

# LevelPRO Measurement Systems

## Continuous Gamma Level System

Installation Guide

PN 1-0702-040





# **LevelPRO Measurement Systems**

## **Continuous Gamma Level System**

Installation Guide

PN 1-0702-040



© 2014 Thermo Fisher Scientific Inc. All rights reserved.

“Microsoft” and “Windows” are either trademarks or registered trademarks of Microsoft Corporation in the United States and/or other countries. “HART” is a registered trademark of the HART Communication Foundation.



FOUNDATION “FOUNDATION fieldbus” and “Fieldbus Foundation” are registered trademarks of Fieldbus Foundation.

“National Instruments” is a registered trademark of National Instruments Corporation.

All other trademarks are the property of Thermo Fisher Scientific Inc. and its subsidiaries.

Thermo Fisher Scientific Inc. (Thermo Scientific) makes every effort to ensure the accuracy and completeness of this manual. However, we cannot be responsible for errors, omissions, or any loss of data as the result of errors or omissions. Thermo Scientific reserves the right to make changes to the manual or improvements to the product at any time without notice.

The material in this manual is proprietary and cannot be reproduced in any form without expressed written consent from Thermo Scientific.



# Revision History

Revision Level	Date	Comments
A	06-2014	Initial Release per ERO 8452



# Contents

	<b>Safety Information &amp; Guidelines</b> .....	<b>ix</b>
	Safety Considerations .....	ix
	Warnings, Cautions & Notes .....	x
<b>Chapter 1</b>	<b>Introduction</b> .....	<b>1-1</b>
	Product Overview .....	1-1
	Configurations .....	1-2
	The Source .....	1-2
	The Detector – Transmitter .....	1-2
	Functional Description .....	1-2
	Communications & Measurement Software .....	1-3
	EZ Cal II Software Configuration .....	1-3
	Multiple Readouts .....	1-3
	Input & Output Signals .....	1-4
	Associated Documentation .....	1-4
<b>Chapter 2</b>	<b>Handling, Storage &amp; Shipping</b> .....	<b>2-1</b>
	ESD Procedures .....	2-1
	Unpacking, Inspection & Storage .....	2-2
<b>Chapter 3</b>	<b>Installation</b> .....	<b>3-1</b>
	General .....	3-1
	Licensing .....	3-1
	Guidelines .....	3-2
	General .....	3-2
	Mounting .....	3-2
	Source-Detector Configurations .....	3-3
	Mounting Instructions .....	3-3
	Alignment .....	3-4
	Measureable Range .....	3-5
	Top of Range .....	3-5
	Bottom of Range .....	3-5
	The Source Housing .....	3-7
	Shutter Actuator .....	3-8
	Fan Beam Source Guidelines .....	3-8
	Multiple Detectors / Source Housings .....	3-9
	System PCAs .....	3-9
	LevelPRO .....	3-10
	LevelPRO-T .....	3-12
	Remote Detector .....	3-12
	Transmitter .....	3-14
<b>Chapter 4</b>	<b>Wiring</b> .....	<b>4-1</b>
	Preparation .....	4-1
	LevelPRO Wiring Procedures .....	4-2

Power Supply Wiring .....	4-3
Protective Earth Ground .....	4-3
Safety Disconnect Mains Requirements .....	4-3
DC Power .....	4-3
AC Power .....	4-4
Serial Communications.....	4-4
RS232 Wiring.....	4-5
RS485 Wiring.....	4-6
RS485 Detector to Transmitter Wiring.....	4-7
Initial Setup for Party-Line Communications .....	4-7
Standard Wiring.....	4-7
USB.....	4-7
Ethernet.....	4-7
Voltage Output.....	4-8
LevelPRO .....	4-8
LevelPRO-T.....	4-8
Current Output .....	4-9
Voltage Input .....	4-9
Current Input .....	4-10
LevelPRO .....	4-10
LevelPRO-T.....	4-10
Relay Outputs .....	4-10
Contact Closure (Digital) Inputs .....	4-11
Temperature Compensation.....	4-11
Wiring the Optional ISIO Boards.....	4-12
Current Output .....	4-12
HART® Communications.....	4-14
FOUNDATION™ Fieldbus Communications.....	4-16
<b>Chapter 5 Support.....</b>	<b>5-1</b>
Contact Information .....	5-1
Warranty.....	5-2
<b>Appendix A Ordering Information .....</b>	<b>A-1</b>
<b>Appendix B Specifications.....</b>	<b>B-1</b>
<b>Appendix C Drawings.....</b>	<b>C-1</b>
<b>Appendix D Risk Assessment .....</b>	<b>D-1</b>

# Safety Information & Guidelines

All persons installing, using or maintaining this equipment must read and understand the information contained in this section.

## Safety Considerations

Failure to follow appropriate safety procedures and/or inappropriate use of the equipment described in this manual can lead to equipment damage or injury to personnel.

Any person working with or on the equipment described in this manual is required to evaluate all functions and operations for potential safety hazards before commencing work. Appropriate precautions must be taken as necessary to prevent potential damage to equipment or injury to personnel.

The information in this manual is designed to aid personnel in correctly and safely installing, operating, and/or maintaining the system described; however, personnel are still responsible for considering all actions and procedures for potential hazards or conditions that may not have been anticipated in the written procedures. If a procedure cannot be performed safely, it must not be performed until appropriate actions can be taken to ensure the safety of the equipment and personnel. The procedures in this manual are not designed to replace or supersede required or common sense safety practices. All safety warnings listed in any documentation applicable to equipment and parts used in or with the system described in this manual must be read and understood prior to working on or with any part of the system.



**Caution:** Using this equipment in a manner not specified by Thermo Scientific may impair the protective features provided by the product, leading to equipment damage and/or personnel injury.




# Warnings, Cautions & Notes

The following admonitions are used throughout this manual to alert users to potential hazards or important information. Failure to heed the warnings and cautions in this manual can lead to injury or equipment damage.



**Warning:** The triangular icon displayed with a warning advises the user about the type of hazard covered by the warning. See the table below for the types of warning symbols used in this manual.

**Table 1.** Warning Symbols

Symbol	Warning Type	Description
	General	Notifies users of procedures, practices, conditions, etc., which may result in injury or death if not carefully observed or followed.
	Electrical Safety	Notifies users of procedures, practices, conditions, etc., which involve electrical circuitry and may result in injury or death if not carefully observed or followed.
	Ionizing Radiation	Notifies users of procedures, practices, conditions, etc., where ionizing radiation may be present and may result in health issues or death if not carefully observed or followed.



**Caution:** Cautions notify users of operating procedures, practices, conditions, etc. which may result in equipment damage if not carefully observed or followed.



**Note:** Notes emphasize important or essential information or a statement of company policy regarding an operating procedure, practice, condition, etc.

# Chapter 1

## Introduction

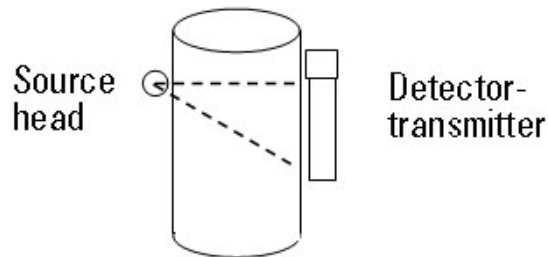
### Product Overview

Thermo Scientific designed the family of LevelPRO measurement systems to provide reliable, accurate level measurements for a wide variety of challenging applications. The level detector, which mounts to the outside of the process vessel never contacts the process material and can measure the process level in any vessel.

Each detector can convert the basic level measurement into a variety of output values as appropriate for specific applications.

The system consists of up to two basic elements: the source head, which contains the radioisotope source; the detector, which converts the incident radiation to a useable electronic signal; and optional transmitter which displays the level value.

The radioisotope source emits gamma radiation, which passes through the vessel wall and the process material before arriving at the detector. The detector then measures the level of arriving radiation to determine the level of the process material. The amount of radiation that reaches the detector varies inversely with the level of the process material.



**Figure 1-1.** LevelPRO Measurement System

## Configurations

The Thermo Scientific LevelPRO level detector consolidates the detector function and the transmitter to form an integrated system.

The LevelPRO-T provides the user with a separate transmitter unit.



**Note:** For the purposes of this manual, instructions referring only to the LevelPRO should be considered applicable to the entire family of LevelPRO/LevelPRO-T measurement systems. Any installation instructions that apply exclusively to the LevelPRO-T will be specifically called out within the text.

## The Source

A Cesium (Cs-137) radioisotope source is used to provide the gamma radiation field for most applications. A Cobalt (Co-60) source is available for applications requiring a higher energy source – typically those with very thick-walled vessels. The source capsule secures the radioisotope inside a glass matrix and then double encapsulates the glass in a pair of sealed stainless steel capsules, ensuring extreme resistant to vibration and mechanical shock.

The source head, a lead-filled, welded steel housing, further encloses the source capsule. A shaped opening in the lead shielding directs the gamma radiation beam through the process material towards the detector. For most level applications, the source is designed to produce a fan beam. Outside of the beam path, the energy emitted from the source head is very low and well within prescribed limits.

Closing the source shutter blocks the radiation, attenuating the energy in the beam path and allowing for safe handling, installation or servicing of the detector. All source housings meet or exceed the safety requirements of regulatory agencies such as the U.S. Nuclear Regulatory Commission (NRC), agreement states, the Canadian Nuclear Safety Commission and local regulatory agencies in other countries. Please refer to the Gamma Radiation Safety Guide (p/n 717904) for more radiation safety information.

## The Detector – Transmitter

The transmitter function in the LevelPRO system is incorporated into the detector housing to create an integrated system, while in the LevelPRO-T system the transmitter is a separate enclosure.

The LevelPRO measurement system uses a PVT scintillation detector to measure the radiation reaching the detector from the source. The detector consists of a PVT scintillator and a photomultiplier tube with the associated electronics. When gamma radiation strikes the scintillation material, small flashes of light are emitted. As the level of the process material increases, more gamma radiation is attenuated by the process material, which allows fewer gamma rays to reach the detector and generates fewer light pulses. The photomultiplier tube and associated detector electronics convert the light pulses into electrical pulses that are processed by electronics in the detector of the integrated unit or transmitter to determine the process material level and related measurement values.

# Functional Description

## Communications & Measurement Software

There are various communications options available with the LevelPRO measurement system.

Using a PC with the Thermo Scientific communication software allows serial data communication with the detector via the RS485 or the RS232 serial ports.

The HART® communication protocol is supported over the 4–20 mA current output. Communication with the detector takes place through an Emerson Electric Co. field communicator, Model 275 or newer, or any other compatible device containing the appropriate device descriptors. LevelPRO systems equipped with the HART communication option are supported on the Emerson Electric Co. Asset Management System (AMS).

With the FOUNDATION™ fieldbus communication option, the LevelPRO system provides users with access to control or program parameters via a host system. The FOUNDATION fieldbus communication option is FISCO-qualified.

LevelPRO systems equipped with the Profibus PA communication option provide users with access to control or program parameters via a host system.

Upon completion of detector setup, any present level measurement appears on the external display.



**Note:** The HART, FOUNDATION fieldbus, and Profibus PA communication options are not available on the beta versions of the LevelPRO systems.

## EZ Cal II Software Configuration

The LevelPRO comes with the Windows-based EZ Cal II configuration software. This program allows you to construct a detector configuration file for a specific application, and either upload it immediately to a connected detector, or store it on your Windows-based PC for later implementation. The EZ Cal II software includes a configuration wizard, significantly simplifying the detector configuration process. Alternately, the EZ Cal II program also provides direct access to a wide range of configuration and troubleshooting tools.

## Multiple Readouts

The LevelPRO detectors can provide a local readout of Level parameters, either by adding an optional local display to the LevelPRO or through the LCD display built into the transmitter of the LevelPRO-T. For those applications where it may be advantageous to display the Level parameters in different units, both types of display can accommodate up to four values.

## **Input & Output Signals**

Any process measurement can be assigned to the 4–20 mA current output, or the measurement values can be read using a ModBus master host. The two contact closure inputs can be used to activate many system commands based on a user-provided switch input.

## **Associated Documentation**

Along with this guide, all persons installing, using or maintaining this equipment must read and understand the following documents:

- Gamma Radiation Safety Guide, p/n 717904
- LevelPRO Foundation Fieldbus Application Guide (for units with Foundation fieldbus installed)
- (pending) LevelPRO / LevelPRO-T with HART Protocol Interface Operation Guide (for units using HART protocol)

## Chapter 2

# Handling, Storage & Shipping

This chapter addresses procedures for handling electrostatic discharge (ESD) sensitive equipment, as well as procedures for unpacking, inspecting, and storing of the system.



**Caution:** This system is an ESD sensitive instrument. Use proper ESD protective equipment and procedures. Failure to comply with ESD procedures can result in circuit damage.

## ESD Procedures

The instrument contains electronic components that can be damaged from discharges of static electricity. Ordinarily, handling the circuit boards by their edges will not damage the circuits.



**Caution:** Do not touch the circuit board components.

Observe the following when installing, setting up, servicing, troubleshooting or repairing the instrument:

1. Use an antistatic bag. Most instrument subassemblies ship in a special antistatic bag. When not installed, keep the assembly in the bag as often as possible.
2. Remove ESD-sensitive subassemblies only under the following conditions:
  - a. When standing at a designated static-free workstation, or when the bag is grounded at a field site.
  - b. After the conductive area of the container has been neutralized.
  - c. After making firm contact with an antistatic mat and/or firmly gripping a grounded individual.
3. Personnel handling ESD-sensitive devices should be neutralized to a static-free workstation by means of a grounding wrist strap connected to the station or to a good grounding point at the field site.
4. Do not allow clothing to make contact with ESD sensitive devices.

## Handling, Storage & Shipping

### Unpacking, Inspection & Storage

5. Avoid touching edge connectors and components.
6. Avoid partially connecting ESD-sensitive devices. Floating leads can damage these devices, especially the power supply connector.
7. Ground all test equipment.
8. Avoid static charges during troubleshooting.

## Unpacking, Inspection & Storage

All personnel involved in the packing, shipping, or receiving of hazardous material must be trained in accordance with the United States Department of Transportation (DOT) and OSHA hazardous materials regulations or in accordance with the Canadian Nuclear Safety Commission (CNSC) regulations.



**Note:** Inspection, adjustment, installation, and maintenance of the instrument must be performed by experienced personnel only.

# Chapter 3

## Installation

Read the Gamma Radiation Safety Guide (p/n 717904) prior to installing the equipment.

Copies of drawings referenced in this manual are provided in [Appendix C](#).

### General

Refer to the table below for the components of the various Thermo Scientific LevelPRO measurement systems.



**Note:** The combination of the detector-transmitter and the source head is referred to as the detector.

**Table 3-1.** LevelPRO Measurement System Components

Component	LevelPRO	LevelPRO-T
Detector-Transmitter	MS2011LU	N/A
Detector	N/A	MS2011LUR
Transmitter	N/A	MS2011T
Source Head	5205,5206,5207,5208,5210	

### Licensing



**Warning:** The instrument is a nuclear device regulated by federal and/or state authorities. The user is responsible for knowing and following the pertinent safety and regulatory requirements. Refer to the Gamma Radiation Safety Guide (p/n 717904) for a summary of these requirements.



**Warning:** Installation and commissioning of Thermo Scientific source heads requires a licensed operator. In the United States, a general license permits the licensee to own and install all of the instrument's components, including the source head. However, a specific license authorizing radiation commissioning is required to commission the instrument by removing the lock and opening the source-housing shutter for the first time. In Canada, only those who possess a CNSC license with a condition authorizing the mounting/dismounting of devices may remove the instrument from the shipping container. For assistance obtaining a license or commissioning/decommissioning the instrument, contact Thermo Scientific.

## Guidelines



**Warning:** Do not install the system in any hazardous area other than those approved. Refer to the equipment tag for the specific approvals applicable to the configuration of your instrument.



**Warning:** Do not apply power to the instrument in any hazardous area unless the safety ground is properly wired inside the instrument and the cover is properly installed.

## General

Review the following guidelines when planning detector installation.

1. Correct power source for the detector:
  - a. 11 – 32 VDC, 770 mA max, at detector input
  - b. 100 to 240 VAC, 50/60 Hz, 300 mA max (with AC power option)
2. Operating temperature range: -40°C to 75°C (-40°F to 167°F)
3. Ensure enough clearance exists to install and service the detector. Refer to the appropriate drawings for your type of detector and mount ([Appendix C](#)).
4. Position the detector so that the radioactive source identification tag is visible. The source housing tag should be upright.



**Note:** Do not paint or overcoat the source housing without first masking its identification tag and other labeling. All labels on the source housing must remain visible.

5. Do not mount the detector where process overflow or other material can collect in the beam path. The source shutter mechanism must be kept free of debris.



**Caution:** Do not place your hand between the source and the vessel wall. Use a brush or other tool to remove accumulated debris.

## Mounting



**Warning:** Installation must be in accordance with local and national electric codes for the area classifications.



**Warning:** The handle of the source housing must be in the OFF position during installation.



**Warning:** Do not reach inside the source housing at any time during installation.



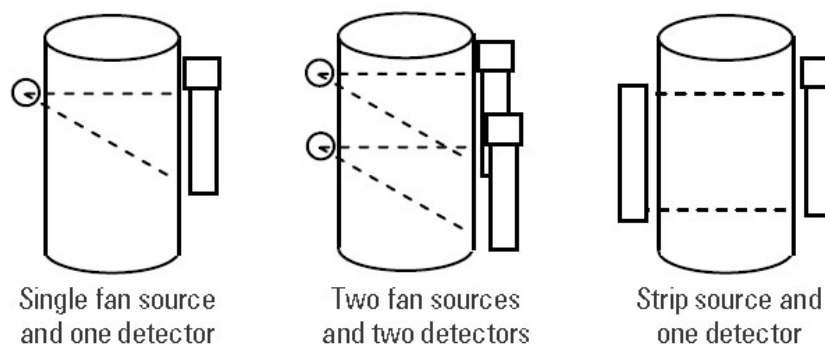
**Warning:** Use proper lifting procedures during installation to avoid injury.

## Source-Detector Configurations

The detector is comprised of a source housing that contains the radioisotope source and the detector-transmitter that contains the scintillation detector and electronics. Sources are available in a fan beam or strip source configuration. For most fan beams, the beam angle spreads at a 45° angle in the vertical dimensions. A 30° beam angle spread is available with model 5210, and 60° beam angle spreads are available with models 5205B, 5206B, 5207B, and 5208B.

Strip sources emit radiation evenly along the length of the vessel from the source and measure the radiation level reaching the detector after passing through the vessel walls and the process material.

The scintillation detector is available in lengths ranging from 1 to 12 feet, in 1-foot increments. For a tall or narrow tank, multiple sources and / or detectors might be required. Contact Thermo Fisher. The specific source -detector configuration depends on the application. Three possible configurations are illustrated below.



**Figure 3-1.** Examples of Detector Installation

## Mounting Instructions

The following sections provide installation details for the various mounting configurations. Refer to the dimensional drawings in [Appendix C](#).



**Warning:** Use proper lifting procedures during installation to avoid injury.

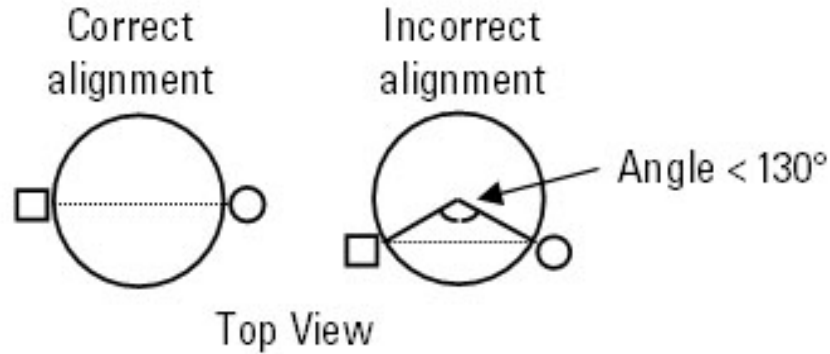


**Caution:** Do not over tighten the bolts.

## Alignment

Refer to drawings 3-0702-150 and 3-0702-152 (water-cooled units) for mounting dimensions of the detector-transmitter.

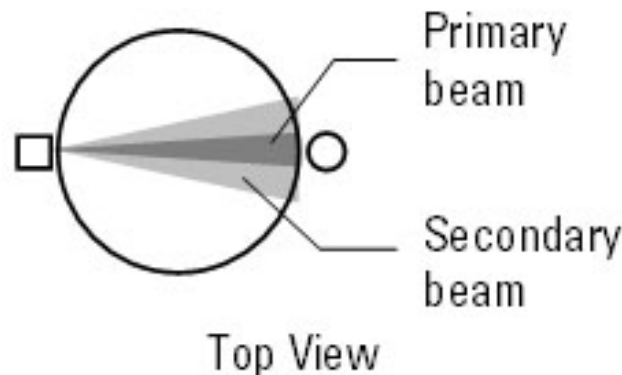
The source housing and detector are normally installed across the diameter of the vessel. If mechanisms internal to the process vessel would interrupt the radiation beam, you can move the installation slightly off center. Contact Thermo Fisher if the angle between the source and detector will be less than 130°, as illustrated below.



**Figure 3-2.** Alignment

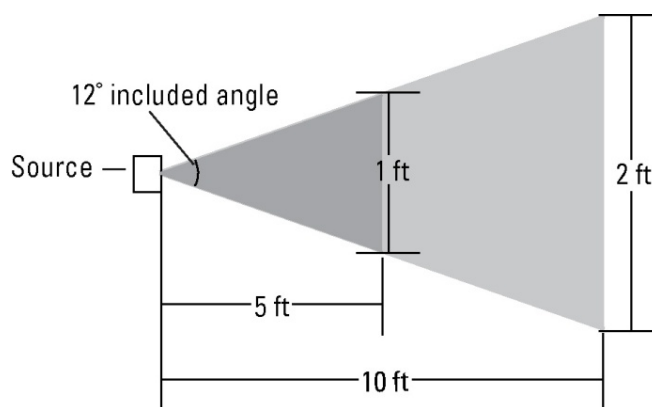
It is important to mount the source housing securely, since any movement or change in alignment can affect the detector's calibration. When mounting the source housing, be sure to include a means of aiming the beam several degrees left or right so the source beam can be aligned with the detector. The exact mounting method will vary depending on the application.

Align the center of the source beam path as closely as possible with the centerline of the detector housing. The source beam is narrow horizontally, and the radiation is uniform only in the primary (center) part of the beam. The shielding in the source housing attenuates the radiation in the secondary part of the beam. The sensitive area of the detector is the center 2-7/8 inches (73 mm) across the width of the detector's housing. This area should lie entirely within the primary beam.



**Figure 3-3.** Primary & Secondary Beams

To determine the primary beam width, you will need the included angle of the beam. For example, the included angle is typically  $12^\circ$ . In this case, the primary beam width will be 1 foot wide 5 feet away from the source. At 10 feet away from the source, the beam width will be 2 feet wide, and so on. This is illustrated in the figure below.



**Figure 3-4.** Determining Primary Beam Width

## Measureable Range

Before beginning the installation, verify that the measurable range (the range over which the process level can be measured) of the proposed installation meets the requirements of your application. The top and bottom of the measurement range depend on the source type (fan or strip), the detector length, and the position of the source relative to the detector's sensitive length. Sensitive length refers to the part of the detector that senses radiation.



**Note:** The sensitive length of the detector is approximately the length from the upper mounting bolt to the lower mounting bolt.

## Top of Range

For a source with a fan beam, the top of the range is at the top of the sensitive length of the detector or at the center of the source housing, whichever is lower.

For a strip source, the top of the range is at the top of the sensitive length of the detector or at the top of the active length of the source, whichever is lower.

## Bottom of Range

For a source with a fan beam, the bottom of range is the point where a line drawn from the source to the detector centerline at the bottom end of the detector's sensitive length intersects the inner vessel wall nearest the detector. This is illustrated in [Figure 3-5](#).



**Note:** If the vertical beam width of the source does not fully illuminate the sensitive length of the detector, the bottom of the range is the point at which the lower limit of the source beam intersects the inner vessel wall.

For a strip source, the bottom of the range is at the bottom of the detector's sensitive length or at the bottom of the active length of the source, whichever is higher.

## Installation

### Mounting

In [Figure 3-5](#), the top of the source beam (center of the source housing) is aligned with the top of the sensitive length of the detector. Thus, the top of the measurable range is defined by the horizontal line drawn from the top of the sensitive length of the detector to the center of the source housing.

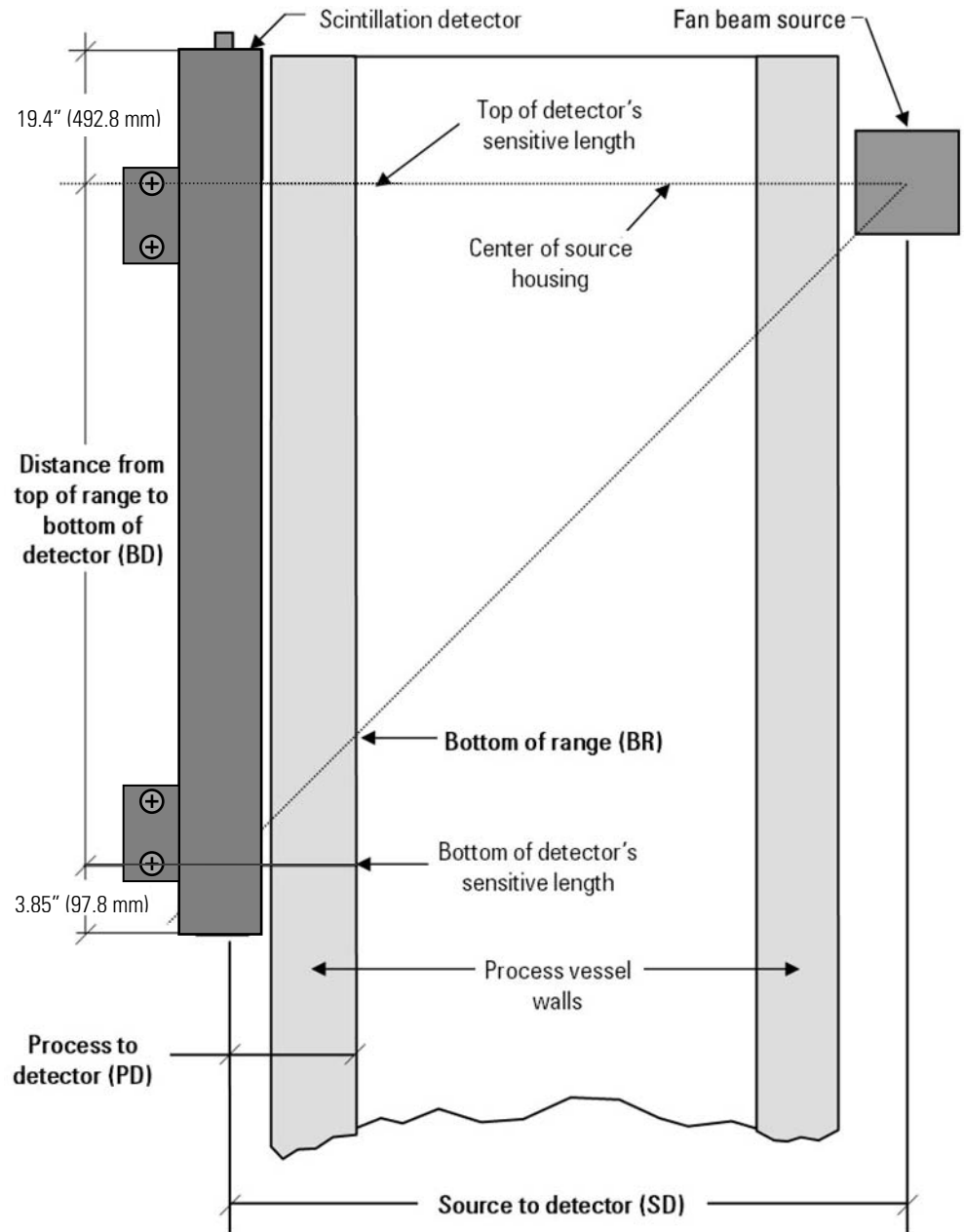
The bottom of the range (BR), measured from the top of the measurable range, is provided by the formula:

$$BR = BD - PD[PD \times BD \div SD], \text{ or, equivalently, } BR = BD \times [1(PD \div SD)],$$

where:

- BD = distance from top of range to the bottom of the sensitive length of the detector (in [Figure 3-5](#), BD = sensitive length of detector).
- PD = distance from the center of the detector to the inner vessel wall.
- SD = distance from the center of the detector to the center of the source.

# The Source Housing



$$\text{Bottom of range (BR)} = \text{BD} - [\text{PD} \times (\text{BD} \div \text{SD})]$$

**Figure 3-5.** Source Housing



**Warning:** In the United States, you may uncrate and mount the source housing, but you may not remove the shipping bolt unless you are licensed to commission the detector. In Canada, you must have a license condition permitting mounting / dismounting, and without this condition, users may not remove the source from the shipping crate.



**Warning:** Use proper lifting procedures to avoid injury.

## Shutter Actuator

If your source housing includes a pneumatic shutter actuator, refer to drawing 866664 for installation details.

## Fan Beam Source Guidelines

If using a source with a fan beam, follow the instructions below.

1. The vertical angle of the fan beam is typically 45°. This means that the beam's vertical range is equal to the horizontal distance between the detector and the source. (In special cases, the angle may be 30° or 60°. If further guidance is required, contact Thermo Scientific.
2. Mount the source housing so that the top of the fan beam is aligned with the top of the sensitive length of the detector.
3. Install the source housing with its mounting face as close to the process vessel as practical, with no structural material (mounting tabs, brackets, etc.) between the beam area and the vessel.
4. The mounting should ensure accurate beam alignment with the detector and provide for easy left-right angular adjustment. The top of the beam should be even with the top of the measurable range.

If using a strip source, follow the instructions below.

1. Refer to the source housing drawings to determine the position of the active length of the strip source and other mounting dimensions.
2. Secure the housing with the 1/2-inch (12 mm) bolts and lock washers (six places). The housing mounting face allows clearance for bolts or studs extending up to 2-1/4 inches (57 mm) from the mounting surface.
3. For best results, the measurable range should be less than the active length of the strip source(s). Position the strip source so that the bottom of the active length of the source is even with the minimum level to be measured. If the measurable range must be greater than the active length of the strip source, position the top of the active length of the source so that it is even with the maximum level to be measured.
4. The mounting surface should be vertical. The mounting should ensure accurate beam alignment with the detector and provide for easy left-right angular adjustment.
5. Install the source housing with its mounting face as close to the vessel as practical, with no structural material (mounting tabs, brackets, etc.) between the beam area and the vessel.

## Multiple Detectors / Source Housings

Certain applications may require the use of multiple detectors and / or multiple source housings to span the desired measurable range.

If multiple detectors are used, the uppermost unit should be mounted so that the top of its sensitive length is even with the top of the measurable range. The remaining units should be mounted so that the top of each detector's sensitive length is aligned with or slightly overlaps the bottom of the sensitive length of the detector mounted just above it.

If more than one source housing is required, the top source housing should be installed with the top of its beam even with the top of the desired measurable range. The other source housings should be spaced evenly along the vertical dimension of the vessel. For example, if the range of interest is 12 feet and three fan beam sources are used, the source housings should be spaced four feet apart.

The installation / arrangement drawings provide mounting dimensions for several configurations (refer to drawings 868566 through 868571).

When mounting two or more pairs of strip sources and detectors on a small diameter tank, adjacent pairs of source housings and detectors may be rotated by 90° if necessary. The source housing and detector for each source-detector pair at the same height must still be mounted on opposite sides of the tank (180°). After mounting the uppermost source-detector pair, the position of the source housing and detector in the next lower pair may be rotated by 90° and so on.

## System PCAs

This section provides general instructions on installing/replacing the PCAs (Printed Circuit Assemblies) in the LevelPRO measurement systems.



**Warning:** Remove all power from the unit before servicing. Electrocutation can result if power is present.



**Warning:** In hazardous locations, ensure that power is removed from the detector before removing the housing cover. Be sure that the housing cover has been replaced and the grounds are properly connected before reapplying power.



**Warning:** Close the shutter on the source housing before servicing the detector.

## LevelPRO

1. Remove the housing to access the detector-transmitter electronics of the integrated unit.
  - a. Ensure all source shutters are in the OFF position.
  - b. Ensure all power to the detector is turned off.
  - c. Remove the Model MS2011LU housing access cover
    - i. For the explosion-proof housing, loosen the screw on the cover retaining bracket and slide the bracket off the housing cover.
    - ii. Remove the two screws securing the card cage into to the housing.

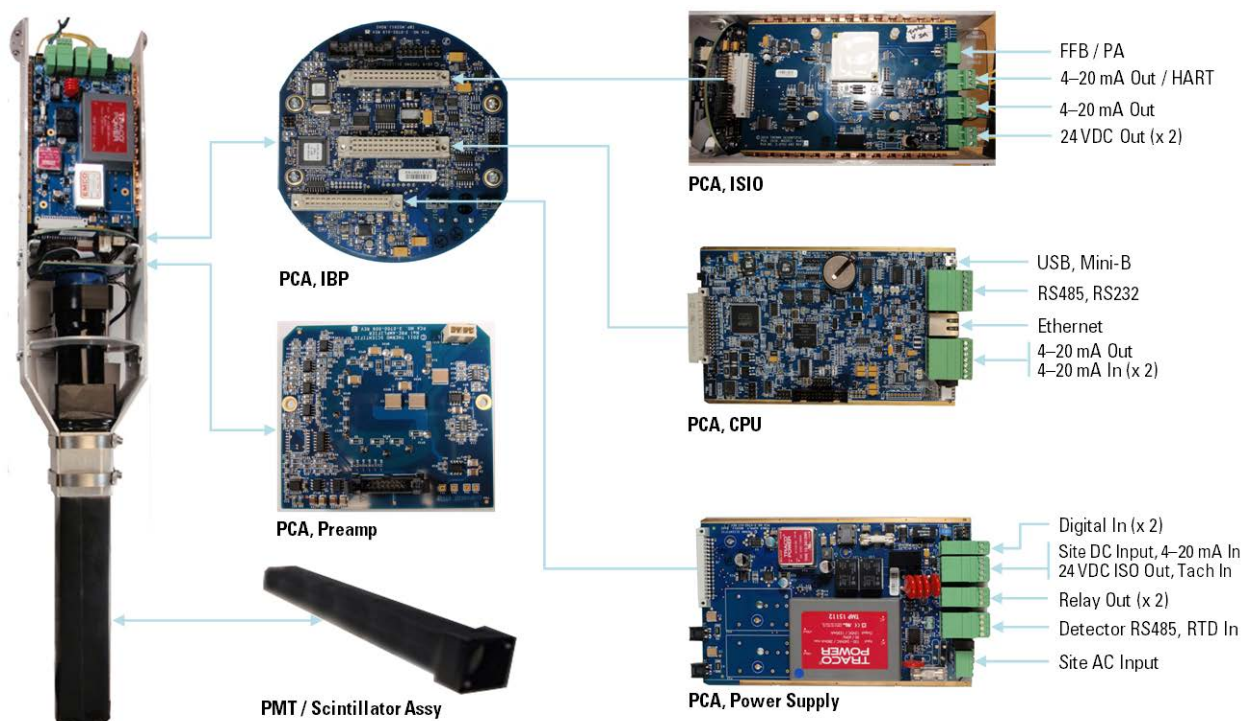


**Note:** To access or change only the ISIO, Main CPU or Power Supply PCAs, skip step 1d and proceed with step 2.

- d. Disconnect the plug-in screw terminals from the board connector. If the connector is tight, brace the board with your hand, taking care not to touch the circuit or components, and pull firmly but carefully. Lay the cables and connectors back over the edge of the housing so they will not be in the way when lifting the unit out of the housing.
1. Change the detector-transmitter electronics of the integrated unit.
    - a. To remove the ISIO, Main CPU or Power Supply PCA
      - i. Detach any cabling and gently pull the PCA from its connection port.
      - ii. Insert the new PCA into the connection port.
      - iii. Reattach any cabling.
    - b. To remove the IBP PCA
      - i. Remove the ISIO, Main CPU and Power Supply PCAs by detaching any cabling and gently pulling the PCAs from their connection ports.
      - ii. Detach any cabling and remove the four retaining screws holding the IBP PCA to the card cage.
      - iii. Remove the IBP PCA by sliding it out parallel to the LVDN\_Preamplifier PCA.
      - iv. Slide the new IBP PCA board in, insert the retaining screws and reconnect any cabling from the old board to the new PCA.
      - v. Reinsert the ISIO, Main CPU and Power Supply PCAs into their connection ports and reattach any cabling.
    - c. To remove the LvDn\_Preamplifier PCA
      - i. Remove the bolts in the card cage located to the left and right of the photomultiplier tube.

Gently pull the photomultiplier tube straight out to disconnect the pins attached to the LvDn\_Preamplifier PCA.

- ii. Detach any cabling from the PCA.
  - iii. Remove and replace the LvDn\_Preamplifier PCA.
  - iv. Reattach any cabling and the photomultiplier tube to the PCA.
  - v. Insert the two screws/bolts.
2. Reinstall the two screws previously removed from the card cage to secure it into the housing.
  3. Reconnect the plug-in screw terminals to the board connectors, and replace the housing access cover.
  4. Apply power to the unit.



**Figure 3-6.** LevelPRO PCAs

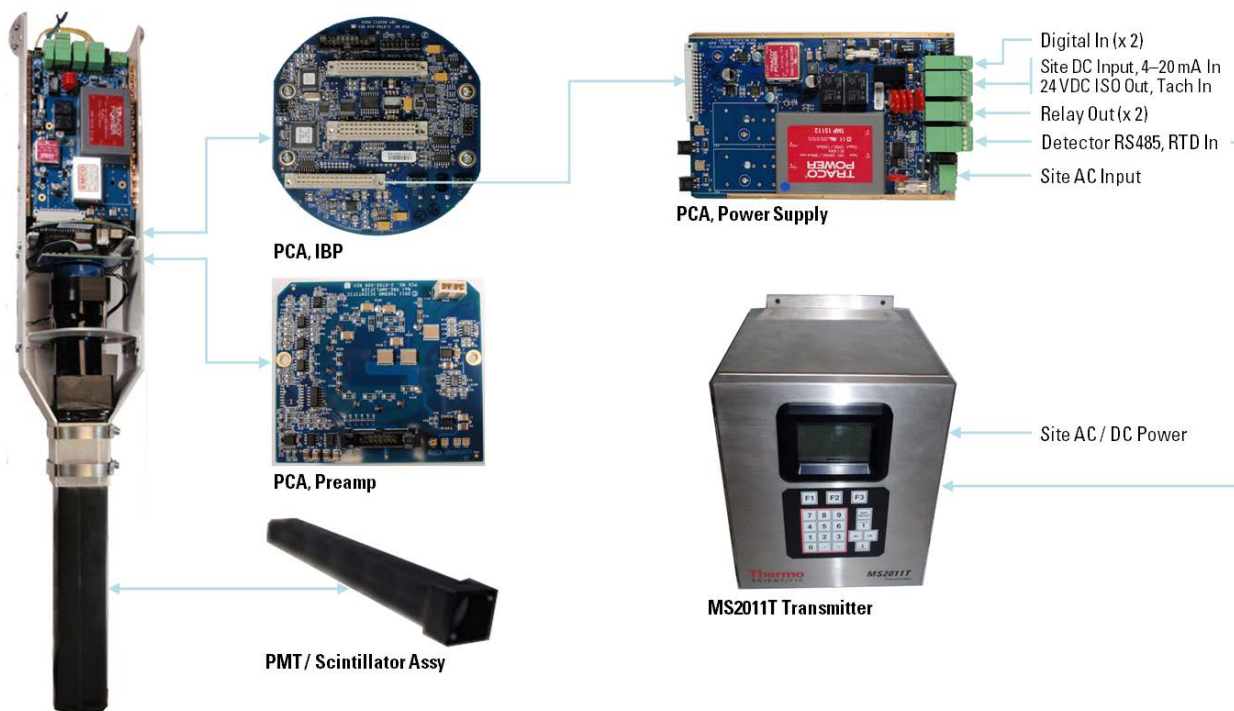
## LevelPRO-T

### Remote Detector

To access the remote detector electronics follows the steps below.

1. Ensure all source shutters are in the OFF position.
2. Ensure all power to the detector is turned off.
3. Remove the Model MS2011LUR housing access cover.
  - a. For the explosion-proof housing, loosen the screw on the cover retaining bracket and slide the bracket off the housing cover.
4. Change the electronics of the remote transmitter unit.
  - a. To remove the Power Supply PCA
    - i. Remove retaining screws from the bulkhead.
    - ii. Remove the power supply cable from the Power Supply PCA.
    - iii. Remove the four retaining screws from the Power Supply PCA.
    - iv. Pull the PCA down to remove it from the IBP PCA.
    - v. Replace.
  - b. To remove the IBP PCA
    - i. Remove the retaining screws from the bulkhead.
    - ii. Remove the four retaining screws from the IBP.
    - iii. Gently remove the IBP PCA.
    - iv. To remove the Preamp, continue to the next step. To reassemble and close the unit, skip to step 5.
  - c. To remove the Preamp PCA
    - i. Remove the eight screws, four from each side, on the PMT side of the card cage.
    - ii. Lift the card cage up to remove the photomultiplier tube assembly.
    - iii. Loosen the two bolts located to the left and right of the photomultiplier tube.
    - iv. Gently pull the photomultiplier tube down and out of the Preamp PCA.
    - v. Remove the four retaining screws and detach any cabling from the Preamp PCA.
    - vi. Remove and replace the Preamp PCA.

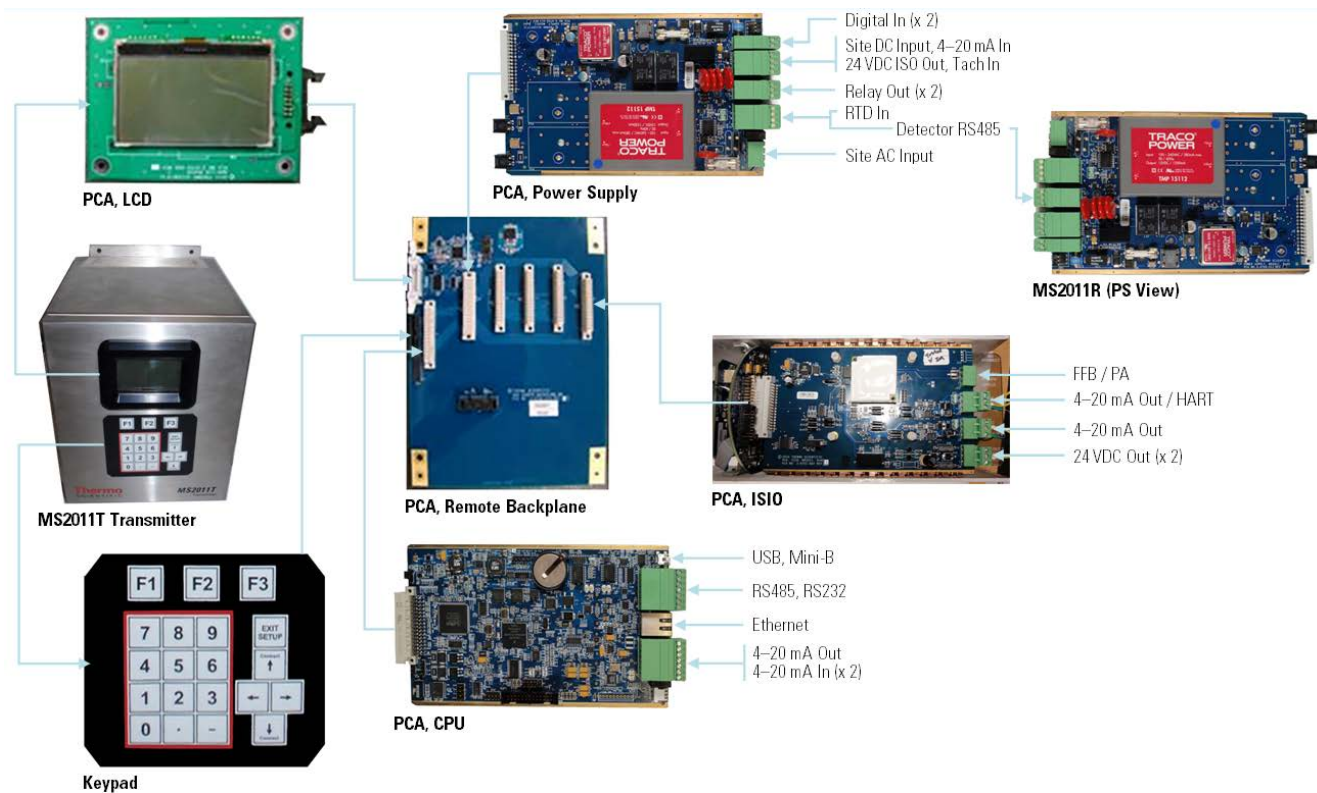
- vii. Reattach any cabling and the four previously removed screws to the PCA.
  - viii. Reattach the photomultiplier tube to the PCA.
  - ix. Tighten the two bolts adjacent to the photomultiplier tube.
  - x. Carefully replace the photomultiplier tube assembly. Insert the two \ previously removed screws.
  - xi. Reattach the PMT assembly to the card cage by reinserting the eight previously removed screws.
5. Place the card cage into the housing cover.
  6. Reinstall the two screws previously removed from the card cage to secure it into the housing.
  7. Reconnect the plug-in screw terminals to the board connectors, reattach any cabling to the bulkhead and replace the housing access cover.
  8. Apply power to the units.



**Figure 3-7.** LevelPRO-T PCAs, Remote Detector

## **Transmitter**

1. Open the transmitter case to access the electronics of the remote transmitter.
  - a. Ensure all power to the transmitter is turned off.
  - b. Unfasten the two latches on the remote transmitter case and open the unit.
  - c. To remove the LCD PCA.
    - i. Detach any cabling and remove the four retaining screws holding the LCD PCA to the face of the transmitter.
    - ii. Gently pull the LCD PCA to remove it from the housing.
    - iii. Insert the new LCD PCA board, insert the retaining screws and reconnect any cabling from the old board to the new PCA.
2. To remove the ISIO, Main CPU or Power Supply PCA.
  - a. Detach any cabling and gently pull the PCA from its connection port.
  - b. Insert the new PCA into the connection port.
  - c. Reattach any cabling.
3. To remove the remote backplane.
  - a. Remove the ISIO, Main CPU and Power Supply PCAs.
  - b. Remove the four screws, one in each corner, securing the card cage into the housing.
  - c. Carefully remove the card cage from the housing, remove the Remote Backplane PCA from the bottom, and replace with the new board.
  - d. Place the card cage back into the transmitter housing and secure the card cage in place by inserting the four previously removed screws.
  - e. Reinstall the ISIO, Main CPU and Power Supply PCAs.
4. Reattach any disconnected cabling.
5. Close and latch the two fasteners.
6. Apply power to the unit.



**Figure 3-8.** LevelPRO-T PCAs, Remote Transmitter



# Chapter 4

## Wiring

Perform wiring in the following order:

1. Connect the power supply to the detector.
2. Connect the remote computer terminal to the detector via the serial communication ports.
3. Optional wiring may include:
  - a. HART® communications
  - b. FOUNDATION™ fieldbus communications
  - c. 4–20 mA current output
  - d. Relay outputs
  - e. Contact closure input
  - f. Remote display
  - g. Sensor input (4–20 mA and 0–10 VDC)

## Preparation

Review the following carefully prior to connecting any wiring.



**Warning:** Remove all power from the unit before making any connections. Electrocutation can result if power is present.



**Warning:** Qualified individuals must perform all wiring, in accordance with applicable codes such as the National Electric Code (NEC) ANSI/NFPA 70 specifications or the Canadian Electrical Code Part 1. Only approved conduit, boxes, and fittings may be used. If metal conduit is used, the conduit must be grounded.



**Warning:** Do not apply power to the unit in any hazardous area unless the safety ground is properly wired inside the unit and the cover is properly installed.



**Warning:** Connect the AC wiring earth ground to the internal safety ground terminal as shown in the wiring diagram.



**Warning:** For hazardous location installations, the cable entries must be sealed. For non-hazardous location installations, the cable entries into the enclosures must be sealed to prevent passage of gas or vapors. The surrounding atmosphere or liquids should not affect the sealing compound. The minimum thickness of the sealing compound should be 5/8-inch (16 mm).



**Warning:** Verify the source shutter is in the OFF position before wiring.

## LevelPRO Wiring Procedures

The steps below provide general instructions for detector-transmitter wiring. For each cable to be connected, refer to the wiring label on the top of the chassis or to the wiring installation diagram. You will need a screwdriver with a 1/8-inch blade to connect the wires to the screw terminal connectors.

1. Ensure all source shutters are in the OFF position.
2. Ensure all power to the detector is turned off.
3. Remove the housing access cover.
  - a. For the explosion-proof housing, loosen the screw on the cover-retaining bracket and slide the bracket off the housing cover. Unscrew the housing access cover. If necessary, use the two lugs provided on the top of the cover to aid in removal.
4. Remove the cable conduit plugs from only the holes that will be used. Lay one conduit for the DC power input and signal cables and, if applicable, a second conduit for the AC power input and relays. Route the cables into the detector housing. Leave approximately six inches (150 mm) for strain relief.
5. Connect the cable to the appropriate connector as follows:
  - a. Remove the screw terminal connector from the on-board connector. If the connector is tight, brace the board with your hand, taking care not to touch any circuit components, and remove the screw terminal connector.
  - b. Loosen the terminal screws on the connector. Insert the wires into the connector and make connections as shown in the MS2011LU installation wiring guide (p/n 1-0702-049) and as described in the remainder of this chapter.
  - c. Tighten the terminal screws to secure the wires. Once all wires are secure, replace the connector on the board.
6. Connect the ground line of the AC input power to the internal safety ground lug of the LevelPRO housing.



**Caution:** When DC input power is used, it is imperative to connect an earth to either the internal or external safety ground lug of the LevelPRO housing.

7. Secure the conduit, making sure it is completely sealed.

8. When the wiring is complete, replace the detector housing cover and secure the cover-retaining bracket.
9. While the mounting hardware of the LevelPRO housing may provide an adequate earth ground, Thermo Scientific recommends always connecting a true earth ground to the external safety ground lug of the housing.

## Power Supply Wiring



**Note:** To meet the requirements of CSA 1010.1, an external switch or circuit breaker must be installed to allow the power source to be disconnected from the detector. In addition, protective bonding (grounding) must always be provided, even if a DC power source is used.

## Protective Earth Ground

The enclosure provides internal and external safety ground lugs for safety protective earth grounding. The external safety ground lug connects the unit to earth ground. The internal safety ground lug connects the AC power input ground line..

## Safety Disconnect Mains Requirements

As permanently connected equipment, the LevelPRO detector requires a switch or circuit breaker as the means for disconnection. Prepare the switch or circuit breaker according to the following requirements:

1. Include a switch or circuit breaker in the wiring installation.
2. Ensure the switch or circuit breaker is in close proximity to the LevelPRO detector and within easy reach of the operator.
3. Mark the switch or circuit breaker as the disconnecting device for the LevelPRO detector.

## DC Power

The detectors are designed to operate from 11 to 32 VDC. The input connector for the DC source voltage wiring is located on the power supply board.



**Note:** To meet the requirements of CSA 1010.1, the input DC terminals shall be supplied from a SELV (Safety Extra Low Voltage) source.

Connections are shown in the table below.

**Table 4-1.** DC Power Wiring

Signal / Connector	Integrated Unit	Remote Unit	
	MS2011LU (LevelPRO)	MS2011LUR Detector	MS2011T Transmitter
DC Power, Positive	VIN+ (PS-PCA J2A Pin 3)	+12 VDC (Connector Pin 1)	VIN+ (PS-PCA J2A Pin 3)
DC Power, Negative	GND (PS-PCA J2A Pin 4)	GND (Connector Pin 2)	GND (PS-PCA J2A Pin 4)

## AC Power

If the optional AC power board is installed, the detector may be operated using voltages from 100 to 240 VAC.

**Table 4-2. Site AC Power**

Signal / Connector	Integrated Unit	Remote Unit	
	MS2011LU (LevelPRO)	MS2011LUR Detector	MS2011T Transmitter
AC Power, Line	Line (PS-PCA J8 Pin 1)	L (Pin 3)	Line (PS-PCA J8 Pin 1)
AC Power, Earth Ground	Earth (J8 Pin 2)	E (Pin 2)	Earth (J8 Pin 2)
AC Power, Neutral	Neutral (PS-PCA J8 Pin 3)	N (Pin 1)	Neutral (PS-PCA J8 Pin 3)

If both AC and DC input power are supplied to the detector, the detector will draw power from whichever source provides the higher DC voltage.



**Caution:** For reliable operation, and to maintain safety approval, only replace the F2 fuse on the AC power board with an approved fuse. Reference the installation wiring guide (p/n 1-0702-049).

The AC power board utilizes color-coded wires. Determine the function of the wire by consulting the color-coding listed below.

**Table 4-3. Site AC Power Wire Color-Coding**

Signal / Standard	USA	International
Hot	Black	Brown
Neutral	White	Blue
Ground	Green	Green with Yellow Stripe

## Serial Communications

The detector provides one RS232 single-drop and one RS485 multi-drop serial interface.

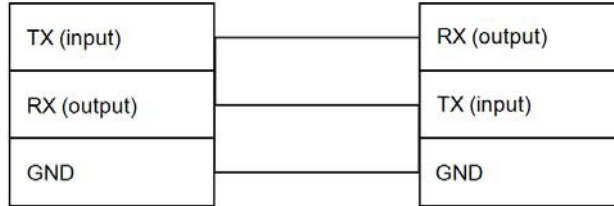
Screw-terminal connectors for both ports are located on the Main CPU board.

Both ports are configurable and able to display measurements, and both provide independent access to the measurement readings and software functions. For information on configuring communications, refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039).

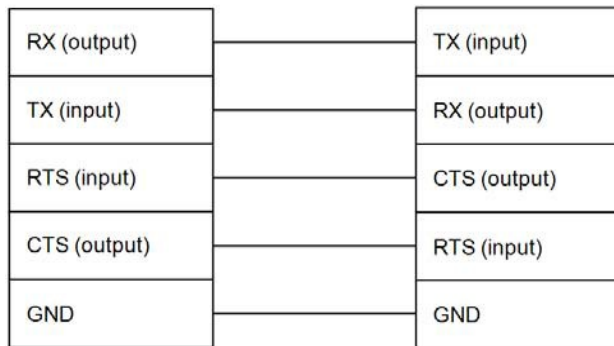
## RS232 Wiring

The serial port on a PC (COM1 or COM2) can connect directly to the detector's RS232 port. The RS232 port connector J2A is located on the Main CPU board. Standard connections are shown in the figures below.

- Do not exceed  $\pm 15$  VDC on any of the communication lines.
- The RS232 bus can drive up to 50 feet of cable.



**Figure 4-1.** Customer Communication Equipment (2-Wire RS232)



**Figure 4-2.** Customer Communication Equipment (RS232 with RTS/CTS)

To communicate with the detector from a PC, the PC must be running the Thermo Scientific EZ Cal II software.

The default communication settings for the RS232 and RS485 ports of the detector and for the Thermo Scientific EZ Cal II are:

- 8 data bits
- No parity
- 1 stop bit
- 9600 baud rate

Refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039) for additional details about configuring and using serial communications.

# RS485 Wiring

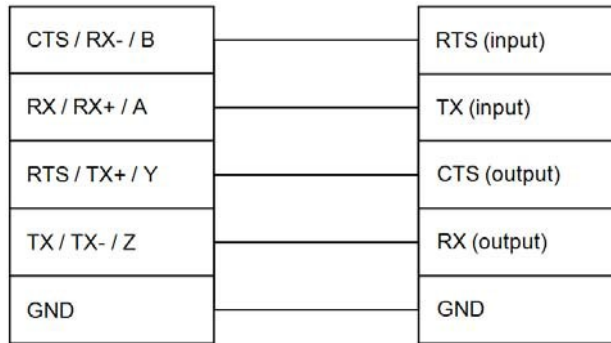
Connecting a PC serial port (COM) to the RS485 port on the detector requires an RS485/RS232 converter, p/n 670045. Refer to the LevelPRO System installation wiring guide (p/n 1-0702-049).

Make the RS485 connections as follows: When making the RS485 connection:

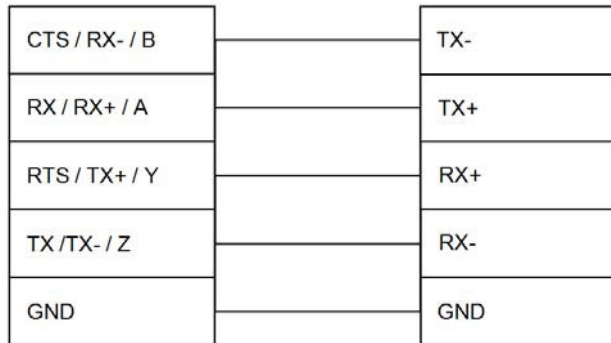
1. Connect RS485 connector J2B to the corresponding connections on the RS485/RS232 converter.
2. Connect the RS485/RS232 converter to the PC using a standard DB9 serial cable.
  - Do not exceed ±15 VDC on any of the communication lines.
  - The RS232 bus can drive up to 50 feet of cable.
  - The RS485 bus can drive up to 4,000 feet of cable.



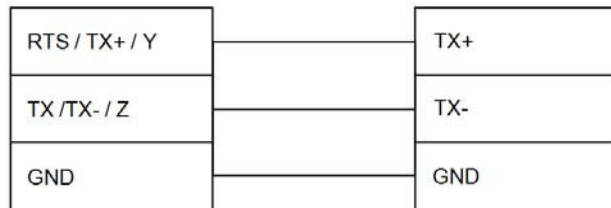
**Note:** This port is configurable as RS485 or RS232. When setting up an RS232 configuration, refer to [Figure 4-3](#). When setting up an RS485 configuration, refer to [Figure 4-4](#) or [4-5](#), as appropriate.



**Figure 4-3.** Customer Communication Equipment (RS232)



**Figure 4-4.** Customer Communication Equipment (4-Wire RS485)



**Figure 4-5.** Customer Communication Equipment (2-Wire RS485)

## RS485 Detector to Transmitter Wiring

Connect the detector's RS485 communication cable between the remote detector unit (MS2011LUR) and the transmitter unit (MS2011T) as shown in the table below.

**Table 4-4.** RS485 Detector to Transmitter Wiring

Signal / Connector	MS2011LUR Detector	MS2011T Transmitter
485A	485A (Connector Pin 7)	485A (PS-PCA J3A Pin 1)
485B	485B (Connector Pin 8)	485B (PS-PCA J3A Pin 2)
GND	GND (Connector Pin 9)	GND (PS-PCA J3A Pin 3)

## Initial Setup for Party-Line Communications

To communicate with multiple detectors via RS485 party line, each unit must be assigned a unique unit identification number so it can be addressed individually. By default, all detectors are assigned unit number one (1).

To assign a unique unit number to each detector, you must be able to communicate with each one individually. Disconnect each detector from the party line in turn and communicate with the disconnected detector directly. Alternatively, remove power from all detectors except one and assign a unit number to the powered detector. Repeat this procedure for the remaining detectors.

If trouble arises when using another device on the RS485 chain, verify that the device is properly terminated for its position on the chain. To terminate a device, connect a 120-ohm resistor between its RS485 +/- data terminals. Never terminate more than the first and last device in the chain.

## Standard Wiring

### USB

The Main CPU PCA includes a USB port, which allows the user to connect to the system using a type A Male to Mini 5-pin Male USB cable. Operators should ensure the area is non-hazardous before connecting or disconnecting the USB cable.

### Ethernet

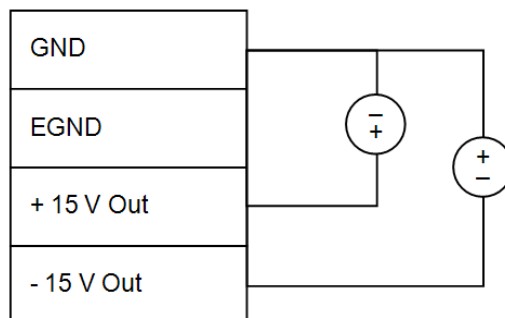
Each LevelPRO unit includes a 10 Base-T minimum Ethernet port on the Main CPU PCA. Operators should ensure the area is non-hazardous before connection or disconnecting the Ethernet cable.

## Voltage Output

### LevelPRO

To power another device, the operator should follow the wiring requirements below, when configuring the Main CPU PCA in the LevelPRO, or in the remote transmitter of the LevelPRO-T.

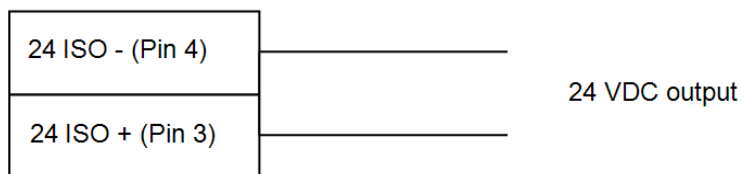
- $\pm 15$  VDC nominal, 100 mA max output



**Figure 4-6.**  $\pm 15$  VDC Output, Main CPU PCA

### LevelPRO-T

The remote detector unit of the LevelPRO-T provides users with an isolated, 24 VDC nominal, 50 mA max output.



**Figure 4-7.** 24 VDC Isolated Output, MS2011LUR

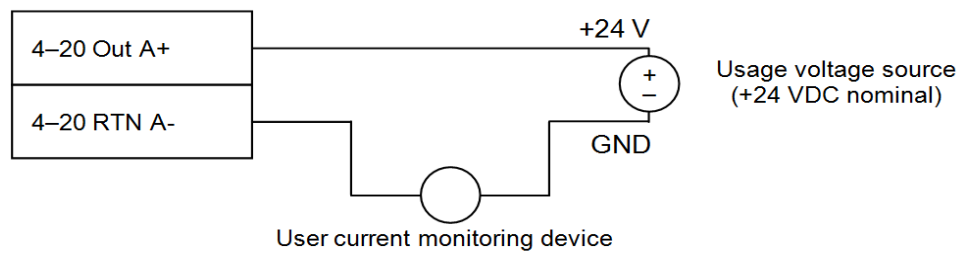
## Current Output

There are three configurations available for the 4–20 mA current output:

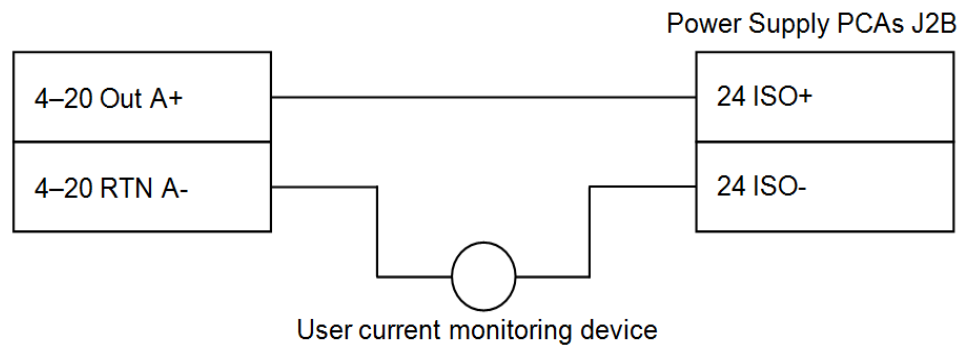
- Isolated, loop-powered (default)
- Isolated, self-powered
- Intrinsically safe, isolated, self-powered output requiring an optional ISIO board (see [Wiring the Optional ISIO Boards](#)).

All configurations can drive a 750-ohm maximum load over the full current output range. The current output is programmable between 3.8 and 20.5 mA. The current output has a fault low condition of 3.6 mA or less and a fault high condition of 20.8 mA or greater.

The default current output configuration is isolated, loop-powered.



**Figure 4-8.** 4-20 mA Isolated, Loop-Powered Configuration

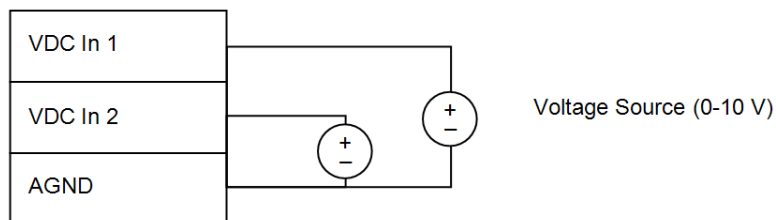


**Figure 4-9.** 4-20 mA Isolated, Self-Powered Configuration

## Voltage Input

The Main CPU PCA allows for a user-provided 4–20 mA voltage input on connector J1A.

Refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039) for details on how to configure the detector to use the voltage input signal.



**Figure 4-10.** Voltage Input Wiring

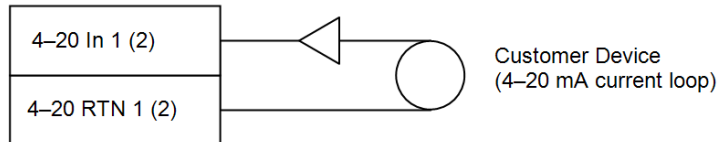
## Current Input

The Main CPU board allows for a user-provided 4–20 mA current input on connector J1B. The maximum cable length from the detector to the user-provided transmitter is 25 feet.

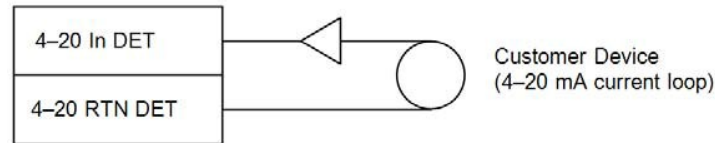
Refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039) for details on how to configure the detector to use the flow input signal.

### LevelPRO

Two 4–20 mA inputs are provided on port J1B of the Main CPU board. There is an additional 4–20 mA input provided through port J2B on the Power Supply board.



**Figure 4-11.** 4-20 mA Input Wiring, Main CPU PCA

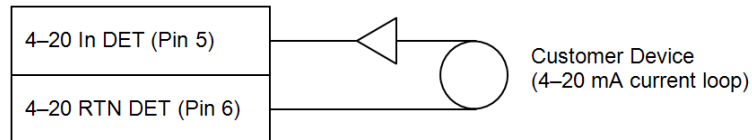


**Figure 4-12.** 4-20 mA Input Wiring, Power Supply PCA

### LevelPRO-T

Two 4–20 mA inputs are provided on the remote transmitter unit, on connectors J1A and J1B of the Main CPU board, with an additional 4–20 mA input provided on the remote detector.

For the wiring configuration of the transmitter inputs, see [Figure 4-11](#).



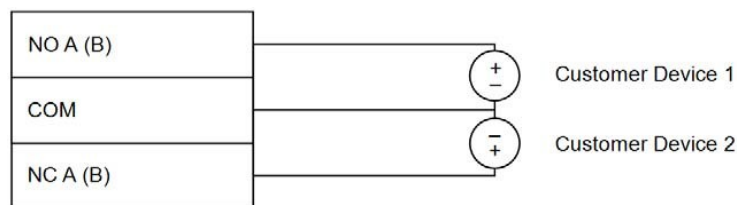
**Figure 4-13.** 4-20 mA Input Wiring, Remote Detector

## Relay Outputs

There are two relays provided on the power supply board. The relays are DPDT-fully sealed 8 A at 250 VAC.



**Note:** Ensure the area is non-hazardous before making or breaking any connections.



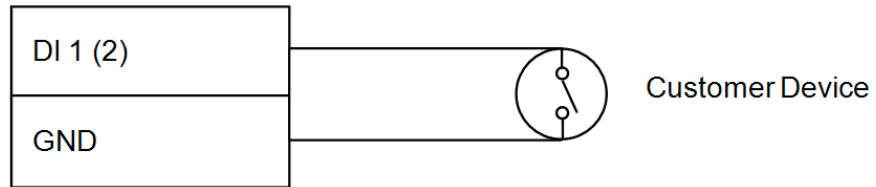
**Figure 4-14.** Relay Wiring

For instructions on how to configure relays to open or close on fault, warning or process measurement alarms, refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039).

## Contact Closure (Digital) Inputs

The two digital contact closure inputs, between ground and DI 1 and ground and DI 2, provide the user with the ability to configure the detector to execute a command or other function upon a user-provided contact opening or closing. A +3.3 V wetting voltage (0.1 mA max) is provided for each discrete input.

Refer to the LevelPRO Measurement System User Manual (p/n 1-0702-039) for details on assigning commands to the contact closure inputs.

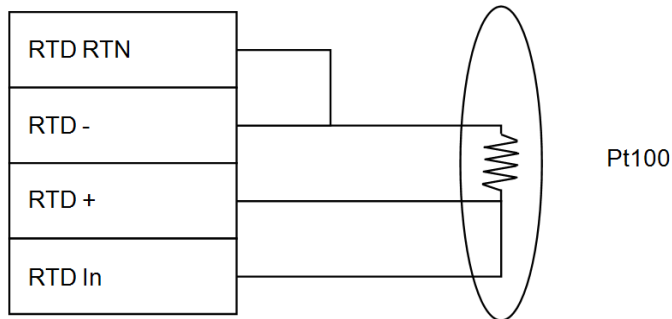


**Figure 4-15.** Discrete Input Wiring

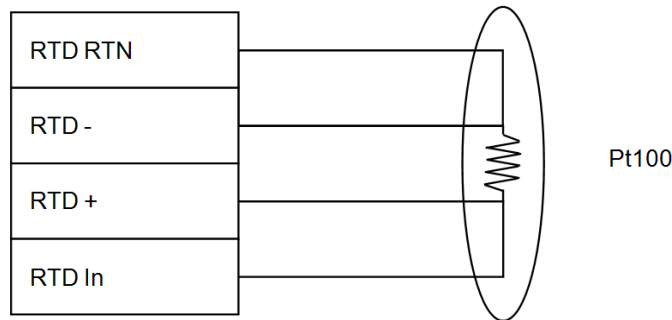
## Temperature Compensation

The LevelPRO measurement system’s temperature compensation circuitry utilizes a 3- or 4-wire, 100-ohm Platinum RTD. Each RTD wire has a maximum per-wire resistance of 1.0 ohm.

Refer to the connections in the figures below.



**Figure 4-16.** RTD, 3-Wire Configuration



**Figure 4-17.** RTD, 4-Wire Configuration

# Wiring the Optional ISIO Boards

## Current Output

There are two configurations available for the 4–20 mA current output on J3 port of the ISIO PCA.

- Intrinsically safe, isolated, loop-powered (default)
- Intrinsically safe, isolated, self-powered

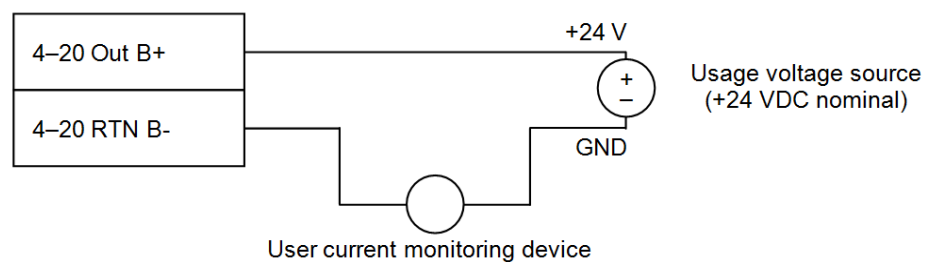
All configurations can drive a 750-ohm maximum load over the full current output range. The current output is programmable between 3.8 and 20.5 mA. The current output has a fault low condition of 3.6 mA or less and a fault high condition of 20.8 mA or greater.

J3 is a standard 4–20 mA output with no fieldbus options. The entity parameters are as follows:

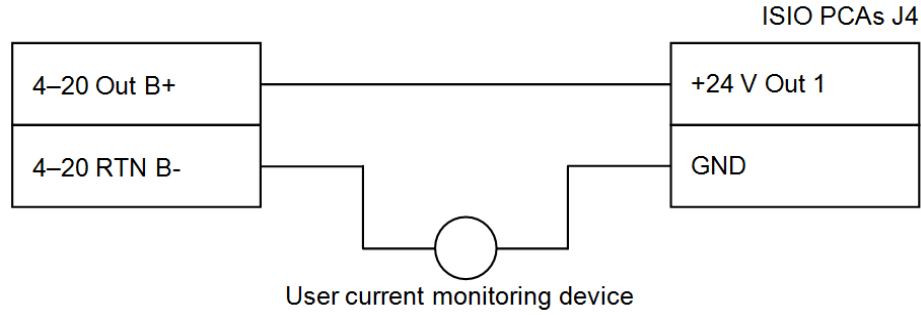
- $V_{max}$  = 35.25 V
- $I_{max}$  = 200 mA
- $C_i$  = 0 nF
- $L_i$  = 0
- $P_{max}$  = 0.81 W

The default current output configuration is isolated, loop-powered.

The figures below demonstrate the wiring configurations possible using the J3 ports on the ISIO PCA.



**Figure 4-18.** Optional 4-20 mA Output, Isolated Loop-Powered



**Figure 4-19.** Optional 4-20 mA Output, Isolated Self-Powered

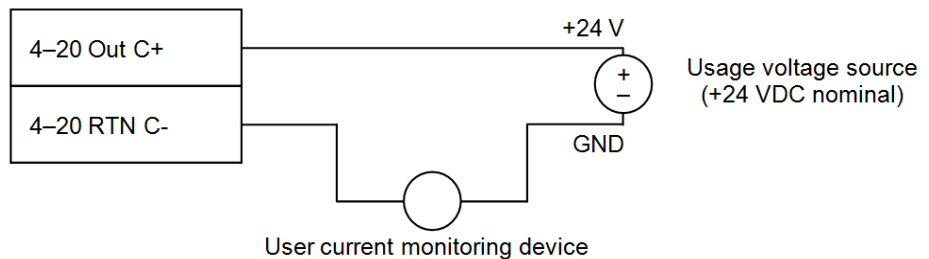
J4 is an isolated 24 volt output with a zener barrier output. The results of calculating the values were very similar to the MTL 787 barrier. The MTL document “Cable Parameters and Permitted Combinations” was used to determine the C and L values below.

- $V_o = 28.35 \text{ V}$
- $I_o = 106 \text{ mA} \geq \text{fuse rated for } 63 \text{ mA}$
- $Ohm = 270$
- $C_o = 79 \text{ nf}$
- $L_o = 2 \text{ mH}$
- $L/R \text{ ratio (uH / ohms)} = 56$
- $P_o = 1.02 \text{ W}$

The figures below demonstrate two of the wiring configurations possible using the J11 ports on the ISIO PCA.

J11 is a 4–20 mA output port that may also be used to support the HART Communication protocol. For information on configuring wiring to support a HART Communication protocol, see [HART® Communications](#). The entity parameters for J11 are as follows:

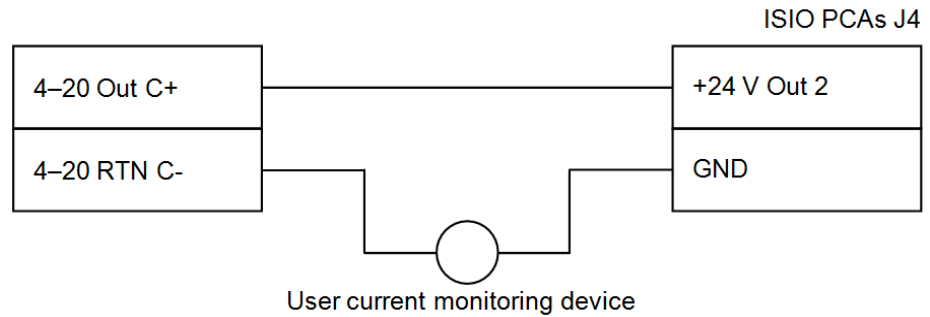
- $V_{max} = 35.25 \text{ V}$
- $I_{max} = 200 \text{ mA}$
- $C_i = 0 \text{ nf}$
- $L_i = 0$
- $P_{max} = 0.81 \text{ W}$



**Figure 4-20.** Optional 4-20 mA Output, Isolated Loop-Powered

## Wiring

### Wiring the Optional ISIO Boards



**Figure 4-21.** Optional 4-20 mA Output, Isolated Self-Powered

J4 is an isolated 24 volt output with a zener barrier output. The results of calculating the values were very similar to the MTL 787 barrier. The MTL document “Cable Parameters and Permitted Combinations” was used to determine the C and L values below.

- $V_o$  = 28.35 V
- $I_o$  = 106 mA  $\geq$  fuse rated for 63 mA
- Ohm = 270
- $C_o$  = 79 nf
- $L_o$  = 2 mH
- L/R ration (uH / ohms) = 56
- $P_o$  = 1.02 W

## Wiring

Wiring the Optional ISIO Boards

# HART® Communications

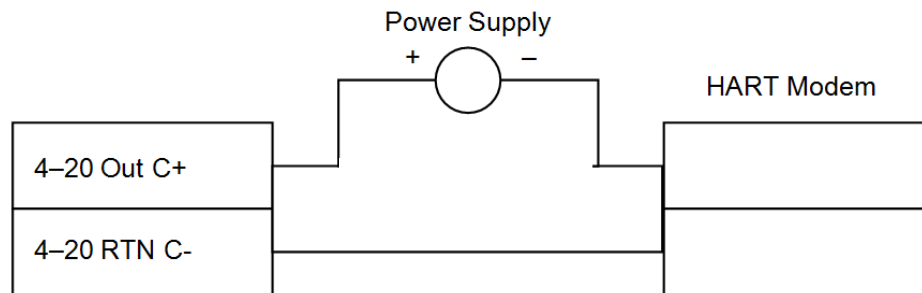
The HART Communication protocol is supported over port J11, the 4–20 mA current output with an optional ISIO board. Communication with the detector takes place through an Emerson Electric Co. field communicator, Model 275 or newer.

The entity parameters for port J11 with the HART option is as follows:

- $V_{max}$  = 35.25 V
- $I_{max}$  = 200 mA
- $C_i$  = 0 nf
- $L_i$  = 0
- $P_{max}$  = 0.81 W

To connect the HART wiring:

- Use shielded, twisted-pair cabling with the proper conductor size
- Ground at one point only
- Ensure a properly specified power supply



**Figure 4-22.** Optional ISIO Board J11, HART Communications

# FOUNDATION™ Fieldbus Communications

With FOUNDATION™ fieldbus, the LevelPRO detector provides users with access to the control or program parameters via a host system. The fieldbus connector, accessible from the faceplate of the detector, only requires connection to the H1 bus for operation.

Twisted, shielded pair cable must be used, in accordance with the FOUNDATION fieldbus specification.

The FOUNDATION fieldbus option is utilized through the J12 port. The entity parameters for port J12 are as follows:

- $V_i$  = 24 V
- $I_i$  = 250 mA
- $C_i$  = Negligibly
- $L_i$  = 10  $\mu$ H
- Temperature class: T4

Shield
FFB- / PA-
FFB+ / PA+

**Figure 4-23.** Optional ISIO Board J12, FOUNDATION Fieldbus

# Chapter 5

## Support

### Contact Information

Should additional assistance be required, please feel free to contact Thermo Scientific directly.

<b>Process Instruments</b>	
1410 Gillingham Lane Sugar Land, TX 77478 USA	Ion Path, Road Three Winsford Cheshire CW7 3GA United Kingdom
+1 (800) 437-7979 +1 (713) 272-0404 direct +1 (713) 272-4573 fax	+44 (0) 1606-548700 +44 (0) 1606 548711 fax
Units 702-715, 7th Floor Tower West, Yonghe Plaza Andingmen East Street 100007 Beijing P.R. CHINA	A-101, ICC Trade Tower Senapati Bapat Road Pune 411016 INDIA
+86 (10) 8419-3588 +86 (10) 8419-3580 fax	+91 (20) 6626-7000 +91 (20) 6626-7001 fax
<b><a href="http://www.thermoscientific.com">www.thermoscientific.com</a></b>	

## **Warranty**

Thermo Scientific products are warranted as free from defects in material and workmanship, either for 12 months from date of installation or 18 months from date of shipment, whichever occurs earlier. Any claimed defects of Thermo Scientific products must be reported within the warranty period. Thermo Scientific shall have the right to inspect such products at Buyer's plant or to require Buyer to return such products to the Thermo Scientific plant.

In the event Thermo Scientific requests the return of its products, Buyer shall ship with transportation charges paid by the Buyer to the Thermo Scientific plant. Shipment of repaired or replacement goods from the Thermo Scientific plant shall be F.O.B. Thermo Scientific plant. The customer will receive a quotation of proposed work before repair work begins. Thermo Scientific shall be liable only to replace or repair, at its option, free of charge, products that are found by Thermo Scientific to be defective in material or workmanship, and which are reported to Thermo Scientific within the warranty period as provided above. This right to replacement shall be Buyer's exclusive remedy against Thermo Scientific.

Thermo Scientific shall not be liable for labor charges or other losses or damages of any kind or description, including but not limited to, incidental, special or consequential damages caused by defective products. This warranty shall be void if recommendations provided by Thermo Scientific or its Sales Representatives are not followed concerning methods of operation, usage and storage, or exposure to harsh conditions.

Materials and/or products furnished to Thermo Scientific by other suppliers shall carry no warranty, with the exception of suppliers' warranties as to materials and workmanship. Thermo Scientific disclaims all warranties, expressed or implied, with respect to such products.

EXCEPT AS OTHERWISE AGREED TO IN WRITING BY Thermo Scientific, THE WARRANTIES GIVEN ABOVE ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND Thermo Scientific HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR PURPOSE.

# Appendix A

## Ordering Information

Code	System Configurations	LevelPRO	LevelPRO-T
1	Single Detector Configuration - Select 'I' or 'R' in "System Options" below	•	•
2	Multi-Detector Configuration (w/ up to max of 4 Remote System Detectors and 1 Transmitter)		•
3	Multi-Detector Configuration (w/ 1 Integrated and up to max of 3 Remote System Detectors - No Transmitter Required)	•	
Code	System Options	LevelPRO	LevelPRO-T
I	Integrated System	•	
R	Remote System (Detector and Transmitter)		•
B	Integrated and Remote Detector ONLY	•	
Code	Transmitter Approvals	LevelPRO	LevelPRO-T
0	No Selection		
1	Transmitter - Remote System ONLY (CSA C/US Class I, Div. 2, Group C&D)		•
2	Transmitter - Remote System ONLY (CE - ATEX Zone 2 / IEC)		•
Code	Detector Enclosure	LevelPRO	LevelPRO-T
XP	Explosion Proof	•	•
XPW	Explosion Proof with Water Cooled Jacket	•	•
Code	Detector Enclosure Type	LevelPRO	LevelPRO-T
1	Carbon Steel	•	•
2	Stainless Steel	•	•
Code	Detector Approvals	LevelPRO	LevelPRO-T
C	CSA C/US Class I, Div 1, Group C & D	•	•
E	CE - ATEX Zone 1 / IECEx	•	•

## Ordering Information

<b>Code</b>	<b>Carbon Steel Detector Length</b>	<b>LevelPRO</b>	<b>LevelPRO-T</b>
01	1 ft detector	•	•
02	2 ft detector	•	•
03	3 ft detector	•	•
04	4 ft detector	•	•
05	5 ft detector	•	•
06	6 ft detector	•	•
07	7 ft detector	•	•
08	8 ft detector	•	•
09	9 ft detector	•	•
10	10 ft detector	•	•
11	11 ft detector	•	•
12	12 ft detector	•	•
<b>Code</b>	<b>Water-cooled Carbon Steel Detector Length</b>	<b>LevelPRO</b>	<b>LevelPRO-T</b>
01	1 ft detector	•	•
02	2 ft detector	•	•
03	3 ft detector	•	•
04	4 ft detector	•	•
05	5 ft detector	•	•
06	6 ft detector	•	•
07	7 ft detector	•	•
08	8 ft detector	•	•
09	9 ft detector	•	•
10	10 ft detector	•	•
11	11 ft detector	•	•
12	12 ft detector	•	•
<b>Code</b>	<b>Stainless Steel Detector Length</b>	<b>LevelPRO</b>	<b>LevelPRO-T</b>
01	1 ft detector	•	•
02	2 ft detector	•	•
03	3 ft detector	•	•
04	4 ft detector	•	•
05	5 ft detector	•	•
06	6 ft detector	•	•
07	7 ft detector	•	•
08	8 ft detector	•	•
09	9 ft detector	•	•
10	10 ft detector	•	•
11	11 ft detector	•	•
12	12 ft detector	•	•

Code	Water-cooled Stainless Steel Detector Length	LevelPRO	LevelPRO-T
01	1 ft detector	•	•
02	2 ft detector	•	•
03	3 ft detector	•	•
04	4 ft detector	•	•
05	5 ft detector	•	•
06	6 ft detector	•	•
07	7 ft detector	•	•
08	8 ft detector	•	•
09	9 ft detector	•	•
10	10 ft detector	•	•
11	11 ft detector	•	•
12	12 ft detector	•	•
Code	Outputs / Communications	LevelPRO	LevelPRO-T
N	No selection		
I	ISIO	•	•
H	ISIO + HART	•	•
F	ISIO + FOUNDATION Fieldbus	•	•
P	ISIO + Profibus	•	•
Code	Accessories	LevelPRO	LevelPRO-T
0	No selection		
1	Lg SS Tag (3.3" x 2.5") with Wired	•	•
2	Model 9723 backlit LCD display	•	

	System Configurations	System Options	Transmitter Approvals	Detector Enclosure	Detector Enclosure Type	Carbon Steel Approvals	Water-Cooled Detector Length	Stainless Steel Detector Length	Water-Cooled CS Detector Length	Water-Cooled SS Detector Length	Outputs / Communications	Accessories	
MS2011LU	1	I	0	XP	1	C	06	-	-	-	H	0	Integrated System
MS2011LUR	2	R	1	XP	2	E	-	-	03	-	I	0	Remote System

Figure A-1. Sample Order Format



# Appendix B

## Specifications

Results may vary under different operating conditions.






**Table B-1.** Performance Specifications



System performance	0.5% of span, typical
Temperature stability	$\pm 0.009\%$ of radiation change per degree Celsius
Response time	1 seconds to 65,535 seconds
Minimum counts for stabilization	400 Hz
Maximum counts for stabilization	Up to 2 MHz

**Table B-2.** Gamma Ray Source

Source type	Cs-137 or Co-60; Double-encapsulated by stainless steel
Activity	1 to 10,000 mCi (37 MBq to 370 GBq) Cs-137 or 1,000 to 3000 mCi (37 GBq to 111 GBq) Co-60
Source housing	<ul style="list-style-type: none"><li>– Polyurethane-painted, lead-filled carbon or stainless steel</li><li>– Three-position shutter (On/Off/Reference) locks in OFF (closed) position</li></ul>




**Table B-3.** LevelPRO Measurement Systems

System architecture	<ul style="list-style-type: none"> <li>– 32-bit, 60 MHz microcomputer</li> <li>– Real-time clock (RTC)</li> <li>– Lithium backup battery; voltage monitor for the RTC and SRAM circuits allows for configuration retention in the event of a power failure</li> <li>– Local I/O, consisting of: <ul style="list-style-type: none"> <li>• Four analog (two current + two voltage) inputs</li> <li>• One 100-ohm Pt RTD input</li> <li>• Two digital outputs (DO)</li> <li>• Two digital inputs (DI)</li> <li>• Two relay outputs</li> <li>• One local serial communication port</li> <li>• One RS232/RS485 host serial communication port</li> <li>• One +15 V, 100 mA power supply output</li> <li>• One isolated 24 V output supporting two 4–20 mA loops</li> <li>• One 10/100BASE-T Ethernet communication port with ESD protection</li> <li>• One USB port</li> </ul> </li> <li>– Optional I/O, consisting of: <ul style="list-style-type: none"> <li>• Two isolated 24 V outputs supporting two 4–20 mA loops</li> <li>• Two 4–20 mA loop outputs</li> </ul> </li> </ul>
Detection type	PVT scintillator with wide dynamic range; resists shock and moisture damage
Detector stabilization	Electronic control without heater stabilization for optimum performance over operating temperature range (patent pending)
Detector enclosure construction	<ul style="list-style-type: none"> <li>– Carbon steel or 316 stainless steel; polyurethane-painted</li> <li>– Optional water-cooled detector for high temperature applications</li> </ul>
Transmitter enclosure construction	<ul style="list-style-type: none"> <li>– Stainless steel enclosure <ul style="list-style-type: none"> <li>• Nema 4X and IP66</li> <li>• 20-pushbutton keypad</li> <li>• 8-line monochrome LCD</li> </ul> </li> </ul>
Approvals LevelPRO (MS2011LU) & LevelPRO-T Detector (MS2011LUR); XP, XPW & 4X	<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 10px;">  </div> <div> <p>Class I, Div 1, Groups B, C, D; T4</p> <p>Class I, Div 2, Groups A, B, C, D; T4</p> <p>Class II, Div 2, Groups E, F, G; T4</p> <p>Class III; T4; Tamb: -40°C to 75°C</p> </div> </div> <p>Enclosure type 4X</p> <div style="display: flex; align-items: center;">   <span style="margin-left: 5px;">I M2 GD Ex d ib<sup>+</sup> IIB+ H2 Gb T4; Tmax: 125°C</span> </div> <div style="display: flex; align-items: center;">   <span style="margin-left: 5px;">II 2 GD Ex d ib<sup>+</sup> IIB+ H2 Gb T4; Tamb: -40°C to 75°C SIRA 13ATEX1187</span> </div> <p>IECEX CSA 13.0013</p> <p>IP66</p>

<p>Approvals LevelPRO-T Transmitter (MS2011T)</p>	 <p>Class I, Div 2, Groups A, B, C, D; T4 Class II, Div 2, Groups E, F, G; T4 Class III; T4; Tamb: -40°C to 75°C</p> <p>Enclosure type 4X</p>  <p>II 3 GD Ex nA nC ib<sup>†</sup> IIC T4 Gc; Tamb: -40°C to 75°C IECEx CSA 13.0018X IP66</p>
<p>Power</p>	<ul style="list-style-type: none"> <li>- 11 to 32 VDC, 770 mA max</li> <li>- 100 to 240 VAC, 50/60 Hz, 380 mA max (MS2011LU)</li> <li>- 100 to 240 VAC, 50/60 Hz, 300 mA max (MS2011LUR &amp; MS2011T)</li> </ul>
<p>Environment</p>	<ul style="list-style-type: none"> <li>- Operating temperature <ul style="list-style-type: none"> <li>• -40°C to 75°C (-40°F to 167°F) ambient</li> </ul> </li> <li>- Storage temperature <ul style="list-style-type: none"> <li>• -40°C to 75°C (-40°F to 167°F) ambient</li> </ul> </li> <li>- Humidity <ul style="list-style-type: none"> <li>• 0 to 95% non-condensing</li> </ul> </li> <li>- Vibration (random) <ul style="list-style-type: none"> <li>• IEC 60068-2-64</li> <li>• 10 to 2,000 Hz, 1 octave/minute, 1 g peak</li> </ul> </li> <li>- Vibration (sinusoidal) <ul style="list-style-type: none"> <li>• IEC 60068-2-6</li> <li>• 10 to 2,000 Hz, ~3 grams, 30 minutes/axis</li> </ul> </li> <li>- Shock resistance <ul style="list-style-type: none"> <li>• IEC 60068-2-27</li> <li>• 30 g, 18 ms, 3 shocks/direction/axis</li> </ul> </li> <li>- Earthquake/Seismic <ul style="list-style-type: none"> <li>• IEEE 344</li> <li>• TFS Generic Profile at 10 g; TVA CEB-SS-5.10 at 15 g</li> </ul> </li> <li>- Composite temperature / humidity cyclic <ul style="list-style-type: none"> <li>• IEC 60068-2-38</li> </ul> </li> </ul>

<sup>†</sup> When ISIO PCA is installed

**Table B-4.** Inputs and Outputs

Inputs	<ul style="list-style-type: none"> <li>– Three 4–20 mA inputs, full scale <math>\pm 0.3\%</math> over operating temperature range; fault high/low detection</li> <li>– Two 0 to 10 VDC voltage inputs, full scale <math>\pm 0.3\%</math> over operating temperature range</li> <li>– Two digital inputs (DI) provide contact input with internal +5 VDC wetting voltage</li> <li>– Temperature compensation circuitry with 100-ohm Platinum RTD, 3- or 4-wire; full scale <math>\pm 0.4^{\circ}\text{C}</math> over operating temperature</li> </ul>
Current outputs	<ul style="list-style-type: none"> <li>– 4–20 mA output, full scale <math>\pm 0.3\%</math> over operating temperature range                             <ul style="list-style-type: none"> <li>• Isolated, loop-powered (default)</li> <li>• Isolated, self-powered output</li> </ul> </li> <li>– Optional Intrinsically Safe Input/Output 4–20 mA output, full scale <math>\pm 0.3\%</math> over operating temperature range                             <ul style="list-style-type: none"> <li>• Isolated, loop-powered (default)</li> <li>• Isolated, self-powered output</li> </ul> </li> </ul>
Contact closure (relay) outputs	Two relays, DPDT-fully sealed 8 A at 250 VAC
Serial outputs	<ul style="list-style-type: none"> <li>– RS485 half duplex</li> <li>– RS232 full duplex</li> <li>–  Fieldbus: A LevelPRO detector's DD is available from the Fieldbus Foundation™ website. The DD is a DD4 or DD5, interpreted by a host implementing DD Services 4.x or 5.x</li> <li>–  (Pending)</li> <li>–  (Pending)</li> </ul>

**Table B-5.** Mounting Hardware

Gamma ray source	Integral bolt-on bracket; compatible with chain or saddle mount
Integrated detector-transmitter	Integral bolt-on bracket

**Table B-6.** Programming Options

Fieldbus host, such as National Instruments™ NI-FBUS Configurator	Provides the interface between the LevelPRO detector and other devices on a Foundation™ fieldbus network
Emerson Electric Co. field communicator, Models 275 and newer	Configures and calibrates any LevelPRO detector by communicating with the detector via the current loop BEL202FSK-standard
Comm PC interface software	EZ Cal II

# Appendix C

## Drawings



**Note:** Information presented in this chapter has been regenerated from original drawings. Every effort is made to maintain document accuracy. However, in order to enhance legibility, the documents may have been restructured, and some information may have been intentionally excluded. Therefore, the drawings within this guide may not be an exact duplicate of the original drawings.



**Note:** Drawings in this manual are included for reference only and may not be the current version. Contact the factory if you need a copy of the latest revision.

**Table C-1.** Installation Wiring Diagrams

Drawing #	Rev	Description	Page
1-0702-038	B	Installation Wiring Guide, MS2011I / DUI / LUI	<a href="#">C-3</a>
1-0702-049	A	Installation Wiring Guide, MS2011T & MS2011LUR	<a href="#">C-7</a>

**Table C-2.** Installation Drawings

Drawing #	Rev	Description	Page
1-0702-041	A	Installation Drawing, MS2011LU	<a href="#">C-13</a>
1-0702-043	A	Installation/Arrangement Drawing, 1 Source with 1 Detector	<a href="#">C-14</a>
1-0702-044	A	Installation/Arrangement Drawing, 2 Sources with 1 Detector	<a href="#">C-15</a>
1-0702-045	A	Installation/Arrangement Drawing, 3 Sources with 1 Detector	<a href="#">C-16</a>
1-0702-046	A	Installation/Arrangement Drawing, 2 Sources with 2 Detectors	<a href="#">C-17</a>
1-0702-047	A	Installation/Arrangement Drawing, 2 Sources with 3 Detectors	<a href="#">C-18</a>
1-0702-048	A	Installation/Arrangement Drawing, 3 Sources with 2 Detectors	<a href="#">C-19</a>
1-0702-142	A	Mounting Dimensions, MS2011LU, XP	<a href="#">C-20</a>
1-0702-143	A	Mounting Dimensions, MS2011LU, XPW	<a href="#">C-21</a>





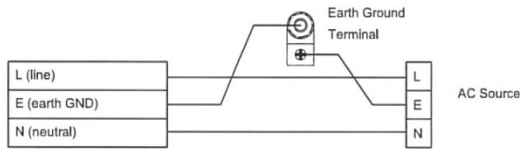
# Drawings

## A. General Wiring Requirements:

- A1. Installation should be in accordance with ANSI/ISA RP 12.6 and the NEC ANSI/NFPA 70, or Canadian Electrical Code Part 1.
- A2. All wiring requires a minimum insulation rating of 85°C
- A3. Approved conduit seals must be installed within 18" [457 mm] of the housing
- A4. Equipment must be installed by qualified personnel
- A5. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous
- A6. Service connections can only be used when the atmosphere is known to be safe

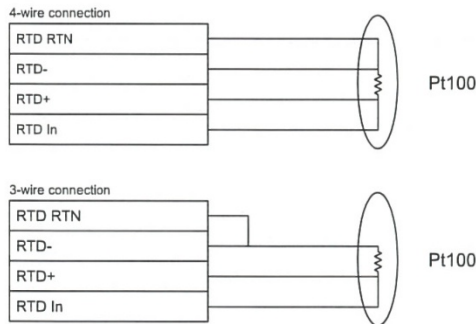
## B. Notes and wiring requirements for Power Supply PCA's J8, AC input voltage

- B1. Universal power supply 100 - 240 VAC, 300mA max.
- B2. Use 14 - 18 AWG wires
- B3. Fuse (F2), 250 V, 1 A, size 5x20 mm



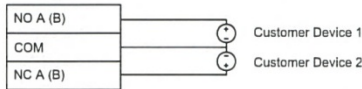
## C. Notes and Wiring requirements for Power Supply PCA's J3B, RTD (Pt100)

- C1. The max wire resistance (per wire) is 0.2 Ω for 2-wire RTD and 1.0 Ω for 3-wire or 4-wire RTD



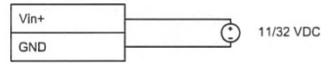
## E. Note and wiring requirements for Power supply PCA's J1A and J1B, Relays

- E1. Ensure the area is non-hazardous before making or breaking any connections
- E2. Relays rated, 240 VAC at 5 A



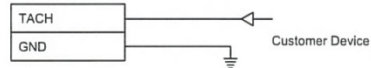
## F. Note and wiring requirements for Power supply PCA's J2A, DC input voltage

- F1. Use 18 AWG wire for DC input voltage
- F2. DC power input: 11 - 32 VDC, 770 mA max.
- F3. Fuse (F1), fast acting, 2 A, 5x20 mm ceramic



## G. Note and wiring requirements for Power supply PCA's J2A, Tachometer

- G1. The pulse input must be resistive or inductive in nature only, with a maximum input of 5 VDC

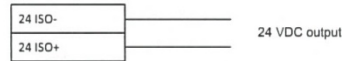


## H. Note and wiring requirements for Power supply PCA's J2B, 4 - 20 mA input



## I. Note and wiring requirements for Power supply PCA's J2B, 24 VDC isolated output

- I1. Isolated 24 VDC nominal, 50 mA max



## J. Note and wiring requirements for Power supply PCA's J7A and J7B, Discrete inputs

- J1. A +3.3 V wetting voltage (0.1 mA max.) is provided for each discrete input



## K. Note and wiring requirements for Main CPU PCA's J5, USB

- K1. Ensure the area is non-hazardous before connecting or disconnecting the USB
- K2. USB A Male to USB Mini 5-Pin Male Cable is required for connecting to the system

## L. Note and wiring requirements for Main CPU PCA's J2A, COMM A (RS-232)

- L1. Do not exceed ±15 VDC on any of the communication lines
- L2. RS-232 buss can drive up to 50 ft. of cable

Figure C-1. Installation Wiring Guide, MS2011I / DUI / LUI (Sheet 2 of 4)

# Drawings

## RS-232 wiring



Customer Communication Equipment (2-wire RS-232)

## RS-232 with RTS/CTS



Customer Communication Equipment (with RTS/CTS)

## M Note and wiring requirements for Main CPU PCA's J2B, COMM B (RS-232/RS-485)

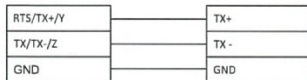
- M1. Do not exceed ±15 VDC on any of the communication lines
- M2. RS-232 bus can drive up to 50 ft. of cable
- M3. RS-485 bus can drive up to 4000 ft. of cable



Customer Communication Equipment (RS-232)



Customer Communication Equipment (4-wire RS-485)



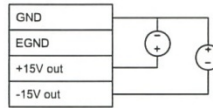
Customer Communication Equipment (2-wire RS-485)

## N Note and wiring requirements for Main CPU PCA's J3, Ethernet

- N1. Ensure the area is non-hazardous before connecting or disconnecting the USB
- N2. 10 Base-T minimum

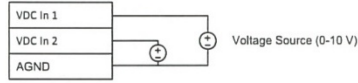
## O Note and wiring requirements for Main CPU PCA's J1A, ±15 VDC output

- O1. ±15 VDC nominal, 100 mA max



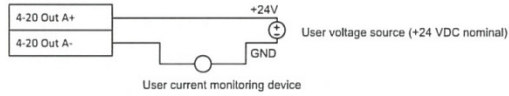
## P. Note and wiring requirements for Main CPU PCA's J1A, Analog Input (0 - 10 V)

- P1. Maximum cable length from gauge to each transmitter is 25 ft.

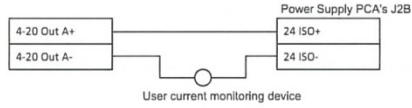


## Q. Note and wiring requirements for Main CPU PCA's J1B, 4 - 20 mA output

- Q1. Maximum resistant load is 750Ω
- Q2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to 4 - 20 mA loop.



- Q3. 4 - 20 mA is configured as an isolated self-powered configuration

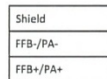


## R. Note and wiring requirements for Main CPU PCA's J1B, 4 - 20 mA inputs



## S. Note and wiring requirements for optional ISIO PCA's J12, Foundation Fieldbus

- S1. Twisted, shield pair cable must be used in accordance with Foundation Fieldbus specification
- S2. The entity parameters for port J12 are as follows:
  - Vi = 24 V
  - Ii = 250 mA
  - Ci = Negligibly low
  - Li = 10 uH
  - Temperature class: T4

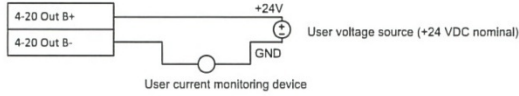


**Figure C-1.** Installation Wiring Guide, MS2011I / DUI / LUI (Sheet 3 of 4)

# Drawings

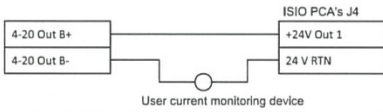
**T. Note and wiring requirements for optional ISIO PCA's J3, 4 - 20 mA output**

- T1. Maximum resistant load is 750Ω
- T2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to a 4 - 20 mA loop.
- T3. The entity parameters are as follows:
  - Vmax = 35.25 V
  - Imax = 200 mA
  - Ci = 0 nf
  - Li = 0
  - Pmax = 0.81 W



- T4. 4 - 20 mA is configured as an isolated self- powered configuration
- T5. The entity parameters are as follows:

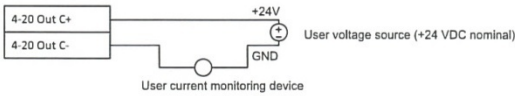
- Vo = 28.35 V
- Io = 106 mA ≥ fuse rated for 63 mA
- Ohm = 270
- Co = 79 nf
- Lo = 2 mH
- L/R ratio (μH / ohms) = 56
- Po = 1.02 W



**U. Note and wiring requirements for optional ISIO PCA's J11, Hart or 4 - 20 mA output**

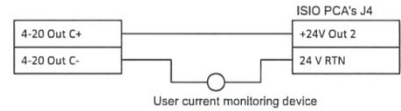
- U1. Maximum resistant load is 750Ω
- U2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to a 4 - 20 mA lo
- U3. The entity parameters for J11 are as follows:

- Vmax = 35.25 V
- Imax = 200 mA
- Ci = 0 nf
- Li = 0
- Pmax = 0.81 W



- U4. 4 - 20 mA is configured as an isolated self- powered configuration
- U5. The entity parameters for J11 are as follows:

- Vo = 28.35 V
- Io = 106 mA ≥ fuse rated for 63 mA
- Ohm = 270
- Co = 79 nf
- Lo = 2 mH
- L/R ratio (μH / ohms) = 56
- Po = 1.02 W

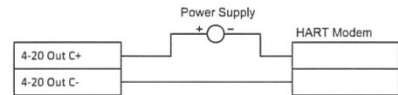


**U6. Hart Wiring**

- Twisted, shield pair cable must be used with the proper conductor size
- Ground at one point only
- Ensure a properly specified power supply

The entity parameters for port J11 with the HART option are as follows:

- Vmax = 35.25 V
- Imax = 200 mA
- Ci = 0 nf
- Li = 0
- Pmax = 0.81 W



**Figure C-1.** Installation Wiring Guide, MS2011I / DUI / LUI (Sheet 4 of 4)

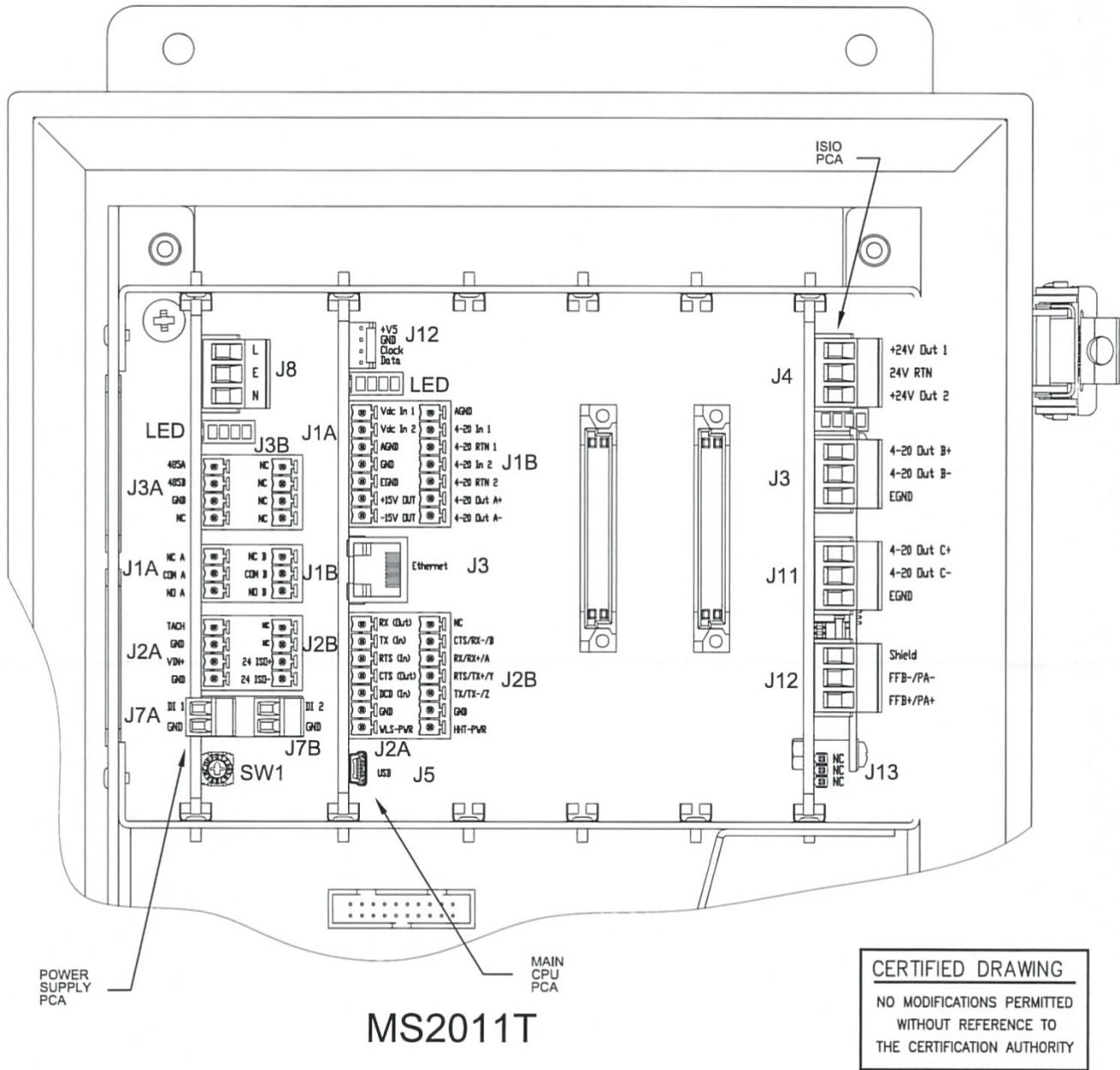
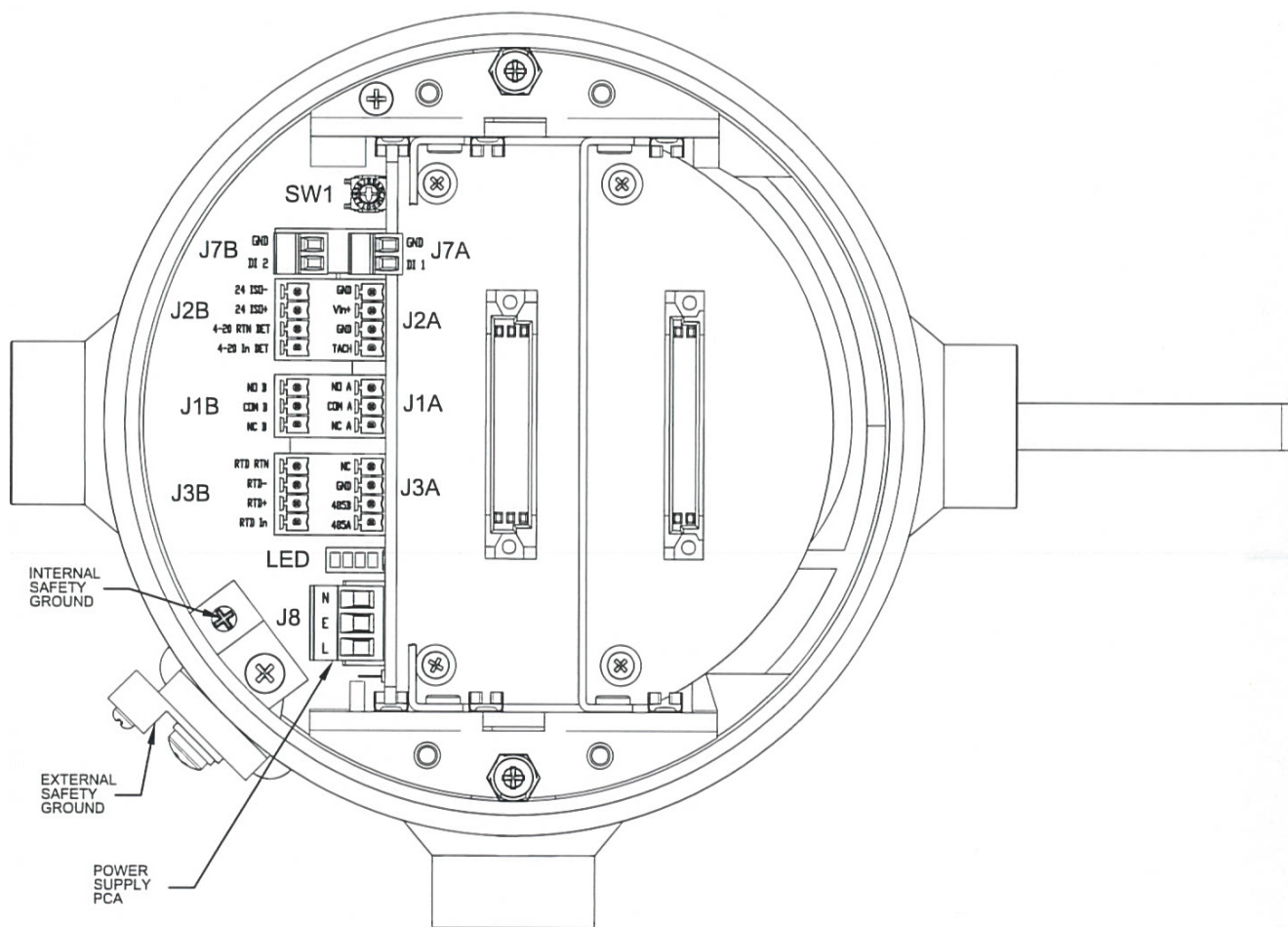


Figure C-2. Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 1 of 6)

# MS2011LUR



**Figure C-2.** Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 2 of 6)

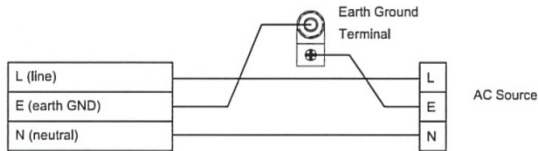
# MS2011T(Transmitter)

**A. General Wiring Requirements:**

- A1. Installation should be in accordance with ANSI/ISA RP 12.6 and the NEC ANSI/NFPA 70, or Canadian Electrical Code Part 1.
- A2. All wiring requires a minimum insulation rating of 85°C
- A3. Approved conduit seals must be installed within 18" [457 mm] of the housing
- A4. Equipment must be installed by qualified personnel
- A5. Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous
- A6. Service connections can only be used when the atmosphere is known to be safe

**B. Notes and wiring requirements for Power Supply PCA's J8, AC input voltage.**

- B1. Universal power supply 100 - 240 VAC, 300 mA max
- B2. Use 14 - 18 AWG wires
- B3. Fuse (F2), 250 V, 1 A, size 5x20 mm

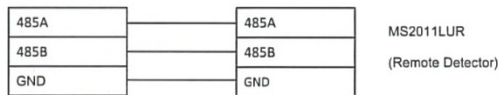


**C. Notes and Wiring requirements for Power Supply PCA's J3B, RTD (Pt100)**

- C1. NOT USED.

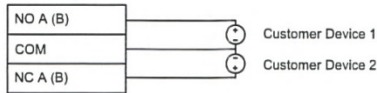
**D. Note and wiring requirements for Power supply PCA's J3A, MS2011LUR (Remote Detector) connection**

- D1. Maximum cable length from MS2011T to MS2011LUR is 2000 ft.
- D2. Use shielded multiconductor cable, 20 - 24 AWG



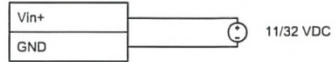
**E. Note and wiring requirements for Power supply PCA's J1A and J1B, Relays**

- E1. Ensure the area is non-hazardous before making or breaking any connections
- E2. Relays rated, 250 VAC at 8 A



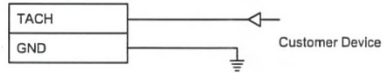
**F. Note and wiring requirements for Power supply PCA's J2A, DC input voltage**

- F1. Use 18 AWG wire for DC input voltage
- F2. DC power input: 11 - 32 VDC, 770 mA max
- F3. Fuse (F1), fast acting, 2A, 5x20 mm ceramic



**G. Note and wiring requirements for Power supply PCA's J2A, Tachometer**

- G1. The pulse input must be resistive or inductive in nature only, with a maximum input of 5 VDC

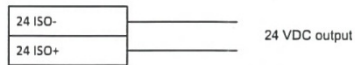


**H. Note and wiring requirements for Power supply PCA's J2B, 4 - 20 mA input**

- H1. NOT USE.

**I. Note and wiring requirements for Power supply PCA's J2B, 24 VDC isolated output**

- I1. Isolated 24 VDC nominal, 50 mA max



**J. Note and wiring requirements for Power supply PCA's J7A and J7B, Discrete inputs**

- J1. A +3.3 V wetting voltage (0.1 mA max) is provided for each discrete input



**K. Note and wiring requirements for Main CPU PCA's J5, USB**

- K1. Ensure the area is non-hazardous before connecting or disconnecting the USB
- K2. USB A Male to USB Mini 5-Pin Male Cable is required for connecting to the system

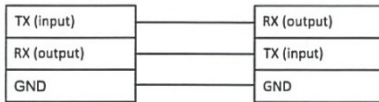
**L. Note and wiring requirements for Main CPU PCA's J2A, COMM A (RS-232)**

- L1. Do not exceed ±15 VDC on any of the communication lines
- L2. RS-232 buss can drive up to 50 ft. of cable

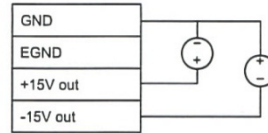
**Figure C-2.** Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 3 of 6)

# Drawings

## RS-232 wiring



Customer Communication  
Equipment (2-wire RS-232)



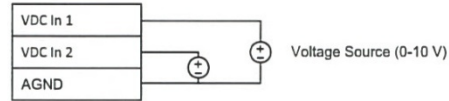
## RS-232 with RTS/CTS



Customer Communication  
Equipment (with RTS/CTS)

## P. Note and wiring requirements for Main CPU PCA's J1A, Analog input (0 - 10 V)

P1. Maximum cable length from gauge to each transmitter is 25 ft.



## M. Note and wiring requirements for Main CPU PCA's J2B, COMM B (RS-232/RS-485)

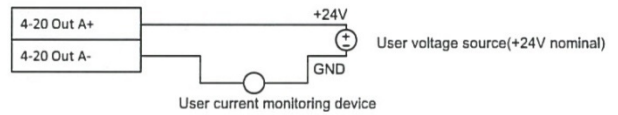
- M1. Do not exceed  $\pm 15$  VDC on any of the communication lines
- M2. RS-232 bus can drive up to 50 ft. of cable
- M3. RS-485 bus can drive up to 4000 ft. of cable



Customer  
Communication  
Equipment (RS-232)

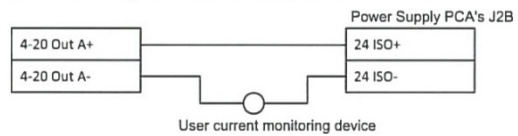
## Q. Note and wiring requirements for Main CPU PCA's J1B, 4 - 20 mA output

- Q1. Maximum resistant load is 750 $\Omega$
- Q2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to a 4 - 20 mA loop.

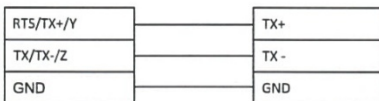


Customer Communication  
Equipment (4-wire RS-485)

## Q3. 4 - 20 mA is configured as an isolated self-powered



## R. Note and wiring requirements for Main CPU PCA's J1B, 4 - 20 mA inputs



Customer Communication  
Equipment (2-wire RS-485)

## 5. Note and wiring requirements for optional ISIO PCA's J12, Foundation Fieldbus

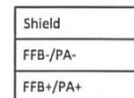
- S1. Twisted, shield pair cable must be used in accordance with Foundation Fieldbus specification
- S2. The entity parameters for port J12 are as follows:
  - Vi = 24 V
  - li = 250 mA
  - Ci = Negligibly low
  - Li = 10  $\mu$ H
  - Temperature class: T4

## N. Note and wiring requirements for Main CPU PCA's J3, Ethernet

- N1. Ensure the area is non-hazardous before connecting or disconnecting the USB
- N2. 10 Base-T minimum

## O. Note and wiring requirements for Main CPU PCA's J1A, $\pm 15$ VDC output

- O1.  $\pm 15$  VDC nominal, 100 mA max



**Figure C-2.** Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 4 of 6)

## Drawings

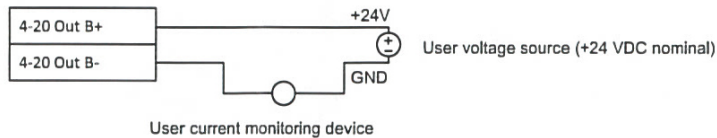
### S. Note and wiring requirements for optional ISIO PCA's J3, 4 - 20 mA output

T1. Maximum resistant load is 750Ω

T2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to 4 - 20 mA loop.

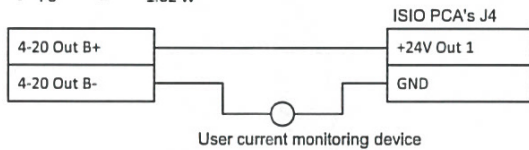
T3. The entity parameters are as follows:

- Vmax = 35.25 V
- Imax = 200 mA
- Ci = 0 nf
- Li = 0
- Pmax = 0.81 W



T4. 4 - 20 mA is configured as an isolated self- powered configuration  
T5. The entity parameters are as follows:

- Vo = 28.35 V
- Io = 106 mA ≥ fuse rated for 63 mA
- Ohm = 270
- Co = 79 nf
- Lo = 2 mH
- L/R ratio (uH / ohms) = 56
- Po = 1.02 W



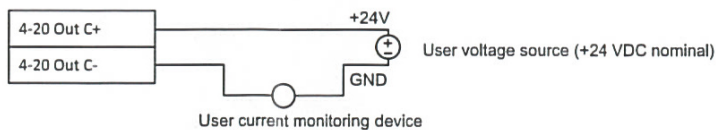
### U. Note and wiring requirements for optional ISIO PCA's J11, Hart or 4 - 20 mA output

U1. Maximum resistant load is 750Ω

U2. The default configuration used for the 4 - 20 mA output is an isolated loop-powered configuration. The user applies a +24 VDC to a 4 - 20 mA loop.

U3. The entity parameters for J11 are as follows:

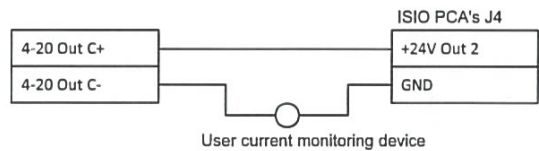
- Vmax = 35.25 V
- Imax = 200 mA
- Ci = 0 nf
- Li = 0
- Pmax = 0.81 W



U4. 4 - 20 mA is configured as an isolated self- powered configuration

U5. The entity parameters for J11 are as follows:

- Vo = 28.35 V
- Io = 106 mA ≥ fuse rated for 63 mA
- Ohm = 270
- Co = 79 nf
- Lo = 2 mH
- L/R ratio (uH / ohms) = 56
- Po = 1.02 W

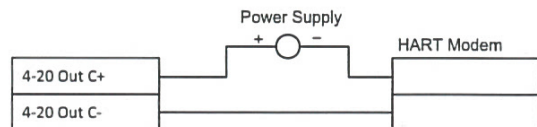


### U6. Hart Wiring

- Twisted, shield pair cable must be used with the proper conductor size
- Ground at one point only
- Ensure a properly specified power supply

The entity parameters for port J11 with the HART option are as follows:

- Vmax = 35.25 V
- Imax = 200 mA
- Ci = 0 nf
- Li = 0
- Pmax = 0.81 W

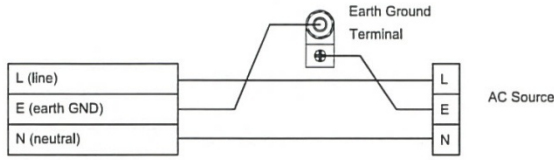


**Figure C-2.** Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 5 of 6)

# MS2011LUR(Remote Detector)

1. Notes and wiring requirements for MS2011LUR I/O, AC input voltage (J8)

- 1.1. Universal power supply 100 - 240 VAC, 300 mA max
- 1.2. Use 14 - 18 AWG wires
- 1.3. Fuse (F2), 250 V, 1 A, size 5x20 mm



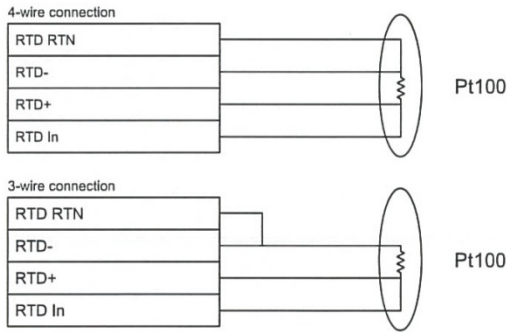
4. Note and wiring requirements for MS2011LUR I/O, DC input voltage (J2A)

- 4.1. Use 18 AWG wire for DC input voltage
- 4.2. DC power input: 11 - 32 VDC, 770 mA max
- 4.3. Fuse (F1), fast acting, 2 A, 5x20 mm ceramic



2. Notes and Wiring requirements for MS2011LUR I/O, RTD (Pt100) (J3B)

- 2.1. The max wire resistance (per wire) is 0.2 ohms for 2-wire RTD and 1.0 ohms for 3-wire or 4-wire RTD

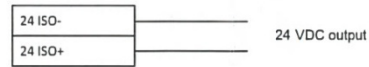


5. Note and wiring requirements for MS2011LUR I/O, 4 - 20 mA input (J2B)



6. Note and wiring requirements for MS2011LUR I/O, 24 VDC isolated output (J2B)

- 6.1. Isolated 24 VDC nominal, 50 mA max



3. Note and wiring requirements for MS2011LUR I/O, MS2011LUR (Remote Detector) connection

- 3.1. Maximum cable length from MS2011T to MS2011LUR is 2000 ft.
- 3.2. Use shielded multiconductor cable, 20 - 24 AWG

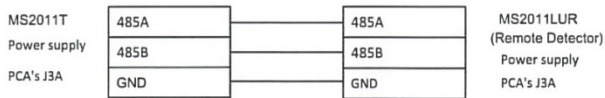
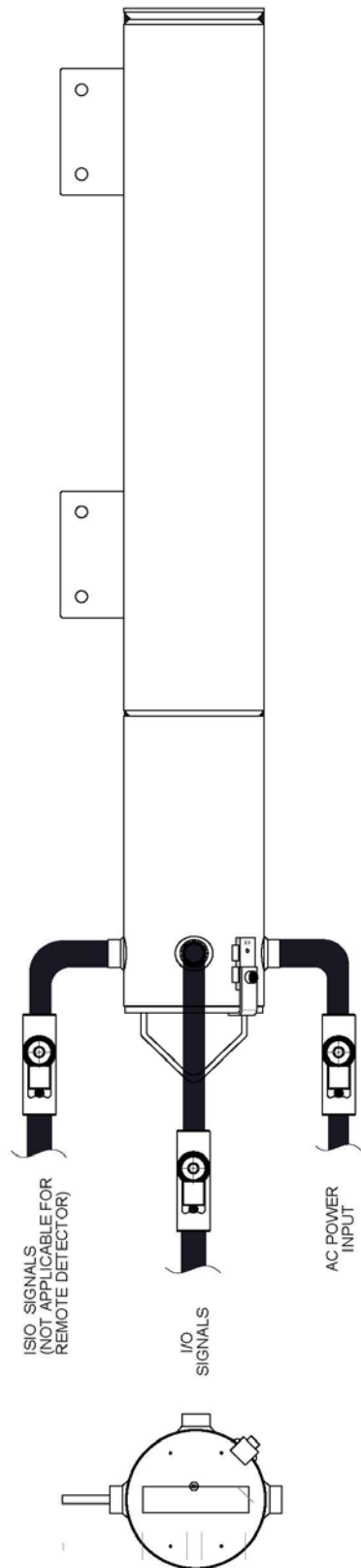


Figure C-2. Installation Wiring Guide, MS2011T & MS2011LUR (Sheet 6 of 6)



**Figure C-3.** Installation Drawing, MS2011LU

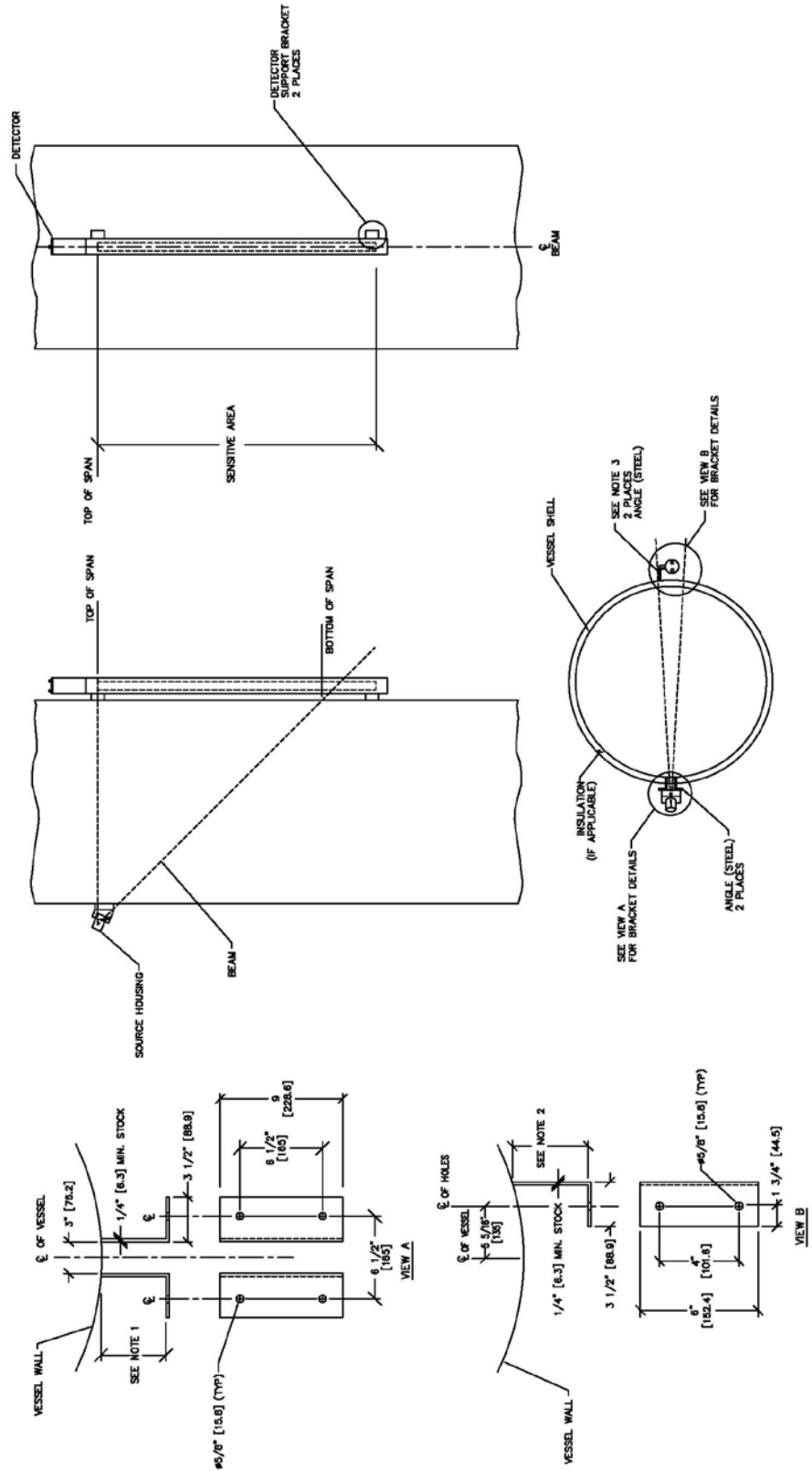


Figure C-4. Installation/Arrangement Drawing, 1 Source with 1 Detector



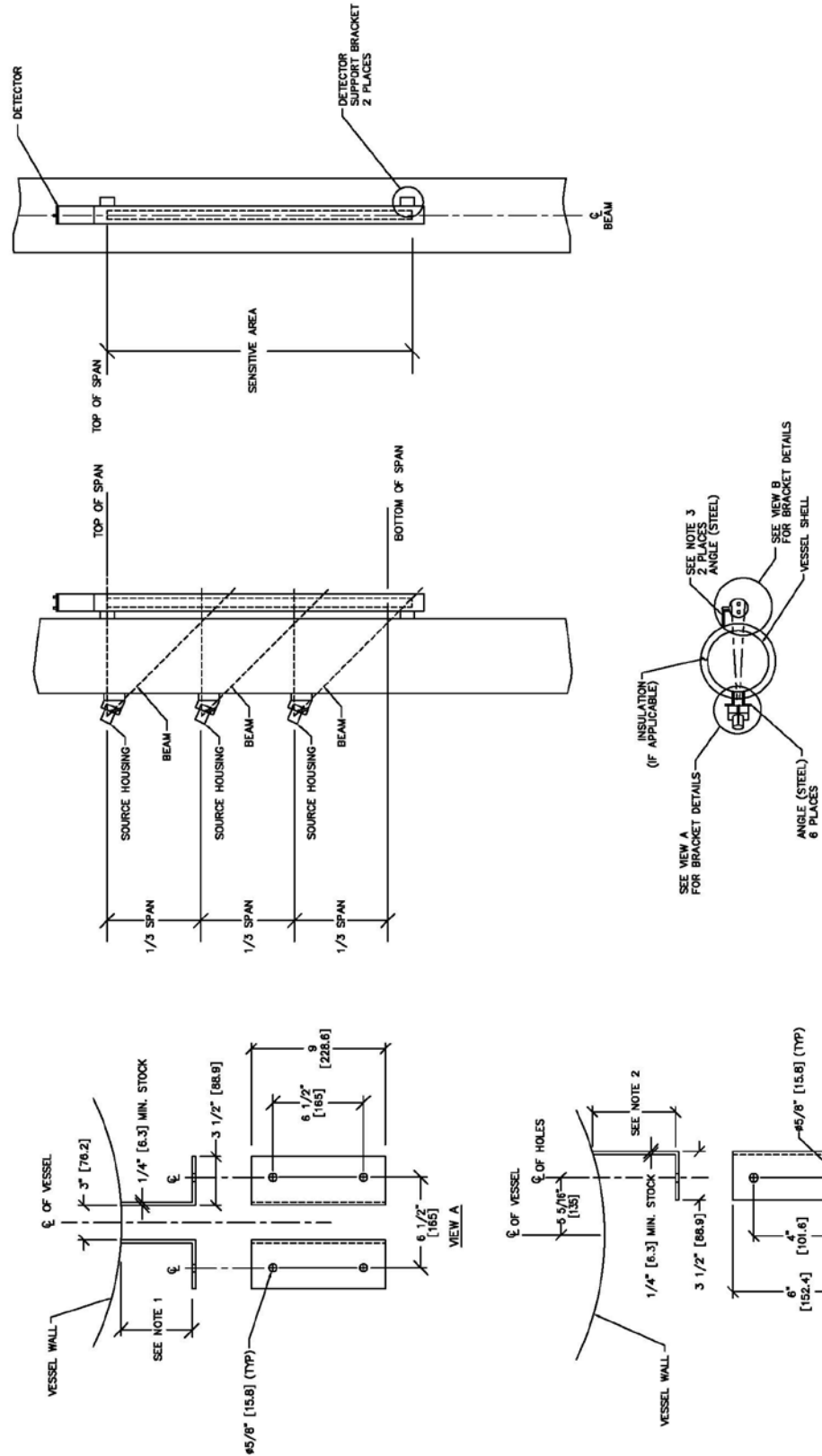


Figure C-6. Installation/Arrangement Drawing, 3 Sources with 1 Detector

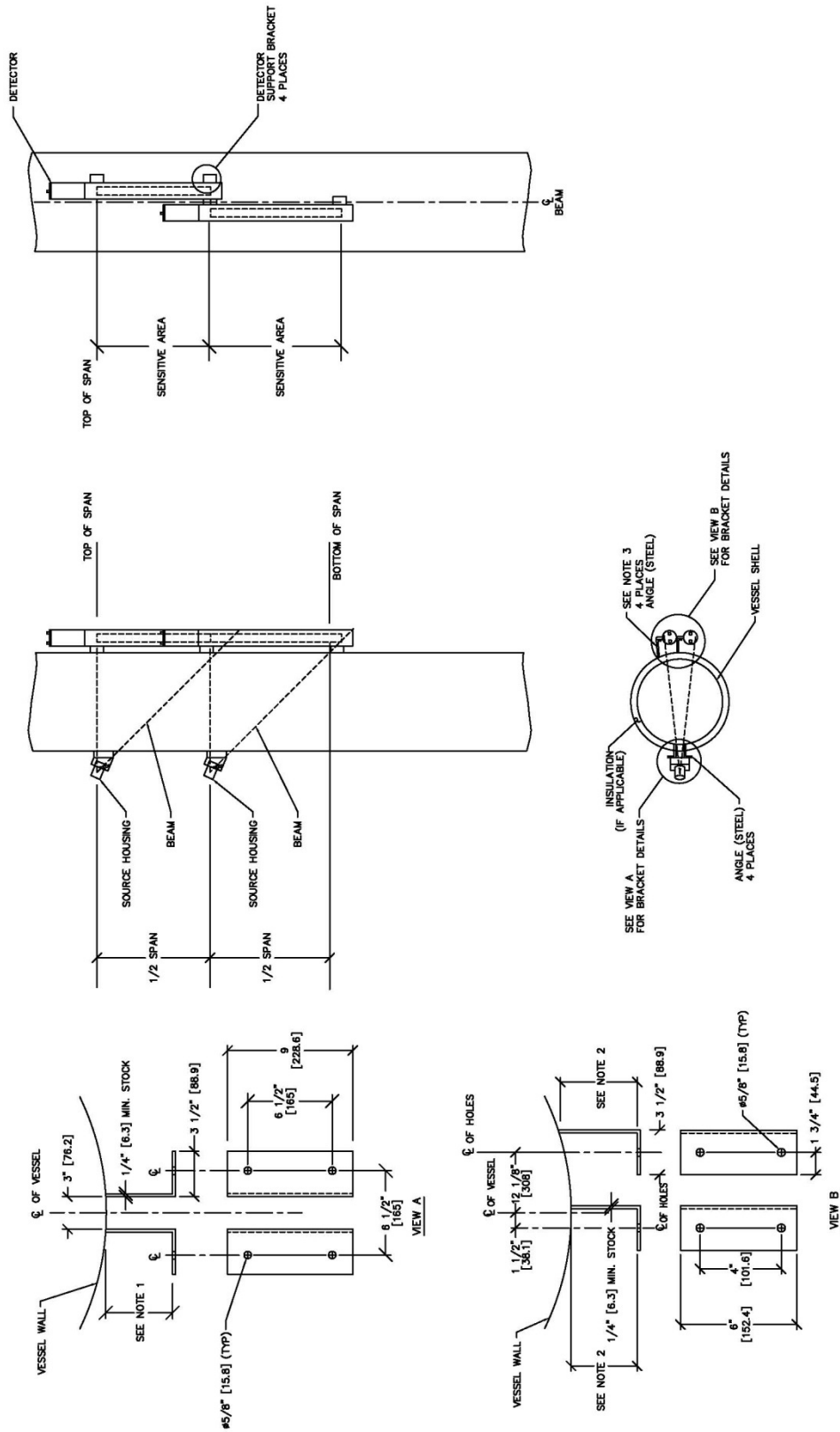


Figure C-7. Installation/Arrangement Drawing, 2 Sources with 2 Detectors

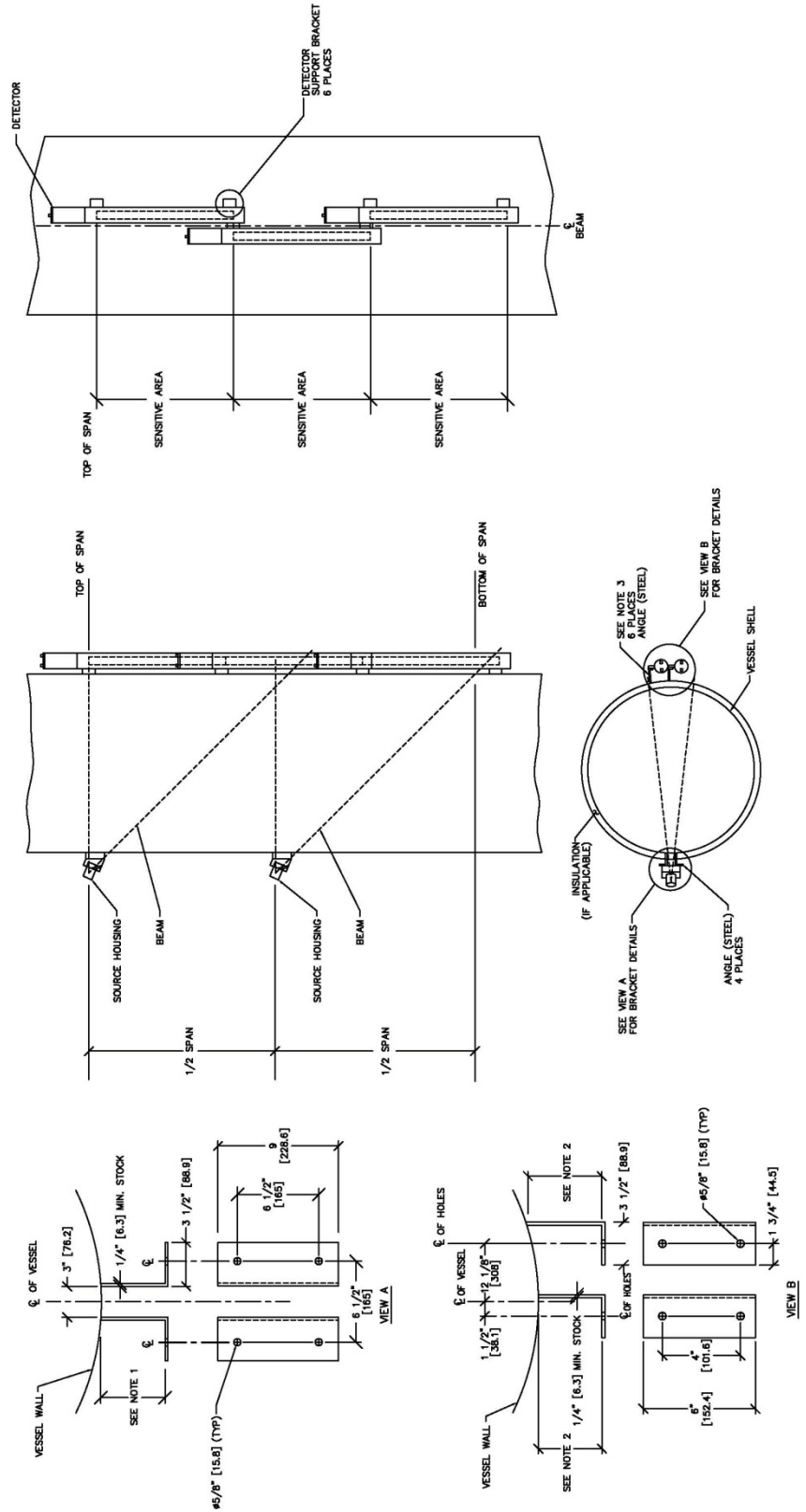


Figure C-8. Installation/Arrangement Drawing, 2 Sources with 3 Detectors

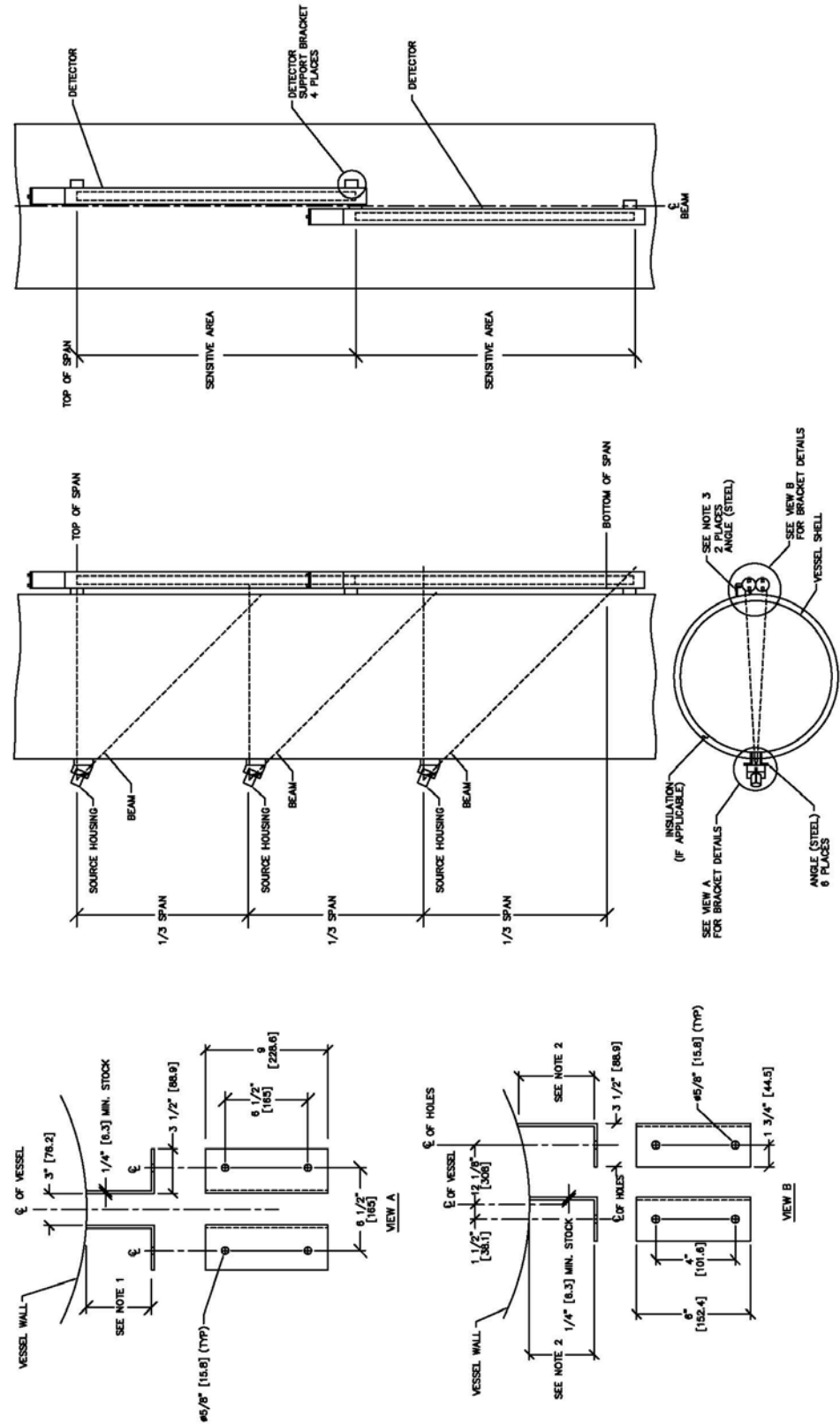


Figure C-9. Installation/Arrangement Drawing, 3 Sources with 2 Detectors

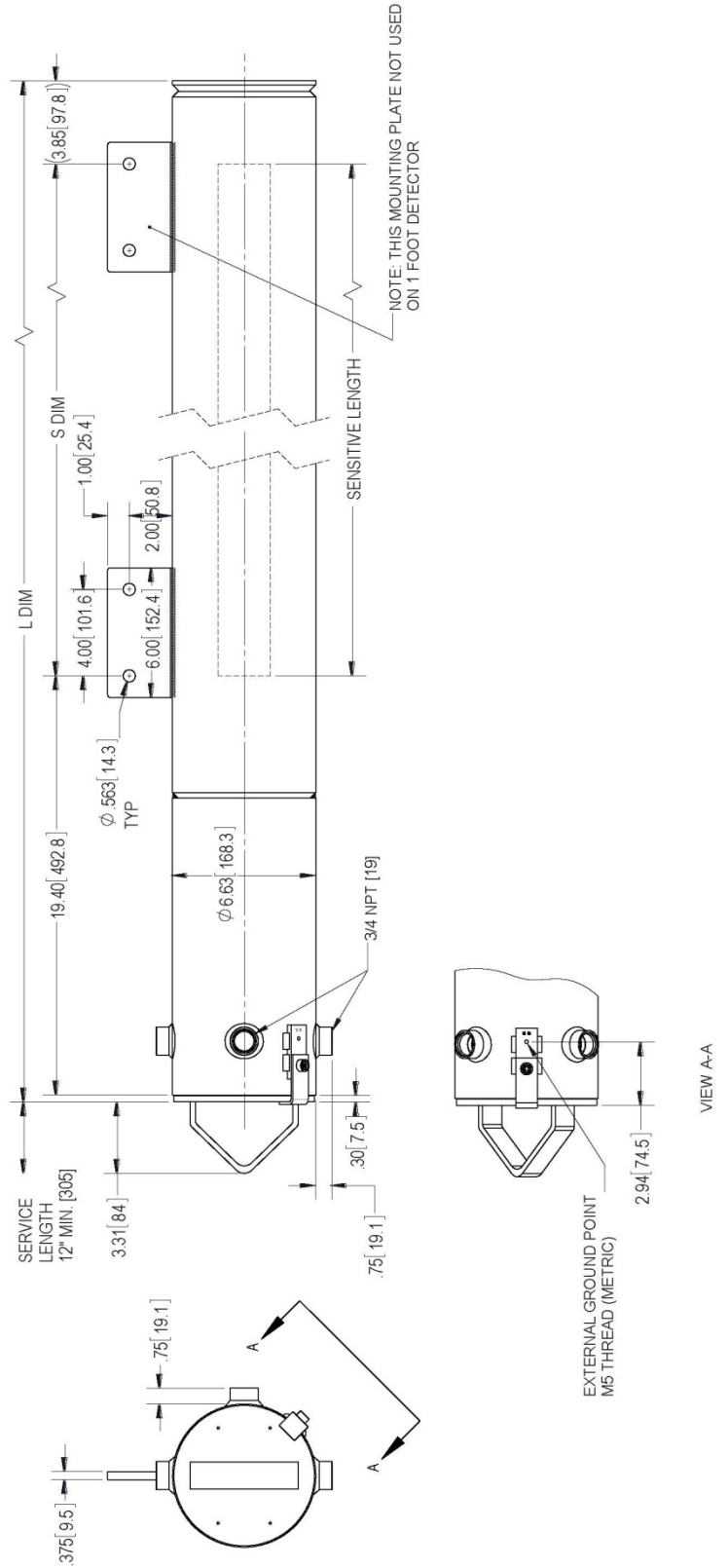


Figure C-10. Mounting Dimensions, MS2011LU, XP





# **Appendix D**

## **Risk Assessment**

The following pages include the risk assessments for the LevelPRO detector and transmitter.



**Table D-1.** LevelPRO Detector Risk Assessment

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
<b>Electromagnetic Hazards</b>							
Electromagnetic Fields	Electromagnetic interference may affect other devices. Equipment malfunction.	4	Susceptibility to electric fields		0		
Magnetic Fields	Electromagnetic interference may affect other devices. Equipment malfunction.	4	Susceptibility to magnetic fields		0		
<b>Electrical Hazards</b>							
Accessibility to Hazardous Live Parts	Electrical Shock	12	Personnel may get electrical shock by touching live parts	No hazardous parts are accessible to personnel (All parts are properly enclosed in enclosure. Metallic enclosure does not have any openings and is bonded to protective conductor terminal). Equipment was designed and tested to IEC 61010- 1: 2010. Installation manual requires power to be switched off before disconnecting equipment	3	Y	N
Touch Current	Electrical Shock	12	Electrical shock to personnel	Equipment was designed and tested to IEC 61010-1: 2010.	3	Y	N
Security of Wiring Connection	Electrical Shock	12	Electrical shock to personnel	All connections are mechanically secure. Loosening of hazardous live wiring will not cause a hazard, since hazardous live parts are separated by earthed chassis members.	3	Y	N
<b>Mechanical Hazards</b>							
Rough Surfaces, sharp corners and edges	Personnel injury (cut hazard)	10	Personnel's fingers may get accidentally cut by touching rough or sharp corners during installation	Easily touchable parts of the equipment have smooth and rounded corners and edges to avoid cut hazard	4	Y	N
Moving parts	NA (Equipment does not contain any moving parts)	0			0		
Stability	NA (Equipment will be secured to a stable structure)	0			0		
Suspended mass	NA (Equipment will be secured to a stable structure)	0			0		
Lifting of equipment	Personnel injury	10	Personnel may get hurt if equipment is not lifted properly and accidentally dropped	Weight information in manual Handling and lifting warning on the manual	4	Y	N
Expelling parts	NA (Metal enclosure contains	0			0		
Enclosure robustness / rigidity	NA (Enclosure passed pressure tests)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Manual Handle robustness	NA	0			0		
Equipment mobility	NA (This is a fixed equipment)	0			0		
Torsion, shear and tensile force	NA (Equipment is not expected to experience torsion, shear or tensile force)	0			0		
Vibration	NA (Equipment will be fixed to a stable structure)	0			0		
High pressure injection	NA (Equipment does not inject any high pressure fluid)	0			0		
Protective Device / Interlocks	NA (Equipment does not contain any protective device / interlocks)	0			0		
<b>Thermal Energy</b>							
High Surface Temperature	Personnel injury (burn)	12	Personnel get exposed to overheated area and get burnt	Equipment was tested to IEC 61010-1: 2010. Easily accessible parts (enclosure, etc.) were within allowable temperature limit. However, several critical components (fuse holder, the voltage selector switches, and the high voltage power supplies) experienced the temperature beyond their ratings when ambient temperature was at 75C. Components out of range are not accessible to personnel	3	Y	N
Low Surface Temperature	NA (Equipment does not incorporate parts which subject to temperature below ambient)	0			0		
Heated Surface for functional reasons	NA (Equipment does not require any heated surface to perform required function)	0			0		
<b>Fire Hazards</b>							
Battery	Fire / Explosion Hazard	4			0		
Constructional requirement (Fire / explosion hazard)	Fire / Explosion Hazard	4			0		
Use in oxygen rich environments	NA (Equipment is not designed or suitable for use in conjunction with oxygen rich environments)	0			0		
Use with flammable materials	NA (Equipment does not use flammable materials)	0			0		
Ionizing Radiation	NA	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
<b>Radiation Energy</b>							
Non-ionizing Radiation	NA (Equipment does not produce non-ionizing radiation)	0			0		
Ultrasonic energy	NA (Equipment does not produce ultrasonic energy)	0			0		
Infrasound energy	NA (Equipment does not produce infrasound energy)	0			0		
Microwave energy	NA (Equipment does not produce microwave radiation)	0			0		
Laser	NA (Equipment only contains divergent indicator LED)	0			0		
<b>Noise Hazards</b>							
Exhaust system	NA (Equipment does not have any exhaust system)	0			0		
High speed gas leak	NA (Equipment does not use any gas)	0			0		
Process related (pressing, grinding, etc.)	NA (Equipment does not contain any noise generating process)	0			0		
Moving parts	NA (Equipment does not contain any moving parts)	0			0		
Unbalanced rotating parts	NA (Equipment does not contain any rotating parts)	0			0		
Noise from pneumatic parts	NA (Equipment does not use any pneumatic parts)	0			0		
<b>Material / Substance Hazards</b>							
Fluid pressure and leakage	NA (Equipment does not use fluids)	0			0		
Poisonous or injurious gas	NA (Equipment does not use poisonous or injurious gas)	0			0		
Flammable gas or liquids	NA (Equipment does not use flammable gas or liquids)	0			0		
Fume	NA (Equipment does not generate any fume)	0			0		
Cleaning, disinfecting or testing agents	NA (Equipment does not require use of any cleaning, disinfecting or testing agents)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Spillage / overflows (external source)	Equipment damage, malfunction	4	Spillage or overflow from vessel may spill onto the equipment and damage the equipment / component		0		
Spillage / overflows (internal source)	NA (Equipment does not incorporate a reservoir or liquid storage chamber)	0			0		
Biological and microbiological agent	NA (Equipment does not use biological agent)	0			0		
Battery electrolyte leakage (acids or alkalis)	NA	0			0		
Radioisotope material	Personnel health	15	Mishandling of equipment containing radioisotope material will severely impact personnel health	Instruction manual clearly states that the source head contains radioisotope material and it is regulated by federal and/or state authorities. Gamma Radiation Safety, PN 717904 provides further information on Gamma radiation safety. Warning signs are also provided throughout in the relevant documentation. The LevelPRO user guide indicates that outside of the beam path, the energy escaping the source head is very low and well within prescribed limits. Closing the source shutter allows the beam to be turned off (the shutter blocks the radiation) during installation or servicing of the detector.	3	Y	N
<b>Informational</b>							
Durability of marking/signs	Personnel injury	4	Hazard may arise if warning signs/labels have been badly damaged and are not readable)		0		
Inadequate marking / signs	Personnel injury	4	Hazard may arise if proper marking/signs are missing		0		
Inadequate instructions	Equipment misuse, Personnel injury	4	Hazard may arise if instructions for use not covering the complete operation of the device		0		
Inadequate description of performance characteristics	Equipment misuse	4	Hazard may arise if performance characteristics are not covering the complete operation of the device		0		
Inadequate Specification of Pre-Use Checks	NA (Equipment does not require or specify any pre-use checks, except that the source head contains radioisotope material and it has to be handled properly according to federal and/or state authorities (see Radioisotope material line item)	3			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Inadequate disclosure of limitations	NA	4			0		
Over-complicated operation instructions	NA	4	Hazard may arise, if operating instructions were not clear and user cannot follow		0		
<b>Operational Hazards: Function / Use Error</b>							
Control (Equipment)	NA (No operating controls / Equipment does not use switch)	0			0		
Control (Display)	Not effective measurement	15	Measurement may not be taken if proper detector operation was not established via display control	LevelPRO user manual provides clear instruction for use / controls.	3	Y	N
Thermal cut-outs or over-current release	NA (Equipment does not contain any thermal cutouts or over current release)	0			0		
Incompatible with Consumables /Accessories	NA (Equipment does not require any consumables or accessories)	0			0		
Transient over voltage limiting device	Equipment I/O designs with MOV's	4			0		
Loss of deterioration of function	NA (Loss or deterioration of function leads to ineffective measurement, but it does not pose a risk to personnel)	0			0		
Misrepresentation of Results	NA (Data is only the direct measurement of data or density. No interpretation will be provided by the equipment)	0			0		
Use by Unskilled / Untrained Personnel	NA (LevelPRO user document states that equipment should be used only by trained personnel. See Radioisotope material line item for additional info on handling equipment containing such equipment)	0	Hazard may arise if equipment was not handled or operated properly		0		
Disconnect from Supply Source	Equipment failure	15	Equipment failure	Equipment is permanently connected equipment. Circuit breaker will be included in building installation.	3	Y	N
Loss of Data	NA (All data are stored in flash memory, RTC with back up battery)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Incorrect measurement	NA (Incorrect measurement will adversely affect the further analysis, etc., but it does not pose a risk to personnel.)	0			0		
Alarm Failure	NA (Equipment includes up to 16 process alarms, which user can set. It is informational purpose and its failure does not pose a risk to personnel.)	0	Not effective measurement due to alarm failure		0		
Data Transfer Issue	NA (The detector provides both RS485 and RS232 serial ports for communications. The necessary components (such as connectors, etc.) have been selected to achieve the life time requirement of the equipment. If data cannot be viewed / transferred, it causes inconvenience, but it does pose a risk to personnel)	0	Data may not be successfully transferred if any relevant components have issues		0		
Software / Programming Error	NA (Software used in device has been validated as part of System Acceptance Testing, in accordance with 1-0700045 DensityPRO NAI/NA+/NAI-O Software Acceptance Test Procedure and 10700-027 DensityPRO NAI/NA+/NAI-O System Level ATP. Software / programming failure will lead to delay in measurement and inconvenience, but it does not pose a risk to personnel.)	0			0		
Vulnerability to Software Tampering	NA (password is required for changing/editing configurations/settings)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
<b>Environmental Hazards / Installation Location</b>							
Electromagnetic Fields	NA (Passed RF/EMI tests)	0			0		
Inadequate Supply of Power	Equipment malfunction	3	LevelPRO user guide and installation guide specifically state the supply power requirement for this equipment		0		
Restriction of Cooling	NA (Equipment does not require any specific cooling)	0			0		
Operation outside prescribed conditions	Equipment malfunction / failure	3	Product specification and user manual		0		
Inadequate installation location	Equipment malfunction Personnel injury	4	LevelPRO installation guide provides warnings on installation location (it shall not be installed in any hazardous area other than those approved) and additional instructions (cable entries must be sealed for Hazardous location installation)		0		
<b>Hazards relating to Handling / Maintenance / Servicing / Adjustments</b>							
Improper Handling	Equipment damage	4	Equipment may get damaged if the ESD sensitive parts were not handled properly. Hazard may arise if the equipment containing radioisotope material was not handled properly		0		
Equipment Disposal	Environmental Hazard	5	Hazard will arise if equipment is incorrectly disposed		1		
Improper Maintenance / Servicing / Adjustments	Equipment damage	5	Equipment may get damaged if the equipment was not serviced properly		1		
Improper material replacement	Equipment malfunction	5	Equipment may malfunction if the replaceable parts were not changed properly		1		
<b>Manufacturing Process</b>							
Insufficient Control of Process Change	Equipment malfunction	5	Failure of previously reliable component(s)		1		
Subcontractor Control	Equipment malfunction	5	Failure of components / assembly		1		
<b>Transport / Storage</b>							
Inadequate Packaging	Equipment damage / failure	12	Equipment may get damaged if proper packaging was not provided for transportation and storage	Equipment will be shipped using a proper size wooden crate based on the length and type. Each wooden crate will have sales order #, dimension, weight, warning instructions printed on the exterior.	4	Y	N
Inappropriate storage environmental conditions	Equipment damage	4	Equipment may get damaged if equipment was not stored under the specified environment		0		

**Table D-2.** LevelPRO-T Transmitter Risk Assessment

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
<b>Electromagnetic Hazards</b>							
Electromagnetic fields	Equipment malfunction; electromagnetic interference may affect other devices	4	Susceptibility to electric fields		0		
Magnetic fields	Equipment malfunction; electromagnetic interference may affect other devices	4	Susceptibility to magnetic fields		0		
<b>Electrical Hazards</b>							
Accessibility to hazardous live parts	Electrical shock	12	Personnel may get electrical shock by touching live parts	No hazardous parts are accessible to personnel (All parts are properly enclosed in enclosure. Metallic enclosure does not have any openings and is bonded to protective conductor terminal). Equipment was designed and tested to IEC 61010-1:2010. Installation manual requires power to be switched off before disconnecting equipment	3	Y	N
Touch current	Electrical shock	12	Electrical shock to personnel	Equipment was designed and tested to IEC 61010-1: 2010	3	Y	N
Security of wiring connection	Electrical shock	12	Electrical shock to personnel	All connections are mechanically secure. Loosening of hazardous live wiring will not cause a hazard, since hazardous live parts are separated by earthed chassis members	3	Y	N
<b>Mechanical Hazards</b>							
Rough surfaces, sharp corners and edges	Personnel injury (cut hazard)	10	Personnel's fingers may get accidentally cut by touching rough or sharp corners during installation	Easily touchable parts of the equipment have smooth and rounded corners and edges to avoid cut hazard	4	Y	N
Moving parts	NA (Equipment does not contain any moving parts)	0			0		
Stability	NA (Equipment will be secured to a stable structure)	0			0		
Suspended mass	NA (Equipment will be secured to a stable structure)	0			0		
Lifting of equipment	Personnel injury	4	Personnel may get hurt if equipment is not lifted properly and accidentally dropped		0		
Expelling parts	NA (Metal enclosure contains parts)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Enclosure robustness / rigidity	Personnel injury	0	Personnel may get exposed to internal electronics, etc., if the enclosure is accidentally broken due to mechanical stress.		0		
Manual handle robustness	Equipment won't function; personnel health	0	Equipment will not properly function if the shutter of the source head breaks.		0		
Equipment mobility	NA (This is fixed equipment)	0			0		
Torsion, shear and tensile force	NA (Equipment is not expected to experience torsion, shear or tensile force)	0			0		
Vibration		0			0		
High pressure injection	NA (Equipment does not inject any high pressure fluid)	0			0		
Protective device / interlocks		0			0		
<b>Thermal Energy</b>							
High surface temperature	Personnel injury (burn)	4	Personnel get exposed to overheated area and get burnt		0		
Low surface temperature	NA (Equipment does not incorporate parts which subject to temperature below ambient)	0			0		
Heated surface for functional reasons	NA (Equipment does not require any heated surface to perform required function)	0			0		
<b>Radiation Energy</b>							
Ionizing radiation		0			0		
Non-ionizing radiation	NA (Equipment does not produce non-ionizing radiation)	0			0		
Ultrasonic energy	NA (Equipment does not produce ultrasonic energy)	0			0		
Infrasound energy	NA (Equipment does not produce infrasound energy)	0			0		
Microwave energy	NA (Equipment does not produce microwave radiation)	0			0		
Laser	NA (Equipment only contains divergent indicator LED)	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
<b>Fire Hazards</b>							
Battery	Fire / Explosion Hazard	0			0		
Constructional requirement (fire / explosion hazard)	Fire / Explosion Hazard	0	Explosion or fire hazard, if any material used in device construction does not have proper flammability rating		0		
Use in oxygen rich environments	NA (Equipment is not designed or suitable for use in conjunction with oxygen rich environments)	0			0		
Use with flammable materials	NA (Equipment does not use flammable materials)	0			0		
<b>Noise Hazards</b>							
Exhaust system	NA (Equipment does not have any exhaust system)	0			0		
High speed gas leak	NA (Equipment does not use any gas)	0			0		
Process related (pressing, grinding, etc.)	NA (Equipment does not contain any noise generating process)	0			0		
Moving parts	NA (Equipment does not contain any moving parts)	0			0		
Unbalanced rotating parts	NA (Equipment does not contain any rotating parts)	0			0		
Noise from pneumatic parts	NA (Equipment does not use any pneumatic parts)	0			0		
<b>Material / Substance Hazards</b>							
Fluid pressure and leakage	NA (Equipment does not use fluids)	0			0		
Poisonous or injurious gas	NA (Equipment does not use poisonous or injurious gas)	0			0		
Flammable gas or liquids	NA (Equipment does not use flammable gas or liquids)	0			0		
Fumes	NA (Equipment does not generate any fumes)	0			0		
Cleaning, disinfecting or testing agents	NA (Equipment does not require use of any cleaning, disinfecting or testing agents)	0			0		
Inadequate disclosure of limitations	Equipment malfunction / failure, personnel injury	4	Hazard may arise if equipment is used in extreme environmental conditions		0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Inadequate specification of pre-use checks	NA (Equipment does not require or specify any pre-use checks, except that the source head contains radioisotope material and it has to be handled properly according to federal and/or state authorities (see Radioisotope material line item)	3			0		
Over-complicated operation instructions		4	Hazard may arise, if operating instructions were not clear and user cannot follow		0		
<b>Operational Hazards: Function / Use Error</b>							
Control (Equipment)	NA (No operating controls / equipment does not use switch)	0			0		
Control (Display)	Not effective measurement	4	Measurement may not be taken if proper detector operation was not established via display control		0		
Thermal cut-outs or over-current release	NA (Equipment does not contain any thermal cutouts or over current release)	0			0		
Incompatible with consumables / accessories	NA (Equipment does not require any consumables or accessories)	0			0		
Transient overvoltage limiting device	Equipment malfunction / failure	4	Equipment malfunction		0		
Loss or deterioration of function	Not effective measurement	0	Equipment malfunction		0		
Misrepresentation of results	NA (The direct data measurement of density or level. No interpretation will be provided by the equipment)	0			0		
Use by unskilled / untrained personnel	Not effective measurement; personnel health	0	Hazard may arise if equipment was not handled or operated properly		0		
Disconnect from supply source	Equipment failure	15	Equipment failure	Equipment is permanently connected; circuit breaker will be included in building installation	0		
Loss of data	Not effective measurement / analysis	0	Data may be lost, if the necessary components fail to function as intended		0		
Incorrect measurement	Not effective measurement / analysis	0	Measurement may not be fully accurate if the measurements were not taken properly or any key components / material function deteriorates		0		
Data transfer issue	Not effective measurement	0	Data may not be successfully transferred if any relevant components have issues		0		
Software / Programming error	Equipment malfunction; not effective measurement	0			0		

Risk	Hazard	Risk Index	Possible Cause(s)	Measures Taken to Mitigate Risk	New RIN	Acceptable Risk	Mitigation Check?
Alarm failure	Not effective measurement	0	Not effective measurement due to alarm failure		0		
Vulnerability to software tampering	Equipment malfunction; not effective measurement	0			0		
<b>Environmental Hazards / Installation Location</b>							
Electromagnetic fields	Equipment malfunction; electromagnetic interference may affect other devices	0	Susceptibility of electric fields		0		
Inadequate supply of power	Equipment malfunction	3	Equipment may not work as intended if incorrect input power was used		0		
Restriction of cooling		0			0		
Operation outside prescribed conditions	Equipment malfunction / failure	3	Component / material failure due to environmental conditions exceeding its rating		0		
Inadequate installation location	Equipment malfunction personnel injury	4	Hazard may arise, if equipment was not installed in an intended / prescribed location		0		
<b>Hazards relating to Handling / Maintenance / Servicing / Adjustments</b>							
Improper handling	Equipment damage	4	Equipment may get damaged if the ESD-sensitive parts were not handled properly. Hazard may arise if the equipment containing radioisotope material was not handled properly		0		
Equipment disposal	Environmental hazard	5	Hazard will arise if equipment is incorrectly disposed		0		
Improper maintenance / servicing / adjustments	Equipment damage	5	Equipment may get damaged if the equipment was not serviced properly		0		
Improper material replacement	Equipment malfunction	5	Equipment may malfunction if the replaceable parts were not changed properly		0		
<b>Manufacturing Process</b>							
Insufficient control of process change	Equipment malfunction	5	Failure of previously reliable component(s)		0		
Subcontractor control	Equipment malfunction	5	Failure of components / assembly		0		
<b>Transport / Storage</b>							
Inadequate packaging	Equipment damage / failure	12	Equipment may get damaged if proper packaging was not provided for transportation and storage	Equipment will be shipped using a proper sized wooden crate based on the length and type. Each wooden crate will have sales order #, dimension, weight, warning instructions printed on the exterior	2	Y	N
Inappropriate storage environmental conditions	Equipment damage	4	Equipment may get damaged if equipment was not stored under the specified environment		0		



Thermo Fisher Scientific  
81 Wyman Street  
P.O. Box 9046  
Waltham, Massachusetts 02454-9046  
United States

[www.thermofisher.com](http://www.thermofisher.com)