



PSM INSTRUMENTATION LTD

Installation Operation & Maintenance Instruction Manual

- **ICT 1000 Level Transmitter**
- **RFM 1 & RFM 4 Network Connection Modules**
- **RFM ISR Network Barrier Module**

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1 General Information ICT 1000, RFM 1 & 4 and RFM ISR

1.1 Safety instructions

To prevent any damage to the device or any injury to the user it is essential that you read the information in this document and observe applicable national standards and safety requirements.

This document is provided to help facilitate the safe and efficient operation of the instrument.

1.2 Product liability and warranty

All apparatus is carefully examined and tested before leaving the workshop and is sent out in perfect order and condition. We, therefore, give the following Guarantee which takes the place of any Guarantee by Statute, common law or otherwise. If within 12 months from date of despatch, any defect or fault is discovered in any component of our manufacture, due to faulty material or bad workmanship, we undertake to make good the defect without charge, provided that notice is given to us immediately on the discovery of the defect and the defective components or parts thereof, are forwarded to us carriage paid for inspection. This guarantee does not apply to defects caused by ordinary wear and tear, misuse, neglect, or by circumstances over which we have no control.

Full terms and conditions are available from our website: www.psmmarine.com/about-us

1.3 Scope of delivery

Inspect the packaging and immediately report any signs of damage to your local agent or PSM Instrumentation.

Check the delivery note to ensure you have received the correct instrument(s).

1.4 Storage

- Store the instrument in a dry location
- Storage Temperature range -20°C to $+80^{\circ}\text{C}$

1.5 Instrument identification

Each instrument is marked with a unique serial number and model code, that identifies type and construction options. This takes the form 123456(78)

1.6 Operations and maintenance

There is no routine maintenance required for the ICT 1000 or RFM modules , other than an occasional check to ensure all wiring/cable glands are in good condition

For the ICT 1000 periodically check that the measurement cell is free from contamination.

1.7 Instrument return

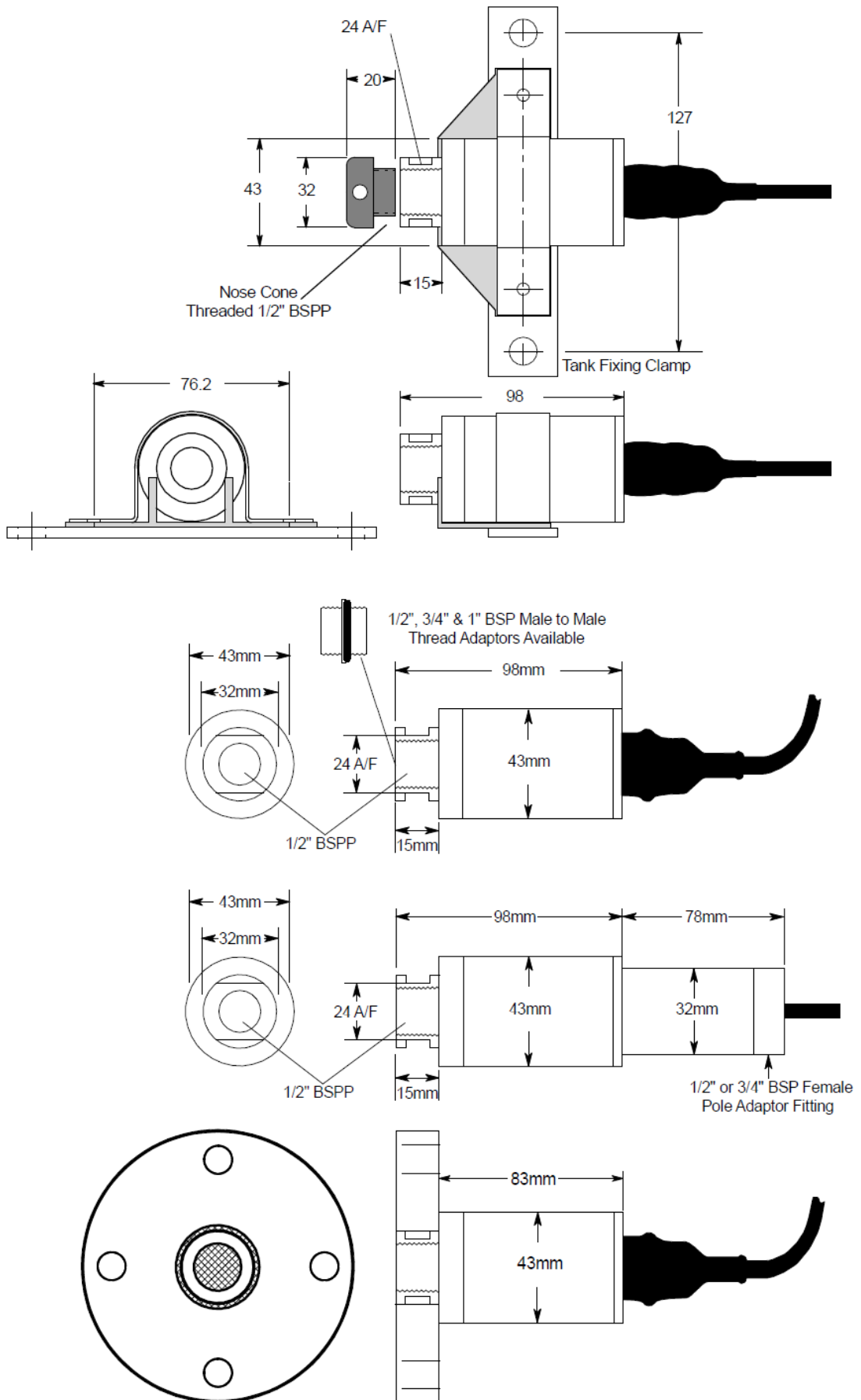
All equipment is carefully examined and tested before leaving the workshop and is sent out in perfect order and condition.

Should it prove necessary to return any equipment for inspection, please ensure you follow the process:

- Contact PSM for an RVN form and number
- The equipment must be accompanied by an RVN with clear instructions as to the reason for return and what actions are requested.
- An explanation of the apparent fault together with details of the service conditions are also required.
- Health & Safety requirements mean that we must be fully aware of any potential hazards prior to working on returns.

Full terms and conditions are available from: www.psmmarine.com/about-us

2.1 Dimension drawing ICT 1000



2.2 Mechanical installation ICT 1000

Prior to installation it is recommended that the following checks are made:

- That any specific factory calibration is in accordance with the process parameters and tank height and that the ICT 1000 nominal range is suitable for the intended duty.
- In analogue mode only, that the mA range is programmed correctly
- In digital mode, that the application parameters such as SG, tank table, duty etc. are programmed correctly. This can be done using the PSM ISS software configuration tool.
- Any instrument identification or tag number to ensure it is fitted in the correct location.

The cable is factory fitted to the ICT ensure a pressure tight seal. and no attempt should be made to remove the cable gland.

Instrument handling

Before and during installation the following precautions should be taken

- Do not touch the measurement cell of the ICT 1000 level transmitter
- Do not apply mains voltage to any cable conductor
- Ensure the ICT 1000 cable is free from damage and defects

Sensor cable

The cable that is factory fitted to the transmitter is purpose designed for the application. It contains a nylon vent tube which provides an atmospheric reference for the sensor if constructed for a "gauge" measurement application. The end of the nylon tube has a short section of silicon tube fitted, which carries a sintered filter. This filter provides a pressure path, but prevents any moisture entering the vent tube and **MUST** remain in place. If the cable is shortened this filter must be transferred to the new cable end.

Note that if the ICT 1000 is constructed as an "absolute" measuring device, then there is no requirement to vent the instrument cable to atmosphere. Precautions must still be taken however to prevent moisture ingress into the cable vent tube.

The cable construction is of sufficient strength to enable the sensor to be directly suspended in deep wells and reservoirs. The outer sheathing is a special material suitable for continuous immersion in water, and many oils and chemicals. When handling the cable take particular care not to damage the outer sheathing.

When a transmitter is suspended by its cable use a proprietary suspension cleat or wind three or four turns around a 100mm diameter pipe or drum. Where the cable is to be brought through the tank wall it is recommended that where possible this be done above the maximum fill line using a suitable compression fitting. (Available from **PSM**).

Ensure the cable is not bent to a radius less than 50mm.

When mounting the sensor allow sufficient free cable at the transmitter end to allow easy removal for testing without straining the gland in the transmitter body.

Sensor fitting height

When a transmitter is used in tank level or volume applications it is essential to ensure that the sensor is fitted at a known position and height above the bottom of the tank. This data must be accurately recorded in the form of X,Y,Z coordinates referenced to known datums on the vessel e.g. baseline, keel or frame numbers.

All calibration data, and any trim or heel tank level measurement correction calculation will be related to this fitting position, as well as the displayed values on any monitoring equipment connected to the level transmitter.

Mounting

When mounting the unit ensure that suitable gaskets or sealants are employed to provide pressure tight seals. The sensor should not be mounted where it will be subject to excessive or continuous vibration, extreme temperature fluctuation or risk of mechanical damage.

Secure the cable as required over longer runs to prevent mechanical abrasion if it moves.

Do not secure the cable to any localised sources of high temperature heating such as steam coils used in heavy oil tanks.

2.3 Electrical installation ICT 1000

The ICT 1000 is a dual mode transmitter offering both a conventional 2 wire 4-20mA output and / or an RS485 serial output with communication based on the Modbus RTU protocol.

The ICT 1000 is also available for hazardous area installation. For such applications additional safety components are required to limit the amount of energy that can be transmitted from the safe to hazardous side.

Refer to the applicable sections

ICT 1000/I	ATEX	Section: 2.4
ICT 1000/X	IECEX	Section: 2.5

Isolated power supplies

For all installations of the ICT 1000 it is important that the instrument is powered from an isolated power supply. The use of a non-isolated power source could lead to issues with any onboard earth fault monitoring system, unwanted earth current loops and the possibility of instability / interference caused by any other equipment on the same power supply

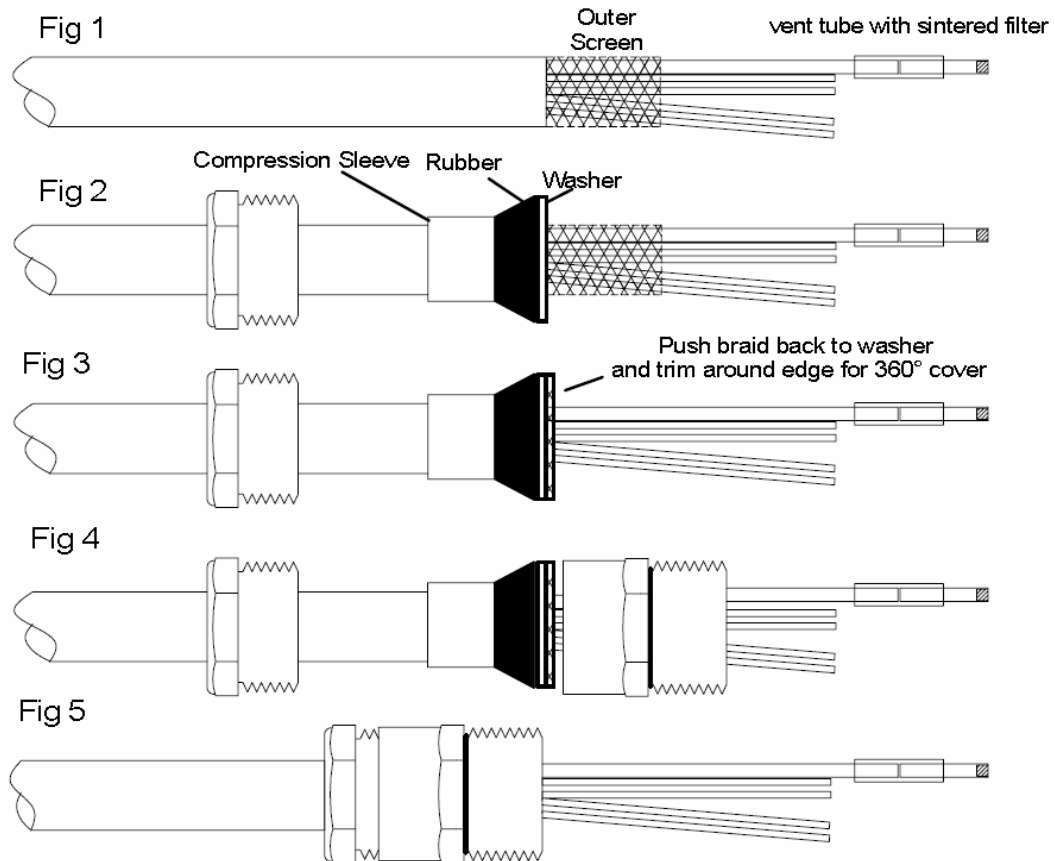
It is also essential to ensure that the sensor body is earthed by secure connection to the ship's structure. This is both to prevent possible galvanic corrosion effects in installations such as ballast tanks and to ensure effective protection against the effects of EMC due to electrical noise from other equipment. Depending on the mounting used this connection may be already made via the mounting flange or tank fixing clamp. However if this is not certain due to tank construction materials or coating. Then a separate bonding strap or connection must be employed.

Electromagnetic Compatibility

To maintain compliance to the EMC standards the following should be observed:

- Instrument body to be earthed
- The overall braid **MUST** be terminated in the entry gland
- The termination enclosure material to be metal or RFI screened
- All input/output cables from the termination enclosure to have overall braided screen terminated to entry gland
- All cable screens should be terminated to the appropriate cable glands
- All termination enclosures should be bonded to earth using an independent earth bonding strap. This strap should consist of either:
 - 2 x Copper conductors each minimum csa 1.5mm²
 - 1 x Copper conductor minimum csa 4mm²

Cable screen termination ICT 1000



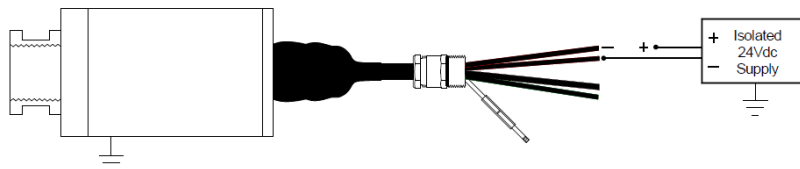
Cable is normally provided to the required length with the ends terminated as depicted above.

The overall braid **MUST** be terminated in the entry gland of the termination enclosure to ensure it is earthed. Particular care should be taken to **ensure that the 360° screen is maintained** to comply with the EMC standards of this unit.

If, exceptionally, the cable has to be shortened, the nylon vent tube should be cut to a free length of approximately 20mm within the enclosure, it must be ensured that this tube is not blocked or otherwise restricted and the silicon tube containing the sintered filter must be re-fitted to the shortened length.

The termination enclosure **MUST** be vented.

Analog and Digital cable identification



Red	+ Power	Analogue	White	+ Data	Digital
Black	- Power	(4-20 mA)	Green	- Data	(Modbus)

Connecting the ICT 1000 Modbus digital output to a RS 485 port

See also Man 052f ICT 1000 & RFM Network Manual

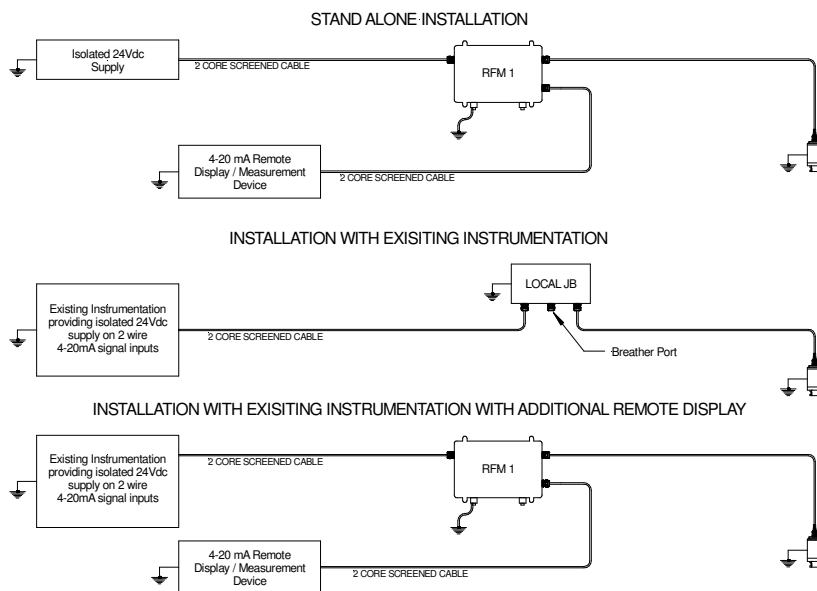
We recommend using the following devices

- EASYSYNC Isolated USB to RS-485 Converter (ES-U-2101-M)

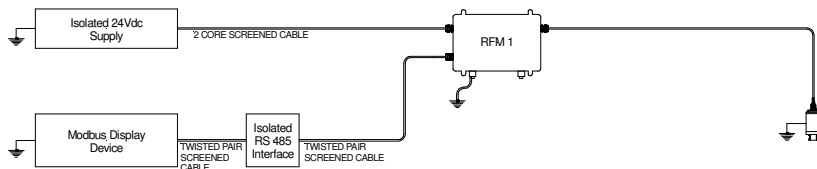
For details of the full functionality and supported functions refer to **Manual 053 ICT 1000 Functionality & Communications Protocol**.

Red	Positive	Power Supply 4-20mA
Black	Negative	
White	A data +	RS485 Modbus
Green	B data -	

Single ICT 1000 Safe Area Connection



Single ICT 1000 digital mode safe area connection



2.4 Additional ATEX Requirements ICT 1000/I

For intrinsically safe installations the ICT 1000/I units in the hazardous area must be connected to the safe area via approved safety barriers. These barriers fall broadly into two categories:

- Zener barriers (based on the shunt diode principle)
- Galvanic isolators

Either type of barrier may be employed subject to it meeting the required safety description. PSM can provide guidance on a range of suitable barriers.

Shunt diode Zener barriers provide a resistor to limit the current flow, a (non-replaceable) fuse to limit power and a Zener diode arrangement to limit voltage levels and provide a safe path to earth. Zener barriers tie the 0v side of the transmitter supply to earth either directly or via a diode arrangement. They must be connected to a high integrity earth to function as intended.

Intrinsically Safe Earth Connections are required to be made but should be made to a separate instrumentation 'Clean Earth'

There are generally two earthing systems recognised. The so-called 'dirty earth' has all the non-critical data equipment and general equipment attached to it. The 'clean earth' has all the critical data systems attached to it on the basis that less 'noise' will be found on this earth

The PSM ISR module is an example of a shunt diode zener barrier . It has been developed specifically to work with the ICT 1000/I transmitter and provides the ability to power up to 100 transmitters when used in digital RS485 mode. It is a dual function barrier which provides protection for both power and data connections to the ICT 1000/I.

Note that when an ICT 1000/I is used in analogue (4-20mA) mode a safety barrier must be used for each individual transmitter. When used in digital RS485 mode both the power and data communications circuits must be protected.

Isolators provide full galvanic isolation between safe area and hazardous area circuits with power limiting achieved by using a diode resistor network similar to that of a shunt-diode barrier. They do not require a high integrity earth, each side may be earthed independently overcoming potential issues with earth loops.

For all intrinsically safe installations of the ICT 1000 it is essential that this instrument is powered from an isolated power supply. When a zener barrier is employed for power limiting this will effectively tie the sensor supply 0V to earth, meaning a non-isolated power source will lead to issues with any onboard earth fault monitoring system, resulting in unwanted earth current loops and instability / interference caused by any other equipment on the same power supply

The use of an isolated supply means that there is no direct connection between the 0 volts / I.S. earth at the sensor and the 0 volts at the ships supply

ICT 1000/I ATEX Approval

The optional intrinsically safe version of the ICT 1000/I is covered by the following certification for use in hazardous areas.

Approval Certification

- ITS09ATEX26339X



Ex ia IIC T4 (T amb -20°C to +80 °C)

ia Intrinsic Safety
IIC Acetylene & Hydrogen (Presence of Flammable/Combustible gas)
T4 135°C (Maximum Surface Temperature)

Barrier selection

When selecting a Barrier the following parameters must be complied with:

U_i = 28Vdc
I_i = 150mA
P_i = 0.8W
L_i = 0
C_i = 49nF(28V) and 948nF(11.8V)

Conditions of Certification

When used with Zener barriers instead of the PSM Instrumentation Ltd proprietary RFM ISR module, all devices must be supplied through one pair of 28v (power supply) and 9V (communications) barriers or each transmitter must have its own pair of barriers.

It is not permitted to use separate power supply barriers and one communication barrier.

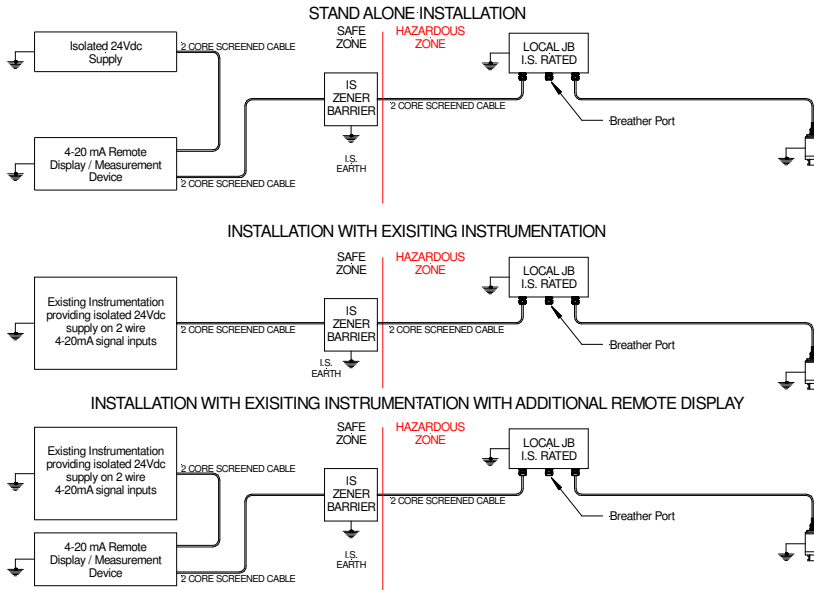
Installation requirements

The following standard should be followed when carrying out a hazardous area installation:
60079 Part 14

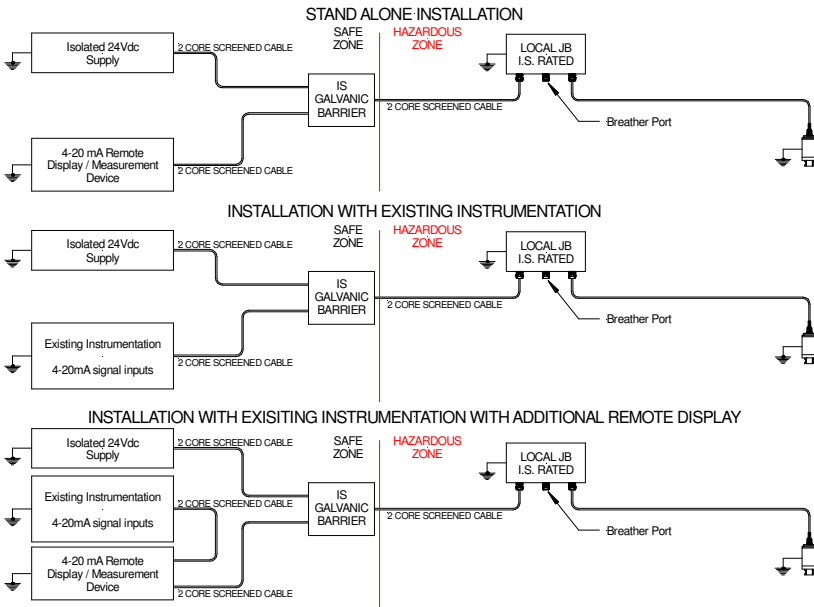
Strictly no modifications or user repairs are allowed

If any problems occur with the equipment please contact PSM Instrumentation.

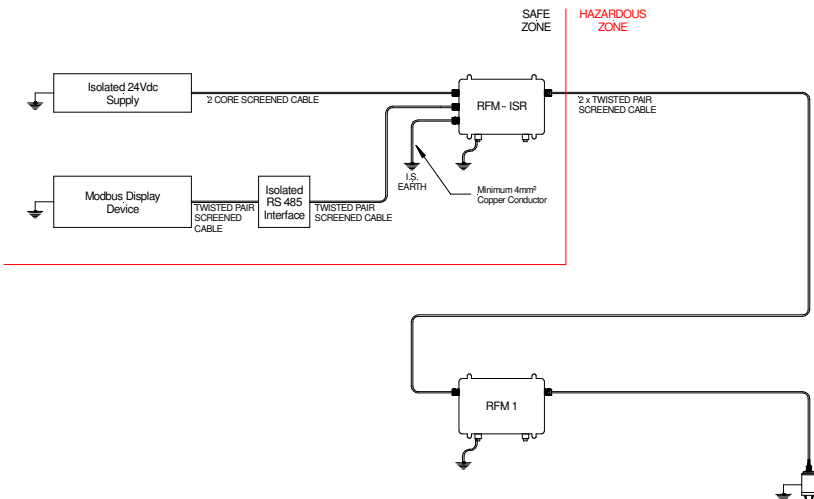
Single ICT 1000/I Hazardous Area Connection using a Zener barrier



Single ICT 1000/I 4—20 mA hazardous area using a galvanic barrier



Single ICT 1000/I digital mode hazardous area using a Zener barrier connection



2.5 Additional IECEx Requirements ICT 1000/X

For intrinsically safe installations the ICT 1000/I units in the hazardous area must be connected to the safe area via approved safety barriers. These barriers fall broadly into two categories:

- Zener barriers (based on the shunt diode principle)
- Galvanic isolators

Either type of barrier may be employed subject to it meeting the required safety description. PSM can provide guidance on a range of suitable barriers.

Shunt diode Zener barriers provide a resistor to limit the current flow, a (non-replaceable) fuse to limit power and a Zener diode arrangement to limit voltage levels and provide a safe path to earth. Zener barriers tie the 0v side of the transmitter supply to earth either directly or via a diode arrangement. They must be connected to a high integrity earth to function as intended.

Intrinsically Safe Earth Connections are required to be made but should be made to a separate instrumentation 'Clean Earth'

There are generally two earthing systems recognised. The so-called 'dirty earth' has all the non-critical data equipment and general equipment attached to it. The 'clean earth' has all the critical data systems attached to it on the basis that less 'noise' will be found on this earth

Note that when an ICT 1000/I is used in analogue (4-20mA) mode a safety barrier must be used for each individual transmitter. When used in digital RS485 mode both the power and data communications circuits must be protected.

Isolators provide full galvanic isolation between safe area and hazardous area circuits with power limiting achieved by using a diode resistor network similar to that of a shunt-diode barrier. They do not require a high integrity earth, each side may be earthed independently overcoming potential issues with earth loops.

For all intrinsically safe installations of the ICT 1000 it is essential that this instrument is powered from an isolated power supply. When a zener barrier is employed for power limiting this will effectively tie the sensor supply 0V to earth, meaning a non-isolated power source will lead to issues with any onboard earth fault monitoring system, resulting in unwanted earth current loops and instability / interference caused by any other equipment on the same power supply

The use of an isolated supply means that there is no direct connection between the 0 volts / I.S. earth at the sensor and the 0 volts at the ships supply

ICT 1000/X IECEx Approval

The optional intrinsically safe version of the ICT 1000/X is covered by the following certification for use in hazardous areas.

Approval Certification

- IECEx ITS 15.0031X

Ex ia IIC T4 (T amb –20°C to +80 °C)

ia Intrinsic Safety
IIC Acetylene & Hydrogen (Presence of Flammable/Combustible gas)
T4 135°C (Maximum Surface Temperature)

Barrier selection

When selecting a Barrier the following parameters must be complied with:

U_i = 28Vdc
I_i = 150mA
P_i = 0.8W
L_i = 0
C_i = 49nF(28V) and 948nF(11.8V)

Conditions of Certification

When used with Zener barriers instead of the PSM Instrumentation Ltd proprietary RFM ISR module, all devices must be supplied through one pair of 28v (power supply) and 9V (communications) barriers or each transmitter must have its own set of barriers.

The installer and user must exercise caution to avoid the accumulation of electrostatic charge on non-metallic parts of this equipment.

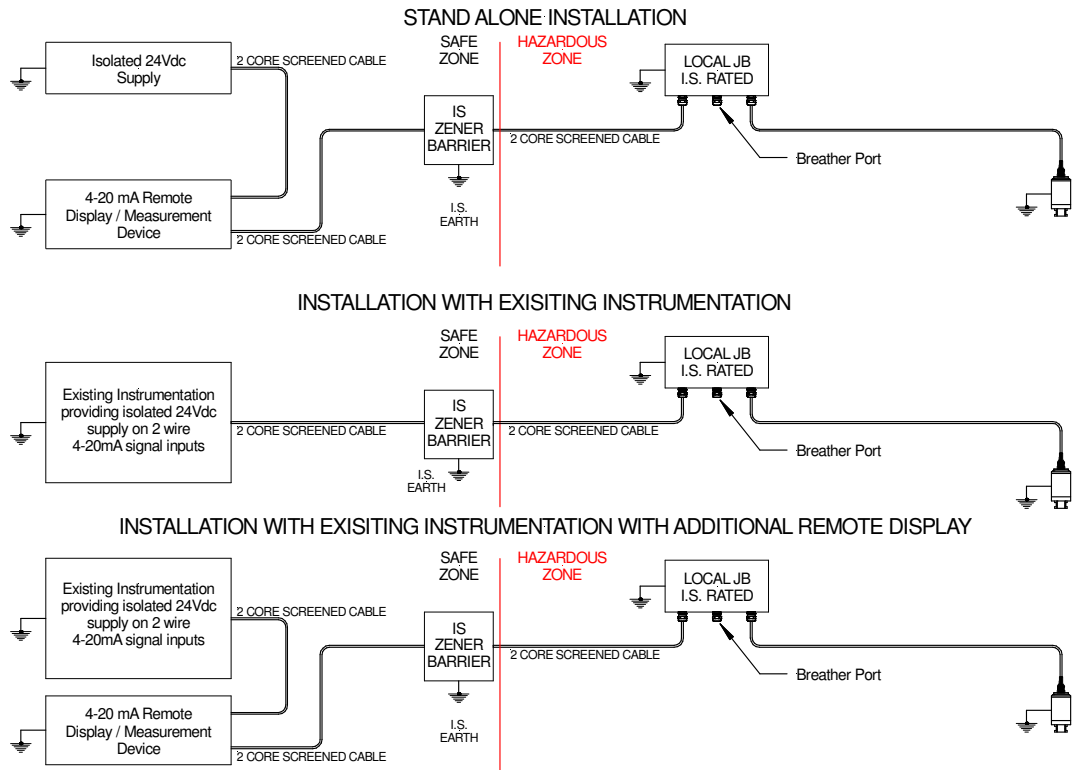
Installation requirements

The following standard should be followed when carrying out a hazardous area installation:
60079 Part 14

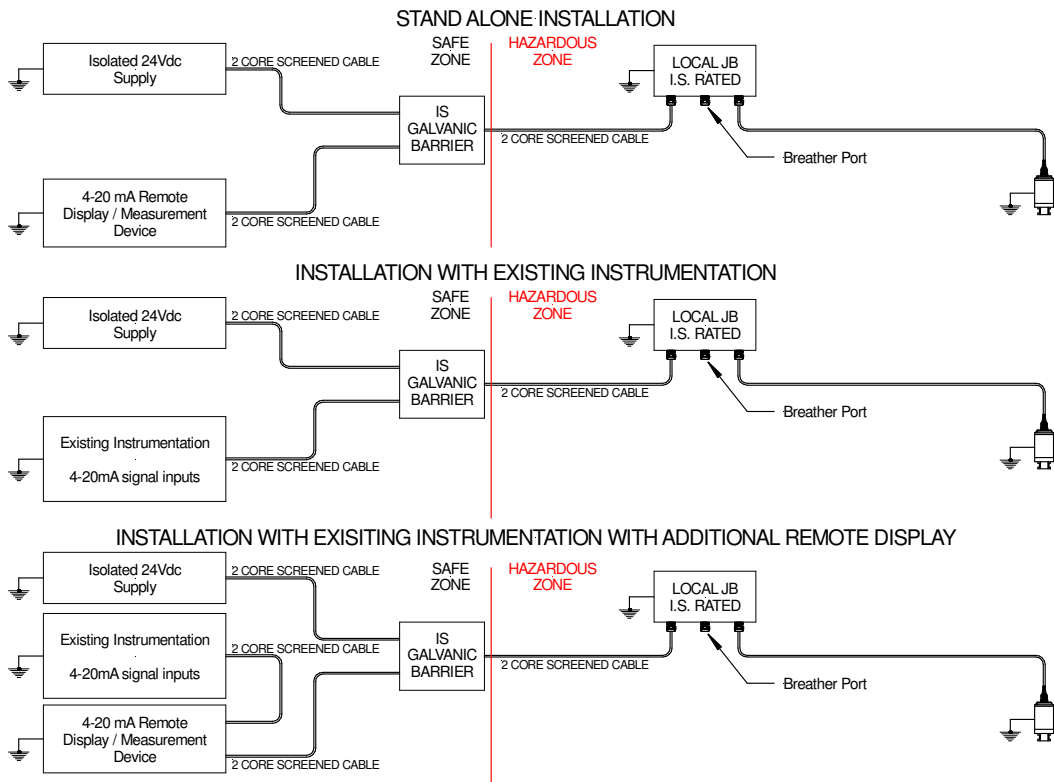
Strictly no modifications or user repairs are allowed

If any problems occur with the equipment please contact PSM Instrumentation.

Single ICT 1000/X Hazardous Area Connection using a Zener barrier



Single ICT 1000/X 4—20 mA hazardous area using a galvanic barrier



2.6 Technical specifications ICT 1000

Specifications			
Power Supply Digital Only Mode	8 - 30 Vdc	Isolated external PSU required	
Power Supply Including Analogue Mode	12 - 30 Vdc		
Accuracy: Level (at 20 °C and 1 bar)	± 0.1% FS (Digital mode only) ± 0.25% FS (Analogue mode or Dual mode)		
Long term stability	< ± 0.2% FS per year		
Accuracy: Temperature	± 1 °C (Measurement available in digital mode only)		
Temperature coefficient	± 0.025% FS per 1 °C (Over calibration range of 0—60 °C Other temperature ranges on request)		
Programmable measurement range	-10 mbar up to 20 bar (Gauge or Absolute reference options)		
Measuring cell pressure overload ratings	Range (Bar)	Proof Pressure (Bar)	Burst pressure (Bar)
	0.20	1.4	2.7
	0.35	1.5	3
	1	3	5
	2	6	10
	5	15	25
	10	30	50
	20	60	100
Analogue Output	4 – 20mA. 2 wire loop powered		
Digital Output	RS485 MODBUS 2 wire half duplex		
Sensing Element	Ceramic (96% AL ₂ O ₃) measuring cell		
Construction	316 SS with Kalrez seal and LSHF PET-E sheathed cable		
Operating Temperature	-20 °C to +80 °C		
IP Rating	IP68 (suitable for continuous immersion)		
Intrinsic Safety	Ex ia IIC T4		

3 General Information RFM 1 & 4 and RFM ISR

3.1 RFM Series

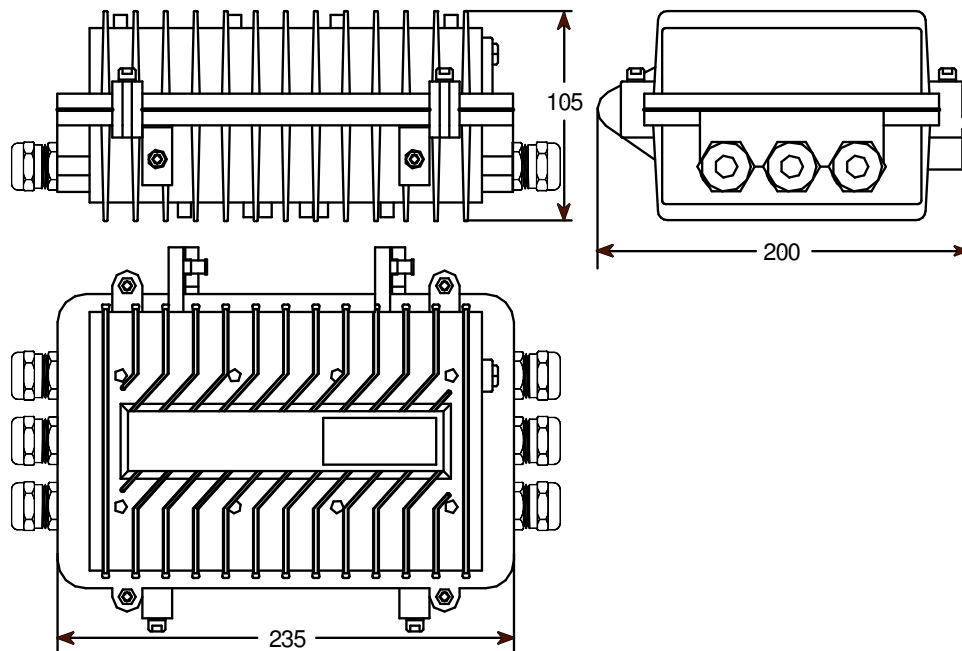
The RFM Series can provide local termination and regulated supply to an ICT network.

It also can provide the required safety components for a hazardous area installation

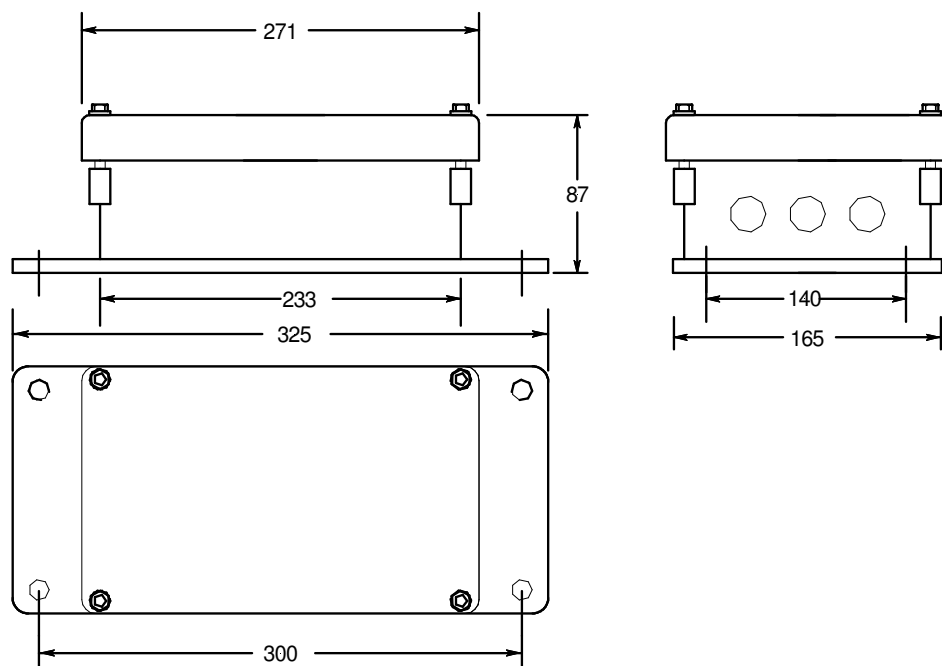
Note: ONLY APPLICABLE to the ICT 1000/I ATEX approved product

3.2 Dimension drawing IRFM 1&4 and RFM ISR

Aluminium case construction

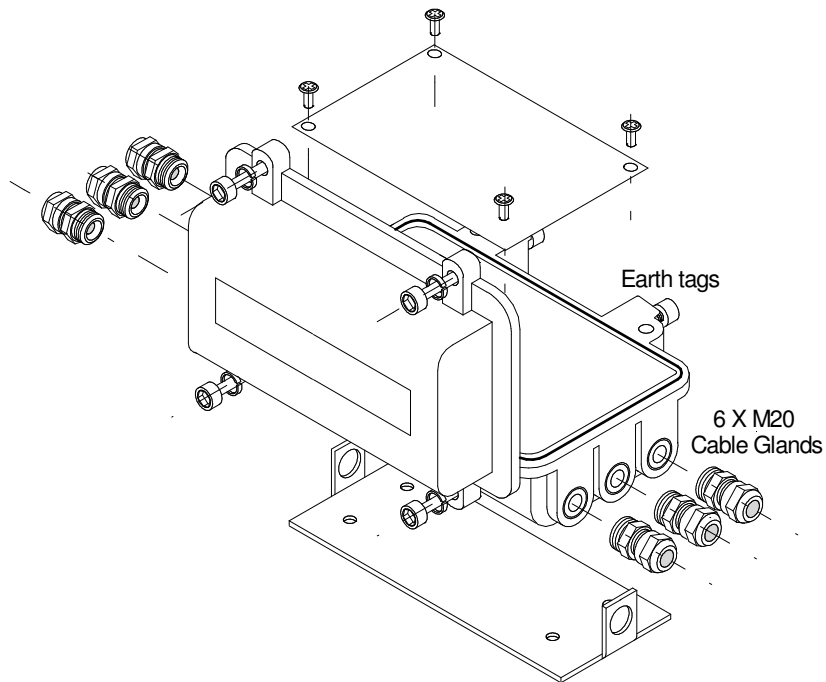


Painted carbon steel case construction

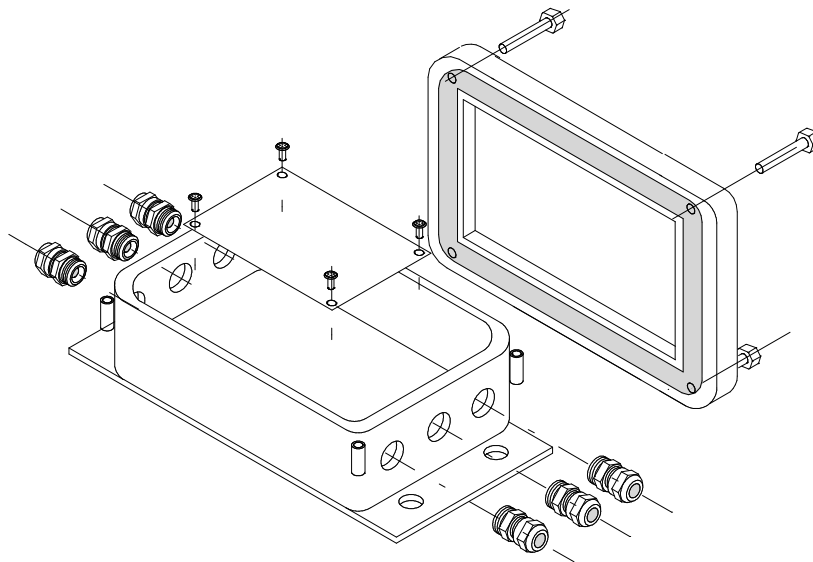


3.3 Mechanical installation RFM 1 & 4 and RFM ISR

Aluminum RFM enclosure



Painted mild steel RFM enclosure



Earthing requirements

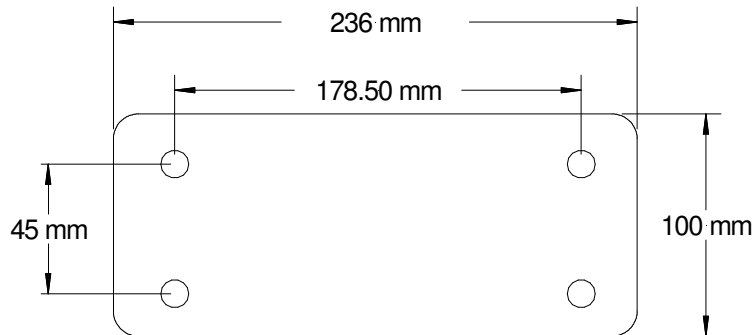
For both case types:

- An earth strap should be connected between the case earth tag and the ship's hull
- Any open gland holes should be sealed off with an O ring and metal blanking plug. These can be supplied by PSM if required.

Mechanical installation RFM 1 & 4 and RFM ISR

Aluminum RFM enclosure has a mounting bracket, which is installed prior to the enclosure being fitted.

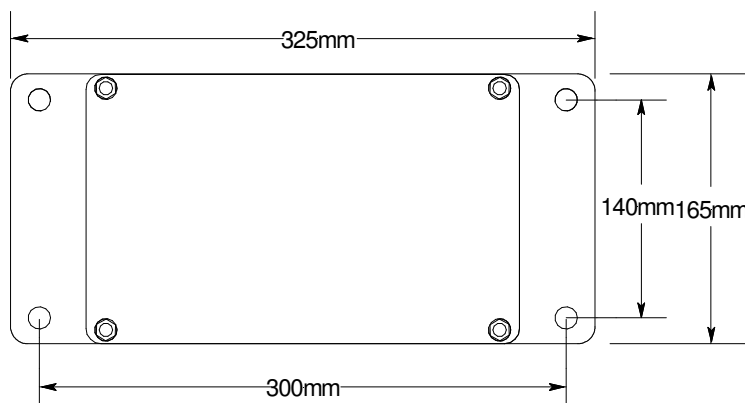
Mounting dimensions



Once the mounting bracket is fixed in place, the enclosure simply clips in and the centre M20 glands at either end are screwed down, securing the enclosure in place.

Painted mild steel RFM enclosure has four mounting holes located around the base

Mounting dimensions

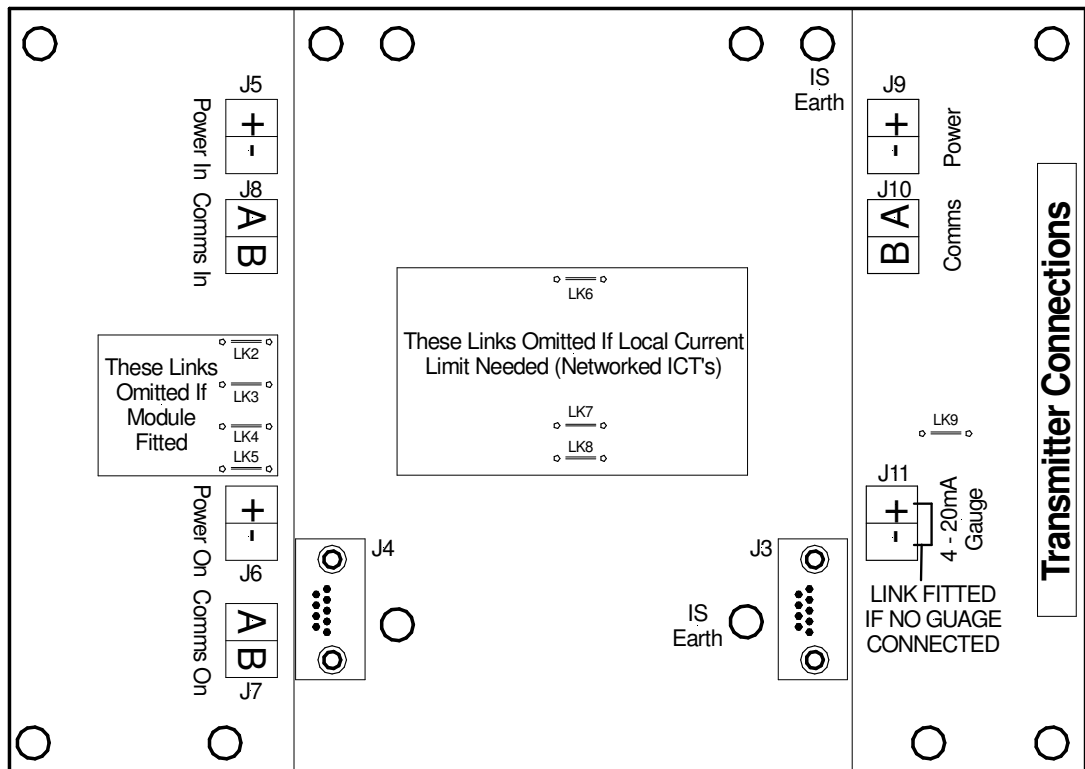


The enclosure can also be welded around the base to the specified location.

3.4 Electrical connection of ICT 1000 to RFM 1 (single transmitter)

See also page 10 for details of cable screen termination.

The RFM 1 module provides connection and Modbus termination for one ICT 1000 transmitter



J5	8-30Vdc Power supply
J8	RS485/Modbus communications (A + Data / B - Data)
J9	Supply to ICT (Red + Black -)
J10	RS485/Modbus to ICT (White + Data / Green - Data)
J11	Optional connection to local 4-20mA Gauge. LINK FITTED IF NOT CONNECTED TO GAUGE
J6	8-30Vdc Power supply - On to next RFM
J7	RS485/Modbus - On to next RFM
J4 & J3	9 way D-Sub connector to optional Modules

Links LK6 - LK8 **MUST NOT** be fitted when used in an intrinsically safe installation.

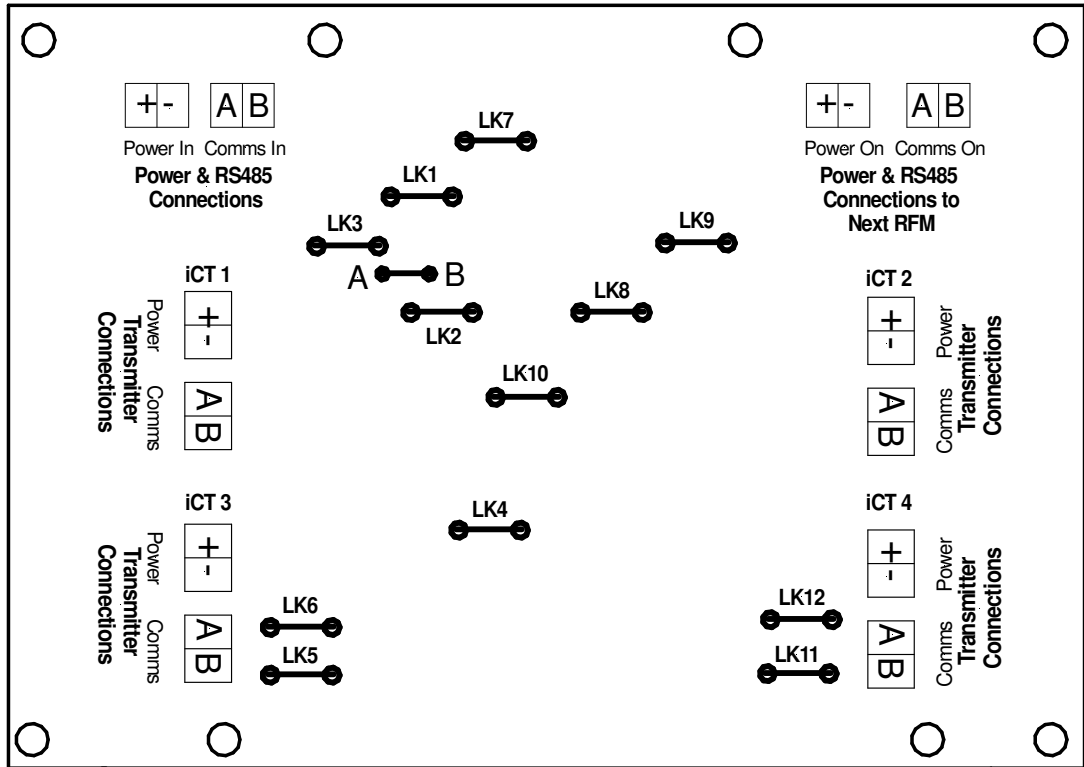
Ensure Link LK9 **IS FITTED**

Electrical connection of ICT 1000 to RFM 4 (up to 4 transmitters)

See also page 10 for details of cable screen termination.

The RFM 4 module provides connection and Modbus termination for up to four ICT 1000 transmitters

RFM-4 Connection Details



PWRIN	8-30 Vdc Power supply
COMMSIN	RS485/Modbus communications (A + Data B - Data)
iCT 1	Connection to ICT (Red + Black -) (A White + Data B Green - Data)
iCT 2	Connection to ICT
iCT 3	Connection to ICT
iCT 4	Connection to ICT
PWRONW	8-30 Vdc Power supply - On to next RFM
COMMSONW	RS485 Modbus communications - On to next RFM

Links LK6 - LK12 **MUST NOT** be fitted when used in an intrinsically safe installation.

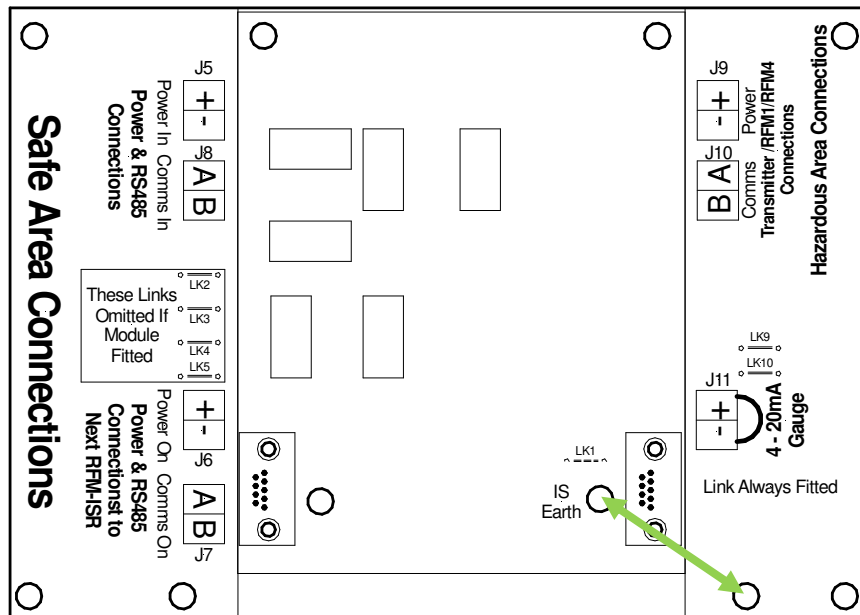
Ensure Link LK9 **IS FITTED**

Electrical connection of RFM ISR

See also page 10 for details of cable screen termination.

The RFM ISR module provides safety barriers for power and data connections to RFM 1 & 4 modules when used as part of an ICT 1000 network

RFM-ISR Connection Details



J5	15-35Vdc Power supply
J8	RS485 Modbus communications (A + Data B - Data)
J9	12Vdc Intrinsically Safe Supply (ICT Red + Black -)
J10	Intrinsically Safe RS485/Modbus (ICT White + Data Green - Data)
J11	Optional connection to local 4-20mA Gauge. Linked out if not used
J6	15-35Vdc Power supply - On to next RFM-ISR (in safe area)
J7	RS485/Modbus - On to next RFM-ISR (in safe area)
J4 & J3	9 way D-Sub connector to Barrier Module

J9/J10 are connected either directly to an ICT (use above colour code) or an RFM termination enclosure(Customer supplied cable check the colour coding)

Ensure Links LK2—LK8 are **NOT FITTED** (links 6 to 8 under barrier board)

Ensure Link LK1,9 and 10 **IS FITTED** (Link 1 under barrier board)

REMOVE the factory fitted earth bonding strap between the “IS earth” stud and the case **ONLY** if an external clean instrument earth is available. The I.S. earth stud should be connected directly to the external clean instrument earth via either:

- 2 x Copper conductors each minimum csa 1.5mm²
- 1 x Copper conductor minimum csa 4mm²

Intrinsically safe installations RFM 1 & 4 and RFM ISR

The optional intrinsically safe version of the RFM 1 is covered by the following certification for use in hazardous areas.

- ITS10ATEX27051X



Ex ia IIB or IIC T4 (T amb –20°C to +50°C)

- ia** Intrinsic Safety
- IIB** Ethylene
- IIC** Acetylene & Hydrogen (Presence of Flammable/Combustible gas)
- T4** 135°C (Maximum Surface Temperature)

The optional intrinsically safe version of the RFM 4 is covered by the following certification for use in hazardous areas.

- ITS10ATEX27051X



Ex ia IIB or IIC T4 (T amb –20°C to +50°C)

- ia** Intrinsic Safety
- IIB** Ethylene
- IIC** Acetylene & Hydrogen (Presence of Flammable/Combustible gas)
- T4** 135°C (Maximum Surface Temperature)

The intrinsically safe version of the RFM ISR is covered by the following certification for use in hazardous areas.

- ITS09ATEX26414X



Ex ia IIB or IIC (T amb –20°C to +50°C)

- ia** Intrinsic Safety
- IIB** Ethylene
- IIC** Acetylene & Hydrogen (Presence of Flammable/Combustible gas)

Installation Requirements

The following standard should be followed when carrying out a hazardous area installation:
60079 Part 14

Strictly No Modifications or user repairs are allowed

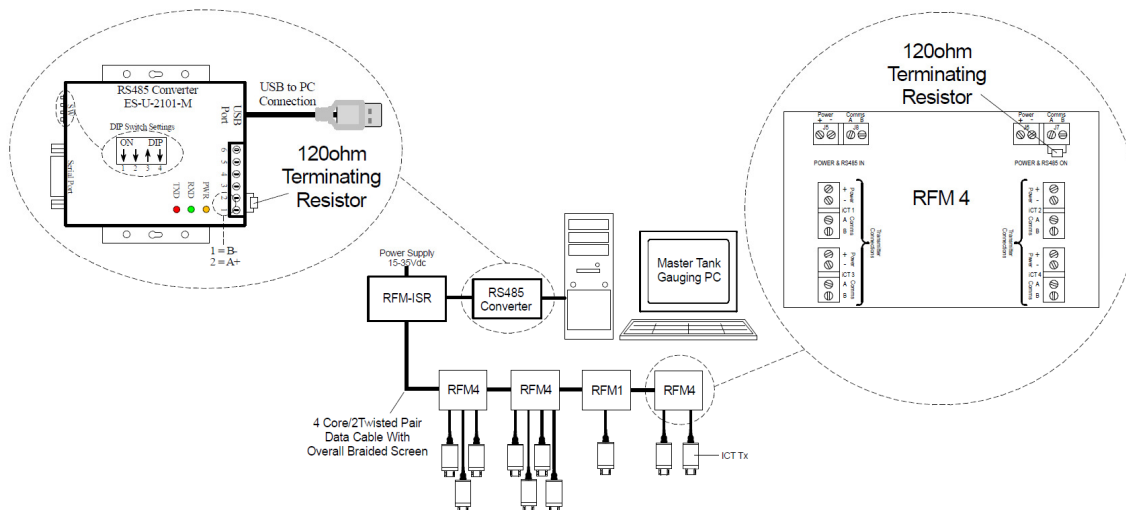
If any problems occur with the equipment please contact PSM Instrumentation.

Use of terminating resistors

Ideally, the two ends of the network cable will have a termination resistor connected across the two wires. Without termination resistors, reflections of fast driver edges can cause multiple data edges that can cause data corruption. Termination resistors also reduce electrical noise sensitivity due to the lower impedance.

It is recommended terminating resistors are used at the extremities of the network and be a value of 120 Ohms.

For Example:



PSM can provide the ISS software configuration tool to test the network performance if required.

If installing as part of a Modbus network please refer to Man 052 iCT & RFM networks for further details.

3.5 Technical specifications RFM 1 & 4 and RFM ISR

Power supply digital only mode	8—30 Vdc	Isolated external PSU required
Power supply analogue or dual mode	12—30 Vdc	
Output	4-20 mA or RS485 Modbus	
Material of construction	Cast aluminium or painted carbon steel	
Operating temperature	-20 °C to + 80 °C	
IP rating	IP67	
Hazardous area rating	Optional according to EX ia intrinsic safety	

PSM WEEE Producer Registration No WEE/HC0106WW

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