Saab LoopRadar™

User´s Guide

Preliminary edition

SAAB AEROSPACE

SAAB
Saab Tank Control

Saab LoopRadar™

User´s Guide

First edition

Trademarks

HART is a registered trademark of HART Communication Foundation.

LoopRadar is a trademark of Saab Marine Electronics AB.

TankRadar is a registered trademark of Saab Marine Electronics AB.

Spare Parts

Any substitution of non-recognized spare parts may jeopardize safety. Repair, e.g. substitution of components etc., may also jeopardize safety and is under no circumstances allowed.

Saab Tank Control will not take any responsibility for faults, accidents, etc. caused by non-recognized spare parts or any repair which is not made by Saab Tank Control.

Safety

This manual applies to equipment covered by certificate number *SIRA 00ATEX2052X*.

The equipment may be used with flammable gases and vapours with apparatus groups IIA, IIB and IIC and with temperature classes T1 to T4 inclusive.

The equipment is only certified for use in ambient temperatures in the range -40 °C to +70 °C and should not be used outside this range.

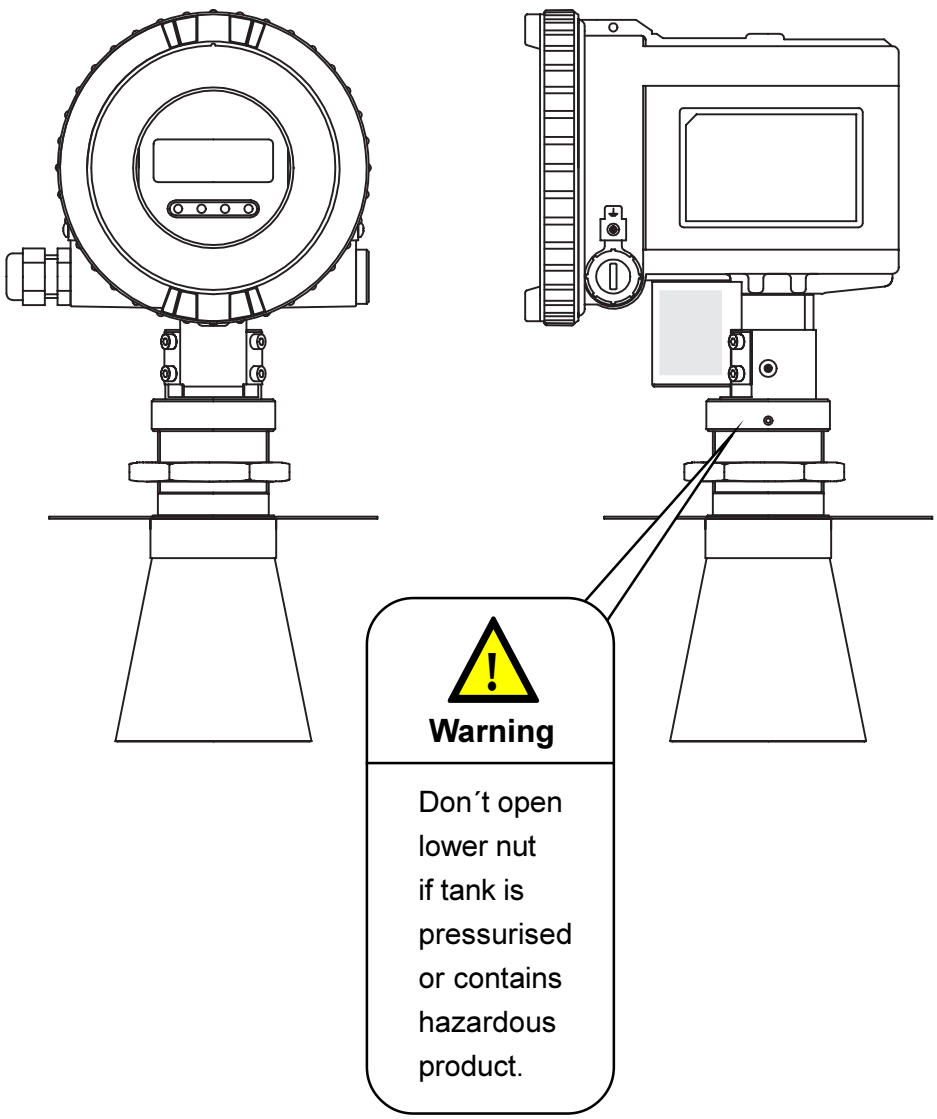
The Saab LoopRadar transmitter must be installed by suitably trained personnel according to the instructions in this manual and in accordance with the applicable code of practice. The certificate number has an 'X' suffix which indicates that special conditions for cable capacitance apply. For specification of cable capacitance see the certificate.

Repair of this equipment shall be carried out in accordance with the applicable code of practice.

The various warning messages shown in the User's Guide are indicated as follows:

Caution	Indicates that incorrect usage may result in personal injury or malfunctioning instruments.

Warning	Indicates a potentially hazardous situation which could result, if not avoided, in death or serious injury.



Contents

About this manual

The main purpose of User's Guide is to act as guide to installing and operating the Saab LoopRadar. 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 a tank.

Chapter 3 describes the electrical installation.

Chapter 4 describes the parameters that need to be configured, how to handle disturbing echoes and various options for volume calculation.

Chapter 5 describes how to use the Display Panel to configure the Saab Loopradar.

Chapter 6 provides technical information.

Chapter 7 lists the various error codes that may appear.

1 Product Description

The LoopRadar transmitter uses a non-contact level gauging measurement technique based on the principle of pulsed microwaves. It is loop-powered and easy to install and can be used for many types of level measurement applications. The LoopRadar is safe for humans and has no environmental impact. Propagation of microwaves is virtually unaffected by temperature, pressure or gas characteristics in the tank resulting in excellent measurement stability.

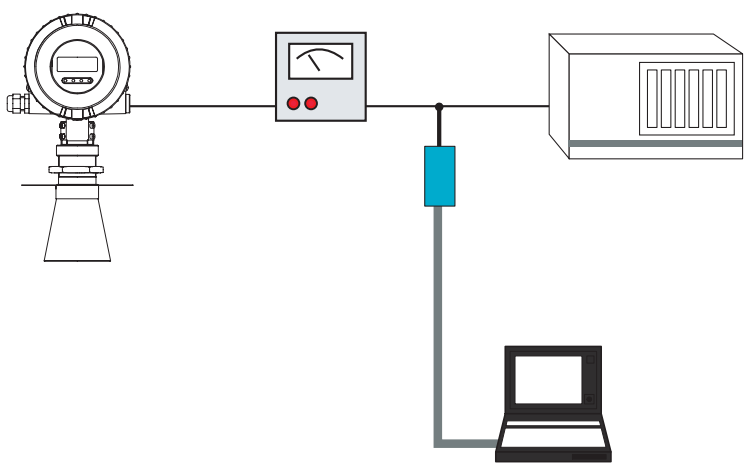
1.1 Features

Loop-Power

The LoopRadar only needs one two-wire line for both power supply and output signal. The LoopRadar is powered by a PLC or a power supply unit.

Communication

The LoopRadar has a 4-20 mA current output and a HART protocol interface for digital data transmission. The transmitter can be configured by using a HART communicator (Device Descriptor in preparation), a PC-based setup software or the Display Panel.

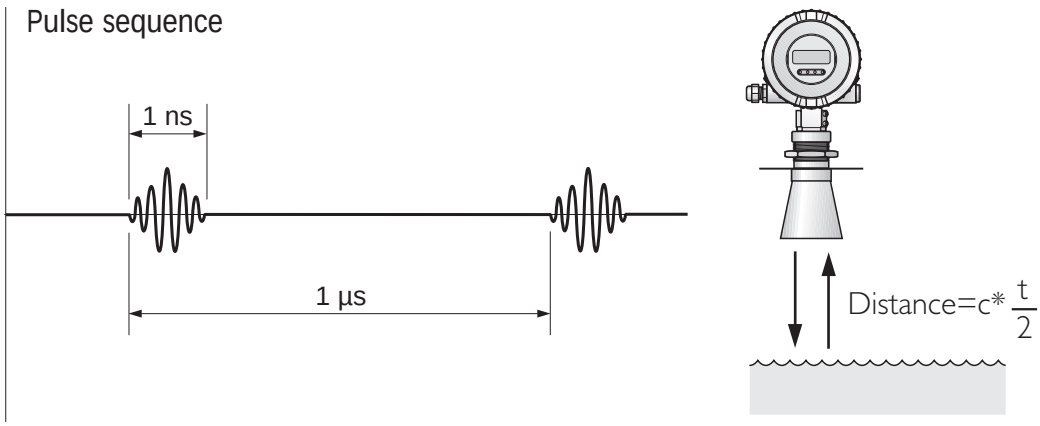


LoopRadar with analog output signal 4-20 mA and HART interface.

Volume calculation function

A calculation function transforms the measured level into the corresponding product volume. The volume calculation is based on one of the standard tank shapes Sphere, Vertical cylinder or Horizontal cylinder. The LoopRadar also offers the possibility to calculate the product volume for an arbitrary tank shape by specifying a Tank Capacity Table consisting of up to 20 levels and corresponding volumes.

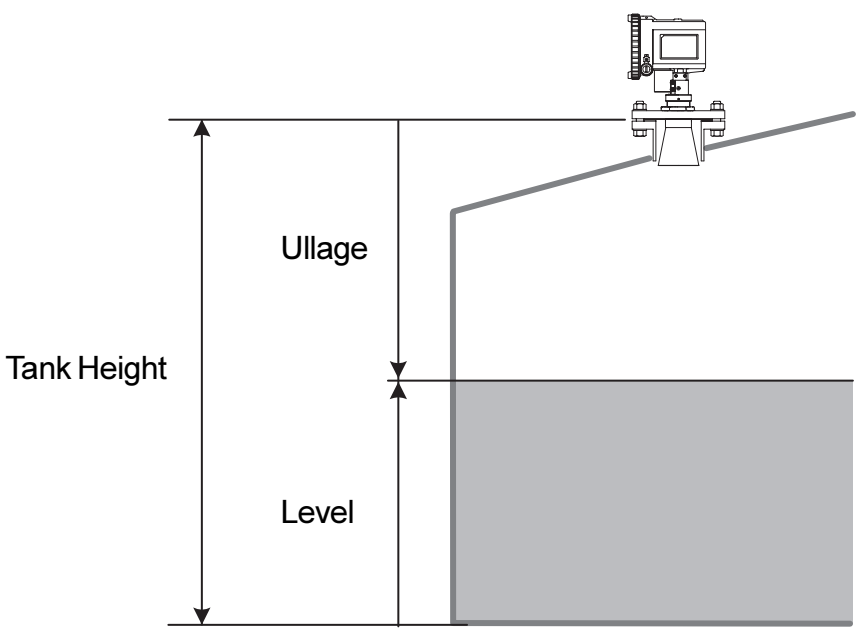
1.2 Measurement Principle



A LoopRadar gauge is installed at the tank top. It emits short microwave pulses towards the product surface in the tank. The emitted microwaves hit the product surface and are reflected back to the antenna for subsequent processing by the transmitter electronics. The time from transmission to reception (t) is detected by a micro-processor and is converted to the distance between the transmitter and the product surface. The measured distance is often referred to as the Ullage.

The product level is calculated by using the following relation between tank height and Ullage:

Level=Tank Height - Ullage.



2 Mechanical Installation

2.1 Requirements

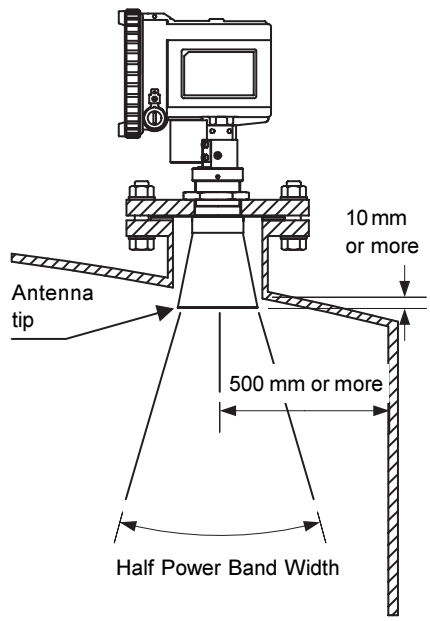
Mounting position

Do not mount the transmitter at the center of the tank or close to the tank wall. This may reduce the measuring range or the accuracy and makes the transmitter more sensitive to disturbing echoes. We recommend that the transmitter is mounted so that the antenna tip is located at least **0.5 m** from the tank wall.

Socket requirements

The antenna tip should be located outside the nozzle (10 mm or more).

If the antenna is located inside the nozzle the antenna tip may cause disturbing echoes which will negatively affect measurement performance.

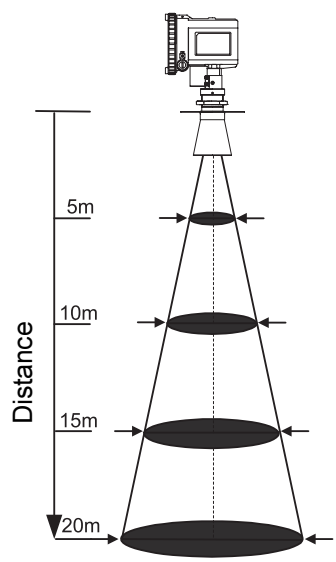


Free space requirements

The transmitter should be mounted so that no obstacles are present in the radar beam. Obstacles in the radar beam may reduce the measuring range.

Antenna Type	Half Power Beam Width (Degrees)
4 " Cone	17
6" Cone	22
8" Cone	34

Half Power Beam Width.



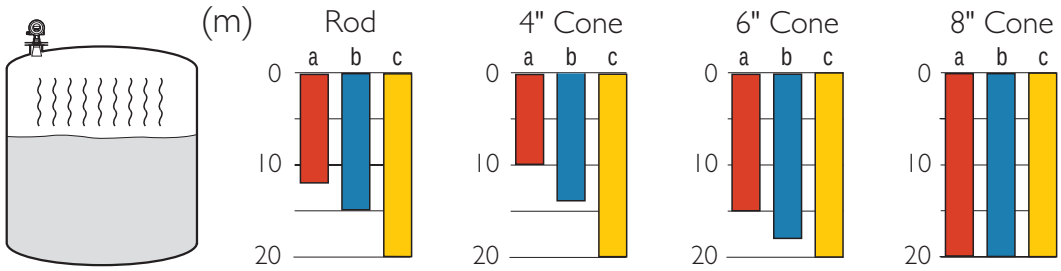
Distance (m)	Antenna Type		
	4” Cone	6” Cone	8” Cone
5	2.9	1.9	1.5
10	5.8	3.8	3.0
15	8.8	5.7	4.4
20	11.7	7.6	5.9

Diameter of radiated area (m).

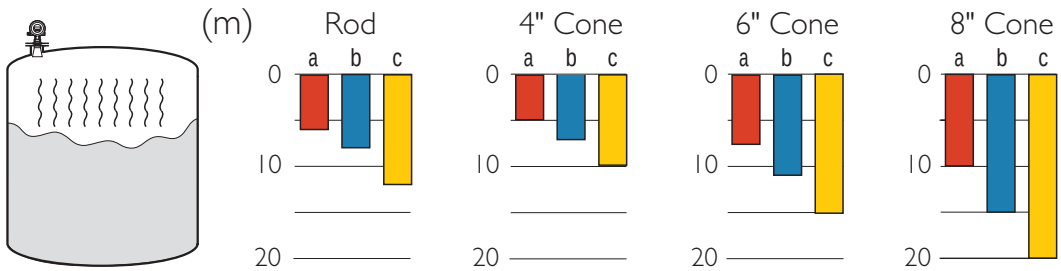
Maximum measuring distance

Maximum measurement distance is determined by antenna type, dielectric constant of the product and product surface conditions. Please refer to the table below. These values are rough estimates, and are strongly influenced by the measuring conditions.

Calm surface

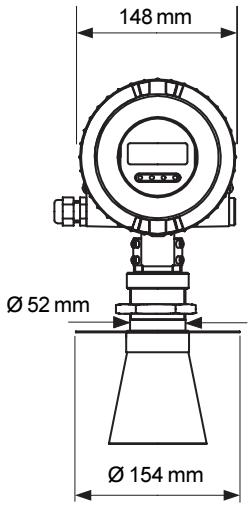


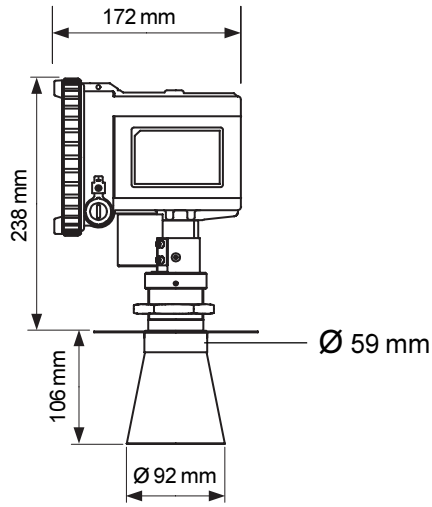
Turbulent surface



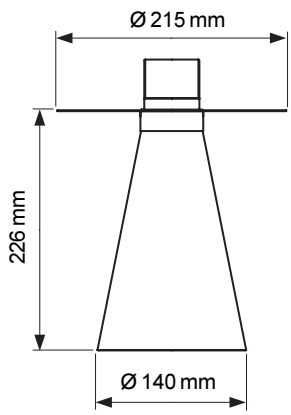
a) Dielectric constant 1.9 - 4.0	Oil, gasoline and other hydrocarbons, petrochemicals
b) Dielectric constant 4.0 - 10	Alcohols, concentrated acids, organic solvents
c) Dielectric constant > 10	Water based liquids, dilute acids, acetone

2.2 Dimensions

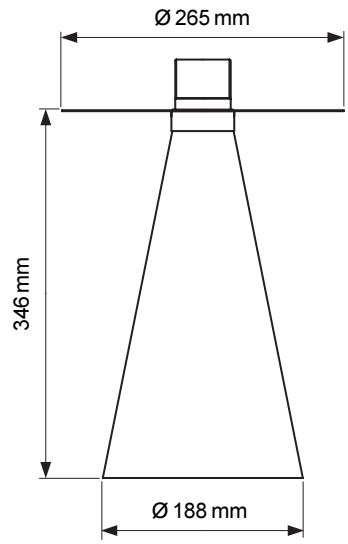




4“ Cone antenna



6“ Cone antenna



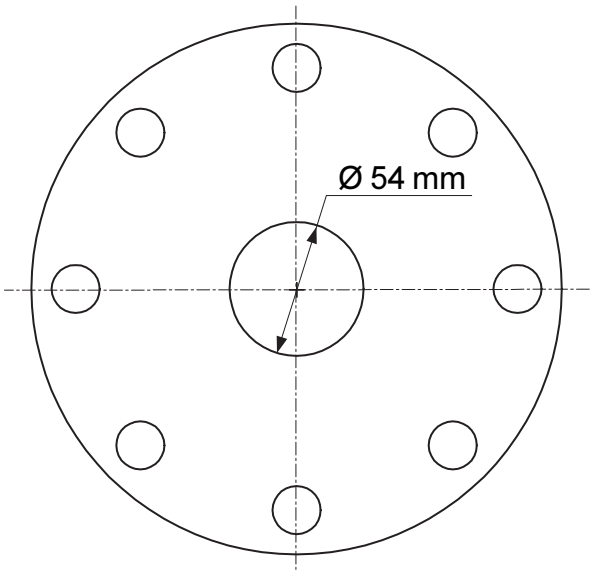
8“ Cone antenna

Weight

LoopRadar(except antenna)	2.5 kg
4” Cone antenna	0.8 kg
6” Cone antenna	1.2 kg
8” Cone antenna	1.8 kg

Flange

The LoopRadar gauge is mounted by using a flange according to the following specifications:



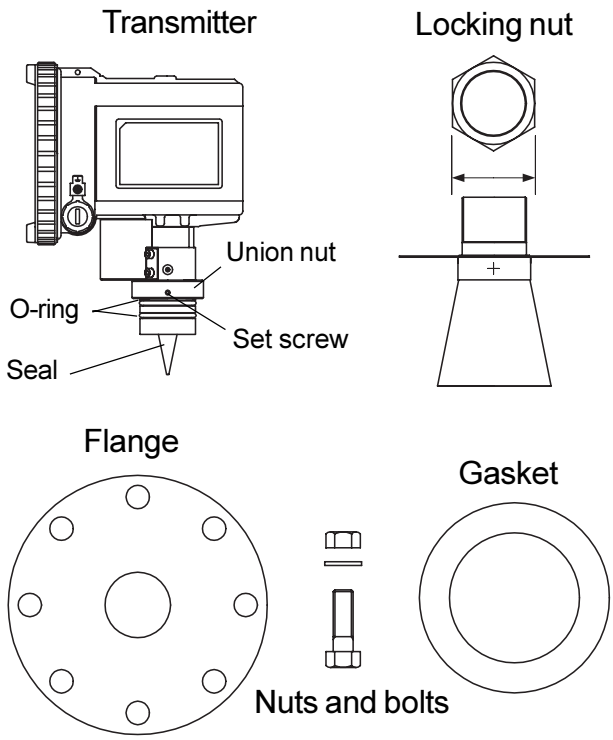
Maximum thickness : 29mm (ANSI Class-150 8”).

2.3 Tools

The following tools are needed for installation of LoopRadar:

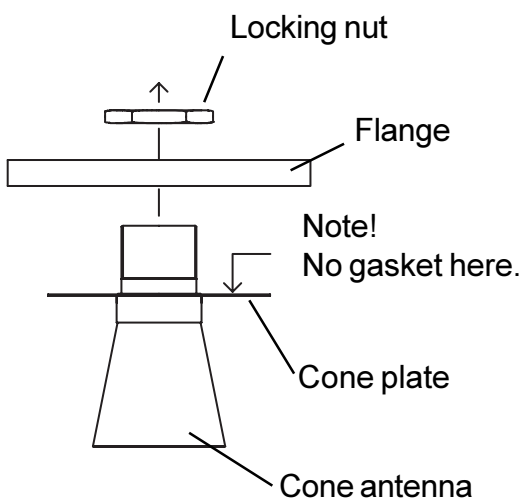
- Hexagon socket screw keys(-4)
- Adjustable wrench (for locking nut)
- Pipe wrench (for neck of cone antenna)
- Screw driver (-) width 3mm

2.4 Mounting the Cone Antenna



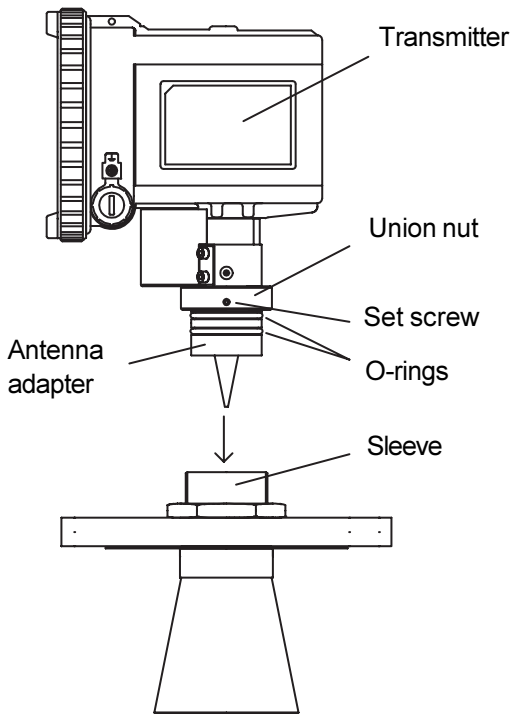
1 Make sure that the following parts are available when installing the gauge.

> **Caution**
>
> Make sure that the PTFE Seal and the O-rings are not damaged. Damaged PTFE Seal or O-ring may cause gas leakage from pressurized tanks.



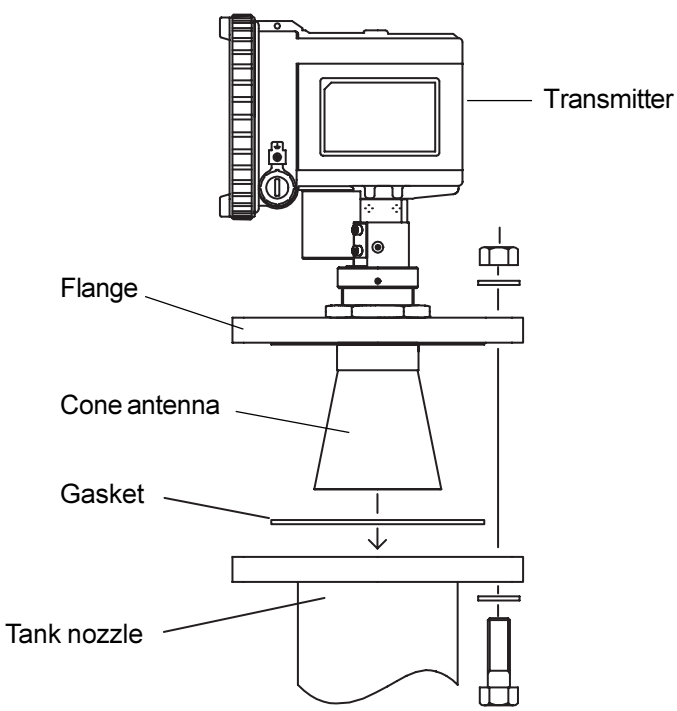
2 Mount the flange on top of the cone plate.
Secure the flange with the locking nut and make sure that the nut is fitted tightly to the flange.

> **Caution**
>
> Make sure that the bottom side of the flange is flat and all parts are clean and dry in order to avoid gas leakage from pressurized tanks.



3 Carefully insert the transmitter antenna adapter into the sleeve and make sure that it fits well into the cone antenna.
Secure the antenna adapter with the union nut.
Secure the union nut with the set screw.

> **Caution**
>
> Make sure that the O-ring and the inside of the sleeve are clean in order to avoid gas leakage when using LoopRadar in pressurized tanks.

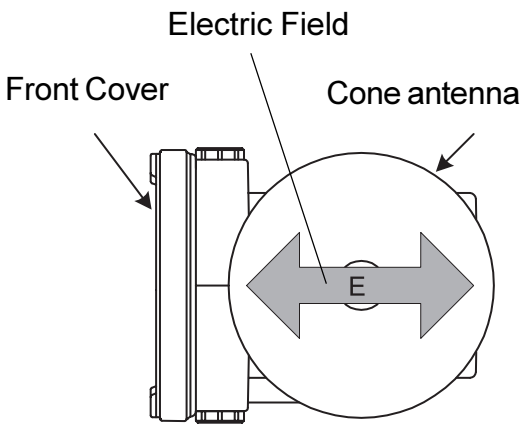


4 Place the gasket on the tank nozzle.
Carefully fit the transmitter with flange and cone antenna on the tank nozzle.
Tighten the screws and nuts.

> **Warning**
>
> Do not loosen union nut when the tank is pressurized.

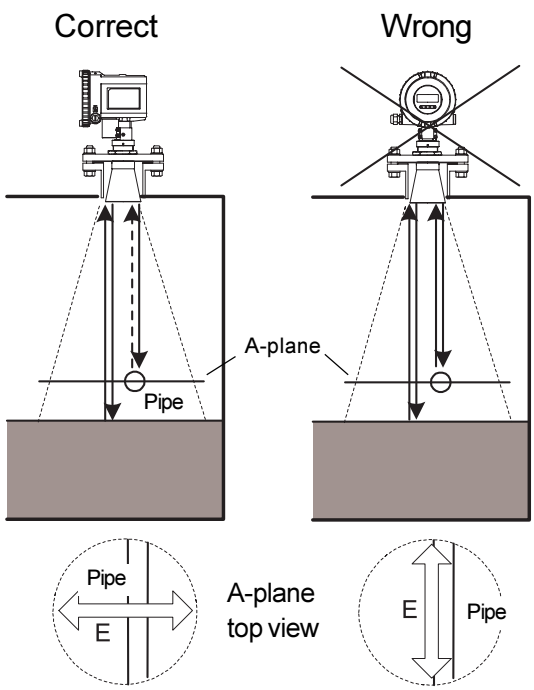
2.5 Installation Hints

If obstacles are present in the radar beam, the signal reflected from the product surface may be weaker than the signal from the disturbing object. In this case the LoopRadar may lock on the disturbing object instead of the liquid surface. To reduce the influence of the disturbing object use the following method:

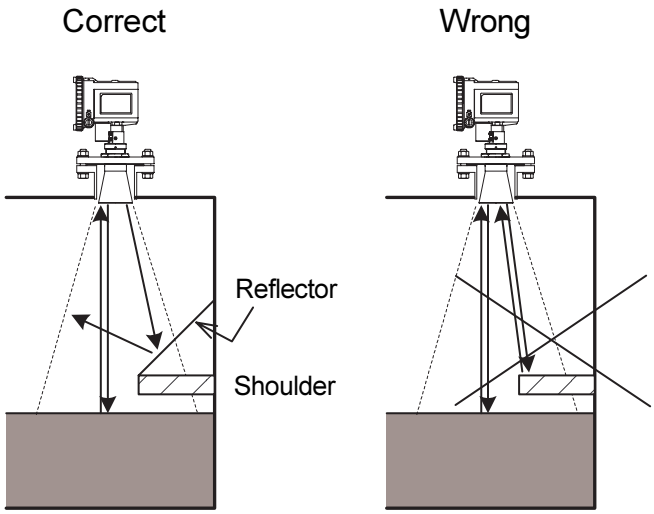


Thin pipes

Reflections of microwaves from elongated metal like thin pipes are strongest when the axis and electric field are parallel. The direction of the electric field is shown in the figure to the right.



Mount the LoopRadar in a direction where the electric field and the obstacle are not parallel. That way the false echo from the obstacle will have less influence on the measurement performance.

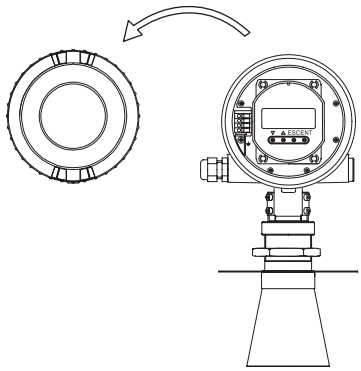


Shoulders and Struts

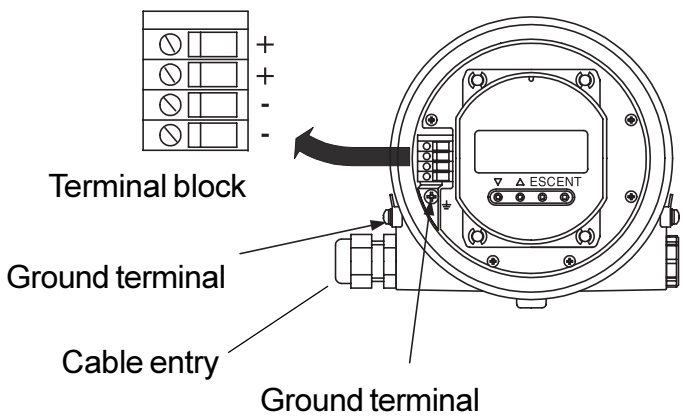
Flat surfaces may cause strong false echoes. In order to reduce the impact of such false echoes you can mount a metal plate above the obstacle as shown in the figure.

3 Electrical Installation

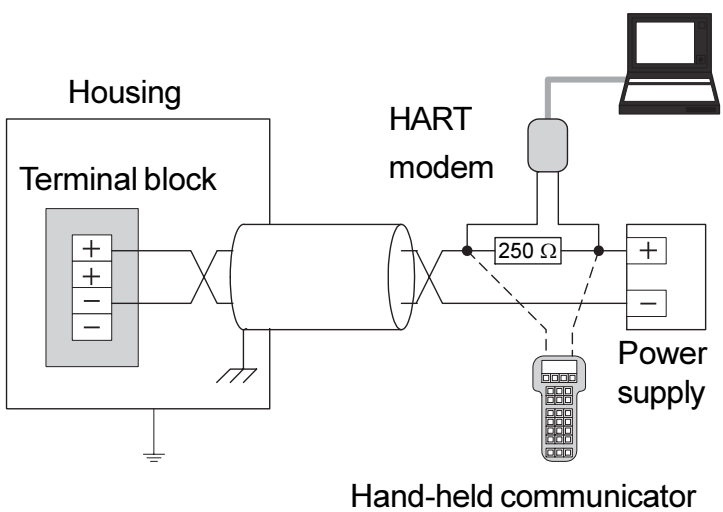
3.1 Connecting the LoopRadar



1 Remove the front cover.



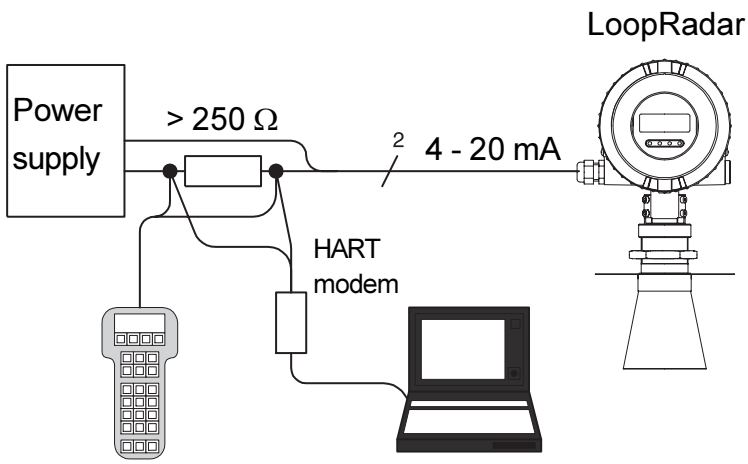
2 Connect the cable to the terminal block trough the cable entry.



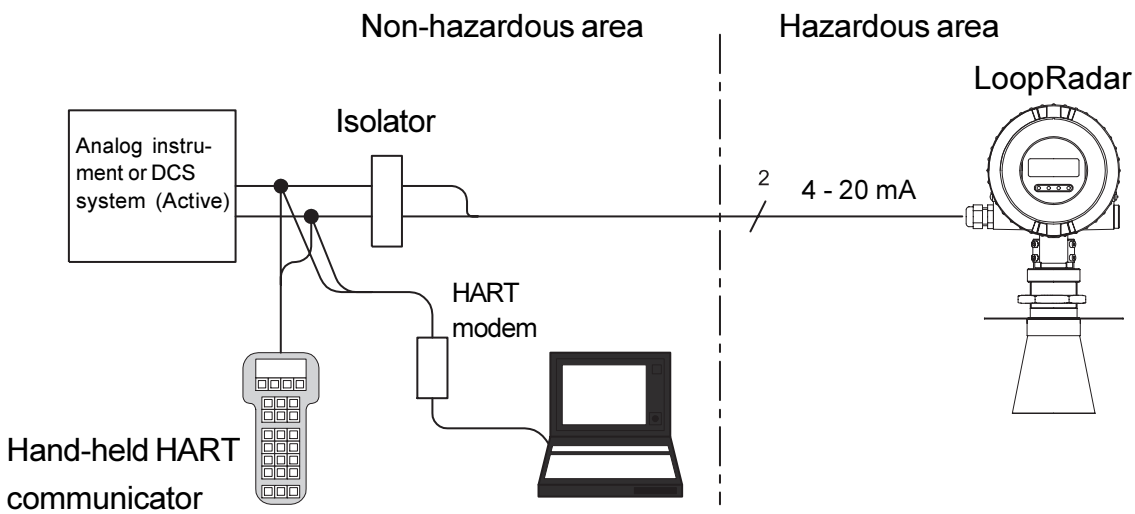
3 Connect the shield to the ground terminal.

4 Tighten the front cover. Please handle it carefully so that the gasket and window are not removed. Make sure that the cover is fully tightened so that the housing is properly sealed by the gasket.

Example-1 Connection to power supply unit. LoopRadar mounted in non-hazardous area.



Example-2 Connection to PLC etc. LoopRadar mounted in hazardous area.



3.2 Cables

Cable	Use shielded twisted pair for connection.
Cable entry	2 x M20 x 1.5, NPT 1/2 " (cable diameter 5-9 mm)

3.3 Load

Minimum load for HART	250 Ω
Maximum load (Non-Ex)	810 Ω
Maximum load (Ex)	620 Ω

3.4 Power supply

Supply voltage (Non-Ex)	18…36 VDC
Supply voltage (EX)	18…30 VDC
IS parameters	Ui=30 V, Ii=110 mA, Pi=825 mW, Li=0, Ci=see certificate

3.5 Grounding

The terminal must be connected to ground before it is connected to other equipment.

4 Transmitter Setup

The LoopRadar can easily be installed by using one of the following tools:

- LoopRadar Display Panel. (See chapter 5 for further information).
- PC Setup Software. (In preparation).
- HART Handheld Communicator (Device Descriptor in preparation).

Installing a Loopradar transmitter includes the following tasks:

- Configuration
- Analog Output parameters
- Volume calculation settings
- Advanced settings (for example disturbance echo handling)

4.1 Configuration

4.1.1 General Settings

Output Parameter Measurement value to be shown on the Display and Analog Output

Measurement Unit Measurement unit, meter or feet.

Antenna Type 4", 6" and 8" Cone are available.

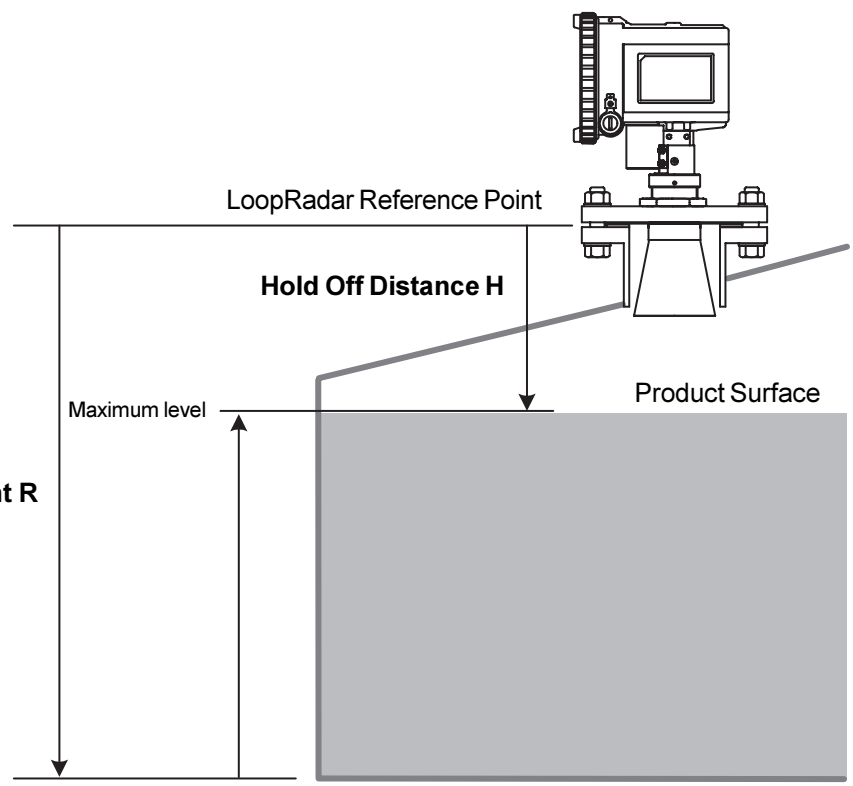
4.1.2 Basic Tank Geometry

Specify the following parameters:

Tank height R The distance from LoopRadar Reference Point to the tank bottom. The LoopRadar Reference Point is defined as the underside of the flange.

Hold Off Distance H The distance from the LoopRadar Reference Point to the maximum product level.

See chapter 5 *Using the Display Panel* for information on how to use the Display Panel for configuration of the Loopradar.



4.1.3 Advanced Tank Geometry

Min. Level Offset C

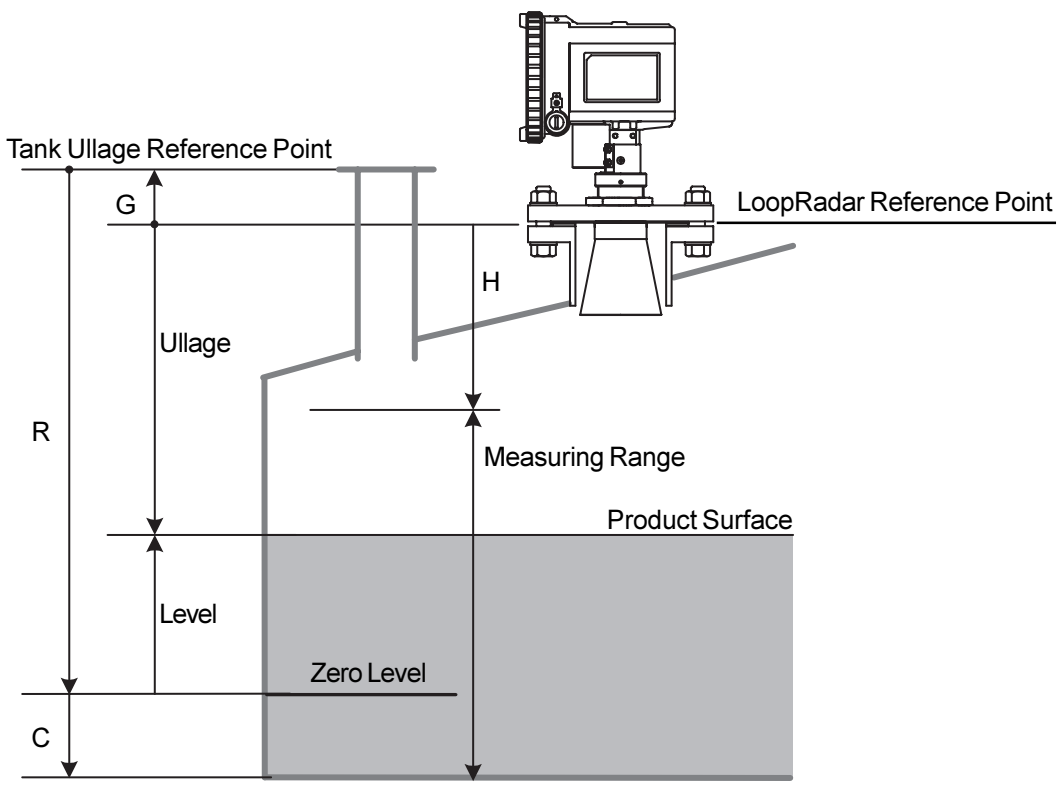
The C distance is used to extend the measurement range beyond the Zero Level Reference Point down to the tank bottom. **C** is defined as the distance between the Zero Level and the tank bottom. Set **C**=0 if you do not want to present negative levels below the Zero Level reference point, or if you use the tank bottom as zero level reference point.

Reference Distance G

In most cases the LoopRadar Reference Point is used as the upper reference point. However, the LoopRadar gauge offers the option to use a nozzle for hand dipping as the upper reference point.
G is the distance between the LoopRadar Reference Point and the Tank Ullage Reference Point. The LoopRadar Reference Point is located at the underside of the flange.

Tank height R

The distance from the Tank Ullage Reference Point to the Zero Level.



4.2 Analog Output

Analog Output Parameter — Specify the source parameter for the analog output. Level is the default parameter. Ullage, Volume or Amplitude are also available.

Minimum Output — Set the measured value that corresponds to 4 mA.

Maximum Output — Set the measured value that corresponds to 20 mA.

Alarm Selection — Set the alarm mode for the analog output current when a measurement error occurs.

Low: the output current is set to 3.9 mA.

High: the output current is set to 22 mA.

Hold last value: the output current is set to the measured value at the time when the error occurs.

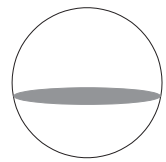
See chapter 5 *Using the Display Panel* for information on how to use the Display Panel for setting the Analog Output parameters.

4.3 Volume Calculation

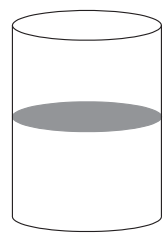
The LoopRadar offers four methods to calculate the product volume depending on the tank type. For presentation of volume values you can choose cubic meter, gallons, barrels or cubic feet.

Predefined Tank Shapes

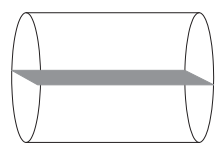
Spherical Tank — The volume is calculated by specifying tank diameter.



Vertical cylinder Tank — The volume is calculated by specifying tank diameter.



Horizontal cylinder Tank — The volume is calculated by specifying tank diameter and the tank length.

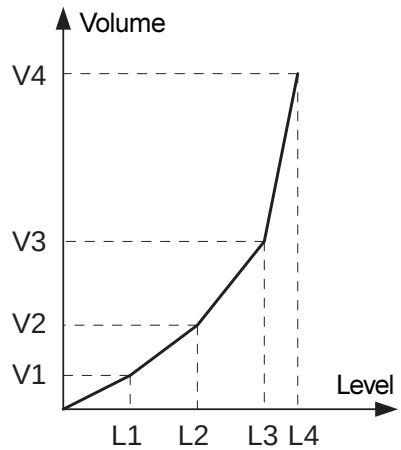


Offset Level

If for some reason zero volume should not correspond to the Zero Level, if you for example want to add the sump volume into the total volume value, an Offset Level can be introduced. The Offset level specifies the distance between the zero level and the level that corresponds to zero volume.

Tank Capacity Table

In order to obtain more accurate volume calculations you can create a table of level values and corresponding volumes. A maximum of 20 points can be specified.



Between the points linearly interpolated values are calculated.

At least two points must be entered for the Tank Capacity Table.

See chapter 5 *Using the Display Panel* for information on how to use the Display Panel to set up the Loopradar transmitter for volume calculations.

4.4 Disturbance Echo Handling.

When disturbing echoes appear in the approved measuring range they can be filtered out by setting up a Noise Table.

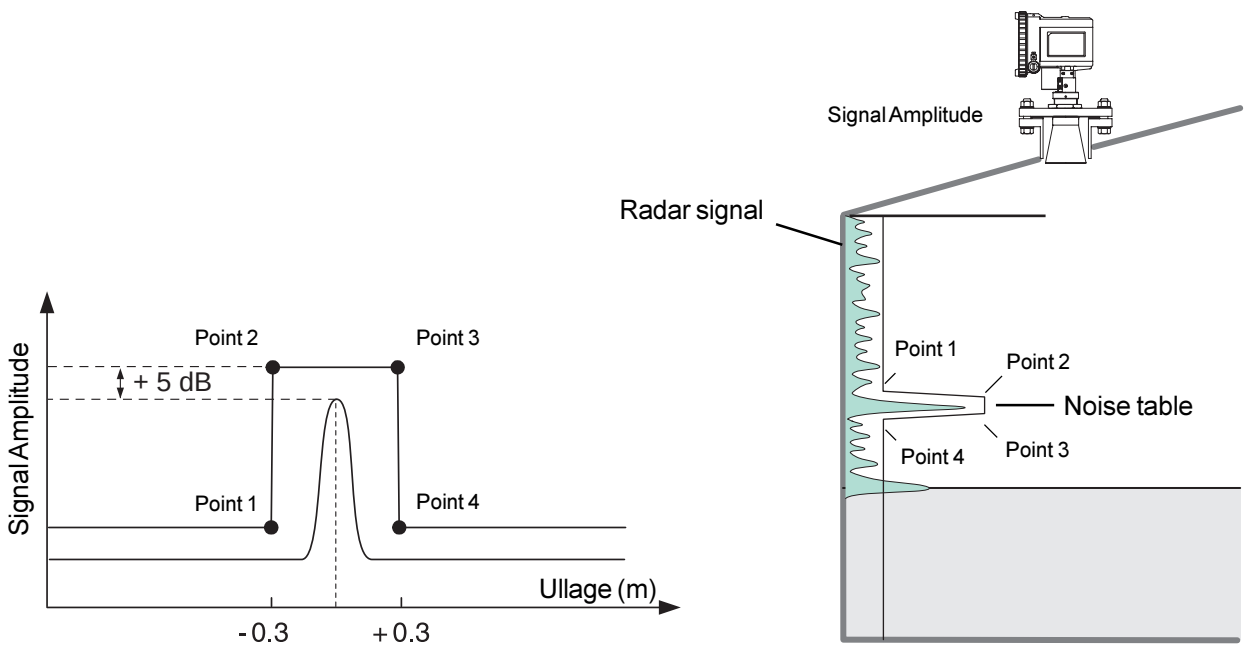
4.4.1 Noise Table

A Noise Table adjusts the threshold level at various parts of the measurement range. By setting the threshold level to an appropriate value the disturbing echo will be suppressed by the transmitter.

A Noise Table is defined by ullage points and signal amplitude threshold values. A maximum of 10 points can be specified. Linear interpolation is used between the points. Make sure that the noise table box around a disturbing echo is big enough to hide the disturbing echo, see illustration below.

If a disturbing echo appears you should start by checking the ullage and the corresponding amplitude of the detected signal. This provides information about the position of the disturbance and the noise threshold required to suppress the disturbing echo.

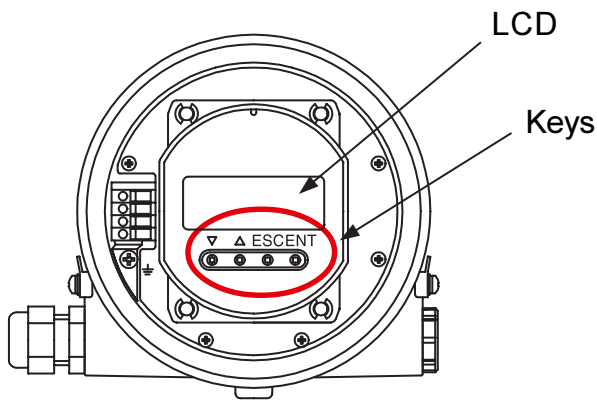
Note! *The transmitter may temporarily loose track of the surface when it passes the noise threshold.*



5 Using the Display Panel

The Display Panel can be used for configuration of the LoopRadar transmitter as well as for viewing tank data. The keys allow you to navigate through the different menus and to enter desired values for various parameters.

5.1 Display Panel

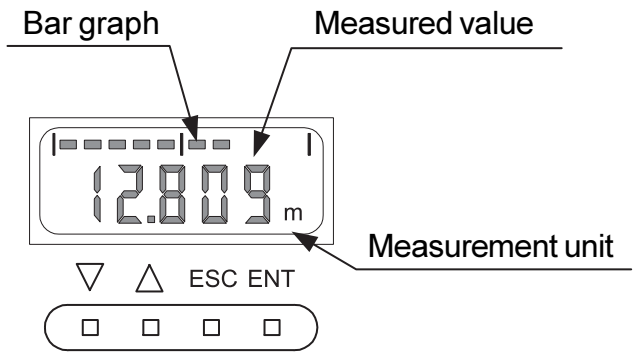


5.1.1 Display

Bar graph, measured data and measuement unit are displayed during normal operation. The last measured value flashes on the display when the gauge is in search mode.

When the Display Panel is used in configuration mode, menu number or registered data is displayed.

5.1.2 Keys



1. ENT (ENTER)
   Press the **Enter** key to change from measurement mode to configuration mode.
   You can also use this key to move from the main menu to various sub menus.
   By pressing the **Enter** key the cursor can be moved from one digit to the other when entering a new parameter value.
2. ESC (ESCAPE)
   Press the **Escape** key to change from configuration mode to measurement mode.
   Use the **Escape** key to move from sub menus to the main menu.
3. △ Up
   The up button increases menu numbers and the value of a flashing digit.
4. ▽ Down.
   The down button decreases menu numbers and the value of a flashing digit.

5.2 Basic Key Parameter List

By using the Display Panel keys you can make a complete configuration of the LoopRadar. The various settings are grouped into seven main menus:

[1--] Configuration Basic configuration of tank dimensions, antenna type and output parameter.

[2--] Analog Configuration of analog output signal.

[3--] Volume Specification of method for volume calculations.

[4--] Calibration Only for service actions. See Appendix 1 for further information.

[5--] Advanced Only for service actions. See Appendix 1 for further information.

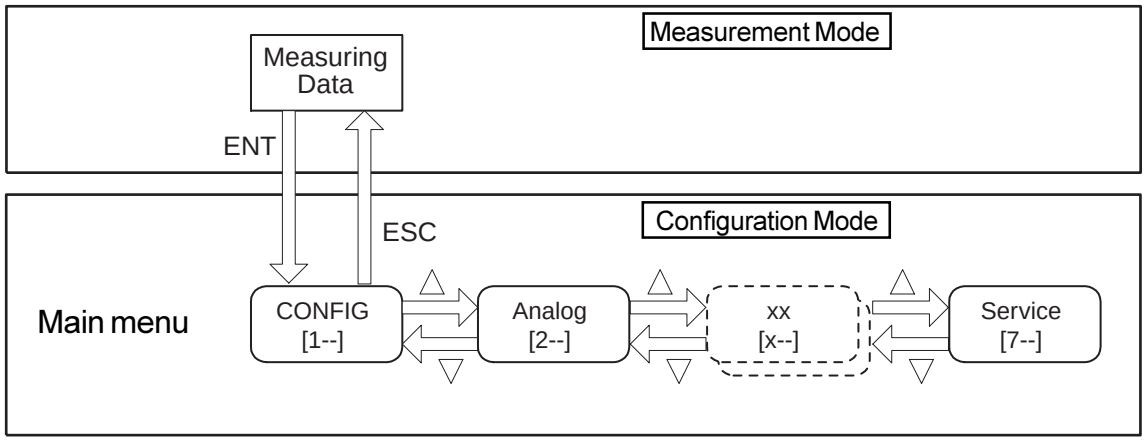
[6--] Noise Option to create a noise table in order to suppress distinct disturbing echoes.

[7--] Service Only for service actions. See Appendix 1 for further information.

Title	Menu Code	Parameter	Sub Menu	Sub Parameter	Input	Input Value
CONFIGURATION	[1--]	Output Parameter	[1-1]			0: Level 1: Ullage 2: Volume(%) 3: Current 4: Amplitude
		Antenna Type	[1-2]			0: 4inch Horn Antenna 1: 6inch Horn Antenna 2: 8inch Horn Antenna
		Meas. Unit	[1-3]			0: meter 1: feet
		G	[1-4]			-3 to +3m, (R+C-G) <=20m
		R	[1-5]			-3 to +23m, (R+C-G) <=20m
		C	[1-6]			0 to +3m, (R+C-G) <=20m
		H	[1-7]			0 to +23m
ANALOG	[2--]	Analog Output Parameter	[2-1]			0: Level 1: Ullage 2: Volume(%) 3: Amplitude
		Minimum Output	[2-2]			-3 to +23m
		Maximum Output	[2-3]			-3 to +23m
		Alarm Selection	[2-4]			0: High(22 mA) 1: Low(3.9 mA) 2: Hold last value
		Fixed Current Output	[2-5]			3.9 to 22 mA Fixed when 0.0 mA

Title	Menu Code	Parameters	Sub Menu	Sub Parameter	Input Range	Input Value
VOLUME	[3–]	Linearisation Selection	[3-1]			0: Not Calculate 1: Vertical Cylinder 2: Spherical 3: Horizontal Cylinder 4: User Tank Table
		Linearisation Point Number	[3-2]			2 to 20
		Input	[3-3]	Level Point	[300]-[319]	-3 to +23 m
			[3-4]	Volume Point	[320]-[339]	0 to 99999.99
		Delete All	[3-5]			Execute by 1
		Diameter	[3-6]			0 to +10 m
		Length	[3-7]			0 to +20 m
		Offset Level	[3-8]			-3 to +23 m
		Volume Unit	[3-9]			0: m^3 1: galons 2: barrels 3: ft^3
CALIBRATION	[4--]	See Appendix 1.				
ADVANCED	[5–]	See Appendix 1.				
NOISE	[6–]	Noise Table Number	[6-1]			0 to 10
		Input	[6-2]	Noise Table	[600]-[609]	-3 to +23 m (Ullage)
			[6-3]	Amplitude Threshold	[610]-[619]	0 to 100.00 dB
		Delete All	[6-4]			Execute by "1"
SERVICE	[7--]	See Appendix 1.				

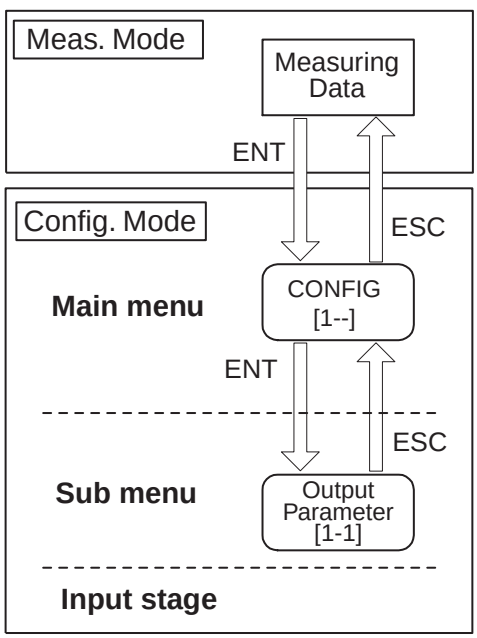
5.3 Navigating the Display Panel Menus



Press the **ENT** key to switch from measurement mode to configuration mode.

Press the **ESC** key to return to measurement mode.

Use the △ and the ▽ keys to increment menu number.



Use the **ENT** and **ESC** keys to move up and down the menu tree.

5.4 Configuration

Output parameter

1. Choose sub menu **[1-1]**.
2. Choose one of the following parameters to be displayed on the panel:
   0: Level, 1: Ullage, 2: Volume (%), 3: Current, 4: Amplitude.

Antenna type

1. Move to sub menu **[1-2]**.
2. Choose one of the following antennas:
   0: 4 inch Horn Antenna.
   1: 6 inch Horn Antenna.
   2: 8 inch Horn Antenna.

Measurement Unit

1. Choose sub menu **[1-3]**.
2. Choose one of the following options:
   0: meter.
   1: feet.

Tank Distances

1. Choose sub menu **[1-5]** and enter the tank height **R**. Measure **R** from the LoopRadar Reference Point to the tank bottom.
2. If the Zero Level reference point is located above the tank bottom, choose sub menu **[1-6]**. (This may be the case if for example a Datum Plate is used).
   In order to be able to measure levels below the Zero Level, enter the **C** distance from the Zero Level to the tank bottom.
   If C is set to 0, levels below the zero reference point will be presented as 0.

See chapter 4.1.2-3 for more information on the definition of tank geometry parameters.

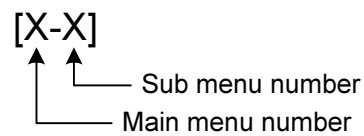
Hold Off Distance

1. Choose sub menu **[1-7]**.
2. Enter the Hold Off distance **H**. The Hold Off distance is defined as the distance from the LoopRadar Reference Point to the upper limit of the Approved Measurement Range.

See chapter 4.1 for further information on the definition of tank geometry.

Example-1

To set the tank height R to 6.275m do the following:

Key	Display	
	7.956m	Measuring Level(m) (Normal operation mode)
ENT	[1--]	Main menu number (Configuration mode)
ENT	[1-1]	
Δ	[1-2]	
Δ	[1-3]	
Δ	[1-4]	
Δ	[1-5]	
ENT	10.000	Default value
ENT	10.000	"0" flashing.
Δ × 5	10.005	×5 : Push 5 times
ENT	10.005	
∇ × 3	10.075	
ENT	10.075	
Δ × 2	10.275	
ENT	10.275	
∇ × 4	16.275	
ENT	16.275	
∇	06.275	
ENT	06.275	Check that figures stop flashing!
ESC	[1-4]	
ESC	[1--]	
ESC	4.231	Measuring Level(m) (Normal operation mode)

5.5 Volume Calculation

Tank Type

1. Choose sub menu **[3-1]** to specify calculation method.
2. Choose one of the following options:

   0 No volume calulation is performed.

   1 Volume calculation is based on the shape of a Vertical Cylinder.

   2 Volume calculation is based on the shape of a Spherical tank.

   3 Volume calculation is based on the shape of a Horizontal Cylinder.

   4 Volume calculation is based on a table of level values and corresponding volumes. See section Tank Capacity Table for further information.

Tank Dimensions

Diameter	Choose sub menu **[3-6]** to specify tank diameter for Vertical Cylinder or Spherical tank.
Length	Choose sub menu **[3-7]** to specify length for Horizontal Cylinder tank.

Offset

Choose sub menu **[3-8]** to specify a level offset if you do not want the volume to be zero at the Zero Level reference point.

Tank Capacity Table

1. Choose sub menu **[3-2]** in order to specify the number of linearization points for the Tank Capacity Table.
2. Choose sub menu **[3-3]** and enter the level values. Enter as many points as specified in sub menu **[3-2]**.
3. Choose sub menu **[3-4]** and enter the volumes that correspond to the level values entered in sub menu **[3-3]**.
4. Choose sub menu **[1-1]** to choose volume as output parameter on the Display Panel.
5. Return to measurement mode.

Example-2

To set the second Volume point to 2345.67m^3 do the following:

A volume point can be set from 00000.00 to 99999.99.

Key	Display	
	4.231	Measuring Level(m) (Normal operation mode)
ENT	[1--]	
Δ× 2	[3--]	Volume(Main menu)
ENT	[3-1]	
Δ × 3	[3-4]	Volume point(Sub menu)
ENT	[320]	Volume point 1
Δ	[321]	Volume point 2
ENT	000.00	Default value
ENT	000.00	"0" is flashing.
Δ × 7	000.07	Push 7 times
ENT	000.07	
Δ × 6	000.67	Push 6 times
ENT	00000	
Δ × 5	00005	Push 5 times
ENT	00005	
Δ × 4	00045	Push 4 times
ENT	00045	
Δ × 3	00345	Push 3 times
ENT	00345	
Δ × 2	02345	Push 2 times
ENT	02435	
ENT	02435	Check that figures stop flashing!
ESC	[321]	
ESC	[3-4]	
ESC	[3--]	
ESC	4.231	Measuring Level(m) (Normal operation mode)

5.6 Setting up the Analog Output

Output parameter

1. Choose sub menu **[2-1]**.
2. Choose one of the following parameters as source signal for the Analog Output:
   0: Level,
   1: Ullage,
   2: Volume (%),
   3: Amplitude.

Output range

1. Choose sub menu **[2-2]** to enter the Minimum Output value corresponding to the Analog Output value 4 mA.
2. Choose sub menu **[2-3]** to enter the Maximum Output value corresponding to the Analog Output value 20 mA.

Setting up the Alarm Mode

1. Choose sub menu **[2-4]** to specify Alarm mode for the Analog Output.
2. Choose one of the following options:
   0: High. The current is fixed at 22 mA when an alarm is activated.
   1: Low. The current is fixed at 3.9 mA when an alarm is activated.
   2: Hold Last Value. The analog output current is fixed at the present value.

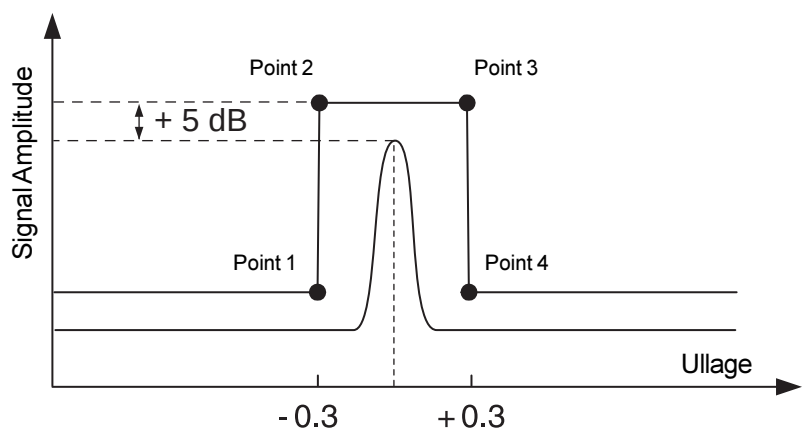
5.7 Disturbance Echo Handling

5.7.1 Setting up a Noise Threshold Table

If the transmitter has locked to a disturbing echo you can create a Noise Threshold Table in order to suppress the disturbing echo:

1. Do the following to check where the disturbing echo is located and the corresponding radar signal amplitude:
   1. Choose sub menu **[1-1]** and set the Output Parameter to Ullage.
   2. Note the Ullage value.
   3. Choose sub menu **[1-1]** and set the Output Parameter to Amplitude.
   4. Note the Amplitude value.
   5. Choose sub menu **[1-1]** and set the Output Parameter to the desired value (see the Key Parameter list).

   Now you can start creating the noise table.
2. Choose sub menu **[6-1]**.
3. Specify the number of points you want to use for the Noise Threshold Table. In order to suppress a single peak signal four points is sufficient. For more complicated noise tables you can use up to ten points.
4. Choose sub menu **[6-2]** and enter the ullage values that correspond to the desired noise table break points. The points must be added in consecutive order. Use a margin of ± 0.3 meter, see illustration below.
5. Choose sub menu **[6-3]** and enter the amplitude threshold values that correspond to the desired noise table break points. A margin of + 5 dB is sufficient in most cases.



6. Return to measuring mode and check that the transmitter detects the product surface.

Example.

A disturbing echo is located at Ullage=3 m. The signal amplitude of the disturbing echo is 3 dB. The following Noise Theshold Table is created to suppress this echo:

Sub menu [6-1]: 4 (4 points in the noise table).

Sub menu [6-2]:

Point 1: [600]=2.7.

Point 2: [601]=2.7.

Point 3: [602]=3.3.

Point 4: [603]=3.3.

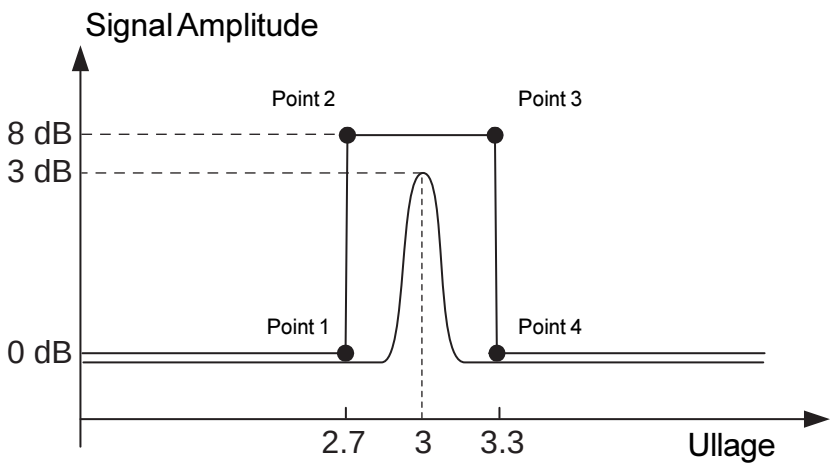
Sub menu [6-3]:

Point 1: [610]=0 dB.

Point 2: [611]=8 dB.

Point 3: [612]=8 dB.

Point 4: [613]=0 dB.



6 Technical Information

System

Operating frequency	• 5.8 GHz • 6.3 GHz (USA only)
Half-power beam width	• 4 " Cone antenna: 34 deg • 6 " Cone antenna: 22 deg • 8 " Cone antenna: 17 deg
Measuring range	Max. 20 m (65 ')
Serial communication	HART communication
Key switch	4 keys for configuration
Display	5 digits LCD and bar graph

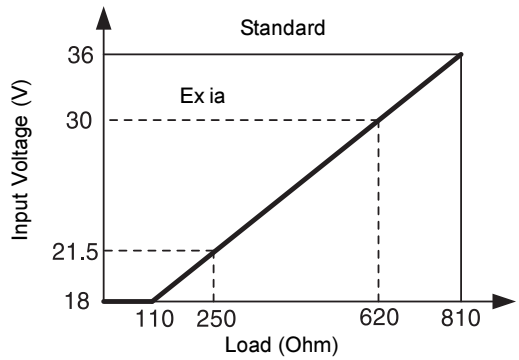
Power

Supply voltage	18..30 VDC(Ex) / 18..36 VDC(Non-Ex)
Specification for HART	• Ripple: 47..125 Hz • Vpp=200 mV (measured at 500 ohm) • Max.noise: 500 Hz..10 kHz • Vrms=2.2 mV (measured at 500 ohm)

Output

Variable	Ullage / Level / Volume / Current / Signal amplitude
Unit	Level, Ullage: m/ft. Volume: %. Current: mA. Signal amplitude: dB.
Signal type	Analog 4..20 mA, HART
Resolution	• Analog: 4 μA • Digital: 1 mm (0.04")
Update time	1 s
Averaging time	1..120 s

Signal on alarm	Hold/Low (3.9 mA)/High (22 mA)
Load	Minimum load for HART communication 250 ohm.



Accuracy

Measured error *)	±10 mm (0.4")
Linearity *)	±10 mm (0.4")
Repeatability *)	±10 mm (0.4")
Ambient temperature effect	±0.01% / 10 K

*): Free-space reflection from flat metal surface, ambient temperature 25 °C (77 °F), atmospheric pressure.

Environment resistance

Ambient temperature	-40..70 °C (-40..158 °F)
Display Unit	-20..70 °C (-4..158 °F)
Storage temperature	-40..80 °C (-40..176 °F)
Tank temperature	-40..150 °C (-40..302 °F)
Tank pressure	-0.1..1.0 MPa (-14..145 Psi)
Water protection	Designed for IP65, NEMA 4
Vibration resistance	IEC 68-2-6 /1G

Electromagnetic compatibility	• Emission: EN 50081-1 • Immunity: EN 50082-2

Cable Connection

Cable type	Shielded twisted pair Cross-section area of cable: 0.2..2.5 mm^2, (AWG24..14)
Cable entry	2-M20X1.5, NPT 1/2" (cable dia. 5..9 mm)
Ground cable	Max. 4 mm^2

Material

Transmitter Case	Aluminum
Cone antenna	316L stainless steel
Sealing parts	PTFE, Viton O-ring

Certificate and Approvals

Hazardous area certification	• CE 0518 Ex II 1 G - EEx ia IIC T4. (T_{amb} - 40 ºC to + 70 ºC) - Ui=30 V, Ii=110 mA, Pi=825 mW, Li=0, Ci=see certificate - Certificate No. SIRA 00ATEX2052X • FM: IS Class I, Division 1, Group A-D (In preparation)
Telecommunication	• BZT (in preparation) • FCC (in preparation)

7 Troubleshooting

LCD status messages

[E--]		Normal Operation
[E01]	Internal Error.	Serious error. Please contact service department.
[E02]	Memory Error.	Serious error. Please contact service department.
[E03]	Receive Error.	No measure data. Please contact service
[E04]	Tank CapacityTable Error.	Incorrect setting of Tank Capacity Table.
[E05]	Noise Table Error.	Incorrect setting of noise table.
[E99]	Searching.	Searching for Echo

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Appendix 1: Key Parameters

By using the Display Panel keys you can make a complete configuration of the LoopRadar. The various settings are grouped into seven main menus:

[1--] Configuration Basic configuration of tank dimensions, antenna type and output parameter.

[2--] Analog Configuration of analog output signal.

[3--] Volume Specification of method for volume calculations.

[4--] Calibration Calibration of analog output range and calibration of level measurements.

[5--] Advanced Advanced configuration for improving measurement performance in difficult environments.

[6--] Noise Option to create a noise table in order to suppress distinct disturbing echoes.

[7--] Service Special functions for service actions.

Title	Menu Code	Parameter	Sub Menu	Sub Parameter	Input	Input Value
CONFIGURATION	[1--]	Output Parameter	[1-1]			0: Level 1: Ullage 2: Volume(%) 3: Current 4: Amplitude
		Antenna Type	[1-2]			0: 4inch Horn Antenna 1: 6inch Horn Antenna 2: 8inch Horn Antenna
		Meas. Unit	[1-3]			0: meter 1: feet
		G	[1-4]			-3 to +3m, (R+C-G) <=20m
		R	[1-5]			-3 to +23m, (R+C-G) <=20m
		C	[1-6]			0 to +3m, (R+C-G) <=20m
		H	[1-7]			0 to +23m
ANALOG	[2--]	Analog Output Parameter	[2-1]			0: Level 1: Ullage 2: Volume(%) 3: Amplitude
		Minimum Output	[2-2]			-3 to +23m
		Maximum Output	[2-3]			-3 to +23m
		Alarm Selection	[2-4]			0: High(22 mA) 1: Low(3.9 mA) 2: Hold last value
		Fixed Current Output	[2-5]			3.9 to 22 mA Fixed when 0.0 mA

Title	Menu Code	Parameters	Sub Menu	Sub Parameter	Input Range	Input Value
VOLUME	[3–]	Linearisation Selection	[3-1]			0: Not Calculate 1: Vertical Cylinder 2: Spherical 3: Horizontal Cylinder 4: User Tank Table
		Linearisation Point Number	[3-2]			2 to 20
		Input	[3-3]	Level Point	[300]-[319]	-3 to +23 m
			[3-4]	Volume Point	[320]-[339]	0 to 99999.99
		Delete All	[3-5]			Execute by 1
		Diameter	[3-6]			0 to +10 m
		Length	[3-7]			0 to +20 m
		Offset Level	[3-8]			-3 to +23 m
		Volume Unit	[3-9]			0: m^3 1: galons 2: barrels 3: ft^3
CALIBRATION	[4--]	4mA Calibration	[4-1]			3.9 to 20.8 mA
		20mA Calibration	[4-2]			3.9 to 20.8 mA
		Offset Calibration	[4-3]			-1 to 1 m
		Span Calibration	[4-4]			0.9 to 1.1
ADVANCED	[5--]	Averaging Times	[5-1]			1 to 120sec
		Window Location	[5-2]			0 - 20 m
		Research Delay	[5-3]			1 to 120 s
		Alarm Delay	[5-4]			1 to 120 s
		Bottom Window	[5-5]			0 to 0.5 m
		First Echo Flag	[5-6]			0: Max echo 1: First echo
		Bottom Visible	[5-7]			0: Bottom Visible 1: Bottom invisible
NOISE	[6–]	Noise Table Number	[6-1]			0 to 10
		Input	[6-2]	Noise Table	[600]-[609]	-3 to +23 m
			[6-3]	Amplitude Threshold	[610]-[619]	0 to 100.00 dB
		Delete All	[6-4]			Execute by "1"
SERVICE	[7--]	Password	[7-1]			to service mode
		Re-Search	[7-2]			
		User Reset	[7-3]			Execute by 1
		Error Status	[7-4]			
		Software Revision	[7-5]			

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