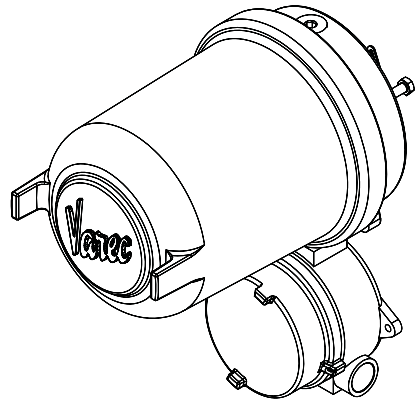
IOM104GVAE1612

2910 Float & Tape Transmitter

Precision instrument for remote monitoring of tank level and temperature information



Installation and Operations Manual

Automation Solutions for oil & gas, defense and aviation applications

Varec®

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Safety Precaution Definitions

Caution! Damage to equipment may result if this precaution is disregarded.

Warning! Direct injury to personnel or damage to equipment which can cause injury to personnel may result if this precaution is not followed.

Safety Precautions

Read this manual carefully and make sure you understand its contents before using this product. Follow all instructions and safety guidelines presented in this manual when using this product. If the user does not follow these instructions properly, Varec cannot guarantee the safety of the system.

Note Comply with all applicable regulations, codes, and standards. For safety precautions, the user should refer to the appropriate industry or military standards.

Caution! Electrical Hazard! Read and understand static and lightning electrical protection and grounding described in API 2003. Make certain that the tank installation, operation, and maintenance conforms with the practice set forth therein.

Warning! Striking the gaugehead of the transmitter with a metal object could cause a spark to occur. When removing or replacing the gaugehead in flammable or hazardous liquid storage areas, take necessary measures to protect the gaugehead from impact.

Warning! Volatile fumes may be present! Ensure that the tank has been leak and pressure tested as appropriate for the liquid to be stored. Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapors, or toxic materials, until a gas-free environment is certified. Carry breathing equipment when entering a tank where oxygen may be displaced by carbon dioxide, nitrogen, or other gases. Wear safety glasses as appropriate. Use a hard hat.

Warning! Sparks or static charge could cause fire or explosion! The mechanical connections between the guide cables, the float, the tape, and the gaugehead provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard.

Warning! Broken negator motor spring pieces can cause injury when the back cover of the gaugehead is removed! Whenever the back cover is removed, stand to one side as the last bolt is removed.

Contents

1 Introduction

This manual provides the information needed to install, maintain, and troubleshoot the Varec 2910 Float & Tape Transmitter (FTT).

1.1 Overview

The 2910 Float & Tape Transmitter (FTT) is a precision digital instrument designed to mount directly to most mechanical float and tape tank gauges and transmit level and other data to an inventory management system.

The 2910 FTT is available for Mark/Space, MODBUS, GSI MODBUS, or Tankway (L&J) field communications. It can be mounted directly to most manufacturers' tank gauges, including GSI, L&J, and others (see Figure 1-1: with the 2910 FTT mounted to the Varec 2500 Automatic Tank Gauge (ATG)).

Figure 1-1:2910 FTT - Installed on Varec 2500 ATG

The 2910 FTT is explosion proof and approved for use in hazardous-classified locations, making it particularly suitable for bulk storage applications found in the oil and gas industry.

1.2 Function & System Design

1.2.1 System functionality

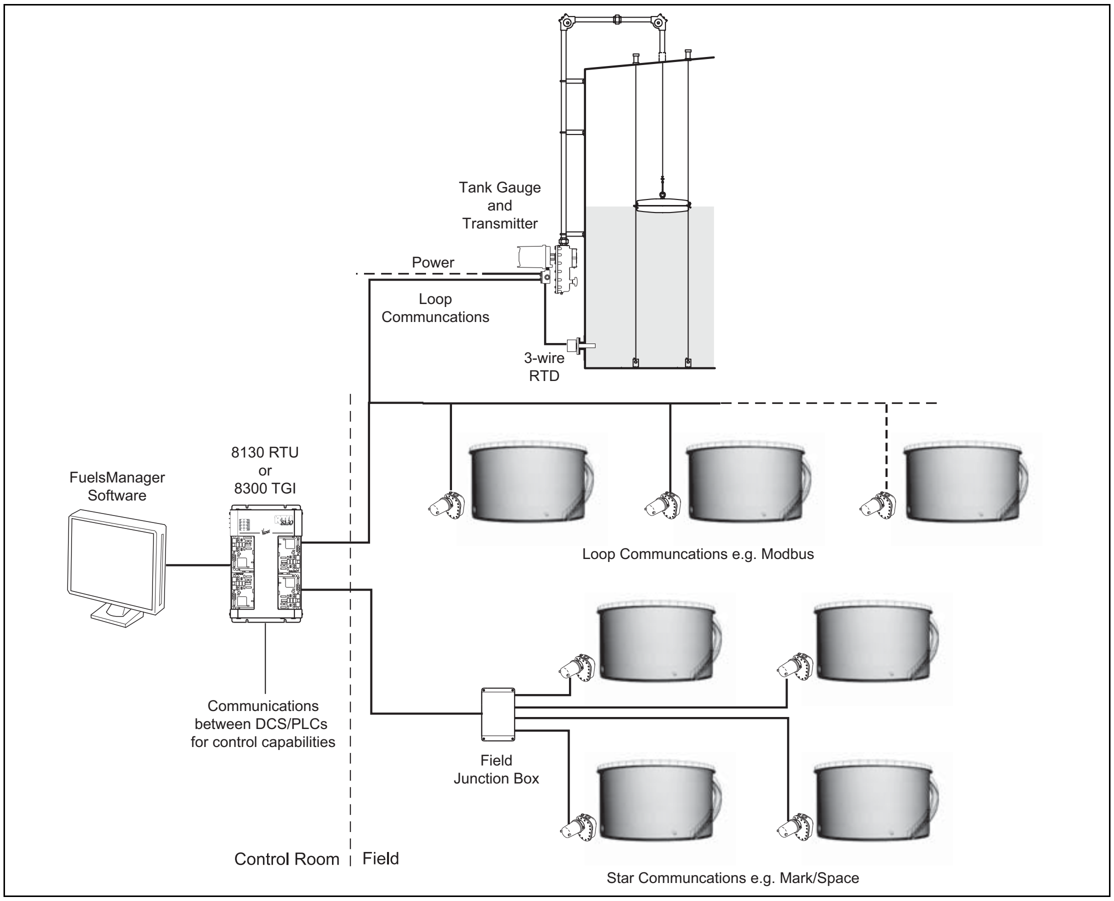


Figure 1-2: 2910 FTT System Diagram

1. In response to changes in liquid level, the mechanical level gauge rotates the 2910 FTT encoder drive shaft.
2. The 2910 FTT's precision direct drive gearing turns two encoder sensors.
3. The two sensors in the encoder detect the angular position of the drive shaft and the high-resolution encoder produces a level value.
4. If a spot temperature RTD (Resistance Temperature Detector) is used, the communications board translates the RTD input to a digital temperature value.
5. The communications circuit board converts the encoded level and temperature to a specific field communications protocol.
6. The communications circuit board transmits the data to an interface device for display in a control room by an inventory management system, such as FuelsManager.

1.2.2 Internal system design

The 2910 FTT is constructed with the following assemblies, as shown in Figure 1-3:

A. Enclosure Cover
B. Communications Circuit Board
C. AC Power Circuit Board (Optional)
D. Connector Circuit Board
E. Encoder Assembly
F. Enclosure Base
G. Junction Box
H. Limit Switch Assembly (Optional)

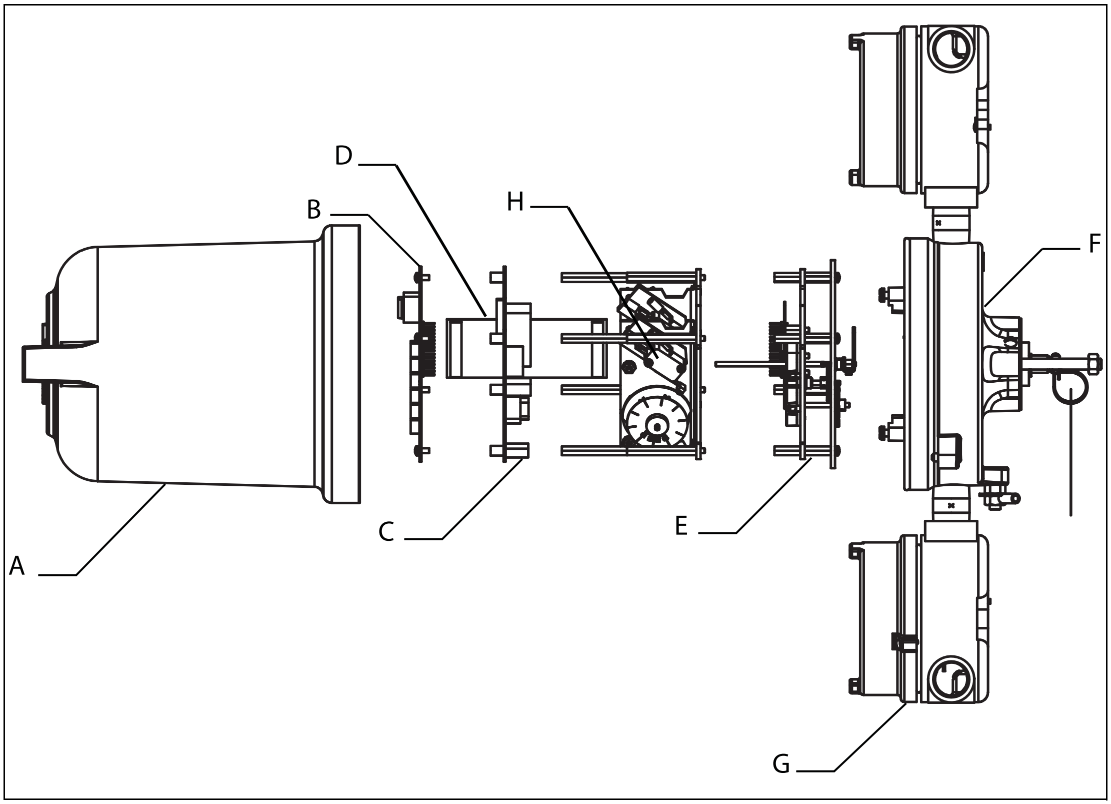


Figure 1-3: System Components - Exploded View

All standard electronics for the 2910 FTT are contained on the communications circuit board (B). This includes DC power, field communications, a 3-wire temperature input, and two discrete inputs.

An optional circuit board (C) contains an AC power supply, two additional discrete inputs, and four contact outputs. The limit switch assembly (H) can support up to four optional limit switches. These limit switches and inputs/outputs can be used in safety applications such as overfill protection, level switch inputs, local alarm control, permissives, and interlocks. The limit switches and inputs/outputs can also provide basic automation control.

2 Preparing for Installation

This chapter provides a pre-installation checklist, safety information, unpacking instructions, grounding instructions, and an overview of the installation steps.

2.1 Site Preparation Checklist

Before installing the 2910 FTT transmitter on a mechanical float and tape gauge, ensure that:

1. The mechanical float gauge is operating correctly.
2. There is sufficient space around the mechanical gauge to install the transmitter and accessories (such as conduit and cabling). Refer to Figure 2-1.
3. The correct transmitter/mechanical gauge adaptor is available, if required.
4. The gaugehead shall be adequately grounded for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product (see Section 2.5 on page 7).
5. The correct field connections at the gaugehead are ready to connect to the 2910 FTT (i.e. power, communications, and temperature sensor wiring).
6. The installlation complies with all safety guidelines as described in Section 2.2 on page 6.

The tank can remain in-service and the mechanical float gauge can remain in place while installing and configuring the 2910 FTT.

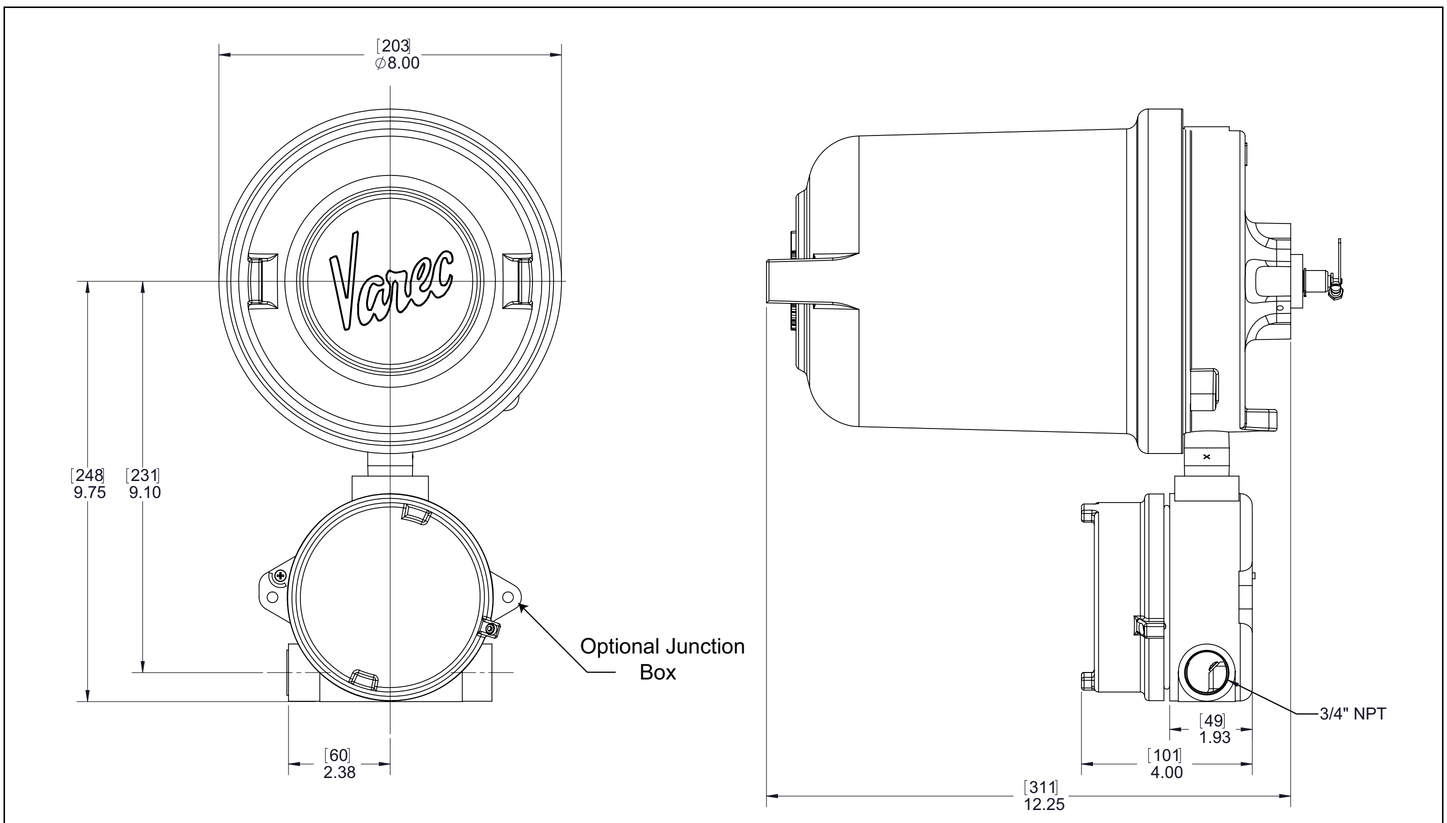


Figure 2-1: 2910 FTT Dimensions

2.2 General Safety Guidelines

The 2910 FTT is certified to be used in Class I, Division 1, Groups C and D, and Class I, Zone 1, Group IIB hazardous locations.

The user should follow other local safety guidelines for additional protection. Information may also be obtained from the following sources:

- National Electric Code (NEC)
- National Fire Protection Association (NFPA)
- Instrument Society of America (ISA)
- FM Approvals LLC (FM)
- Underwriters Laboratories Incorporated (UL)

When in doubt about the safety of an area, the user should check with the local safety authorities. Always observe equipment labels and warning signs posted in the area.

2.3 Unpacking

Varec 2910 Float & Tape Transmitters are shipped fully assembled and ready for installation.

To unpack the 2910 FTT:

1. Place the shipping container on a secure bench.
2. Open the shipping container, taking care not to damage the contents.
3. Carefully remove transmitter from the shipping container and place it on the bench.
4. Inspect the transmitter for shipping damage. Report any damage to the carrier.

   Note If the transmitter must be stored prior to installation, it should be repacked in its shipping container and stored in a temperature- and humidity- controlled environment.

2.4 Becoming Familiar with the 2910 FTT

The 2910 FTT is housed within an explosion-proof enclosure (see Figure 9-3 on page 60). The cover is provided to permit access to the 2910 FTT’s electronics (i.e. circuit boards). "O" Ring seals are provided to prevent moisture from entering the termination or electronics compartments.

The 2910 FTT housing provides an external grounding lug and 3/4-inch NPT plugs. The plugs permit access to the 2910 FTT wiring connections.

2.5 Grounding the Equipment

Warning! The 2910 FTT must be grounded before communication and power connections are made.

An external grounding lug is provided on the 2910 FTT. A connection from the ground lug to earth ground must be made before any other wiring connections are made.

Note For proper operation of the 2910 FTT, a ground strap must be attached to the FTT. Grounding through mounting kits or pipe coupling is not adequate.

Properly seal all ports to prevent moisture or other contamination from entering the wiring compartment.

2.6 Installation Overview

To install the transmitter, follow the steps shown in the following flowchart:

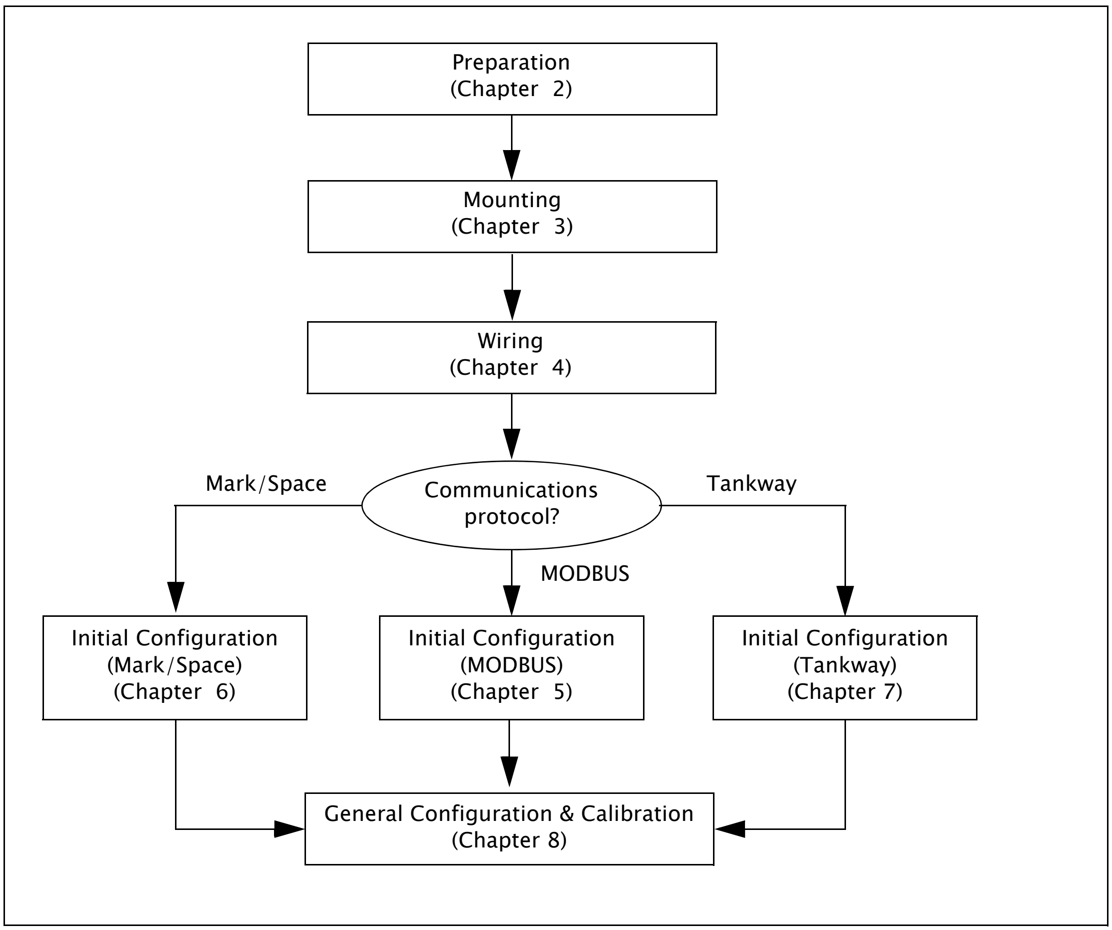


Figure 2-2: 2910 FTT Installation Sequence

3 Mounting

The 2910 FTT can be mounted in the following ways:

- Mount the complete transmitter on a 2500 ATG gaugehead (see Section 3.2, "Mounting on a Varec Gaugehead" on page 10).
- Mount the complete transmitter on a non-Varec gauge (see Section 3.3, "Mounting on Alternate Gaugeheads" on page 12).

This chapter describes each of the above procedures.

The tank can remain in-service and the mechanical float gauge can remain in place while installing and configuring the 2910 FTT.

Note Please read the safety guidelines section before beginning the mounting process.

3.1 Installation Safety Guidelines

- This equipment should be installed only by qualified personnel familiar with the installation of tank gauging equipment.
- Caution should be exercised when entering any area that is posted or otherwise assumed to contain hazardous gases. Always follow other local guidelines.
- Obtain a hot permit before removing the transmitter cover with power applied.
- To prevent shock hazards, the housing of all units should be properly grounded in accordance with the National Electric Code. A grounding conductor should be wired to the grounding terminal provided on the 2910 FTT.

Warning! Before attempting installation of the 2910 FTT, review the General Safety Guidelines described in Chapter 2 "Preparing for Installation" on page 5. Installation and maintenance personnel should become familiar with any hazards present as well as any agency requirements before working with any equipment.

3.2 Mounting on a Varec Gaugehead

This procedure provides instructions to mount the transmitter on a 2500 ATG gaugehead, as shown in Figure 3-1.

Instructions applicable to other tank gauges follow in later paragraphs. To install the gaugehead, refer to the *2500 Automatic Tank Gauge Installation and Operations Manual*. The exploded view in that manual shows the mechanical relationship between this accessory and the gaugehead.

Warning! Whenever the back cover of the gaugehead is removed, stand to one side as the last bolt is removed. If the negator motor spring is broken, the broken pieces may cause injury when the cover is removed.

Warning! The mechanical connections between the gauge float guide cables, the float, the tape, and the gaugehead provide an adequate ground connection for the safe drain of electrostatic charges that may accumulate in the tank and the product. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard.

Make certain grounding straps are fastened properly to the case of each unit. Ground connections via mounting clamps and bolts are not sufficient to a ensure proper ground.

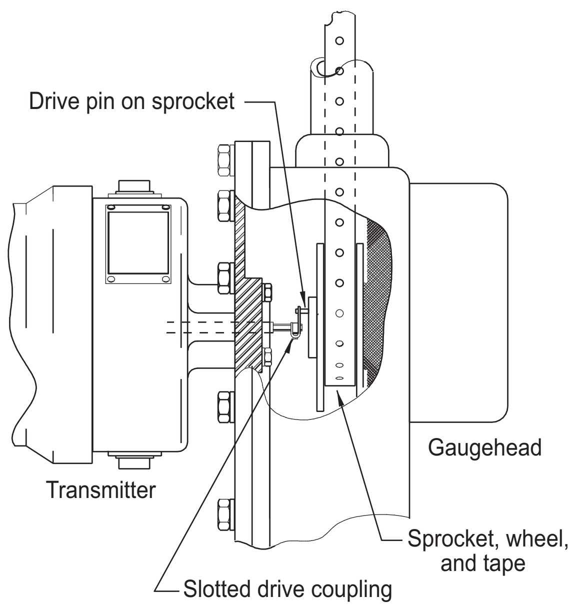


Figure 3-1: Typical Transmitter Mounting

1. Remove the back cover of the gaugehead (see the *2500 Automatic Tank Gauge Installation and Operations Manual*).
2. Remove the access cap from the back cover of the gaugehead (see the *2500 Automatic Tank Gauge Installation and Operations Manual*). Remove and discard the four fiber washers.
3. Mount the transmitter in place of the cap onto the back cover of the gaugehead, using the four hex head cap screws that are attached to the access cap. Make sure that the top of the 2910 FTT housing (marked with “TOP”) lines up with the top of the back cover. Position the circular gasket with the four bolt holes between the transmitter and back cover.
4. Position the back cover and transmitter so that the drive pin on the gaugehead sprocket passes through the slotted drive coupling on the transmitter drive shaft.
5. Fasten the back cover to the gaugehead.
6. Proceed with field wiring, as described in Chapter 4 "Wiring" on page 13.

3.3 Mounting on Alternate Gaugeheads

The following steps describe the typical tasks required for mounting the transmitter on other manufacturers' gaugeheads. An adapter is required. Refer to Chapter 9 "Maintenance and Troubleshooting" on page 57.

The gaugehead is assumed to be installed on the tank. See Figure 3-1 on page 10 and perform the following steps.

1. Remove the mounting plate (back cover) from the gaugehead.
2. Remove the access cap from the mounting plate of the gaugehead. Keep the original gasket and bolts.
3. Mount the transmitter to the adapter, using the included gasket.
4. Install the transmitter with adapter on the gaugehead mounting plate, using the four hex head cap screws that are included with the adapter kit. Use the manufacturer's original gaugehead gasket between the mounting plate and the adapter. Make sure that the top of the 2910 FTT housing (marked with "TOP") lines up with the top of the mounting plate.
5. Position the mounting plate and transmitter so that the drive pin on the gaugehead sprocket passes through the slotted drive coupling on the transmitter drive shaft.
6. Fasten the mounting plate to the gaugehead.
7. Proceed with field wiring, as described in Chapter 4 on page 13.

4 Wiring

This chapter describes how to connect wiring terminations for the 2910 FTT. Wiring should be done after the unit is mounted as described in Chapter 3 "Mounting" on page 9.

4.1 Overview

The wiring of the junction boxes to the 2910 FTT varies based on the order options. Figure 4-1 shows the wiring options available for the 2910 FTT. Some typical order options are illustrated in this section.

The following table presents typical ordering codes with a description of the options and the associated figure:

Order Code	Option Description	Associated Figure
N2910-xx-2-yy-0-N-0-A	AC Only	Figure 4-2 on page 16
N2910-xx-2-yy-3-A-0-B	Discrete I/O, 2 Limit Switches, and AC	Figure 4-3 on page 17
N2910-xx-1-yy-3-A-0-A	2 Limit Switches	Figure 4-4 on page 18
N2910-xx-2-yy-3-B-0-B	Discrete I/O, 4 Limit Switches, and AC	Figure 4-5 on page 19

Table 4-1: Typical Order Options

Field wiring the 2910 FTT Transmitter consists of the following steps:

1. Calculating line resistance (see Section 4.3, "Checking Line Resistance" on page 15).
2. Connecting field wiring to the junction box terminals (see Section 4.8, "Terminating System Wiring at the Transmitter" on page 20).

To connect the internal wiring for the 2910 FTT, see Section 4.9, "Connecting Wiring in the Transmitter" on page 24.

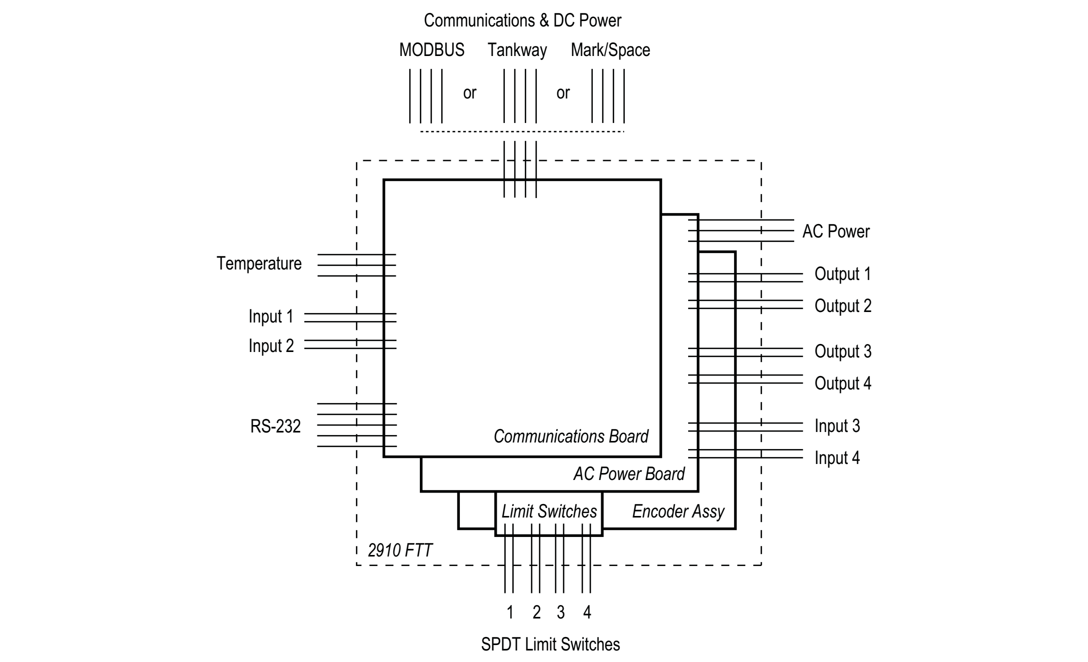


Figure 4-1: 2910 FTT Diagram with Standard and Optional Connections

4.2 Safety Guidelines

- Maintenance should be performed only by authorized personnel.
- Caution should be exercised when entering any area that is posted or otherwise assumed to contain hazardous gases. Always follow local guidelines.
- Obtain a hot permit before removing the transmitter cover with power applied.
- Before installing/repairing any wiring to the 2910 FTT, make sure that the power is turned off at the main circuit breaker or switch. The power switch should be locked in the OFF position and labeled to prevent other personnel from turning the power on during installation.
- To prevent shock hazards, the housing of all units should be properly grounded in accordance with the National Electric Code. A grounding conductor should be wired to the grounding terminal provided on the 2910 FTT.
- Do not apply power to the transmitter until all wiring connections have been made and the cover of the transmitter has been replaced.
- Do not apply power until the instrumentation's communications network has been checked (see Section 4.3, "Checking Line Resistance" on page 15).
- Do not apply power in a hazardous environment until the explosion proof enclosure is closed.
- Incorrect field wiring connections can damage the transmitter electronics and cause system malfunctions.

4.3 Checking Line Resistance

The specification, quality, and condition of the cable between the 2910 FTT and the control room is critical to the reliability of the entire system. Before wiring the 2910 FTT(s) to your system, ensure that the field wiring meets the following criteria:

- The number of transmitters wired in each area does not exceed 31 (MODBUS) or 50 (Mark/Space). See Section 4.8.3, "Communications wiring" on page 22 for more information.
- Wiring distance of the entire communications network does not exceed 10,000 feet (Mark/Space) or 4,000 feet (MODBUS).

When existing or proposed wiring does not meet these limits, the Varec Engineering department should be consulted for a specific evaluation.

4.4 2910 FTT Wiring Diagram — AC Option

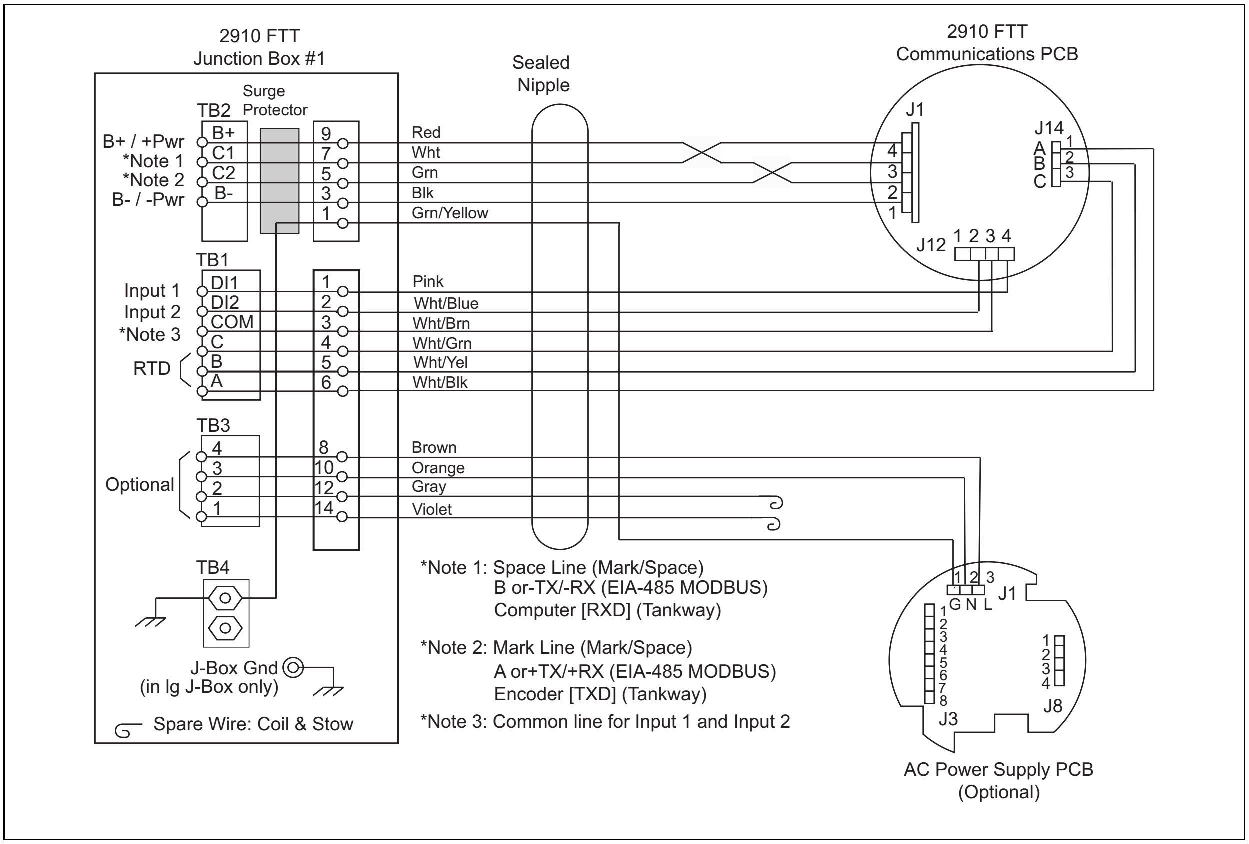


Figure 4-2: 2910 FTT Internal Wiring Diagram — AC Option (Order Code: N2910-xx-2-yy-0-N-0-A)

4.5 2910 FTT Wiring Diagram — Discrete I/O, AC, and 2 Limit Switches Option

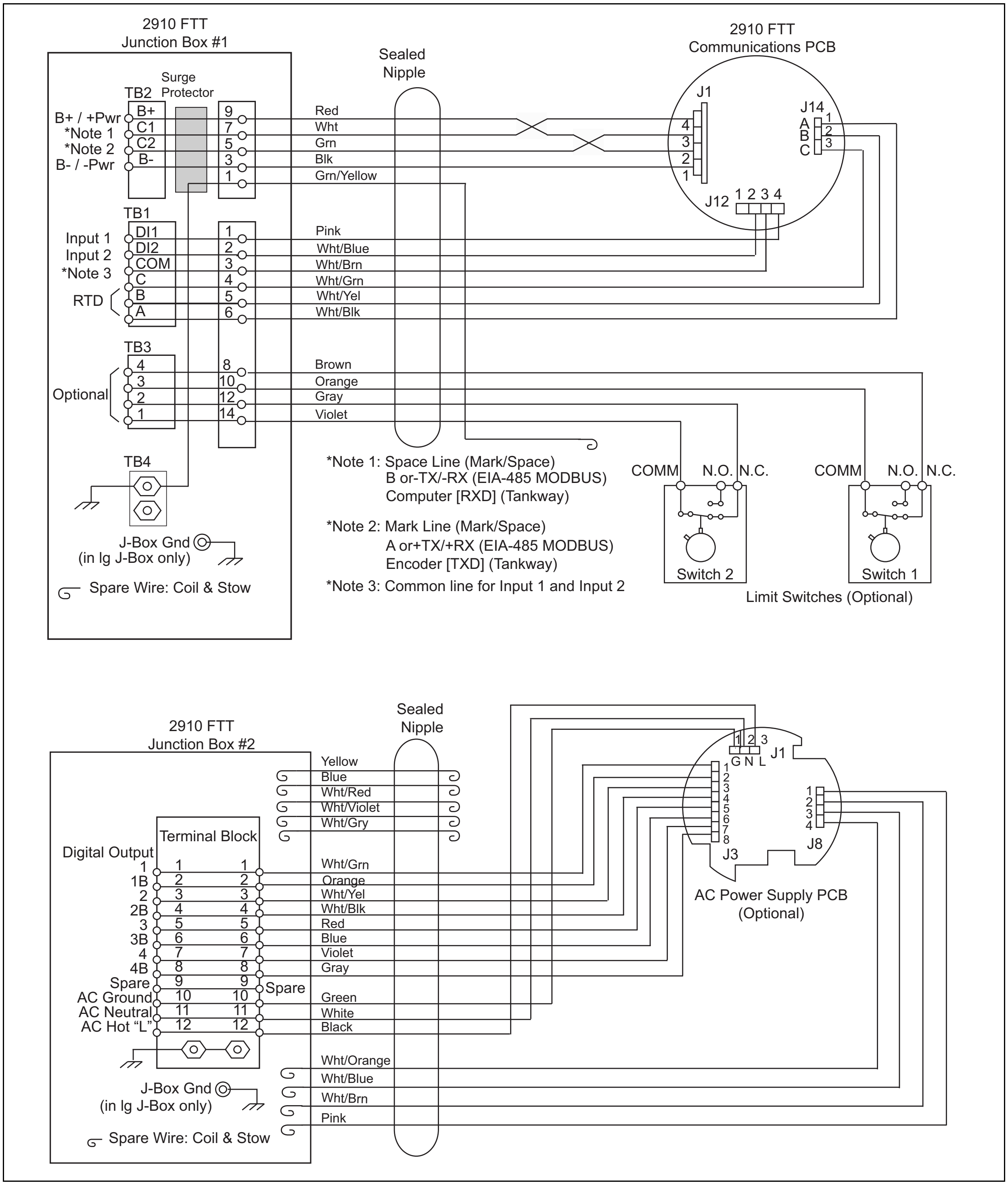


Figure 4-3: 2910 FTT Wiring Diagram — Discrete I/O, AC, and 2 Limit Switches Option (Order Code: N2910-xx-2-yy-3-A-0-B)

4.6 2910 FTT Wiring Diagram — Discrete Input and 2 Limit Switches Option

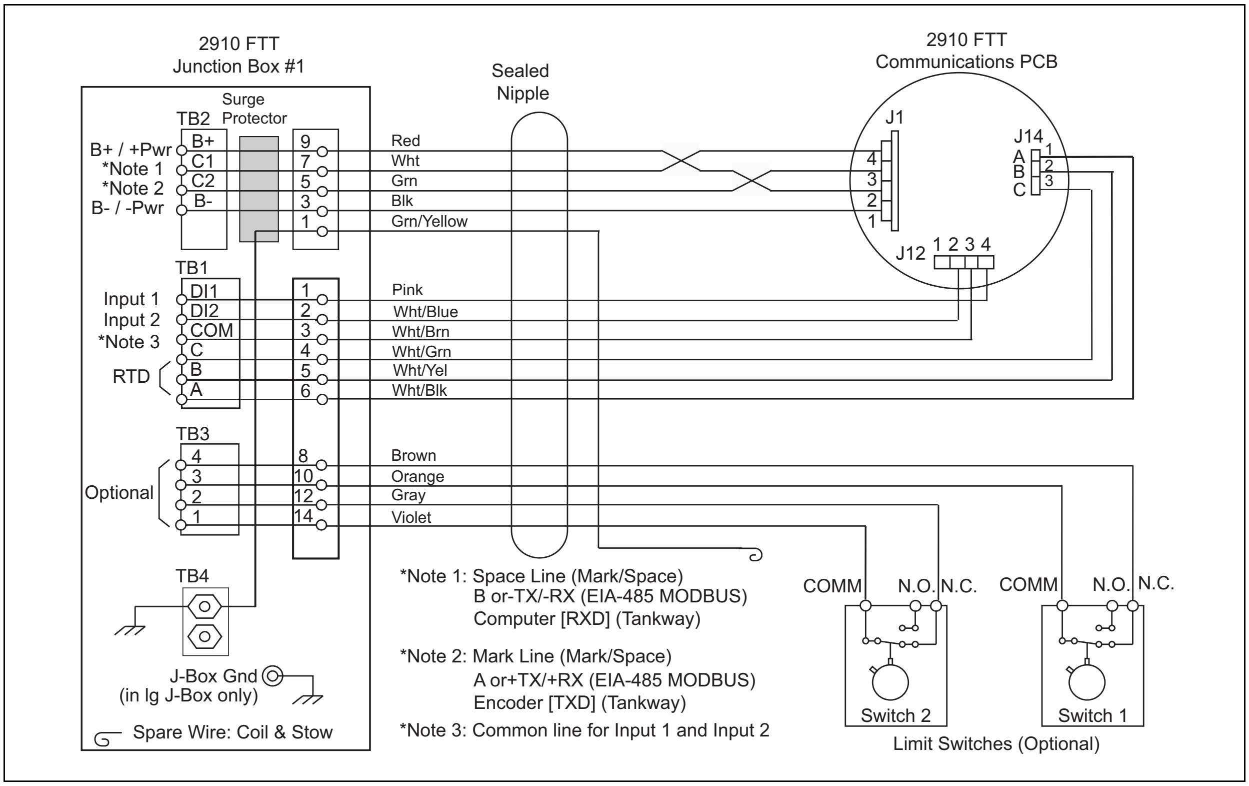


Figure 4-4: 2910 FTT Internal Wiring Diagram — Discrete Input and 2 Limit Switches Option (Order Code: N2910-xx-1-yy-3-A-0-A)

4.7 2910 FTT Wiring Diagram — Discrete I/O, AC, and 4 Limit Switches Option

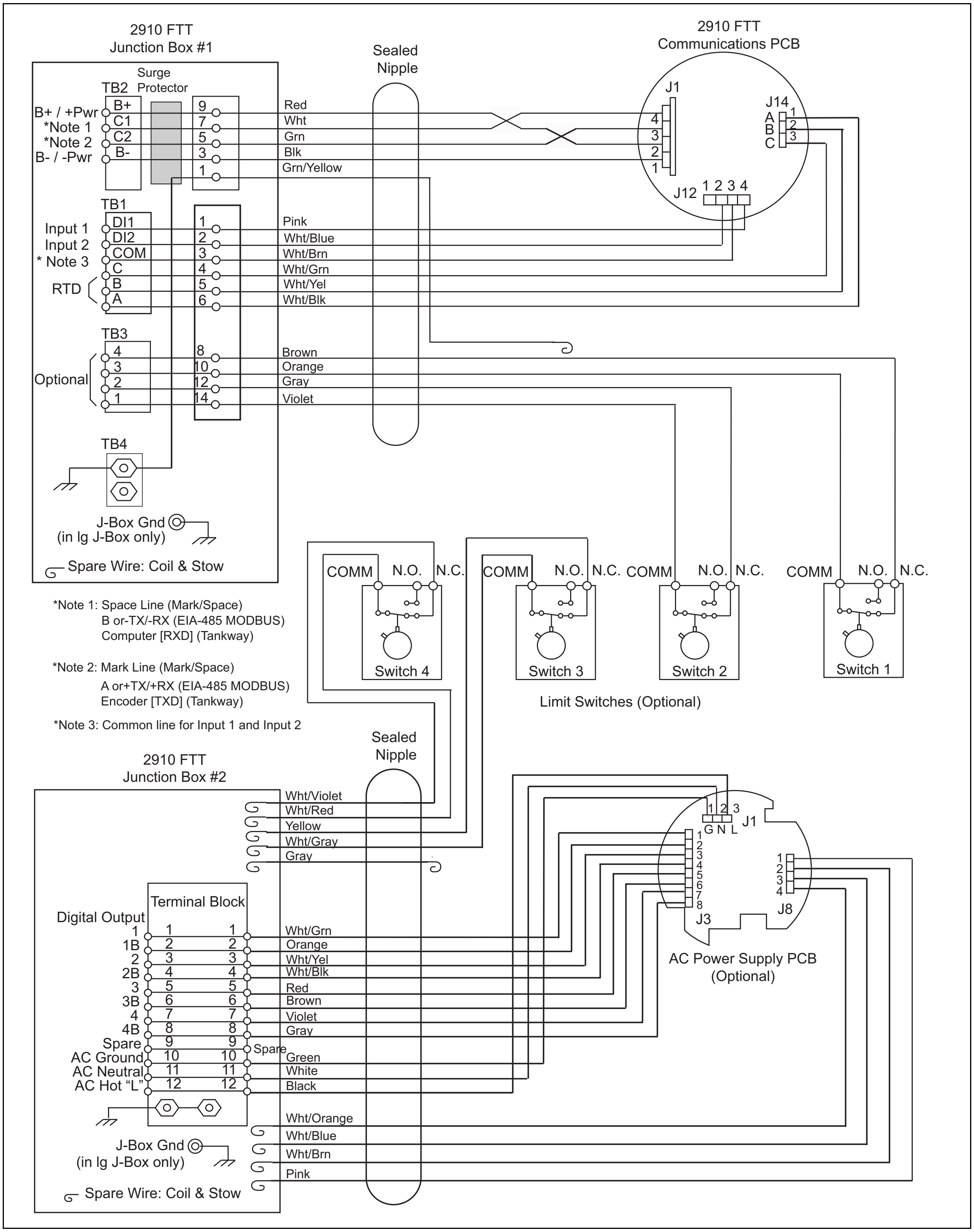


Figure 4-5: 2910 FTT Wiring Diagram — Discrete I/O, AC, and 4 Limit Switches Option (Order Code: N2910-xx-2-yy-3-B-0-B)

4.8 Terminating System Wiring at the Transmitter

This section provides field wiring termination information for the 2910 FTT, including junction box terminal connections for communications, RTD input, discrete inputs, contact outputs, and input power

Note Varec recommends using 18 AWG shielded twisted pair wiring.

4.8.1 Junction box terminals

All wiring from the 2910 FTT is terminated at one or more junction boxes connected to the transmitter housing. The standard junction box provides 14 terminals using pluggable terminal connectors, and includes two earth ground terminals. The standard junction box is shown in Figure 4-6. The second junction box, if required, contains 12 terminals. One junction box is included in the standard configuration, and fittings are provided for additional junction boxes if they are required.

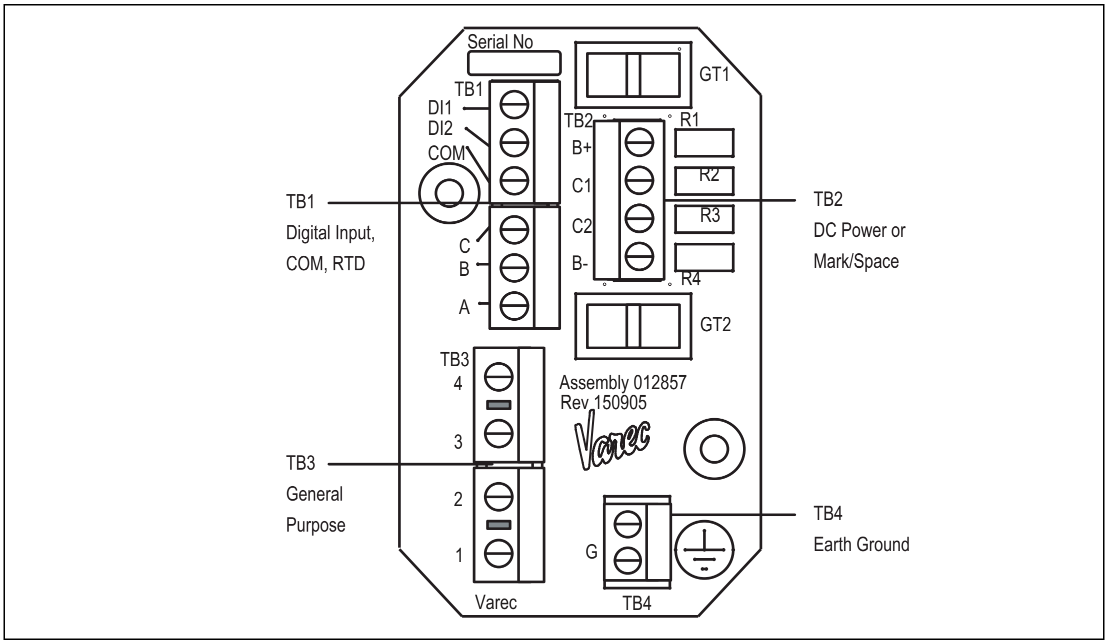


Figure 4-6: Earth Ground Connector, Terminal Circuit Board (Junction Box)

Table 4-2 on page 21 describes the terminal connections for the terminal circuit board. For transmitter wiring diagrams, see Figures 4-2 to Figure 4-5 on pages 16 -19.

Note Earth Ground is located on the terminal circuit board in the junction box as shown in Figure 4-6. For the second junction box, see Figure 4-9 on page 25.

4.8.2 Terminal assignments: terminal circuit board

Terminal/Function	Terminal	Assignment	Description
TB1 – Digital Input / Temperature Input	DI1	Digital Input 1	Digital Input
	DI2	Digital Input 2	Digital Input
	COM	Digital Input Common	For DI1 & DI2
	C	C	RTD Return 2
	B	B	RTD Return 1
	A	A	RTD Signal
TB2 – Communications	B+	B+ / +Power	(All Boards)
	C1	Space Line	(Mark/Space)
		B or –TX/–RX	(EIA-485 MODBUS)
		Computer (RXD)	(Tankway)
	C2	Mark LIne	(Mark/Space)
		A or +TX/+RX	(EIA-485 MODBUS)
		Encoder (TXD)	(Tankway)
	B–	B– / –Power (Gnd)	(All Boards)
TB3 – Optional	1	None	Optional
	2	None	
	3	None	
	4	None	
TB4 – Earth Ground	G	Earth Ground	Earth Ground to Junction Box
	G	Earth Ground	

Table 4-2: Terminal Assignments – Terminal Circuit Board

4.8.3 Communications wiring

Table 4-3 describes the wiring considerations for each communications protocol.

Communications Protocol	Description
Mark/Space	Two shielded, twisted pairs of 18 AWG wire are recommended. This option provides compatibility with the Varec Tank Scanning Unit (TSU), RTU 8130 or Tank Gate interface devices. The 2910 FTT can then be multi-dropped on the same Mark/Space data highway as the Varec 1800/1900 MWT/4000 Transmitter or MFT/HIU devices. Up to 50 devices can be connected. Mark/Space Communications requires 48 VDC.
EIA-485 MODBUS	The 2910 FTT uses a 2-wire EIA-485 hardware interface to communicate with the MODBUS master. EIA-485 is a high speed differential communications network which allows up to 32 devices to operate on one network. The 2910 FTT and MODBUS master communicate over a maximum distance of 4000 feet (1230 meters). The EIA-485 communications interface is compatible with the RTU 8130 (along with any MODBUS-compatible device) and other MODBUS masters. This connection can typically be accomplished with two (2) shielded, twisted pairs of 18 AWG wires.
L&J Tankway	L&J Tankway is a 4-wire system which includes power and ground connections. Fifty or more devices can be connected on the field communication bus. The network is typically installed using two (2) shielded, twisted pairs of wires.

Table 4-3: Communications Wiring Information

4.8.4 RTD wiring

To use a 4-wire RTD with the 2910 FTT, tie two of the RTD return wires together electrically.

4.8.5 Discrete inputs

As standard, the 2910 FTT contains 2 discrete inputs for connection to ancillary devices such as limit switches and float switches. The 2910 FTT then provides an Open/Closed signal to the host system. All wiring must be connected to the appropriate terminals in the junction box supplied with the 2910 FTT. The discrete input connector (J12) is located on the underside of the main PCB.

When the AC Power option is installed, an additional 2 discrete inputs are available. These additional inputs are located on the AC Power PCB.

4.8.6 Contact outputs

When the AC Power option is installed, 4 contact outputs are provided. These are software driven "Normally Open/Closed" outputs. The outputs can be configured using a MODBUS host interface or a computer running ViewRTU. They can be set to trigger alarm lights, horns etc. for temperature or level alarms.

4.8.7 Input power

The standard 2910 FTT uses 20–65 V DC power, supplied through the main communications board. With an optional AC power PCB, the 2910 FTT can also be supplied with 40–65 VAC, 110 VAC, or 220 – 240 VAC at 50/60 Hz. Both options are galvanically-isolated from the micro controller.

To connect DC or AC power to the transmitter, connect the power wires to the appropriate terminals in the junction box(es) supplied with the 2910 FTT.

> **Note** Before connecting power wires to the 2910 FTT, ensure that power is switched off and the instrument is correctly grounded.

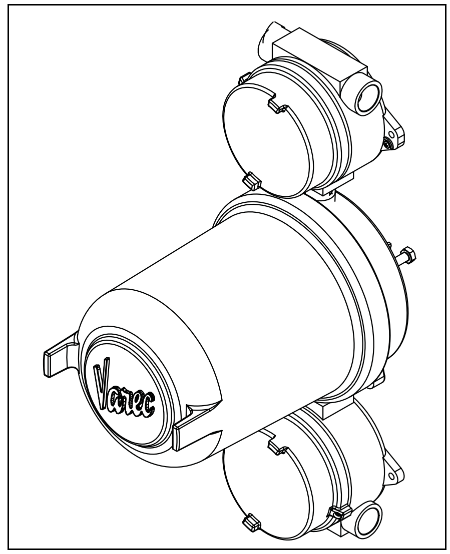


Figure 4-7: Transmitter Housing with Two Junction Boxes

4.9 Connecting Wiring in the Transmitter

4.9.1 Overview

All standard electronics for the 2910 FTT are contained on the main communications circuit board. This includes 20-65 VDC power, field communications, 3-wire temperature input, and two discrete inputs. An optional secondary circuit board contains an AC power supply with three voltage ranges, two additional discrete inputs, and four discrete outputs. See Section 4.8.7, "Input power" on page 23 and Section 4.9.7, "Selecting the AC voltage setting" on page 29 for more information.

All wiring is terminated in junction box(es) . A standard application requires one junction box for communications, temperature, two discrete inputs, and two SPDT contacts. Depending on the complexity of the application, multiple junction boxes can be attached to the transmitter housing.

To connect wires to the electronics assembly, refer to Sections 4.9.3 – 4.9.9 for connector locations, terminal assignments, and special instructions. The system wiring diagrams are shown in Figure 4-2 to Figure 4-5 on pages 16 to 19.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

Note Earth Ground is located on the terminal circuit board in the junction box, as shown in Figure 4-8 (standard) and Figure 4-9 (second junction box version).

4.9.2 Earth ground locations

4.9.2.1 Standard terminal board

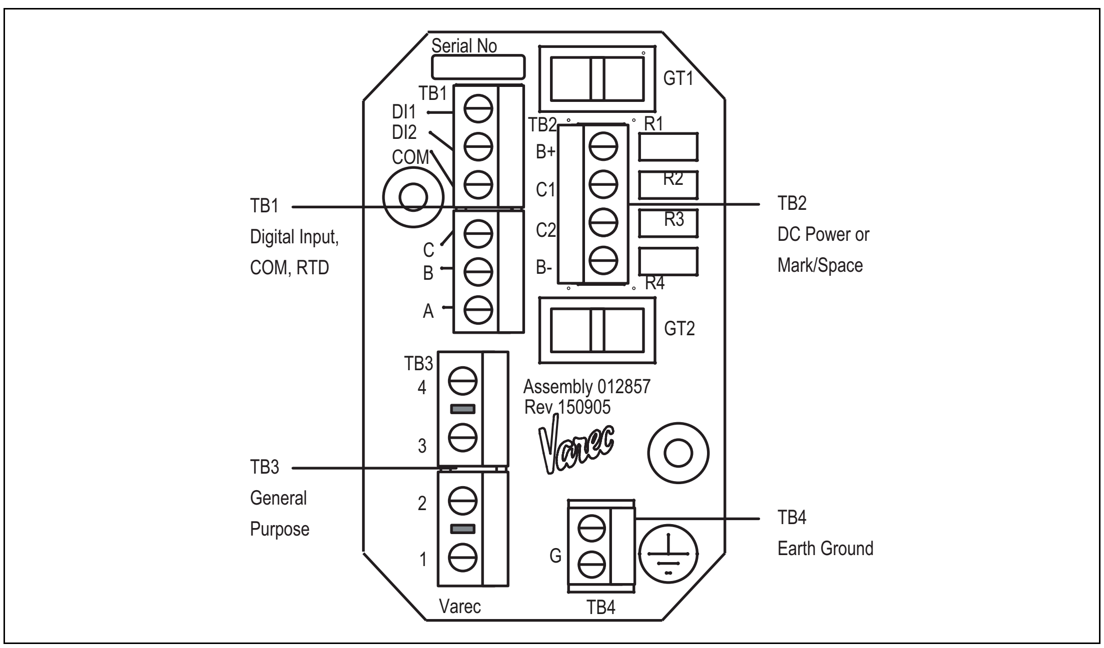


Figure 4-8: Earth Ground Connector: Standard Terminal Board Junction Box

4.9.2.2 Earth ground location: second junction box terminal board

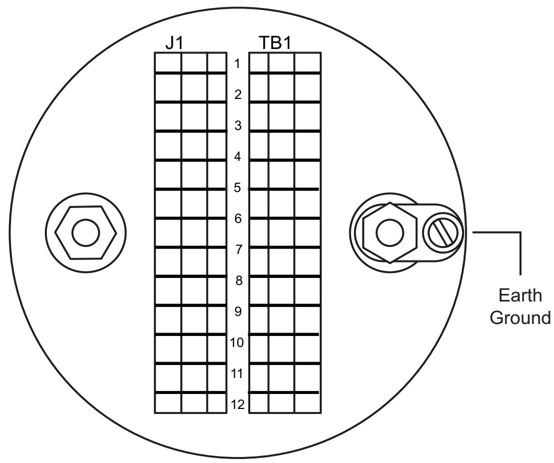


Figure 4-9: Earth Ground Connector: Second Junction Box Terminal Board

4.9.3 Connector locations: communications circuit board

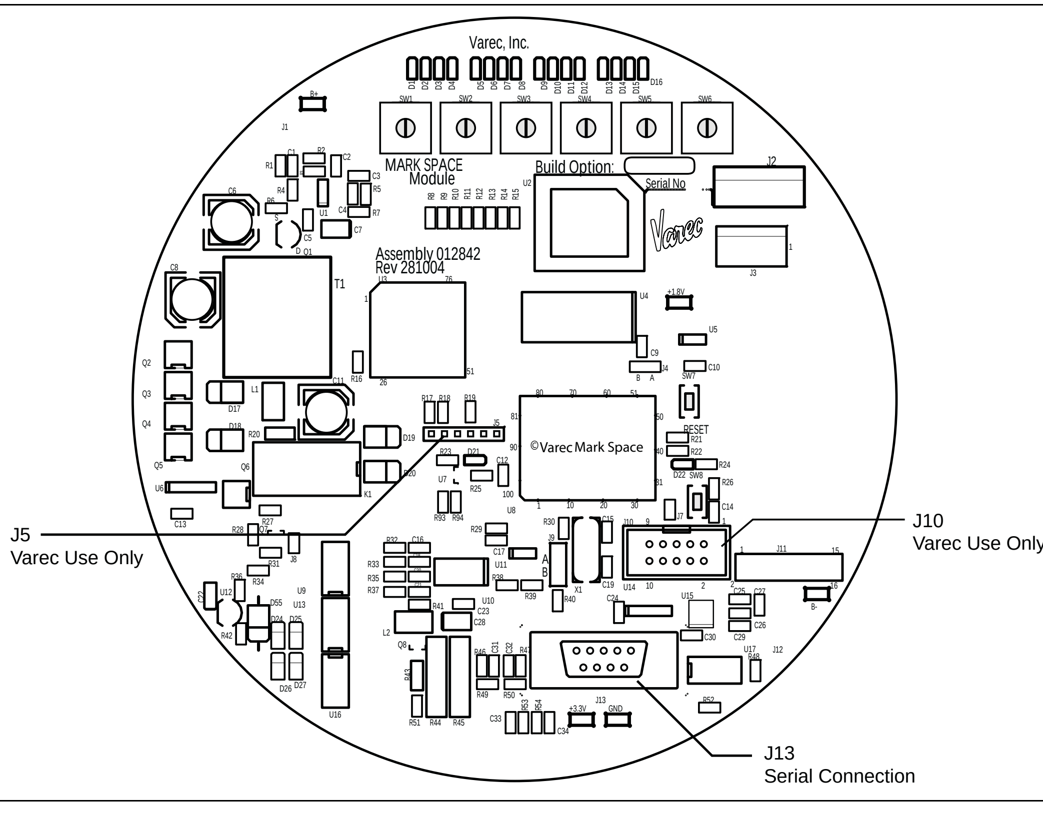


Figure 4-10: Communications Board Connectors: Top View (Mark/Space shown)

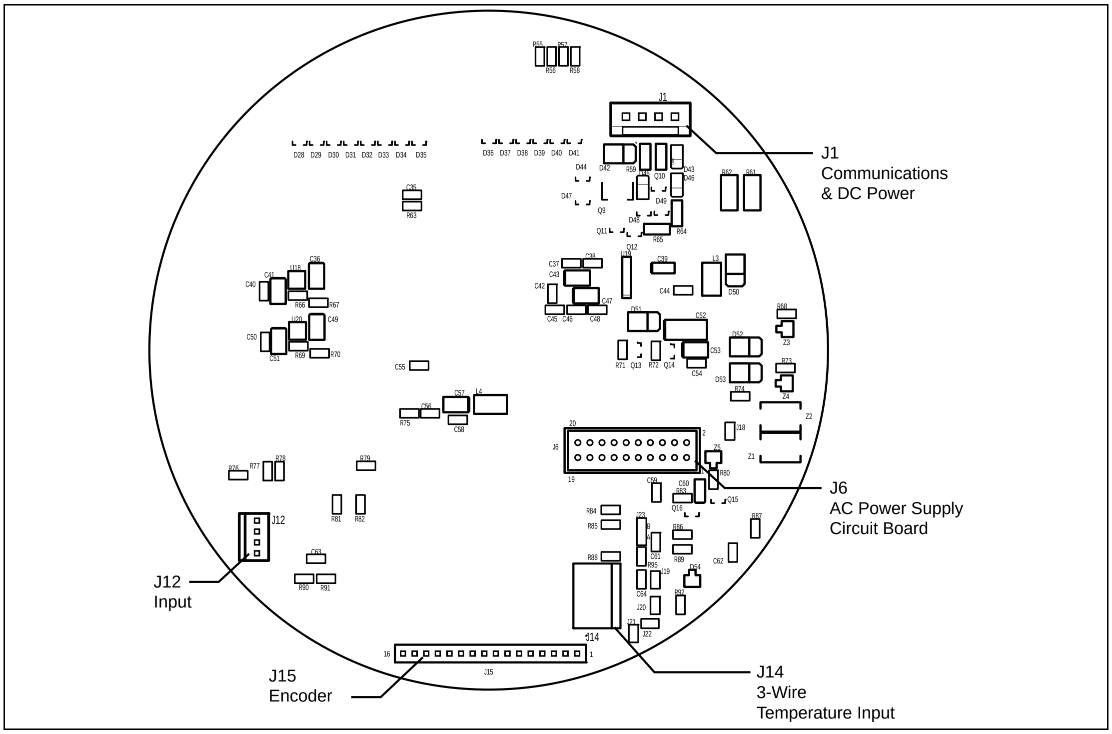


Figure 4-11: Communications Board Components: Bottom View (Mark/Space shown)

4.9.4 Connector assignments: communications circuit board

Connector/Function	Terminal	Assignment	Description
J1 - Communications	1	B- / -Power (Gnd)	(All Boards)
	2	B+ / +Power	(All Boards)
	3	Mark Line	(Mark/Space)
		A or +TX/+RX	(EIA-485 MODBUS)
		Encoder (TXD)	(Tankway)
	4	Space Line	(Mark/Space)
		B or -TX/-RX	(EIA-485 MODBUS)
		Computer (RXD)	(Tankway)
J5 - Programming			(Varec Use Only)
J6 - AC Power Circuit Board			Connection to optional AC Power Circuit Board
J9 - ROM Selection		Position A: selects microcontroller & internal Flash	Jumper Pins for selection of ROM source
		Position B: selects PROM located in U2 (plug-in EPROM)	
J10 - Programming			Flash Programming (Varec Use Only)

Table 4-4: Connector Assignments: Communications Circuit Board

Connector/Function	Terminal	Assignment	Description
J12 – Alarms (Discrete Inputs)	1	Common	Common return
	2	Alarm 1	
	3	Common	Common return
	4	Alarm 2	
J13 – Serial Connection (RS-232)	2	RXD	
	3	TXD	
	5	RS-232 Gnd	
J14 – 3-Wire Temperature Input	1	A	RTD Signal
	2	B	Return 1
	3	C	Return 2

Table 4-4: Connector Assignments: Communications Circuit Board

4.9.5 Connector and switch locations: AC power supply circuit board

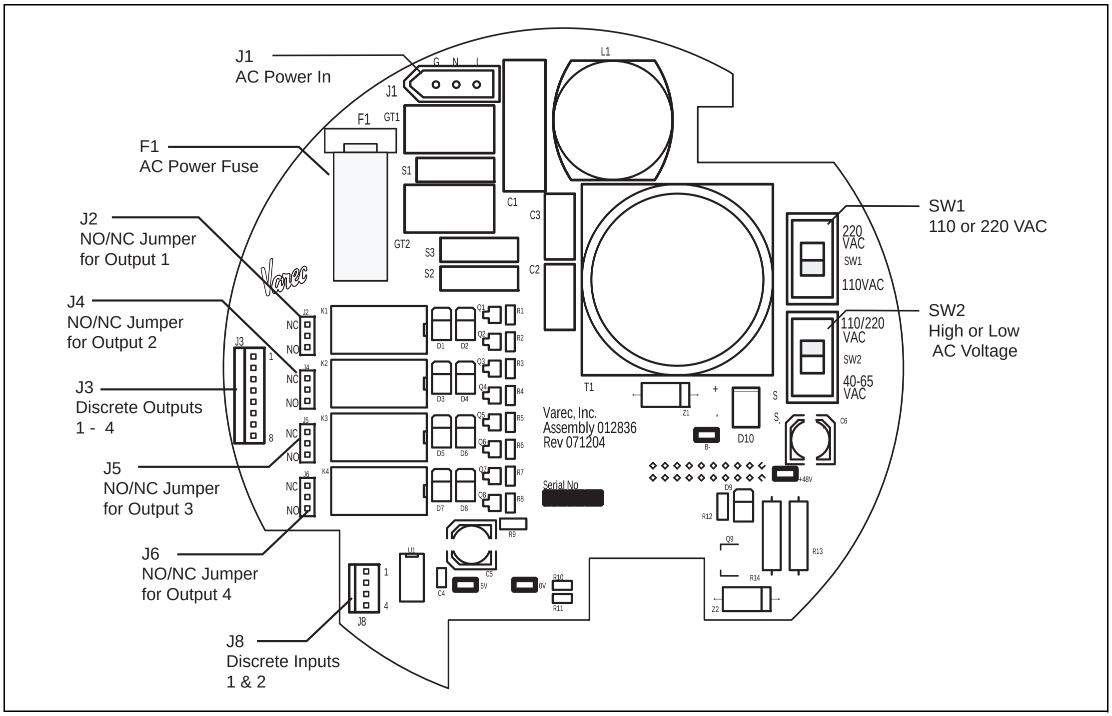


Figure 4-12: AC Power Supply Circuit Board: Top View

4.9.6 Connector assignments: AC power supply circuit board

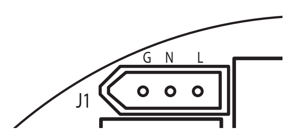
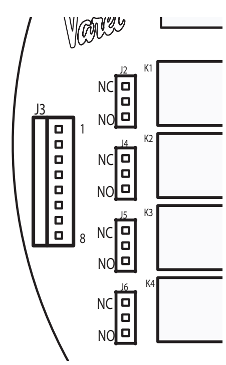
Connector/Function	Terminal	Assignment	Illustration
J1 AC Power	L	Line	
	N	Neutral	
	G	Ground	
J3 Discrete Outputs (4)	1	Output 1 +	
	2	Output 1 –	
	3	Output 2 +	
	4	Output 2 –	
	5	Output 3 +	
	6	Output 3 –	
	7	Output 4 +	
	8	Output 4 –	

Table 4-5: Terminal Assignments: AC Power Circuit Board

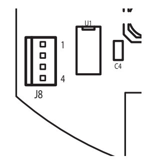
Connector/Function	Terminal	Assignment	Illustration
J8 Discrete Inputs (2)	1	Common	
	2	Alarm3	
	3	Common	
	4	Alarm4	

Table 4-5: Terminal Assignments: AC Power Circuit Board

Note Switches SW1 and SW2 on the AC Power circuit board determine the AC voltage setting for the 2910 FTT. See the “Selecting the AC voltage setting” section for instructions on setting the AC Power level.

Note Each optional discrete output is set to NO or NC using a jumper setting. See the “Setting optional outputs as NC or NO” section for instructions on setting optional outputs as NC or NO using the appropriate jumper.

4.9.7 Selecting the AC voltage setting

The optional AC Power Supply circuit board can operate at one of three voltage ranges: low (40 – 65 VAC), medium (110 VAC), or high (220 – 240 VAC).

To set the voltage:

1. Set SW2 to low voltage (40 – 65 VAC) or medium/high voltage (110/220 VAC).
2. If SW2 is set to 110/220 VAC, set SW1 to 110 VAC or 220 VAC as appropriate.

   Caution! If SW2 is set to 40 – 65 VAC, set SW1 to 110 VAC to avoid blowing fuse F1.

Figure 4-13 shows AC voltage switches SW1 and SW2.

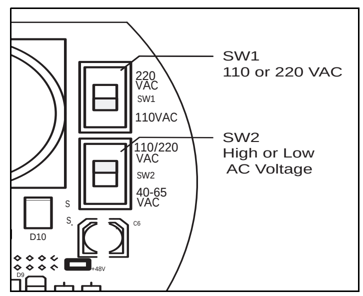


Figure 4-13: AC Voltage Selection Switches

4.9.8 Setting optional outputs as NC or NO

Each of the four discrete outputs on the AC Power Supply circuit board can be set to operate as Normally Closed (NC) or Normally Open (NO). A jumper connector determines the setting for each output, as shown in Figure 4-12 and in Table 4-5 on page 28.

To set each output, push the jumper onto the NC and center pins for NC operation, or onto the NO and center pins for NO operation.

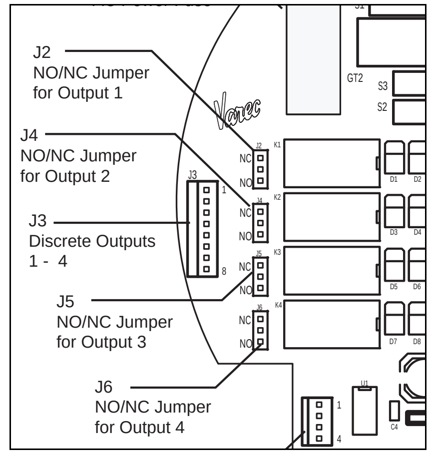


Figure 4-14: Optional Outputs and Jumpers

Output	Jumper
1	J2
2	J4
3	J5
4	J6

Table 4-6: Output - Jumper Assignments - AC Power Circuit Board

Note Outputs are set to NC at the factory.

4.9.9 Wiring limit switches

Each of the optional SPDT limit switches can be wired for Normally Open (NO) or Normally Closed (NC) operation by using the appropriate terminals:

- Under normal operating conditions, the Normally Closed (NC2) and Common (COM1) terminals of the limit switch are connected. The Normally Open (NO3) and Common (COM1) terminals of the limit switch become connected as the switch arm rides up the cam, as shown in Figure 4-15.

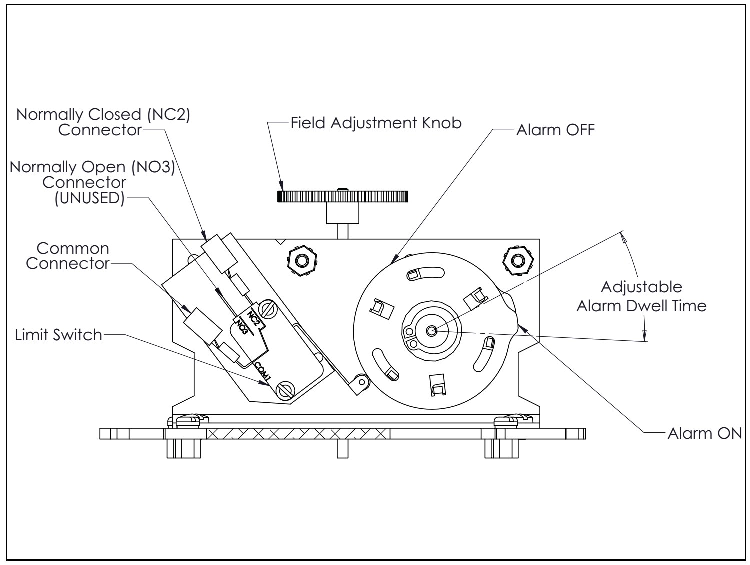


Figure 4-15: Limit Switch Connections

- When the limit switch arm rides up on the cam, it makes contact between the Normally Open (NO3) and Common (COM1), but it also breaks the connection between the Normally Closed (NC2) and Common (COM1).

Figure 4-6 on page 20 shows the limit switch terminal connections.

5 Initial Configuration (MODBUS or GSI MODBUS)

After the 2910 FTT has been mounted and wired, it must be calibrated/configured as described below. To transmit GSI MODBUS data, see step 3.

1. Set the unit address (see Section 5.1, "Setting the Unit Address" on page 35).
2. Choose the communications setting (see Section 5.2, "Choosing Communications Settings" on page 36).
3. Set the data format (English or Metric units, MODBUS or GSI MODBUS) and rotation direction (see Section 5.3, "Setting the Data Format" on page 37).
4. Choose the RTD type (see Section 5.4, "Setting the RTD Type" on page 38).
5. Terminate the MODBUS network (if required) (see Section 5.5, "Terminating the MODBUS Network" on page 38).
6. Set the bias current (see Section 5.6, "Setting the Bias Current" on page 39).
7. Calibrate the transmitter level and limit switches, and configure outputs (see Chapter 8 on page 49).

   Note This chapter contains instructions relevant to a MODBUS or GSI MODBUS application. If using Mark/Space, see Chapter 6 on page 41; for Tankway, see Chapter 7 on page 45.

Alarm and output setpoints can be configured via MODBUS registers. see Section A, "Appendix A — MODBUS Implementation" on page 73 for an explanation of the MODBUS protocol and MODBUS register mapping tables.

Figure 5-1 shows the MODBUS communications circuit board switch and LED locations.

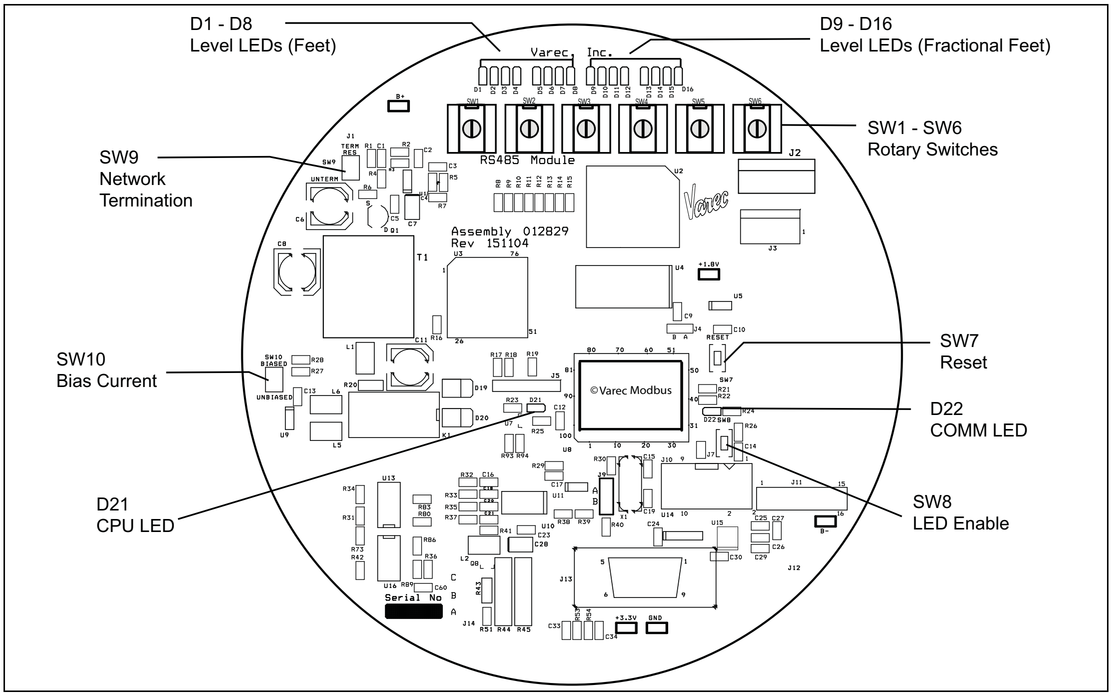


Figure 5-1: MODBUS Communication Board Switches and LEDs

Note Firmware version indicates MODBUS.

Note To check the status of the communications circuit board CPU, see Section 9.1.1, "Checking the CPU status" on page 57. To check the communications status, see Section 9.1.2, "Checking communications status" on page 59.

Note To activate the LEDs on the communications circuit board, press switch SW8 shown in Figure 5-1. The LEDs will be enabled for about three minutes.

5.1 Setting the Unit Address

The unique address that identifies the 2910 FTT is set using rotary switches SW1–SW3. An address from 000 – 255 can be selected.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the unit address:

1. Remove the transmitter cover.
2. Set SW1 to SW3 to the desired unit address.
   For example: to assign an address of 001, set SW1 = 0, SW2 = 0, and SW3 = 1.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

5.2 Choosing Communications Settings

For the 2910 FTT in the MODBUS configuration, switch SW4 is used to select the communication baud rate and parity setting.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To select communications settings:

1. Remove the transmitter cover.
2. Rotate switch SW4 to the appropriate position, as identified in the following table.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting	Description
0	19200 N	19200 Baud, no parity
1	19200 O	19200 baud, odd parity
2	19200 E	19200 baud, even parity
3	9600 N	9600 Baud, no parity
4	9600 O	9600 baud, odd parity
5	9600 E	9600 baud, even parity
6	4800 N	4800 Baud, no parity
7	4800 O	4800 baud, odd parity
8	4800 E	4800 baud, even parity
9	2400 N	2400 Baud, no parity
A	2400 O	2400 baud, odd parity
B	2400 E	2400 baud, even parity
C	1200 N	1200 Baud, no parity
D	1200 O	1200 baud, odd parity
E	1200 E	1200 baud, even parity
F	9600 N	9600 Baud,no parity

Table 5-1: Rotary Switch SW4 Positions

5.3 Setting the Data Format

The 2910 FTT can transmit data as standard MODBUS data in feet or meters, with forward or reverse rotation. The 2910 FTT can also transmit GSI MODBUS data in forward or reverse rotation. The position of switch SW5 determines which of those settings is used.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the data format:

1. Remove the transmitter cover.
2. Rotate switch SW5 to the appropriate position, as identified in Table 5-2.

   Note Setting the 2910 FTT data format to Meters assumes that the transmitter is/will be installed on a metric mechanical gauge. Setting the data format to Feet assumes that the transmitter is/will be installed on an Imperial mechanical gauge.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting
0	Decimal Feet & Forward Rotation
1	Meters & Forward Rotation
2	Decimal Feet & Reverse Rotation
3	Meters & Reverse Rotation
4	GSI MODBUS MAP & Forward Rotation (Decimal Feet)
5	GSI MODBUS MAP & Reverse Rotation (Decimal Feet)
6	Feet & Forward Rotation (Feet/Inches/16^{ths} of an Inch)
7-F	Decimal Feet & Forward Rotation
8-F	Feet and Reverse Rotation (Feet/Inches/16^{ths} of an inch)

Table 5-2: Rotary Switch SW5 Positions

5.4 Setting the RTD Type

To accurately obtain readings from a spot temperature RTD (Resistance Temperature Detector), the 2910 FTT must be set to match the RTD type and temperature format. Types vary according to the metal used, the probe resistance, and the temperature format (Fahrenheit/Celsius).

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the RTD type:

1. Remove the transmitter cover.
2. Rotate switch SW6 to the appropriate position, as identified in Table 5-3.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting	Description
0	Pt100 & F	Platinum, 100 ohms, Fahrenheit
1	Pt100 & C	Platinum, 100 ohms, Celsius
2	Cu100 & F	Copper, 100 ohms, Fahrenheit
3	Cu100 & C	Copper, 100 ohms, Celsius
4	Cu90 & F	Copper, 90 ohms, Fahrenheit
5	Cu90 & C	Copper, 90 ohms, Celsius
6	No Temperature	Temperature disabled

Table 5-3: Rotary Switch SW6 Positions

5.5 Terminating the MODBUS Network

In an EIA485 network, devices at each end of the communications network are typically terminated. In typical installations, these devices are the MODBUS host interface device and the transmitters with the greatest amount of cable between the transmitter and the host. The user can terminate the network at a 2910 FTT by closing a switch to apply a 100-ohm resistor across the network line. This switch is normally set in the UNTERM position.

Note Typically, a terminating resistor is not needed for MODBUS networks operating at a baud rate below 9600.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To terminate the network line at the transmitter:

1. Remove the transmitter cover.
2. On the communications circuit board, set switch SW9 to the TERM RES (up) position.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Note Typically, no more than one transmitter on a communications bus should terminate the network.

5.6 Setting the Bias Current

In a MODBUS network, during periods of no communications, all devices on the network are in high-impedance states. This causes the data+ and data- lines to “float” meaning that they may not have a fixed voltage.

To remedy this situation, pull-up and pull-down resistors are typically used to provide a small bias current on the network. This current holds the data+ and data- lines at predetermined high and low voltage settings. Bias current is normally provided at the host, but can be provided at the 2910 FTT using switch SW10.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To apply the bias resistors to the MODBUS network:

1. Remove the transmitter cover.
2. On the communications circuit board, set switch SW10 to the BIASED (up) position.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Note Applying the Bias Current on multiple 2910 FTT transmitters could cause poor performance in the EIA485 communications network.

6 Initial Configuration (Mark/Space)

After the 2910 FTT has been mounted and wired, it must be calibrated/configured as described below.

1. Set the unit address (see Section 6.1, "Setting the Unit Address" on page 42).
2. Choose the communications setting (see Section 6.2, "Choosing Communications Settings" on page 42).
3. Set the data format (see Section 6.3, "Setting the Data Format" on page 43).
4. Choose the RTD type (see Section 6.4, "Setting the RTD Type" on page 44).
5. Calibrate transmitter level, calibrate limit switches, and configure outputs (see Chapter 8 "Configuration & Calibration — Level, Limits, and Outputs" on page 49).

   Note This chapter contains instructions relevant to a Mark/Space application. If using MODBUS or GSI MODBUS, see Chapter 5 "Initial Configuration (MODBUS or GSI MODBUS)" on page 33; for Tankway, see Chapter 7 "Initial Configuration (Tankway)" on page 45.

See Figure 6-1 for the location of the switches and LEDs on the 2910 FTT Mark/Space communications circuit board.

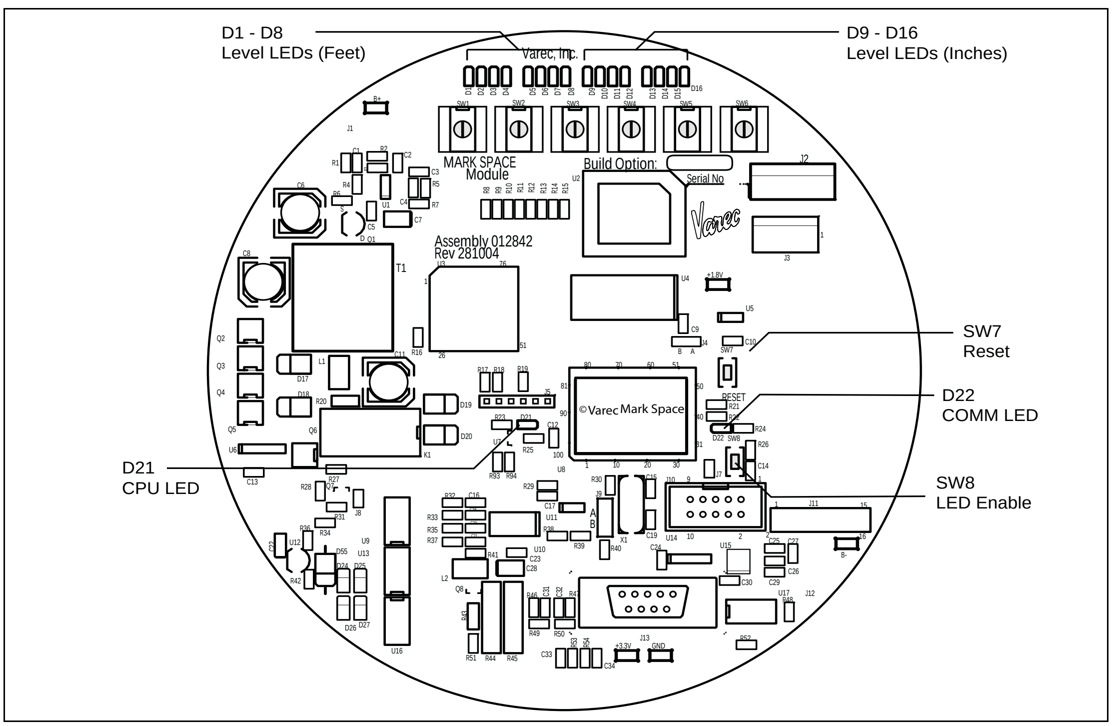


Figure 6-1: Mark/Space Communications Board — Switches and LEDs

Note Firmware version indicates Mark/Space.

Note To check the status of the communications circuit board CPU, see Section 9.1.1, "Checking the CPU status" on page 57. To check the communications status, see Section 9.1.2, "Checking communications status" on page 59.

Note To activate the LEDs on the communications circuit board, press switch SW8, shown in Figure 6-1. The LEDs will be enabled for about three minutes.

6.1 Setting the Unit Address

The unique address that identifies the 2910 FTT is set using rotary switches SW1–SW3. An address from 000 – 999 can be selected.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the unit address:

1. Remove the transmitter cover.
2. Set SW1 to SW3 to the desired unit address.
   For example: to assign an address of 001, set SW1 = 0, SW2 = 0, and SW3 = 1.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

6.2 Choosing Communications Settings

The 2910 FTT can operate as a Varec 1800 or 1900 MWT transmitter, or as a GSI 2000 transmitter for level and temperature format. The data speed can be set to high or low, and the transmitter can be set for forward or reverse rotation.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To select communications settings:

1. Remove the transmitter cover.
2. Rotate switch SW4 to the appropriate position, as identified in Table 6-1.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting
0	1900 MWT & High Speed & Forward Rotation
1	1900 MWT & High Speed & Reverse Rotation
2	1900 MWT & Low Speed & Forward Rotation
3	1900 MWT & Low Speed & Reverse Rotation
4	1800 & High Speed & Forward Rotation
5	1800 & High Speed & Reverse Rotation
6	1800 & Low Speed & Forward Rotation
7	1800 & Low Speed & Reverse Rotation
8	GSI 2000 & High Speed & Forward Rotation
9	GSI 2000 & High Speed & Reverse Rotation
10	GSI 2000 & Low Speed & Forward Rotation
11	GSI 2000 & Low Speed & Reverse Rotation
C–F	1900 MWT & High Speed & Forward Rotation

Table 6-1: Rotary Switch SW4 Positions

6.3 Setting the Data Format

The 2910 FTT can transmit data in English or Metric format.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the data format:

1. Remove the transmitter cover.
2. Rotate switch SW5 to the appropriate position, as identified in Table 6-2.
3. Refer to Section B.2.3, "Decimal Feet/Inches and Fractional Inches to Binary Conversion (Forward and Reverse Encoding)" on page 94 and

   Note Setting the 2910 FTT data format to meters assumes that the transmitter is/will be installed on a metric mechanical gauge. Setting the data format to feet assumes that the transmitter is/will be installed on an Imperial mechanical gauge.
4. Press switch SW7 to reset the CPU.
5. Replace the transmitter cover.

Position	Setting
0	Fractional Feet (10s of Feet/1s of Feet/Inches/16^{ths} of an Inch)
1	Decimal Feet (10s of Feet/1s of Feet/10^{ths} of Feet/100^{ths} of Feet)
2	0-20 Meters
3	0-30 Meters
4-F	Fractional Feet (10s of Feet/1s of Feet/Inches/16^{ths} of an Inch)

Table 6-2: Rotary Switch SW5 Positions

6.4 Setting the RTD Type

To accurately obtain readings from a spot temperature RTD (Resistance Temperature Detector), the 2910 FTT must be set to match the RTD type and temperature format. Types vary according to the metal used, the probe resistance, and the temperature format (Fahrenheit/Celsius).

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the RTD type:

1. Remove the transmitter cover.
2. Rotate switch SW6 to the appropriate position, as identified in Table 6-3.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting	Description
0	Pt100 & F	Platinum, 100 ohms, Fahrenheit
1	Pt100 & C	Platinum, 100 ohms, Celsius
2	Cu100 & F	Copper, 100 ohms, Fahrenheit
3	Cu100 & C	Copper, 100 ohms, Celsius
4	Cu90 & F	Copper, 90 ohms, Fahrenheit
5	Cu90 & C	Copper, 90 ohms, Celsius
6	No MS Temperature	no temperature input 40-bit Mark/Space Response message
7	Pt100 & F & 100 Offset	Platinum, 100 ohms, Fahrenheit, 100 deg. offset
8	Pt100 & C & 100 Offset	Platinum, 100 ohms, Celsius, 100 deg. offset
9	Cu100 & F & 100 Offset	Copper, 100 ohms, Fahrenheit, 100 deg. offset
A	Cu100 & C & 100 Offset	Copper, 100 ohms, Celsius, 100 deg. offset
B	Cu90 & F & 100 Offset	Copper, 90 ohms, Fahrenheit, 100 deg. offset
C	Cu90 & C & 100 Offset	Copper, 90 ohms, Celsius, 100 deg. offset
D-F	Pt100 & F & 100 Offset	Platinum, 100 ohms, Fahrenheit, 100 deg. offset

Table 6-3: Rotary Switch SW6 Positions

7 Initial Configuration (Tankway)

After the 2910 FTT has been mounted and wired, it must be calibrated/configured as described below.

1. Set the unit address (see Section 7.1, "Setting the Unit Address" on page 46).
2. Choose the communications setting (see Section 7.2, "Choosing Communications Settings" on page 46).
3. Choose the RTD type (see Section 7.4, "Setting the RTD Type" on page 48).
4. Calibrate transmitter level, calibrate limit switches, and configure outputs (see Chapter 8 on page 49).

   Note This chapter contains instructions relevant to a Tankway application. If using Mark/Space, see Chapter 6 on page 41; for MODBUS or GSI MODBUS, see Chapter 5 on page 33.

See Figure 7-1 for the location of the switches and LEDs on the 2910 FTT Tankway communications circuit board.

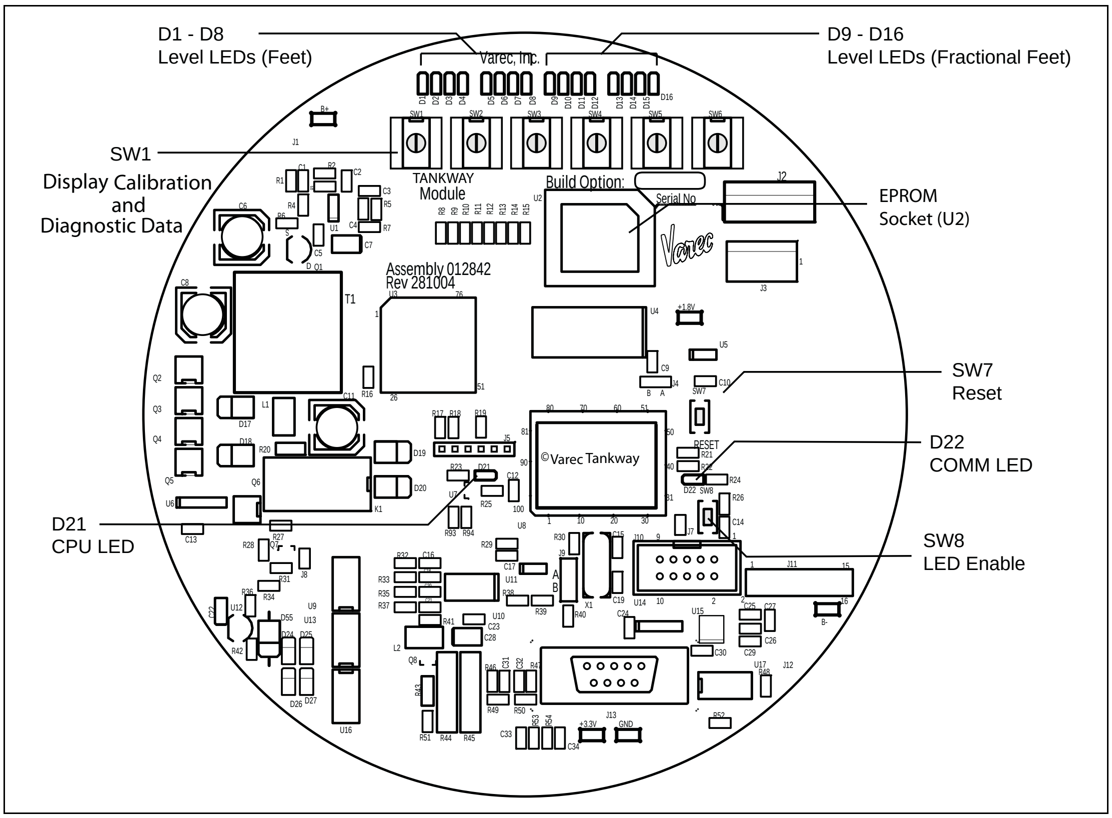


Figure 7-1: Tankway Communications Board — Switches and LEDs

Note Firmware version indicates Tankway.

Note To check the status of the communications circuit board CPU, see Section 9.1.1, "Checking the CPU status" on page 57. To check the communications status, see Section 9.1.2, "Checking communications status" on page 59.

Note To activate the LEDs on the communications circuit board, press switch SW8, shown in Figure 7-1. The LEDs will be enabled for about three minutes.

7.1 Setting the Unit Address

The unique address that identifies the 2910 FTT is set using rotary switches SW1–SW3. An address from 000 – 127 can be selected.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the unit address:

1. Remove the transmitter cover.
2. Set SW1 to SW3 to the desired unit address.
   For example: to assign an address of 001, set SW1 = 0, SW2 = 0, and SW3 = 1.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

7.2 Choosing Communications Settings

The 2910 FTT can operate as an L&J 1000 MWT, 1500 MWT, or 2000 MWT. The Tank Data can be set for 1 or 4 data modes.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To select communications settings:

1. Remove the transmitter cover.
2. Rotate switch SW4 to the appropriate position, as identified inTable 7-1.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

Position	Setting	Description
0	Device Type 1	L&J 2000 MWT, for Varec gauges (forward encoding)
1	Device Type 2	L&J 2000 MWT, for Shand & Jurs gauges (reverse encoding)
2	Device Type 3	L&J 1000 MWT / 1500 MWT
3	Device Type 4	L&J 1000 MWT / 1500 MWT
4-F	Device Type 1	L&J 2000 MWT, for Varec gauges (forward encoding)

Table 7-1: Rotary Switch SW4 Positions

7.3 Setting the Data Format

The 2910 FTT transmits data in English format.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the data format:

1. Remove the transmitter cover.
2. Rotate switch SW5 to the appropriate position, as identified in Table 7-2.
3. Refer to section B.2.3, "Decimal Feet/Inches and Fractional Inches to Binary Conversion (Forward and Reverse Encoding)" on page 94 and

   Note Setting the 2910 FTT data format to feet assumes that the transmitter is/will be installed on an Imperial mechanical gauge.
4. Press switch SW7 to reset the CPU.
5. Replace the transmitter cover.

Position	Setting
0	Fractional Feet (10s of Feet/1s of Feet/Inches/16^{ths} of an Inch)
1	Decimal Feet (10s of Feet/1s of Feet/10^{ths} of Feet/100^{ths} of Feet)
2-F	Fractional Feet (10s of Feet/1s of Feet/Inches/16^{ths} of an Inch)

Table 7-2: Rotary Switch SW5 Positions

7.4 Setting the RTD Type

To accurately obtain readings from a spot temperature RTD (Resistance Temperature Detector), the 2910 FTT must be set to match the RTD type and temperature format. Types vary according to the metal used and the probe resistance.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the RTD type:

1. Remove the transmitter cover.
2. Rotate switch SW6 to the appropriate position, as identified in Table 7-3.
3. Press switch SW7 to reset the CPU.
4. Replace the transmitter cover.

l

Position	Setting	Description
0	Pt100	Platinum, 100 ohms
1	Cu100	Copper, 100 ohms
2	Cu90	Copper, 90 ohms
3	none	RTD not used
4 - F	Pt100	Platinum, 100 ohms

Table 7-3: Rotary Switch SW6 Positions

8 Configuration & Calibration — Level, Limits, and Outputs

After the user has performed the protocol-specific configuration procedures for the 2910 FTT, the following configuration & calibration tasks remain:

1. Perform a manual measurement of the tank level (hand dip).
2. Set the transmitter level to match the tank gauge level reading (see Section 8.1.2, "Setting the transmitter level" on page 50).
3. Calibrate limit switches (if used) to the desired tank level (see Section 8.2, "Calibrating Limit Switches" on page 51).
4. Configure outputs (if used) (Section 8.3, "Configuring Outputs" on page 53).

   Note Configuration is not required for input devices. Each input must be wired to the 2910 FTT as described in Chapter 4 "Wiring" on page 13. The input (alarm) status can then be monitored from the system master as described in Section C.4.2.2, "Monitoring input devices" on page 101.

See Figure 8-1 for the location of the switches and LEDs on the 2910 FTT Mark/Space communications circuit board.

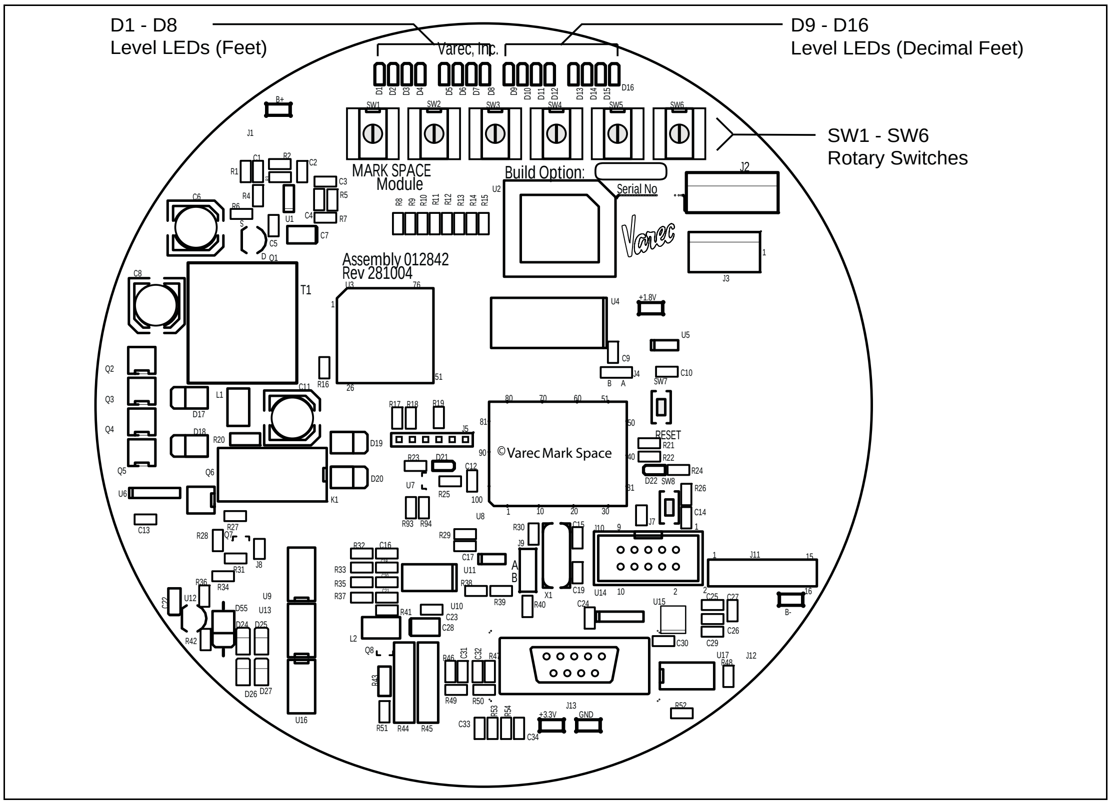


Figure 8-1: Mark/Space Communication Board Switches and LEDs

8.1 Calibrating the Transmitter Tank Level

8.1.1 Before beginning the calibration process

Before setting the transmitter level, perform a manual tank level measurement (hand dip) and verify that the level gauge is calibrated properly. If it is not, calibrate the gauge as directed in the gauge installation and operation manual.

This procedure assumes that the transmitter has been mounted to the gaugehead back cover and wired.

Note The 2910 FTT utilizes a capacitive encoder that maintains the correct level reading during and after a power outage, without a battery backup. No additional configuration is required after a power outage.

8.1.2 Setting the transmitter level

To set the transmitter level:

1. Remove the transmitter cover.

   Warning! Obtain a hot permit before removing the transmitter cover with power applied.

2. Loosen the set screw on the encoder drive shaft slotted coupling, as shown in Figure 8-2. This allows the encoder to rotate freely without rotating the coupling.

   Caution! Excessively loosening the set screw will cause the coupling to fall. Loosen the set screw only to the extent required to free the encoder.

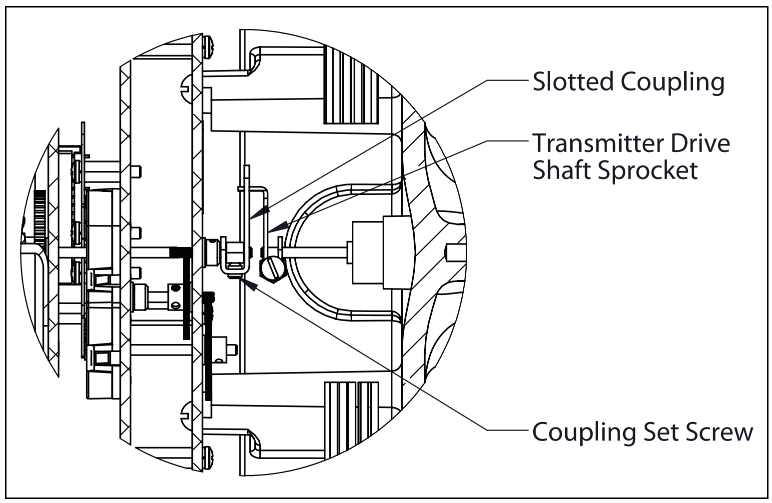


Figure 8-2: 2910 FTT Drive Shaft Coupling

3. Rotate the encoder shaft until the correct level reading is displayed by the host system, a laptop running ViewRTU, a TXA, or diagnostic LEDs D1 - D16.

   Note To use the LEDs for calibration, see “Appendix B — Setting the Transmitter Level Using BCD” on page 89.

   Note When using ViewRTU to display the level for calibration, feet, inches, and sixteenths level information is desired (view the ENC point for feet, inches, and sixteenths values). For more information, see “Appendix C — Database Points” on page 95, and Section 9.2.2, "Using ViewRTU to troubleshoot the 2910 FTT" on page 65.

4. Tighten the set screw on the encoder coupling.
5. Replace the transmitter cover.

8.2 Calibrating Limit Switches

Limit switches are cam-operated SPDT (Single-Pole, Double-Throw) switches that are used to turn on alarms or other devices when the tank contents reach a predetermined level. The adjustable cams on the 2910 FTT provide a limited amount of dwell adjustment. The adjustable dwell can be used to extend the duration of an alarm. Assemblies containing two or four limit switches are available as an option with the 2910 FTT.

Limit switches are mounted on the 2910 FTT encoder assembly and are mechanically driven directly from the transmitter drive shaft. Each switch can be set to close or open at any tank level.

Note All limit switches are wired to operate as a Normally Closed (NC) circuit at the factory. If a Normally Open (NO) operation is required, the user must change the wiring at the switch. See Section 4.9.9, "Wiring limit switches" on page 31.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To calibrate limit switches:

1. Remove the transmitter cover.
2. Loosen the slotted coupling on the transmitter drive shaft (see "Caution" on page 50).
3. Rotate the 2910 FTT encoder shaft until the level reading to activate the switch is displayed by the host, TXA, or diagnostic LEDs D1 - D16 (see Figure 8-3).

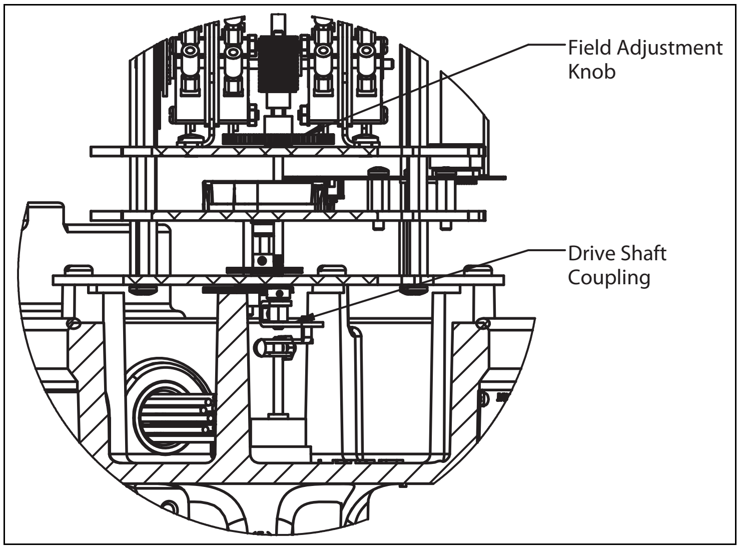


Figure 8-3:Drive Shaft Coupling

4. Turn the cam until the switch activates with an audible click (see Figure 8-4).
5. Gently turn the encoder shaft back and forth to verify that the switch is operating properly.

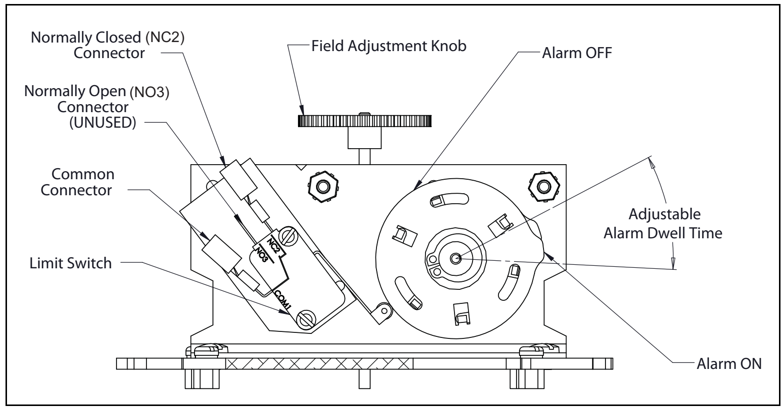


Figure 8-4:Dwell on Cams

6. Twist the adjustable cams relative to each other to adjust the length of the dwell (the duration of the alarm).

   Note Care should be taken to avoid having too much dwell that will cause the low alarm to sound at the high levels and vice versa.

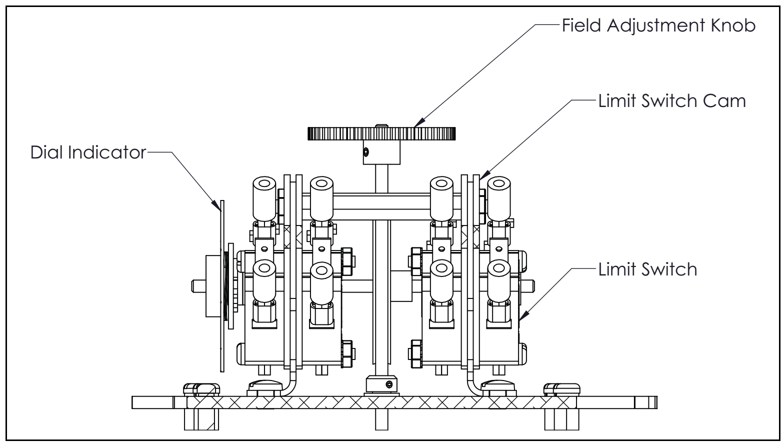


Figure 8-5:Limit Switch Cams

7. After adjusting the dwell, verify that the level that the limit switch activates did not change (see Figure 8-6).
8. Repeat steps 3 through 7 for each of the remaining limit switches.

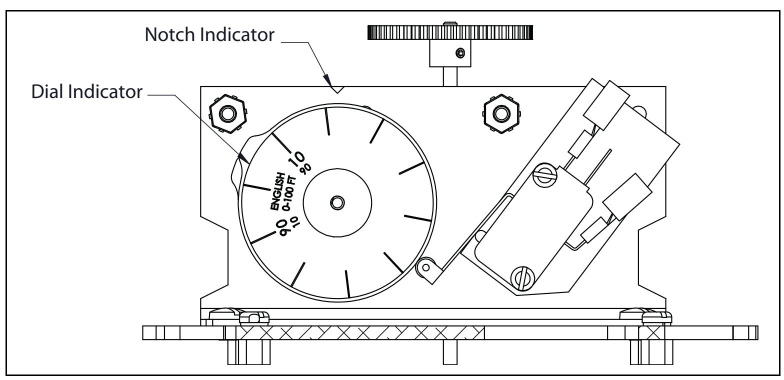


Figure 8-6: Dial and Notch Indicators

9. Rotate the 2910 FTT encoder shaft until the correct level reading (matching the gauge) is displayed by the host system, TXA, or diagnostic LEDs D1 - D16.
10. Tighten the coupling on the transmitter drive shaft.
11. Replace the transmitter cover.

8.3 Configuring Outputs

To configure outputs for the 2910 FTT, the user must connect a laptop computer running the ViewRTU software to the RS-232 port. Then use ViewRTU to define alarm conditions and to assign a condition to each output. For the MODBUS 2910 FTT, the outputs can also be configured through the MODBUS interface by writing data to the appropriate registers.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

Note For more detailed information regarding the ViewRTU program, refer to any Varec RTU Installation and Operation manual.

To configure outputs:

1. Remove the 2910 FTT cover.
2. Connect a laptop computer running ViewRTU software to the RS-232 connector (J13) on the communications circuit board. Figure 8-7 shows the connector.

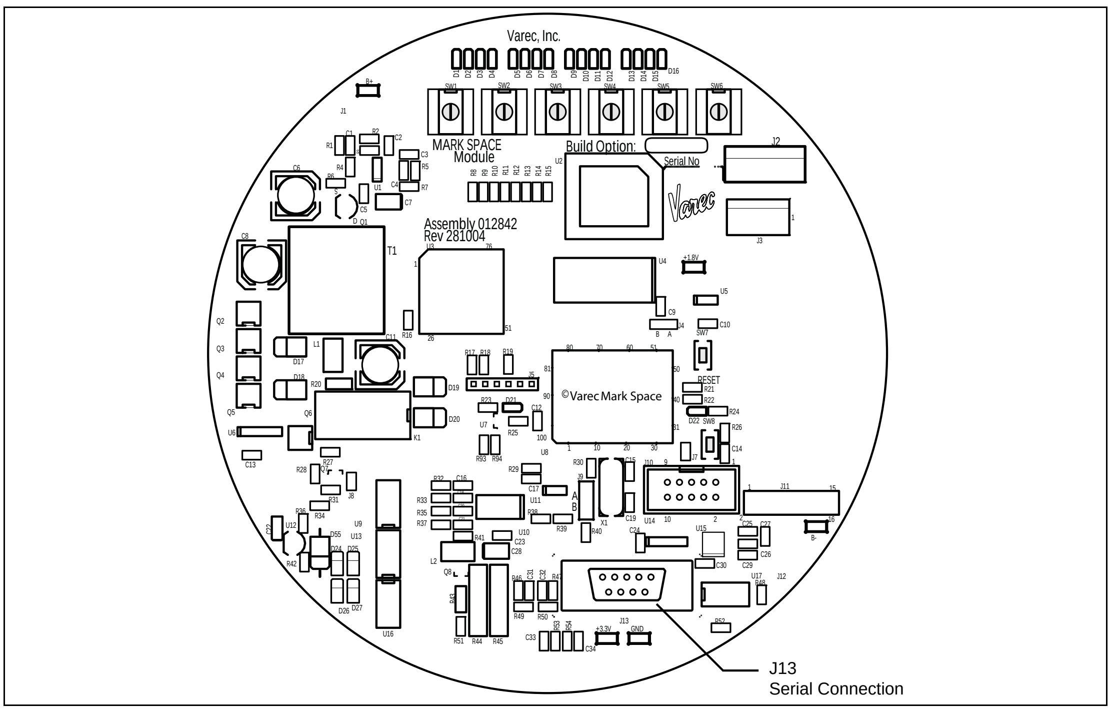
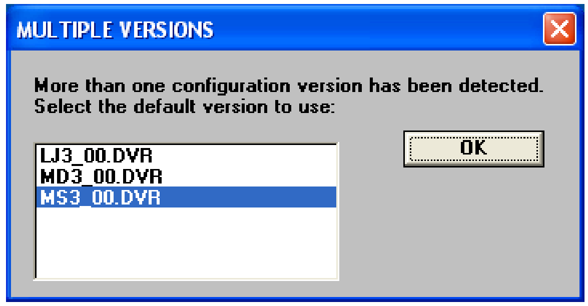


Figure 8-7: Communication Board Connectors, Top View (Mark/Space shown)

Note Input and output contacts are identified in Table 4-4 on page 26 and Table 4-5 on page 28.

Start the ViewRTU application. The user will be prompted to select a firmware version file.



In the file names, LJ = L&J Tankway, MD = MODBUS, and MS = Mark/Space.

3. Select the file that matches the communications protocol used by the 2910 FTT, and then click OK. The main screen appears, as shown in Figure 8-8.

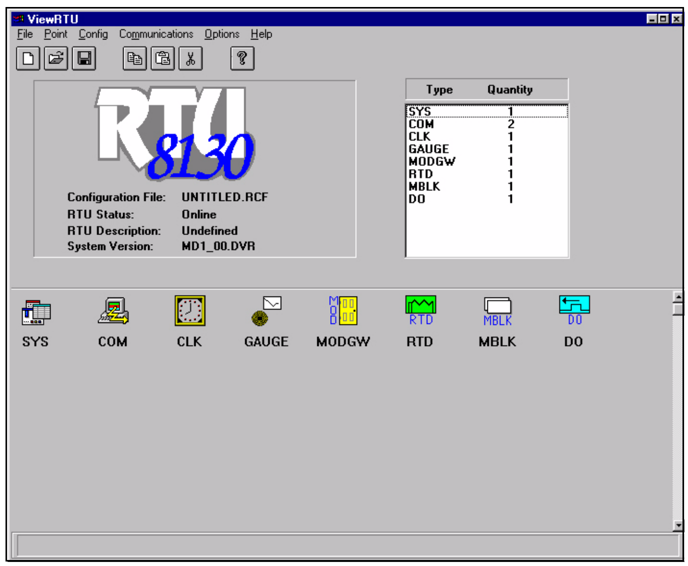


Figure 8-8: ViewRTU Main Window

4. Using the icons or the Point menu, select the MBLK point. The MBLK dialog box appears, showing data items that can be modified.

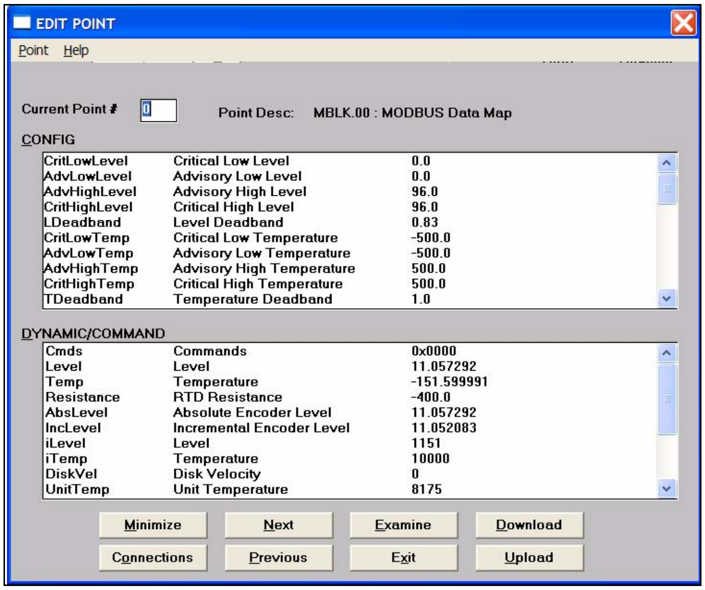


Figure 8-9: ViewRTU Edit Point - MBLK Window

5. Define the alarm conditions that can be used for outputs. At minimum, set values for the following parameters:

   CritLowLevel, AdvLowLevel, AdvHighLevel, CritHighLevel, LDeadband, CritLowTemp, AdvLowTemp, AdvHighTemp, CritHighTemp, TDeadband, MinLevel, MaxLevel, MinTemp, MaxTemp

   Refer to Section C.4, "MODBUS Register Block (MBLK)" on page 101 for information about each point (parameter).

6. Set any other MBLK parameters as appropriate.
7. Click the Exit button to return to the main screen.
8. Using the icons or the Point menu, select the DO point. The DO dialog box appears, showing data items that can be modified.

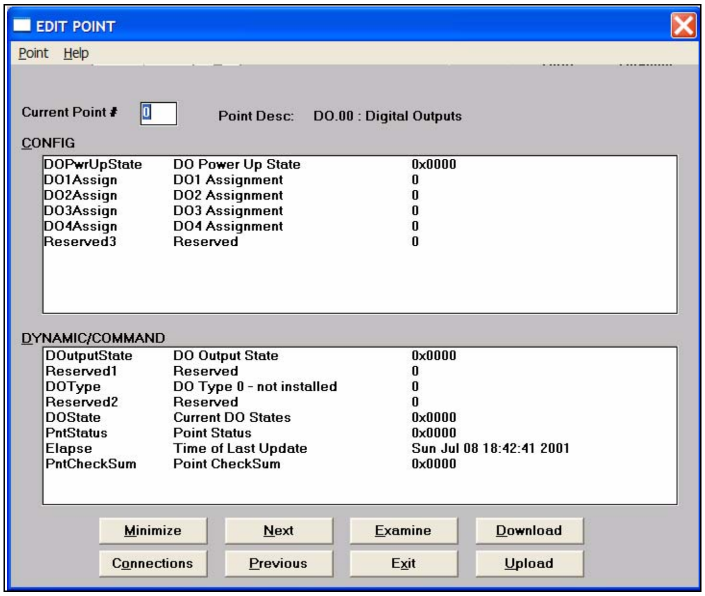


Figure 8-10: ViewRTU Edit Point - DO Window

9. Assign a control & activation event to each direct output by defining parameters DO1Assign - D04Assign. Refer to Section C.5, "Digital Outputs (DO)" on page 105 for more information.
10. To make a relay active at system startup, set the appropriate register in the DOPwrUpState parameter.
11. Click the Exit button.
12. Close ViewRTU.
13. Disconnect the laptop computer cable from the RS-232 connector.
14. Replace the 2910 FTT cover.

9 Maintenance and Troubleshooting

9.1 Maintenance

The 2910 FTT is designed and manufactured to provide accurate and reliable operation with no scheduled maintenance. The microprocessor is galvanically isolated from the power supply and optically isolated from the communications circuits. The 2910 FTT can also perform self-diagnostics. If a problem is encountered, the transmitter will isolate itself from the field communication bus.

Firmware upgrades and additional features can be installed in the field using a plug-in EPROM. For instructions, see Section 9.1.7, "Upgrading software" on page 63.

Varec can provide spare parts, maintenance kits, preventive maintenance advice, training, and warranties upon request.

> **Note** To activate the LEDs on the communications circuit board, press switch SW8, shown in Figure 9-1 on page 58. The LEDs will be enabled for about three minutes.

> **Note** The communications board must be reset to register configuration changes, including changes to rotary switches. To restart the CPU, see Section 9.2.4, "Resetting the 2910 FTT" on page 67.

9.1.1 Checking the CPU status

The 2910 FTT provides a CPU status LED (D21) on the communications circuit board. The user can visually check this LED to ensure that processor is operating properly.

> **Warning!** Obtain a hot permit before removing the transmitter cover with power applied.

To check the processor status:

1. Remove the 2910 FTT cover.
2. Press switch SW8 on the communications circuit board. The LEDs illuminate.
   See Figure 9-1 for switch and LED locations.
3. Verify that LED D21 (CPU) flashes on and off about once every three seconds. This indicates normal CPU operation.

   > **Note** If LED D21 does not flash on and off about once every three seconds, return the unit for service.

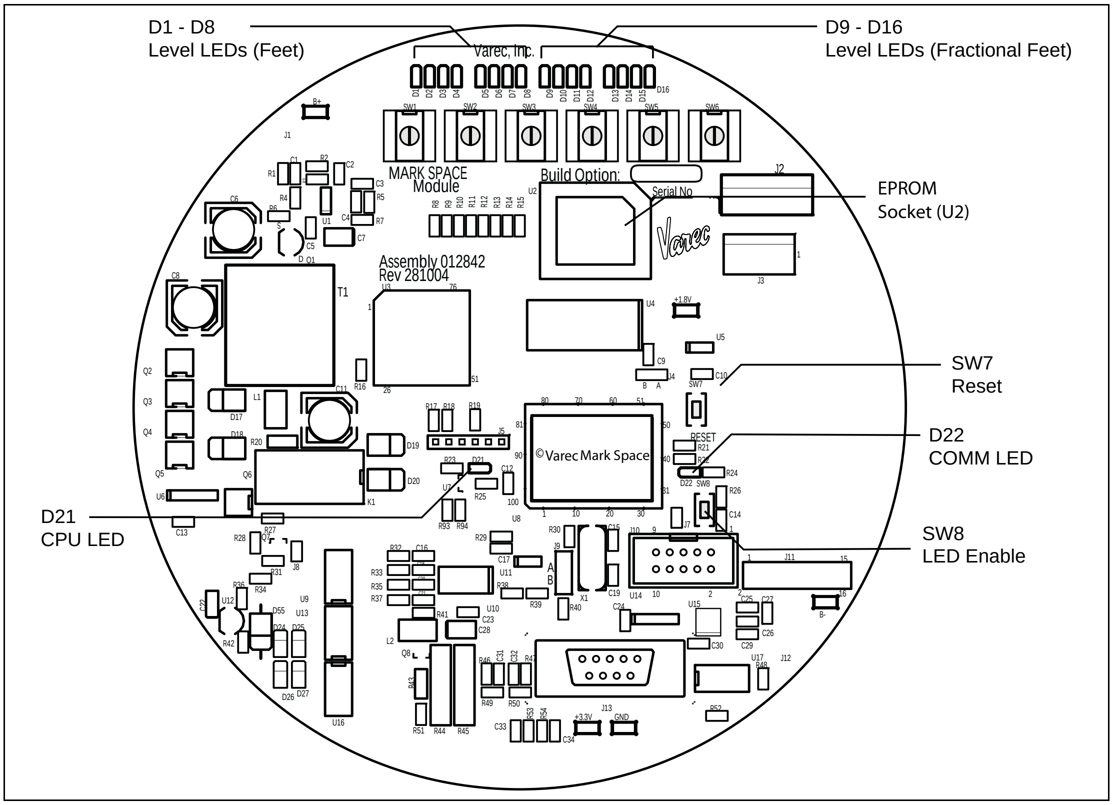


Figure 9-1: Communications Board: Diagnostic Switches and LEDs (Mark/Space shown)

9.1.2 Checking communications status

The 2910 FTT provides a COMM status LED (D22) on the communications circuit board. The user can use this LED to visually verify that the circuit board is being polled by a host system and/or is transmitting information.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To check the communications status:

1. Remove the 2910 FTT cover.
2. Press switch SW8 on the communications circuit board. The LEDs illuminate. See Figure 9-2 for switch and LED locations.
3. Check LED D22 (COMM):
    - If the LED flashes on and off periodically, the 2910 FTT is communicating with an external system (being polled and/or transmitting). The rate is dependent on the rate the transmitter is being polled by the host system.
    - If the LED stays on (illuminated) or off, the 2910 FTT is not communicating with an external system.

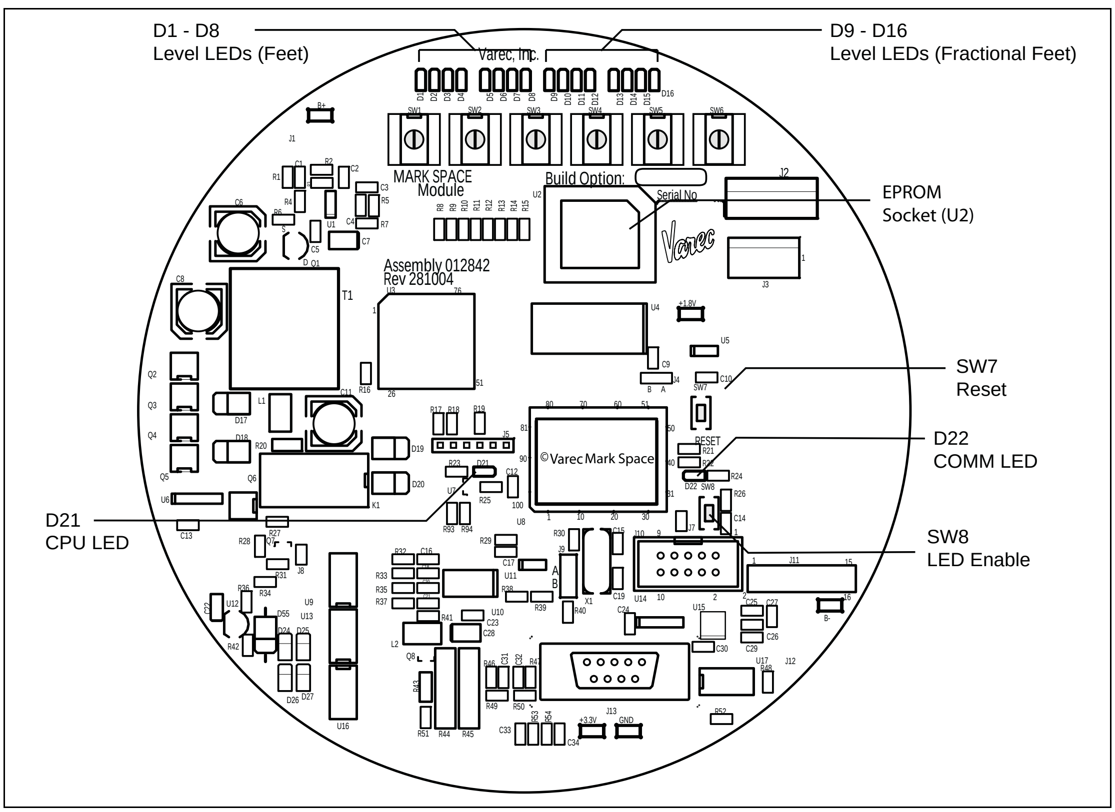


Figure 9-2: Communications Board: Diagnostic Switches and LEDs (Mark/Space shown)

9.1.3 2910 FTT exploded view

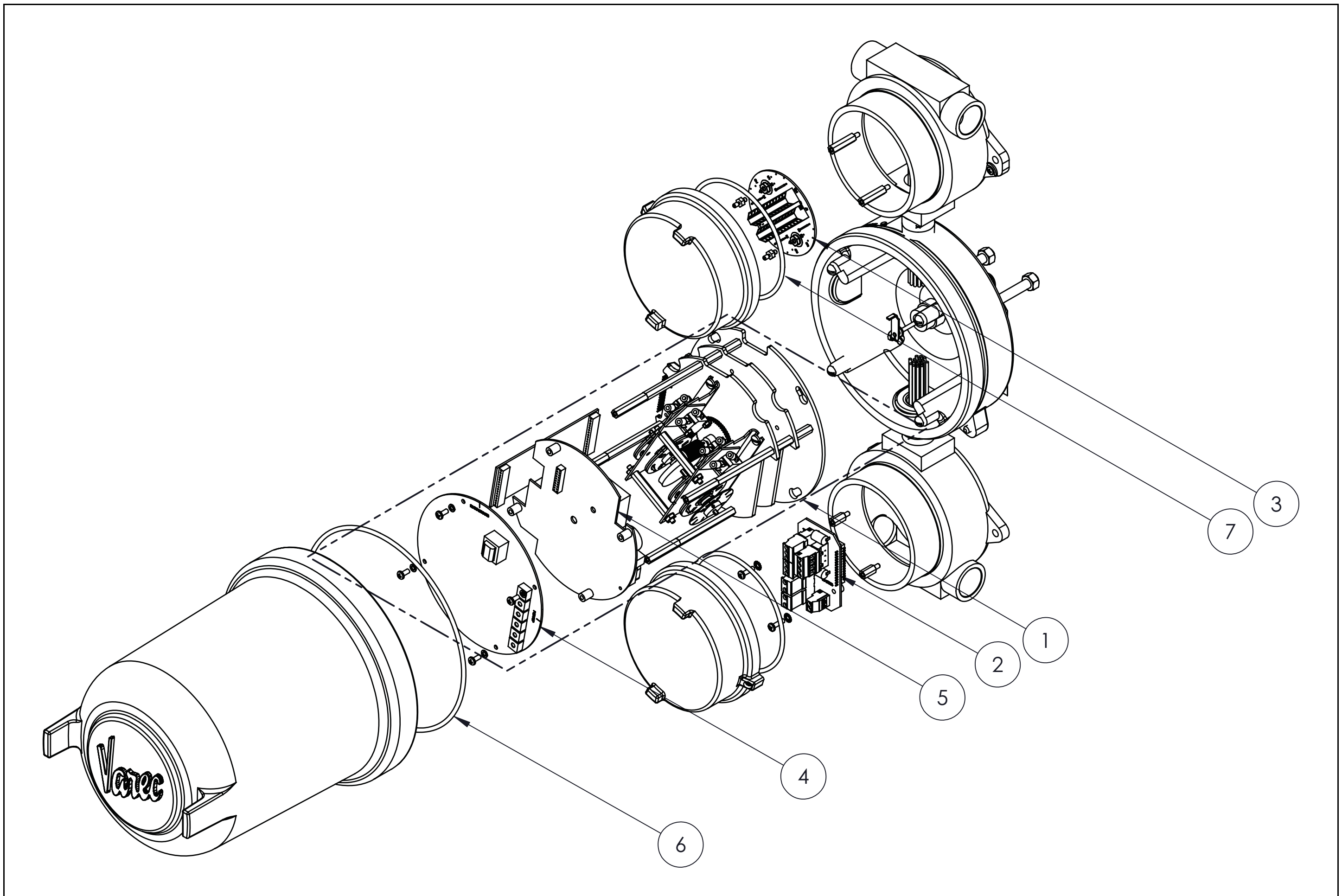


Figure 9-3: 2910 FTT Exploded View

9.1.4 2910 FTT spare parts list

Item No.	**Spare Part #**	**Quantity**	**Description**
1	N2910EAxxxxxxx	1	2910 FTT Electronics Assembly
2	08-12856	1	Terminal Board, 16 Terminals w/Surge Protection
3	08-08744-2	1	Terminal Board Assembly, 12 Terminals w/o Surge Protection
4A	08-12829	1	MODBUS Communications Board
4B	08-12842-1	1	Mark/Space
4C	08-12842-2	1	L&J Tankway Communications Board
5	08-12836	1	AC / DIDO Board
6	P14-170	1	O-Ring, Main Cover
7	P14-08230	1	O-Ring, Junction Box

Table 9-1: 2910 FTT Spare Parts List

9.1.5 2910 FTT exploded view — with limit switches only

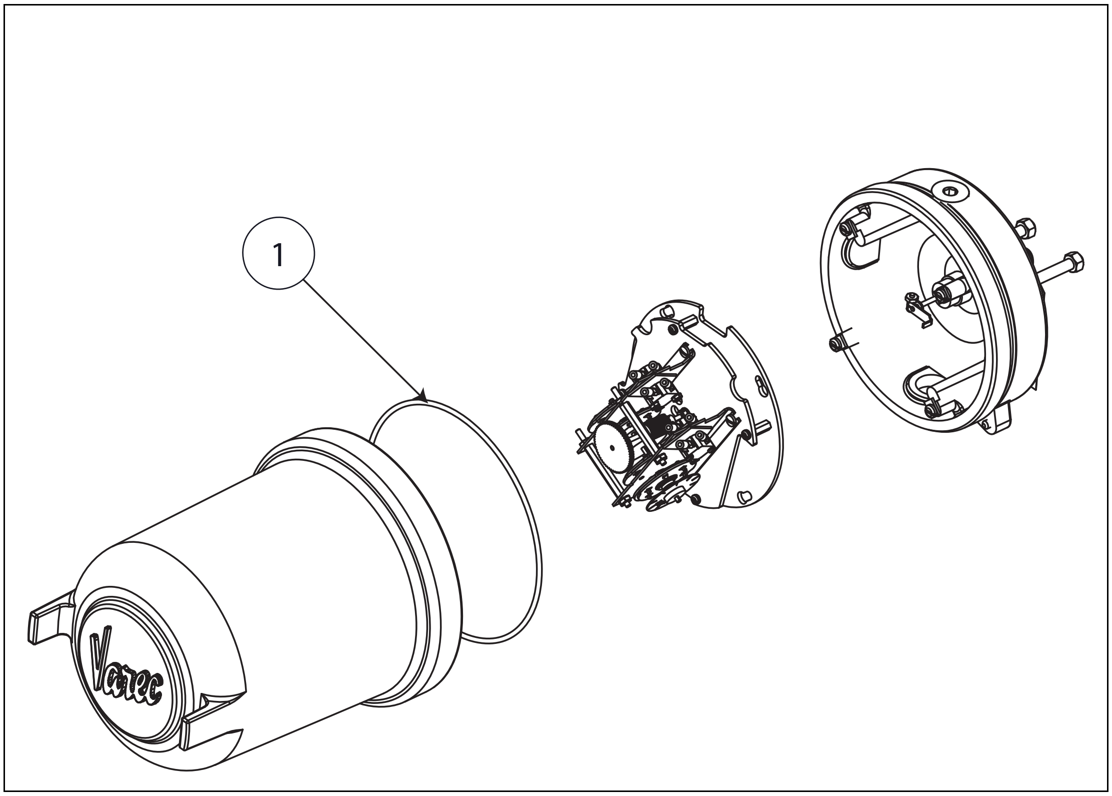


Figure 9-4: 2910 FTT Exploded View — With Limit Switches Only

9.1.6 2910 FTT spare parts list — with limit switches only

Item No.	Part No.	QTY	Description
1	P14-170	1	O-Ring, Main Cover

Table 9-2: 2910 FTT Spare Parts List — With Limit Switches Only

9.1.7 Upgrading software

The 2910 FTT uses a Flash EPROM module for upload software upgrades or service packs to the application software.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To upgrade the software:

1. Remove the 2910 FTT cover.
2. Insert the EPROM module into the EPROM socket (U2), shown in Figure 9-5.

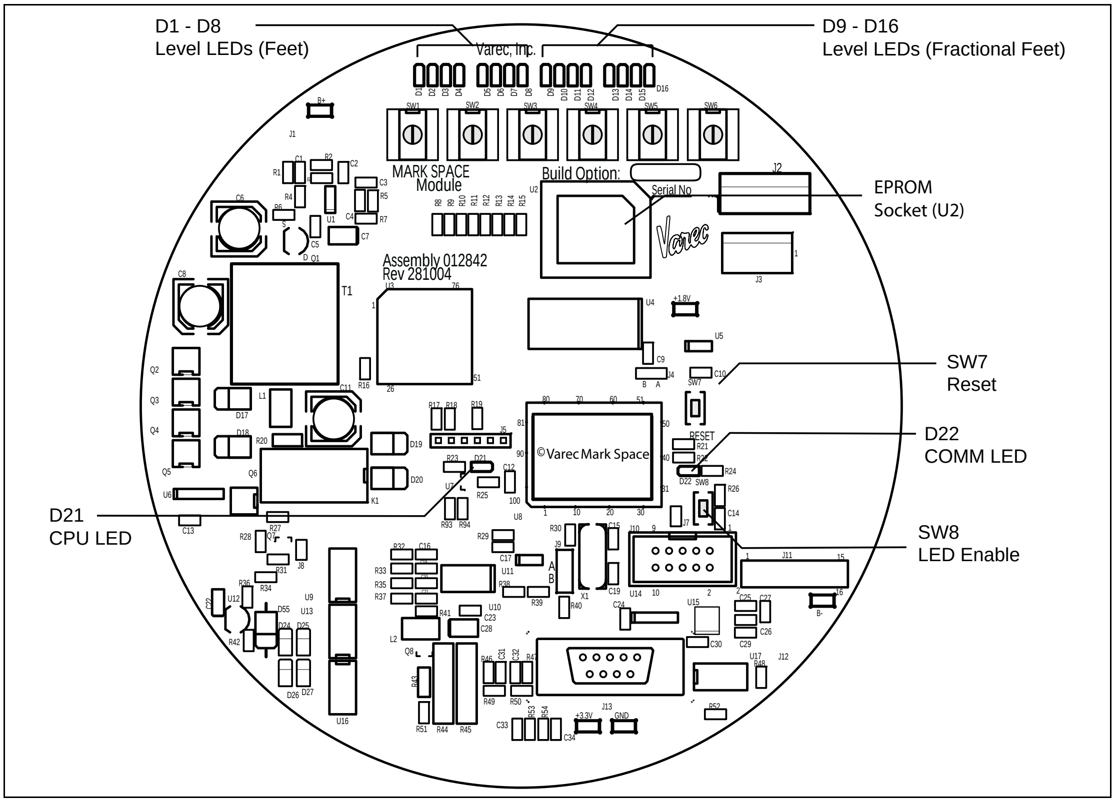


Figure 9-5: EPROM Socket on Communications Circuit Board (Mark/Space shown)

3. Set jumper J9 to position B.
4. Replace the 2910 FTT cover.

9.2 Troubleshooting

This section provides instructions for:

- 9.2.1, "Replacing the AC power supply fuse" on page 64
- 9.2.2, "Using ViewRTU to troubleshoot the 2910 FTT" on page 65
- 9.2.3, "Returning the 2910 FTT to factory default settings" on page 67
- 9.2.4, "Resetting the 2910 FTT" on page 67
- 9.2.5, "Using the LEDs to check the transmitter level" on page 68
- 9.2.6, "Verifying temperature data – checking RTD resistance" on page 68

9.2.1 Replacing the AC power supply fuse

To replace the AC Power Supply fuse:

1. Remove power from the 2910 FTT.
2. Remove the 2910 FTT cover.
3. With a common screwdriver, unscrew the cylindrical fuse and remove it from the fuse holder on the AC Power Supply circuit board.

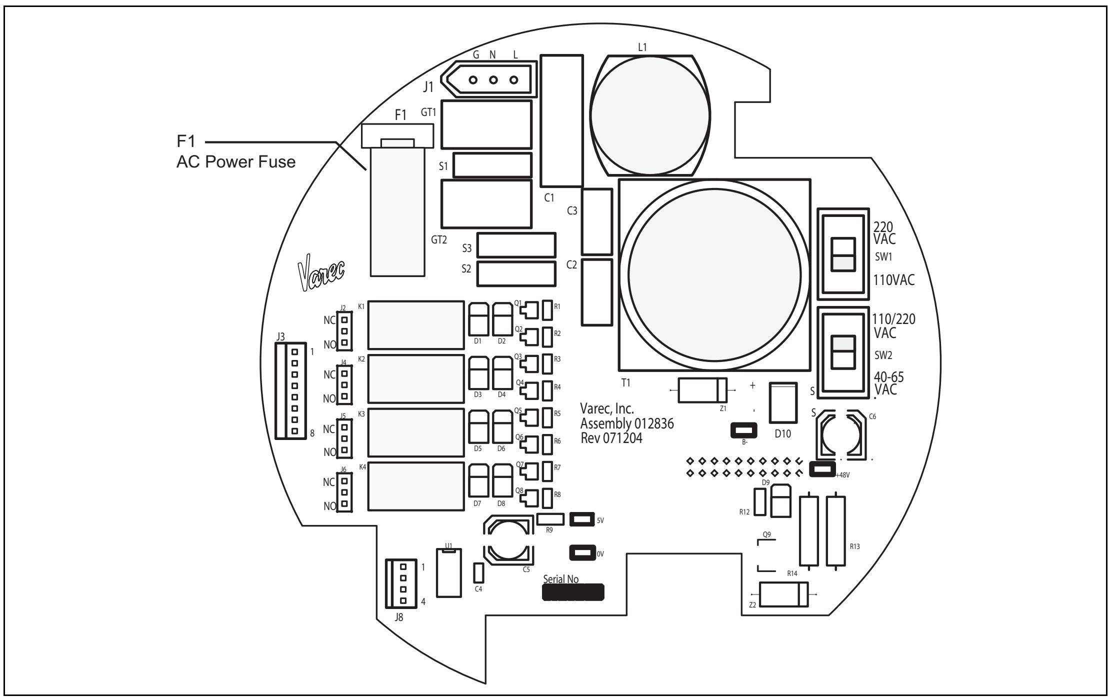


Figure 9-6: AC Power Supply Circuit Board, Top View

4. Insert the new fuse and tighten it.
5. Replace the 2910 FTT cover.

9.2.2 Using ViewRTU to troubleshoot the 2910 FTT

For diagnostics and troubleshooting of the 2910 FTT, a laptop computer running the ViewRTU software can be connected to the RS-232 port. The user can then use ViewRTU to run diagnostics or perform other troubleshooting procedures on the transmitter.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

Note For more detailed information regarding the ViewRTU program, refer to any Varec RTU Installation and Operation manual.

1. Remove the 2910 FTT cover.
2. Connect the communications port of a laptop computer running ViewRTU software to the RS-232 connector (J13) on the communications circuit board using a crossover (Null MODEM) cable. Figure 9-9 shows the connector.

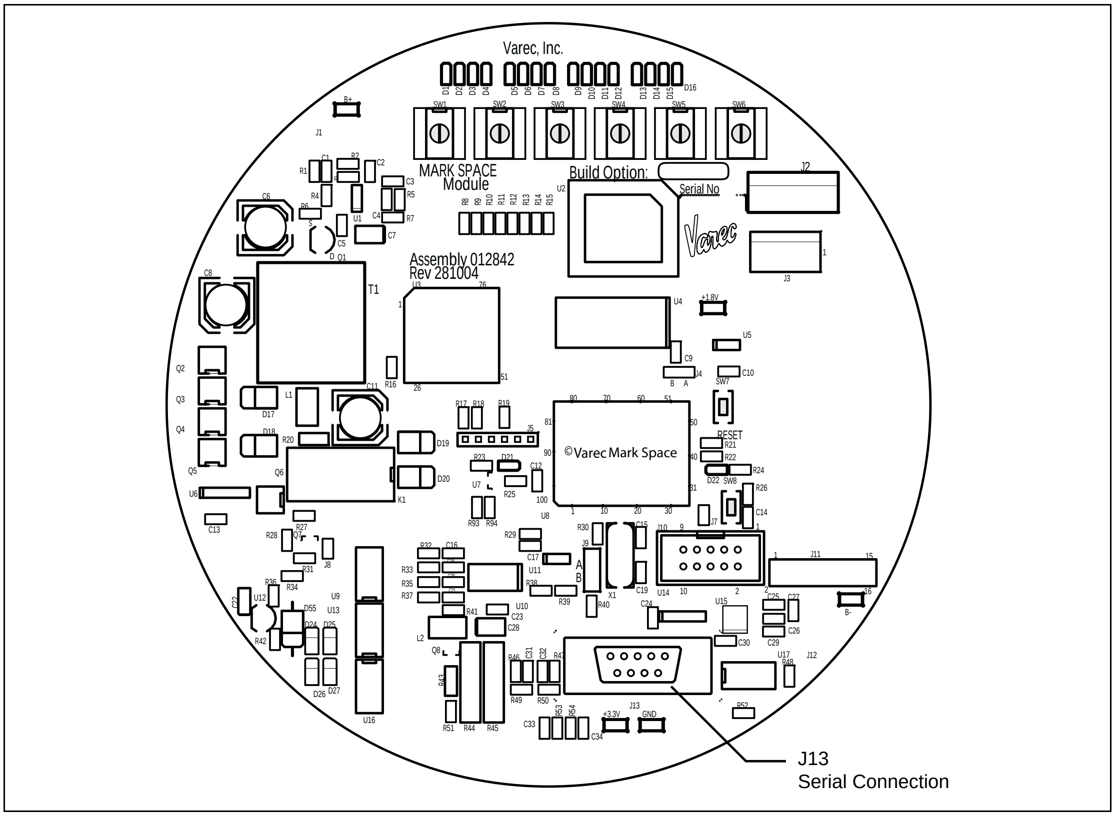
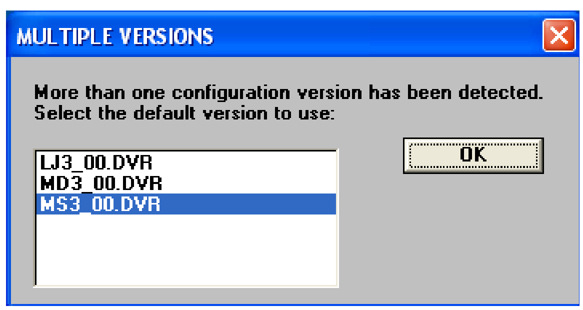


Figure 9-7: RS-232 Connector on Communications Circuit Board (Mark/Space shown)

3. Start the ViewRTU application.
   The user will be prompted to select a firmware version file. Select the file that matches the communications protocol used by the 2910 FTT, and then click OK.

In the file names, LJ = L&J Tankway, MD = MODBUS, and MS = Mark/Space.



4. The main screen appears, as shown in Figure 9-10.

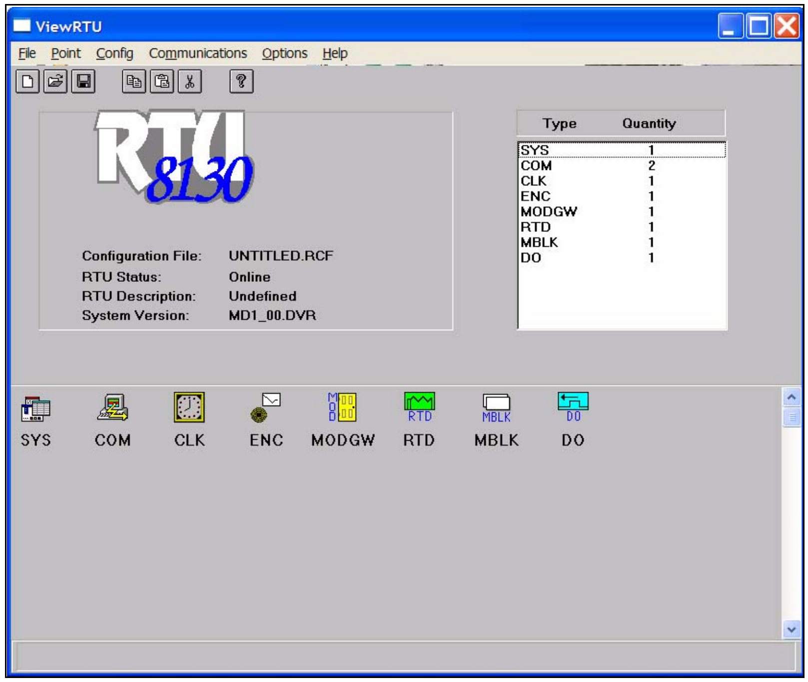


Figure 9-8: ViewRTU Main Window

5. Using the icons or the Point menu, select a point. The dialog box for that point appears.
6. View or edit the information as needed. Refer to “Appendix C — Database Points” on page 95 for information about each database point.
7. Repeat steps 5 and 6 as needed for other points.
8. Close ViewRTU.
9. Disconnect the laptop computer cable from the RS-232 connector.
10. Replace the 2910 FTT cover.

9.2.3 Returning the 2910 FTT to factory default settings

Note This procedure will reset all level and temperature alarm setpoints.

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To initialize all 2910 FTT configuration parameters to factory default settings:

1. Remove the 2910 FTT cover.
2. Press switches SW7 and SW8 simultaneously. See Figure 9-9 for switch locations.

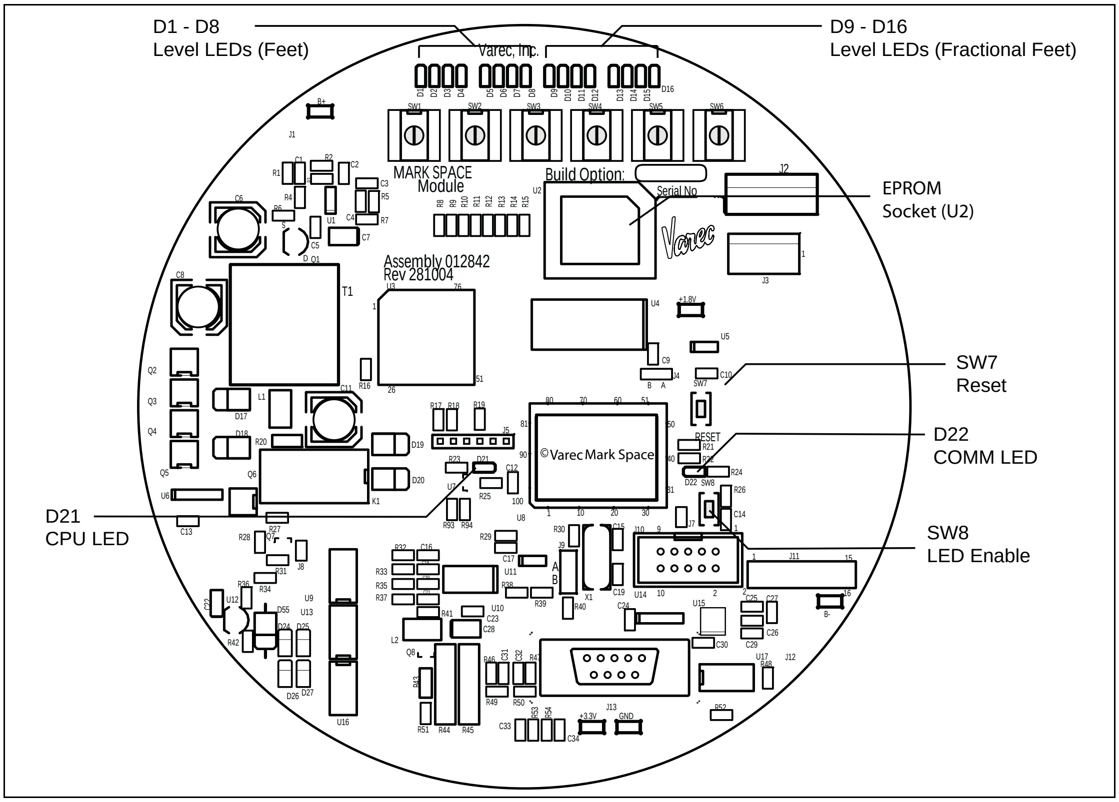


Figure 9-9: Communications Board: Diagnostic Switches and LEDs (Mark/Space shown)

3. Release SW7. Continue pressing SW8 until LEDs D21 and D22 illuminate. Release SW8.
4. Replace the 2910 FTT cover.

9.2.4 Resetting the 2910 FTT

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

1. Remove the 2910 FTT cover.
2. Press RESET switch SW7 (see Figure 9-9) to restart the application program.
3. Replace the 2910 FTT cover.

9.2.5 Using the LEDs to check the transmitter level

LEDs D1 – D16 on the communications circuit board (see Figure 9-9) indicate the transmitter level setting from 0 to119 ft. 15/16^{ths} , in 1/16th of an inch increments.

Refer to "Appendix B — Setting the Transmitter Level Using BCD" on page 89 for detailed information about the level LEDs and LED pattern tables.

9.2.6 Verifying temperature data - checking RTD resistance

To verify the accuracy of the 2910 FTT temperature data, the user can determine if the RTD probe resistance is correct for the tank temperature.

Warning! Obtain a hot permit before removing the junction box or transmitter cover with power applied.

To check 2910 FTT temperature measurement:

1. Remove the 2910 FTT junction box cover.
2. Disconnect the RTD wires from the terminal block.
3. Measure the actual tank temperature, using an analog tank thermometer or other method.
4. Check the RTD resistance. Compare this to the actual tank temperature using the appropriate table for the RTD element type in "Appendix D — RTD Resistance - Temperature Charts" on page 107.
5. Reconnect the RTD wires to the terminal block.
6. Replace the cover on the junction box.

10 Specifications

10.1 Environmental

Item	Description
Operating Temperature	–4 °F to +185 °F (–20 °C to +85 °C)
Operating Humidity	0 to 95% relative humidity, non-condensing
Safety Approvals	Factory Mutual (cFMus) – (USA and Canada) Explosionproof, Class I, Division 1, Groups C&D T5 –25 °C ≤ Ta ≤ +85 °C Flameproof, Class I, Zone 1, AEx/Ex d IIB T5 –20°C ≤ Ta ≤ +85 °C
	ATEX/IECEx (International) Flameproof, Class I, Zone 1, Ex II 2G, Ex d IIB T5 Gb –20 °C ≤ Ta ≤ +85 °C
Environmental Approvals	IP66, NEMA 4

10.2 Encoder

Item	Description
Type	Absolute Capacitance Encoder
Accuracy	+/– 1/16” (1.58 mm)

10.3 Functional

Item	Description
Power Requirements	20 to 65 VDC 0.05A 40 to 65 / 110 / 220 – 240 VAC 750 mW nominal, 50/60 Hz
Available Ranges	Feet: 0 – 120 ft Meters: 0 – 36 m **Note: Limit switch ranges up to 100 feet.**

10.4 Primary Components

Component	Description
Main Processor Board	MODBUS, Mark/Space, or Tankway options

10.5 Switches and Indicators

Item	Description
Reset Switch	Sends reset signal to processor
Rotary Switches	6 16-position rotary switches
Status Indicators	18 LEDs
Limit Switches	2 or 4 SPDT limit switches (optional): • 11 amp – 125, 250, 277 VAC • 4 amp – 125 VAC Tungsten filament Lamp Load • 1/3 HP – 125 VAC, 250 VDC • 1/2 amp – 125 VDC, 1/4 amp – 250 VDC

10.6 Input/Output Options

Item	Description
Digital Inputs	Dry Contact (100 ohm maximum)

10.7 Physical

Item	Description
Net Weight	13 lbs (5.9 kg)
Shipping Weight	18 lbs (8.2 kg)
Enclosure	Explosion proof die-cast aluminium
Conduit Entries	2910 FTT Die cast housing 2 x 3/4” NPT Conduit junction box supplied with 3 x 3/4” NPT (utilizes one entry on 2910 FTT housing above)

11 Ordering Information

11.1 Order Codes

Approvals	
EA	Electronics Assembly (No Housing) - **Not available with Communications Code NA**
FM	cFMus (USA & Canada))
	--Explosionproof, Class I, Division 1, Groups C&D T5 -25 °C ≤ Ta ≤ +85 °C
	--Flameproof, Class I, Zone 1, AEx/Ex d IIB T5 -20 °C ≤ Ta ≤ +85 °C
AT	ATEX/IECEx (International))
	--Flameproof, Class I, Zone 1, Ex II 2G, Ex d IIB T5 Gb -20 °C ≤ Ta ≤ +85 °C

Power Input	
1	DC
2	AC

Communication	
NA	N/A (Limit switches only)
MS	Mark/Space
MB	EIA-485 MODBUS/GSI Type MODBUS
LJ	Tankway (L&J)

Range (Applies only to models with limit switches)	
0	N/A (Select this option if no limit switches are supplied)
1	25 ft
2	50 ft
3	100 ft
4	7.5 m
5	15 m
6	30 m

Limit Switches	
N	None
A	Two (2) SPDT Limit Switches (adjustable dwell, positive activation)
B	Four (4) SPDT Limit Switches (adjustable dwell, positive activation)

Additional Junction Box	
0	No additional JB
	Note: Communications code NA comes with 0 junction boxes.
	Note: Communications codes MS, MB, and LJ come with 1 or 2 junction boxes depending on the options chosen.
1	Additional JB
	Note: Applies only to Communications code NA.

Digital Inputs/Outputs	
A	No Additional DIDO (Select this option if Communications code= NA)
	Note: Communications codes MS, MB, and LJ come with 2 discrete inputs.
	Note: Power Input code 2 (AC models) come with a total of 4 discrete inputs and 4 dry contact outputs.
B	Additional DIDO (Select this option for Power Input code 1 (DC models))
	Note: Comes with a total of 2 discrete inputs and 4 dry contact outputs.

N2910-								Complete product designation

11.2 Transmitter Adapter Kits

Part	Description
13-05956-102	Adapter kit for mounting to L&J 92514, 92020 and 92030 gauges
13-05956-202	Adapter kit for mounting to L&J 92006 and Whessoe Varec 2006, 2026, and 2036 gauges

A Appendix A — MODBUS Implementation

A.1 Introduction

This protocol guide explains the operation of the MODBUS as it pertains to the 2910 Float & Tape Transmitter.

A.2 Implementation

The implementation of the MODBUS protocol for the 2910 FTT provides a standard form of digital communications. An effort has been made to parallel current implementations to the greatest extent possible, so that the 2910 FTT communicates with existing MODBUS masters.

Check compatibility carefully to ensure that the 2910 FTT is properly configured for the data format expected by the host computer. Exceptions made because of the unique requirements of the 2910 FTT application have been noted. This is no guarantee, however, that the interpretation made here will be the same as that followed by the MODBUS master.

The 2910 FTT implementation of the MODBUS protocol provides for the passing of measured and calculated variables, configuration information, and diagnostics in data registers. Data is sent in these registers as floating-point values, integer values, numeric codes related to configuration lists, status summary words (packed bits), or individual status flags (single bits).

One master and up to 31 2910 FTTs may be multi-dropped on a single EIA485 communication bus.

The MODBUS functions implemented in the 2910 FTT are listed in Table A-1.

A.3 Configuration

The MODBUS port on the 2910 FTT must be configured to establish communications, as described in Section 5.2, "Choosing Communications Settings" on page 36.

The 2910 FTT address provides a unique identification for the host. The 2910 FTT address is set via rotary switches, as described in Section 5.1, "Setting the Unit Address" on page 35. This address may range from 1 to 254 and must be unique. Each 2910 FTT only responds when a query has been sent to its unique address by the host.

The MODBUS protocol supports two modes of transmission, Remote Terminal Unit (RTU) or ASCII (American Standard Code for Information Interchange). The choice between these two modes is dependent on the preference of the host. RTU is often the preferred protocol because of its improved error detection capabilities and higher throughput. ASCII mode uses ASCII printable characters to represent hexadecimal values. This mode of transmission requires almost twice as many characters to pass information as does the RTU transmission mode. The 2910 FTT only supports the RTU mode of communications.

Function Code	Function	Information Type	MODBUS Nomenclature
01	Read	Bits	Read output status
02	Read	Bits	Read input status
03	Read	Integer, Code, Status word, Floating point	Read output registers

Table A-1: MODBUS Functions

Function Code	Function	Information Type	MODBUS Nomenclature
04	Read	Integer, Code, Status word, Floating point	Read input registers
05	Write	Bits	Force single output status
06	Write	Integer, Code, Status word	Preset single register
15	Write	Bits	Force multiple outputs
16	Write	Integer, Code, Status word, Floating point	Preset multiple registers
65	Read	Floating point	Read floating point registers
66	Write	Floating point	Write floating point registers

Table A-1: MODBUS Functions

Note Exception: Because the 2910 FTT does not distinguish between inputs and outputs, function codes 01 and 02 as they apply to bits, and function codes 03 and 04 as they apply to numeric values refer to the same data registers. For example, either function code 03 or function 04 can be used to read the integer form of the true mass variable at data address 0053.

Configuration Item	Valid Entries (default in bold type)	MODBUS Configurable	ViewRTU Configurable
MODBUS Address	1 to 254	No	No
Maximum Integer Size	Whole number (0 to 65,534) (default: **9999**)	Yes	Yes
Integer Scaling Factors	Floating point number	Yes	Yes
Unit Selection	Coding list	No	No
Baud Rate	300, 600, 1200, 2400, 4800, **9600**, 19200	No	No
Number of Stop Bits	**1**	No	No
Parity	Odd, Even, **None**	No	No

Table A-2: MODBUS Configuration Information

Note Default communications settings are shown in bold type in Table A-2.

A.4 Functions and Data Formats

The MODBUS data in the 2910 FTT is arranged in integer registers, floating point registers, and status bits. The assignments for these registers are found at the end of this appendix.

Function codes 03, 04, 06, and 16 are used with integer registers.

Because of the multiple MODBUS hosts available today, the 2910 FTT supports two floating-point data formats: a two 16-bit register format and a one 32-bit register format. These two formats provide maximum system flexibility. In the two 16-bit registers format, function codes 03 and 04 are used to read floating-point registers while function code 16 is used to write floating-point registers. In the one 32-bit register format, function code 65 is used to read floating-point registers, while function code 66 is used to write floating-point registers.

Function codes 01, 02, 05, and 15 are used with status bits.

A complete description of all the preceding commands, except floating point, can be found in the Modicon MODBUS Protocol Reference Guide, document number PI-MBUS-300 Rev B.

A.5 Integer Registers

Integer registers are the most commonly used type of MODBUS data and are supported by most MODBUS hosts. In the 2910 FTT implementation, the MODBUS registers are arranged in one of the following four formats:

Integer Data - a scaled number from 0 to the maximum MODBUS integer

Coded Data - Multiple choice configuration data chosen from a coded list

Packed Bit Data - Register form of 16 packed single bits

The integer, and coded data registers contain all of the information needed to configure and read process data. Any integer register may be read with function code 03 or function code 04. These same registers may be written one at a time with function code 06 or multiple registers can be written with function code 16.

For future compatibility, the 2910 FTT accepts reads and writes to reserved registers. Writes to reserved registers have no effect. Reads from reserved registers return a zero (0).

Term	Definition
Address	User-assigned address of the slave device
Function Code	Function the slave is to perform
Start Register (H)	High-order data address byte of the number of registers to read or write
Start Register (L)	Low-order data address byte of the first register to read or write
Number of Registers (H)	High-order byte of the number of registers to read or write
Number of Registers (L)	Low-order byte of the number of registers to read or write
Byte Count	Number of data bytes
Data MSB	Data register's most significant byte
Data LSB	Data register's least significant byte
Status Bit (H)	High-order data address byte of the first bit to read or write
Status Bit (L)	Low-order data address byte of the first bit to read or write
Error Check	Message checksum CRC (Cyclical Redundancy Check)

Table A-3: Terms and Definitions

Note In all of the following communication examples, the error check value is dependent upon the mode of transmission.

A.5.1 Integer data

The integer data is a whole number between 0 and the maximum MODBUS integer (inclusive). The maximum MODBUS integer is a user-configurable variable that is a whole number between 0 and 65,535 (inclusive). The integer data must also be scaled for each data type by entering the desired units, a minimum, and a maximum value. In order for the integer value to be correctly interpreted, these scaling factors must match the format expected by the host system.

The following communication example shows the request for one register starting at register 0 (0000 Hex).

For the following example, assume:

- minimum = 1 meter
- maximum = 15 meters

- maximum MODBUS integer = 65,534

Host Request						
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Error Check
01	03	00	00	00	01	XX
2910 FTT Response						
Address	Function Code	Byte Count	Data MSB	Data LSB	Error Check	
01	03	02	41	24	XX	

Table A-4: Communication Examples

Note A formula for converting numbers to scaled integer format is provided in Section A.5.2, "Integer data" on page 76.

A.5.2 Integer data

- Hexadecimal representation
- 4124 Decimal equivalent: 16,676

The data returned for data address 0 is 16,676 (4124 Hex). This value must be scaled using the following formula to give it meaning.

$$\text{result} = \frac{\text{data} * (\text{max} - \text{min})}{\text{max integer value}} + \text{min}$$

$$\text{result} = \frac{16{,}676 * (15 - 1)}{65{,}534} + 1$$

$$\text{result} = 4.56 \text{ meters}$$

If a variable goes out-of-bounds (outside the minimum or maximum scale points), a value equal to the maximum MODBUS integer + 1 is returned. Writing to dynamically calculated parameters has no effect on those parameters.

A.5.3 Coded data

Coded data represents a table look-up value. Data written to these registers must be a valid table entry. Invalid data may cause a Configuration Error to occur. The following example shows coded data at data address 20 (0014 Hex) representing level units. The value 2 (0002 Hex) returned from the 2910 FTT corresponds to level units = FT-IN-16TH.

Host Request						
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg	Error Check
01	03	00	14	00	01	XX
2910 FTT Response						
Address	Function Code	Byte Count	Data MSB	Data LSB	Error Check	
01	03	02	00	01	XX	

Table A-5: Coded Data Look-Up Value Registers

- Hexadecimal representation 0001
- Level unit table representation: FT

A.5.4 Packed bit data

Packed bits represent 16 individual status bits packed into one register. The status bits have been packed this way for systems that prefer handling only register information. These bits may also be read or written individually using a bit command. The bits within the packed registers are grouped by data or function type. The following communication example of packed bits shows alarm status information at data address 5 (0005 Hex) returned by the 2910 FTT.

Host Request						
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Error Check
01	03	00	05	00	01	XX
2910 FTT Response						
Address	Function code	Byte Count	Data MSB	Data LSB	Error Check	
01	03	02	00	01	XX	

Table A-6: Status Bits Packed Registers

Note Bit #0 is ON indicating a critical low level Alarm

A.6 Floating-Point Registers

Although not part of the MODBUS protocol specification, floating point numbers have been implemented using the IEEE 754 standard. Floating point numbers reduce the complexity required in scaling integer values and provide a means to transmit numbers used by the 2910 FTT that are not easily scaled (such as the scaling factors themselves).

A.6.1 Floating-point data

The 2910 FTT is capable of using a two 16-bit registers format and a one 32-bit register format. Examples and descriptions of both formats follow.

> **Note** Although this type of data does not require scaling, it is important that the measurement unit selected in the 2910 FTT be the same as that expected by the host. In addition, where possible, data is available in both integer and floating-point formats.

A.6.2 The Two 16-bit registers format

Function code 03 or 04 is used to read floating-point registers in this format. Function code 16 is used to write floating-point registers in this format. An example of reading the temperature, register 102 (0066 Hex), in floating-point format from the 2910 FTT is shown as follows:

Host Request							
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Error Check	
01	03	00	66	00	02	XX	
2910 FTT Response							
Address	Function Code	Byte Count	Data MSB	Data LSB	Data MSB	Data LSB	Error Check
01	03	04	42	C8	00	00	XX

Table A-7: 16-Bit Floating-Point Registers

A.6.3 Floating point data

- Hexadecimal representation: 42 C8 00 00
- Decimal equivalent: 100.00

Floating-point registers that are defined as reserved have zero (0) as their only legal value. A write command to a reserved floating-point register is ignored.

A.6.4 The one 32-bit register format

Function code 65 (41 Hex) is used to read floating-point registers in this format. An example of a floating-point register read is shown below with the a temperature of 100.0 degrees is being read from register 1 (0001 Hex).

Host Request								
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Error Check		
01	41	00	01	00	01	XX		
2910 FTT Response								
Address	Function Code	# of Reg H	# of Reg L	Data MSB	Data	Data	Data LSB	Error Check
01	41	00	01	42	C8	00	00	XX

Table A-8: 32-Bit Floating-Point Registers

A.6.5 Floating point data

- Hexadecimal representation: 42 C8 00 00
- Decimal equivalent: 100.00

Function code 66 (42 Hex) is used to write floating-point registers. An example of a floating-point register write is shown below with the value 100.0 being written into the Advisory High Temperature Alarm Setpoint, register 12 (000C Hex).

Host Request						
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Data MSB
01	42	00	0C	00	01	42
			Data	Data	Data LSB	Error Check
			C8	00	00	XX
2910 FTT Response						
Address	Function Code	# of Reg H	# of Reg L	Error Check		
01	03	02	41	XX		

Table A-9: Floating Point Data

A.6.6 Floating point data

- Hexadecimal representation: 42 C8 00 00
- Decimal equivalent: 100.00

Floating-point registers that are defined as reserved have zero (0) as their value. A write command to a reserved floating-point register will be ignored.

A.7 Status Bits

In the 2910 FTT implementation, status bits contain alarms, commands, and status information. The state of a MODBUS status bit is defined as either ON (true) or OFF (false). The ON state is represented by a "1". The status bits may be read with function code 1 or 2. They may be written one at a time with function code 5 or multiple bits may be written with function code 15. An example of a read message for bits 2 through 6 as returned by the 2910 FTT is shows as follows.

Host Request						
Address	Function Code	Start Reg H	Start Reg L	# of Reg H	# of Reg L	Error Check
01	02	00	02	00	04	XX
2910 FTT Response						
Address	Function Code	Byte Count	Data	Error Check		
01	02	01	12	XX		

Table A-10:

A.7.1 Status bit data

Binary representation 1 0010 (bits 6-2)

Bit #2: High Advisory Alarm OFF

Bit #3: High Critical Alarm ON

Bit #4: Unauthorized Mass Movement OFF

Bit #5: Standard Density Alarm OFF

Bit #6: Critical Zone Alarm ON

A.8 Exception Responses

The exception responses returned by the 2910 FTT are listed below:

Exception	Response	Reason
01	Illegal Function	Message is not allowed
02	Illegal Data Address	Data address (bit or register) requested is not defined
03	Illegal Data Value	Data value being written is out of range
04	Busy	During power-up

Table A-11: Exception Responses Returned by the 2910 FTT

In addition, messages that are received with a parity error, checksum error, or message format error will be ignored.

A.9 Data Out of Range

When integer data calculated by the 2910 FTT is outside the minimum or maximum scale points or is otherwise out of range, the value returned is that of the maximum MODBUS integer + 1. For example, if the maximum MODBUS integer is 65,534 (as used in our previous examples) the “data out of range” value is 65,535. The “data out of range” convention does not apply to the status bits, packed status bits, character data, and coded data.

The following error conditions will also cause the 2910 FTT to return scaled integer values of maximum MODBUS integer + 1.

- Off-line Mode
- Strap Error
- No CALC
- API Correction Error
- CALC Error

This permits a host to detect a serious failure without monitoring other 2910 FTT status bits.

A.10 Loopback Test

In accordance with the MODBUS specification, function code 8 initiates a loopback test. The purpose of this test is to check the communication system. It does not affect the operation of the 2910 FTT. The 2910 FTT supports only diagnostic code 00. This is a request to return query data. Upon receiving a loopback message containing this code, the 2910 FTT will echo the message sent by the host. The entire message returned will be identical to the message transmitted by the host field-per-field. An example of a loopback message is as follows:

Host Request						
Address	Function Code	Code HO	Code LO	Data	Data	Error Check
01	08	00	02	F3	26	XX
2910 FTT Response						
Address	Function Code	Code HO	Code LO	Data	Data	Error Check
01	08	00	00	F3	26	XX

Table A-12: Function Code — Loopback Test

A.11 Hardware Implementation

The 2910 FTT uses a 2-Wire EIA485 hardware interface to communicate with the MODBUS master. EIA485 is a high speed differential communications network which allows up to 32 devices to operate on one network. The 2910 FTT and MODBUS master share a twisted pair of wires to communicate.

The communication distance EIA485 can reliably travel is dependent on baud rate (communication speed), wire quality, environmental noise, wiring configuration, and the number of multi-dropped 2910 FTTs. The recommended wire for EIA485 systems is 18-gauge or larger, shielded, twisted pairs. The shield should be earth grounded at the MODBUS master (control system or computer end). The shield at the 2910 FTT should be open. The 2910 FTT-power line acts as a common reference tie to the MODBUS master.

Termination resistors of 100 Ohms are shown at each end of the communication bus to minimize reflections on the line. Termination resistors may not be necessary at baud rates of 9600 bits per second or slower.

Pull-up and pull-down resistors are also shown at the MODBUS master end of the cable. These resistors minimize the affects of noise when the lines are idle. Only one set of pull-up or pull-down resistors are required per twisted pair cable. These resistors are included in the 2910 FTT and can be included in the circuit using the procedure described in Chapter 5 on page 33.

A.12 Integer Register Map

Register Number	Type	Description
0	Scaled	Level
1	Scaled	Temperature
2 – 4	Reserved	
5	Bit Field	AimStat Bit Usage 0 CRIT LO LEVEL 1 ADV LO LEVEL 2 ADV HI LEVEL 3 CRIT HI LEVEL 4 CRIT LO TEMP 5 ADV LO TEMP 6 ADV HI TEMP 7 CRIT HI TEMP 8 HW IN 1 9 HW IN 2 10 HW IN 3 * 11 NW IN 4 * 12 – 15 RESERVED * when optional AC Power module is installed
6	Bit Field	DiagStat Bit Usage 0 BAD LEVEL 1 BAD TEMP 2 – 15 RESERVED
7	Bit Field	CmdsBit Usage 0 – 4 RESERVED 5 CALIB LEVEL 6 – 15 RESERVED
8	Reserved	Reserved
9	Reserved	Reserved
10	Scaled	Crit Low Level Setpoint
11	Scaled	Adv Low Level Setpoint
12	Scaled	Adv High Level Setpoint
13	Scaled	Crit High Level Setpoint

Table A-13: Integer Register Map

Register Number	Type	Description
14	Scaled	Level Deadband
15	Scaled	Crit Low Temp Setpoint
16	Scaled	Adv Low Temp Setpoint
17	Scaled	Adv High Temp Setpoint
18	Scaled	Crit High Temp Setpoint
19	Scaled	Temp Deadband
20	Code Read-only	Level Units 0 – METERS 1 – FEET
21	Code (Read-only)	Temp Units 0 – C 1 – F
22	Code (Read-only)	Level Type 1 – FORWARD 2 – REVERSE
23	Code (Read-only)	Temp Type 0 – Pt100 1 – Cu100 2 – Cu90
24	Scaled	Manual Temperature
25	Code	Max Integer Value
26	Reserved	
27	Scaled	Calibration Level
28 – 99	Reserved	
100	Float	Level
102	Float	Temp
104	Float	RTD Resistance
106	Reserved Float	
108	Reserved Float	
110	Float	Crit Low Level
112	Float	Adv Low Level
114	Float	Adv High Level
116	Float	Crit High Level
118	Float	Level Deadband
120	Float	Crit Low Temp
122	Float	Adv Low Temp
124	Float	Adv High Temp
126	Float	Crit High Level
128	Float	Temp Deadband
130	Float	Min Level
132	Float	Max Level

Table A-13: Integer Register Map

Register Number	Type	Description
134	Float	Min Temp
136	Float	Max Temp
138	Reserved Float	
140	Float	Man Temp
142	Float	Calib Level
144 - 199	Reserved Float	
200	Float	Level
202	Float	Temp
204	Float	RTD Resist
206	Reserved Float	
208	Reserved Float	
210	Bit Field	AlmStart
211	Bit Field	DiagStat
212 – 214	Reserved	Reserved
215	Code (Read-only)	Level Units
216	Code (Read-only)	Temp Units
217– 219	Reserved	Reserved
220	Code (Read-only)	Level Type
221	Code (Read-only)	Temp Type
222 – 229	Reserved	Reserved
230	Float	Crit Low Level
232	Float	Adv Low Level
234	Float	Adv High Level
236	Float	Crit High Level
238	Float	Level Deadband
240	Float	Crit Low Temp
242	Float	Adv Low Temp
244	Float	Adv High Temp
246	Float	Crit High Level
248	Float	Temp Deadband
250	Float	Min Level
252	Float	Max Level
254	Float	Min Temp
256	Float	Max Temp
258	Reserved Float	
260	Float	Man Temp
262 – 267	Reserved	Reserved

Table A-13: Integer Register Map

Register Number	Type	Description
268	Reserved Long	Reserved
270	Bit Field	DO State Bit Usage 0 – Output #1 1 – Output #2 2 – Output #3 3 – Output #4 4 – 15 – Reserved
271	Bit Field	DO Output in power-up state; when set the DO will close at power-up. Bit Usage: 0 – Output #1 1 – Output #2 2 – Output #3 3 – Output #4
272 – 284	Reserved	Reserved
285	Code	DO #1 Output Assignment: 0 – Not Assigned 1 – Host Control 2 – Critical High Level 3 – Advisory High Level 4 – Advisory Low Level 5 – Critical Low Level 6 – Critical High Temp 7 – Advisory High Temp 8 – Advisory Low Temp 9 – Critical Low Temp
286	Code	DO #2 Output Assignment: 0 – Not Assigned 1 – Host Control 2 – Critical High Level 3 – Advisory High Level 4 – Advisory Low Level 5 – Critical Low Level 6 – Critical High Temp 7 – Advisory High Temp 8 – Advisory Low Temp 9 – Critical Low Temp

Table A-13: Integer Register Map

Register Number	Type	Description
287	Code	DO #3 Output Assignment: 0 – Not Assigned 1 – Host Control 2 – Critical High Level 3 – Advisory High Level 4 – Advisory Low Level 5 – Critical Low Level 6 – Critical High Temp 7 – Advisory High Temp 8 – Advisory Low Temp 9 – Critical Low Temp
288	Code	DO #4 Output Assignment: 0 – Not Assigned 1 – Host Control 2 – Critical High Level 3 – Advisory High Level 4 – Advisory Low Level 5 – Critical Low Level 6 – Critical High Temp 7 – Advisory High Temp 8 – Advisory Low Temp 9 – Critical Low Temp
289 – 300	Reserved	Reserved

Table A-13: Integer Register Map

A.13 32-Bit Floating Point Register Map

Register Number	Description
0	Level
1	Temp
2	RTD Resist
3	Reserved
4	Reserved
5	Crit Low Level
6	Adv Low Level
7	Adv High Level
8	Level Deadband
9	Adv Low Temp
10	Crit High Level
11	Min Level
12	Min Temp
13	Reserved

Table A-14: 32-Bit Floating Point Register Map

Register Number	Description
14	Reserved
15	Reserved
16	Reserved
17	Reserved
18	Reserved
19	Reserved
20	Reserved
21	Reserved

Table A-14: 32-Bit Floating Point Register Map

A.14 Status Bit Register Map

Register Number	Description
0 - 15	AlmStat
16 - 31	Diag Stat
32 - 47	Cmds

Table A-15: Status Bit Register Map

B Appendix B — Setting the Transmitter Level Using BCD

The 2910 FTT communications circuit board contains LEDs that indicate the transmitter level setting to the 1/16th of a fractional foot (inches), as well as to the 100ths of a foot. This section provides instructions for using binary coded decimal (BCD) to set the transmitter level and a decimal to binary conversion table used when converting the level in the tank from decimal to binary and fractional feet.

Metric modes are from 0 - 30 meters and are also discussed in this section.

B.1 Before Beginning to Set the Transmitter Level

B.1.1 LEDs and switch functions and locations

Figure B-1 shows the LED locations on the communications circuit board. LEDs D1 - D8 indicate the level in feet, in 1 foot increments. LEDs D9 - D16 indicate the level in fractional and decimal feet, in 16ths of an inch, and 100ths feet increments respectively.

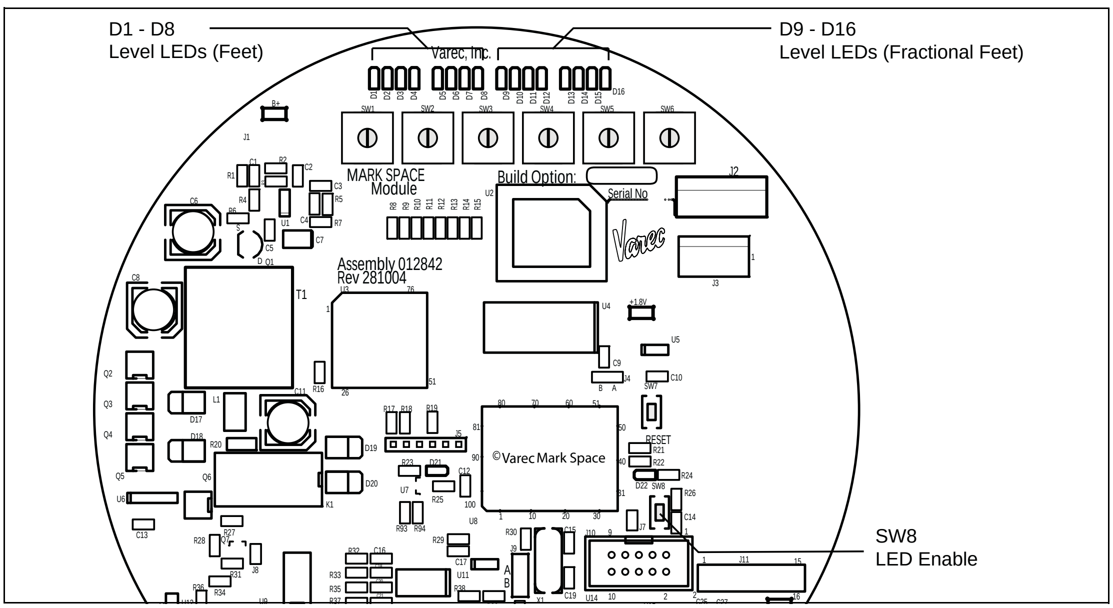


Figure B-1: LED and Switch Locations (Mark/Space Communications circuit board — Top View)

Note To activate the LEDs on the communications circuit board, press switch SW8, shown in Figure B-1. The LEDs will be enabled for about three minutes.

B.1.2 Forward or reverse encoding

The level indicated by the LEDs is independent of the transmitter's encoder direction setting. The LEDs present the level in a decimal format with D1- D4 representing the foot 10's digit in binary, D5 - D8 representing the foot 1's digit in binary. D9 - D12 represent the decimal feet 10's value, and D13 - D16 representing the decimal feet 100's value. Refer to Table B-3, "Decimal Feet/Inches and Fractional Inches to Binary Conversion", on page 94.

The encoder direction is set with a rotary switch. For more information, refer to the relevant Initial Configuration chapter.

B.2 Setting the Transmitter Level Using BCD (Forward and Reverse Encoding)

Note 1 = LED On
0 = LED Off

Warning! Obtain a hot permit before removing the transmitter cover with power applied.

To set the encoder level:

1. Remove the 2910 FTT cover.
2. Press switch SW8 to enable the LEDs.
3. Refer to Table B-3 on page 94. Find the whole number entry that matches your target level in feet, decimal 10^{ths} of feet, and 100^{ths} of feet.

   For example, if the target level is 41 feet, 8 8/16 inches, locate the entry for 41 feet.

4. Convert the inches into decimal feet.
   a. 8 8/16 inches = 8.5 inches.
   b. Now convert 8.5 inches to decimal by dividing 8.5 by 12, which equals .7083 feet.
   c. Now round .7083 to the nearest 100^{ths} of feet, which equals .71.

5. Rotate the encoder shaft clockwise or counter-clockwise until LEDs D1 - D4 (10s of Feet) display the desired foot pattern.

3	0011
4	0100
5	0101

Figure B-2: Decimal to Binary Example - 10s of Feet

6. Continue rotating the encoder shaft clockwise or counter-clockwise until LEDs D5 - D8 (1s of Feet) display the desired foot pattern.

0	0000
1	0001
2	0010

Figure B-3: Decimal to Binary Example - 1s of Feet

7. Rotate the encoder shaft clockwise or counter-clockwise to adjust the level until LEDs D9 - D12 (10^{ths} of decimal feet) display the decimal feet pattern shown in Figure B-4:.

6	0110
7	0111
8	1000

Figure B-4: Decimal to Binary Example - 10^{ths} of Feet

8. Rotate the encoder shaft clockwise or counter-clockwise to adjust the level until LEDs D13 - D16 (100^{ths} of decimal feet) display the decimal feet pattern shown in Figure B-5:.

0	0000
1	0001
2	0010

Figure B-5: Decimal to Binary Example - 100^{ths} of Feet

9. D1 - D16 should show the following pattern:
   - 0100 0001 0111 0001
10. Replace the 2910 FTT cover.

B.2.1 Decimal to Binary Conversion (Forward and Reverse Encoding)

Table B-1 should be used when converting the level in the tank from decimal to binary (see Example 1 below).

Example 1: Decimal

41 feet, 8 inches, and 8/16^{ths} of an inch (41.71 Decimal) = 0100 0001 0111 0001 Binary

Decimal/Binary 10s of Feet		Decimal/Binary 1s of Feet		Decimal/Binary 10^{ths} of Feet		Decimal/Binary 100^{ths} of Feet	
0	0000	0	0000	0	0000	0	0000
1	0001	**1**	**0001**	1	0001	**1**	**0001**
2	0010	2	0010	2	0010	2	0010
3	0011	3	0011	3	0011	3	0011
4	**0100**	4	0100	4	0100	4	0100
5	0101	5	0101	5	0101	5	0101
6	0110	6	0110	6	0110	6	0110
7	0111	7	0111	**7**	**0111**	7	0111
8	1000	8	1000	8	1000	8	1000
9	1001	9	1001	9	1001	9	1001
10	1010						
11	1011						

Table B-1: Decimal to Binary Conversion

Note 1 = LED On
0 = LED Off

B.2.2 Meters to Binary Conversion (Forward and Reverse Encoding)

Table B-2 should be used when converting the level in the tank from meters or feet to binary (see Example 2 below).

Example 2: Metric

12.7127 meters = 0001 0010 0111 0001 Binary

Note The binary equivalent has been rounded to the nearest one hundredths of a meter; therefore, total meters equal 12.71, as shown in Table B-2.

Meters/Binary 10s		Meters/Binary 1s		Meters/Binary 10^{ths}		Meters/Binary 100^{ths}	
0	0000	0	0000	0	0000	0	0000
1	**0001**	1	0001	1	0001	**1**	**0001**
2	0010	**2**	**0010**	2	0010	2	0010
3	0011	3	0011	3	0011	3	0011
		4	0100	4	0100	4	0100
		5	0101	5	0101	5	0101
		6	0110	6	0110	6	0110
		7	0111	**7**	**0111**	7	0111
		8	1000	8	1000	8	1000
		9	1001	9	1001	9	1001

Table B-2: Meters to Binary Conversion

Note 1 = LED On
0 = LED Off

B.2.3 Decimal Feet/Inches and Fractional Inches to Binary Conversion (Forward and Reverse Encoding)

Table B-3 should be used when converting the level in the tank from decimal feet/inches and fractional inches to binary (see Example 1 below).

Example 1: Decimal

41 feet, 8 inches, and 8/16^{ths} of an inch = 0100 0001 1000 1000 Binary

Decimal/Binary 10s of Feet		Decimal/Binary 1s of Feet		Decimal/Binary Inches		Fractional Inches/Binary 1/16^{ths} of an Inch	
0	0000	0	0000	0	0000	0/16	0000
1	0001	**1**	**0001**	1	0001	1/16	0001
2	0010	2	0010	2	0010	2/16	0010
3	0011	3	0011	3	0011	3/16	0011
4	**0100**	4	0100	4	0100	4/16	0100
5	0101	5	0101	5	0101	5/16	0101
6	0110	6	0110	6	0110	6/16	0110
7	0111	7	0111	7	0111	7/16	0111
8	1000	8	1000	**8**	**1000**	**8/16**	**1000**
9	1001	9	1001	9	1001	9/16	1001
10	1010					10/16	1010
11	1011					11/16	1011
						12/16	1010
						13/16	1011
						14/16	1010
						15/16	1011

Table B-3: Decimal Feet/Inches and Fractional Inches to Binary Conversion

Note 1 = LED On
0 = LED Off

C Appendix C — Database Points

This appendix describes the 2910 FTT database points. These points contain configuration parameters for the transmitter, as well as dynamic (real-time) data that show status during transmitter operation.

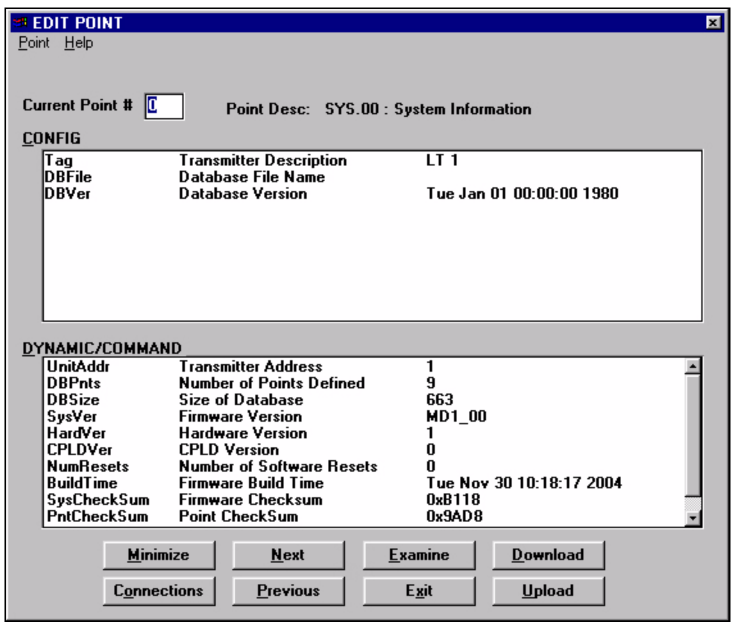
To access the points, the user must connect a laptop computer running the ViewRTU software to the RS-232 (EIA232) connector. See Section 8.3, "Configuring Outputs" on page 53, or “Section 9.2.2, "Using ViewRTU to troubleshoot the 2910 FTT" on page 65.

C.1 System Information (SYS)

C.1.1 Description

The System Information Point lists the hardware and software specifications of the system. Other information includes the hardware version.

C.1.2 ViewRTU dialog box: EDIT POINT



C.1.3 Parameters

The database parameters used by the SYS point are listed and described below:

Configuration Parameters	Function
Tag	The Tag contains 7 bytes of data to identify the transmitter. The format of the TAG is “LT xxx” where xxx is the transmitter address.
DBFile	The database file name. DBFile is the name of the RCF database configuration file.
DBVer	The database version.

Table C-1: View RTU Dialog Box: EDIT POINT — Parameters

Dynamic Parameters	Function
UnitAddr	The transmitter Unit Address (SW1-SW3)
DBPnts	The number of database points defined
DBSize	The size of the database in bytes
SysVer	The Firmware version
HardVer	The PCB hardware version
CPLDVer	The CPLD program version
NumResets	Records the number of system resets that have occurred since the last “Hard Reset” of the system
BuildTime	The Date and Time the database structure was generated
SysCheckSum	CRC-16 Checksum of the Firmware
PntCheckSum	CRC-16 Checksum of point's static Configuration Parameters
PntStatus	Byte value indicating status of point Values are: 0: No error

Table C-2: View RTU Dialog Box: EDIT POINT — Dynamic Parameters

C.2 Encoder Information (ENC)

C.2.1 Description

The ENC Information Point lists the parameters associated with the internal operation of the transmitter hardware. This includes parameters associated with the operation of the encoder.

C.2.2 Application

The ENC point is used to diagnose the current operation of the transmitter. The parameters can be used to evaluate the proper operation of the rotary switches as well as the proper operation of the encoders. The raw absolute and incremental encoder values can be evaluated. The current sensor states can be evaluated. The calculated reference values can be evaluated.

C.2.3 Parameters

The database parameters used by the ENC point are listed and described below:

Configuration Parameters	Function
Command	This parameter is reserved for future use.
EncValue	This parameter is a 16-bit value indicating the incremental value.
FDisk	This parameter is a 12-bit value indicating the level read from the foot encoder sensor.
IDisk	This parameter is a 16-bit value indicating the level read from the fractional foot (inches) encoder sensor.
EncState	This is a diagnostic code that describes the encoder state.
Level	This parameter represents the level in feet derived from the absolute encoding process. This parameter is always encoded in the forward rotation direction.
IncLevel	This parameter represents the level in feet derived from the incremental encoding process. This parameter is always encoded in the forward rotation direction.
Feet	This parameter indicates the feet portion of the level derived from the absolute encoding process. This parameter is shown in foot units from zero to ninety-nine in binary.
Inches	This parameter indicates the inches portion of the level derived from the absolute encoding process. This parameter is shown in inch units from zero to eleven in binary.
Sixteenths	This parameter indicates the 1/16-inch portion of the level derived from the absolute encoding process. This parameter is shown in 1/16-inch units.
PntStatus	Byte value indicating status of point Values are: 0: No error
Elapse	Time of last Point update.
PntCheckSum	CRC-16 Checksum of point's static Configuration Parameters

Table C-3: Encoder Information (ENC) — Configuration Parameters

C.3 Resistive Temperature Detector (RTD)

C.3.1 Description

The Resistive Temperature Detector point displays the data associated with the temperature measurement circuit on the 2910. The RTD point processes temperature using SI units, so the temperature is always displayed in degrees Celsius within the RTD point.

C.3.2 Parameters

The database parameters used by the RTD point are listed and described below:

Configuration Parameters	Function
TempMode	This parameter is set using SW6. The value of this parameter indicates the type of RTD to be interfaced with the 2910. 0: PT100 1: Cu100 2: Cu90
Cal1-Cal5	These parameters are used to provide additional calibration to the RTD circuit. The factory default values are 20, 60, 100, 140, and 180. These values are sufficient for most applications. Set these parameters to adjust the interpolation points used in temperature calculation.
Filter	Value between 1-10 indicating the number of temperature samples used in temperature filtering. The default value is 4.

Table C-4: Resistive Temperature Detector (RTD) — Configuration Parameters

Dynamic Parameters	Function
Command	Parameter used to activate calibration parameters.
Temp	Measured temperature in degrees Celsius.
RawValue	Un-calibrated resistance measurement value.
Resistance	Calibrated Resistance measure value. The Value used to calculate the actual temperature parameter.
Value1-Value3	Parameters used in ratio metric resistance measurement.
Ref100	24-bit value representing the ratio metric value of a 100-ohm precision reference resistor.
Ref200	24-bit value representing the ratio metric value of a 200-ohm precision reference resistor.
PntStatus	Byte value indicating status of point Values are: 0x0001: Hardware Failure 0x0002: Measurement is over range 0x0004: Measurement in under range 0x0008: Measurement is using modified calibration values
Elapse	Time of last Point update.
PntCheckSum	CRC-16 Checksum of point's static Configuration Parameters

Table C-5: Resistive Temperature Detector (RTD) — Dynamic Parameters

C.4 MODBUS Register Block (MBLK)

C.4.1 Description

The MODBUS Register Block point serves a data block to store user configuration data as well as converted data to be transmitted to the Host. The data block is organized in a structure useful for efficient MODBUS transactions, but this data block is also used as an access point for other versions of the 2910 FTT.

C.4.2 Application

The MBLK point is used to set advanced configuration parameters. These parameters include level and temperature alarm set points as well as Relay Output control sources. Configuration parameters can be written and read either using ViewRTU or in the case of the RS485 MODBUS communications module using MODBUS.

C.4.2.1 Scaled integers vs. floating point values

Configuration data can be written either as scaled integers or floating point. Writing data to floating point values will cause the associated scaled integer data to be updated and, writing data to scaled integer values will cause the associated floating point values to be updated. For a description of scaled integers, see Section A.3, "Configuration" on page 73.

C.4.2.2 Monitoring input devices

The status of each input device wired to the 2910 FTT is shown in a unique register in the dynamic parameter AlmStat described in Table C-7 on page 104. These registers are 0x0100, 0x0200, 0x0400 and 0x0800.

C.4.3 Parameters

The database parameters used by the MBLK point are listed and described below:

Configuration Parameters	Function
CritLowLevel	Floating-point value representing the Critical Low Level Set point for Level alarms. The parameter must be set in current Level units.
AdvLowLevel	Floating-point value representing the Advisory Low Level Set point for Level alarms. The parameter must be set in current Level units.
AdvHighLevel	Floating-point value representing the Advisory High Level Set point for Level alarms. The parameter must be set in current Level units.
CritHighLevel	Floating-point value representing the Critical High Level Set point for Level alarms. The parameter must be set in current Level units.
LDeadband	Floating-point value used to determine change in level alarm state. The Level value must be above Low Level set points and below high level set points by this amount for the alarm condition to clear. The parameter must be set in current Level units.
CritLowTemp	Floating point value representing the Critical Low temperature Set point for temperature alarms. The parameter must be set in current temperature units.

Table C-6: Configuration Parameters

Configuration Parameters	Function
AdvLowTemp	Floating point value representing the Advisory Low temperature Set point for temperature alarms. The parameter must be set in current temperature units.
AdvHighTemp	Floating point value representing the Advisory High temperature Set point for temperature alarms. The parameter must be set in current temperature units.
CritHighTemp	Floating point value representing the Critical High temperature Set point for temperature alarms. The parameter must be set in current temperature units.
TDeadband	Floating-point value used to determine change in temperature alarm state. The temperature value must be above Low Temp set points and below high Temp set points by this amount for the alarm condition to clear. The parameter must be set in current Temp units.
MinLevel	Floating point value representing the minimal level value used in calculating scaled integer level parameters. The parameter must be set in current Level units.
MaxLevel	Floating point value representing the maximum level value used in calculating scaled integer level parameters. The parameter must be set in current Level units. **Note: The default maximum integer value is 120 feet.**
MinTemp	Floating point value representing the minimal temperature value used in calculating scaled integer temperature parameters. The parameter must be set in current temperature units.
MaxTemp	Floating point value representing the maximum temperature value used in calculating scaled integer temperature parameters. The parameter must be set in current temperature units.
Reserved3	This value is used to maintain compatibility with the 4000 ATT register map.
ManTemp	Floating-point value representing a manual temperature value.
Cleave	Floating-point value used to calibrate to the current level. This parameter is used in conjunction with Cmds parameter to set the transmitter level. The parameter must be set in current level units.
NoiseRej	This value is used to maintain compatibility with the 4000 ATT register map. Setting this parameter has no effect, as by default the A/D circuit rejects both 50 and 60 Hz noise.
LoLoLevSet	Scaled Integer value representing the Critical Low Level Set point for Level alarms.
LowLevSet	Scaled Integer value representing the Advisory Low Level Set point for Level alarms.
HighLevelSet	Scaled Integer value representing the Advisory High Level Set point for Level alarms.
HiHiLevSet	Scaled Integer value representing the Critical High Level Set point for Level alarms.

Table C-6: Configuration Parameters

Configuration Parameters	Function
LevDead	Scaled Integer value used to determine change in level alarm state. The Scaled Integer Level iLevel value must be above Low Level set points and below high level set points by this amount for the alarm condition to clear.
LoLoTempSet	Scaled Integer value representing the Critical Low temperature Set point for temperature alarms.
LowTempSet	Scaled Integer value representing the Advisory Low temperature Set point for temperature alarms.
HighTempSet	Scaled Integer value representing the Advisory High temperature Set point for temperature alarms
HiHiTempSet	Scaled Integer value representing the Critical High temperature Set point for temperature alarms.
TempDead	Scaled Integer value used to determine change in temperature alarm state. The Scaled Integer temperature iTemp value must be above Low temperature set points and below high temperature set points by this amount for the alarm condition to clear.
LevUnits	Read only parameter – Units for Level to be transmitted to the Host interface. This value is derived from the rotary switches at startup. 0: M (Meters) 1: F (Feet)
TempUnits	Read only parameter – Units for temperature data to be transmitted to the Host interface. This value is derived from the rotary switches at startup 0: C (Celsius) 1: F (Fahrenheit)
LevType	This Read only parameter sets the rotation direction for the Level Gauge. This value is derived from the rotary switches at startup. 1: Forward 2: Reverse
TempType	This Read only parameter sets the RTD type. This value is derived from the rotary switches at startup. 0: PT100 1: Cu100 2: Cu90
iManTemp	Scaled Integer value representing a manual temperature value.
MaxInt	This parameter sets the maximum integer value used in Scaled Integer calculations. **Note: The default maximum integer value is 9999.**
DampVal	This value is used to maintain compatibility with the 4000 ATT register map.
iCalLevel	Scaled Integer value used to calibrate to the current level. This parameter is used in conjunction with Cmds parameter to set the transmitter level.

Table C-6: Configuration Parameters

Dynamic Parameters	Function
Cmds	Parameter used to send commands to the transmitter 0x20: Calibrate Level.
Level	Transmitted Level. This parameter reflects a value calculated using the encoding direction, Level units, and any calibration level.
Temp	Transmitted Temperature. This parameter reflects the set temperature units.
Resistance	Transmitted Resistance measure value
AbsLevel	This parameter represents the level in feet derived from the absolute encoding process. This parameter is always encoded in the forward rotation direction.
IncLevel	This parameter represents the level in feet derived from the incremental encoding process. This parameter is always encoded in the forward rotation direction.
iLevel	Transmitted Scaled integer Level.
iTemp	Transmitted Scaled integer Temperature.
DiskVel	Integer Value indicates the relative rotation speed of the encoder.
NumResets	Records the number of system resets that have occurred since the last “Hard Reset” of the system
AlmStat	Integer Value indicating any alarm conditions. 0x0001: Critical Low Level 0x0002: Advisory Low Level 0x0004: Advisory High Level 0x0008: Critical High Level 0x0010: Critical Low Temperature 0x0020: Advisory Low Temperature 0x0040: Advisory High Temperature 0x0080: Critical High Temperature 0x0100: Digital Input 1 0x0200: Digital Input 2 0x0400: Digital Input 3 0x0800: Digital Input 4
DiagStat	Integer Value indicating any diagnostic alarm conditions. 0x0001: Invalid Level 0x0002: Invalid Temperature
PntStatus	Byte value indicating status of point Values are: 0: No Errors
Elapse	Time of last Point update.
PntCheckSum	CRC-16 Checksum of point's static Configuration Parameters

Table C-7: Dynamic Parameters

C.5 Digital Outputs (DO)

C.5.1 Description

The Digital Output point contains the configuration and control parameters for activating the 4 optional output relays.

C.5.2 Parameters

Configuration Parameters	Function
DOPwrUpState	This parameter is used to force a Relay to be active at startup. 0x0001: Relay 1 Activated at Startup 0x0002: Relay 2 Activated at Startup 0x0004: Relay 3 Activated at Startup 0x0008: Relay 4 Activated at Startup
DO1Assign – D04Assign	These parameters are used to assign the control and activation source for the output relays. 0: Not Assigned 1: Host Interface (MODBUS 2: Critical High Level 3: Advisory High Level 4: Advisory Low Level 5: Critical Low Level 6: Critical High Temperature 7: Advisory High Temperature 8: Advisory Low Temperature 9: Critical Low Temperature
Reserved3	This value is used to maintain compatibility with the 4000 ATT register map.

Table C-8: Configuration Parameters

Dynamic Parameters	Function
DOOutputState	This is a command parameter used to activate the output relays. 0x0001: Activate Relay 1 (When set for HOST Control) 0x0002: Activate Relay 2 (When set for HOST Control) 0x0004: Activate Relay 3 (When set for HOST Control) 0x0008: Activate Relay 4 (When set for HOST Control)
Reserved1	This value is used to maintain compatibility with the 4000 ATT register map.
DOType	This value is used to maintain compatibility with the 4000 ATT register map.
Reserved2	This value is used to maintain compatibility with the 4000 ATT register map.

Table C-9: Dynamic Parameters

Dynamic Parameters	Function
DOState	This parameter indicates the current state of the Output Relays. 0x0001: Relay 1 Activated 0x0002: Relay 2 Activated 0x0004: Relay 3 Activated 0x0008: Relay 4 Activated
PntStatus	Byte value indicating status of point Values are: 0x0001: Hardware Failure
Elapse	Time of last Point update.
PntCheckSum	CRC-16 Checksum of point's static Configuration Parameters

Table C-9: Dynamic Parameters

D Appendix D — RTD Resistance - Temperature Charts

This appendix describes the relationship between temperature and resistance for the three RTD types that can be used with the 2910 FTT. This information can be used to verify the accuracy of the RTD probe used with the 2910 FTT.

The following tables are provided:

- Section D.1, "Pt100 RTD Resistance vs. Temperature" on page 107
- Section D.2, "Cu100 RTD Resistance vs. Temperature" on page 111
- Section D.3, "Cu90 RTD Resistance vs. Temperature" on page 114

For troubleshooting instructions, see Section 9.2.6, "Verifying temperature data – checking RTD resistance" on page 68.

D.1 Pt100 RTD Resistance vs. Temperature

Pt100		
RTD Resistance	**Temp °C**	**Temp °F**
16.76	–204.0	–335.2
18.49	–200.0	–328.0
20.22	–196.0	–320.8
21.94	–192.0	–313.6
23.66	–188.0	–306.4
25.37	–184.0	–299.2
27.08	–180.0	–292.0
28.78	–176.0	–284.8
30.47	–172.0	–277.6
32.16	–168.0	–270.4
33.85	–164.0	–263.2
35.53	–160.0	–256.0
37.21	–156.0	–248.8
38.88	–152.0	–241.6
40.55	–148.0	–234.4
42.21	–144.0	–227.2
43.87	–140.0	–220.0
45.52	–136.0	–212.8
47.18	–132.0	–205.6
48.82	–128.0	–198.4
50.47	–124.0	–191.2
52.11	–120.0	–184.0
53.74	–116.0	–176.8

Table D-1: Pt100 RTD Resistance vs. Temperature

Pt100		
RTD Resistance	**Temp °C**	**Temp °F**
55.38	-112.0	-169.6
57	-108.0	-162.4
58.63	-104.0	-155.2
60.25	-100.0	-148.0
61.87	-96.0	-140.8
63.49	-92.0	-133.6
65.11	-88.0	-126.4
66.72	-84.0	-119.2
68.33	-80.0	-112.0
69.93	-76.0	-104.8
71.53	-72.0	-97.6
73.13	-68.0	-90.4
74.73	-64.0	-83.2
76.33	-60.0	-76.0
77.92	-56.0	-68.8
79.51	-52.0	-61.6
81.1	-48.0	-54.4
82.69	-44.0	-47.2
84.27	-40.0	-40.0
85.85	-36.0	-32.8
87.43	-32.0	-25.6
89.01	-28.0	-18.4
90.59	-24.0	-11.2
92.16	-20.0	-4.0
93.73	-16.0	3.2
95.3	-12.0	10.4
96.87	-8.0	17.6
98.44	-4.0	24.8
100	0.0	32.0
101.56	4.0	39.2
103.12	8.0	46.4
104.68	12.0	53.6
106.24	16.0	60.8
107.79	20.0	68.0
109.35	24.0	75.2
110.9	28.0	82.4
112.45	32.0	89.6
113.99	36.0	96.8
115.54	40.0	104.0

Table D-1: Pt100 RTD Resistance vs. Temperature

Pt100		
RTD Resistance	Temp °C	Temp °F
117.08	44.0	111.2
118.62	48.0	118.4
120.16	52.0	125.6
121.7	56.0	132.8
123.24	60.0	140.0
124.77	64.0	147.2
126.31	68.0	154.4
127.84	72.0	161.6
129.37	76.0	168.8
130.89	80.0	176.0
132.42	84.0	183.2
133.94	88.0	190.4
135.46	92.0	197.6
136.98	96.0	204.8
138.5	100.0	212.0
140.02	104.0	219.2
141.53	108.0	226.4
143.04	112.0	233.6
144.55	116.0	240.8
146.06	120.0	248.0
147.57	124.0	255.2
149.07	128.0	262.4
150.57	132.0	269.6
152.08	136.0	276.8
153.58	140.0	284.0
155.07	144.0	291.2
156.57	148.0	298.4
158.06	152.0	305.6
159.55	156.0	312.8
161.04	160.0	320.0
162.53	164.0	327.2
164.02	168.0	334.4
165.5	172.0	341.6
166.98	176.0	348.8
168.46	180.0	356.0
169.94	184.0	363.2
171.42	188.0	370.4
172.9	192.0	377.6
174.37	196.0	384.8

Table D-1: Pt100 RTD Resistance vs. Temperature

Pt100		
RTD Resistance	**Temp °C**	**Temp °F**
175.84	200.0	392.0
177.31	204.0	399.2

Table D-1: Pt100 RTD Resistance vs. Temperature

D.2 Cu100 RTD Resistance vs. Temperature

Cu100		
RTD Resistance	Temp °C	Temp °F
12.78	–204.0	–335.2
14.3	–200.0	–328.0
15.82	–196.0	–320.8
17.35	–192.0	–313.6
18.87	–188.0	–306.4
20.39	–184.0	–299.2
21.92	–180.0	–292.0
23.44	–176.0	–284.8
24.97	–172.0	–277.6
26.49	–168.0	–270.4
28.01	–164.0	–263.2
29.54	–160.0	–256.0
31.06	–156.0	–248.8
32.58	–152.0	–241.6
34.11	–148.0	–234.4
35.63	–144.0	–227.2
37.15	–140.0	–220.0
38.68	–136.0	–212.8
40.2	–132.0	–205.6
41.72	–128.0	–198.4
43.25	–124.0	–191.2
44.77	–120.0	–184.0
46.3	–116.0	–176.8
47.82	–112.0	–169.6
49.34	–108.0	–162.4
50.87	–104.0	–155.2
52.39	–100.0	–148.0
53.91	–96.0	–140.8
55.44	–92.0	–133.6
56.96	–88.0	–126.4
58.48	–84.0	–119.2
60.01	–80.0	–112.0
61.53	–76.0	–104.8
63.06	–72.0	–97.6
64.58	–68.0	–90.4
66.1	–64.0	–83.2

Table D-2: Cu100 RTD Resistance vs. Temperature

Cu100		
RTD Resistance	Temp °C	Temp °F
67.63	-60.0	-76.0
69.15	-56.0	-68.8
70.67	-52.0	-61.6
72.2	-48.0	-54.4
73.72	-44.0	-47.2
75.24	-40.0	-40.0
76.77	-36.0	-32.8
78.29	-32.0	-25.6
79.81	-28.0	-18.4
81.34	-24.0	-11.2
82.86	-20.0	-4.0
84.39	-16.0	3.2
85.91	-12.0	10.4
87.43	-8.0	17.6
88.96	-4.0	24.8
90.48	0.0	32.0
92	4.0	39.2
93.53	8.0	46.4
95.05	12.0	53.6
96.57	16.0	60.8
98.1	20.0	68.0
99.62	24.0	75.2
101.15	28.0	82.4
102.67	32.0	89.6
104.19	36.0	96.8
105.72	40.0	104.0
107.24	44.0	111.2
108.76	48.0	118.4
110.29	52.0	125.6
111.81	56.0	132.8
113.33	60.0	140.0
114.86	64.0	147.2
116.38	68.0	154.4
117.9	72.0	161.6
119.43	76.0	168.8
120.95	80.0	176.0
122.48	84.0	183.2
124	88.0	190.4
125.52	92.0	197.6

Table D-2: Cu100 RTD Resistance vs. Temperature

Cu100		
RTD Resistance	Temp °C	Temp °F
127.05	96.0	204.8
128.57	100.0	212.0
130.09	104.0	219.2
131.62	108.0	226.4
133.14	112.0	233.6
134.66	116.0	240.8
136.19	120.0	248.0
137.71	124.0	255.2
139.24	128.0	262.4
140.76	132.0	269.6
142.28	136.0	276.8
143.81	140.0	284.0
145.33	144.0	291.2
146.85	148.0	298.4
148.38	152.0	305.6
149.9	156.0	312.8
151.42	160.0	320.0
152.95	164.0	327.2
154.47	168.0	334.4
155.99	172.0	341.6
157.52	176.0	348.8
159.04	180.0	356.0
160.57	184.0	363.2
162.09	188.0	370.4
163.61	192.0	377.6
165.14	196.0	384.8
166.66	200.0	392.0
168.18	204.0	399.2

Table D-2: Cu100 RTD Resistance vs. Temperature

D.3 Cu90 RTD Resistance vs. Temperature

Cu90		
RTD Resistance	Temp °C	Temp °F
51.77	–100.00	–148.00
53.32	–96.0	–140.8
54.87	–92.0	–133.6
56.42	–88.0	–126.4
57.97	–84.0	–119.2
59.52	–80.0	–112.0
61.07	–76.0	–104.8
62.61	–72.0	–97.6
64.16	–68.0	–90.4
65.71	–64.0	–83.2
67.26	–60.0	–76.0
68.81L	–56.0	–68.8
70.36	–52.0	–61.6
71.91	–48.0	–54.4
73.46	–44.0	–47.2
75.01	–40.0	–40.0
76.56	–36.0	–32.8
78.11	–32.0	–25.6
79.66	–28.0	–18.4
81.20	–24.0	–11.2
82.75	–20.0	–4.0
84.30	–16.0	3.2
85.85	–12.0	10.4
87.40	–8.0	17.6
88.95	–4.0	24.8
90.50	0.0	32.0
92.05	4.0	39.2
93.60	8.0	46.4
95.15	12.0	53.6
96.70	16.0	60.8
98.25	20.0	68.0
99.80	24.0	75.2
101.34	28.0	82.4
102.89	32.0	89.6
104.44	36.0	96.8
105.99	40.0	104.0
107.54	44.0	111.2

Table D-3: Cu90 RTD Resistance vs. Temperature

Cu90		
RTD Resistance	Temp °C	Temp °F
109.09	48.0	118.4
110.64	52.0	125.6
112.19	56.0	132.8
113.74	60.0	140.0
115.29	64.0	147.2
116.84	68.0	154.4
118.39	72.0	161.6
119.93	76.0	168.8
121.48	80.0	176.0
123.03	84.0	183.2
124.58	88.0	190.4
126.13	92.0	197.6
127.68	96.0	204.8
129.23	100.0	212.0
130.78	104.0	219.2
132.33	108.0	226.4
133.88	112.0	233.6
135.43	116.0	240.8
136.98	120.0	248.0
138.53	124.0	255.2
140.07	128.0	262.4
141.62	132.0	269.6
143.17	136.0	276.8
144.72	140.0	284.0
146.27	144.0	291.2
147.82	148.0	298.4
149.37	152.0	305.6
150.92	156.0	312.8
152.47	160.0	320.0
154.02	164.0	327.2
155.57	168.0	334.4
157.12	172.0	341.6
158.66	176.0	348.8
160.21	180.0	356.0
161.76	184.0	363.2
163.31	188.0	370.4
164.86	192.0	377.6
166.41	196.0	384.8
167.96	200.0	392.0

Table D-3: Cu90 RTD Resistance vs. Temperature

Cu90		
RTD Resistance	Temp °C	Temp °F
169.51	204.0	399.2
198.94	280.00	536.00

Table D-3: Cu90 RTD Resistance vs. Temperature

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