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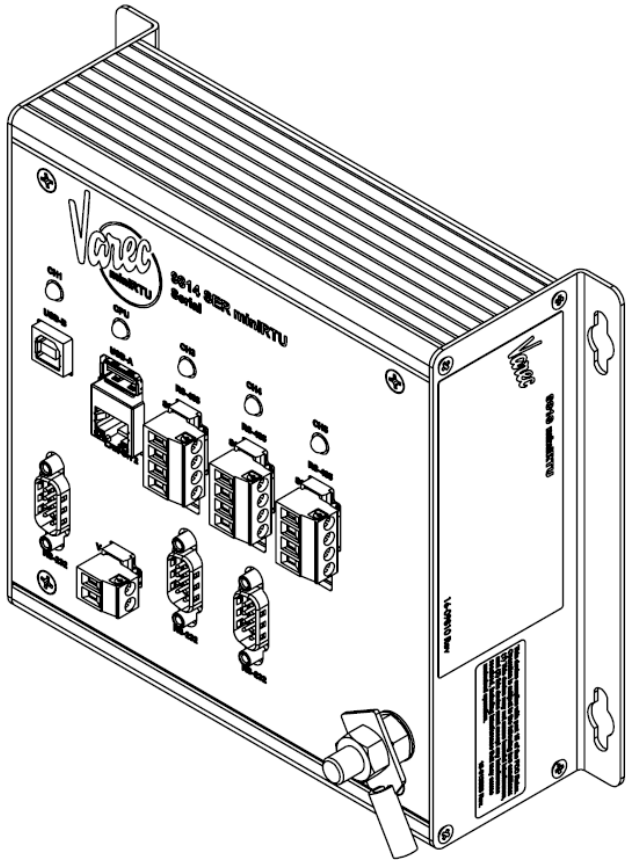
9810 miniRTU Installation and Operations Manual



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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.

Note Qualified personnel are required for installation of this product in a hazardous environment.

Safety Precautions

Before you install, configure, operate, or maintain this product, read this document and familiarize yourself with installation, wiring instructions, and in addition all applicable codes, laws, and standards. 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 This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 RP 2003. Make certain that the installation, operation, and maintenance conforms with the practice set forth therein.

Change History

Revision #	Date	Author	Approved By	Description of Change
A	12/05/2024	B. Mattingly	C. McKenzie	Initial Release
B	02/25/2025	M. McGrath	C. McKenzie	Updated Order Codes and the RS485 Termination Guidelines
C	03/12/2025	M. McGrath	C. McKenzie	Removed the RS485 Termination Guideline Reference and updated Serial Baud Rate
D	04/02/2025	M. McGrath	B. Mattingly	Updated with Tank Calculations information

1 Overview

The 9810 miniRTU is a family of reduced-size Remote Terminal Units (RTU), with distinct products for Serial, Bi-Phase Mark, Mark/Space, and Tankway interfaces. The 9810 miniRTU is member of Varec's complete line of industrial control systems and products. The 9810 miniRTU primarily is designed for applications where a cost-effective control system is needed for remote collection of field data and control of equipment.

The 9810 miniRTU is ideally suited for Tank Farms, Terminals, Pipeline Stations, and Refineries and other industrial applications. It is an effective solution intended to be used in supervisory control and data acquisition (SCADA) or stand-alone programmable control unit applications.

"9810" refers to the entire family of miniRTU's. 9810 is not a specific model. The specific models available for purchase are:

- 9812 BPM (Bi-Phase Mark)
- 9814 SER (Serial)
- 9815 M/S (Mark/Space)
- 9816 TW (Tankway)

Features and Specifications

General

Built-in software function library
Field surge protection circuits
Host communication via Ethernet, RS-232 and RS-485
Industry standard protocols: Modbus RTU and TCP/IP, and OPC UA
Non-volatile database
5 or 6 channels
Supports up to 32 tanks

Common Applications*

Level, temperature, and density
Bottom sediment & water (BS&W)
Pump status & control Valve status & control
Local indications

** There are many other common applications and the full list is too long to list.*

CPU

480 MHz CPU

Memory

64 MB flash
128 MB SDRAM

Power Requirements

24 VDC nominal, 18 – 60 VDC operational range, 20 W max; supplied by SELV source

Note Input power shall be limited to 20 W with a circuit protection device.

TCP/IP Communications

100 Mbps Ethernet interface using OPC UA over TCP/IP and Modbus TCP over TCP/IP

Host/Slave Communications

Selectable data rate, 2400 to 115200 baud
RS-232 or RS-485 communications
RS-485 maximum cable length (18 AWG) 4000 feet
RS-485 maximum multi-dropped units, 32

Physical

9810 miniRTU Case: 7.61" W x 6.50" H x 3.24" D

Environmental

Operating temperature: -40°F to 176°F; -40°C to 80°C Storage temperature: -40°F to 212°F; -40°C to 100°C Humidity: 5% to 95% RH non-condensing

Altitudes up to 2000m (6600 ft) without de-rating of fuses. Refer to IEEE C37.13.2015 for how to de-rate 9810 miniRTU fuses at higher altitudes.

Pollution degree rating 3: Conductive pollution or dry non-conductive pollution that becomes conductive due to condensation occurs. To be found in industrial environment or constructive sites (harsh environments).

Intelligent Communications Interfaces

Tank gauge communications
Automatically scans for level, temperature and status information
Industry standard protocols: Modbus
Tank gauge interfaces: Enraf, Modbus, Mark/Space

Mounting Information/Requirements

Use 18 AWG or larger diameter wires for power connections Limit the input power to 20W using a fuse or circuit breaker
A grounding conductor of 14 AWG or larger shall be wired to the grounding terminal on the lower right corner of the miniRTU.
The 9810 miniRTU shall be mounted in an external cabinet.
For indoor use, an enclosure with a minimum rating of IP 54 or NEMA 12 is recommended.
For outdoor use, an enclosure with a minimum rating of IP 66 or NEMA 4/4x is recommended.

9810 Wiring and Connection Ports

The 9810 miniRTU contains RS232/485, USB, and RJ-45 connections ports that are low level signal lines. No electrical shock can arise.

See each individual module sections in this manual for a description of each of the connectors on the modules.

Note All terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm^2)/ 300 V min. wiring rated for 87°C or greater on all terminals.

Note Remove 8 mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Field Maintenance

Field maintenance of the 9810 miniRTU is simplified by several built-in features. Field maintenance should be performed by authorized personnel only.

Note Replace fuses with correctly rated fuses.

2 Hardware, Software, and Security

In addition to the data input/output functions of the 9810 miniRTU, several other standard features are provided. These features include multitasking, an embedded OPC UA server, a built-in software library, data-scanning routines, and database management as well as being field upgradeable.

The 9810 miniRTU is designed to be supported by modern digital I/O interfaces such as the Bi-Phase Mark, Mark/Space, as well as others. Through these interfaces, the 9810 miniRTU can connect most signals encountered in industrial environments. The 9810 miniRTU can also interface to Host systems using a variety of industry standard protocols.

Hardware Description

The 9810 miniRTU consists of a high-performance CPU module with a 480 MHz CPU and one interface module, contained within a physical enclosure. There are several versions of the 9810 miniRTU, with each version determined by the interface module used:

- 9812 BPM (Bi-Phase Mark)
- 9814 SER (Serial)
- 9815 M/S (Mark/Space)
- 9816 TW (Tankway)

An illustration of the 9814 SER miniRTU is shown next.

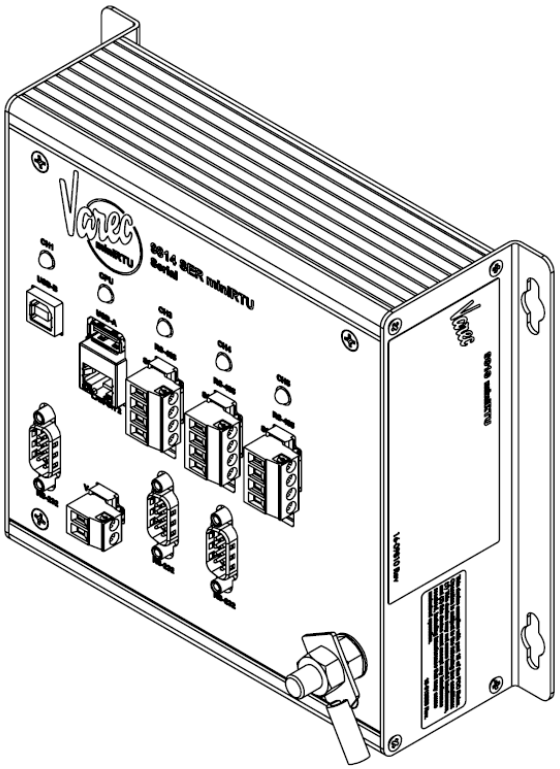


Figure 2-1: 9814 SER miniRTU Isometric View

9810 miniRTU Label Explanation

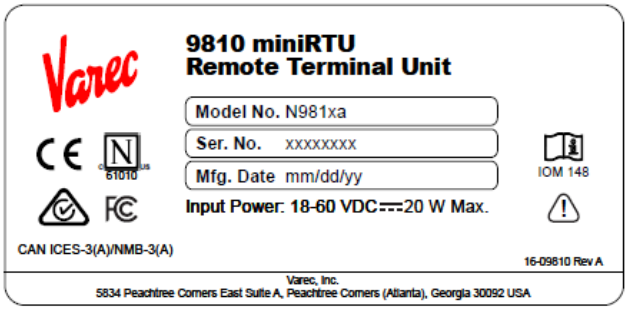


*Figure 2-2: Product Label with Caution and Instruction Symbols ***Not Defined Yet*

Caution Symbol: Consult accompanying documents

Instructions Symbol: Refer to the operating instructions manual IOMxxx

Software Description

The 9810 miniRTU software platform is based on a real-time, multi-tasking operating system. The software consists of I/O scanning functions for data acquisition, a configuration database, and communication functions for data transfer. The software incorporates a variety of protocols allowing the 9810 miniRTU to interface as a master or slave device.

Software Features

Real-Time / Multiprocessing Support

The operation of the 9810 miniRTU is based on a highly reliable, field-proven real-time multiprocessing design built into the real-time operating system (RTOS) to get the most out of the processor.

Real-Time Clock

Integral to the RTOS is the system's real-time clock. All timed events of the 9810 miniRTU are coordinated by this clock. In addition to the real-time executive interaction, all field data scanning is coordinated by the real-time clock. This clock is accurate to within three minutes per year.

Automatic Fault Recovery

The 9810 miniRTU is designed so that system resources will have the CPU time and memory to fulfill their tasks without other demands on the software and miniRTU interfering with processes. Even if an unintended event occurring that impacts one thread, the rest of the system processes can make use of the multi-threading capabilities of the CPU to continue to run without issues and keep the operating system's integrity as a whole intact.

Firmware Features

The 9810 miniRTU firmware can be updated via the USB flash drive inserted into the CPU module. This capability allows for future field installation of product enhancements. As new features are released, the user can install new firmware.

The process of updating the firmware is straightforward. The administrator or Varec service technician inserts a USB flash drive with the updated firmware and then

commands the transfer of the firmware file from the USB to the 9810 miniRTU. The user then removed the USB flash drive, causing the 9810 miniRTU to restart using the new firmware.

Real-Time Operating System

The 9810's real-time operating system is designed to take full advantage of the CPU's capabilities for computing performance to not be affected by demanding processes as well as system taxing information flows on the 9810's monitoring capabilities.

Communications

All versions of 9810 miniRTU have four common communication channels. Channel 1 uses either a USB Type B or RS-232 connector for serial communication. Channel 2 uses an Ethernet connector for TCP/IP communications. Channel 3 uses an RS-232 connector for serial communication. Channel 4 uses either a RS-232 or RS-485 connector for serial communication.

The 9814 Serial miniRTU provides two additional RS-485 connectors in channels 3 and 5 for serial communication.

The serial channels support the following data protocols:

Modbus Master
Modbus Slave
RTU Master
Enraf Master
TLS Master
HLS Master
Engauge
Debug

Except for the Debug Channel, each serial channel has a maximum baud rate of 57,600 bps. OPC UA uses the Ethernet channel at 100 Mbps to communicate.

The default configuration the three common serial channels are:

- Channel 1 – "RTU Slave" at 57,600 bps
- Channel 3 – "Debug Channel" at 115,200 bps
- Channel 4 – "RTU Slave" at 19200 bps

For Channel 5 and 6, the default configuration is "Virtual Channel" which has no baud rate.

Tank, Module, CPU, and Port Points

The 9810 miniRTU allows users to create points to monitor the status of and also communicate with the CPU, interface module, port, Modbus, and tank points to provide insight into their tank farms and other equipment.

Compatibility

The 9810 miniRTU is compatible with FuelsManager® software. It is also compatible with a variety of other host systems through Modbus protocols. Several types of protocols are available for assignment to the communication ports.

For example, if FuelsManager® is connected using a serial channel to the 9810 miniRTU, then FuelsManager® is the master and the 9810 miniRTU is the slave. If using OPC UA, then the 9810 miniRTU is the server and FuelsManager is the client.

OPC UA Security

The 9810 miniRTU also allows for no authentication (Anonymous) or simple username and password for connection between it and OPC UA clients. Below are the different ways to configure the 9810's OPC UA security modes.

Anonymous

Select Security Mode of None, then User Identify of Anonymous in order to connect without any authentication.

User Name

Select Security Mode of None, then User Identify of User Name in order to connect with a username and password.

Remote File Transfer

Remote File Transfer allows users to transfer files between the 9810 miniRTU and a remote laptop similar to how the 9810 miniRTU can use USB flash drives to transfer files. The maximum file size is 2 MB.

Remote File Transfer allows the users to upload and update the following types of files:

Application firmware
RTU database
Strap Files
Debug log
Tank Enraf item command files
Tank NNN Enraf configuration files

Tank NNN Enraf log files

Firmware

The firmware consists of a single executable file. The firmware is write-only and cannot be read from the miniRTU.

RTU Database

The 9810 miniRTU's configuration database is contained in a single file called **RTUdb**. By having the database as a single file, reading the RTUdb speeds up the loading of the database, takes less than 10 seconds to back up or to restore via the external USB flash or remote file transfer capabilities.

Debug Logs

Using the remote file transfer function or using a USB flash drive, debug logs (DebugLog.txt) can be exported and analyzed to see what issues could have impacted the proper functionality of the 9810 miniRTU to help Varec understand and fix any problems.

Tank Files (Strap Files as well as Enraf Command, Configuration, and Log Files)

The 9810's Strap File (also known as the tank strapping file or chart) can be read or written over by making sure the **FileName** is set to the same value as that TANK's **StrapFile** parameter.

To read or write a TANK's Item Command File, the **FileName** should be set to the same value as that TANK's **ItemCmdFile** parameter.

Enraf Command Files have associated configuration and log files. These filenames are named in the form <NNN>_<Label>.cfg or <NNN>_<Label>.log, where <NNN> corresponds to the 3-digit tank number (i.e., 001 to 032) and <Label> refers to the ASCII string defined in the Label parameter.

Note The underscore ("_") and ".cfg" or ".log" are part of the filename.

3 Installation

Note Installation and maintenance should be performed by qualified service personnel.

Before attempting installation, review the Safety Precautions below. Installation and maintenance personnel should become familiar with any hazards present as well as any agency requirements before working with any equipment.

General Safety Guidelines

The 9810 miniRTU is certified to be used in nonhazardous (unclassified) locations. The user should follow safety guidelines provided by the Occupational Safety and Health Administration (OSHA) for additional protection. Information may be obtained from the following sources:

International Electrotechnical Commission (IEC)
National Electrical Code (NEC)
National Fire Protection Association (NFPA)
Instrument Society of America (ISA)
FM Approvals (FM)
Underwriters' Laboratories Incorporated (UL)
Canadian Standards Association (CSA)

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

Installation Safety Guidelines

Note Maintenance should be performed only by authorized personnel.

To prevent shock hazards, the housing of all units shall be properly grounded in accordance with the National Electrical Code. A grounding conductor shall be wired to the grounding terminal provided on the 9810 miniRTU. Make sure to install 14 AWG or larger diameter wire from Earth stud on the unity to dedicated Earth Ground on the lower right corner of the miniRTU.

Caution! Do not bring in unfiltered outside air. It may introduce harmful contaminants that could damage the 9810 miniRTU and components.

Caution! Be careful of sharp edges on the 9810 miniRTU and associated components.

Installation

A standard system is shipped complete assembly, with serial, Bi-Phase Mark, Mar/Space, or Tankway interface module already installed. 9810 miniRTU installation includes the following steps:

1. Mounting the 9810 miniRTU
2. Mounting the Enclosure
3. Grounding the 9810 miniRTU
4. Wiring up Power
5. Configuring an IP Address

9810 miniRTU Product Dimensions

Before mounting the 9810 miniRTU, make certain that the enclosure can house the 9810 miniRTU. Refer to the dimensional drawing below (all dimensions are in inches).

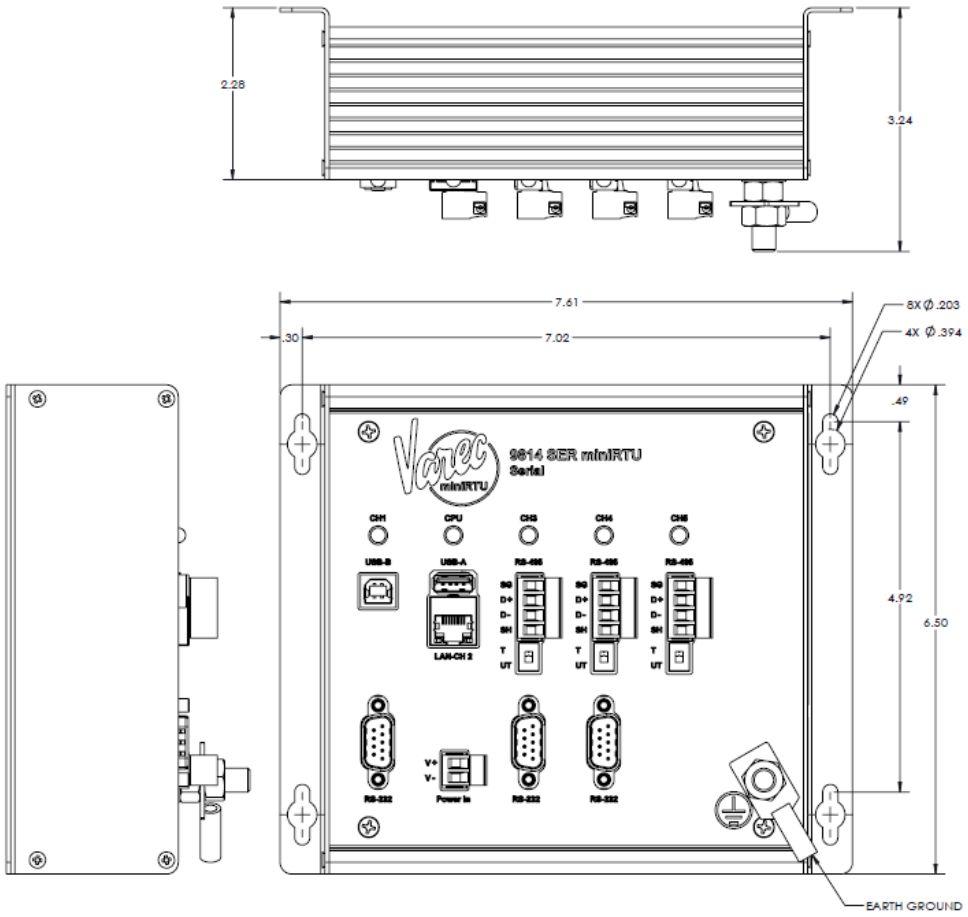


Figure 3-1: 9810 miniRTU Dimension Drawing

Warning! The miniRTU must be installed in an electrical cabinet, an electrical enclosure, or a controlled location to avoid accidental or incidental damage from non-qualified technicians.

Mounting the Enclosure

Companies purchasing the 9810 miniRTU will be able to request either having Varec mount the 9810 into an optional, sold separately, enclosure for them or to install the 9810 into an enclosure themselves.

Note The 9810 miniRTU shall be mounted in an external cabinet. For indoor use, an enclosure with a minimum rating of IP 54 or NEMA 12 is recommended. For outdoor use an enclosure with a minimum rating of IP 66 or NEMA 4/4x is recommended.

Grounding

Grounding the 9810 miniRTU is an essential step to ensure the safety of anyone who will interact with the hardware as well as protect the electronic components from electrical damage. To allow use in harsh industrial environments, the 9810 miniRTU incorporates IEEE surge protection. In solid-state control systems, grounding helps limit the effects of noise due to electromagnetic interference (EMI) and provides additional safety through surge protection when high voltage switching circuits are connected to the unit. The grounding path for the 9810 miniRTU and its enclosure is provided by the equipment earth grounding connector at in the bottom left corner of the enclosure as shown in Figure 3-1 on page 20.

Grounding Connector

The 9810 miniRTU enclosure is supplied with a ground stud on the front of the unit.

A 14 AWG minimum copper wire shall be connected between this ground bar and a good earth ground before connecting any other wires.

The resistance from the 9810 miniRTU ground to the grounding electrode must not exceed 1 ohm. Limit the input power to 20W using a fuse or circuit breaker.

All applicable codes and ordinances must be observed when wiring the 9810 miniRTU.

Wiring Up Power

Warning! Power to the miniRTU must be limited externally to 20 W.

Warning! miniRTU connectors may have voltages up to 60 VDC.

The 9810 miniRTU is externally powered by a 24 VDC nominal power supply. The 9810 miniRTU can operate over an operation range of 18 to 60 VDC. The miniRTU has a single power input connection. Power is applied using a 18 AWG/300 V wire.

Note Use 300 V/18 AWG or larger diameter wires rated for 87°C or greater for power connections.

Note Remove 8 mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Configuring an IP Address

To configure an IP address for a 9810 miniRTU, use the following steps:

1. Create a text file named “ipconfig” (no file type suffix at the end). When setting up the 9810 miniRTU onto an existing network, the first three values of the IP address need to match the computer network it is supposed to communicate with which are the following 3 ASCII strings: IpAddress, SubnetMask, and Gateway.

Each value needs to be on a new line. For example, here are the factory default IP addresses for the 9810 miniRTU as they would be entered into the "ipconfig" text file:

192.168.1.1
255.255.255.0
192.168.0.1

2. Copy the ipconfig file onto a USB flash drive, and then plug it into one of the two USB ports located on the 9810 miniRTU CPU Module faceplate.

   The 9810 will auto detect the insertion of this flash drive. If the flash drive contains the file named “ipconfig”, then the 9810 will attempt to update the IP Address, Gateway, and Subnet Mask configuration.

   The miniRTU will change the name on the flash drive to ipconfig.old so that it won’t update the 9810 miniRTU if that USB flash drive is ever reinserted with the same ipconfig file. If successful, the Debug Channel will display a message.

3. Remove the USB flash drive from the 9810 once the Debug Channel indicates successful. Once the USB drive is removed, the 9810 will reboot to use the new IP address.

4. If the update succeeds, the 9810 will rename the file to ipconfig.<IpAddress>, where <IpAddress> represents the IP address found in the file.

Note This is to prevent the flash drive from being inserted into another 9810 and inadvertently updating that 9810’s IP address with one already used.

5. To verify the new IP address, subnet mask and gateway address, connect with ViewRTU, and then go to the CPUM point to view the IP address, subnet mask, and gateway address.

Establishing Host Communications

When the system power is turned on, the Host communications status is set to On-line by default. The 9810 miniRTU then waits for a valid poll from the Host computer. If the communication cable is installed and the Host is running, a communications link is established.

4 miniRTU Common Characteristics

This section describes characteristics that are common to all versions of the 9810 miniRTU.

The 9810 miniRTU is available in several versions:

- 9812 Bi-Phase Mark
- 9814 Serial
- 9815 Mark/Space
- 9816 Tankway

All versions of miniRTU share the following physical characteristics:

- Channel 1 – USB Type B connector and RS-232 DB9 Male connector with status LED
- Channel 2 – Ethernet RJ45 connector
- Channel 3 – RS-232 DB9 Male connector with status LED
- Channel 4 – RS-232 DB9 Male connector and RS-485 connector with termination switch and status LED
- CPU status LED
- 1 USB Type A connector
- Power In connector
- Ground stud

All versions contain a high-performance CPU module with a 480 MHz CPU and one interface module, contained within a single physical enclosure.

The CPU module is the heart and brains of the 9810 miniRTU. It executes the 9810's firmware, stores the 9810's configuration in nonvolatile memory, communicates internally to the interface module, communicates externally with various devices using physical Ethernet & serial ports, distributes power to itself and the installed module, and controls any inserted USB flash drive. It collects information from these various sources and communicates with external systems such as FuelsManager.

Features

Here are some of the shared functions and features of the 9810 miniRTU:

Provides an interface for Ethernet connection
Manages all the configured tank points

Monitors the quantity and configured status of connected devices Monitors power and temperature
Monitors for fault conditions as configured
Keeps track of what protocols are used
Keeps track and communicates with the installed interface module
Keeps track of commands sent and status of each tank
Keeps track of and communicates with inserted USB flash drive

Concept

The concept behind the CPU module is to manage and facilitate communication between tank gauging devices connected to the 9810 miniRTU and external management software such as FuelsManager.

Features

All versions of 9810 miniRTU share common communications ports, LEDs, and ground stud.

Common face plate attributes:

Channel 1 – USB Type B connector and RS-232 DB9 Male connector with status LED
Channel 2 – Ethernet RJ45 connector
Channel 3 – RS-232 DB9 Male connector with status LED
Channel 4 – RS-232 DB9 Male connector and RS-485 connector with termination switch and status LED
CPU status LED
1 USB Type A connector
Power In connector
Ground stud

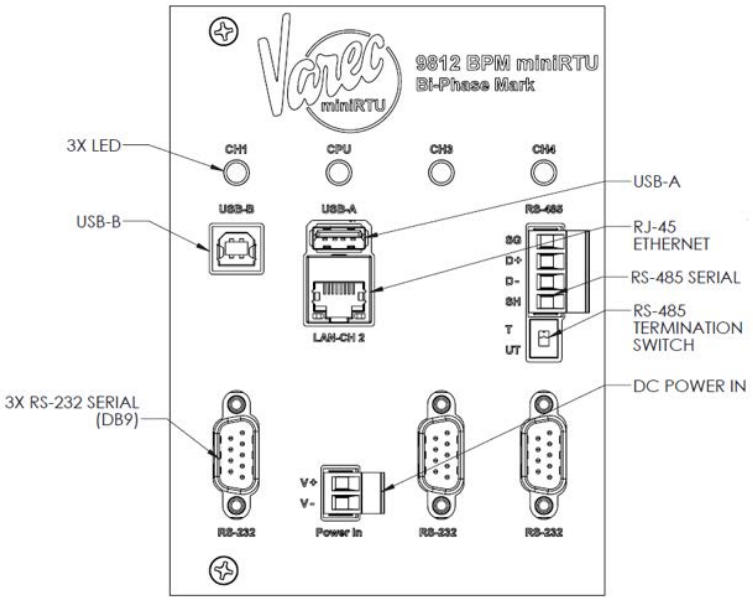


Figure 4-1: Common Face Plate

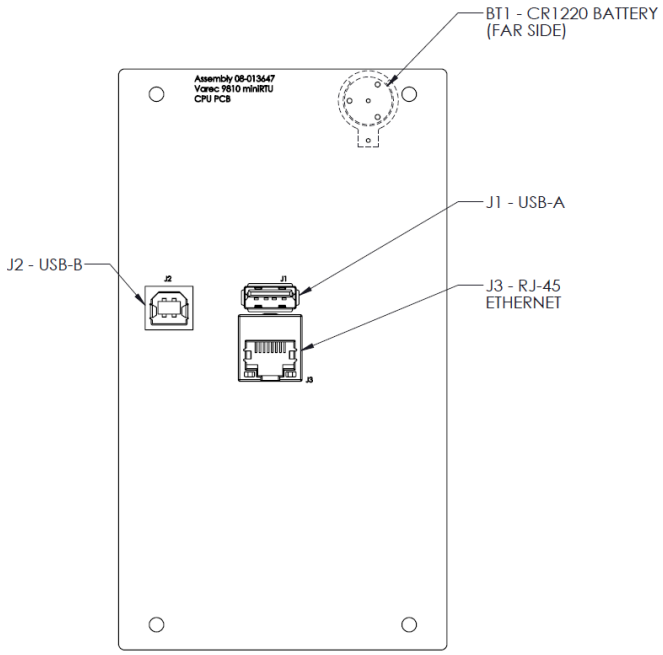


Figure 4-2: CPU Board

Note Battery BT1 may be replaced by the end user with a CR1220 coin battery. Battery replacement requires powering off the miniRTU, removing the board stack from the chassis, removing the old battery, installing the new battery, and reinstalling the board stack into the chassis.

Caution! Care must be taken to install the battery in its correct orientation with the positive (+) side up (i.e., visible when installed).

Hardware Interface

RS-485 Terminals Connection

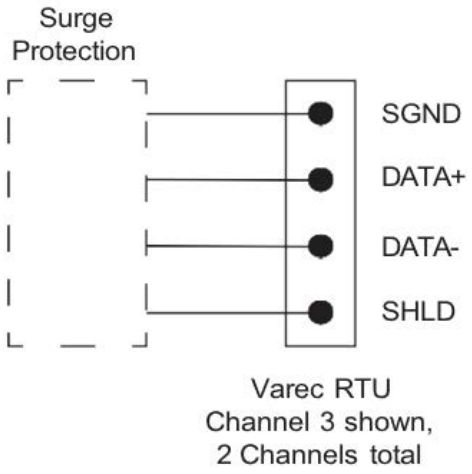


Figure 4-3: RS-485 Terminals Connection

Note All terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm^2)/300 V min. wiring rated for 87°C or greater on all 8811 connecting terminals.

Note Remove 8 mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Backup and Restore Functionality

Backup Functionality

The 9810 miniRTU allows users to backup files located on the CPU module's non-volatile memory. This includes the configuration database (RTUdb) and Enraf Item Command Files.

Note The backup functionality does not include firmware files which are stored in separate non-volatile memory.

The steps to use the Backup functionality are as follows:

1. Insert a USB flash drive into the CPU module's USB port.
2. Select **Backup to USB** option in the CPU module's **ModCmd** using an OPC UA client.
3. **CmdStatus** reports "Complete" when the backup finishes.

Restore Functionality

The 9810 miniRTU allows users to upload a backup of all files that were created using the **Backup to USB** option.

The steps to use the Restore functionality are as follows:

1. Insert the USB flash drive that contains the backup to restore into the CPU module's USB port.
2. Select **Restore to USB** option in the CPU module's **ModCmd** using an OPC UA client.
3. **CmdStatus** reports "Remove USB" when the restore finishes. When the USB flash drive is removed, the miniRTU will reboot so the restored files can take effect.

Configuration

In the below listed tables, each CPU Module variable is defined to explain the concept behind it.

Name	Default	Definition
Label	<CPU Module>	The point description - a 32-character ASCII string that allows the user to assign a human-readable name to the miniRTU. Example: "9810 North Field" or "9810 West"
IpAddress	192.168.1.1	The miniRTU's IP address - used for communication through the Ethernet channel using OPC UA.
SubnetMask	255.255.255.0	The miniRTU's subnet mask - used for network configuration.
Gateway	192.168.0.1	The miniRTU's default gateway - used for network configuration.
UnitAddress	1	The miniRTU's unit address - used for communication through the RTU Slave channel protocol.
AdminName	admin	minRTU administrator's username - a 32-chararacter ASCII string used by OPC UA to connect to the miniRTU with unrestricted ability to modify parameters.
AdminPassword	9810rtu	miniRTU administrator's password - a 32-chararacter ASCII string used by OPC UA to connect to the miniRTU with unrestricted ability to modify parameters.
User1Name	user1	miniRTU user's username - a 32-chararacter ASCII string used by OPC UA to connect to the miniRTU with restricted ability to modify parameters.
User1Pwd	password	miniRTU user's password - a 32-chararacter ASCII string used by OPC UA to connect to the miniRTU with restricted ability to modify parameters.
TempUnits	Fahrenheit	The unit's setting for miniCPU Module temperature parameters: • 1 = Fahrenheit • 2 = Celsius This does not affect the unit's setting for tanks, which are configured separately.
DBFile	<null>	The configuration database's file name which is a 32-character ASCII string. When used with the legacy interface (Example: ViewRTU), this represents the *.rcf configuration file.
DBDirectory	<9810 miniRTU>	This represents the name of the directory the miniRTU's configuration will be copied to/from on the External USB Flash Drive. (Refer to *ModCmd*)
NumberOfTanks	16	The number of configurable tanks (value ranges from 1-32).
NumberOfRegMap	32	The number of register maps (1-128).
NumberOfMfpreg	32	The number of Modbus floating point registers (1- 64).
NumberOfMireg	32	The number of Modbus integer registers (1-64).
NumberOfGwblk	32	The number of gateway blocks (1-72).

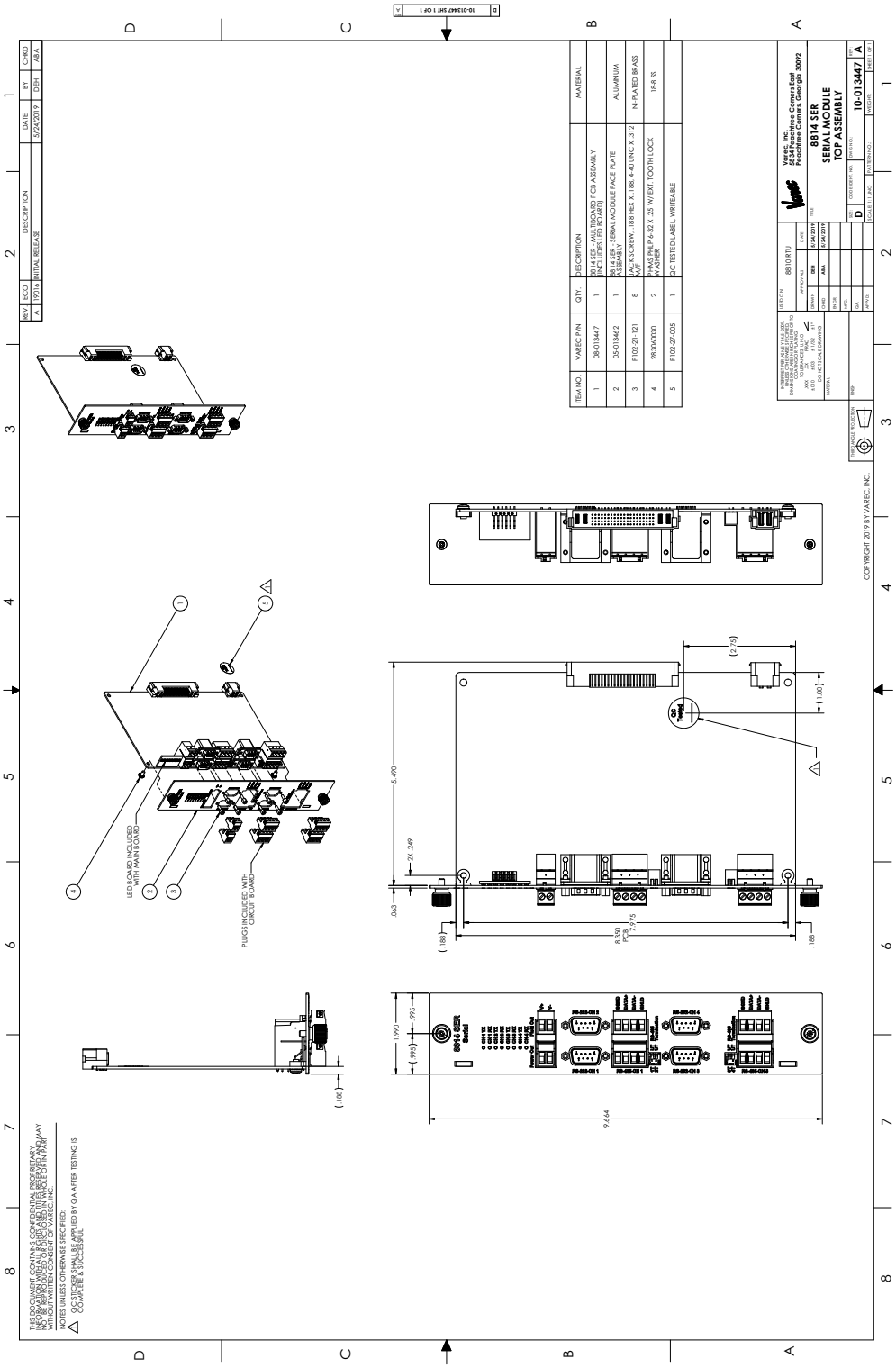
Name	Default	Definition
ViewRTUPoints	0x00FF	Bits that determine which point types are reported by the RTU Slave protocol. SYS, CLK, and CPUM point types are always reported. • 0x0001 = INTFM (1) • 0x0002 = PORT (6) • 0x0004 = MFPREG (NumberOfMfpreg) • 0x0008 = MIREG (NumberOfMireg) • 0x0010 = GWBLK (NumberOfGwblk) • 0x0020 = TLS (1) • 0x0040 = TANKA (NumberOfTanks) • 0x0080 = REGMAP (NumberOfRegMap)
AmbientTempSrc	1	The ambient temperature source for tank calculations. • 1 = AmbientTemp • 2 = ManAmbientTemp
ManAmbientTemp	75.5	The manual ambient temperature in either Celsius or Fahrenheit.
AmbTempConvert	FtoF	The conversion for AmbientTemp. (For example, “FtoC” for Fahrenheit to Celsuius) • 1 = AmbientTemp • 2 = ManAmbientTemp
AmbTempDB	1.0	The ambient temperature deadband.
SecurityMode	1	The security mode the 9810 miniRTU uses to allow OPC UA connections. **Note** A CPU module reset is required if modified. • 1 = None
SecurityPolicy	1	The security policy the 9810 miniRTU uses to allow OPC UA connections. **Note** A CPU module reset is required if modified. • 1 = None
UserIdentity	1	The user identity mode the 9810 miniRTU uses to allow OPC UA connections. **Note** A CPU module reset is required if modified • 1 = Anonymous • 2 = UserName
Watchdog	1	Used to enable the hardware watchdog (which resets the CPU when tripped. **Note** A CPU module reset is required if modified • 1 = Disable • 2 = CPU Watchdog

Dynamic/Command

Name	Default	Definition
ModCmd	0 (undefined)	The current command the module is doing: • 1 = Reset Module - Equivalent to power-cycling the miniRTU. • 2 = Copy Firmware to RTU - Copies the firmware from the External USB Flash Drive to the MiniRTU. The CPU Module will reset (see above) if the copy is successful. • 3 = Copy Database to RTU - Copies the miniRTU configuration from a directory with a name specified by DBFile on the External USB Flash Drive to the miniRTU. • 4 = Copy Database to USB - Copies the miniRTU configuration from the miniRTU to a directory with a name specified by DBFile on the External USB Flash Drive. • 5 = Database Factory Reset - Restores the miniRTU's configuration to its factory settings. • 6 = Limited Database Factory Reset - Restores the miniRTU's configuration to its factory settings, except for IpAddress, SubnetMask, and Gateway, which are unchanged. • 7 = Copy Debug Log to USB - Copies the Debug Log file from the miniRTU to an external USB flash drive. • 8 = Backup from RTU to USB. Copies all files from the miniRTU into a directory called backup_<IpAddress> on the external USB flash drive. • 9 = Restore from USB to RTU. Copies all files located in the directory called backup_<IpAddress> on the external flash drive to the miniRTU. • 10 = List Files. Prints a list of all files to the Debug Channel. • 11 = Delete File. Deletes the file specified by FileName.
CmdStatus		The status of the las ModCmd: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout • 7 = Remove USB • 8 = Database In Use
SystemTime	Date & Time	The system time in seconds - the miniRTU reports this as Coordinated Universal Time (UTC) which might be displayed as local time, depending on the device used to connect to the miniRTU.
ModInstalled	CPU Module	The module currently installed in the slot: • 1 = Unknown Module • 2 = CPU Module This always should be reported as CPU Module.
SysVer	<database version>	An ASCII string specifying the version of the miniRTU's configuration. Used by the customer to check for database compatibility.

Name	Default	Definition
FwVer	<firmware version>	The firmware version composed of an ASCII string.
SysCheckSum	<integer>	The firmware version CRC - a number identifying the 32-bit CRC of the executable firmware program.
HwDate	<string>	The CPU Module's manufacture date.
HwSerialNo	<integer>	The CPU Module's serial number.
HwVer	<integer>	The CPU Module's PCB hardware version.
NumResets	<integer>	The number of times the CPU Module has been power cycled.
ErrorCode	0	The error code detected by the firmware.
CpuTemp	<float>	The current temperature of the CPU in either Celsius or Fahrenheit.
InputVolt	<float>	The input voltage (V) which is a measured value of the primary input voltage.
ExternalUSB	Removed	The status of the external USB flash drive along with the status of any ModCmd commands that use the external USB flash drive. • 1 = Removed • 2 = Inserted • 3 = Detected • 4 = Executing • 5 = Failure • 6 = Complete • 7 = Remove USB
ResetTime	Date&Time	Time at system reboot.
AmbientTemp	0.0	The ambient temperature as set as Celsius or Fahrenheit.
MacAddress		The MAC address of the 9810 miniRTU.
DBInUse	0	The number of database writes in progress.
NvmInUse	0	Non-volatile Memory write in Progress
FileName	<null string>	Name of file to be deleted by ModCmd.
WatchdogTimer		Number of milliseconds since the watchdog timer was last serviced.
PntStatus	0	A bitmap field representing the status of the CPU Module: • 0x0000 0000 - No errors • 0x0100 0000 - Module is not installed • 0x0400 0000 - Hardware communication error. Set when the firmware is unable to communicate with the hardware. • 0x0800 0000 - Unknown module type. Typically happens if a module is not connected correctly.

Network Termination Resistance Switches



5 9812 BPM miniRTU

This section describes functionality specific to the Bi-Phase Mark (BPM) version of the miniRTU, which adds BPM connectors to channels 5 and 6, in addition to the four common interfaces included in channels 1 to 4.

Features

- Two additional channels for Bi-Phase Mark
- Transformer isolated
- Up to 10 tanks per channel
- Honeywell Engauge support using a serial channel
- Two 3 position pluggable (removable) terminal block per channel for convenient connection of field wiring
- Communications with Enraf 811, Enraf 854, Enraf 873. Enraf 954, and Enraf 990 Smart Radar tank gauges

The 9812 BPM miniRTU is used to communicate with Enraf GPU-based tank gauges. A maximum of 20 tanks may be connected per miniRTU. The 9812 communicates using a Bi-Phase Mark protocol. The following figure illustrates the 9812 BPM miniRTU.

Note A Varec 2920 Float & Tape Transmitter can emulate an Enraf 854 and can interface with the BPM module.

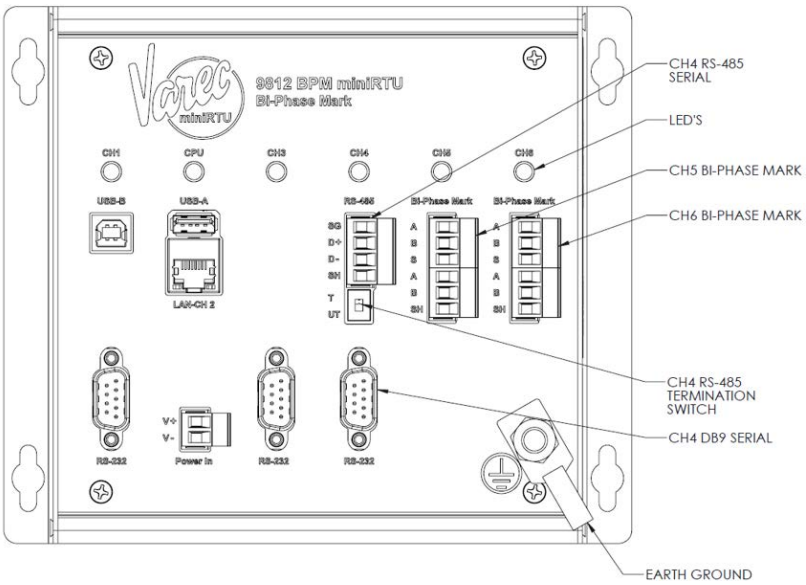


Figure 5-1: 9812 BPM miniRTU

As seen in the above figure, Bi-Phase Mark uses channels 5 and 6.

Description

This section explains how to connect field wiring.

Status LED Indicators (CH5 – CH6)
Field wiring terminal blocks (CH5 – CH6)

Field Wiring Terminal Blocks

The 9812 Bi-Phase Mark has three termination points for each of the two channels— two termination signal connections and a shield. A schematic illustrating the terminal connections of any single channel is shown below:

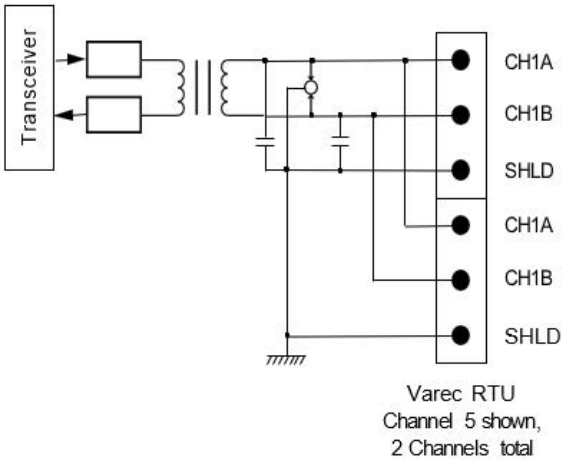


Figure 5-2: 8812 Bi-Phase Mark Terminals

Connect the Field Wiring

Wire the 9812 BPM according to the following diagram.

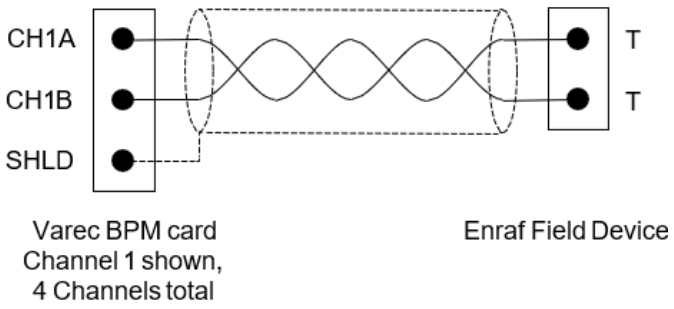


Figure 5-3: 9812 Bi-Phase Mark Field Wiring

Note All 9812 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring rated 87C or greater on all 9812 connecting terminals.

Note Remove 8 mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Software Interface

The 9812 Bi-Phase Mark can be configured to work with any tank or other storage requirements as needed. This can be configured using Varec's ViewRTU or standard OPC UA clients such as Softing dataFEED.

6 9814 SER miniRTU

This section describes functionality specific to the Serial (SER) version of the miniRTU, which adds RS-485 connectors to channels 3 and 5, in addition to the four common interfaces included in channels 1 to 4.

Features

Two RS-485 connectors in channels 3 and 5 in addition to the one RS-485 connector in channel 4 common to all versions of miniRTU

Up to 31 devices per channel (RS-485)

ANSI/IEEE surge protection

The 9814 Serial can communicate with a variety of devices using RS-232 or RS-485 interfaces. The current available protocols are Modbus, RTU Slave, Enraf Master, TLS Master, and HLS Master.

Each channel automatically switches between using RS-485 or RS-232. By default, each channel uses RS-485. If a cable is correctly connected to an RS-232 channel from another RS-232 device, the hardware automatically switches to use RS-232.

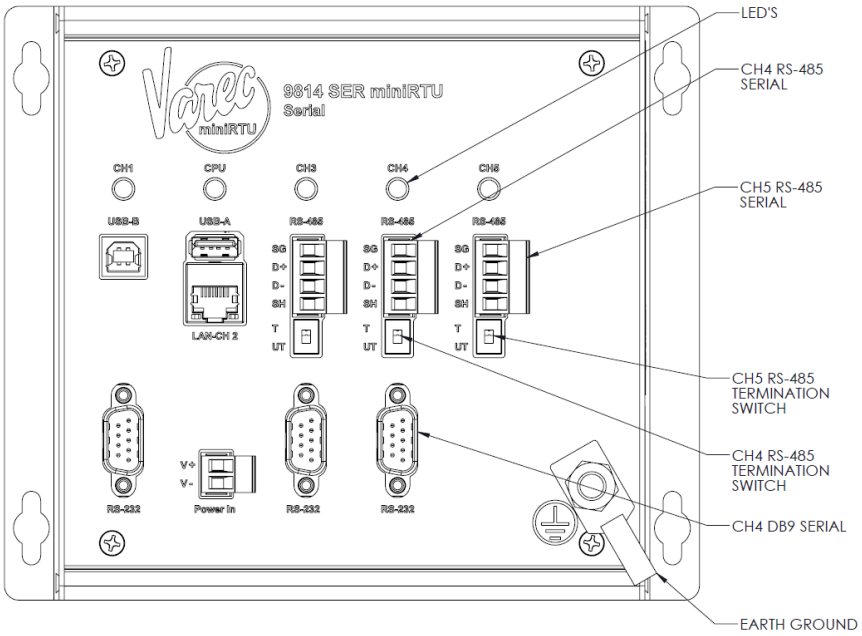


Figure 6-1: 9814 Serial

Description

This section explains how to connect field wiring for the two RS-485 connectors in channels 3 and 5 as well as the common RS-485 in channel 4 and RS-232 connectors in channels 3, 4, and 5.

LED indicators (CH3 – CH5)
DB–9 male RS–232 connectors (CH3 – CH4)
Field wiring terminal block for RS–485 (CH3 – CH4)
Switches for enabling termination resistors for RS–485 (CH3 – CH5)

Field Wiring Terminal Block

The 8914 Serial has 4 termination points per RS-485 port. The following schematic illustrates the terminal channels:

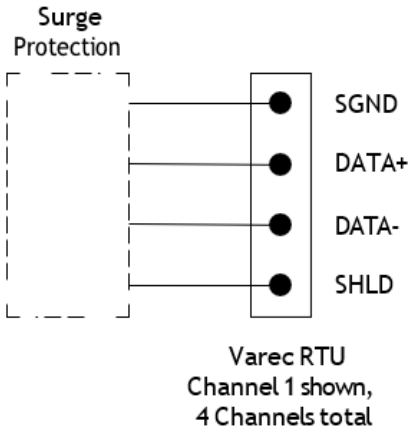


Figure 6-2: 9814 Serial RS-485 Terminals

Note All 9814 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring rated for 87C or greater on all 9814 connecting terminals.

Note Remove 8 mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Network Terminating Resistor Switches

Close the appropriate network termination switch to enable network termination resistors for the RS-485.

Hardware Interface

Modbus

The following diagram shows how to use the 9814 Serial with Modbus devices such as the Varec 2920 FTT or 4000 ATT.

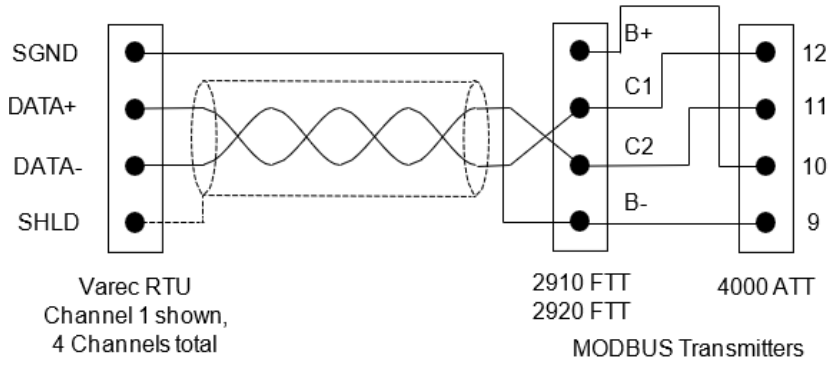


Figure 6-3: 9814 Serial RS-485 Field Wiring

The following diagram shows how to use the 9814 Serial with Veeder-Root Modbus devices such as the TLS-3xx gauge line.

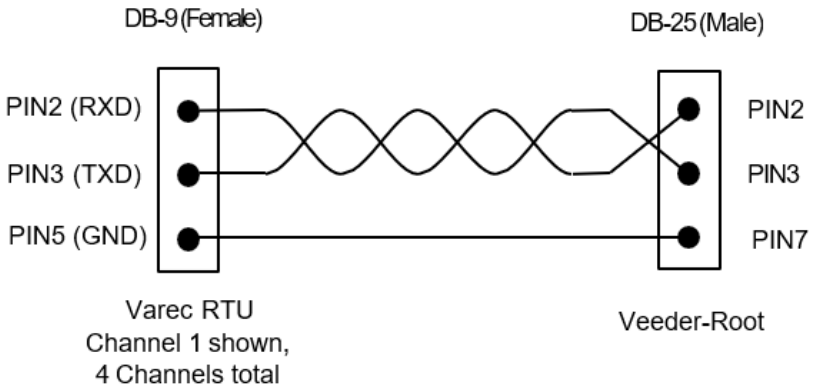


Figure 6-4: 9814 Serial Veeder-Root Field Wiring

Software Interface

RS-232 and RS-485 Connectors

The RS-232 and RS-485 connectors are used to communicate via various serial data protocols. The CPU Module is the hardware device that has the software and protocols used to communicate with devices in the field or in the office. The 9810 miniRTU has three serial ports (channels 1, 3, and 4) common to all versions of miniRTU. The 9814 adds RS-485 connectors to channels 3 and 5.

Modbus

The RS-232 and RS-485 connectors are used as the physical conduit for the CPU to communicate with Modbus devices. This allows the miniRTU to perform various tasks, such as reading level, temperature, and status information from a tank gauge.

7 9815 M/S miniRTU

This section describes functionality specific to the Mark/Space (M/S) version of the miniRTU, which adds a Mark/Space connector to channel 5.

Features

Supports up to 32 tanks
Communicates using Mark/Space protocol
Interfaces to Varec 1900 MWT compatible Tank Gauge transmitters

The 9815 Mark/Space interfaces with tank gauge transmitters using Varec's Mark/Space protocol to communicate. There are a number of transmitters that are Mark/Space compatible, including:

Varec 1800
Varec 1900 MWT
Varec 4000 ATT
Varec 4200 MFT
Varec 2900 FTT, 2910 FTT, and 2920 FTT
Varec 6000/6500 Servo Tank Gauges Gauging Systems Inc. Model 2000
L&J Technologies MCG 2000MAX
L&J Technologies MCG 1500SFI Servo Gauge
L&J Technologies MCG 1600SFI / evo 1610 / evo 2600 Radar Level gauge

The following figure illustrates the 9815 Mark/Space.

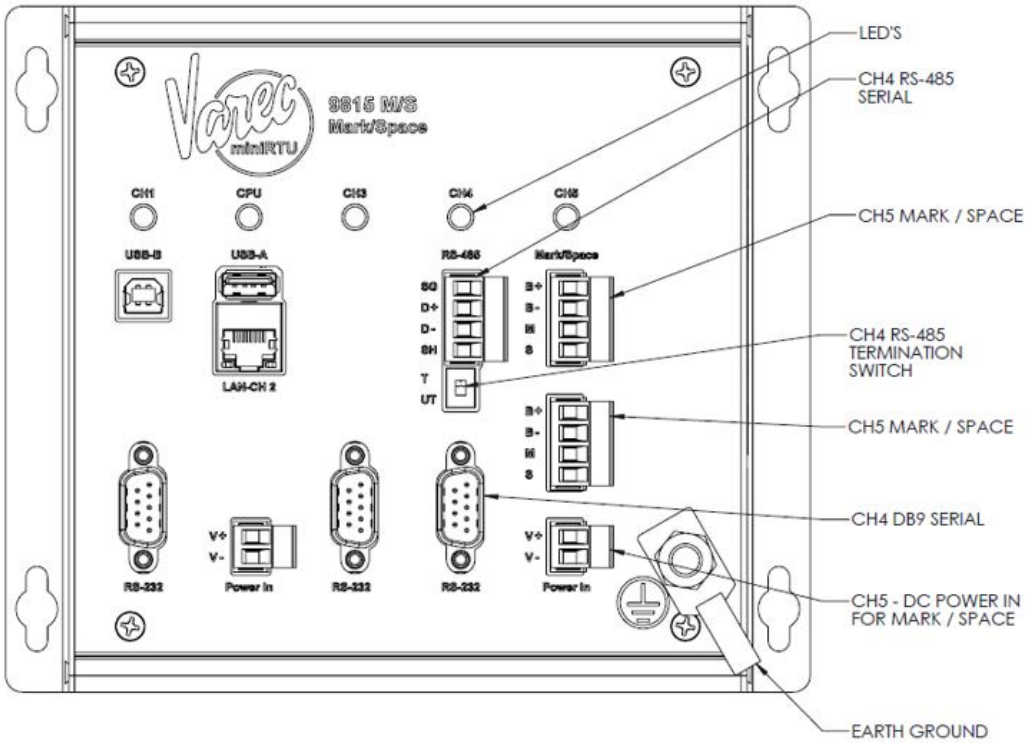


Figure 7-1: 9815 Mark/Space

Description

The components of the 9815 are illustrated in the previous figure. This section explains how to connect field wiring.

Power for the Mark/Space bus, typically 48 VDC, is provided by the Power In connector.

Note All M/S terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring rated for 87C or greater on all 9815 connecting terminals.

Note Remove 8mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Field Wiring Terminal Block

A schematic illustrating the terminal connections of the M/S is shown below:

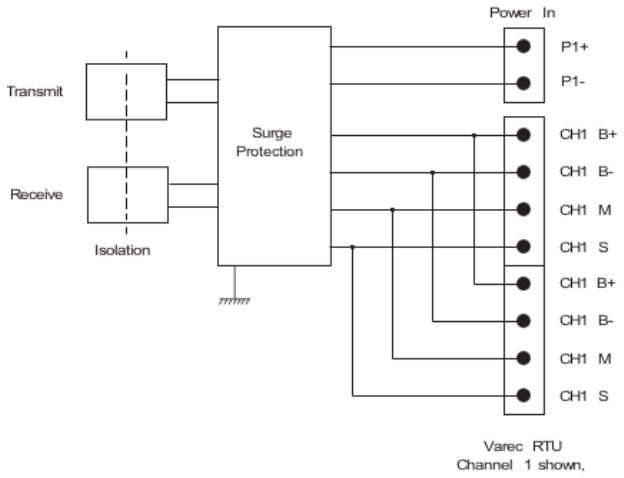


Figure 7-2: 9815 Mark/Space Terminals

To connect the field wiring

1. Connect the wiring from the Mark/Space to the appropriate device.
2. The 9815 can be connected to a variety of different transmitters.

Note Refer to your tank transmitter user's manual for instruction on wiring the devices to the 9815. The following schematic is provided only as an example:

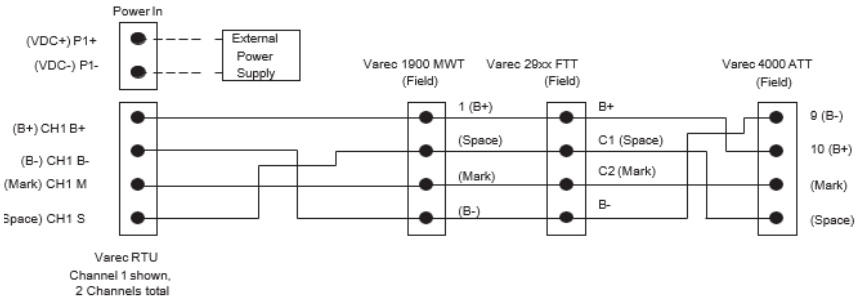


Figure 7-3: 9815 Mark/Space Field Wiring

8 9816 TW miniRTU

This section describes functionality specific to the Tankway (TW) version of the miniRTU, which adds a Tankway connector to channel 5.

Features and Specifications

Supports up to 32 tanks
Communicates using L&J Tankway protocol
Interfaces to L&J Tankway compatible Tank Gauge transmitters
Supports tank level range of up to 96 feet

The 9816 miniRTU uses two Tankway buses to communicate. There are a number of transmitters that are compatible, including:

L&J MCG 1000
L&J MCG 1500
L&J MCG 2000

Note A Varec 2920 Float & Tape Transmitter can emulate an L&J MCG 2000 and can interface with the Tankway module.

Description

The 9816 is illustrated in the following figure. This section explains how to connect field wiring.

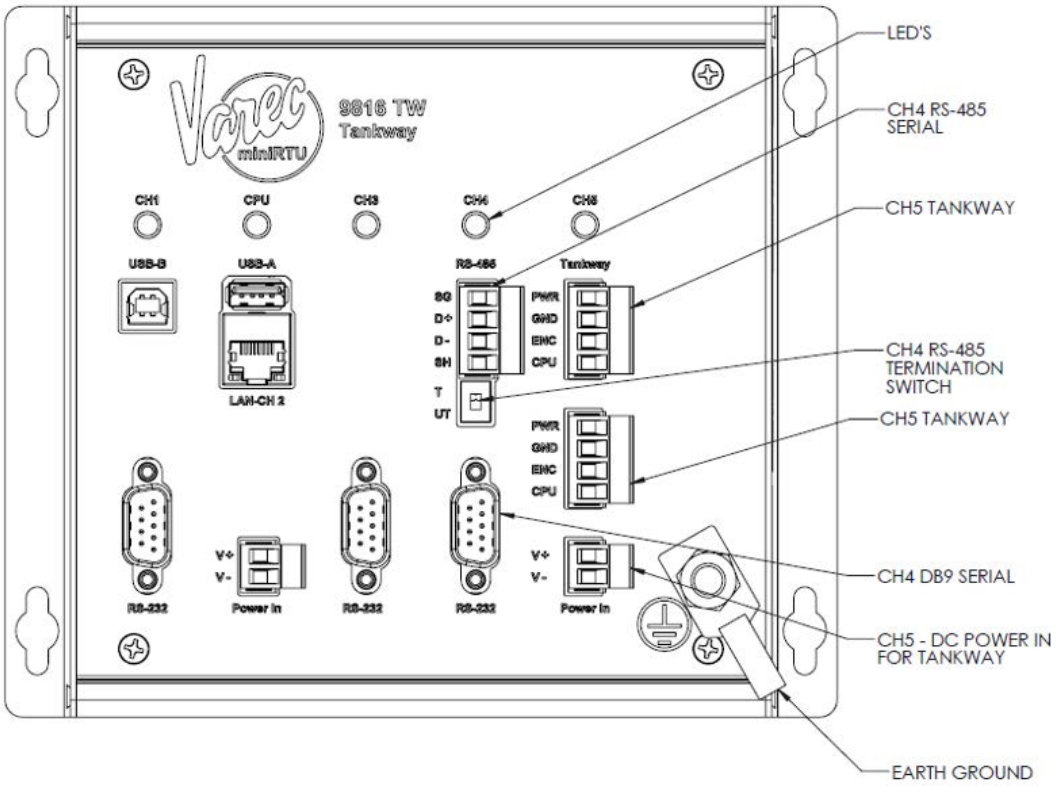


Figure 8-1: 9816 TW miniRTU

Power for the Tankway bus is provided by the Power In connector on the 9816 card.

Note All 9816 terminal connections are rated for 60 VDC max., 2 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring rated for 87C or greater on all 9816 connecting terminals

Note Remove 8mm or less from insulation and conductors are to be soldered or a ferrule crimped on them prior to install.

Field Wiring Terminal Block

A schematic illustrating the terminal connections of the 9816 Tankway module is shown below:

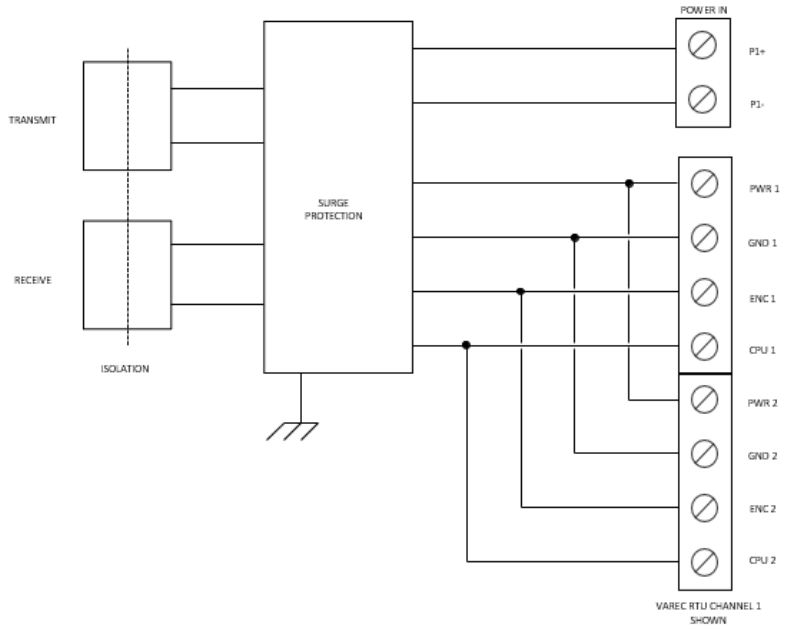


Figure 8-2: 9816 Tankway Input Circuitry

To connect the field wiring

1. Connect the wiring from the 9816 Tankway to the appropriate device.
2. The 9816 can be connected to a variety of different transmitters. Three examples are shown below.

Note Refer to your tank transmitter user's manual for instruction on wiring the devices to the 9816. The following schematics are provided only as examples:

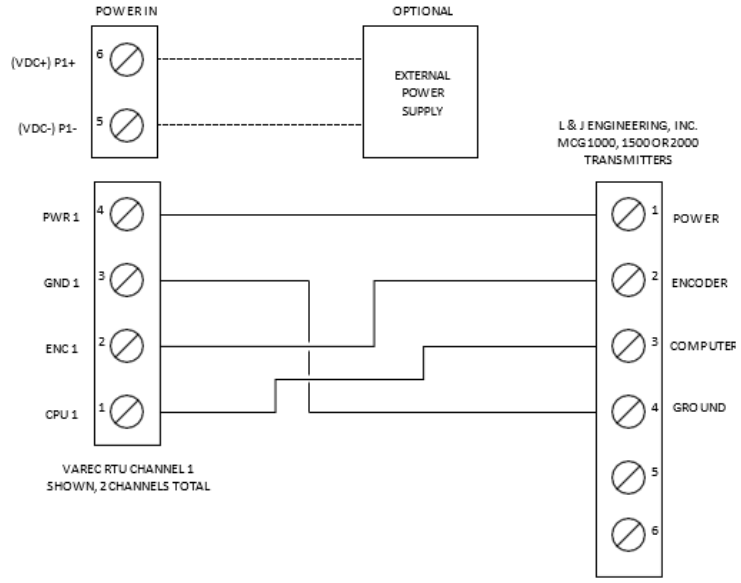


Figure 8-3: 9816 Tankway Field Wiring

Configuring the 9816 Tankway

When configuring the 9816 Tankway, make sure to set the protocol to "Tankway."

If you are working with the LJ2000, there are some points to consider when setting up both the Tankway module and the LJ2000 itself.

Turning the LJ 2000 shaft clockwise results in the transmitted tank level increasing, while turning the shaft counterclockwise results in the transmitted level decreasing.

Setting the Reverse Bit in the DataMode parameter is comparable to setting the DevType to 2 in the legacy LJ2000 point, while clearing the Reverse Bit in the DataMode parameter is comparable to setting the DevType to 1 in the legacy LJ2000 point.

For a typical interface with an LJ2000 transmitter connected to a Shand and Jurs level gauge, the Reverse Bit should not be set.

Configuring the 2920 FTT as a Tankway Device

The Varec 2920 Float & Tape Transmitter can interface with the 8816 Tankway module. Things to note:

The Reverse Bit must be set in order for the level to be displayed on the 2920 to match the value transmitted over the Tankway protocol.

If the 2920 FTT is installed on a Varec 2500 level gauge, the encoder type should be set to **Forward**. This is in the 2920 configuration.

If the 2920 FTT is installed on a Shand and Jurs level gauge, the encoder type should be set to **Reverse**.

Configuration Issues

Because the Tankway protocol only works with a distance of 96 feet and the Varec 2920 FTT operates with a range of 120 feet, the 2920 will give an invalid level value if the 2920 is a level over 96 feet away and will give an invalid level in tank's "PntStatus".

9 Veeder-Root Functionality

The 9810 miniRTU works with Veeder Root automatic tank gauges and communicates with Veeder Root communication protocols through one of the serial channels.

Basic Information

Veeder Root uses one of the RS-232 serial channel connectors.

The serial channel is able to communicate with the following Veeder Root automatic tank gauges:

TLS-300 Automatic Tank Gauge
TLS-300i Automatic Tank Gauge
TLS-300C Automatic Tank Gauge
TLS-350R Automatic Tank Gauge
TLS-350PLUS Automatic Tank Gauge
TLS-450PLUS Automatic Tank Gauge
Ronan X76CTM (Continuous Tank Monitoring)

Veeder Root Communication Protocol and Modbus Master Communication Protocol

Adding Veeder Root functionality is done using the "TLS Master" protocol. Part of the specific functionality of the TLS Master protocol are two specific functions: a "# of Stop Bits" option to ComParams and the DetectTime configuration parameter.

A TLS can connect to a maximum of 16 tanks.

Otherwise, the Veeder Root functions are similar to the Modbus Master protocol. See the 9810 miniRTU Service Manual for the Modbus Communication Protocol for more information on how Modbus Master communication works.

Veeder Root Protocol and Alarm Settings

The Veeder Root protocol enables the 9810 to understand and connect with the TLS-3XX automatic tank gauge through a point designed to communicate specifically with the gauge called "TLS."

Veeder Root has a specific function code (Function Code 101) to keep track of three types of alarms: Major, Minor, and System using a set of numbers in the AANNTT format (Alarm, Alarm Type Number, and Tank/Sensor Number. Below is a list of the types of alarms Function Code 101 keeps track of:

AA - Alarm/Warning Category

00 = All Functions Normal
02 = Tank Alarm
14 = Auto-Dial Fax Alarm

NN - Alarm Type Number

If AA is 02 and the NN is:

03 = Tank High Water Alarm
04 = Tank Overfill Alarm
05 = Tank Low Product Alarm
08 = Tank Invalid Fuel Level Alarm
09 = Tank Probe Out Alarm
11 = Tank Deliver Needed Warning
12 = Tank Maximum Product Alarm
13 = Tank Gross Leak Test Fail Alarm
14 = Tank Periodic Leak Test Fail Alarm
15 = Tank Annual Leak Test Fail Alarm
27 = Tank Cold Temperature Warning

If AA is 15 and NN is:

02 = Autodial Failed Alarm

Tanks and sensors are numbered from 00 to 16 which the 9810 miniRTU calls the TT number. The following is a list of the TLS parameters and what they each mean:

Parameter	Definition
Label	A 32-character ASCIII string used to assign a human readable name to the TLS
Channel	32-bit unsigned integer used to assign the TLS to a specific "TLS Master" channel. **Note** Each channel supports no more than one TLS device. This is a limitation of the Veeder Root protocol itself as defined in the Veeder Root protocol manual.
AlarmTestCmd	Simulates TLS alarms and warnings. Uses the 6-character ASCII format AANNTT as defined in the Veeder Root protocol manual for Function Code 101 (System Status Report) where: • AA = Alarm/Warning Category • NN = Alarm Type Number • TT = Tank/Sensor Number This pattern can be repeated to simulate multiple alarms.

Parameter	Definition
MajorAlarms	A bitmap field with bits set for each device (00 to 16) that has a Major Alarm active.
MinorAlarms	A bitmap field with bits set for each device (00 to 16) that has a Minor Alarm active.
SystemAlarms	A bitmap field with bits set for each device (00 to 16) that has a System Alarm active.
AlarmCode00 to AlarmCode16	For each Veeder Root device (00 to 16), this is an ASCII string containing each AANN number for all active alarms for that device.
AlarmText00 to AlarmText16	For each Veeder Root device (00 to 16), this is a text string of the highest active alarm for that device.
ScanStatus	Status of scanning the tank as well as why the tank isn't being scanned • 1 = Scanning • 2 = Invalid Module • 3 = Invalid Channel • 4 = Disabled Channel • 5 = Invalid DeviceType • 6 = Invalid ScanCmd • 7 = Invalid AuxID • 8 = Invalid Controller • 9 = Invalid Interface Module • 10 = Invalid Protocol • 11 = RegMap Source
Elapse	Time of the last update.
PntStatus	Bitmap field indicating status of the point: • 0x0000 0004 = Not Scanning • 0x0000 0001 = Device Timeout

Veeder Root Tank Device Types

The Veeder Root functionality works through the "TLSx" and "Ronan" DeviceTypes.

The TLS DeviceTypes are the TLS3xx and the TLS4xx devices. Both devices have the full Veeder Root TLS functionality.

The Ronan DeviceType is the X76CTM device. It supports many of the same functions as the TLS, but not all of them. The Ronan device supports the following functionality:

Level
Temp
WaterLevel
TLSVolume
TLSTCVolume
TLSWaterVolume
TLSUllage
TLSStatusBits
TLSTankAlarms
System Status Report

10 Configuration

This chapter describes the general concept behind configuring the 9810 miniRTU to use, as well as links to the relevant tables to the values.

The relevant tables can be found in the chapters after this chapter.

9810 miniRTU Configuration Concepts

Configuration Order

The general order of configuring an 9810 miniRTU is as follows:

1. Go to the CPU and configure network information such as IpAddress.
2. Configure channels and communication protocols to communicate with the gauges they will interface with.
3. Assign tanks to channels and configure the tanks.

Configuring the CPU

Connecting to the CPU

1. Connect to the CPU with the **IP Address** of the 9810 miniRTU.
2. Log in depending upon the security settings established. The default username is **admin** and the password is **9810rtu**.

Configuring a Channel

1. Go to the **Chassis** section of the 9810's settings.
2. Select the **channel** you want to configure.
3. Configure the correct **Protocol**.
4. Click **Config** and configure the following:
5. Enter the **Label** (an optional setting) for the channel.

6. Set **ChanState** to **Enable Chan**.

Configuring a Tank

1. Select a tank you want to configure.
2. Enter the **Label** (an optional setting) for the tank.
3. Set the **Channel** to what channel the tank is connected to.
4. Set the **DeviceID**.
5. If not using a CIU, FCU, or DAU, then **AuxID** can stay as the default setting of 255.
6. Set **DeviceType** to what type of device the tank is communicating through to the 9810 miniRTU.
7. Configure any other settings as is needed.

Verification of Proper Channel and Tank Setup

To make sure a channel is properly configured as well as whether a tank is connected and reading, check the values for Position, Level, or Temp to verify values are displaying for the current status of the material stored in the tank. If the values are 0, walk back through the above settings to make sure the configuration of the channel and tank are correct.

11 Hardware Devices and Communications Protocols

The 9810 miniRTU allows users to work with a number of hardware devices (Varec hardware and other devices) to work with tanks and other storage devices. The following data protocols are currently supported by the 9810 miniRTU:

Virtual Channel
RTU Slave
Enraf Master
Modbus Master
Modbus Slave
Ethernet
Mark/Space
L&J Tankway
TLS Master
HLS Master
Engauge
Debug Channel

The following tables display the hardware the 9810 miniRTU supports and the protocols available to each piece of supported hardware and the four protocols that support the hardware the 9810 works with.

USB to Ethernet

The 9810 miniRTU allows users to connect a USB-to-Ethernet adapter to allow for a second Ethernet connection. The 9810 currently supports four types of USB-to-Ethernet dongles:

TRENDnet TU ET100C
Belkin 55D5050
TRENDnet TU2 ET100
D-Link DUBE100B

The connected dongle is automatically assigned an IP address of 169.254.0.1. This will allow a laptop or similar mobile device to connect and configure the RTU while it is on the network via the Ethernet port.

Hardware Devices and Supported Communication Protocols

Hardware Device	Communications protocols
EN811	Enraf GPU Master
EN854	Enraf GPU Master
EN873	Enraf GPU Master
EN954	Engauge Enraf GPU Master
EN990	Engauge Enraf GPU Master
FTT 29XX	Enraf GPU Master Mark/Space Modbus Master
ATT 4000	Modbus Master Mark/Space
MTS (MTS Sensors/ Temposonics)	Modbus Master
NMR8X	Modbus Master
NMS5X	Modbus Master
NRF590	Modbus Master
NMS8X	Modbus Master
NRF81	Modbus Master
RAPTOR	Modbus Master
REX	Modbus Master
RTG	Modbus Master
GSI 2000	Ethernet Mark/Space Modbus Master
Varec 1800	Mark/Space
Varec 1900	Mark/Space
Varec 6500	Mark/Space
LJ1000	Tankway
LJ1500	Tankway
LJ2000	Tankway
TLS	TLS Master
TLS3xx	TLS Master
TLS4xx	TLS Master
X76CTM	TLS Master
Optilevel	HLS Master

Communication Protocols and Supported Hardware Devices

Communication Protocols	Supported Hardware Devices
Engauge	EN954 EN990
Enraf GPU Master	EN811 EN854 EN873 EN954 EN990 FTT 29XX
Ethernet	GSI 2000
Modbus Master	ATT 4000 FTT 29XX GSI 2000 MTS (MTS Sensors/ Temposonics) NMS5X NMS8X NRF590 NRF81 NMR8X RAPTOR REX RTG
Mark/Space	ATT 4000 FTT 29XX GSI 2000 Varec 1800 Varec 1900 Varec 6500
Tankway	LJ1000 LJ1500 LJ2000
TLS Master	TLS3xx TLS4xx X76CTM
HLS Master	Optilevel

CPU Configuration Parameters

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
IpAddress		The miniRTU's IP address
SubnetMask		The miniRTU's subnet mask
Gateway		The miniRTU's default gateway setting
UnitAddress		The miniRTU's unit address
AdminName		The administration username
AdminPassword		The password for the administration login
User1Name		The user name of User 1
User1Password		The password for User 1
TempUnits	1	The temperature units for the miniRTU to display measurements • 1 = Fahrenheit • 2 = Celsius
DBFile	RTUdb	The name of the miniRTU's database
DBDirectory	9810 miniRTU	The miniRTU's database directory name
NumberOfTanks	16	The number of tanks (1-32).
NumberOfRegMap	32	The number of register maps (1-128)
NumberOfMfpreg	32	The number of Modbus floating point registers (1-64)
NumberOfMireg	32	The number of Modbus integer registers (1-64)
NumberOfGwblk	32	The number of gateway blocks (1-72)
ViewRTUPoints	0x0FF	Bits that determine which point types are reported by the RTU Slave protocol. SYS, CLK, and CPUM point types are always reported. • 0x0001 = INTFM (1) • 0x0002 = PORT (6) • 0x0004 = MFPREG (NumberOfMfpreg) • 0x0008 = MIREG (NumberOfMireg) • 0x0010 = GWBLK (NumberOfGwblk) • 0x0020 = TLS (1) • 0x0040 = TANKA (NumberOfTanks) • 0x0080 = REGMAP (NumberOfRegMap)
AmbientTempSrc	1	The ambient temperature source for tank calculations • 1 = Fahrenheit • 2 = Celsius
ManAmbientTemp	75.5	The manual ambient temperature in either Celsius or Fahrenheit

Configuration		
Name	**Default**	**Definition**
AmbTempConvert	FtoF	The conversion for AmbientTemp (For example, "FtoC" for Fahrenheit to Celsius) • 1 = Fahrenheit • 2 = Celsius
AmbTempDB	1.0	The ambient temperature deadband
SecurityMode	1	The security policy. The CPU must be reset for this change to take effect. • 1 = None
SecurityPolicy	1	The security mode. The CPU must be reset for this change to take effect. • 1 = None
UserIdentity	1	The user identity for login. The CPU must be reset for this change to take effect. • 1 = Anonymous • 2 = UserName
Watchdog	1	Used to enable the hardware watchdog (which resets the CPU when tripped. The CPU must be reset for this change to take effect. • 1 = Disable • 2 = CPU Watchdog

Dynamic/Command	
Name	**Description**
ModCmd	The module command: • 1 = Reset Module • 2 = Copy Firmware to RTU • 3 = Copy Database to RTU • 4 = Copy Database to USB • 5 = Database Factory Reset • 6 = Limited Database Factory Reset • 7 = Copy Debug Log to USB • 8 = Backup from RTU to USB • 9 = Restore from USB to RTU • 10 = List Files • 11 = Delete File (Filename)
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout • 7 = Remove USB • 8 = Database In Use

Dynamic/Command	
Name	**Description**
ModInstalled	The module installed in the slot: • 1 = Unknown module • 2 = CPU Module
SysVer	The system version for legacy
FwVer	The firmware version
SysCheckSum	The firmware checksum
HwDate	The module's manufacture date
HwSerialNo	The module's serial number
HwVer	The printed circuit board's hardware version
NumResets	The number of resets
ErrorCode	The error detected by the firmware
CpuTemp	The temperature of the CPU in Celsius or Fahrenheit
InputVolt	The input voltage in volts
ExternalUSB	The status of the external USB flash drive along with the status of any ModCmd commands that use the external USB flash drive. • 1 = Removed • 2 = Inserted • 3 = Detected • 4 = Executing • 5 = Failure • 6 = Complete • 7 = Remove USB
ResetTime	The time of the last miniRTU reset
AmbientTemp	The ambient temperature as set as Celsius or Fahreneheit
MacAddress	The MAC address
DBInUse	The number of database writes in progress
NvmInUse	Non-Volatile Memory write in progress
FileName	Name of file to be deleted by ModCmd
WatchdogTimer	Number of milliseconds since the watchdog timer was last serviced
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module Type • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed

CPU — Remote File Transfer

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point

Dynamic/Command	
Name	**Description**
FileCmd	Current command concerning the files. • 1 = Reset File • 2 = List Files • 3 = Delete File (FileName)
CmdStatus	The status of the last command • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
FileName	File name with a maximum of 80 characters • miniRTU.mot = firmware (write only) • RTUdb = RTU database • DebugLog.txt = Debug Log • <StrapFile> = Tank Calculations Strap File • <ItemCmdFile> = Tank Enraf item command file • <NNN> <Label>.cfg = Tank NNN Enraf configuration file • <NNN> <Label>.log = Tank NNN Enraf log file
FileState	State of the file • 1 = File Is Open For Reading • 2 = File Is Open For Writing • 3 = File Is Closed
FileStatus	Status of the file • 1 = No File Error • 2 = Invalid FileName • 3 = File Not Found • 4 = Invalid Argument • 5 = Invalid State • 6 = File Is Write Only • 7 = Private Key Filename Mismatch • 8 = Memory Device Error • 9 = Invalid OPC UA Node ID • 10 = NVM In Use

Dynamic/Command	
Name	**Description**
PntStatus	Point status • 0x0000 0100 = NVM in Use • 0x0000 0080 = Invalid OPC UA Node ID • 0x0000 0040 = Memory Device Error • 0x0000 0010= File Is Write Only • 0x0000 0008 = Invalid State • 0x0000 0004 = Invalid Argument • 0x0000 0002 = File Not Found • 0x0000 0001 = Invalid File Name

CPU — Configuration for Ethernet Port

Protocol		
Name	**Default**	**Definition**
Protocol		Protocol & Devices Supported. Other options are available but the Ethernet channel should always be configured as follows: • 6 = Ethernet (GSI 2000)

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode		Bitmap operational mode of the channel • 0x0001 = Byte Swap (Modbus TCP server) • 0x0002 = Word Swap (Modbus TCP Server) • 0x0003 = Swap Both (Modbus TCP Server) • 0x0004 = Preload CRC with 0 (Modbus TCP Server) • 0x0008 = Modbus Over TCP (Modbus TCP Server) • 0x0010 = Disable Modbus TCP Server Stats • 0x0020 = Disable Modbus TCL Client Stats • 0x0040 = Disable OPC UA Server Stats
Timeout	10000	Modbus TCP Client timeout in milliseconds
RespDelay	50	Modbus TCP Server response delay in milliseconds
ScanDelay	500	Modbus TCP Client scan delay (in milliseconds)
ModbusID	1	Modbus TCP Server device address

Configuration		
Name	**Default**	**Definition**
ModbusMap	Default Map	32-character (max) case-sensitive ASCII string used to associate gateway blocks with this channel

Dynamic/Command	
Name	**Description**
ChanCmd	Channel command • 1 = Reset Channel
CmdStatus	Status of the last command • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	Communication bus for the slot • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
ComStatus	Communication status of the module • 1 = Offline • 2 = Online
CurLabel	The configured Label of the device (MFPREG, MIREG, or TANK) currently being scanned by the Modbus TCP client
CurMessage	The message (displayed as hex bytes) currently being received by the Modbus TCP Server
NumRequests	Total number of channel requests
NumTrans	Total number of successful channel transactions
NumComErrors	Number of channel requests with errors
NumTimeouts	Number of channel requests (Modbus TCP client only) that have timed out
NumScanList	Total number of devices being scanned by the Modbus TCP Client
NumClientList	Total number of Modbus TCP clients connected to the Modbus TCP Server

Dynamic/Command	
Name	**Description**
DeviceList	List of devices the Modbus TCP Client is scanning (limited to 32 characters). The following abbreviations are use: • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
GwblkList	List of gateway blocks (limited to 32 characters) associated with the Modbus TCP Server
Elapse	Time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 8000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexConnAddr (Engauge Only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Hardware Module Configuration

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point

Dynamic/Command	
Name	**Description**
ModCmd	The module command: • 1 = Reset Module

Dynamic/Command	
Name	**Description**
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ModInstalled	The module installed in the slot: • 1 = Unknown • 2= Bi-Phase Mark • 3 = Serial Module • 4 = Mark/Space • 5 = Tankway • 6 = Frequency Shift Keying
HwVer	The printed circuit board's hardware version
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module Type • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed

12 Channel Variables

The 9810 miniRTU supports several data protocols to keep track of the tanks and other storage devices. The following protocols are currently supported:

Virtual Channel
RTU Slave
Enraf Master (EN811, EN854, EN873, EN954, EN990, FTT 29xx)
Modbus Master (MFPREG, MIREG, ATT 4000, FTT 29xx, GSI 2000, NMS5x, NRF590, NRF81, NMR8x, MTS)
Modbus Slave (GWBLK)
Ethernet (OPC UA, MFPREG, MIREG)
Mark/Space (ATT 4000, FTT 29xx, GSI 2000, Varec 1800, Varec 1900, Varec 6500)
L&J Tankway (LJ1000, LJ1500, LJ2000)
TLS Master (TLS, TLS3xx, TLS4xx, X76CTM)
HLS Master (Optilevel)
Engauge
Debug Channel

The following tables display the protocols available to channels and the Configuration as well as the Dynamic information displayed on each channel.

Virtual Channel Variables

Name	Default	Definition
Protocol		The type of protocol the 9810 will use to communicate: • 1 = Virtual Channel • 2 = RTU Slave • 3 = Enraf Master (EN811, EN854, EN873, EN990, FTT 29xx) • 4 = Modbus Master (MFPREG, MIREG, ATT 4000, FTT 29xx, GSI 2000, NMS5x, NRF590, NRF81, NMR8x, MTS, RAPTOR, REX, RTG, RTG/DAU) • 5 = Modbus Slave (GWBLK) • 6 = Ethernet (OPC UA, MFPREG, MIREG, GSI 2000) • 7 = Mark/Space (ATT 4000, FTT 29xx, GSI 2000, • Varec 1800, Varec 1900, Varec 6500) • 8 = L&J Tankway (LJ1000, LJ1500, LJ2000) • 9 = TLS Master (TLS, TLS3xx, TLS4xx, X76CTM) • 10 = HLS Master (Optilevel) • 11 = Engauge • 12 = Debug Channel

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 characters max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway • 8 = FSK
Elapse	The time of the last transaction

PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

RTU Slave Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode		The operational mode state
BaudRate	19200	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits • O = Odd • E = Even • N = None
Timeout	2000	Activity timeout (msec)
RespDelay	50	The response delay (in milliseconds)

InitDelay	60	The initialization delay from 0 to 300 seconds. Used to delay the start of a channel to allow time for tank data to stabilize.

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
ComStatus	The communication status of the module (online or offline)
NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the channel successfully processed
NumComErrors	The total number of requests with errors
Elapse	The time of the last transaction

PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Enraf Master Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
BaudRate	2400	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2
Timeout	2000	The communication timeout (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries

TempInterleave	10	The temperature interleave factor; for protocols that use this parameter, this is the number of level readings between each temperature reading
HoldOff	10	The gauge down HoldOff count
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
CurDeviceID	The address of the current device
CurCommand	The current command for the module
CurLabel	The current point descriptor
NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the channel successfully processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan

DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The last time the channel scanned a device
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Modbus Master Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 =Enable Channel

Mode	0	The operational mode state
BaudRate	19200	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2
Timeout	2000	The communication timeout (in milliseconds)
DetectTime	20	The Modbus detect time (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries (Client only)
TempInterleave	10	The temperature interleave factor; for protocols that use this parameter, this is the number of level readings between each temperature reading
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout

Dynamic/Command	
Name	**Description**

ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
CurDeviceID	The address of the current device
CurCommand	The current command
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The total number of requests in the channel
NumTrans	The total number of successful transactions the channel processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan
DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The time of the last transaction

Dynamic/Command	
Name	**Description**

PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Modbus Slave Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode	0	The operational mode state
BaudRate	19200	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2
Timeout	2000	Activity timeout (msec)
RespDelay	50	The response delay (in milliseconds)
DetectTime	20	The Modbus detect time (in milliseconds)

ModbusID	1	The device address to respond to (Server only)
ModbusMap	Default Map	ModbusMap is a 32-character (max) ASCII string and is case-sensitive. ModbusMap is used to associate a Gateway Block with one or more Modbus Slave channels, or with the Modbus TCP port on the Ethernet channel (i.e., CPU Module Channel 2). Each of these channels has its own ModbusMap parameter, which can be set to different values. When a Modbus message is received on one of these Modbus channels, the 9810 miniRTU searches for Gateway Blocks with identical ModbusMap values and uses matching Gateway Blocks to respond to that Modbus message. This allows the 9810 miniRTU to support multiple Modbus Maps simultaneously. For example, depending on the configuration of the Gateway Blocks, one Modbus Slave channel might interpret Modbus register 100 as a “Level”, while a different Modbus Slave channel might interpret that same register as “Temp”.

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
CmdStatus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway • 8 = FSK

ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
ComStatus	The communication status of the module
CurMessage	The current message
NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the module successfully processed
NumComErrors	The total number of requests with errors
GwblkList	The Modbus Gateway Blocks list
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Ethernet Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel (affects Modbus TCP only) • 1 = Disable Channel • 2 = Enable Channel
Mode	0	The operational mode state
Timeout	2000	The communication timeout (in milliseconds)
RespDelay	50	The response delay (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
Maxtime	600	Max time between updates
MaxRetry	2	The number of retries (Client only)
ModbusID	1	The device address to respond to (Server only)
ModbusMap	Default Map	ModbusMap is a 32-character (max) ASCII string and is case-sensitive. ModbusMap is used to associate a Gateway Block with one or more Modbus Slave channels, or with the Modbus TCP port on the Ethernet channel (i.e., CPU Module Channel 2). Each of these channels has its own ModbusMap parameter, which can be set to different values. When a Modbus message is received on one of these Modbus channels, the 9810 miniRTU searches for Gateway Blocks with identical ModbusMap values and uses matching Gateway Blocks to respond to that Modbus message. This allows the 9810 miniRTU to support multiple Modbus Maps simultaneously. For example, depending on the configuration of the Gateway Blocks, one Modbus Slave channel might interpret Modbus register 100 as a “Level”, while a different Modbus Slave channel might interpret that same register as “Temp”.

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
ComStatus	The communication status of the module
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the channel successfully processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request timeouts
NumScanList	The number of points in a scan list
NumClientList	The number of Modbus TCP clients
DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
GwblkList	The ASCII string containing a list of gateway blocks assigned to this channel

Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Mark/Space Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Timeout	2000	The communication timeout (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries (Client only)
HoldOff	10	The gauge down HoldOff count
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
CurDeviceID	The address of the current device
CurLabel	The current point descriptor
NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the channel successfully processed
NumComErrors	The total of requests with errors
NumTimeouts	The total of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan
DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS

AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Tankway Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel
Timeout	2000	The communication timeout (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries (Client only)
HoldOff	10	The gauge down HoldOff count

FastScanPct	40	The fast scan percent (between 1% to 40%)
LevelFilter	0.5	The value used by LJ1000, LJ1500, and L2000 points for filtering level changes when the level changes to filter inaccurate readings coming from the Tankway devices
TempFilter	10	The value used by LJ1000, LJ1500, and L2000 points for filtering temperature changes when the level changes to filter inaccurate readings coming from the Tankway devices.
FilterCnt	5	The number of bad values of LevelFilter and TempFilter that are ignored until the number of good values are received to

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway • 8 = FSK
CurDeviceID	The address of the current device
CurCommand	The current command
CurLabel	The current point descriptor
CurMessage	The current message

NumRequests	The total number of requests in the channel
NumTrans	The total number of transactions the channel successfully processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan
DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

TLS Master Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode	0	The operational mode state
BaudRate	19200	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2
Timeout	2000	The communication timeout (in milliseconds)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries (Client only)
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout

ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The total number of requests in the channel
NumTrans	The total number of successful transactions the channel processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan
DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The time of the last transaction

PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

HLS Master Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode	0	The operational mode state
BaudRate	19200	The baud rate
ComParams	8N1	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2
Timeout	2000	The communication timeout (in milliseconds)

ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
MaxRetry	2	The number of retries (Client only)
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout
ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The total number of requests in the channel
NumTrans	The total number of successful transactions the channel processed
NumComErrors	The total number of requests with errors
NumTimeouts	The total number of request that timed out
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan

DeviceList	The devices in the scan list • F = Modbus Floating Point Register • I = Modbus Integer Register • T = Tank • V = Veeder-Root TLS
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

Engauge Channel Variables

Parameter	Value	Notes
Protocol	Engauge	
Label		Any ASCII string can be used.
ChanState	Enable Channel	
Mode	0x0000	Bitmap field used for debugging only, so a value of 0x0000 should be used.

BaudRate	38400	Engauge also supports 1200, 2400, 4800, 9600, and 19200 but use the fastest baud possible to improve performance.
CamParams	8N1	8 data bits, no parity, 1 stop bit

Debug Channel Variables

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ChanState	1	The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode	0	The channel mode
BaudRate	115200	The channel baud rate
ComParams	8N1	Data Bits, parity, and stop bits • Data Bits — 7, 8 • Parity — O (Odd), E (Even), N (None) • Stop Bits — 1, 2

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Failure • 4 = Executing • 5 = Invalid • 6 = Timeout

ComBus	The communication bus for the slot: • 1 = Bi-Phase Mark • 2 = RS-232 • 3 = RS-485 • 4 = USB • 5 = Ethernet • 6 = Mark/Space • 7 = Tankway
Elapse	The last time the channel was scanned
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0100 0000 = Module Not Installed • 0x0000 4000 = Duplicate Channel (Engauge and Debug only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0040 = Protocol Mismatch • 0x0000 0020 = Disabled • 0x0000 0010 = Transmit Error • 0x0000 0008 = USB Controller Error • 0x0000 0004 = HW Communication Error • 0x0000 0002 = Initialization Failure • 0x0000 0001 = Communication Timeout

13 Tank Configuration

Purpose

The Tank Configuration and Command Parameters allow the miniRTU to communicate with the tank using the assigned channel.

Tank Configuration Parameters

In the below listed table of tank Configuration parameters, each parameter is grouped by similar functionality and defined to explain the concept behind it and how it fits together in the 9810 miniRTU/FuelsManager ecosystem.

Name	Default	Definition
Tank Name		
Label	Tank xxx	The point description or label for the tank.
Channel	0	Channel address (1-6)
DeviceID	0	Device ID
AuxID	255	CIU Address (0-9 or 255) FCU Tank ID (1-32 or 255) DAU ID (1-247 or 255)

Name	Default	Definition
DeviceType	0	Device type depends upon the protocol of the associated channel. Options include: 1 = Enraf 811 2 = Enraf 854 3 = Enraf 873 4 = Enraf 990 5 = ATT 4000 6= FTT 29xx 7 = GSI 2000 8 = Varec 1800 9 = Varec 1900 10 = Varec 6500 11 = NMS5x 12 = NMS8x 13 = NRF590 14 = NRF81 15 = NMR8x 16 = LJ1000 17 = LJ1500 18 = LJ2000 19 = MTS 20 = TLS3xx 21 = TLS4xx 22 = X76CTM 23 = OptiLevel 24 = RAPTOR 25 = REX 26 = RTG 27 = RTG/DAU 28 = Enraf 954
Advanced Gauging		
TankVisible	No	Used by some external tools to determine if the tank is visible to the tool: 1 = No 2 = Yes
TOI	B	Type of instrument For the EN811, EN854, EN954, EN990, FTT 29XX
Mode	Run Mode	Mode of operation: 1 = Run Mode 2 = Test Mode

Name	Default	Definition
DataMode	0	Data mode: 0x0001 = Byte Swap 0x0002 = Word Swap 0x0003 = Swap Both 0x0004 = Reverse (LJ2000) 0x0004 = Read All Temps (RAPTOR, REX, RTG/DAU) 0x0008 = Old Firmware (LJ1000, LJ1500) 0x0008 = 16-bit Level (RAPTOR, REX, RTG, RTG/DAU) 0x0008 = Modbus Over TCP (GSI 2000) 0x0010 = 2160 FCU (RAPTOR, REX, RTG, RTG/DAU) 0x0040 = Ignore Invalid Temp (Mark/Space only)
ScanCmd	BC	Scan commands for the instrument For the EN811, EN854, EN873, EN954, EN990, FTT 29xx, OptiLevel Enraf: A (Alarm Request Record), B (Level Request Record), C (Temperature Request Record), D (Combined Level and Temperature Request Record), E (Stored Level Request Record), F (Stored Combined Data Request Record), G, J, L (High Resolution Level Request Record), M (Water Request Record) OptiLevel: A=Level, B=Volume, C=Ullage
PerInterleave	0	Periodic interleave factor For the EN811, EN854, EN954, EN990, FTT 29XX
PerItemCmd	(null)	Periodic item command For the EN811, EN854, EN954, EN990, FTT 29XX
PerFilter		Periodic reply data filter For the EN811, EN854, EN954, EN990, FTT 29XX
MSSpeed	High	Mark/Space speed: 1 = High 2 = Low
ScanMode	Normal Scan	Scan mode: 1 = Normal Scan 2 = Auto Scan
FastScanDelta	0.00	Fast scan delta
FastScanTime	60	Fast scan time in minutes
LvlStatFilter		Level status filter C, B, L, R, T, W, D
LvlStatTimer		Level status timer in seconds
FlexConnAddr		FlexConn address (0-1899)
IPAddress		IP Address For the GSI 2000
Tank Calculations		
StandardsOrg	API	Standards organization: 1 = API (American Petroleum Institute)
StandardsRev	Commodity 2004	Standards revision: 1 = Commodity 2004 (API standard)

Name	Default	Definition
CommodityType		Commodity type: • 1 = Alpha 60 • 2 = Crude oil • 3 = Refined products • 4 = Lubricating oil
Alpha60	0.00	Alpha 60 coefficient. Range is 0.00023 to 0.00096 for Fahrenheit and 0.000414 to 0.001674 for Celsius
StdTemp	15	Standard temperature. Only used if Temp is in Celsius. Set to either 15C or 20C, although any floating point value is allowed. If Temp is in Fahrenheit, then 60C is used regardless of the StdTemp value.
StrapFile	(null)	Strap file table (a.k.a., tank strapping chart). ASCII name of the Strap File (up to 32 characters).
LevelConvert	FtoF	INtoOUT: e.g., FtoM • C = Centimeters • F = Feet • I = Inches • M = Meters • m = millimeters • P = Feet-Inches-Sixteenths (or Ft-In-16th) • S = Sixteenths • T = Thirtyseconds
TempConvert	FtoF	INtoOUT: e.g. FtoC • C = Celsius • F = Fahrenheit • 1 = Add 100 to Fahrenheit Temp (Mark/Space only)
DensityConvert	AtoA	INtoOUT: e.g., AtoK • A = API • G = GMML • K = KG/M3 • L = LB/F3
WeightConvert	LtoL	INtoOUT: e.g., LtoK • K = Kilograms • L = Pounds • M = Metric Tons • T = Tons
VolumeConvert	GtoG	INtoOUT: e.g., GtoL • B = Barrels • G = Gallons • L = Liters • M = Cubic Meters

Name	Default	Definition
PressConvert	PtoP	INtoOUT: e.g., PtoM C = KG/CM2 I = inH2O K = Kilopascals M = Megapascals m = Millibars P = PSI S = Pascals
FlowConvert	G/mtoG/m	INtoOut: e.g. G/mtoG/h B = Barrels G = Gallons L = Liters M = Cubic Meters s = second m = minute h = hour
SWPct	0	Sediment & water %
LevelDeadband	0.1	Affects the Change of State processing of the level deadband. It allows the user to filter out insignificant changes, freeing the communication link to send other data.
TempDeadband	0.25	Affects the Change of State processing of the temperature deadband. It allows the user to filter out insignificant changes, freeing the communication link to send other data.
LevelOffset	0.00	Numeric offset applied to level
TempOffset	0.00	Numeric offset applied to temperature
FlowSamples		Number of StrapVol samples used to calculate flow rate Value ranges from 2-16 Default = 8
FlowInterval		Minimum time interval in seconds between flow rate Default = 0
FlowDeadband		Flow rate deadband Used if FlowDeadband or less away than 0 which forces the flow rate to have a value of 0 Default = 0.0
Tank Properties		
RoofType	Not In Table	Roof Type: • 1 = In Table (floating roof) • 2 = Not In Table (floating roof) • 3 = Fixed Roof • 4 = No Roof Note: Similar to FuelsManager, this combines the concepts of "Roof Type" and "Weight in Strapping Table" into one parameter.

Name	Default	Definition
TankGeometry	Vert Cylinder	Tank Geometry: • 1 = Vertical Cylinder • 2 = Horizontal Rounded • 3 = Horizontal Flat
ShellCorrect	No Correction	Tank Shell Correction: • 1 = No Correction • 2 = Uninsulated Tank • 3 = Insulated Tank
TankMaterial		Tank Shell Material. Only used if ShellCorrect is "Uninsulated" or "Insulated": • 1 = Mild Steel • 2 = Stainless Steel • 3 = Aluminum • 4 = Other Material
ExpCoef	0	Tank shell expansion coefficient. Only used if ShellCorrect is "Uninsulated" or "Insulated." User configurable if TankMaterial is "Other Material" or unspecified. Otherwise, this field is automatically filed out.
MinOpLevel	4.0	Minimum operating level
MaxOpLevel	36.0	Maximum operating level
Calculation Source		
LevelSrc	Level	Product level source: • 1 = Level 2 = ManLevel
ManLevel	0	Manual level value
TempSrc	Temp	Product temperature source: • 1 = Temp • 2 = ManTemp
ManTemp	0	Manual temperature value
SolidsLevelSrc	ManSolidsLevel	Solids level source: • 1 = SolidsLevel • 2 = ManSolidsLevel
ManSolidsLevel	0	Manual solids level value. SolidsVol is forced to 0 if ManSolidsLevel is a negative number.
WaterLevelSrc	ManWaterLevel	Water level source: • 1 = WaterLevel • 2 = ManWaterLevel
ManWaterLevel	-1	Manual water level. WaterVol is forced to 0 if ManWaterLevel is a negative number
DensityMethod	No Method	Density method: • 1 = No Method • 2 = Gauged • 3 = Manual Standard

Name	Default	Definition
StdDensity	0	Standard density. If DensityMethod is "Manual Standard," then this is manually configured by the user If "Gauged," then StdDensity is calculated when the value of GaugedDensity or DensityTemp change Whether "Manual Standard" or "Gauged," the value of StdDensity is saved in non-volatile memory
Analog		
AIlMinValue	4.0	Minimum nominal mAmp input value as a 16-bit integer
AIlMaxValue	20.0	Maximum nominal mAmp input value as a 16-bit integer
Al1LowRange	0	Nominal low setting for the 32-bit floating point value reported in Analog1
Al1HighRange	100	Nominal high setting for the 32-bit floating point value reported in Analog1
Al2LowRange	0	Nominal low setting for the 32-bit floating point value reported in Analog2
Al2HighRange	100	Nominal high setting for the 32-bit floating point value reported in Analog1
Al3LowRange	0	Nominal low setting for the 32-bit floating point value reported in Analog3
Al3HighRange	100	Nominal high setting for the 32-bit floating point value reported in Analog1

Tank Command Parameters

In the below listed table of tank Command parameters, each parameter is grouped by similar functionality and defined to explain the concept behind it and how it fits together in the 9810 miniRTU ecosystem.

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
Tank Name		

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
GaugeStatus	0 (undefined)	The value that indicates the status of the gauge The values are: 1 = Block 2 = Bottom 3 = Doing Profile 4 = Failure 5 = Finding Water 6 = Following Level 7 = Following Water 8 = Invalid 9 = Lock Test 10 = Service Mode 11 = Transitional 12 = UnderRange 13 = Valid 14 = NMS Status
Position	0	Displacer Position
Level	0	Sourced product level in either millimeters ("m") or inches ("i") LevelConvert should be configured accordingly
Temp	0	Sourced product temperature in either Fahrenheit ("F") or Celsius ("C") TempConvert should be configured accordingly
SolidsLevel	0	Sourced solids level (a.k.a., sediment level) The solids level can be manually configured (see SolidsLevelSrc) or based on SolidsLevel, with SolidsLevel being the same as the bottom level Note that only some Enraf and E+H devices support bottom level
WaterLevel	0	Sourced water level Note that only some Enraf and E+H devices support water level
GaguedDensity	0	Gauged density
DensityTemp	0	Sourced product temperature at the time that GaugedDensity was calculated Note that only some Enraf and E+H devices support gauged density
RTD1	0	Resistance temperature detector (ATT 4000, FTT 29xx)

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
ScanStatus		Scan status 1 = Scanning 2 = Invalid Channel 3 = Disabled Channel 4 = Invalid Device Type 5 = Invalid ScanCmd 6 = Invalid AuxID 7 = Invalid Interface Module 8 = Invalid Protocol 9 = RegMap Source
ScanTime		Time of the last good response
Elapse	(Displays current DateTime of unit)	Time of last update/scan
PntStatus	112	Byte value indicating status of point. The values are: 0x0000 0080 = Stale Level 0x0000 0040 = Invalid Density 0x0000 0020 = Invalid Temperature 0x0000 0010 = Invalid Level 0x0000 0004 = Not Scanning 0x00000002 = AuxID Device Timeout 0x00000001 = Device Timeout
Advanced Gauging		
DeviceCmd		Device commands are available based on the selected device type and protocol: 1 = Reset Gauge 2 = Raise Servo 3 = Freeze Servo 4 = Find Water Level 5 = Follow Level 6 = Run Test 7 = Run Immersed Profile 8 = Find Bottom 9 = Copy ItemCmdFile to RTU 10 = Read Device Config 11 = Write Device Config 12 = Copy .cfg to USB 13 = Copy .log to USB 14 = Calibrate 15 = Set Turn Around Delay

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
CmdStatus		The status of the last command: 1 = Start 2 = Complete 3 = Failure 4 = Executing 5 = Invalid 6 = Timeout
CalLevelCmd	0	Calibration product level command
CalIntfCmd		Calibrate interface level command
AlarmStatus	0x0	Tank alarm status
DeviceStatus	0	Device status 0x4000 0000 = Invalid Density 0x0000 0040 = RegMap Source 0x0000 0008 = Invalid Temp 0x0000 0004 = Invalid Level 0x0000 0002 = Device Timeout 0x0000 0001 = Not Scanning Device status for RTG/DAU devices 0x8000 0000 = Invalid Level (register) 0x4000 0000 = Level Warning 0x2000 0000 = NMI Legal Level 0x1000 0000 = NMI Approved RTG 0x0800 0000 = Presentation Level 0x0100 0000 = LPG Verify Copy 0x0080 0000 = RTG Comm Error 0x0040 0000 = Analog 3 Error 0x0020 0000 = Analog 2 Error 0x0010 0000 = Analog 1 Error 0x0000 0080 = AuxID Device Timeout 0x0000 0040 = RegMap Source 0x0000 0020 = Floating Roof Landed 0x0000 0010 = Calculation Error 0x0000 0008 = Invalid Temp 0x0000 0004 = Invalid Level 0x0000 0002 = Device Timeout 0x0000 0001 = Not Scanning

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
LevelStatus	0	Tank level status Enraf devices report: 0 = Uncertain no communication last usable value F = Level information not valid C = Motor limit switch B = Block of freeze active L = Locktest or calibrate active R = Density scan active ([TP] or [IP]) T = The gauge is searching for level or test gauge, balance test, or measure frequency command is active W = Water level found D = Searching for water (downward) - = Valid level
TempStatus	0	Tank temperature status
WaterStatus	0x0	Water level status
ItemCmd		Item command
TestCmd		Operational test command
CmdReply		Command reply
PerCmdReply		Periodic command reply
PerFPValue1	0	Periodic floating point value #1
PerFPValue2	0	Periodic floating point value #2
PerIValue1	0	Periodic integer value #1
PerIValue2	0	Periodic integer value #2
ItemCmdFile		ItemCmd file name
FastScanCmd	Disable	Fast scan command: 1 = Disable 2 = Enable
FastScanTimer	0	Fast scan timer in minutes
ScanList	Normal Scan	Scan list: 1 = Normal Scan 2 = Fast Scan
Volume	0	Reported volume
Ullage	0	Reported ullage
Offset	0	Reported probe offset
Version	0	Displays the software version
LevelRate		Level rate in units of meters per hour or feet per hour, depending upon whether the unconverted Level is in millimeters or inches
Tank Calculations		

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
CalcCmd		Tank calculation command: • 1 = Copy StrapFile to RTU = copy StrapFile from USB to the RTU (a.k.a., upload the StrapFile) • 2 = Copy StrapFile to USB = copy StrapFile from the RTU to USB (a.k.a., download the StrapFile) • 3 = Run Calculation Note: Typically, calculations are only run when an input changes. The Run Calculation option allows the user to manually force a one-time recalculation.
CalCmdStatus		Calculation command status • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout
CalcCode		Tank calculation status code, with a value of "0" meaning there is no error with the most recent tank calculations.
CalcText	StrapFile Not Configured	ASCII text explanation of CalcCode
StrapTemp	0	Product temperature read from the StrapFile
StrapDensity	0	Product density read from the StrapFile
RoofFloatingHt	0	Roof floating height read from the StrapFile. Used with RoofLandedHt to determine Critical Zone and Landed floating roofs. (The Critical zone is the level between the roof fully floating and fully landed.)
RoofLandedHt	0	Roof landed height read from the StrapFile.
RoofWt	0	Roof weight read from the StrapFile.
Density Calculations		
ObsDensity	0	Observed product density. ObsDensity is calculated from StdDensity and the product temperature.
DensinAir	0	Product density in air. Converted from ObsDensity based on API 12.3, table 5.
StdDensinAir	0	Product standard density in air. Converted from StdDensity based upon API 12.3, table 5.
Volume Calculations		
VolCorFactor (CTPL)	0	Volume correction factor. Calculated from StdDensity and product temperature and pressure.
TempCorFactor (CTL)	0	Correction due to temperature
PressCorFactor (CPL)	0	Correction due to pressure
TankShellTemp (TSh)	0	Tank shell temperature If ShellCorrect is "Insulated," then TankShellTemp is the same as Temp. Otherwise, TankShellTemp is: ((7 x Temp) + AmbientTemp) / 8.

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
TankShellCor (CTSh)	0	Tank shell correction factor. Only used if ShellCorrect is set to "Correction." 1 + (2 x ExpCoef x (TankShellTemp - StrapTemp)) + (ExpCoef^2 x (TankShellTemp *StrapTemp)^2)
FloatRoofCor (FRC)	0	Floating roof correction Only used if RoofType is "Not In Table." RoofWt / (DensInAir x VolCorFactor)
FloatRoofAdj (FRA)	0	Floating roof adjustment Only used if RoofType equals "In Table." (RoofWt / StrapDensity) - (RoofWt / ObsDensity)
StrapVol (TOV)	0	Total observed volume. Strap look up from product level.
SolidsVol	0	Strap lookup for SolidsLevel
WaterVol	0	Strap lookup for WaterLevel, with SolidsVol subtracted.
FreeWaterVol (FW)	0	Free water volume SolidsVol + WaterVol
RoofVol	0	Roof volume If RoofType equals "Not In Table," then RoofVol = FloatRoofCor. If RoofType equals "In Table," then RoofVol = FloatRoofAdj.
GrossObsVol (GOV)	0	Gross observed volume ((StrapVol - FreeWaterVol) x TankShellCor) +/- FloatRoofCor or FloatRoofAdj
GrossStdVol (GSV)	0	Gross standard volume GrossObsVol x VolCorFactor
TotalCalcVol (TCV)	0	Total calculated volume GrossStdVol + FreeWaterVol
NetStdVol (NSV)	0	Net standard volume Note that the x (100 - SW%) / 100" portion of the equation is called "Correction for Solids & Water (CSW)." ((100 - SWPct) / 100) x GrossStdVol
SWVol (S&Wvol)	0	Sediment & water volume GrossStdVol - NetStdVol
TOVFlowRate		Calculated flow rate for Strap Volume (StrapVol or TOV) Calculated in the units of StrapVol per minute The value can be a positive or negative floating point number
MinOpVol		Minimum operating volume. Strap table lookup from MinOpLevel.
MaxOpVol		Maximum operating volume. Strap table lookup from MaxOpLevel.
AvailVol		Available volume. StrapVol - MinOpVol (report as 0 if less than 0)
RemCapVol		Remaining capacity volume. MaxOpVol - StrapVol (report as 0 if less than 0)

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
NetAvailVol		Net Standard Available volume. NetStdVol - ((MinOpVol + RoofVol) * VolCorFactor) (report as 0 if less than 0)
Weight Calculation		
GrossStdWt (GSW)	0	Gross standard weight GrossStdVol x DensInAir
NetStdWt (NSW)	0	Net standard weight NetStdVol x DensInAir
NMS NRF NMR		
NMSDeviceCmd		NMS device command: 1 = Follow Level 2 = Raise Servo 3 = Freeze Servo 4 = Find Bottom 5 = Follow Upper Interface Level 6 = Follow Lower Interface Level 7 = Upper Density 8 = Middle Density 9 = Lower Density 10 = Repeatability 11 = Find Water Level 12 = Release Overtension 13 = Tank Profile Density 14 = Interface Profile Density 15 = Manual Profile Density 16 = Level Standby
NMSCmdStatus		Status of the last NMS command 1 = Start 2 = Complete 3 = Failure 4 = Executing 5 = Invalid 6 = Timeout
NMSStatusCode		Gauge status code
NMSStautsText		Gauge status text
UpperIntLevel		Upper interface level
LowerIntLevel		Lower interface level
BottomLevel		Tank bottom
UpperDensity		Upper density
UpperDensTemp		Upper density temperature
MiddleDensity		Middle density
LowerDensity		Lower density
NxxObsDensity		Nxx observed density
P1		P1 (bottom)

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
P2		P2 (middle)
P3		P3 (top)
VaportTemp		Vapor temperature
AirTemp		Air temperature
LevelPct		Tank level %
MeasLevel		Measured level without corrections
TankUllage		Tank ullage
ActualDiag		Actual diagnostics
Alarm1		Alarm 1
Alarm2		Alarm 2
Alarm3		Alarm 3
Alarm4		Alarm 4
FilteredDist		Filtered distance
SignalQuality		Signal quality
TankProfDens		Tank profile density
TankProfTemp		Tank profile temperature
IFProfDens		Interface profile density
IFProfTemp		Interface profile temperature
Manual ProfDens		Manual profile density
ManualProfTemp		Manual profile temperature
TLS		
TLSVolume		Volume
TLSTCVolume		TC volume
TLSWaterVolume		Water volume
TLSUllage		Ullage
TLSStatusBits		Tank status bits

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
TLSTankAlarms		Tank Alarms as a bitmap: 0x8000 0000 = Fuel Quality Alarm 0x4000 0000 = Density Warning 0x2000 0000 = Delivery Density Warning 0x1000 0000 = Tank/Line Gross Leak Alarm 0x0800 0000 = Tank Missing Delivery Ticket Warning 0x0400 0000 = Tank Cold Temperature Warning 0x0200 0000 = Tank HRM Reconcilliation Alarm 0x0100 0000 = Tank HRM Reconcilliation Warning 0x0080 0000 = Tank Accu Chart Calibration Warning 0x0040 0000 = Tank CSLD Rate Increase Warning 0x0020 0000 = Tank Siphon Break Active Warning 0x0010 0000 = Tank No CSLD Idle Time Warning 0x0008 0000 = Tank Leak Test Active 0x0004 0000 = Tank Annual Test Needed Alarm 0x0002 0000 = Tank Periodic Test Needed Alarm 0x0001 0000 = Tank Annual Test Needed Warning 0x0000 8000 = Tank Periodic Test Needed Warning 0x0000 4000 = Tank Annual Leak Test Fail Alarm 0x0000 2000 = Tank Periodic Leak Test Fail Alarm 0x0000 1000 = Tank Gross Leak Test Fail Alarm 0x0000 0800 = Tank Maximum Product Alarm 0x0000 0400 = Tank Delivery Needed Warning 0x0000 0200 = Tank High Water Warning 0x0000 0100 = Tank Probe Out Alarm 0x0000 0080 = Tank Invalid Fuel Level Alarm 0x0000 0040 = Tank High Product Alarm 0x0000 0020 = Tank Sudden Loss Alarm 0x0000 0010 = Tank Low Product Alarm 0x0000 0008 = Tank Overfill Alarm 0x0000 0004 = Tank High Water Alarm 0x0000 0002 = Tank Leak Alarm 0x0000 0001 = Tank Setup Data Warning
TLSSensorStat		Sensor status value
TLSStartTime		Starting date/time
TLSDuration		Test duration (in hours)
TLSStartTemp		Starting temp
TLSEndTemp		Ending temp
TLSStartVolume		Starting volume
TLSEndRate		Ending rate
TLSTestType1		Test 1 result type
TLSStartTime1		Test 1 start time
TLSManuStatus1		Test 1 manifold status
TLSTestResult1		Test 1 leak test result

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
TLSTestType2		Test 2 result type
TLSStartTime2		Test 2 start time
TLSManiStatus2		Test 2 manifold status
TLSTestResult2		Test 2 leak test result
TLSTestType3		Test 3 result type
TLSStartTime3		Test 3 start time
TLSManiStatus3		Test 3 manifold status
TLSTestResult3		Test 3 leak test result
		Analog
Analog1		Analog Input #1
Analog2		Analog Input #2
Analog3		Analog Input #3
		Temp
Temp1-14		Temperature #1-14
TempInLiquid		Specifies which temperature probes are in the product 0x8000 = Calibration Error 0x4000 = System Error 0x2000 = Temp 14 In Liquid 0x1000 = Temp 13 In Liquid 0x0800 = Temp 12 In Liquid 0x0400 = Temp 11 In Liquid 0x0200 = Temp 10 In Liquid 0x0100 = Temp 9 In Liquid 0x0080 = Temp 8 In Liquid 0x0040 = Temp 7 In Liquid 0x0020 = Temp 6 In Liquid 0x0010 = Temp 5 In Liquid 0x0008 = Temp 4 In Liquid 0x0004 = Temp 3 In Liquid 0x0002 = Temp 2 In Liquid 0x0001 = Temp 1 In Liquid

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
TempBlocked		Temperature blocked status 0x8000 = NMI Approved DAU 0x4000 = Legal NMI Temp 0x2000 = Temp 14 Blocked 0x1000 = Temp 13 Blocked 0x0800 = Temp 12 Blocked 0x0400 = Temp 11 Blocked 0x0200 = Temp 10 Blocked 0x0100 = Temp 9 Blocked 0x0080 = Temp 8 Blocked 0x0040 = Temp 7 Blocked 0x0020 = Temp 6 Blocked 0x0010 = Temp 5 Blocked 0x0008 = Temp 4 Blocked 0x0004 = Temp 3 Blocked 0x0002 = Temp 2 Blocked 0x0001 = Temp 1 Blocked
TempError		Specifies which temperature probes are reporting an error 0x8000 = Temp Average Error 0x4000 = Master, FCU 0x2000 = Temp 14 Error 0x1000 = Temp 13 Error 0x0800 = Temp 12 Error 0x0400 = Temp 11 Error 0x0200 = Temp 10 Error 0x0100 = Temp 9 Error 0x0080 = Temp 8 Error 0x0040 = Temp 7 Error 0x0020 = Temp 6 Error 0x0010 = Temp 5 Error 0x0008 = Temp 4 Error 0x0004 = Temp 3 Error 0x0002 = Temp 2 Error 0x0001 = Temp 1 Error

14 Conversion Parameters

Purpose

The purpose of Conversion Parameters tables are to explain what parameters the 9810 uses for level and temperature calculations as well as explain what each abbreviation means.

Length Parameters

Below are the tank measurement parameters that the 9810 miniRTU uses to measure the height and depth of the tanks and substance being measured.

Abbreviation	Measurement
F	Feet
M	Meters
I	Inches
C	Centimeters
m	Millimeters
S	Sixteenths
T	Thirty Seconds
e	Round to 8th of an inch
s	Round to 16th of an inch

Temperature Parameters

Below are the two parameters the 9810 miniRTU uses to measure the temperature of the tanks and the substance being measured.

Abbreviation	Measurement
F	Fahrenheit
C	Celsius

The Mark/Space module also has the following parameters:

Note XtoY stands for X converted to Y where X is the device's native units and Y is the units for the final conversion.

1toF Transmitter with 100 degrees Fahrenheit offset
2toC Transmitter with 100 degrees Celsius offset

Density Parameters

Below are the parameters the 9810 miniRTU users to calculate the density of the substance being measured.

Abbreviation	Measurement
G	Grams Per Milliliter or g/mL
A	API
K	Kilograms Per Cubic Meter or kg/m^3
L	LBF3

Pressure Parameters

Below are the parameters used to measure and calculate the pressure the substance being measured is under.

Abbreviation	Measurement
I	Inches H20 or inches water
P	PSI
m	Millibar
S	Pascal
K	KPascal
M	MPascal
C	Kilograms Per Square Centimeter or kg/cm^2

Volume Parameters

Below are the parameters used to measure and calculate the volume of the substance being measured.

Abbreviation	Measurement
G	Gallons
L	Liters
M	Cubic Meters, Meters Cubed, or M^3
B	Barrels

Flow Parameters

Below are the parameters used to measure and calculate the amount of the flow of the substance being measured.

Abbreviation	Measurement
G	Gallons Per Minute or gal/min

Abbreviation	Measurement
L	Liters Per Minute or l/min
B	Barrels Per Minute or bar/min
M	Cubic Meters Per Minute, Meters Cubed Per Minute, or M^3/min

Mass Parameters

Below are the parameters used to measure and calculate the mass of the substance being measured.

Abbreviation	Measurement
L	Pounds
K	Kilograms
T	Tons
M	Metric Tons

15 Setting Calculation Methods

Volume Correction Methods

This section describes the correction methods and tank calculations used in the 9810 miniRTU. Since the volume of the product in a tank varies with the temperature and density, you must use a correction method to correct for variations in temperature and density of the product.

Volume Correction Basics

In 2004, American Petroleum Institute (API) updated the standards for volume correction in their Manual of Petroleum Measurement Standards (MPMS) in a chapter known as Chapter 11.1, "Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils."

The 8810 RTU uses the latest calculations from API's 2004 standards. To understand the concepts behind the calculations, here are the following definitions and a graphic to help explain how volume correction values work together to give the volume correction factor (VCF). Once the VCF has been calculated, the value can be used to help calculate volume based upon the temperature of the stored liquid.

Volume Correction Definitions

Observed, Standard/Base, and Alternate

According to the API, there are three concepts behind the values that make up volume correction calculations: Observed values, Standard (or Base) values, and Alternate values. They define the three types of values as the following:

Observed conditions are the temperature and pressure at which the density of a liquid is actually or assumed to have been measured.

Standard or **base** conditions are defined combinations of temperature and pressure at which liquid volumes are expressed for purposes of custody transfer, stock accounting, etc. The terms standard and base are used interchangeably. Accepted standard temperatures are 60°F, 15°C, and 20°C. Accepted standard pressures are zero gauge pressure or the liquid's vapor pressure at the standard temperature.

Alternate conditions are any other temperature and pressure conditions to which the observed or standard density can be corrected.

An example of the terms to help with understanding how it fits together:

*A storage tank contains a liquid that has an average temperature of 122°F. A sample is withdrawn and the **observed** density of the liquid is measured at 85°F. Since the accepted **standard** temperature for liquids is 60°F, the user would like to correct the temperature to 60°F from the current 85°F. While the temperature in the tank in this situation is the 122°F, the temperature is different from what the observed result was (85°F), it cannot be applied to the tank volume. Because of the variation, the 122°F temperature is considered the **alternate** condition.*

The volume correction techniques listed below explain the values associated with the calculations to perform the calculations by hand that the 8810 RTU has built in to calculate for the users.

Volume Correction Techniques

Custody transfers and billing are used based on volumes at a given temperature, or Standard Temperature. The 8810 RTU provides the following temperature correction techniques. All correction techniques are based on internationally recognized standards developed by the American Petroleum Institute (API).

The goal of a correction technique is to calculate a Volume Correction factor (VCF) and to use this factor to calculate standard volumes from measured volumes. The VCF is defined as:

- Correction for temperature for a liquid
- Compensates for the effect of temperatures on a liquid

Corrects a volume at an observed temperature to a standard temperature.

Petroleum Tables

Type	Method	Product	Table Entry	Range	Temp Range
API °F	6A/5A	Generalized Crude Oil	API gravity @ 60°F in API	0-40 40.1-50.0 50.1-100.0	0-300°F 0-250°F 0-200°F
	6B/5B	Generalized Products	API gravity @ 60°F in API	0-40 40.1-50.0 50.1-85.0	0-300°F 0-250°F 0-200°F
	6C	Individual & Special Applications	API gravity @ 60°F in API	0-40 40.1-50.0 50.1-100.0	0-300°F 0-250°F 0-200°F
	6D	Generalized Lubricating Oils	API gravity @ 60°F in API	0-50 50.1-100.0	0-150°F 0-125°F

Type	Method	Product	Table Entry	Range	Temp Range
API °C	54A/53A	Generalized Crude Oil	Density @ 15°C in kg/m^3	610.5-778.5 779-824 824.5-1075	-18-95°C -18-125°C -18-150°C
	54B/53B	Generalized Products	Density @ 15°C in kg/m^3	610.5-778.5 779-824 824.5-1075	-18-90°C -18-125°C -18-150°C
	54C	Individual & Special Applications	Thermal Expansion Coefficient in Alpha x 10^6	489-918 919-945	-18-150°C -18-125°C
	54D	Generalized Lubricating Oils	Density @ 15°C in kg/m^3	800-824 824.1-1164	-18-125°C -18-150°C
	54A/53A 30°C	Generalized Crude Oil	Density @ 30°C in kg/m^3	610.5-778.5 779-824 824.5-1075	-18- 95°C -18-125°C -18-150°C
	54B/53B 30°C	Generalized Products	Density @ 30°C in kg/m^3	653-778.5 779-824 824.5-1075	-18- 95°C -18-125°C -18-150°C
	54C 30°C	Individual & Special Applications	Thermal Expansion Coefficient in Alpha x 10^6	486-918 919-954	-18-150°C -18-125°C
	54D 30°C	Generalized Lubricating Oils	Density @ 30°C in kg/m^3	800-824 824.1-1164	-18-125°C -18-150°C
	60A	Generalized Crude Oil	Density @ 20°C in kg/m^3	610.5-778.5 779-82 824.5-1075	-18- 95°C -18-125°C -18-150°C
	60B	Generalized Products	Density @ 20°C in kg/m^3	653-778.5 779-824 824.1-1075	-18- 90°C -18-125°C -18-150°C
	60D	Generalized Lubricating Oils	Density @ 20°C in kg/m^3	800-824 824.1-1164	-18-125°C -18-150°C

Chemical Tables

Correction Type	Table Entry	Product	VCF Range	Temp Range
ASTM D1555 °F 2004	VCF @ 60°F	300°F/148.9°C Aromatic	0.9741-1.0286	5-110°F
		350°F/176.7°C Aromatic	0.9756-1.0266	5-110°F
		Benzene	0.9597-1.0130	40-120°F
		Cumene	0.9670-1.0297	5-120°F
		Cyclo-hexane	0.9597-1.0132	40-120°F
		Ethyl-benzene	0.9660-1.0306	5-120°F
		Mixed Xylene	0.9671-1.0293	5-120°F
		o-Xylene	0.9683-1.0288	5-120°F
		p-Xylene	0.9496-1.0027	55-150°F
		Styrene	0.9675-1.0242	15-120°F
		Toluene	0.9647-1.0383	-5-120°F
ASTM D1555M °C 2004	VCF @ 15°C	300°F/148.9°C Aromatic	0.9729-1.0278	-15-44°C
		350°F/176.7°C Aromatic	0.9745-1.0262	-15-44°C
		Benzene	0.9583-1.0123	4.5-49.5°C
		Cumene	0.9660-1.0293	-15-49.5°C
		Cyclo-hexane	0.9585-1.0126	4.5-49.5°C
		Ethyl-benzene	0.9646-1.0300	-15-49.5°C
		Mixed Xylene	0.9661-1.0289	-15-49.5°C
		o-Xylene	0.9673-1.0285	-15-49.5°C
		p-Xylene	0.9492-1.0025	12-65.5°C
		Styrene	0.9664-1.0237	-9.5-49.5°C
		Toluene	0.9634-1.0376	-20.5-49.5°C

Correction Type	Product	VCF Range	Temp Range °F	Temp Range °C
ASTM D1555M °F/°C 2009	Benzene	.94591-1.01107	43-140	6.11-60
	Cumene	.95581-1.02973	5.0-140	-15-60
	Cyclo-hexane	.94614-1.01058	44-140	6.67-60
	Ethyl-benzene	.95467-1.03058	5-140	-15-60
	Styrene	.95654-1.02420	15-140	-9.44-60
	Toluene	.95291-1.03827	-5-140	-20.56-60
	Mixed Xylene	.95583-1.02927	5-140	-15-60
	o-Xylene	.95785-1.02882	5-140	15-60
	p-Xylene	.94958-1.00219	56-150	13.33-65.56
	300°F/148.9°C Aromatic	.95844-1.02853	5-140	-15-60
	350°F/176.7°C Aromatic	.96086-1.02668	5-140	-15-60

Liquid Hydrocarbon Gas Table

Type	Method	Product	Table Entry	Range	Temp Range
API°F	24E/23E	Light Hydrocarbon	Density @ 60°F in Specific Gravity	0.350-0.688	-50-200°F
LPG°C	LPG	Liquid Petroleum Gases	Density @ 15°C in kg/m3	Not Specified	-110.0- 60°C

Asphalt Tables

Type	Method	Product	Table Entry	Range	Temp Range
Asphalt	ASTM D4311°C 2004	Asphalt	Density @ 15°C in kg/m3	850- Unspecified	-25- 275°C
	ASTM D4311°C 2009	Asphalt	Density @ 15°C in kg/m3	850- Unspecified	-25- 274.5°C
	ASTM D4311°F 2004	Asphalt	Density @ 60°F in API	0- 34.9	0- 500°F
	ASTM D4311°F 2009	Asphalt	Density @ 60°F in API	0- 34.9	0- 449°F
	ASTM-IP Table 7	Asphalt	Density @ 60°F in API	0- 100	0- 500°F

Polynomial

This technique is used for specialized products that do not fall within one of the correction tables already identified. A table of density versus temperature data can be converted to a polynomial using the least square method of curve fitting. Using the least square method results in a set of polynomial coefficients. The 8810 RTU accommodates a fourth order polynomial to obtain a VCF.

The VCF polynomial equation is as follows:

$VCF = K_0 + K_1 (\Delta Temp) + K_2 (\Delta Temp^2) + K_3 (\Delta Temp^3) + K_4 (\Delta Temp^4)$		
Where:		
VCF	=	Volume Correction Factor
$\Delta Temp$	=	Current Temperature - Standard Temperature
$K_0 - K_4$	=	Coefficients of polynomial

Traditional Tank Calculations

Traditional tank sensors return the level and temperature of the tank. From these two values plus the tank configuration, a series of calculations is performed by the 8810 RTU.

The Five Volume Types and Calculated or Derived Data

There are five volume types used in volume calculations: **Total Observed Volume (TOV)**, **Total Calculated Volume (TCV)**, **Gross Observed Volume (GOV)**, **Gross Standard Volume (GSV)**, and **Net Standard Volume (NSV)**.

Below is a table that displays what is or isn't included in the volume correction calculations depending upon what type of volume is being examined. The following abbreviations are used in the table:

- **CTSh:** Tank Shell Correction
- **FRA:** Floating Roof Adjustment
- **FW:** Free Water
- **%BSW:** Percentage Bottom Sediment and Water
- **VCF:** Volume Correction Factor

Volume Type	Abbrev.	CTSh	FRA	FW	%BSW	VCF
Total Observed Volume	TOV	No	No	No	No	No
Total Calculated Volume	TCV	No	No	No	No	Yes
Gross Observed Volume	GOV	Yes	Yes	Yes	No	No
Gross Standard Volume	GSV	Yes	Yes	Yes	No	Yes
Net Standard Volume	NSV	Yes	Yes	Yes	Yes	Yes

Strap Table Volume (TOV)

The strap volume is obtained from the tank strapping table for the measured tank level. The 8810 RTU calculates the volume for a given level based on the tank shape as shown below.

Cylindrical Tanks

Calculations
LevelRatio = (Level - LowLevel)/(HighLevel - LowLevel)
TOV = (LowVolume + ((HighVolume - LowVolume) x LevelRatio))

Where (conditions)
Level = Current Tank Liquid Level
LowLevel = Strapping point level in table immediately below Level

HighLevel = Strapping point level in table immediately above Level
LowVolume = Strapping point volume in table for LowLevel point
HighVolume = Strapping point Volume in table for HighLevel point

Horizontal Tanks

Calculations
LevelRatio1 = [((Level-HighLevel) x (Level-HighestLevel))/
((LowLevel-HighLevel) x (LowLevel-HighestLevel))]
CalcVolume1 = (LowVolume x LevelRatio1)
LevelRatio2 = [((Level-LowLevel) x (Level-HighestLevel))/
((HighLevel-LowLevel) x (HighLevel-HighestLevel))]
CalcVolume2 = (HighVolume x LevelRatio2)
LevelRatio3 = [((Level-LowLevel) x (Level-HighLevel))/
((HighestLevel-LowLevel) x (HighestLevel-HighLevel))]
CalcVolume3 = (HighestVolume x LevelRatio3)
TOV = (CalcVolume1 + CalcVolume2 + CalcVolume3)

Where (conditions)
Level = Current Tank Liquid Level
LowLevel = Strapping point level in table immediately below Level
HighLevel = Strapping point level in table immediately above Level
HighestLevel = Strapping point level in table immediately above HighLevel
LowVolume = Strapping point volume in table for LowLevel point
HighVolume = Strapping point Volume in table for HighLevel point
HighestVolume = Strapping point Volume in table for HighestLevel point

Spherical Tanks

Calculations
Top1 = LowestVolume x (Level-LowLevel) x (Level-HighLevel) x (Level-HighestLevel)
Top2 = LowVolume x (Level-LowestLevel) x (Level-HighLevel) x (Level-HighestLevel)
Top3 = HighVolume x (Level-LowestLevel) x (Level-LowLevel) x (Level-HighestLevel)
Top4 = HighestVolume x (Level-LowestLevel) x (Level-LowLevel) x (Level-HighLevel)
Bottom1 = (LowestLevel-LowLevel) x (LowestLevel-HighLevel) x (LowestLevel-HighestLevel)

Calculations
Bottom2 = (LowLevel-LowestLevel) x (LowLevel-HighLevel) x (LowLevel-HighestLevel)
Bottom3 = (HighLevel-LowestLevel) x (HighLevel-LowLevel) x (HighLevel-HighestLevel)
Bottom4 = (HighestLevel-LowestLevel) x (HighestLevel-LowLevel) x (HighestLevel-HighLevel)
TOV = (Top1/Bottom1 + Top2/Bottom2 + Top3/Bottom3 + Top4/Bottom4)

Where (conditions)
Level = Current Tank Liquid Level
LowLevel = Strapping point level in table immediately below Level
HighLevel = Strapping point level in table immediately above Level
HighestLevel = Strapping point level in table immediately above HighLevel
LowestLevel = Strapping point level in table immediately below LowLevel
LowVolume = Strapping point volume in table for LowLevel point
HighVolume = Strapping point Volume in table for HighLevel point
HighestVolume = Strapping point Volume in table for HighestLevel point
LowestVolume = Strapping point Volume in table for LowestLevel point

Polynomial Spherical Tank

Calculations
$TOV = P \cdot (Lx' + L0')^3 + Qn \cdot (Lx' + L0')^2 + Rn \cdot (Lx' + L0') + Sn + VR'$

Where (conditions)
Ln-1= Lxw < Ln and n is an integer between 1 = n < 9
Lwx' = Lwx/1000
VR' = VR/1000
Lx = measured liquid level (mm)
L0 = correction volume (mm)
Ln = levels at the registered pointers (mm)
P = constant (±X. XXXXXXXXX)
Qn = constant (±XXX. XXXXXXX)
Rn = constant (±XXXX. XXXXXX)
Sn = constant (±XXXXXXX. XXX)
VR = correction volume (L)

Product and Water Strapping Tables

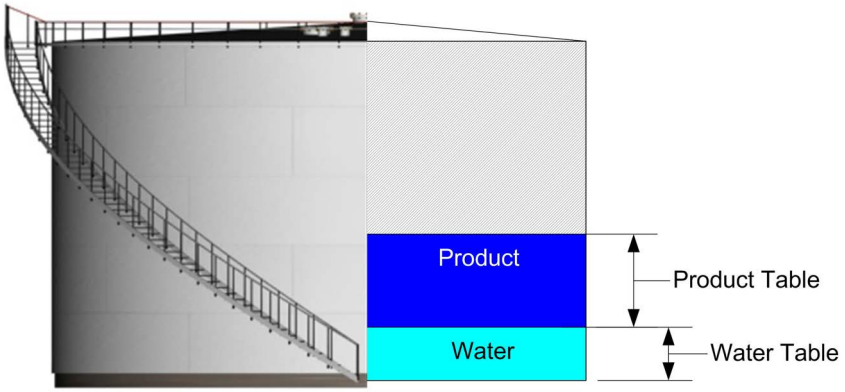
It is typical for customers to have two separate strapping tables, one for product and one for water bottom. These tables can be either related to one another or totally independent. This section details the calculation methods used by the 8810 RTU when configured to use separate water and product tables.

When using product and water tables, Configuration can be used to set the water and strapping table method for either integrated Product and Water tables or Separated Product and Water tables. Under Strap/Water Table Mode, select either Combined or Separated.

Integrated Product and Water Tables (Combined)

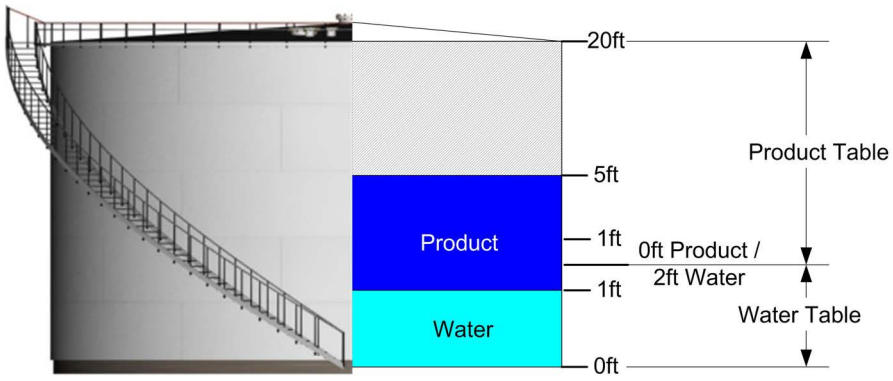
The key concept in the integrated product and water table mode of operation is that the top point of the water table is assumed to coincide with the bottom point of the product table.

In the integrated product and water table mode, the product table begins were the water table ends.



Example 1

Water level lower than the top point in the water table:



Example 1 shows how the product and water volumes are calculated when the water level is less than the water table

Product Table		Water Table	
Product Level	**Product Vol**	**Water Level**	**Water Vol**
0	0	0	0
1ft	1000 gal	1ft	1000 gal
2ft	2000 gal	2ft	2000 gal
5 ft	5000 gal		
20 ft	20,000 gal		

- Measured product level = +5ft
- Measured water level = +1ft

From the product table, the product volume = 5000 gal

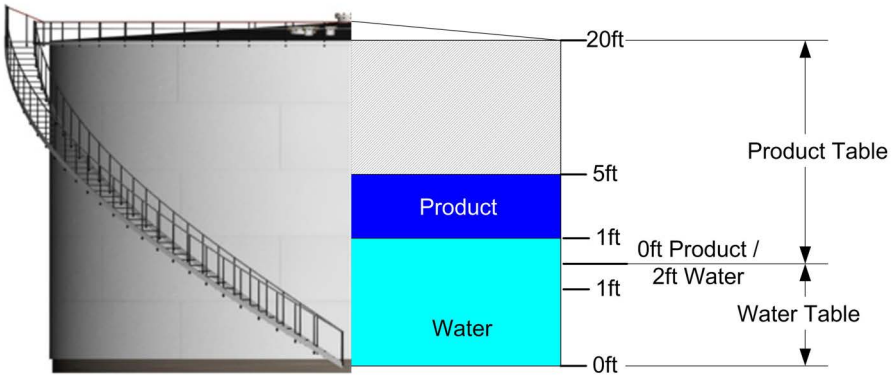
The 8810 RTU recognizes that the measured product level is below that of the bottom point in the product table, so it uses the top of the water table to extend the range:

- From the water table +1ft [+2ft (top) minus +1ft (measured water level)] = 1000 gal
- Total product volume for +5ft of product and +1ft of water = 6000 gal

From the water table +1ft of water = 1000 gal

Example 2

Water level higher than the top point in the water table:



Example 2 shows how the product and water volumes are calculated when the water level is higher than the top point in the water table

Product Table		Water Table	
Product Level	**Product Vol**	**Water Level**	**Water Vol**
0	0	0	0
1ft	1000 gal	1ft	1000 gal
2ft	2000 gal	2ft	2000 gal
5 ft	5000 gal		
20 ft	20,000 gal		

- Measured product level = +5ft
- Measured water level = +3ft

From the product table the product volume = 5000 gal

The 8810 RTU recognizes that the measured water level is above that of the top point in the water table, so it uses the bottom of the product table to extend the range:

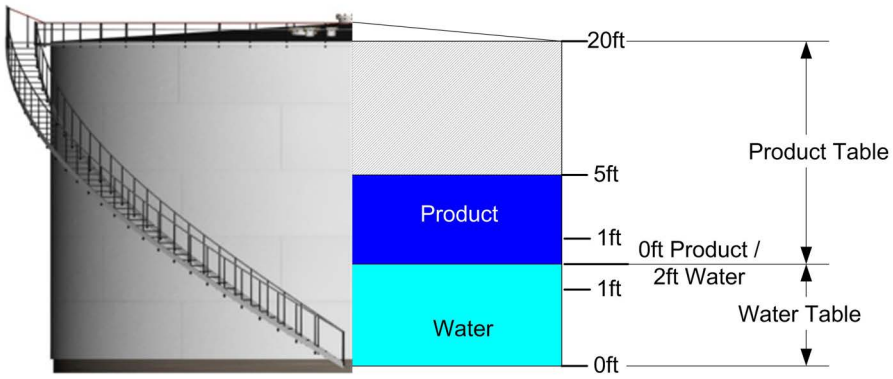
- From the water table +2ft of water = 2000 gal
- From the product table +1ft of water = 1000 gal
- Total water volume for + 3ft of water = 3000 gal

Subtracting the 1ft of water volume from the product volume (5000 – 1000 gal) equals: Product volume = 4000 gal

Example 3

Water level equals the top point in the water table:

Example 3 shows how the product and water volumes are calculated when the water level is equal to the top point in the water table



This example shows how the product and water volumes are calculated when the water level is equal to the top point in the water table.

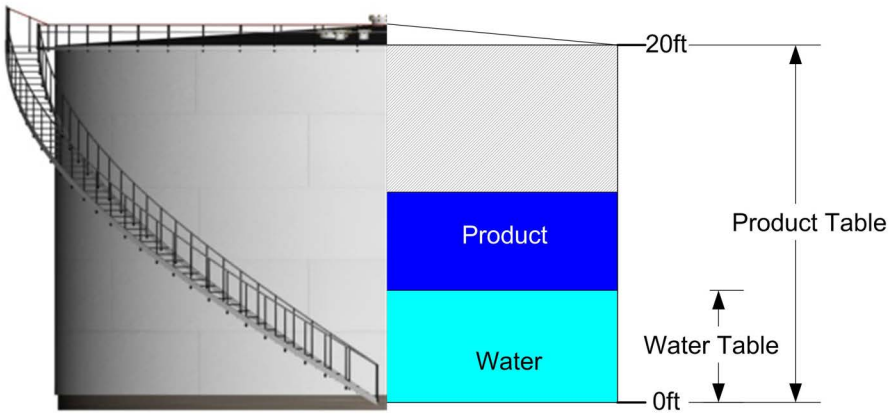
Product Table		Water Table	
Product Level	**Product Vol**	**Water Level**	**Water Vol**
0	0	0	0
1 ft	1000 gal	1 ft	1000 gal
2 ft	2000 gal	2 ft	2000 gal
5 ft	5000 gal		
20 ft	20,000 gal		

Separate Product and Water Tables (Separated)

When configured to use the separate product and water table mode, the 8810 RTU assumes no correlation between the water and product tables.

Since this mode of operation provides no correlation between the product and water tables, it is assumed that the tables start at the same point and overlap in the lower part of the tank.

Separated strapping and water tables example



- Water volume = Measured water level lookup in water table
- Product volume = Measured product level lookup in product table

Floating

Roof Adjustment (FRA)

Tanks with floating roofs require a correction to offset the effect of the displacement of the floating roof.

Default

This correction is calculated in the following manner.

If no floating roof or level is <= Roof Landed Height:

FRA = 0
No Correction Required.

If floating roof is not included in the strap table:

FRA = Roof Mass/ProductDensity

If floating roof is included in the strap table:

FRA = (RoofMass/StrapDensity) – (RoofMass/ProductDensity)

Bottom Sediment Water (BS&W)

Product samples are periodically taken to determine its quality and purity. Analyzing these samples results in a purity measurement referred to as percentage bottom sediment and water (%BS&W). The operator usually manually enters this value. The %BS&W value differs from the Water volume and Solids volume values in that, the %BS&W impurities are suspended in the product, the water and solids volumes have settled and rest at the bottom of the tank.

Volume of Sediment and Water (VSW)

This is the volume associated with the percentage of impurities suspended in the product (%BSW) and is calculated as follows:

VSW = (TOV - FW) x (%BSW/100.0)

Where:

VSW	=	Volume of Sediment and Water
TOV	=	Total Observed Volume
%BSW	=	Percentage of Bottom, Sediment and Water

Free Water

This is the amount of water in the bottom of the tank and Tank Bottom Solids (if any). This is calculated as follows:

FW = H20VOL + SOLVOL

Where:

FW	=	Combined Water and Solids volume
H20VOL	=	Water Volume
SOLVOL	=	Solids Volume

Correction Volume

This is the un-measurable volume associated with line segments and manifolds connected to the tank. The operator usually manually enters this value.

Volume Correction Factor (VCF)

This is the correction factor calculated via one of the methods defined in the table(s) above. The value is used to correct the gross volume for the effects of temperature.

Tank Shell Correction (CTSh)

Volume correction for the temperature of the shell. Compensates for the effect of ambient and liquid temperature effects on the shell of the tank.

CTSh is calculated as follows:

CTSh = 1 + ExpCoef x DTs + AreaCoef x (DTs x DTs)

Where:

ΔTs = Ts-Ref Temp (60°F)	
ExpCoef =	
	MILD STEEL = 12.4 x 10-6
	STAINLESS STEEL = 9.6 x 10-6
	ALUMINUM = 13.0 x 10-6
AreaCoef = 4.0 x 10-9	

For Non-Insulated Tanks:

Ts = [(7xTl) + Ta] / 8

Where:

Tl = Tank Liquid Temperature
Ta = Ambient Temperature

For insulated tanks:

Ta = Tl = Liquid temperature

Setting the Tank Material to "Other" allows you to manually enter the ExpCoef and the AreaCoef.

Gross Observed Volume (GOV)

The strap volume value needs to be corrected in order to arrive at the Gross Observed volume data. The exact calculation used is dependent on the how the tank point was configured. The following correction methods are available:

Default

The following formula is used to calculate Gross Volume:

GOV = [(TOV-FW) x CTSh] +/- FRA + CORRVOL

Where:

TOV	=	Strap Volume at the current tank level
FW	=	Free water + Tank Bottom Solids (if any)
CTSh	=	Tank Shell Correction

TOV	=	Strap Volume at the current tank level
FRA	=	Floating Roof Adjustment
CORRVOL	=	Un-measurable volume associated with tank pipe work

Net Standard Volume (NSV)

Default

Net volume (net standard volume) is defined as Gross observed volume corrected for %BS&W and temperature. The following equation is used to calculate net volume:

NSV = [(GOV x (1.0-%BS&W/100.0)) x VCF]

Where:

NSV	=	Net Standard Volume
FRA	=	Floating Roof Adjustment
%BSW	=	Percentage of bottoms, sediment and water impurities
VCF	=	Volume Correction Factor

$$Pb = \frac{Wm - Wb}{V} + Pm$$

Where:

NSV	=	Net Standard Volume
TOV	=	Strap Volume at the current tank level
FW	=	Free Water
CTSh	=	Tank Shell Correction
r15	=	Product Density
BSG	=	Strap Density
VCF	=	Volume Correction Factor
%BSW	=	Percentage of bottoms, sediment and water impurities
FRA	=	Floating Roof Adjustment

MASS

Default

Mass is defined as net standard volume corrected for density at the observed temperature. The following equation is used to calculate Mass:

Mass = NSV x Standard Density

In tables where density is expressed in API, Density is calculated as:

Density (KG/M3) = 141.5 x 999.012/(API Gravity + 131.5)

The Molar Method

NW = NSV (r15 - 0.0011) + GW

The GW is the Gas Weight derived by following equation.

$$GW = (V\ max\text{-}GOV)\ \frac{273}{273+GT} \times \frac{1.033+P}{1.033} \times \frac{M}{22.4} \times \frac{1}{p15} \times \frac{1}{1000} \times (\rho 15\text{-}0.0011)$$

Where:

NW	=	Net Weight
NSV	=	Net Standard Volume
GW	=	Gas weight
GOV	=	Gross Observed Volume
Vmax	=	Total Tank Capacity
r15	=	15°C liquid density
P	=	Gas Pressure
GT	=	Gas Temperature
M	=	Mole constant

Food Oil Method

NW=GOV x r15

Where:

NW	=	Net Weight
GOV	=	Gross Observed Volume
r15	=	15°C liquid density

Available Volume/Available Mass

Available Volume is defined as the amount of net or gross volume available for pumping out of a tank. It is calculated as “0” if one or more of the following conditions are true:

Level <= Low level Alarm, Low-Low level Alarm, or User Defined
Level <= Water Volume
Level <= Minimum level as defined in the strap table

If these conditions are not met, the available volume calculation is defined as using the following equations:

Net Available Volume:

NAV = Current Net Volume of Tank – [(((SVC-FW) x CTSh x ((100.0-%BS&W)/100.0)) +/- FRA) x VCF]

Available Mass:

AM = NAV x Standard Density

Gross Available Volume:

GAV = Current Gross Volume of Tank – [((SVC-FW) x CTSh) +/- FRA]

Where:

SVC	=	Strap Volume at the Minimum Working level
FW	=	Free water + Tank Bottom Solids (if any)
CTSh	=	Tank Shell Correction
FRA	=	Floating Roof Adjustment
VCF	=	volume correction Factor

Remaining Volume/Remaining Mass

Remaining volume is defined as the amount of net or gross volume that can be pumped into a tank. It is calculated as “0” if none or more of the following conditions are true:

Level >= High level Alarm, High-High level Alarm, or User Defined
Level >= Maximum level as defined in the strap table

If these conditions are not met, the remaining volume calculation is defined using the following equations:

Net Remaining Volume:

NRV = [((SVC-FW) x CTSh x ((100.0-%BS&W)/100.0) +/- FRA) x VCF] – Current Net Volume in Tank

Remaining Mass:

RM = NRV x Standard Density

Gross Remaining Volume:

GNV = [((SVC-FW) x CTSh) +/- FRA] – Current Gross Volume in Tank

Where:

SVC	=	Strap Volume at the Maximum Working level
FW	=	Free water + Tank Bottom Solids (if any)
CTSh	=	Tank Shell Correction
FRA	=	Floating Roof Adjustment
VCF	=	volume correction Factor

Typical Tank Calculation

Analytical and Measured Data

Level (ft-in-16)	12-3-12
Water Level (ft-in-16)	0-9-5

Level (ft-in-16)	12-3-12
Solids Level (ft-in-16)	0-1-3
%BS&W	0
Product Temperature (°F)	75.6
Product Density (lbs /US Gal)	6.8
Density Temperature (°F)	70.8
Standard Density 5 (lbs / US Gal)	6.84
Ambient Temperature (°F)	56.2

Tank Point Configuration Parameters

Volume Correction Method	API °F: Table 6B/5B
Floating Roof Type	Roof Mass Not in Strap
Roof Mass (lbs)	589
Tank Shell Material	Mild Steel (Coeff of Expansion = 1.24 x 10-5)
Tank Insulated	No
Maximum Fill Volume (US Gal)	850,000.00
Minimum Empty Volume (US Gal)	150,000.00

Calculated or Derived Data	Symbol	Action	Values Reported (rounded)	Units	Values used in calculations (unrounded)
Total Observed Volume [1]	TOV		435,218.32	US Gals	
Water Volume [2]	H20VOL	subtract	189.35	US Gals	
Solids Volume [3]	SOLVOL	subtract	34.12	US Gals	
			434,994.85	US Gals	434,994.8500000000
Correction for Temperature of Shell	CTSh	multiply	1.00016		1.0001640643225
			435,066.22	US Gals	435066.2171353560
Floating Roof Adjustment	FRA	subtract	86.61765	US Gals	86.61764706
Gross Observed Volume [4]	GOV		434,979.60	US Gals	434,979.5994882970
Correction for Product Temperature [5]	VCF	multiply	0.99230		
Correction for %BS&W	BS&W	multiply	1.00000		
Net Standard Volume [6]	NSV		431,630.26	US Gals	431630.2565722380
Available Product (Gross)			285,265.11		
Available Product (Net)			283,068.57		
Remaining Product (Gross)			414,849.73		
Remaining Product (Net)			411,655.39		

Table 15-1: Tank Point Configuration Parameters explained

Notes

1	Quantity derived from tank strapping table using level value to enter table.
2	Quantity derived from tank strapping table (or separate water table) using water level value to enter table.
3	Quantity derived from tank strapping table using solids level value to enter table.
4	Gross volume uncorrected for temperature effects and floating roof adjustment
5	From API Tables 5/6B
6	Net volume corrected to 60 °F

Flow calculations

The following sections detail how the 8810 RTU performs Flow calculations.

Flow

$$Q = \frac{GOV_{n+1} - GOV_n}{T_{n+1} - T_n}$$

Where:

Q	=	Flow rate
GOVn+1-GOVn	=	Gross Volume change in the sampling cycle
Tn+1, Tn	=	Sample times

Level Rate

$$Q = \frac{Level_{n+1} - Level_n}{T_{n+1} - T_n}$$

Where:

Q	=	Flow rate
Leveln+1-Leveln	=	Level change in the sampling cycle
Tn+1, Tn	=	Sample times

Mass Flow

$$\mathbf{Q = \frac{WN_{n+1} - WN_n}{T_{n+1} - T_n}}$$

Where:

Q	=	Flow rate
WNn+1-WNn	=	Weight change in the sampling cycle
Tn+1, Tn	=	Sample times

Net Flow

$$Q = \frac{VN_{n+1} - VN_n}{T_{n+1} - T_n}$$

Where:

Q	=	Flow rate
VNn+1 -VNn	=	Net volume change in the sampling cycle
Tn+1, Tn	=	Sample times

16 Point Status Tables

Purpose

The purpose of the Point Status Tables section is to give users the understanding of what options the 9810 miniRTU provides for point status configuration depending upon the tank, alarm, or device.

Channel Point Status Table

Channel - Pnt Status	Text
0x0000 0001	Communication Timeout
0x0000 0002	Channel Initialization Failure
0x0000 0004	Hardware Communication Error
0x0000 0008	
0x0000 0010	Transmit Data Error
0x0000 0020	Channel Disabled
0x0000 0040	Protocol Mismatch (configured protocol is incompatiable with installed module)
0x0000 0080	
0x0000 0100	
0x0000 0200	Mark/Space Line Shorted
0x0000 0400	Power Failure
0x0000 0800	
0x0000 1000	
0x0000 2000	
0x0000 4000	Duplicate FlexConnAddr (Engauge only)
0x0000 8000	Duplicate Channel (Engauge and Debug only)
0x0001 0000	
0x0002 0000	
0x0004 0000	
0x0008 0000	
0x0010 0000	
0x0020 0000	
0x0040 0000	
0x0080 0000	
0x0100 0000	Module Not Installed
0x0200 0000	

Channel - Pnt Status	Text
0x0400 0000	Module Communication Error (set when the OS reports a hardware error)
0x0800 0000	Unknown Module Type
0x1000 0000	
0x2000 0000	
0x4000 0000	
0x8000 0000	

Tank Point Status Table

Tank - PntStatus	Text
0x0000 0001	Device Communication Timeout
0x0000 0002	AuxID Device Communication Timeout
0x0000 0004	Not Scanning
0x0000 0008	
0x0000 0010	Invalid Level
0x0000 0020	Invalid Temp
0x0000 0040	Invalid Density
0x0000 0080	Stale Level
0x0000 0100	
0x0000 0200	
0x0000 0400	
0x0000 0800	
0x0000 1000	
0x0000 2000	
0x0000 4000	
0x0000 8000	
0x0001 0000	
0x0002 0000	
0x0004 0000	
0x0008 0000	
0x0010 0000	
0x0020 0000	
0x0040 0000	
0x0080 0000	
0x0100 0000	
0x0200 0000	
0x0400 0000	
0x0800 0000	
0x1000 0000	
0x2000 0000	

Tank - PntStatus	Text
0x4000 0000	
0x8000 0000	

17 Tank Device Status Tables

Purpose

The purpose of the Tank Device Status tables are to help the user understand what the 9810 miniRTU can understand from the supported devices and what the devices' respective status errors are.

The tables are broken into the following:

- First table consists of the EN811, EN854, EN873, EN954, and EN990 Enraf devices.
- Second table consists of the ATT 4000, FTT 29xx, GSI 2000, V1800, V1900, and V6500 devices.
- Third table consists of the NMS5x, NMS8x, NRF590, NRF81, and NMR8x devices.
- Fourth table consists of the LJ1000, LJ1500, LJ2000, and MTS devices.
- Fifth
- table consists of the TLS3xx, TLS4xx, X76CTM, and the OptiLevel devices.
- Sixth table consists of the RAPTOR, REX, RTG, and DTG/DAU devices.

Table 17-1: EN811, EN854, EN873, EN954, and EN990 Device Status Table

DeviceStatus Bit	Error	EN811	EN854	EN873	EN954	EN990
0x00000001	Not Scanning	Y	Y	Y	Y	Y
0x00000002	Device Timeout	Y	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y	Y
0x00000010						
0x00000020						
0x00000040	Register Map Source	Y	Y	Y	Y	Y
0x00000080	AuxID Device Timeout					
	↑ Common Bits					
	↓ Unused					
0x00000080						
0x00000100						
0x00000200						
0x00000400						
0x00000800						

DeviceStatus Bit	Error	EN811	EN854	EN873	EN954	EN990
	↑ Unused					
	↓ Device Specific Bits					
0x00001000	Bad EE					
0x00002000	Bad EE Checksum					
0x00004000	Bad RAM					
0x00008000	Bad EPROM					
0x00010000	Local Mods					
0x00020000	No Calculation					
0x0040000	Configuration Error					
0x0080000	Calculation Error					
0x00100000	Bad CPU Board					
0x00200000	Bad Comms Board					
0x00400000	Stale Level					
0x00800000	40 Bit Response					
0x01000000	Temp Overrange					
0x01000000	Dual Band Error					
0x02000000	Low Speed Response					
0x04000000	Vin Power					
0x08000000	Vf Power					
0x08000000	Discrete 2					
0x08000000	Missing Comm Board					
0x08000000	Space Short					
0x10000000	Discrete 1					
0x10000000	Transmitter Error					
0x10000000	Mark Short					
0x20000000	Fuse Blown					
0x40000000	No Power					
0x40000000	Bad Density		Y		Y	
0x80000000	Alarm Status					
0x80000000	Temp Value is Positive					
0x80000000	Not Balanced					
0x80000000	Low Encoder Battery				Y	
0x80000000	CIU Timeout	Y	Y	Y		Y

Table 17-2: ATT 4000, FTT 29xx, GSI 2000, V1800, V1900, and V6500 Device Status Table

DeviceStatus Bit	Error	ATT 4000	FTT 29xx	GSI 2000	V1800	V1900	V6500
0x00000001	Not Scanning	Y	Y	Y	Y	Y	Y
0x00000002	Device Timeout	Y	Y	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y	Y	Y
0x00000010							
0x00000020							
0x00000040	Register Map Source	Y	Y	Y	Y	Y	Y
0x00000080	AuxID Device Timeout	Y	Y	Y	Y	Y	Y
	↑ Common Bits						
	↓ Unused						
0x00000080							
0x00000100							
0x00000200							
0x00000400							
0x00000800							
	↑ Unused						
	↓ Device Specific Bits						
0x00001000	Bad EE	Y					
0x00002000	Bad EE Checksum	Y					
0x00004000	Bad RAM	Y					
0x00008000	Bad EPROM	Y					
0x00010000	Local Mods	Y					
0x00020000	No Calculation	Y					
0x00040000	Configuration Error	Y					
0x00080000	Calculation Error	Y					
0x00100000	Bad CPU Board	Y					
0x00200000	Bad Comms Board	Y					
0x00400000	Stale Level	Y	Y	Y	Y	Y	Y
0x00800000	40 Bit Response	Y	Y	Y	Y	Y	Y
0x01000000	Temp Overrange						
0x01000000	Dual Band Error						
0x01000000	Low Speed Response	Y	Y	Y	Y	Y	Y
0x02000000	Vin Power	Y	Y	Y	Y	Y	Y
0x04000000	Vf Power	Y	Y	Y	Y	Y	Y
0x08000000	Dicrete 2						

DeviceStatus Bit	Error	ATT 4000	FTT 29xx	GSI 2000	V1800	V1900	V6500
0x08000000	Missing Comm Board						
0x08000000	Space Short	Y	Y	Y	Y	Y	Y
0x10000000	Discrete 1						
0x10000000	Transmitter Error						
0x10000000	Mark Short	Y	Y	Y	Y	Y	Y
0x20000000	Fuse Blown	Y	Y	Y	Y	Y	Y
0x40000000	No Power	Y	Y	Y	Y	Y	Y
0x40000000	Bad Density						
0x80000000	Alarm Status						
0x80000000	Temp Value is Positive						
0x80000000	Not Balanced						
0x80000000	Low Encoder Battery	Y					
0x80000000	CIU Timeout		Y				

Table 17-3: NMS5x, NMS8x, NRF590, NRF81, and NMR8x Device Status Table

DeviceStatus Bit	Error	NMS5x	NMS8x	NRF590	NRF81	NMR8x
0x00000001	Not Scanning	Y	Y	Y	Y	Y
0x00000002	Device Timeout	Y	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y	Y
0x00000010						
0x00000020						
0x00000040	Register Map Source	Y	Y	Y	Y	Y
0x00000080	AuxID Device Timeout					
	↑ Common Bits					
	↓ Unused					
0x00000080						
0x00000100						
0x00000200						
0x00000400						
0x00000800						
	↑ Unused					
	↓ Device Specific Bits					
0x00001000	Bad EE					
0x00002000	Bad EE Checksum					
0x00004000	Bad RAM					
0x00008000	Bad EPROM					
0x00010000	Local Mods					

DeviceStatus Bit	Error	NMS5x	NMS8x	NRF590	NRF81	NMR8x
0x00020000	No Calculation					
0x00040000	Configuration Error					
0x00080000	Calculation Error					
0x00100000	Bad CPU Board					
0x00200000	Bad Comms Board					
0x00400000	Stale Level					
0x00800000	40 Bit Response					
0x01000000	Temp Overrange					
0x01000000	Dual Band Error					
0x01000000	Low Speed Response					
0x02000000	Vin Power					
0x04000000	Vf Power					
0x08000000	Discrete 2					
0x08000000	Missing Comm Board					
0x08000000	Space Short					
0x10000000	Discrete 1					
0x10000000	Transmitter Error					
0x10000000	Mark Short					
0x20000000	Fuse Blown					
0x40000000	No Power					
0x40000000	Bad Density	Y	Y	Y	Y	Y
0x80000000	Alarm Status					
0x80000000	Temp Value Is Positive					
0x80000000	Not Balanced	Y	Y			
0x80000000	Low Encoder Batter					
0x80000000	CIU Timeout					

Table 17-4: LJ1000, LJ1500, LJ2000, and MTS Device Status Table

DeviceStatus Bit	Error	LJ100	LJ150	LJ2000	MTS
0x00000001	Not Scanning	Y	Y	Y	Y
0x00000002	Device Timeout	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y
0x00000010					
0x00000020					
0x00000040	Register Map Source	Y	Y	Y	Y
0x00000080	AuxID Device Timeout				
	↑ Common Bits				
	↓ Unused				
0x00000080					
0x00000100					

DeviceStatus Bit	Error	LJ100	LJ150	LJ2000	MTS
0x00000200					
0x00000400					
0x00000800					
	↑ Unused				
	↓ Device Specific Bits				
0x00001000	Bad EE				
0x00002000	Bad EE Checksum				
0x00004000	Bad RAM				
0x00008000	Bad EPROM				
0x00010000	Local Mods				
0x00020000	No Calculation				
0x00040000	Configuration Error				
0x00080000	Calculation Error				
0x00100000	Bad CPU Board				
0x00200000	Bad Comms Board				
0x00400000	Stale Level				
0x00800000	40 Bit Response				
0x01000000	Temp Overrange			Y	
0x01000000	Dual Band Error	Y	Y		
0x01000000	Low Speed Response				
0x02000000	Vin Power	Y	Y	Y	
0x04000000	Vf Power	Y	Y	Y	
0x08000000	Discrete 2			Y	
0x08000000	Missing Comm Board	Y	Y		
0x08000000	Space Short				
0x10000000	Discrete 1			Y	
0x10000000	Transmitter Error	Y	Y		
0x10000000	Mark Short				
0x20000000	Fuse Blown	Y	Y	Y	
0x40000000	No Power				
0x40000000	Bad Density				
0x80000000	Alarm Status				Y
0x80000000	Temp Value Is Positive	Y	Y	Y	
0x80000000	Not Balanced				
0x80000000	Low Encoder Batter				
0x80000000	CIU Timeout				

Table 17-5: TLS3xx, TLS4xx, X76CTM, and OptiLevel Device Status Table

DeviceStatus Bit	Error	TLS3xx	TLS4xx	X76CTM	Opti-Level
0x00000001	Not Scanning	Y	Y	Y	Y

DeviceStatus Bit	Error	TLS3xx	TLS4xx	X76CTM	Opti-Level
0x00000002	Device Timeout	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y
0x00000010					
0x00000020					
0x00000040	Register Map Source	Y	Y	Y	Y
0x00000080	AuxID Device Timeout				
	↑ Common Bits				
	↓ Unused				
0x00000080					
0x00000100					
0x00000200					
0x00000400					
0x00000800					
	↑ Unused				
	↓ Device Specific Bits				
0x00001000	Bad EE				
0x00002000	Bad EE Checksum				
0x00004000	Bad RAM				
0x00008000	Bad EPROM				
0x00010000	Local Mods				
0x00020000	No Calculation				
0x00040000	Configuration Error				
0x00080000	Calculation Error				
0x00100000	Bad CPU Board				
0x00200000	Bad Comms Board				
0x00400000	Stale Level				
0x00800000	40 Bit Response				
0x01000000	Temp Overrange				
0x01000000	Dual Band Error				
0x01000000	Low Speed Response				
0x02000000	Vin Power				
0x02000000	Undocumented Error				Y
0x04000000	Vf Power				
0x04000000	Temp Sensor Error				Y
0x08000000	Discrete 2				
0x08000000	Missing Comm Board				
0x08000000	Space Short				
0x08000000	Adjustment in Progress				Y
0x10000000	Discrete 1				
0x10000000	Transmitter Error				
0x10000000	Mark Short				

DeviceStatus Bit	Error	TLS3xx	TLS4xx	X76CTM	Opti-Level
0x10000000	No Dry/Wet Adjustment				Y
0x20000000	Fuse Blown				
0x20000000	No Electronics Adjustment				Y
0x40000000	No Power				
0x40000000	Bad Density				
0x40000000	No EEPROM Connection				Y
0x80000000	Alarm Status				
0x80000000	Temp Value Is Positive				
0x80000000	Not Balanced				
0x80000000	Low Encoder Batter				
0x80000000	CIU Timeout				
0x80000000	Wrong DIP Settings				Y

Table 17-6: RAPTOR, REX, RTG, and RTG/DAU Device Status Table

DeviceStatus Bit	Error	RAPTOR	REX	RTG	RTG/ DAU
0x00000001	Not Scanning	Y	Y	Y	Y
0x00000002	Device Timeout	Y	Y	Y	Y
0x00000004	Bad Level	Y	Y	Y	Y
0x00000008	Bad Temperature	Y	Y	Y	Y
0x00000010					
0x00000020					
0x00000040	Register Map Source	Y	Y	Y	Y
0x00000080	AuxID Device Timeout				Y
	↑ Common Bits				
	↓ Unused				
0x00000080					
0x00000100					
0x00000200					
0x00000400					
0x00000800					
	↑ Unused				
	↓ Device Specific Bits				
0x00001000	Bad EE				
0x00002000	Bad EE Checksum				
0x00004000	Bad RAM				
0x00008000	Bad EPROM				
0x00010000	Local Mods				

DeviceStatus Bit	Error	RAPTOR	REX	RTG	RTG/ DAU
0x00020000	No Calculation				
0x00040000	Configuration Error				
0x00080000	Calculation Error				
0x00100000	Analog Input 1 Error	Y	Y	Y	Y
0x00100000	Bad CPU Board				
0x00200000	Analog Input 2 Error	Y	Y	Y	Y
0x00200000	Bad Comms Board				
0x00400000	Analog Input 3 Error	Y	Y	Y	Y
0x00400000	RTG Comm Failure	Y	Y	Y	Y
0x00800000	40 Bit Response				
0x01000000	LPG Verify Copy	Y	Y	Y	Y
0x01000000	Temp Overrange				
0x01000000	Dual Band Error				
0x01000000	Low Speed Response				
0x02000000	Vin Power				
0x02000000	Undocumented Error				
0x04000000	Vf Power				
0x04000000	Temp Sensor Error				
0x08000000	Presentation Level	Y	Y	Y	Y
0x08000000	Discrete 2				
0x08000000	Missing Comm Board				
0x08000000	Space Short				
0x08000000	Adjustment in Progress				
0x10000000	NMI Approved RTG	Y	Y	Y	Y
0x10000000	Discrete 1				
0x10000000	Transmitter Error				
0x10000000	Mark Short				
0x10000000	No Dry/Wet Adjustment				
0x20000000	NMI Legal Leval	Y	Y	Y	Y
0x20000000	Fuse Blown				
0x20000000	No Electronics Adjustment				
0x40000000	Level Warning	Y	Y	Y	Y
0x40000000	No Power				
0x40000000	Bad Density				
0x40000000	No EEPROM Connection				
0x80000000	Invalid Level	Y	Y	Y	Y
0x80000000	Alarm Status				
0x80000000	Temp Value Is Positive				
0x80000000	Not Balanced				
0x80000000	Low Encoder Batter				

DeviceStatus Bit	Error	RAPTOR	REX	RTG	RTG/ DAU
0x80000000	CIU Timeout				
0x80000000	Wrong DIP Settings				

18 NMS Status Codes

The NMS Status Code in the 9810 miniRTU indicates the value of the Gauge Status parameter in the NMS8x Proservo Tank Gauge. (For the NMR8x and NRF81, this parameter will return zero.)

Depending on the Compatibility mode parameter, the content of the Gauge Status parameter is adjusted.

- In the NMS8x mode all Gauge Status values are available.
- In the NMS5x mode only values which also existed in the NMS5x / N6005 Gauge Status are available.

NMS Status Codes

Gauge status of device	Compatibility Mode Setting			
	NMS8x		NMS5x	
	Code [decimal]	NMS8x Designation	Code [decimal]	NMS5x Designation
Displacer at reference position	1	Displacer at reference position	1	Displacer at reference position
Displacer hoisting up	2	Displacer hoisting up	2	Displacer hoisting up
Displacer stop	4	Displacer stop	4	Displacer stop
Level measurement balanced	5	Level measurement balanced	5	Level measurement, balanced
Upper interface level balanced	6	Upper interface level balanced	6	Upp. I/F level, balanced
Lower interface level balanced	7	Lower interface level balanced	7	Midd. I/F level, balanced
Bottom measurement balanced	8	Bottom measurement balanced	8	Bottom meas. balanced
Upper density done	9	Upper density done	9	Upper Dens, finished
Middle density done	10	Middle density done	10	Middle Dens, finished
Lower density done	11	Lower density done	11	Bottom Dens, finished
Release overtension	12	Release overtension	12	Release over tension
Calibration activated	13	Calibration activated	13	Calibration activated
Seek level	14	Seek level	14	Seek level
Follow level	15	Follow level	15	Follow level

Seek upper interface level	19	Seek upper interface level	19	Seek Upper I/F level
Follow upper interface level	20	Follow upper interface level	20	Follow up. I/F level
Seek lower interface level	21	Seek lower interface level	21	Seek Mid. I/F level
Follow lower interface level	22	Follow lower interface level	22	Follow Mid. I/F level
Seek bottom level	23	Seek bottom level	23	Seek Bottom Level
Stopped at high stop	25	Stopped at high stop	25	Stopped at High Stop.
Stopped at low stop	26	Stopped at low stop	26	Stopped at Low Stop
Repeatability testing	27	Repeatability testing	27	Repeatability testing
Seek water level	28	Seek water level	28	Seek water level
Water dip done	29	Water dip done	29	Water level, balanced
Proof test done	32	Maintenance Mode	32	Maintenance Mode
Dip displacer	32	Maintenance Mode	32	Maintenance Mode
Verify weight	32	Maintenance Mode	32	Maintenance Mode
Verify distance	32	Maintenance Mode	32	Maintenance Mode
Start detector update	32	Maintenance Mode	32	Maintenance Mode
Detector update running	32	Maintenance Mode	32	Maintenance Mode
Verify updated detector software	32	Maintenance Mode	32	Maintenance Mode
Finish detector update	32	Maintenance Mode	32	Maintenance Mode
Startup	33	Startup	4	Displacer stop
Check detector software version	33	Startup	4	Displacer stop
Water level error	34	Water level error	28	Seeking water level
Slow hoist up	35	Slow hoist up	2	Displacer hoisting up
Level found	36	Level found	15	Follow level
Bottom done	37	Bottom done	8	Bottom meas. balanced
Profile done	38	Profile done	9	Upper Dens, finished
Above liquid	39	Above liquid	27	Repeatability testing
Overtension released	40	Overtension released	12	Release over tension
Temporary balanced	41	Temporary balanced	5	Level measurement, balanced
Lower density error	42	Lower density error	11	Bottom Dens, finished
Middle density error	43	Middle density error	10	Middle Dens, finished
Profile error	44	Profile error	9	Upper Dens, finished
Upper density error	45	Upper density error	9	Upper Dens, finished
Wait for level	46	Wait for level	14	Seek level
Seek standby position	47	Seek standby position	14	Seek level
Move to target	48	Move to target	16	Seek Upper Density
Measure density	49	Measure density	16	Seek Upper Density

Measure in air	50	Measure in air	16	Seek Upper Density
Bottom error	51	Bottom error	23	Seek Bottom Lev

19 Veeder-Root Alarm Tables

Purpose

The purpose of the Veeder-Root alarm tables section is to give users a list to help choose the best alarm configurations for a Veeder-Root gauge and how the 9810 miniRTU interprets the Veeder Root alarm code (the rank as shown in the table below).

Veeder-Root Alarms

AA	NN	Alarm/Warning Category	Alarm Type	Group	Rank
01	01	System Alarm	Printer Out Of Paper	System	552
01	02	System Alarm	Printer Error	Minor	394
01	03	System Alarm	EEPROM Configuration Error	System	553
01	04	System Alarm	Battery Off	Critical	6
01	05	System Alarm	Too Many Tanks	System	554
01	06	System Alarm	System Security Warning	System	555
01	07	System Alarm	ROM Revision Warning	System	556
01	08	System Alarm	Remote Display Communication Error	System	502
01	09	System Alarm	Autodial Error	System	557
01	10	System Alarm	Software Module Warning	System	558
01	11	System Alarm	Tank Test Shutdown Warning	Minor	395
01	12	System Alarm	Protective Cover Alarm	System	559
01	13	System Alarm	BIR Shift Close Pending	Minor	390
01	14	System Alarm	BIR Daily Close Pending	Minor	389
01	15	System Alarm	PC (H8) Revision Warning	System	560
01	16	System Alarm	System Self Test Error	System	561
01	17	System Alarm	System Clock Incorrect Warning	System	562
01	18	System Alarm	System Device Poll Timeout	System	563
01	19	System Alarm	Maintenance Tracker NVMem Removed	System	564
01	20	System Alarm	Maintenance Tracker Communication Module Removed	System	565
01	21	System Alarm	Database Error	System	566
01	22	System Alarm	File System Error	System	567
01	23	System Alarm	BIR Status Warning	Minor	344
02	01	Tank Alarm	Tank Setup Data Warning	System	520
02	02	Tank Alarm	Tank Leak Alarm	Major	101
02	03	Tank Alarm	Tank High Water Alarm	Major	102
02	04	Tank Alarm	Tank Overfill Alarm	Major	103

02	05	Tank Alarm	Tank Low Product Alarm	System	529
02	06	Tank Alarm	Tank Sudden Loss Alarm	Major	104
02	07	Tank Alarm	Tank High Product Alarm	Major	105
02	08	Tank Alarm	Tank Invalid Fuel Level Alarm	Major	106
02	09	Tank Alarm	Tank Probe Out Alarm	Major	161
02	10	Tank Alarm	Tank High Water Warning	System	530
02	11	Tank Alarm	Tank Delivery Needed Warning	System	600
02	12	Tank Alarm	Tank Maximum Product Alarm	Major	162
02	13	Tank Alarm	Tank Gross Leak Test Fail Alarm	Major	163
02	14	Tank Alarm	Tank Periodic Leak Test Fail Alarm	Major	107
02	15	Tank Alarm	Tank Annual Leak Test Fail Alarm	Major	108
02	16	Tank Alarm	Tank Periodic Test Needed Warning	Minor	328
02	17	Tank Alarm	Tank Annual Test Needed Warning	Minor	330
02	18	Tank Alarm	Tank Periodic Test Needed Alarm	Minor	332
02	19	Tank Alarm	Tank Annual Test Needed Alarm	Major	126
02	20	Tank Alarm	Tank Leak Test Active	System	511
02	21	Tank Alarm	Tank No CSLD Idle Time Warning	Major	109
02	22	Tank Alarm	Tank Siphon Break Active Warning	Minor	366
02	23	Tank Alarm	Tank CSLD Rate Increase Warning	Minor	310
02	24	Tank Alarm	Tank AccuChart Calibration Warning	Minor	367
02	25	Tank Alarm	Tank HRM Reconciliation Warning	Minor	368
02	26	Tank Alarm	Tank HRM Reconciliation Alarm	Minor	370
02	27	Tank Alarm	Tank Cold Temperature Warning	Minor	371
02	28	Tank Alarm	Tank Missing Delivery Ticket Warning	Minor	373
02	29	Tank Alarm	Tank/Line Gross Leak Alarm	Major	111
02	30	Tank Alarm	Delivery Density Warning	Minor	374
02	31	Tank Alarm	Density Warning	Minor	376
02	32	Tank Alarm	Fuel Quality Alarm	Minor	377
03	02	Liquid Sensor Alarm	Liquid Sensor Setup Data Warning	System	568
03	03	Liquid Sensor Alarm	Liquid Sensor Fuel Alarm	Major	133
03	04	Liquid Sensor Alarm	Liquid Sensor Out Alarm	Minor	345
03	05	Liquid Sensor Alarm	Liquid Sensor Short Alarm	Critical	13
03	06	Liquid Sensor Alarm	Liquid Sensor Water Alarm	Minor	346
03	07	Liquid Sensor Alarm	Liquid Sensor Water Out Alarm	Minor	347
03	08	Liquid Sensor Alarm	Liquid Sensor High Liquid Alarm	Major	134
03	09	Liquid Sensor Alarm	Liquid Sensor Low Liquid Alarm	Minor	348
03	10	Liquid Sensor Alarm	Liquid Sensor Liquid Warning	Minor	349
04	02	Vapor Sensor Alarm	Vapor Sensor Setup Data Warning	System	569
04	03	Vapor Sensor Alarm	Vapor Sensor Fuel Alarm	Major	135
04	04	Vapor Sensor Alarm	Vapor Sensor Out Alarm	Critical	14
04	05	Vapor Sensor Alarm	Vapor Sensor Short Alarm	Critical	15
04	06	Vapor Sensor Alarm	Vapor Sensor Water Alarm	Minor	350
05	01	Input Alarm	Input Setup Data Warning	System	523
05	02	Input Alarm	Input Normal	System	551
05	03	Input Alarm	Input Alarm	System	550
05	04	Input Alarm	Generator Off	System	549
05	05	Input Alarm	Generator On	System	548

05	06	Input Alarm	Input Out Alarm	System	547
06	01	Volumetric Line Leak Alarm	VLLD Setup Data Warning	System	504
06	02	Volumetric Line Leak Alarm	VLLD Self Test Alarm	System	505
06	03	Volumetric Line Leak Alarm	VLLD Shutdown Alarm	Major	112
06	04	Volumetric Line Leak Alarm	VLLD Leak Test Fail Alarm	Major	113
06	05	Volumetric Line Leak Alarm	VLLD Selftest Invalid Warning	System	506
06	06	Volumetric Line Leak Alarm	VLLD Continuous Handle On Warning	Minor	301
06	07	Volumetric Line Leak Alarm	VLLD Gross Line Test Fail Alarm	Major	114
06	08	Volumetric Line Leak Alarm	VLLD Gross Line Selftest Fail Alarm	Minor	302
06	09	Volumetric Line Leak Alarm	VLLD Gross Pump Test Fail Alarm	Minor	303
06	10	Volumetric Line Leak Alarm	VLLD Gross Pump Selftest Fail Alarm	Minor	304
06	11	Volumetric Line Leak Alarm	VLLD Periodic Test Needed Warning	Minor	305
06	12	Volumetric Line Leak Alarm	VLLD Annual Test Needed Warning	Minor	306
06	13	Volumetric Line Leak Alarm	VLLD Periodic Test Needed Alarm	Major	115
06	14	Volumetric Line Leak Alarm	VLLD Annual Test Needed Alarm	Major	116
06	15	Volumetric Line Leak Alarm	VLLD Periodic Line Test Fail Alarm	Major	117
06	16	Volumetric Line Leak Alarm	VLLD Periodic Line Selftest Fail Alarm	Minor	307
06	17	Volumetric Line Leak Alarm	VLLD Periodic Pump Test Fail Alarm	Minor	308
06	18	Volumetric Line Leak Alarm	VLLD Periodic Pump Selftest Fail Alarm	Minor	309
06	19	Volumetric Line Leak Alarm	VLLD Annual Line Test Fail Alarm	Major	118
06	20	Volumetric Line Leak Alarm	VLLD Annual Line Selftest Fail Alarm	Minor	311
06	21	Volumetric Line Leak Alarm	VLLD Annual Pump Test Fail Alarm	Major	119
06	22	Volumetric Line Leak Alarm	VLLD Annual Pump Selftest Fail Alarm	Minor	312
06	23	Volumetric Line Leak Alarm	VLLD Pressure Warning	Critical	4
06	24	Volumetric Line Leak Alarm	VLLD Pressure Alarm	Critical	5
06	25	Volumetric Line Leak Alarm	VLLD Gross Test Fault Alarm	Minor	313
06	26	Volumetric Line Leak Alarm	VLLD Periodic Test Fault Alarm	Minor	314
06	27	Volumetric Line Leak Alarm	VLLD Annual Test Fault Alarm	Major	120

06	28	Volumetric Line Leak Alarm	VLLD Fuel Out Alarm	Minor	315
07	02	Groundwater Sensor Alarm	Groundwater Sensor Setup Data Warning	System	507
07	03	Groundwater Sensor Alarm	Groundwater Sensor Fuel Alarm	Critical	17
07	04	Groundwater Sensor Alarm	Groundwater Sensor Out Alarm	Major	136
07	05	Groundwater Sensor Alarm	Groundwater Sensor Short Alarm	System	501
07	07	Groundwater Sensor Alarm	Groundwater Sensor Water Out Alarm	Minor	316
08	02	Type A Sensor Alarm	Type A Sensor Setup Data Warning	System	508
08	03	Type A Sensor Alarm	Type A Sensor Fuel Alarm	Major	137
08	04	Type A Sensor Alarm	Type A Sensor Out Alarm	Minor	317
08	05	Type A Sensor Alarm	Type A Sensor Short Alarm	Critical	11
08	06	Type A Sensor Alarm	Type A Sensor Water Alarm	Minor	318
11	01	Relay Alarm	Relay Setup Data Warning	System	525
11	02	Relay Alarm	Relay Out Alarm	System	546
12	02	Type B Sensor Alarm	Type B Sensor Setup Data Warning	System	509
12	03	Type B Sensor Alarm	Type B Sensor Fuel Alarm	Major	138
12	04	Type B Sensor Alarm	Type B Sensor Out Alarm	Minor	319
12	05	Type B Sensor Alarm	Type B Sensor Short Alarm	Critical	12
12	08	Type B Sensor Alarm	Type B Sensor High Liquid Alarm	Major	139
12	10	Type B Sensor Alarm	Type B Sensor Liquid Warning	Minor	320
13	02	Universal Sensor Alarm	Universal Sensor Setup Data Warning	System	526
13	03	Universal Sensor Alarm	Universal Sensor Fuel Alarm	Major	147
13	04	Universal Sensor Alarm	Universal Sensor Out Alarm	Major	148
13	05	Universal Sensor Alarm	Universal Sensor Short Alarm	Major	149
13	06	Universal Sensor Alarm	Universal Sensor Water Alarm	Major	150
13	07	Universal Sensor Alarm	Universal Sensor Water Out Alarm	Major	151
13	08	Universal Sensor Alarm	Universal Sensor High Liquid Alarm	Major	152
13	09	Universal Sensor Alarm	Universal Sensor Low Liquid Alarm	Major	153
13	10	Universal Sensor Alarm	Universal Sensor Liquid Warning	Major	154
14	01	Auto-Dial Fax Alarm	Autodial Setup Data Warning	System	603
14	02	Auto-Dial Fax Alarm	Autodial Failed Alarm	Minor	391
14	03	Auto-Dial Fax Alarm	Autodial Service Report Warning	Minor	399
14	04	Auto-Dial Fax Alarm	Autodial Alarm Clear Warning	Minor	398
14	05	Auto-Dial Fax Alarm	Autodial Delivery Report Warning	Minor	397
18	01	Mechanical Dispenser Interface	DIM Setup Data Warning	System	543
18	02	Mechanical Dispenser Interface	DIM Disabled Alarm	System	528
18	03	Mechanical Dispenser Interface	DIM Communication Failure Alarm	System	527
18	04	Mechanical Dispenser Interface	DIM Transaction Alarm	System	544
19	01	Electronic Dispenser Interface	DIM Setup Data Warning	System	545
19	02	Electronic Dispenser Interface	DIM Disabled Alarm	System	542

19	03	Electronic Dispenser Interface	DIM Communication Failure Alarm	System	541
19	04	Electronic Dispenser Interface	DIM Transaction Alarm	System	540
20	01	Product Alarm	BIR Setup Data Warning	System	524
20	02	Product Alarm	BIR Threshold Alarm	System	539
20	03	Product Alarm	BIR Close Shift Warning	System	538
20	04	Product Alarm	BIR Close Daily Warning	System	536
21	01	Pressure Line Leak Alarm	PLLD Setup Data Warning	System	510
21	02	Pressure Line Leak Alarm	PLLD Gross Test Fail Alarm	Major	121
21	03	Pressure Line Leak Alarm	PLLD Annual Test Fail Alarm	Major	122
21	04	Pressure Line Leak Alarm	PLLD Periodic Test Needed Warning	Minor	321
21	05	Pressure Line Leak Alarm	PLLD Periodic Test Needed Alarm	Minor	322
21	06	Pressure Line Leak Alarm	PLLD Sensor Open Alarm	System	512
21	07	Pressure Line Leak Alarm	PLLD High Pressure Alarm	Critical	7
21	08	Pressure Line Leak Alarm	PLLD Shutdown Alarm	Major	123
21	09	Pressure Line Leak Alarm	PLLD High Pressure Warning	Critical	8
21	10	Pressure Line Leak Alarm	PLLD Continuous Handle On Warning	Minor	323
21	11	Pressure Line Leak Alarm	PLLD Periodic Test Fail Alarm	Major	124
21	12	Pressure Line Leak Alarm	PLLD Annual Test Needed Warning	Minor	324
21	13	Pressure Line Leak Alarm	PLLD Annual Test Needed Alarm	Major	125
21	14	Pressure Line Leak Alarm	PLLD Low Pressure Alarm	Major	140
21	15	Pressure Line Leak Alarm	PLLD Sensor Short Alarm	Critical	9
21	16	Pressure Line Leak Alarm	PLLD Continuous Handle On Alarm	Minor	325
21	17	Pressure Line Leak Alarm	PLLD Fuel Out Alarm	Minor	326
21	18	Pressure Line Leak Alarm	PLLD Line Equipment Alarm	System	513
26	01	Wireless PLLD Alarm	WPLLD Setup Data Warning	System	514
26	02	Wireless PLLD Alarm	WPLLD Gross Test Fail Alarm	Major	127
26	03	Wireless PLLD Alarm	WPLLD Periodic Test Fail Alarm	Major	128
26	04	Wireless PLLD Alarm	WPLLD Periodic Test Needed Warning	Minor	327
26	05	Wireless PLLD Alarm	WPLLD Periodic Test Needed Alarm	Minor	329
26	06	Wireless PLLD Alarm	WPLLD Sensor Open Alarm	System	515
26	07	Wireless PLLD Alarm	WPLLD Communications Alarm	Major	129
26	08	Wireless PLLD Alarm	WPLLD Shutdown Alarm	Major	130
26	09	Wireless PLLD Alarm	WPLLD Continuous Handle On Warning	Minor	331
26	10	Wireless PLLD Alarm	WPLLD Annual Test Fail Alarm	Major	131
26	11	Wireless PLLD Alarm	WPLLD Annual Test Needed Warning	Minor	333
26	12	Wireless PLLD Alarm	WPLLD Annual Test Needed Alarm	Major	132
26	13	Wireless PLLD Alarm	WPLLD High Pressure Warning	Critical	1
26	14	Wireless PLLD Alarm	WPLLD High Pressure Alarm	Critical	2
26	15	Wireless PLLD Alarm	WPLLD Sensor Short Alarm	Critical	3
26	16	Wireless PLLD Alarm	WPLLD Continuous Handle On Alarm	Minor	334
26	17	Wireless PLLD Alarm	WPLLD Fuel Out Alarm	Minor	335
26	18	Wireless PLLD Alarm	WPLLD Line Equipment Alarm	System	516
28	01	Smart Sensor Alarm	Smart Sensor Setup Data Warning	System	517
28	02	Smart Sensor Alarm	Smart Sensor Communication Alarm	Major	155
28	03	Smart Sensor Alarm	Smart Sensor Fault Alarm	Major	156

28	04	Smart Sensor Alarm	Smart Sensor Fuel Warning	Major	157
28	05	Smart Sensor Alarm	Smart Sensor Fuel Alarm	Critical	16
28	06	Smart Sensor Alarm	Smart Sensor Water Warning	Minor	351
28	07	Smart Sensor Alarm	Smart Sensor Water Alarm	Minor	361
28	08	Smart Sensor Alarm	Smart Sensor High Liquid Warning	Major	145
28	09	Smart Sensor Alarm	Smart Sensor High Liquid Alarm	Major	146
28	10	Smart Sensor Alarm	Smart Sensor Low Liquid Warning	Minor	362
28	11	Smart Sensor Alarm	Smart Sensor Low Liquid Alarm	Minor	363
28	12	Smart Sensor Alarm	Smart Sensor Temperature Warning	Minor	364
28	13	Smart Sensor Alarm	Smart Sensor Relay Active	Minor	365
28	14	Smart Sensor Alarm	Smart Sensor Install Alarm	System	518
28	15	Smart Sensor Alarm	Smart Sensor Sensor Fault Warning	Major	158
28	16	Smart Sensor Alarm	Smart Sensor Vacuum Warning	Minor	396
28	17	Smart Sensor Alarm	Smart Sensor No Vacuum Warning	Major	159
29	01	Modbus Alarm	Improper Setup Alarm	System	570
29	02	Modbus Alarm	Communication Loss Alarm	Major	164
30	01	ISD Site Alarm	Stage 1 Transfer Monitoring Failure Warning	Minor	385
30	02	ISD Site Alarm	Containment Monitoring Gross Failure Warning	Minor	369
30	03	ISD Site Alarm	Containment Monitoring Gross Failure Alarm	Major	165
30	04	ISD Site Alarm	Containment Monitoring Degradation Failure Warning	Minor	372
30	05	ISD Site Alarm	Containment Monitoring Degradation Failure Alarm	Major	166
30	06	ISD Site Alarm	Containment Monitoring CVLD Failure Warning	Minor	375
30	07	ISD Site Alarm	Containment Monitoring CVLD Failure Alarm	Major	167
30	08	ISD Site Alarm	Vapor Processor Over Pressure Failure Warning	Minor	378
30	09	ISD Site Alarm	Vapor Processor Over Pressure Failure Alarm	Major	168
30	10	ISD Site Alarm	Vapor Processor Status Test Warning	Minor	342
30	11	ISD Site Alarm	Vapor Processor Status Test Alarm	Minor	343
30	12	ISD Site Alarm	Missing Relay Setup Alarm	System	571
30	13	ISD Site Alarm	Missing Hose Setup Alarm	System	572
30	14	ISD Site Alarm	Missing Tank Setup Alarm	System	573
30	15	ISD Site Alarm	Missing Vapor Flow Meter Alarm	Minor	380
30	16	ISD Site Alarm	Missing Vapor Pressure Sensor Alarm	Minor	379
30	17	ISD Site Alarm	Missing Vapor Pressure Input Alarm	System	533
30	18	ISD Site Alarm	Setup Fail Warning	System	574
30	19	ISD Site Alarm	Setup Fail Alarm	System	575
30	20	ISD Site Alarm	Sensor Out Warning	Major	169
30	21	ISD Site Alarm	Sensor Out Alarm	Major	170
30	22	ISD Site Alarm	PC-ISD Offline	Major	171
31	01	ISD Hose Alarm	Collection Monitoring Gross Failure Warning	Minor	381
31	02	ISD Hose Alarm	Collection Monitoring Gross Failure Alarm	Minor	382
31	03	ISD Hose Alarm	Collection Monitoring Degradation Failure Warning	Major	172
31	04	ISD Hose Alarm	Collection Monitoring Degradation Failure Alarm	Major	173
31	05	ISD Hose Alarm	Flow Performance Hose Blockage Failure Warning	Minor	383
31	06	ISD Hose Alarm	Flow Performance Hose Blockage Failure Alarm	Minor	384
31	07	ISD Hose Alarm	Vapor Flow Meter Setup Alarm	System	576

32	01	ISD Vapor Flow Meter Alarm	Locked Rotor Alarm	Major	174
32	02	ISD Vapor Flow Meter Alarm	VFM Setup Data Warning	System	577
32	03	ISD Vapor Flow Meter Alarm	VFM Setup Data Alarm	System	578
33	01	PMC Alarm	Vapor Processor Run Time Fault Warning	System	535
33	02	PMC Alarm	Processor Monitoring Effluent Emissions Failure Warning	Minor	387
33	03	PMC Alarm	Processor Monitoring Effluent Emissions Failure Alarm	Major	178
33	04	PMC Alarm	Processor Monitoring Over Pressure Failure Warning	Minor	386
33	05	PMC Alarm	Processor Monitoring Over Pressure Failure Alarm	Major	175
33	06	PMC Alarm	Processor Monitoring Duty Cycle Failure Warning	Minor	388
33	07	PMC Alarm	Processor Monitoring Duty Cycle Failure Alarm	Major	180
33	08	PMC Alarm	PMC Setup Warning	System	531
33	09	PMC Alarm	PMC Out Alarm	Minor	393
34	01	Pump Relay Monitor Alarm	Setup Data Warning	System	579
34	02	Pump Relay Monitor Alarm	Pump Relay Alarm	Minor	392
35	01	VMCI Dispenser Interface Alarm	VMCI Dispenser Interface Setup Data Warning	System	580
35	02	VMCI Dispenser Interface Alarm	VMCI Dispenser Interface Disabled VMCI Alarm	Minor	358
36	01	VMC Alarm	VMC Communication Timeout	Minor	359
36	02	VMC Alarm	VMC Meter Not Connected	Minor	360
36	03	VMC Alarm	VMC FP Shutdown Warning	Major	176
36	04	VMC Alarm	VMC FP Shutdown Alarm	Major	177
58		ISD Ullage Pressure Sensor Alarm	NOT DEFINED	Minor	357
59	02	MAG Sensor Alarm	MAG Sensor Setup Data Warning	System	519
59	03	MAG Sensor Alarm	MAG Sensor Communication Alarm	Major	141
59	04	MAG Sensor Alarm	MAG Sensor Fault Alarm	Critical	10
59	05	MAG Sensor Alarm	MAG Sensor Fuel Warning	Minor	336
59	06	MAG Sensor Alarm	MAG Sensor Fuel Alarm	Major	142
59	07	MAG Sensor Alarm	MAG Sensor Water Warning	Minor	337
59	08	MAG Sensor Alarm	MAG Sensor Water Alarm	Minor	338
59	09	MAG Sensor Alarm	MAG Sensor High Liquid Warning	Major	143
59	10	MAG Sensor Alarm	MAG Sensor High Liquid Alarm	Major	144
59	11	MAG Sensor Alarm	MAG Sensor Low Liquid Warning	Minor	339
59	12	MAG Sensor Alarm	MAG Sensor Low Liquid Alarm	Minor	340
59	13	MAG Sensor Alarm	MAG Sensor Temperature Warning	Minor	341
59	14	MAG Sensor Alarm	MAG Sensor Relay Active	System	521
59	15	MAG Sensor Alarm	MAG Sensor Install Alarm	System	522
60		Vacuum Sensor Alarm	NOT DEFINED	Minor	356
63	01	Line Pressure Sensor Alarm	LPR Sensor Setup Data Warning	System	532

63	02	Line Pressure Sensor Alarm	LPR Sensor Communication Alarm	Major	160
64	01	Printer Alarm	Printer Out Of Paper	System	534
64	02	Printer Alarm	Printer Error	System	503
65	01	Pump Alarm	Pump Setup Data Warning	System	590
65	02	Pump Alarm	Pump Out Alarm	Minor	352
66	01	Line Alarm	Line Setup Data Warning	System	537
66	02	Line Alarm	Line Out Alarm	Major	179
73	01	Communication Alarm	Communication Setup Data Warning	System	591
74	01	Contact Alarm	Autodial Setup Data Warning	System	592
74	02	Contact Alarm	Autodial Failed Alarm	System	593
74	03	Contact Alarm	Autodial Service Report Warning	System	594
74	04	Contact Alarm	Autodial Alarm Clear Warning	System	595
74	05	Contact Alarm	Autodial Delivery Report Warning	System	602
74	06	Contact Alarm	Autodial No Dialtone Alarm	System	596
74	07	Contact Alarm	Autodial Fax Failed Alarm	System	597
74	08	Contact Alarm	Email Failed	System	598
74	09	Contact Alarm	SMS Failed	System	599
75	01	Auto Event Alarm	Auto Event Setup Data Warning	System	601
99	01	Externally Detected Alarm	Externally Detected Communication Alarm	Major	110
99	02	Externally Detected Alarm	Communications - Data Reception Timeout	System	581
99	03	Externally Detected Alarm	Communications - Failed Checksum	Minor	353
99	04	Externally Detected Alarm	Communications - Parity Error	Minor	354
99	05	Externally Detected Alarm	Modem - Line Busy	System	582
99	06	Externally Detected Alarm	Modem - No Answer	System	583
99	07	Externally Detected Alarm	Modem - No Carrier	System	584
99	08	Externally Detected Alarm	Modem - No Dial Tone	System	585
99	09	Externally Detected Alarm	Modem - Modem Error	System	586
99	10	Externally Detected Alarm	Modem - Modem Not Responding	System	587
99	11	Externally Detected Alarm	Modem - Port Not Available	System	588
99	12	Externally Detected Alarm	Polling - Could Not Update Queue	Minor	355
99	13	Externally Detected Alarm	Polling - Invalid Data Type Requested	System	589

20 Troubleshooting

This chapter describes the procedures used to isolate hardware faults.

Troubleshooting the 9810 miniRTU

CPU LED

The miniRTU's CPU LED flashes green if the firmware is running and there is no system error. If the CPU LED stops flashing, then the firmware has stopped running. If the CPU LED flashes red or amber, then the CPU Module's ErrorCode parameter and the output to the Debug Channel can be examined for additional information.

Power Cycling the 9810

Power cycling or reinitializing the 9810 miniRTU is either done by:

- Resetting the CPU Module using an OPC UA client or ViewRTU.
- Physically removing power from the miniRTU and then re-inserting it.

CPU Module Software Installed Resets

The following actions will cause the CPU module to reset:

- Reset CPU Module command
- Apply Firmware command
- Apply
- New Database to RTU command
- Factory
- Reset command
- Factory
- Reset Limited command

9810 miniRTU Error Codes

The following list is designed to assist the user to determine what is happening with the 9810 to help them fix issues that are occurring. Any error code that is not displayed below will require assistance from Varec's Technical Support.

These error codes are reported in the CPU Module ErrorCode parameter. In addition, these error codes and descriptions are saved in the Debug Log and printed on the terminal connected to the Debug Channel.

Error Code	Description	Resolution	CPU LED
0x0D09	The Modbus client used an unsupported Modbus WriteCmd.	Reconfigure WriteCmd in MFPREG or MIREG. Supported Modbus write Functions are: 5, 6, 16, 66.	Amber
0x0D0A	The Modbus client used an unsupported Modbus ReadCmd.	Reconfigure ReadCmd in MFPREG or MIREG. Supported Modbus read Functions are: 1, 2, 3, 4, 8 (loopback), 65	Amber
0x0F20	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x011A7	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x1209	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x1309	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x1409	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x150B	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x1750	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x1A70	The external USB flash drive was not installed when trying to copy the Error Log to the external USB flash drive.	Insert an external USB Flash Drive. If one is installed, then try removing the External USB and plugging it back in.	Amber
0x2002	The user tried to configure an invalid MFPREG IPAddress.	Reconfigure using a valid IP address. If this error happens again, contact Varec.	Amber
0x2003	Error encountered with MFPREG Size1, Size2, Size3, or Size4 parameter.	The sum of Size1, Size2, Size3, and Size4 must equal 64 or less. Reconfigure these parameters so they add up to 64 or less.	Amber
0x2102	The user tried to configure an invalid MIREG IPAddress.	Reconfigure using a valid IP address.	Amber
0x2103	Error encountered with MIREG Size1, Size2, Size3, or Size4 parameter.	The sum of Size1, Size2, Size3, and Size4 must equal 64 or less. Reconfigure these parameters so they add up to 64 or less.	Amber
0x2504	Tank has an invalid IpAddress.	Configure a valid IpAddress.	Amber

0x2512	Error encountered while using a Tank's DeviceCmd "Copy ItemCmdFile", "Copy Cfg to USB", or "Copy Log to USB" options.	Install a USB Flash Drive and try the operation again.	Amber
0x2B03	Problem encountered while executing a Tank DeviceCmd.	A bad response was received to a command in the ItemCmdFile. Verify that the contents of the ItemCmdFile are correct and try executing this again.	Red
0x2B04	Problem encountered while executing a Tank DeviceCmd.	A tank's ItemCmdFile could not be opened. Verify that the configured ItemCmdFile exists.	Amber
0x2B07	Problem encountered while executing a Tank DeviceCmd.	No response was received to a command in the ItemCmdFile. Verify that the contents of the ItemCmdFile are correct and try executing this again.	Red
0x2B08	Tank ItemCmd timed out.	Try executing this ItemCmd again. If this error persists, then verify that this ItemCmd is being sent to a device that supports it.	Red
0x2B09	Tank ItemCmd bad response.	Try executing this ItemCmd again. If this error persists, then verify that this ItemCmd is being sent to a device that supports it.	Red
0x2B0A	Tank ItemCmd CIU timed out.	Try executing this ItemCmd again. If this error persists, then verify that this ItemCmd is being sent to a CIU that supports it.	Red
0x2B0B	Tank ItemCmd CIU bad response.	Try executing this ItemCmd again. If this error persists, then verify that this ItemCmd is being sent to a CIU that supports it.	Red
0x3004	An incorrectly formatted Modbus Function 1, 2, 3, or 4 was received on a Modbus Slave channel.	Check the device that is sending the Modbus message to the miniRTU.	Red
0x300B	An incorrectly formatted Modbus Function 5 or 6 was received on a Modbus Slave channel.	Check the device that is sending the Modbus message to the miniRTU.	Red
0x300C	Unable to find an address match for the incoming Modbus Function 5 or 6.	Check the Gateway Block Addresses to make sure that they match what's being sent by the Modbus Master device.	Red
0x300E	Invalid Force Data field received for Modbus Function 5.	Check the device that is sending message to the miniRTU. FF00 indicates "ON", 0000 indicates "OFF".	Red
0x3011	An incorrectly formatted Modbus Function 8 was received on a Modbus Slave channel.	Check the device that is sending the Modbus message to the miniRTU.	Red
0x3012	An incorrectly formatted Modbus Function 15 or 16 was received on a Modbus Slave channel.	Check the device that is sending the Modbus message to the miniRTU.	Red
0x3013	Unable to find an address match for the incoming Modbus Function 15 or 16.	Check the Gateway Block Addresses to make sure that they match what's being sent by the Modbus Master device.	Red

0x3017	The miniRTU received a Modbus command for a function that the miniRTU does not support.	Check device sending message to the miniRTU.	Red
0x3502	The Modbus Master channel used an unsupported Modbus WriteCmd.	Reconfigure WriteCmd in MFPREG or MIREG. Supported Modbus write Functions are: 5, 6, 16, 66.	Amber
0x3503	The Modbus Master channel used an unsupported Modbus ReadCmd.	Reconfigure ReadCmd in MFPREG or MIREG. Supported Modbus read Functions are: 1, 2, 3, 4, 8 (loopback), 65.	Amber
0x3609	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x3900	USB flash drive not detected while copying the firmware from the USB flash drive to the miniRTU.	Insert a USB flash drive. If one is installed, then try removing the USB and plugging it back in.	Amber
0x3901	Error encountered while copying the firmware from the USB flash drive to the miniRTU.	The miniRTU firmware file must be on the external USB flash drive. Verify that the file is present.	Amber
0x3910	USB flash drive not detected while copying the configuration database from the USB flash drive to the miniRTU.	Insert a USB flash drive. If one is installed, then try removing the USB and plugging it back in.	Amber
0x3911	The value of DBDirectory used to copy the configuration database from the USB flash drive to the miniRTU is invalid.	The first character of DBDirectory must be alpha-numeric. Configure a valid DBDirectory and try copying the database again.	Amber
0x3912	Error encountered while copying the configuration database from the USB to the miniRTU.	The DBDirectory does on exist on the USB flash drive. However, the datafile is missing. Add the RTUdb database file.	Amber
0x3920	USB flash drive not detected while copying the configuration database from the miniRTU to the USB flash drive.	Insert a USB flash drive. If one is installed, then try removing the USB and plugging it back in	Amber
0x3921	The value of DBDirectory used to copy the configuration database from the miniRTU to the USB flash drive is invalid.	The first character of DBDirectory must be alpha-numeric. Configure a valid DBDirectory and try copying the database again.	Amber
0x3930	USB flash drive installed while trying to set the configuration to factory default.	Remove the USB flash drive and execute the command again.	Amber
0x3940	USB flash drive not detected while performing a backup or restore of the miniRTU files.	Insert a USB flash drive. If one is installed, then try removing the USB and plugging it back in	Amber
0x3E09	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x3F09	An OPC UA client sent an unsupported Node ID to the miniRTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID.	Red
0x4702	A periodic task missed its scheduling deadline.	This error should correct itself. If it does not, then manually reset the miniRTU.	Amber

21 Order Codes

9810 miniRTU

Model	a	Description
N9812		BPM -Bi-Phase Mark
N9814		SER - Serial
N9815		M/S - Mark/Space
N9816		TW - Tankway
	A	Flange Mount
	B	DIN Rail Mount

Spare Parts

Part Number	Description
	Cables & Connectors
P108-04-024	RS232 DB9 F/F Null Modem Cable, 10 ft, Low-Profile Connectors
P108-04-027	USB 2.0 A/B Cable, 6.6 ft / 2 meter, Black
P108-04-028	Ethernet Patch Cable, 6 ft / 2 meter
13-013512	9812 GPU BPM Module Terminal Plug Kit
13-013514	9814 Serial Module Terminal Plug Kit
13-013515	9815 Mark/Space Module Terminal Plug Kit
13-013516	9816 Tankway Module Terminal Plug Kit
200061338	RS232 DB9 F/F Null Modem Cable, 6 ft, Black
210061215	Terminal Plug, Right Angle, with Screw Terminals, Female, Green, 3 Position, 0.200" Spacing, MSTB
210061303	Terminal Plug, Right Angle, with Screw Terminals, Female, Green, 2 Position, 0.200" Spacing, MSTB
210061380	Terminal Plug, Right Angle, with Screw Terminals, Female, Green, 4 Position, 0.200" Spacing, MSTB
	Enclosure Components
P031-45-1773	9810 Chassis Ground Lug Retaining Nut
P102-18-021	9810 Chassis Ground Lug
P117-01-010	9810 CPU CR1220 3V Lithium Coin Cell Battery

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