.

Response: the Change Password window is closed.

- 6 Click the **Close** button in the *Supervisor's Password* window.

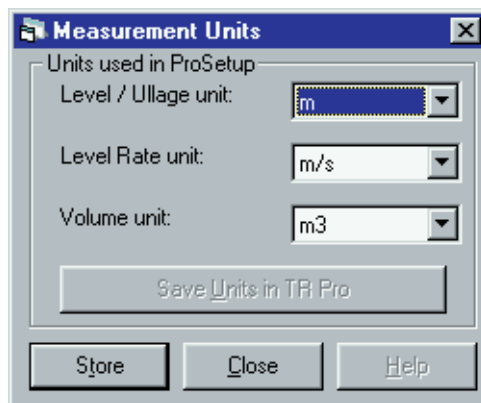
Logging on to a password protected system.

To log on to a password protected system do the following:

- 1 Select Password from the **Setup** menu.
- 2 Enter your password in the **Password** input field.
- 3 Click the **Log On** button.
- 4 When your password is accepted click the **Close** button.

Setting measurement units

- 1 Select **Measurement Units** from the **Setup** menu.

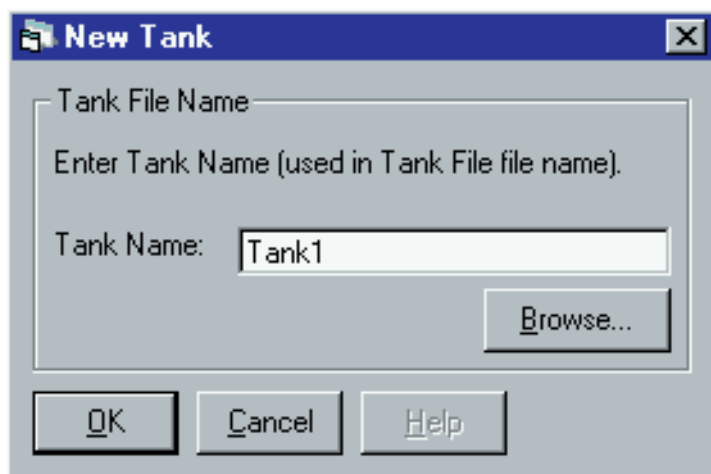


- 2 Select the desired units for Level/Ullage, Level Rate and volume.
- 3 Click the **Store** button.

Installing a Pro Transmitter

Do the following to install and configure a Pro transmitter:

- 1 Connect to a TankRadar PRO transmitter.
 - 1 Select **New Tank** from the **File** menu in the **Main** window.



- 2 Enter a tank name to associate with the tank and click the **OK** button.

Response: the Tank Radar PRO Setup window is opened with the address tab active.

2 Enter protocol and address data.

- 1 In the **Protocol** box specify the protocol that you will use for the serial communication.
 - Choose **HART** if your gauge is equipped with an analog output and a HART interface (make sure that the HART interface is correctly installed according to the recommendations for active and passive analog outputs, see *Electrical Installation*).
 - or -
 - Choose **Saab Modbus** if your gauge is equipped with a TRL/2 Bus interface.

Make sure that you select the same protocol that was specified during the Pro Setup installation. If you need to change the current communication settings (if you for example have changed modem), open the **IO Master Server** program from the Windows95 task bar. Choose **Parameters** from the **Format** menu to view the communication parameters. The following settings are used for TRL2 Bus and HART interface:

	HART	TRL2 Bus
Protocol	HartMaster	ModbusMaster
Baudrate	1200	4800
Parity	Odd	No parity

- 2 Set the communication **address**. To set a new address you have to know the current address or the Unit ID/Long Address (HART) to establish communication with the gauge. The default address is 0 for HART and 246 for Modbus.

To change the address, do the following:

- 1 Enter the address that is currently stored in the gauge (the default address for a new gauge) into the address field.
- 2 Click the **Read** button.
Response: the Unit ID/Long Address is displayed.
- 3 Set the address of your own choice.
- 4 Click the Store button.

If the transmitter did not respond to the old address do the following:

- 1 Enter the Unit ID (Saab Modbus)/Long address (HART) in the corresponding field. The Unit ID can be found on the label, see Chapter 3.
- 2 Enter the desired address in the Address field
- 3 Click the **Store** button.

If the transmitter did not respond to the old address, and you can not find the Unit ID, (for example if the transmitter is located far from the configuration PC), do the following:

- 1 Click the **Scan Search** button. Pro Setup automatically scans through a range of possible addresses in order to find connected devices.

Note! For Modbus devices the scan may be very time consuming if the default address is still valid. Normally the scan starts at address 0 for HART buses and address 1 for Saab Modbus. You can enter other start addresses in the Address field in order to reduce the scanning time.

This function may be useful if you want to find out which addresses that are currently used by connected devices.

- 2 Stop the scanning when the correct device is found.
The scan continues until a device is found, or until the search is stopped by the operator.
- 3 Enter the address that you want to use for the particular device.
- 4 Click the **Store** button.

Now the address is stored in the gauge and will be used for the communication between the PC and the transmitter.

3 Select the Start Radar tab

- 1 Click the **Read** button.
Response: the current settings and the Start Code are displayed.
- 2 Check that the correct set of available options is displayed. Contact your local representative if you like to add one or more of the following software options: EchoFixer, MET, FFAST filtering or strap table volume calculations.
- 3 Mark the check boxes that corresponds to available software options that you want to enable.

Note! The strapping table option can only be enabled by selecting the Strapping Table option in the Volume tab.

- 4 Select the type of **antenna** to be used.
 HP=high performance (Hastelloy, Tantalum, Titanium, Monel).
 Std=standard.
 P=PTFE tank sealing.
 Q=Quartz tank sealing.
 C=Ceramic.
 Enter the **pipe inner diameter** if the antenna is mounted in a still pipe.
 The **TCL** parameter is entered for non-standard antennas only.

- 5 In the Tank Environment and Presentation **Standard** tab there are two groups of parameters. In the Environment box mark the check boxes that correspond to the conditions in your tank:

Rapid level changes optimizes the transmitter for measurement conditions where the level changes quickly due to filling and emptying of the tank.

Turbulent Surface This parameter may be used if the tank e.g. contains boiling products causing a turbulent surface. By setting this parameter the performance of the transmitter will be improved when there are small and quickly changing amplitudes and levels.

Foam Setting this parameter optimizes the transmitter for conditions with weak and varying surface echo amplitudes.

Solid Products Setting this parameter optimizes the transmitter for products which are not transparent for radar signals. The effect will be more reliable handling of false echoes from beams.

You should not choose more than two options for best performance.

In the **Presentation** box the following options are available:

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 be used if you have set a C distance in the tank geometry configuration (see the *Configuration* tab and chapter *Tank Distances*).

Bottom Echo always visible if empty tank Mark this check box if the tank shape allows bottom echoes to be detected. 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

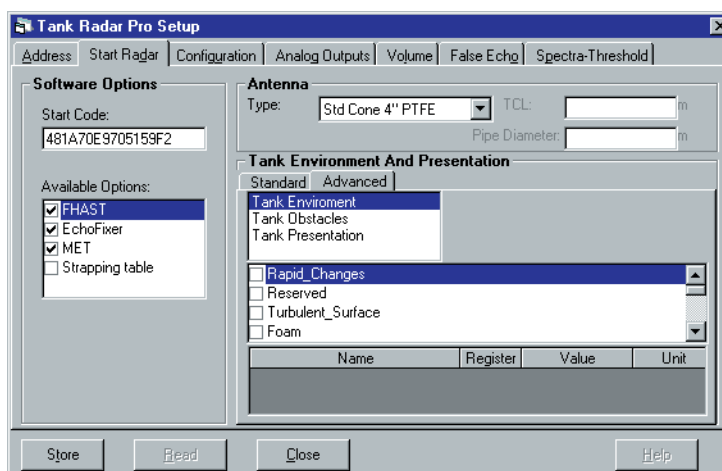
restricted to a region close to the tank bottom (Related database register: *Full tank detection area, 1516*).

Do not set this parameter if the bottom echo is not visible.

Slow Search

This variable controls how to search for the surface if a surface echo is lost. With this parameter set the transmitter 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 transmitter searches through the whole tank. This parameter may typically be used for tanks with turbulent conditions.

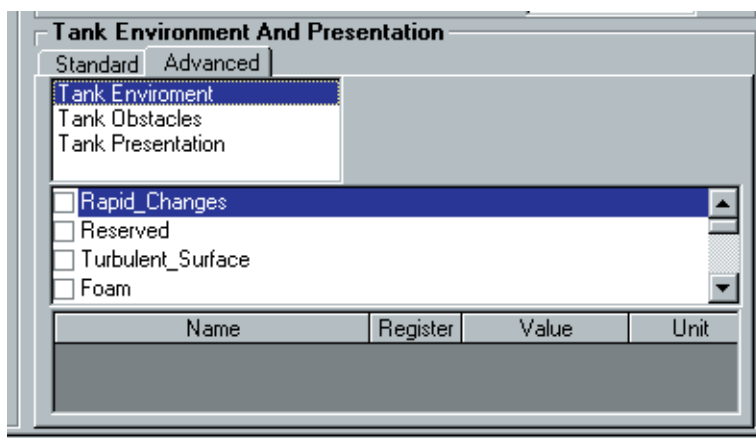
- 6 Click the **Store** button if no further settings are required,
- or -
open the Tank Environment and Presentation **Advanced** tab to make further settings:



For some parameters , e.g. Slow Search in the Tank Presentation group, there is a related holding register which may need to be changed in order to achieve the best measurement result. For these parameters the related database registers appear in the bottom pane of the Advanced tab.

You can edit the register value by simply putting the cursor in the corresponding input field and enter the desired value.

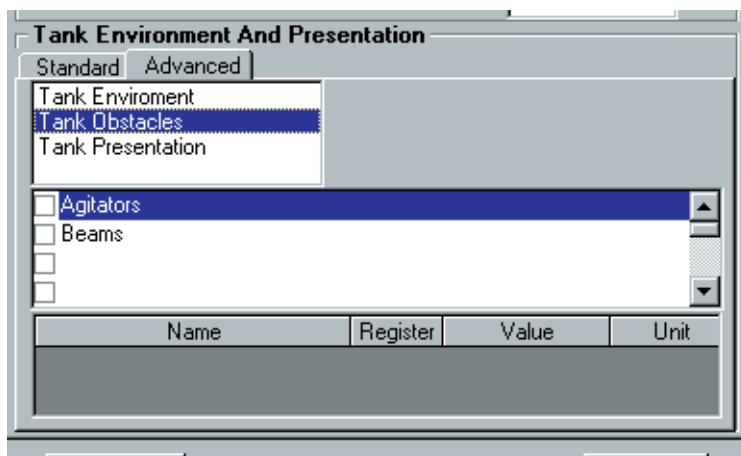
Tank Environment



See description of the Tank Environment parameters in the **Standard** tab.

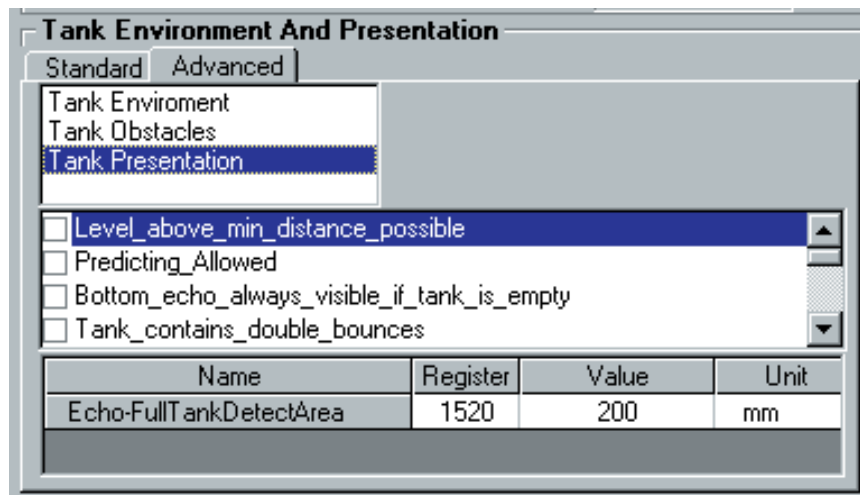
Note! The Tank Environment parameter settings overrides some of the Holding register settings.

Tank Obstacles



This option is not used in the current version of the Pro application software.

Tank Presentation



Level above min distance possible

If the surface echo is lost in the vicinity of the antenna, full tank is indicated and searching for the surface echo is limited to a region close to the antenna.

Predicting allowed

Improves the performance when filling or emptying a tank. Setting this parameter may reduce the time to detect a lost surface echo resulting in better tracking of a moving surface.

Bottom echo always visible if tank empty

See description of the **Standard** tab parameters.

Double bounce possible

Some radar waves are reflected against the tank roof and back to the surface before they are detected by the transmitter. Normally, these signals have a low amplitude and are therefore neglected by the transmitter. In some rare cases the amplitude may be strong enough to lead the transmitter to interpret the double bounce as the surface echo. By setting the Double bounce parameter this type of measurement situation may be improved. This function should only be used if the problem of double bounces can not be

solved by changing the mechanical installation. Related database register: *DoubleBounceOffset* (1522).

Slow search

See description of the **Standard** tab parameters. Related database register: *SearchSpeed* (1524).

Double surface

Indicates that there are two liquids in the tank resulting in two reflecting surfaces. The upper liquid is must to be partly transparent to the radar signal. If this function is activated, you can specify which surface to ignore by setting the *Ignore top surface* parameter.

Ignore top surface

This function should only be used if *DoubleSurface* is set. See description of *Double surface*. If *IgnoreTopSurface* is set the lower surface will be presented as the product surface.

Show negative values as zero

See description of the **Standard** tab parameters.

Monotone ullage/level presentation

When a tank is filled the level value may fluctuate up and down due to a turbulent surface. By setting this parameter the transmitter will not present decreasing level values for a tank that is being filled unless the level decreases more than an amount given by the *MonFilt Hysteresis* parameter (holding register 1058).

For a tank that is being emptied only decreasing values are presented, unless the level rises more than an amount given by the *MonFilt Hysteresis* parameter.

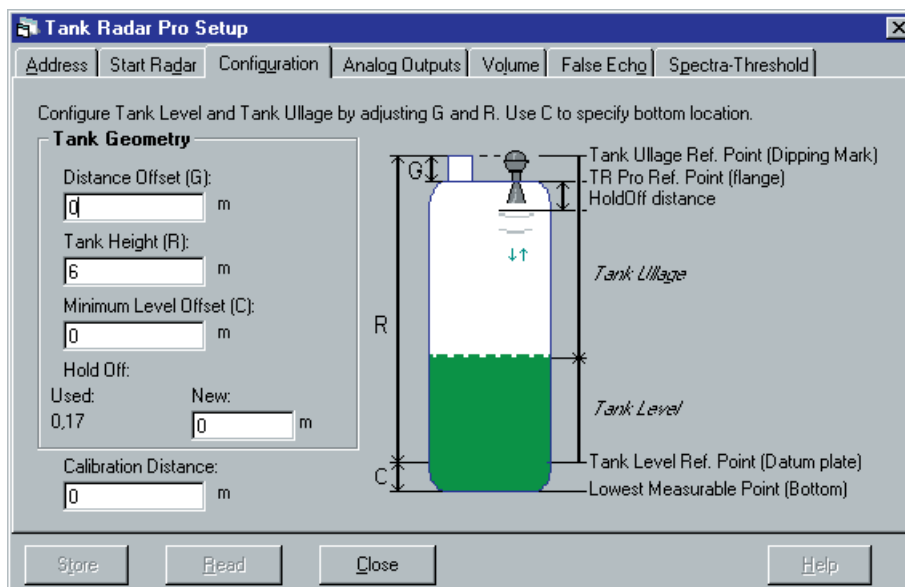
*Invalid level is not set
if tank is full or empty*

If the surface echo is lost close to the top or close to the bottom of the tank, the level value full/empty 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.

Click the Store button when all settings are finished.

4 Select the Configuration tab



- 1 Click the **Read** button.
Response: the current settings are displayed.
- 2 In the Tank Geometry box, enter values for Distance Offset (G), Tank Height (R) and Minimum Level Offset (C).

The **Distance Offset (G)** is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Tank Radar Pro Reference Point*). You can use **G** to specify your own reference point at the top of the tank. Set **G=0** if you want the flange as upper reference point. **G** is defined as positive if you use an upper reference point above the *TR Pro Reference Point*. For tanks with an ullage plug for hand dipping the *Tank Ullage Reference Point (dipping mark)* can be used as upper reference point, but you can use other reference points as well.

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).

The **Minimum Level Offset (C)** is used to extend the measurement range down to the tank bottom. **C** can not be a negative value. **C** is defined as the distance between the zero level (*Tank Level Reference Point*) and the minimum accepted level. If your zero level is located above the bottom of the tank, set the **C** distance equal to

the distance between the zero level and the tank bottom. Set **C**=0 if you use the tank bottom as zero reference point.

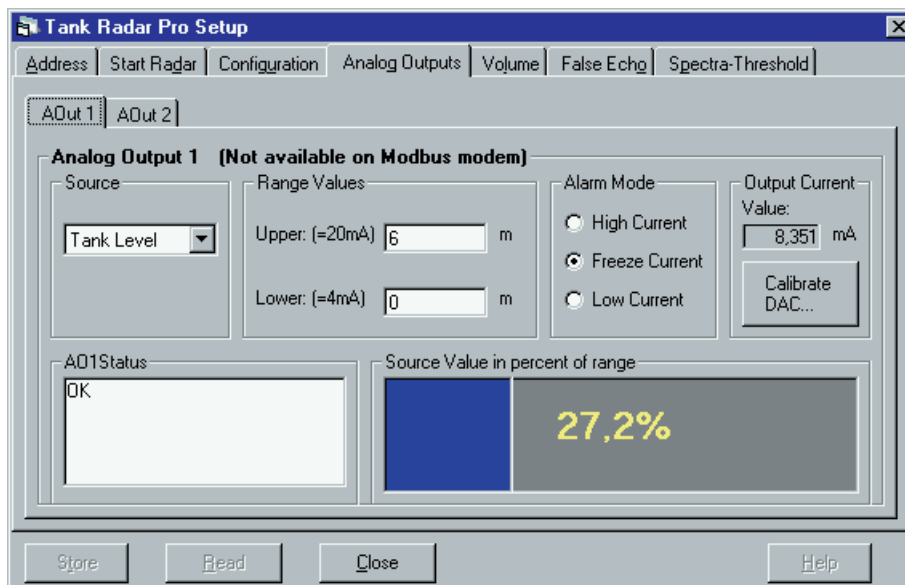
The **Hold Off** (H) distance defines how close to the TR Pro reference point a level value is accepted. Normally the **Hold Off** distance does not need to be changed. However, if there are disturbing echoes in the upper part of the tank, for example from the tank nozzle, you can increase the Hold Off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

The **Calibration Distance** is by default set to zero. It can be used to compensate for systematic errors due to e.g. disturbances from the tank nozzle which may be case if the gauge is not mounted properly according to the free space requirements.

See chapter **6: Tank Distances** for further information on how to set the tank geometry parameters.

- 3 Click the **Store** button.

5 Select the Analog Outputs tab

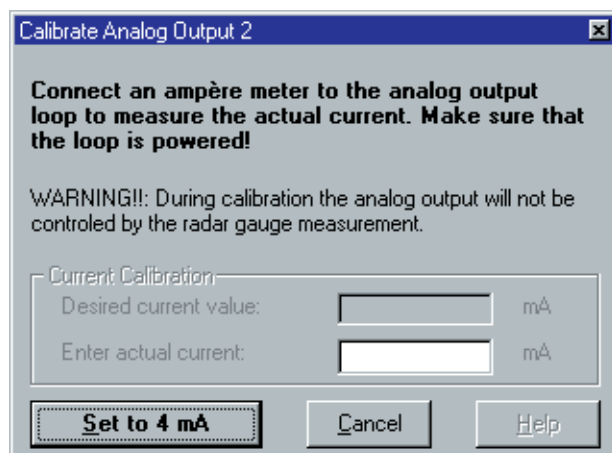


- 1 Click the **Read** button.
Response: the current settings are displayed.
- 2 If your transmitter is equipped with a HART® modem select the Analog Out1 tab. (Analog 1 is not available when using TRL2 Bus communication).
- 3 Select the source to control the analog output.
- 4 Enter the range values that correspond to the analog output values 4 and 20 mA.
- 5 Enter the alarm mode, i.e the analog out state on measurement error.
 - High: the output current is set to 22 mA.
 - Low: the output current is set to 3.8 mA.
 - Hold Last Value: the output current is set to the present measurement value at the time when the error occurred.
- 6 The analog output is calibrated at factory and does normally not need to be recalibrated. However, if you still need to calibrate the analog output current, click the **Calibrate DAC** button and follow the instructions on the next page.
- 7 If your transmitter is equipped with an optional analog output select the Analog Out2 tab and configure as described in steps 2 to 6.
- 8 Click the **Store** button to save the current settings.

Calibrating the Digital to Analog Converter (DAC)

The Digital to Analog Converter (DAC) is factory calibrated. However, if you want to check the calibration by measuring the output current, do the following:

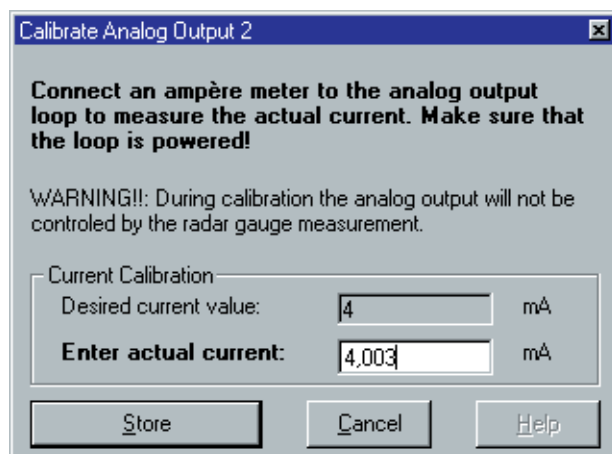
- 1 Click the **Calibrate DAC...** button.



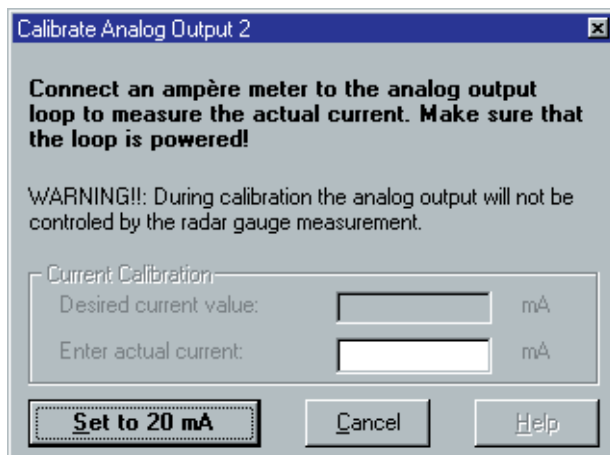
- 2 Read the instruction and the warning.

Note! The analog output will be set to fixed current mode. Make sure that control systems connected to the output are not harmed.

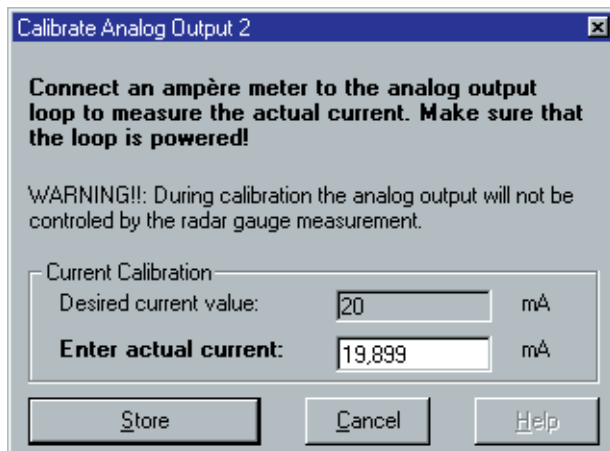
- 3 Click the **Set to 4 mA** button.



- 4 Enter the measured output current and click the **Store** button.



- 5 Click the **Set to 20 mA** button.



- 6 Enter the measured output current and click the **Store** button.
- 7 Click the **Cancel** button to close the window and finish the calibration.

6 Volume Calculations

Pro Setup performs Volume Calculations by using one of two methods: predefined tank shape or strapping table. The strapping table is an optional function. If it is not available a new Start Code can be ordered from Saab Tank Control.

To enable Strapping Table select the corresponding option in the Pro Setup/Volume window.

To configure the TR Pro Transmitter for volume calculations do the following:

- 1 Select the Volume tab

Tank Radar Pro Setup

Address | Start Radar | Configuration | Analog Outputs | **Volume** | False Echo | Spectra-Threshold

Select a Tank Shape

☐ None ☐ Strapping Table ☐ Ideal Sphere ☐ Ideal Horiz. Cylinder ☒ Ideal Vert. Cylinder

Strapping Table (Any shape)

Level (m)	Volume (m3)
1	28
2	56
3	84
4	112
5	140
6	168

Interpolation:
☒ Linear
☐ Quadratic

Adjusting Offsets: m m3

Ideal Shapes

Diameter: m

Length: m

Distance between zero volume and zero level mark: m

Store Read Close Help

- 2 Select a tank shape.

Select one of the tank shape options. Choose **None** if you don't want to use volume calculations. Use one of the ideal tank shape options if approximation of your tank with an ideal tank shape provides sufficient accuracy. The strapping table 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 Strapping Table option can be used only if it is in the list of available software options in the Start Radar tab.

Ideal tank

Use this option if approximation of your tank with an ideal tank shape provides sufficient accuracy. Enter the following parameters:

- Tank diameter (or the length if it is a horizontal tank).
- “Distance between zero volume and zero level mark”: set 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).

The screenshot shows the 'Tank Radar Pro Setup' dialog box with the 'Configuration' tab selected. Under 'Select a Tank Shape', 'Strapping Table' is selected. The 'Strapping Table (Any shape)' section contains a table with 6 rows of Level (m) and Volume (m3) data. To the left of the table is an 'Interpolation' section with 'Linear' selected. Below the table are 'Adjusting Offsets' for level (0 m) and volume (0 m3). To the right, the 'Ideal Shapes' section has input fields for Diameter (3 m), Length (0 m), and Distance between zero volume and zero level mark (0 m). At the bottom are 'Store', 'Read', 'Close', and 'Help' buttons.

Level (m)	Volume (m3)
1	28
2	56
3	84
4	112
5	140
6	168

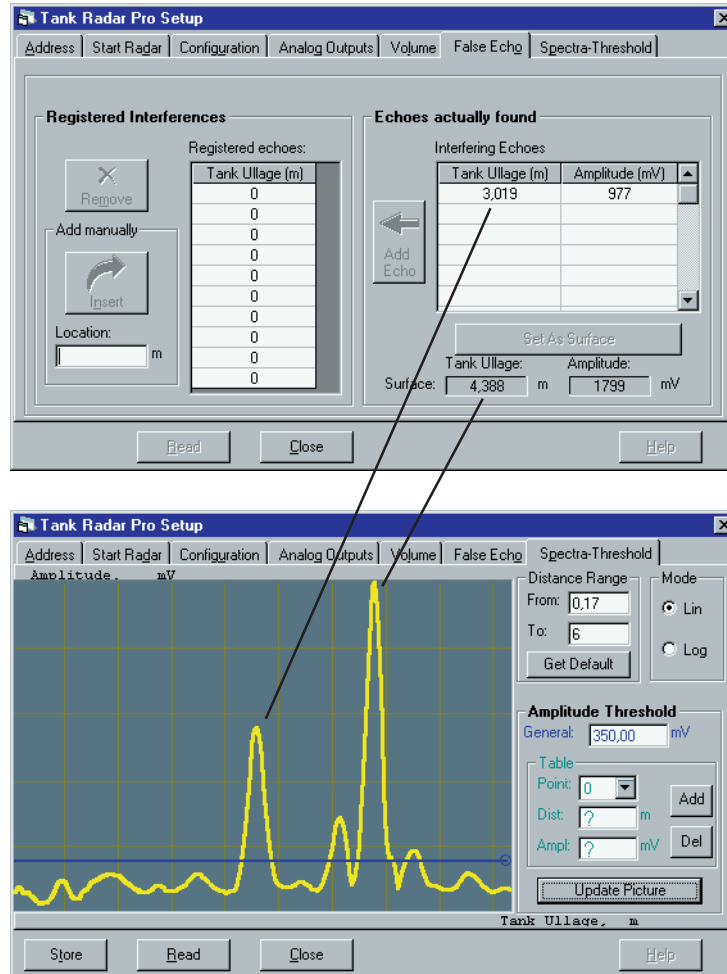
Strapping table

- Enter level and corresponding volume values. These figures can typically be obtained from tank drawings or from 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 adjust by adding corresponding offset values in the **Adjusting Offsets** fields. The Adjusting 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. However, it may be necessary to try both methods in order to evaluate which one is best in your particular case. By using linear interpolation and a sufficient number of values in the strapping table, the interpolation error can normally be reduced to a minimum.

3 Click the **Store** button.

7 Disturbance Echo Handling

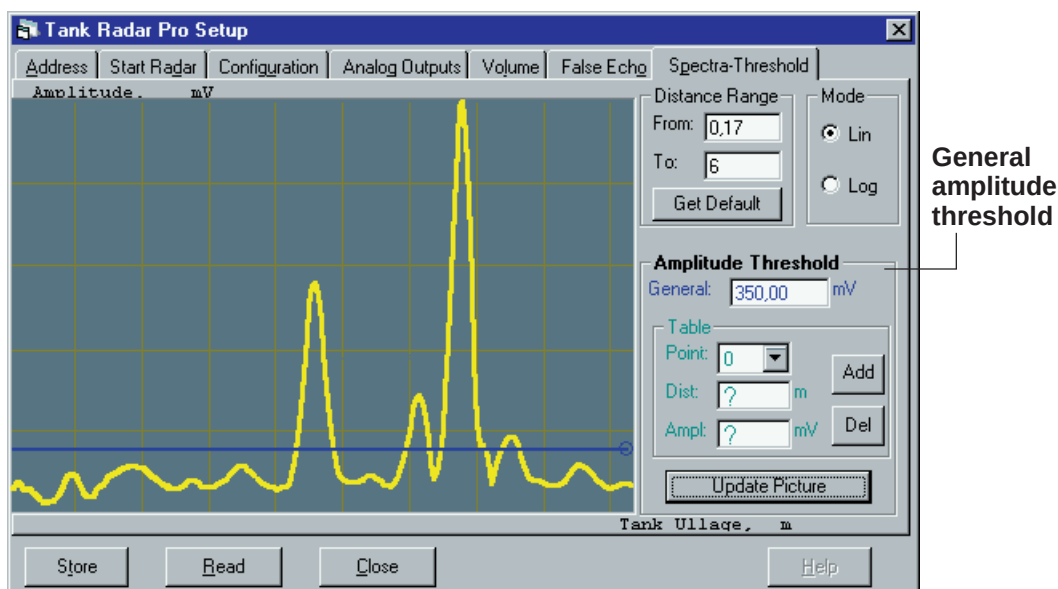
Pro Setup offers you powerful tools to handle disturbing echoes. The False Echo tab displays a list of echoes detected by the Pro transmitter. To optimize measurement performance you can register false echoes which are due to disturbing objects in the tank like beams, agitators and heating coils.



The Spectra-Threshold tab shows the amplitude of the measured signal along the tank. This diagram is often used to obtain an overview of the conditions in the tank. You can use this diagram to set a general Amplitude Threshold level in order to filter out disturbing noise. You can also design an Amplitude Threshold which is a function of distance from the transmitter to the tank bottom.

Setting a general amplitude threshold

- 1 Click the *Read* button



Response: a spectrum is displayed showing the radar amplitude vs. distance from the gauge to the product surface (ullage).

- 2 Set the general Amplitude Threshold. Echoes with amplitudes below the general amplitude threshold will be disregarded. Recommended threshold value:

Calm conditions: no turbulence, foam or condensation. Set amplitude threshold to approximately 20% of surface echo amplitude.

Foam, agitators: check amplitude of surface echo when foam is present or agitator is running. Set amplitude threshold to approximately 30% of surface echo amplitude.

Note that these figures are approximate estimations. Significant deviations from these figures may have to be used in many cases.

Creating a customized noise threshold 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 transmitter 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 transmitter starts following the surface when the tank is filled again.

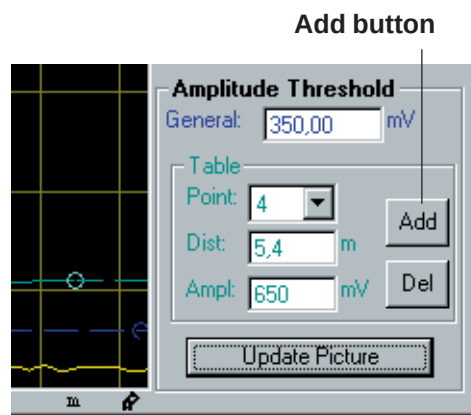
To add points to the diagram:

- 1 Place the mouse pointer in the diagram at the position where you want to add a point to the Amplitude Threshold curve.
- 2 Click the right-hand mouse button and select **Add point**,

- or -

click the **Add** button in the Spectra-Threshold window.

Note! The Amplitude Threshold Table displays the position of the currently selected point, not the position of the added point.

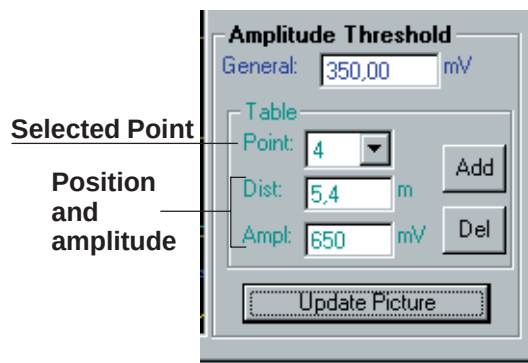


To move points:

Select the point to be moved and drag to desired position,

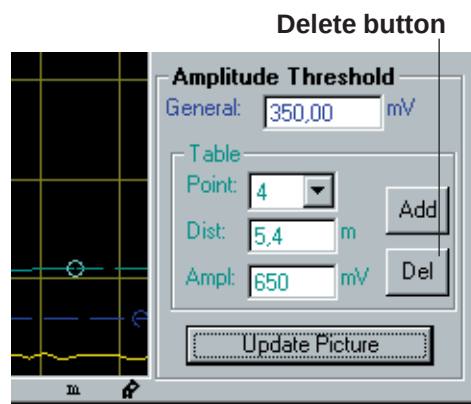
- or -

select the point and specify new position and amplitude in the Amplitude threshold table.

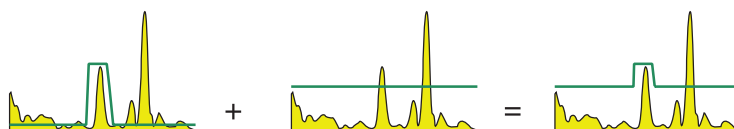


To remove points:

- 1 Select the point to be removed.
- 2 Click the **Delete** button in the Spectra-Threshold window.



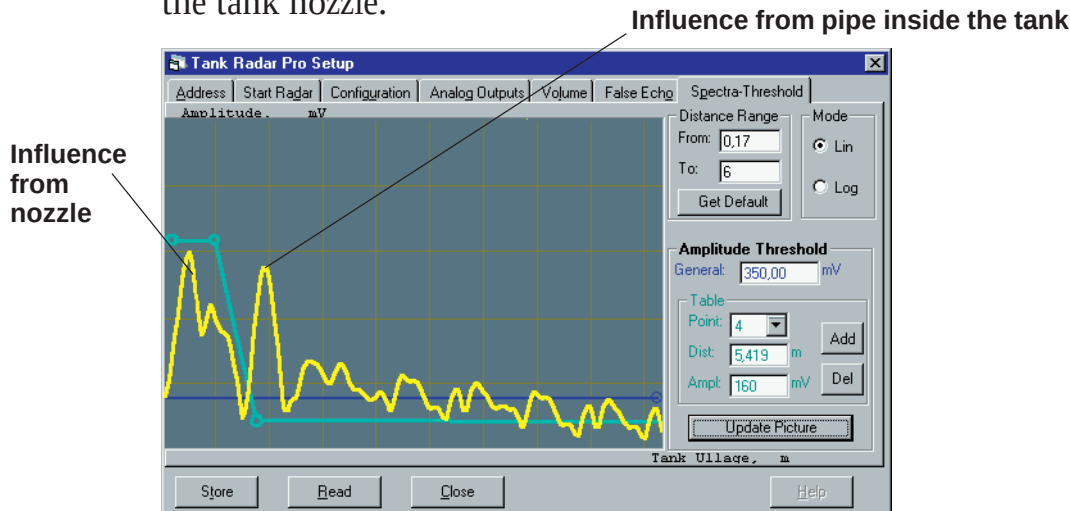
Do not create noise thresholds around echoes which are already registered as interfering echoes. The general amplitude threshold is the lower limit of the noise threshold table:



The following examples illustrate how the Amplitude Threshold table can be used:

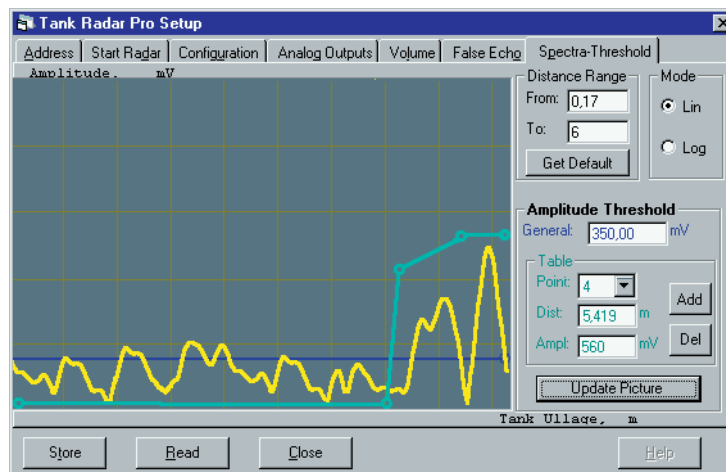
Example 1:

The amplitude threshold is used to remove the influence from the tank nozzle.



Example 2:

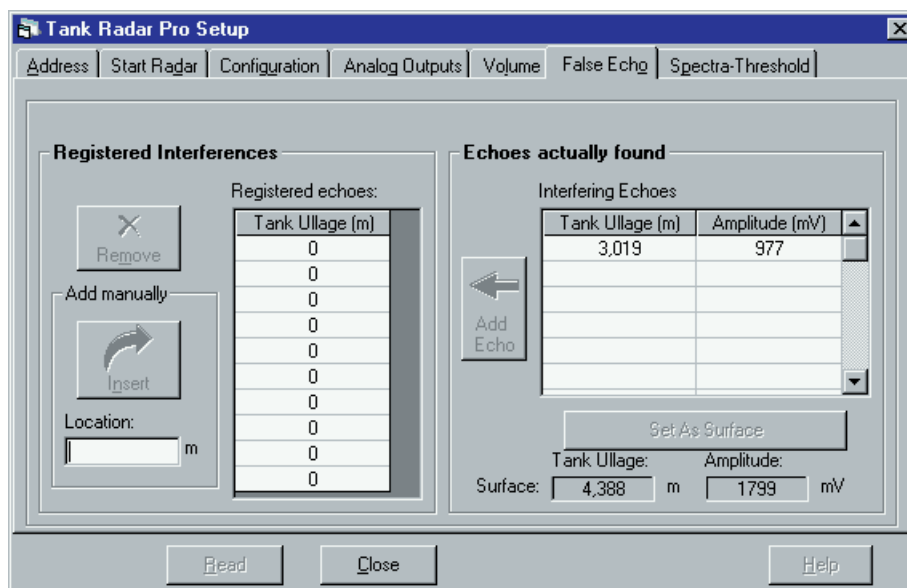
In this example the amplitude threshold is used to filter out weak disturbances close to the tank bottom. By using this technique the risk of locking to a disturbance echo close to the tank bottom is eliminated. This technique is particularly useful in tanks with weak bottom echoes, like e.g. tanks with cone shaped outlets. In this case you should also make sure that the Tank Presentation/Bottom_echo_always_visible parameter is not set (see the description of Start Radar tab).



Registration of False Echoes

The False Echo function allows you to let the transmitter 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.

- 1 Select the False Echo tab



- 2 Click the Read button to update the list of interfering echoes.

The right-hand list displays disturbances that was detected by the transmitter. In order to optimize the measurement performance, you may need to register interfering echoes as described below.

Note! *Registration of disturbing echoes requires that Saab's echofixer is enabled.*

When should I register?

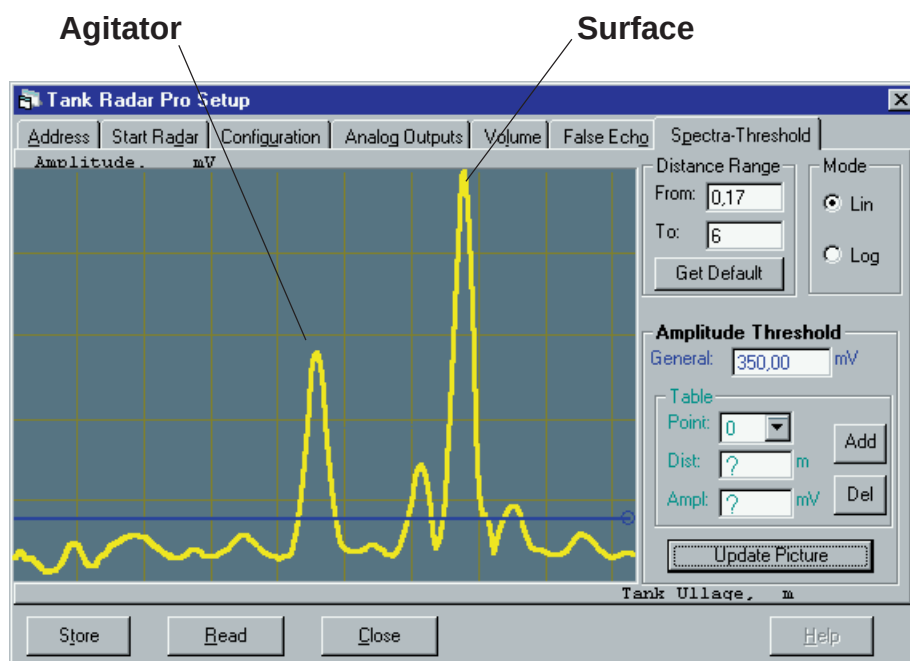
See the following recommendations before you register new interfering echoes:

- 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 disturbing echo if the amplitude is below the general amplitude threshold, see description of the Spectra-Threshold window.
- Do not register a disturbing 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 disturbing echoes can be filtered out by creating a noise threshold table, see description of the Spectra-Threshold window).
- It may be necessary to register new disturbance echoes at a later stage when objects have become visible due to surface movement.

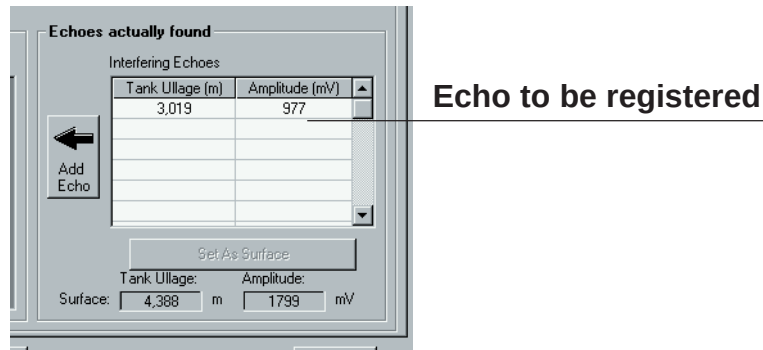
Example 3:

This example illustrates a signal spectrum resulting from a tank with an agitator. The product level is slightly below the agitator in this example. In a case like this it is recommended that the disturbing echo is registered, in order to achieve reliable measurements when the product surface is passing the agitator. Of course this is true also for disturbing echoes resulting from other types of objects.

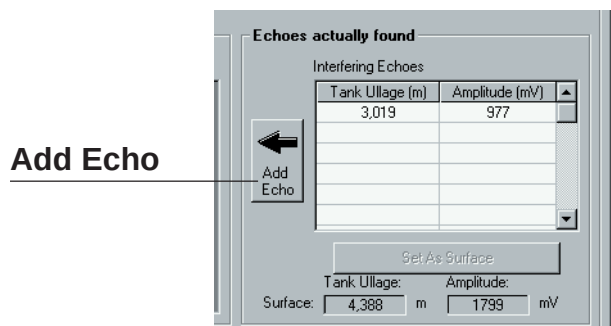


To register interfering echoes do the following:

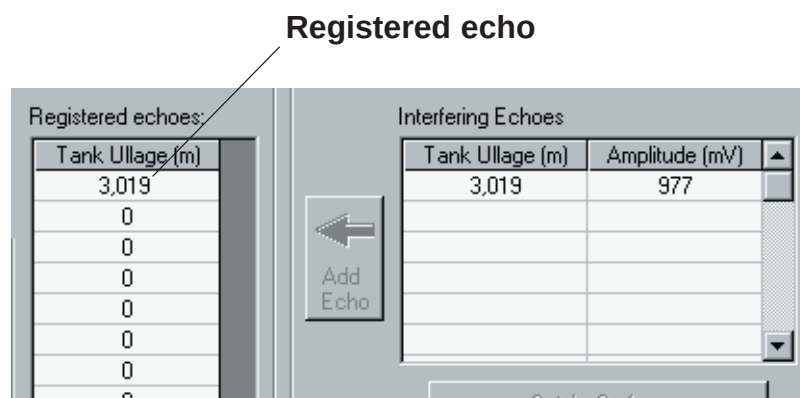
- 1 Select an echo from the list of Interfering Echoes.



- 2 Click the **Add Echo** button.



Response: the echo is displayed in the table of Registered echoes.



- 3 Repeat step 2 until all echoes that you want to register as interfering echoes (see recommendations on the previous page) are added to the left-hand table.
- 4 When you have finished the registration of disturbing echoes, click the **Close** button to close the window.

To manually add items to the list of registered disturbing echoes

You can manually enter disturbing echoes which are not present in the list of automatically detected echoes. This function can be useful if there are objects below the product surface which can not be detected by the gauge at the time of installation.

To manually add echoes do the following:

- 1 Enter an ullage value in the **Location** field. The entered value may deviate up to 100 mm from the actual position of the object.
- 2 Click the **Insert** button.

Registered Interferences

Registered echoes:

Tank Ullage (m)
0
0
0
0
0
0
0
0
0
0

Remove

Add manually

Insert

Location: 2,500 m

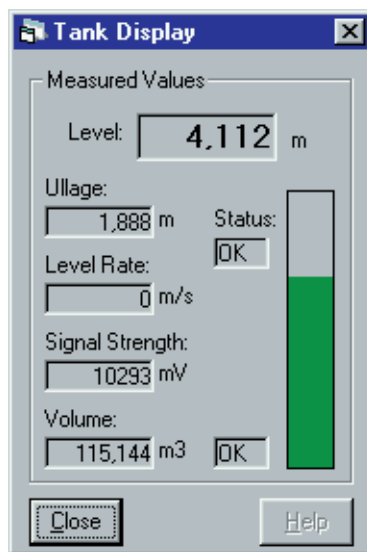
Using the Set As Surface button

If the transmitter has locked on a disturbing object you can use the **Set As Surface** function to point out the surface level. If there is an echo that you recognize as the product surface rather than an interfering echo, mark the echo and click the **Set As Surface** button.

Viewing Level Data

To view level data do the following:

1. Start the Pro Setup program.
2. Open a tank file by choosing **Open Tank** from the **File** menu
or
by clicking the **Open Tank** button.
3. Select the **Tank Display** option from the **View** menu,
- or -
click the **Display** button in the PRO Setup Main window.



The contents of this window is continuously updated. You can change measurement units by choosing the **Measurement Units** option from the **Setup** menu.

Service

The following options are available from the Service menu:

Diagnostics

This option allows you to view the TankRadar Pro status registers.

Input and Holding Registers

You can view the Input registers as well as the Holding registers by selecting the corresponding option from the Service menu. The Holding registers can be edited.

Searching for the Product Surface

Select this option if you want to initiate a search for the product surface without restarting the transmitter.

Restarting TR Pro

Select this option if you need to restart the TankRadar Pro transmitter.

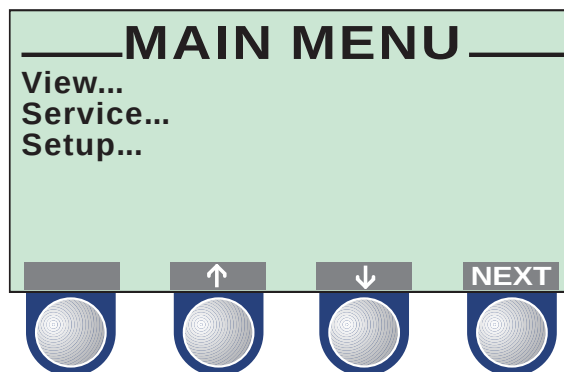
5 Using the Pro Display Panel

Operation

You can use the Display Panel (DP) 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.

If you leave the DP in Service or Setup mode without pushing any button for 10 minutes, the DP is automatically switched to View mode, presenting the same measurement variable that was displayed last time View mode was open.

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* transmitter.

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.



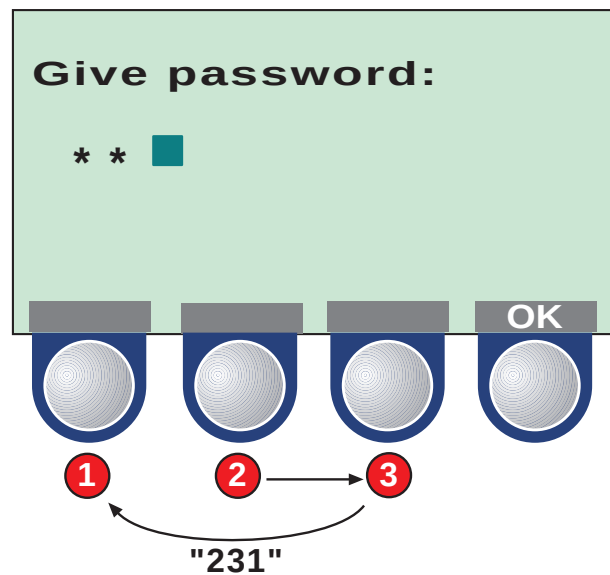
Entering a Password

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**

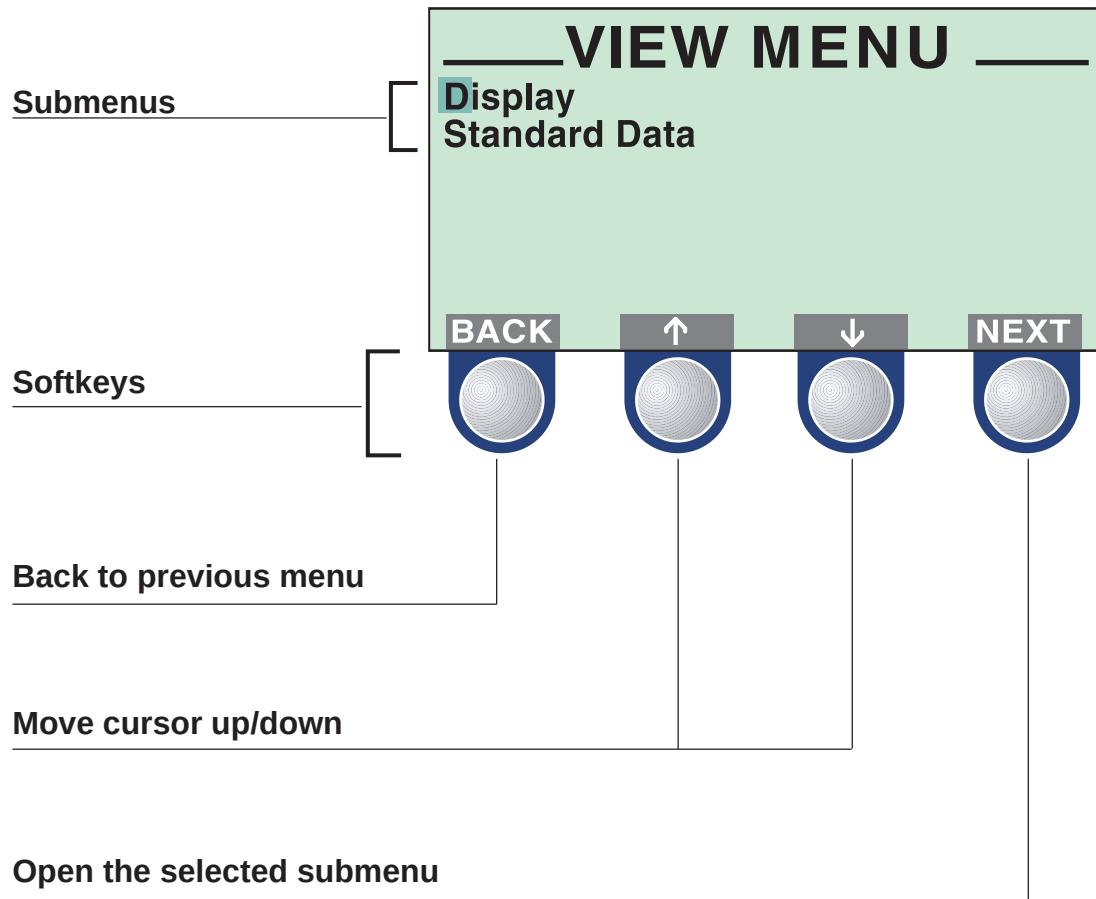
button. In order to use the password protection you have to set the password as described in *Installing a Pro Transmitter/Display Panel Setup*.

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 Setup/Display Panel menu.



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.



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.

Measurement Indicator

Measurement Unit

Measured Variable

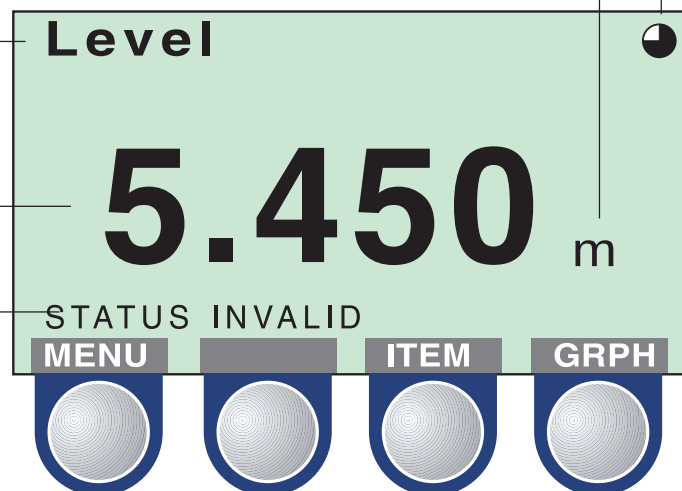
Measured Value

Invalid Data

Back to View Menu

Change Measurement Variable to be Displayed

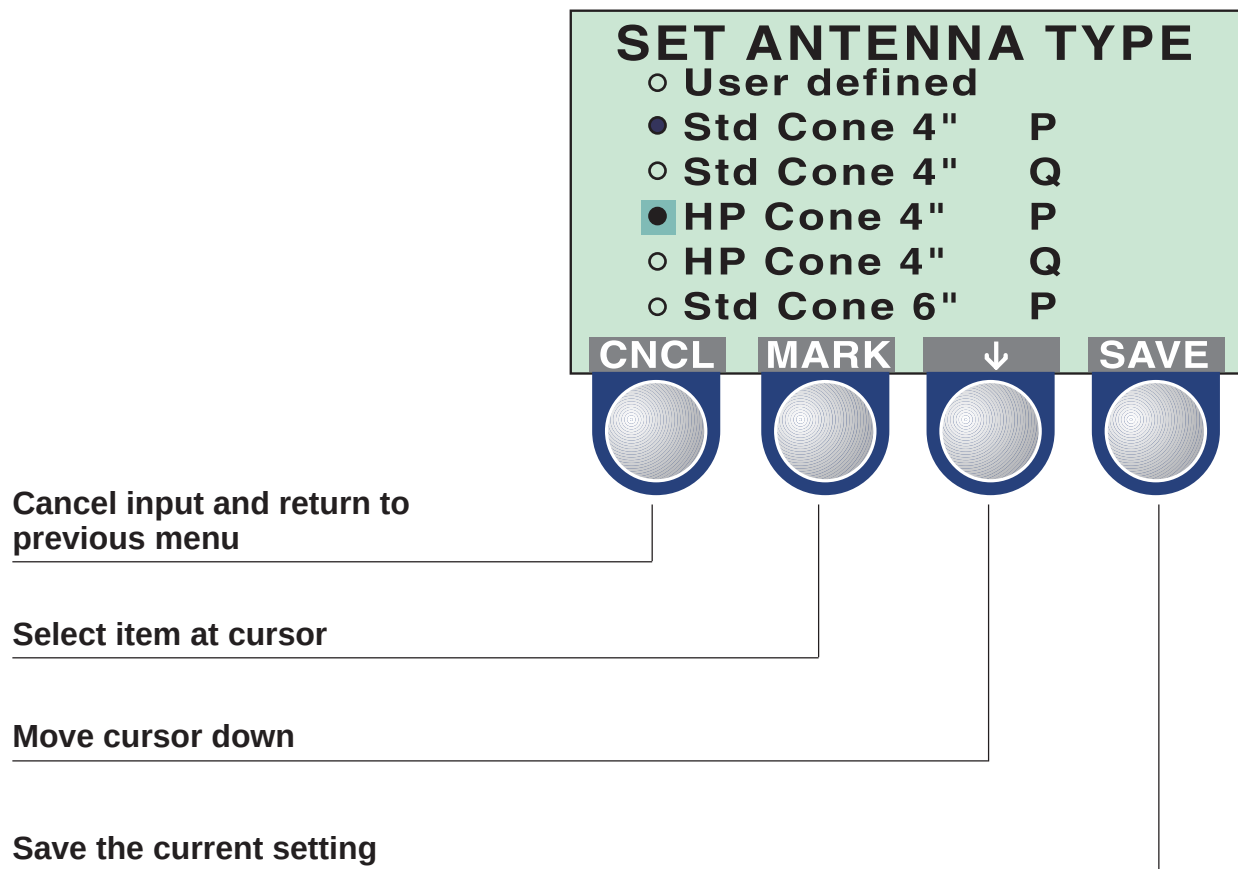
Change Display Mode



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 choice.

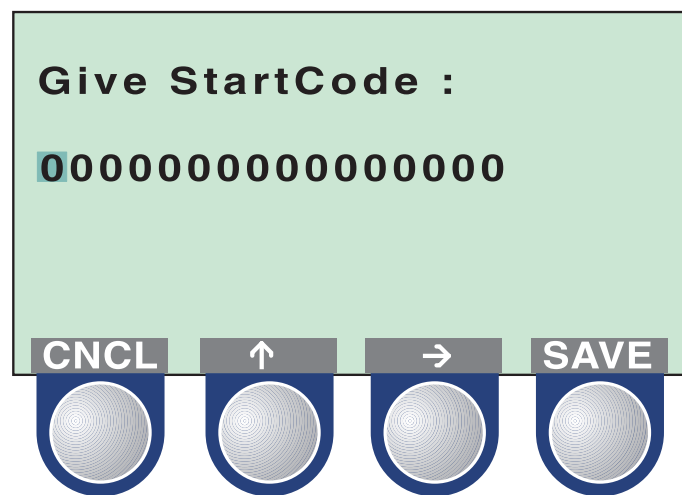
When the cursor has reached the last item, it jumps back to the first item by pressing the  button.



Entering numerical values

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

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.



Cancel input and return to previous menu

Each click increases the numerical value one step

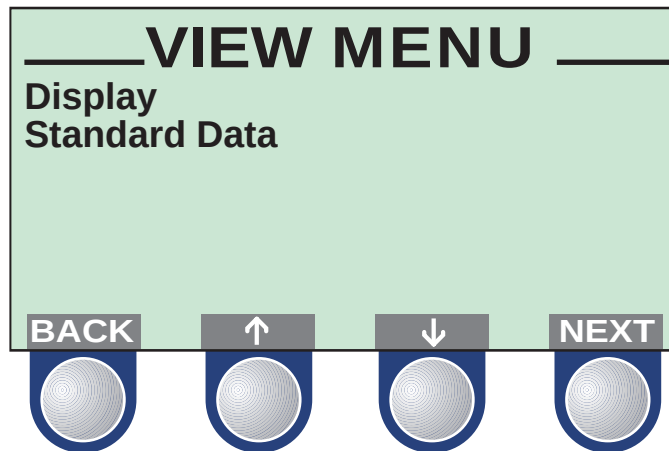
Each click moves the cursor one step to the right

Save the current setting

Viewing Level Data

The View Menu

The View Menu includes options for viewing tank and gauge related data:



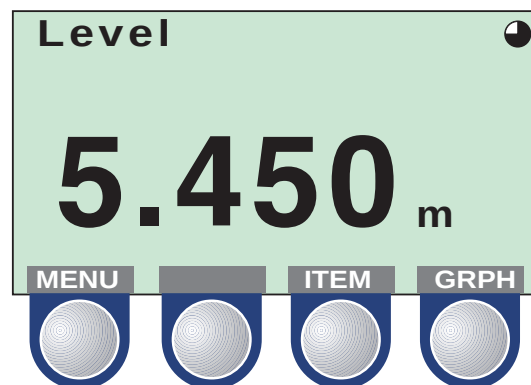
- Press the **BACK** button to return to the Main menu.
- Use the **↑** or the **↓** button to move the cursor up or down.
- Press the **NEXT** button to open the selected submenu.

Display

Select the Display submenu to view measured data:

Press the ITEM button to choose between the different options:

- Level
- Ullage
- Level Rate
- Volume
- Signal Strength

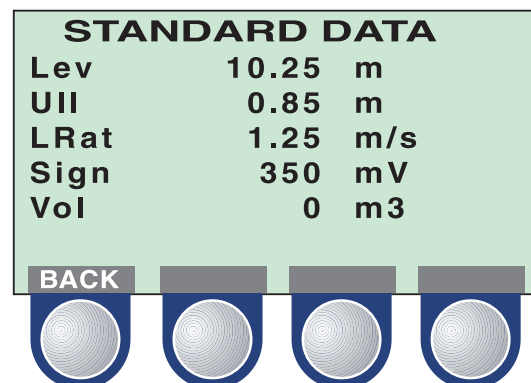


The GRPH button allows you to switch between display modes:

Numerical	measured data is presented as a value.
Bargraph	the measured value is presented in a bar graph showing the current value.
Trend	a set of vertical lines are displayed representing values sampled at a predefined rate. See Display Panel Setup for descriptions on how to set up the trend display.

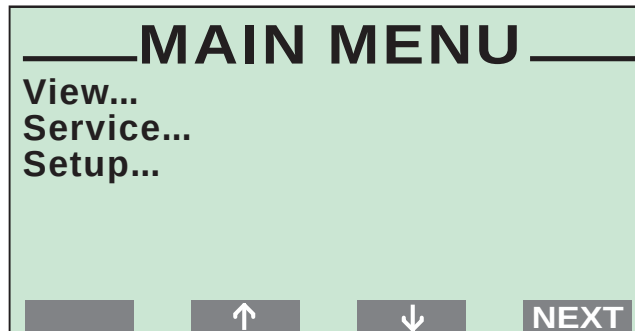
Standard Data

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

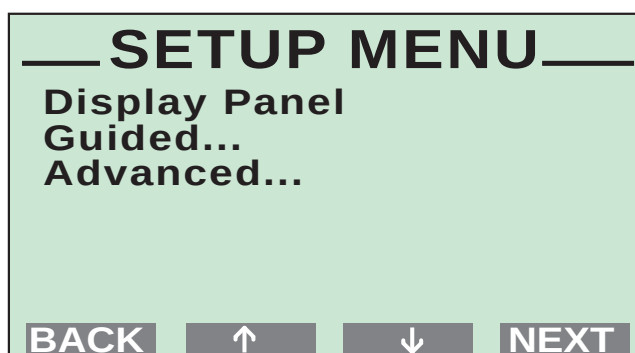


Installing a Pro Transmitter

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



The Setup dialog is automatically opened when a transmitter is started for the first time. You can always return to the Setup dialog if you want to change settings later on.



Display Panel

This option allows you to set units for measured values, to set language and to change the user password.

Guided Setup

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

Advanced Setup

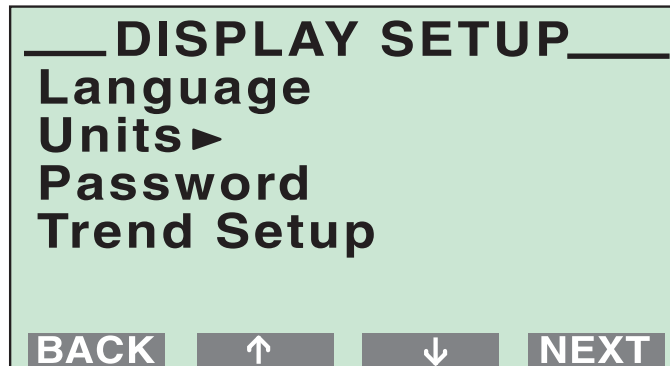
Use the Advanced Setup option if you for example want to include options for volume calculations and disturbance echo handling.

Display Panel 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 Advanced Setup.

To configure the display panel do the following:

1. Select the **Display Panel** option from the **Setup Menu** and press the **NEXT** button.



2. Select the **Units** option and press the **NEXT** button. Set the measurement units to be used for presentation of data and click the **SAVE** button.
3. 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 transmitter configuration. Follow the procedure for changing to a new password.
4. To set the time scale for trend display (one of the options in the Display mode) select the **Trend Setup** option and press the **NEXT** button. Set the time scale and select the **SAVE** button.

To change language

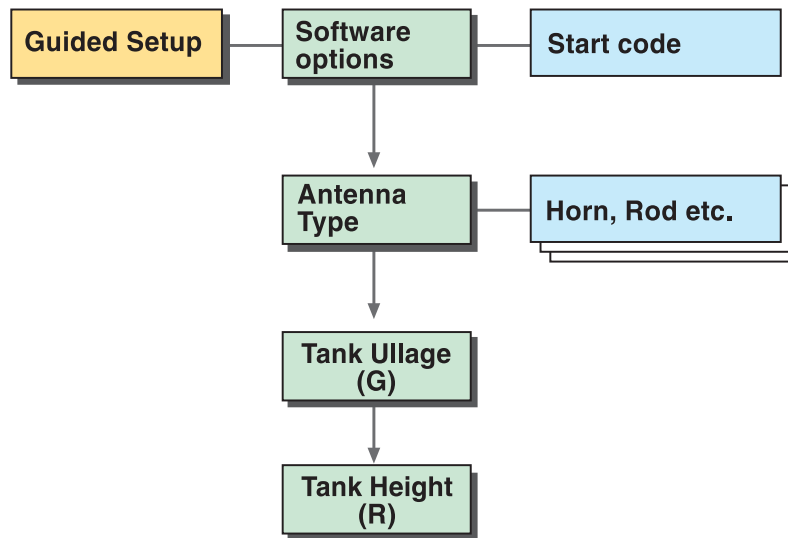
1. Select the **Display Panel** option from the **Setup Menu** and press the **NEXT** button
2. Select **Language** and press the **NEXT** button.
3. Move the cursor to the preferred language and press the **MARK** button.
4. Save your choice by pressing the **SAVE** button

Response: the display returns to view mode.

Guided Setup

The Guided Setup includes the basic steps to start the transmitter.

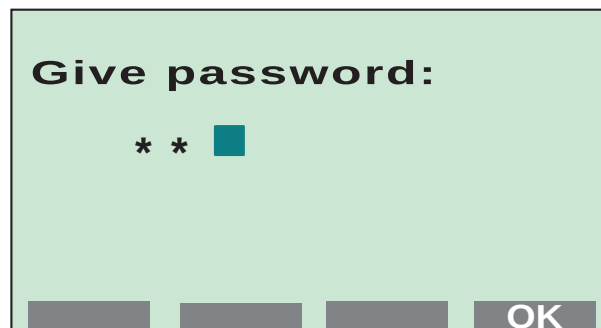
By using this option you are guided step by step through a sequence of configuration windows. The windows are automatically opened in a predefined order.



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

1. Choose Setup from the Main Menu.

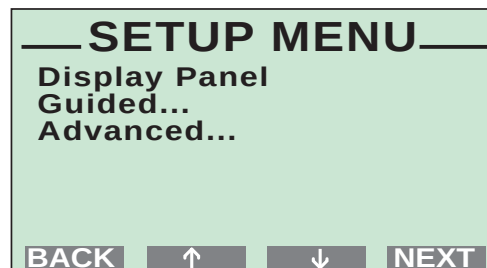
Response: a request for password is displayed.



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*.

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



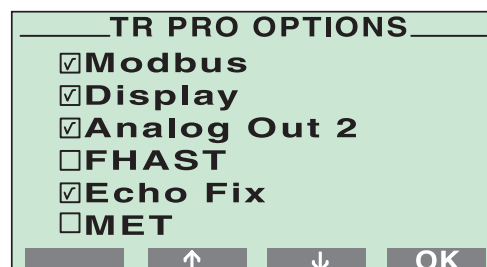
4. Confirm your Start Code by selecting the **SAVE** button.

The transmitter is delivered with a start code that enables the ordered software options. If you wish to change the set of available options, (Saab'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.



5. Note the available software options. (To see all options use the arrow button to scroll down the list. Strap table is the last one).

Go to the next menu by selecting the **OK** button.



6. Set the Antenna Type.

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

HP=high performance (Hastelloy, Tantalum, Titanium, Monel),

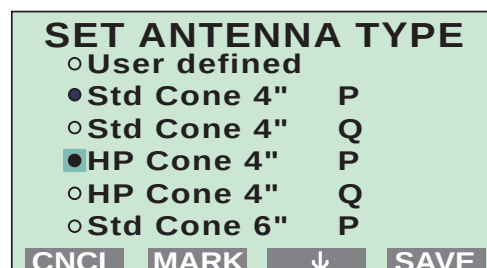
Std=standard,

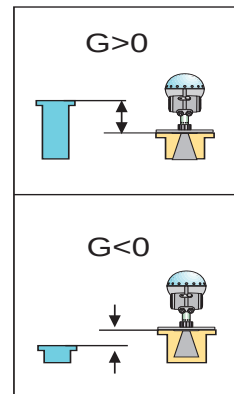
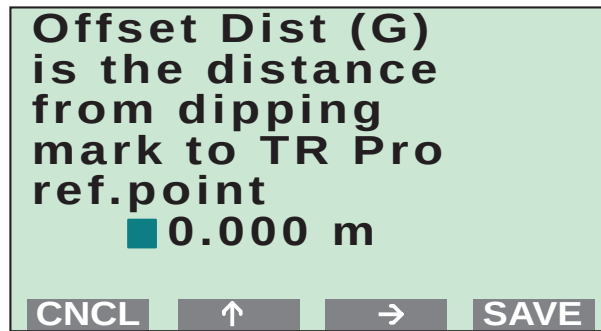
P=PTFE tank sealing,

Q=quartz sealing,

C=Ceramic.

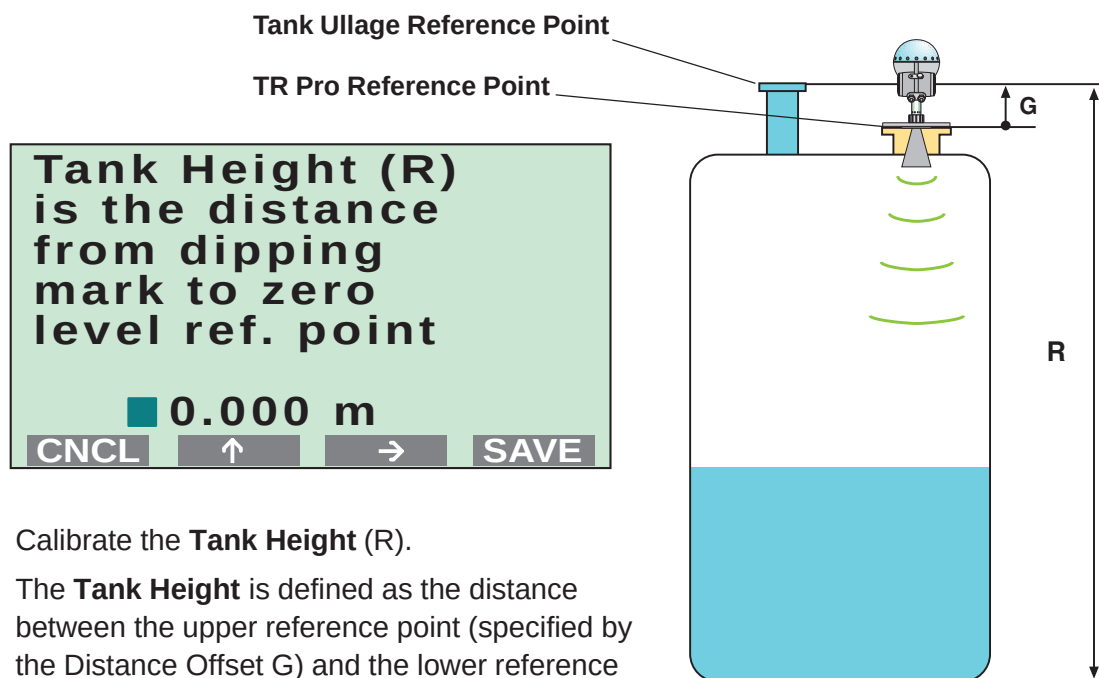
Finish by pressing the **SAVE** button.





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

The **Distance Offset** is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Tank Radar Pro Reference Point*). You can use **G** to specify your own reference point at the top of the tank. Set **G=0** if you want the flange as upper reference point. **G** is defined as positive if you use an upper reference point above the *TR Pro Reference Point*. For tanks with an ullage plug for hand dipping the *Tank Ullage Reference Point* (dipping mark) can be used as upper reference point, but you can use other reference points as well. Finish by pressing the **SAVE** button.



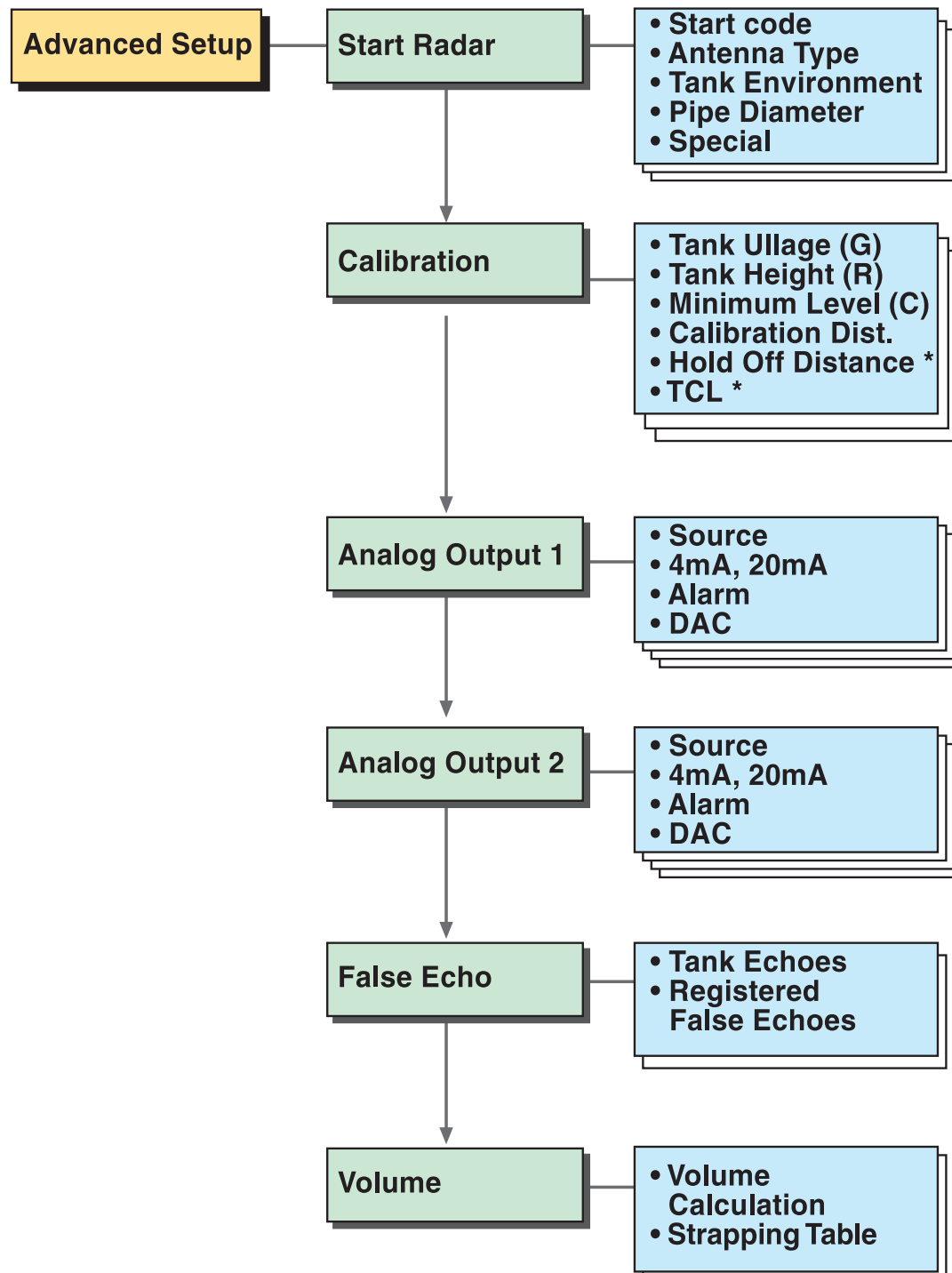
8. Calibrate the **Tank Height (R)**.

The **Tank Height** 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

Note! See chapter Tank Distances for further information on how to set the tank geometry parameters.

Advanced Setup

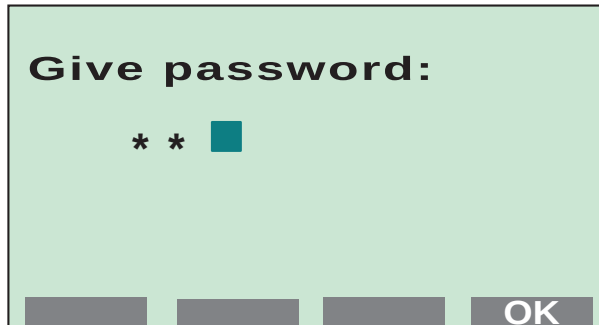
Use the Advanced Setup if you want to make a complete configuration of the transmitter:



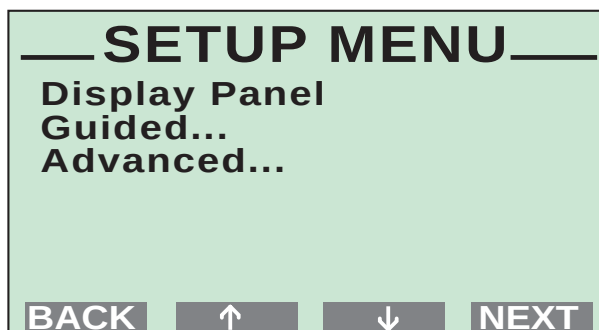
To configure a radar gauge using the Advanced Setup option:

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

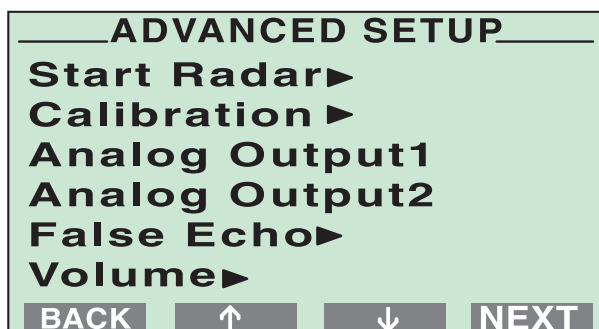
Response: a request for password is displayed.



2. Enter your password and press the **OK** button.

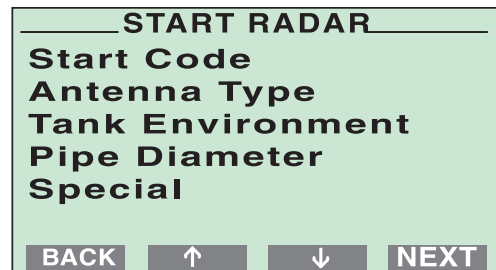


3. Select “Advanced...” from the Setup Menu and press the **NEXT** button.



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

- 1 Choose the **Start Code** option.



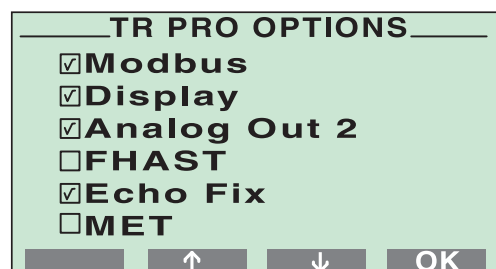
- 2 Confirm your **Start Code** by selecting the **SAVE** button.

The transmitter is delivered with a start code that enables the ordered software options. If you wish to change the set of available options, (Saab'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



- 3 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.

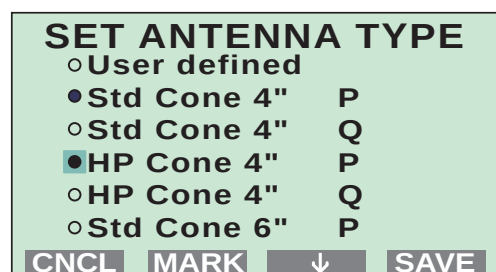


- 4 Choose the **Antenna Type** option from the **Start Radar** menu.

HP=high performance (Hastelloy, Tantalum, Titanium, Monel),
Std=standard,
P=PTFE tank sealing,
Q=quartz 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.



- 5 Choose the **Tank Environment** option.
Select appropriate surface conditions. Mark the options that describes 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

TANK ENVIRONMENT

☐ **Rapid Changes**

☐ **Turbulent**

☒ **Foam**

☐ **Solid**

CNCL **MARK** **↓** **SAVE**

Response: the display returns to the Start Radar menu.

- 6 Choose the **Pipe Diameter** option if you are using a Still Pipe antenna.
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.

Give Pipe diameter

0.05 **m**

CNCL **↑** **→** **SAVE**

Response: the Start Radar menu is opened.

7. Press the **BACK** button to return to the **Advanced Setup** menu.
The **Special** option allows you to make advanced setup of Tank Environment database registers. For trained personnel only.

START RADAR

Start Code

Antenna Type

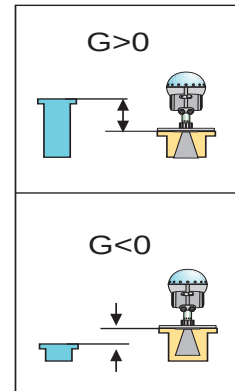
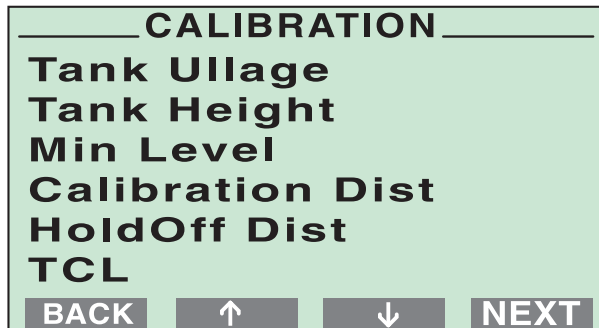
Tank Environment

Pipe Diameter

Special

BACK **↑** **↓** **NEXT**

5. Select the **Calibration** option from the Advanced Setup menu.



The tank calibration distances are defined as illustrated on the next page.

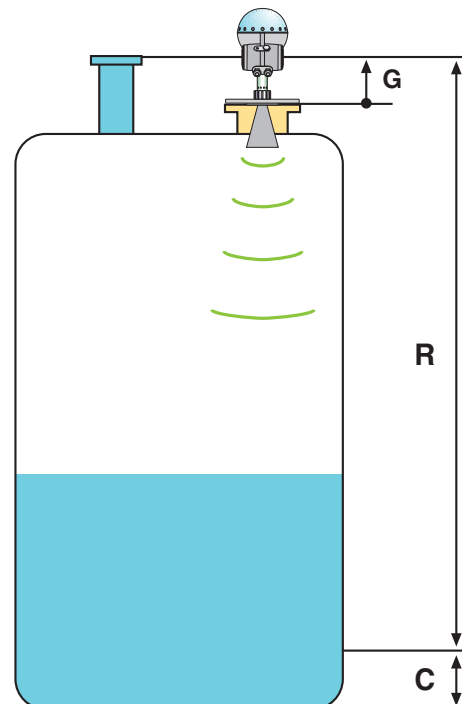
- 1 Set the **Distance Offset (G)**.

The **Distance Offset** is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Tank Radar Pro Reference Point*). You can use **G** to specify your own reference point at the top of the tank. Set **G=0** if you want the flange as upper reference point. **G** is defined as positive if you use an upper reference point above the *TR Pro Reference Point*. For tanks with an ullage plug for hand dipping the *Tank Ullage Reference Point (dipping mark)* can be used as upper reference point, but you can use other reference points as well

- 2 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).
- 3 Set the **Minimum Level (C)**.

The **Minimum Level Offset** is always positive and is defined as the distance between the zero level (*Tank Level Reference Point*) and the minimum accepted level. Normally you set the **C** distance in order to extend the measurement range to the tank bottom.

- 4 Set the **Calibration Distance**. It should normally be set to zero but can be used to compensate for systematic errors due to e.g. disturbances from the tank nozzle. This may be the case if the gauge is mounted in a nozzle which does not conform to the free space requirements.



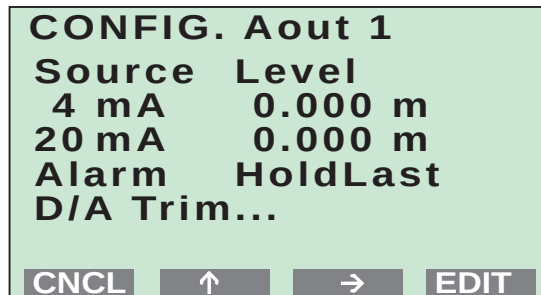
Note! See chapter Tank Distances for further information on how to set the tank geometry parameters.

The following steps are only applicable when a non-standard antenna is used.

- 5 Set the **Holdoff Distance** (H). The **Hold Off** distance defines how close to the RTG reference point a level value is accepted. Normally the **Hold Off** distance 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.
- 6 Set the Tank Connection Length **TCL**. This value is set automatically when you use one of the standard antennas.

6. Select the **Analog output1** option from the Advanced 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 (G and R). If you want to change this setting, do the following:

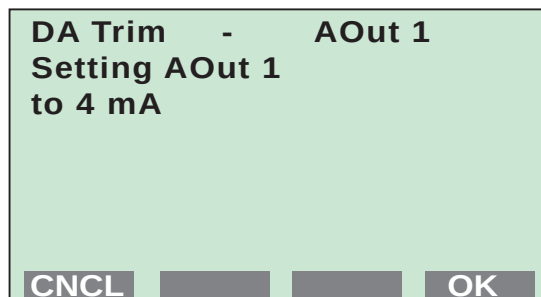


- Enter **Source**. Available options are: level, level rate, ullage, signal strength and volume.
- Enter the analog output values that correspond to **4 mA** and **20 mA**, respectively.
- Select **Alarm mode**.
 - Select **High** if you want the analog output to lock on a value higher than 20 mA when an error is encountered.
 - Use **Low** if you want it to lock on a value below 4 mA.
 - The **Hold Last** option freezes the analog output to the current value when an alarm is triggered.
- **DA 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.

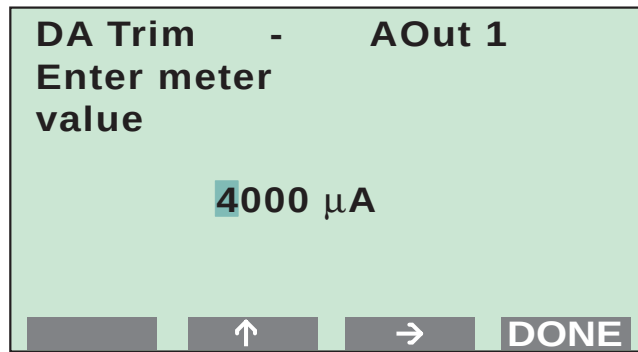
To calibrate the DAC do the following:

- 1 Choose the **D/A Trim** option.



- 2 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.



3 Enter the measured value that corresponds to the 4 mA setting.

4 Click the **DONE** button.

Response: the analog output is set to 20 mA.

5 Enter the measured value that corresponds to the 20 mA setting.

6 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 output2** option from the Advanced Setup menu (optional).

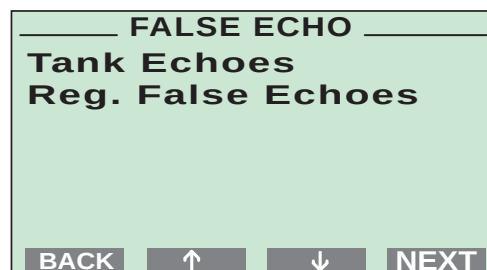
If the gauge is equipped with an extra analog output, follow the same configuration procedure as for Analog Output1.

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

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

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

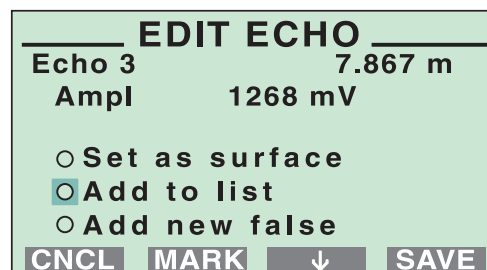
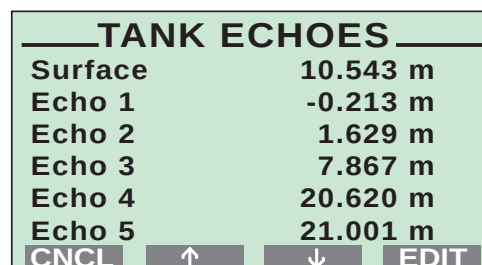
To view a list of echoes that the gauge has detected select the **Tank Echoes** option.



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 chapter 5 *Pro Setup Software* for further information on when to register disturbance echoes.

To register a disturbing echo, do the following:

- 1 Move the cursor to the echo you want to add to the list.
- 2 Click the **EDIT** button.
- 3 Move the cursor to **Add to list**, and click the **MARK** button.
- 4 Click the **SAVE** button to register the marked echo.



- 5 Repeat steps 1 to 4 if you wish to register more disturbing 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.

- 6 Click the **CNCL** button to return to the False Echo menu.

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

REG. FALSE ECHOES	
1	0.56 m
2	8.45 m
3	14.20 m
4	15.37 m
5	32.00 m
CNCL ↑ ↓ EDIT	

To remove a registered disturbing echo, do the following:

- 1 Move the cursor to the echo you want to remove.
- 2 Click the **EDIT** button.

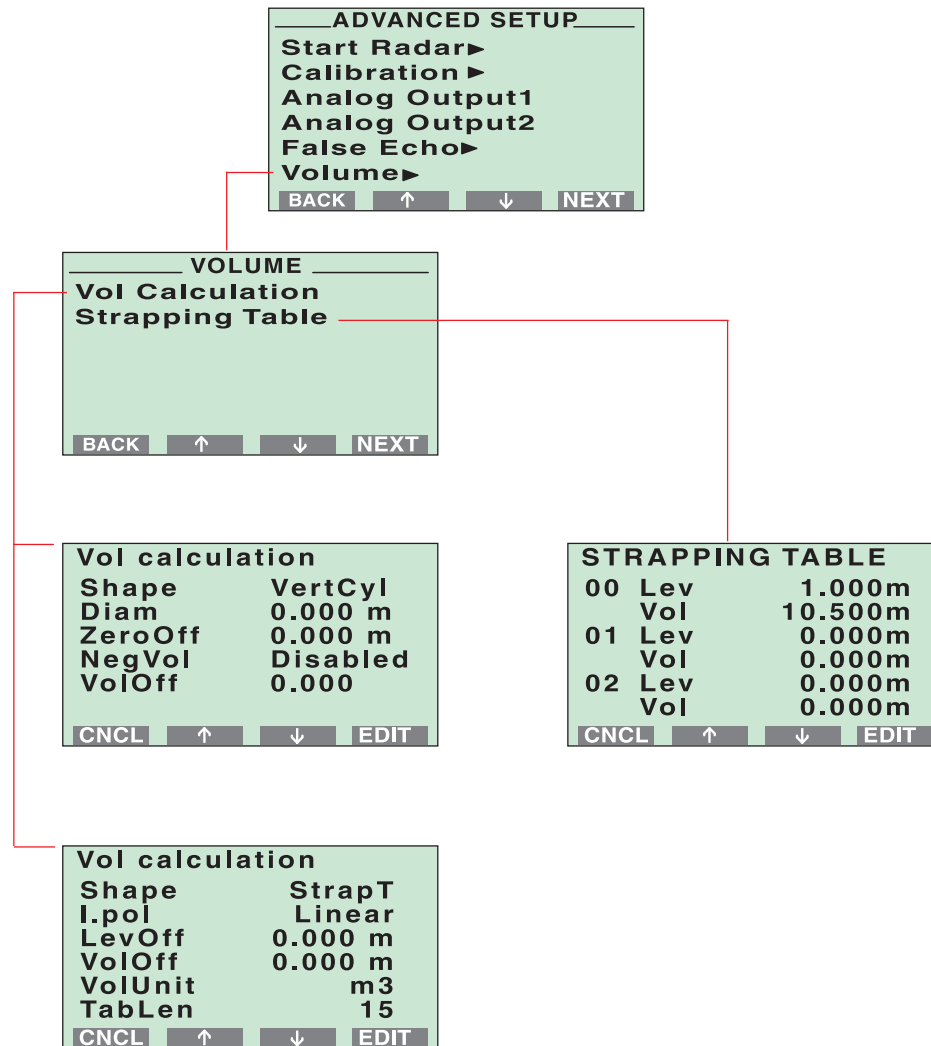
EDIT REG. ECHOES	
Echo 2	8.45 m
☐ Add new false	
☒ Remove echo	
☐ Clear list	
CNCL MARK ↓ SAVE	

- 3 Select the **Remove echo** option and click the **MARK** button.
- 4 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 disturbing echoes.
Mark the **Clear list** option if you want to remove the whole list of registered disturbing echoes. This option may be useful if you want to create a completely new list.

See chapter 5 *Pro Setup Software* for further information on disturbance echo handling. We recommend that the Pro Setup software is used for configuration of tanks with several disturbance echoes.

9. Select the **Volume** option from the Advanced Setup menu (optional).

The **Volume** option allows you to setup the Pro transmitter for volume calculations. You can choose between using either a predefined tank shape like a sphere or a horizontal or vertical cylinder, or entering level and volume values into a strapping table



When the configuration is finished you can start viewing measured data by returning to display mode.

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*.

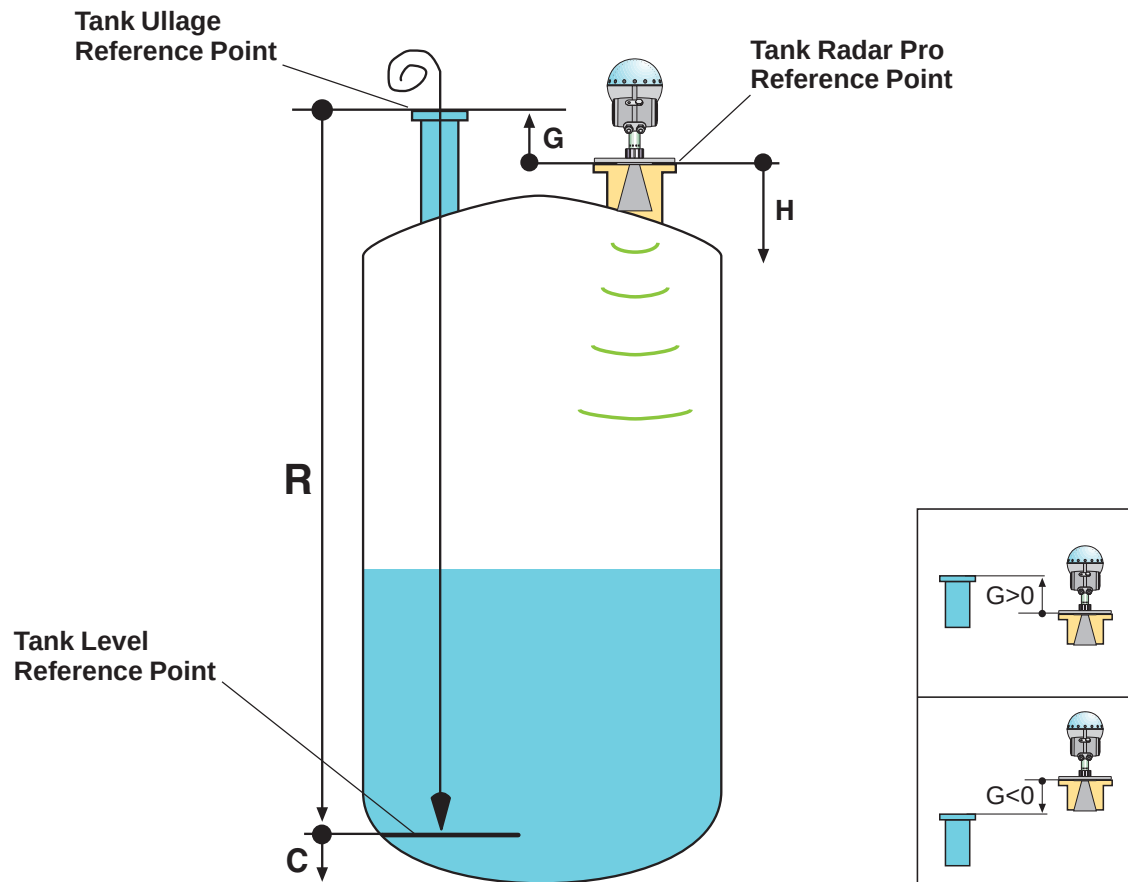
Config Report	Shows information on antenna type, software versions, software and hardware configuration, operation time, error status and unit code. Please provide this information if you contact Saab Tank Control for trouble shooting.
Echo Search	Starts a search for the surface echo.
Factory Settings	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, FFAST, Strap Table) for one week. Use this option if you want to test options not available in your transmitter.
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.



6 Tank Distances

Definitions

The Distance Offset (G) is defined as the distance between the upper reference point and the flange (the flange is referred to as the *Tank Radar Pro Reference Point*). You can use G to specify your own reference point at the top of the tank. Set $G=0$ if you want the flange as upper reference point. G is defined as positive if you use an upper reference point above the *TR Pro Reference Point*. For tanks equipped with an ullage plug for hand dipping the *Tank Ullage Reference Point* (dipping mark) can be used as upper reference point, but you can use other reference points as well.



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).

If no datum plate or zero level exist the tank bottom usually is used as zero reference point. In this case $C=0$.

The Minimum Level Offset (C) is always positive and is defined as the distance between the zero level (*Tank Level Reference Point*) and the minimum accepted level. Normally you set the C distance in order to extend the measurement below your zero reference point.

The Hold Off (H) distance defines how close to the TR Pro reference point a level value is accepted. Normally the Hold Off distance 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.

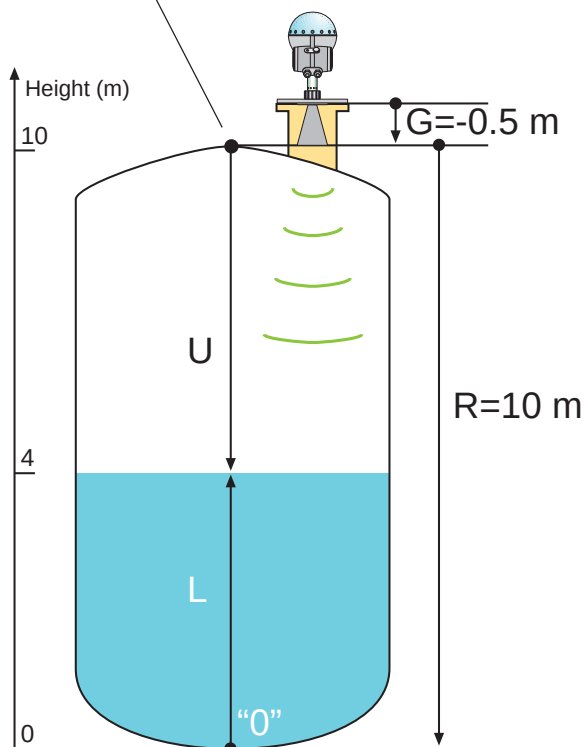
Examples

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

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. $C=0$.

Upper reference point



U=ullage
L=level

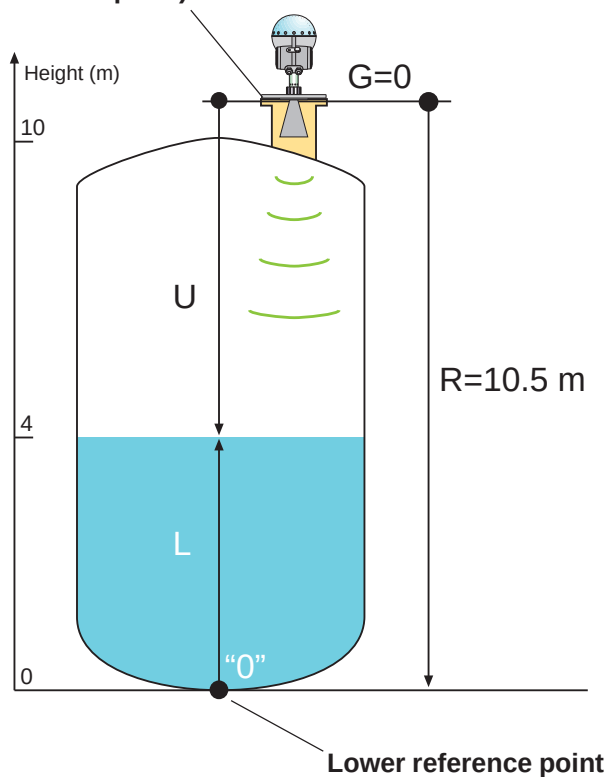
Lower reference point

STANDARD DATA		
Lev	4.000	m
Ull	6.000	m
LRat	0.000	m/s
Sign	350	mV
Vol	0	m3
STATUS	VALID	
BACK		

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 C=0.

RTG reference point
(Upper reference point)

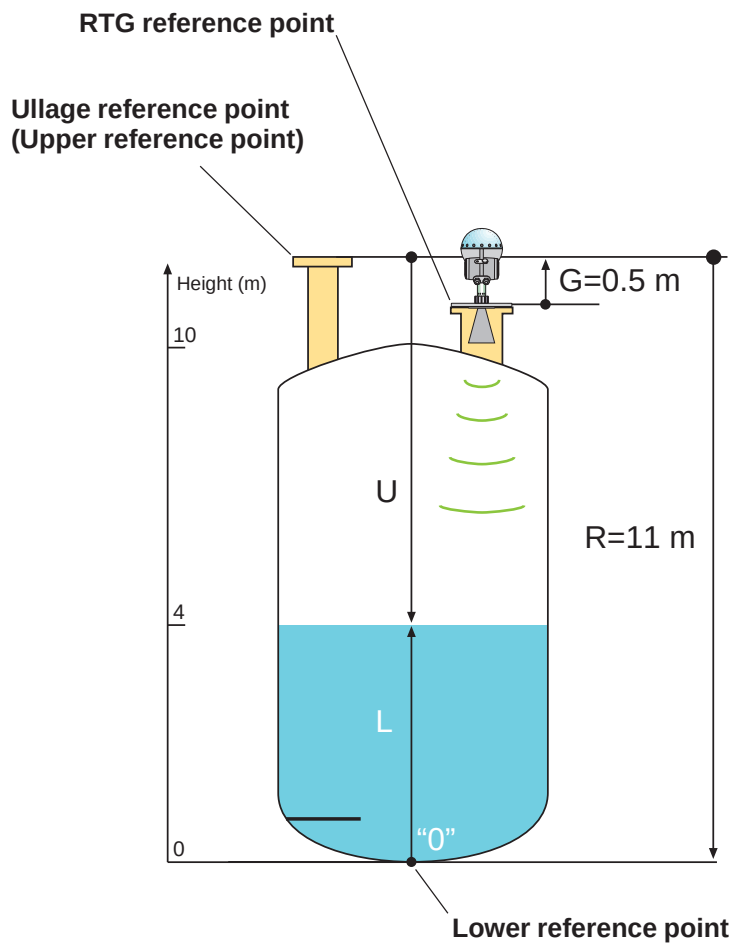


U=ullage
L=level

STANDARD DATA		
Lev	4.000	m
Ull	6.500	m
LRat	0.000	m/s
Sign	350	mV
Vol	0	m3
STATUS VALID		
BACK		

Example 3

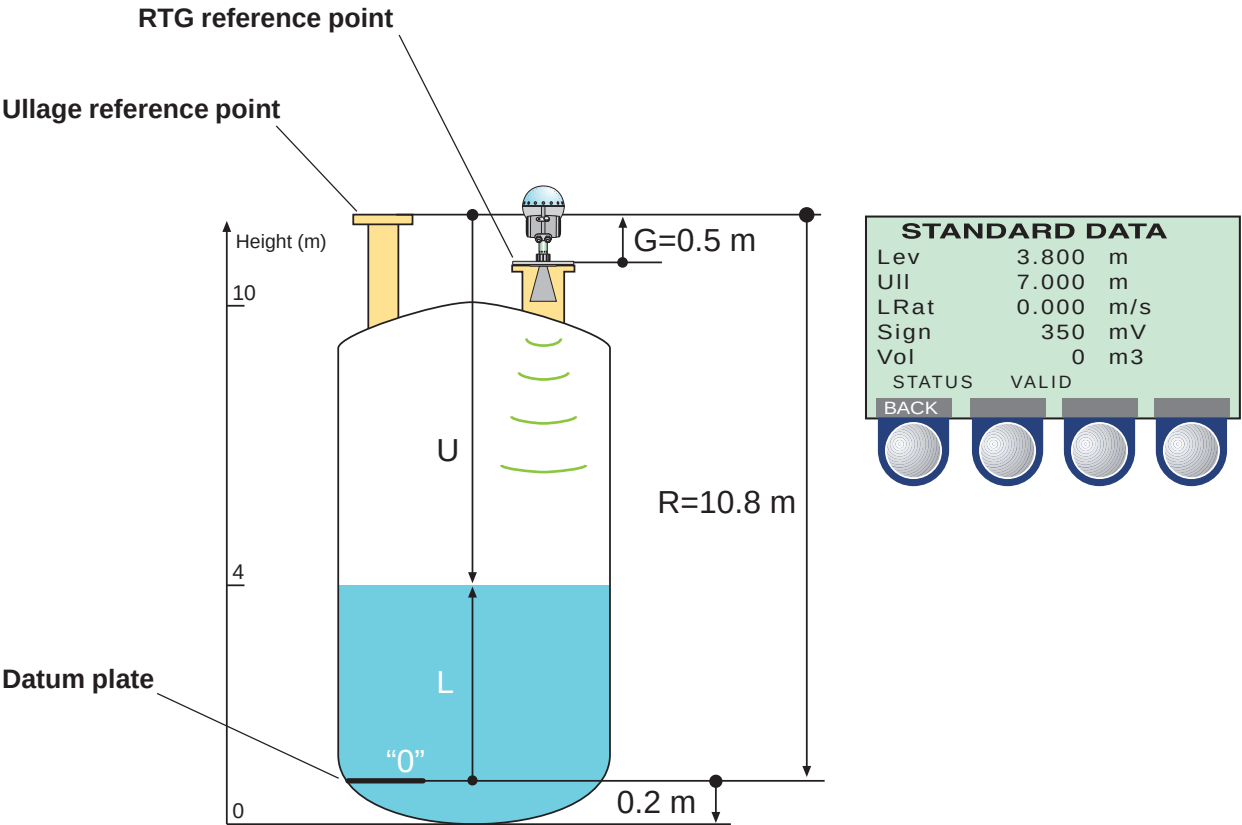
If you want	set
Upper reference point at the ullage reference point	G=distance between ullage and RTG reference points.
Lower reference point at the tank bottom	R=distance between ullage reference point and tank bottom. C=0.



STANDARD DATA	
Lev	4.000 m
Ull	7.000 m
LRat	0.000 m/s
Sign	350 mV
Vol	0 m3
STATUS	VALID
BACK	

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=to distance from ullage reference point to datum plate. C=distance between datum plate and tank bottom.



7 Technical Information

Technical Data

Power supply	100-240 VAC or 24-48 VDC
Power consumption	Maximum 15 W
Output cabling	Twisted and shielded pair, min. 0.5 mm ²
Cable glands	EExe approved (CENELEC)
Tank temperature	-40-400 °C (-40-750 °F)
Ambient temperature	-40-70 °C (-40-158 °F)
Standard measuring range	0-50 m (0-165 ft)
Instrument accuracy	± 5 mm (±0.2")
Repeatability	±1 mm (±0.04")
Processors	Dual processor design. 32-bit DSP, 50 Mflops
Signal processing	FFT, FFAST
Optional disturbance echo handling	Saab's Echofixer and Multiple Echo Tracking
Level output	Display panel, analog 4-20 mA signal with digital HART, serial Saab TRL/2 Bus
Ex approval Transmitter Head	CENELEC:
(Standard and Gold versions)	EEx de [ib] IIC T6. FM: Explosion proof Class I, Div. I & 2, Groups A, B, C and D.

Ex approval Transmitter Head including Display Panel	CENELEC: EEx de [ib] ib IIC T4 FM: Explosion proof/ IS Class I, Div. I & 2, Groups A, B, C and D
Pressure	-1 to 20 Bar (Vacuum to 300 Psi)
Antennas	Rod, Cone, Process Seal and Parabola
Antenna materials	Teflon®, SS 316L/HC4/Tantalum, Viton/ Kalrez®
Dimensions	545 (H) x 200 (W) mm (4" cone)
Weight	8 kg
Height above flange	400 mm (15")
Water protection	IP 65
Serial communication	HART or Saab TRL/2 Bus

Display Panel

- For presentation of measured values and configuration of the transmitter
- Graphical LCD display 128 x 64 pixels
- Four softkeys
- Text: 7 lines with 16 characters
- Graphics up to 128 X 56 pixels
- Supports service functions

Analog Outputs

Type	Galvanically isolated, passive or active output (external or internal loop supply)
Range	4-20 mA
Alarm level	<3.6 mA or >21 mA software selectable
Resolution	0,5 µA (0.003%)
Output impedance	> 10 MΩ
Loop resistance	< 700 Ω with 24 V external supply
Voltage compliance	7-30 V



8 Troubleshooting

SYMPTOM

ACTION

No level reading

Check the power supply.

Check the cables for serial data communication.

Incorrect level reading

Check the transmitter calibration.

Check that the transmitter has not locked on an interfering object.

Check that the mechanical installation is correct.

Serial communication failure

Check the COM port setting in the Pro Setup program.

Check the serial communication address.

Check the cable connections and that the correct cables are used.

Insufficient power supply to Field Bus Modem.

Display Panel window is blank

Check the power supply

Poor Display Panel contrast

Press the two right-hand buttons to increase the LCD contrast.

Display Panel Error Messages

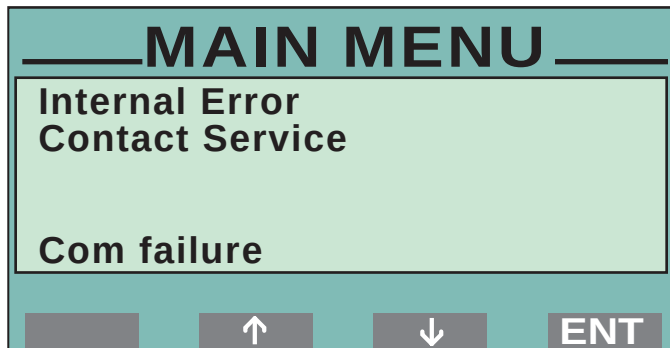
User Input Errors

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



Internal Software Errors

This message indicates an error in the Display Panel software.



Saab Tank Control Local Representative:

**Second edition. September 1998.
Ref. nr. 306010 E.**



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