

Nitus

Gamma Backscatter Sensor

Installation Guide

P/N 717926

Revision A



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Revision History

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Information & Guidelines

This section contains information that must be read and understood by all persons installing, using, or maintaining this equipment.

Safety Considerations

Failure to follow appropriate safety procedures 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 to correctly and safely install, operate, and / or maintain 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.

Failure to correctly perform the instructions and procedures in this manual or other documents pertaining to this system can result in equipment malfunction, equipment damage, and / or injury to personnel.

Warnings, Cautions, & Notes

Warnings, cautions, and notes 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 Warnings notify users of procedures, practices, conditions, etc. which may result in injury or death if not carefully observed or followed. The triangular icon displayed with a warning varies depending on the type of hazard (general, electrical, radiation). ▲



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

Product Overview

Refer to the Nitus user guide for descriptions of instrument functions and features.

Associated Documentation

In addition to this guide, the following documents must be read and understood by all persons installing, using, or maintaining this equipment:

- Nitus for Level and Density Applications, p/n 717925
- Gamma Radiation Safety, p/n 717904
- LevelPRO installation manual, p/n 717760 – for transmission applications
- LevelPRO HART® operation manual, p/n 717817 – for HART communications
- LevelPRO with FOUNDATION™ fieldbus application guide, p/n 717915 or DensityPRO with FOUNDATION™ fieldbus application guide, p/n 717917 – for FOUNDATION fieldbus communications

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Chapter 2

Handling & Storage

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: **Do not** touch the circuit board components. Ordinarily, handling the circuit boards by their edges will not damage the circuits.

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

1. Use an antistatic bag. Most instrument subassemblies are shipped 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 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 that is 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

Unpacking, Inspection, & Storage

5. Avoid touching edge connectors and components.
6. Avoid partially connecting ESD sensitive devices. These devices, especially the power supply connector, can be damaged by floating leads.
7. Ground test equipment.
8. Avoid static charges during troubleshooting.

Unpacking, Inspection, & Storage

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

1. Upon receipt, inspect the instrument for damage that may have occurred while in transit. If there is evidence of rough handling or damage, file a damage claim with the transportation company immediately. Notify Thermo Fisher and / or your sales representative as soon as possible.
2. Carefully inspect the packing material prior to discarding it to ensure that all equipment and instruction paperwork has been removed.
3. Use the original packing material and container for storage if necessary.
4. If storing the instrument, the storage environment should be protected, free from extremes of temperatures and high humidity, and fall within the environmental constraints listed in the specifications.

Packing, Shipping, Transporting, & Receiving

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.

Chapter 3

Hardware Installation

Read the Gamma Radiation Safety Guide (p/n 717904) PRIOR TO installing the equipment.

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

For detector-transmitter housing layout details, refer to drawing [0-0704-096](#). For mounting dimensions, refer to drawing [0-0704-078](#).

Licensing



Warning The instrument is a nuclear device regulated by federal and / or state authorities. You are 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 Moving or removing an installed source housing or any assembly that includes a source housing requires a person who is specifically licensed to install and commission Thermo Scientific source housings. ▲

In the United States, your general license permits you to own and install all of the instrument's components, including the source housing. However, you may not commission the instrument (remove the lock and open the source housing shutter for the first time) without a specific license authorizing radiation commissioning of the instrument. In Canada, you are only allowed to remove the instrument from the shipping container if your CNSC license has a condition authorizing mounting / dismounting of devices. For assistance obtaining a license and / or commissioning / decommissioning the instrument, contact [Thermo Fisher](#).

Source-Detector Configurations

The gauge is comprised of a source head that contains the radioisotope and the detector-transmitter that contains the scintillation detector and electronics.

With its multiple source-detector configurations, Nitus provides significant installation flexibility. [Figure 3–1](#) illustrates typical source-detector configurations for different applications. The main factors that require consideration for the source-detector mounting include:

- The type of application – point density measurement, continuous level measurement, both point density and level measurement, density profiling, etc. (At least two detectors are required for applications performing both point density and level measurements.)
- The shape and dimension of vessel – vertical vessel, horizontal vessel, or pipe (diameter must be at least 24 inches).
- The range of measurement.

It is recommended that you consult [Thermo Fisher](#) to determine the optimal installation configuration for your application. Refer to installation arrangement drawing [0-0704-098](#) for details.

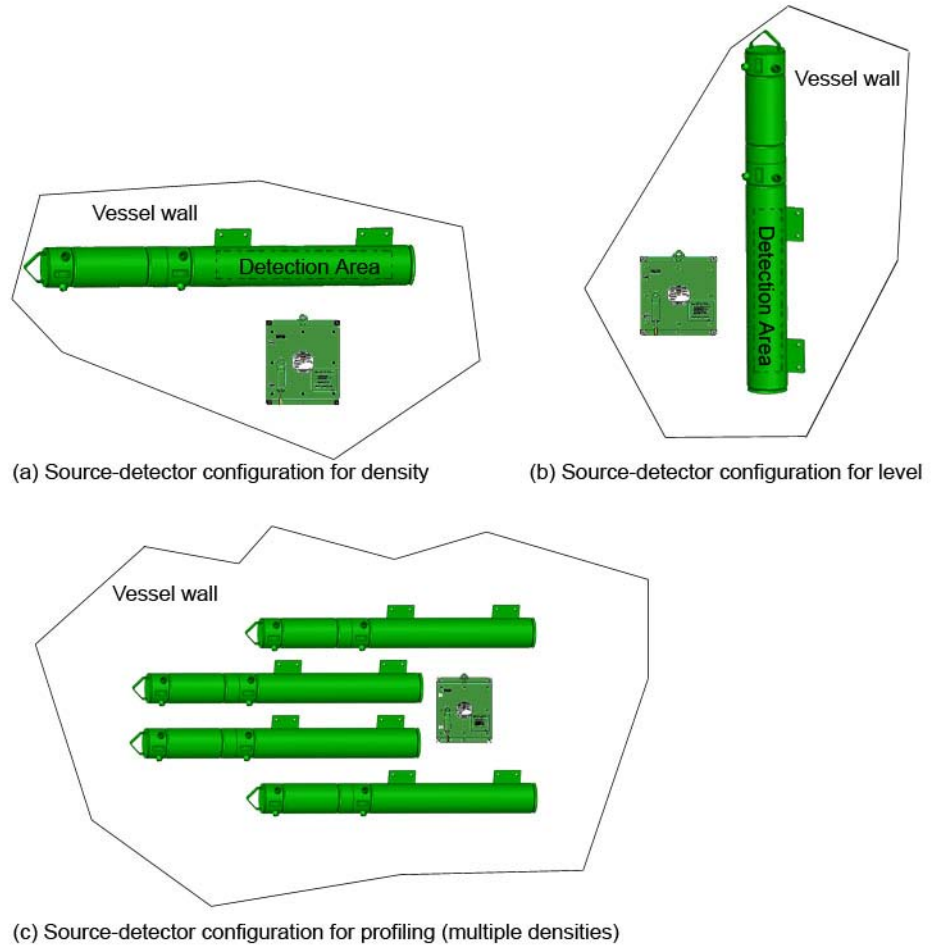


Figure 3–1. Typical source-detector configurations

The scintillation detector is available in lengths ranging from 1 foot to 12 feet. For a tall or narrow tank, multiple sources and / or detectors might be required. Contact [Thermo Fisher](#) for assistance. The specific source-detector configuration depends on the application. Refer to installation arrangement drawing [0-0704-098](#) for details.

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. ▲

Instrument approvals are listed in [Appendix B](#).

General

Review the following guidelines when planning gauge installation:

1. Ensure the correct power source is available. See “[System Power Requirements](#)” later in this chapter.
2. You will need to supply the necessary brackets and hardware required for mounting the gauge to the vessel.
3. There should be enough clearance to install and service the source head and the detector. Refer to the appropriate dimensional drawings in the [drawing appendix](#).
4. Position the source head so the radioactive source identification tag is visible. Mount it so the tag is upright.
5. The gauge should not be mounted where process overflow or other material can collect in the beam path. The source head shutter mechanism must be kept free of debris.
6. If the handheld terminal will be used for configuration, the connection must be located in a safe area.
7. The source head is designed to work up to approximately 1100°C. However, the detector can only work up to 75°C and therefore must be non-contacting for hot vessels.
8. As the measurement is independent of process pressure, there is no limitation on pressure.

System Power Requirements

Ensure the correct power source is available. One of the following input power sources is required: 115 or 230 Vac \pm 15%, 50/60 Hz. The maximum power requirement is 12 VA.

Detector- Transmitter



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. ▲



Warning For hazardous location installations, the cable entries must be sealed per the installation layout drawing [0-0704-096](#). ▲



Warning For non-hazardous location installations, the enclosure cable entries must be sealed with a compound to protect against the passage of gas or vapors. The sealing compound should not be affected by the surrounding atmosphere or liquids. The sealing compound must have a thickness of at least 5/8" (16 mm). ▲



Warning Use proper lifting procedures during installation to avoid injury. Refer to drawing [0-0704-078](#) for weights and dimensions of the detector housing. ▲

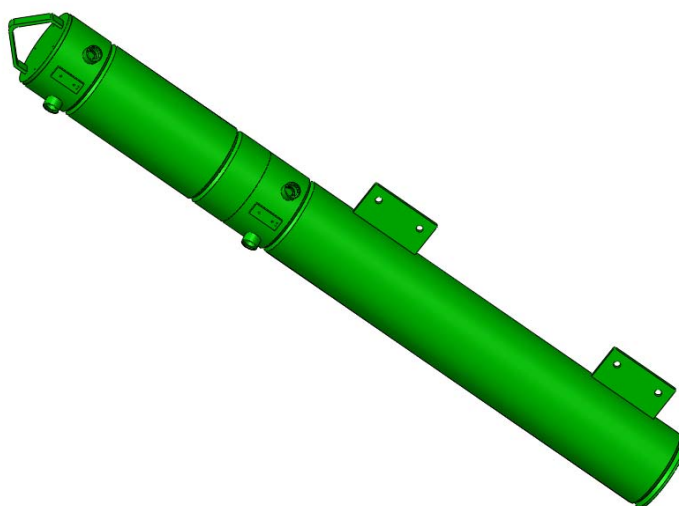


Figure 3–2. Detector (integrated model)

Alignment

Refer to drawings [0-0704-096](#) and [0-0704-078](#) for mounting dimensions of the detector-transmitter.

The source head and detector are installed on the same side of the vessel. To ensure good measurement sensitivity, it is recommended that the detection area of the detector be symmetric to the source head center (where the source is located), as shown in the figure below. An easy way to ensure proper alignment is to center the two mounting tabs on the detector to the source center. Refer to drawing [0-0704-098](#) for details. For applications where this symmetric arrangement cannot be achieved (e.g. profiling measurement or limitation on installation space), contact [Thermo Fisher](#) for proper arrangement.

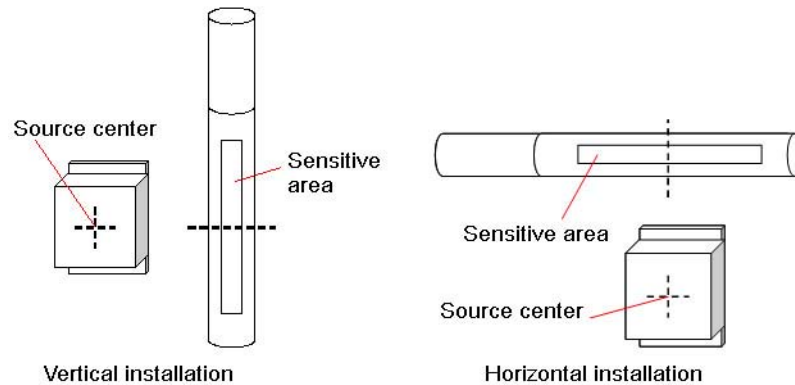


Figure 3-3. Alignment of detector and source head

For horizontal installations, the detector can be mounted above or below the source. For vertical installations, it may be mounted to the left or right. In both cases, the detector must be mounted parallel or tangential to the vessel wall. Refer to drawing [0-0704-098](#) for details. The standard mounting for Nitus detectors uses angle brackets that are welded on the outer wall of the vessel. The minimum bracket length is determined by the customer insulation thickness and bolt length.

Note If welding is not practical, other mounting arrangements are available. Contact [Thermo Fisher](#) for assistance. ▲

The Nitus detector can be used with the Thermo Scientific LevelPRO source for transmission measurement. Transmission measurement is normally recommended for pipe applications where the minimum pipe diameter is 24 inches (60.96 cm). Multiple detectors can be used for a large range of measurement. Contact [Thermo Fisher](#) for additional information.

Measurable Range

Before beginning the installation, verify that the measurable range (the range over which the process level or density 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-detector configuration, detector length, and the position of the source relative to the detector's detection length. Detection length refers to the part of the detector that senses radiation.

Note The detection length of the detector is between the upper mounting bolts and the lower mounting bolts, as shown in installation arrangement drawing [0-0704-098](#). ▲

Note The Nitus system measures the average density of the area that is between the source and the detector. ▲

Remote Mounting of Electronics

For convenience, the transmitter electronics can be mounted separately from the detector. The maximum distance between the electronics and the detector assembly is 50 feet (15.24 m). Conduits that provide good sealing are required for the installation. Refer to installation layout drawing [0-0704-096](#) for details.

Note Remote electronics is standard with the water-cooled option. ▲

Note The gauge must be purchased as a remote unit to have a separate electronics. The integrated unit cannot be broken apart. ▲

The Source Head



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 gauge. 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 The Nitus source head weighs approximately 180 lb (81.8 kg). Safety of personnel must be addressed prior to handling. Use proper lifting procedures to avoid injury. ▲

The source head mounting plate is a 12 x 14 inch (4.724 x 5.52 cm) rectangular shape. It has six 0.5” mounting holes on the top and bottom flanges (three per side). It is recommended to have six studs welded on the vessel outer wall for the source head mounting. The stud length needs to be determined by the diameter of the vessel. Unistruts can also be used to hold the source head, especially under circumstances when the point of measurement interest might change. The exact mounting method will vary depending on the application.

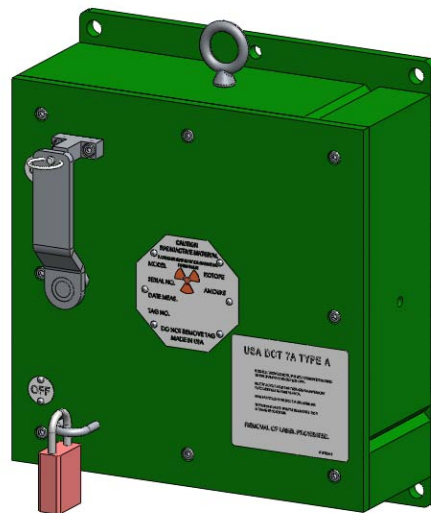


Figure 3–4. Source head

It is extremely important to have the source head in direct contact with the vessel outer wall, so any insulation layers on the vessel must be removed. The source needs to be installed securely, since any movement or change in alignment can affect the gauge’s calibration.

Compensation for Small Curvature of Vessel

For small diameter vessels, it may be necessary to compensate the curvature of the vessel outer wall to ensure measurement accuracy. The standard method of compensation is to use angled shims. As shown in the figure below, two angled shims are installed under the source head mounting plate on both sides to block unwanted flux.

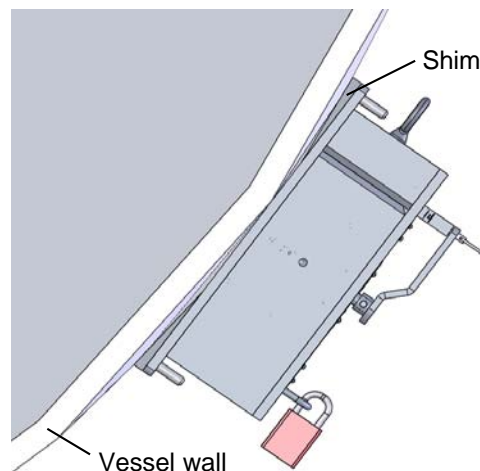


Figure 3–5. Using shims for vessel curvature compensation

The need for compensation is determined when the source head is ordered. Typically, shims are required if the vessel OD is less than 8 feet (2.44 m).

Multiple Detectors / Source Housings

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

If multiple sources and detectors are used for continuous level measurement for a large span, the uppermost unit should be mounted so that the top of its detection length is even with the top of the measurable range. The remaining units should be mounted so that the top of each detector's detection length is aligned with or slightly overlaps the bottom of the detection length of the detector mounted just above it. A maximum of eight detectors can be daisy-chained together, allowing for a level measurement span of up to 32 feet (9.75 m).

Note It is practical to space the pairs so that there is minimum interference between subsequent pairs. Consult [Thermo Fisher](#) for assistance. ▲

If one source and multiple detectors are used for density profiling measurement, position the detectors around the source as closely as possible to ensure good sensitivity. Improved profiling resolution can be achieved by adding detectors to the system.

Drawing [0-0704-098](#) provides mounting dimensions for several configurations.

Chapter 4

Wiring

Overview

Wiring should be performed in the following order:

1. Power to the gauge
2. Remote computer terminal or HHT to the gauge via the serial communication ports
3. Optional wiring:
 - a. 4–20 mA current output
 - b. Contact closure inputs
 - c. Remote display
 - d. Auxiliary 4–20 mA current input
 - e. FOUNDATION fieldbus
 - f. EMC surge protection option
 - g. Wiring to cascade multiple units (level applications only)
 - h. Temperature compensation (density applications only)

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 All wiring must be done by qualified individuals in accordance with applicable codes such as the NEC (National Electric Code) ANSI / NFPA 70 specifications or the Canadian Electrical Code Part 1. ▲



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 For hazardous location installations, the cable entries must be sealed per the installation layout drawing [0-0704-096](#). ▲



Warning For non-hazardous location installations, the cable entries into the enclosure must be sealed with a compound to protect against the passage of gas or vapors. The sealing compound should not be affected by the surrounding atmosphere or liquids. The sealing compound must have a thickness of at least 5/8" (16 mm). ▲



Warning If metal conduit is used, the conduit must be grounded. ▲



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

Wiring Drawings

The installation layout drawing [0-0704-096](#) provides general guidance for routing the cables to the unit. The installation wiring drawing [0-0704-095](#) shows the function of each connector pin on the CPU board and power board. In addition, the drawing shows cable requirements for connecting the sensor to the transmitter, power requirements, and grounding locations.

The label on the top of the detector-transmitter chassis also shows connector pin information for wiring the power boards, including the contact closure inputs and the current output. It provides instructions for wiring the RS485 and RS232 serial port connectors. Additional instructions for wiring of the FOUNDATION fieldbus connectors are also shown in drawing [0-0704-095](#).

General Procedure

Follow this general procedure to access the detector electronics for wiring.

1. Ensure all source housing shutters are in the OFF position.
2. Ensure all power to the gauge is turned off.
3. Remove the housing access cover by loosening the screw on the cover retaining bracket and sliding the bracket off of the housing cover. Unscrew the housing access cover. Two lugs on the top of the cover aid with removal.

4. Remove the cable conduit plugs from the hole(s) that will be used. As shown in installation layout drawing [0-0704-096](#), lay one conduit for the power cables and a second conduit for signal cables, if applicable. Route the cables into the detector housing and connect input power and signal wires as shown in wiring drawing [0-0704-095](#).
5. The ground line of the AC input power needs to be connected to the internal safety ground lug of the Nitus housing.
6. Pull each cable through the correct conduit fitting and into the enclosure. Leave approximately 6 inches (150 mm) for strain relief. Secure the conduit, making sure it is completely sealed.
7. Continue through the remaining sections in this chapter for wiring instructions specific to the power supply, serial and HART® communications, etc.
8. When the wiring is complete, replace the detector housing cover, and secure the cover retaining bracket.

The CPU Board

The CPU board is the system's main board. The gauge is shipped from the factory with all CPU jumpers configured properly for your system configuration. Should you need to replace the CPU board, note the jumper settings for connectors J7 (current output configuration) and J11 (system configuration) before replacing the board. After installing the new board, verify that the jumpers are set properly for your system configuration. Figure 4–1 shows the location of connectors and jumpers.

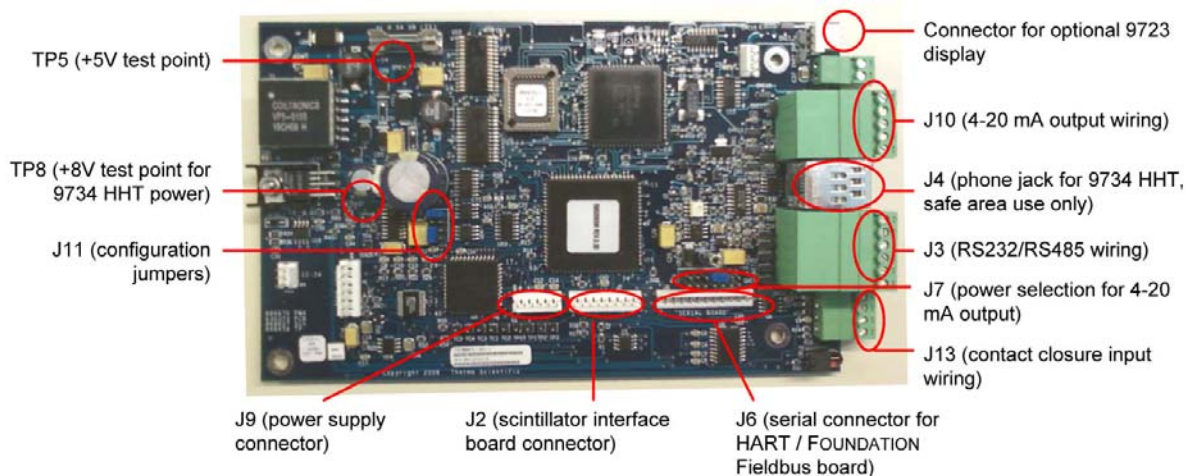


Figure 4–1. Connectors and jumpers on the CPU board

Erasing System Memory



Move the jumper to pins 1 and 8 of the J11 connector to erase system memory.

Caution Placing a jumper across pins 1 and 8 on the J11 connector erases system memory. All user-entered parameters are erased and reset to factory defaults. ▲

If you are going to erase memory by placing a jumper across pins 1 and 8, first remove power from the detector-transmitter. Note the location of the jumpers on the J11 connector. Place a jumper across pins 1 and 8, apply power, and leave power on for approximately 30 seconds to erase memory. Remove power and restore the configuration jumpers to their original settings.

AGC and Pre-Amp Boards

The instrument is equipped with an Automatic Gain Control (AGC) adaptive system. The fundamental principle of AGC is that the average output signal level will be fed back to adjust the gain to an appropriate level for a range of input signal levels. AGC is used to adjust the voltages applied to the photomultiplier tubes (PMTs) to control the system for optimal performance. The pre-amp board picks up the PMT pulse signals and amplifies the working pulses.

Note The gauge is shipped from the factory with the AGC and pre-amp boards configured properly for your system. If replacement becomes necessary, consult [Thermo Fisher](#) before removing the board from the system. ▲



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

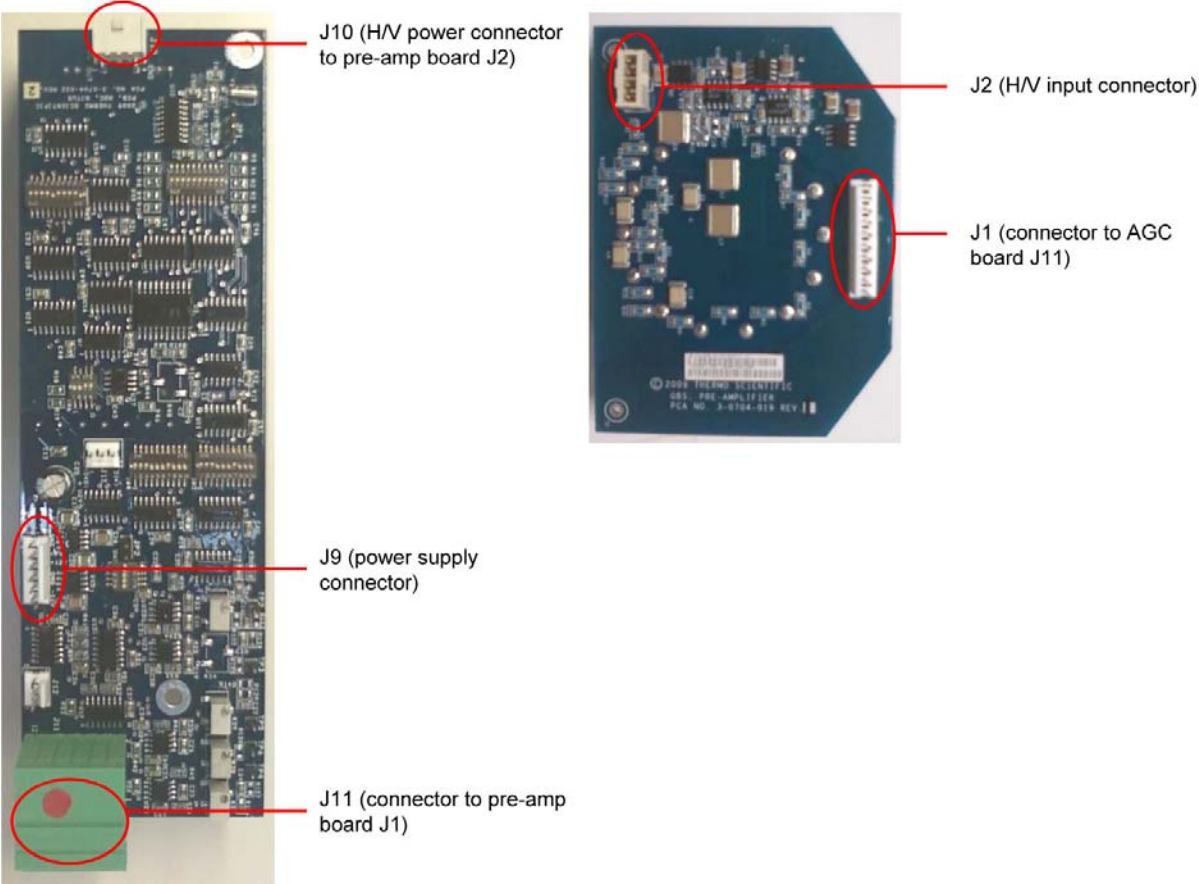



Figure 4–2. Connectors on the AGC (left) and pre-amp (right) boards

Table 4–1. AGC and Pre-Amp board connections

AGC Board Connector	Connects to	Comment
J10	J2 on pre-amp board	 Caution High voltages are present at these terminals.
J11	J1 on pre-amp board	
J9	J2 on AGC power supply board	Power input

Refer to wiring drawing [0-0704-056](#) for cable information and other wiring details.

System Power

The system is designed to operate on 115 or 230 Vac ($\pm 15\%$). The maximum input power requirement is 12 VA. The maximum length of the cable that can be used to supply power varies depending on the wire gauge. Refer to wiring drawing 0-0704-056 for cable information and other wiring details.



Warning All wiring must be done by qualified individuals in accordance with applicable codes such as the NEC (National Electric Code) ANSI / NFPA 70 specifications or the Canadian Electrical Code Part 1. For intrinsically safe systems, refer to ANSI / ISA RP 12.6. ▲

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 gauge. In addition, protective bonding (grounding) must always be provided. ▲

CPU Power Supply Board

The CPU power supply (PS) board is shown below.



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



Caution The AC selector switch is shown in the figure below. Applying 230 Vac with the selector switch in the 115 Vac position will damage the equipment. ▲



Caution For reliable operation and to maintain safety approval, the fuse on the CPU PS board must only be replaced with an approved fuse. ▲

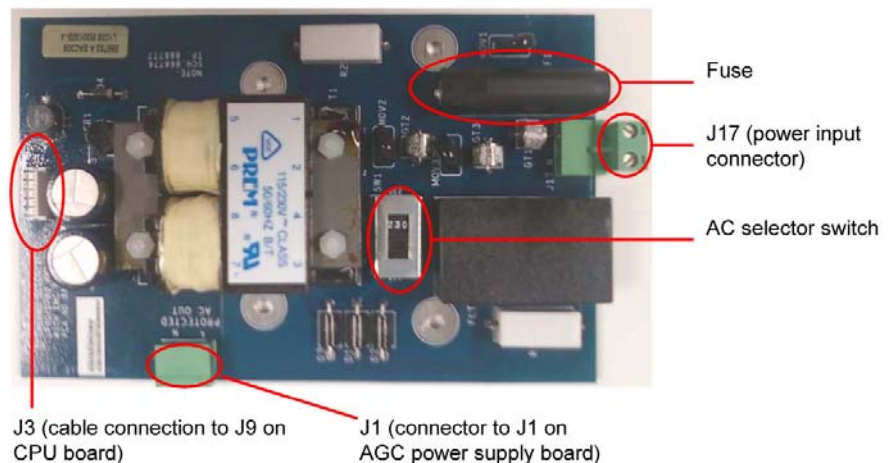


Figure 4-3. CPU power supply board

Table 4–2. CPU power supply board connections

CPU PS Board Connector	Connects to	Comment
J17	Power input	
J3	J9 on CPU board	Power to CPU board
J1	J1 on AGC power supply board	

For additional details, refer to wiring drawing [0-0704-056](#).

AGC Power Supply Board

The AGC power supply (PS) board is shown below.



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



Caution The AC selector switch is shown in the figure below. Applying 230 Vac with the selector switch in the 115 Vac position will damage the equipment. ▲



Caution For reliable operation and to maintain safety approval, the fuse on the AGC PS board must only be replaced with an approved fuse. ▲

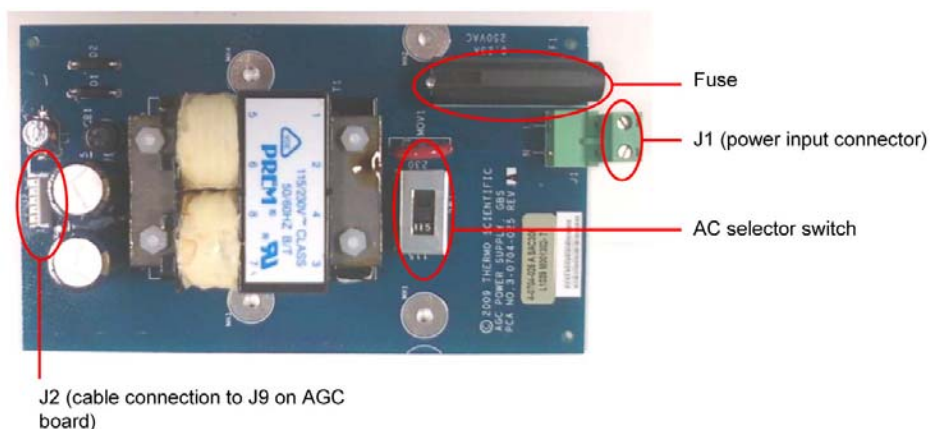


Figure 4–4. AGC power supply board

Table 4–3. AGC power supply board connections

AGC PS Board Connector	Connects to	Comment
J1	J1 on CPU power supply board	Power input
J2	J9 on AGC board	Power to AGC board

For additional details, refer to wiring drawing [0-0704-056](#).

Optional EMC Surge Protection Board

To eliminate the possibility of unwanted electromagnetic signals either going from Nitus into other customer equipment or from other customer equipment into Nitus, an EMC protection system has been developed.

J3 is the connector to the J3, J10, and J13 on the CPU board. J4 on the surge protection board is connected to the TB1 on the top of the electronics chassis, which is designed for customer wiring. Refer to drawings [0-0704-056](#) and [0-0704-095](#) in the drawing appendix for the wiring requirements.

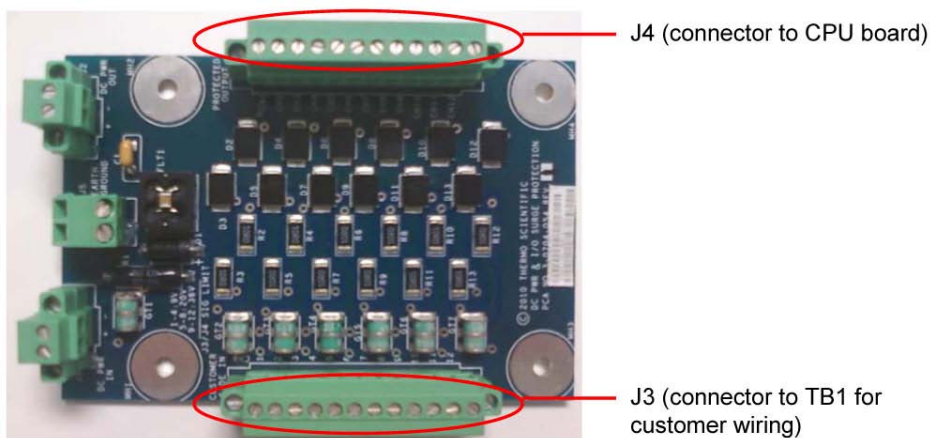


Figure 4–5. Connectors on the optional EMC surge protection board

Serial Communications

The gauge provides one RS232 single drop and one RS485 multi-drop serial interface. Screw terminal connectors for both ports are located at J3 on the CPU board.

The RS485 connector includes the +8 Vdc required to power the Thermo Scientific 9734 handheld terminal (HHT) as well as the +DATA and –DATA connections. An RJ11 (phone jack) connector is also provided for the RS485 port at J4 on the CPU board. The HHT can be connected directly to the RJ11 connector in safe areas.

Both ports provide independent access to the measurement readings and software functions. They are always active and can be used to display measurements. The setup menus, however, may only be accessed by one port at a time.

RS485 Wiring

Connecting the serial (COM) port on a PC to the RS485 port on the gauge requires the RS485/RS232 converter (p/n OTO515D).

1. Connect J3-12 (+DATA) and J3-11 (–DATA) to the corresponding connections on the RS485/RS232 converter.
2. Connect the converter to the PC using the supplied DB9 serial cable.
3. Refer to drawings [0-0704-056](#) and [0-0704-095](#) for additional details.

Initial Setup for Party-Line Communications

To communicate with multiple gauges via a RS485 party-line, each unit must be assigned a unique unit identification number so it can be addressed individually. All gauges are assigned unit number 0 (zero) by default.

To assign a unique unit number to each gauge, you must be able to communicate with each one individually. Disconnect each gauge from the party-line in turn and communicate with the disconnected gauge directly. Alternately, you can remove power from all gauges except one and assign a unit number to the powered gauge.

If you have trouble using another device on the RS485 chain, verify that it 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.

RS232 Wiring

The serial port on a PC (COM1 or COM2) can be connected directly to the RS232 port on the gauge. This requires five wires: ground, transmit (TX), receive (RX), request-to-send (RTS), and clear-to-send (CTS). The connections between the RS232 port (J3 on the CPU board) and the PC serial port are summarized in the table below for standard DB9 and DB25 PC serial port connectors.

Figure 4–6.

J3 on CPU Board	PC Serial Port DB9 Connector	PC Serial Port DB25 Connector
J3-2 (RX)	Pin 3	Pin 2
J3-3 (TX)	Pin 2	Pin 3
J3-4 (RTS)	Pin 8	Pin 5
J3-5 (CTS)	Pin 7	Pin 4
J3-6 (GND)	Pin 5	Pin 7

Using Serial Communications

To communicate with the gauge from a PC requires that the PC be running a terminal emulation software. The default communication settings for the gauge's RS485 and RS232 ports and for the HHT are: 7 data bits, Even parity, 1 stop bit, 9600 baud.

Refer to the Nitus user guide for additional details about setting up and using serial communications.

HART Communications

The HART® communication protocol is supported over the 4–20 mA current output with the HART interface board. The HART interface board is an optional daughter board that is wired via a cable to J6 on the CPU board. Communication with the gauge is via the 275 or 375 Field Communicator from Emerson Electric Co. Refer to the LevelPRO HART operation manual (p/n 717817).

Note HART communication protocol allows you to configure and calibrate the gauge in most applications; however, due to limitations of the protocol, the complete range of functions is only available when using the Thermo Scientific Model 9734 handheld terminal and the RS485 port. ▲

FOUNDATION Fieldbus Communications

The FOUNDATION fieldbus communication protocol is supported over connector TB2 on the top of the electronics chassis. The interface board is an optional daughter board that is wired via a cable to J6 on the CPU board. Communication with the gauge is via the 375 or 475 Field Communicator from Emerson Electric Co. Refer to the LevelPRO with FOUNDATION fieldbus application guide (p/n 717915) or the DensityPRO with FOUNDATION fieldbus application guide (p/n 717917) for detailed instructions.

Contact Closure Inputs

The contact closure inputs are dry contact inputs between ground and Switch 1 and ground and Switch 2 at J13 on the CPU board. The gauge can be configured via software settings to execute a command or other function upon a user-provided contact opening or closing. Refer to the Nitus user manual for instructions on assigning commands to the contact closure inputs.

When operating in “cascade” mode, where multiple units are wired together to act as a single detector, contact closure Switch 2 is dedicated to performing the cascading function. Refer to drawings [0-0704-056](#) and [0-0704-095](#).

Current Output

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

- Isolated, loop-powered (default)
- Non-isolated, self-powered
- Isolated, self-powered output (requires optional piggyback board p/n 886595-1)

All three configurations can drive an 800 ohm maximum load over the full current output range. The current output is programmable between 3.8 and 20.5 mA. The fault low condition for the current output is 3.6 mA or less, and the fault high condition is 20.8 mA or greater.

The default current output configuration is isolated, loop-powered. A jumper is placed across pins 4 and 5 of the J7 connector on the CPU board. For this configuration, pins 6 and 7 of the J10 connector are for the 4–20 mA output connections.

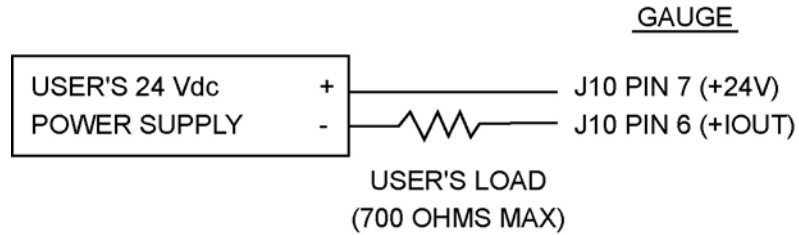


Figure 4-7. 4–20 mA loop powered configuration

To configure the current output as non-isolated, self-powered, move the jumper to pins 3 and 4 of the J7 connector. For this configuration, pins 6 and 9 of the J10 connector are for the 4–20 mA output connections.

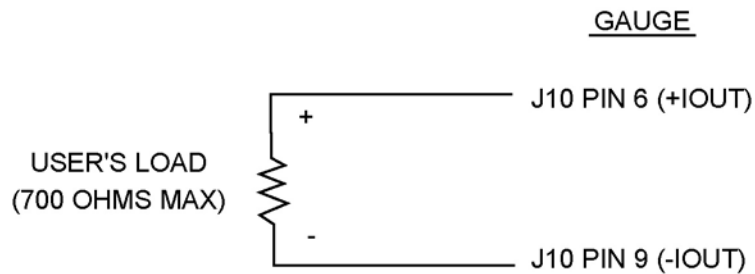


Figure 4-8. 4–20 mA non-isolated, self-powered configuration

To configure the current output as isolated, self-powered, a piggy-back board must be installed on the J7 connector (no jumpers used). For this configuration, pins 6 and 8 of the J10 connector are for the 4–20 mA output connections.

Auxiliary Input Wiring

There is an auxiliary connection on connector J10 for applications requiring an outside 4–20 mA signal be input into the Nitus and used as a form of compensation adjustment (vapor density, pressure, etc.). The outside 4–20 mA signal should be wired so that the positive connection of the loop is connected at J10 pin 1 and the negative side connected to J10 pin 2. The special equation is then utilized to incorporate this input into the Nitus program. Refer to the Nitus user guide for information on special equations.

Cascade Mode Wiring (Level Applications Only)

For applications requiring a detector length greater than 12 feet (3.66 m), up to eight units can be wired together to act as one continuous detector. In this situation, the last unit in the line is referred to as the primary unit. All wiring for the serial ports, relays, etc. is done in the primary unit. Remaining units are referred to as secondary units. All secondary units must be powered in the same manner as the primary unit. Each secondary unit must be wired such that the cascade “out” from one goes into the cascade “in” of the next unit in line. These totaled signals are accumulated in the primary unit, which outputs the actual level indication. All programming for secondary units must be set at default conditions for the cascade to work properly.

Refer to drawings [0-0704-056](#) and [0-0704-095](#) in the drawing appendix for the wiring requirements.

Temperature Compensation Wiring (Density Applications Only)

For applications that require temperature compensation, the instrument can accept a temperature input to compensate the density measurement for changes in process temperature. This requires the Thermo Scientific temperature compensation board (p/n 886609), which is shown below.

Refer to drawings [0-0704-056](#) and [0-0704-095](#) for additional details.

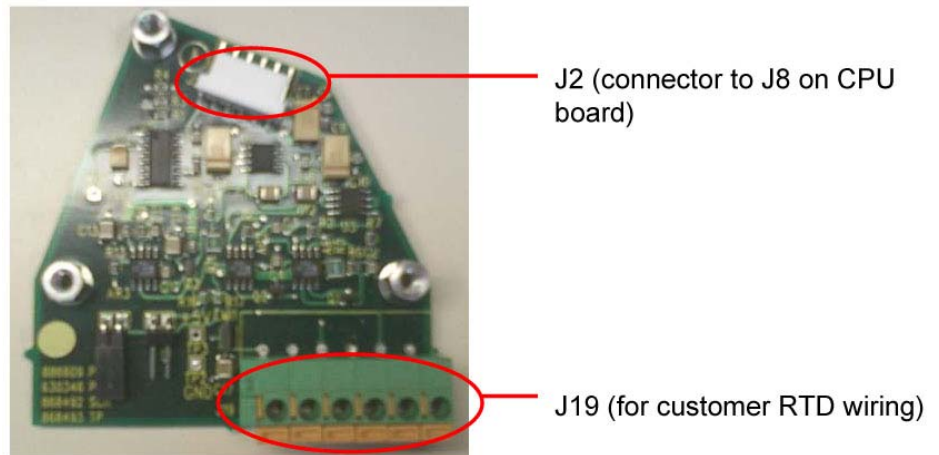


Figure 4–9. Temperature compensation board

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Chapter 5

Service & Support

Getting Help

The local representative is your first contact for support and is well equipped to answer questions and provide application assistance. You can also obtain support by contacting Thermo Fisher directly.

Process Instruments		
1410 Gillingham Lane Sugar Land, TX 77478 USA +1 (800) 437-7979 +1 (713) 272-0404 direct +1 (713) 4573 fax	14 Gormley Industrial Avenue Gormley, Ontario LOH 1G0 CANADA +1 (905) 888-8808 +1 (905) 888-8828 fax	Unit 702-715, 7/F Tower West Yonghe Plaza No. 28 Andingmen East Street, Beijing 100007 CHINA +86 (10) 8419-3588 +86 (10) 8419-3580 fax
A-101, 1CC Trade Tower Senapati Bapat Road Pune 411 016 Maharashtra, INDIA +91 (20) 6626 7000 +91 (20) 6626 7001 fax	Ion Path, Road Three Winsford, Cheshire CW7 3GA UNITED KINGDOM +44 (0) 1606 548700 +44 (0) 1606 548711 fax	
www.thermoscientific.com		

Warranty

Thermo Scientific products are warranted to be free from defects in material and workmanship at the time of shipment and for one year thereafter. Any claimed defects in Thermo Scientific products must be reported within the warranty period. Thermo Fisher Scientific Inc. (Thermo Fisher) shall have the right to inspect such products at Buyer's plant or to require Buyer to return such products to Thermo Fisher plant.

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

Thermo Fisher 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 Fisher or its Sales Representatives are not followed concerning methods of operation, usage and storage or exposure to harsh conditions.

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Appendix A

Ordering Information

A complete Nitus system consists of any number of integrated detector-transmitter(s) and sources as applicable to the application, and a type of communication.

Table A-1. 6000 series gamma source head

Code	Vessel Orientation
H	Horizontal
V	Vertical
Code	Vessel Outer Diameter
XXXX	Vessel outer diameter in ft (minimum 2.0 ft)
Code	Source Type and Size
CS10	10 mCi/270 MBq Cs-137 stainless steel, doubly encapsulated, Special Form certified from a Competent Authority
CS20	20 mCi/740 MBq Cs-137 stainless steel, doubly encapsulated, Special Form certified from a Competent Authority
CS50	50 mCi/1.85 GBq Cs-137 stainless steel, doubly encapsulated, Special Form certified from a Competent Authority
CS100	100 mCi/3.7 GBq Cs-137 stainless steel, doubly encapsulated, Special Form certified from a Competent Authority
Code	Source Housing Material
CS	Carbon steel
SS	Stainless steel
Code	Actuators
S	Standard manual handle
Code	Temperature
H	< 600°C
Code	Mounting Pattern
S	Standard 4 corner hole

Table A-2. IP2010 detector for level (IP2010L)

Code	Detector/Transmitter Enclosure Type
CS	Carbon steel detector, CSA/US, ATEX
SS	Stainless steel detector, CSA/US, ATEX
CW	Carbon steel water-cooled jacketed steel detector, CSA/US, ATEX
SW	Stainless steel water-cooled jacketed steel detector, CSA/US, ATEX
Code	ECC Option
N	No selection
E1	ECC – 1 μ Cu
E2	ECC – 2 μ Cu
Code	Carbon Steel Detector/Transmitter Length
00 to 12	00 = no selection, 01 to 12 for lengths 1 ft to 12 ft
Code	Carbon Steel Water-Cooled Detector/Transmitter Length
00 to 12	00 = no selection, 01 to 12 for lengths 1 ft to 12 ft
Code	Stainless Steel Detector/Transmitter Length
00 to 12	00 = no selection, 01 to 12 for lengths 1 ft to 12 ft
Code	Stainless Steel Water-Cooled Detector/Transmitter Length
00 to 12	00 = no selection, 01 to 12 for lengths 1 ft to 12 ft
Code	Electronics Packaging Type
I	Integrated
R	Remote
Code	Input Power
A	115 Vac
B	230 Vac
Code	Certification
C	CSA/CUS
A	ATEX
Code	4–20 mA Output Type
L	Isolated, loop-powered
S	Isolated, self-powered
N	Non-isolated, self-powered

Code	Communications
N	No selection
A	Thermo Scientific 9734 HHT RS485 & RS232 cable
B	HART communication module
C	FOUNDATION fieldbus module
D	9734 HHT RS485 & RS232 cable with HART
E	9734 HHT RS485 & RS232 cable with FOUNDATION fieldbus
Code	Optional Accessories
L	Lg SS tag (3.3" x 2.5") wired
R	RJ-11 modular connector jack
D	Thermo Scientific Model 9723 backlit LCD
A	3/4" NPT to metric adapter

Table A-3. IP2010 detector for density (IP2010D)

Code	Detector/Transmitter Enclosure Type
CS	Carbon steel detector, CSA/US, ATEX
SS	Stainless steel detector, CSA/US, ATEX
CW	Carbon steel water-cooled jacketed steel detector, CSA/US, ATEX
SW	Stainless steel water-cooled jacketed steel detector, CSA/US, ATEX
Code	Input Power
A	115 Vac
B	230 Vac
Code	4–20 mA Output Type
S	Isolated, self-powered
Code	Electronics Packaging Type
I	Integrated
R	Remote
Code	Certification
C	CSA/CUS
A	ATEX
Code	Temperature Compensation
N	No selection
T	Temperature compensation board

Ordering Information

Code	Communications
N	No selection
A	Thermo Scientific 9734 HHT RS485 & RS232 cable
B	HART communication module
C	FOUNDATION fieldbus module
D	9734 HHT RS485 & RS232 cable with HART
E	9734 HHT RS485 & RS232 cable with FOUNDATION fieldbus
Code	Optional Accessories
L	Lg SS tag (3.3" x 2.5") wired
R	RJ-11 modular connector jack
D	Thermo Scientific Model 9723 backlit LCD
A	3/4" NPT to metric adapter

Appendix B

Specifications

Results may vary under different operating conditions.

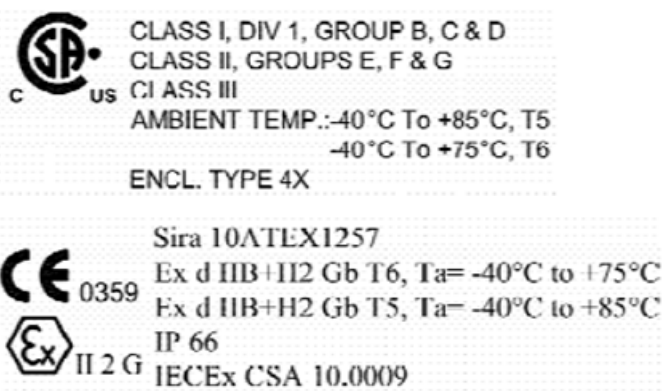
Table B-1. System performance specifications

Level measurement	0.5% of span, target density should be between 0 and 3 g/cc
Density measurement	From ± 0.0001 g/cc depending on application; density range 0–3 g/cc

Table B-2. Gamma ray source

Source name	6000 series
Source type	Cs-137 stainless steel, doubly encapsulated
Size	10–1000 mCi Cs-137 (source size dependent upon application)
Source housing	Carbon steel or stainless steel construction with tungsten core Two-position rotary shutter, lockable in open and closed positions.
ANSI/HPS rating	ANSI-94-554-565-R6
Fire proof rating	Fire proof, passed 2000 °F (1093 °C) testing for 4 hours
Vibration test	MIL 810F, Method 514.6, Transportation
Reliability	Shutter tested for 1 million cycles with no failures
Shock test	Multiple drops from 1 meter height on concrete surface
Weight	180 lb (81.8 kg)
Size	12 x 14 in (4.724 x 5.52 cm)
Mounting	Source head designed to match vessel radius. Standard 4 corner hole feature for ease of mounting. Source head must be in contact with actual vessel wall. Will not work over insulation. No air gap allowed. A minimum vessel diameter of 2 ft required.

Table B-3. IP2010 detector

Detector name	IP2010
System architecture	Available in two options: - Integrated electronics - Remote electronics Surface mount technology provides high degree of reliability. All user data doubly stored in non-volatile memory with no battery backup required.
Detection type	PVT plastic scintillator with wide dynamic range. PVT resists shock and moisture damage. Dual PMT configuration to reduce Signal-to-Noise ratio.
Detector lengths	Density measurement: 2 ft Level measurement: 1 ft increments, from 1 to 4 ft with one source. For lengths longer than 4 ft, multiple detectors required.
Detector stabilization	Electronic control without heater stabilization for optimum performance.
Power	120/230 Vac, 50-60 Hz, 500 mA max
Operating temperature	-40°C to +75°C (-40°F to 167°F) ambient
Enclosure construction	Carbon steel or stainless steel polyurethane painted. Optional water-cooled detector for higher temperature applications. Water-cooled available only with remote electronics.
Approvals	 <p>CLASS I, DIV 1, GROUP B, C & D CLASS II, GROUPS E, F & G CLASS III AMBIENT TEMP.: -40°C To +85°C, T5 -40°C To +75°C, T6 ENCL. TYPE 4X</p> <p>Sira 10ATEX1257 Ex d IIB+II2 Gb T6, Ta= -40°C to +75°C Ex d IIB+H2 Gb T5, Ta= -40°C to +85°C IP 66 II 2 G IECEx CSA 10.0009</p>
Current outputs	4-20 mA isolated, loop-powered into 800 ohms, field scalable 4-20 mA isolated, self-powered into 800 ohms, field scalable 4-20 mA non-isolated self-powered into 800 ohms, field scalable
Serial outputs	RS485 half duplex; RS232 full duplex
Contact closure outputs	Two – 115 Vac/28 Vdc SPDT @ 10 amps (230 Vac SPDT @ 8 A)

Inputs	<p>Signal from another Thermo Scientific LevelPRO detector. Additional input for gas density compensation or buildup available.</p> <p>Dry contact closure.</p> <p>Temperature compensation circuitry with 100 ohm platinum RTD 2 or 3-wire</p>
Mounting hardware	<p>Integral bolt-on bracket. Can be mounted up to 6" from the vessel wall. Insulation allowed between detector and wall.</p>
Thermo Scientific Model 9723	<p>Local remote display.</p> <p>Backlit LCD with two lines, 16 alphanumeric characters.</p> <p>Hazardous enclosure is FMRC and CSA approved: Class I, Div. 1, Groups E, F, G; Class III, Div. 1.</p> <p>Display powered from electronics.</p> <p>Maximum separation from electronics 300 ft (91.4 m).</p>
Programming	<p>Menu driven</p> <p>Emerson 375/475 Field Communicator: For gauge configuration and calibration. Communicates with any Nitus via the current loop. BEL202FSK standard.</p> <p>Thermo Scientific HHT: For gauge configuration and calibration. Communicates with any Nitus via RS485 connector. Provides upload/download of gauge configuration to/from PC via RS232 interface.</p> <p>Comm PC interface software: For interfacing with up to 32 Nitus units over RS485. RS485/RS232 converter provided.</p>

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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 manual may not be exact duplicates 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.

Drawing	Rev.	Description	Page
0-0704-056	A	Wiring schematic, detector electronics, Nitus	C-2
0-0704-078	A	General assembly, EXd enclosures, Nitus	C-5
0-0704-095	A	Drawing, installation wiring, Nitus	C-8
0-0704-096	A	Drawing, installation layout, Nitus	C-9
0-0704-097	A	Schematic, cascade wiring, Nitus	C-10
0-0704-098	A	Drawing, installation arrangement, Nitus	C-11

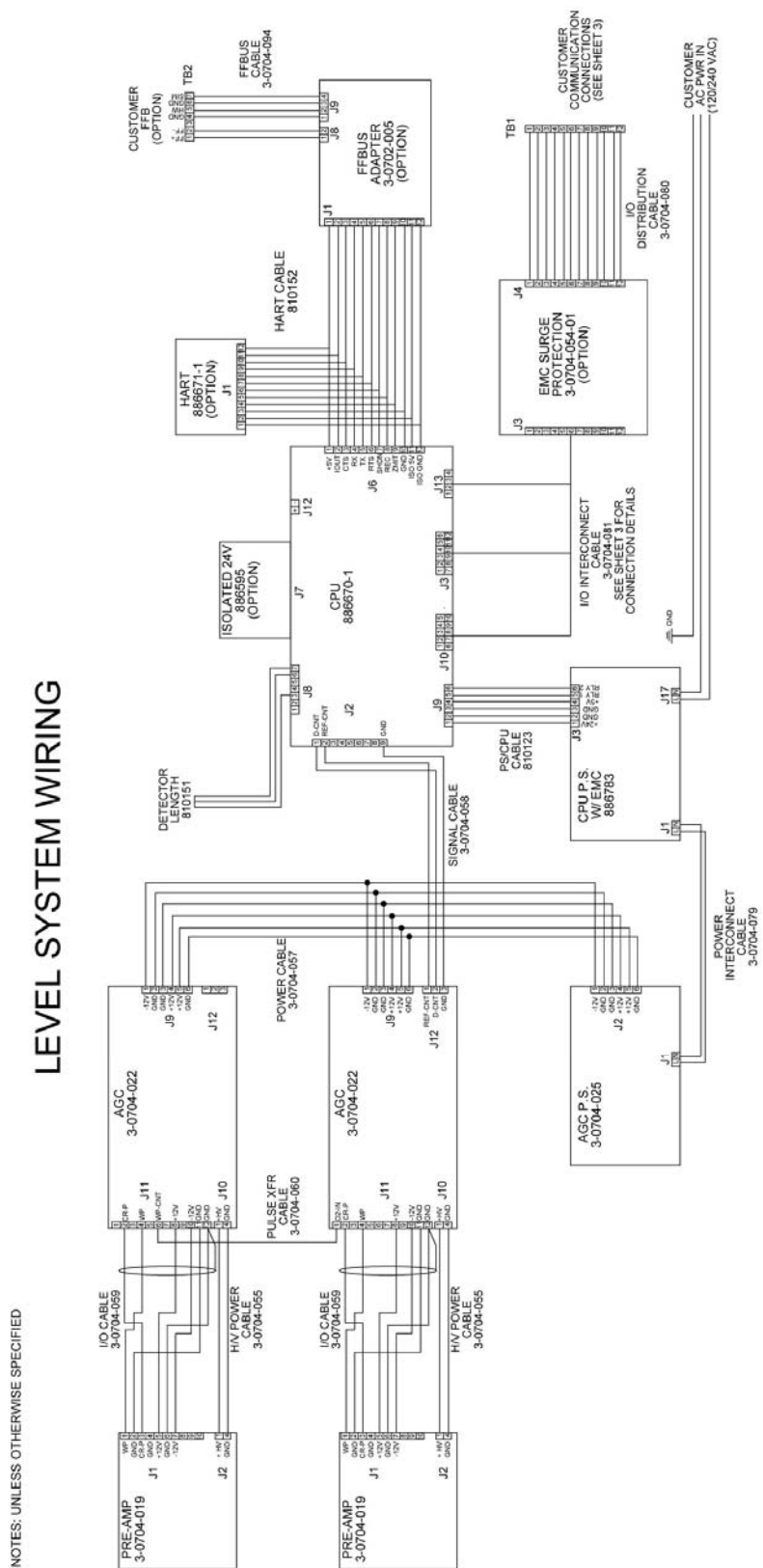


Figure C-1. 0-0704-056: Wiring schematic, detector electronics, Nitus (sheet 1 of 3)

DENSITY SYSTEM WIRING

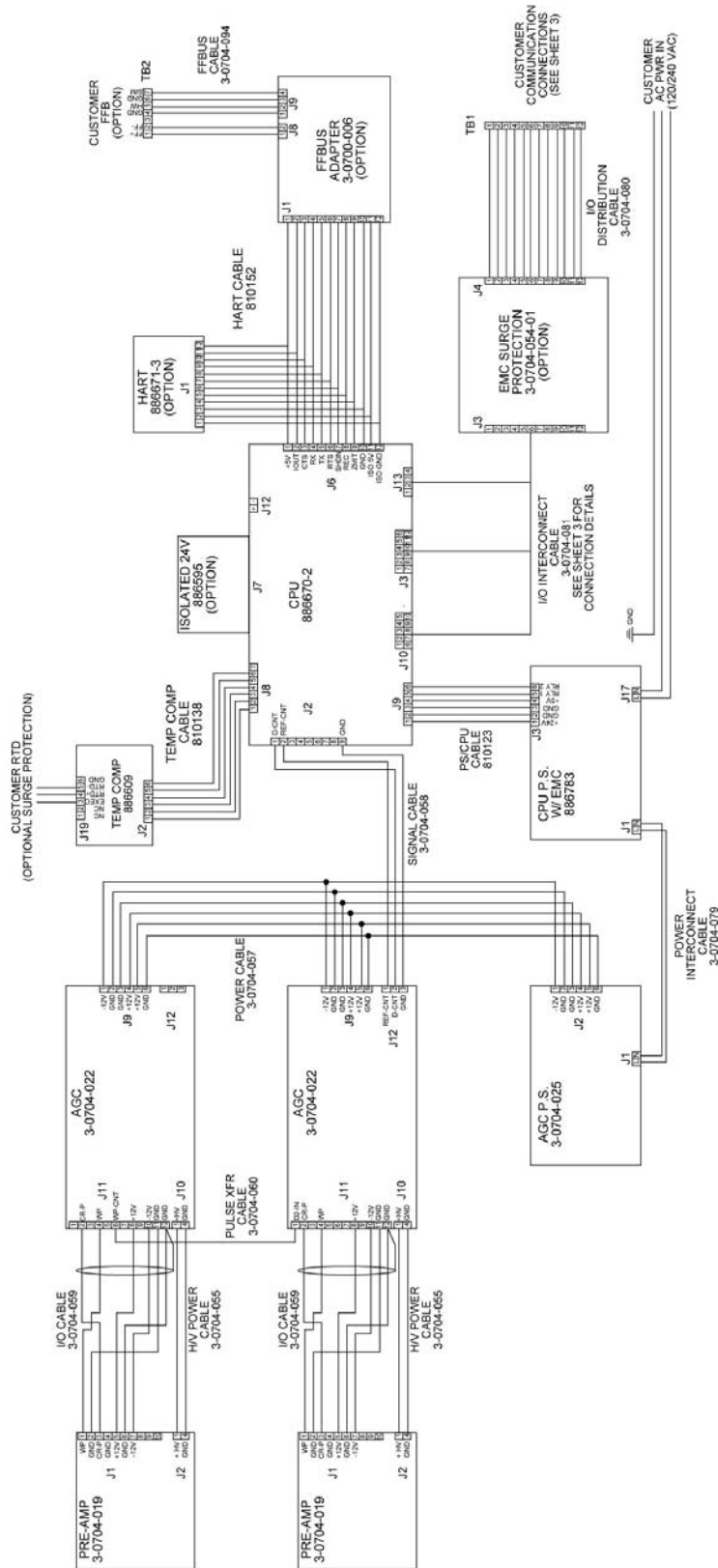


Figure C-2. 0-0704-056: Wiring schematic, detector electronics, Nitus (sheet 2 of 3)

EMC SURGE PROTECTION WIRING OPTIONS

		Surge Protection Board J3/J4 Connector Positions											
		1	2	3	4	5	6	7	8	9	10	11	12
1	INTERFACE	W-1	W-2	W-3	NC	D+	D-	+5V	GND	F+	F-	I+	I-
	SIGNAL	RTD Inputs Temp Comp BD J19		RS485 CPU J3B		+8V		GND		Flow In (4-20mA) CPU J10A		4-20mA (HART) CPU J10B	
2	INTERFACE	SW1	GND	SW2	GND	RX	TX	RTS	CTS	+8V	GND	I+	I-
	SIGNAL	Contact-1 CPU J13		Contact-2 CPU J13		RS232 CPU J3A		4-20mA (HART) CPU J10B					
3	INTERFACE	SW1	GND	SW2	GND	D+	D-	+5V	GND	NC	NC	I+	I-
	SIGNAL	Contact-1 CPU J13		Contact-2 CPU J13		RS485 CPU J3B		4-20mA (HART) CPU J10B					
4	INTERFACE	W-1	W-2	W-3	NC	D+	D-	+5V	GND	SW1	GND	I+	I-
	SIGNAL	RTD Inputs Temp Comp BD J19		RS485 CPU J3B		Contact-1 CPU J13		4-20mA (HART) CPU J10B					
5	INTERFACE	W-1	W-2	W-3	NC	+5V	GND	DATA	SCLK	F+	F-	I+	I-
	SIGNAL	RTD Inputs Temp Comp BD J19		Local Display CPU J1		Flow In (4-20mA) CPU J10A		4-20mA (HART) CPU J10B					
6	INTERFACE	+5V	GND	DATA	SCLK	D+	D-	+5V	GND	SW1	GND	I+	I-
	SIGNAL	Local Display CPU J1		RS485 CPU J3B		Contact-1 CPU J13		4-20mA (HART) CPU J10B					

Figure C-3. 0-0704-056: Wiring schematic, detector electronics, Nitus (sheet 3 of 3)

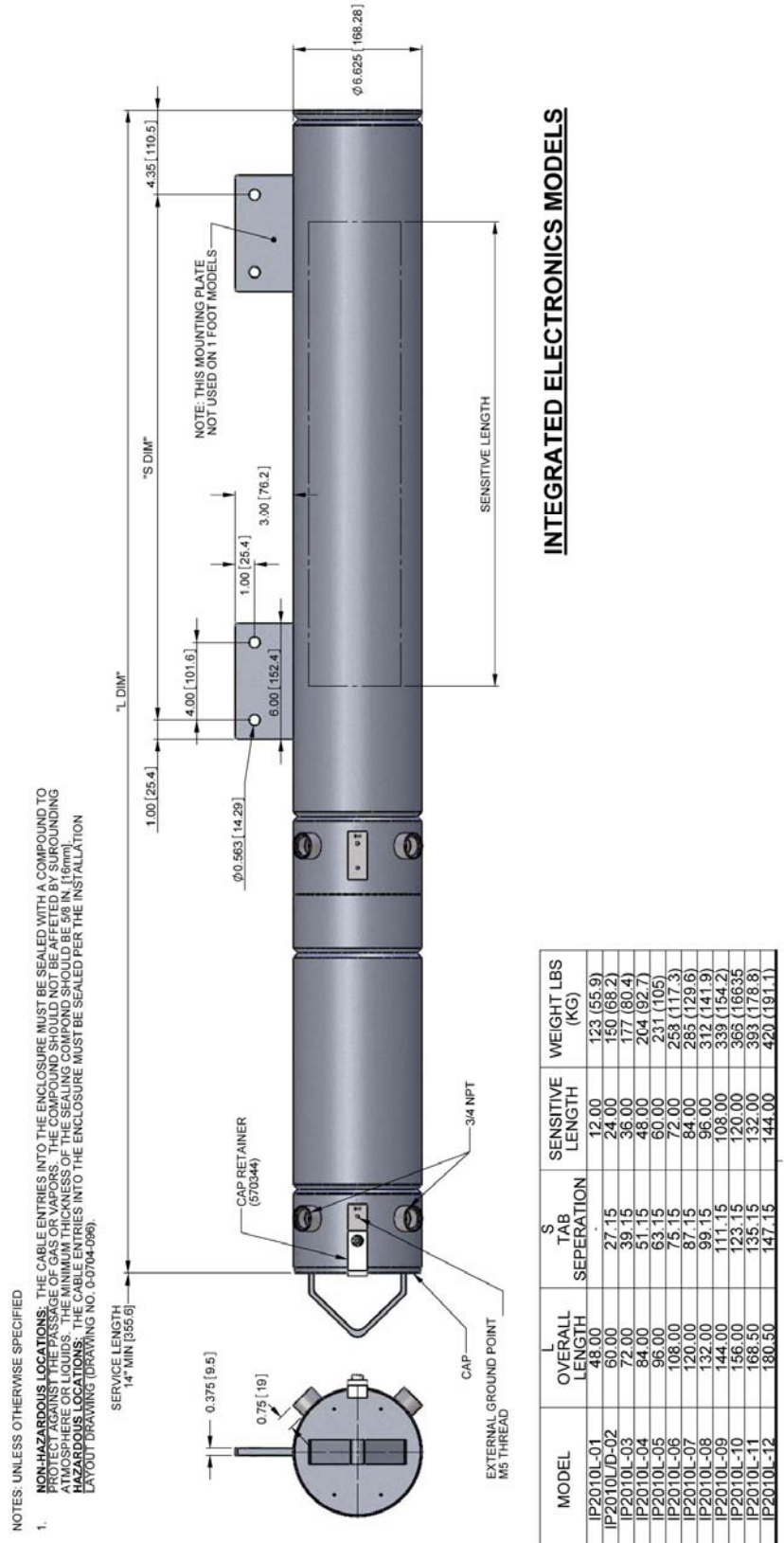
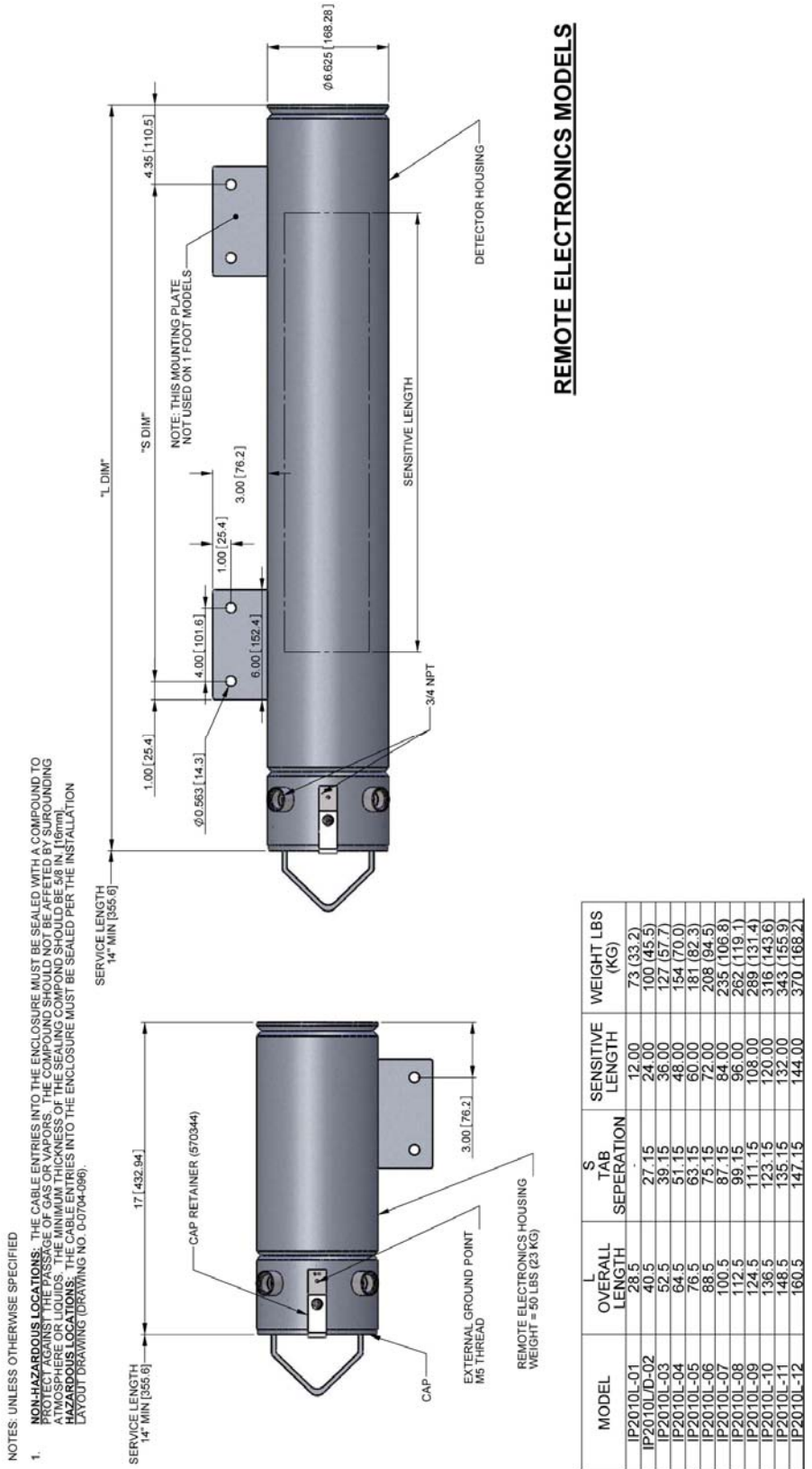
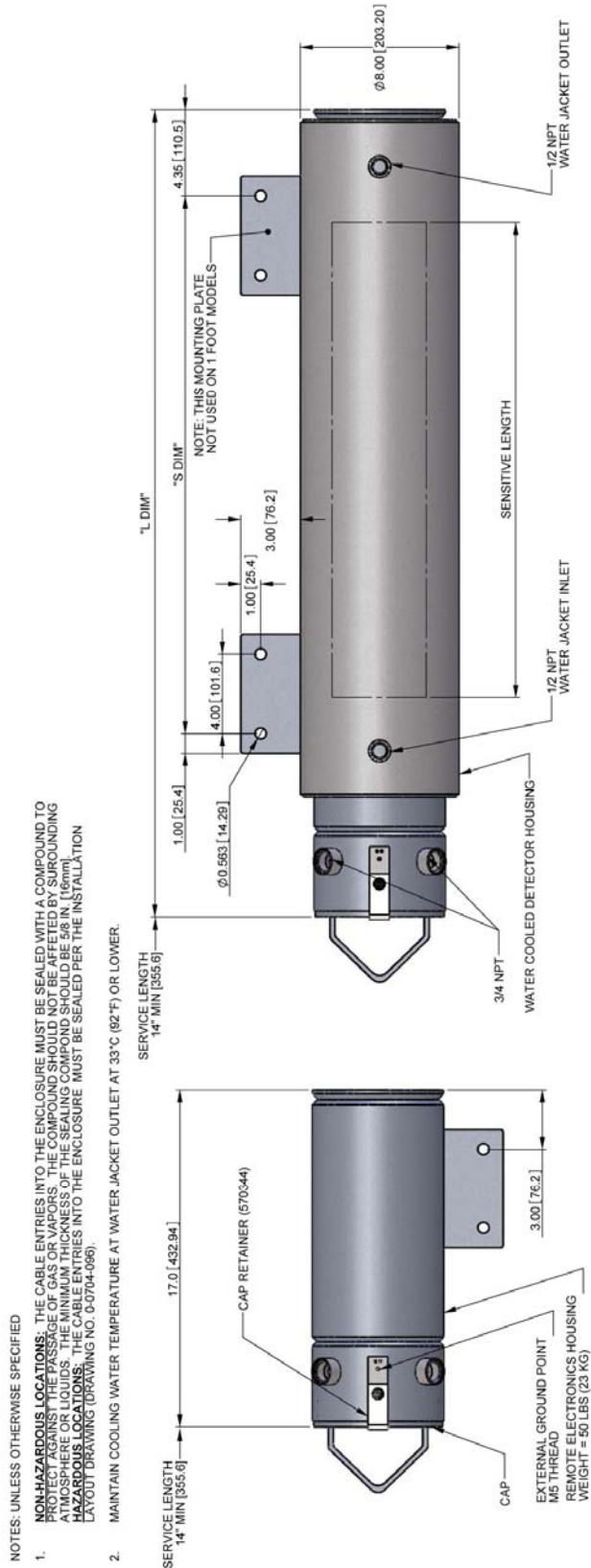


Figure C-4. 0-0704-078: General assembly, EXd enclosures, Nitus (sheet 1 of 3)



REMOTE ELECTRONICS MODELS

Figure C-5. 0-0704-078: General assembly, EXd enclosures, Nitus (sheet 2 of 3)



WATER COOLED MODELS

MODEL	OVERALL LENGTH	S TAB SEPERATION	SENSITIVE LENGTH	WEIGHT LBS (KG)
IP2010I-01	23.5	12.00	105 (47.7)	
IP2010I/D-02	40.5	24.00	142 (64.6)	
IP2010I-03	52.5	36.00	179 (81.4)	
IP2010I-04	64.5	48.00	216 (98.2)	
IP2010I-05	76.5	60.00	253 (115.0)	
IP2010I-06	88.5	72.00	290 (131.8)	
IP2010I-07	100.5	84.00	327 (148.6)	
IP2010I-08	112.5	96.00	364 (165.5)	
IP2010I-09	124.5	108.00	401 (182.3)	
IP2010I-10	136.5	120.00	438 (199.1)	
IP2010I-11	148.5	132.00	475 (215.9)	
IP2010I-12	160.5	144.00	512 (232.7)	

Figure C-6. 0-0704-078: General assembly, EXd enclosures, Nitus (sheet 3 of 3)

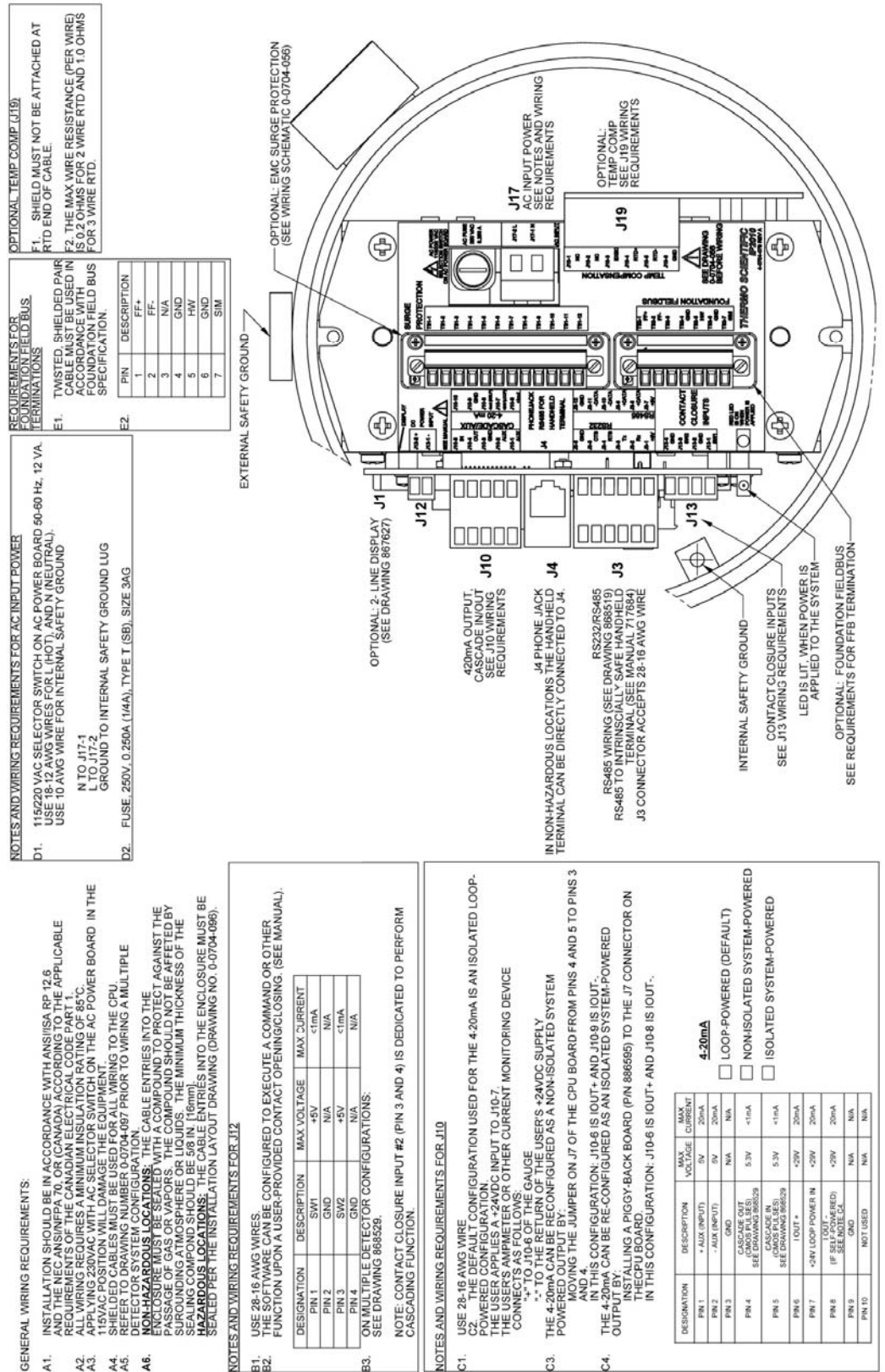


Figure C-7. 0-0704-095: Drawing, installation wiring, Nitus (sheet 1 of 1)

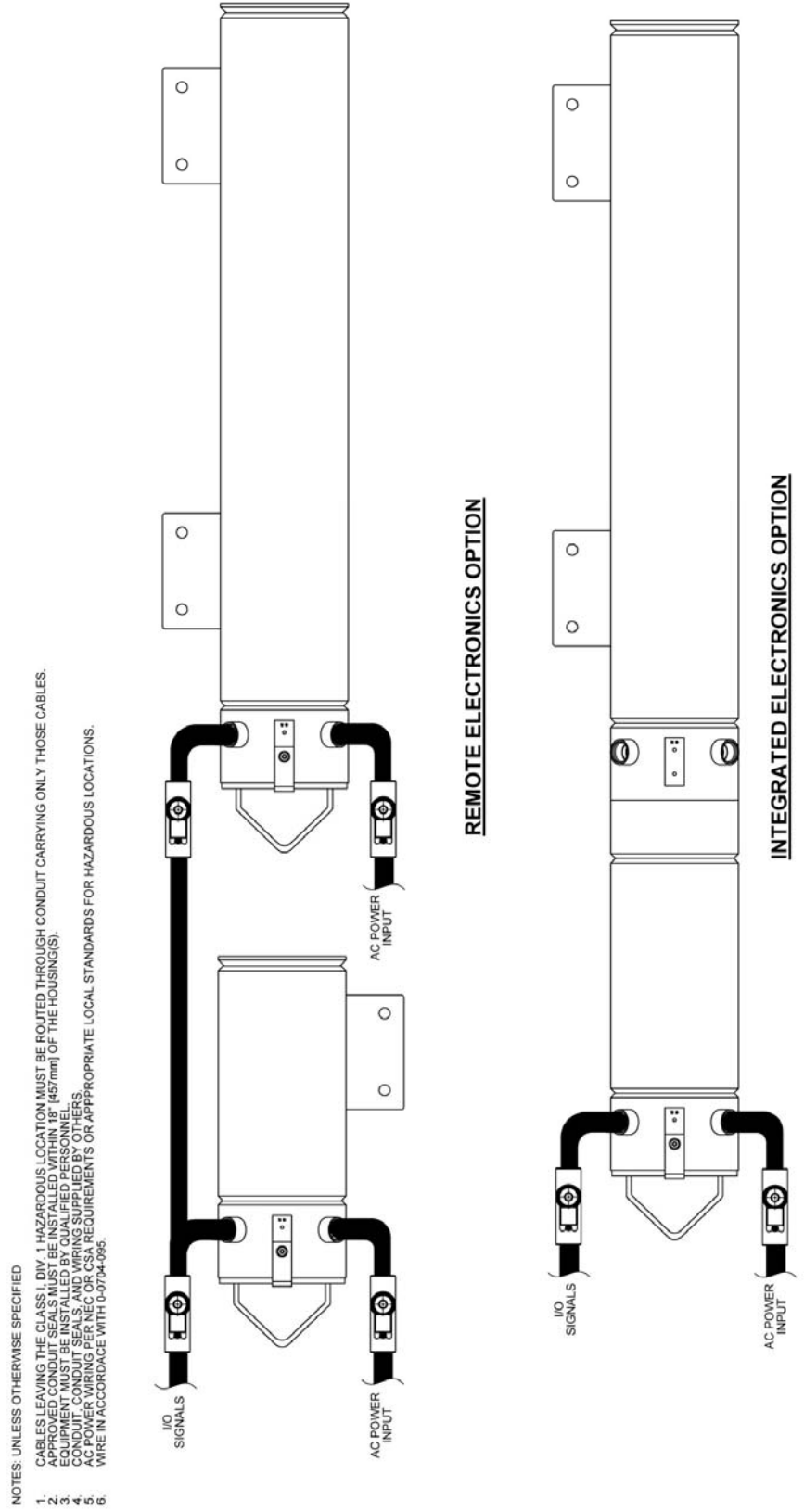


Figure C-8. 0-0704-096: Drawing, installation layout, Nitus (sheet 1 of 1)

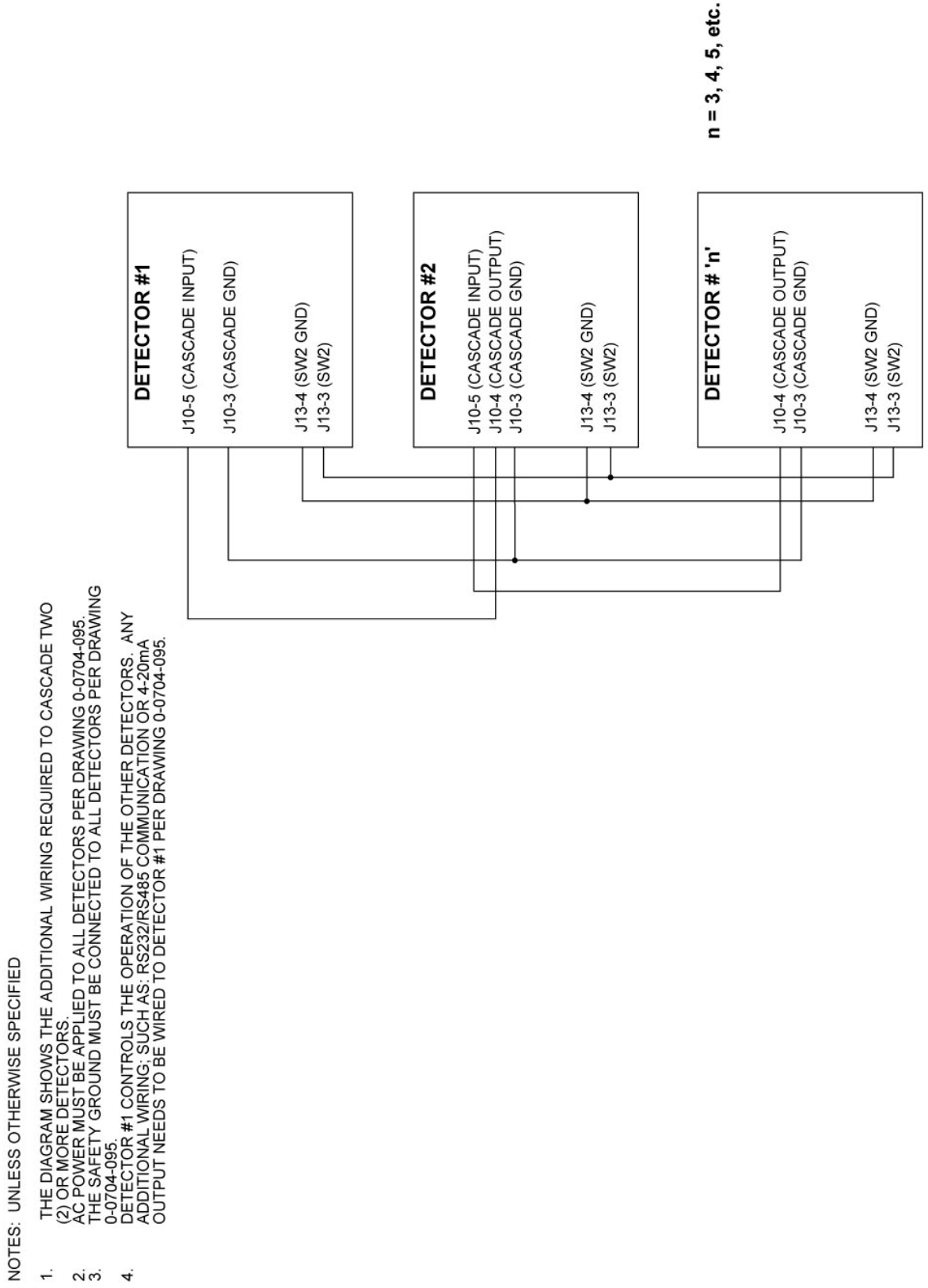


Figure C-9. 0-0704-097: Schematic, cascade wiring, Nitus (sheet 1 of 1)

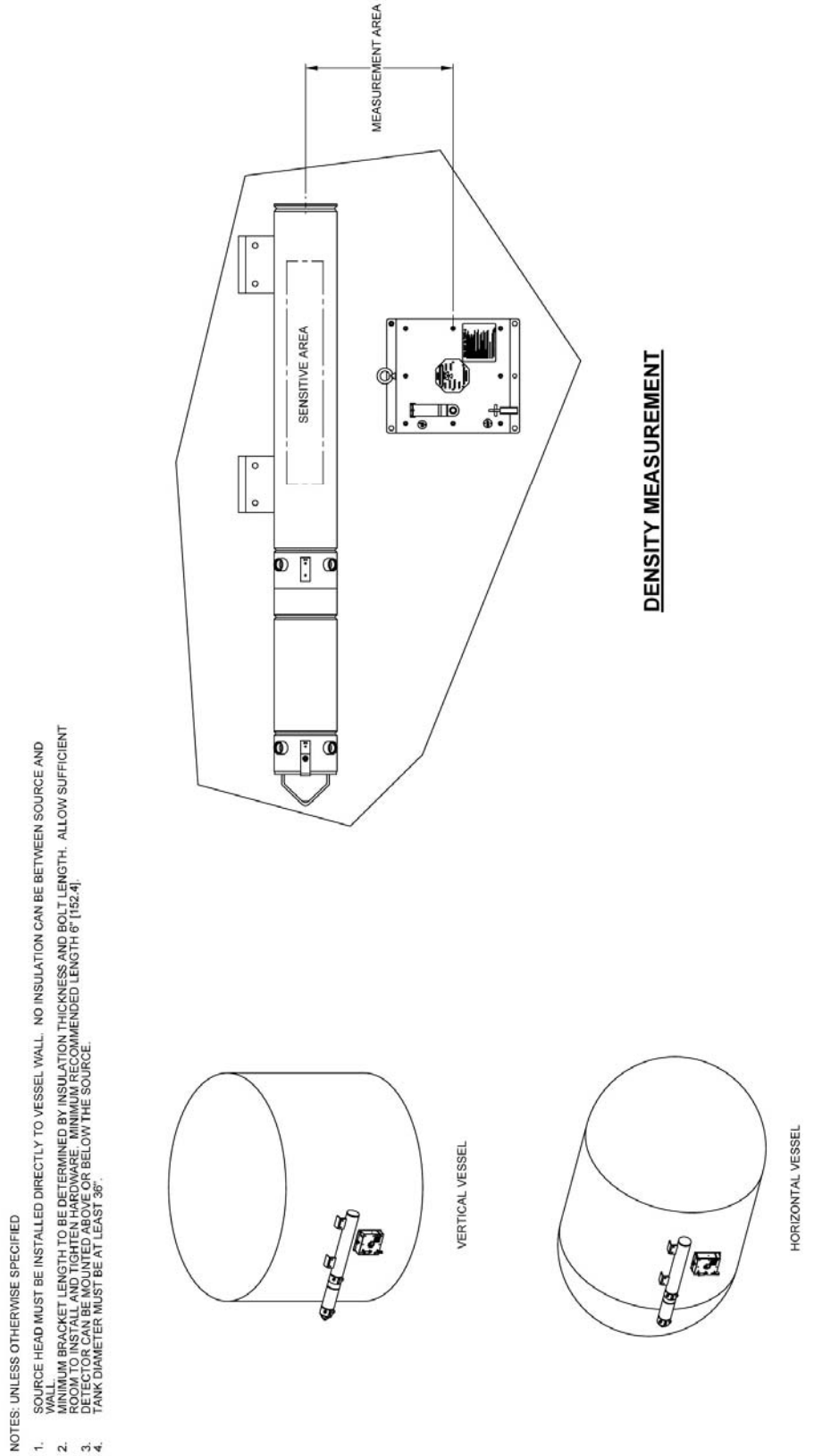
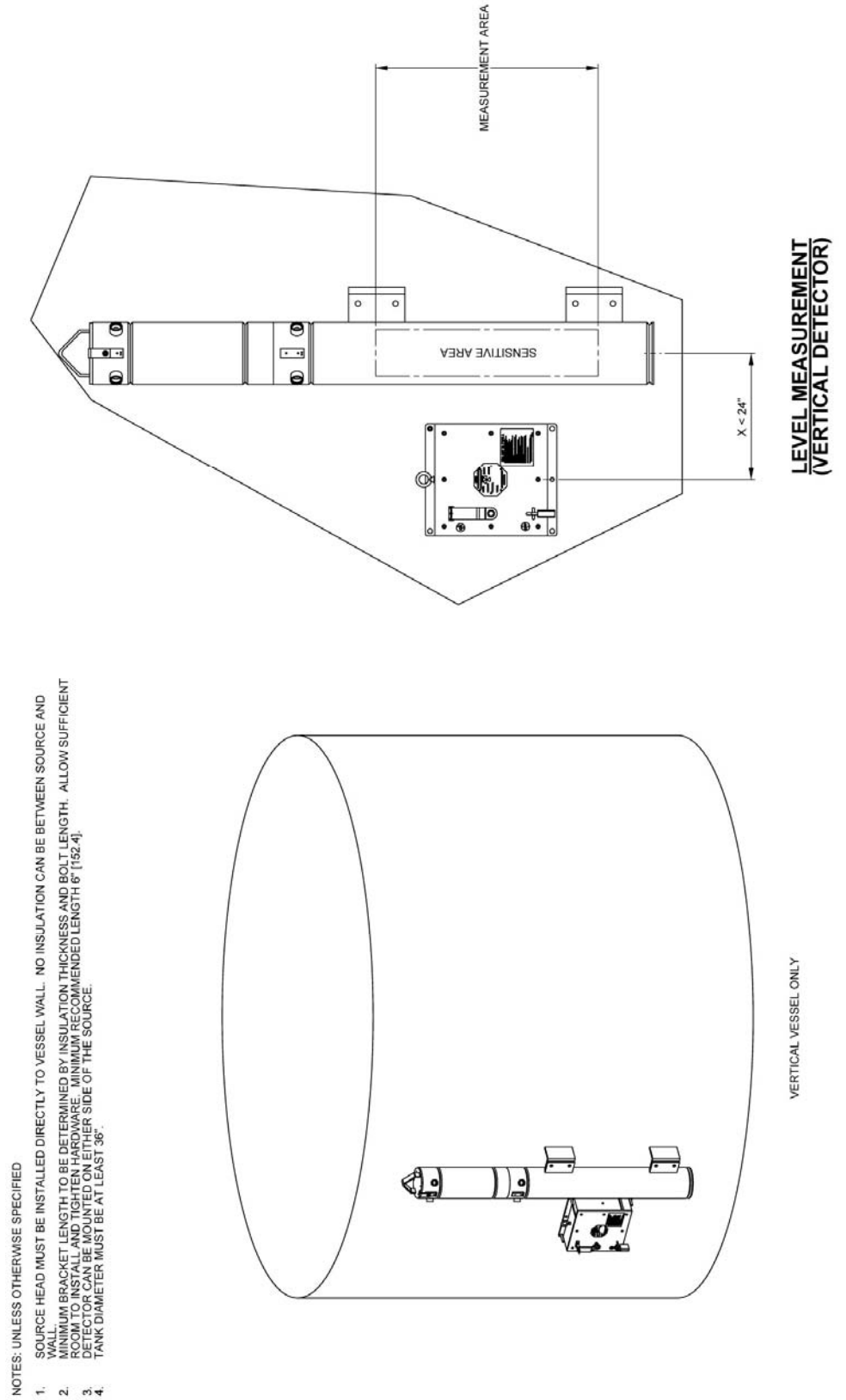
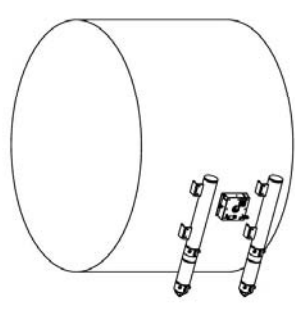


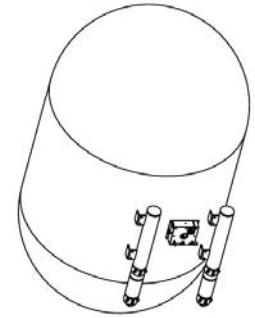
Figure C-10. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 1 of 7)



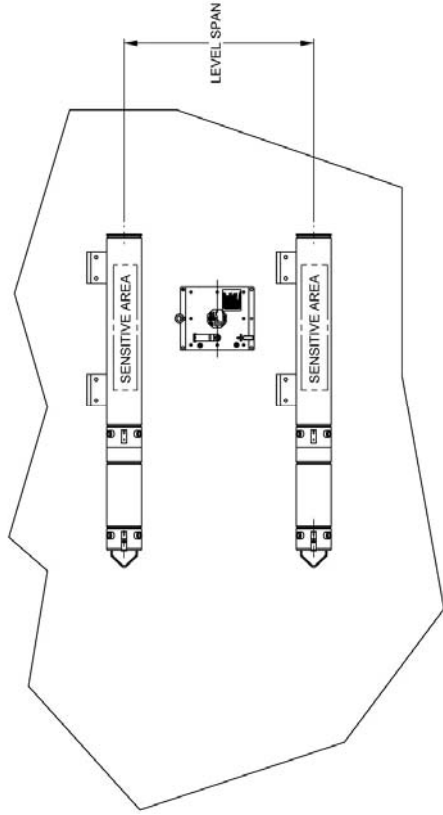
- NOTES: UNLESS OTHERWISE SPECIFIED
1. SOURCE HEAD MUST BE INSTALLED DIRECTLY TO VESSEL WALL. NO INSULATION CAN BE BETWEEN SOURCE AND WALL.
 2. MINIMUM BRACKET LENGTH TO BE DETERMINED BY INSULATION THICKNESS AND BOLT LENGTH. ALLOW SUFFICIENT ROOM TO INSTALL AND TIGHTEN HARDWARE. MINIMUM RECOMMENDED LENGTH IS 1 (152-4).
 3. TANK DIAMETER MUST BE AT LEAST 36".
 4. THE NUMBER OF DETECTORS (1 OR 2) DEPENDS ON THE LEVEL SPAN.



VERTICAL VESSEL



HORIZONTAL VESSEL



LEVEL MEASUREMENT
(HORIZONTAL DETECTOR(S))

Figure C-12. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 3 of 7)

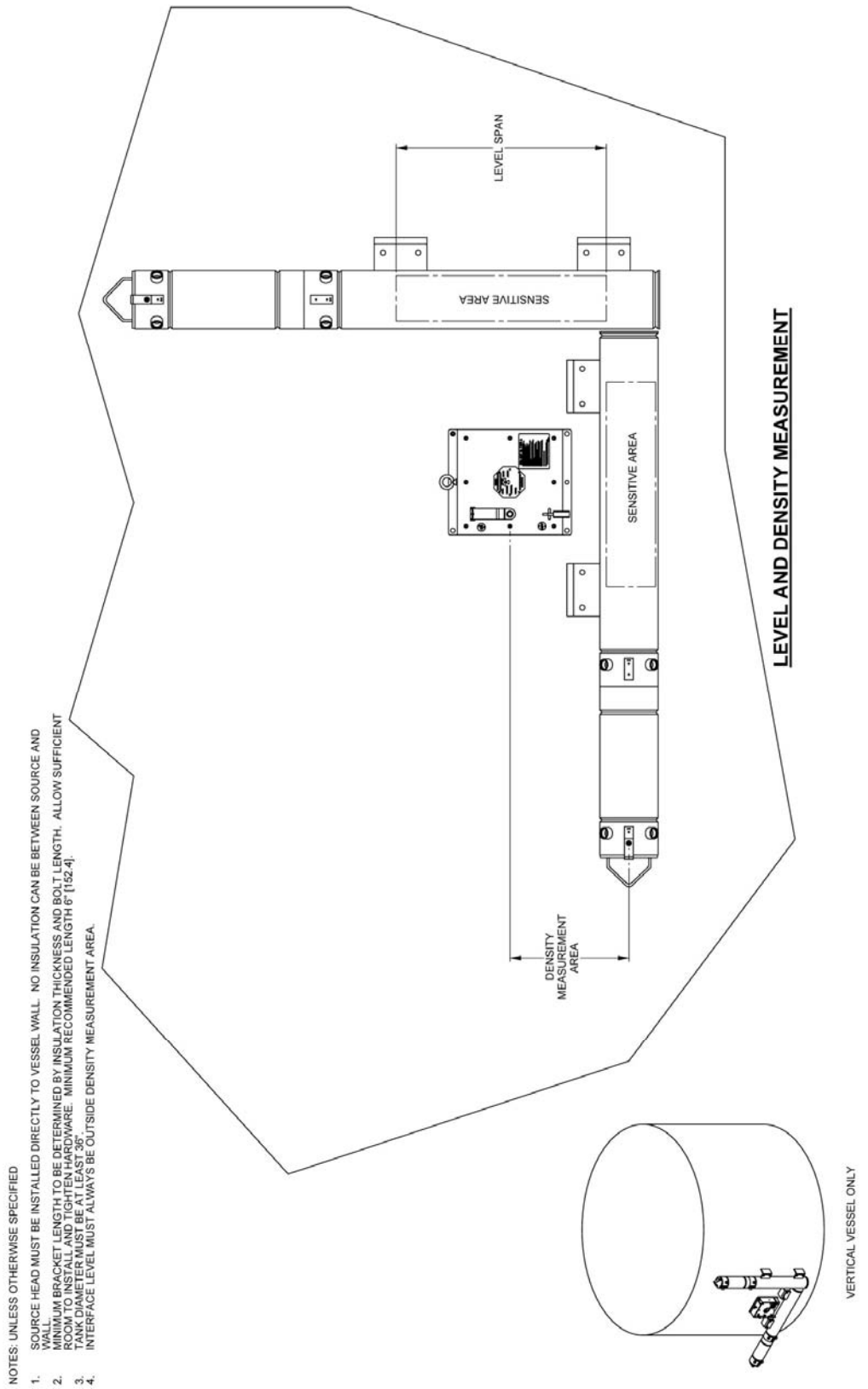
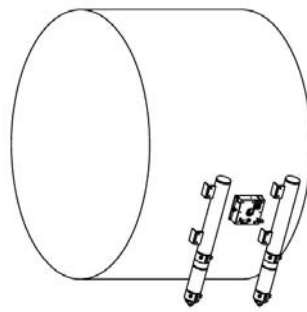
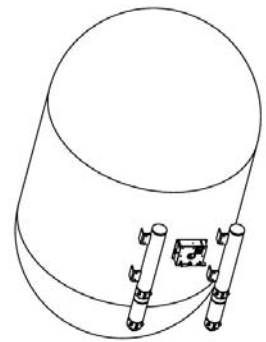


Figure C-13. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 4 of 7)

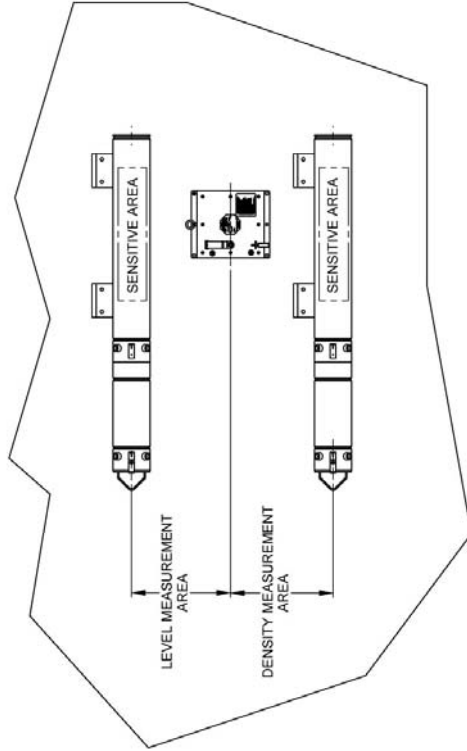
- NOTES: UNLESS OTHERWISE SPECIFIED
1. SOURCE HEAD MUST BE INSTALLED DIRECTLY TO VESSEL WALL. NO INSULATION CAN BE BETWEEN SOURCE AND WALL.
 2. MINIMUM BRACKET LENGTH TO BE DETERMINED BY INSULATION THICKNESS AND BOLT LENGTH. ALLOW SUFFICIENT ROOM TO INSTALL AND TIGHTEN HARDWARE. MINIMUM RECOMMENDED LENGTH IS [52.4].
 3. TANK DIAMETER MUST BE AT LEAST 36".
 4. INTERFACE LEVEL MUST ALWAYS BE OUTSIDE DENSITY MEASUREMENT AREA.
 5. DENSITY MEASUREMENT CAN BE THE TOP OR BOTTOM (SHOWN) PHASE.



VERTICAL VESSEL

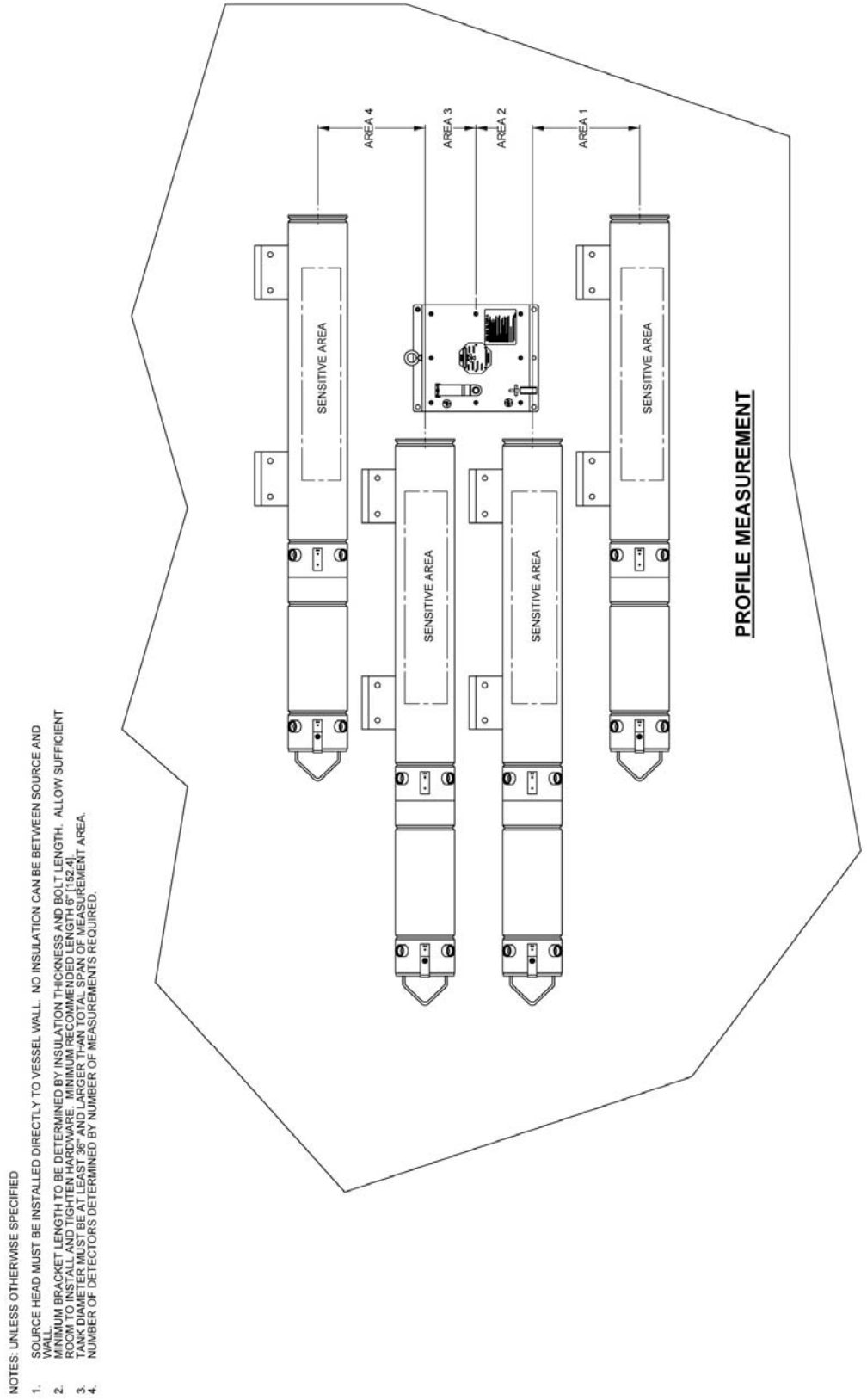


HORIZONTAL VESSEL



**DENSITY AND LEVEL MEASUREMENT
(HORIZONTAL DETECTORS)**

Figure C-14. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 5 of 7)



- NOTES: UNLESS OTHERWISE SPECIFIED
1. SOURCE HEAD MUST BE INSTALLED DIRECTLY TO VESSEL WALL. NO INSULATION CAN BE BETWEEN SOURCE AND WALL.
 2. MINIMUM BRACKET LENGTH TO BE DETERMINED BY INSULATION THICKNESS AND BOLT LENGTH. ALLOW SUFFICIENT ROOM TO INSTALL AND TIGHTEN HARDWARE. MINIMUM RECOMMENDED LENGTH 6" (152.4).
 3. TANK DIAMETER MUST BE AT LEAST 36" AND LARGER THAN TOTAL SPAN OF MEASUREMENT AREA.
 4. NUMBER OF DETECTORS DETERMINED BY NUMBER OF MEASUREMENTS REQUIRED.

Figure C-15. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 6 of 7)

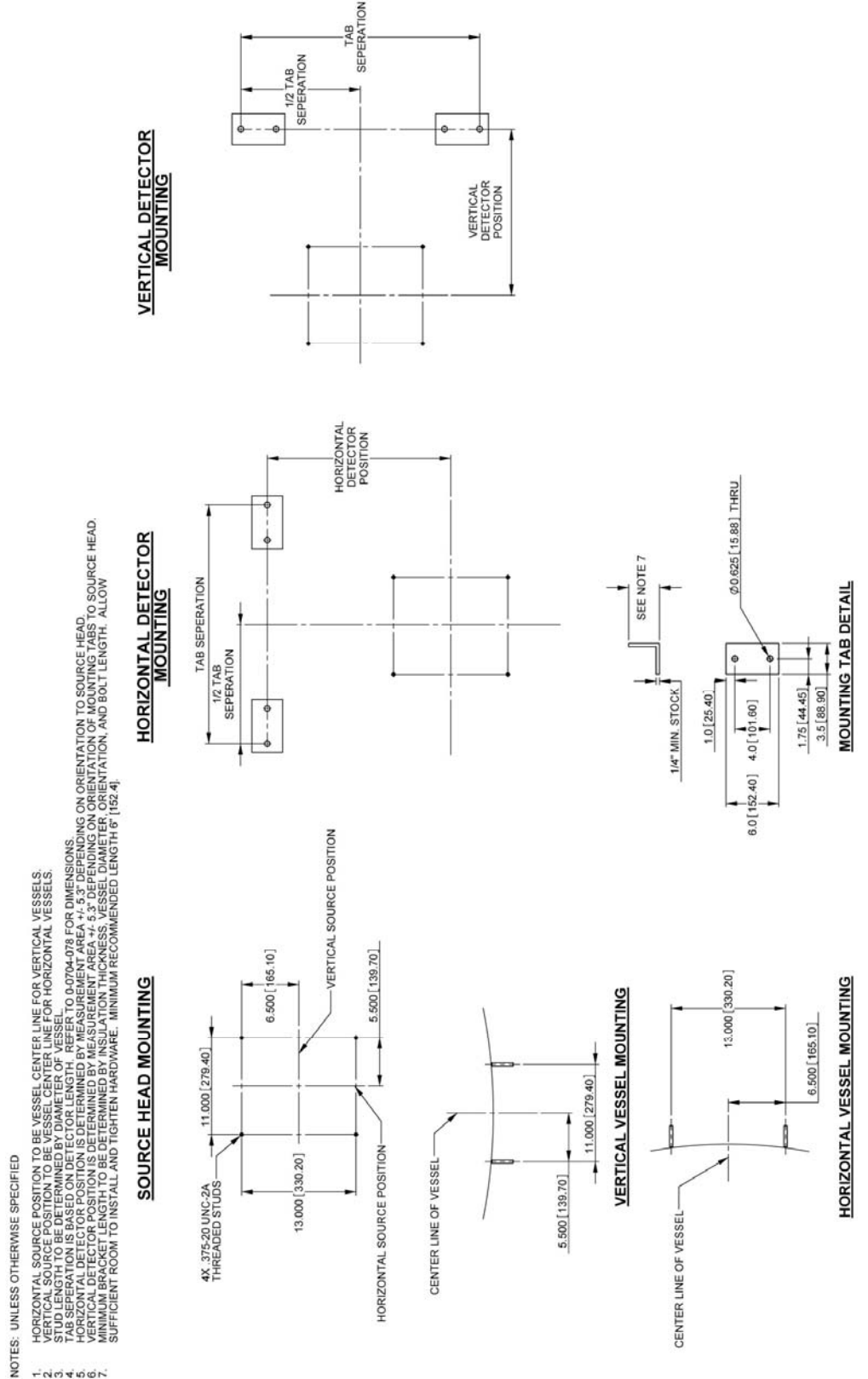


Figure C-16. 0-0704-098: Drawing, installation arrangement, Nitus (sheet 7 of 7)

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

www.thermofisher.com