User manual

Liquid level sensor with batteryless float support
LevelMaster 7100

Accurate and reliable measurement of storage tank liquid level for custody transfer and tank level management applications

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Typographical conventions

Element	Convention	Example
Cross-reference to a figure or table in the document	Hyperlink the figure or table label and number. If the figure or table is not immediately following the cross-reference, add the page number where it is located.	See Figure 2, or See Table 3 (page 12).
Cross-reference to a specific section in the document	Hyperlink both the section number and title, with the section title in italics	Go to section 2.1, *Device setup*.
Greater than character (>)	Indicates that the following item is an additional menu selection.	Use the key pad to locate and select **Calibrate** > **Diff. Press. Sensor** > **Calibration Units** > **Edit**.
Programs, including utility and accessory programs	Title capitalization	Microsoft Word
URL	All lowercase for a fully specified URL. If necessary, break long URLs before a forward slash or break a long URL before it begins	http://www.microsoft.com/ seattle.sidewalk.com
User input	Lowercase, unless case sensitive. Bold or italic, depending on element. If the user input string contains placeholder text, use italics for that text.	Type **Name tag**

Additional information

Additional free publications and user interface software for the sensor are available for download at www.abb.com/totalflow or by scanning this code:

Documents and user drawings for board part number 2104836	Part number
LevelMaster startup guide	2105836
LevelMaster upgrade kit application guide (required for batteryless float support)	2105824
XRC/XFC connected to LevelMaster	2105833
RMC connected to LevelMaster	2105831
RMC and serial converter connected to LevelMaster	2105832
Software	
MasterLink software version 2.0 (software)	2100197-005
Documents and user drawings for board with part number 2018546-005 (legacy board)	
LevelMaster startup guide	2103656
LevelMaster user manual	2018374
LevelMaster (2018546 BD) W/Barrier to RMC-100 (2105350) COMM (RS485) Drawing	2105583
LevelMaster (2018546 BD) W/Barrier to TFIO COMM Interface Module (RS-485) Drawing	2103686

1 Health and safety

1.1 General information and notes

For safe installation and operation of the product:

- Read instructions carefully prior to installation and commissioning. For reasons of clarity, the instructions do not contain details about all types of product and, therefore, do not take into account every conceivable assembly, operating, or maintenance scenario. For further information, or if specific problems arise which are not addressed in the instructions, please contact ABB. The content of these instructions is neither part of nor provided for changing a previous or existing agreement, promise, or legal relationship. All obligations on ABB result from the respective sales contract, which also contains the full and solely valid warranty clauses. These are neither limited nor extended by the content of these instructions.
- Read and comply with all safety, warning, and important notes throughout this manual to ensure safe operation and to maintain the product in a safe condition.
- The product, or other related options described in this manual, may include connections to high pressure equipment and may be located where there is corrosive media present. Serious injury and/or considerable damage can result if the product or options are handled incorrectly. Ensure compliance with the regulations applicable in the country of use when working with this product and options.

1.2 Safety, warning, and note symbols

DANGER – Serious damage to health / risk to life. This symbol, in conjunction with the signal word "DANGER", indicates an imminent danger. Failure to observe this safety information will result in death or severe injury. The text may state the hazard, how to avoid the hazard, and what the result would be if not followed.

DANGER – Serious damage to health / risk to life. This symbol, in conjunction with the signal word "DANGER", indicates an imminent electrical hazard. Failure to observe this safety information will result in death or severe injury. The text may state the hazard, how to avoid the hazard, and what the result would be if not followed.

WARNING – Bodily injury. This symbol, in conjunction with the signal word "WARNING", indicates a potentially dangerous situation. Failure to observe this safety information may result in severe injury. The text may state the hazard, how to avoid the hazard, and what the result would be if not followed.

WARNING – Bodily injury. This symbol, in conjunction with the signal word "WARNING", indicates a potential electrical hazard. Failure to observe this safety information may result in death or severe injury. The text may state the hazard, how to avoid the hazard, and what the result would be if not followed.

CAUTION – Minor injuries. This symbol, in conjunction with the signal word "CAUTION", indicates a potentially dangerous situation. Failure to observe this safety information may result in minor or moderate injury.

CAUTION – Equipment / Property damage. This symbol, in conjunction with the signal word "CAUTION", indicates a potentially damaging situation. Failure to observe this safety information may result in property damage. The text may state the hazard, what to do or not do to avoid the hazard, and what the result would be if not followed.

NOTICE – Tainted results / Loss of data. This symbol indicates a potential situation where data could be corrupted, samples could be contaminated, or normal operation could be effected if recommendations are not followed. The text may state the condition, how to avoid undesirable results, and what the result would be if not followed.

IMPORTANT NOTE: This symbol indicates operator tips, particularly useful information, or important information about the product or its further uses. The signal word "IMPORTANT NOTE" does not indicate a dangerous or harmful situation.

1.3 Safety requirements for installation

The LevelMaster operating voltage range is 9 Vdc to 15 Vdc. There are no hazardous voltages present.

WARNINGS – Bodily injury. For electrical connections, use sufficiently insulated tools, according to the EN 60900 standard.

This manual does not address all the requirements for the installation of products in hazardous (classified) locations. Refer to the ABB Certification (installation) drawing that is indicated on the unit name plate and local and national electrical codes for installation requirements in hazardous (classified) locations.

To avoid potential hazards associated with the sensor, comply with the following:

- Observe warning signs on the packaging and on the sensor.
- Installation, maintenance, and repairs of the sensor should only be performed by trained, qualified, and authorized technicians or specialists. Specific training and skills required include: training and instruction on the use, operation, and maintenance of devices with electrical circuits in general purpose locations and possibly in classified hazardous locations.
- Follow relevant national and local electrical code requirements and the certification (installation) drawing (listed on the name plate) shipped with the sensor.
- Removal of the enclosure cover in a hazardous location must follow guidelines stipulated in the certified (installation) drawing shipped with the sensor and the warnings as indicated on the various tags or on the cover(s).
- Connecting and disconnecting equipment in a hazardous location, for installation or maintenance of electric components, must follow guidelines stipulated in the certification (installation) drawing shipped with the sensor and the warnings as indicated on the various tags.
- Prevent impact or friction when handling the sensor during installation and maintenance. The enclosure contains either aluminium or stainless steel which may be a risk of ignition of the classified hazardous location if impact or friction occurs.
- Access to the sensor for local communication using the MasterLink cable must follow guidelines stipulated in the certification (installation) drawing shipped with the sensor and the warnings as indicated on the various tags.

IMPORTANT NOTE: Replacement or additional copies of the certification (installation) drawings are available from ABB.

2 System description

2.1 Overview

The Totalflow® LevelMaster is an Intelligent Digital Level Sensor and is designed for custody transfer accuracy in demanding level measurement applications, including, but not limited to, oil, gas, water, wastewater, flood warning and chemical applications. Figure 1 displays a typical LevelMaster installation.

The LevelMaster uses simple ASCII protocol for communications and, therefore, can be interfaced to nearly any host system. When used in conjunction with ABB Totalflow host controllers (remote controllers or flow computers), a wide range of data gathering and site automation applications are available.

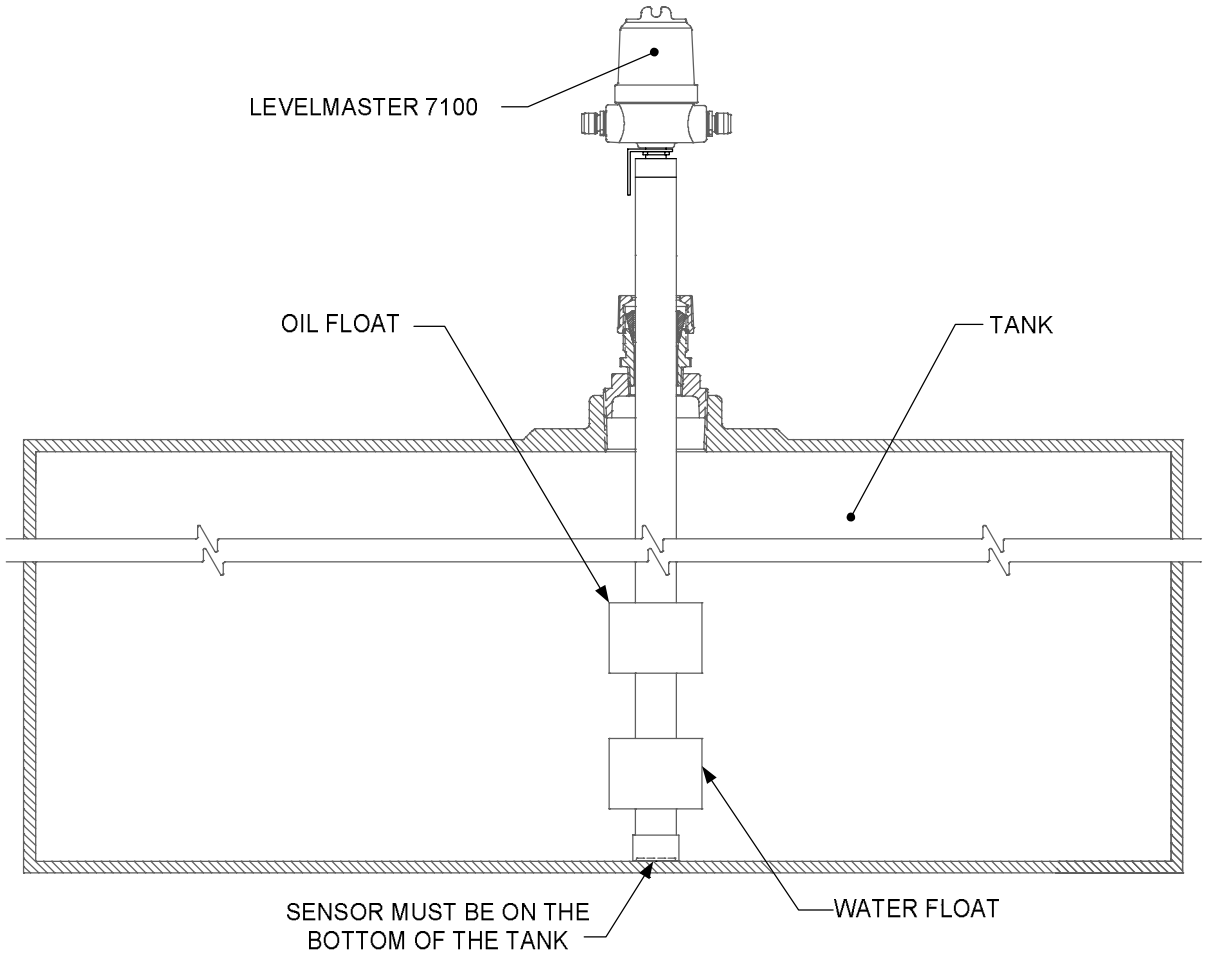

Figure 1: Typical LevelMaster oil and water tank installation

The LevelMaster consists of a sensor that sits on the bottom and extends through the top of a vessel. A reducer bushing and compression fitting can be provided for tanks with standard 3 inch or 4 inch diameter tank top ports. The LevelMaster can be adapted to nearly any type of vessel. The sensor tube can be any length from 2 to 25 feet. A small junction box with a screw-on cover sits atop the sensor tube. The junction box houses a small electronics board and is the termination point for the power and communication wiring.

2.2 General specifications

Table 1 describes the LevelMaster general specifications.

Table 1: General LevelMaster specifications

Power		
Supply voltage	9-15 Vdc	
Current	40 mA transmitting; 1 mA standby	
Power cycling	Available for optimal power management	
Environmental/Safety		
Operating temperature	Non-submerged	-20 °F to 185 °F (-29 °C to +85 °C)
	Submerged floats	26 °F to 185 °F (-3 °C to +85 °C)
CSA-approved for intrinsically safe operation	Class 1, Div 1, Group D	4 level sensors max / barrier
	Class 1, Div 1, Group C and D	3 level sensors max / barrier
Measurement		
Range (depth)	2 - 25 feet (0.6 to 7.6 meters) in 1 foot (0.31 meters) increments	
Relative level accuracy	+ 0.1 inches (2.5 mm) Optional: + 0.05 inches (1.25 mm)	
Level resolution	+ 0.01 inches (0.25 mm)	
Level repeatability	+ 0.05 inches (1.25 mm)	
Temperature sensor accuracy	+ 1.8 °F (1.0 °C)	
Temperature sensor range	0 °F to 185 °F (-17.7 °C to 85 °C)	
Pressure	Non-pressurized tanks: single or dual floats **Note**: No SSTL, No high pressure supported	
Single surface float specific gravity (at 68 °F)	0.41 (3 inch diameter), 0.60 (2.85 inch diameter)	
Oil float specific gravity (at 68 °F)	0.47	
Water float specific gravity (at 68 °F)	0.91	
Emulsion float specific gravity (at 68 °F)	0.75	
Materials and dimensions		
Casing material	Fiberglass or stainless steel (pressurized tanks)	
Casing outer diameter	1.95 inches (48.5 mm)	
Float outer diameter	3.17 inches (80.5 mm) (2.85 inch single float on request)	
Reducer bushing and compression fitting	Fits standard 3 and 4 inch (10.16 mm) tank port	
Temperature sensor location	12 inches (300 mm) from bottom of sensor (other locations possible)	
Communications		
Output	Standard digital serial half duplex RS-485, ASCII protocol	
Speed (baud rate)	1200, 9600, 19200 bps	

2.3 LevelMaster components

2.3.1 Sensor assembly

The LevelMaster measures both tank fluid level and fluid temperature. The sensor assembly or coil assembly consists of a rod with wound conductive wire througout the length of the rod. The temperature sensor is installed on the rod as well. The coil assembly is an internal component and is installed inside the casing. The casing has the same length as the coil assembly. A ribbon cable and connector on the top of the coil assembly provide the connection to the electronics board.

The sensor casing or tube is manufactured with different materials, depending on the corrosiveness of the fluid. These fluids include, but are not limited to: culinary water, oils, solvents, or acids.

2.3.1.1 Level sensor

Level sensing involves the coil assembly and the float(s). The coil assembly senses the movement and position of the floats as they slide up or down the casing when the fluid level increases or decreases. The signal generated from this interaction is read by the electronics board and processed to determine the actual fluid level in units of length.

2.3.1.2 Temperature sensor

Temperature is provided along with fluid level readings. A standard configuration includes one temperature sensor located 12 inches (304.8 mm) from the bottom of the sensor tube which reads accurately to within 1 °F (0.6 °C).

2.3.2 Floats

Level(s) are sensed by the movement of one or two floats which slide up and down the sensor casing as the fluid level changes. Two floats are used when the vessel contains fluids with two different densities such as oil and water. Each float will accurately measure the level of its respective fluid over the full vertical range of the sensor tube with a relative accuracy to the nearest ± 0.1 inch (2.5 mm), optional ± 0.05 inch (1.27mm).

Floats have an outer material that can withstand most solvents and chemicals.

2.3.1 Electronics board

The electronics board is installed inside of the enclosure or junction box assembled at the top end of the unit. The board stores the configuration of the unit, calibration data and measurement data. The board is connected to the sensor assembly.

The board is the termination point for power and communications through its onboard ports. The onboard port(s) provide the power and communication connection points to operate the LevelMaster. Depending on the board type, there may be a single connector handling both power and communications or two separate connectors for each. The ports have terminal connectors that are removable for convenient field wiring.

IMPORTANT NOTE: Access to the onboard ports for wiring or local connection requires removal of the enclosure cover.

2.3.1.1 Sensor port

An onboard 16-pin port provides the connection point for the sensor assembly ribbon cable and connector. The cable is run through the neck of the enclosure from the sensor to the board. The onboard connector is keyed for correct one-way insertion of the sensor cable connector. The cable can be unplugged as needed for sensor testing or board replacement or reconfiguration during troubleshooting or maintenance procedures.

2.3.1.2 Power port

The onboard power port provides the connector to supply power to the LevelMaster. The power port supports connections to:

— An external power supply or

— ABB Totalflow control or measurement equipment such as remote controllers and flow computers.

2.3.1.3 Serial communications (RS-485) port

The onboard serial port is used for communication with other devices. The LevelMaster uses RS-485 hardware protocol and standard ASCII softfware protocol to communicate at speeds of 1200, 9600, and 19200 bps.

The RS-485 port supports connections to:

— A laptop or PC: for direct communication for local operator setup or monitoring or measurement data

— Additional LevelMasters when daisy-chained as part of an RS-485 bus

— ABB Totalflow remote controllers and flow computers supporting the ASCII communication protocol

IMPORTANT NOTE: Wiring distance from the LevelMaster to a host controller is limited by RS-485 specifications and by the use of safety barriers required in hazardous locations. For details see Table 5, *Wiring limits on the RS-485 bus*, and Table 6, *Wiring limitations when using barrier boards*.

2.4 Software interfaces

The user interface used to configure, monitor, and calibrate the LevelMaster is the MasterLink software. MasterLink is a Windows®-based application that can be installed in the operator's PC or laptop and is used to communicate directly to the MasterLink after installation. Its main purpose is to provide direct connection to the device for basic parameter configuration, measurement reading verification, and calibration.

The software interface used to collect and monitor the LevelMaster measurement readings when connected to the ABB Totalflow host controller is PCCU32. PCCU32 is the common user interface for the ABB Totalflow remote controller and flow computer family of products.

2.4.1 Using MasterLink

MasterLink is the user interface for local configuration (setup) and monitoring of the LevelMaster. It has been developed specifically for the setup and calibration of the LevelMaster after installation.

IMPORTANT NOTES: MasterLink version 2.0 and later include default files for all sensor lengths supported by legacy and newer LevelMaster electronics boards. If performing an upgrade or hardware replacement, and if the existing configuration file is not available, a file for the appropriate length can be located in the MasterLink folders and used to update the unit.

MasterLink version 2.0 is required for support of batteryless floats and for LevelMasters with board part number 2104836.

MasterLink is used to accomplish the following:

Basic configuration

- Configuration of unit ID
- Configuration of Baud rate

Advanced configuration

- Software configuration of RS-485 bus termination for boards part number 2104836-001 (last or only sensor, and intermediate sensor on the bus)
- Reconfiguration after hardware change or part replacement (electronics board or sensor replacement, float change)
- Back up configuration and data (data stored in the LevelMaster memory can be saved to a file and stored in a laptop to avoid loss)
- Restore configuration and data (backup file can be sent to the LevelMaster to restore or reconfigure the unit)

Monitoring

- View current measurement values (level and temperature)
- View status
- View configuration

Testing

- Available for advanced users or technical support for troubleshooting

Calibration

- Level calibration or bias if accurate level measurements, taken manually, are available

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IMPORTANT NOTE: When the LevelMaster is connected to an ABB Totalflow remote controller or flow computer, calibration must be done from PCCU.

2.4.2 Using PCCU32

PCCU32 is the primary interface for the family of ABB Totalflow host controller products. It is used to configure the controller to be able to support communication with the LevelMaster. A special purpose application, the LevelMaster application, is activated within the controller to request, receive, display, and store measurement data from the sensor.

IMPORTANT NOTE: PCCU32 versions 4.1 and higher support the LevelMaster application.

PCCU is used to accomplish the following:

- Activation and configuration of the LevelMaster application in the host controller
- Data collection and display for up to eight LevelMasters
- Gross volume calculation for up to eight tanks using tank strapping table inputs.
- Terminal connection over the local communications port.
- Data trending through the Trend System application
- RAMS-configurable alarms, alarm by exception and alarm cry-out.
- Selectable tank data display and storage units for collected levels, temperature, and volume data. Units may be selected using PCCU32, WinCCU or MODBUS® protocol.
- Power duty cycling for power conservation through digital outputs using the I/O system application.
- Push-to-Read display to allow a view of selected data on the LCD display
- Level calibration or bias

IMPORTANT NOTE: Configuration of the flow computer or remote controller to support LevelMaster can also be done using WinCCU. WinCCU supports a remote configuration utility which provides the same configuration functionality as PCCU. Collection of the LevelMaster data stored in the flow computer or remote controller is also supported from WinCCU and other ABB Totalflow software applications.

2.5 Installation scenarios

The LevelMaster can be installed in several different field configurations. The choice of configuration depends on the site requirements, measurement data gathering requirements, and the level of automation and control required.

The scenarios described in this section apply to both the general-purpose (non-hazardous) and hazardous location installations. Hazardous locations require an additional component in the installation: an intrinsically safe barrier also available for purchase from ABB.

2.5.1 Installation with host control

The LevelMaster installation with host control consists of a single or multiple LevelMasters (on an RS-485 bus) connected to a host controller (Figure 2). The host controller can be either an ABB Totalflow host controller or a third-party controller which supports standard RS-485 communication and ASCII protocol.

When connected to any of the ABB Totalflow host controllers (flow computers or remote controllers), options for automated measurement data retrieval, level control, and monitoring become available. Totalflow host applications such as PCCU32, WinCCU32, and TDS32 can be configured to communicate with the LevelMaster (using ASCII protocol) for data-gathering and reporting.

Power to the LevelMaster can be provided from the host controller or from an external power supply. When powering from the controller, power can be available from the same RS-485 port used for communication. ABB Totalflow flow computers or remote controllers, for example, offer power from the COMM ports.

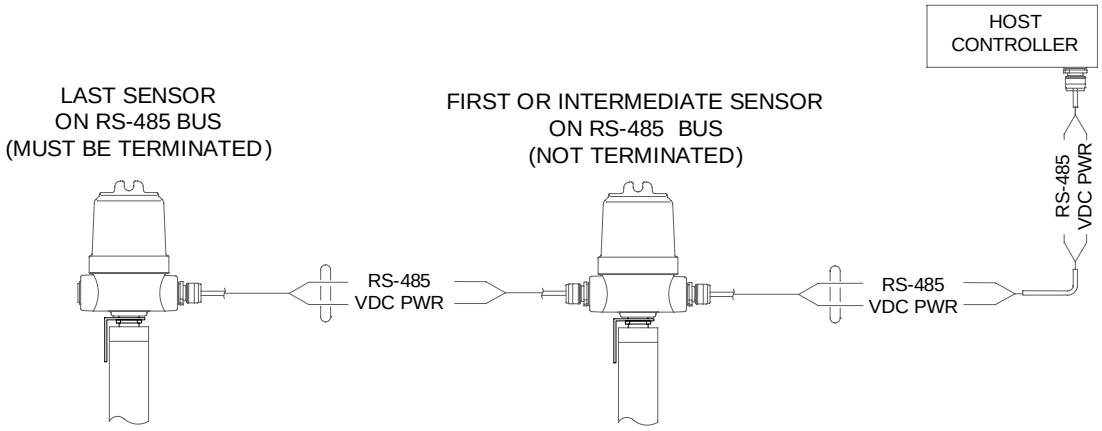

Figure 2: Typical LevelMaster configuration for general-purpose locations

2.5.2 Hazardous location installation (with barrier board)

The LevelMaster installation in a hazardous location consists of a single or multiple LevelMasters (on an RS-485 bus) connected to a host controller through an intrinsically safe barrier board (Figure 3). No direct connection to the LevelMaster(s) is allowed in the hazardous area. Connecting a laptop for local monitoring or data retrieval should also be done through the barrier.

Power the LevelMaster from the host controller or from an external power supply. If using an external power supply, connection must also be done through the barrrier.

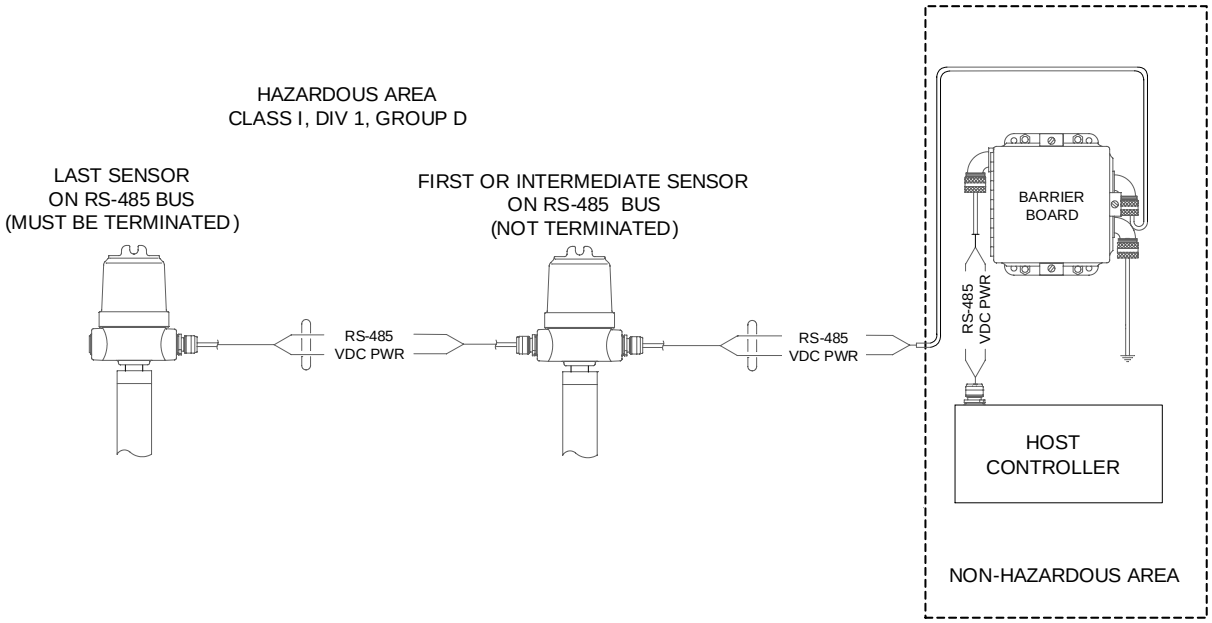

Figure 3: LevelMaster configuration example for a hazardous location

2.5.3 Installation with optional high level auxiliary switch

The high level auxiliary switch is an optional component for installation. This additional switch can be installed with the LevelMaster to function as an auxiliary shutdown switch. The switch is a float-type switch that can be configured in the field to function as normally open or normally closed. The switch comes in four configurations based on the distance from the top of the tank to the float switch location: 12, 16, 24 and 36 inch. Figure 4 shows the 12-inch switch assembly.

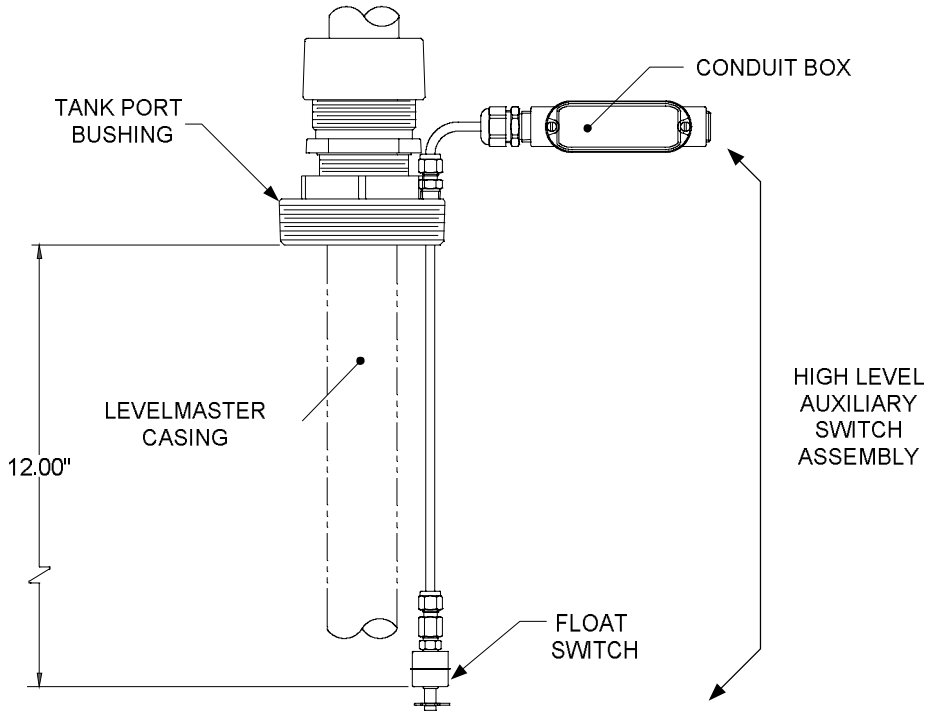

Figure 4: Installation with high level auxiliary switch (12-inch option)

3 Installation

This section provides information and procedures for the LevelMaster installation. Instructions provided in this section are designed for a typical installation. Although there may be other methods of installation, it is recommended that technicians perform the procedures in the order presented in this manual.

IMPORTANT NOTE: Read through this chapter before beginning installation and establish an installation strategy. For safety installation requirements make sure to review section 1.3, *Safety requirements for installation*. It is very important to refer to any instructions, drawings or wiring diagrams that are included with the LevelMaster. The detail part of any assembly will typically use the documentation that accompanies the unit. If a discrepancy exists between this manual and documentation that accompanies the unit, the unit's documentation will take precedence.

3.1 Site planning and requirements

Review the planning considerations and requirements for installation described in this section.

3.1.1 Installation options

There are several configuration options to install the LevelMaster. Before starting the installation, verify which configuration is required to ensure that all components are available and that proper guidelines are followed. See section 2.5, *Installation scenarios* for descriptions.

The two main installation scenarios are the general purpose installation and the hazardous location installation. The main difference between the two types of installation is the additional safety barrier required for the hazardous locations (see section 3.1.4, *Hazardous locations installation requirements*). Both types of installation typically have the following:

— LevelMaster: single or multiple LevelMasters (multiple units connected on an RS-485 bus)

— A control system (host controller): a flow computer or remote controller used for automation and level control

IMPORTANT NOTE: The installation and configuration of the host controller (remote controller or flow computers) is beyond the scope of this manual. Only pertinent details to their interface and communication configuration with the LevelMaster are included in this manual. Refer to the user manual and the help files in PCCU32 for details. If using third-party control equipment, consult their respective user manuals.

3.1.2 General planning

Before installing the LevelMaster(s) determine the following:

— Company and site-specific policies regarding access to the tank(s) and connection to the LevelMaster once it is installed inside of the tank. Local operator connection to the installed LevelMaster may be required for final verification or initial monitoring or troubleshooting. Follow company safety guidelines and procedures applicable to local connections and physical access.

— Number of technicians required to install the unit and conduct the commissioning efficiently. Installation may require more than one person depending on the height of the tank (length of the sensor), the weight of the unit, and the distance to additional units in other tanks and to other devices (flow computers, remote controllers).

3.1.3 General purpose installation requirements

The following is required for first-time installation:

— The appropriate number of floats and type: Float number and type vary depending on the liquid type or composition. Order the appropriate float kit, if it was not shipped with the sensor. LevelMasters with batteryless floats require electronics board part number 2104836-001 or later.

— When planning to connect to additional units on an RS-485 bus, determine which units to configure as intermediate sensors and which unit terminates the bus. RS-485 bus termination may be configured on hardware (onboard termination pin jumpering) or on software depending on the type of electronics board on the LevelMaster. Jumper-based termination requires access to the board. Ensure it is done prior to board installation or while the enclosure is still removed.

— MasterLink software version 2.0 or later can be used for all board versions and it is required for support of batteryless floats. It contains default or generic configuration files for every sensor length available.

— When connecting to Totalflow equipment (flow computers or remote controllers), PCCU32 software is required. Adding and setting up the LevelMaster application is required for communication between the Totalflow devices and the LevelMaster.

3.1.4 Hazardous locations installation requirements

In addition to general requirements in section 3.1.3, above, the installation and grounding of the LevelMaster in hazardous locations require the following:

— Intrinsically safe Totalflow CSA-certified barrier board

— Grounding must meet the requirements as specified in the National Electrical Code (NEC) or the Canadian Electrical Code (CEC).

LevelMaster sensors are CSA-certified for installations in hazardous locations when connected through Totalflow CSA-certified barrier boards in accordance with the Totalflow certification drawings (see Figure 5).

— Class 1, Division 1, Group D when connected through Totalflow CSA-certified barrier boards. One barrier board supports up to four level sensors, with a maximum distance of 500 feet.

— Class 1, Division 1, Group C, D when connected through Totalflow CSA-certified barrier boards . One barrier board supports up to three level sensors, with a maximum distance of 500 feet.

IMPORTANT NOTE: Figure 5 shows the barrier enclosure (not the actual barrier board). The barrier board required depends on the location classification. Two board options are available for Class 1, Division 1 locations. For Group D, barrier boards must be part number 2100336-001. For Group C and D, barrier boards must be part number 2100336-002. Barrier boards are sold with their enclosure. Replacement barrier board kits are also available. Contact ABB for details.

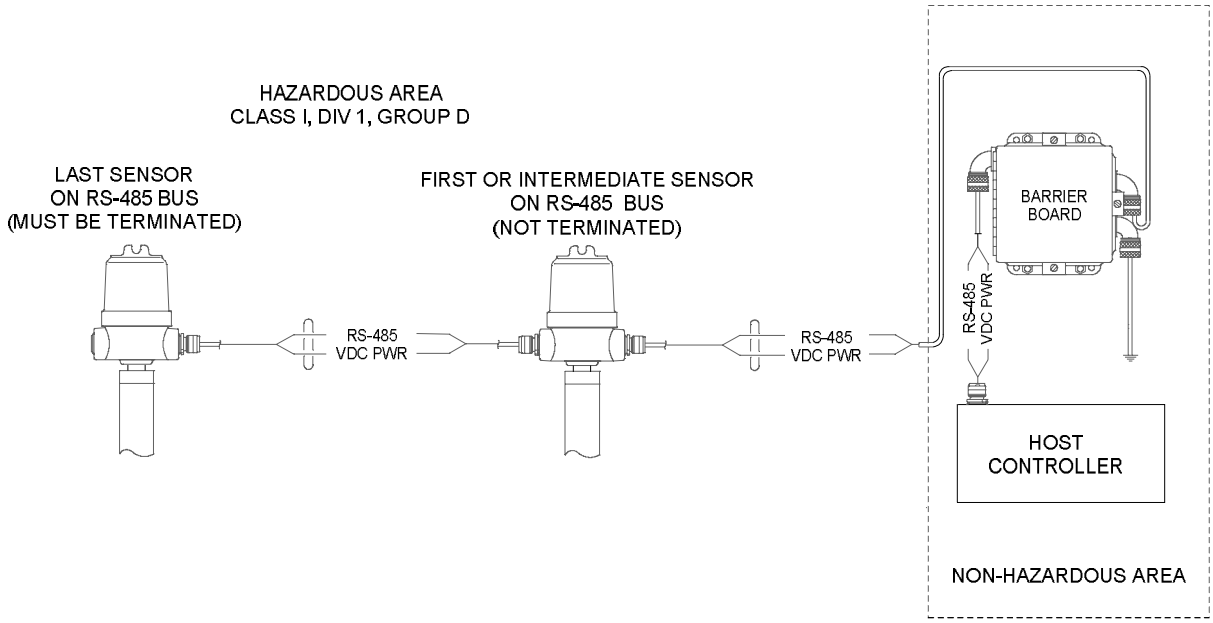

Figure 5: LevelMaster Group D hazardous location installation

3.2 Unpack and inspect

The LevelMaster is shipped in a specially designed shipping carton which contains the sensor unit, electronics board with enclosure, mounting components, parts list, wiring and interconnect diagrams. If an intrinsically safe barrier is provided, it and its associated hardware are shipped in a separate carton.

IMPORTANT NOTE: If there is any damage to the shipping carton, keep the carton and packing materials until the contents are inspected and found to be damage-free.

1. Inspect all of the shipping cartons for damage.

2. Carefully unpack and remove the items from each carton and inspect for damage:
   a. The exterior of the individual components for dents, chipped paint, etc.
   b. The sensor wiring harness for damage or breakage
3. Open the electronics enclosure by removing its cover.
   a. Visually inspect the electronics board and cables for damage.
4. Compare the packing list with the materials received. Check for missing or incorrect parts.
5. To report any discrepancies, call the ABB office listed under *Contact us* on the back cover of this manual.

IMPORTANT NOTE: Do not return equipment to ABB without prior written consent. Returns are subject to the terms and conditions specified by ABB.

3.2.1 Damaged components

If any components have been damaged or if there are noticeable defects, notify an ABB representative. Keep all shipping materials for the carrier's inspection. ABB will arrange for immediate repair or replacement; see the *Contact us* section located on the last page of this manual.

3.2.2 Parts list

Figure 6 depicts each component of the fully assembled LevelMaster as required for installation. The figure shows a typical oil and water application that requires two floats. Some applications will measure only one medium and will use only one float. Use this figure as a reference to identify the required parts.

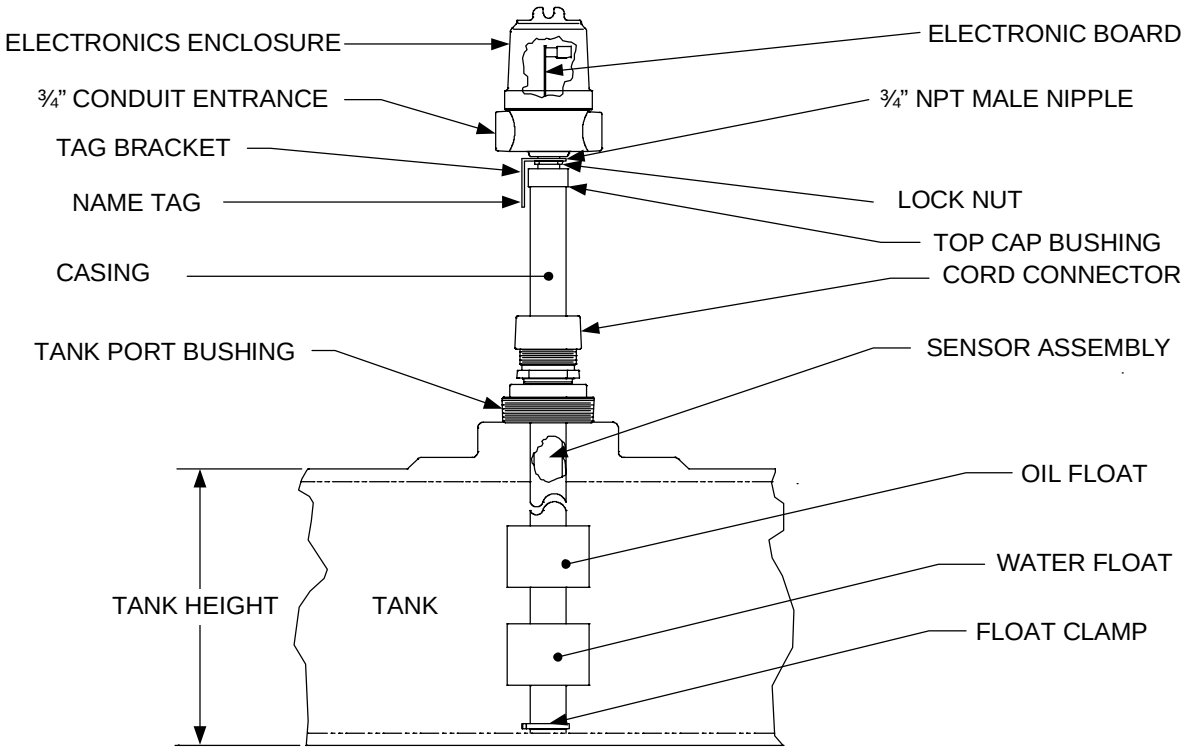

Figure 6: LevelMaster components in typical installation

Table 2 describes the LevelMaster parts list. The list is for the convenience of those who receive the LevelMaster in a kit form. Some parts may be connected to, or already installed in, other individual parts, but should be accounted for before starting the installation.

IMPORTANT NOTE: Components and replacement kits with other part numbers may be available. Contact ABB for additional details or if the list provided does not meet the site requirements.

Table 2: LevelMaster parts list

Qty	Part name	Description	Part number	Notes
1	Sensor assembly	Sensor coil assembly Shipped inside of the casing. It has the same length as the casing. It has a ribbon cable coming out one end terminated with a 16-pin connector.	Number is different for each sensor length supported.	The sensor assembly must remain inside the casing to avoid damage to the coil.
1	Electronic enclosure	Approximately 3 ½ inch diameter x 6 inch long with a screw-on cover	None	Houses the electronics board
1	Top cap	Aluminum bushing that screws on to the top of the casing, leaving a ¾ inch NPT threaded female opening	None	
1	Nipple	¾ inch pipe nipple located between the top cap bushing and the electronics enclosure	None	
1 or 2	Float	1, 2, or 3 inch diameter	Number is different for each type of float	Float types: passive or active (inlcuding batteryless) Liquid type: Oil or water Two floats are required for an oil and water application.
			2018392-017	Batteryless float kit requires board with part number 2104836-001. Oil level float part number 2103766-006 Water level float part number 2103766-007
1	Electronic headboard	Approximately 2 ½ inch x 4 inch. It may be shipped inside the electronics enclosure.	2104836-001	Firmware version 7.0 Required for batteryless floats Supports all existing types
			2018546-005	Legacy part is available while supplies last.

3.2.3 Optional parts list

Table 3 describes optional parts used in LevelMaster installations.

Table 3: LevelMaster optional parts list

Qty	Part name	Description	Part number	Notes
1	Installation clamps	Aid in the assembly and installation of LevelMasters received as a kit	1801393-001	
1	Tank port bushing	3 inch NPT male x 2 inch NPT female reducer bushing or 4 inch NPT male x 2 inch NPT female reducer bushing, depending on the tank port opening size	1291003-023 (3 inch) 1291003-024 (4 inch)	Mounting kit to secure unit to the tank
1	Cord connector	2 inch NPT male cord connector that screws into the tank port bushing	1291026-008	

Qty	Part name	Description	Part number	Notes
1	Barrier assembly	Electrical barrier required if the LevelMaster is installed in a Division 1 or 2 hazardous area	2100339-003 (Group D) 2100339-004 (Group C and D)	Includes barrier board and enclosure Part numbers for barrier board only: For Group D: 2100336-001 For Group C and D: 2100336-002 Replacement kits available Required for installations in hazardous locations
1	High level switch	A float type switch that can be ordered in a 12, 16, 24 or 36 inch version which is the distance below the tank port bushing	Vary depending on length	Available for 4 inch tank port bushing only (part number 100164-001)
1	MasterLink communication cable	Combination of an RS-485-to-RS-232 converter cable and adapter used for the local connection of a laptop or PC to the LevelMaster	*See* Table 4*, Cables and adapters for direct connection to the LevelMaster*.	Required when using the MasterLink software for setup and local operation. Additional USB-to-serial converter may be required for modern laptops.

3.2.4 Cables for local connection

Table 4 describes converter cables and adapters required for direct or local connection to the LevelMaster. Local connection is required for installation and startup configuration. Because of board design differences, the choice of the cables and adapters depends on the board part number. Verify that the correct cable and adapter are available for the installation.

IMPORTANT NOTE: Variations of cable types with other part numbers may be available. Contact ABB if the list provided in Table 4 does not meet the site requirements.

Table 4: Cables and adapters for direct connection to the LevelMaster

Board	Description	Part number	Notes
2104836-001 (new)	Cable adapter	2100250-002	Cable end connecting to the board has a 2-position terminal connector for power and a 4-position terminal connection for the communication port (RS-485)
	RS-485-to-RS-232 Converter cable	2100241-005	6 feet long, contains 1 battery (9 Vdc) See Figure 7.
2018546-005 (legacy)	Cable adapter	2100250-001	Cable end connecting to the board has a single 6-position terminal connector for both power and the communication port
	RS-485-to-RS-232 Converter cable	2100241-002	6 feet long, contains 2 batteries (9 Vdc) See Figure 8.
Both boards	RS-232-to-USB converter cable	1801382-001	Digi® Edgeport/1 USB Converter Must be used if connecting to a USB port on a laptop (if legacy RS-232 ports are not available on the laptop)

IMPORTANT NOTE: In locations where there may be a mix of board types, make sure cables and adapters for both, legacy or newer, board types are available. Always ensure to carry extra fully charged 9 Vdc batteries for the cables if needed. Review section 5.2.1, *Preparing cables for local connection*, to prepare to establish local communication for configuration.

Figure 7 shows the cable converter and adapter required for connection to board part number 2104836-001.

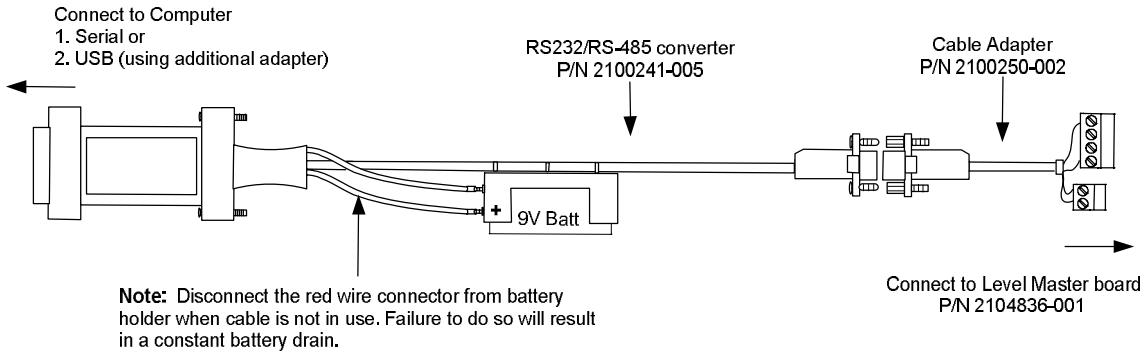

Figure 7: MasterLink communication cable (for boards with part number 2104836-001)

CAUTION – Equipment damage. The RS-485-to-RS-232 converter cables have 1 or 2 batteries (9 Vdc) which supply power to the boards during direct connection. No additional voltage source is required during direct connection for configuration.

Do not use two batteries to supply power to boards with part number 2104836-001. The boards will be damaged when the supplied power is greater than 15 Vdc (2 fully charged 9 Vdc batteries can supply up to 18 Vdc).

To prevent battery drain when converter cables are not in use, make sure the red wire is removed from the positive terminal contact on the battery holder.

Figure 8 shows the cable converter and adapter required for connection to board part number 2018546-005.

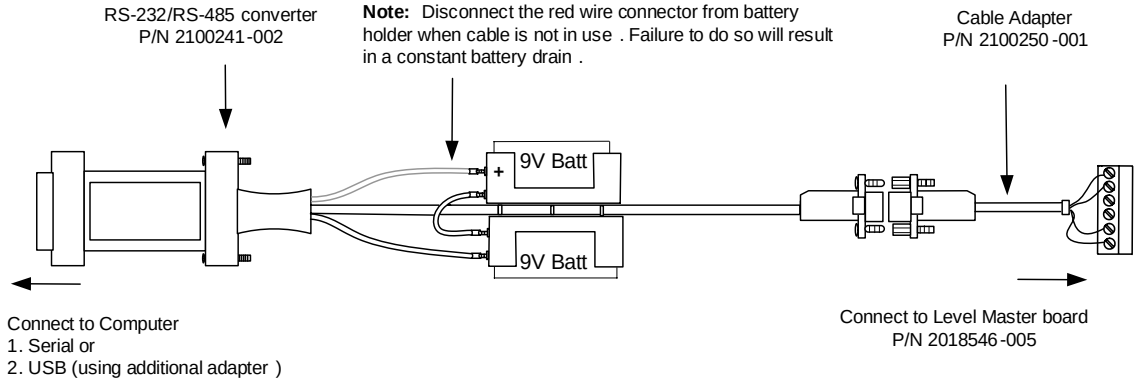

Figure 8: MasterLink communication cable (for boards with part number 2018546-005)

3.3 Assembly

The cord connector, tank port bushing, floats and float clamp are not typically installed on the LevelMaster for shipping. Follow this procedure to install these components after verifying all parts have been received and while the unit is lying on wooden blocks on the ground. It is assumed that the LevelMaster is being installed through a standard 3 inch or 4 inch tank port opening.

Tools and materials required:

- 24 inch pipe wrench
- Phillips screwdriver
- Teflon® tape
- 2 wooden blocks to support the unit

To assemble components on the LevelMaster before insertion into the tank:

1. After unpacking and inspecting, place the LevelMaster on the ground in a horizontal position on top of the wooden blocks for support.

CAUTION – Equipment damage. In locations with hydrogen sulfide (H_2S) present, permanently seal the electronics enclosure weep holes to prevent damage to the electronics board. Exposure to H_2S can cause corrosion and eventually lead to electronic component and board failure.

2. Wrap Teflon® tape or another sealing material on the cord connector threads.
3. Wrap Teflon® tape or another sealing material on the tank port bushing threads.
4. Slide the cord connector and bushing into the bottom of the LevelMaster with the cord connector on top (Figure 9). The nut on the cord connector may need to be losened so it slides freely on the casing.

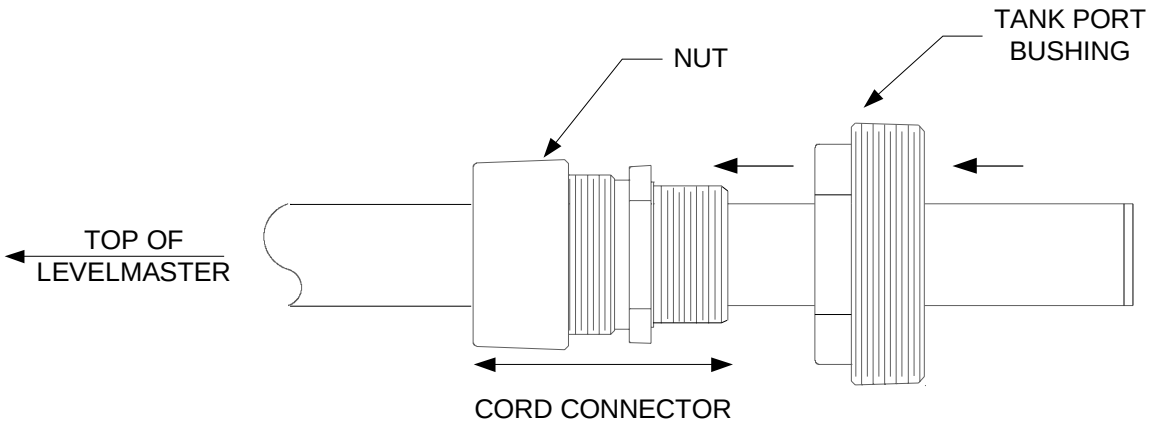

Figure 9: Cord connector and tank port bushing installation

5. Slide the float(s) onto the bottom of the LevelMaster casing.

IMPORTANT NOTE: Position the float(s) correctly so that the text on the float label will be in the upright position (it can be read) when the LevelMaster is in the vertical position. Not all floats include arrows indicating the position for insertion.

a. If installing one float, see Figure 10.

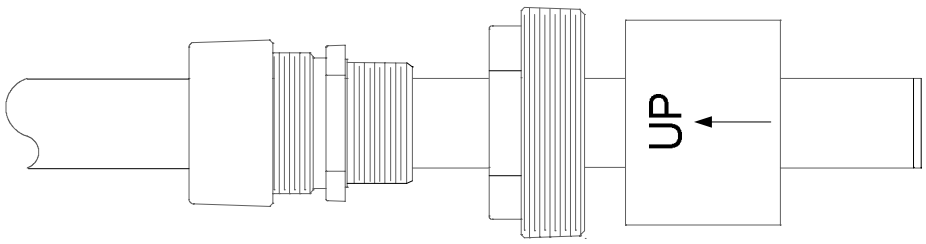

Figure 10: Single float assembly

b. If installing two floats, see Figure 11. Install the float labeled OIL first and the float labeled WATER second.

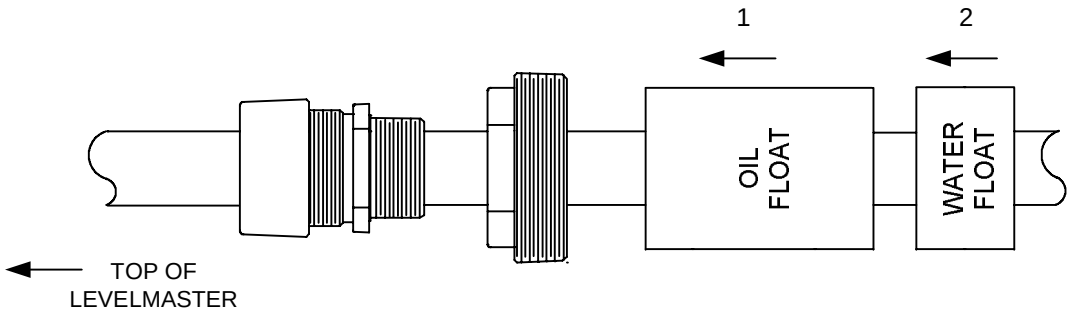

Figure 11: Dual float assembly

6. Slide the float clamp onto the bottom of the LevelMaster casing.
7. Use the Phillips screwdriver to tighten the clamp 1 inch above the bottom of the casing (Figure 12). Considerable force may be required to lock the clamp on tight.

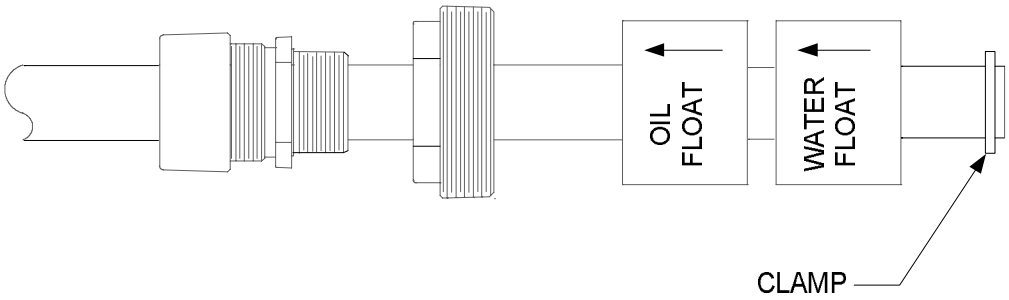

Figure 12: Casing clamp installation

8. Proceed with the installation:
   a. If installing a high level auxiliary switch, proceed to section 3.4, *Install or set the position of the high level auxiliary switch*.
   b. If not installating a high auxiliary switch, proceed to section 3.5, *Insert the unit into the tank*.

3.4 Install or set the position of the high level auxiliary switch (optional)

The following sets the position of the high level auxiliary switch.

IMPORTANT NOTE: The LevelMaster is typically shipped with the auxiliary switch assembly already installed in the 4 inch tank port bushing. The following procedure describes how to position the float for the desired operation. If purchased separately, the switch should be installed while the unit is lying supported on wooden blocks on the ground. Only 4 inch tank port bushings are supported when installing the auxiliary switch.

Tool needed:

— snap ring pliers

To verify or set the high level auxillary switch position:

1. Verify that the high level switch assembly is installed in the tank port bushing. The installation should look similar to what is displayed in Figure 13. In this example a 12 inch switch installation is depicted.

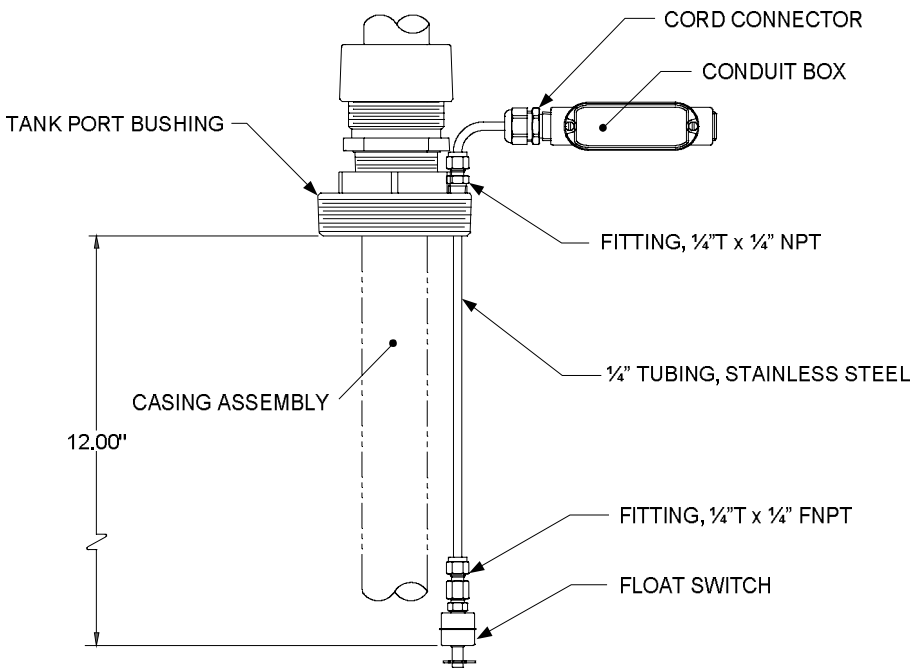

Figure 13: High level auxiliary switch installation

2. Decide whether the switch needs to function as normally open (NO) or normally closed (NC). This determines the position of the switch float.
3. Read the two-character inscription above the center of the float (Figure 14). The inscription should be in the upright position (it can be read) when the LevelMaster is in the vertical position. It will read either NO or NC (Figure 14 displays NO). If it is not in the desired position:
    a. Pull the retainer clip off.
    b. Turn the float over.
    c. Re-install the float switch.
    d. Place the retainer clip back into place.

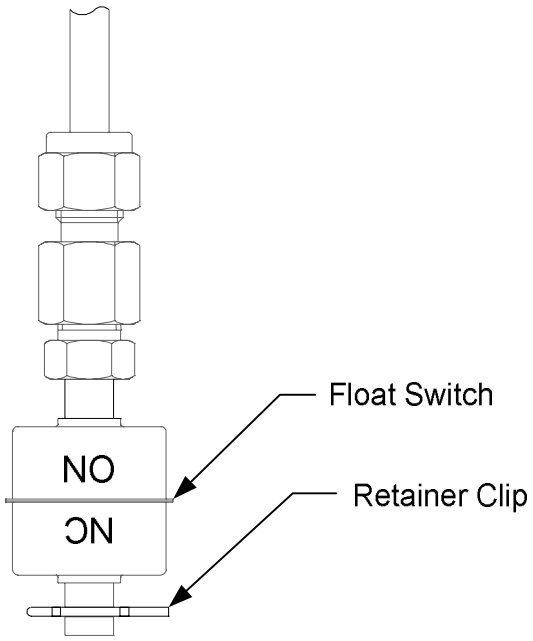

Figure 14: Auxiliary float switch for Normally Open (NO) operation

IMPORTANT NOTE: Once the desired switch float position is verified or corrected, the switch assembly is ready to be inserted in the tank with the LevelMaster. The height of the auxiliary switch can be adjusted later by loosening the nut on the fitting installed on the top side of the tank port bushing (Figure 15). The tubing can be pulled up providing a range of approximately 9 inches.

When the tubing is slid all the way down, the switch will actuate at approximately 12 inches below the bottom of the tank port bushing for the 12 inch switch, and at 16 inches below the bottom of the tank port bushing for the 16 inch switch.

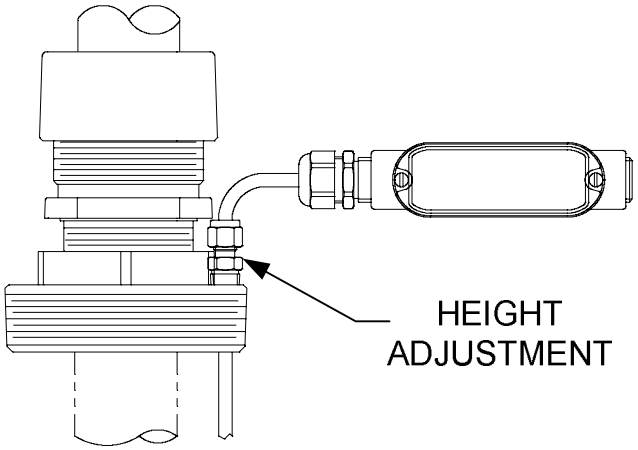

Figure 15: Auxiliary float switch height adjustment

IMPORTANT NOTE: If applicable, plumb the conduit or cable into the conduit box for the high level switch. Terminate the wiring inside the conduit box using wire nuts. There are two wires coming from the switch representing the two sides of the switch. There are no polarity considerations.

4. Proceed to section 3.5, *Insert the unit into the tank*.

3.5 Insert the unit into the tank

The following installation assumes the LevelMaster is being installed through a standard 3 inch or 4 inch tank port opening and that all components have been assembled (including the high level auxiliary switch, if purchased).

IMPORTANT NOTE: The following procedures are for both, general-purpose installation or hazardous location installation, unless otherwise noted.

CAUTION – Equipment damage. Failure to follow these procedures may cause damage to the LevelMaster.

To install the LevelMaster in the tank:

IMPORTANT NOTE: The insertion of the LevelMaster typically requires at least two people, as the length and weight of the LevelMaster can make it very difficult or impossible for a single installer to handle. The ideal situation incorporates the use of a crane. The following procedure assumes no crane.

1. Prepare the tank for installation of the sensor prior to beginning assembly:

CAUTION - Equipment damage. If the tank has an operating agitator or mixer, it should be turned off before attempting to insert the LevelMaster assembly. Leaving it in operation could cause harm to the equipment.

a. Remove the bull plug from the top of the tank.

b. Clean the threads on the tank opening.

2. While keeping the LevelMaster in the horizontal position:

   a. Slide the float(s) and tank port bushing all the way to the bottom of the casing to ensure that the floats do not slide down when the unit is raised vertically.

   b. Slide the cord connector all the way to the bottom of the casing. Loosening the connector may be required so that it can slide through the casing with no resistance.

3. Raise the LevelMaster vertically.

4. Ensuring that the float(s) are still all the way at the bottom of the casing, lift the unit and move to the top of the tank.

5. Once on top of the tank, carefully feed the casing and float(s) through the tank port opening.

6. Slowly lower the LevelMaster assembly and allow the unit's weight to keep the unit vertical. If the bottom of the tank has sludge, the unit may need to be worked up and down a few times to allow the unit to be properly seated.

7. Screw the tank port bushing into the tank opening and tighten (Figure 16). If the 24 inch version of the high level switch was purchased, ensure that the tubing is assembled and that the offset points away from the casing.

8. Ensure all fittings are tight except for the fitting on the top side of the tank port bushing.

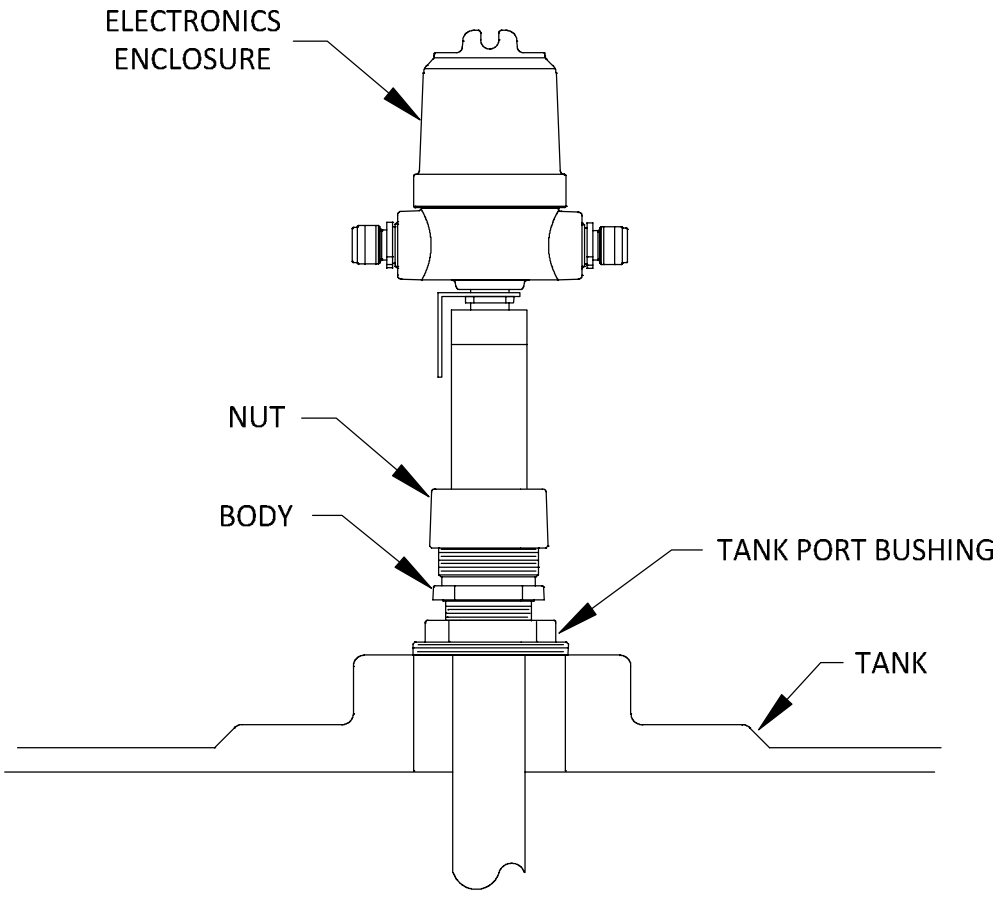

Figure 16: Tank port bushing installation

9. Slide the cord connector down and screw into the tank port bushing.

10. Tighten using the lower part of the body (Figure 17).

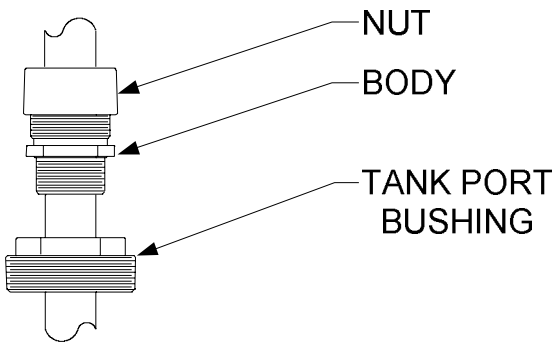

Figure 17: Nut and body installation

11. Tighten the nut of the cord connector to form a rain-tight seal around the casing.
12. Plumb the conduit or cable for the wiring into the ¾ inch hub on the side of the electronics enclosure:
    a. For division 1 and 2 hazardous areas, use a conduit.
    b. For general-purpose areas, a cable with a cord connector can be used.
13. Proceed to section 4, *Wiring*.

4 Wiring

The following sections describe the LevelMaster wiring for both power and communications. Wiring may involve a single or multiple LevelMasters in general-purpose or hazardous areas.

IMPORTANT NOTES: Wiring pinout on the LevelMaster depends on the board version. Wiring may involve only older boards, only newer boards or a combination of both (at sites with previously installed units). The wiring procedures described in this section illustrate wiring for the newer board (part number 2104836-001). For wiring drawings for legacy boards, please refer to the *Additional information* section or contact technical support.

If planning for batteryless float support, upgrading from older board versions is required. Restoring wiring after upgrading a LevelMaster to a newer board is covered in detail in the LevelMaster upgrade kit application guide (see the *Additional information* section). Upgrade procedures are not included in this manual.

CAUTION - Equipment damage. The LevelMaster electronics board, as with any electronics board, is susceptible to damage by static electricity or improper handling. To prevent this from occurring, wear a grounding strap.

A grounding strap is a conductive device used to make a connection between the person handling the board and a high quality ground point. Before handling the board, install a ground strap on the body and then connect it to a grounded point. This discharges electrical static buildup from the body to ground, preventing static from discharging to the electronics.

4.1 Board versions overview

Wiring and configuration of the LevelMaster vary depending on the electronics board version. Installations may involve the same type of board or a mix (if installing new LevelMasters in a site where older units are already in place). This section describes pinouts for the available versions, onboard termination jumpers and indicator LEDs.

4.1.1 Port pinout

Depending on the board version, there may be a single port or two separate ports for power and communications. Figure 18 depicts the ports on a legacy board (left) and a newer board (right). Legacy boards have a single port handling both power and communications (J1), while the newer board version has one port for each (J11 for communications and the power port). The pinout and labels for the communication ports are also different. Use the appropriate pinout for the board in the LevelMaster being installed.

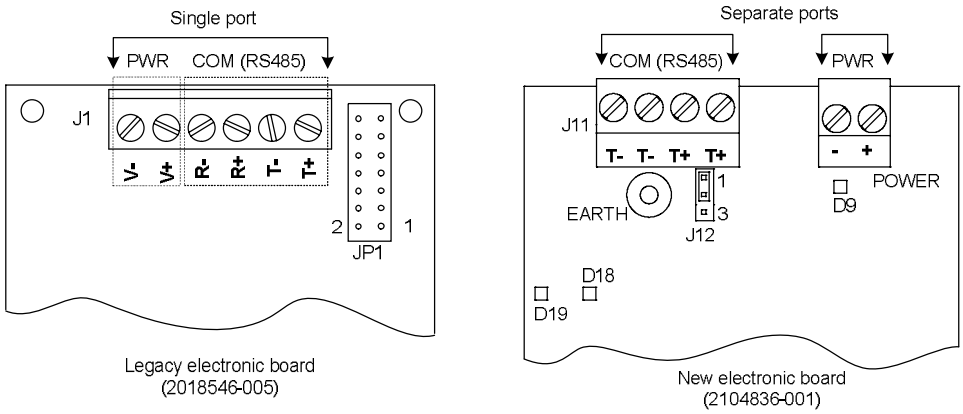

Figure 18: Communication and power ports pinouts

The communication and power ports have removable terminal connectors for convenience. If the connectors are plugged in the ports when shipped, they can be removed for ease in field wiring (Figure 19).

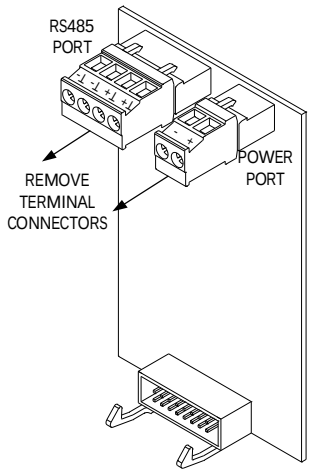

Figure 19: Removing terminal connectors (2104836-001)

4.1.2 Onboard LEDs (2104836-001 boards only)

For electronics boards, part number 2104836-001 or later, onboard LEDs provide visual indication that help troubleshoot the connections to the power and communication ports (right board in Figure 18):

- LED D19 and D18, located below the COM (RS-485) port, are used to indicate when data is being transmitted or received on the port. The D18 LED flashes to indicate that a packet has been transmited. D19 flashes to indicate that a poll request has been received.
- LED D9, located below the Power port, is used to indicate reverse polarity when lit.

4.1.3 Onboard termination jumpers (legacy boards only)

For electronics boards, part number 2018546-005 only, onboard jumpers (JP1 in Figure 20) provide a way to configure the LevelMaster for connection to additional LevelMasters on an RS-485 bus. Figure 20 shows the placement of the JP1 jumpers depending on the position of the LevelMaster on the bus.

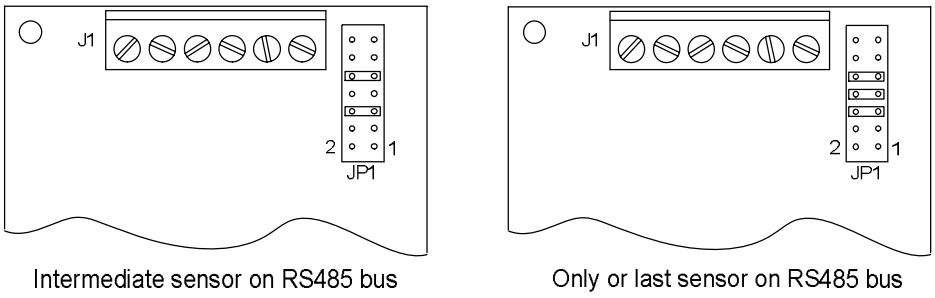

Figure 20: RS-485 termination for legacy board (part number 2018546-005)

IMPORTANT NOTE: The MasteLink cable will not operate with the fourth jumper installed (pins 7-8 jumpered on the only or last sensor). Remove this jumper when connecting directly to the electronics board for local communication (during configuration). Once configuration is complete and local communication is terminated, the jumper can be placed again as required for the terminating sensor.

4.2 Selecting wire type

The power and communication terminals connectors support 12 AWG to 22 AWG. Wire gauge selection should be based on the voltage and current requirements of the circuitry as well as the expected length of the wires. The gauge differs for each application:

— Wiring for communication must conform to RS-485 specifications and limits (Table 5, *Wiring limits on the RS-485 bus*).

— Wiring for power is based on how the LevelMaster is powered: using an external power supply or the output power from the controller RS-485 (COM) port.

— Wiring through a barrier must conform to the hazardous location specifications and limitations (Table 6, *Wiring limitations when using barrier boards*, on page 35).

Follow local electrical codes when selecting the appropriate wire gauge and type based on the load current, voltage, signal type, wire length, and location.

IMPORTANT NOTE: The terminal connectors on the LevelMaster board are 2 and 4-position Phoenix Contact® removable connector type with screw termination. The connectors can handle more than one wire in each position when connecting multiple LevelMasters, depending on the gauge and type of wire chosen. Review the Phoenix Contact® terminal connection specifications for acceptable wire gauge and type when connecting multiple wires to a single contact point. There are limits defined for the wire conductor's cross section area based on whether stranded or solid wires are used.

4.3 Wiring the first LevelMaster

Wiring requires wire termination at both the LevelMaster and the host controller or additional units. The procedures in this section describe the wiring at the first LevelMaster end. The first LevelMaster on an RS-485 bus is the unit that connects to the host controller directly or through a barrier. All communication and power to additional units depend on this connection.

Wiring is completed with termination at the host controller and additional units. After wiring the LevelMaster end and adding additional units (if required), wire the host controller as described in section 4.5, *Wiring the host controller*.

IMPORTANT NOTE: It is assumed that the wires for both communication and power will be run through the conduits and that the wire length conforms to the specified limits. Wire length limits vary based on the installation scenario. Wire ends must be run through the entry holes until they are visible inside the enclosure.

4.3.1 Wiring for communication

The LevelMaster supports serial communication on the RS-485 port (4-position terminal connector, J11 in Figure 21). Two pin pairs are available for two RS-485 connections on this port:

— Outer (T+, T-) pair, first and fourth pin on J11

— Inner (T+, T-) pair, second and third pin on J11

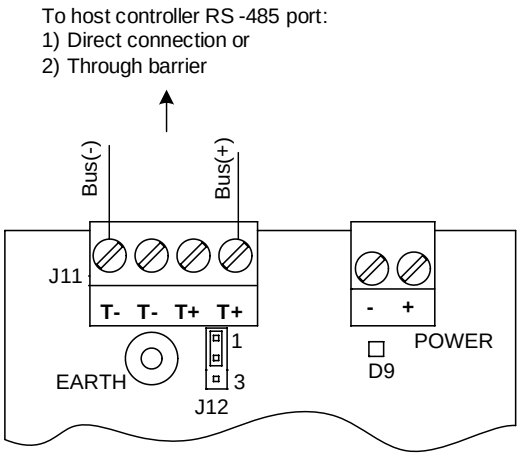

Figure 21: Wiring for communication with host controller (first or only LevelMaster)

To wire for communication:

1. Remove the communication 4-position terminal connector from the port (J11).
2. Loosen the screws on the communication connector.
3. Insert the wires in the connector, observing the pinout required. If wires are color-coded, take note of the color for each pin. If not color-coded, label or keep track of the wire positions to ensure that they will be connected to the correct pins on the other end of the wire, either at the controller or another LevelMaster (if connecting to a multiple-unit bus).

IMPORTANT NOTES: For electronics boards, part number 2104836-001, RS-485 termination is performed on software. No jumpers for hardware configuration are available onboard.

Configure RS-485 termination according to the position of the LevelMaster on the RS-485 bus:

- If it is the only unit installed, ensure that it is configured to terminate the RS-485 bus. See section 5.3.2, *Configuring RS-485 bus termination*.
- If it is the first of unit on the RS-485 bus, ensure that it is configured as an intermediate sensor (factory default).

For legacy boards (part number 2018546-005), terminate as described in section 4.1.3, *Onboard termination jumpers (legacy boards only)*.

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   a. If the unit is the only unit connected to the flow computer or remote controller, insert the wires run from the host controller in one of the pin pairs available (first and fourth pin, or second and third pins on J11). Secure the inserted wires by tightening the screws on the connector.
   b. If the unit will be connected to a multiple-unit RS-485 bus:
      i. Insert the communication wires run from the host controller in the outer (T+, T-) pair, first and fourth pin on J11.
      ii. Insert the communication wires run from an additional LevelMaster in the remaining pin pair as described in Section 4.4, *Wiring additional LevelMasters*.
4. Proceed to section 4.3.2, *Wiring for power*.

4.3.2 Wiring for power

The LevelMaster can be powered from an external power source or from the host controller (Figure 22).

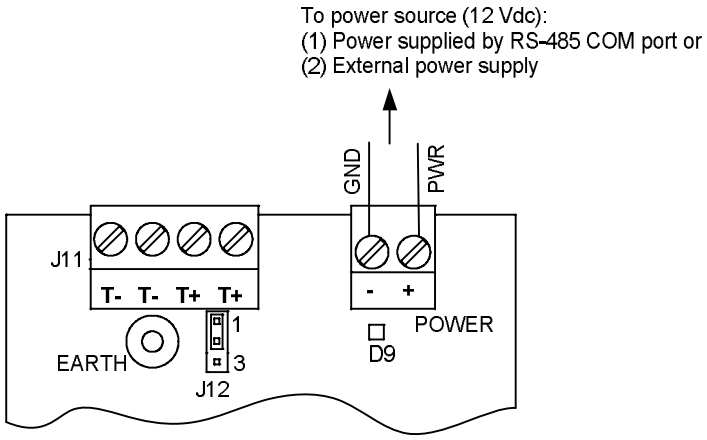

Figure 22: Wiring for power (single board installation)

When using ABB Totalflow flow computers or remote controllers, power can be provided from their serial (COM) ports, eliminating the need for an external power supply.

CAUTION - Equipment damage. The output voltage (VOUT) at the serial (COM) ports on an ABB Totalflow flow computer or remote controller is dependent upon the external power supply connected to these devices.

Before connecting the LevelMaster to these ports, ensure that the flow computer or remote controller input voltage does not exceed 15 Vdc.

Connecting the LevelMaster to host controllers with an input power larger than 15 Vdc (for example devices powered by 24 Vdc voltage sources) will result in damage to the LevelMaster because the output power from the serial port (VOUT) will also be larger than 15 Vdc. Use an independent power source if unable to power the unit from the flow computer or controller.

To wire for power:

CAUTION - Equipment damage. Do not connect any cable shields or drain wires to the POWER connector (-) terminal. The drain wire or cable shields should be connected to the Earth Ground terminal of the safety barrier or the host controller (See Figure 33, *Wiring the LevelMaster to the barrier board*).

1. Remove the 2-position terminal connector from the POWER port.
2. Loosen the screws on the power connector.
3. Insert the wires in the power connector, observing correct polarity. If wires are color-coded, take note of the color used for each pin. If not color-coded, label or keep track of the wire positions to ensure that they will be connected to the correct pins on the other end of the wire.
    a. If the unit is the only unit, insert the wires run from the host controller or alternate power source in the (+, -) positions. Secure the inserted wires by tightening the screws on the connector.
    b. If the unit is an intermediate unit on the bus (additional units will be connected):
        i. Insert the wires for power, run from the host controller or alternate power source, in the (+, -) positions and leave screws loose to insert the wires from an additional LevelMaster.
        ii. Insert the wires for power, run from the additional LevelMaster, in the (+, -) positions. Secure wires by tightening the position screw. See section 4.4, *Wiring additional LevelMasters*.
4. If installing only one unit, proceed to terminate the wires at the host controller end.
    a. For non-hazardous locations, proceed to section 4.5.1, *General purpose locations*.
    b. For hazardous locations, proceed to section 4.5.2, *Hazardous location*.
5. If installing additional units, proceed to section 4.4, *Wiring additional LevelMasters*.
6. Insert the power connector back into the board.
7. Verify that the power LED (labeled D9 and located below the power connector) is not lit. If it is lit, it indicates that the wrong polarity has been used and it must be rewired to correct polarity.

4.4 Wiring additional LevelMasters

Multiple LevelMasters can be interconnected (daisy-chained) on an RS-485 bus configuration (Figure 23) when measuring levels at a site with multiple tanks. Use this procedure to wire the remaining units on the bus.

IMPORTANT NOTES: This procedure assumes that all LevelMasters in a bus are powered from the same source which is wired to the first unit on the bus.

LevelMaster RS-485 termination must be configured correctly based on the position of the unit on the bus.

For legacy boards (part number 2018546-005), terminate as described in section 4.1.3, *Onboard termination jumpers (legacy boards only)*.

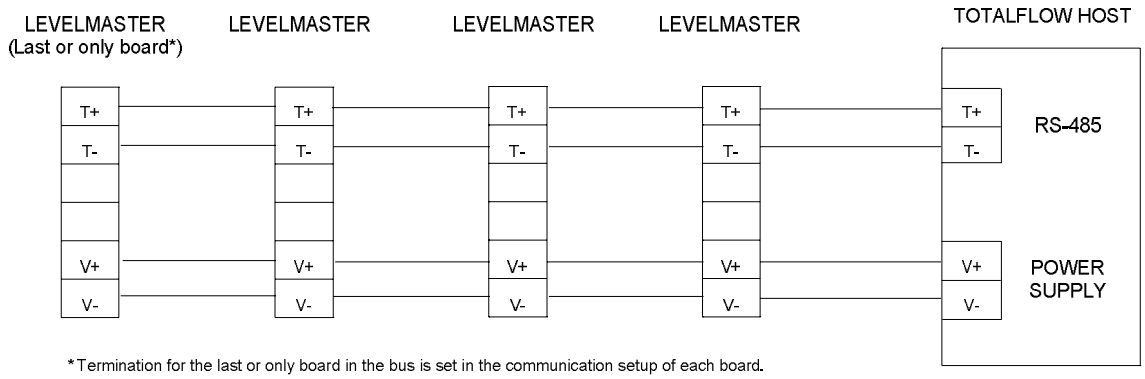

Figure 23: General schematic of a multi-LevelMaster bus (general purpose location)

4.4.1 Limitations

The number of units that can be supported per bus, and the length of the bus, depends on the type of location and installation scenario. Table 5 describes the maximum bus length and the maximum number of units for each scenario.

IMPORTANT NOTES: It is assumed that the wires for both communication and power will be run through the conduits and that the wire length conforms to the specified limits. Wire length limits vary depending on the installation scenario.

Connecting multiple LevelMasters requires wiring more than one wire at the same contact point in the power or communication connectors. Review section 4.2, *Selecting wire type*, to ensure that the correct wire type and gauge has been selected.

Table 5: Wiring limits on the RS-485 bus

Installation scenario	Description	Maximum bus length (total wire length in feet)	Maximum number of LevelMasters on the bus
General-purpose (unclassified area) with host controller	Direct connection to host controller. No barrier required	4000	8
Hazardous location (classified area) with host controller	No direct connection to host controller. CSA-certified barrier required between first LevelMaster on the bus and host controller	500	Group D:4 sensors per barrier Group C,D: 3 sensors per barrier

4.4.2 Wiring for communication

To wire the additional LevelMaster(s) for communication:

1. Remove the communication 4-position terminal connector from the port (J11) on the additional LevelMaster.
2. Loosen the screws on the communication connector.
3. Insert the wires in the correct position (see Figure 24, Figure 25, Figure 26, or Figure 27 for sample wiring):
   a. If the additional LevelMaster is the last unit on the bus, insert the wires from the first LevelMaster in the outer (T+, T-) pair (first and fourth pin on J11). Secure the inserted wires by tightening the screws on the connector.
   b. If the additional LevelMaster is an intermediate unit on the bus:
      i. Insert the wires from the first LevelMaster in the outer (T+, T-) pair, first and fourth pin on J11.
      ii. Insert the wires to the next LevelMaster in the inner (T+, T-) pair, second and third pin on J11.
      iii. Secure the inserted wires by tightening the screws on the connector.

IMPORTANT NOTES: Configure RS-485 termination according to the position of the LevelMaster on the RS-485 bus:

- If it is the last unit, ensure that it is configured to terminate the RS-485 bus. See section 5.3.2, *Configuring RS-485 bus termination*.
- If it is an intermediate unit, ensure that it is configured as an intermediate sensor (factory default).

For legacy boards (part number 2018546-005), terminate as described in section 4.1.3, *Onboard termination jumpers (legacy boards only)*.

4.4.3 Wiring for power

CAUTION - Equipment damage. Other than the wire for 12 Vdc ground, do not connect any ground wire or shield from the cable or any other source to the board. The LevelMaster must float above ground potential.

To wire the additional LevelMaster for power:

1. Remove the 2-position terminal connector from the POWER port on the additional LevelMaster.
2. Loosen the screws on the power connector.
3. Insert the wires in the power connector, observing correct polarity (see Figure 24, Figure 25, Figure 26, and Figure 27 for sample wiring).
    a. If the additional LevelMaster is the last unit on the bus, insert the power wires from the first LevelMaster in the power (+, -) positions. Secure the wires by tightening the screws for each terminal position wired.
    b. If the additional LevelMaster is an intermediate unit on the bus (additional units will be connected):
        i. Insert power wires from the first LevelMaster in the (+, -) positions and leave screews loosen to insert the wires from the next LevelMaster.
        ii. Insert power wires from the next LevelMaster in the (+, -) positions.
        iii. Secure both pairs of power wires by tightening the screws for each terminal connector position.
4. Proceed to complete wiring.
    a. For general-purpose locations, proceed to section 4.5.1, *General purpose locations*.
    b. For hazardous locations, proceed to section 4.5.2, *Hazardous locations*.

4.4.4 Examples of multi-unit bus wiring

Figure 24, Figure 25, Figure 26, and Figure 27 display different connections for multi-unit installations.

Figure 24 displays a two-LevelMaster bus with boards of the same type. The board of an additional LevelMaster is connected to the board of the first LevelMaster of the RS-485 bus. The power connection for the additional LevelMaster is through the power port on the first LevelMaster. The communication connection is through the additional connection pair on the RS-485 port on the first LevelMaster. The first LevelMaster is an intermediate node. The additional LevelMaster is last on the bus and must be configured to terminate the bus.

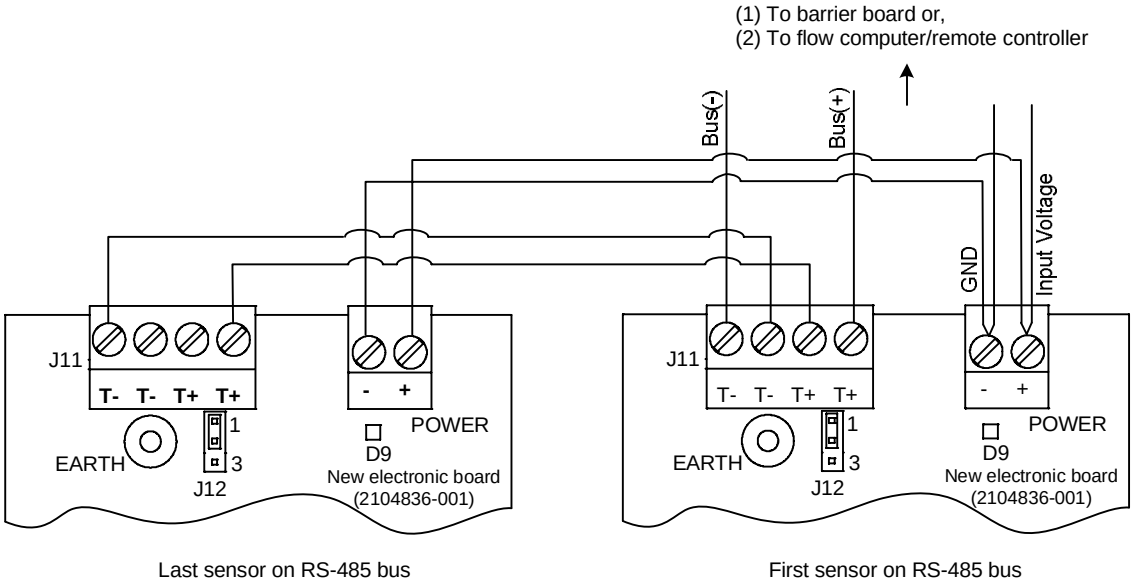

Figure 24: Two-LevelMaster RS-485 bus of same board type using both communication contact pairs

Figure 25 displays two additional LevelMasters connected to the first LevelMaster. The first and second LevelMasters are intermediate units on the bus. The third must be configured to terminate the bus. Communication connections in intermediate nodes use both pairs on the RS-485 ports.

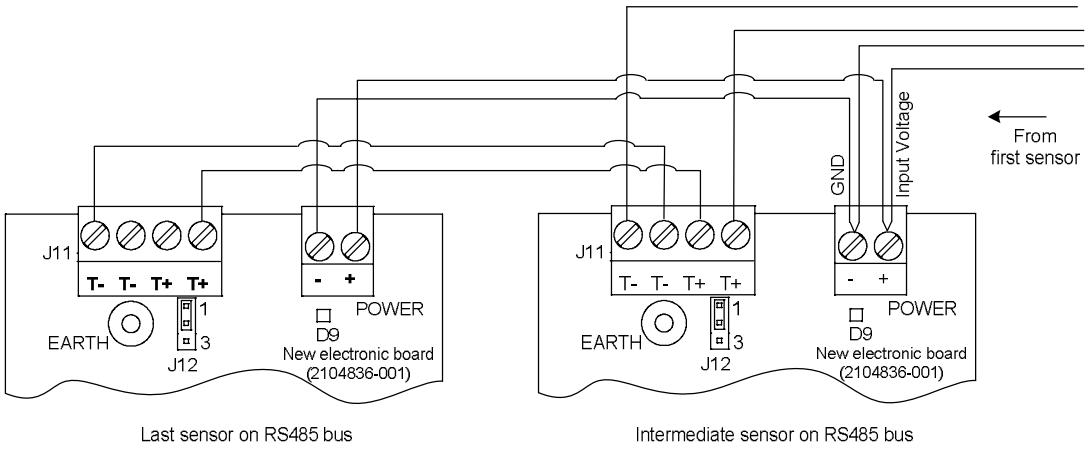

Figure 25: Three-LevelMaster RS-485 bus (same board type)

IMPORTANT NOTES: Connection options depend on the type of wire, gauge, and user preference (see section 4.2, *Selecting wire type*). Figure 26 shows a two-LevelMaster bus with boards of the same type, where the communication connection for the additional LevelMaster is through the same connection pair on the RS-485 port on the first LevelMaster (instead of using both pairs as in shown in Figure 24). While using both pairs is recommended, this connection also works and is left up to customer preference.

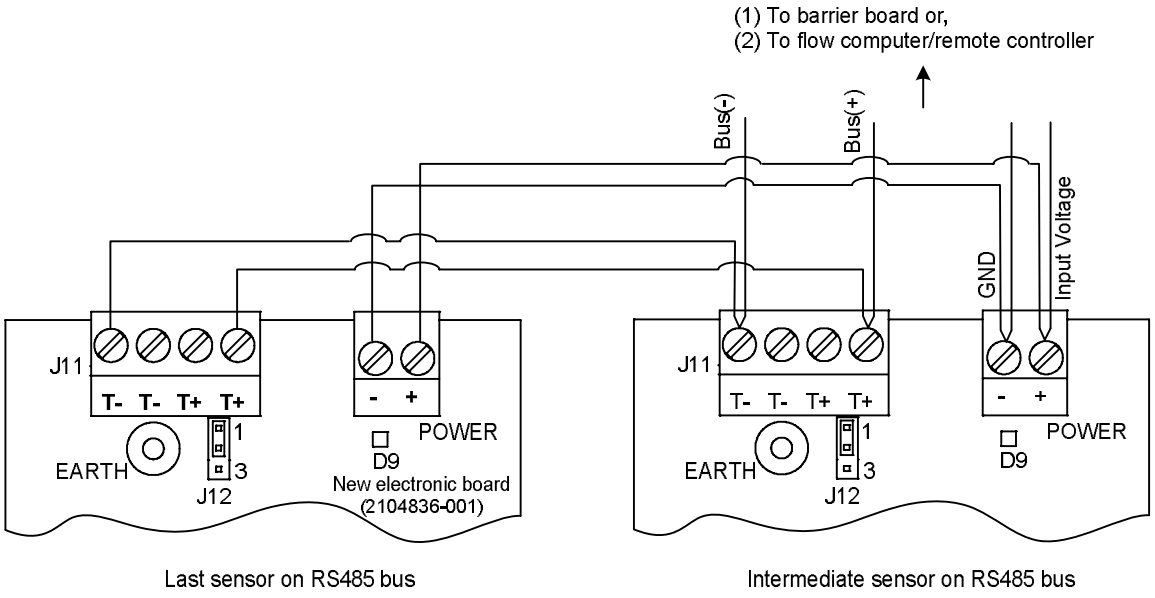

Figure 26: Two-LevelMaster RS-485 bus of same board type using single communication contact pair

Figure 27 displays wiring between two LevelMasters with different board types. The first LevelMaster is the intermediate sensor on the bus. The additional LevelMaster, with a legacy board, is the last sensor on the bus and must be configured to terminate the bus (JP1 jumpers are placed on 5-6, 7-8 and 9-10 as indicated in section 4.1.3, *Onboard termination jumpers (legacy boards only)*.

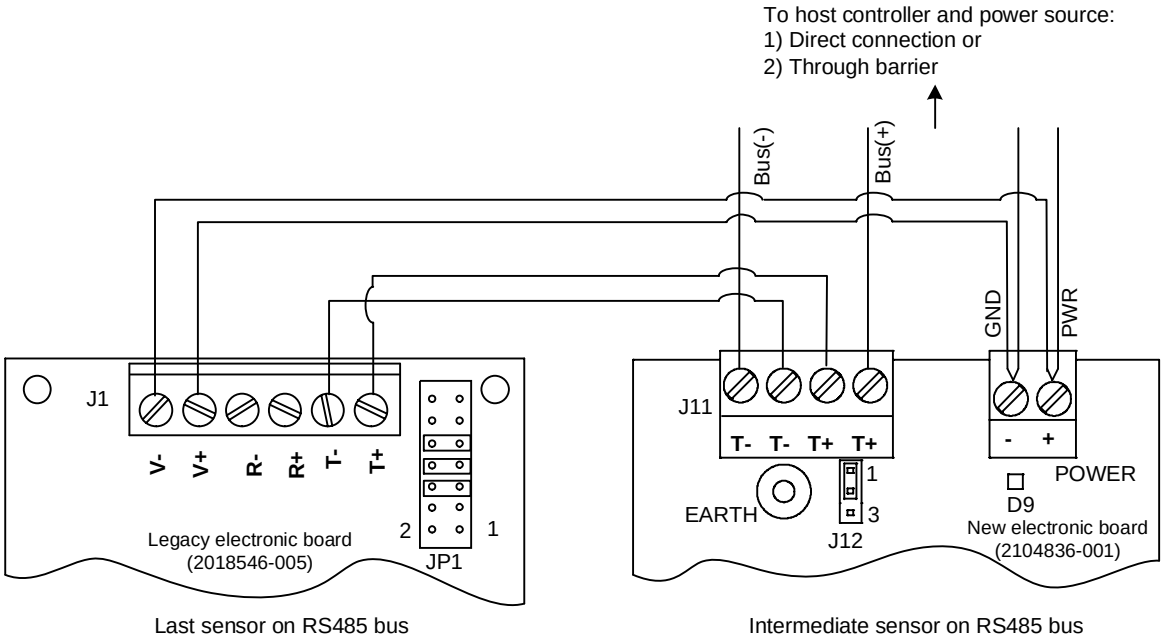

Figure 27: Two-LevelMaster RS-485 bus (mixed board type)

IMPORTANT NOTE: When wiring from the LevelMaster to the host controller, do not cut off spare wires. Tape them securely back to the cable jacket as spares, in case of damage.

4.5 Wiring the host controller

The procedures in this section describe the wiring at the host controller end in general purpose locations and hazardous locations. General purpose installations wire the LevelMaster directly to the host controller. Hazardous location installations wire the LevelMaster and host controller through a required CSA-certified barrier (no direct wiring is permitted). Select the appropriate procedure for the type of location where the LevelMaster(s) is being installed.

CAUTION - Equipment damage. The output voltage (VOUT) at the serial (COM) ports on an ABB Totalflow flow computer or remote controller is dependent upon the external power supply connected to these devices.

Before connecting the LevelMaster to these ports, ensure that the flow computer or remote controller input voltage does not exceed 15 Vdc.

Connecting the LevelMaster to host controllers with an input power larger than 15 Vdc (for example devices powered by 24 Vdc voltage sources) will result in damage to the LevelMaster because the output power from the serial port (VOUT) will also be larger than 15 Vdc. Use an independent power source if unable to power the unit from the flow computer or controller.

4.5.1 General purpose locations

In general-purpose or unclassified locations, the LevelMaster can be wired directly to the host controller and external power source (if one is required). This procedure assumes power is being supplied from one of the host controller serial (COM) ports.

IMPORTANT NOTES: Determine which COM port is available for wiring on the host controller. Some ABB Totalflow devices have COM1 pre-configured and reserved for remote communications.

COM ports on Totalflow flow computers or remote controllers must be configured as RS-485 ports to support the connection with the LevelMaster. Ensure that legacy RS-485 modules or hot-swappable configurable serial modules (for newer controller models) are installed prior to wiring.

When no COM ports are available onboard the controller, TFIO modules for serial communications or Ethernet-to-serial converters can be used to connect the LevelMaster. TFIO modules or compatible third-party converters are available for purchase from ABB.

4.5.1.1 Wiring the host controller

To wire the host controller:

1. Select an available COM port on the host controller. Ensure that the COM port is configured for RS-485 communication.
2. Remove the COM port terminal connector from the remote controller or flow computer.
3. Loosen the screws on the COM connector.
4. Insert the wires from the LevelMaster in the COM port. See Figure 28 for quick reference or see detailed drawings depicting specific equipment in section 4.5.1.2, *Examples of wiring to different ABB Totalflow host controllers*.

IMPORTANT NOTE: Wiring pinouts on ABB Totalflow remote controllers or flow computers vary depending on the model installed in the field.

a. Insert the communication wires from (T+, T-) in the COM port communication pins BUS(+) and BUS (-) respectively.
b. If the COM port is supplying power to the LevelMaster, insert the power wires in the COM port power pins (PWR or PWR and GND).

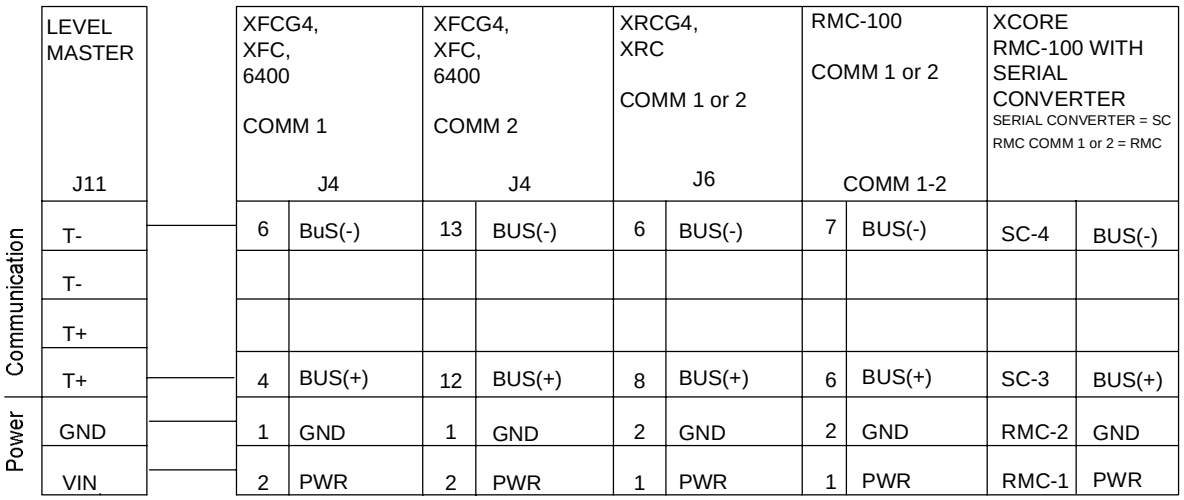

Figure 28: LevelMaster wiring to different types of ABB Totalflow host controllers

4.5.1.2 Examples of wiring to different ABB Totalflow host controllers

Detailed wiring diagrams are provided in Figure 29, Figure 30, and Figure 31 included in this section.

IMPORTANT NOTE: The power pin on COM ports may have different labels on each product. Consult the user manual for the details specific to the flow computer or remote controller being wired.

Figure 29 shows how to wire the LevelMaster to either of the onboard COMM ports available on the XRC or XFC. Any port can be selected as long as the communication module for RS-485 is installed.

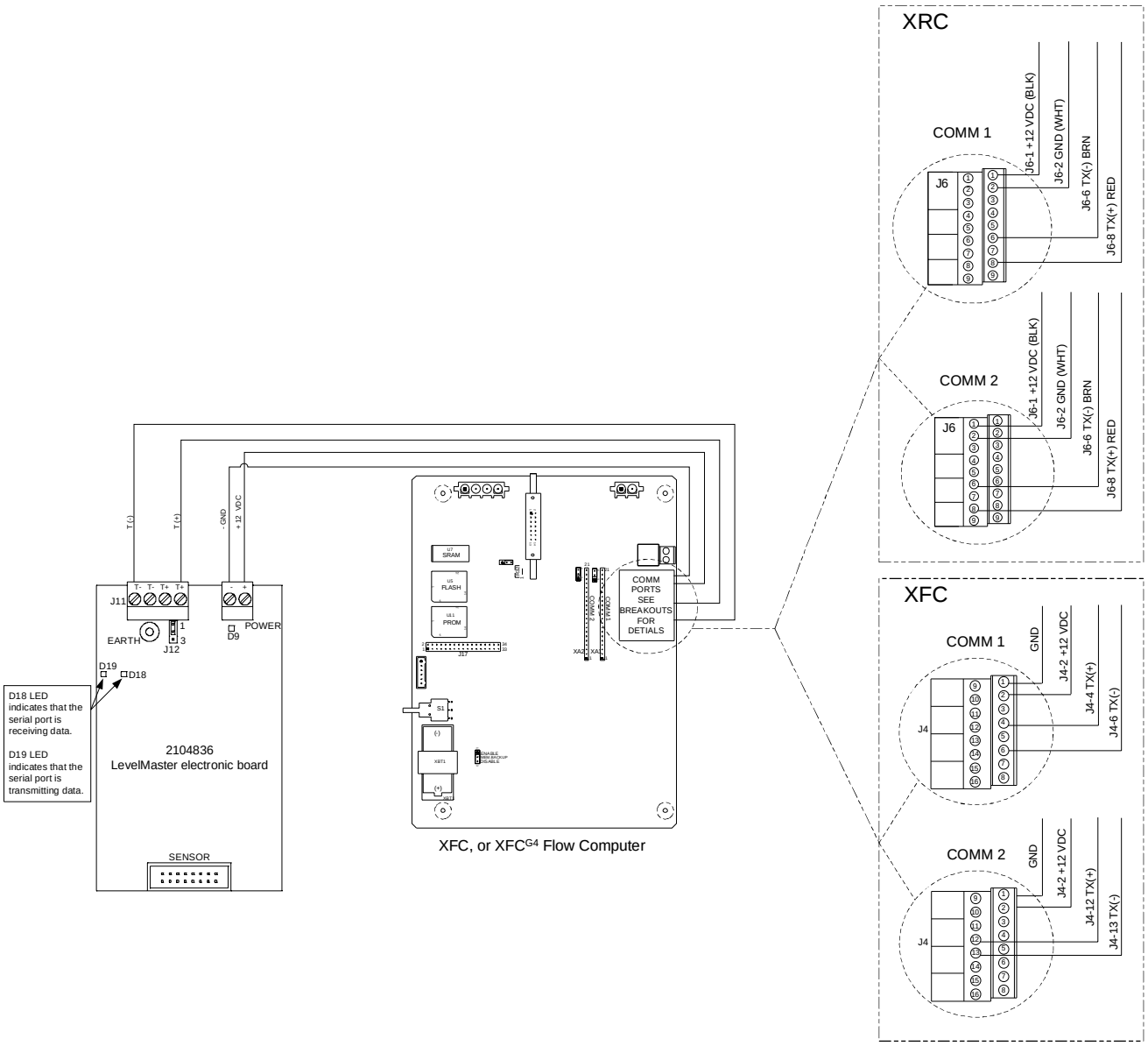

Figure 29: Wiring the LevelMaster to an XFC

Figure 30 shows how to wire the LevelMaster to either of the onboard COMM ports available on the RMC-100. Hot-swappable plugable modules must be installed and configured for RS-485 operation.

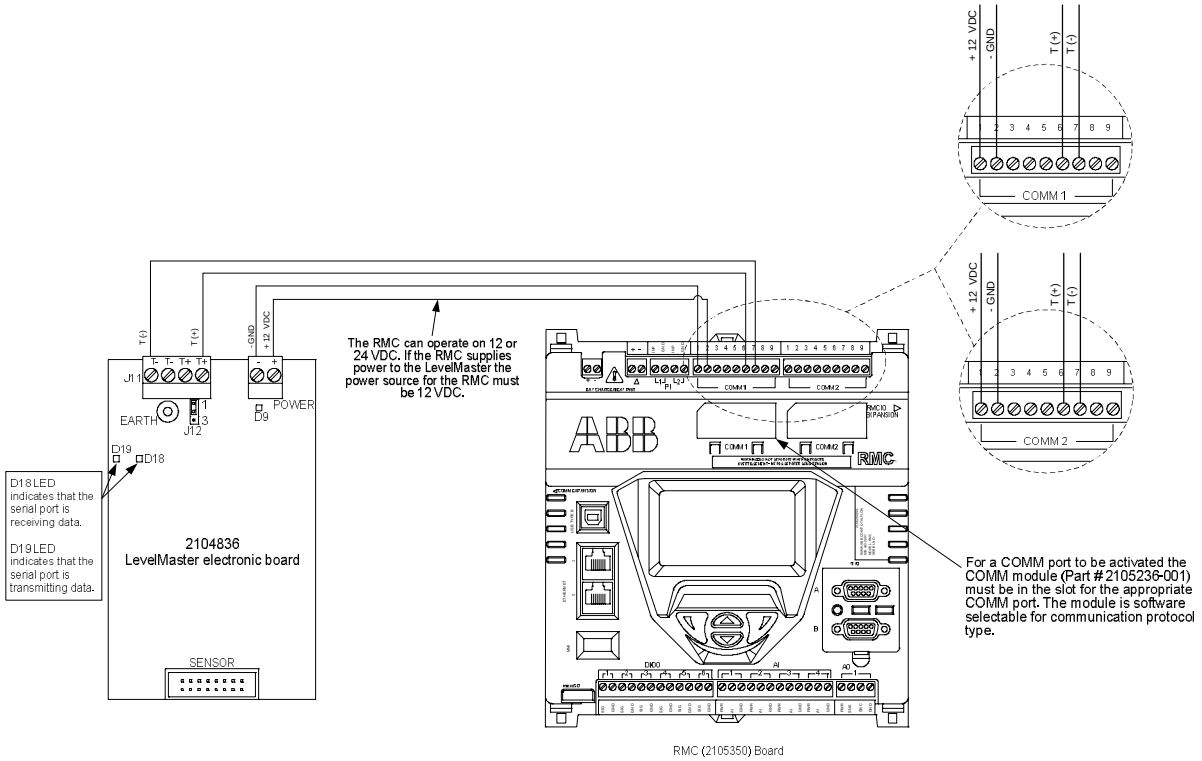

Figure 30: Wiring the LevelMaster to the RMC-100 (onboard COMM port)

Figure 31 shows how to wire the LevelMaster to a third-party Ethernet-to-serial converter which is connected to the RMC-100. In this configuration, the RS-485 communication with the remote controller is handled through the serial port on the converter. The onboard COMM ports are used only for powering the LevelMaster. For more details on the connection to the RMC-100, refer to the RMC user manual.

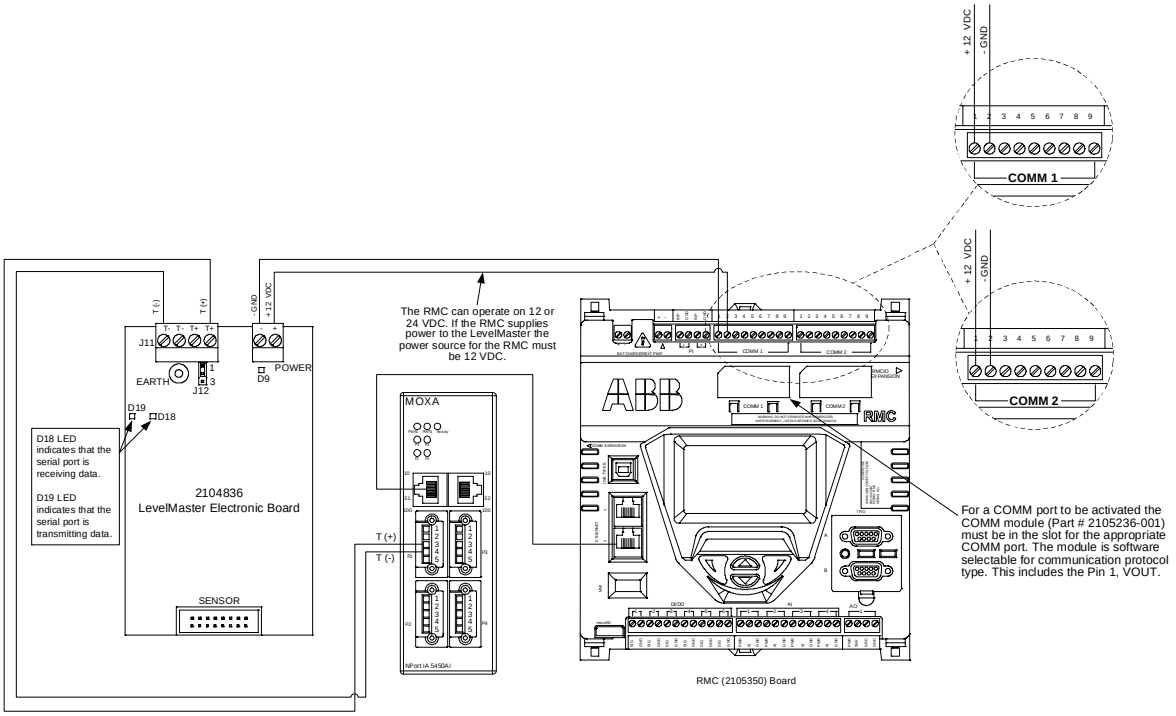

Figure 31: Wiring the LevelMaster to Ethernet-to-serial converter and the RMC-100

4.5.2 Hazardous locations

In hazardous locations, the LevelMaster can not be directly wired to the host controller or power supply. The LevelMaster and the host controller must be wired through a CSA-certified barrier board that can be purchased from ABB Totalflow. Figure 32 shows the barrier board, onboard connectors and pinouts.

The intrinsically-safe terminal connectors (shown at the bottom left corner of the board) provide the connection points for the LevelMaster. The terminal connectors shown at the top of the board provide the connection points to the host controller and power supply (if one is required).

IMPORTANT NOTE: The CSA-certified barrier must be installed in a safe area, in conformance with the control installation drawing document listed on the nametag (document number 2018387-CD).

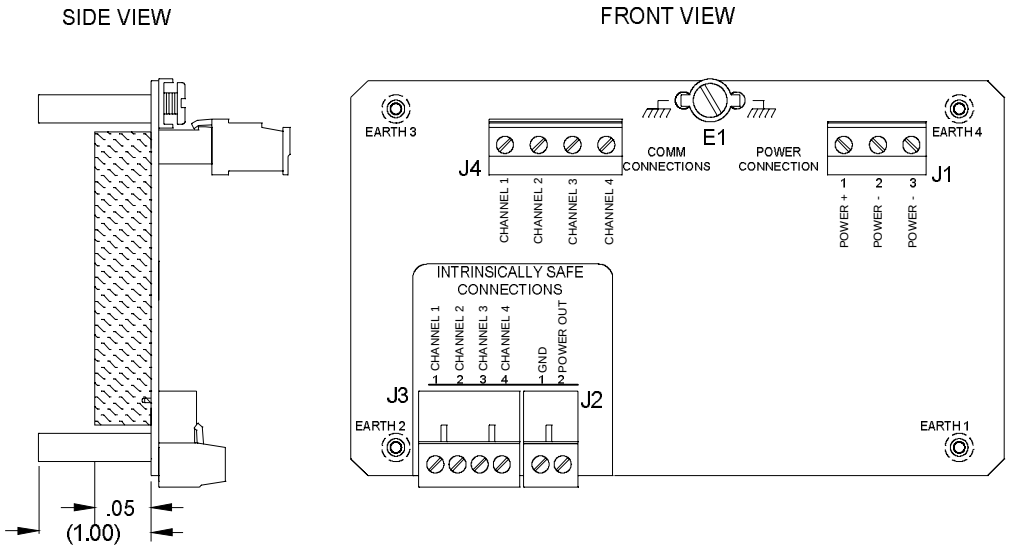

Figure 32: Totalflow CSA-certified barrier board

4.5.2.1 Limitations when using barrier boards

Hazardous area certification restrictions limit the number of LevelMasters and the length of cable that can be fed through the barrier. Those limitations are described in Table 6.

Table 6: Wiring limitations when using barrier boards

Installation scenario	Barrier board part number	Number of barriers	Maximum wire length (in feet) from barrier to LevelMaster	Maximum number of LevelMasters on the bus per barrier
Group D Locations	2100336-001	1	500	4
Group C Locations	2100336-002	1	500	3

4.5.2.2 Wiring the LevelMaster to the barrier board

This procedure wires the LevelMaster to the intrinsically safe connectors on the barrier board.

To wire the LevelMaster to the barrier board:

1. Remove the intrinsically safe J2 and J3 terminal connectors (Figure 33).
2. Loosen the screws on the J2 and J3 terminal connectors.
3. Insert the wires from the LevelMaster in the correct connector pins:
   a. Insert communication wires in CHANNEL 1 and CHANNEL 2 on J3.
   b. Insert power wires in the Power OUT and GND pins on J2.

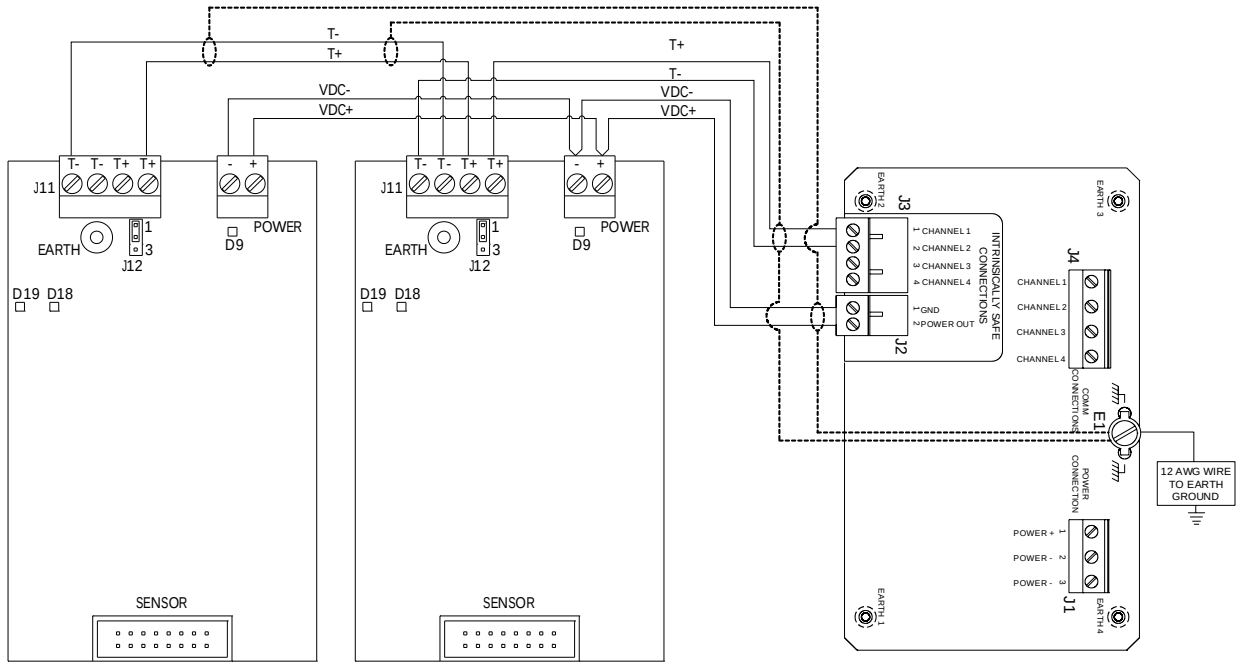

Figure 33: Wiring the LevelMaster to the barrier board

4. Secure the inserted wires by tightening the connector screws.
5. Insert the J2 and J3 terminal connectors back on the barrier board.
6. Proceed to section 4.5.2.3, *Wiring the barrier board to the host controller*.

4.5.2.3 Wiring the barrier board to the host controller

This procedure wires the barrier board to the host controller to complete end-to-end wiring in the hazardous location.

To wire the barrier board to the host controller:

1. Remove the J1 and J4 terminal connectors.
2. Loosen the screws on the J1 and J4 terminal connectors.
3. Insert the wires from the host controller in the correct connector pins. See Figure 34 for quick reference for ABB Totalflow devices.

IMPORTANT NOTE: Wiring pinouts on ABB Totalflow remote controllers or flow computers vary depending on the model installed in the field.

   a. Insert communication wires in CHANNEL 1 and CHANNEL 2 on J4.
   b. Insert power wires in the J1-1 (POWER +) and J1-2 (POWER –) pins.

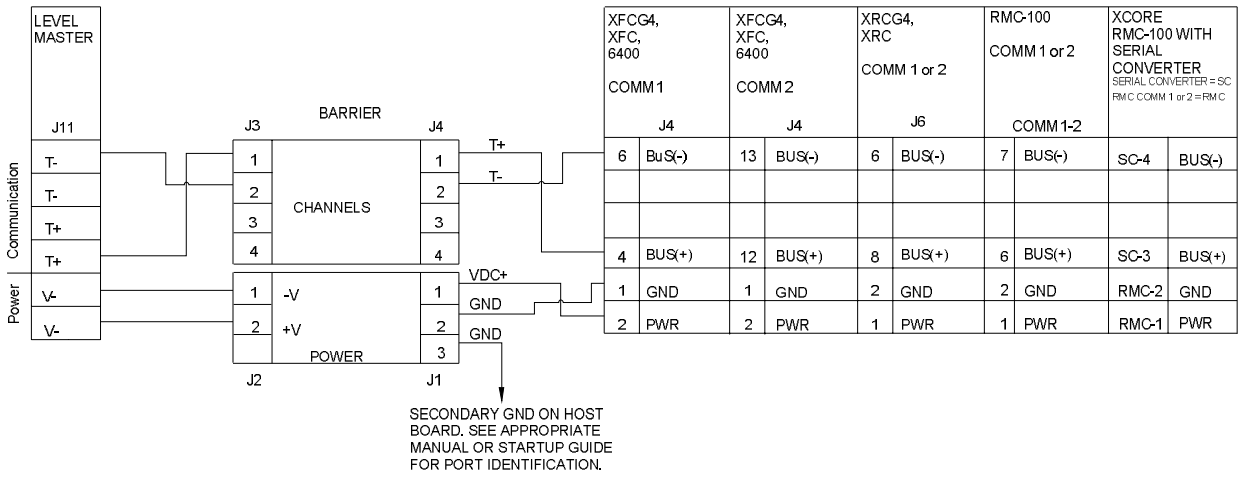

Figure 34: LevelMaster wiring to different types of ABB Totalflow host controllers through a safe barrier

4. Secure the inserted wires by tightening the connector screws.
5. Insert the J1 and J4 terminal connectors back on the barrier board.

4.6 Applying power to the LevelMaster

After completing all the wiring and securing the wires in the terminal connectors, it is important to verify that the wiring was done correctly and that the LevelMaster(s) can be powered.

To apply power and verify wiring:

1. On the host controller, ensure that the COM terminal connector is inserted back into the host controller board. If the host controller is powered, the COM port power pins have output power.
2. On the first LevelMaster, insert the power connector back into the board. This applies power to the LevelMaster.
3. Verify that the power LED (labeled D9 and located below the power connector) is not lit. If it is lit, it indicates that the wrong polarity has been used and it must be rewired to correct polarity.
4. Verify that the power LED does not light in additional LevelMasters that may be connected.
5. When verification of wiring is complete, remove the power connector from the LevelMaster electronic board and proceed to ground (section 4.7) or configure (section 5) the unit.

IMPORTANT NOTE: The LevelMaster can not be connected to the controller while being configured using MasterLink as there is only one communication port available. The power connector can be reconnected once configuration is complete and local communication cables are removed.

4.7 Grounding

WARNING – Bodily injury/ property damage. Grounding the LevelMaster in a hazardous location must meet the requirements as specified in the National Electrical Code (NEC) or the Canadian Electrical Code (CEC).

If an earth ground is available, ground the electronics board as follows:

1. Connect the EARTH connector to the ground connector as shown in Figure 35.
2. Jumper pins 2 and 3 on J12.

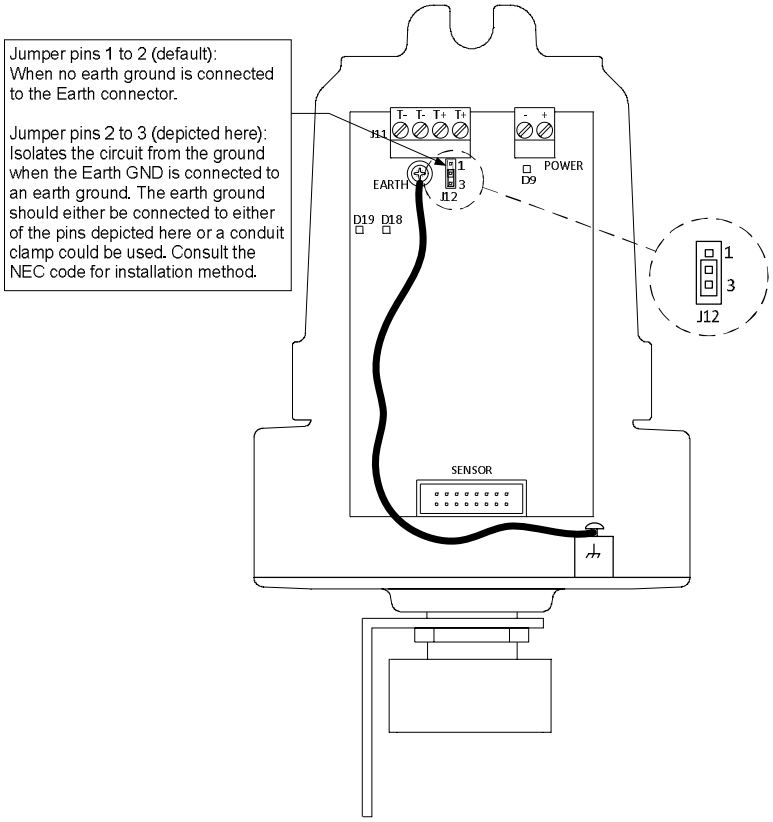

Figure 35: Grounding the electronics board

5 Configuring LevelMasters using MasterLink

This section includes the procedures for configuring and calibrating the LevelMaster(s) using the MasterLink software. Follow each of the procedures in the presented order to configure each LevelMaster being installed. For multi-unit installations that include host controllers, configure and connnect all the LevelMasters first.

The calibration procedure included in this section is performed only if the LevelMasters are not connected to a host to controller and if the customer has been able to perform manual level measurements. When host controllers are used, it is preferred that calibration be done through the controller to ensure calibration data is available for audit trail purposes.

It is recommeded that configuration be done with the electronics board removed from the enclosure. When installing several LevelMasters, all the electronics boards can be removed to be configured and tested before field installation. The procedures in this section assume the board has been removed from the LevelMaster enclosure.

IMPORTANT NOTE: Use MasterLink version 2.0 for initial configuration. This version is backwards compatible with LevelMasters with previous electronics board versions and float types. Before beginning the configuration, ensure that the correct MasterLink version is installed in the laptop or PC used to communicate with the LevelMaster. If not available, follow the installation procedure (section 5.1, *Installing MasterLink*).

All MasterLink screens have online help. Click **Help** to access additional information at any time if needed.

5.1 Installing MasterLink

MasterLink version 2.0 or later is required to configure the LevelMaster. Version 2.0 or later supports all board versions and all floats types.

IMPORTANT NOTES: Installation of the MasterLink version 2.0 does not upgrade an existing MasterLink version. The new version is a new installation independent of the previous version and therefore there could be two separate instances of MasterLink in the same laptop. The new instance will not have any existing configuration files because they are not automatically available in the new installation directory. To continue managing all the installed LevelMasters with MasterLink 2.0, configuration files may be copied to the new installation directory.

To install software:

1. Go to the Liquid level sensor LevelMaster 7100 link. This link is the LevelMaster product page on the ABB website. If no access to the website is possible. See the Contact us section in the back of this manual for support.
2. Click the **Downloads** tab.
3. Scroll down to locate and select **Software**.
4. Click the **PDF** icon to download the software.
5. Install the software on the PC or laptop that will connect to the LevelMaster. Take note of the path of the installed directory.
6. (Optional) To manage previously installed LevelMasters, copy any required data (configuration) files from the older MasterLink installation to the new main installation folder. Data files have the .dat and .tlm extensions and reside in the main MasterLink directory by default. The .dat files contain configuration and calibration data. The .tlm files contain location files. The location files define the names of the location and the LevelMasters at those locations. The number of configuration or location files depends on the number of units and locations.

IMPORTANT NOTES: If the files from the old MasterLink directory were kept with their default names, they will overwrite files with the same default names in the new MasterLink main folder. To avoid overwriting any default files in the new installation, rename the files being copied or save into another folder.

5.2 Connecting to the LevelMaster

Configuring the LevelMaster requires local communication with a laptop running the MasterLink software. Depending on the type of location, the laptop can be used as follows:

— In non-hazardous locations (general-purpose installations), the laptop can be directly connected to the LevelMaster. The laptop can be taken to the top of the tank and plugged directly into the LevelMaster's electronics board.

— In hazardous locations, the laptop must be connected through the barrier board. No direct connection to the LevelMaster is permitted.

IMPORTANT NOTES: Electronics boards can be removed from the enclosure for configuration purposes if remaining at the top of the tank during configuration is not possible or safe. The cables designed to connect the laptop to the board have batteries which power the LevelMaster during local connection, eliminating the need for an external power source. If boards are removed from the LevelMaster for configuration, they can be reinstalled for final wiring and verification. Consider removing the board from the enclosure for convenience during initial configuration. The removable terminal connectors can be easily unplugged and inserted back in without disturbing the wiring previously completed.

5.2.1 Preparing cables for local connection

The cables required for connecting the laptop to the LevelMaster depend on the board version. Table 4: *Cables and adapters for direct connection to the LevelMaster*, describes several options. The pictures of the assembly of the cables is replicated in this section for convenience. The converter cables, adapters, and USB adapters must be all be connected to be able to attach the laptop to the LevelMaster. The cables and adapters described in this section are included as examples. Additional cable lengths and variations are available for purchase from ABB.

To assemble the cable and adapters for connection:

1. Connect the RS-485-to-RS-232 converter to the cable adapter.

   a. For boards part number 2104836-001, connect the RS-485-to-RS-232 converter (2100241 – 005) to the cable adapter (2100250 – 002), the cable with two separate terminal connectors at one end (Figure 36).

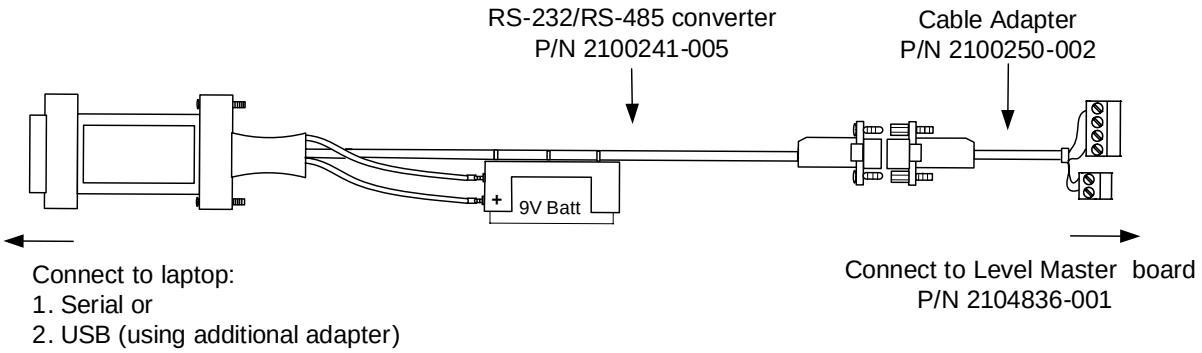

Figure 36: Cable and adapters for local communications (2104836-001 boards)

   b. For boards part number 2018546-005 (legacy boards), connect the RS-485-to-RS-232 converter (2100241 - 002) to the cable adapter (2100250 – 001), the cable with a single terminal connector at one end (Figure 37).

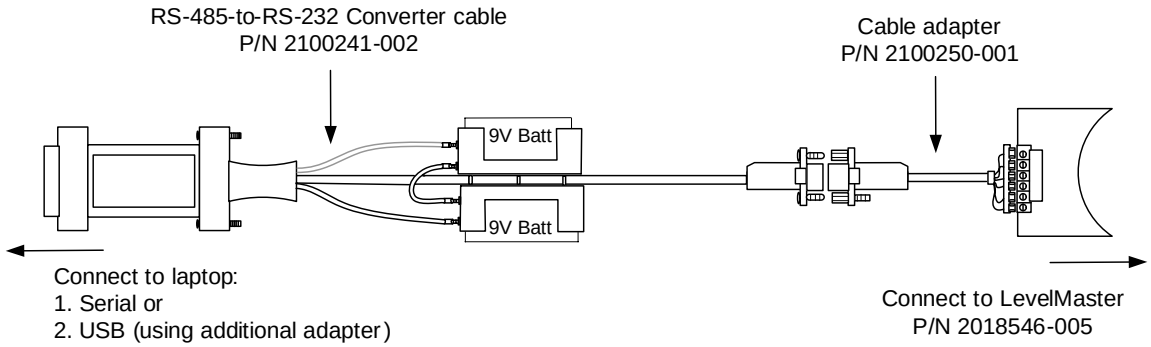

Figure 37: Cable and adapters for local communication (2018546-005 boards)

2. If using a USB port on the laptop, connect the RS-485-to-RS-232 converter cable to the Digi® Edgeport/1 USB Converter (USB-to-serial adapter).
3. Connect the red wire connector to the positive terminal on the cable battery. The cable battery supplies the power to the board during local communication.

5.2.2 Connecting the laptop to the LevelMaster

This procedure removes the board from the enclosure for convenience. During local communication, the board does not need to be powered from a source other than the battery on the cable used for connection with the laptop.

CAUTION – Equipment damage. A static electric discharge can result in damage to the electronics board. Wear a grounding strap to eliminate static electricity when connecting or disconnecting terminal connectors to and from the board or when handling the board during removal. Use an anti-static bag to store the board if moved.

To connect the laptop to the board:

1. Remove the power and communication terminal connectors from the board. Removing the plugs does not disturb the wiring previously completed.
2. Remove the board from the enclosure.
3. Using the correct cable and adapters, connect the laptop to the board (Figure 38).
   a. Plug the communication and power connectors of the cable to their corresponding ports on the board.
   b. Plug the RS-232-to-RS-485 converter to the USB converter (if using the laptop USB port).
   c. Plug the USB converter to the USB port on the laptop.

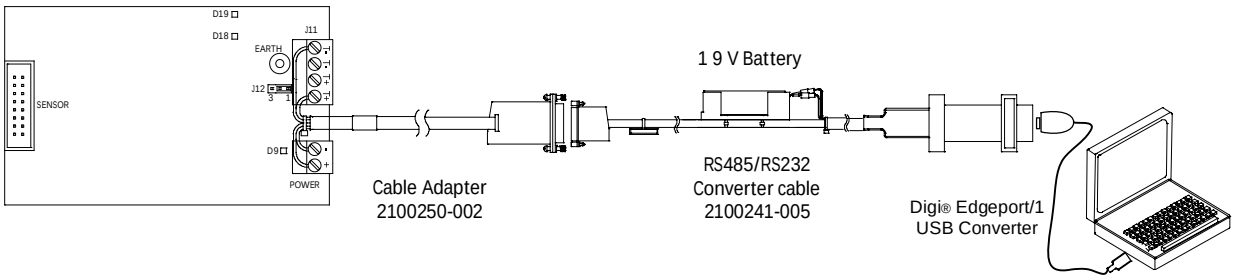

Figure 38: Connecting the laptop to the electronics board

IMPORTANT NOTES: For boards part number 2018546-005 (legacy boards), the MasteLink cable will not operate with the fourth jumper installed (JP1 pins 7 and 8 jumpered on the only or last sensor). Remove this jumper when connecting directly to the electronics board for local communication (during configuration). Once configuration is complete and local communication is terminated, the jumper can be placed again as required for the terminating sensor. See section 4.1.3, *Onboard termination jumpers (legacy boards only)*.

4. Proceed to configure the board as described in section 5.3, *Configuring the first LevelMaster.*

5.3 Configuring the first LevelMaster

Initial configuration of the LevelMaster includes basic parameter configuration and calibration. The procedures in this section configures the LevelMaster to be able to communicate with the host controller and additional devices and to adjust level readings to reflect field conditions and manual measurements. If wishing to save the factory configuration and calibration data before making any changes, perform the procedure in section 8.9, *Preserve sensor data and configuration*.

IMPORTANT NOTES: Referring to a LevelMaster as the "first" serves to identify the unit with the direct connection to the host controller on a RS-485 bus, once field wiring is completed. The procedures in this section are applicable to the configuration of any additional LevelMasters.

5.3.1 Basic configuration

Basic parameter configuration includes configuring the LevelMaster ID and baud rate for communication with the host controller and other LevelMasters. The factory default ID and baud rate are set to 1 and 9600 respectively. Configure as follows:

— Assign a unique ID. If installing several units, each must have its own ID.

— Assign the desired baud rate (1200, 9600 or 19200). All LevelMasters on a bus, as well as the host controller, must be configured with the same baud rate. Mismatch in communication speed will prevent communication.

IMPORTANT NOTES: To manage multiple locations and LevelMasters for large installations, the MasterLink software provides the option to identify LevelMasters and their location by allowing the assignment of location and unit names. This information is automatically retained in a location file created by the software. Several location files can be created to reflect different customer sites, if needed, to keep them separate. Locations and units are displayed by the MasterLink main screen in tree view format to ease unit selection for configuration or monitoring.

The procedure included in this section assumes that a new location file is being created for the new LevelMaster(s) being installed. Adding the LevelMaster to an existing location, for which a location file was previously created, may require opening the existing file (if it is not the one automatically displayed). If the file was created with a previous version of MasterLink, click **Location** from the file menu and select **Open Location File**. Click on the appropriate file name and click **Open**.

To configure the new board:

1. Start the MasterLink version 2.0 software. The main screen displays (Figure 39). If no default location file is opened, the screen displays no location or existing LevelMasters.

Figure 39: MasterLink main screen

2. Select location.

   a. If no location exists or a new location is to be used, right-click inside the screen (white area) and select **Add New Location**.

      i. Enter up to 25 characters for a location name.

ii. Click **OK** to save the name. Verify that the location name is created and displayed.

iii. Select the location (ensure it is highlighted).

b. If the desired location has been created and is displayed, select the location (ensure it is highlighted).

3. Click the **Comm. Port** drop-down list.
4. Select the laptop communication port used.
5. Leave Baud Rate at 9600 (factory default). It is assumed that the unit is new and is still configured with its factory defaults.
6. Click **Setup LevelMaster**. The New LevelMaster Setup window displays (Figure 40).

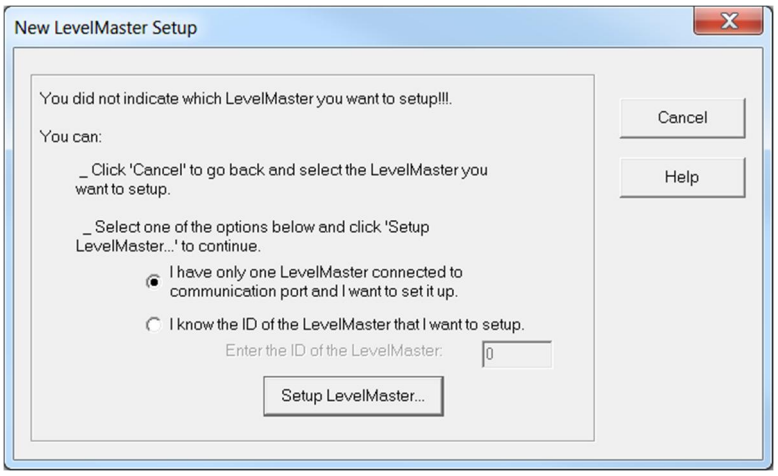

Figure 40: New LevelMaster Setup

7. Select **I have only one LevelMaster connected to communication port and I want to set it up**.
8. Click **Setup LevelMaster**.
9. When prompted to add the LevelMaster to the list, click **Yes**.
10. When prompted for the LevelMaster name, type up to 15 characters and click **OK**. The name will be stored in the location file and associated with the newly created location.
11. Observe the messages displayed on the monitor screen (Figure 41). Verify that the communication is successful. The screen should indicate the number of tries and 100% success. If errors are displayed and communication is not established, verify that the cables and adapters are properly attached and that the correct laptop port and baud rate were selected. If unable to communicate, see the contact information on the back of this manual for support.

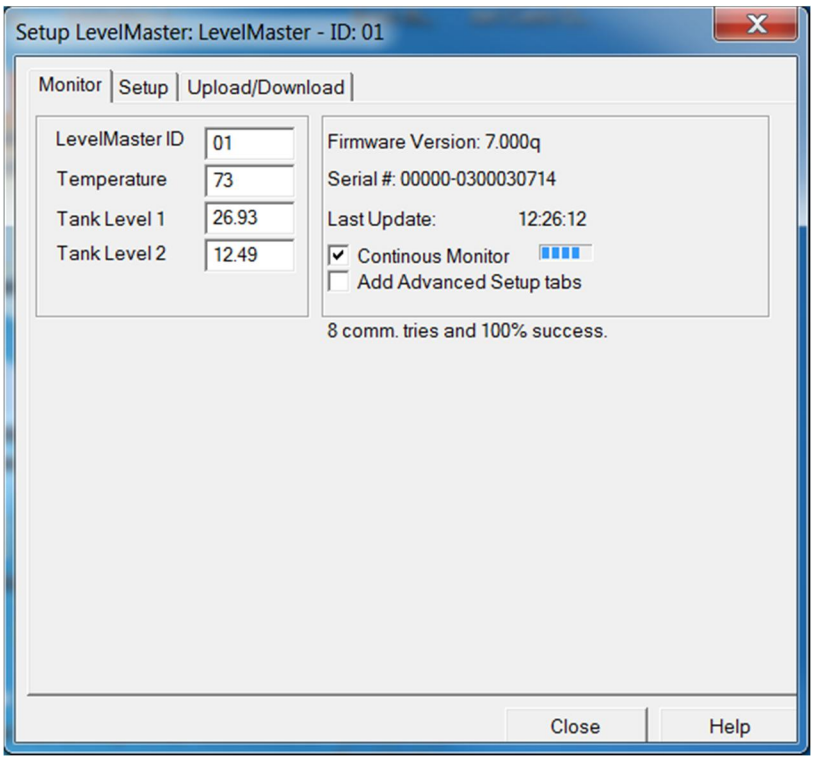

Figure 41: MasterLink Monitor tab

12. Click the **Setup** tab.

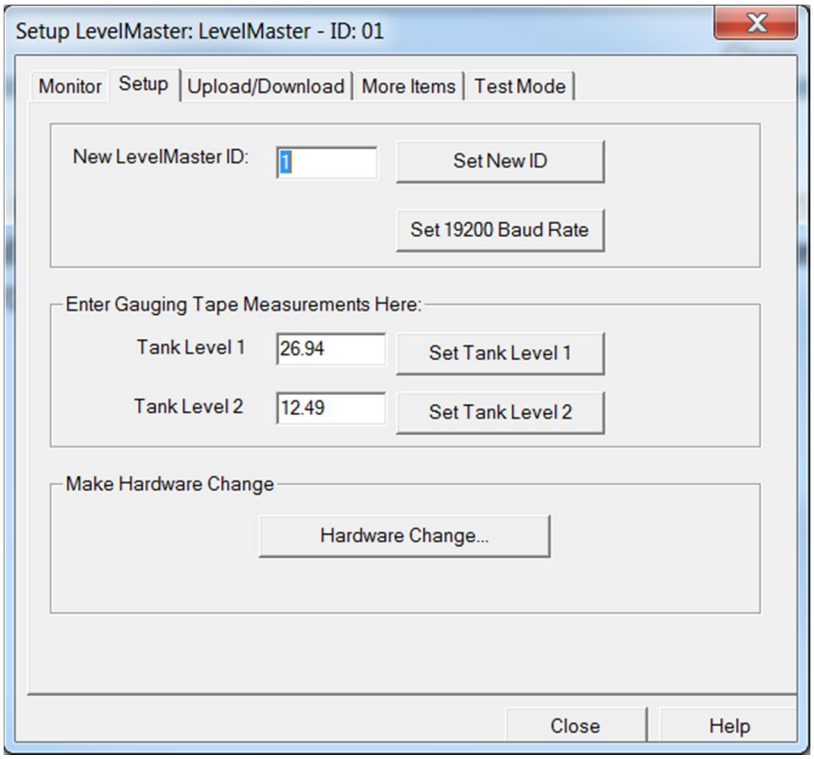

Figure 42: MasterLink Setup tab

13. In the New LevelMaster ID field, type a number from 1 to 99 for the ID. Take note of the ID used and ensure it is not used for any of the other LevelMasters on the site if all are connected on a common RS-485 bus. Each ID on the bus must be unique for communication to succeed.

14. Click **Set New ID**. A notification will appear when this is complete.
15. Click **OK**.
16. When prompted to update to reflect the new ID, click **Yes**. The ID is saved in the location file associated with the LevelMaster and will be displayed on the main screen when the LevelMaster is selected.
17. If the unit will be connected to additional units, configure termination RS-485 if needed.
    a. If the LevelMaster is an intermediate unit on the bus, there is no need to change configuration for termination. The factory default sets the unit as intermediate. Proceed as follows:
        i. If connecting to an ABB Totalflow host controller, proceed to section 6, *Configuring the host controller.*
        ii. If the unit is not connected to an ABB Totalflow host controller, proceed to calibrate the unit or add level bias in section 5.3.3, *Calibration (standalone installations only)*.
    b. If the LevelMaster is the only unit installed or it is the last unit on an RS-485 bus, proceed to section 5.3.2, *Configuring RS-485 bus termination*.

5.3.2 Configuring RS-485 bus termination

Use this procedure in order to eliminate signal echo if the LevelMaster is the only unit or the last unit on an RS-485 bus. This procedure applies to boards with part number 2104836-001.

To configure termination:

1. Click on the **Monitor** tab and select the **Add Advanced Setup** tabs. Additional tabs display.
2. Click the **More items** tab.
3. Select **Show memory map**.
4. Scroll down to locate the 844 memory address. The description of this memory location is "RS485 bus termination" (Figure 43).

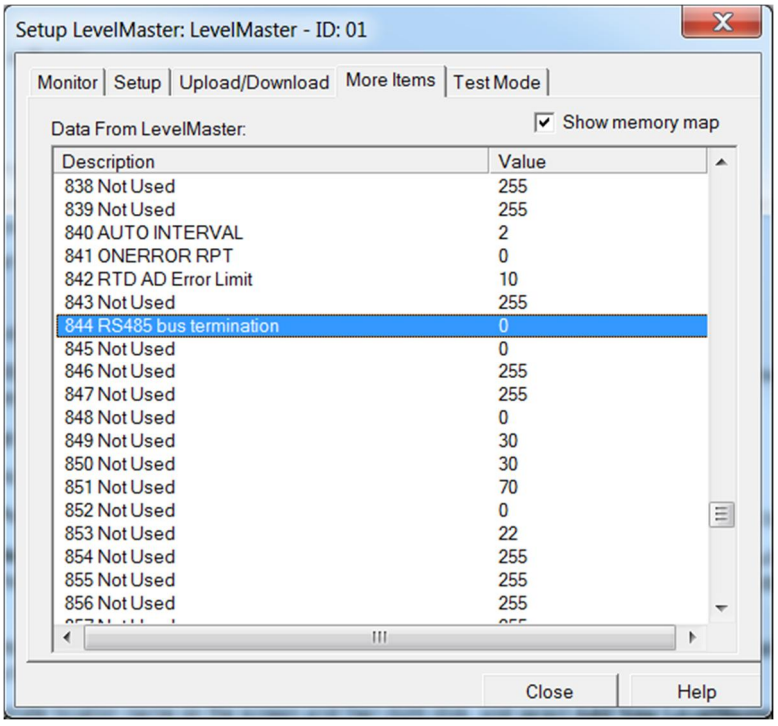

Figure 43: RS-485 termination

5. Double-click on **844 RS485 bus termination**.
6. When the edit box displays (Figure 44), if the value is 0, change the value to 1. The value of 1 configures the unit as the only or last sensor on the RS-485 bus.

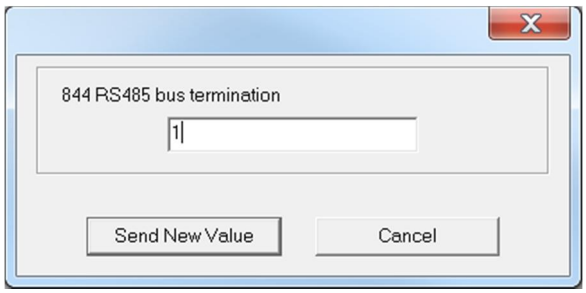

Figure 44: Configure the LevelMaster to terminate the RS-485 bus

7. Click **Send New Value**.
8. Verify that the RS-485 termination address is now set to 1 (Figure 45).

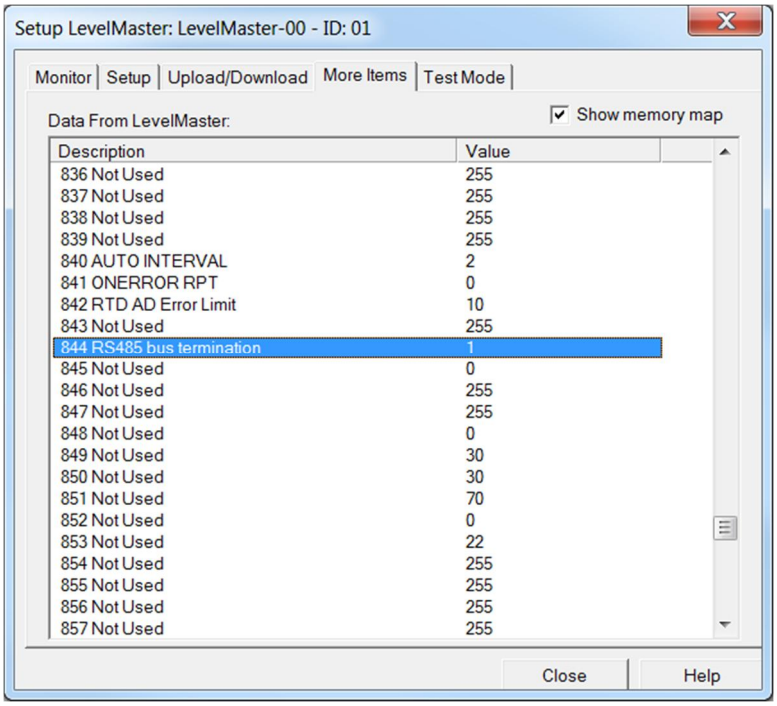

Figure 45: RS-485 termination configuration for only or last LevelMaster

IMPORTANT NOTE: The RS-485 bus termination value for intermediate LevelMasters on the RS-485 bus should be 0. Units are configured as intermediate sensors by default.

9. If connecting to an ABB Totalflow host controller directly or through the RS-485 bus, proceed to section 6, *Configuring the host controller*.
10. If the unit is not connected to an ABB Totalflow host controller, proceed to calibrate the unit or add level bias in section 5.3.3, *Calibration (standalone installations only)*, next.

5.3.3 Calibration (standalone installations only)

Although the LevelMaster is a highly accurate factory-calibrated device, there can be subtle discrepancies that may require the floats to be calibrated in the field. For example, discrepancies such as the specific gravity of the fluid being slightly different than what the float was calibrated for, may cause the float to sit slightly higher or lower in the fluid, resulting in less precision in the measurement reading.

Calibrating the float in the field in this case is done by determining a new level factor and making a positive or negative adjustment to the level. This is called a bias.

If the user has been manually gauging the levels and is confident that the measurements are accurate, determine the need to set a bias by comparing the reading level of each float to that of an actual measurement. If the level(s) differ significantly, the user can enter the manually-measured levels in the LevelMaster to automatically generate calibration offset values.

IMPORTANT NOTES: Perform this procedure only if the LevelMaster(s) does not connect to a host controller (standalone installation). When a MasterLink is connected to a flow computer or remote controller, configuring a level bias is also possible through PCCU32. Adding a level bias through PCCU32 ensures that the record of the adjustment is kept in the audit trail. If planning to connect to a flow computer or remote controller, skip this procedure.

Because this procedure uses a direct connection using MasterLink, it must be performed before the card is installed back into the enclosure and field connections to additional LevelMasters are restored.

To calibrate using manual measurements:

1. On the Setup tab, under Enter gauging tape measurement, type the measured value for the upper (or only) level in the Tank Level 1 field.
2. Click **Set Tank Level 1**.
3. Click **OK** when prompted.
4. If the LevelMaster has two floats, enter the value for the lower level in the **Tank Level 2** field.
5. Click **Set Tank Level 2**.
6. Click **OK** when prompted.
7. Follow the procedure in section 5.3.4, *Verify calibration (standalone installations only),* once the electronics board is inserted back into the enclosure and connected to the sensor.

5.3.4 Verify calibration (standalone installations only)

Perform this procedure only if the calibration was done through MasterLink as described in section 5.3.3, *Calibration (standalone installations only)*, above.

IMPORTANT NOTE: Verification of calibration consists of verifying that the actual level readings of the LevelMaster, once inserted in the tank, agree with the tank levels inserted manually. Follow the steps below once the electronics board is inserted back into the enclosure and connected to the sensor. It is assumed that the unit has already been inserted into the tank and the configuration was done with the electronics board removed from the unit.

1. Reinstall the electronics board in the enclosure and connect to the sensor.
2. Reconnect the laptop to the electronics board and restablish communication.
3. Once succesfully connected, click on the **Monitor** tab.
4. Check the **Continuous Monitor** box and wait for an update. The new reading(s) should agree with the entered value(s).

5.3.5 Save the LevelMaster configuration

After all configuration is completed, save the LevelMaster configuration for backup purposes. The following procedure creates a configuration file and saves it onto the laptop where it can be retrieved later if needed (see section 8.10, *Restore sensor data and configuration*). If the unit's configuration is inadvertently changed, corrupted, or there is need for part replacement, the configuration file can be used to restore the configuration of the LevelMaster, saving configuration time. A configuration file stores calibration data as well.

To save the configuration of the LevelMaster:

1. Click **Upload/Download**.
2. Under Read data from the LevelMaster and save them to file, use the default path and file name displayed or select a different path and/or user-defined file name. (If changing the name, ensure the file keeps the .dat extension.) The default name is the base serial number of the LevelMaster.

IMPORTANT NOTE: The default path for the saved file depends on the MasterLink version used. The files are automatically saved in the main installation directory of each version. Make sure to take note of the name of the file and the location chosen.

3. Click **Read and Save Data to File**.
4. Click **OK** when saving the configuration is complete.

5.3.6 Save the location file with a different name (optional)

New locations and new LevelMasters are saved automatically in the MasterLink default file (called FirstSetup) unless the file is saved with a different name. If there are several large locations with many tanks, it is recommended to create different location files. If desired, the file created during configuration can be given a name different than the default. Note that if the location file saved in this procedure is the last viewed file, it is automatically reopened the next time MasterLink is started. If additional LevelMasters are added to the same location in the procedure in section 5.4, *Configuring additional LevelMasters*, there is no need to perform this procedure again.

To save the location file with a different name:

1. Select **Location** from the file menu at the top of the window.
2. On the main MasterLink screen, on the top tool bar, click the diskette icon. The file browser displays the main MasterLink directory, the default directory for location files.
3. Type the desired file name and click **Save**. Take note of the name and location of the saved file (if not using the default folder).

5.3.7 Restore field wiring connections

When all configuration is completed and saved, and calibration (if performed) is verified, ensure that the field wiring connections are restored.

IMPORTANT NOTE: If the electronics boards are removed for configuration, final verification of communication on the RS-485 bus will need to take place once all boards are installed back into their enclosures and the field wiring connections are restored. The first LevelMaster must also be connected to the host controller. Verification of communication can be done by checking if measurement readings are received error-free by the host controller and displayed on the host controller interface software.

To establish and verify field wiring connections:

1. Reinsert the electronics board in its enclosure.
2. Connect the board to the sensor.
3. Insert terminal connectors into the power and communication ports.

IMPORTANT NOTE: Communication port LEDs will not light up until communication begins with the flow computer or remote controller. When the flow computer or remote controller port is activated and assigned to the LevelMaster, LEDs D19 and D18 should indicate receiving and sending data from and to the host controller. Communication status can also be monitored from the controller LCD display, so that there is no need to keep the enclosure of the LevelMaster removed.

4. Reinstall and secure the enclosure cover.
5. If this is a standalone installation, the configuration is completed.
6. If additional LevelMasters are being installed, configure the next LevelMaster.
7. Proceed to configure the host controller for communication with the LevelMaster(s) in section 6, *Configuring the host controller.*

5.4 Configuring additional LevelMasters

IMPORTANT NOTE: Make sure that the units have the correct RS-485 termination configuration. The last unit must terminate the bus.

To configure additional LevelMasters:

1. Close the MasterLink screen.
2. Disconnect the laptop from the first or previous LevelMaster.
3. Connect the laptop to the additional LevelMaster.
4. Follow the procedures in section 5.3, *Configuring the first LevelMaster.*

IMPORTANT NOTES: It is assumed that the additional LevelMaster will be defined under the same location name as the first LevelMaster and therefore it will be stored in the same location file. MasterLink opens the default location file or the file that was last saved in the procedure in section 5.3.6, *Save the location file with a different name.*
Ensure a unique ID is assigned to the LevelMaster.

5. Repeat steps 1 through 4 for each additional LevelMaster.

6 Configuring the host controller

The procedures included in this section describe the configuration of the ABB Totalfllow host controller to support the LevelMaster. The host controller can be a flow computer or remote controller in the Totalflow product family. The term host controller may be used to refer to either type of product.

IMPORTANT NOTE: The installation and configuration of the host controller (remote controller or flow computers) is beyond the scope of this manual. Only pertinent details to their interface and communication configuration with the LevelMaster are included in this manual. Refer to the user manual and the help files in PCCU32 for details.

This manual focuses on procedures when using ABB Totalflow products. If using third-party control equipment, consult their respective user manuals.

Flow computers or remote controllers can be configured to poll the LevelMaster at user-programmable intervals and can store the current level and temperature measurements. LevelMaster measurements received by the host controller can also be used by other control applications, enabled in the host controller, for level control if required. Tank level and temperature measurement data received from the LevelMaster is available on the controller for retrieval by PCCU32 or WinCCU32.

The configuration consists of setting up the LevelMaster application which handles the connection with the LevelMaster within the host controller. The configuration involves:

- Setup of the communication parameters for RS-485 communication between the host controller and the LevelMaster
- Defining the number of LevelMasters that will be connected (number of tanks)
- Setup of the controller display for visual display of LevelMaster alarms or status
- Setup of the controller for volume calculation

IMPORTANT NOTE: The LevelMaster application has online help files that can be displayed by clicking **Help** from the LevelMaster screens in PCCU32.

Configuration procedures may vary depending on the product model used as well the PCCU32 version used. Table 7 provides the PCCU version numbers for different generations of Totalflow equipment.

Table 7: PCCU32 versions supporting the LevelMaster application

Software	Hardware
PCCU32 4.30–6.xx	XFC, XRC
PCCU32 7.00 or later	XFC^{G4} XRC^{G4}
PCCU32 7.59 or later	RMC-100

Tools required:

- Laptop computer
- Applicable PCCU32 version (see Table 7)
- MMI cable (RS-232), USB cable or Ethernet cable (depending on what port is available for local communication on the host controller)

6.1 Activate the LevelMaster application

The LevelMaster application may or may not be activated in the host controller. The following procedure provides steps to activate the application.

IMPORTANT NOTE: This procedure assumes that there are no other LevelMaster applications already activated. To activate, administrative access to the security system is required. See the online help files in PCCU32 for more information.

To activate the LevelMaster application:

1. Connect the laptop running PCCU32 to the host controller with either an MMI cable (RS-232), a USB cable or an Ethernet cable.
2. Start PCCU.
3. Click **Operate** on the tool bar.
4. Open the pull-down menu and move down to **Security**.
5. Select **Login** from the cascading menu.
6. Enter the user name and password for administrative access.
7. Click **Enter**.

IMPORTANT NOTE: The status bar across the bottom of the PCCU screen displays the status of the connection and the computer user login name.

8. To establish a connection to the flow computer, click the **Connect to Totalflow** icon and then click **Entry**. Or go directly to the Entry screen by clicking the **Entry** icon.
9. Click on the **Station ID** in the tree-view Entry screen. If there are multiple stations, select the location being set up in the tree-view so that it is highlighted.
10. Click the **Applications** tab.

IMPORTANT NOTE: This procedure assumes that the basic applications used by the flow computer are already instantiated. See the PCCU help files for more information about setting up the flow computer or remote controller and instantiating applications.

11. Click **Add App**.
12. Click the **Application to Add** drop down list.
13. Locate and select **LevelMaster**. If this is the first instance of the LevelMaster application being activated, the default slot for the application (App number) is 51. The application number for LevelMaster can be slot 51 through 55. Use the suggested application number. Take note of the application number for a later step.
14. Click **OK**.
15. Click **Send** to save and activate the LevelMaster application.
16. Select **OK**, when prompted. The LevelMaster application displays in the list and is shown in the navigation tree (Figure 46).

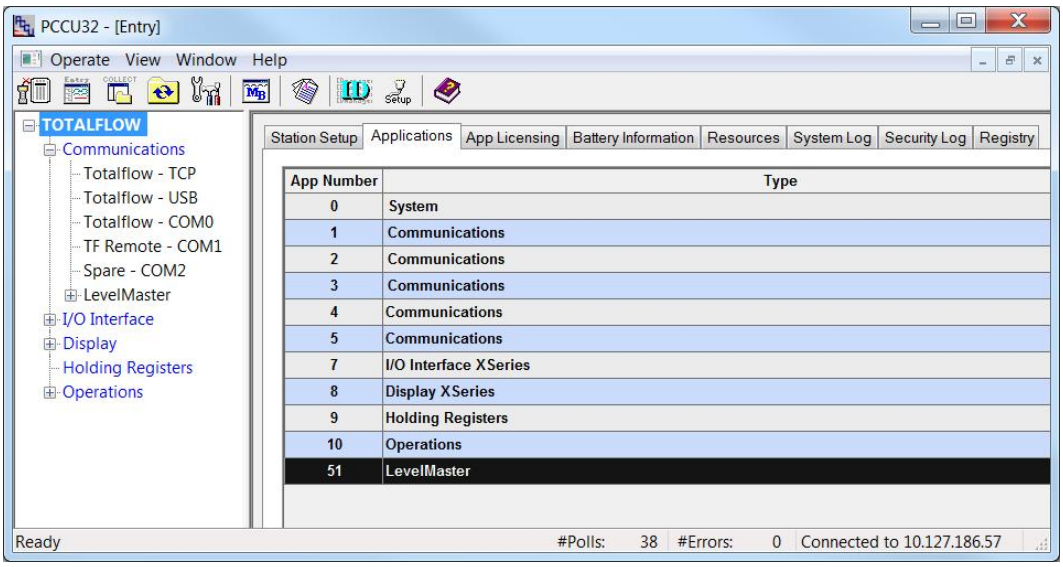

Figure 46: Activating the LevelMaster application

17. Remain on the main PCCU32 screen.
18. Proceed to section 6.2, *Set up general and communications*, next.

6.2 Set up general and communications parameters

The following information will detail the steps to set up the number of tanks and assign the communications port for the LevelMaster.

IMPORTANT NOTE: For XFCs or XRCs, ensure that the serial communication port has the correct communication module (RS-485). For RMC-100s, ensure that the hot-swappable module is inserted and set for RS-485 operation.

To set up the number of tanks and communications parameters:

1. Expand the **Communications** node in the navigation tree.
2. Expand the **LevelMaster** node in the navigation tree.
3. Click **Setup** under LevelMaster.
4. On the **Setup** tab, the value of the Device/APP ID may be changed. Any name change will be reflected in the tree-view. (Figure 47).
5. Type the number of tanks that will handled by the application. Figure 47 displays an application handling 2 tanks.
6. Click **Send**.

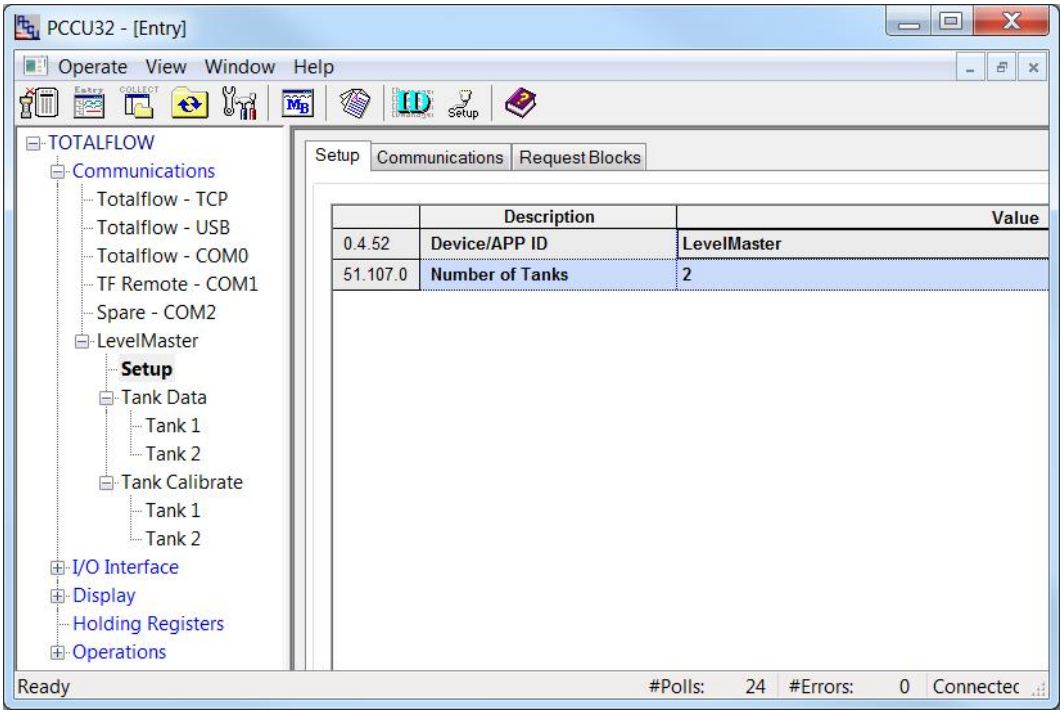

Figure 47: LevelMaster application Setup tab

7. Select the **Communications** tab (Figure 48). For the purpose of these instructions, it is assumed that COM2 will be used.
8. Type **"COM2:"** in the serial port field.
9. Click **Send**. This will assign COM port 2 to the LevelMaster.

IMPORTANT NOTE: Based on the configuration files that were loaded onto the board, the remaining field default values should be sufficient to begin operation.

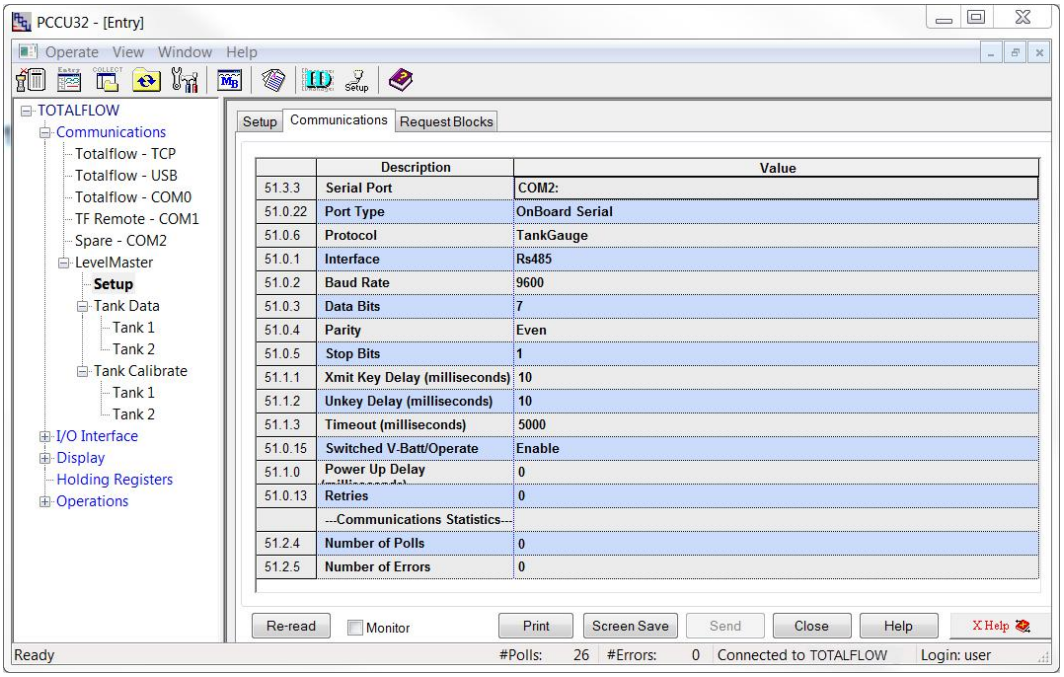

Figure 48: LevelMaster application Communications tab

6.3 Set up the LevelMaster request blocks files

In order for a Totalflow device to poll a LevelMaster and retrieve its data, there must be a MODBUS® request block file for each tank. This procedure creates a file to hold the data for each tank.

To set up the LevelMaster request block files:

1. Select the **Request Blocks** tab (Figure 49).

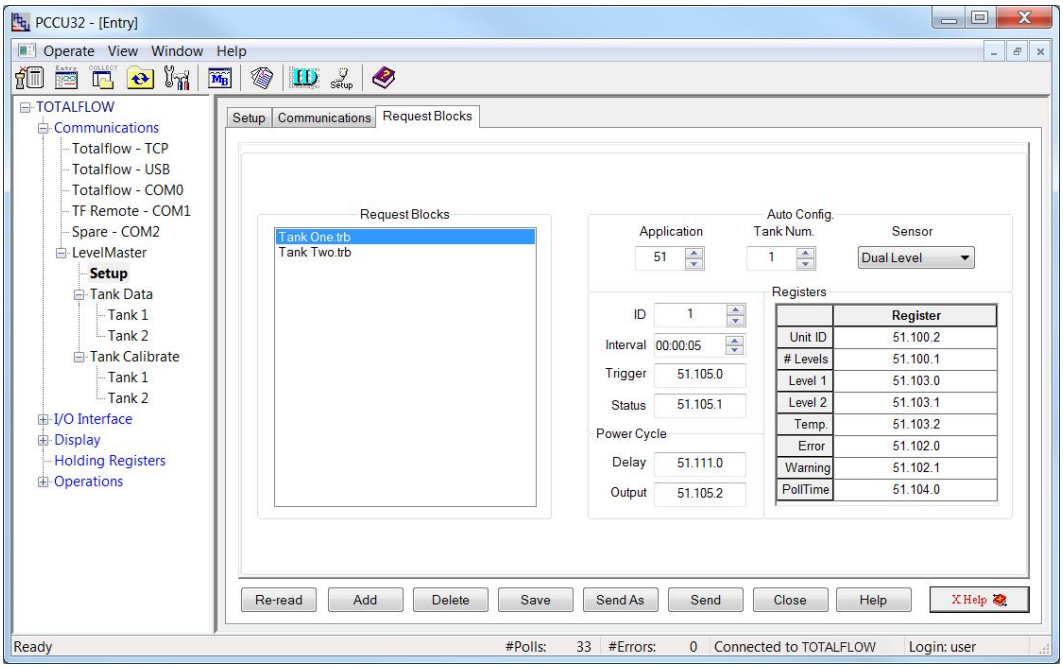

Figure 49: LevelMaster application request block files

2. Select **Add** and enter a file name for the tank this file will be associated with. If multiple tanks are being set up, assign a unique name for each tank.
3. Click **OK**.
4. Modify the application, if required, to reflect the application slot instantiated previously. In this instance, the application number is set to **51**.
5. Select the first tank number associated with the Tank Application.
6. Set Tank Number to **1**, in this instance. Additional tanks will follow incrementally after this number. In repeating instances for multiple tanks, change the tank number and ID for each new tank.
7. Set the correct number of sensors for this tank. In this instance, a Dual Level sensor is being used.
8. Modify the ID to match the unit ID. In this instance, set ID to **1**. Additional tanks will follow incrementally after this ID number.
9. Set the interval to the time desired between data requests. Typically, this is set to poll every **15** minutes.
10. Click **Send** to save the file on the flow computer or remote controller.
11. After adding each tank, click **Save** to save this file in PCCU to keep a copy for backup. In the Save Request File screen, the path may read like this: “C:/PCCU32/LMBlockRequest/TankReq1.TRB”.
12. It may be necessary to create the LMBlockRequest folder shown in this example. In repeating instances, append the file name with the tank number. For example, change 1 to 2, etc.
13. Repeat steps 2 through 12 if setting up more than one tank. Rename the file for each tank set up in step 2.
14. When files for all tanks are created and saved, proceed to configure the LCD display.

6.4 Configure the LCD display

The following procedure configures the host controller LCD display to show the status of the communication between the host controller and the LevelMaster. Displaying the status provides a quick visual identification of communication success or failure. The display allows the viewing of the LevelMaster Protocol “R” and Receive “¬ ” functions as the flow computer polls the LevelMaster for information.

IMPORTANT NOTE: If the enclosure is still removed and the electronics board is visible, LED D19 and D18 should be lit to indicate receiving and sending data from and to the host controller. Configuring the LCD to provide visual indication from the host controller is more convenient since access to the top of the tank to see the board is not required.

To set up the display and annunciator:

1. Make sure the LevelMaster and the controller are connected.
   a. Reconnect the communication and power connectors on the LevelMaster board.
   b. Reconnect the COM port connector on the controller if it was removed.
2. On the PCCU32 navigation tree, click **Display**.
3. Click on the **Annunciators** tab.
4. Determine which unassigned annunciator can be used to reflect the status of the communication port that has been dedicated to the LevelMaster.
5. On the navigation tree, click the node next to **LevelMaster Device ID**.
6. To view each tank, select the tank.
7. Click **Re-read** on the bottom of the screen.
8. Record the register number in the left-hand shaded column for each item that needs a display built. Do this for each tank that a display is being built for.
9. Click the node next to **Display**.
10. Click the **Display Group** to edit, or create a New Display Group. To create a New Display Group, see the PCCU32 help files.
11. On the Setup screen, the Group Description may be changed along with the Number of Displays.
12. Click **Send** if any changes were made to the Group Description or the Number of Displays. This will download the new application information to the flow computer. This requires the unit to reconnect automatically. A message screen will appear. Select **OK**.
13. Return to the **Display Group**.
14. Click on the first **Spare**. This will open the Item Setup screen for this item.
15. Modify the first display item by entering the Name of Display Item and entering the Register number for the value to be added.
16. Change the Display Interval to a minimum of five seconds. This may be changed to any length from 0 to 255 seconds. Entering 0 turns the display off. To modify any other values, see the PCCU32 help files for more information.
17. Click **Send**. The front display should start scrolling after going to the Entry screen.
18. Observe the annunciators to ensure communication success is indicated. If communication is successful, proceed to verifty that valid measurement readings are being received by the controller. See section 6.5, *Verify basic configuration*.

6.5 Verify basic configuration

Perform this procedure to verify that the host controller is communicating with the LevelMaster. If communication is taking place, level measurement(s) should be displayed.

To verify if measurements are being displayed:

1. Make sure the LevelMaster and the controller are connected.

a. Reconnect the communication and power connectors on the LevelMaster board.

b. Reconnect the COM port connector on the controller if it was removed.

2. On the navigation tree, select **LevelMaster** (Figure 50).

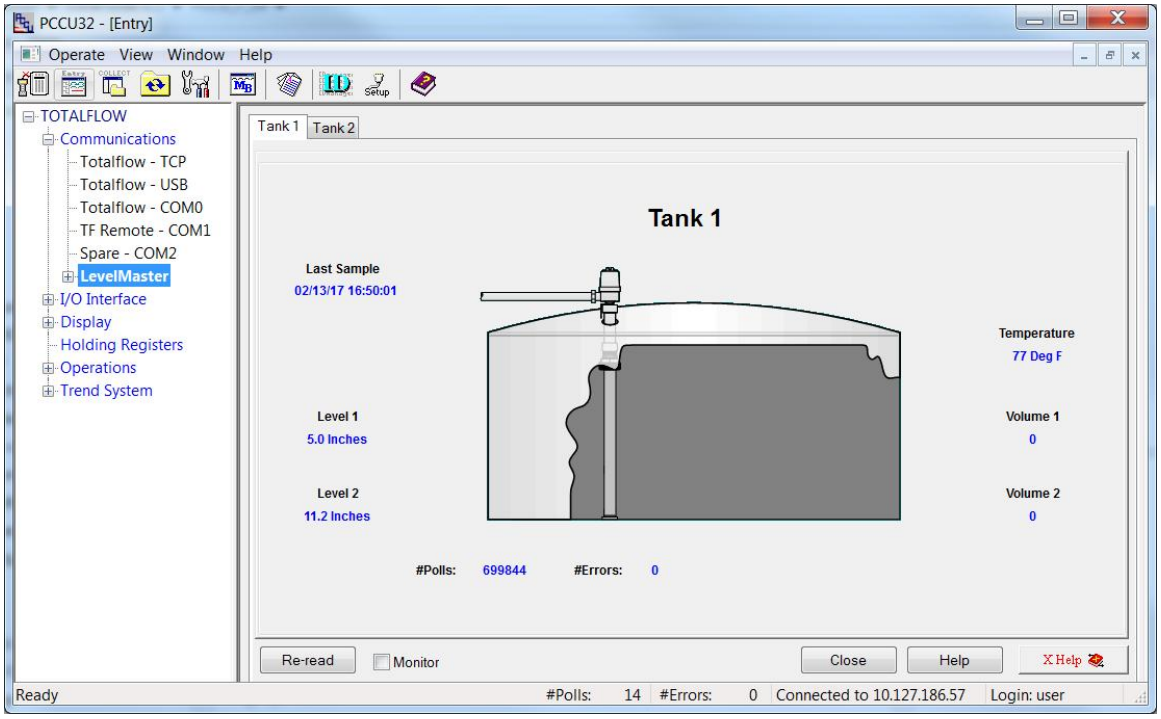

Figure 50: Verifying level and temperature measurements are received by host controller

3. For the first tank, verify that Level 1, Level 2, and Temperature measurements reflect expected values.

4. For additional tanks, select each corresponding tab, and verify that Level 1, Level 2, and Temperature measurements reflect expected values

5. Verify that there are no errors displayed.

6. If measurement values are not displayed, or invalid values are observed, take note of the error displayed and proceed to section 9, *Troubleshooting*.

IMPORTANT NOTES: Level measurement can be calibrated as needed as described in section 7.1, *Calibration for level measurement (level bias)*.

Volume calculations are not displayed until the unit is calibrated for volume. Configuration of the host controller for volume calculation is described in section 7.2, *Calibration for volume calculations*.

Additional verification is recommended after the calibration procedures are completed.

6.6 Configuring for data collection

Data collection from the LevelMaster can be accomplished in two ways:

— In standalone installations, communicate directly with the LevelMaster using the MasterLink software to read the measurements.

— In installations with a Totalflow host controller, communicate with the host controller and obtain the LevelMaster data it has received. The host controller trend application can be configured to store the LevelMaster data.

6.6.1 Configure trending

The Trend application can be configured to retain the LevelMaster data at a specific location from where they can later be retrieved. The trend functionality provides the ability to define which data from the LevelMaster will be trended. Each data item or variable is defined and the app/array/register address storing the variable value is configured.

IMPORTANT NOTES: Details about configuring trending on the flow computer or remote controller vary depending on the model number and the PCCU32 version used. Click **Help** for specifics about that version. For the purpose of illustration, PCCU32 version 7.59 has been used. It is assumed that the Trend application or functionality has already been activated. If not, and assistance is need, contact technical support.

Advanced users may configure the Trend function to use the Push-to-Read feature to poll on demand.

To configure the Trend application to store the LevelMaster data:

1. Determine the data item or variable that will be trended. For example: level 1 measurement for tank 1.
2. Determine the register (app/array/reg) address where the LevelMaster application is storing the chosen variable LevelMaster value.
   a. On the navigation tree, expand **Tank Data**.
   b. Click the desired tank.
   c. Locate the desired variable on the **Setup/Status** or **Levels** tabs (Figure 51).

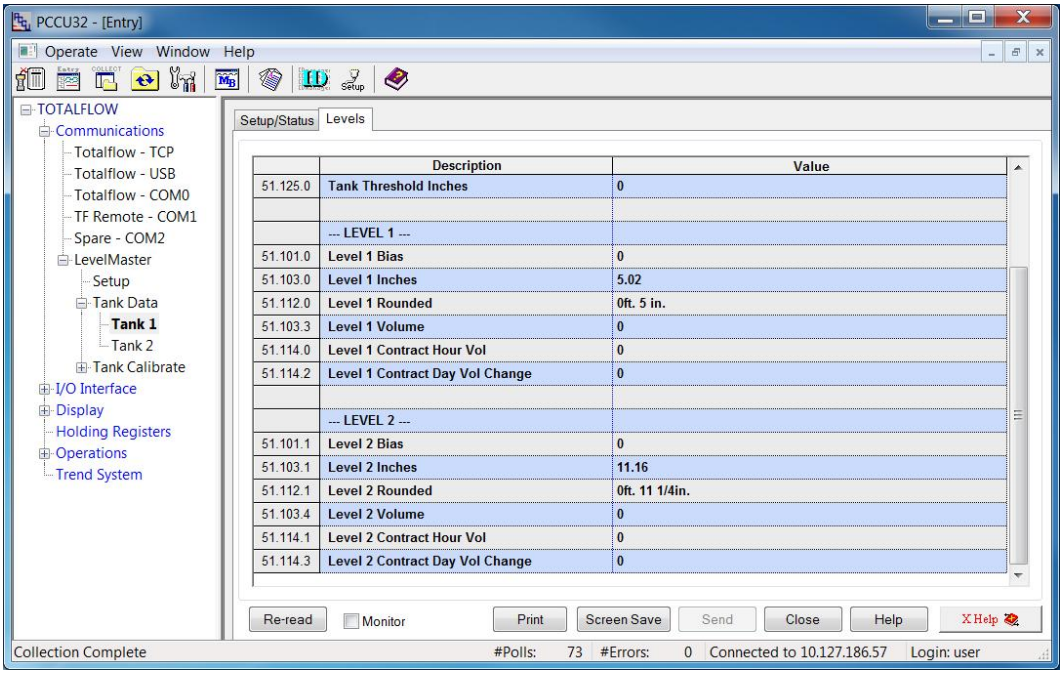

Figure 51: Determining register address for LevelMaster measurement values (Levels tab)

   d. Take note of the register address on the left of the description of the required variables.
3. On the navigation tree, click **Trend System**.
4. Click **Add**.
5. Type the name for the trend file and click **OK**. The name of the trend file which will contain the data for the LevelMaster is displayed in the Trend Files list.
6. Under the Variables section, click **Add**.
7. At the Trend Variable Configuration Window (Figure 52), type the desired variable parameters and register address determined in step 2 above, and click **OK**. The variable name and its units (if defined) are listed.

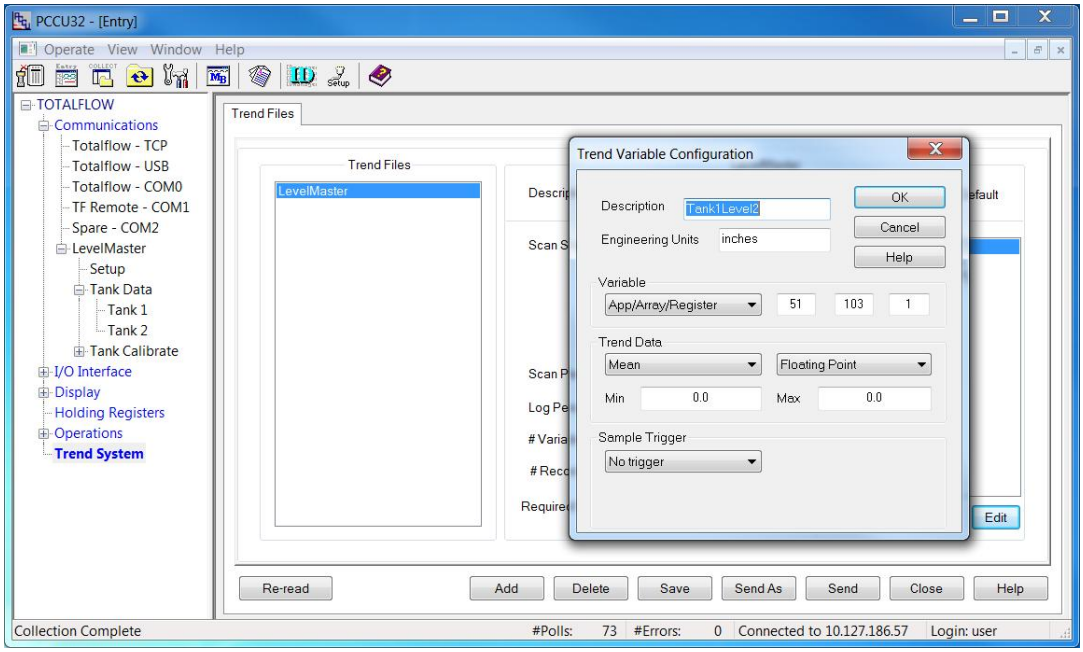

Figure 52: Adding a variable (measurement) to trend

8. Repeat steps 6 and 7 for additional LevelMaster data items or variables.
9. Click **Send** to save the configuration.
10. Test the configuration in the next procedure.

6.6.2 Test configuration by collecting the data

To verify that the variables were defined correctly:

1. Select the collect icon on the top tool bar.
2. At the collection screen, on the navigation tree, expand **TOTALFLOW**.
3. Expand **Trend files** and select the LevelMaster file.
4. Select **Screen** as ouput and click **Collect**.
5. Select the tab for the preferred view (graph or table) (Figure 53).Verify that the defined variables and their values are displayed as expected. Each variable defined in the trend file can be edited and corrected, or the variable can be deleted and redefined with the correct information from the Trend System screen.

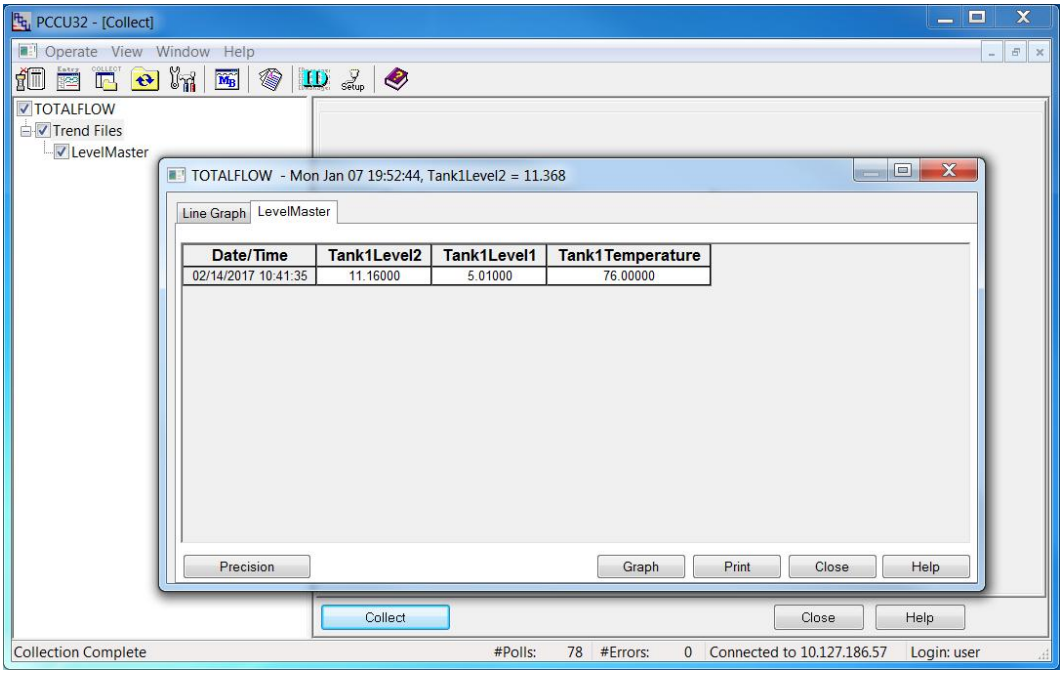

Figure 53: Verifying trending of the LevelMaster data (example)

6. Click **Close** to exit the screen output.
7. Click **Close** to exit collection screen and return to the main PCCU screen.
8. Proceed to save the configuration. If optional configurations are still required, save after completing those configurations.
9. Save the controller configuration to ensure that all the LevelMaster application configuration is preserved.

6.7 Save the configuration

As with any configuration of other applications on the host controller, saving the configuration of the flow computer or remote controller is recommended for backup purposes.

IMPORTANT NOTE: The procedure to save the configuration of the flow computer or remote controller varies depending on the model. For more details, refer to the specific user manual for the model used in the installation. This section provides the procedure for G3 and G4 devices as examples.

6.7.1 Saving the configuration files for a G4 flow computer

To save the configuration files for a G4 flow computer:

1. Click the Save and Restore icon (folder with circular arrows) on the PCCU top toolbar.
2. Click **Save Station Files**.
3. Chose the desired file path.
4. Ensure that the box is checked for **All Setup and Configuration Files**.
5. Click **OK.**
6. When prompted, select **Yes** or **No** to write (restore) configuration files to the TFCOLD data file.

6.7.2 Saving the configuration files for a G3 flow computer

To save the configuration files for a G3 flow computer:

1. Ensure that the Enable Memory Backup pins located on the flow computer board are set correctly. See the G3 user's manual or the PCCU32 help files for more information.

2. On the task bar, click **Operate>File Utilities>Save and Restore Utility.**
3. Click **Save Station Files**.
4. Select the file path to store a copy of the configuration. The destination directory may look like this: C:/PCCU32/Station Files/Station Name/.
5. Select the **All Setup or Configuration Files** box. Do not change either the Extension List or the From location.
6. Click **OK**. This may take a few minutes to complete.

IMPORTANT NOTE: If the save and restore function has been performed at a prior time, the program may state that the files already exist and ask if the user would like to Overwrite/Merge or Rename the existing file to a backup file. Choose preferred method.

7. Click **Yes** when prompted to copy the files to the S Drive. The Upload Completed! screen will appear.

IMPORTANT NOTE: The Destination Directory is now the Source Directory. This it is the location where the station files are saved on the computer's hard drive. The field **From location** is now called **Download To**, and the location is S:\. Do not change this.

8. Click **OK**.
9. Click **OK** when the Download Completed screen appears.

6.8 Duty cycling power (optional)

Duty cycling allows the host device to turn on power to the LevelMaster, collect data and then turn the power off. For systems operated using solar and battery power, each LevelMaster draws 1 mA power while idle and 40 mA during the read/collect function. The cycling is done via a digital output in the host software.

Setup is done in the host software and may be accomplished by setting the suggested parameters shown in Table 8. This feature is not required and can be enabled or disabled using the cycle option below. It is disabled by default. Example of digital output pinouts are provided in Figure 54, *Host hardware digital outputs*.

Table 8: Duty cycle parameters

Parameter	Description	Suggested settings
Cycle Option	Enables (on) or disables (off) the Duty Cycle option.	On or enable
Read Now	Setting this flag to Yes causes the host to initiate an immediate read from all of the LevelMasters. The flag then returns to the No state. The Scan Time counter is zeroed so that the next scheduled Scan Time is from the time this read was initiated.	No
Power DO	For the Duty Cycle option to work, the host turns the power on and off via one of its digital outputs. This parameter assigns the digital output connected. See Figure 54, *Host hardware digital outputs* for connection information.	DO 1
Power Up Time	This is a delay time in milliseconds from when the Power DO is energized until the read request is sent to the LevelMaster. This allows the LevelMaster to stabilize after power-up before requesting data.	1000 ms
Rd Freq.	This is the frequency the flow computer will read data from the LevelMaster in minutes. If the Cycle option is turned on, this Rd Freq. (scan time) overrides the Rd Freq. under the individual tank setups. If the Duty Cycle option is not enabled, the read frequency is established by the Scan Time in individual tank setups.	60 minutes
Rd Timeout	This is simply a counter that counts down to the next time data is requested from the LevelMaster. It is based on Rd Freq. above.	Not applicable

Additional parameters located on some screens may not be used for enabling and scheduling power cycling, for example: Push-to-Read, Read Now DI and Round To parameters. These may be used and set at other times.

IMPORTANT NOTE: See the *Contact us* information on the back of this manual for support with this configuration.

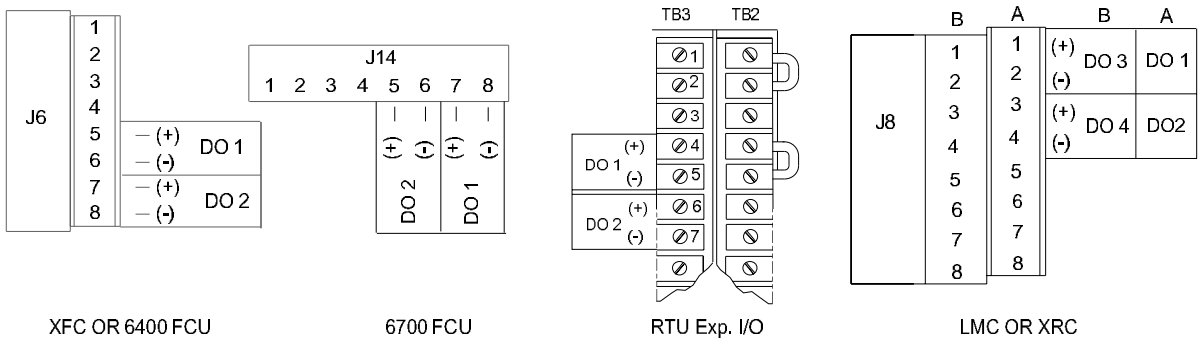

Figure 54: Host hardware digital outputs

6.9 Push-to-Read (optional)

The Push-to-Read function is applicable when the LevelMaster is powered from the Totalflow host controller (power provided by the serial RS-485 port on the controller). Normal function of these control units consists of a scrolling display of information. Because these units normally control and collect data from multiple devices, the Push-to-Read function is particularly useful to force communication with the LevelMaster and then display only those items programmed to display during the Push-to-Read operation. This is actually combining two separate but useful functions:

- Force poll of one or more LevelMasters: function before and after a sale
- Switch display to LevelMaster readings: goes directly to the information requested

6.9.1 Wiring the Push-to-Read input button

To wire the push-to-read input button:

1. Locate the pulse or digital input + and – on the main electronics board as shown in Figure 55.
2. Install the switch in the enclosure per the manufacturer's instructions, leaving enough wire to reach the location of the DI or PI.
3. Remove power from the main electronics board, and wire the switch into the connector. The connector is removable from the board to aid in field wiring.

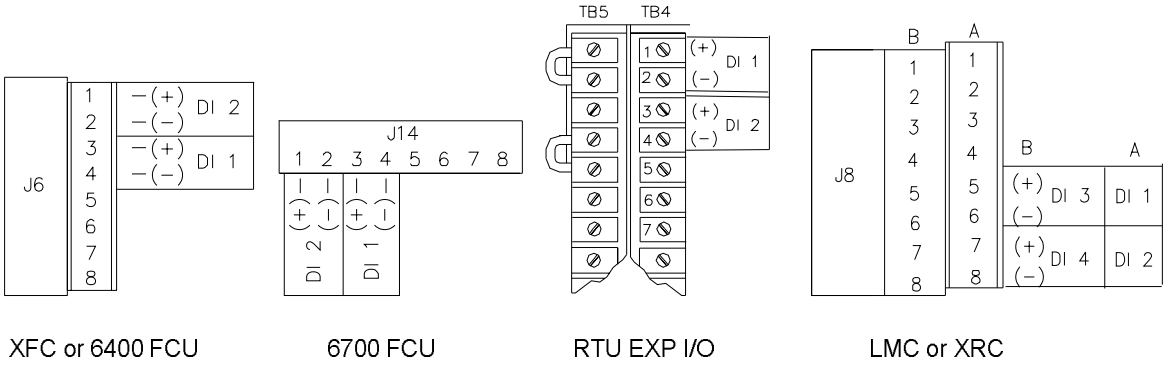

Figure 55: Host hardware digital inputs

IMPORTANT NOTE: See the *Contact us* information on the back of this manual for support with this procedure.

7 Calibration from the host controller

The calibration procedures included in this section fine-tune the level measurement and the calculation of the gross volume of the tank. The procedures are required to account for field variations in fluid and tank properties.

IMPORTANT NOTE: Perform the calibration procedures included in this section when connecting the LevelMaster(s) to a flow computer or controller. When the host controller is part of the installation scenario, calibration data is kept in the audit trail.

7.1 Calibration for level measurement (level bias)

Although the LevelMaster is a highly accurate factory-calibrated device, there can be subtle discrepancies that may require the floats to be calibrated in the field. Discrepancies such as the specific gravity of the fluid being slightly different than what the float was calibrated for, may cause the float to sit slightly higher or lower in the fluid, resulting in less precision in the measurement reading.

Calibrating the float in the field in this case is done by determining a new level factor and making a positive or negative adjustment to the level. This is called a bias.

If the user has been manually gauging the levels and is confident that the measurements are accurate, determine the need to set a bias by comparing the reading level of each float as indicated by the LevelMaster application to that of an actual measurement. If the level(s) differ, the user can enter the manually measured levels to generate the calibration offset values.

IMPORTANT NOTE: While calibration for level measurement by adding level biases is also available from the MasterLink, it is recommended that level calibration be performed from the host controller and not the MasterLink.

To add level bias at the host controller:

1. On the navigation tree, expand **Tank Data**.
2. Select the **Levels** tab (Figure 56).

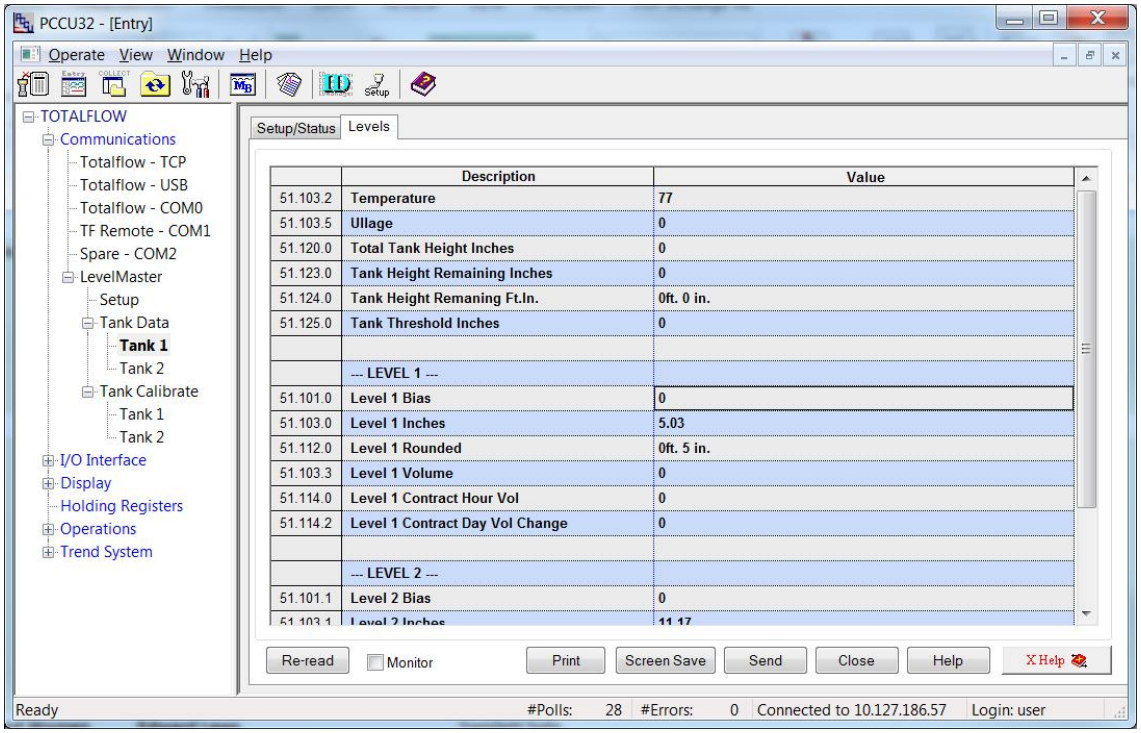

Figure 56: Adding level bias from PCCU

3. Under LEVEL 1, click the value field next to Level 1 Bias, and type the manual measurement value.
4. Under LEVEL 2, click the value field next to Level 2 Bias and type the manual measurement value.
5. Click **Send** to save the configuration.
6. Proceed to calibrate for volume calculations.

7.2 Calibration for volume calculations

In addition to displaying and storing the level and temperature measurements received from the sensor, the LevelMaster application calculates the gross volume of the fluids being measured. This section provides an overview of the calibration required for accurate gross volume calculations which reflect actual field conditions.

Gross volume calculations take into consideration the height of a tank and the measured levels. Because there can be tank shape irregularities (tank skin bulging or other external damage) at different tank sections, the volume calculation accuracy can be affected if these irregularities are not accounted for. The LevelMaster application provides the ability to adjust volume calculations to account for those irregularities by allowing the use of correction factors. Section 7.2.1, *Overview of the strapping table*, describes this functionality.

IMPORTANT NOTE: The strapping table configuration screen may vary depending on the host controller model and the PCCU32 version used. Click **Help** for additional information for each version.

Calibration for volume calculations is available only from the host controller. MasterLink does not support this functionality.

7.2.1 Overview of the strapping table

Gross tank volumes are calculated using a formula that uses tank levels and a strapping table for individual tanks. Creating a strapping table consists of defining several sections for the tank which represent different heights and assigning a correction factor to each section so that the calculated volume accurately reflects any irregularity.

IMPORTANT NOTE: The strapping table configuration is applicable only when the LevelMaster is connected to a Totalflow host controller. There is no capability for developing a strapping table when the LevelMaster is installed standalone. MasterLink does not support this capability.

7.2.1.1 Strapping table parameters

The following three strapping table parameters must be configured to create a strapping table:

- **Number of tank sections (10 max)** – The tanks can be divided into horizontal sections. Usually the actual straps around the tank are used for section dividers. Because tanks may not be uniform from bottom to top, dividing each tank into sections allows more accurate information for each section. If the tank is uniform, the user may enter only one section.
- **Section number height** – Each section (1-10) of the tank has an entry for its height, in inches.
- **Section number volume factor** – Each section (1-10) of the tank has an entry for its own volume factor per ¼ inch of height. By default, this is barrels per ¼ inch. However, because the tank is broken into sections, individual volume factors can be adjusted based on the condition of each section. Therefore, a section which has sustained damage, either concave or convex, may be adjusted to allow for the missing or additional storage space.

For example, a twenty-foot tank may be divided into five, 48-inch calibration sections. Using default English units, enter the height at the top of each of the five sections and the barrels per quarter inch of tank volume within that section. The host software then calculates the gross volume for each of the tank sections and adds them together.

7.2.2 Configuring the strapping table

To configure the strapping table:

1. On the navigation tree, expand **Tank Calibrate**.
2. Select the tank required.
3. On the **Calibrate** tab, scroll down to locate the No. of Tank Sections (Figure 57). The default is set to 0.
4. Select the value field and type the number of sections (1-10).

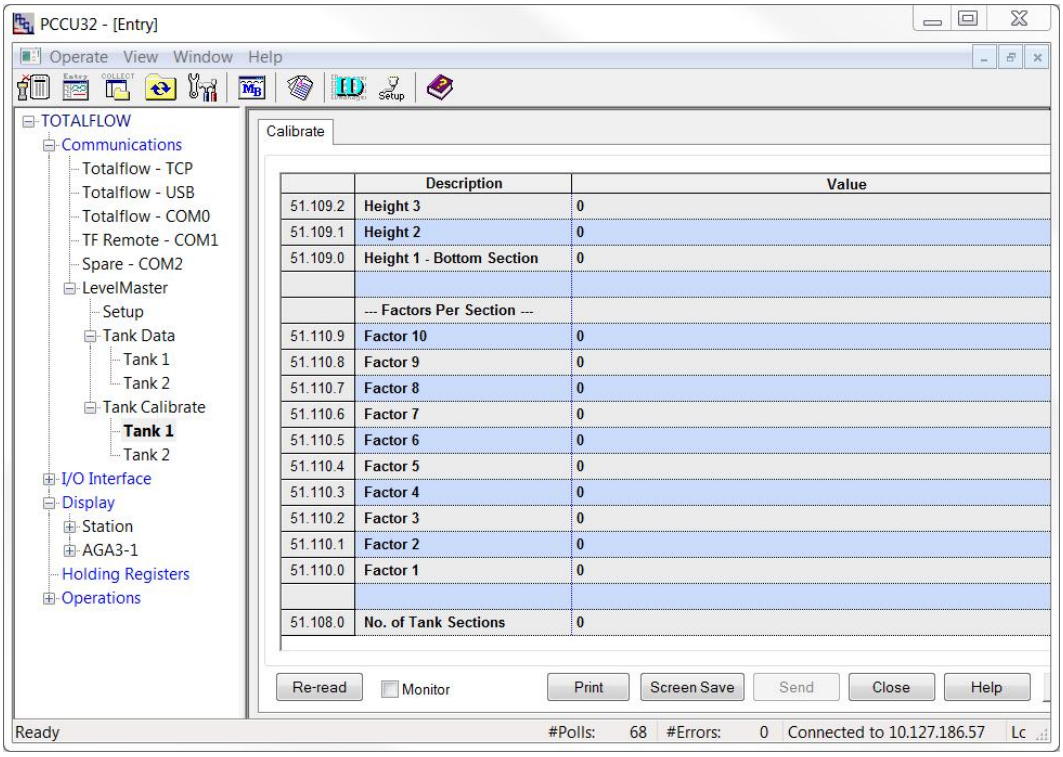

Figure 57: Configuring the strapping table

5. Scroll back up to navigate to Section Heights, select the value field and type the height in inches for every section defined.
6. Scroll down to navigate to Factors Per Section and type the factor for each section defined.
7. Click **Send** to save the configuration.
8. On the navigation tree, click **LevelMaster**.
9. Verify the volume calculations are displayed.
10. After all calibration is complete and verified, save the controller configuration as described in section 6.7, *Save the configuration*.

8 Service and maintenance

This chapter provides information for performing part replacement and maintenance on the LevelMaster. Common steps to all part replacements are described first. These steps are then referenced from within the sequence of a particular procedure. Before performing any part replacement, review the order of the steps carefully to ensure safety and minimize rework.

Hardware changes such as electronics board replacement, float (type and number) change, or internal sensor assembly replacement require updates to the LevelMaster configuration. Local communication with the unit using MasterLink is required for reconfiguration after hardware changes.

IMPORTANT NOTE: Batteryless float support requires electronics board part number 2104836-001 and MasterLink version 2.0 or later. All procedures in this chapter can be performed using MasterLink version 2.0. This version is backwards-compatible with previous electronics board versions and float types. All MasterLink screens have online help. Click **Help** to access additional information at any time if needed.

DANGER - Serious damage to health/risk to life. When performing service or using a laptop in a classified area, ensure explosive gasses are not present.

Part replacement or maintenance requiring full removal of the unit requires careful planning, taking into consideration the height of the tank (length of the sensor) and access to the top of the tank. Follow the company safety guidelines required for the site and determine the appropriate number of field personnel required to perform the removal.

IMPORTANT NOTE: All service and maintenance procedures assume that the LevelMaster is installed in the tank and is wired. Removing and restoring field wiring is required for all procedures. It is assumed that the original wiring was done correctly and that the unit was working correctly before service was required.

The following tools may be required in all or some of the procedures included in this section:

- Phillips screwdriver
- Small slotted screwdriver
- 24 inch pipe wrench
- Wooden blocks or other means to support the sensor on the floor when removed from the tank
- Grounding strap

8.1 Remove the enclosure cover

All LevelMaster part replacement procedures require removal of the enclosure cover. Removing the cover provides access to the electronics board for:

- Removal of connections (field wiring) to allow for board and internal sensor assembly replacement or for full sensor removal from the tank
- Local communication (direct connection) with the board for configuration update, monitoring or verification

IMPORTANT NOTE: The enclosure may have to be removed and replaced several times during a procedure to avoid damage to the board or the sensor during removal or movement of the entire unit.

To remove the cover:

1. Remove the power going to the LevelMaster by disconnecting the LevelMaster from the remote controller, flow computer or independent power source as applicable:
   a. If powered from the serial (COM) port on a remote controller or flow computer, disconnect the LevelMaster from that port.
   b. If connected through a barrier board, disconnect the LevelMaster from the barrier board.

2. Remove the cover from the electronics enclosure: rotate it in a counter-clockwise direction to unscrew it from the base. The electronics board is exposed when the cover is removed (Figure 58).

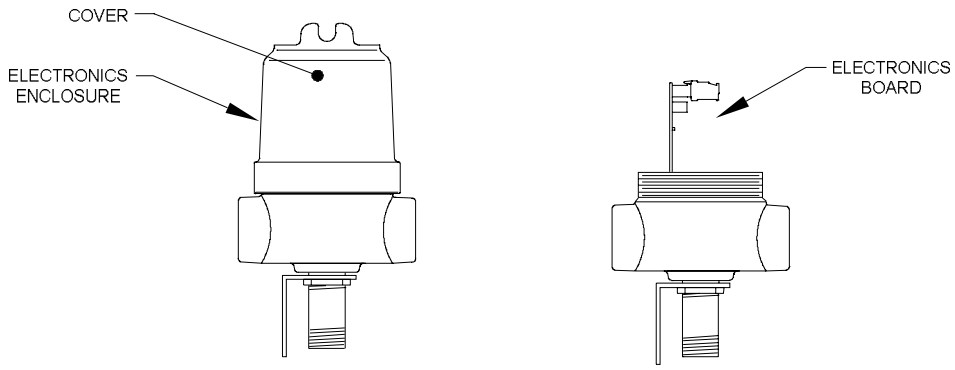

Figure 58: Removing the electronics enclosure cover

3. Place the cover in a safe place.

8.2 Remove field wiring

The removal of field wiring is required for service. Field wiring may include connection to additional LevelMasters, barrier boards, power supplies, or remote controllers or flow computers.

IMPORTANT NOTE: Ensure that power connected to the LevelMaster is disconnected before removing field wiring.

Depending on the type of board, there may be one or two connectors for power and communications.

To remove field wiring:

1. Remove the power to the unit and the cover as described in section 8.1, *Remove the enclosure cover*.
2. Hold the board by the edges, and pull it slowly out.
3. Use the small slotted screwdriver to remove the power and communication connectors attached to the electronics board.
   a. When removing wiring from older boards (2018546-005), there may be one or two connectors.
   b. When removing wiring from newer boards (2104836-001), there are always two connectors, one for each: power and communications.
4. Identify which wires connect to each connector pin. If not color-coded, wires may be labeled or marked for easy identification.
   a. Identify or label the two wires used for power (+V, -V).
   b. Identify or label the wire pairs used for communication:
      i. For 2018546-005 boards, identify +T, -T, +R, -R.
      ii. For 2104836-001 boards, identify +T, +T, -T, -T.
5. If removing the unit from the tank:
   a. Remove connectors from wires to be able to pull the conduit off of the enclosure (connectors can not fit through the conduit holes). Use the small slotted screwdriver to losen and remove the wires from each contact. Keep connectors in a safe place. They will be needed when wiring is restored after part replacement.
   b. Remove the cable or conduit from the base of the electronics enclosure. The removed wires will hang at the end of the conduit.
   c. Position the conduit safely until ready to install back into the enclosure and restore wiring.

8.3 Restore field wiring

Restoring field wiring is required if the unit has been removed from the tank. This procedure reinserts individual wires back into the connectors which were removed to allow the detachment of the conduits from the enclosure. It is assumed that the wires and their position were identified (labeled) when removed. If unable to identity the position of each wire refer to section 4, *Wiring*.

To rewire:

1. Re-insert wires on the communication and power connector(s).
2. Re-insert the connector(s) to the board terminal(s).
3. Reconnect or rewire the LevelMaster to the remote controller, flow computer or independent power source as applicable:
   a. If powered from the serial (COM) port on a remote controller or flow computer, re-connect to that port.
   b. If connected through barrier board, re-connect to the appropriate ports on the barrier board.
4. Verify that measurements are being received and displayed by the LevelMaster application on PCCU.

8.4 Remove the unit from the tank

Full removal from the tank is required to change the floats or the internal sensor assembly.

To remove the unit from the tank:

1. Remove the cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring*.
3. Reinstall the cover on the electronics enclosure (to keep the electronics board protected if it was not removed).
4. Loosen the nut on the cord connector (Figure 59).

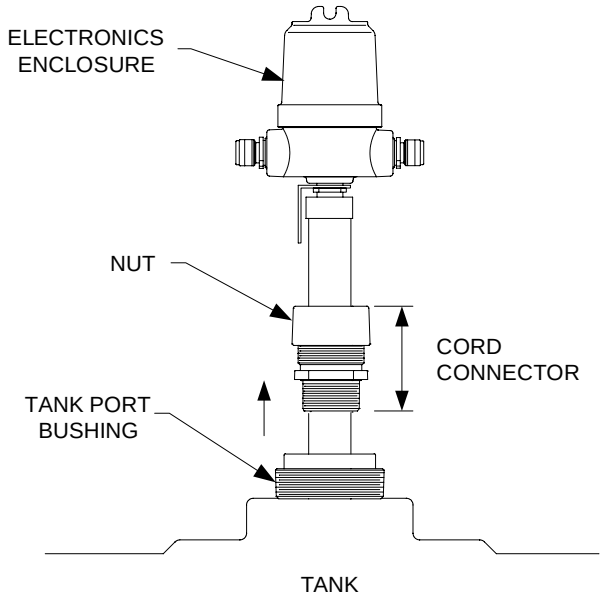

Figure 59: Removing the unit from tank

5. Unscrew the tank port bushing.
6. Pull the unit up until it is completely out of the tank.
7. Lay the unit on the ground using the wooden blocks underneath for support. (If no wooden blocks are available use any stable and even support to keep the unit from rotating while in a horizontal position).
8. If changing floats or the internal sensor assembly, proceed to the appropriate procedure.

8.5 Reinstall the unit into the tank

To reinstall the unit:

1. Ensure that the cover is secured back on the base of the electronic enclosure.
2. Lift the unit from the floor and prepare to reinsert it into the tank.
3. Once positioned for reinsertion, slowly lower the LevelMaster down through the hole in the tank. Make sure that the unit is vertical until it is resting on the bottom. If there is sludge at the bottom, work the unit up and down a few times to reach the bottom.
4. Screw the tank port bushing into the tank port opening.
5. Tighten the nut on the cord connector.
6. Carefully straighten or position the lose wires at the end of the conduit.
7. Plumb the cable or conduit into the electronics enclosure ensuring that the wires go through the holes and into the inside of the enclosure. If needed, pull the wires gently to make sure they can be connected to the electronics board.
8. Restore field wiring as described in section 8.3, *Restore field wiring*.

8.6 Remove the enclosure from the casing

Full removal of the enclosure is required to replace the casing (due to sensor assembly replacement). It is assumed that the LevelMaster is out of the tank.

To remove the enclosure from the casing:

1. Once the unit is out of the tank and positioned horizontally on the supports, remove the enclosure cover again.
2. Remove the sensor connector from the electronics board.
3. Remove the existing electronics board and place in a safe place (store in an anti-static bag if one is available).
4. Hold the casing firmly with one hand near the top cap (Figure 60).

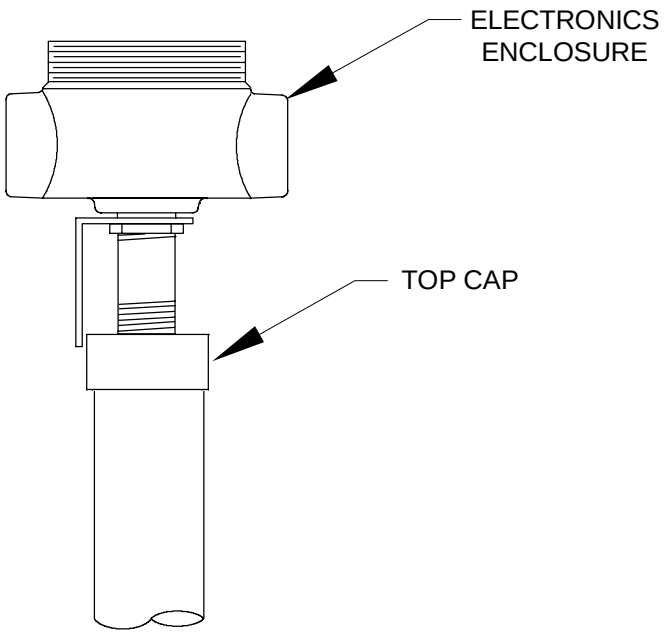

Figure 60: Removing electronic enclosure from casing

5. Hold the enclosure with the other hand and rotate counter-clockwise. Do not stop holding the enclosure as it detaches from the casing to avoid pulling the sensor cable.

6. Position the connector of the sensor cable so it can fit in the neck of the enclosure. Push the connector gently inside the neck.
7. Gently pull the cable through the enclosure until completely removed.
8. Place the enclosure in a safe place.

8.7 Reinstall the enclosure on the casing

Reinstalling the enclosure after casing or sensor assembly replacement includes reconnection of the board to the sensor cable. It is assumed that the LevelMaster is still out of the tank.

To reinstall the enclosure on the casing:

1. Position the new casing horizontally on the wooden support blocks.
2. Position the new sensor connector cable to fit through the neck of the enclosure and push the connector through the neck until the connector is inside the enclosure. Avoid pulling the cable or letting the enclosure hang while the cable is inside. Continue to hold the enclosure.
3. Reinstall the enclosure back on the casing by carefully rotating clock-wise to avoid twisting the sensor cable.
4. Reconnect the board to the sensor cable. The connector is keyed so it will only plug in one way. Push some of the excess cable back down through the bottom of the sensor assembly while sliding the electronics board back into position. Allow a small loop of cable to fold back towards the top of the enclosure.
5. Brace the electronics board inside the housing by using the yellow fiberglass tab inserted into the enclosure.
6. Bend the tab gently into a semicircle using the thumb and forefinger, making sure the apex of the arch is placed against the board while the ends of the tab are braced to the inside of the housing.

8.8 Establish local communication with electronics board

All LevelMaster part replacement procedures require local communication with the electronics board. Connecting to the board allows access for:

- Basic parameter viewing
- Configuration backup (save sensor data)
- Configuration update (download) after hardware changes
- Verification after hardware changes

IMPORTANT NOTE: The electronics board does not have to remain in the enclosure for configuration viewing or backup. If the board is removed temporarily for local communication, error messages are displayed to indicate disconnection from the internal sensor assembly. If the board is left connected to the sensor assembly for local communication, ensure that the connection to the laptop does not cause excessive pulling of the sensor cable which can cause damage to the cable or connector.

To communicate with the LevelMaster:

1. Remove the cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring.*
3. Connect the laptop directly to the electronics board using the correct cable and adapters for the board.
   a. When connecting to older boards (2018546-005), use the RS-485-to-RS-232 converter (2100241-002) with the cable adapter (2100250-001, the cable with a single terminal connector at one end).
   b. When connecting to newer boards (2104836-001), use the RS-485-to-RS-232 converter (2100241-005) with the cable adapter (2100250-002, the cable with two separate terminal connectors at one end).

IMPORTANT NOTE: The cables designed to connect the laptop to the board provide power to the board through one or two 9 Vdc batteries. Always ensure that the batteries are charged. Make sure to connect the positive

terminal (red wire) to the positive contact on the battery holder to ensure that power flows to the board for the connection.

4. Start the MasterLink software.
5. Select the location and the LevelMaster.
6. Click the **Comm. Port** drop down list and select the laptop communication port used.
7. Select the baud rate that was configured for the board. The default rate is 9600.
8. Click **Setup LevelMaster**. The monitor tab displays.
9. Observe the messages displayed on the monitor tab. Verify that communication is successful. The screen should indicate the number of tries and 100% success. If the board has been completely removed, an error will display due to disconnection from the internal sensor assembly.

8.9 Preserve sensor data and configuration

Sensor data and configuration stored on the LevelMaster can be saved in a separate file on a PC or laptop for backup purposes. The configuration file can then be used to restore the configuration on the same board the file originated from or on a new board (if the original board has failed or was upgraded). Reuse of an original file may be convenient to preserve the sensor's calibration data. If the internal sensor assembly has not been replaced, then the same calibration information can be used when the board or the float configuration are changed.

IMPORTANT NOTE: Follow this procedure after configuration is completed during first-time installation or after configuration or hardware changes. It is important to maintain an up-to-date configuration file to be able to quickly restore the unit to operation without the need for reconfiguration.

To save the configuration:

1. Follow the steps described in section 8.8, *Establish local communication with electronics board*.
2. When connection with the unit is successfully established, select the **Upload/Download** tab.
3. Under Read data from the LevelMaster and save them to file, use the default path and file name displayed or select a different path and/or user-defined file name. (Ensure that the file keeps the .dat extension.) Take note of the location selected to save the file.
4. Click **Read and Save Data to File**. Observe the progress bar as the configuration is copied to the file in the laptop.
5. Click **OK** when saving the configuration is complete.
6. Disconnect the laptop from the board.
7. If no further maintenance or service procedure is required, restore the permanent wiring connections and secure the enclosure cover back into place.
8. If saving the configuration file for an upgrade or part replacement, proceed to the appropriate procedure.

8.10 Restore sensor data and configuration

If a configuration file was saved, it can be used to restore the configuration on the same electronics board the file originated from or on a new board if the board was replaced or upgraded.

This procedure downloads the configuration to the board and overwrites the current configuration.

IMPORTANT NOTES: Using an existing file when the board is upgraded is acceptable and is meant to preserve the calibration data (the sensor assembly remains the same during a board upgrade). See the LevelMaster upgrade kit application guide for details on upgrade procedures.

A file created to preserve the factory calibration the unit was shipped with can also be used. If this file was saved before configuration was performed however, it will not have the field configuration and the LevelMaster will have

to be reconfigured. The calibration data from the original file will be the most accurate because it is the original data from the factory.

A generic file for the length of the sensor (from the files provided with the MasterLink software) can also be used, but there may be a minor loss of accuracy (precise calibration data is only available on the configuration the sensor shipped with). Use these files if the original factory sensor data or subsequent configuration file were not saved or cannot be retrieved due to electronics board failure.

To download the configuration to the LevelMaster:

1. Follow the steps described in section 8.8, *Establish local communication with electronics board*.
2. When connection with the unit is established, select the **Upload/Download** tab.
3. Under Send data to the LevelMaster from the file, click the browse (**[…]**) button.
4. At the browser, navigate to the folder where the existing configuration file was saved (for example, C:\Program Files (x86)\ABB\MasterLink).
5. Locate and select the configuration file.
6. Click **Open**.
7. Click **Download Data to LevelMaster**.
8. Click **OK** when the download is complete.
9. If no further maintenance or service procedure is required, restore permanent wiring connections and secure the enclosure cover back into place.
10. If saving the configuration file for an upgrade or part replacement, proceed to the appropriate procedure.

8.11 Upgrade the electronics board

A board upgrade replaces the electronics board part number 2018546-005 with board part number 2104836-001. The purpose of the upgrade is to support batteryless floats. The older board version does not support these types of floats. With the newer board version, all float configurations are supported: single or dual, passive, active, or batteryless floats.

The upgrade process is described in detail in the LevelMaster upgrade kit application guide.

Board upgrades may replace an electronics board that is still in working condition.

IMPORTANT NOTE: An existing configuration file can be downloaded to the replacement board to preserve existing configuration and calibration data stored in the previous board. If the file was previously saved, locate the file when ready to download to the new board. If the file was not saved and the board being replaced is still in working condition, obtain the file from the board as described in section 8.9, *Preserve sensor data and configuration*. If unable to obtain the file, use the factory default files provided with the MasterLink software.

To upgrade the electronics board:

1. Obtain the LevelMaster upgrade kit application guide. See the *Additional information* section of this manual for the link to the document location.
2. Follow the instructions described in the guide.
3. Save the configuration after the upgrade to ensure that the configuration file is up-to-date with the change in boards and/or floats. Use the procedures described in section 8.9, *Preserve sensor data and configuration*.

8.12 Replace the electronics board

Board replacement requires removing field wiring, but not full removal of the unit from the tank. For convenience, the electronics board can be configured before it is installed in the enclosure if local connection to the board is difficult or not allowed once the sensor is inside of the tank.

The following procedure assumes the following:

— The board is being replaced without removing the unit from the tank.

— The board is being replaced with another board of the same type (no rewiring will be required). If replacing a board with part number 2018546-005 to a board with part number 2104836-001, please refer to the LevelMaster upgrade kit application guide.

— There is a configuration or setup (.dat) file available that can be downloaded to the replacement board to preserve the existing configuration and calibration data. If the board is still in working condition, obtain the configuration file as described in section 8.10, *Restore sensor data and configuration*.

If the configuration file is not available and cannot be obtained from the existing board (due to board failure or local connection failure), a generic or factory default calibration file can be used. Default files are included in the MasterLink version 2.0 directory, in the DefaultDat folder. Select the files as follows:

— If replacing board part number 2018546-005, select the file for the length of the sensor from the DefaultDat folder. These boards are available until supplies last and are being phased out. If planning to support batteryless floats, then an upgrade is required.

— If replacing boards with part number 2104836-001, select the file for the length of the sensor from the DefaultDat/7.0 Head board folder.

IMPORTANT NOTE: If a sensor board is replaced due to failure, the original calibration file for the sensor must be loaded into the replacement board. If the file is not available use one of the default files included in the installation directory of MasterLink version 2.0. This version contains default files for specific lengths for both legacy boards and newer boards.

Tool required:

— Small slotted screwdriver

8.12.1 Remove the existing board

To remove the LevelMaster electronics board:

1. Remove the power and cover as described in section 8.1, *Remove the enclosure cover*.
2. Disconnect the communication and power terminal connector(s) from the electronics board. There may be one or two connectors depending on the board. Do not remove wires from connectors. They will be reinserted on the new board when it is placed in the enclosure.
3. Hold the board by the edges and pull it slowly out.
4. Unplug the 16-pin connector at the bottom of the board. The 16-pin cable connects the electronics board with the internal sensor assembly inside the casing.
5. Remove the board and place it in a safe place.

8.12.2 Insert the new board

CAUTION – Equipment damage. A static electric discharge can result in damage to the electronics board. Wear a grounding strap to eliminate static electricity when connecting or disconnecting terminal connectors to and from the board or when handling a board during installation or removal. Use an anti-static bag to store the board.

To insert a new LevelMaster electronics board:

1. Remove the replacement board from the anti-static bag.
2. If the board was shipped with terminal connectors, with the small slotted screwdriver remove the terminal connector(s) from the power and communication (RS-485) port(s). There may be one or two connectors depending on the type of board.
3. Plug the 16-pin connector from the sensor assembly into the new electronics board. The connector is keyed so it will only plug in one way. Push some of the excess cable back down through the bottom of the sensor assembly while sliding the electronics board back into position. Allow a small loop of cable to fold back towards the top of the enclosure.
4. Brace the electronics board inside the housing by using the yellow fiberglass tab inserted into the enclosure.
5. Bend the tab gently into a semicircle using the thumb and forefinger, making sure the apex of the arch is placed against the board while the ends of the tab are braced to the inside of the housing.

6. Connect the laptop to the board as described in section 8.8, *Establish local communication with electronics board*.
7. If using the existing configuration, proceed to section 8.12.3, *Configure the new electronics board with an existing file*.
8. If using a default configuration file, proceed to section 8.12.4, *Configure the new electronic board with a factory default configuration file*.

8.12.3 Configure the new electronics board with an existing file

Use this procedure if configuring the new board with the existing configuration file. In this procedure the existing configuration is downloaded to the new board. The ID, baud rate, and calibration data from the previous board are automatically saved in the unit.

Downloading the configuration can be done from the hardware change screen or from the **Upload/Download** tab. The procedure described uses the hardware change screen.

To download the existing configuration:

1. Click the **Setup** tab.
2. Under Make Hardware change, click **Hardware change**.
3. In the Select category drop down list, select **Electronics board**.
4. When prompted to download the configuration file, click **Next**.
5. When the upload/download tab displays (Figure 61), click the browse (**[…]**) button.

Figure 61: MasterLink Upload/Download tab

6. At the browser, navigate to the folder where the existing configuration file was saved (for example, C:\Program Files (x86)\ABB\MasterLink). If not modified or saved with a different name, the default file name will have the 5-digit base serial number.
7. Locate the file, select it and click **Open**. The file path and name should now display in the window.
8. Click **Download Data to LevelMaster**. Another screen will appear during the download to show when it is finished.
9. Click **OK** to acknowledge and close the screen.
10. Click the **Monitor** tab and verify that the newly downloaded setup information displays.
11. From the monitor screen, verify that the level and temperature readings display expected or reasonable values based on the float position and temperature.
12. Ensure that the boards have the correct RS-485 termination. Termination may be performed on hardware or software depending on the board part number.

a. If the LevelMaster is an intermediate unit on a RS-485 bus:
   i. For boards with part number 2018546-005 verify that JP1 pins 5-6 and 9-10 are jumpered (factory default).
   ii. For boards with part number 2104836-001 leave the default configuration (no change is required).
b. If the LevelMaster is the only unit installed, or it is the last unit on a RS-485 bus:
   i. For boards with part number 2018546-005 verify that JP1 pins 5-6, 7-8, and 9-10 are jumpered.
   ii. For boards with part number 2104836-001 terminate as described in section 5.3.2, *Configuring RS-485 bus termination*.

13. Save configuration for backup as described in section 8.9. *Preserve sensor data and configuration*.
14. Disconnect the laptop from the electronics board.
15. Re-insert the communication and power connector(s) onto the new board.
16. If connected to a Totalflow flow computer or remote controller, verify that no errors are displayed and that measurement readings are updated by the LevelMaster application (PCCU).
17. Reinstall the enclosure cover.

8.12.4 Configure the new electronic board with a factory default configuration file

Use this procedure if configuring the new board with one of the default files included with the MasterLink 2.0 software. Using the default file provides only calibration data for the specific length of the unit. Other basic parameters must be manually configured to match the existing configuration.

IMPORTANT NOTE: A generic file for the length of the sensor from the files provided with the MasterLink software can also be used, but there may be a minor loss of accuracy (precise calibration data for the sensor or coil assembly is only available on the original board the sensor shipped with). Use default configuration files if the original factory sensor data or subsequent configuration file were not saved or cannot be retrieved due to electronics board failure.

To configure the board with a default file:

1. Click the **Upload/Download** tab.
2. Under the Send data to the LevelMaster option, click the browse button (**[…]**).
3. At the browser, navigate to the default file folder applicable to the new board.
   a. For example, for boards with part number 2018546-005, the file may be located at C:\Program Files (x86)\ABB\MasterLink\DefaultDat.
   b. For example, for boards with part number 2104836-001, the file may be located at C:\Program Files (x86)\ABB\MasterLink\DefaultDat\7.0 Head board.
4. Locate the file for the correct length of sensor and click **Open**.
   a. For example, for a 20 foot sensor with a 2018546-005 board, select the "dual_20ft.dat " file from the DefaultDat folder.
   b. For example, for a 20 foot sensor with a 2104836-001 board, select the "Dual_20ft_batteryless.dat" file from the 7.0 Head board folder (Figure 62).

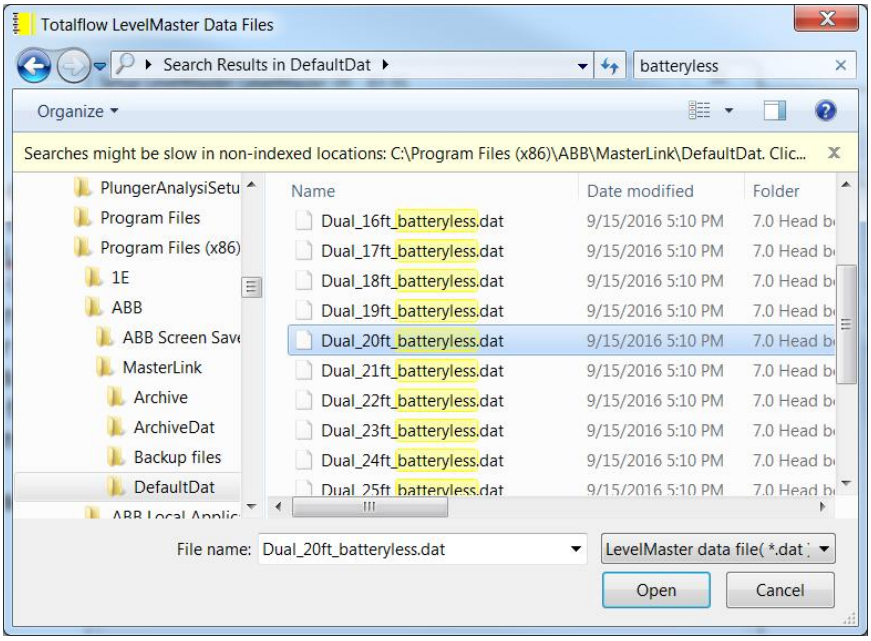

Figure 62: Locating the correct factory default configuration file

5. Under Send Data to the LevelMaster from file, verify that the file path displays correctly (Figure 63).

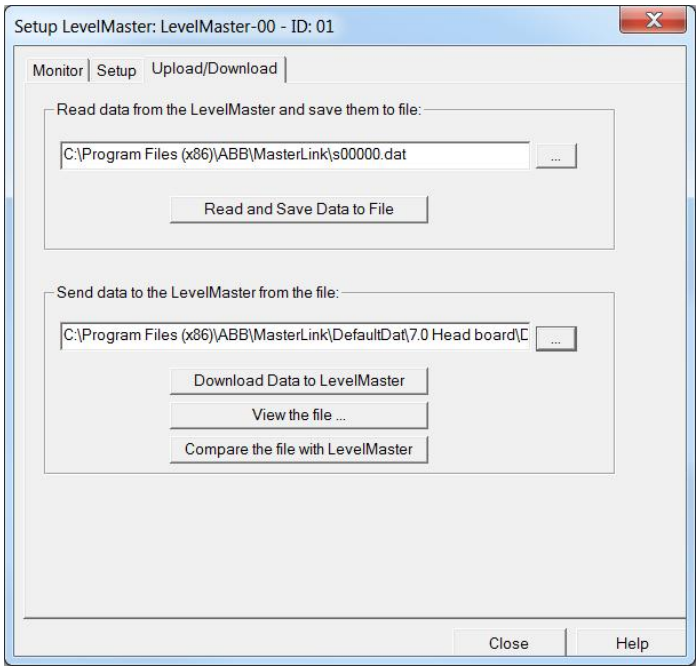

Figure 63: LevelMaster Upload/Download tab

6. Click **Download Data to LevelMaster**.
7. Click **OK** when the download is complete.

8. Click the **Setup** tab (Figure 64).

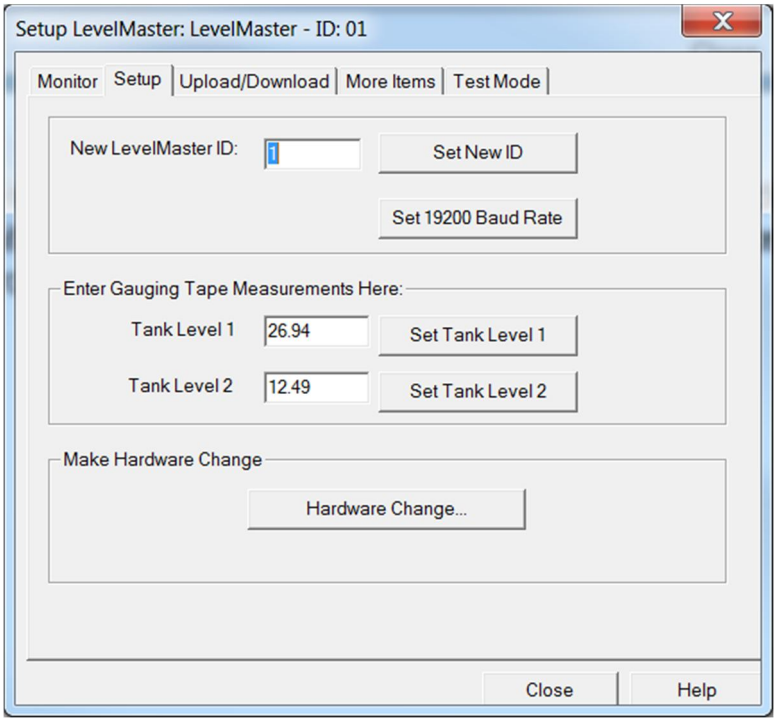

Figure 64: LevelMaster Setup tab for ID and Baud rate configuration

9. Change the LevelMaster ID by typing the correct ID into the New LevelMaster ID field and then clicking **Set New ID**.
10. Ensure that the baud rate is set to the correct value. The factory default is 9600.

IMPORTANT NOTE: Baud rates for units connected to a RS-485 bus must match.

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11. Click the **Monitor** tab. Verify that the new setup values display.
12. From the monitor screen, verify that the level and temperature readings display expected or reasonable values based on the float position and temperature.
13. Ensure that the boards have the correct RS-485 termination. Termination may be performed on hardware or software depending on the board part number.
    a. If the LevelMaster is an intermediate unit on a RS-485 bus:
        i. For boards with part number 2018546-005 verify that JP1 pins 5-6 and 9-10 are jumpered (factory default).
        ii. For boards with part number 2104836-001 leave default configuration (no change is required).
    b. If the LevelMaster is the only unit installed, or it is the last unit on a RS-485 bus:
        i. For boards with part number 2018546-005 verify that JP1 pins 5-6, 7-8, and 9-10 are jumpered.
        ii. For boards with part number 2104836-001 terminate as described in section 5.3.2, *Configuring RS-485 bus termination*.
14. Save configuration for backup as described in section 8.9, *Preserve sensor data and configuration*.
15. Disconnect the laptop from the electronics board.
16. Re-insert the communication and power connector(s) onto the new board.
17. If connected to a Totalflow flow computer or remote controller, verify that no errors are displayed and that measurement readings are updated by the LevelMaster application (PCCU).
18. Reinstall the enclosure cover.

8.13 Replace floats

The following procedures describe how to replace floats with the same or different type of float. Float types include: passive, active and batteryless. Units with one float will usually have a passive float, whereas units with two floats must have active or batteryless floats. Active and batteryless floats can also be different from each other when considering the density of the measured medium, such as floats used for oil versus water.

IMPORTANT NOTE: Float replacement requires removing field wiring and taking the unit out of the tank.

Changing floats generally requires test programs to be run on the LevelMaster and certain setup data to be modified to support the new float. When replacing active float(s) with a passive float, two test programs must be run. This is all done by the MasterLink software program by selecting the correct float configuration from a list of options.

DANGER - Serious damage to health/risk to life. When performing service, or using a laptop in a classified area, ensure that explosive gasses are not present.

Tools required:

- Small slotted screwdriver
- Phillips screwdriver

8.13.1 Replace existing floats

To replace one or more floats:

1. Remove the power and cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring.*
3. Remove the unit from the tank as described in section 8.4, *Remove the unit from the tank*.
4. Remove the float clamp from the bottom of the casing.
5. Slide the exsiting float**(s)** off the bottom of the casing.
6. Slide the new float(s) onto the bottom of the casing. If using two floats, install in the correct order (Figure 65).

IMPORTANT NOTE: If the float labels do not have arrows indicating the direction for insertion, position the float(s) correctly so that the text on the float label will be in the upright position when the LevelMaster is inserted back into the tank.

   a. Install the oil level float first.
   b. Install the water level float second.

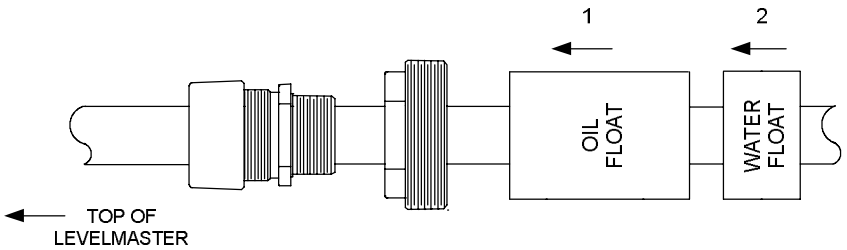

Figure 65: Inserting new floats

7. Slide the float clamp back onto the bottom of the casing.
8. Use a Phillips screwdriver to tighten the clamp 1 inch above the bottom of the casing. Considerable force may be required to lock the clamp on tight.

8.13.2 Update configuration to reflect float change

If the float type or number has changed, then the float configuration must be updated.

To update configuration:

1. Connect to the LevelMaster as described in section 8.8, *Establish local communication with electronics board*.
2. When the communication is succesful and the monitor tab displays, click the **Setup** tab.
3. Under Make Hardware change, click **Hardware change**.
4. In the Select category drop down list, select **Float Configuration**.
5. Click **Next**.
6. Select the appropriate float configuration.
7. Click **Next**, and follow on-screen instructions.
8. Click the **Monitor** tab when complete to verify the new readings. If the readings look correct, this concludes the setup portion.
9. Disconnect the laptop.
10. Reinstall the unit back into the tank as described in section 8.5, *Reinstall the unit into the tank*.

8.14 Replace the sensor assembly

The following procedure will instruct how to replace the sensor assembly and then use the MasterLink software program to update the configuration to reflect the change.

IMPORTANT NOTE: Sensor assembly replacement requires removing field wiring and taking the unit out of the tank.

DANGER - Serious damage to health/risk to life. When performing service, or using a laptop in a classified area, ensure explosive gasses are not present.

Tool and materials required:

- Slotted screwdriver
- Wooden blocks to support the unit on the floor once extracted from the tank

8.14.1 Replace sensor assembly and casing

A replacement sensor assembly is typically shipped inside its casing to prevent damage to the sensor coil. This procedure removes the existing casing and installs a new one in order to replace the internal sensor assembly. If only the sensor assembly is available, see section 8.14.2, *Replace sensor assembly only (no casing)*.

To replace both the sensor assembly and casing:

1. Remove the power and cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring*.
3. Reinstall the cover back on the enclosure to protect the board during extraction from the tank.
4. Remove the unit from the tank as described in section 8.4, Remove the unit from the tank.
5. Remove the enclosure as described in section 8.6, *Remove the enclosure from the casing*.
6. Remove the casing from the support wooden blocks and position the new one on the blocks.
7. Reinstall the enclosure on the new casing as described in section 8.7, *Reinstall the enclosure on the casing*.

8. Proceed to section 8.14.3, *Update configuration to reflect sensor change*.

8.14.2 Replace sensor assembly only (no casing)

This procedure requires pulling the internal sensor out of the existing casing and inserting the replacement sensor assembly into the casing.

CAUTION – Equipment damage: With this procedure, the sensor assembly coil is exposed when removed from the casing. When possible, it is recommended that replacement sensors be ordered from ABB to follow the procedure described in section 8.14.1, *Replace sensor assembly and casing*.

If only the sensor assembly is available, handle with extreme care to avoid damage.

To replace only the internal sensor assembly:

1. Remove the cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring.*
3. Reinstall the cover back on the enclosure to protect the board during extraction from the tank.
4. Remove the unit from the tank as described in section,
5. Remove the enclosure as described in section 8.6, *Remove the enclosure from the casing*.
6. Remove the rectangular foam pad at the top of the casing, folded around the sensor.
7. Save the foam pad to use with the new sensor assembly.
8. Take hold of the cable tie that should be at the top of the sensor assembly. Use it to pull the assembly out far enough so that a hold can be established on the sensor. Do not pull on the wire cable.
9. Pull the assembly all the way out.
10. Place the faulty sensor assembly in a safe place.
11. Insert the bottom of the new sensor assembly through the top of the casing.
12. Feed the assembly until the end is within a few inches of the top of the casing.
13. Push the sensor in until it reaches the end of the casing (bottom), leaving the wire cable and connector sticking out of the top of the casing.
14. Bend and push the cable tie in out of the way.
15. Insert the foam at the top of the casing and fold it around the sensor.
16. Reinstall the enclosure back on the new casing as described in section 8.7, *Reinstall the enclosure on the casing*.
17. Proceed to section 8.14.3, *Update configuration to reflect sensor change*.

8.14.3 Update configuration to reflect sensor change

Changing the sensor assembly requires configuration update. Calibration may be required too.

To update configuration after sensor assembly change:

1. Connect to the LevelMaster as described in section 8.8, *Establish local communication with electronics board*.
2. When the communication is succesful and the monitor tab displays, click the **Setup** tab.
3. Under Make Hardware change, click **Hardware change**.
4. In the Select category drop down list, click **New Sensor Assembly**.
5. Click **Next** and provide the required input every time a prompt displays. The required tasks to update are automatically programmed in MasterLink.
6. If prompted to download a configuration file, type the path and name of the file or use the **Browse** button to locate the file.

7. Click **Download Data to LevelMaster.**
8. Click **OK** when finished.
9. Select the **Monitor** tab to verify that the temperature and tank level readings are being displayed. Floats can be moved to ensure readings reflect and update float position as expected. Ensure the temperature reading is as expected.
10. Disconnect the laptop from the board.
11. Reinstall the unit back into the tank as described in section 8.5, *Reinstall the unit into the tank*
12. Restore field wiring as described in section 8.3, *Restore field wiring*.
13. If required, calibrate the unit as described in section 7, *Calibration from the host controller*.

8.15 Move a LevelMaster from one tank to another

The following procedure will describe how to prepare and remove the LevelMaster from one tank and install it into another tank. Installing a LevelMaster from another tank is similar to a first-time installation. Wiring and new conduits may be required depending on the location of the new tank and the distance from the flow computer, remote controller or barrier board. When planning the installation of a LevelMaster that has been in operation in another tank determine the following:

- Verify that the length of unit is the same as required for the new tank.
- Verify that the existing float(s) type is the appropriate for the liquid being measured in the new tank.
- Determine the basic setup for the unit: ID, baud rate, etc.
- Determine if the unit will be the only unit on the site.
- If connecting to additonal units on a RS-485 bus, determine if the unit is an intermediate or the last unit on the bus.

Use the MasterLink software package to run a test which will establish new offsets to match the LevelMaster to its new surroundings.

DANGER - Serious damage to health/risk to life. When performing service or using a laptop in a classified area, ensure explosive gasses are not present.

Tool required:

- Phillips screwdriver

To move a LevelMaster from one tank to another:

1. Remove the power and cover as described in section 8.1, *Remove the enclosure cover*.
2. Remove field wiring as described in section 8.2, *Remove field wiring.*
3. Reinsert cover for safe handling of the unit.
4. Remove the unit from the tank as described in section 8.4, *Remove the unit from the tank*.
5. Remove enclosure cover again.
6. Connect to the unit as described in section 8.8, *Establish local communication with electronics board*.
7. Configure the unit as required for the new location.
8. Reinstall the enclosure cover.
9. Insert the unit into the new tank as described in section 8.5, *Reinstall the unit into the tank*.
10. Wire the unit as required. Wiring the unit in the new tank is the same as if it was being installed for the first time. Review section 4, *Wiring*, to use applicable procedures.
11. If connecting to a Totalflow flow computer or remote controller, verify measurement readings and ensure that no errors are displayed in the LevelMaster application (PCCU). See section 6.5, *Verify basic configuration*.

9 Troubleshooting

Troubleshooting covers new installations as well as existing installations. It is assumed with new installations that the problem is related to a configuration issue or possible damage during shipping or installation. In existing installations that have been working, it is assumed that the configuration is correct and that the issue is with a hardware failure. Error codes or messages are displayed in MasterLink or PCCU32 to aid in resolving the issue. Take close note of what is displayed to determine what may be the cause. Review and perform the suggested action in the troubleshooting tips. If unable to resolve the issue, contact ABB support. See the back page of this manual.

Another tool for troubleshooting is provided in PCCU32 and is called Tank Level Pass Through. This feature allows the user to communicate directly with the LevelMaster, outside of PCCU32, in Terminal mode. By using this feature, the user can communicate at a base level. See Appendix A, *Tank level pass-through*.

9.1.1 Error messages

The MasterLink software displays errors messages in its Monitor tab which can help troubleshoot error conditions or component failure. Each condition has an assigned error code. Take note of the codes or messages displayed as they can help ABB support personnel or developers determine the cause of the problem.

IMPORTANT NOTE: Error codes from LevelMasters with boards part number 2104836-001 (firmware version 7.0 and later) are not listed in this section, but they are displayed with complete description on the MasterLink monitor tab.

Table 9 provides the error code description for legacy boards part number 2018546-005. It is included here to provide additional reference information to what appears on the MasterLink screens.

Table 9: Error messages for board part number 2018546-005 (firmware versions 5.015 – 5.018)

Code	Level	Message	Troubleshooting tip
0000	General	No errors	
0001	Float 0 (Oil)	Detection of broken primary coil	Primary coil may be broken. Use the sensor test box to test the primary winding.
0002	Float 0 (Oil)	No float Float not recognized Float battery dead Float malfunction A to D gain too low	A to D gain may be too low. Use the test cable and the MasterLink program to increase the gain of the analog-to-digital converter. If this does not solve the problem, the top float may be malfunctioning. Remove sensor and replace float.
0003	Float 0 (Oil)	Float position out of range, float is not positioned in sensor range	The float is not positioned over the windings on the sensor. Check that the float is present on the sensor or is not stuck at the top of the tank (casing). Or if the tank is empty, the float may be at the very bottom of the casing and out of sensor range.
0004	Float 0 (Oil)	Analog-to-digital converter saturation (gain too high), or sensor failure	Reading for the top float has saturated the analog-to-digital converter. Reduce the gain setting using the MasterLink program.
0005	Float 0 (Oil)	Level bias calculation error. Compensated value below 0” or above 655”, or wrong calibration file for this hardware (board/sensor)	Check the value entered for level offset for the top float and verify that it has been entered correctly.
0010	General	Broken primary coil	Use the LevelMaster sensor test box to test the primary coil.
0020	General	Measurement error – gain set too high or bad sensor element	Connect a laptop to the sensor board. Using test cable and the MasterLink program, reduce the analog-to-digital gain. If reducing the gain does not eliminate the error condition, the sensor wiring may have failed. Use the sensor test box and test the sensor primary and secondary windings. If neither of the above solves the problem, then the sensor PC board may be defective.
0030	General	Analog-to-digital converter saturation (gain too high)	Reduce the analog-to-digital gain. After installation, proximity of metal tank walls or other metal close to the sensor may

			increase sensor efficiency and gain may have to be reduced until the alarm clears.
0100	Temp	No temperature reading	If the level is reading correctly then the RTD may have failed. If so, replace the sensor.
0200	Temp	Calculated temperature error value below 0 or above 255 °F	Temperature is out of range.
1000	Float 1 (Water)	Detection of broken primary coil	Primary coil may be broken. Use the sensor test box to test primary winding.
2000	Float 1 (Water)	No float Float not recognized Float battery dead Float malfunction A to D gain too low	A to D gain may be too low. Use test cable and the MasterLink program to increase the gain of the analog-to-digital converter. If this does not solve the problem, the bottom float may be malfunctioning. Remove the sensor and replace the float.
2002	Float 1 (Water)	No oil or water float recognized.	See codes 0002 and 2000.
4000	Float 1 (Water)	Analog-to-digital converter saturation, or sensor failure	Gain too high. Reduce gain, or replace sensor.
5000	Float 1 (Water)	Level bias calculation error. Compensated value below 0" or above 655", or wrong calibration file for this hardware (board/sensor)	Check the value entered for level offset for the top float and verify it has been entered correctly.

9.1.2 Troubleshooting a new installation

Use Table 10 for troubleshooting a new installation. If rewiring is required refer to section 4, *Wiring*, for port pinout details.

IMPORTANT NOTE: To help determine which type of problem is occurring, use the following table to help narrow the possibilities. In the following procedures, specific wiring information is called by the common name for a component, followed by its jumper number (abbreviated J) and pin number (for example: V-BATT, J4-1.) If the host hardware is a 6790 RTU, locate the correct pins on the RTU termination board. If the host hardware is an XRC, replace the J4 jumper number with the correct pins on the J6 jumper.

For other flow computers and remote controller models, refer to the specific user manuals for pinout details.

Table 10: Troubleshooting new installations

Error condition	Check	Procedure
Hardware wiring	Board to T+ wiring	Verify wiring from host hardware board to LevelMaster board (J1) is correct. Verify board jumper settings (JP1) on legacy boards are correct. See section 4.1.3, *Onboard termination jumpers (legacy boards only)*.
	Board to barrier wiring	Verify that host hardware board wiring to optional barrier board is correct.
	Barrier to board wiring	Verify that optional barrier board wiring to LevelMaster board is correct.
	Red light on LevelMaster board not blinking during a poll	Verify that T+ and T- wires are not reversed.
	Compare host voltage to LevelMaster voltage	If no voltage is received at the LevelMaster, the barrier may be blown. If the voltage received at the LevelMaster is greater than or less than the host voltage, the power side of the barrier may be blown. The newer CSA barriers exhibit a 1 volt drop from the host to the LevelMaster side. In older UL barriers, the ground may be fused and can show smaller or even greater voltage than the LevelMaster is providing. This is due to a "floating ground." The current (mA) in these cases will be near zero. Continuity can be checked to trace parted power wire problems. Be sure to trace the wiring for polarity before supplying power.

Error condition	Check	Procedure
	V-BATT supply voltage	Using a digital voltmeter, measure transceiver V-BATT power supply voltage between the following host hardware board J4 connector terminals. Switched voltage should be greater than 11.5 Vdc. J4-1 (GND [BLK]) and J4-2 (V-BATT)
Hardware wiring	Line driver voltage	Using an oscilloscope or digital voltmeter, connect to the host hardware board J4 connector between the following terminals: J4-4 (BUS+) and J4-6 (BUS-) COM1 J4-12 (BUS+) and J4-13 (BUS-) COM2 Voltage should vary between +5 Vdc and 0 Vdc when communication data is being transmitted from CCU to XFC.
	Request to Send (RTS) voltage	Using an oscilloscope or digital voltmeter, connect to the XFC-195 board J4 connector between the following terminals: J4-1 (GRD) and J4-8 (RTS) COM1 J4-1 (GRD) and J4-14 (RTS) COM2 Voltage should be +5 Vdc when sending data to CCU, 0 Vdc when not transmitting. When RTS is high, the transmitter must be keyed and transmitting data.
Is host hardware operating?	Battery voltage	Verify battery pack voltage is at least 11.5 Vdc. See the troubleshooting section of host hardware user manual.
Annunciator display	"R" (LevelMaster Protocol) not displayed	Protocol selected for the communication port may be incorrect. Configure the correct protocol. See section 6.2, *Set up general and communications parameters*.
	Wrong position	Make sure the annunciator has the communications port displayed, not the LevelMaster.
	Wrong port wired	Verify wiring.
	No "R" is visible in the annunciators	LevelMaster annunciator is not assigned. Follow instructions for setting up the display. See section 6.4, *Configure the LCD display*.
Communication port configuration	During polling, the "R" is not replaced by an ® and/or ¬	Depending on the baud rate, the user may not see both, but should see the "R" become at least one of these arrows. Ensure data parameters are set correctly for the unit. If using an X Series unit, the LevelMaster Request Block file not downloaded to the Level subdirectory of the communications port. If it is an older unit, check the tank parameters to ensure the tank is enabled and the duty cycle is off.
No float level, but temperature reads ok.	Check power source	Check the voltage of the power source. The sensor needs 8.5 Vdc to acquire a level reading. Temperature and communication require only 5 Vdc. When using MasterLink and the LevelMaster test cable, the sensor is powered by the batteries on the cable. If the output voltage of the battery is below 8.5 Vdc, the sensor will not report a level; however, the sensor board will communicate with the MasterLink program, and a temperature will be reported.

9.1.3 Troubleshooting existing installations

Troubleshooting techniques will vary slightly when an installation was previously working but now is not. When the location has already been functioning properly, the assumption is that an event has occurred to render it inoperable. First look at equipment failures possibly caused by damage from an external source, for example: a power surge caused by a storm.

The two main groups of problems are:

— Hardware

— Software

To help determine which types of problem(s) exist, see Table 11 for error conditions, checks, and procedures.

IMPORTANT NOTE: In the following procedures, specific wiring information is called by the common name for a component, followed by its jumper number (abbreviated J) and pin number (for example: V-BATT, J4-1.) If the host hardware is a 6790 RTU, locate the correct pins on the RTU termination board. If the host hardware is an XRC, replace the J4 jumper number with the correct pins on the J6 jumper.

Table 11: Troubleshooting an existing installation

Error condition	Check	Procedure
Host hardware not operating	Battery voltage	Verify that the battery pack voltage is at least 11.5 Vdc. See the troubleshooting section of host hardware user manual.
Unit won't power up	Outbound voltage from host hardware	Using a digital voltmeter, measure transceiver V-BATT power supply voltage between the following host hardware board J4 connector terminals: J4-1 (GND [BLK]) J4-2 (V-BATT) Switched voltage should be greater than 11.5 Vdc. See the troubleshooting section of host hardware user manual.
	Inbound voltage at barrier	Using a digital voltmeter, measure power supply voltage incoming from the host hardware on the RS-485 cable. At the barrier, voltage should be greater than 11.5 Vdc. J1-2 (POWER -) J1-1 (POWER +) Negative voltage indicates damage to the RS-485 cable.
	Outbound voltage at barrier	Using a digital voltmeter, measure power voltage outbound from the barrier to the LevelMaster. At the barrier, voltage should be greater than 11.5 Vdc. J1-2 (POWER -) J1-1 (POWER +) Negative voltage indicates damage to the barrier. If the voltage received at the LevelMaster is greater than or less than the host voltage, the power side of the barrier could be blown. In older UL barriers, the ground may be fused and can show smaller or even greater voltage than the LevelMaster is providing. This is due to a "floating ground." The current (mA) in these cases will be near zero. Continuity can be checked to trace a parted power wire problem. Be sure to trace the wiring for polarity before supplying power.
	Inbound voltage at the LevelMaster	Using a digital voltmeter, measure voltage incoming from host hardware on the RS-485 cable. At the LevelMaster, voltage should be greater than 11.5 Vdc. J1-1 (GND) J1-2 (+12 Vdc) Negative voltage indicates damage to RS-485 cable.
	Power received at the LevelMaster	If power is received at the LevelMaster board but the board is still not functioning, this indicates the LevelMaster board is damaged.
Host hardware LCD returned to Totalflow display	Software files	The system has likely cold-started if the screen displays something similar to this: XSeries Flow Computer 2100xxx-xxx (COPYRIGHT) This requires uploading configuration files from the computer to the host hardware. See the user manual for the host hardware and the help files in the host software.

9.1.4 Testing the sensor

Test the LevelMaster sensor using the following procedure.

DANGER - Serious damage to health/risk to life. When performing service, or using a laptop in a classified area, ensure that explosive gasses are not present.

Equipment required:

— Test box (2101403-001)

— Cable for test box (2100979-001)

— Digital multi meter (DMM)

To test the LevelMaster sensor:

IMPORTANT NOTE: Refer to section 8, *Service and maintenance* to review procedures involving removal and reconnection of terminal connectors/wiring, electronics boards, and other LevelMaster components. Review the site guidelines for safety and hazardous locations. Sensor testing may require removal of the unit from the tank, if physical access to the top of the tank for this procedure is not allowed.

1. Remove enclosure cover as described in section 8.1, *Remove the enclosure cover*.
2. Disconnect the power and communication terminal connector(s) (green Phoenix® connector).
3. Remove the yellow fiberglass tension support.
4. Remove the electronics board as described in section 8.12.1, *Remove the existing board*. Place it in a safe place during the test.
5. Disconnect the ribbon cable.
6. Connect the sensor ribbon cable to the test box cable.
7. Set the DMM to the 2K ohms range and attach the leads to the test box.
8. Record the readings.

IMPORTANT NOTE: On the backside of the test box there is a resistance table with different windings for each sensor length supported. If the winding readings are +/- 5.0% of the resistance table, then the sensor passes the test. If the reading is open or shorted, then the sensor has failed the test, and will need to be replaced.

9. Disconnect the ribbon cable from the test box cable.
10. Reconnect the ribbon cable to the electronics board.
11. Set the board in enclosure.
12. Replace the yellow fiberglass tension support.
13. Reconnect the communication and power connector(s) (green Phoenix® terminal connector).
14. Replace the enclosure cover.

Appendix A Tank level pass-through

Tank level pass-through is the ability to establish direct communication with the LevelMaster from the PCCU32 Terminal Mode. The LevelMaster procotol used for this communication defines commands that can be issued to obtain different types of data (values stored in the LevelMaster memory) that can help in troubleshooting. The following sections provide a description of the commands supported, and the procedures to activate the pass-through and issue commands. Two examples are provided to illustrate how data requested from the LevelMaster is displayed on the terminal screen.

A.1 LevelMaster protocol commands

By using tank level pass-through (TLPT), the user can to locate problems by communicationg at a base level using the commands found in Table 12 and

Table 13. Choose the commands corresponding to the firmware version of the electronics board in the LevelMaster. Table 12 defines the commands for version 5.015-5.018 and

Table 13 defines the commands for version 7.0.

Table 12: Commands for TLPT for board part number 2018546-005 (firmware versions 5.015 - 5.018)

Command syntax	Description	Type example	Read example (value displayed)	Meaning of read
U**?	Return level(s), temperature, errors, warnings, any ID respond	U**?	U03D020.96D011.94F076E 0000W000C5ac0	03 ID, 20.96" Oil, 11.94" Water, No Errors, CRC Use only with 1 LevelMaster connected.
Unn?	Return level(s), temperature, errors, warnings	U03?	U03D020.96D011.94F076E 0000W000C5ac0	03 ID, 20.96" Oil, 11.94" Water, No errors, CRC
U**N?	Return ID	U**N?	U03N03Cd746	03 ID, CRC
UnnF?	Return # floats	U03F?	U03F2C01f6	2 Floats, CRC
UnnOL?	Return level offset	U03OL?	U03OL+0079C0732	+.79 Offset, CRC
UnnV?	Return firmware version	U03V?	U03V5.018C09d3	5.108 firmware, CRC
UnnEDn	Return EPROM memory. 3 Blocks, enter 0,1,2, or 3	U03ED0	See section A.2.1, *Example 1: Obtaining the content* of the EPROM memory	All memory blocks. Used to check gain and others
U???	Return level(s), temperature, errors in test mode, any ID	U???	See section A.2.2, *Example 2: Obtaining raw data values* .	Shows raw values and other data, ie: V0, V1 to check gain.
Unn??	Return level(s), temperature, errors, warnings until power off	U03??	U03D020.96D011.94F076E 0000W000C5ac0 (repeated)	Aid to trouble-shoot RS485 bus.
UnnNnn	Change ID	U03N00	U03N00NOKCOf11	ID change from 03 to 00, CRC
UnnFnROS	Change # floats	U03F1ROS	U03FOKC6f57	# Floats change OK, CRC

Table 13: Commands for TLPT for board part number 2104836-001 (firmware version 7.000)

Command syntax	Description
U**?	Measure displacement
U**??	Measure displacement in endless loop
U???	Measure displacement in old test mode

Command syntax	Description
U**T	Measure displacement in new test mode
U**ED	EEPROM dump in DEC 16x16 format
U**EE	EEPROM dump in DEC 8x32 format
U**EH	EEPROM dump in HEX 8x32 format
U**ERaaaE Wddd	Write to memory aaa data to ddd
U**F	Read/write mode number
U**N	Read/write unit number
U**OL	Oil level offset
U**OW	Water level offset
U**OF	Temperature reading offset
U**OV	Voltage reading offset
U**PS	Phase shift test
U**V	Return software version
U**S	Return settings
UxxPxxxxxx	Enter password
UxxCxxxxxx	Change password
U**GS	Gain set
U**GR	Gain read
U**GAxxx	Gain all set

A.2 Activating the tank level pass-through

To use terminal mode for tank level pass-through:

1. Connect the PC running PCCU32 to the flow computer with either an MMI cable (RS-232), a USB cable or an Ethernet cable.
2. Start PCCU.
3. Click **Entry** on the toolbar.
4. Click **Communications** on the navigation tree.
5. Set the Unkey Delay to **1.**
6. Click **Send**.
7. Click **Terminal** on the toolbar.
8. To activate Tank Level Pass Through:
   a. Type "**TLPT=1"** (**T**ank **L**evel **P**ass **T**hrough Activate), at the prompt -> for XSeries FCUs and XRCs.
   b. Type "**TLPT=0"** (**T**ank **L**evel **P**ass **T**hrough Activate), at the prompt -> for 64XX and 67XX FCUs.
9. Wait for the prompt LM> to appear to issue commands. The prompt indicates that the LevelMaster protocol is now in use.
   a. For LevelMasters with boards whose firmware version is 5.015-5.018, use the commands listed in Table 12.

      For LevelMasters with boards whose firmware version is 7.000, use the commands listed in
   b. Table 13.
10. Press **Enter** on the keyboard after the command has been typed.

IMPORTANT NOTES: If no port is set to LevelMaster protocol, the following message will appear: “No port protocol set to LevelMaster Interface.” To verify communication configuration or correct port parameters, see section 6.2, *Set up general and communications parameters.*

The characters at the Character Return Checks (CRC) are used to ensure good communications. These start with “C” and can be ignored.

11. Capture or take a snapshot of the values displayed if needed.
12. To exit terminal mode and return to the PCCU32 Entry screen, press the **ESC** key.

A.2.1 Example 1: Obtaining the content of the EPROM memory

The following example shows how to use one of the commands to obtain the contents of the EPROM memory.

To display the values:

1. At the terminal mode screen prompt, type the command to obtain memory values: **LM>U03ED0.**
2. Observe the values displayed:

003 003 008 003 003 100 001 025 001 010 044 000 079 000 010 007

002 083 001 001 083 000 006 001 000 001 010 010 005 129 002 091

000 012 002 204 000 079 003 050 246 004 040 246 004 058 000 200

246 009 199 255 254 077 240 011 248 000 000 000 000 000 006 200

128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

128 128 128 128 128 128 128 128 128 128 128 128 128 128 128 128

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

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255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

255 255 255 255 255 255 255 255 255 255 255 255 255 255 255 255

A.2.2 Example 2: Obtaining raw data values

The following example shows how to use one of the commands to obtain raw data values.

To display the values:

1. At the terminal mode screen prompt, type the command to obtain memory values: **LM> U???**
2. Observe the values displayed:

V0=+00006 V1=-00708 V2=-00085 V3=-00802 AVG

V0=-06447 V1=+05155 V2=-06952 V3=-07166 PC00548 F0

V0=+07765 V1=+01656 V2=+04361 V3=+08909 PC00548 F1

V0=-06447 V1=+05155 V2=-06952 V3=-07166 5 7 S00557 L02285 021 F0

V0=+07765 V1=+01656 V2=+04361 V3=+08909 2 3 S00245 L01113 010 F1

R=10727 T1=10950 T2=10762 T3=10733 T4=10722 T5=10731

R=10728 T1=10955 T2=10760 T3=10733 T4=10722 T5=10731

R=10728 T1=10948 T2=10762 T3=10732 T4=10723 T5=10731

R=10727 T1=10950 T2=10763 T3=10736 T4=10722 T5=10730

R=10729 T1=10953 T2=10761 T3=10734 T4=10724 T5=10730

R=10728 T1=10955 T2=10763 T3=10734 T4=10722 T5=10728

R=10728 T1=10950 T2=10761 T3=10733 T4=10723 T5=10730

R=10728 T1=10950 T2=10765 T3=10733 T4=10726 T5=10730

R=10728 T1=10953 T2=10761 T3=10735 T4=10721 T5=10730

R=10727 T1=10953 T2=10763 T3=10735 T4=10723 T5=10731

DIST=022.93 TC=+000.00 F0

DIST=011.13 TC=+000.00 F1

U03D023.72D012.11F076E0000W0000Ca982

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