Saab TankRadar® Pro

User´s Guide

SAAB
Saab Tank Control

Saab TankRadar® Pro

User´s Guide

Second edition

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Specific FCC Requirements (USA only)

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

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.

Contents

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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.
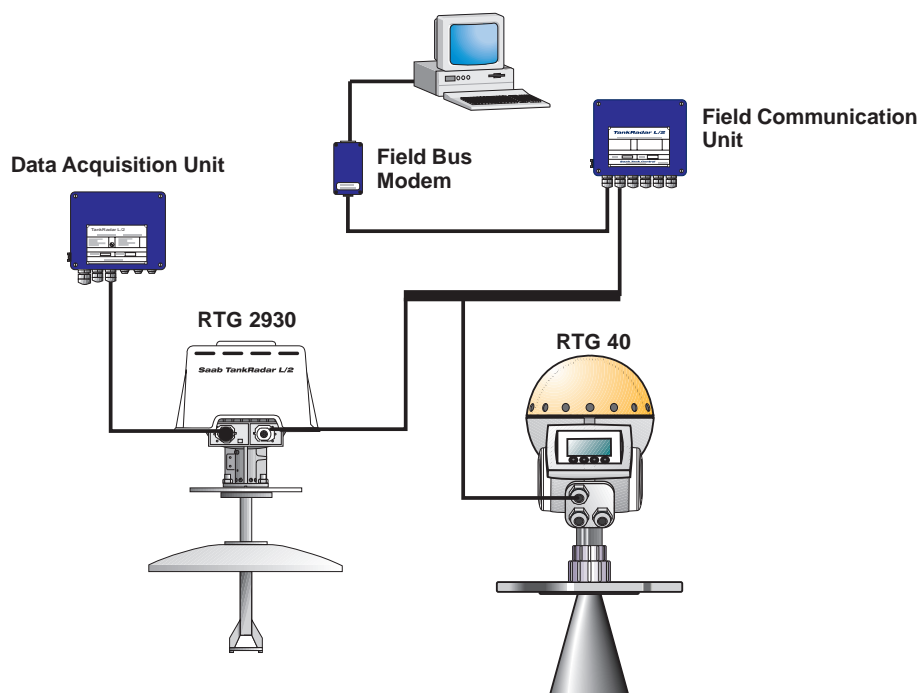
A specially designed software package, Pro Setup, offers configuration and service capabilities. It also includes functions for presentation of measurement data.
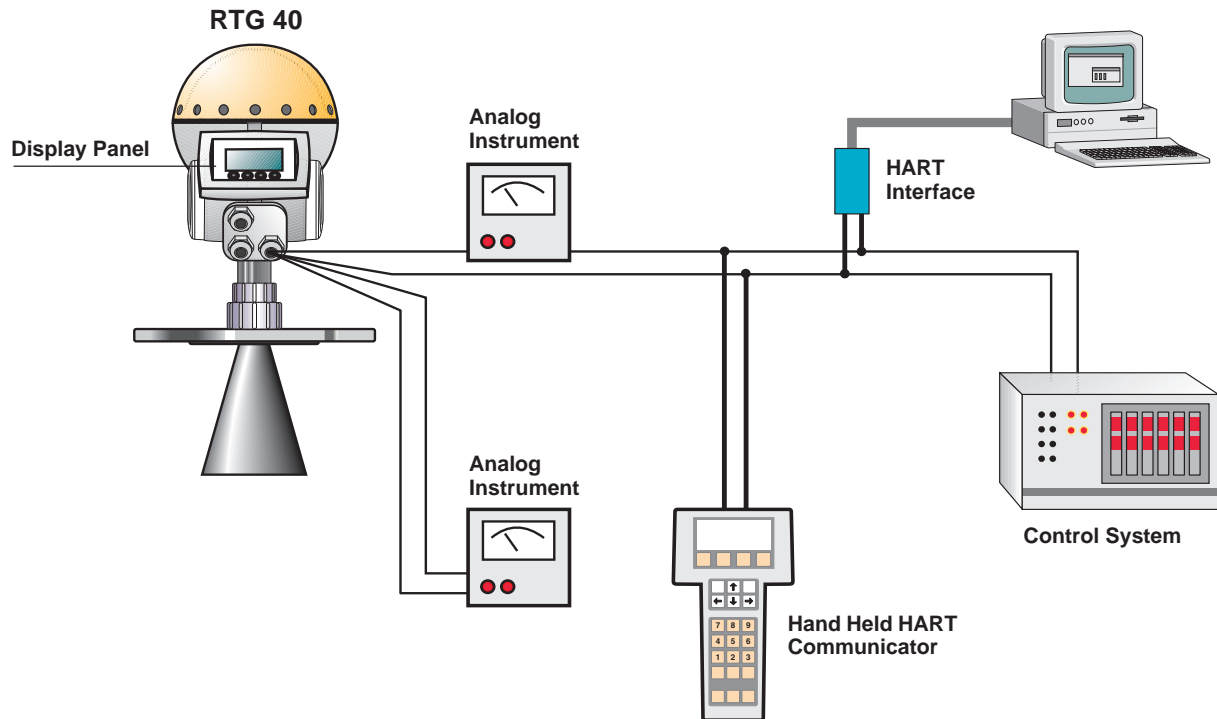
If HART technology is used you can configure and monitor measurement data via a hand held communicator or a PC.

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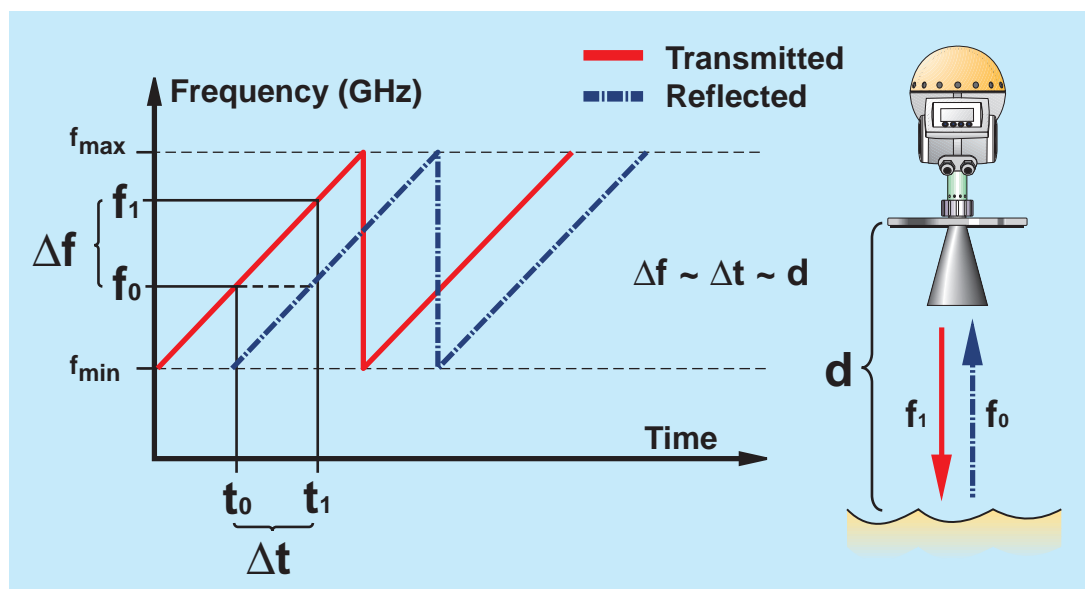
Since the transmitter continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals.

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.
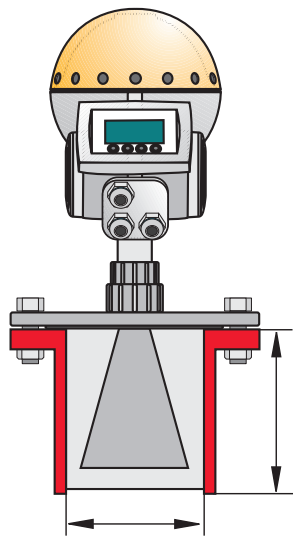
L_{max} (mm):	300	(4" cone antenna)
	410	(6" cone antenna)
	525	(8" cone antenna)
	600	(parabolic antenna)
	150	(rod antenna)
	300	(Process Seal antenna)

$\emptyset_{min}$ (mm):	98	(4" cone antenna)
	146	(6" cone antenna)
	194	(8" cone antenna)
	500	(parabolic antenna)
	50/60	(rod antenna)
	100	(4" Process Seal antenna)
	150	(6" Process Seal antenna)

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

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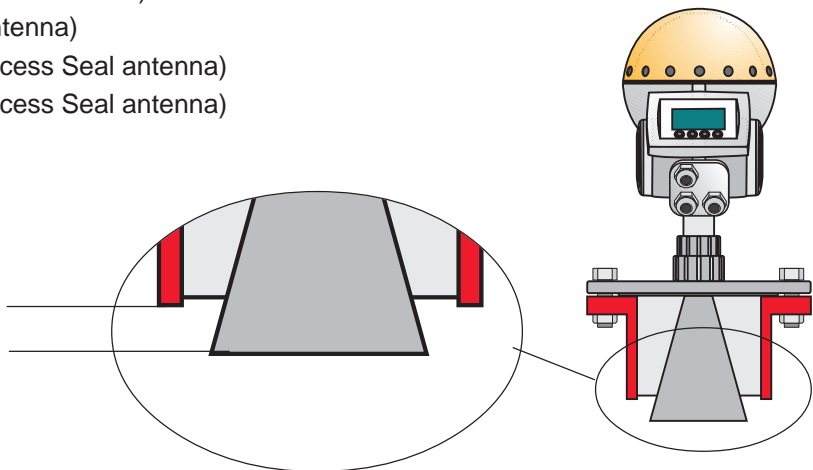
Free Space Requirements

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

Service space 550 mm

Service space (mm):
• Cone antenna: 650
• Rod antenna: 700
• Process Seal antenna: 800
• Parabolic antenna: 700

Maximum angle:
• Cone antenna: 1°
• Rod antenna: 3°
• Process Seal antenna: 3°
• Parabolic antenna: 0.5°

Minimum distance (m):
• Cone antenna: 0.6
• Rod antenna: 0.3
• Process Seal antenna: 0.6
• Parabolic antenna: 0.6

Dimensions

200 mm

395 mm

150 mm (4" cone antenna)
260 mm (6" cone antenna)
370 mm (8" cone antenna)

92   mm (4" cone antenna)
140 mm (6" cone antenna)
188 mm (8" cone antenna)

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")

1. Put a gasket on the socket and insert the antenna.

Gasket

Loose flange

2. 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.

O-ring

Wave guide tube

Nut

4. Place the transmitter on top of the antenna and tighten the nut.
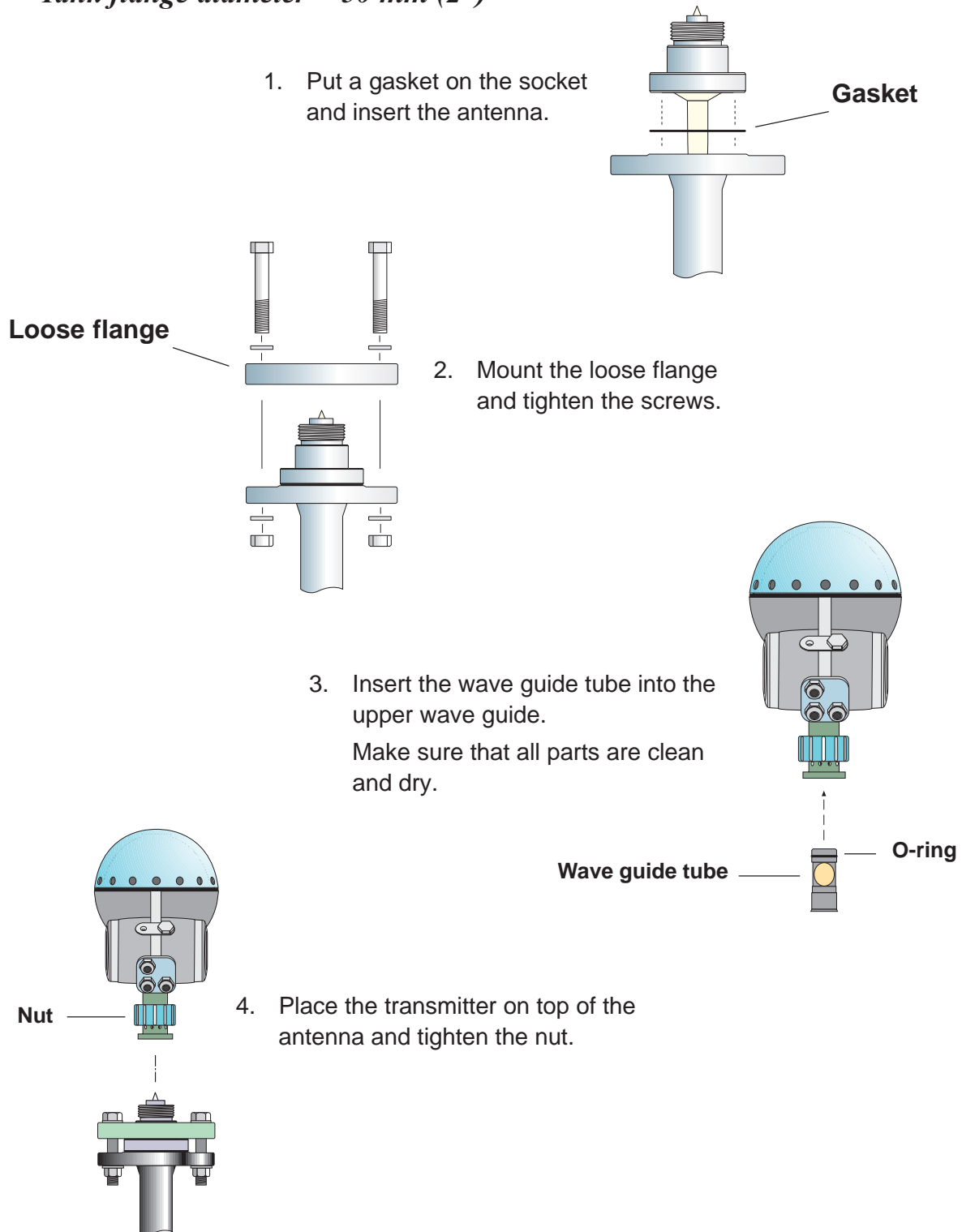
Tank flange diameter = 65 mm (3")

Flange adapter

1. Carefully center the flange adapter on top of the tank flange.

   Use gaskets under and above the flange adapter.
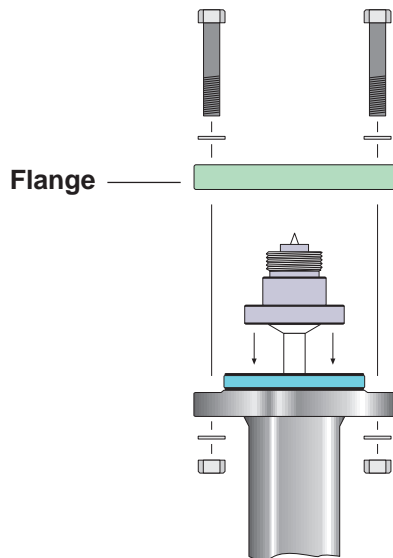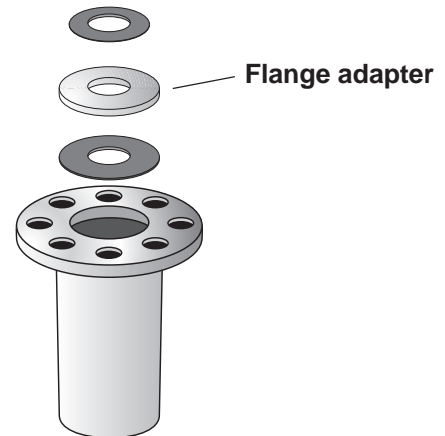
Flange

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.

Wave guide tube

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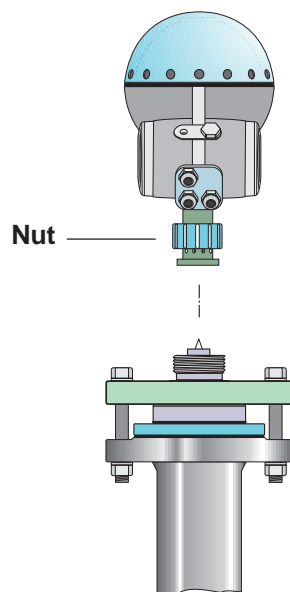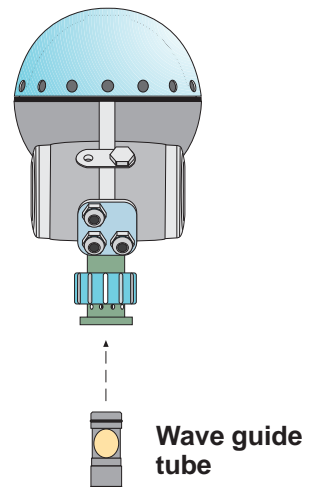
4. Place the transmitter on top of the antenna and tighten the nut.

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.

   Flange

   Diameter=33 mm

   **Note!
   No gasket on top of this plate**
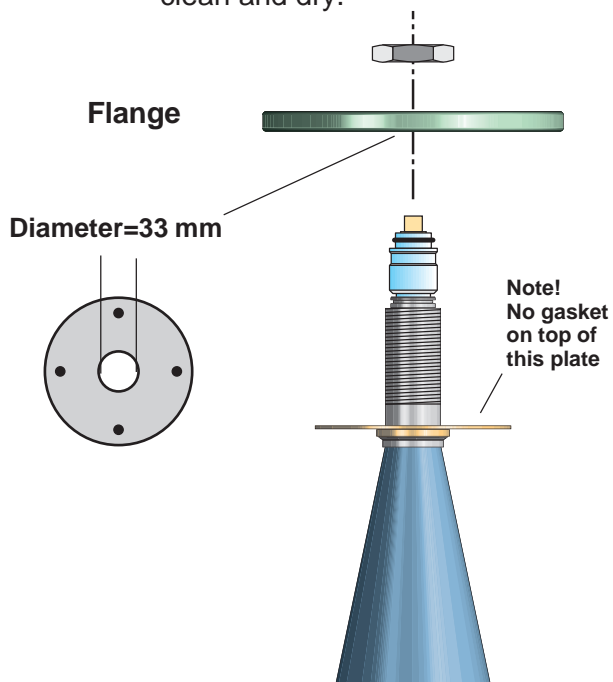
2. Secure the flange with the locking nut.

   Make sure that the nut fits tightly to the flange.

   Locking nut
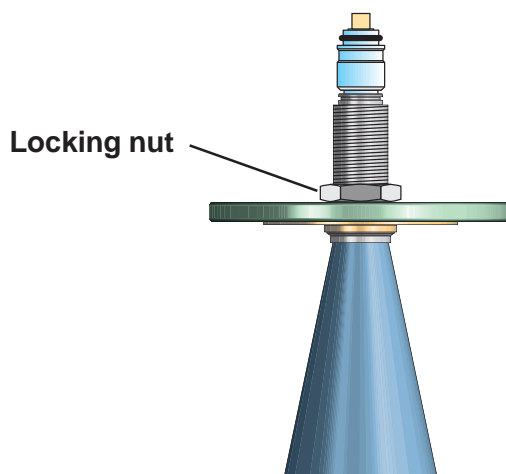
3. Mount the adapter on top of the sleeve.
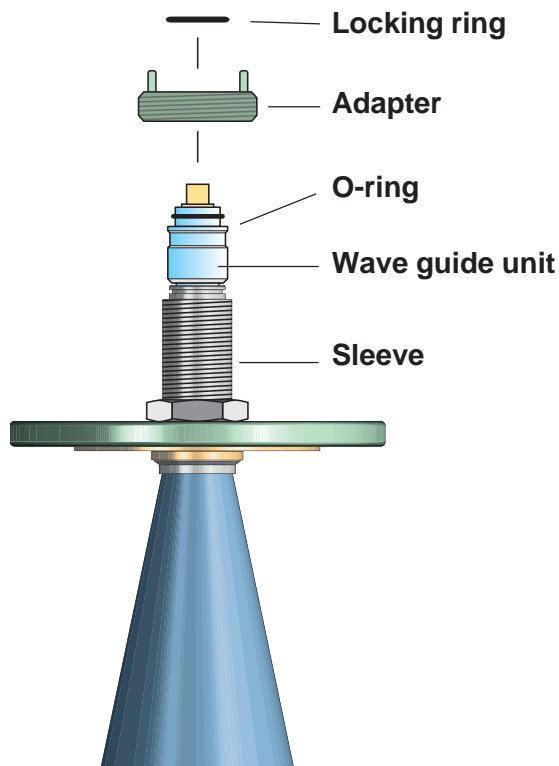
   Locking ring

   Adapter

   O-ring

   Wave guide unit

   Sleeve

4. Secure the adapter with the locking ring.

   Locking ring

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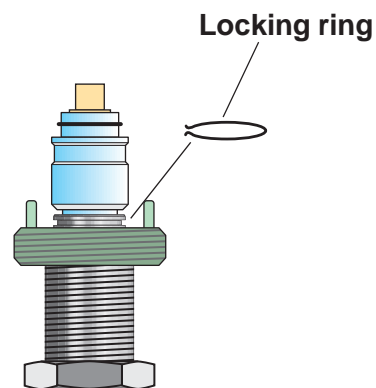
5. Carefully fit the flange and the cone antenna on the tank nozzle.

    Tighten with screws and nuts.
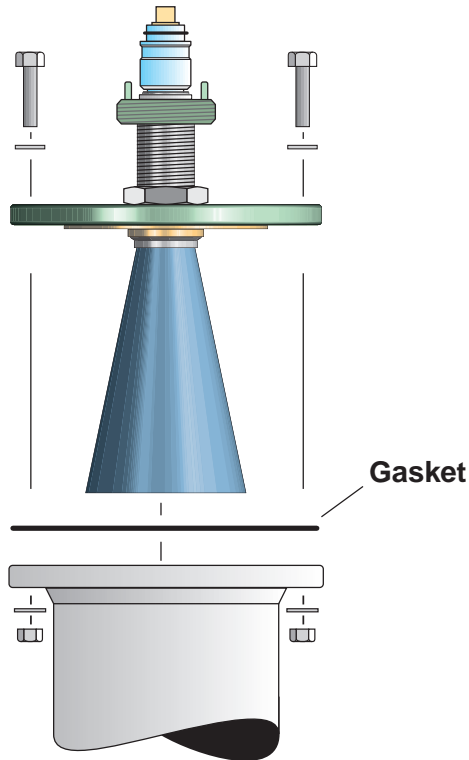
Gasket

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.

Upper wave guide

Protection sleeve

Guide pins

Adapter
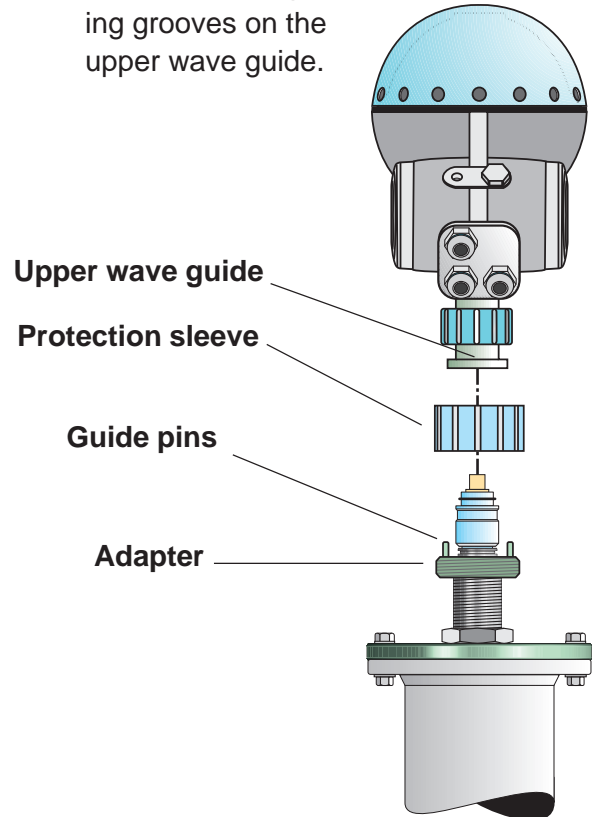
6. Insert the wave guide tube into the upper wave guide.

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

Upper wave guide

Wave guide tube

O-ring
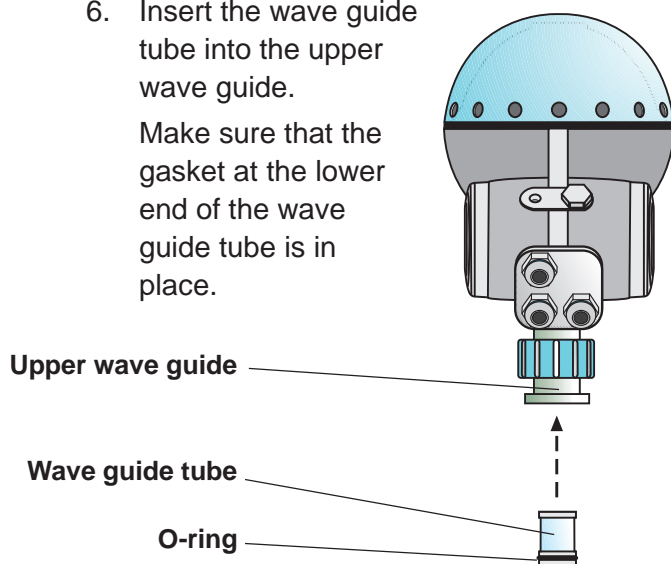
8. Proceed with the electrical installation.
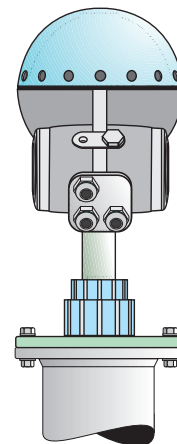
Mounting the Cone Antenna - Quartz Sealing

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.

    Flange

    **Note!
    No gasket
    on top of
    this plate**
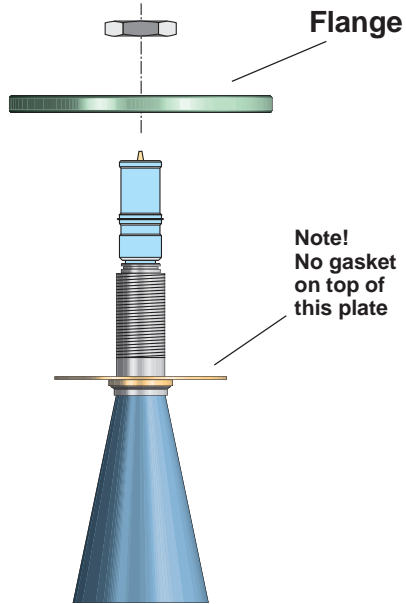
2. Secure the flange with the locking nut.

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

    Locking nut
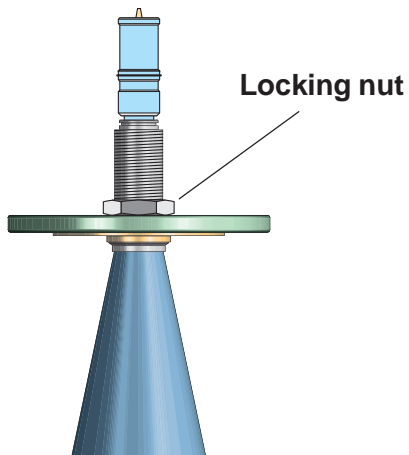
3. Mount the adapter on the sleeve.
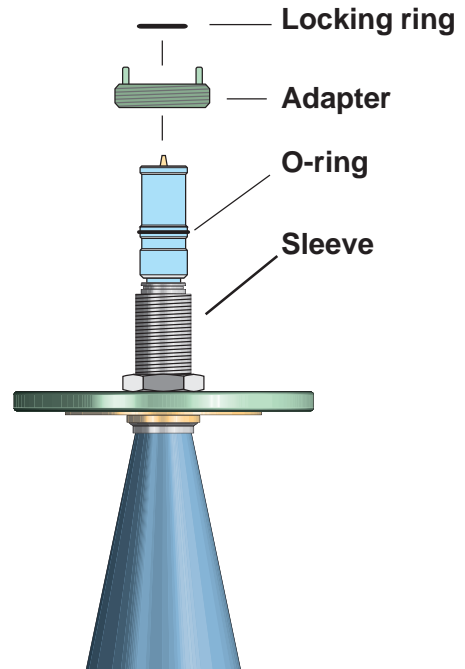
    Locking ring

    Adapter

    O-ring

    Sleeve

4. Secure the adapter with the locking ring.

    Locking ring

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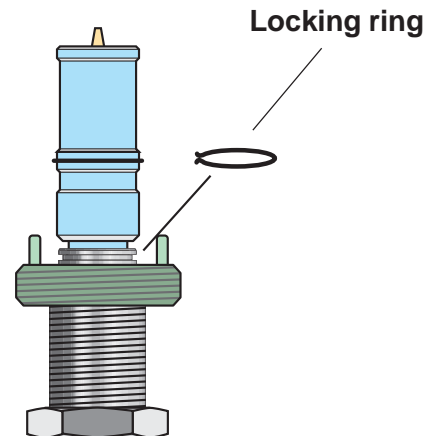
5. Carefully fit the flange and the cone antenna on the tank flange.

    Tighten with screws and nuts.
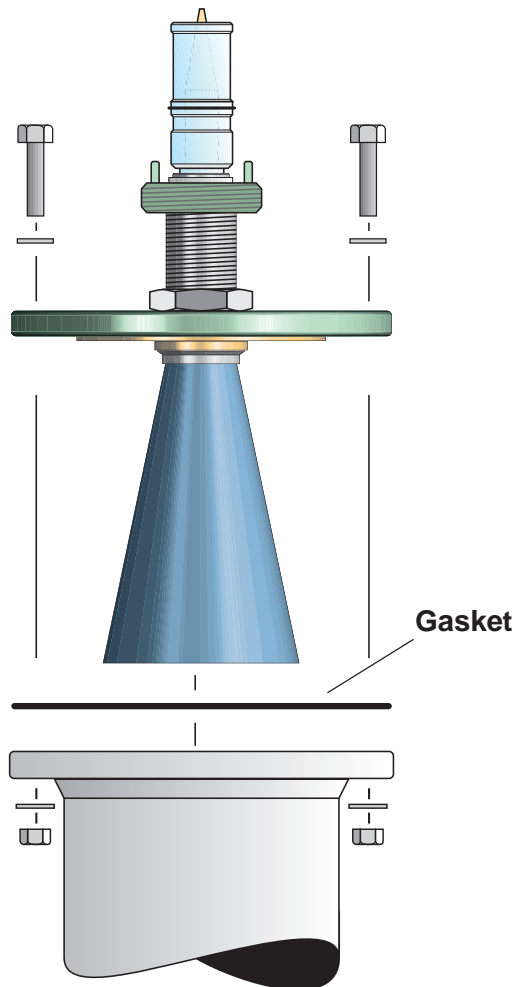
Gasket

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.

Upper wave guide

Protection sleeve

Guide pins

Adapter
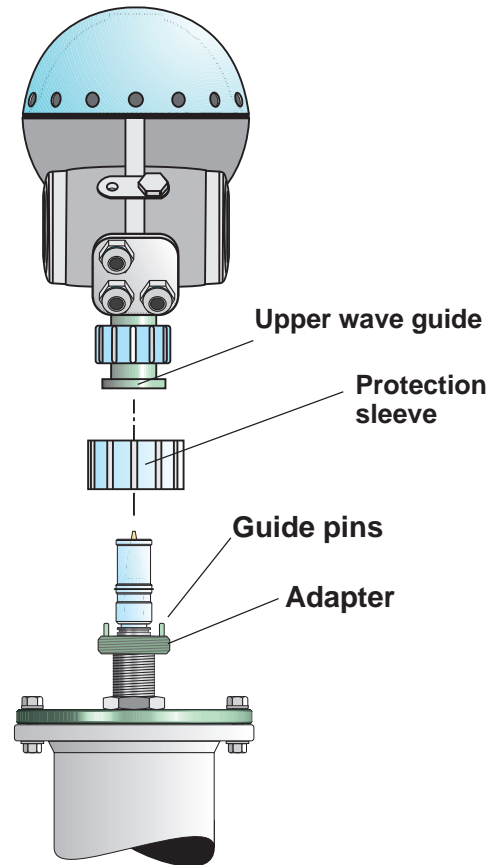
7. Proceed with the electrical installation.
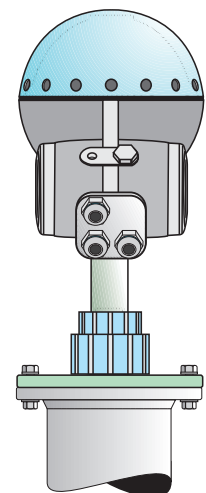
Mounting the Cone Antenna - Process Seal

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 mm
PTFE window: d<0.5 mm
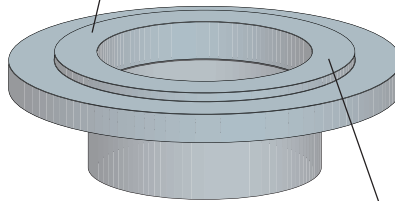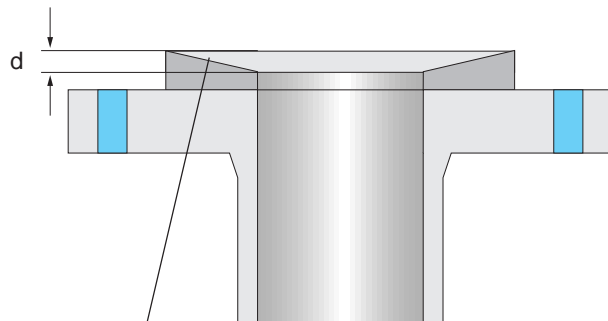
Convex:
Ceramic window: d<0.1 mm
PTFE window: d<0.5 mm
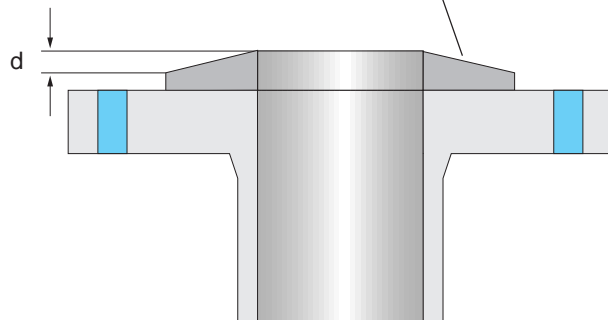
To mount the antenna do the following:

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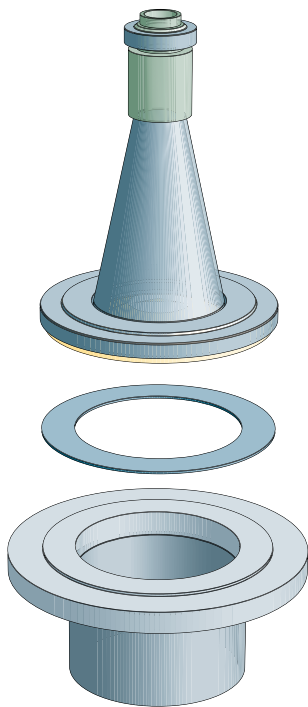
> *Note!*   **Use gaskets delivered by Saab. These gaskets are optimized for use with microwave emitting equipment. No other gaskets than Saab original may be used for Process Seal antennas!**

2. Put the loose flange on top of the antenna
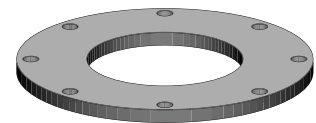
3. Tighten the flange to the antenna by using screws and nuts. Use lubricating grease to minimize friction when the screws are tightened.
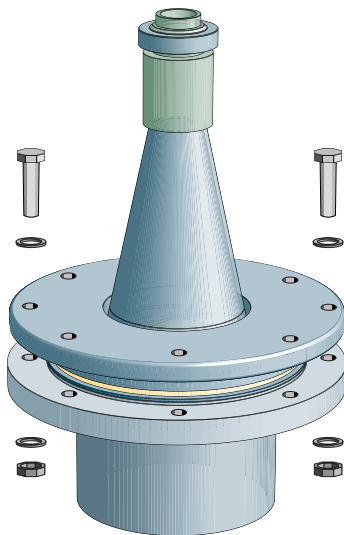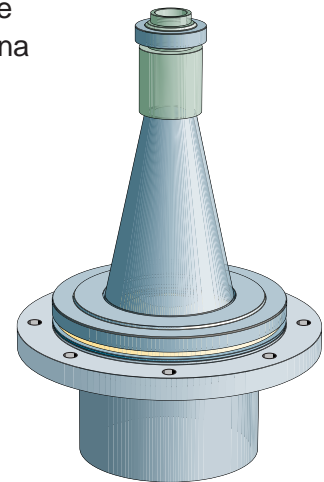
> *Note!*   *Tighten the screws carefully to a torque according to the recommended values in table 1.*
> *Tighten opposite screws in pair.*
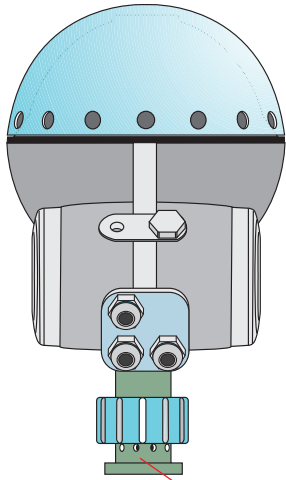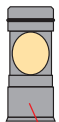
4. Insert the wave guide tube into the upper wave guide.

Wave guide

Wave guide tube
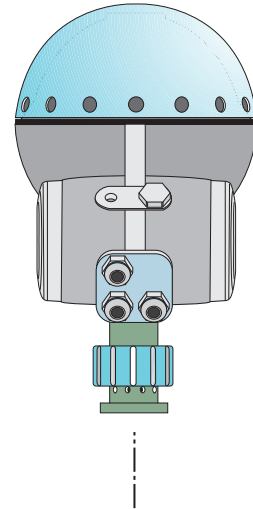
5. Mount the transmitter head onto the adapter.
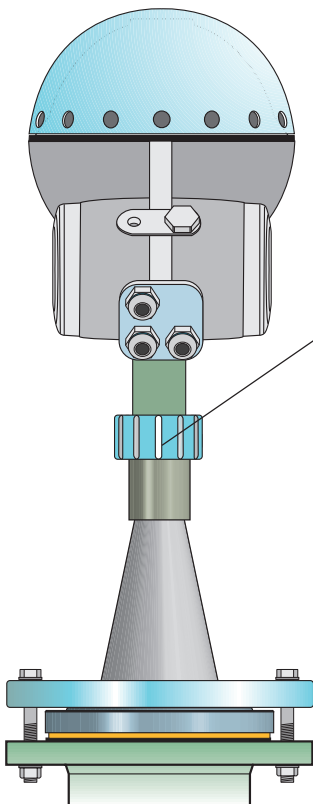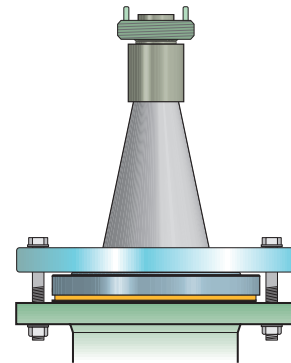
Nut

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

Flange

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.

Guide pin

Hole

Antenna feeder

TRL2 adapter
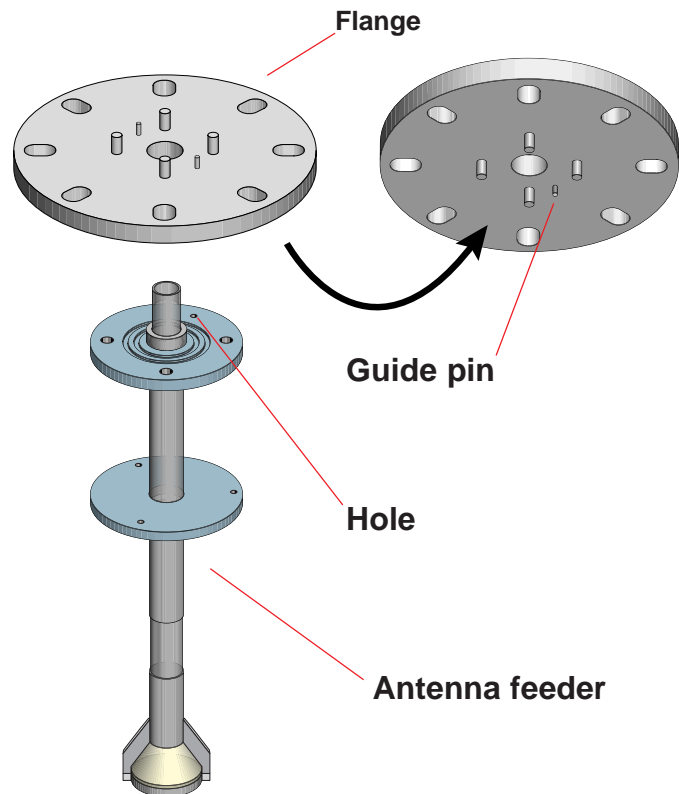
Guide pin

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.

Guide pin

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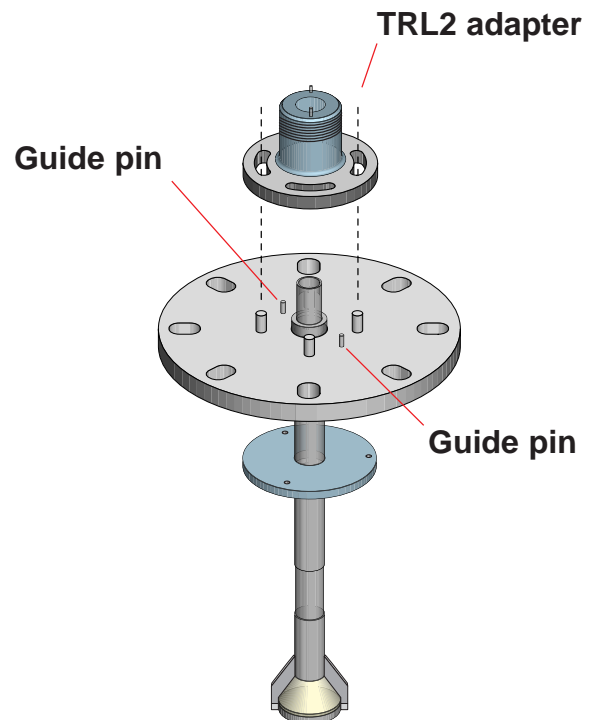
3. Mount the antenna feeder to the tank nozzle.

If necessary, use angular rings (inclination device) to align the antenna within ±0.5^{o}. The rings can be used if the tank nozzle flange is horizontal within ±4°.

Flange

Antenna feeder

Angular rings

Gaskets

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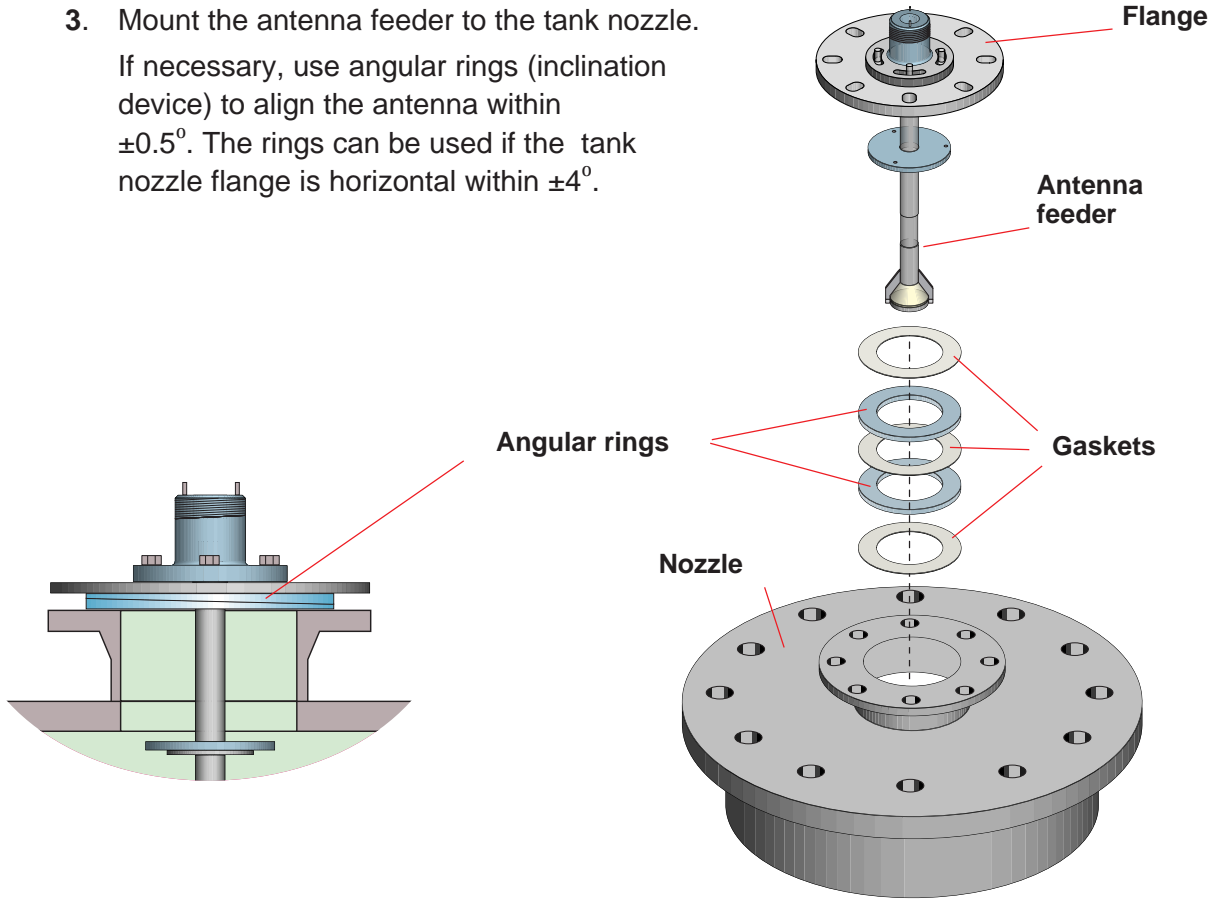
4. Mount the parabola onto the lower flange on the antenna feeder.

Lower flange

Parabola
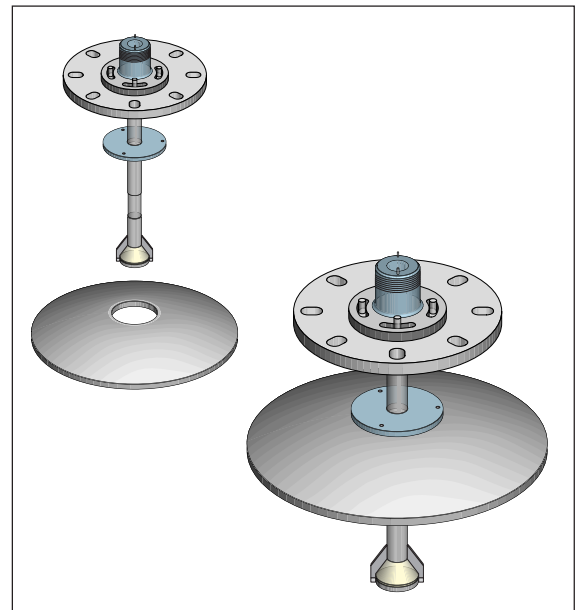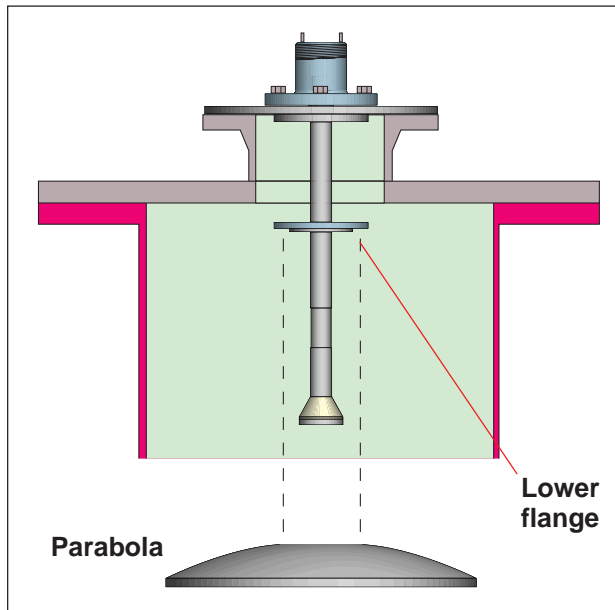
5. Mount the TCP tube into the TRL2 adapter.

TCP tube
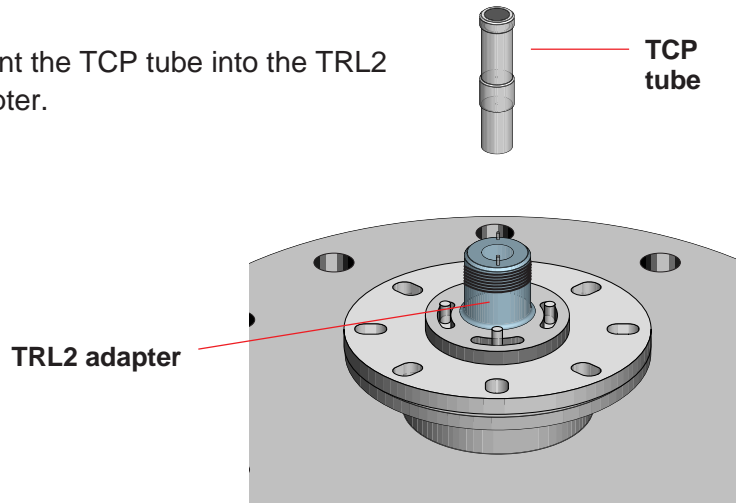
TRL2 adapter

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.*

Transmitter head

Cover Locking

Guide pins
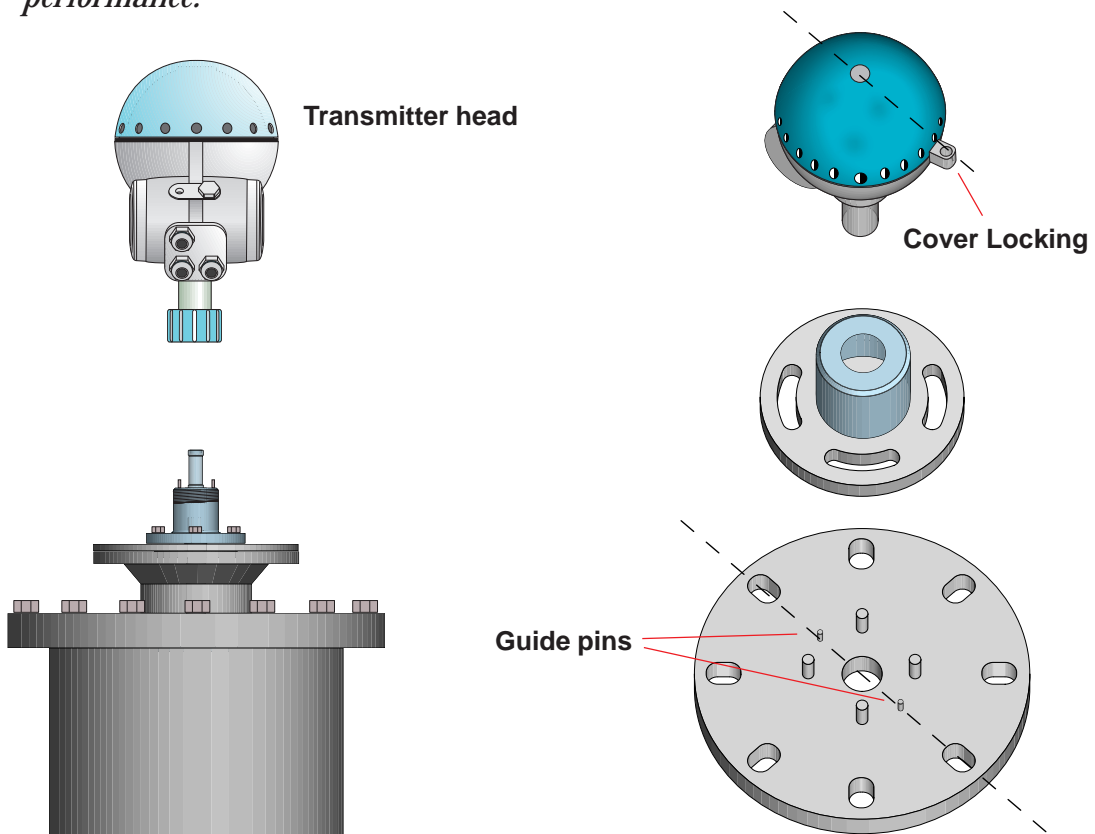
3 Electrical Installation

Identication of Installed Options

Type TH 40CA1BPB

I   II   III   IV   V

Approval
Power Supply
Primary Output
Display Panel
Secondary Output

Saab TankRadar® Pro
Transmitter Head   *Type TH 40CA1BPB*

EEx de[ib]ib IIC T4(T$_{amb}$-40°C, +70°C) , SCS Ex97D1028

I. S. Options:
DI 40   HM 40+IS 40   XA 40+IS 40
Non-I.S. Options/Power Supply:
AC 40 (85-260 VAC, 10W)

⟨Ex⟩ C E

Serial No: 1434   HART UI: 7923914346118   FCC ID K8CPRO

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

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.

Flameproof enclosure

**CENELEC: EExe
FM: Explosion proof**

**CENELEC: EExi
(Optional: EExe)
FM: Intrinsically safe
(Explosion proof)**

**Primary analog output
or
serial communication
(FM: conduit fitting)**

**Connection for
Display Panel**

**Power supply
(FM: conduit fitting)**

**Intrinsically safe
analog outputs (or
conduit for non-IS
outputs)**

Saab Tank Control
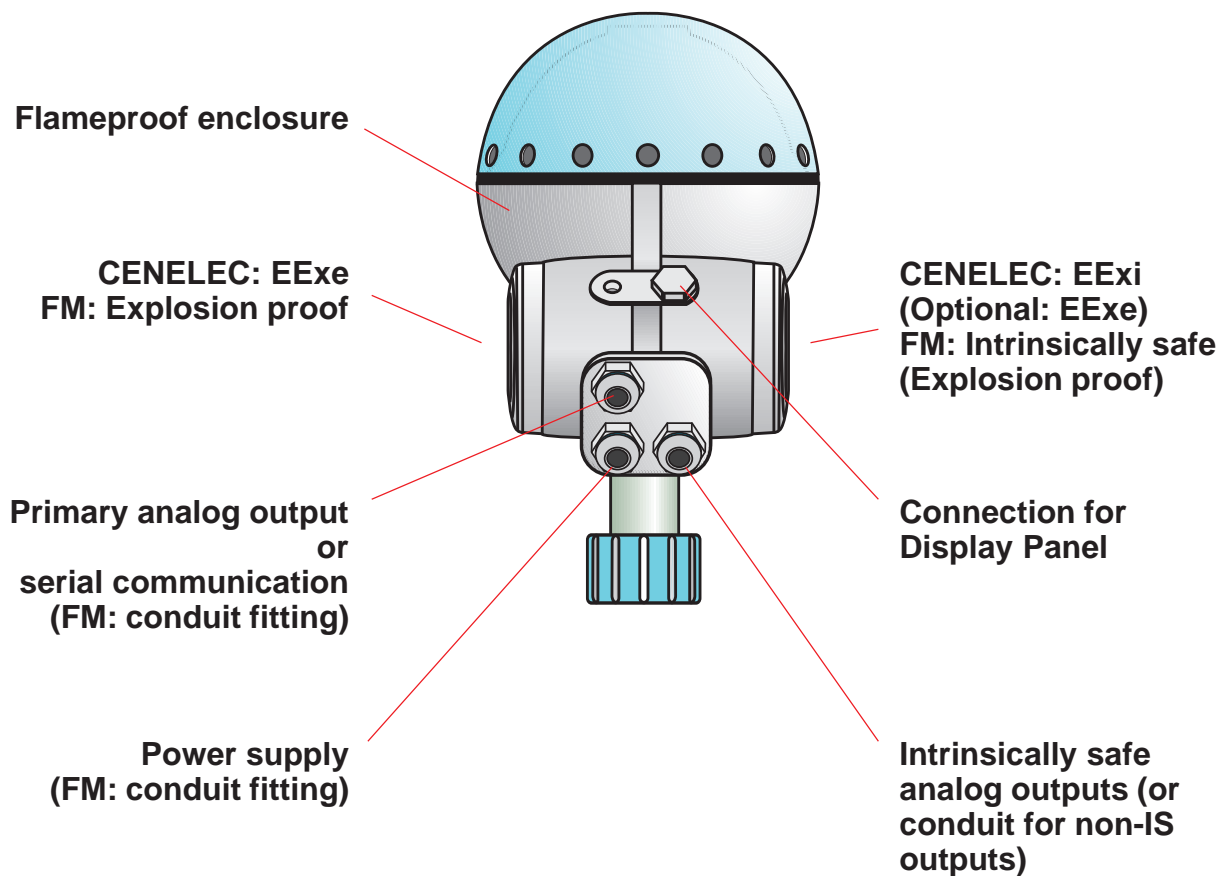
External Connections

Non-Intrinsically SafeJunction Box -EEx e

This Junction Box is for non-intrinsically safe connections and power supply.
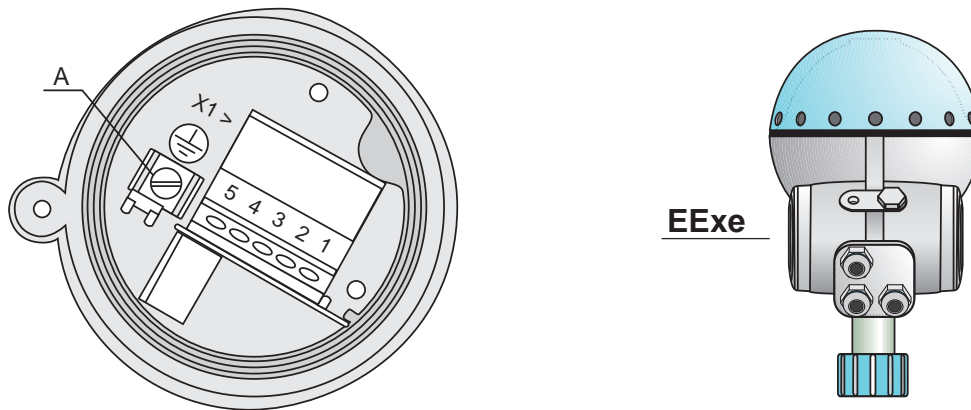
1-2 Non-intrinsically safe HART/4-20 mA primary analog output, or
TRL/2 Bus

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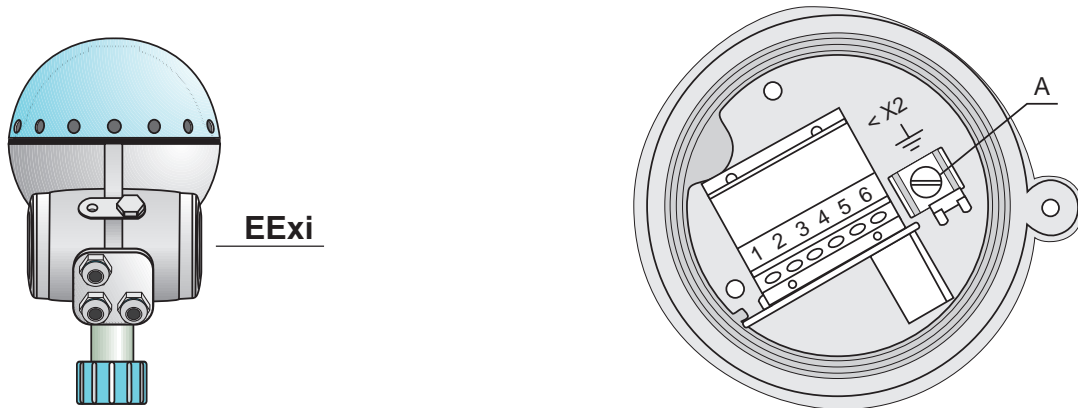
1-2 Intrinsically safe HART/4-20 mA primary analog output.

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.

Saab Tank Control

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.

EExi/e

A
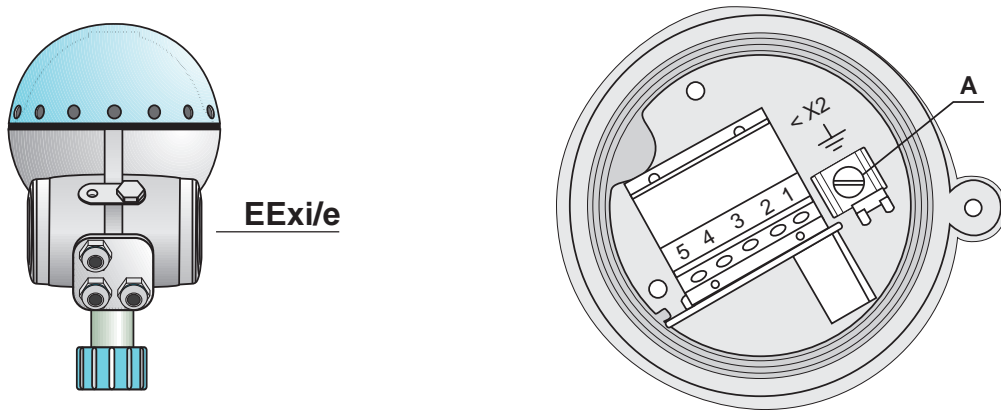
1-2   Not used

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.

SAAB
Saab Tank Control

Connecting to a TRL2 Bus Interface

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

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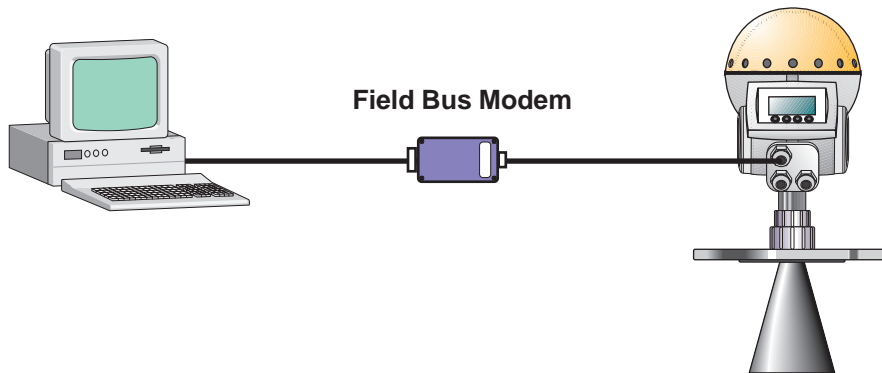
Connect to the non-intrinsically safe junction box (EEx e).

Junction Box EEx e

+

–

1
2
3
4
5

X1

**100-240 VAC
or
24-48 DC**

SAAB
Saab Tank Control
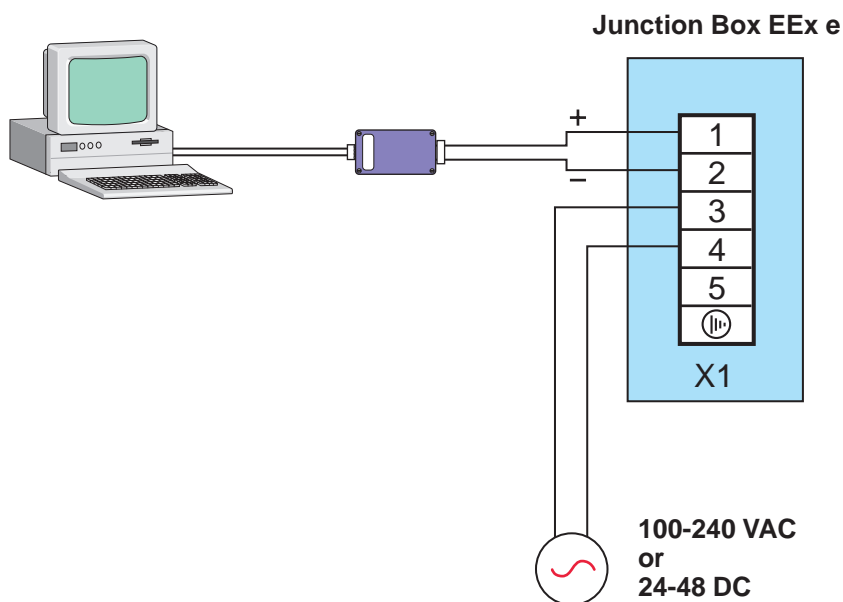
Connecting HART devices

Active output (internal loop supply)

For Pro gauges with active output a hand-held terminal or a HART modem can be connected as follows:
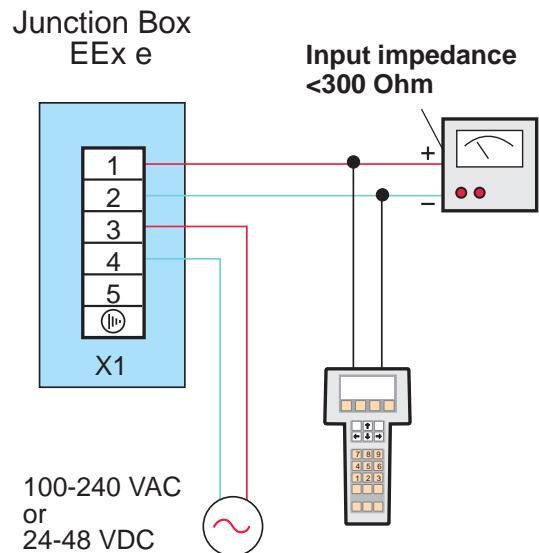
Passive output (external loop supply)

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.

Saab Tank Control
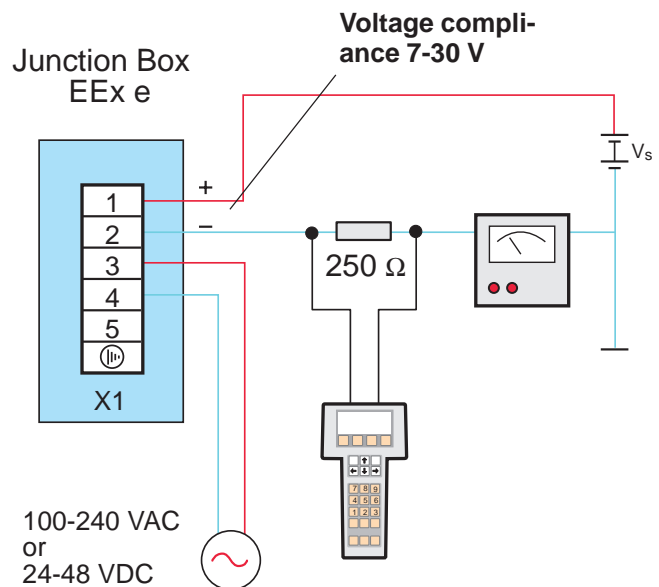
Intrinsically safe conditions

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.

Hazardous Area   **Non-Hazardous Area**

RTG 40

Zener
barrier

HART
interface

Analog instrument
and/or DCS system

**Hand held HART
communicator**

Non-Intrinsically safe conditions

RTG 40

HART
interface

Analog instrument
and/or DCS system

**Hand Held HART
Communicator**

Saab Tank Control
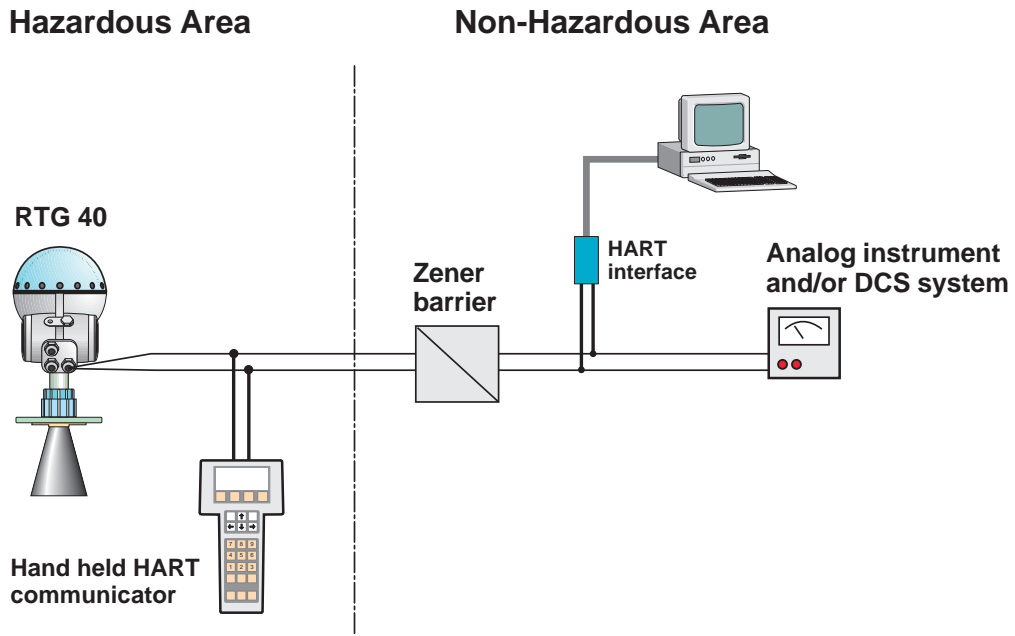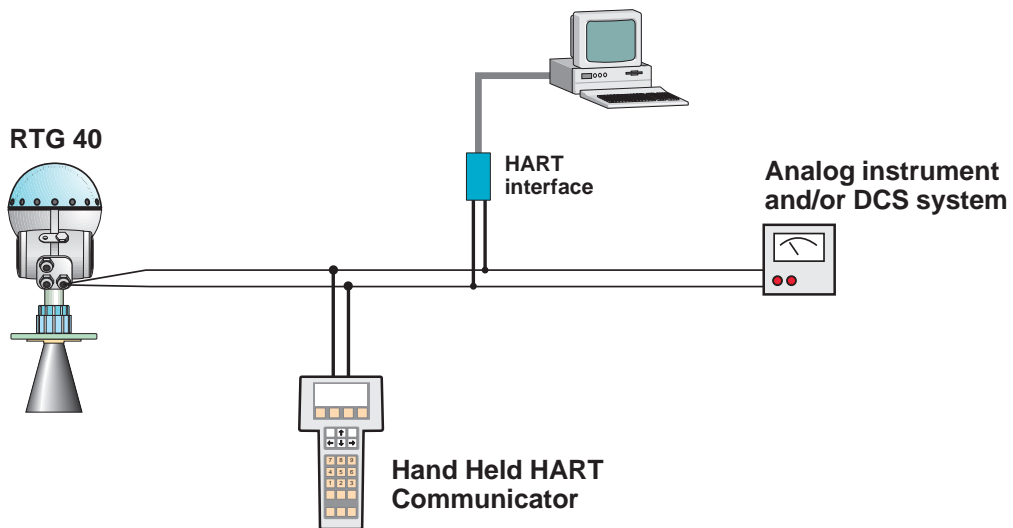
Connecting the Display Panel

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
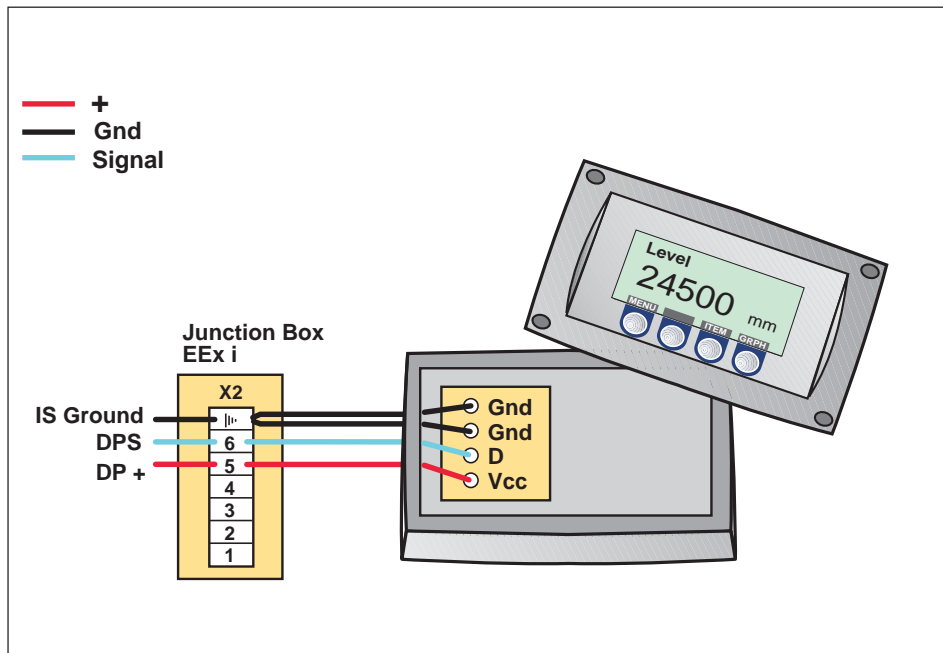
Cables

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 instrinsically safe junction box (*EEx i*) use cable glands with integral shield connection for cable diameter 6-12 mm or conduit.

Use shielded instrument cable 0.5 mm² (AWG 20) for analog outputs and serical 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-intrincisally 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.
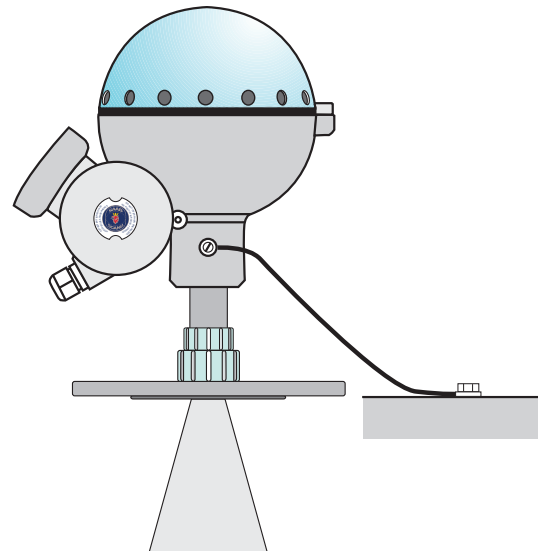
This grounding also serves as electrical safety ground. Additional connection to the protective ground terminal of terminal X1 in Junction Box EExe is not recommended except where required according to national code of practice. A ground loop with circulating current may occur. See also the *Special 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 (EEx e).

Schematic illustration of Pro transmitter connections

Saab Tank Control
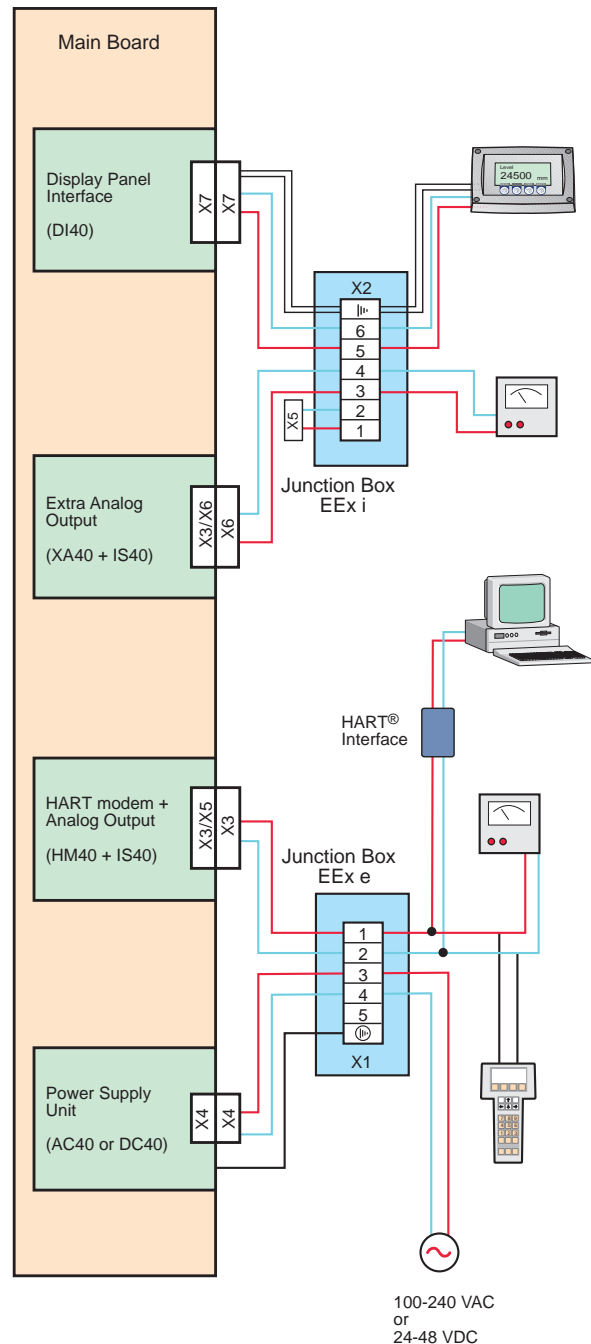
Internal Connections

Non-Intrinsically Safe (EEx e)
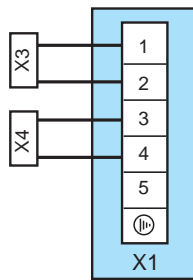
Intrinsically Safe (EEx i)
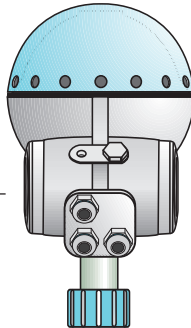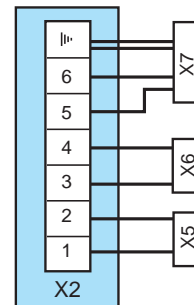
Power Supply

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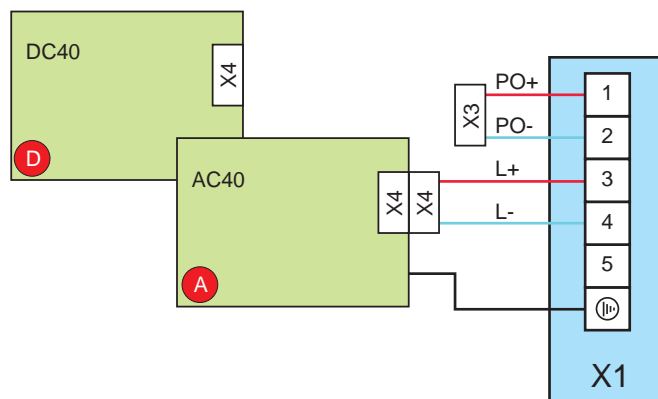
Display Panel

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

SAAB
Saab Tank Control
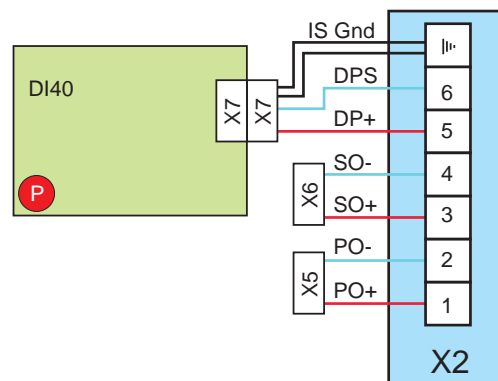
Primary Output

Non-Intrinsic Safety (EEx e)

Option	Description	Board
1A	Non-intrinsically safe HART/4-20 mA, active.	HM40+IS40
1C	Non-intrinsically safe HART/4-20 mA, passive	HM40
2A	TRL2 Bus	TM40
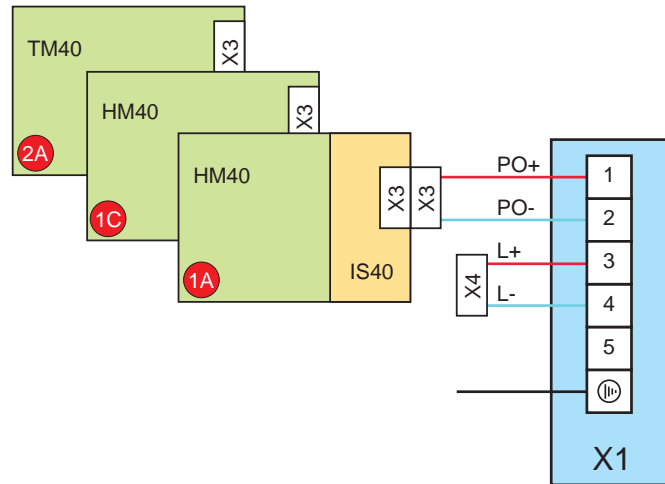
Intrinsic Safety (EEx i)

Option	Description	Board
1B	Intrinsically safe HART/4-20 mA, active	HM40+IS40
1D	Intrinsically safe HART/4-20 mA, passive	HM40

Saab Tank Control
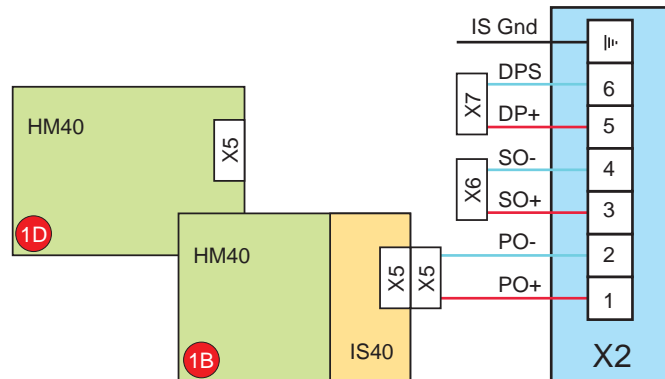
Secondary Output

Intrinsic Safety (EEx i)

Option	Description	Board
B	Intrinsically Safe 4-20mA active	XA40+IS40
D	Intrinsically Safe 4-20mA passive	XA40

Non-Intrinsic Safety (EEx e)

Option	Description	Board
A	Non-intrinsically safe 4-20mA active	XA40+IS40
C	Non-intrinsically safe 4-20mA passive	XA40
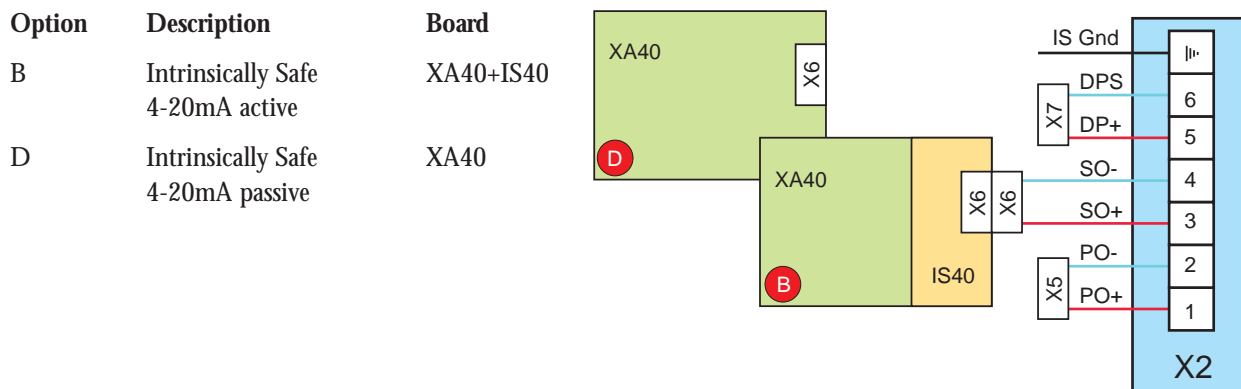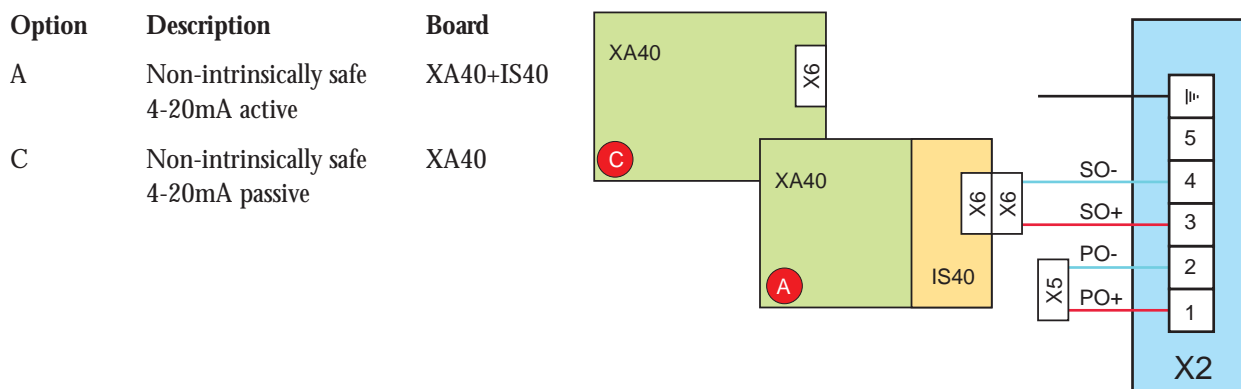
Note!　　This junction box is normally used for intrinsically safe connections. This version is a non-intrinsically safe option equipped with an alternative connector for non-intrinsically safe output.

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.
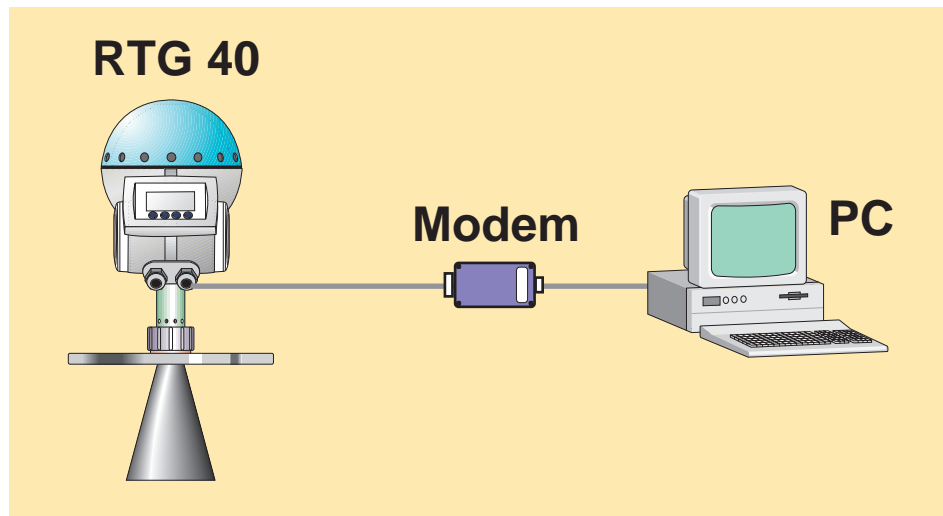
It is a simple task to start and configure the TankRadar Pro transmitter. When the gauge is mounted on the tank flange, and the cables are properly connected you only need to run through a straightforward configuration procedure to start the transmitter. In this procedure you will set a few parameters 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.
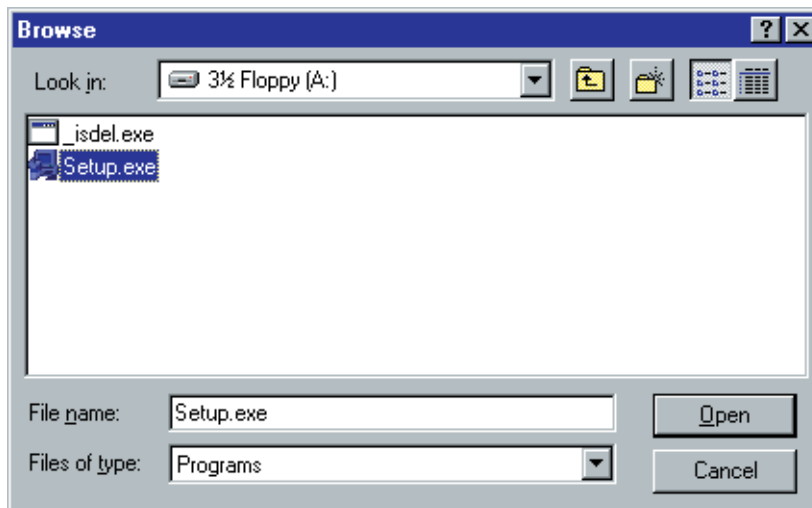
Browse to the diskett drive and select the **setup** file. Follow the instructions.

SAAB
Saab Tank Control
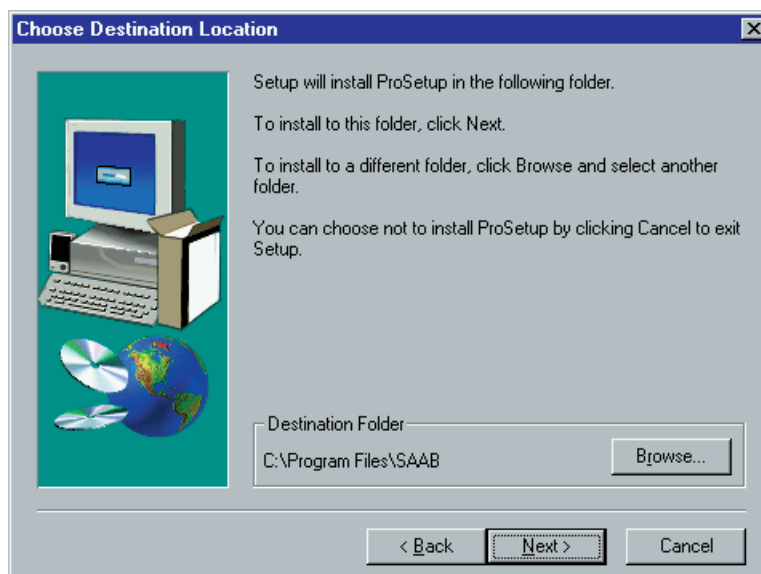
4   Choose installation directory.

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

Click the **Next** button.
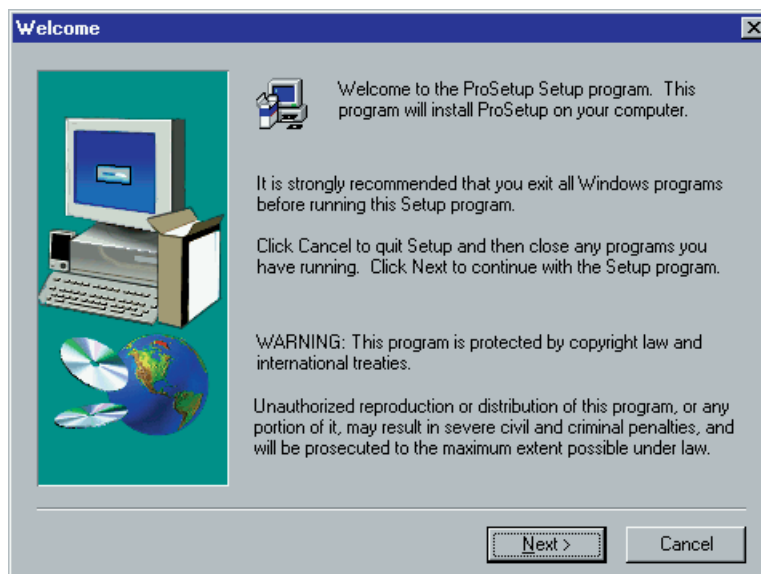
5.   Follow the instructions in the installation wizard.

Click the **Next** button.
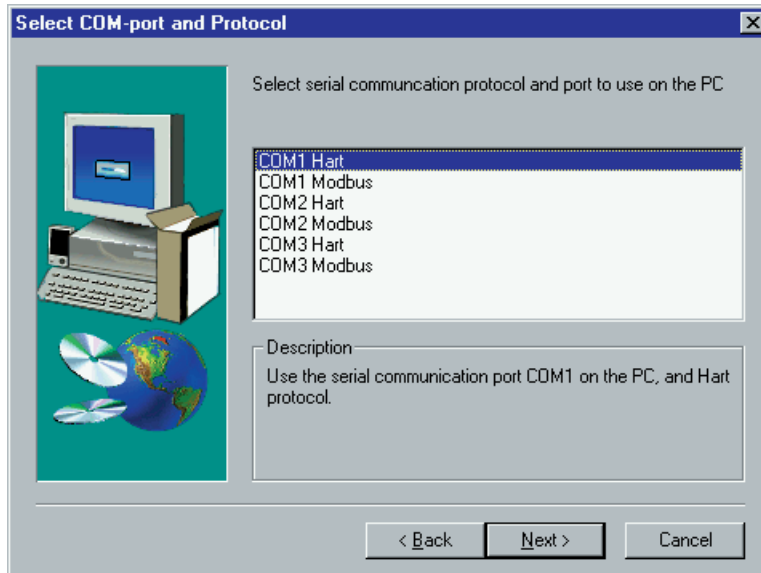
6   Specify the Com port and communication protocol you will use to connect the gauge. Com port and protocol can be changed later.
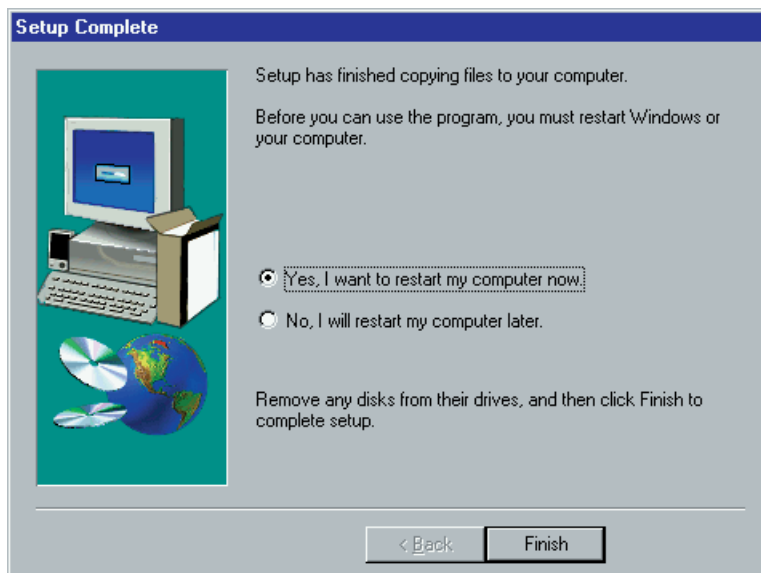
7   Finish the installation.

Starting the Pro Setup Program

Do the following to start Pro Setup:

1   Click the Start button in the Windows95 Task bar.

Pro Setup icon

Programs menu

Start button
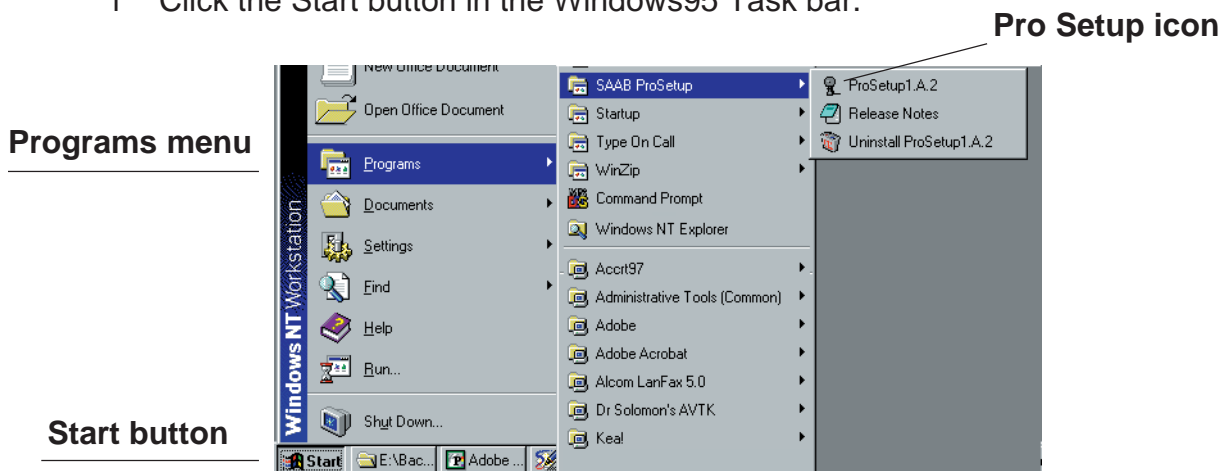
2   Open the Programs menu.
3   Open the Saab ProSetup folder.
4   Click the Pro Setup icon.
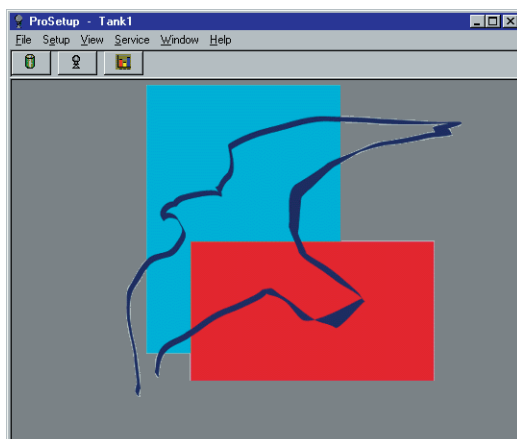
Note!   *While Pro Setup is running, the Win95 Task Bar contains two
             buttons named "Pro Setup" and "Saab TankRadar IO Master
             Server". The last button refers to a communication program support-
             ing Pro Setup. Normally, you do not need to open this window unless
             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.
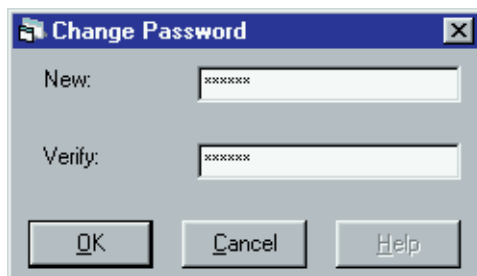
3   Click the **Change** button.
4   Enter a new password in the **New** input field.
5   Verify the new password and click the **OK** button.
     Response: the Change Password window is closed.

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.
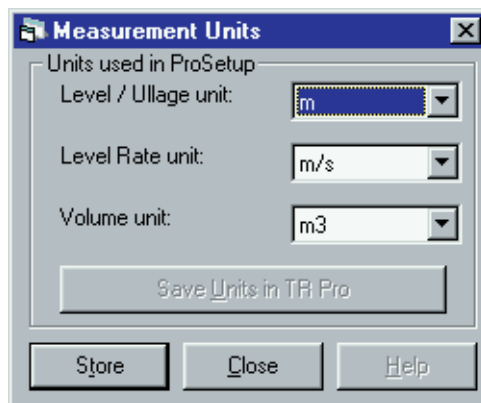
2   Select the desired units for Level/Ullage, Level Rate and volume.

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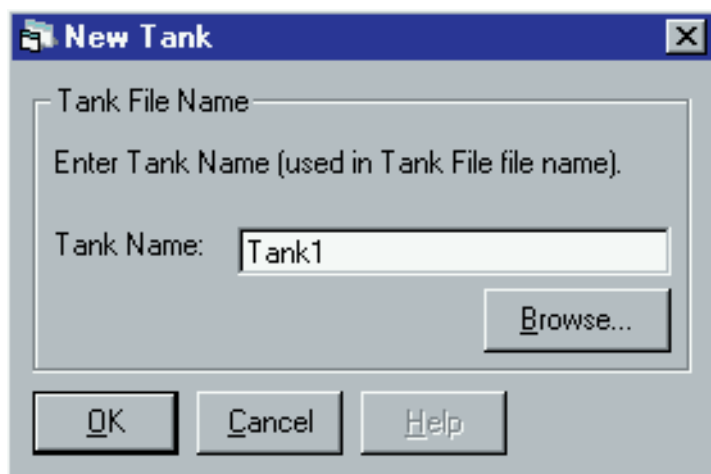
2   Enter a tank name to associate with the tank and click the **OK** button.

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

2 Enter protocol and address data.
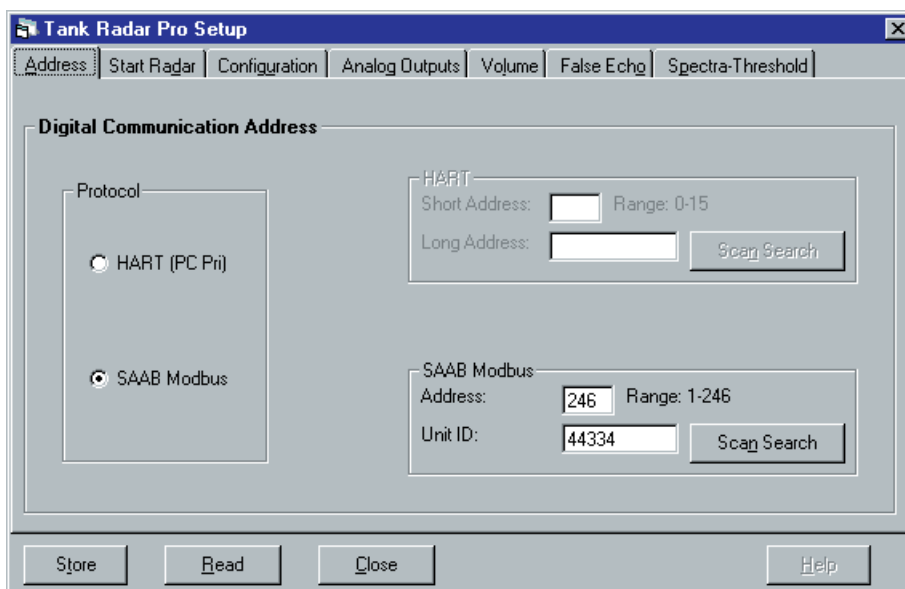
1 In the **Protocol** box specify the protocol that you will use for the serial communication.

- • 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

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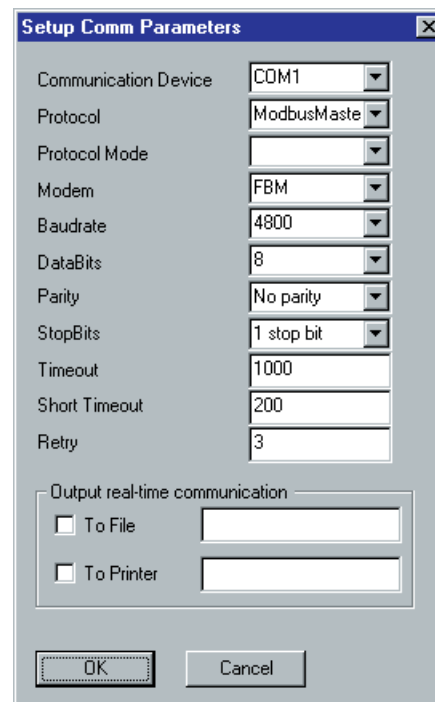
2   Set the communication **address.** To set a new address you have to know the current address or the Unit ID/Long Address (HART) to establish communication with the gauge. The default address is 0 for HART and 246 for Modbus.

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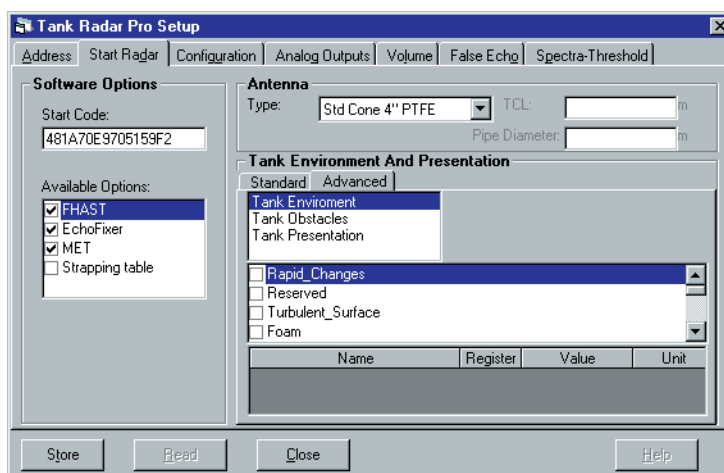
For some parameters , e.g. Slow Search in the Tank Presentation group, there is a related holding register which may need to be changed in order to achieve the best measurement result. For these parameters the related database registers appear in the bottom pane of the Advanced tab.

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

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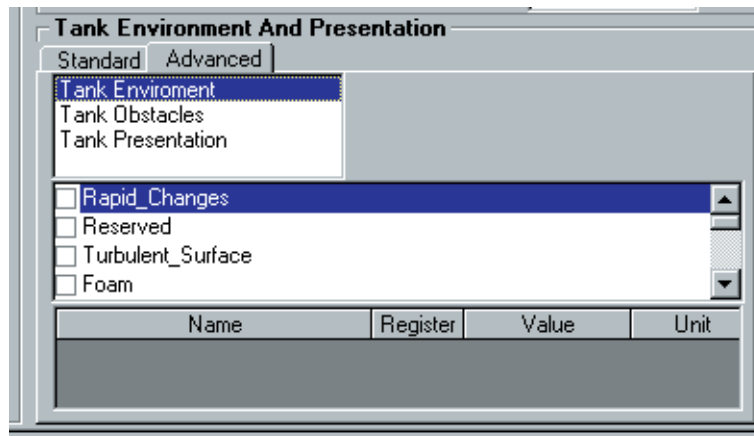
See description of the Tank Environment parameters in the
Standard tab.

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

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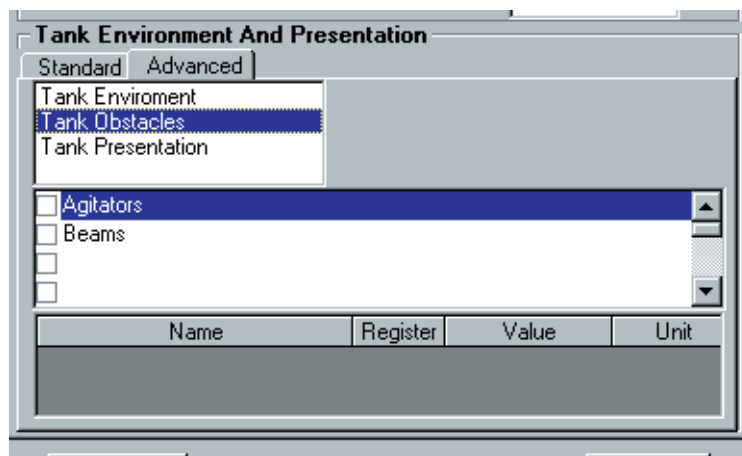
*This option is not used in the current version of the Pro application
software.*

Tank Presentation
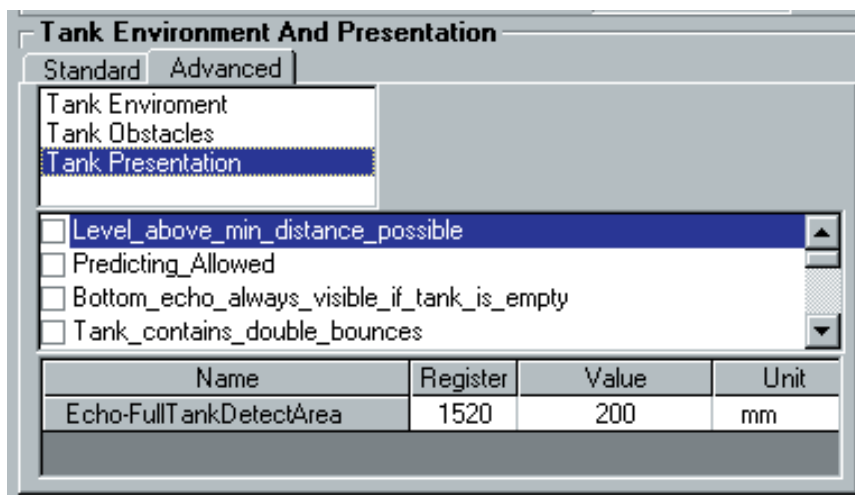
Level above min distance possible	If the surface echo is lost in the vicinity of the antenna, full tank is indicated and searching for the surface echo is limited to a region close to the antenna.
Predicting allowed	Improves the performance when filling or emptying a tank. Setting this parameter may 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 instal-
lation. Related database register:
DoubleBounceOffset (1522).

Slow search

See description of the **Standard** tab pa-
rameters. 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 trans-
parent 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
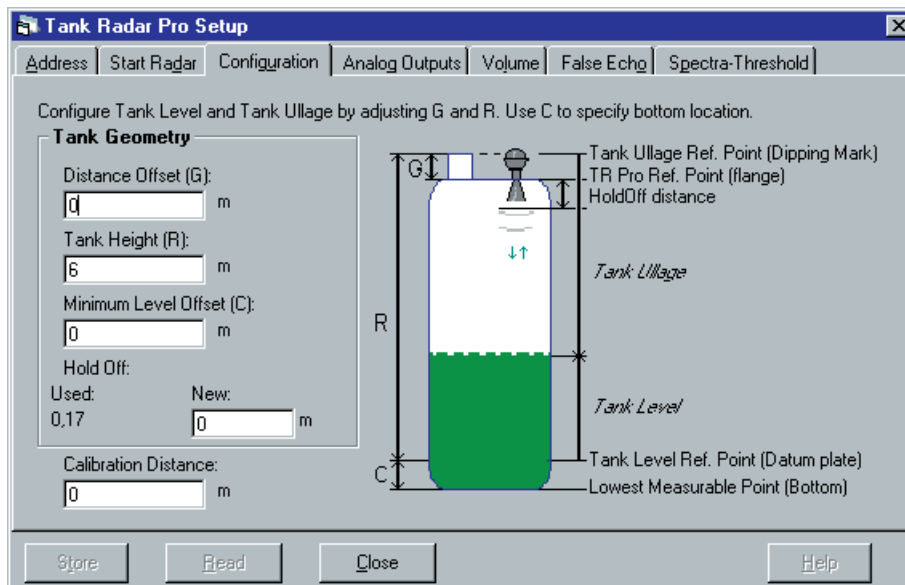
1   Click the **Read** button.

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
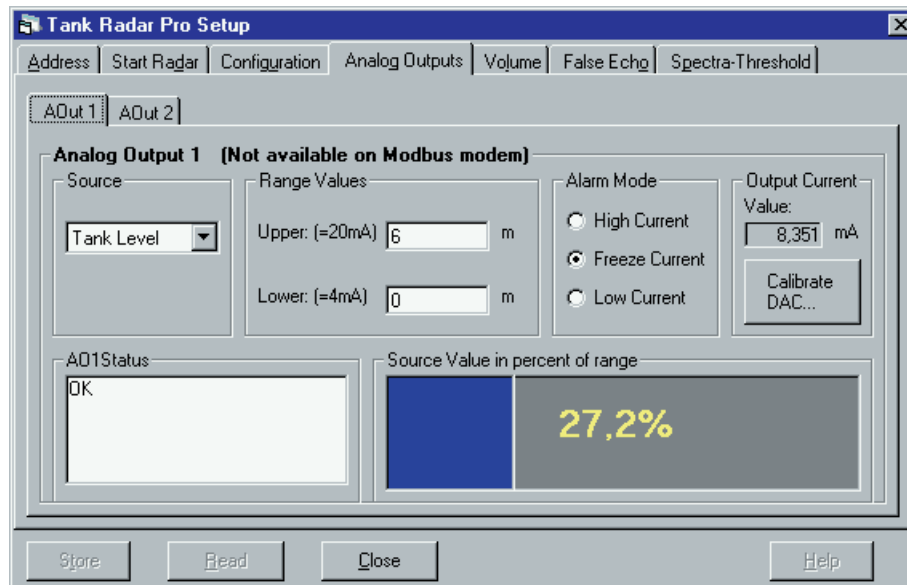
1. Click the **Read** button.

   Response: the current settings are displayed.

2. If your transmitter is equipped with a HART® modem select the Analog Out1 tab. (Analog 1 is note 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.
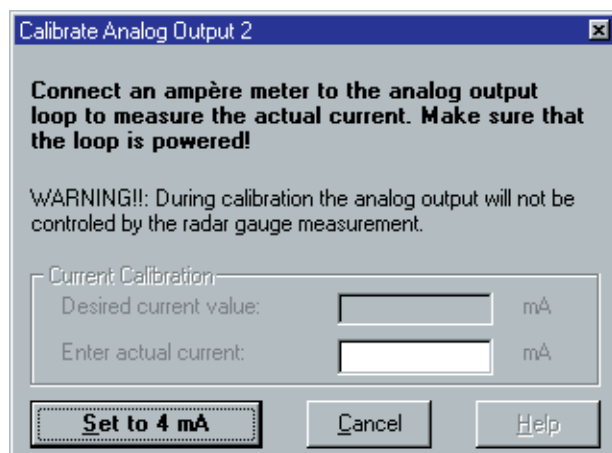
2   Read the instruction and the warning.

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.
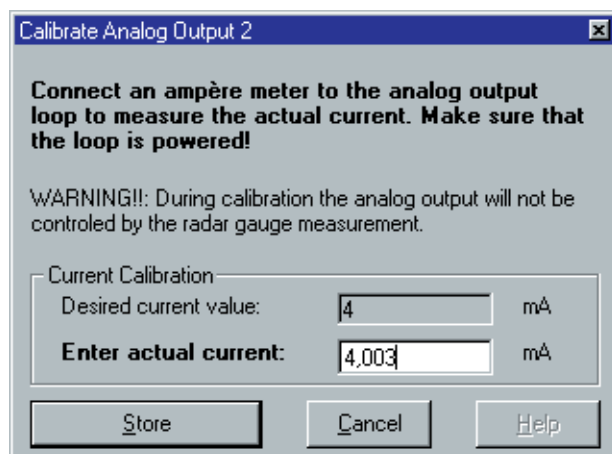
4   Enter the measured output current and click the **Store** button.
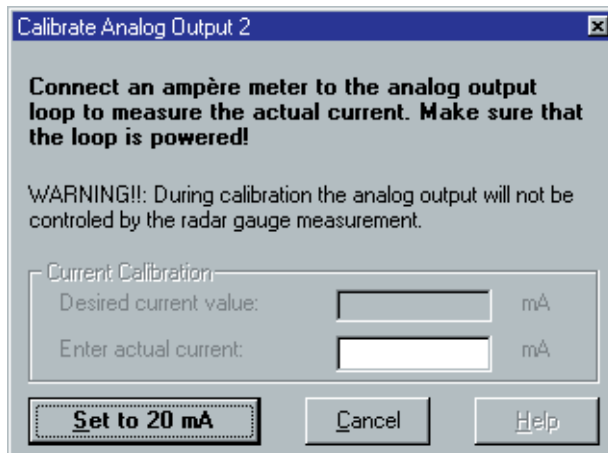
5   Click the **Set to 20 mA** button.
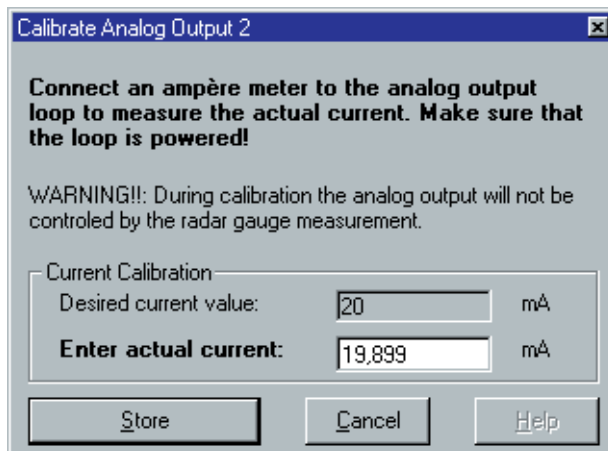
6   Enter the measured output current and click the **Store** button.
7   Click the **Cancel** button to close the window and finish the calibra-
     tion.

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

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.*

Saab Tank Control

Ideal tank

Use this option if approximation of your tank with an ideal tank shape provides sufficient accuracy. Enter the follwoing 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).
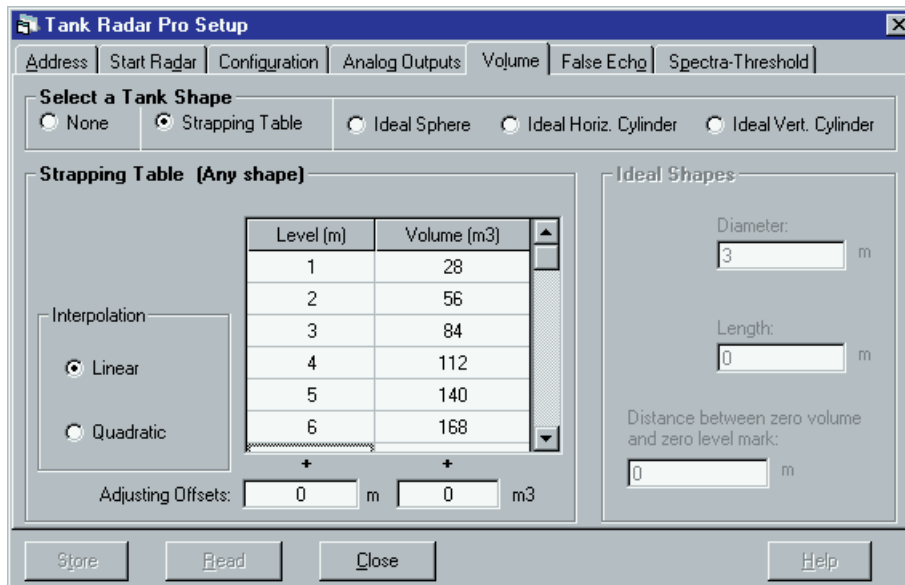
Strapping table

• 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.
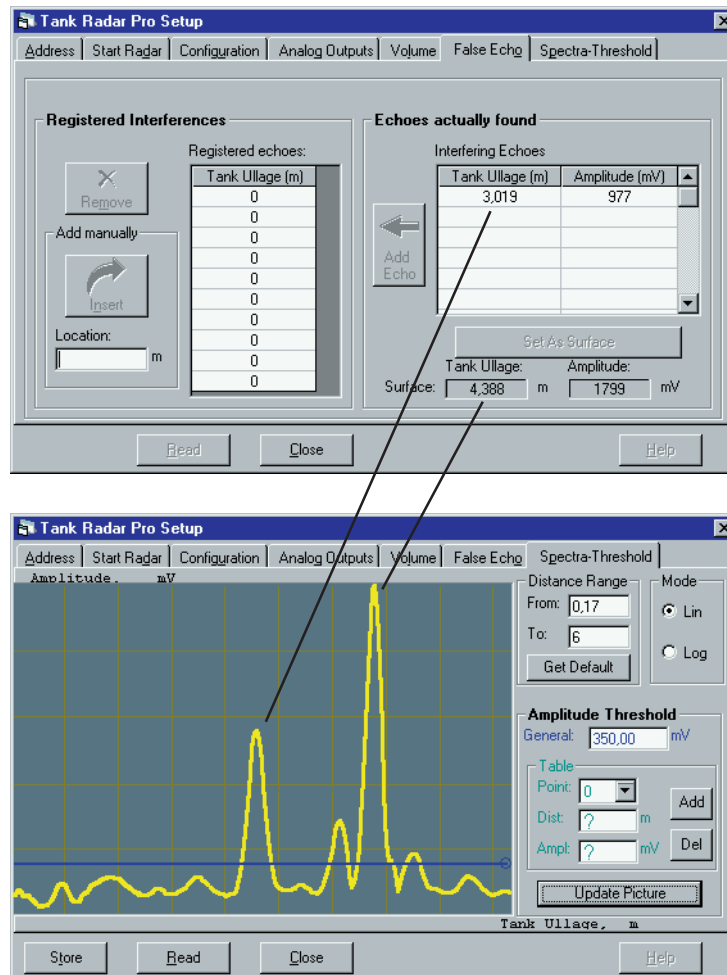
The **Spectra**-**Threshold** tab shows the amplitude of the measured signal along the tank. This diagram is often used to obtain an overview of the conditions in the tank. You can use this diagram to set a general **Amplitude Threshold** level in order to filter out disturbing noise. You can also design 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
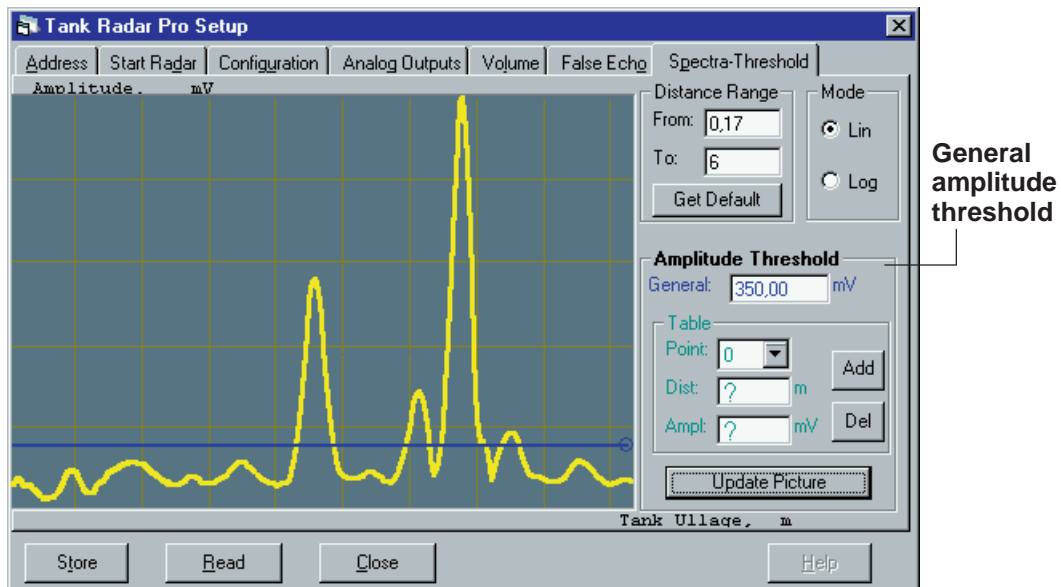
Response: a spectrum is displayed showing the radar amplitude vs. distance from the gauge to the product surface (ullage).

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 be 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.

Add button

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.
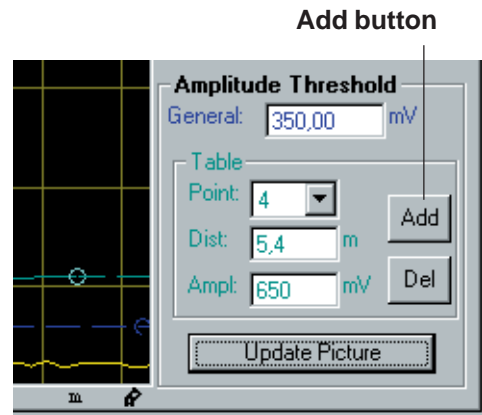
To move points:

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.

Selected Point

Position and amplitude
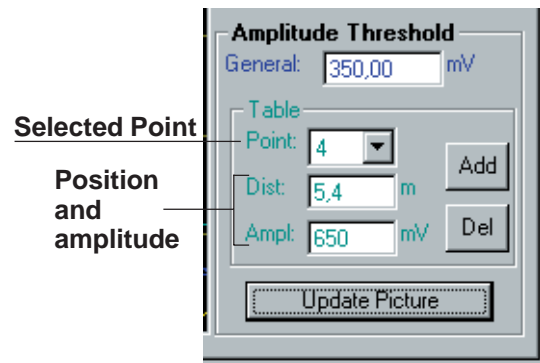
Delete button

To remove points:

1 Select the point to be removed.

2 Click the **Delete** button in the Spectra-Threshold window.
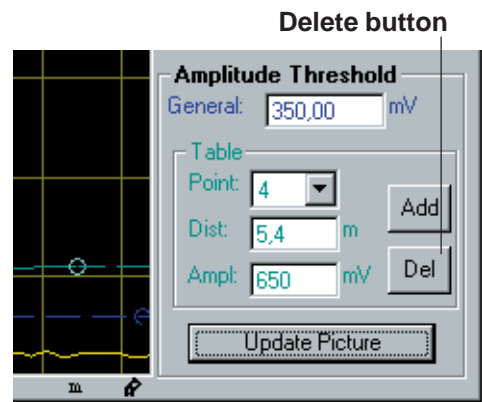
Do not create noise thresholds around echoes which are already registered as interfering echoes. The general amplitude threshold is the lower limit of the noise threshold table:
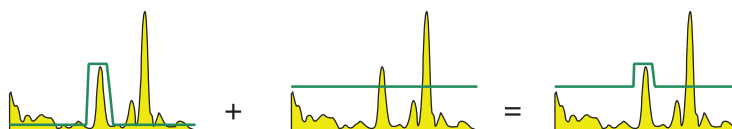
The following examples illustrate how the Amplitude Threshold table can be used:

Example 1:

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

Influence from pipe inside the tank

Influence from nozzle
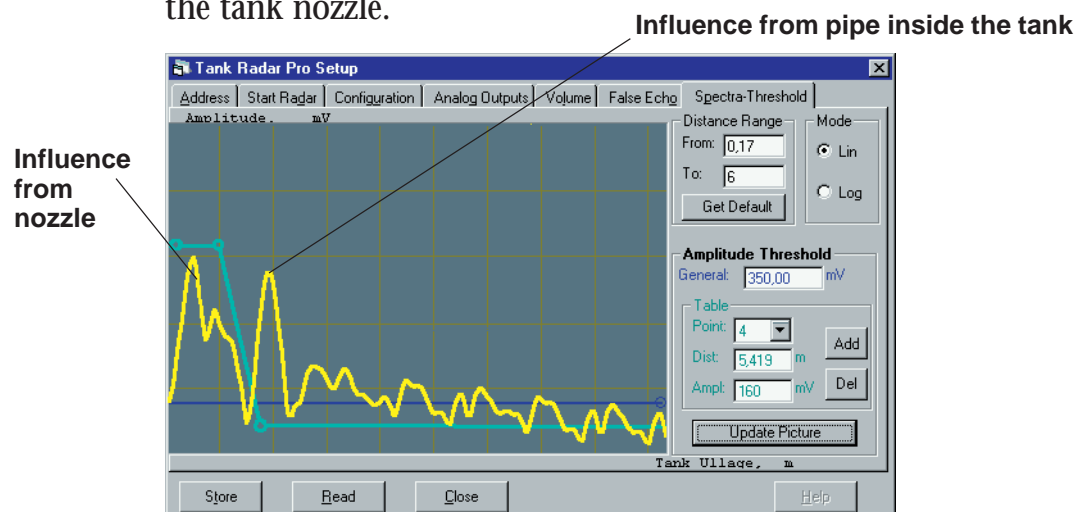
Example 2:

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).
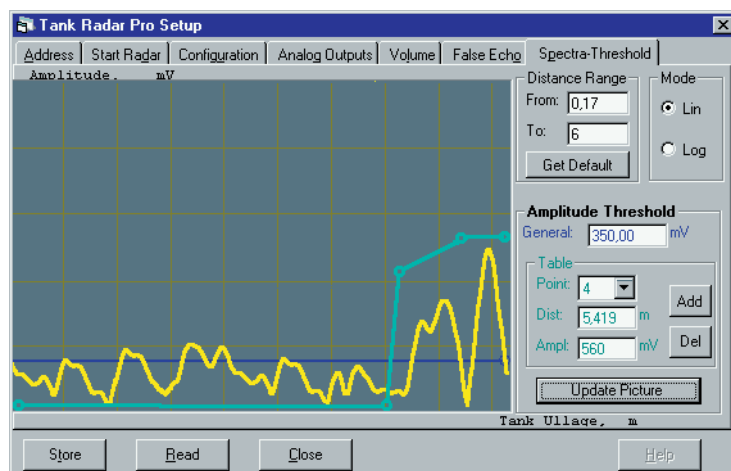
Registration of False Echoes

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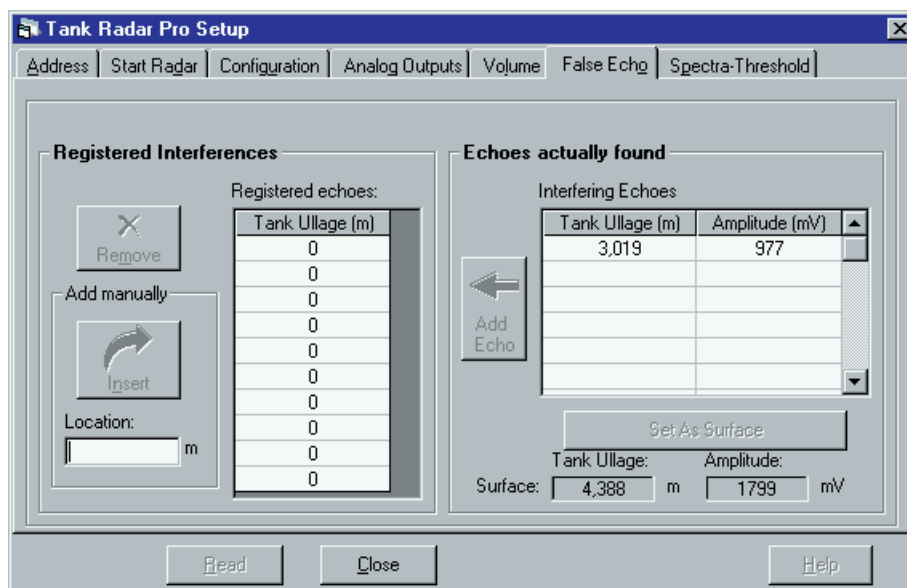
2   Click the Read button to update the list of interfering echoes.

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.
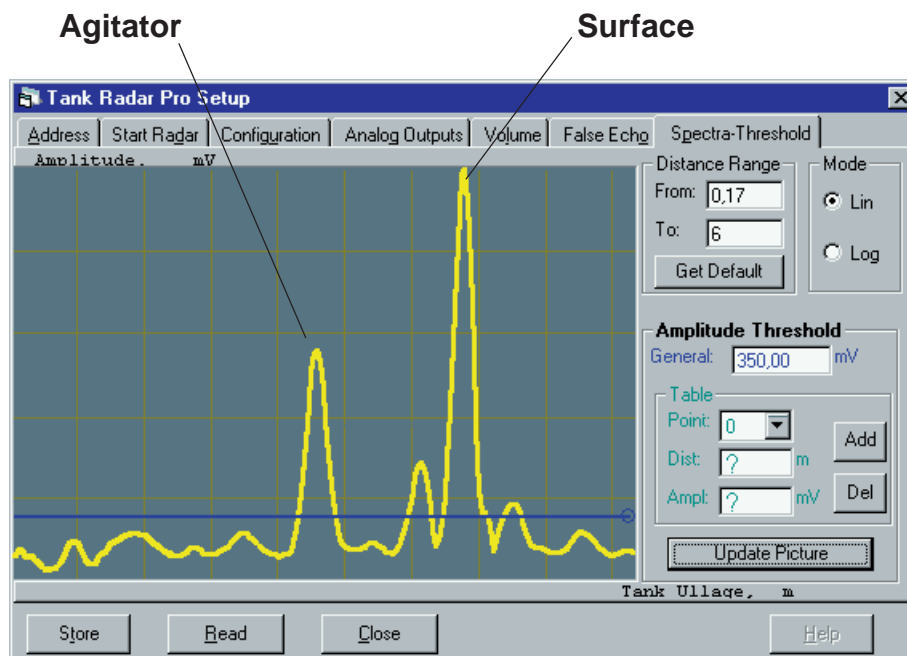
To register interfering echoes do the following:

1   Select an echo from the list of Interfering Echoes.

Echo to be registered
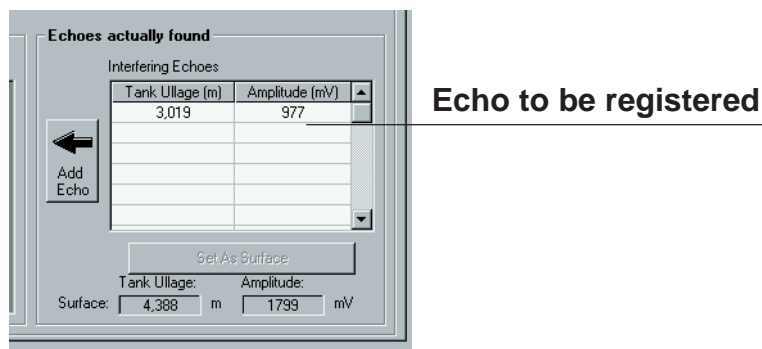
2   Click the **Add Echo** button.
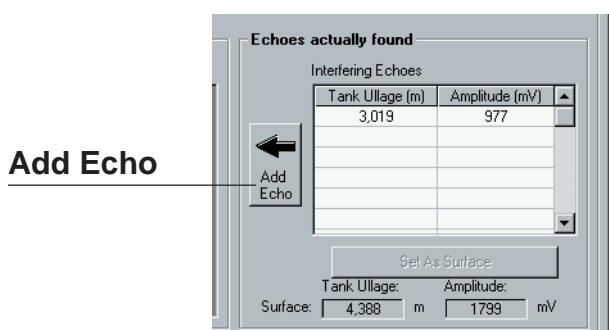
Add Echo

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

Registered echo
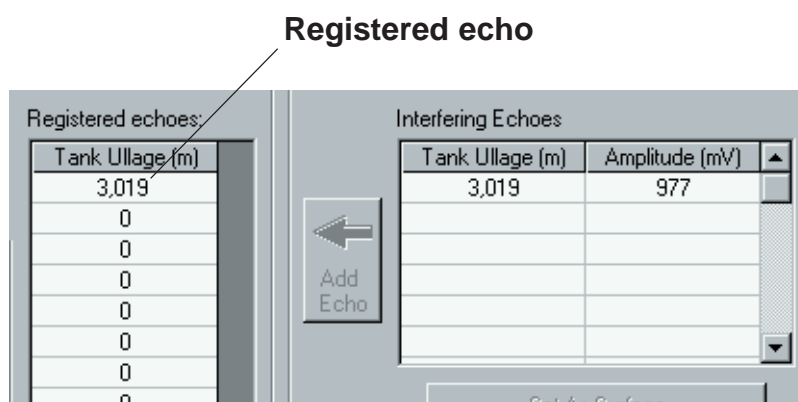
3   Repeat step 2 until all echoes that you want to register as interfering echoes (see recommendations on the previous page) are added to the left-hand table.

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.
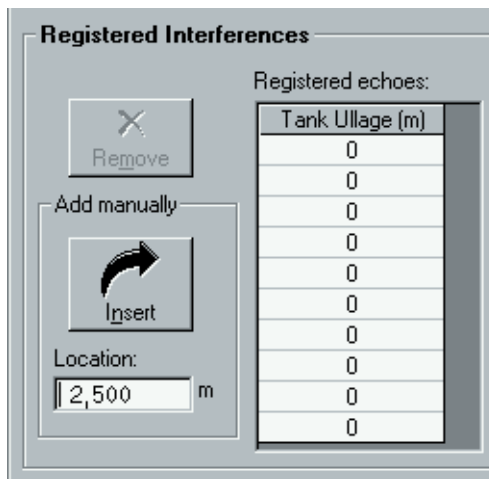
Using the Set As Surface button

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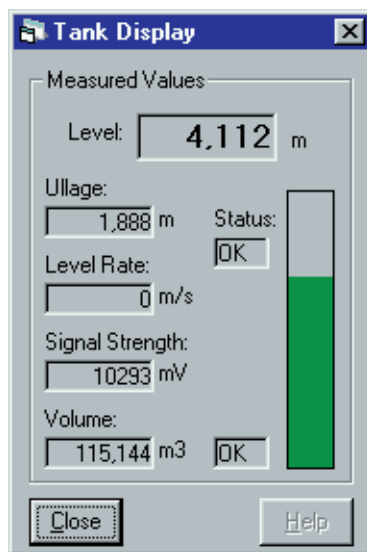
The contents of this window is continuously updated. You can change measurement units by choosing the **Measurement Units** option from the **Setup** menu.

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.

Saab Tank Control

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:
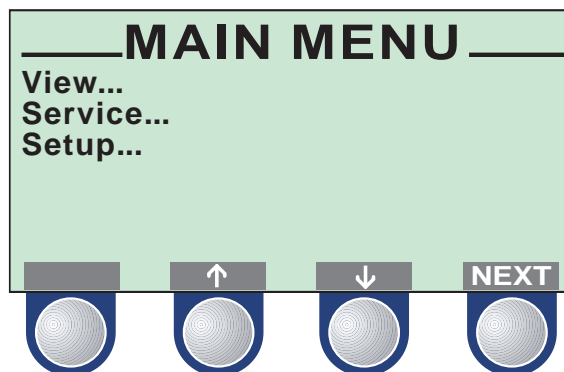
- The **View** option allows you to view level data and signal strength.

- 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.

SAAB
Saab Tank Control
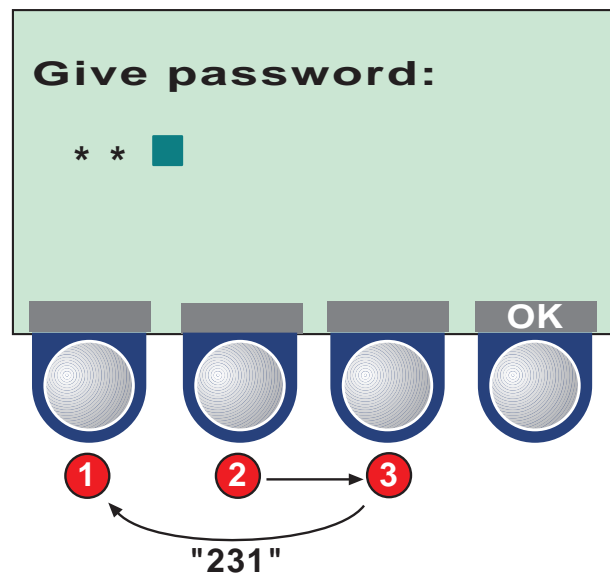
Softkeys

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.

Submenus

═══ VIEW MENU ═══
Display
Standard Data

| BACK | ↑ | ↓ | NEXT |

Softkeys

Back to previous menu

Move cursor up/down

Open the selected submenu
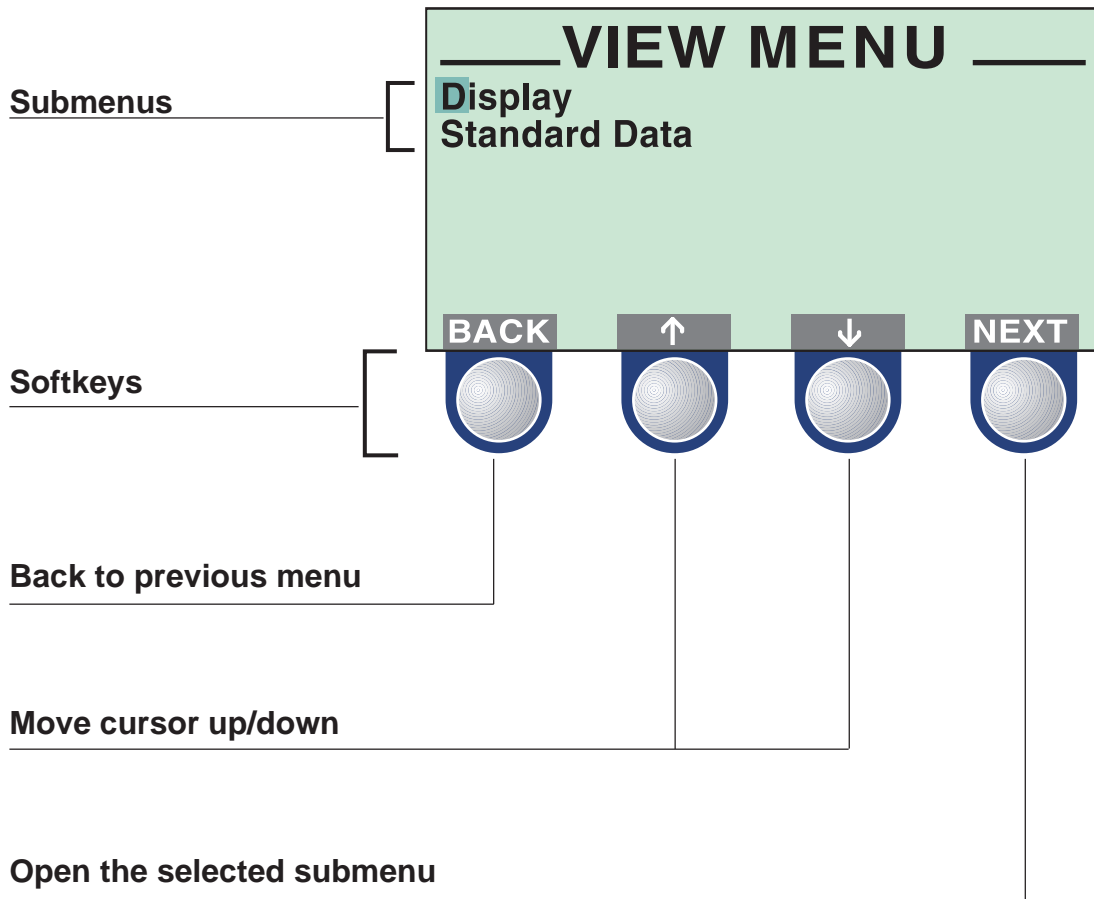
Presentation of measured data

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

```
Level                    ◕

     5.450 m

STATUS INVALID
MENU          ITEM  GRPH
```

SAAB
Saab Tank Control
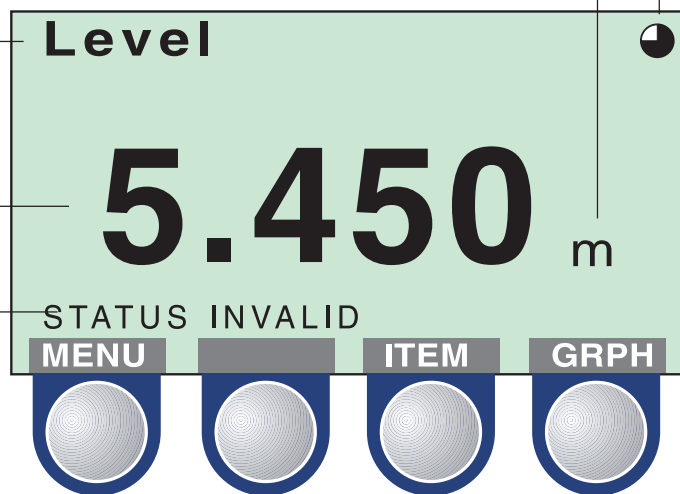
Selecting between different alternatives

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.

```
SET ANTENNA TYPE
 ○ User defined
 ● Std Cone 4"    P
 ○ Std Cone 4"    Q
 ◉ HP Cone 4"     P
 ○ HP Cone 4"     Q
 ○ Std Cone 6"    P
  CNCL   MARK    ↓    SAVE
```
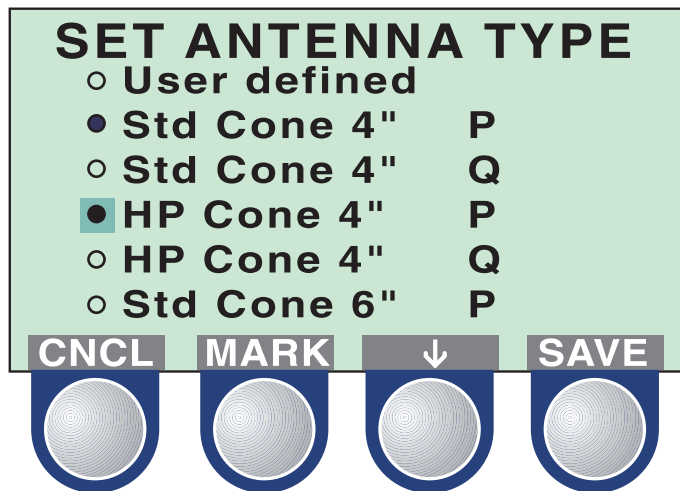
Cancel input and return to previous menu

Select item at cursor

Move cursor down

Save the current setting

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.

```
Give StartCode :

0000000000000000

CNCL      ↑         →      SAVE
```
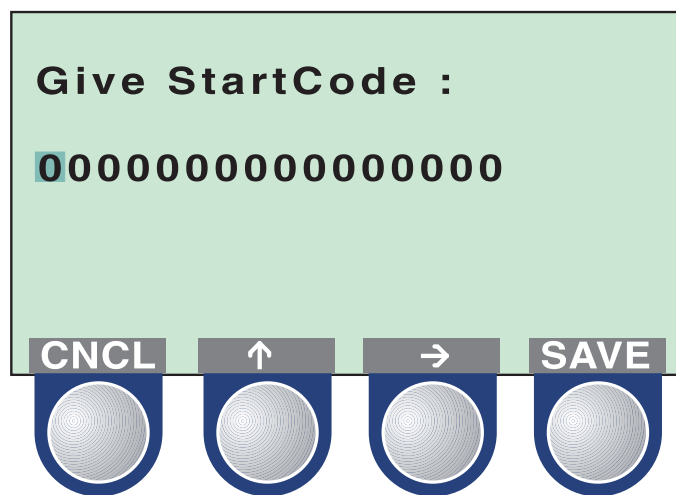
Cancel input and return to previous menu

Each click increases the numerical value one step

Each click moves the cursor one step to the right

Save the current setting

SAAB
Saab Tank Control

Viewing Level Data

The View Menu

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

```
────VIEW MENU ────
Display
Standard Data



BACK      ↑          ↓       NEXT
```
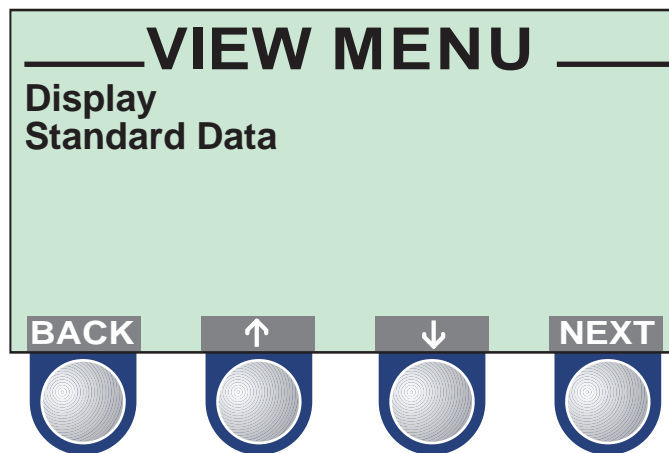
- Press the BACK button to return to the Main menu.

- 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

```
┌──────────────────────────┐
│ Level                  ◖ │
│                          │
│    5.450 m               │
│                          │
│ MENU        ITEM   GRPH  │
└──────────────────────────┘
```
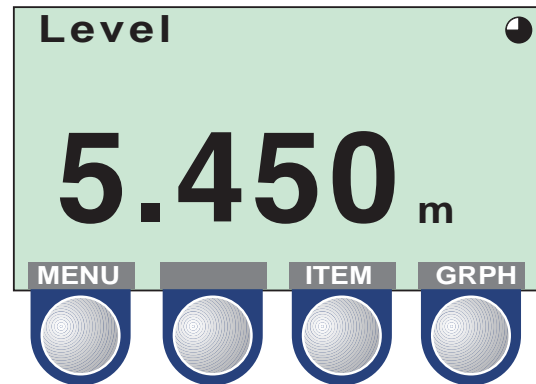
The **GRPH** button allows you to switch between display modes:

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.

```
┌──────────────────────────┐
│    STANDARD DATA         │
│ Lev       10.25   m      │
│ Ull        0.85   m      │
│ LRat       1.25   m/s    │
│ Sign        350   mV     │
│ Vol           0   m3     │
│                          │
│ BACK                     │
└──────────────────────────┘
```

SAAB

Saab Tank Control
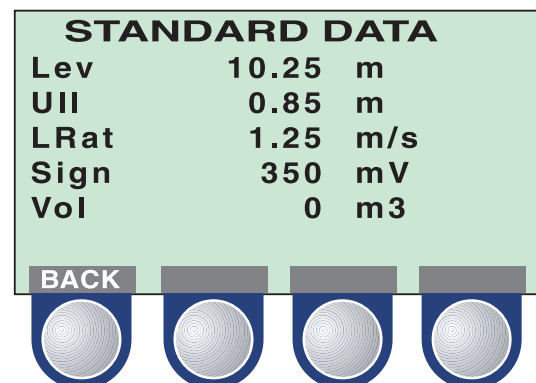
Installing a Pro Transmitter

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

```
_____MAIN MENU_____
View...
Service...
Setup...



[      ] [  ↑  ] [  ↓  ] [NEXT]
```

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.

```
__SETUP MENU__
 Display Panel
 Guided...
 Advanced...



[BACK] [  ↑  ] [  ↓  ] [NEXT]
```
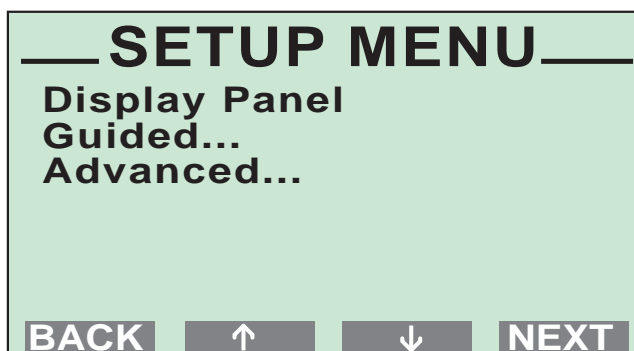
Display Panel

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.

```
___DISPLAY SETUP___
Language
Units►
Password
Trend Setup


 BACK      ↑          ↓      NEXT
```
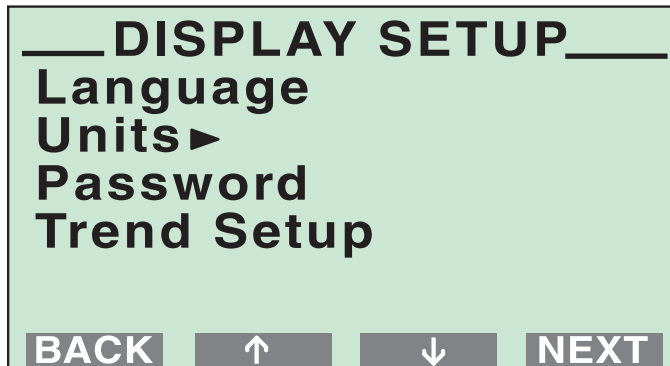
2. Select the **Units** option and press the NEXT button. Set the measurement units to be used for presentation of data and click the SAVE button.

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.

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ Guided Setup │───│  Software    │───│  Start code  │
│              │   │  options     │   │              │
└──────────────┘   └──────┬───────┘   └──────────────┘
                          │
                          ▼
                   ┌──────────────┐   ┌──────────────┐
                   │  Antenna     │───│ Horn, Rod etc.│
                   │  Type        │   │              │
                   └──────┬───────┘   └──────────────┘
                          │
                          ▼
                   ┌──────────────┐
                   │  Tank Ullage │
                   │  (G)         │
                   └──────┬───────┘
                          │
                          ▼
                   ┌──────────────┐
                   │  Tank Height │
                   │  (R)         │
                   └──────────────┘
```
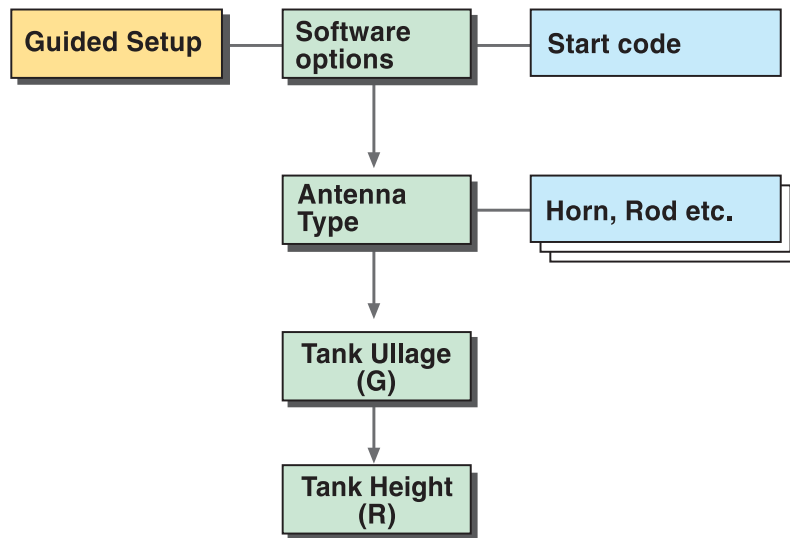
To configure a new radar gauge using the **Guided Setup** option do the following:

1. Choose Setup from the Main Menu.

Response: a request for password is displayed.

```
┌────────────────────────────────────┐
│                                    │
│  Give password:                    │
│                                    │
│      * *  ■                         │
│                                    │
│                                    │
│                                    │
│  ┌────┐ ┌────┐ ┌────┐ ┌──────┐      │
│  │    │ │    │ │    │ │  OK  │      │
│  └────┘ └────┘ └────┘ └──────┘      │
└────────────────────────────────────┘
```
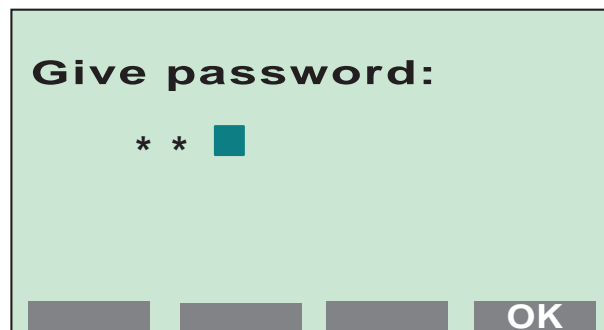
2. Enter your password and press the [NEXT] button.

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.

```
____ SETUP MENU ____
Display Panel
Guided...
Advanced...



 BACK      ↑       ↓     NEXT
```

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.

```
Give StartCode :

481A70E9705159F2



 CNCL     ↑       →     SAVE
```

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.

```
_____ TR PRO OPTIONS _____
☑Modbus
☑Display
☑Analog Out 2
☐FHAST
☑Echo Fix
☐MET
          ↑       ↓      OK
```
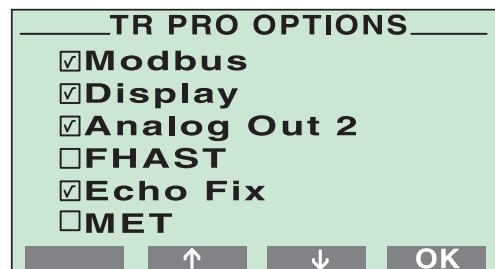
6. Set the Antenna Type.

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.

```
SET ANTENNA TYPE
○User defined
●Std Cone 4"    P
○Std Cone 4"    Q
◉HP Cone 4"    P
○HP Cone 4"    Q
○Std Cone 6"    P
 CNCL  MARK    ↓     SAVE
```

SAAB
AEROSPACE

SAAB
Saab Tank Control

**Offset Dist (G)
is the distance
from dipping
mark to TR Pro
ref.point
▪0.000 m**

CNCL   ↑   →   SAVE

G>0

G<0
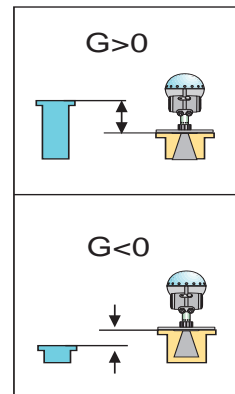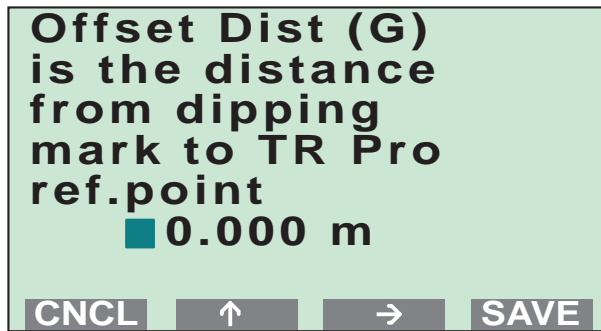
7. Set the **Distance Offset** (G)

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.

Tank Ullage Reference Point

TR Pro Reference Point

G

R

**Tank Height (R)
is the distance
from dipping
mark to zero
level ref. point**

   ▪0.000 m

CNCL   ↑   →   SAVE

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.*

SAAB
Saab Tank Control

Advanced Setup

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

Advanced Setup	**Start Radar**	• Start code • Antenna Type • Tank Environment • Pipe Diameter • Special
	Calibration	• Tank Ullage (G) • Tank Height (R) • Minimum Level (C) • Calibration Dist. • Hold Off Distance * • TCL *
	Analog Output 1	• Source • 4mA, 20mA • Alarm • DAC
	Analog Output 2	• Source • 4mA, 20mA • Alarm • DAC
	False Echo	• Tank Echoes • Registered False Echoes
	Volume	• Volume Calculation • Strapping Table

SAAB

SAAB
Saab Tank Control

To configure a radar gauge using the **Advanced Setup** option:

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

Response: a request for password is displayed.

```
Give password:

    * * ■




                      OK
```
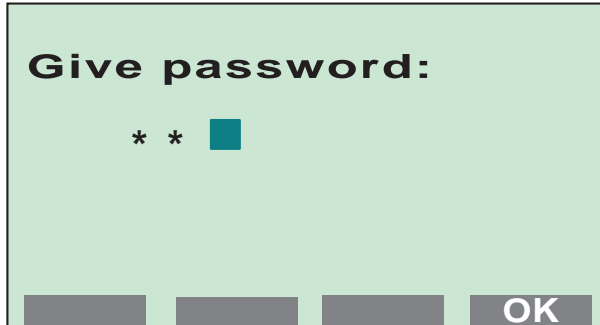
2. Enter your password and press the ▭ OK ▭ button.

```
___SETUP MENU___
Display Panel
Guided...
Advanced...



BACK      ↑        ↓      NEXT
```
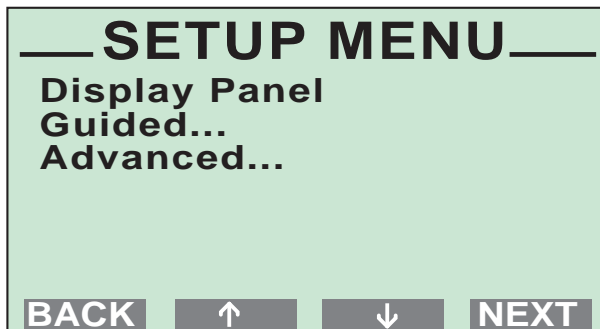
3. Select "**Advanced**..." from the Setup Menu and press the ▭NEXT▭ button.

```
____ADVANCED SETUP____
Start Radar▶
Calibration ▶
Analog Output1
Analog Output2
False Echo▶
Volume▶
BACK      ↑        ↓      NEXT
```
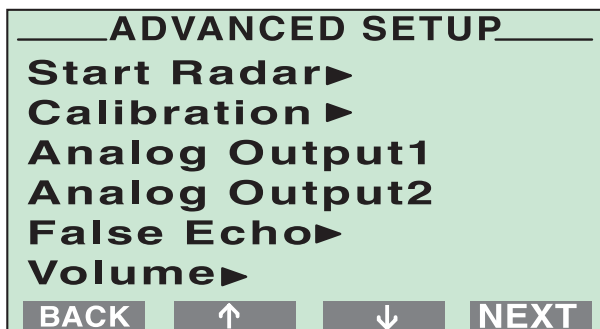
4. Select the **Start Radar** option from the Advanced Setup menu.

1   Choose the **Start Code** option.
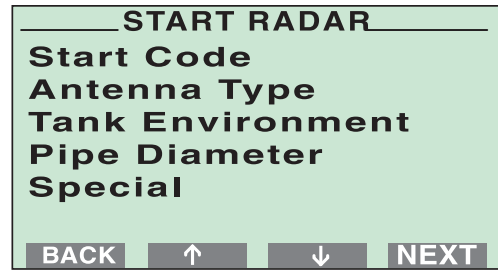
```
_____START RADAR_____
Start Code
Antenna Type
Tank Environment
Pipe Diameter
Special

  BACK      ↑        ↓      NEXT
```

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

```
Give StartCode :

481A70E9705159F2


  CNCL      ↑        →      SAVE
```

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

    Response: the Start Radar menu is
    opened.

```
_____TR PRO OPTIONS_____
☑Modbus
☑Display
☑Analog Out 2
☐FHAST
☑Echo Fix
☐MET
            ↑        ↓       OK
```
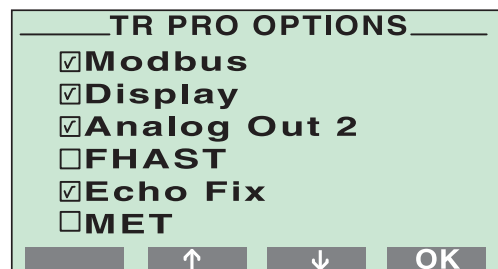
4   Choose the **Antenna Type** option from
    the **Start Radar** menu.
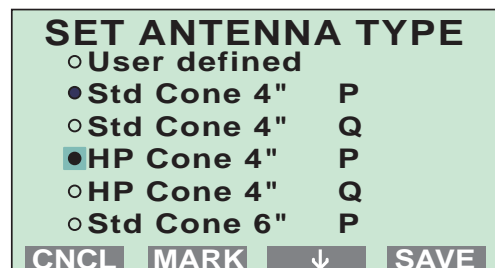   HP=high performance (Hastelloy,
    Tantalum, Titanium, Monel),
    Std=standard,
    P=PTFE tank sealing,
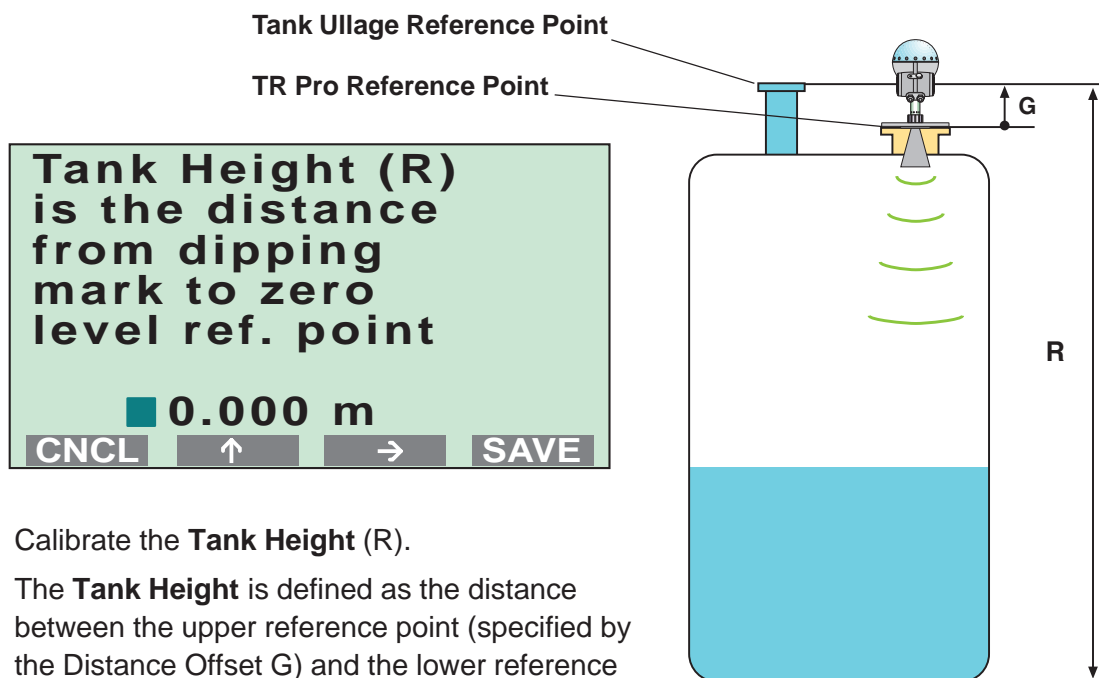   Q=quartz sealing,
    C=Ceramic.

```
SET ANTENNA TYPE
 ○User defined
 ●Std Cone 4"    P
 ○Std Cone 4"    Q
 ◉HP Cone 4"     P
 ○HP Cone 4"     Q
 ○Std Cone 6"    P
 CNCL  MARK     ↓     SAVE
```

    Select the type of antenna that is mounted on the gauge and click
    the SAVE button.

Response: the Start Radar menu is opened.

SAAB
Saab Tank Control
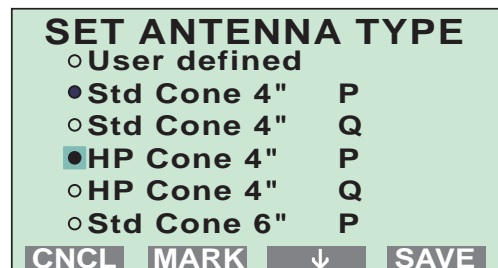
5 Choose the **Tank Environment** option.

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│   │
│ └────┘└────┘└────┘└────┘   │
└─────────────────────────────┘
```
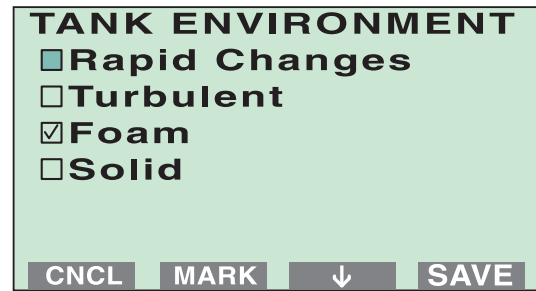
Response: the display returns to the Start Radar menu.

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│   │
│ └────┘└────┘└────┘└────┘   │
└─────────────────────────────┘
```
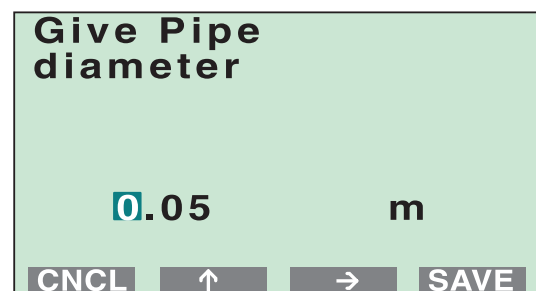
Response: the Start Radar menu is opened.

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│   │
│ └────┘└────┘└────┘└────┘   │
└─────────────────────────────┘
```
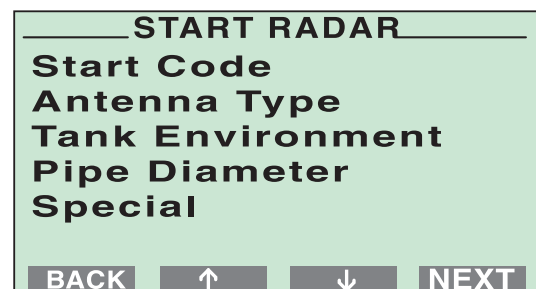
5. Select the **Calibration** option from the Advanced Setup menu**.**


```
_____CALIBRATION_____
Tank Ullage
Tank Height
Min Level
Calibration Dist
HoldOff Dist
TCL
 BACK      ↑        ↓      NEXT
```


G>0

G<0
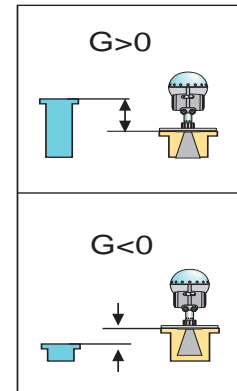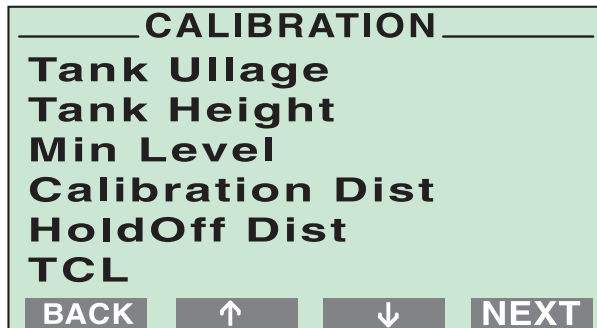
The tank calibration distances are defined as illustrated on the next page.

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.
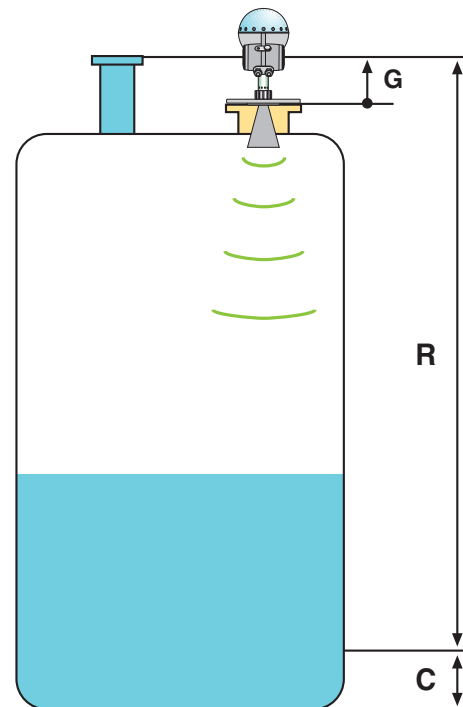
G

R

C

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:

```
CONFIG. Aout 1
Source  Level
 4 mA      0.000 m
20 mA      0.000 m
Alarm    HoldLast
D/A Trim...

CNCL     ↑        →      EDIT
```
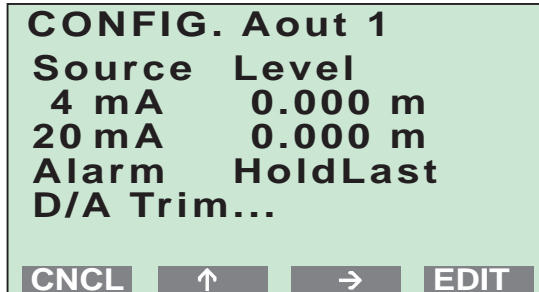
- Enter **Source**. Available options are: level, level rate, ullage, signal strength and volume.
- Enter the analog output values that correspond to **4 mA** and **20 mA**, respectively.
- Select **Alarm mode**.
  - Select **High** if you want the analog output to lock on a value higher than 20 mA when 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.

```
DA Trim    -       AOut 1
Setting AOut 1
to 4 mA




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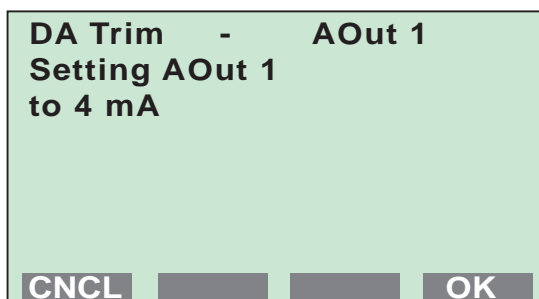
2   Click the **OK** button if you want to continue, (or click the **CNCL** button to quit without calibrating the D/A converter).

Response: the analog output is set to 4 mA.

```
DA Trim     -      AOut 1
Enter meter
value


          4000 µA



    ┌────┐ ┌────┐ ┌────┐ ┌─────┐
    │    │ │ ↑  │ │ →  │ │DONE │
    └────┘ └────┘ └────┘ └─────┘
```
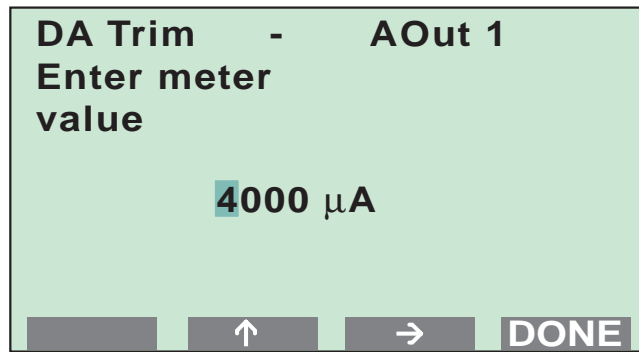
3   Enter the measured value that corresponds to the 4 mA setting.

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 wich one is the actual product surface.

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

```
_____ FALSE ECHO _____
Tank Echoes
Reg. False Echoes



 BACK      ↑         ↓      NEXT
```

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.

```
____TANK ECHOES____
Surface              10.543 m
Echo 1               -0.213 m
Echo 2                1.629 m
Echo 3                7.867 m
Echo 4               20.620 m
Echo 5               21.001 m
 CNCL      ↑         ↓      EDIT
```

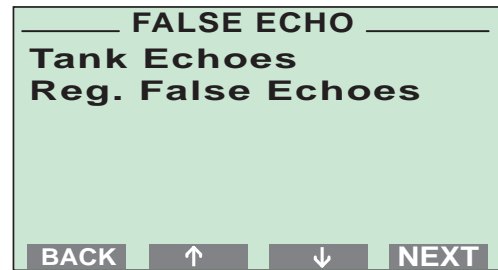3   Move the cursor to **Add to list**, and click the MARK button.

4   Click the SAVE button to register the marked echo.

```
_____ EDIT ECHO _____
Echo 3               7.867 m
 Ampl        1268 mV

 ○ Set as surface
 ○ Add to list
 ○ Add new false
 CNCL   MARK      ↓     SAVE
```
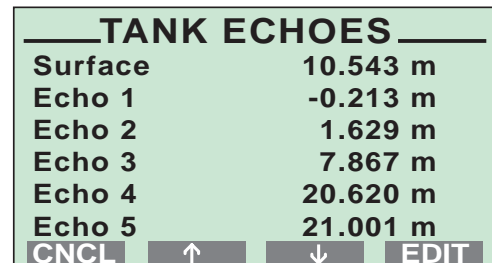
5   Repeat steps 1 to 4 if you wish to register more disturbing echoes.

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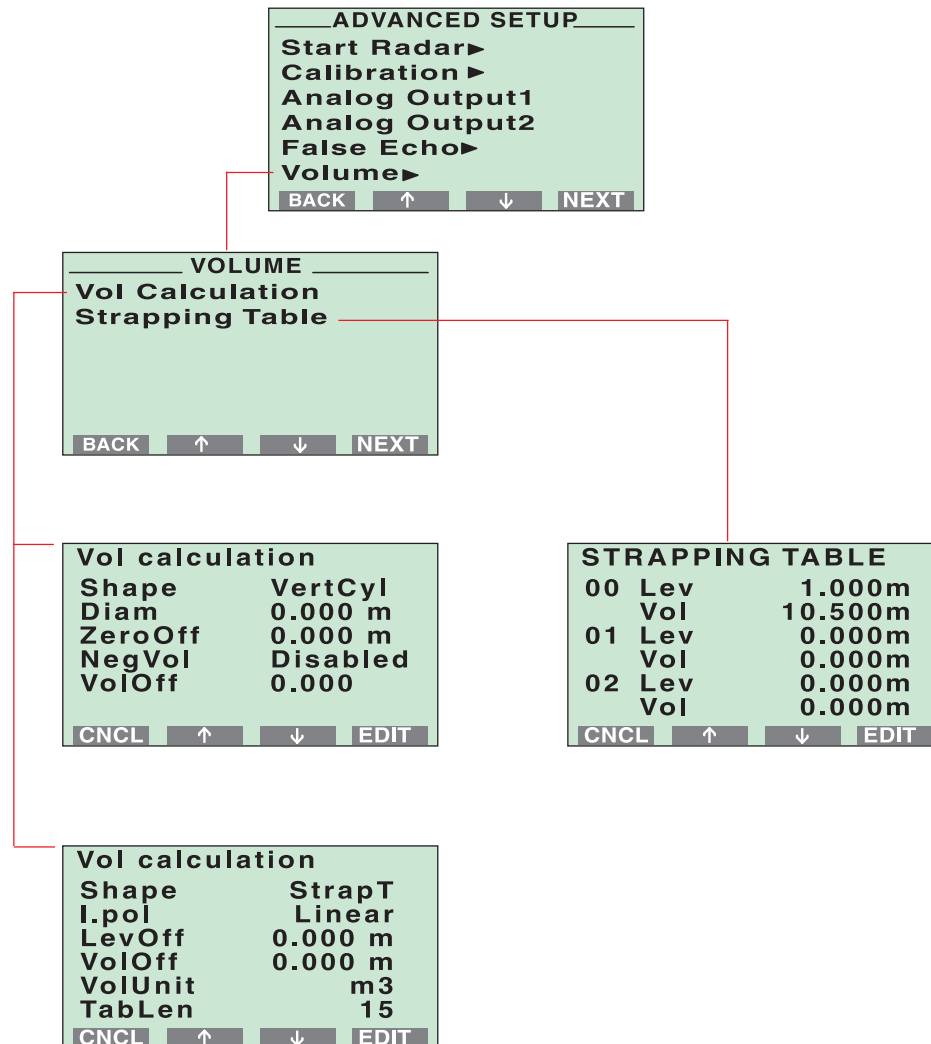
When the configuration is finished you can start viewing measured data by returning to display mode.

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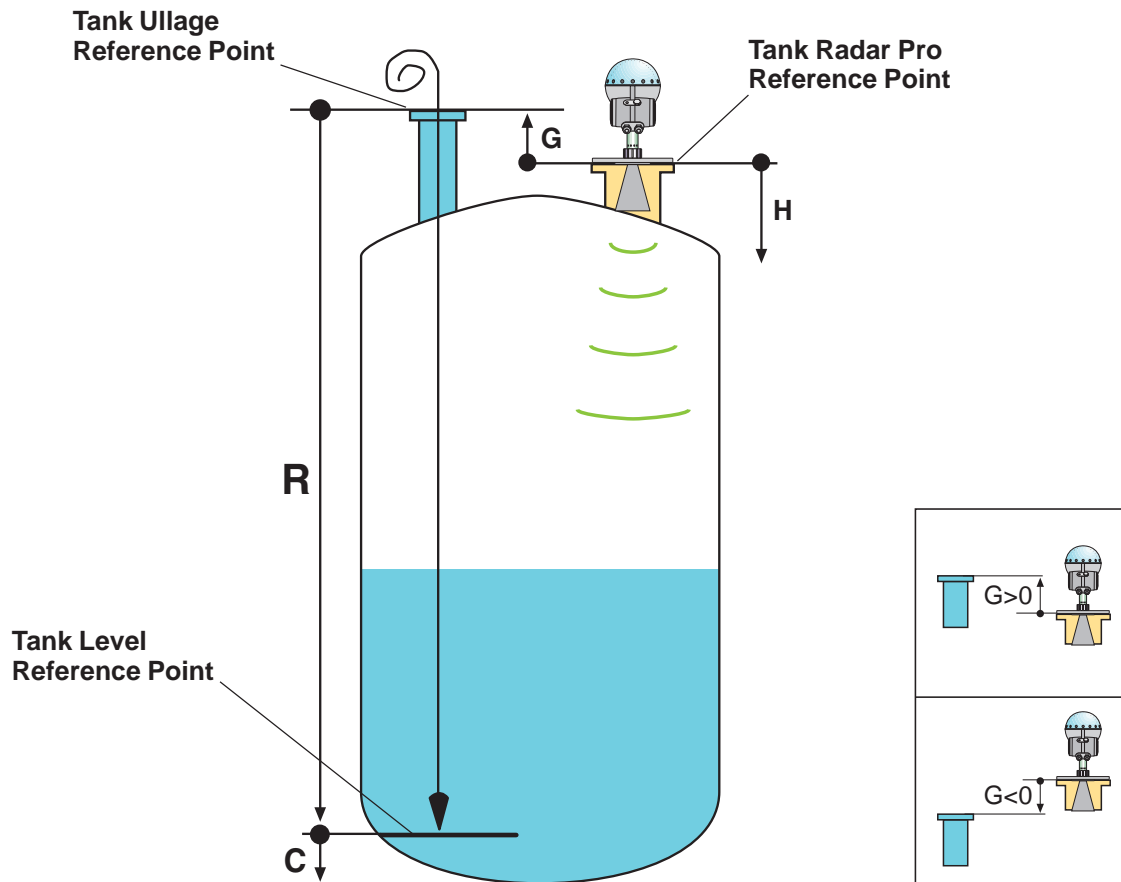
The **Tank Height** (R) is defined as the distance between the upper reference point (specified by the Distance Offset G) and the lower reference point (zero level).

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

G=-0.5 m

R=10 m

U

L

U=ullage
L=level

"0"

Lower reference point

Height (m)

10

4

0
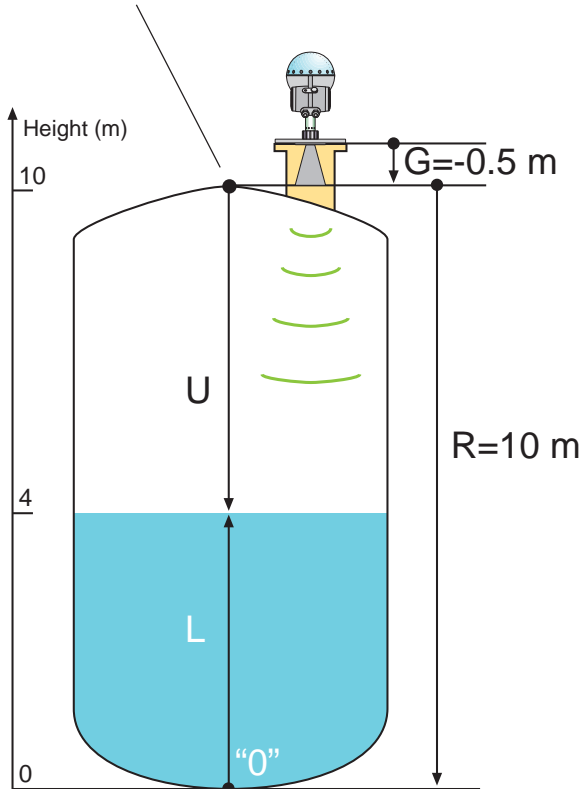
STANDARD DATA

Lev	4.000	m
UII	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)**

Height (m)

G=0

10

U

R=10.5 m

4

L

0   "0"

Lower 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
```

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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.

RTG reference point

Ullage reference point (Upper reference point)

Height (m)

10

G=0.5 m

U

R=11 m

4

L

0   "0"

Lower reference point
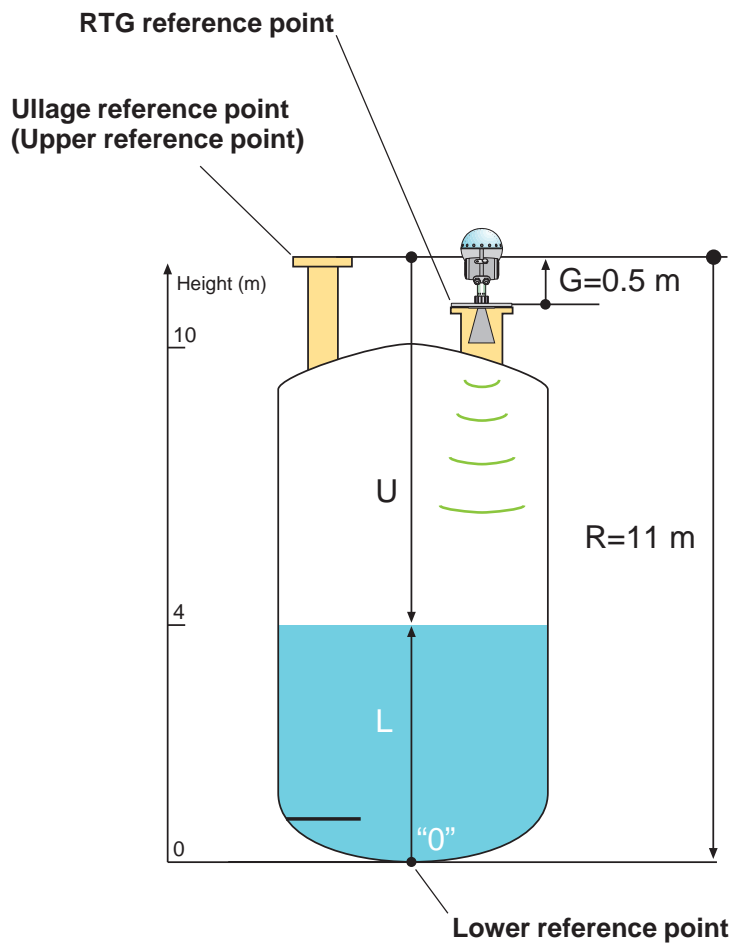
```
     STANDARD DATA
Lev        4.000  m
Ull        7.000  m
LRat       0.000  m/s
Sign        350   mV
Vol           0   m3
   STATUS    VALID
 BACK
```
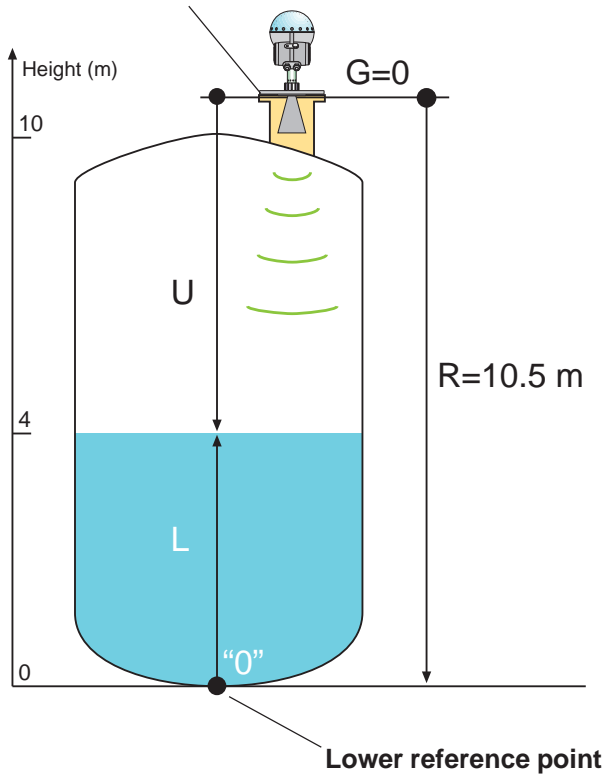
Example 4

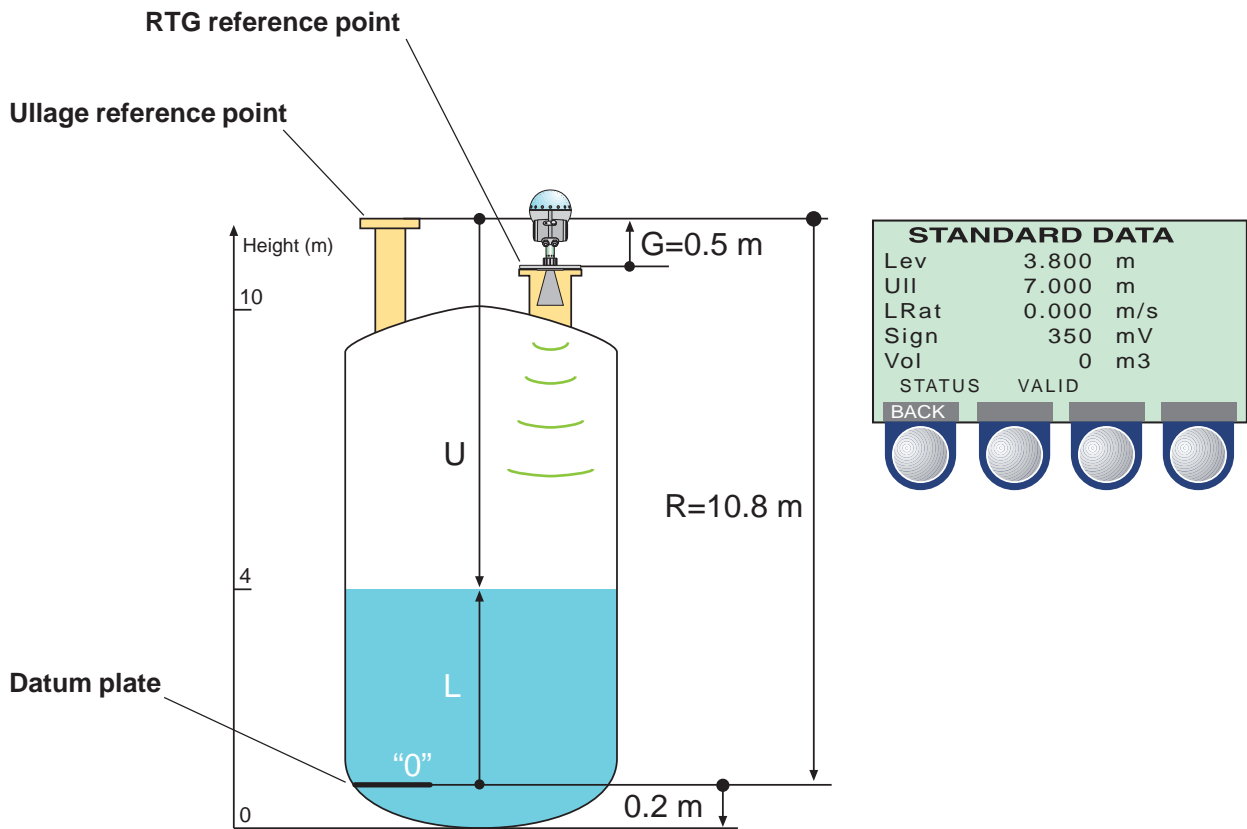| If you want	set
Upper reference point at ullage reference point	G=distance between ullage and RTG reference points.
Lower reference point at datum plate	R=to distance from ullage reference point to datum plate.
	C=distance between datum plate and tank bottom.

RTG reference point

Ullage reference point

Height (m)

10

G=0.5 m

U

R=10.8 m

4

L

Datum plate

"0"

0.2 m

0

```
STANDARD DATA
Lev       3.800   m
Ull       7.000   m
LRat      0.000   m/s
Sign       350    mV
Vol          0    m3
  STATUS    VALID
BACK
```

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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, FHAST
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 (Standard and Gold versions)	**CENELEC**: 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

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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

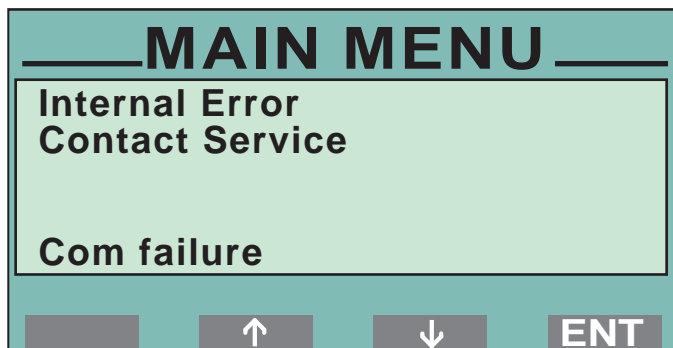| SYMPTOM	ACTION
No level reading	Check the power supply.
	Check the cables for serial data communication.
Incorrect level reading	Check the transmitter calibration.
	Check that the transmitter has not locked on an interfering object.
	Check that the mechanical installation is correct.
Serial communication 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 unvalid value into a holding register.

```
Calibrate ullage
b
d    ERROR
d  Not a valid
T  numerical
   value


                      OK
```
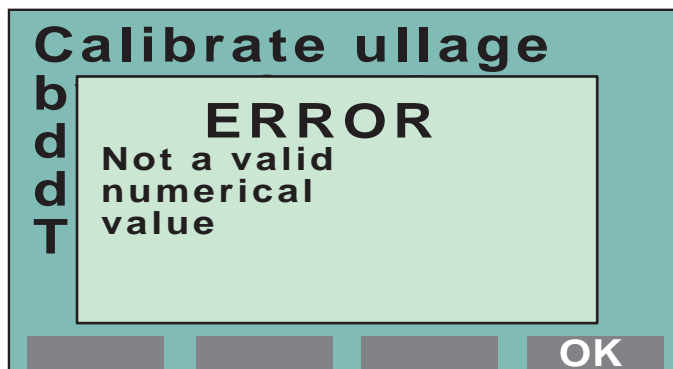
Internal Software Errors

This message indicates an error in the Display Panel software.

```
____MAIN MENU____
Internal Error
Contact Service


Com failure

        ↑        ↓      ENT
```

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Saab Tank Control Local Representative:

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