SmartRadar
FlexLine

Installation Guide

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1 General

1.1 Using this installation guide

For use in measurement systems for inventory measurement and control. The SmartRadar Flexline can integrate data from other measurement devices, such as temperature RTD sensors. Data from Radar and connected sensors can be communicated to host computer systems via a variety of industry standard protocols.

1.2 Related documents

- SmartRadar FlexLine Safety instructions for installation, commissioning, operation and maintenance, shipped with the device.
- Installation guide SmartRadar Antennas.
- CE Declaration of Conformity
- EC-Type Examination Certificate
- IECEx Certificate of Conformity
- FCC Authorization
- Control drawings for FM and CSA.

1.3 Trademarks

HART™ is a registered trademark of the HART Communication Foundation.

1.4 Contact

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2 Safety

2.1 Correct for use

The SmartRadar FlexLine is a radar-based level gauge to use in inventory measurement systems and can be used to interface with other systems and sensors such as temperature gauges.

2.2 Safety conventions

"Warnings", "Cautions" and "Notes" are used throughout this installation guide to bring special matters to the immediate attention of the reader.

• A Warning concerns danger to the safety of the technician or user.
• A Caution draws the attention to an action which may damage the equipment.
• A Note points out a statement deserving more emphasis than the general text, but not requiring a "Warning" or a "Caution".

2.3 Safety instructions

2.3.1 Safety instructions

Refer to the safety instructions shipped with the device for installation, commissioning, operation and maintenance.

2.3.2 EC declaration of conformity (for E.U.)

Refer to the EC declaration of conformity, shipped with the device.

2.3.3 Control drawings for FM & CSA

Refer to the control drawings shipped with the device.

2.3.4 Users

The mechanical and electrical installation must be carried out only by trained personnel with knowledge of the requirements for installation of explosion proof equipment in hazardous areas. The entire installation procedure must be carried out

in accordance with national, local and company regulations. The entire electrical installation shall be carried out in accordance with the national requirements for electrical equipment to be installed in hazardous areas.

> **NOTE**
> Refer to EN IEC 60079-14 or NEC (NFPA70).

2.3.5   Additional information

If you require additional information, contact Enraf or its representative.

2.3.6   Environmental conditions

Observe the environmental conditions for the temperature and the pressure. Refer to the chapter "Technical data".

2.4   Liability

The information in this installation guide is the copyright property of Enraf B.V., Netherlands. Enraf B.V. disclaims any responsibility for personal injury or damage to equipment caused by:

- Deviation from any of the prescribed procedures,
- Execution of activities that are not prescribed,
- Neglect of the safety regulations for handling tools and use of electricity.

The contents, descriptions and specifications in this installation guide are subject to change without notice. Enraf B.V. accepts no responsibility for any errors that may appear in this installation guide.

Warning!
Only certified technicians are authorized to make changes on the SmartRadar configuration. All modifications must be in accordance to the guidelines as set forth by Enraf. Modifications not authorized by Enraf will invalidate the approval certificates.
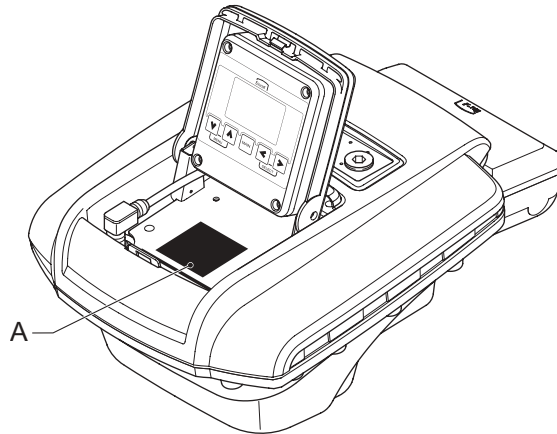
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2.5   Labels

Fig. 2.1 Labels

A Identification label with safety note.

Fig. 2.2 Identification label (Example)

2.6   Personal safety

Warning!
In hazardous areas it is compulsory to use personal protection and safety gear. This can be:

• Safety helmet, fire-resistive overall, safety shoes, safety glasses, working gloves, LEL-meter.

Pay attention to the kind of product in the tank. If there is any danger for your health, wear a gas mask and take all necessary precautions.

Warning!
Take appropriate precautions when chemical or toxic product vapors are present (compressed air, chemical protection suit, detection equipment).

NOTE
The emitted microwave energy is far below the accepted limits for exposure of the human body. The antenna generates a maximum radiation of 0.1 mW/cm^2.

2.7   Warnings and cautions

2.7.1   General

When it is required to open the instrument in an explosive hazardous environment.

Warning!
Make sure that all power to the device is switched off before you open the covers of the device. Failure to do so may cause danger to persons or damage the equipment. All covers of the device must be closed before switching the power on again.

Warning!
Treat the flange surface of the cover and the housing with care.
Keep the flange surface free of dirt.
The O-ring must be present and undamaged.

Tools

Warning!
Use non-sparking tools and explosion-proof testers. Use suitable explosion-proof tools (e.g. testing devices)!

Working environment

Warning!
Avoid generation of static electricity. Make sure that no explosive gas mixtures build up in the working area.

Required skills

Warning!
The technician must have technical skills to be able to safely install the equipment. The technician also must be trained to work in accordance with the national requirements for electrical equipment in hazardous areas.

2.8 Electrical

2.8.1 IEC safety standards

- The entire electrical installation must be in accordance with the International Standard EN IEC 60079-14 for electrical equipment in hazardous areas or with NEC (NFPA70) requirements.
- The stopping plugs, cable glands and reducers must be installed in accordance with appropriate IP requirements
- Use explosion proof (Ex-d) compound barrier glands (due >2 litres IIB) in case of use without SmartConn (Ex-e junction box).
- Use increased safe (Ex-e) cable glands in case a SmartConn box is used.
- Improper installation of cable glands, conduits or stopping plugs will invalidate the Ex approval of this device.

2.8.2 Grounding

Warning!
Make sure the housing of the device is properly connected to the ground reference! Make sure that the electrical resistance of the ground connection is below the maximum of prescribed by local requirements!

2.9 Accordance to regulations

2.9.1 Device without SmartConn

Type of protection:

ATEX / IEC Ex / CSA

Certificate numbers:
SmartRadar FlexLine: KEMA 07ATEX0010X and IECEX KEM 07.0003 X.
SmartView: KEMA 07ATEX0011X and IECEX KEM 07.0004 X.
SmartConn: KEMA 07ATEX0093 and IECEX KEM 07.0031.

Without SmartView: Ex d [ia] T6 Ta: -40 °C - +65 °C.
With SmartView: Ex d [ia] ia T4 Ta: -25 °C - +65 °C.

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FM

Without SmartView: Class EDIV Egroup C,D T6 NEMA 4X Ta: -40 °C - +65 °C.
With SmartView: Class EDIV Egroup C,D T4 NEMA 4X Ta: -25 °C - +65 °C.

CSA

Without SmartView: Class EDIV Egroup C,D T6 NEMA 4X Ta: -40 °C - +65 °C.
With SmartView: Class EDIV Egroup C,D T4 NEMA 4X Ta: -25 °C - +65 °C.

2.9.2 Device with SmartConn

Type of protection:

ATEX / IEC Ex / CSA

Without SmartView: Ex de [ia] T6 Ta: -40 °C - +65 °C.
With SmartView: Ex de [ia] ia T4 Ta: -25 °C - +65 °C.

2.10 Compliance to FCC, R&TTE

This device complies with EN 302372 of the R&TTE Directive and Part 15 of the FCC Rules. The device does not cause harmful interference and accepts any interference received.

Warning!
Changes or modifications made to this equipment not approved by Enraf B.V. invalidate the R&TTE/FCC authorization to operate this equipment.

Caution!
This equipment has been tested. It complies with a Field disturbance sensor device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates, uses and radiates radio frequency energy. If this device is not installed and used in accordance with the instructions, it can cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

> **NOTE**
> This device is certified to measure liquid levels in metal, concrete or similar materials, enclosed tanks.

> **NOTE**
> The radiated output power of the device is far below the exposure limits. Nevertheless, use the device in such a manner that the potential for human contact during normal operation is minimal.

2.10.1 EN302372-1 ANNEX B

The following installation requirements shall be fulfilled:

1 SmartRadar FlexLine instruments are required to be installed at a permanent fixed position at a closed (not open) metallic tank or reinforced concrete tank, or similar enclosure structure made of comparable attenuating material;
2 Flanges and attachments of the radar equipment shall provide the necessary microwave sealing by design.
3 Sight glasses shall be coated with a microwave proof coating when necessary (i.e. electrically conductive coating);
4 Manholes or connection flanges at the tank shall be closed to ensure a low-level leakage of the signal into the air outside the tank.
5 Whenever possible, mounting of the radar equipment shall be on top of the tank structure with the orientation of the antenna to pointing in a downward direction;
6 Installation and maintenance of the radar equipment shall be performed by professionally trained individuals only.

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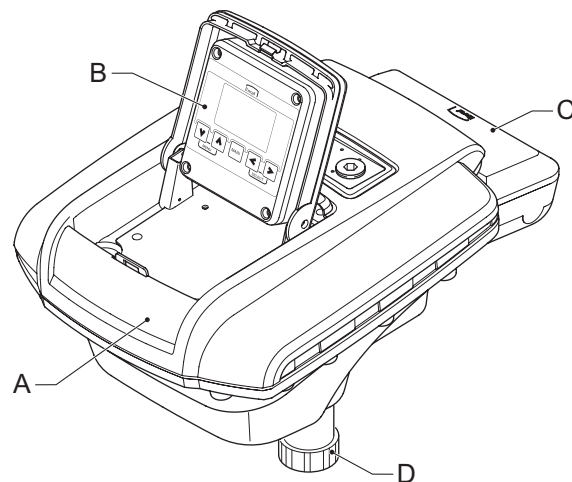# 3   Product Description

3.1   SmartRadar components

Fig. 3.1 System components

The device has following components:

A SmartRadar FlexLine with separator coupling to radar antenna
B SmartView (optional)
C SmartConn (optional)
D Antenna connection (refer to the antenna installation guide)

3.2   SmartRadar FlexLine

3.2.1   Function

The SmartRadar Flexline is the core component. It provides the level measurement, integrates optional sensor data and communicates via the fieldbus to the host computer system.
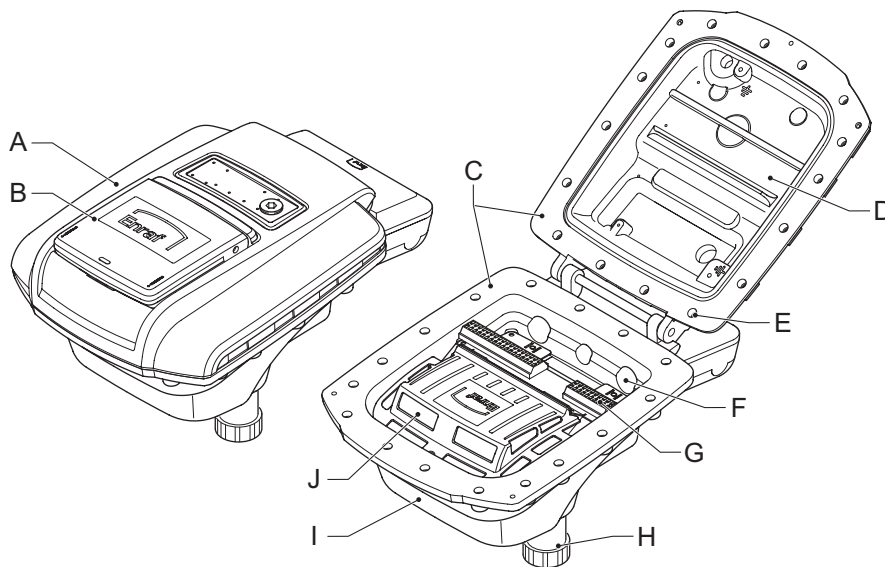
3.2.2 Components

Fig. 3.2 General view and main components of the FlexConn box (FCB)

A Top cover
B Display cover
C FlexConn box and FlexConn cover flange
D FlexConn cover
E Bolts with reduced shank (turn into thread when closing the cover)
F Cable entry
G Connection terminals with identification labels
H Separator coupling (connection between antenna and SmartRadar FlexLine)
I FlexConn box
J Inner cover (do not open, do not touch), tampering label

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3.3 SmartView

3.3.1 Function

The SmartView display can be part of the device. You can install it as stand alone version as well. In this case it is placed in a larger housing. Refer to the display installation guide.

3.4 SmartConn

3.4.1 Function

SmartConn is an optional Ex-e junction box and is only certified for ATEX, IEC Ex and CSA. It simplifies the external connection of the device and provides additional cable entries.

3.4.2 Components
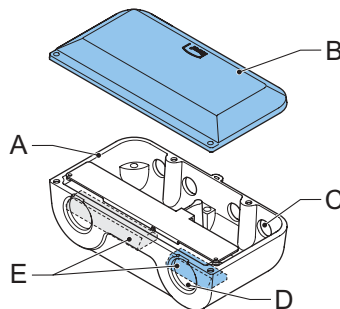
A Enclosure
B Cover
C Cable entry M20 (4 (6 is optional))
D Connection to FlexConn box
E Terminals for intrinsic safe and non intrinsic safe connections

3.5   Configurations

Each device has several configurations. They can differ in:

*   Accuracy of measurement
*   Allowed process temperature ranges
*   Chemical compatibility
*   Allowed tank pressure
*   Weights and Measurements (W&M) approval
*   Explosion safety approvals
*   Optional features like SmartView (Display) and SmartConn (junction box)
*   Allowed process temperature (Gas temperature)

4   Installation

4.1   Safety

⚠️ **Warning!**
Make sure that the power to the device is switched off, before you open the cover of the device.

⚠️ **Caution!**
Do not make any additional holes in the housing. Do not incorporate rotating machines or other devices, which create turbulence inside the FlexConn box.

⚠️ **Warning!**
Always clean the FlexConn box flange, when you open or before you close the housing.

4.2   Receipt

1. Open the box.
2. Make sure that following items are in the box:

   • The device
   • Safety instruction
   • Declaration of conformity
   • Installation guide

3. Inspect the package upon arrival. Make sure that the items are not damaged. Contact your local representative or Enraf B.V. in the event of damage.

ℹ️ NOTE
Do not throw away the packaging. The packaging is necessary for further transport on site. The packaging is necessary if the device is returned for service or warranty.

4.3   Storage

4.3.1   Storage of uninstalled devices

Keep the device in its original packing during storage. Keep the device indoors during storage.

Ambient conditions	
Temperature	-50 to +85 °C (SmartView -30 to +85 °C)
Humidity	20 to 90 %

4.3.2   Storage of installed devices

If you do not use an installed device for a longer period, we recommend not to disconnect the mains connection line. If this is not possible, put some moisture-absorbing material (e.g. silica gel) into the electronic compartment and store the device in a closed plastic bag.

4.4   Before installation

Make sure that following conditions are obeyed:

•   The antenna and the tank separator are already installed on the tank (refer to the Installation guide SmartRadar Antennas).
•   The top cover of the device can open without obstruction. Refer to illustration 4.1 for distances required for installation.
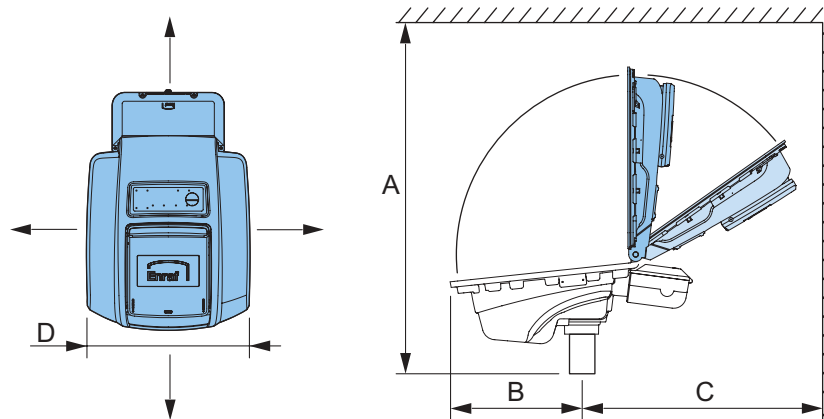
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Fig. 4.1 Distances to installed device

A   550 mm. (21.7")
B   260 mm. (10.2")
C   430 mm. (16.9")
D   300 mm. (11.8")

Device weight: 16,3 kg. (36 lbs)

4.5   Installation overview

Installation of the SmartRadar requires the following steps:
1. Mechanical installation of the device on the tank separator.
2. Preparations for connection
3. Installing the compound glands and conduits
4. Electrical connection
5. Finishing installation
These steps are further explained in the following sections.
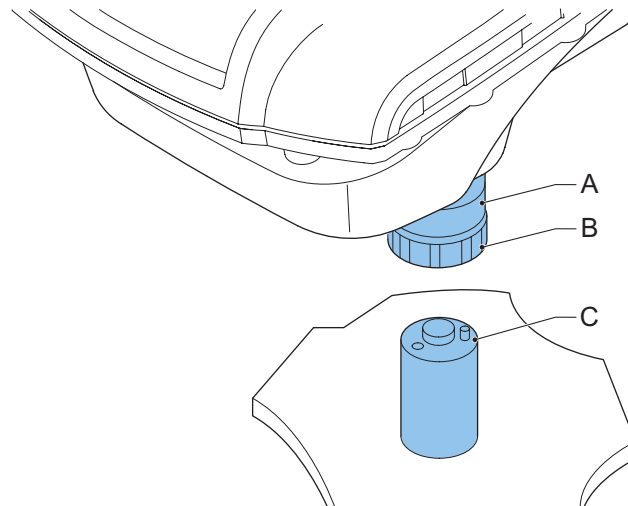
4.6   Mechanical installation

Fig. 4.2 Separator coupling and separator

Connect the SmartRadar to the tank separator.

1. Place the separator coupling (A) of the device on the tank separator (C). Make sure that the pin of the separator coupling fits into the corresponding opening of the tank separator.
2. Turn the ring (B) clockwise to fasten the device. Fasten the ring hand tight.

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4.7   Preparations for installation with SmartConn

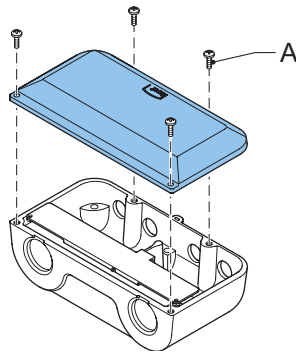### 4.7.1   Open the cover of the SmartConn

Fig. 4.3 SmartConn box
1. Loosen the 4 bolts (A) of the cover. Use an Allen key (4 mm).
2. Remove the cover.

4.8 Preparations for installation without SmartConn
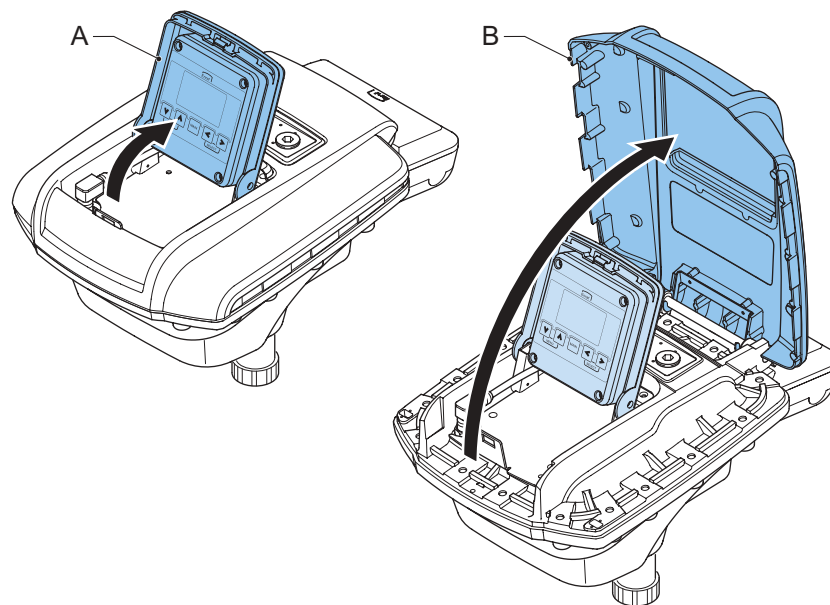
4.8.1 Remove the top cover

Fig. 4.4 Remove the top cover

1. Open the display cover (A).
2. Move up the top cover (B) at the front side and remove the top cover.

4.8.2   Open the cover
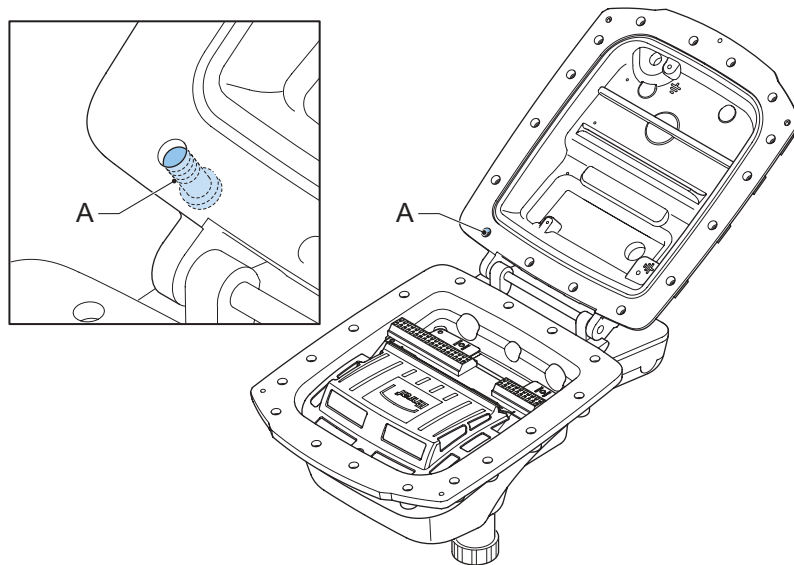

Fig. 4.5 Open the cover of the device

1. Loosen the 16 bolts of the cover. Use an Allen key (8mm).

WARNING!
Make sure that the 4 bolts (A) at the side of the hinge are entirely screwed into the cover and do not protrude beyond the flange of the cover.
Otherwise the flange of the housing can be damaged when closing the cover, and invalidate the Ex certificate!

2. Open the cover.

4.9 Installing the cable glands and stopping plugs with SmartConn

⚠️ **Warning!**
Only use Ex-e or flameproof certified materials of an appropriate IP value.

⚠️ **Warning!**
Improper installation of cable glands or stopping plugs will invalidate the Ex approval of the SmartRadar.

4.9.1 Cable glands

Increased safe (Ex-e) M20 cable glands with an appropriate IP value must be used. Refer to the type plate on the device.

ℹ️ NOTE
Install the cable glands according to the instructions provided by the manufacturer.

4.9.2 Unused cable inlets

Seal unused cable inlets with approved threaded stopping plugs.

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4.10   Installing the compound glands, conduits and stopping plugs without SmartConn

Depending on local regulations this device can be cabled by using compound glands, direct entry or conduits.

Warning!
Only use Ex-d certified materials of an appropriate IP value.

Warning!
Improper installation of cable glands, conduits or stopping plugs will invalidate the Ex approval of the SmartRadar.

NOTE
Only for use in ATEX and IEC Ex approved installations.

4.10.1   Compound glands

Explosion proof (Ex-d) compound glands with an appropriate IP value must be used.

NOTE
Install the compound glands according to the instructions provided by the manufacturer.

4.10.2   Conduits

Explosion proof (Ex-d) conduits with an appropriate IP value must be used. Refer to the type plate on the device.

Warning!
If the SmartRadar is installed in a hazardous area:

- Metal conduits must be used, size 3/4".
- Stopper boxes must be installed within 45 cm (18") of the device to seal the cabling in the conduit.

> **NOTE**
> Install the conduits according to the instructions provided by the manufacturer.

4.10.3   Unused cable inlets

Seal unused cable inlets with approved 3/4" threaded stopping plugs.

4.11   Electrical connection

> **Warning!**
> Cables must always comply with the defined cable specifications.

> **Warning!**
> - Minimum incoming wire cross section should be at least 0.2mm^2 and may consist of a single-, fine- or multi-wire. With the use of wire with a cross section between $\varnothing$0.2mm^2 and <0.5mm^2, the maximum current I [A] should be reduced to a maximum of I = 0.55A.
> - With a minimum wire cross section of $\varnothing$0.5mm^2 the maximum current I should not be higher then 3A and may consist of a single-, fine- or multi-wire.

> **NOTE**
> The field cabling entering the SmartConn box must be as short as possible.

> **NOTE**
> Depending on the ambient temperature classification the cables must be suitable for Ta > 70 °C.

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4.11.1   Grounding

The SmartRadar housing must be properly grounded to the ground reference (generally the tank), according to local regulations. This is a safety grounding requirement.

Warning!
When measuring the ground resistance, use a suitable instrument which is approved for use in hazardous areas.

Caution!
Safety depends on proper grounding. Check the resistance of the ground connection directly after installation. The measured ground resistance must be below the maximum prescribed by local and/or national grounding requirements.

4.11.2   Introduction

Caution!
The intrinsically safe options have been certified for use in hazardous areas. Make sure that the certificate of approval is available on site and act in accordance with the instructions as given in the certificate.

Caution!
Intrinsically safe wiring must be separated from all other wiring. The cable lay-out must be in accordance with local and/or national regulations.

NOTE
Connect the armouring of the cable externally in the cable gland at both ends of the cable.

Location

The terminal compartment is located at the rear, inside of the device (refer to figure 4.7). If there is a SmartConn present, you use the terminals of the SmartConn (refer to figure 4.6). These terminals are numbered identical to the terminal compartment in the device.

Connections

The intrinsically safe cabling must enter at the gland (C) only. This entry is marked "Ex-i". Refer to figure 4.6. "Ex-i entry with SmartConn". Blue marked cables are recommended for the intrinsically safe options.
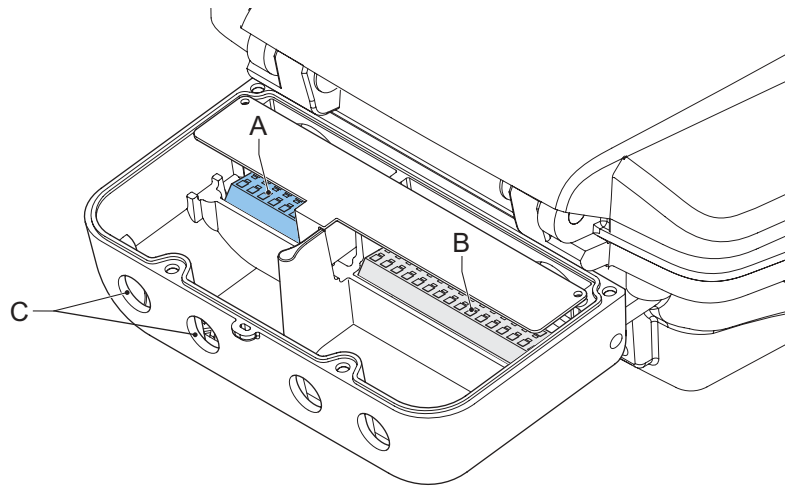

Fig. 4.6 Ex-i entry with SmartConn

A   Blue terminals, for intrinsically safe connections.
B   Grey terminals, for non-intrinsically safe connections.
C   Glands for intrinsically safe cabling only.

NOTE
The SmartConn box is also available with 6 cable entries.

Terminals

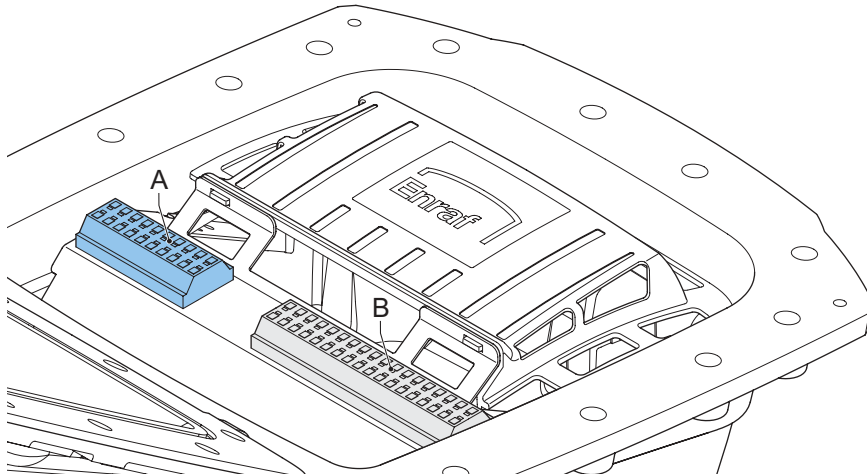The terminal compartment is divided into two zones:

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Fig. 4.7 Terminal layout without SmartConn

• Blue terminals (A), for intrinsically safe connections, such as HART, VITO and SmartView.
• Grey terminals (B), for non-intrinsically safe connections.

The indices of the terminals are variable. For each option there are indices on the terminal row. They are specified in a label attached in front of the terminal row, as is schematically indicated in figure 4.8.
The terminals for the power supply are standard.
Some terminal contacts can be double labelled. In this case the white text on black label is the first option for connection. The black text on white label is the second option for connection.
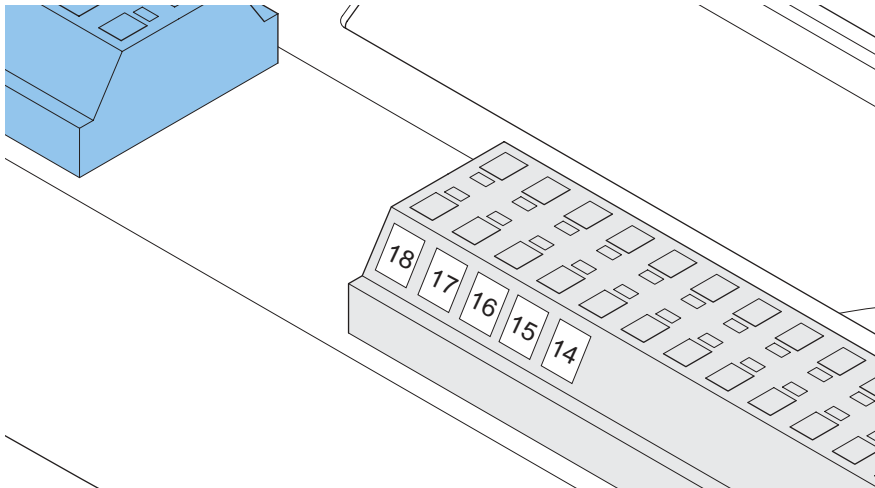
Fig. 4.8 Terminal labelling

General procedure

The general procedure for electrical connection is:

1 Connect the wiring to the terminals with the numbers as shown in the tables in the following sections.

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4.11.3   Non-intrinsically safe connections

The non-intrinsically safe connections are connected to the grey wiring terminal.
If local and or national regulations allow, the power supply, Enraf fieldbus and
hardware relay outputs can be combined in one, unshielded, cable.
A separate cable can also be used for each.

Power supply

Connect the power supply to either:

-   DC: 24 - 65 Volt
-   AC: 65 - 240 Volt

> **i** NOTE
> The DC polarity is not critical.

> **i** NOTE
> Install an explosion proof mains switch in the mains cable to the
> SmartRadar.

Cable specifications	
Type	Suitable for the SmartRadar power rating and approved for use in hazardous areas

Label	Parameters
00. Vin-a/L	24-65 Vdc -15/+10%
01. Vin-b/N	65-240 Vac -15/+10% 50/60 Hz ± 10% Automatic selection

Enraf fieldbus (BiPhase Mark)

Cable specifications	
Type	Twisted pair. R_{max} = 200 Ohm /line, C_{max} = 1 μF.
Maximum length	10 km.

Label	Parameters
06. TL1	1200/2400/4800 bps
07. TL2	Selection by software

Topology

A maximum of 10 devices can be connected to the Enraf field bus line.

For short distances up to 20 devices can be connected. This number will be specific to every situation.

Host communication EIA 485

Cable specifications	
Type	Twisted pair, shielded
Maximum length	1200 meter

> **NOTE**
> If necessary the 'common' of the EIA 485 can be connected to the ground GND_ISO.

Label	Parameters
11. 485A	1k2/2k4/4k8/9k6/19k2/38k4 bps
12. 485B	Selection by software
13. GND_ISO	

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Topology

Up to 31 gauges can be connected to one EIA 485 Host communication. The gauges are connected in parallel, as described in figure 4.9.
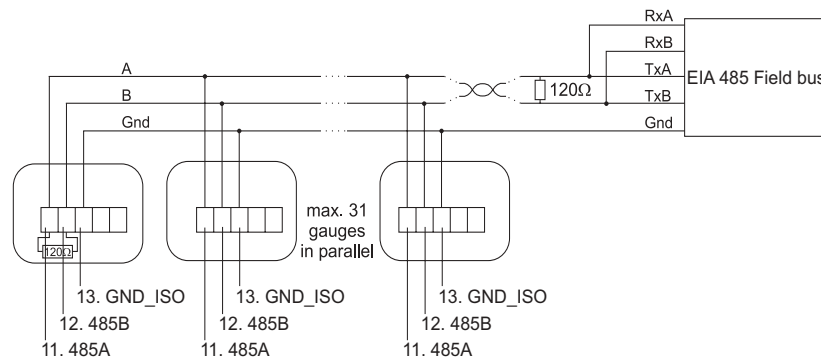

Fig. 4.9 EIA 485 topology

Host communication EIA 232

Cable specifications	
Type	Shielded
Maximum length	15 meter

Label	Parameters
08. 232RX	38k4/19k2/9k6/4k8/2k4/1k2 bps
09. 232TX	Selection by software
10. GND_ISO	

Topology

EIA 232 Host communication is for point-to-point communication. One gauge can be connected per host.
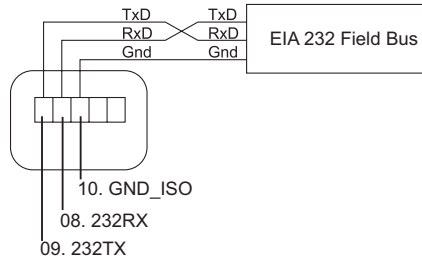
Fig. 4.10EIA 232 topology

Hardware relay outputs

The hardware relay outputs can be used as an alarm signal or to operate a remote device.
The signals corresponding with the terminal labels are programmed during commissioning.

Cable specifications	
Type	Approved for use in hazardous areas and suitable for the specified power rating.

Label	Parameters
14. Ry1_a 15. Ry1_b	V_{max} = 125 Vac, I_{max} = 0,5 A V_{max} = 110 Vdc, I_{max} = 0,3 A P_{max} = 30W NO/NC by factory jumper
16. Ry2_a 17. Ry2_b	V_{max} = 125 Vac, I_{max} = 0,5 A V_{max} = 110 Vdc, I_{max} = 0,3 A P_{max} = 30W NO/NC by factory jumper (default = NO)
18. Ry3_a 19. Ry3_b	V_{max} = 250 Vac, I_{max} = 3 A V_{max} = 40 Vdc, I_{max} = 3 A P_{max} = 750W NO/NC by factory jumper

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Label	Parameters
20. Ry4_a	V_{max} = 250 Vac, I_{max} = 3 A
21. Ry4_b	V_{max} = 40 Vdc, I_{max} = 3 A P_{max} = 750W NO/NC by factory jumper

4.11.4 Intrinsically safe connections

The intrinsically safe connections are connected to the blue wiring terminal.

VITO

For temperature and water bottom measurement.

Cable specifications	
Type	Twisted pair, shielded. R_{max} = 25 / line
Maximum length	1000 meter

Label	Parameters
22. V_Loop	[Ex ia] IIB
23. GND_Loop	U_o = 23,1 V I_o = 124 mA P_o = 0.6 W C_o=1.0 µF L_o = 9 mH

Topology
Only one device can be connected to the VITO connection.

HART

Cable specifications	
Type	Twisted pair, shielded. $R_{max} = 25$ / line
Maximum length	1000 meter

Label	Parameters
24. V_Loop	[Ex ia] IIB
25. GND_Loop	$U_o = 23,1$ V $I_o = 124$ mA $P_o = 0.6$ W $C_o = 1.0$ µF $L_o = 9$ mH

Topology
A maximum of 5 devices can be connected to the HART connection.

Caution!
Before connecting the HART devices:
Check if the sum of the start up currents fits the parameters.

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Stand-alone SmartView display

The labelling on the wiring terminal in the SmartView is identical to the labelling in the SmartRadar.

Cable specifications	
Type	4-wire, shielded
Maximum length	50 meter

Label	Parameters
26. SGND	[Ex ia] IIB
27. Vsafe_+	U_o = 14,2 V
28. Safe_A	I_o = 522 mA
29. Safe_B	P_o = 1,7W
	C_o=2,18 µF
	L_o = 0,25 mH

4.12   Finishing installation with SmartConn

Warning!
Check if the separation between intrinsic and non intrinsic cabling is sufficient and complies with any local and/or national regulations.

1. Replace the cover on the SmartConn.
2. Tighten the 4 bolts of the cover. Use an Allen key (4 mm).
3. The installation is now completed.

4.13   Finishing installation without SmartConn

⚠️ **Warning!**
Tighten all bolts with a torque of 30 Nm (711 ft·lb$_f$) to prevent danger of explosion!

⚠️ **Caution!**
Always clean the flange of the housing and the cover, before you close the cover.

4.13.1   Close the cover of the device

⚠️ **Warning!**
Make sure the flange of the housing is clean and the O-ring is not damaged before closing the cover.

1. Close the cover. Make sure that the cover does not squeeze any cables inside the housing.
2. Tighten the 16 bolts of the cover. Tighten the bolts crosswise. Use an Allen key (8mm).

4.13.2   Replace the top cover

1. Open the display cover.
2. Place the 2 hooks at the rear of the top cover behind the axis of the cover.
3. Push down the top cover carefully.
4. The installation is now completed.

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5   Technical data

5.1   Weights and dimensions

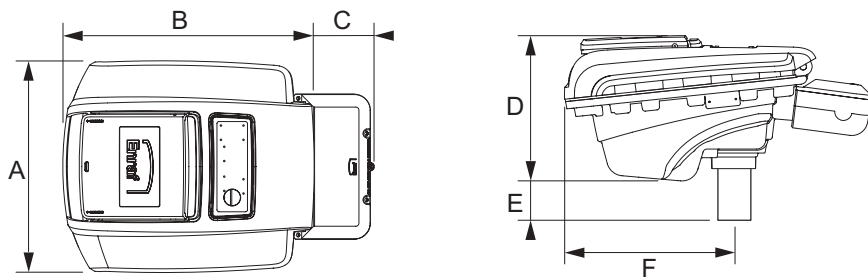*Fig. 5.1 SmartRadar and SmartConn dimensions*

A   300 mm (11,82").
B   330 mm (12,99").
C   90 mm (3,54").
D   220 mm (8,66").
E   70 mm (2,76").
F   260 mm (10,24").

Weight: 13,6 kg (36 lbs).

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Installation Guide
Article Nr. 4417760
Revision: 01