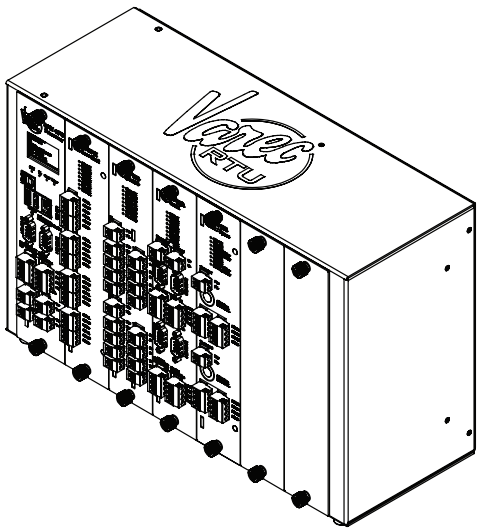
IOM142-20220421

8810 Remote Terminal Unit

Next Generation Remote Terminal Unit for
bulk liquid inventory management

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 A statement pointing out something that the reader needs to pay attention to when dealing with what is described in the general text.

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	6/15/2021	J. M. Rollins		Initial Change History table addition
B	4/13/2022	J. M. Rollins		Added updated info concerning the Digital Input/Output modules & expansion of Enraf's Engauge
C	4/21/2022	J. M. Rollins		Added Enraf-based parameters to the TANK table

1 Overview

The 8810 RTU is a member of Varec's complete line of industrial control systems and products. The 8810 RTU is primarily designed for applications where a cost-effective control system is needed for remote collection of field data and control of equipment.

The 8810 RTU is ideally suited for Tank Farm, Terminal, Pipeline, and Refinery 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.

Features and Specifications

General

- Built-in software function library
- Field problem surge protection circuits
- Host communication via Ethernet RS-232 and RS-485
- Industry standard protocols: Modbus and OPC UA
- I/O interfaces: DI, DO
- Quick-disconnect I/O terminations
- Modular construction for optimum expandability
- Non-volatile database
- Redundant power inputs
- 6 expansion slots
- 27+ channels (more for DIO)
- Supports up to 400 tanks
- 100,000+ OPC UA objects

Common Applications*

- Low, Low-Low, High, and High-High alarms
- Pressure, temperature, level, and flow
- Bottom sediment & water (BS&W)
- Pump status & control
- Valve status & control
- Emergency shut-off
- Leak detection
- Local indication & alarms

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

CPU

- 800 MHz quad-core CPU
- Green Hills INTEGRITY RTOS with ARINC-653 partitioning
- NIST SP 800-53 & FIPS 140-2 compliant (future)

Memory

- 1 x 32 GB USB flash drive
- 2 x 32 GB micro SD cards
- 2048 MB high-speed RAM

Power Requirements

- 24 VDC, nominal, input power shall be limited to 20 W with current protection device
- 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 over TCP

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

- 8810 RTU Case: 15.50" W x 9.85" H x 6.05" 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 8810 RTU fuses at higher altitudes.
- Pollution degree rating 3: Conductive pollution or dry nonconductive pollution that becomes conductive due to condensation occurs. To be found in industrial environment or constructive sites (harsh environments).

** For Outdoor Use: The product shall be enclosed in either an IP 55 minimum rated or NEMA 3R rated enclosure.*

Digital Inputs/Outputs DC Powered

- Maximum quantity: 48
- Isolation voltage: Up to 4000 Vrms*
- Operating voltage:
  - Output: 60 VDC max, 1A max*
  - Input: 8813 input module P111-41-013 is rated 60 VDC max, 6 mA max. All other 8813 input modules are rated 32 VDC max., 18 mA max.

  Note Each channel is different. Refer to the 8814 Digital I/O module's chapter for more information.

Intelligent Communications Interfaces

- Tank gauge communications via expansion modules
- 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 left side of the RTU.

8810 Wiring and Connection Ports

The 8810 RTU contains RS232/485, USB, and RJ connections ports that are low level signal lines. The 8810 RTU input power and modules utilize Phoenix contact type connectors which are intended to interconnect with external signals and low-voltage sources limited to less than 100VA. 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 on all terminals.

Field Maintenance

Field maintenance should be performed by authorized personnel only.

Field maintenance of the 8810 RTU is simplified by several built-in features. The modular design of the computer control system, in conjunction with quick-disconnect connectors, allows for on-site replacement of questionable components.

Note Replace fuses with correctly rated fuses.

I/O Expansion

The 8810 RTU can interface to a variety of field devices and intelligent instrumentation via expansion modules. Many diverse products are available to serve a variety of needs. The available expansion modules are listed below:

- 8812 BPM: Bi-Phase Mark
- 8813 DIO: Digital I/O
- 8814 SER: Serial
- 8815 M/S: Mark/Space
- 8816 LJ: L&J Tankway
- 8817 VR: Veeder-Root
- 8818 AI: Analog Input

2 Hardware, Software, and Security

In addition to the Input/Output functions of the 8810 RTU, several other standard features are provided. These features include multitasking, partitioned architecture, an embedded OPC UA server, 1000 user-configurable alarm conditions, a built-in software library, data-scanning routines, and database management as well as being field upgradeable.

The 8810 RTU is designed to be supported by modern digital I/O interfaces such as the Bi-Phase Mark, Mark/Space, and Digital I/O cards as well as others. Through these interfaces, the 8810 RTU can connect most signals encountered in industrial environments. The 8810 RTU can also interface to Host systems using a variety of industry standard protocols.

Hardware Description

The 8810 RTU consists of an enclosure, a high-performance CPU module containing a 800 MHz quad-core CPU, communication subsystems, and with a full complement of digital input/output circuitry.

The basic 8810 RTU is constructed as an 8811 CPU module connected to a backplane slot with an additional space for six expansion modules. The modules are described and illustrated in Chapters 5 through 8. An illustration of the 8810 RTU is shown below.

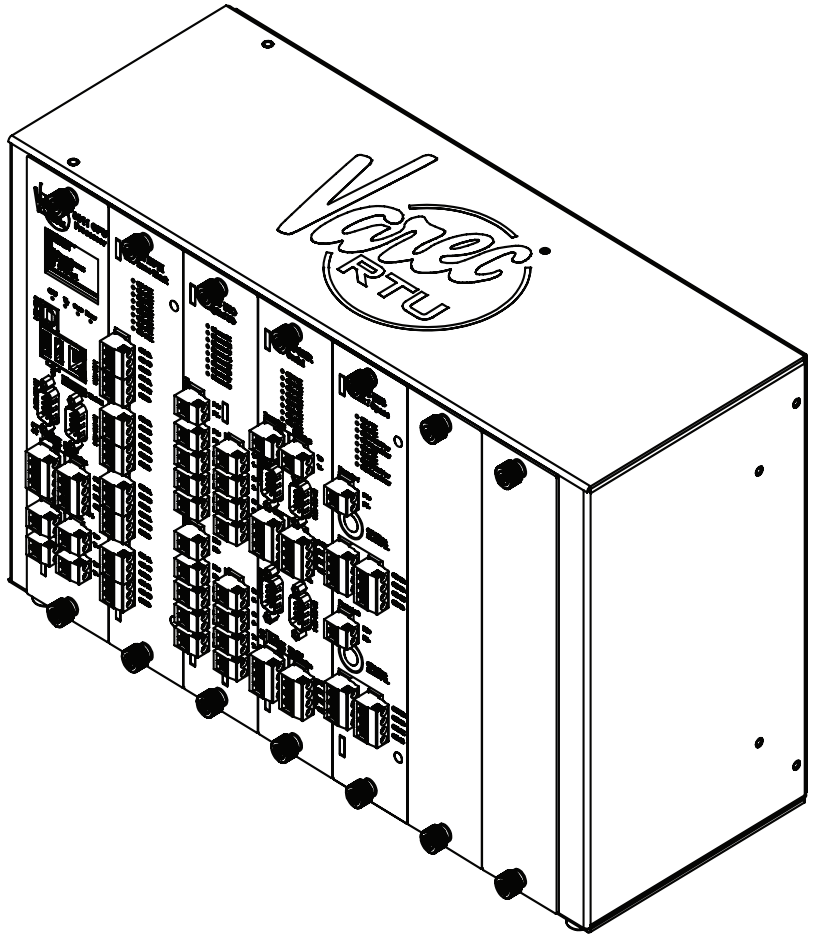


Figure 2-1: 8810 RTU Isometric View

8810 Modules

An example of the 8810 RTU is shown below with four optional modules installed. The CPU module (8811) cannot be installed in any other slot other than slot 0. Other types of modules can be installed in slots 1 through 6 in the 8810 RTU.

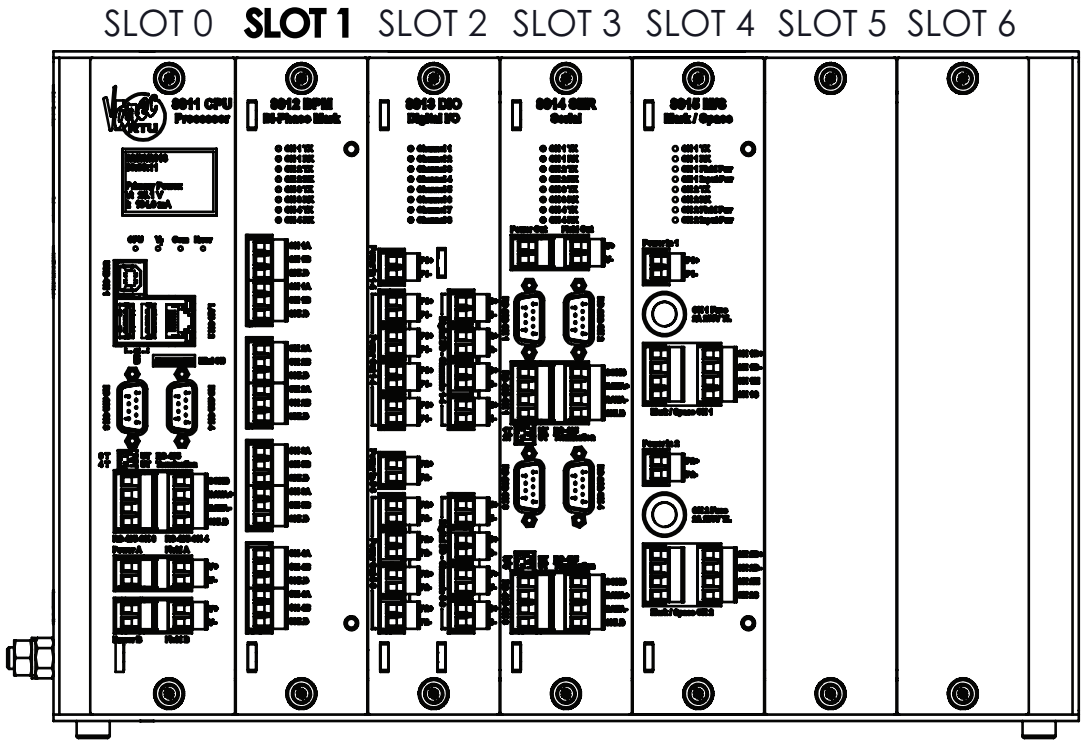


Figure 2-2: 8810 RTU Front View with Four Modules with Slot 1 Highlighted

The 8811 CPU Module in Slot 0 incorporates an 800 MHz quad-core CPU with 2048 MB of high-speed RAM with expansion for two 32 GB USB flash drive and one 32 GB micro SD card drive. The optional modules in the above view are the 8812 Bi-Phase Mark module in Slot 1, 8813 Digital I/O module in Slot 2, 8814 Serial module in slot 3, and 8815 Mark/Space module in slot 4. The above configuration is just an example of what can be used in each slot.

8810 Label Explanation

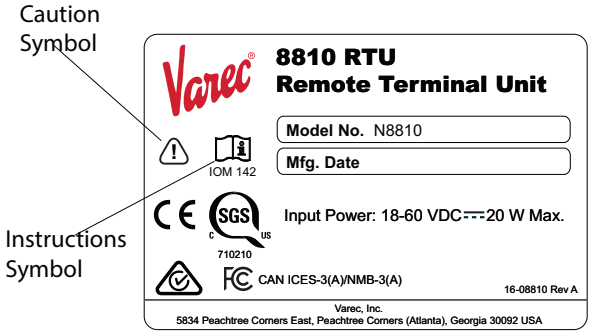


Figure 2-3: 8810 Chassis Label with Caution and Instruction Symbols

- Caution Symbol: Consult accompanying documents
- Instructions Symbol: Refer to the operating instructions manual IOM142

Software Description

The 8810 RTU 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 8810 RTU to interface as a master or slave device.

Software Features

Real-Time / Multiprocessing Support

The operation of the 8810 RTU 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 8811's multicore processors.

Real-Time Clock

Integral to the RTOS is the system's real-time clock. All timed events of the 8810 RTU 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 8810 RTU is designed so that system resources will have the CPU time and memory to fulfill their tasks without other demands on the software and RTU interfering with processes. Even if an unintended event occurring that impacts one thread, the rest of the system processes can make use of the multithreading capabilities of the CPU to continue to run without issues and keep the operating system's integrity as a whole intact.

Firmware Features

The 8810 RTU 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.

Using Vertue, the process of updating the firmware is straightforward. First the administrator or Varec service technician inserts a USB flash drive with the updated firmware and Vertue enables the admin or service technician to start the process. The 8811 CPU's LED screen displays the status of the process and will state when to remove the USB flash drive to start the 8811's reboot process so it can start up with the updated firmware.

Real-Time Operating System

The 8810 uses the Green Hills Software INTEGRITY real-time operating system which is designed around reliability via hardware memory protection to isolate and protect applications. The security of the OS is designed to keep malicious code or errors from interfering with processes. The Green Hills OS is also 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 8810's monitoring capabilities.

Communications

There are two COM/serial ports built into the 8811 CPU module and four on each of the six possible 8814 Serial Modules for a total of up to 26 serial ports. In addition, the 8811 CPU Module has a USB Type B port that can be used for communications. Refer to Chapter 4 for the location of these ports. Finally, the 8811 has an Ethernet port for TCP/IP communications.

The serial ports (on both the CPU and the serial modules) support the following data protocols:

- RTU Slave
- Enraf Master
- Modbus Slave
- Modbus Master

Each serial port has a maximum baud rate of 115,200 bps. The OPC UA uses the Ethernet port at 100 Mbps to communicate.

On the 8811 CPU Module, the default configuration for channels 1, 3, and 4 is set to "RTU Slave" with the above-mentioned baud rate of 115,200 bps for channel 1, while ports 3 & 4 default to 19200 baud. (Channel 2 is the Ethernet port.)

For all other channels, the default configuration is "Virtual Channel" which has no baud rate.

Tank, Alarm, Module, CPU, and Port Points

The 8810 RTU allows users to create points to monitor the status of and also communicate with tanks, alarms, modules, the CPU, and port points to provide insight into their tank farms and other equipment.

> **Note** If the values of NumberOfMfpreg, NumberOfMireg, NumberOfGwblk, and NumberOfTanks add up to more than 160, the default number of points for the MFPREG, MIREG, GWBLK, and TANKA point types will be reported through the "RTU Slave" protocol."

Compatibility

The 8810 RTU 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 8810 RTU, then FuelsManager® is the master and the 8810 RTU is the slave. If using OPC UA, the 8810 RTU is the server and FuelsManager is the client.

The 8810 RTU and Security

The 8810 RTU also allows for encryption of communications between Itself and any OPC UA Clients—no authentication (Anonymous), simple username and password, and certificates. Below are the different ways to configure the 8810's security modes to connect to the 8810 RTU: via use of X.509 certificates or simple username and password (which is the default method to connect).

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.

The 8810 Server Certificate

When a client first connects to the 8810, the Server Certificate will be presented. The user will be prompted as to whether to add the certificate to the Trusted Store. The user must click Yes in order for this client to be able to communicate with the 8810.

This self-signed certificate is used for any connection that requires Sign or Sign & Encrypt, even if the User Identity is set to Username. Make sure to copy this self-signed certificate into one of the 8810's certificate slots.

Client certificates must have a .pfx file present and located in C:\ProgramData\Softing\OpcClient\pki\own\private. Client certificates are only used when Mode is set to Sign or Sign & Encrypt **and** User Identity is set to Certificate. This certificate must also be copied into one of the 8810's certificate slots.

Note The Security Mode, Security Policy, and User Identity parameters are stored in the .rtuconfig file. When working with saved files, be sure to confirm the parameters are set properly for your RTU prior to doing a Write To RTU.

Note Use the pwreset file to restore default security on the RTU if you are unable to connect to it. The pwreset file will set Security Mode back to None, Security Policy to None, and User Identity to Username. It will restore the default admin and user1 passwords so those accounts can be used to connect.

Configuring the 8810 RTU's Authentication Options

1. Select the SecurityMode to use for authentication between users and the 8810 RTU.

   Note With the use of X.509 certificates, the 8810 RTU can ensure three different levels of security: None, Signed, and SignedAndEncrypted.

   Administrators are able to configure the RTU to use the three listed methods:

   - **None** which means using no security: no certificates and the data is transmitted unencrypted
   - **Sign** where the client and the 8810 have confirmed their identities using X.509 certificates allowing for unencrypted data transfer
   - **SignAndEncrypt** where the client and the 8810 have confirmed their identities using X.509 certificates and are exchanging encrypted data so only the 8810 and the confirmed client can understand the encrypted data being transferred

   Note There are five communication options that the 8810 RTU use with or without the use of X.509 certificates through the following settings:

   - **Anonymous** is where the client connects to the 8810 with no form of verification
   - (Default) **Unsigned & Unencrypted Username Login** is where only a username and password are required for verification like the default 8810 RTU login listed in this manual.
   - **Signed & Unencrypted Certificate Login** is where both the 8810 and the client have connected server and client X.509 certificates to allow secure, but unencrypted data communication
   - **Signed & Encrypted Username Login** is where the client can connect with the 8810 via username and password, but the communications are encrypted

- **Signed & Encrypted Certificate Login** is where both the 8810 and client have connected server and client X.509 certificates, allowing for secure and encrypted data communication

2. Set the SecurityPolicy which is what form of encryption the 8810 RTU will use which gives the options of Basic256Sha256, Aes128Sha256Oae, and Aes256Sha256Pss.

   Note The following list explains the basic concepts of the three SecurityPolicy choices:

   - **Basic256Sha256** is the standard OPC UA security policy designed for high security needs
   - **Aes128Sha256Oae** is one of the two choices for the gold standard of encryption using 128 bit variable encryption method
   - **Aes256Sha256Pss** is the second choice for the gold standard of encryption, but uses a more robust 256-bit variable encryption method

3. Set the User Identity by selecting one of the following choices:

   - **Anonymous** for allowing people to log in with no username and password or certificate
   - **UserName** for requiring a username and password combination to log in

Remote File Transfer

File Transfer allows users to upload files similar to how the 8810 RTU can use USB flash drives to upload firmware and files to the device, except with a wider range of options other than just the firmware. The maximum file size is just under 20 MB which is 4 MB larger than the largest 8810 RTU file (the boot.uimage).

Note Vertue is required to perform any remote file transfers with the 8810 RTU. Users can still use USB flash drives to transfer files such as firmware, ipconfig files, database, and the Debug Log file.

Note Very large files can take over 30 seconds to read or write depending upon the connection. To prevent the client from timing out, change the client's "Browse Timeout" and "Call Timeout" to 60 seconds.

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

- Boot firmware
- Application firmware
- RTU database
- Debug log
- X.509 certificates
- X.509 server private keys (write only)
- Tank calculation strap files
- Tank Enraf item command files
- Tank NNN Enraf configuration files
- Tank NNN Enraf log files

Firmware

The firmware consists of two executable files—the boot firmware and the application firmware. The larger of the two files, the boot.uimage (the boot firmware) contains the operating system, libraries, and Board Support Package (BSP). The smaller of the two files, the ngrtu (the application firmware) contains the application. It is possible to upgrade either one or both at the same time.

The firmware is only write-only and cannot be read from the RTU.

RTU Database

The 8810 RTU'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 10 seconds to back up or to restore via an external USB flash drive, and only takes 1-2 minutes to update through Vertue's 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 analysed to see what issues could have impacted the proper functionality of the 8810 RTU to help Varec understand and fix any problems.

X.509 Certificates and Keys

X.509 certificates and private keys can be uploaded to the 8810 RTU.

For X.509 certificates, the.der file extension must be used to download an X.509 certificate. If the filename matches the name in the first X.509 certificate **CertFile** parameter, then the file will be treated as the 8810 RTU server certificate. Otherwise, it will be treated as a client certificate.

For X.509 private keys, .pem file extension must be used to download an X.509 Private Key. If the filename matches the name in the first X.509 certificate **PrivateKeyFile** parameter, then the file will be treated as the 8810 RTU server private key. Otherwise, it will be rejected. This file is write-only.

Note Client private keys should not be installed on the 8810 RTU.

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

The 8810'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 the 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 400) 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 8810 RTU 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.

The 8810 has been designed so that cables, wires, modules, SD cards, and USB flash drives can be added or removed while the device is powered on. The one component that needs to be powered off is the 8811 CPU since the incoming power connects to the 8811 CPU, and through it to the rest of the RTU. Without the 8811's power, the rest of the RTU will not be able to function.

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 8810 RTU. Make sure to install 14 AWG or larger diameter wire from Earth stud on the unity to dedicated Earth Ground on the left side of the RTU.

Caution! Do not bring in unfiltered outside air. It may introduce harmful contaminants that could damage the 8810 RTU and components.

Caution! Be careful of sharp edges on the 8810 RTU and associated components.

Installation

A standard system is shipped with an 8811 CPU module and any requested optional modules. The 8810 RTU installation procedure includes the installation of these individual components. 8810 RTU installation includes the following steps:

1. Mounting the 8810 RTU
2. Mounting the Enclosure
3. Grounding the 8810 RTU
4. Wiring up Power
5. Configuring an IP Address
6. Installing Modules
7. Configuring I/O Expansion Modules

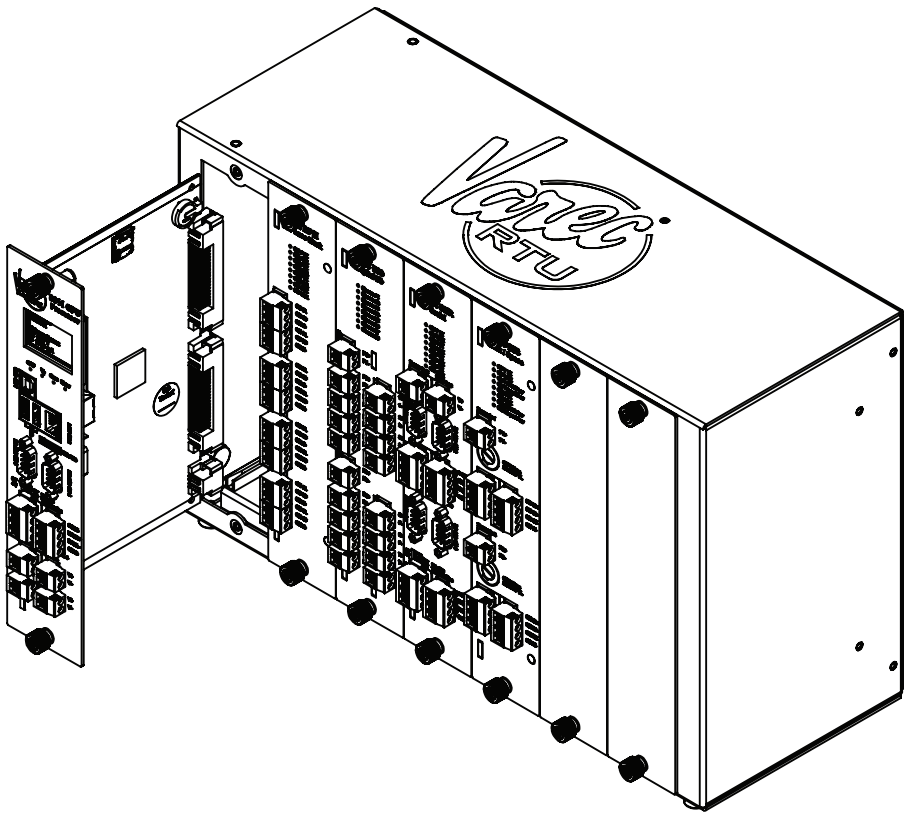


Figure 3-1: 8810 RTU with 8811 CPU Module pulled out

Mounting the 8810 RTU

Before mounting the 8810 RTU, make certain that the enclosure can house the 8810 RTU. Refer to the dimensional drawing below (all dimensions are in inches).

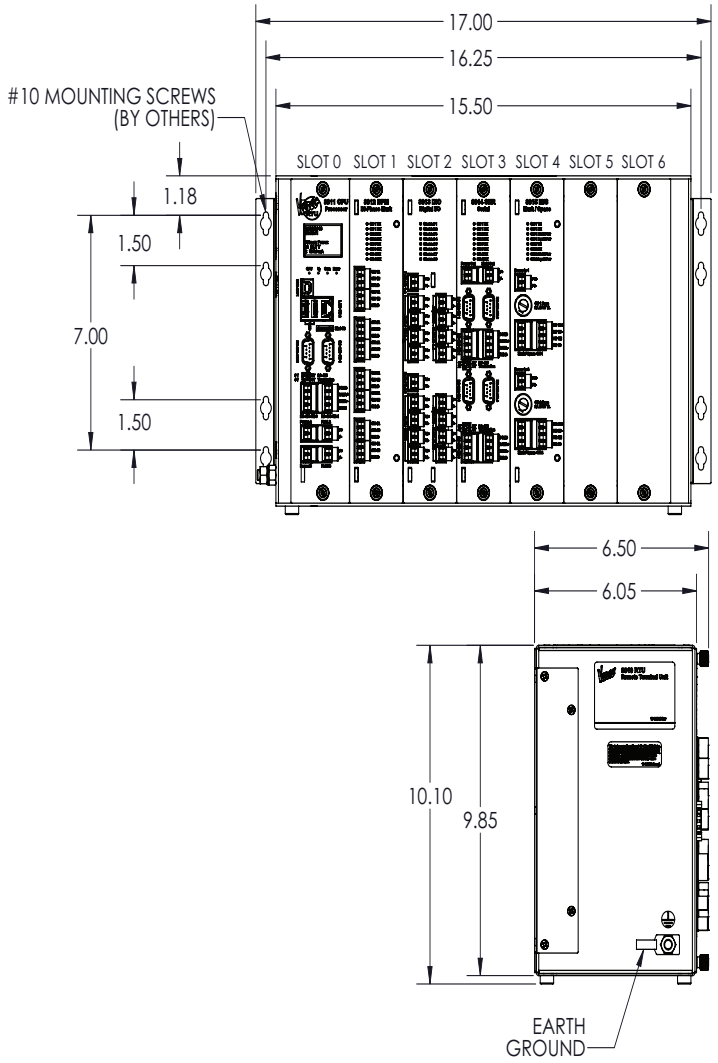


Figure 3-2: 8810 RTU Dimension Drawing

Warning! The RTU 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 8810 RTU will be able to request either having Varec mount the 8810 into an optional, and sold separately, enclosure for them or to install the 8810 into an enclosure themselves.

Note The 8810 RTU shall be mounted in an external cabinet, with a minimum of IP Type 20 or NEMA 12 is recommended for indoor use and either an IP Type 55 or NEMA Type 3R for outdoor use.

Grounding

Grounding the 8810 RTU 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 8810 RTU 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 8810 RTU and its enclosure is provided by the equipment earth grounding connector at in the bottom left corner of the enclosure as shown in Figure 3-2 on page 15.

Grounding connector

- The 8810 RTU enclosure is supplied with a ground stud on the left side 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 8810 RTU 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 8810 RTU.

Wiring Up Power

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

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

The 8810 RTU is externally powered by a 24 VDC nominal power supply. The 8810 RTU can operate over an operation range of 18 to 60 VDC. In addition, the RTU has redundant power input connections.

The input power can be connected to Power A (+,-) or Power B (+,-). Typically, primary power is connected to Power A and backup (redundant) power is applied to Power B. Power is applied using a 18 AWG/300 V wire.

Note Use 300 V/18 AWG or larger diameter wires for power connections.

Configuring an IP Address

To configure an IP address for an 8810 RTU, use the following steps:

1. Create a text file named “ipconfig” (no file type suffix at the end). When setting up the 8810 RTU 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 8810 RTU as they would be entered into the "ipconfig" text file:

   192.168.1.1
   255.255.255.0
   192.168.0.1

   Each value needs to be on a new line.

2. Copy the ipconfig file onto a USB flash drive, and then plug it into one of the two USB ports located on the 8810 RTU CPU Module faceplate.

   The 8810 will auto detect the insertion of this flash drive. If the flash drive contains the file

named “ipconfig”, then the 8810 will attempt to update the IP Address, Gateway, and Subnet Mask configuration.

The RTU will change the name on the flash drive to ipconfig.old so that it won’t update the 8810 RTU if that USB flash drive is ever reinserted with the same ipconfig file. If successful, the screen will display "Ip Config Succeeded."

3. Remove the USB flash drive from the 8810 once the screen on the 8810 reads "Please remove the external USB." Once the USB drive is removed, the 8810 will reboot to use the new IP address.

4. If the update succeeds, the 8810 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 8810 and inadvertently updating that 8810’s IP address with one already used.

5. To verify the new IP address is configured as well as the subnet mask and gateway address, connect with VeRTUe, and then go to Host Network Settings to view the IP address, subnet mask, and gateway address.

   Another option is going to Assets on the left-side menu or Chassis Setup and Module Configuration on the main screen area, selecting the CPU module and then select Config on the right side to see the IP address, subnet mask, and gateway address.

Installing Modules

Warning! Maintenance on the RTU shall only be performed by qualified technicians following appropriate safety guidelines.

Excluding the 8811 CPU module, all of the other modules can be hotswapped even while the RTU is powered on.

Note Before removing any non-CPU interface module, disconnect all cables.

Remove the appropriate slot’s blank face and insert the module, ensuring the main circuit board aligns with the card guides on top and bottom. Press firmly while inserting the module to ensure a good electrical connection. Once the module has clicked into place on the 8810 backplane face, use the screws to secure the module into place.

Power-Up

Before the field cables are attached, perform an initial system verification.

Initial system verification

- Connect the power cable to power connector Power A or Power B.
- Power up the unit.

The CPU indicator LED will go green and start to flash. At power-up, the RTU displays the Varec logo followed by a product identifier ("8810 Remote Terminal Unit"). After this, the LCD displays the current date and time, and alternates between the unit's IP address and the number of active alarms. If the CPU LED is not flashing or the LCD does not display the sign-on message, turn off system power and proceed with the Troubleshooting section of this manual.

Establishing Host Communications

When the system power is turned on, the Host communications status is set to On-line by default. The 8810 RTU 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.

Configuring I/O Expansion Modules

The 8810 RTU is supported by a full range of I/O interfaces. I/O expansion modules are available for connection to almost every type of signal encountered in industrial applications. See the individual chapter for the specific module for instructions on how to configure and connect wiring for each module.

Recommended Maintenance Procedures

The following standard procedure is used for replacing the 8810 RTU's CPU module (the 8811) as all other 8810 modules are hot swappable and do not require the system to be powered down to replace them:

Replacing the CPU module (the 8811 module)

1. Disconnect power to the RTU.
2. Unscrew the bolts that hold the module in place.
3. Remove the old 8811 CPU module.
4. Install the new 8811 CPU module and make sure it is clicked into place on the circuit board.
5. Tighten the screws to secure the module into place.
6. Turn on power and check the status on the LCD to verify the system is working properly.

4 8811 CPU Module

The 8811 CPU Module is the heart and brains of the 8810 RTU. It executes the 8810's firmware, stores the 8810's configuration in nonvolatile memory, communicates internally to interface modules over the backplane, communicates externally with various devices using physical ethernet & serial ports, distributes power to itself and other installed modules, and controls inserted USB flash drives and Micro SD cards. It collects information from these various modules and communicates with external systems such as FuelsManager.

Features

Here are some of the base functions and features of the 8811 CPU Module in terms of how it connects and relates to the 8810 and other modules as a whole:

- Displays the current status on the LCD
- Displays the networking information on the LCD
- Displays date and time on the LCD
- 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 of the 8810
- Monitors for fault conditions as configured
- Keeps track of what protocols each installed module uses
- Keeps track and communicates with each installed module
- Keeps track of communication status of each installed module
- Keeps track of commands sent and status of each installed module
- Keeps track of and communicates with inserted USB flash drives and SD cards

Concept

The concept behind the 8811 CPU module is to manage and facilitate communication between Interface Modules and FuelsManager. The following settings communicate the status of the 8811 CPU module and any other connected module to FuelsManager.

Features

8811 CPU Module Face Plate

- An LCD screen which displays the current date and time, the RTU address, the IP address, as well as the error message the 8810 RTU is experiencing if an issue is occurring with the device
- Four LED indicators which displays the CPU, Vf, Com, and Error
- A USB Type B connector (Channel 1)
- 2 USB Type A connectors
- An Ethernet RJ45 connector (Channel 2) with an ability to connect a USB-to-Ethernet dongle to have two Ethernet connectors
- A micro SD card reader

- An RS-232 DB9 Male connector (Channel 3)
- An RS-232 DB9 Male connector (Channel 4)
- An RS-485 Termination Switch (Channel 3)
- An RS-485 Termination Switch (Channel 4)
- An RS-485 connection point (Channel 3)
- An RS-485 connection point (Channel 4)
- A primary Power In connection (Power A)
- A primary Field power input connection (Field A)
- A secondary Power In connection (Power B)
- A secondary Field power input connection (Field B)

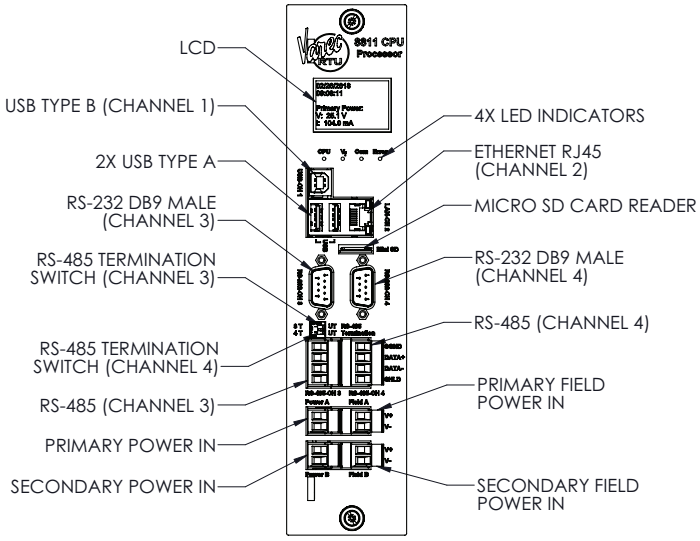


Figure 4-1: 8811 CPU Module Face Place

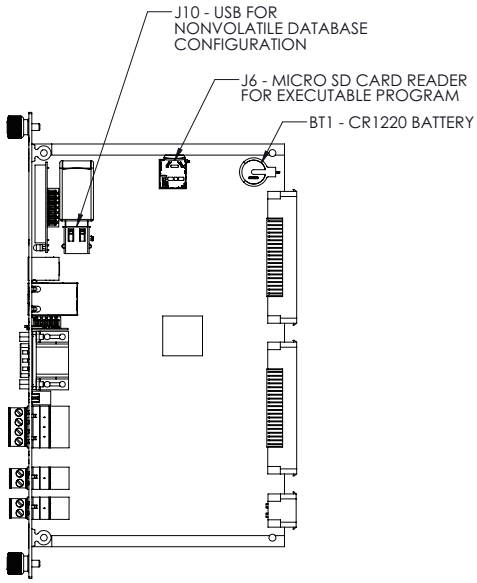


Figure 4-2: 8811 CPU Module Side View

Note Battery BT1 may be replaced by the end user with a CR1220 coin battery.

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

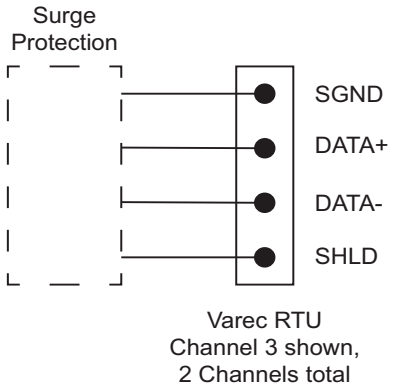


Figure 4-3: 8811 CPU RS-485 Terminals Connection

Note All 8811 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring on all 8811 connecting terminals.

RTU Internal Power Circuitry

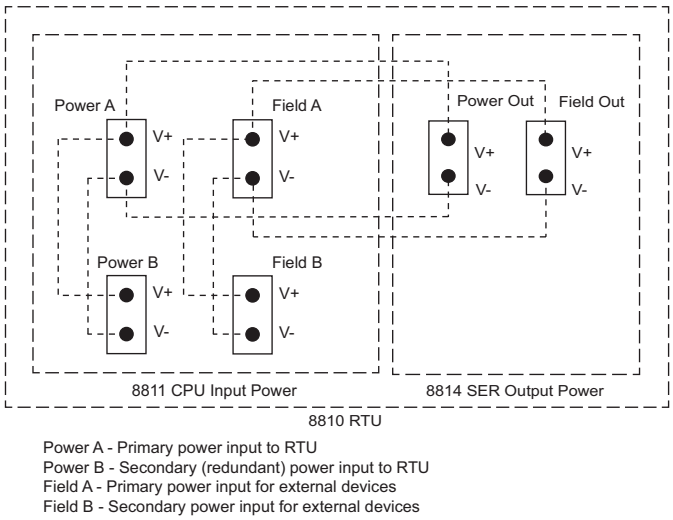


Figure 4-4: RTU Internal Power Circuitry

The above RTU internal power circuitry graphic describes how power is routed from the 8811 CPU module to another module.

USB to Ethernet

The 8810 RTU allows users to connect a USB-to-Ethernet adaptor to allow for a second Ethernet connection. The 8810 currently supports four 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.

Configuration

In the below listed tables, each variable is defined to explain the concept behind it and how it fits together in the 8810 RTU/Vertue ecosystem. See the Vertue manual for more information.

Name	Default	Definition
Label	8810 RTU	The point description A 32 character ASCII string that allows the user to assign a human-readable name to the RTU For example, "8810 North Field" or "8810 West"
ModConfigured	CPU Module	The configured module in the interface slot This should always be "CPU Module" for the CPU Module
IpAddress	192.168.1.1	The RTU's IP address Used for communication through the Ethernet channel using OPC UA
SubnetMask	255.255.255.0	The RTU's subnet mask Used for network configuration
Gateway	192.168.0.1	The RTU's default gateway Used for network configuration
UnitAddress	1	The RTU's unit address Used for communication through the RTU Slave channel protocol
AdminName	admin	RTU administrator's username A 32 chararacter ASCII string used by OPC UA to connect to the RTU with unrestricted ability to modify parameters
AdminPassword	8810rtu	RTU administrator's password A 32 chararacter ASCII string used by OPC UA to connect to the RTU with unrestricted ability to modify parameters
User1Name	user1	RTU user's username. A 32 chararacter ASCII string used by OPC UA to connect to the RTU with restricted ability to modify parameters
User1Pwd	password	RTU user's password. A 32 chararacter ASCII string used by OPC UA to connect to the RTU with restricted ability to modify parameters

Name	Default	Definition
IpDisplay	On	The setting for whether to display the IP address on the CPU Module's LCD • 1 = Off • 2 = On
SystemTime	Date & Time	The system time in seconds The RTU reports this as Coordinated Universal Time (UTC) which might be displayed as local time, depending on the device used to connect to the RTU
UTCOffset	0	An offset to the UTC reported in SystemTime in minutes This only affects the time displayed on the CPU Module's LCD It has no affect on SystemTime
DSTState	Off	United States daylight savings time setting for SystemTime • 1 = Off • 2 = On This only affects the time displayed on the CPU Module's LCD. It has no affect on SystemTime
TempUnits	Fahrenheit	The unit's setting for CPU Module and Interface 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 (e.g., ViewRTU), this represents the *.rcf configuration file
DBDirectory	<8810 RTU>	This represents the name of the directory the RTU's configuration will be copied to/from on the External USB Flash Drive (Refer to ModCmd)
NumberOfTanks	30	The number of configurable tanks connected to the 8810 (values range from 1-400).
NumberOfAlarms	250	The number of configurable alarms (1-1000)
NumberOfRegMap	100	The number of register maps (1-800)
NumberOfMfpreg	20	The number of Modbus floating point registers (1-100)
NumberOfMireg	20	The number of Modbus integer registers (1-100)
NumberOfGwblk	20	The number of gateway blocks (1-108)
AmbientTempSrc		The ambient temperature source for tank calculations • 1 = AmbientTemp • 2 = ManAmbientTemp
ManAmbientTemp	75.5	The manual ambient temperature in either Celsius or Fahrenheit

Name	Default	Definition
AmbTempConvert		The conversion for AmbientTemp (For example, "FtoC" for Fahrenheit to Celsius) • C = Celsius • F = Fahrenheit
AmbTempDB		The ambient temperature deadband
SecurityMode	1	The security mode the 8810 RTU uses to allow connections **NOTE:** A CPU module reset is required if modified • 1 = None • 2 = Sign • 3 = SignAndEncrypt
SecurityPolicy	1	The security policy the 8810 RTU uses to allow connections **NOTE:** A CPU module reset is required if modified • 1 = None • 2 = Basic256Sha256 • 3 = Aes128Sha256RsaOaep • 4 = Aes256Sha256RsaPss
UserIdentity	1	The user identity mode the 8810 RTU uses to allow connections **NOTE:** A CPU module reset is required if modified • 1 = Anonymous • 2 = UserName • 3 = Certificate

Dynamic/Command

Name	Default	Definition
ModCmd	0 (Undefined)	The current command the module is doing • 1 = Reset Module – Equivalent to power-cycling the RTU. • 2 = Copy Firmware to RTU – Copies the firmware from the External USB Flash Drive to the RTU. The CPU Module will be reset (see above) if the copy is successful. • 3 = Copy Database to RTU – Copies the RTU configuration from a directory with a name specified by DBFile on the External USB Flash Drive to the RTU. • 4 = Copy Database to USB – Copies the RTU configuration from the RTU to a directory with a name specified by DBFile on the External USB Flash Drive. • 5 = Database Factory Reset – Restores the RTU's configuration to its factory settings. • 6 = Limited Database Factory Reset – Restores the RTU'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 RTU to an external USB flash drive. • 8 = Delete Client Certificates – Allows the deletion of the X.509 client certificates. • 9 = Delete Server Certificates – Allows the deletion of the 8810 RTU's server certificate to allow the creation and new one to replace it.
CmdStatus		The status of the last ModCmd • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout • 7 = Remove USB • 8 = Database In Use
ModInstalled	CPU Module	The module currently installed in the slot • 1 = CPU Module • 2 = Unknown Module This always should be reported as CPU Module unless there is an issue communicating with the hardware
SysVer	<database version>	An ASCII string specifying the version of the RTU's configuration. Used by the client 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
HwID	<integer>	Numeric identifier for the CPU Module
HwDate	<string>	The CPU Module's manufacture date
HwSerialNo	<integer>	The CPU Module's serial number
HwPartNo	<integer>	The CPU Module's part 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 This is the core temperature of the processor
InputVolt	<float>	The input voltage (V) which is a measured value of the primary input voltage
InputCurrent	<float>	The input current (mA) which is a measured value for the primary input current (instantaneous)
Zone1Temp	<float>	Measured temperature for Zone 1 on the CPU Module in Celsius or Fahrenheit
Zone2Temp	<float>	Measured temperature for Zone 2 on the CPU Module in Celsius or Fahrenheit
VccVolt	<float>	The Vcc voltage (V) which is the measured voltage of the primary digital bus
FieldVoltStat	<float>	The field voltage status • 1 = Voltage Off • 2 = Voltage On
FieldVolt	<float>	The field voltage (V) which is the measured value of the field input current (instantaneous)
FieldCurrent	<float>	The field current (mA)
Zone3Temp	<float>	Measured temperature for Zone 3 on the CPU Module in Celsius or Fahrenheit
Zone4Temp	<float>	Measured temperature for Zone 4 on the CPU Module in Celsius or Fahrenheit
Zone5Temp	<float>	Measured temperature for Zone 5 on the CPU Module in Celsius or Fahrenheit
IsoVccVolt	<float>	The isolated Vcc voltage (V) which is the measured voltage of the isolated digital bus
ExternalUSB	Removed	Whether a device is inserted in one of the two External USB Flash Drive slots • 1 = Removed • 2 = Inserted **Note:** A device must not be installed when powering up the CPU Module.

Name	Default	Definition
ExternalSDC	Removed	Whether a device is inserted in the External SD Micro SD Card slot • 1 = Removed • 2 = Inserted **Note:** A device must not be installed when powering up the CPU Module.
ResetTime	Date&Time	Time at system reboot.
AmbientTemp		The ambient temperature as set as Celsius or Fahrenheit
BootVer		The boot version
MacAddress		The MAC address of the 8810 RTU
DBInUse		The number of database writes in progress
PntStatus	0	A bitmap field representing the status of the CPU Module • 0x00000000 – No errors • 0x01000000 – Module is not installed • 0x02000000 – The values of ModConfigured and ModInstalled do not match • 0x00000004 – Hardware communication error. Set when the firmware is unable to communicate with the hardware • 0x00000008 – Unknown module type. Typically happens if a module is not plugged in correctly
PntCheckSum	<integer>	The point checksum A 16-bit number representing the CRC of the CPU Module's configuration database

Channel Variables

Name	Default	Definition
Protocol		The type of protocol the 8810 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) • 5 = Modbus Slave (GWBLK) • 6 = Digital Input • 7 = Digital Output • 8 = Ethernet (OPC UA, MFPREG, MIREG) • 9 = Mark/Space (ATT 4000, FTT 29xx, GSI 2000, Varec 1800, Varec 1900, Varec 6500) • 10 = L&J Tankway (LJ1000, LJ1500, LJ2000) • 11 = TLS Master (TLS, TLS3xx, TLS4xx, X76CTM) • 12 = HLS Master (Optilevel) • 13 = Analog Input
Configuration		
Label		The point description A 32 character ASCII string that allows the user to assign a human-readable name to the RTU For example, "8810 North Field" or "8810 West"
ChanState		The current state of the channel • 1 = Disable Channel • 2 = Enable Channel
Mode		The operational mode state
BaudRate		The baud rate
ComParams		The communication parameters in data bits and parity
RespDelay		The response delay (msec)
InitDelay	5	The initialization delay from 0 to 300 seconds

Dynamic/Command		
Name	**Default**	**Description**
ChanCmd		The channel command • 1 = Reset Channel • 2 = Reset Alarm

Dynamic/Command		
Name	**Default**	**Description**
CmdStatus		The status of the last command • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ComStatus		The communication status of the module • 1 = Offline • 2 = Online
CurCommand		The current command for the module
NumRequests		The current number of requests in the module
NumTrans		The current number of successful transactions the module is processing
NumComErrors		The number of requests with errors
Elapse		The time of the last transaction

Dynamic/Command		
Name	**Default**	**Description**
PntStatus	0	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	<integer>	The point checksum

5 8812 Bi-Phase Mark

Features

- Transformer isolated
- Up to 10 tanks per channel
- Four channels per interface module
- Two 3 position pluggable (removable) terminal block per channel for convenient connection of field wiring
- Communications with Enraf 811, Enraf 854, Enraf 872, Enraf 873. Enraf 954, and Enraf 990 Smart Radar tank gauges

The 8812 Bi-Phase Mark Module is used to communicate with Enraf GPU-based tank gauges. A maximum of 40 tanks may be connected on a single interface module. The 8812 communicates using a Bi-Phase Mark protocol. The following figure illustrates how the Model 8812 appears when installed on the 8810 RTU.

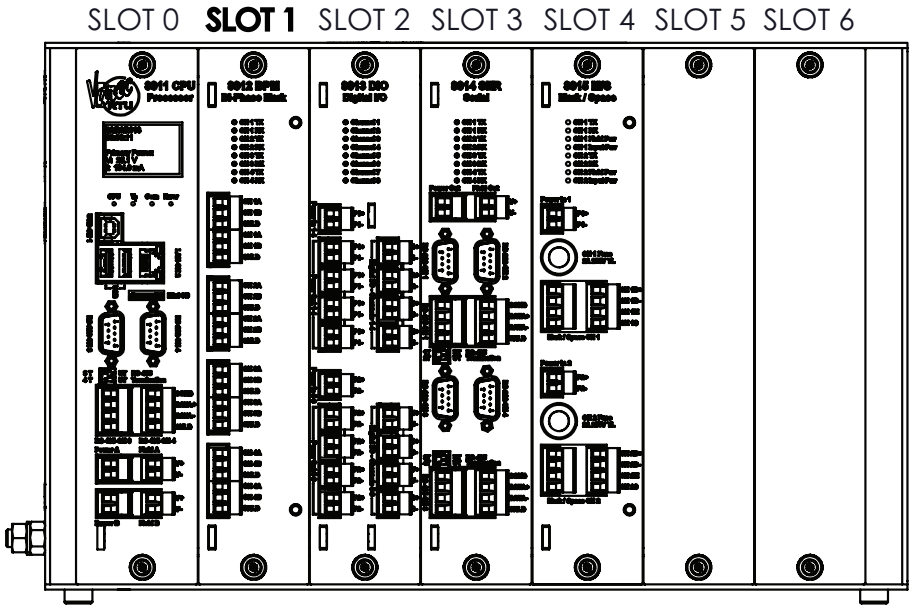


Figure 5-1: 8810 RTU with the 8812 Bi-Phase Mark Module in Slot 1

As seen in the above figure, the slots start with the 8811 CPU Module always in Slot 0 on the far left and goes to Slot 6 on the far right. Interface modules can be added in Slots 1-6, even while the 8810 is powered on.

Description

The components of the 8812 are illustrated in the following figure. This section explains how to connect field wiring.

- *8 LED Indicators (CH1 - CH4, Tx (Transmit), Rx (Receive)*
- *Field wiring terminal blocks (CH1 - CH4)*

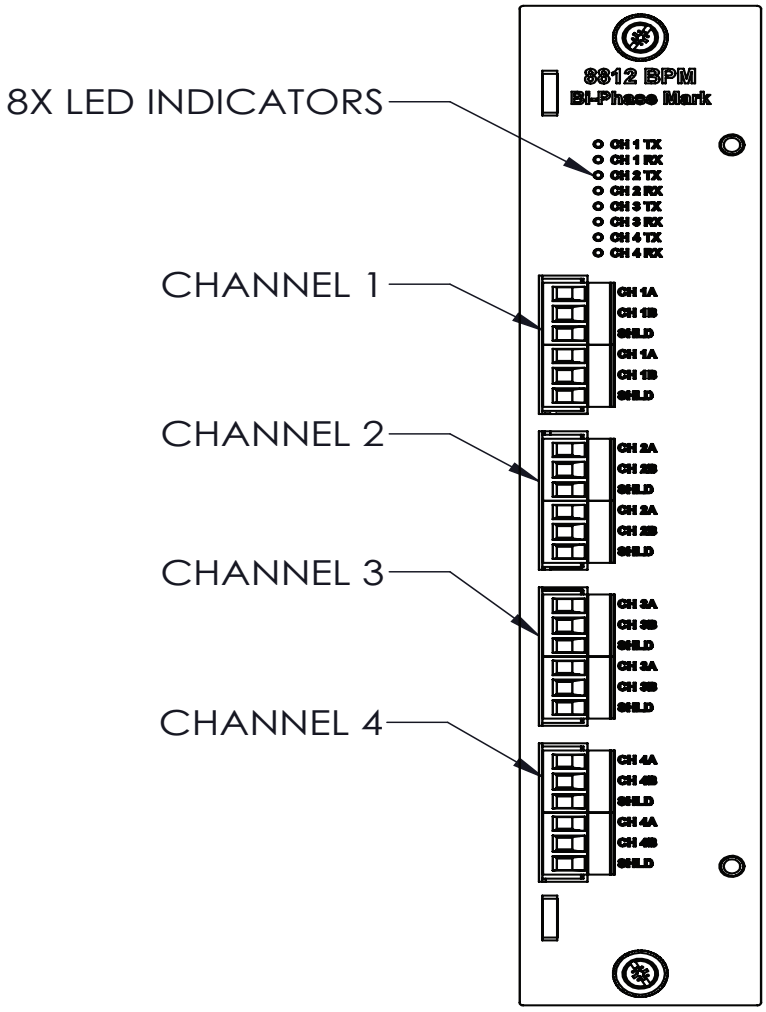


Figure 5-2: 8812 Bi-Phase Mark Module Face Plate

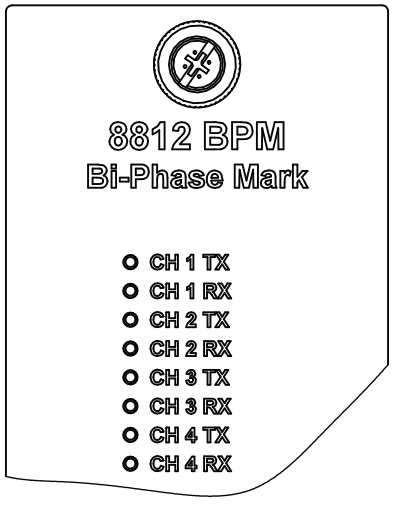


Figure 5-3: 8812 Bi-Phase Mark Module LED Indicators

Field wiring terminal blocks

The 8812 Bi-Phase Mark has three termination points for each of the four channels—two termination signal connections and a shield. A schematic illustrating the terminal connections of any single channel is shown below:

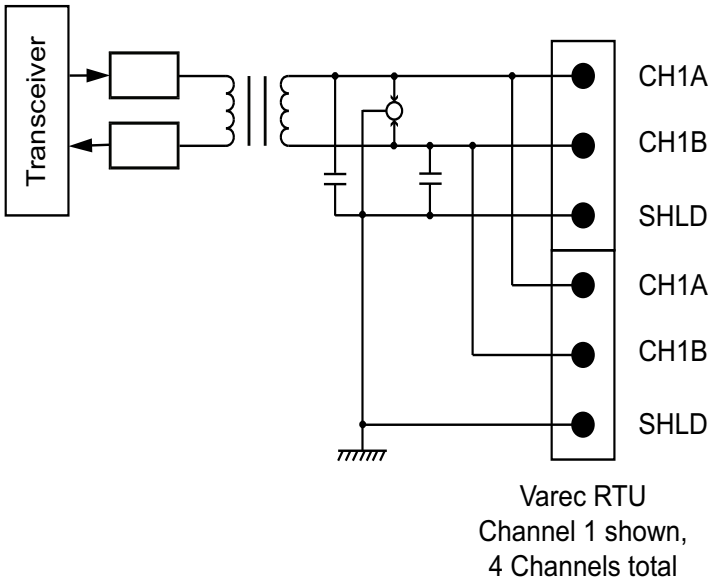


Figure 5-4: 8812 Bi-Phase Mark Terminals

Connect the field wiring

Wire the 8812 BPM module according to the following diagram.

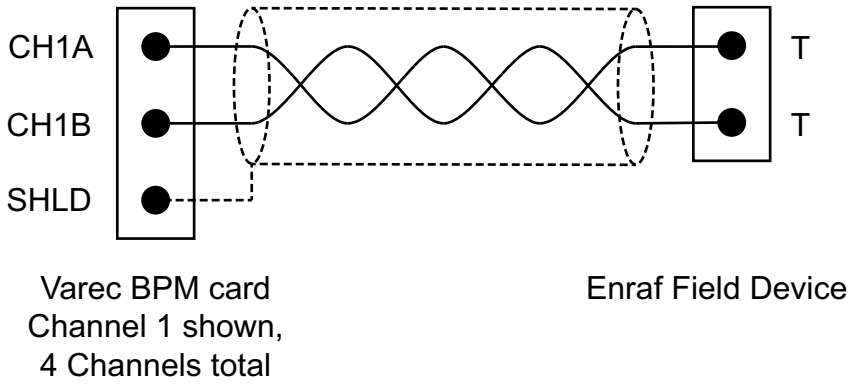


Figure 5-5: 8812 Bi-Phase Mark Field Wiring

Note All 8812 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm^2)/ 300 V min. wiring on all 8812 connecting terminals.

Software Interface

Use Varec's Vertue software to configure the 8812 Bi-Phase Mark module to work with any tanks or other storage requirements as needed. Vertue allows the user to configure the 8812 to work with any tanks and set up any alarms as needed.

6 8813 Digital I/O Module

Features

- 8 digital I/O channels
- Optically isolated solid state relays
- Each channel individually configurable for Input or Output
- Dedicated status LED
- Dedicated fuse for each channel
- Hardware watchdog built in

The following figure illustrates how the 8813 Digital I/O module appears when installed on the 8810 RTU.

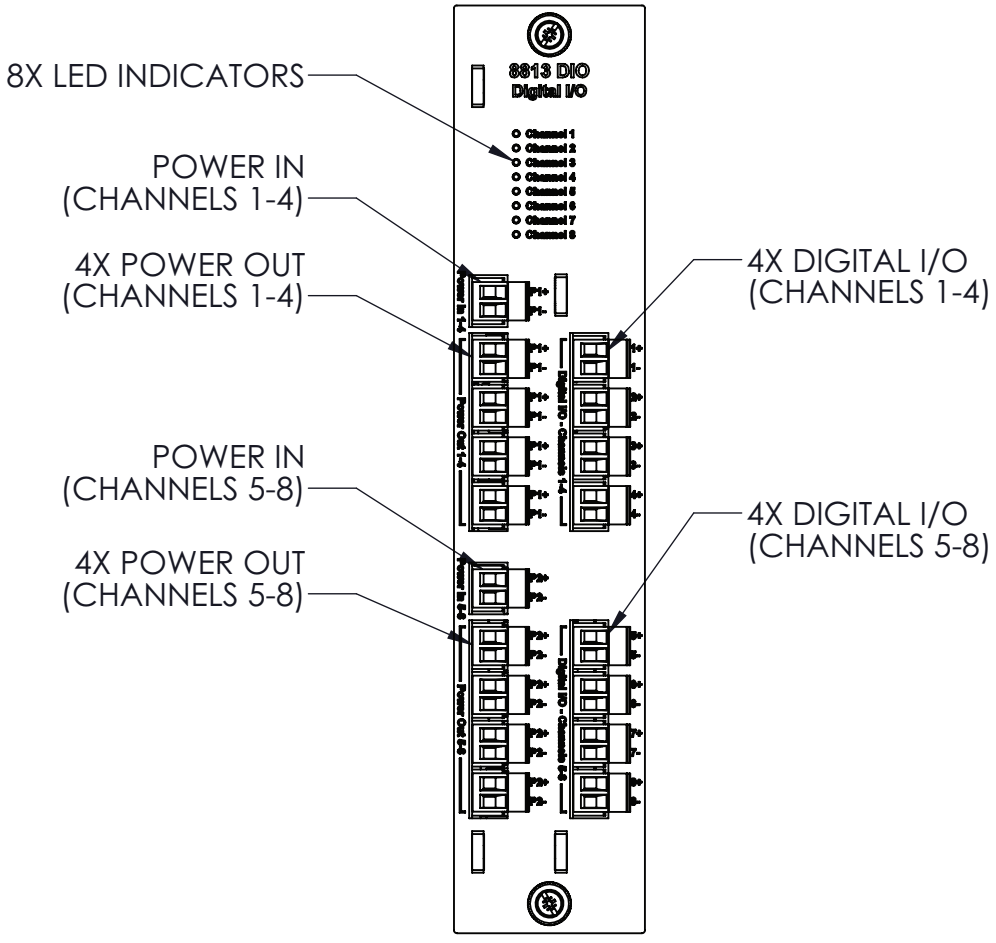


Figure 6-1: 8813 Digital I/O Module

The module is placed into one of the six slots on the 8810 RTU. The only slot a Digital I/O module cannot be put into is Slot 0—the only location for the 8811 CPU Module.

Description

A diagram of the 8813 Digital I/O module with internal plug-in modules is shown in the following figure. This section explains how to connect field wiring relay. A thorough description of the allowable I/O plug-in modules has also been included.

- Fuses (1.6A 250V TR5) (F1-F8)
- External Power Connector
- Field Wiring termination block
- Plug-in Module (M1 - M8)

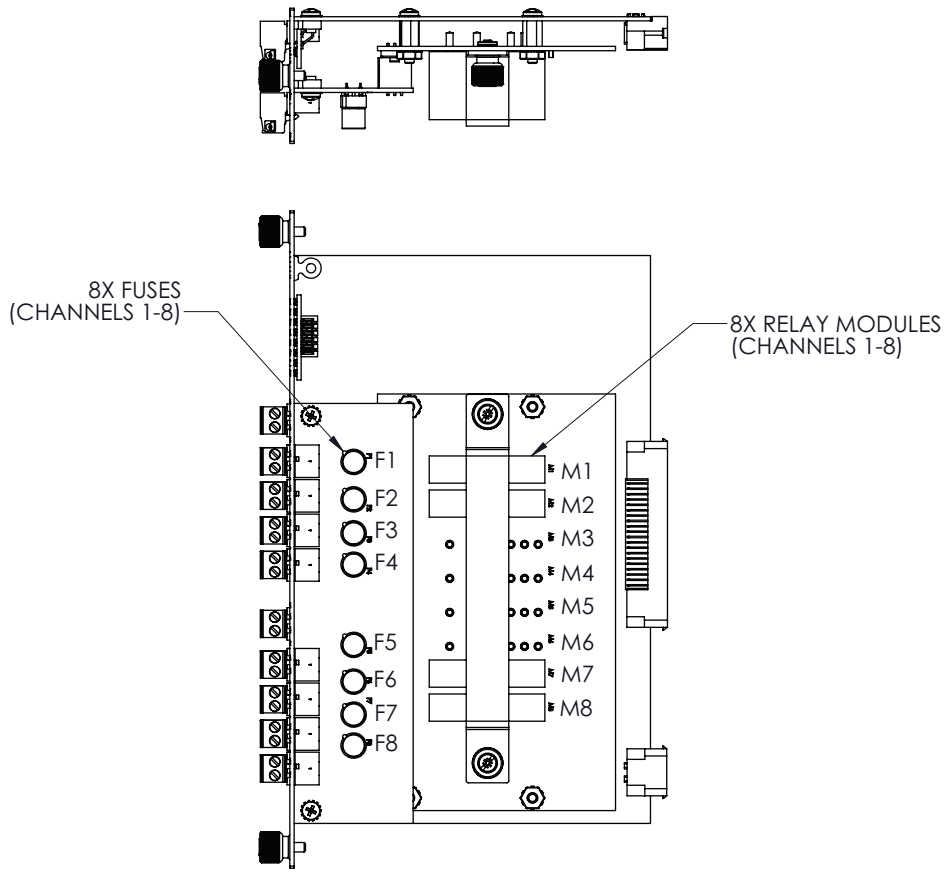


Figure 6-2: Digital I/O Module circuit boards and top view

External Power Connector (Power In 1-4, Power In 5-8)

The External Power Connector is a connection point to the Power Bus. There are two independent power buses. Only DC power can be used.

Warning! Digital I/O connectors may have voltages up to 60 VDC.

Field Wiring Termination Block

The 8813 Digital I/O module has two termination points per channel. Refer to the provided tables for channel assignments at the end of this section.

Note All 8813 output module terminal connections are rated for 60 VDC max., 1 A max.

Note 8813 input module P111-41-013 is rated 60 VDC max, 6 mA max. All other 8813 input modules are rated 32 VDC max., 18 mA max.

Plug-In Modules

Plug-in input and output relay modules are used for interfacing to field circuits and devices. The modules are used in receiving digital signals for data acquisition, as well as monitoring and controlling devices. Several different types of plug-in modules are supported by the 8-Channel Digital I/O. These module types are listed below:

- DC Output Module
- DC Input Module

The user can mix and match module types on the same 8813 Digital I/O board. These plug-in modules can be placed at any location on the 8813 board. In order to minimize EMI, the similar module types should be grouped together.

The color of each module identifies the function. The industry standard case colors are listed below:

- DC Input.....White
- DC Output.....Red

Each plug-in module is described in detail below.

Note Refer to the end of the section for a listing of manufacturers and part numbers.

Plug-In Modules Parts List

Part Number	Description
P111-41-008*	DC Output Module, 3-60 VDC, 1.5 mA Max. Off-State Leakage @ Max. Line
P111-41-009*	DC Input Module, 3-32 VDC
P111-41-011*	DC Output Module, 4-200 VDC, 0.1 mA Max. Off-State Leakage @ Max. Line
P111-41-012*	DC Output Module, 3-60 VDC, 0.1 mA Max. Off-State Leakage @ Max. Line
P111-41-013*	DC Input Module, 35-60 VDC
P111-41-014*	DC Input Module, 10-32 VDC

* These mini I/O modules all have an isolation voltage of 4000 V rms, a storage temperature range of -40 to 125° C, and an operating temperature range of -40 to 100° C

Note All 8813 output module terminal connections are rated for 60 VDC max., 1 A max.

Note 8813 input module P111-41-013 is rated 60 VDC max, 6 mA max. All other 8813 input modules are rated 32 VDC max., 18 mA max.

DC Input Modules

DC input modules are used for sensing ON/OFF DC voltage levels. Modules can provide up to 4000 Vrms of optical isolation between the field inputs and field circuit.

Application

Typical uses and applications include sensing the presence or absence of voltage or sensing contact closures from sources such as the following:

- Proximity Switches
- Limit Switches
- Selector Switches
- Push-buttons
- Photoelectric Switches
- TTL Compatible Devices

Internal Circuitry

The following figure shows the circuitry of a typical DC input plug-in module.

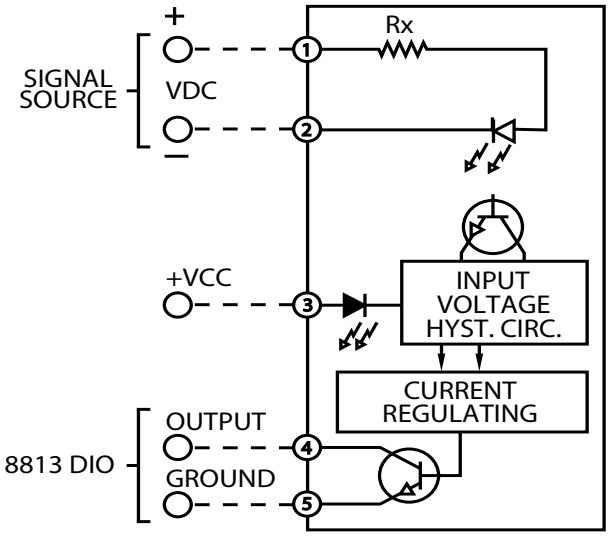


Figure 6-3: 8813 Digital DC Input Solid-state Relay

Note This is representative of an input module, but the user should refer to module documentation for details of the specific module ordered.

Wiring Diagram

The following figures illustrate how the DC input plug-in module is wired to a termination block.

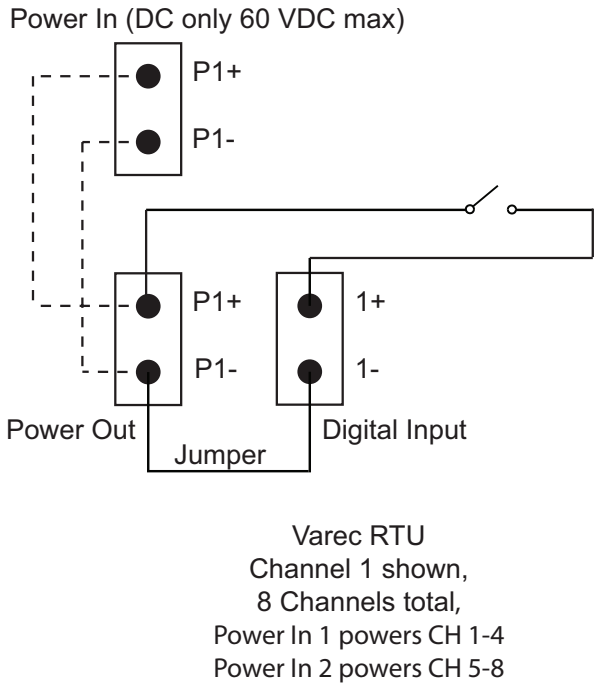


Figure 6-4: 8813 DC Input Wiring Diagram

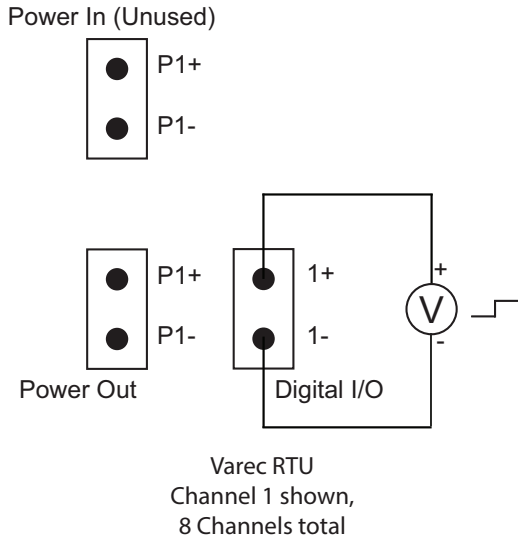


Figure 6-5: 8813 DC Input Wiring Diagram

DC Output Module

DC Output Modules are used for controlling or switching DC loads. Modules can provide 4000 Vrms of optical isolation between the field devices and the control logic. These modules can operate DC load over a wide voltage range.

Application

Typical uses and applications for DC output modules include switching the following loads:

- DC Relays

- DC Solenoids
- Motor/Pump Starters
- DC Lamps or Indicators

Internal Circuitry

The following figure shows the circuitry of a typical DC output plug-in module.

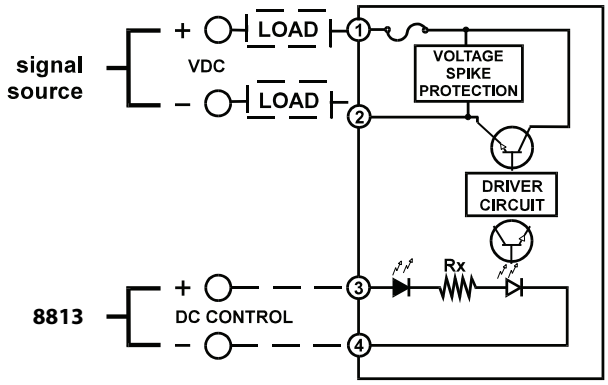


Figure 6-6: 8813 Digital DC Output Solid-state Relay

Wiring Diagram

The following figure illustrates how the DC output plug-in module is wired to a termination block.

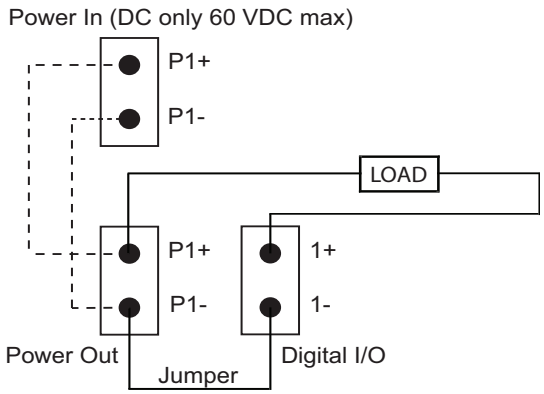


Figure 6-7: 8813 DC Output Wiring Diagram - RTU Powered

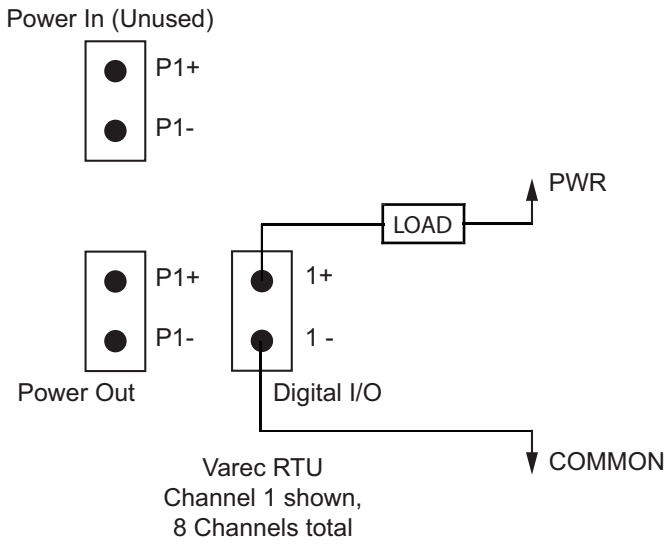


Figure 6-8: 8813 DC Output Wiring Diagram

Software Interface

The 8813 Digital I/O module is used in conjunction with port points.

The Digital Input point interfaces to discrete input signals such as contact closures and proximity switches. The Digital Output point interfaces to digital output signals such as pumps, valves, annunciators, or any other type of actuators.

Use Varec's Vertue software to configure the 8813 Digital I/O module to work with any tanks or other storage requirements as needed. Vertue allows the user to configure the 8813 to work with any tanks and set up any alarms as needed.

Hardware Watchdog Timer

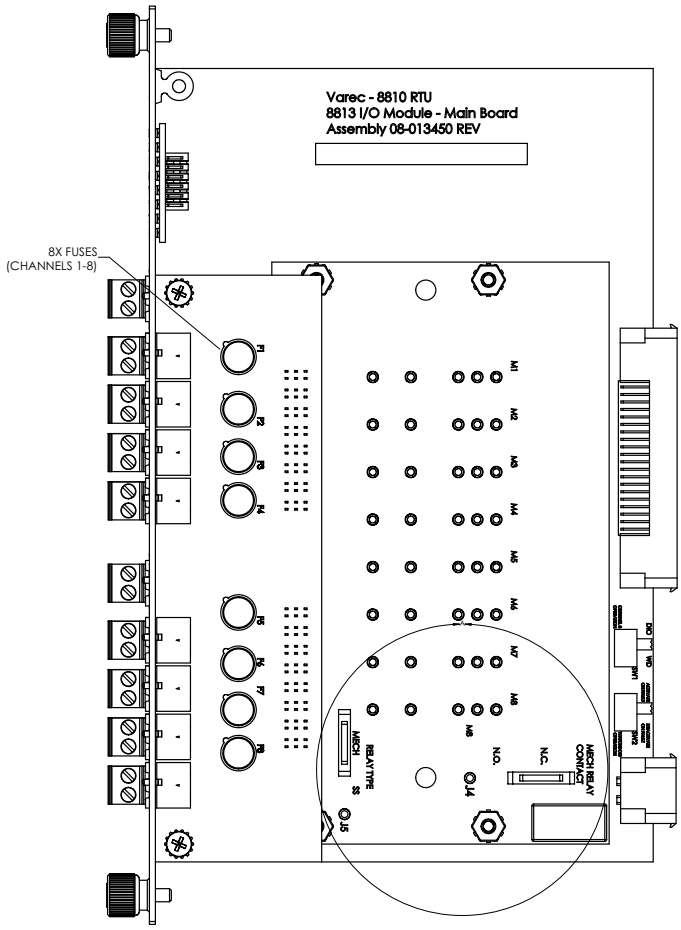


Figure 6-9: 8813 Digital Input/Output Module Circuit Board with Hardware Watchdog

A watchdog timer is an electronic timer designed to check for any hardware issues or malfunctions and then notify users of a potential hardware issue. The 8810's watchdog mechanism monitors the 8810's CPU to determine that it is working as expected and will create an alert to notify the users and the monitoring system.

The 8810 has a firmware component that activates the watchdog with every scan the RTU does if the watchdog is inactive so it can, in turn, keep checking on the 8810's health and functionality.

When the watchdog feature scans the 8811 CPU and doesn't receive the expected response, it sends a signal to alert the user by activating or deactivating the circuit to which it is connected. When the watchdog trips, it could be any of the 60 various tasks that the CPU performs, which causes the watchdog to alert the user. The watchdog will trip (or timeout) between 10 seconds (at the minimum) and 20 seconds (at the maximum).

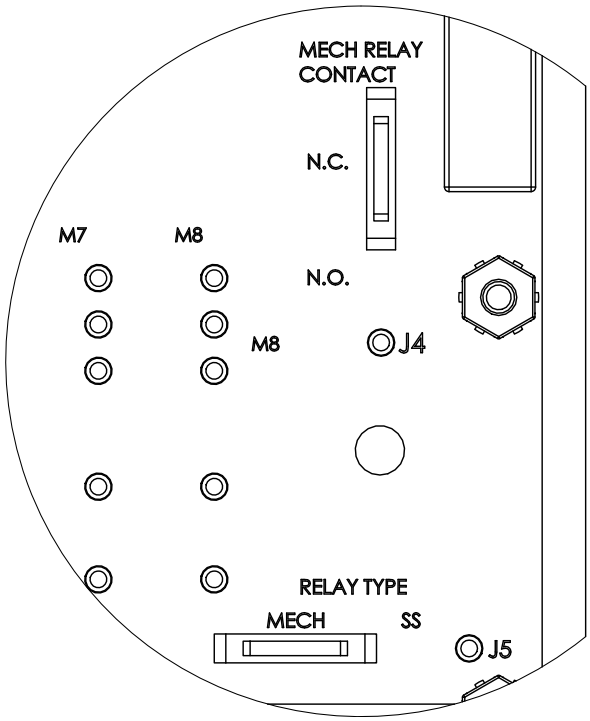


Figure 6-10: 8813 Digital Input/Output Module Watchdog Switch Details

There are four switches that are part of the hardware component of the watchdog:

- Switch 1: Sets the Digital I/O Channel 8 to either be only working as a Digital I/O (off) or activates the watchdog feature (on).
- Switch 2: Sets the watchdog to either be deactivated on fault (off) or activated on fault (on).
- Switch 3: Sets the mechanical relay to be either normally open (off) or normally closed (on).
- Switch 4: Sets Channel 8 (DIO or watchdog) to work with either a solid state relay (off) module or the built-in mechanical relay module (on).

The software component of the watchdog can be set up on Channel 8 on the 8813 Digital I/O. It can be configured to either be an alarm watchdog or a CPU watchdog. Channel 8 must be enabled for the watchdog feature to work. Also, Channel 8's Protocol must be set to Digital Out (choice 7) to use it.

Any of the 8810 modules can be set up to work as a software watchdog by setting a channel on the module to Virtual Channel and enabling the watchdog feature to either work as Alarm Watchdog or CPU Watchdog. This will allow the 8810 to monitor for any potential software task failures.

The following are the three configurations for the watchdog feature in Vertue under the Config setting for the channel:

1. Disable
2. Alarm Watchdog
3. CPU Watchdog

Under the Dynamic settings for the channel, the WatchdogTimer settings displays in milliseconds the amount of time since the watchdog was last serviced. If the watchdog parameter is set to Disable, this WatchdogTimer parameter will continually increase.

How to Reset (Clear) a Watchdog Timeout

Any of these methods can be used to reset the watchdog timer:

- Power cycle the RTU
- Set the Watchdog parameter under Config on the channel to Disable
- Remove and reinstall the interface module

7 8814 Serial Module

Features

- Four high-speed communications channels
- Up to 31 devices per channel (RS-485)
- ANSI/IEEE surge protection
- Is the physical component that allows the CPU software to communicate with RS-232 and RS-485 protocols.

The 8814 Serial Module 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.

Currently, the 8814 Serial module is configured to use the Varec Advance Technology Transmitter 4000 and the Float & Tape Tank 29xx gauges with more serial gauges in the future.

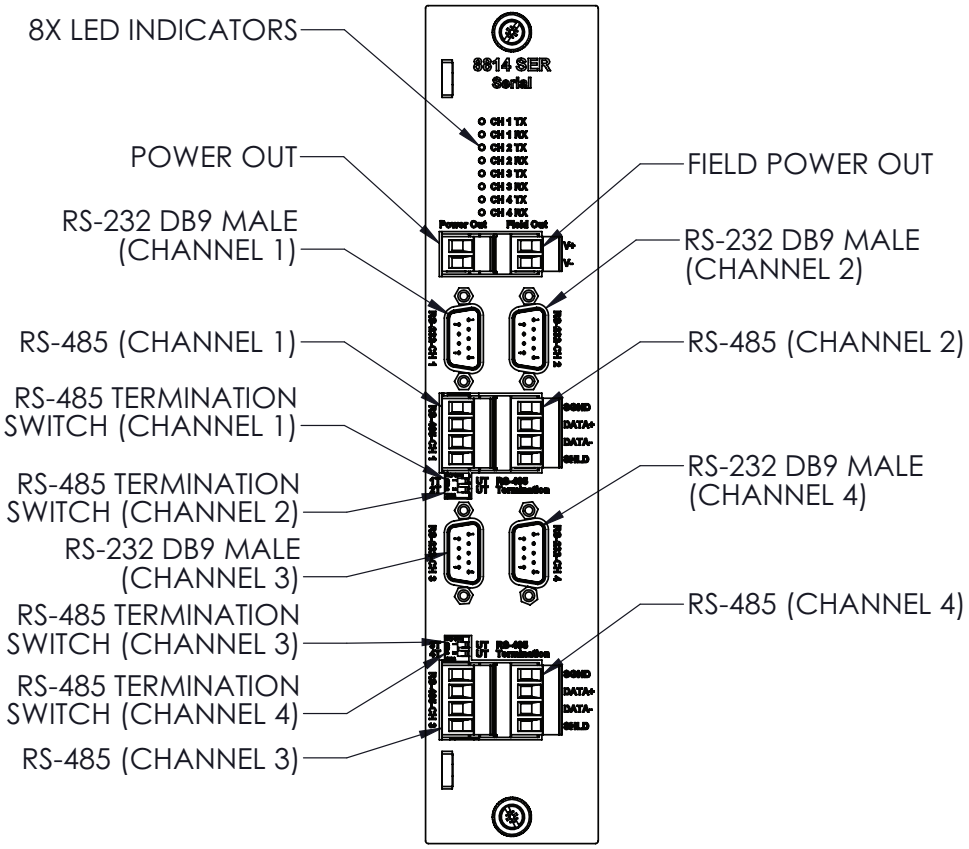


Figure 7-1: 8814 Serial Module Front View

Description

The components of the 8814 are illustrated in the following figure. This section explains how to connect field wiring.

- LED indicators (CH1 – CH4, Tx and Rx)
- DB-9 male RS-232 connectors (CH1 – CH4)
- Field wiring terminal block for RS-485 (CH1 – CH4)
- Switches for enabling termination resistors for RS-485 (CH1 – CH4)

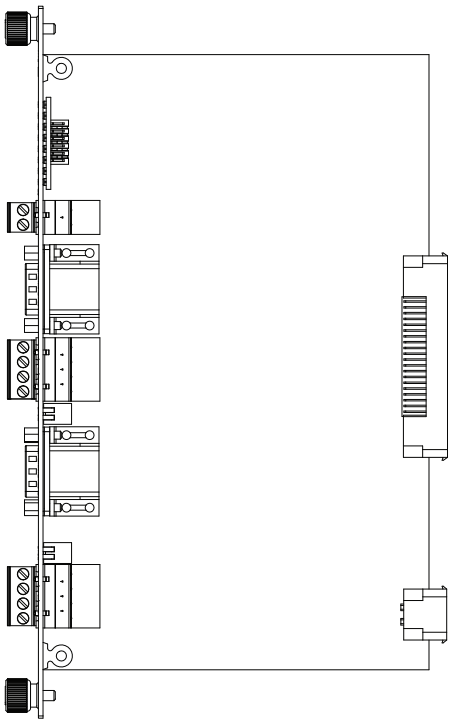


Figure 7-2: 8814 Serial Module Side View

LED Indicators (D1-D8)

The LEDs indicate the status of four channels for transmitting and receiving data for the 8814 Serial Module.

Figure 7-3: 8814 Serial Module LED Indicators

LED	Function
CH1 TX	Channel 1 Transmitting data
CH1 RX	Channel 1 Receiving data
CH2 TX	Channel 2 Transmitting data
CH2 RX	Channel 2 Receiving data
CH3 TX	Channel 3 Transmitting data
CH3 RX	Channel 3 Receiving data
CH4 TX	Channel 4 Transmitting data
CH4 RX	Channel 4 Receiving data

Field Wiring Terminal Block

The 8814 Serial Module has 4 termination points per RS-485 channel. The following schematic illustrates the terminal channels:

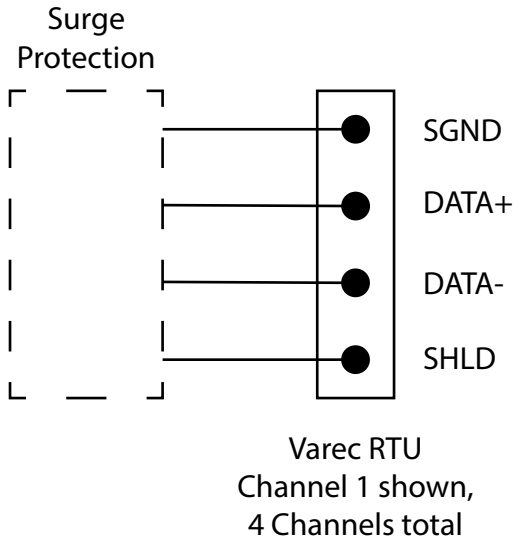


Figure 7-4: 8814 Serial Module RS-485 Terminals

Note All 8814 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring on all 8814 connecting terminals.

Network Terminating Resistor Switches

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

Hardware Interface

Modbus

The following diagram shows how to use the 8814 Serial Module with Modbus devices such as the Varec 2920 FTT or 4000 ATT.

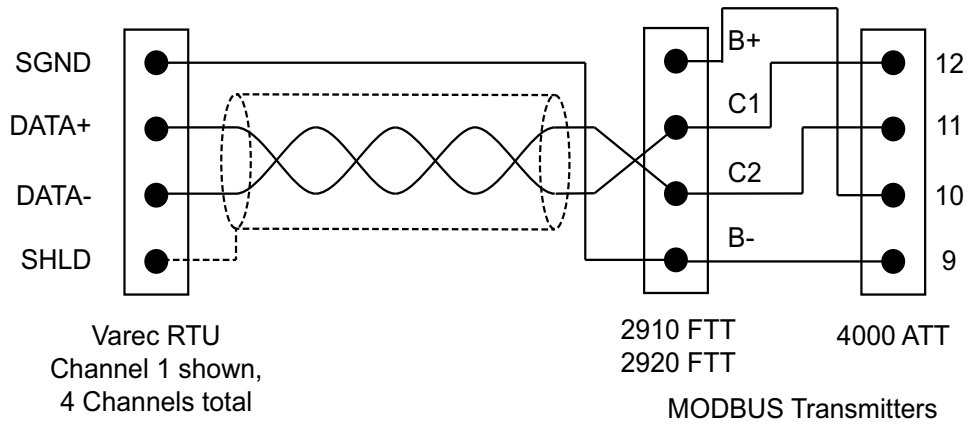


Figure 7-5: 8814 Serial Module RS-485 Field Wiring

The following diagram shows how to use the 8814 Serial Module with Veeder-Root Modbus devices such as the TLS-3xx gauge line.

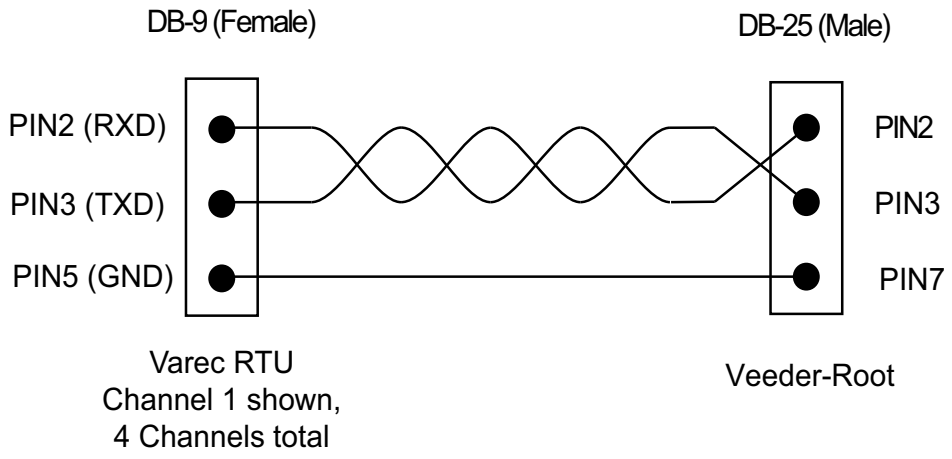


Figure 7-6: 8814 Serial Module Veeder-Root Field Wiring

Software Interface

RS-232 and RS-485 Protocols and the 8811 CPU

The 8814 Serial Module is the hardware used by the 8810 RTU to communicate with various RS-232 and RS-485 protocols. The 8811 CPU Module is the hardware device that has the software and protocols the 8814 module uses to communicate with devices out in the field or in the office. The 8811 CPU module also has two serial ports built into it for Modbus communication if needed.

Modbus

The 8814 Serial Module is used as a physical conduit for the CPU to communicate with the Modbus interface in conjunction with Vertue to configure pre-defined subprograms known as Modbus Maps. These bits of programming allows the 8810 RTU to perform various tasks, such as temperature and status information from a tank gauge. 18 different functions are part of a Modbus Map.

Points are the individual instances of a Modbus Map. At the I/O level, a point is needed to manage the operation of each input, output, or communications channel. The user configures the Config parameters and is provided real time data through the Dynamic parameters.

The Series 8810 RTU contains 18 built-in software functions. These functions can be implemented by configuring a Modbus Map in Vertue.

8 8815 Varec Mark/Space Module

Features

- Supports up to 50 tanks
- Communicates using Mark/Space protocol
- Interfaces to Varec 1900 MWT compatible Tank Gauge transmitters
- ANSI/IEEE surge protection

The 8815 module interface with tank gauge transmitters uses 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

The following figure illustrates how the 8815 Mark/Space module appears when installed on the 8810 RTU.

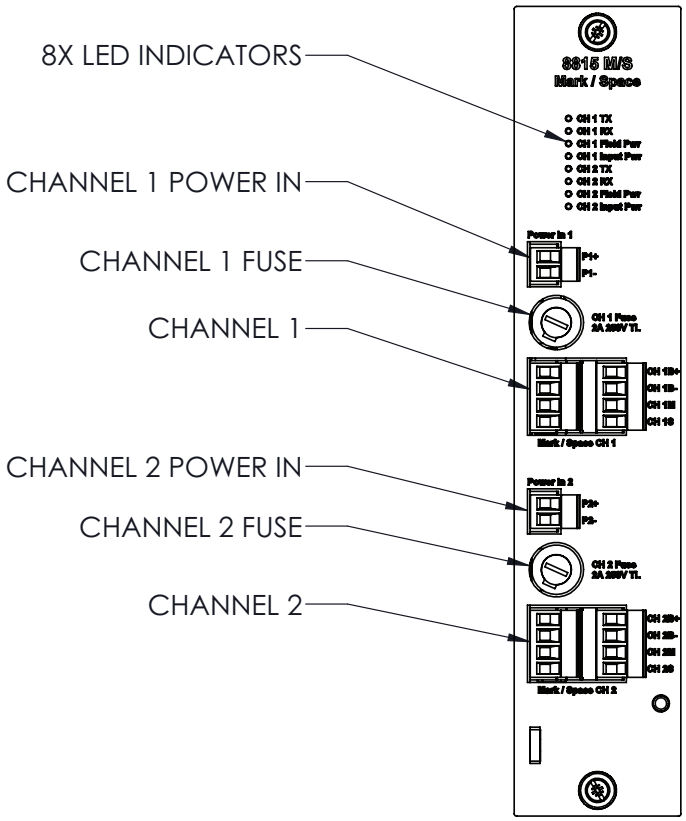


Figure 8-1: 8815 Varec Mark/Space Interface Module

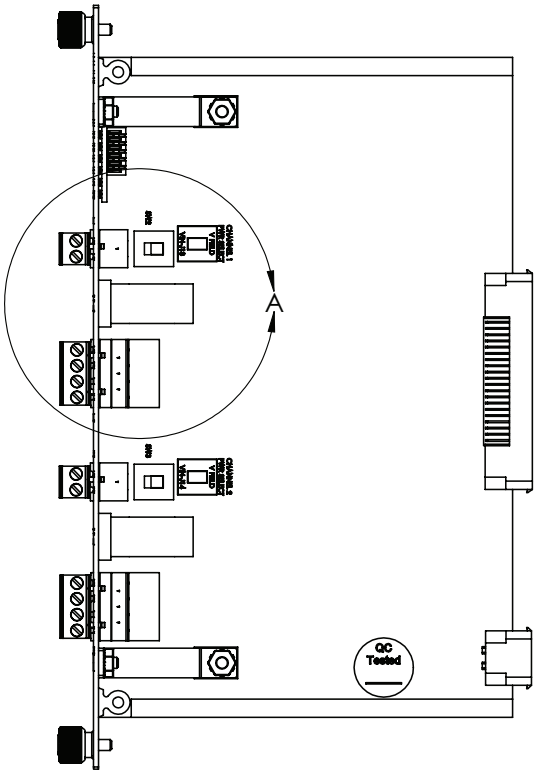


Figure 8-2: 8815 Mark/Space Module Side View

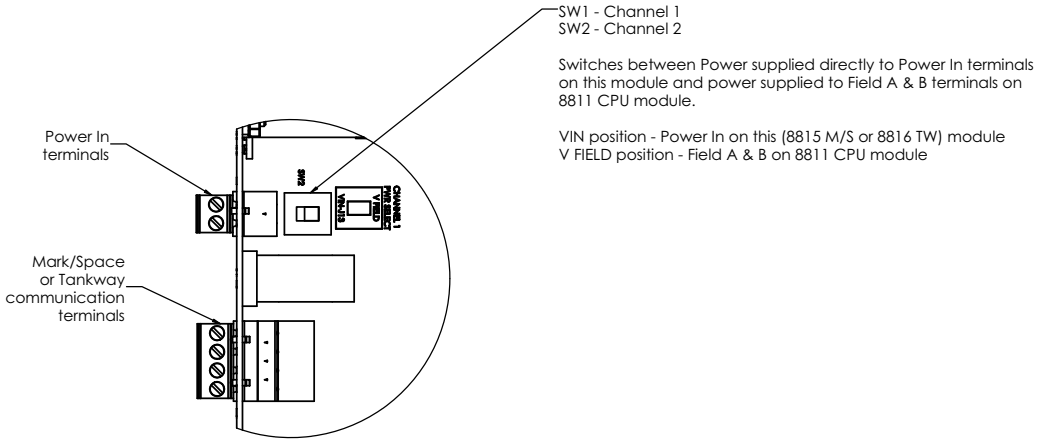


Figure 8-3: 8815 Mark/Space Module Terminals and Switches Closeup

Switches SW2 and SW3 switch between power supplied directly to the Power In terminals on the Mark/Space module and power supplied through the Field A & B terminals on the 8811 CPU module.

- VIN Position: Power In on 8815 Mark/Space module
- V FIELD position: Field A & B on the 8811 CPU module

The module is placed into one of the six slots on the 8810 RTU. The only slot a Mark/Space module cannot be put into is Slot 0—the only location for the 8811 CPU Module.

Description

The components of the 8815 are illustrated in the following figure. This section explains how to connect field wiring.

- Power in 1 & 2
- LED Indicators
- Channel 1 & 2 Fuses
- Channel 1 & 2 Communication terminals

The LED displays indicate the status of the 8815 Mark/Space module. The LED that is adjacent to the External Power Connector indicates that external power is applied.

- TX: Transmitting data to tank gauge
- RX: Receiving data from tank gauge
- Field Pwr: Field power (Backplane Power) is being used to power the bus
- Input Pwr: Input Power (front power connector) is being used to power the bus

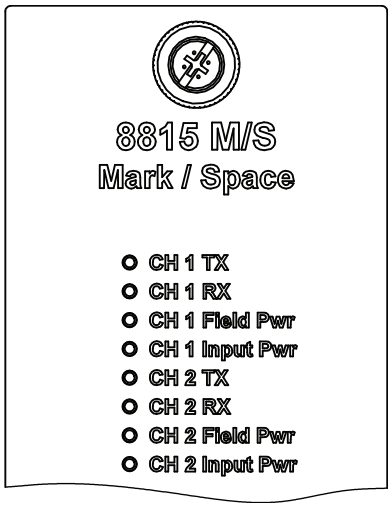


Figure 8-4: 8815 Mark/Space Module LED Indicators

A power LED (Field or Input) will light up when power is applied correctly, selector switch is set correctly, and the fuses are good.

Set switches SW2 (Channel 1) and SW3 (Channel 2) on the 8815 module to select the correct power source.

Power for the Mark/Space bus can be provided by the Power In connectors on the 8815 card. Power for the Mark/Space bus (48 VDC typically) can be provided through the Backplane using Field A or Field B connectors on the CPU module.

Note All 8815 terminal connections are rated for 60 VDC max., 1 A max.

Note Use 18 AWG (0.82 mm^2)/ 300 V min. wiring on all 8815 connecting terminals.

Field Wiring Terminal Block

A schematic illustrating the terminal connections of the 8815 Mark/Space module is shown below:

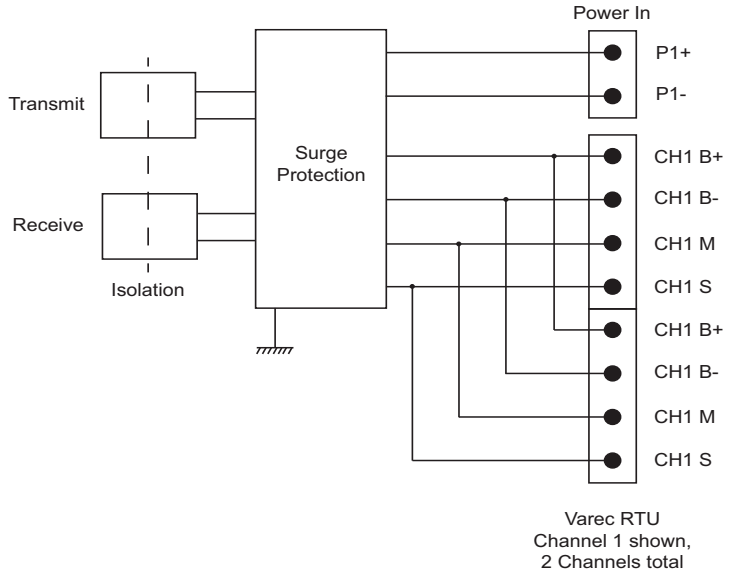


Figure 8-5: 8815 Mark/Space Module Terminals

To connect the field wiring

1. Connect the wiring from the 8815 Mark/Space module to the appropriate device.
2. The 8815 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 8815. The following schematics are provided only as examples:

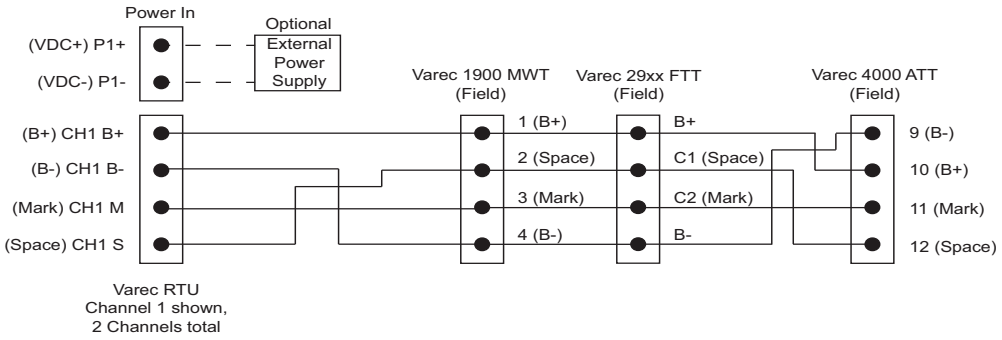


Figure 8-6: 8815 Mark/Space Module Field Wiring

9 8816 TW Tankway Module

Features

- Supports up to 50 tanks
- Communicates using L&J Tankway protocol
- Interfaces to L&J Tankway compatible Tank Gauge transmitters
- ANSI/IEEE surge protection
- Supports tank level range of up to 96 feet

The 8816 TW Tankway Module uses two Tankway busses to communicate. There are a number of transmitters that are compatible, including:

- L&J MCG 1000
- L&J MCG 1200
- 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 components of the 8816 are illustrated in the following figure. This section explains how to connect field wiring.

- Power in 1 & 2
- LED Indicators
- Channel 1 & 2 Fuses
- Channel 1 & 2 Communication terminals

The LEDs indicate the status of the 8816 Tankway module.

- TX: Transmitting data to tank gauge
- RX: Receiving data from tank gauge
- Field Pwr: Field power (Backplane Power) is being used to power the bus
- Input Pwr: Input Power (front power connector) is being used to power the bus

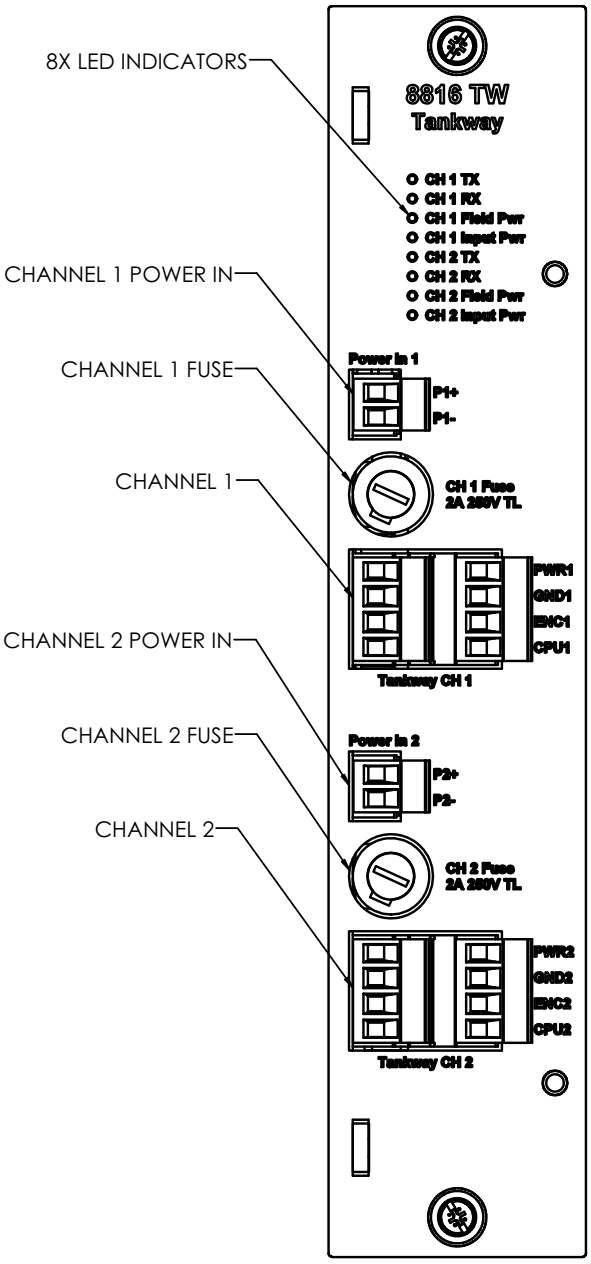


Figure 9-1: 8816 TW Tankway Module Face Plate

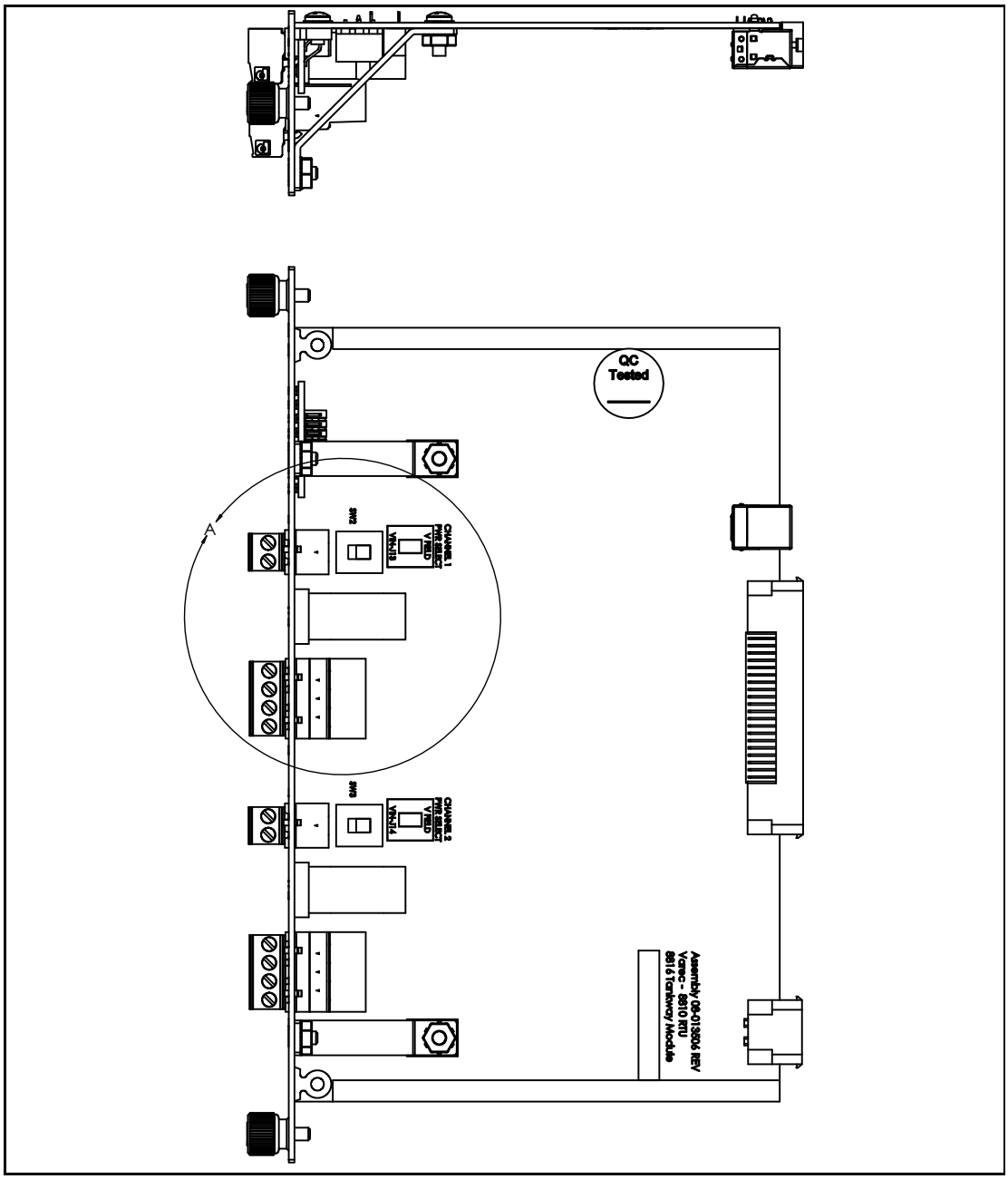


Figure 9-2: 8816 TW Tankway Module Top and Side Circuit Boards

LED Indicators (D1-D6)

The LED displays indicate the status of the 8816's communications and power status of the two channels. The indicators are identified in the following figure.

- CH x TX: Transmitting data to tank gauge
- CH x RX: Receiving data from tank gauge
- CH x Field Pwr: Field power (Backplane Power) is being used to power the bus
- CH x Input Pwr: Input Power (front power connector) is being used to power the bus

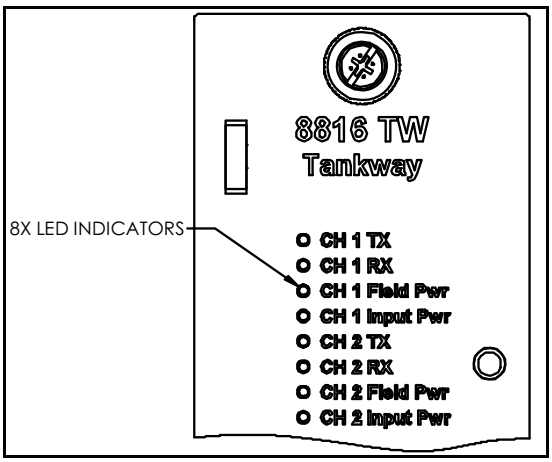


Figure 9-3: 8816 TW LED Indicators

Terminals and Switches

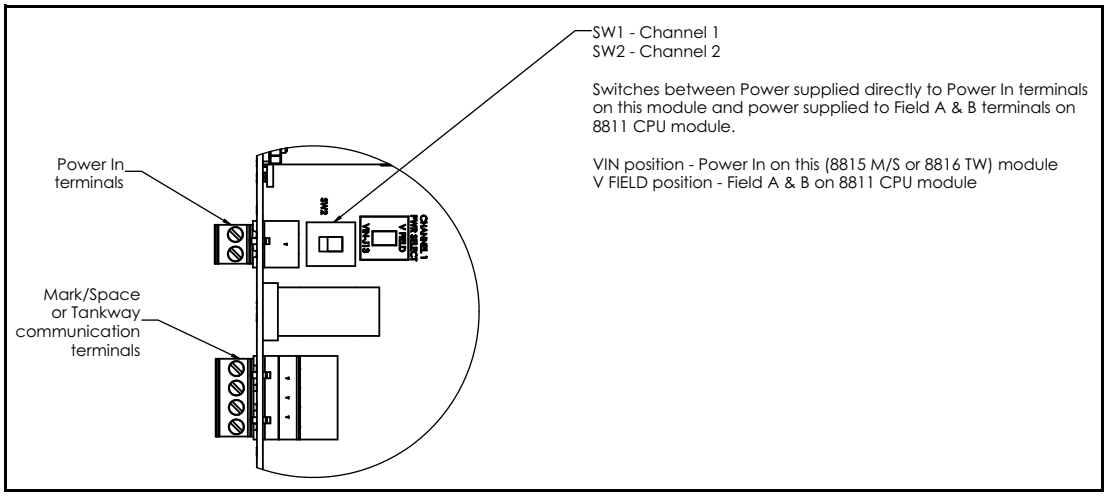


Figure 9-4: 8816 Tankway Module Terminals and Switches Closeup

Switches SW2 and SW3 switch between power supplied directly to the Power In terminals on the Tankway module and power supplied through the Field A & B terminals on the 8811 CPU module.

- VIN Position: Power In on 8816 Tankway module
- V FIELD position: Field A & B on the 8811 CPU module

The module is placed into one of the six slots on the 8810 RTU. The only slot a Tankway module cannot be put into is Slot 0—the only location for the 8811 CPU Module.

A power LED (Field or Input) will light up when power is applied correctly, selector switch is set correctly, and the fuses are good.

Set switches SW1 (Channel 1) and SW2 (Channel 2) on the 8816 module to select the correct power source.

Power for the Tankway bus can be provided by the Power In connectors on the 8816 card. Power for the Tankway bus (48 VDC typically) can be provided through the Backplane using Field A or Field B connectors on the CPU module.

Note All 8816 terminal connections are rated for 60 VDC max., 2 A max.

Note Use 18 AWG (0.82 mm²)/ 300 V min. wiring on all 8816 connecting terminals.

Field Wiring Terminal Block

A schematic illustrating the terminal connections of the 8816 Tankway module is shown below:

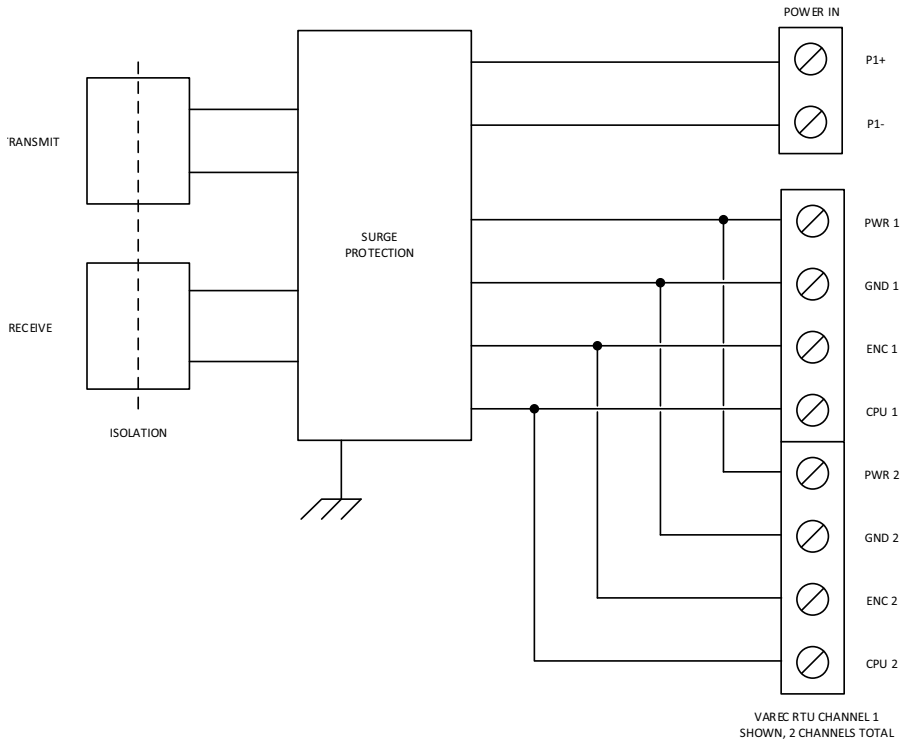


Figure 9-5: 8816 Tankway Module Input Circuitry

To connect the field wiring

1. Connect the wiring from the 8816 Tankway module to the appropriate device.
2. The 8816 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 8816. The following schematics are provided only as examples:

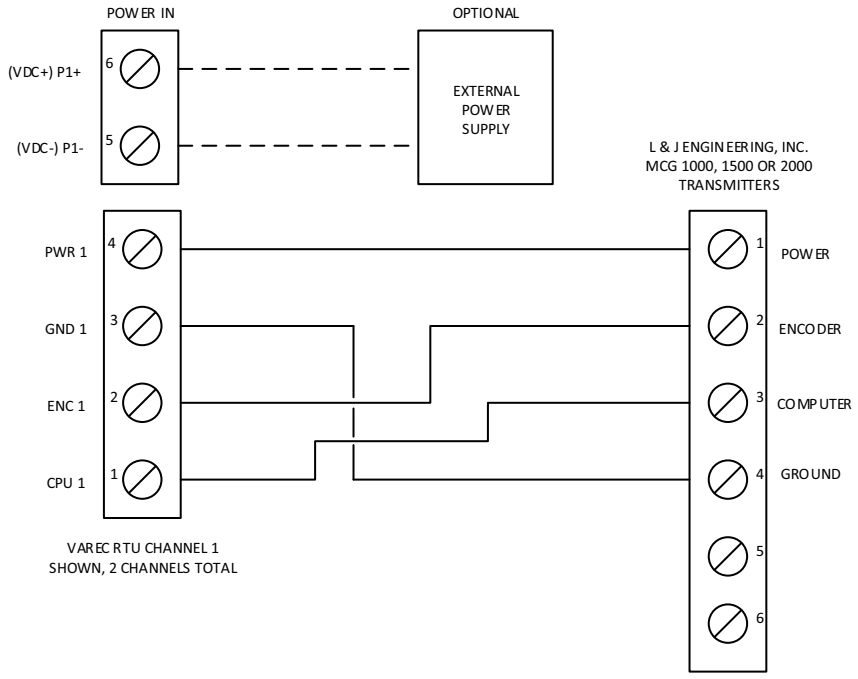


Figure 9-6: 8816 Tankway Module Field Wiring

Configuring the 8816 Tankway

When configuring the 8816 Tankway module, 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 clearning 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 the "PntStatus of the 8810.

10 Veeder-Root Functionality

The 8810 RTU works with Veeder Root automatic tank gauges and communicates with Veeder Root communication protocols through firmware in the 8810's CPU module's Serial port or through the 8814 Serial module. There are no changes needed to the physical makeup of the CPU or the 8814 Serial module to enable the module to communicate with any of the Veeder Root tank gauges.

Basic Information

Veeder Root uses the RS-232 serial channel available on the 8811 CPU module (channels 3 and 4) and the 8814 Serial module.

The Serial module 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

Veeder Root Communication Protocol and Modbus Master Communication Protocol

Adding Veeder Root functionality to the CPU and the 8814 Serial module done is through configuring CPU or 8814 to use 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 lack of the DetectTime configuration parameter.

Each TLS can connect to a maximum of 16 tanks which means that an 8814 Serial module can connect to a total of 64 tanks with the Veeder Root device.

Otherwise, the Veeder Root functions are identical to the Modbus Master protocol. See the 8810 Remote Terminal Unit 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 8810 to understand and connect with the TLS-3XX automatic tank gauges through a point designed to communicate specifically with the gauges called "TLS." The Serial module's Veeder Root firmware allows the Serial module to perform Veeder Root scanning on the TLS automated tank gauges and send that information back to the 8810.

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 8810 RTU 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
Module & Channel	32-bit unsigned integrers used to assign the TLS to a specific "TLS Master" channel. **Note** Each channel supports no more than one TLS device. This is not a physical limitation. 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.
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.

Parameter	Definition
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.

Veeder Root Tank DeviceTypes

The Veeder Root functionality in the 8810 RTU 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

11 8818 8-Channel Analog Input Module

Features

- 8 Channel Analog Input
- 23 bit resolution
- ANSI/IEEE surge protection on each channel
- Each channel individually configurable (4 modes)
  - Loop-powered 4-20 mA input
  - Self-Power 4-20 mA (single-ended)
  - Self-Power 4-20 mA (differential)
  - 0-5V Voltage mode (single-ended or differential)
- Each channel has current limited (short circuit protection) for loop-powered devices
- Noise reduction (hardware low-pass filters)

The 8810 RTU can interface to analog input signals using standard transmitter signal levels such as 4-20 mA or 0-5 V.

Description

The components of the 8818 are illustrated in the following figure. This section displays the physical aspects of the 8810 AI module, as well as the terminals and switch, and explains how to connect field wiring and to configure jumper settings.

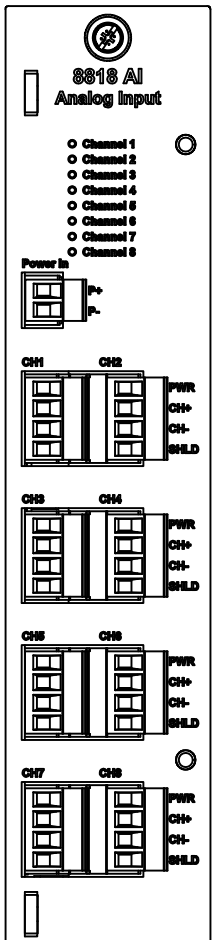


Figure 11-1: 8818 AI Analog Input Module Face Plate

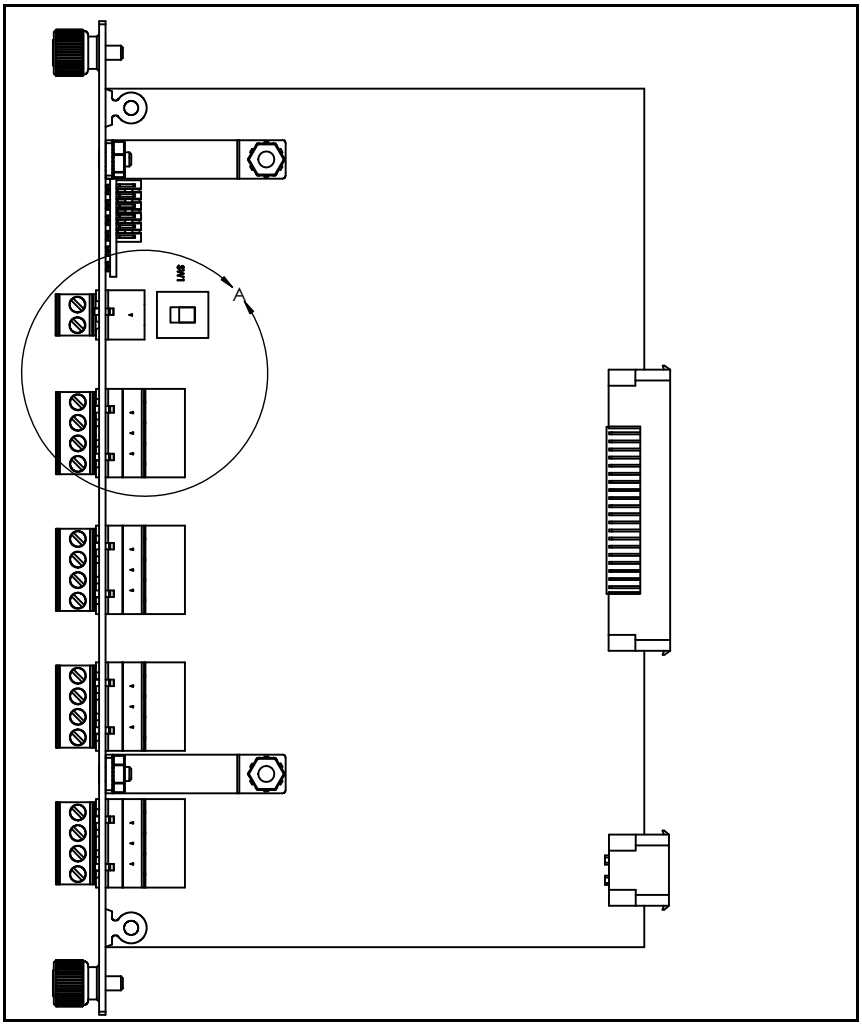


Figure 11-2: 8818 AI Analog Input Module Circuit Board Side View

Channel LED Indicators

The LEDs display channel configuration and indicate when the channel is enabled. When the channel is set to current mode, the current must bet between 3.6 – 21 mA.

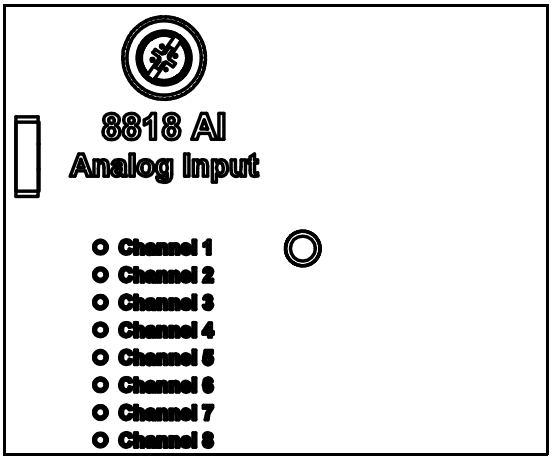


Figure 11-3: 8818 AI LED Indicators

Terminals and Switch

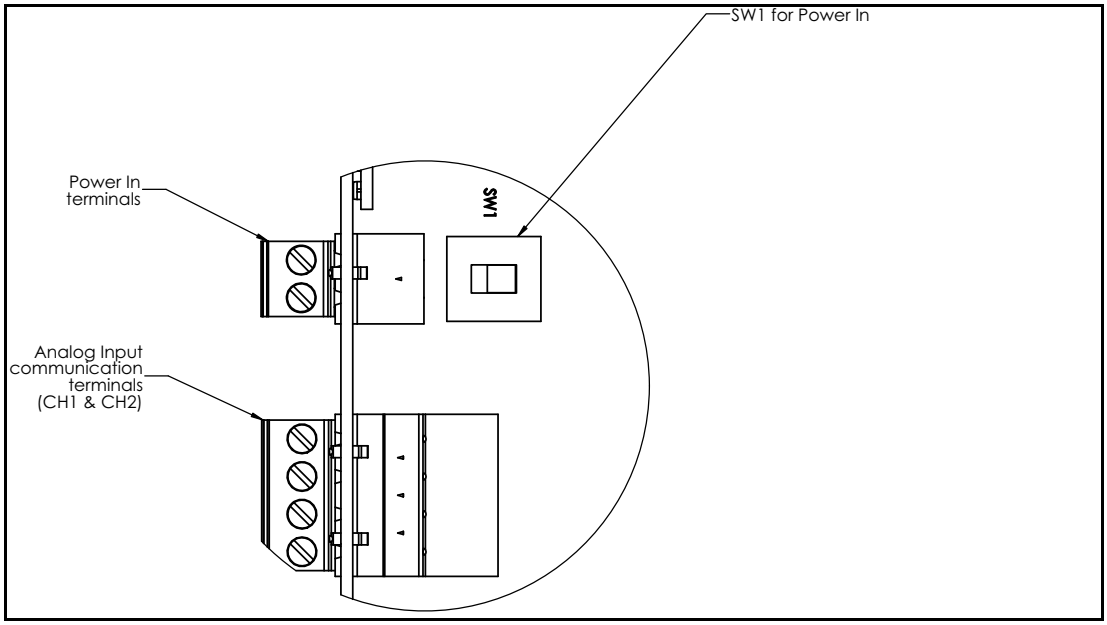


Figure 11-4: 8818 Analog Input Module Terminals and Switch Closeup

The SW1 switch between power supplied directly to the Power In terminal on the Analog Input module and power supplied through the Field A & B terminals on the 8811 CPU module.

- VIN Position: Power In on 8818 AI module
- V FIELD position: Field A & B on the 8811 CPU module

The module is placed into one of the six slots on the 8810 RTU. The only slot an Analog Input module cannot be put into is Slot 0—the only location for the 8811 CPU Module.

Set the SW1 switch on the 8818 module to select the correct power source.

Note *All 8818 terminal connections are rated for 60 VDC max., 2 A max.*

Note *Use 18 AWG (0.82 mm²)/ 300 V min. wiring on all 8818 connecting terminals.*

Field Wiring Terminal Block

To connect the field wiring:

1. Connect the wiring from the 8818 Analog Input module to the appropriate device.
2. The 8818 can be connected to a variety of different transmitters.

Refer to your tank transmitter user's manual for instruction on wiring the devices to the 8818.

The 8818 Analog module has four termination points per channel. The cables should be routed to the terminal blocks so that the whole assembly can be removed easily in the event of system or component failure.

The following four wiring diagrams illustrate the possible ways the terminal connections of the 8818 Analog Input module should be configured depending up the needed connection:

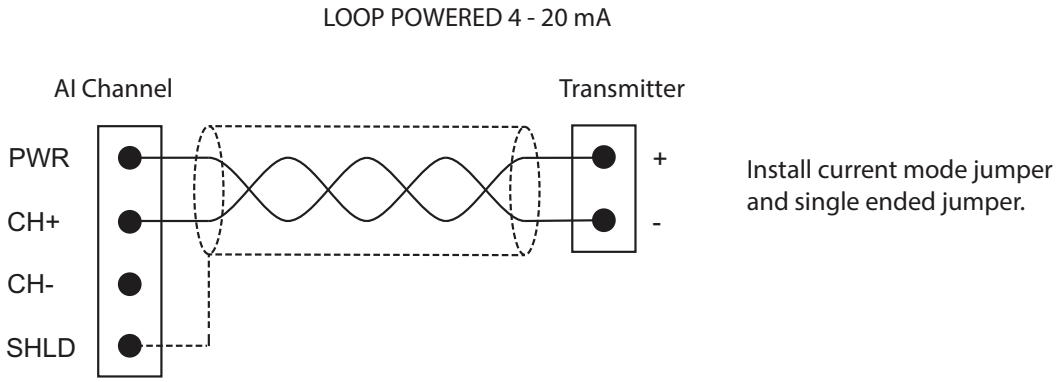


Figure 11-5: 8818 Analog Loop Powered 4-20 mA Wiring

For the Loop Powered 4-20 mA, the power is coming from the 8818 PWR terminal.

For the two self-powered modes below, the device has its own power source with the output being a 4-20 mA signal.

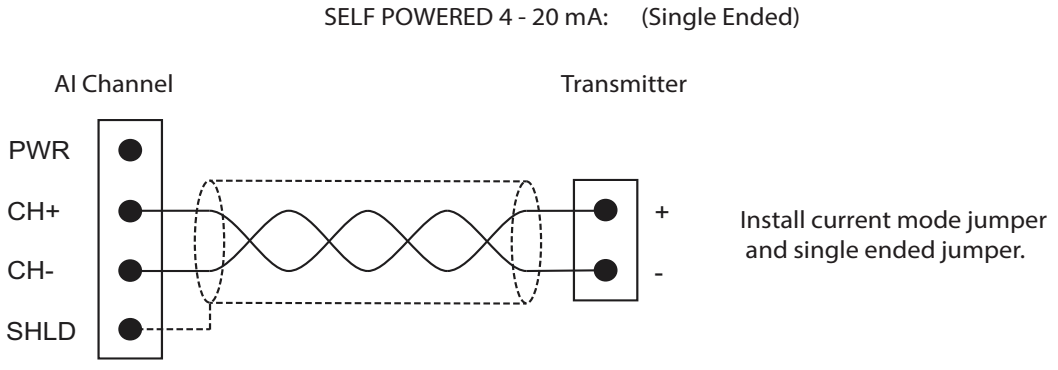


Figure 11-6: 8818 Analog Self-Powered 4-20 mA (Single Ended) Wiring

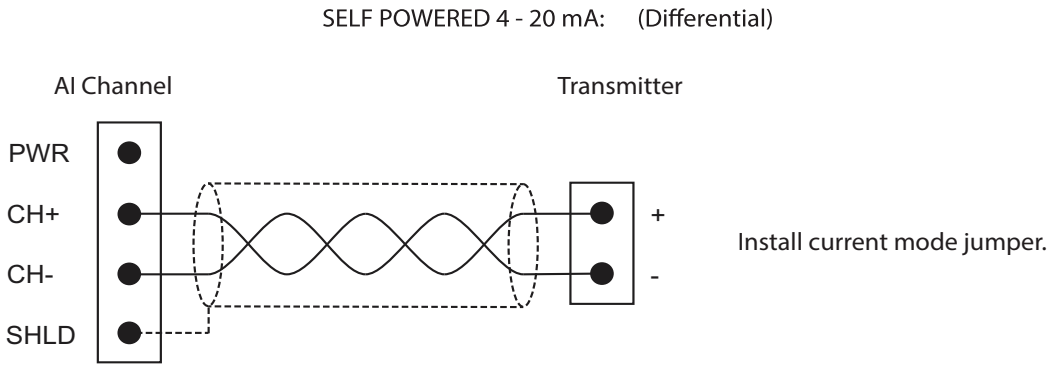


Figure 11-7: 8818 Analog Self-Powered 4-20 mA (Differential) Wiring

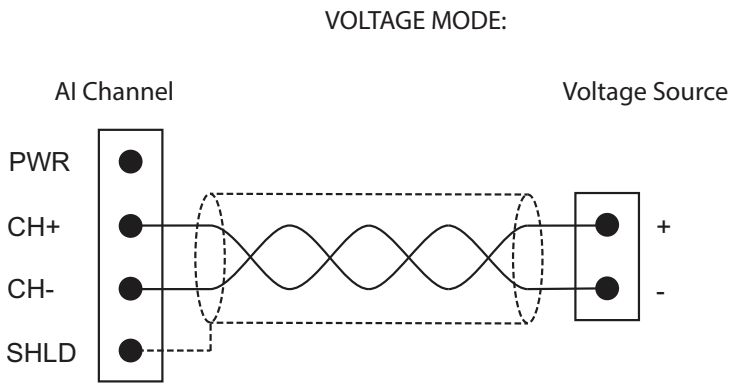


Figure 11-8: 8818 Analog Voltage Mode Wiring

Each of the four field wiring diagrams explains how to configure the jumper placement. There are two jumpers per channel—one determines the mode (current or voltage) and one determines whether the connection is single-ended or differential.

The following list explains mode configuration jumper configurations:

- **Current mode:** Install jumper
- **Voltage mode:** No jumper
- **Single-ended:** Install jumper
- **Differential:** No jumper

Software Interface

The 8818 Analog module is used in conjunction with Analog Input (AI) points. The AI point interfaces to analog input signals such as temperatures, pressures, flow rates, and levels. The AI point converts the raw data from the converter into an IEEE floating point format. A software filtering algorithm may be applied to condition noisy signals.

12 Configuration

This chapter describes the general concept behind configuring the 8810 RTU to use, as well as links to the relevant tables to the values. The concept listed below work with configuring Vertue or any other method of configuration.

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

> **Note** Vertue is designed to take the guess work out, make it easier to avoid mistakes, and to simplify the configuration process by excluding values that do not work depending upon configuration settings of the modules, tanks, and alarms. There are detailed set up instructions in the Vertue manual.

8810 RTU Configuration Concepts

The Order of Configuration

The general order of configuring an 8810 RTU is as follows:

1. Go to the CPU and configure any installed modules.
2. Configure the channels and communication protocols to communicate with the gauges they will interface with.
3. Assign tanks to channels, and configure the tanks.
4. Configure alarms as needed.

Configuring the CPU and Installed Modules

Connecting to the CPU

1. Connect to the CPU with the **IP Address** of the 8810 RTU.
2. Log in depending upon the security settings established. The default username is **admin** and the password is **8810rtu**.

Configuring a Module

1. Go to the Chassis section of the 8810's settings.
2. Modules section on the left side of the screen over to the appropriate slot for on the Chassis. If you make a mistake, you can drag the Empty module over the slot you want to reset.

   > **Note** The CPU is hardcoded in the first slot, slot 0. Other modules can be swapped out as needed.

3. Enter the desired label for the installed module.
4. Click either the channel you want to configure on the physical image of the module or click the channel listing under the textual listing of the card's channels.
5. Select the correct Protocol under the Protocol section.
6. Click Config and configure the following:
7. Enter the Label (an optional setting) for the channel.

8. Set **ChanState** to **Enable Chan**.
9. Confirm that the card you selected is the correct module by verifying that the **HwID** or **ModInstalled** under the Dynamic section of the module is the same. If so, continue. If not, reconfigure the card.

Configuring a Tank

1. Select a tank you want to configure.
2. Set the **Module** to what slot the module is in that the tank is connected to.
3. Set the **Channel** to what channel the tank is connected to.
4. Set the **DeviceID**.
5. If not using CIU, **CIUAddr** can stay as the default setting of 255.
6. Set **DeviceType** to what type of device the tank is communicating through to the 8810 RTU.
7. Set **ScanMode** to either Normal Scan or Auto Scan as desired.
8. Set **Priority** to as desired.
9. Configure the information under the **Tank Roof** section as needed.
10. Configure the **DensityMethod** to the method to be used.

    Note If Manual Standard is selected, set **ManStdDensity**, to the density to use.

11. 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.

Configuring Alarms

To add and configure an alarm for a tank, first follow the steps to configure a channel and a tank for the configured channel, and then follow the steps below. To add and configure any other alarms, make sure you've set up the associated device and follow the steps below:

1. Select an alarm.
2. Set the **PntType** to the desired type.
3. Set the **PntIndex** to the setting based upon the PntType selected above.
4. Select the **PntParameter** from the list.
5. Select the alarm **Type**.
6. Enter the **Mask**, **Threshold**, or **CharArray** depending upon what Type was selected above.
7. Set the **HoldOff** field to the timed delay setting as desired.
8. Set the **Deadband**, if needed, to what extra amount the threshold should reach before deactivating the alarm.
9. Set the **OutModules** setting to the correct module
10. Set the **Channel** setting to the correct channel.
11. Set the **AlarmState** to Enable Alarm if the alarm should be enabled at this time.

12. Make sure to give the alarm a unique name.

13 Hardware Devices and Communications Protocols

The 8810 RTU 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 protocols are currently supported by the 8810 RTU with the various hardware devices that can be configured through Vertue:

- Virtual Channel
- RTU Slave
- Enraf Master
- Modbus Master
- Modbus Slave
- Digital Input
- Digital Output
- Ethernet
- Mark/Space
- L&J Tankway
- TLS Master
- HLS Master
- Analog Input
- Engauge

The following tables display the hardware the 8810 RTU supports and the protocols available to each piece of supported hardware and the four protocols that support the hardware the 8810 works with.

USB to Ethernet

The 8810 RTU allows users to connect a USB-to-Ethernet adaptor to allow for a second Ethernet connection. The 8810 currently supports four 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	Communication Protocols
EN811	Enraf Master
EN854	Enraf Master
EN873	Enraf Master

Hardware Device	Communication Protocols
EN954	Enraf Master
EN990	Enraf Master
FTT29XX	Enraf Master Mark/Space Modbus Master
ATT 4000	Modbus Master Mark/Space
MTS	Modbus Master
NMR8X	Modbus Master
NMS5X	Modbus Master
NRF590	Modbus Master
NRF81	Modbus Master
RAPTOR	Modbus Master
REX	Modbus Master
RTG	Modbus Master
GSI 2000	Mark/Space
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
Enraf Master	EN811 EN854 EN873 EN954 EN990 FTT29XX

Communication Protocols	Supported Hardware Devices
Modbus Master	ATT 4000 FTT 29XX MTS 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
ModConfigured	1	The module installed in the interface module slot: • 1 = Bi-Phase Mark (Enraf Master) • 2 = Serial Module (RTU Slave, Modbus Master, Modbus Slave, TLS Master, HLS Master) • 3 = Digital IO (Digital Input, Digital Output) • 4 = Mark/Space • 5 = Tankway • 6 = Analog Input
IpAddress		The RTU's IP address
SubnetMask		The RTU's subnet mask
Gateway		The RTU's default gateway setting
UnitAddress		The RTU's unit address
AdminName		The administration username
AdminPassword		The password for the administration login
User1Name		The user name of User 1

Configuration		
Name	**Default**	**Definition**
User1Password		The password for User 1
IpDisplay		The display IP address: • 1 = Display off • 2 = Display on
SystemTime		The system time for the RTU
UTCOffset	-300	UTC offset in minutes
DSTState	2	Daylight savings time • 1 = DST off • 2 = DST on
TempUnits	1	The temperature units for the RTU to display measurements • 1 = Fahrenheit • 2 = Celsius
DBFile	RTUdb	The name of the RTU's database
DBDirectory	8810 RTU	The RTU's database directory name
NumberOfTanks		The number of tanks (1-400)
NumberOfAlarms		The number of alarms (1-1000)
NumberOfRegMap	100	The number of register maps (1-800)
NumberOfMfpreg	25	The number of Modbus floating point registers (1-100)
NumberOfMireg	25	The number of Modbus integer registers (1-100)
NumberOfGwblk	10	The number of gateway blocks (1-100)
NumberOfSchCmd	400	The number of scheduled commands (1-400)
AmbientTempSrc	1	The ambient temperature source for tank calculations: • 1 = AmbientTemp • 2 = ManAmbientTemp
ManAmbientTemp	0	The manual ambient temperature in either Celsius and Fahrenheit
AmbTempConvert	FtoF	The conversion for AmbientTemp (as in INtoOUT, as in FtoC)
AmbTempDB	1	The ambient temperature deadband
SecurityMode	1	The security policy — the CPU must be reset for any changes to take effect • 1 = None • 2 = Sign • 3 = SignAndEncrypt
SecurityPolicy	1	The security mode — the CPU must be reset for any changes to take effect • 1 = None • 2 = Basic256Sha256 • 3 = Aes128Sha256RsaOaep • 4 = Aes256Sha256RsaPss

Configuration		
Name	**Default**	**Definition**
UserIdentity	1	The user identity for login — the CPU must be reset for any changes to take effect • 1 = Anonymous • 2 = UserName • 3 = Certificate

Dynamic/Command	
Name	**Description**
ModCmd	The module command: • 1 = Reset Module
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout • 7 = Remove USB (CPU only) • 8 = Database In Use (CPU only)
ModInstalled	The module installed in the slot: • 1 = CPU module • 2 = Unknown module
SysVer	The system version for legacy
FwVer	The firmware version
SysCheckSum	The firmware checksum
HwID	The module board ID
HwDate	The module's manufacture date
HwSerialNo	The module's serial number
HwPartNo	The module's part 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
InputCurrent	The input current in mA
Zone1Temp	The temperature of Zone 1
Zone2Temp	The temperature of Zone 2
VccVolt	The voltage common collector voltage
FieldVoltStat	The field voltage status • 1 = Voltage off • 2 = Voltage on
FieldVolt	The field voltage in volts

Dynamic/Command	
Name	**Description**
FieldCurrent	The field current in mA
Zone3Temp	The temperature of Zone 3
Zone4Temp	The temperature of Zone 4
Zone5Temp	The temperature of Zone 5
IsoVccVolt	The isolated voltage common collector voltage
ExternalUSB	The status of the external USB flash drive • 1 = Removed • 2 = Inserted
ExternalSDC	The status of the external SDC • 1 = Removed • 2 = Inserted
ResetTime	The time of the last RTU reset
AmbientTemp	The ambient temperature in Celsius or Fahrenheit
BootVer	The boot version
MacAddress	The MAC address
DBInUse	The number of database writes in progress
WatchdogTimer	The elapsed time in milliseconds since the WatchdogTimer was last serviced
PntStatus	The point status as a bitmap: • 0x8000 0000 = Invalid Security Configuration • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed
PntCheckSum	The point checksum

Hardware Configuration Parameters

Configuration		
Name	**Default**	**Definition**
Label	pntname	An ASCII string (32 byte max) that stands as a name for the point
ModConfigured	1	The module installed in the interface module slot: • 1 = Bi-Phase Mark • 2 = Serial Module • 3 = Digital IO • 4 = Mark/Space • 5 = Tankway • 6 = Analog Input
Watchdog	1	The state of the watchdog functionality of the module (DIO Channel 8): • 1 = Disable • 2 = Alarm Watchdog • 3 = CPU Watchdog

Dynamic/Command	
Name	**Description**
ModCmd	The module command: • 1 = Reset Module
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout • 7 = Remove USB (CPU only) • 8 = Database In Use (CPU only)
ModInstalled	The module installed in the slot: • 1 = Bi-Phase Mark • 2 = Serial Module • 3 = Digital IO • 4 = Mark/Space • 5 = Unknown Module • 6 = Tankway • 7 = Analog Input
ModTemp	The module's temperature in Celsius or Fahrenheit (as configured on the CPU's TempUnits)
HwID	The module board ID
HwDate	The module's manufacture date
HwSerialNo	The module's serial number
HwPartNo	The module's part number

Dynamic/Command	
Name	**Description**
HwVer	The printed circuit board's hardware version
FpgaVer	The version of the field-programmable gate array
WatchdogTimer	The elapsed time in milliseconds since the WatchdogTimer was last serviced
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed
PntCheckSum	The point checksum

14 Channel Variables

The 8810 RTU allows users to work with a number of protocols to keep track of the tanks and other storage devices. The following protocols are currently supported by the 8810 RTU and can be configured through Vertue:

- 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)
- Digital Input
- Digital Output
- 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)
- Analog Input

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

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
Priority	1	Change of state priority • 1 = No Priority • 2 = High Priority • 3 = Low Priority
Maxtime	600	Max time between change of state updates

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm

Dynamic/Command	
Name	**Description**
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
DIOValue	The Digital I/O value (firmware bitmap value) • 0x01 = Manual Input/Output Value • 0x02 = Hardware Input Value • 0x04 = Alarm Output Value
DIOHwValue	The Digital I/O hardware value (input or output value in the hardware) • 0 = Off • 1 = On
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0001 0000 = Action Failed (Digital Input only) • 0x0000 4000 = Duplicate Engauge Channel (Engauge only) • 0x0000 4000 = Duplicate FlexAddr (Engauge only) • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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
BaudRate	19200	The baud rate
ComParams	8N	The number of data bits and parity • O = Odd • E = Even • N = None
RespDelay	50	The response delay (in milliseconds)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ComStatus	The communication status of the module (online or offline)
CurCommand	The current command for the module
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

Enraf Master Channel Variables

All Options Excluding the 954

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
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)
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%)

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
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)
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%)

For the 954 via Engauge

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurDeviceID	The address of the current device
CurCommand	The current command for the module
CurLabel	The current point descriptor
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

For the 954 via Engauge

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		Not used at this time
BaudRate	2400	The baud rates of 1200, 2400, 4800, 9600, 19200, and 38400
ComParams	8N1	How the 954 communicates: 8 data bits, no parity, and 1 stop bit

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm

Dynamic/Command	
Name	**Description**
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
DuplicateAddr	The displaying of any duplicate addresses for a FlexConn address where 0-1899 are what addresses are duplicated and a value of 1900 means there are no duplicated addresses
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 8000 = Duplicate Engauge Channel • 0x0000 4000 = Duplicate FlexConnAddr • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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	8N	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • O = Odd • E = Even • N = None
Timeout	2000	The communication timeout (in milliseconds)

Configuration		
Name	**Default**	**Definition**
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 • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of successful transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
NumScanList	The number of points in a scan list
NumFastScan	The number of points in a fast scan

Dynamic/Command	
Name	**Description**
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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

Configuration		
Name	**Default**	**Definition**
ComParams	8N	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • O = Odd • E = Even • N = None
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 8810 RTU searches for Gateway Blocks with identical ModbusMap values and uses matching Gateway Blocks to respond to that Modbus message. This allows the 8810 RTU 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 • 2 = Reset Alarm

Dynamic/Command	
Name	**Description**
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ComStatus	The communication status of the module
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The 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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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

Dynamic/Command	
Name	**Description**
PntCheckSum	The point checksum

Digital Input 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
Priority	1	Change of state priority • 1 = No Priority • 2 = High Priority • 3 = Low Priority
Maxtime	600	Max time between change of state updates
ContactType		The state of the contact: • 1 = Normally Open • 2 = Normally Closed
FilterCnt		The hardware digital input uses FilterCnt to prevent noise from causing an inadvertent action and is applied to the digital input A FilterCnt value of 0 is treated as the same as 1 and a value above 100 is treated as 100
DI0to1Action		The action taken when DIOValue transitions from 0 to non-0. The options are: • "No Action" = No action is taken • "Reset All Alarms" = Resets all active ALARMs — this is the same as setting each ALARM's AlarmCmd parameter to "Reset Alarm" for all active alarms • "Reset RTU" = Resets the RTU — this is the is the same as what happens when the user sets the CPU Module's ModCmd parameter to "Reset Module" • "Reset Password" = This sets the CPU Module's AdminName, AdminPassword, User1Name, User1Password, SecurityMode, SecurityPolicy, and UserIdentity configuration parameters to their factory default settings • "Issue Command" = Issues the TANK command specified in DIXtoYValue to the TANK specified in PntIndex • "Write Modbus" = Writes the value specified in DIXtoYValue to the MIREG specified in PntIndex using the ValueXX parameter specified in PntParameter

Configuration		
Name	**Default**	**Definition**
DI1to0Action		Similar to DI0to1Action but this action is taken when DIOValue transitions from non-0 to 0
DI0to1Value		Only used if DI0to1Action is either Issue Command or Write Modbus For DeviceTypes NMS5x or NMS8x: • 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 (NMS8x only) • 13 = Run Tank Profile • 14 = Run Interface Profile • 15 = Run Manual Profile • 16 = Level Standby (NMS8x only) For any other DeviceType: • 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 If DI0to1Action is "Write Modbus", then this is the value of the 16- or 32-bit integer parameter to be written to the MIREG specified in PntIndex using the Value XX parameter specified in PntParameter
DI1to0Value		The value changed to when DI1to0Action transitions from a non-0 value back to 0
PntIndex		If DIXtoYAction is "Issue Command", then this is the point index of the TANK (1 to 400) If DIXtoYAction is "Write Modbus", then this is the point index of the MIREG (1 to 100) Note that you cannot set DI0to1Action to "Issue Command" and also set DI1to0Action to "Write Modbus" at the same time

Configuration		
Name	**Default**	**Definition**
PntParameter		If DIXtoYAction is "Write Modbus", then this represents the point parameter of the 64 different MIREG ValueXX parameters: • 99 = Value00 • 100 = Value01 ... • 162 = Value63
DI0to1FPValue		Digital input 0-to-1 floating point value (used if Action is 7): If Action is 7, this is the value to be written to Modbus floating point register
DI1to0FPValue		Digital input 1-to-0 floating point value (used if Action is 7): If Action is 7, this is value to be written to Modbus floating point register

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel (resets the DIoHwValue filter and StatusText) • 2 = Reset Alarm
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ContactType	The values that represent if the channel is open or not • 1 = Normally open (Default value) • 2 = Normally closed

Dynamic/Command	
Name	**Description**
DIOValue	The most recent Digital I/O value that represents both the physical hardware input as well as the ALARM output • 0x01 = Manual Input/Output Value • 0x02 = Hardware Input Value • 0x04 = Alarm Output Value
DIOHwValue	The Digital I/O hardware value • 0 = Off • 1 = On
FilterCnt	The filter count for the number of times before the filter value is updated (ranges from 1–100)
FilteredValue	The filtered value of DIOHwValue with FilteredCrit being used as the filter Note that DIOHwValue is updated approximately 10 times a second, so a FilterCrit of 100 is effectively a 10 second filter
StatusText	The human readable text string that reports the status of the action
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0001 0000 = Action Failed (for digital input only) • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

Digital Output 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
Priority	1	Change of state priority • 1 = No Priority • 2 = High Priority • 3 = Low Priority
Maxtime	600	Max time between change of state updates
ContactType		The values that represent if the channel is open or not • 1 = Normally open (Default value) • 2 = Normally closed

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
DIOValue	The Digital I/O value • 0x01 = Manual Input/Output Value • 0x02 = Hardware Input Value • 0x04 = Alarm Output Value

Dynamic/Command	
Name	**Description**
DIOHwValue	The Digital I/O hardware value • 0 = Off • 1 = On
Elapse	The time of the last transaction
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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 • 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

Configuration		
Name	**Default**	**Definition**
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 8810 RTU searches for Gateway Blocks with identical ModbusMap values and uses matching Gateway Blocks to respond to that Modbus message. This allows the 8810 RTU 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 • 2 = Reset Alarm
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ComStatus	The communication status of the module
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The 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

Dynamic/Command	
Name	**Description**
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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 • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurDeviceID	The address of the current device
CurLabel	The current point descriptor
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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 • 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%)

Configuration		
Name	**Default**	**Definition**
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 • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurDeviceID	The address of the current device
CurCommand	The current command
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts

Dynamic/Command	
Name	**Description**
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

TLS Master Channel Variables

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

Configuration		
Name	**Default**	**Definition**
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	8N	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • O = Odd • E = Even • N = None
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 • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurLabel	The current point descriptor
CurMessage	The current message

Dynamic/Command	
Name	**Description**
NumRequests	The current number of requests in the module
NumTrans	The current number of successful transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

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	8N	The number of data bits, parity, and stop bits (1 stop bit is assumed if not specified) • O = Odd • E = Even • N = None
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)
FastScanPct	40	The fast scan percent (between 1% to 40%)

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of successful transactions the module is processing
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

Analog Input 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
ScanDelay	100	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
FilterCnt		The number of AI channel scan samples to be collected for the filter. Range is 1 to 8 samples for the analog input channel.

Configuration		
Name	**Default**	**Definition**
FilterMode		The filter to be applied to the FilterCnt number of samples. Values are: • "Middle Filter" – Use the median value of the samples. In the case of an even number of samples being collected, use the average of the 2 middle samples. • "Average Filter" – Calculate the average of the samples. • "Lag Filter" – Use all FilterCnt samples, but give more weight to the most recent samples.
SignalMode		The input signal in volts or amps. Values are: • "Voltage Signal" – The input signal is in volts • "Current Signal" – The input signal is in milliamps
OutputMin		Used in conjunction with OutputMax, these determine how the analog input signal is scaled. For example, for a 40-foot tank, OutputMin might be set to 0, while OutputMax might be set to 40. For an amp input signal, the normal range is 4-20 mAmp, and the OutputMin/OutputMax should be set to reflect to this normal range. It's possible for the amp input signal to exceed this range. If it does, then this will result in a ConvertedValue that is outside of the range defined by OutputMin/OutputMax.
OutputMax		Used in conjunction with OutputMin, these determine how the analog input signal is scaled. For example, for a 40-foot tank, OutputMin might be set to 0, while OutputMax might be set to 40. For an amp input signal, the normal range is 4-20 mAmp, and the OutputMin/OutputMax should be set to reflect to this normal range. It's possible for the amp input signal to exceed this range. If it does, then this will result in a ConvertedValue that is outside of the range defined by OutputMin/OutputMax.

Dynamic/Command	
Name	**Description**
ChanCmd	The channel command • 1 = Reset Channel • 2 = Reset Alarm
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
NumRequests	Keeps track of the number of times the firmware attempted to read the analog input signal
NumTrans	Keeps track of the number of successful analog input signal reads
NumComErrors	Keeps track of the number of times a call to low-level hardware drivers have failed
NumIoErrors	Keeps track of the number of times RawValue is outside its fault range (3.6-21.0 mAmp) (i.e., the number of requests with input or output errors)
RawValue	This is the raw 24-bit value read from the analog input signal. • OPCUA Status Code “Bad Sensor Failure” is reported if an interface module is not installed • OPCUA Status Code “Bad Out Of Service” is reported if ChanState is disabled
FilteredValue	This is the 24-bit value with the filter applied • OPCUA Status Code “Bad Sensor Failure” is reported if an interface module is not installed. • OPCUA Status Code “Bad Out Of Service” is reported if ChanState is disabled. • OPCUA Status Code “Bad Out Of Range” is reported if FilteredValue is under or over range.
ConvertedValue	This is the FilteredValue scaled according to OutputMin and OutputMax • OPCUA Status Code “Bad Sensor Failure” is reported if an interface module is not installed • OPCUA Status Code “Bad Out Of Service” is reported if ChanState is disabled • OPCUA Status Code “Bad Out Of Range” is reported if FilteredValue is under or over range • OPCUA Status Code “Bad Out Of Range” is reported there is an error with the calibration data
Elapse	The last time the analog input module was scanned

Dynamic/Command	
Name	**Description**
PntStatus	The point status as a bitmap: • 0x0800 0000 = Unknown Module • 0x0400 0000 = Module Communication Error • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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 NOTE: • 0x0000 0800 = Under Range – FilteredValue has been less than the NAMUR NE43 standard fault value (3.6 mAmp) for 4 seconds. • 0x0000 1000 = Over Range – FilteredValue has been greater than the NAMUR NE43 standard fault value (21.0 mAmp) for 4 seconds. • 0x0000 2000 = Calibration Error – The AI Module's calibration data is wrong. As a result, the AI channel might report inaccurate values.
PntCheckSum	The point checksum

The Complete List of 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	8N	The number of data bits and parity • O = Odd • E = Even • N = None
RespDelay	50	The response delay (in milliseconds)
Timeout	2000	The communication timeout (in milliseconds)
DetectTime	20	The Modbus detect time (in milliseconds)
MaxRetry	2	The number of retries (Client only)
ScanDelay	50	Delay between scans (in milliseconds) (Client only) with the minimum scan delay is 100 msec and maximum scan delay is 60 seconds
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%)
Maxtime	600	Max time between change of state updates
Priority	1	Change of state priority • 1 = No Priority • 2 = High Priority • 3 = Low Priority
ModbusID	1	The device address to respond to (Server only)

Configuration		
Name	**Default**	**Definition**
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 8810 RTU searches for Gateway Blocks with identical ModbusMap values and uses matching Gateway Blocks to respond to that Modbus message. This allows the 8810 RTU 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 • 2 = Reset Alarm
NormalScanCmd	The normal scan command • 1 = Disable • 2 = Enable
CmdStatus	The status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 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 = Digital IO • 6 = Ethernet • 7 = Mark/Space • 8 = Tankway • 9 = Analog Input
ComStatus	The communication status of the module (1 = Offline, 2 = Online)
CurCommand	The current command for the module
CurDeviceID	The address of the current device
CurLabel	The current point descriptor
CurMessage	The current message
NumRequests	The current number of requests in the module
NumTrans	The current number of transactions the module has successfully transmitted
NumComErrors	The number of requests with errors
NumTimeouts	The number of request timeouts
NumScanList	The number of points in a scan list
NumClientList	The number of Modbus TCP clients
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
GwblkList	The ASCII string containing a list of gateway blocks assigned to this channel
AutoScanStatus	The auto scan status • 1 = Inactive • 2 = Active
DIOValue	The Digital I/O value • 0x01 = Manual Input/Output Value • 0x02 = Hardware Input Value • 0x04 = Alarm Output Value
DIOHwValue	The Digital I/O hardware value • 0 = Off • 1 = On
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 • 0x0200 0000 = Module Configuration Mismatch • 0x0100 0000 = Module Not Installed • 0x0000 2000 = Calibration Error • 0x0000 1000 = Over Range • 0x0000 0800 = Under Range • 0x0000 0400 = Power Failure • 0x0000 0200 = Line Shorted • 0x0000 0100 = Digital Output Loopback Mismatch • 0x0000 0080 = Digital Input Value Mismatch • 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
PntCheckSum	The point checksum

15 Alarm & Tank Configuration

Purpose

The purpose of the Alarm configuration settings are to help the user understand with what basic alarm settings can be configured to work with the 8810's hardware, the CPU, interface modules, and tanks.

After the Alarm Configuration and Command parameters are the Tank Configuration and Command Parameters which are to help the user understand the basic tank parameters that can be configured as a reference.

Alarm Configurations Parameters

Parameter	Point	Values	Factory Default	Notes
PntType		None CPU Pnt Interface Pnt Port Pnt FP Reg Pnt INT Reg Pnt Tank Pnt Alarm Pnt	None	This is the point type for the point index for which the point parameter is associated. PntType serves as a filter to restrict the list of PntIndexes that are returned in the next field.
PntIndex		CPU Module (1) Interface Module (1-6) Port (1-56) FP Register (1-1000) Integer Register (1-100) Gateway Block (1-108) Tank (1-400) Alarm (1-1000)	None	This is the point index for the alarm.
PntParameter		40 = PntStatus 78 = DIOHwValue 238 = GaugeStatus 239 = Position 240 = Level 241 = Temp 250 = LevelStatus	None	This is what parameter is being monitored by the alarm. The listed numbers are samples. The full list of Point Parameters is available through Vertue.

Parameter	Point	Values	Factory Default	Notes
Type		Bitmap (Mask) Match (Mask) Mismatch (Mask) Low Threshold (Threshold) High Threshold (Threshold) Char Array (CharArray)		The **Bitmap** alarm type reports an alarm by performing a bitwise AND of the Mask with the value of the parameter being monitored. The **Match** alarm type reports an alarm if the Mask matches the value of the parameter being monitored. The **Mismatch** alarm type reports an alarm if the Mask does not match the value of the parameter being monitored. The **Low Threshold** alarm type reports an alarm if the value of the parameter being monitored is less than or equal to Threshold. The **High Threshold** alarm type reports an alarm if the value of the parameter being monitored is greater than or equal to Threshold. The **Char Array** alarm type reports an alarm if the value of the parameter matches any of the ASCII characters in CharArray.
Mask			0	This is the integer mask. Mask is displayed in Hex format in Vertue if the alarm Type is set to Bitmap. Mask is displayed in decimal format if the alarm Type is configured as Match or Mismatch.
Threshold		100.00		This is the floating point threshold.
CharArray				This is the character array.
HoldOff			0	This is the alarm hold off in seconds. A value of 0 means that the alarm is immediately activated if detected. Otherwise, the alarm condition must be true for the specified number of seconds before the alarm will be activated.
Deadband			0.02	This is the alarm deadband for threshold. This is the amount the value of the parameter being monitored has to drop below the "High Threshold" or raise above the "Low Threshold" for the alarm to be considered cleared.

Parameter	Point	Values	Factory Default	Notes
OutMod/Chan		**Output Modules:** CPU Module (0) Interface Modules (1-6) **Output Channels:** Channel (1-8)		OutMod/Chan represents the configured output module and channel on the RTU to which the alarm's output will be written.
AlarmState		Disable Alarm Enable Alarm		This is the operational state of the alarm.
OutputBit				The value of the alarm output

Alarm Command Parameters

Parameter	Point	Values	Factory Default	Notes
AlarmCmd		Reset Alarm		This is where users will come to reset an alarm that has been triggered.
Output				This is the alarm output. 0 means the alarm is inactive (a.k.a., clear), 1 means the alarm is active (a.k.a., triggered).
PntStatus				This is the current status of the point.

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 8810 RTU/FuelsManager ecosystem.

Certain information will be available and visible depending upon how you access the settings. For example:

- In Vertue, command lists are filtered or not displayed for view depending on DeviceType.
- In an OPC UA client, the user will have to use the values shown next to each setting. For example, NMS Raise is would be setting 2 for the value. This is how FuelsManager v10 would access and write via Ethernet.
- In Serial (the Varec OPC UA Driver), values are defined by DVR file. For example, NMS Raise in the DVR is a 152 via Raise Displacer. This is how FuelsManager v7.5x would access and write via serial.

Name in 8810/API Term	Default Value	Definition
Tank Name		
Label	Tank xxx	The point description or label for the tank.
Module	0	Module address (CPU Module = 0, Interface Modules = 1-6)
Channel	0	Channel address (1-8)
DeviceID	0	Device ID
CIUAddr	255	CIU address (0-9 or 255)

Name in 8810/API Term	Default Value	Definition
DeviceType	0	Device type depends upon the protocol of the associated channel. Options include: • Enraf 811 • Enraf 854 • Enraf 873 • Enraf 990 • ATT 4000 • FTT 29xx • GSI 2000 • Varec 1800 • Varec 1900 • Varec 6500 • NMS5x • NMS8x • NRF590 • NRF81 • NMR8x • LJ1000 • LJ1500 • LJ2000 • MTS • TLS3xx • TLS4xx • X76CTM • OptiLevel • RAPTOR • REX • RTG
Advanced Gauging		
TankVisible	No	Tank visible is set during the Activate and Deactivate tank functions: • No • Yes
TOI	B	Type of instrument
Mode	Run Mode	Mode of operation: • Run Mode • Test Mode
DataMode	0	Data mode: • 0x0001 = Byte Swap • 0x0002 = Word Swap • 0x0003 = Swap Both • 0x0004 = Read Temp • 0x0008 = 16-bit Level
ScanCmd	BC	Scan command for instrument
PerInterleave	0	Periodic interleave factor
PerItemCmd	(null)	Periodic item command

Name in 8810/API Term	Default Value	Definition
PerFilter		Periodic reply data filter
MSSpeed	High	Mark/Space speed: • High • Low
ScanMode	Normal Scan	Scan mode: • Normal Scan • Auto Scan
FastScanDelta	0.00	Fast scan delta
FastScanTime	60	Fast scan time in minutes
Change of State		
Priority	High Priority	Change of state priority: • No Priority • High Priority • Low Priority
Maxtime	600	Specifies the maximum time (in seconds) between automatic Change of State data being sent to the Host in response to a Change of State request. When the Maxtime period expires, the Value to is forced to appear as if it has changed even if has not, ensuring that the data is sent to the host periodically. Setting Maxtime to 0 disables this option. The maximum is 255 seconds.
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.
Tank Properties		
RoofType	Not In Table	Roof Type: • In Table • Not In Table • Fixed Roof • No Roof Note: Similar to FuelsManager, this combines the concepts of "Roof Type" and "Weight in Strapping Table" into one parameter.
TankGeometry	Vert Cylinder	Tank Geometry: • Vert Cylinder • Horz Rounded • Horz Flat
ShellCorrect	No Correction	Tank Shell Correction: No Correction Uninsulated Tank Insulated Tank

Name in 8810/API Term	Default Value	Definition
TankMaterial		Tank Shell Material. Only used if ShellCorrect is "Uninsulated" or "Insulated": • Mild Steel • Stainless Steel • Aluminum • 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.
Tank Calculations		
StandardsOrg	API	Standards organization: API (American Petroleum Institute)
StandardsRev	Commodity 2004	Standards revision: Commodity 2004 (API standard)
CommodityType		Commodity type: • Alpha 60 • Crude oil • Refined product • 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 = Fractional Feet (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)

Name in 8810/API Term	Default Value	Definition
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
PressConvert	PtoP	INtoOUT: e.g., PtoM • C = KG/CM2 • I = inH2O • K = Kilopascals • M = Megapascals • m = Millibars • P = PSI • S = Pascals
SWPct	0	Sediment & water %
LevelOffset	0.00	Numeric offset applied to level
TempOffset	0.00	Numeric offset applied to temperature
Calculation Source		
LevelSrc	Level	Product level source: • Level • ManLevel
ManLevel	0	Manual level value
TempSrc	Temp	Product temperature source: • Temp • ManTemp
ManTemp	0	Manual temperature value
SolidsLevelSrc	ManSolidsLevel	Solids level source: • SolidsLevel • ManSolidsLevel
ManSolidsLevel	0	Manual solids level value. SolidsVol is forced to 0 if ManSolidsLevel is a negative number.
WaterLevelSrc	ManWaterLevel	Water level source: • WaterLevel • ManWaterLevel

Name in 8810/API Term	Default Value	Definition
ManWaterLevel	-1	Manual water level. WaterVol is forced to 0 if ManWaterLevel is a negative number
DensityMethod	No Method	Density method: • No Method • Gauged • Manual Standard
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		
AIMinValue	4.0	Minimum nominal mAmp input value as a 16-bit integer
AIMaxValue	20.0	Maximum nominal mAmp input value as a 16-bit integer
AI1LowRange		Nominal low setting for the 32-bit floating point value reported in Analog1
AI1HighRange		Nominal high setting for the 32-bit floating point value reported in Analog1
AI2LowRange		Nominal low setting for the 32-bit floating point value reported in Analog2
AI2HighRange		Nominal high setting for the 32-bit floating point value reported in Analog1
AI3LowRange		Nominal low setting for the 32-bit floating point value reported in Analog3
AI3HighRange		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 8810 RTU/FuelsManager ecosystem.

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
Tank Name		
GaugeStatus	0 (Undefined)	The value that indicates the status of the gauge The values are: • Block • Bottom • Doing Profile • Failure • Finding Water • Following Level • Following Water • Invalid • Lock Test • Service Mode • Transitional • UnderRange • Valid
Position	0	Displacer Position
Level	(null)	Sourced product level in either millimeters ("m") or inches ("i") LevelConvert should be configured accordingly
Temp	(null)	Sourced product temperature in either Fahrenheit ("F") or Celsius ("C") TempConvert should be configured accordingly
SolidsLevel	(null)	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.
GaugedDensity	(null)	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.
Pressure	0	To be used with flowing products, which is not supported at this time. Currently always reported as 0.
RTD1	0	Resistance temperature detector
ScanStatus		Scan status
ScanTime		Time of the last good response

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
Elapse	(Displays current DateTime of unit)	Time of last update/scan
PntStatus	112	Byte value indicating status of point. The values are: • 0x0000: No error • 0x00000080 = Stale Level • 0x00000040 = Invalid Density • 0x00000020 = Invalid Temperature • 0x00000010 = Invalid Level • 0x00000008 = Calculation Error • 0x00000004 = Not Scanning • 0x00000002 = CIU Timeout • 0x00000001 = Device Timeout
PntCheckSum		CRC-16 Checksum for point's static Configuration Parameters
Advanced Gauging		
DeviceCmd		Device commands are available based on the selected device type and protocol: • Reset Gauge • Raise Servo • Freeze Servo • Find Water Level • Follow Level • Run Test • Run Immersed Profile • Find Bottom • Copy ItemCmdFile to RTU • Read Device Config • Write Device Config • Copy .cfg to USB • Copy .log to USB • Calibrate
CmdStatus		The status of the last command: • Start • Complete • Error • Executing • Invalid • Timeout
CalLevelCmd	0	Calibration level command
AlarmStatus	0x 0	Tank alarm status
DeviceStatus	0	Device status

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	0x 0	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: Disable Enable
FastScanTimer	0	Fast scan timer in minutes
LvlStatFilter		16-character (max) ASCII string that determines which LevelStatus values are reported as an invalid level
LvlStatTimer		Number of seconds since the last valid Level must elapse before a LevelStatus matching one of the characters in LevelStatFilter results in an invalid level
ScanList	Normal Scan	Scan list: • Normal scan • Fast scan
Volume	0	Reported volume
Ullage	0	Reported ullage
Offset	0	Reported probe offset
Version	0	Displays the software version

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
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		
CalcCmd		Tank calculation command: • Copy SF to RTU = copy StrapFile from USB to the RTU (a.k.a., upload the StrapFile) • Copy SF to USB = copy StrapFile from the RTU to USB (a.k.a., download the StrapFile) • 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
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	0	Volume correction factor. Calculated from StdDensity and product temperature and pressure.
TempCorFactor	0	Correction due to temperature
PressCorFactor	0	Correction due to pressure

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
TankShellTemp	0	Tank shell temperature If ShellCorrect is "Insulated," then TankShellTemp is the same as Temp. Otherwise, TankShellTemp is: ((7 x Temp) + AmbientTemp) / 8.
TankShellCor	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	0	Floating roof correction Only used if RoofType is "Not In Table." RoofWt / (DensInAir x VolCorFactor)
FloatRoofAdj	0	Floating roof adjustment Only used if RoofType equals "In Table." (RoofWt / StrapDensity) – (RoofWt / ObsDensity)
StrapVol	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	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	0	Gross observed volume ((StrapVol – FreeWaterVol) x TankShellCor) +/– FloatRoofCor or FloatRoofAdj
GrossStdVol	0	Gross standard volume GrossObsVol x VolCorFactor
TotalCalcVol	0	Total calculated volume GrossStdVol + FreeWaterVol
NetStdVol	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	0	Sediment & water volume GrossStdVol – NetStdVol
Weight Calculation		
GrossStdWt	0	Gross standard weight GrossStdVol x DensInAir
NetStdWt	0	Net standard weight NetStdVol x DensInAir

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
NMS NRF NMR		
NMSDeviceCmd		NMS device command: • Follow Level • Raise Displacer • Stop Displacer • Find Bottom Lvl • Follow Upper IF • Follow Lower IF • Upper Density • Middle Density • Lower Density • Repeatability • Find Wtr Level • Release Tension • Run Tk Profile • Run IF Profile • Run Man Prof • Level Standby
NMSCmdStatus		Status of the last NMS command
NMSStatusCode		Gauge status code
NMSStatusText		Gauge status text
UpperIntLevel		Upper interface level
LowerIntLevel		Lower interface level
BottomLevel		Tank bottom
UpperDensity		Upper density
MiddleDensity		Middle density
LowerDensity		Lower density
NxxObsDensity		Nxx observed density
P1		P1 (bottom)
P2		P2 (middle)
P3		P3 (top)
VaporTemp		Vapor temperature
AirTemp		Air temperature
LevelPct		Tank level %
MeasLevel		Level without corrections
TankUllage		Tank ullage
ActualDiag		Actual diagnostics
Alarm1		Alarm 1
Alarm2		Alarm 2
Alarm3		Alarm3
Alarm4		Alarm 4
FilteredDist		Filtered distance

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
SignalQuality		Signal quality
TLS		
TLSVolume		Volume
TLSTCVolume		TC volume
TLSWaterVolume		Water volume
TLSUllage		Ullage
TLSStatusBits		Tank status bits
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
TLSManiStatus1		Test 1 manifold status
TLSTestResult1		Test 1 leak test result
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
Temperature		
Temp1-14		Temperature #1-14

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
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
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

Name (& API Abbreviation Where Appropriate)	Default Setting	Definition
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

16 Level and Temperature Conversion Parameters

Purpose

The purpose of the Level and Temperature Conversion Parameters tables are to explain what parameters the 8810 uses for level and temperature calculations as well as explain what each abbreviation means.

Length Parameters

Below are the tank measurement parameters that the 8810 RTU 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 8810 RTU 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 8810 RTU users to calculate the density of the substance being measured.

Abbreviation	Measurement
G	Grams Per Milliliter or g/ml

Abbreviation	Measurement
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
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

17 Setting Calculation Methods

Volume correction methods

This section describes the correction methods and tank calculations used in the 8810 RTU. 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.

Data rounding

Selecting any of the correction methods designated "Japan" allows you to configure the following special data rounding methods.

Volume Correction Factor (VCF)

- None
- 0.00001
- 0.0000001

Level

This includes both Product and Water Level

- None
- Nearest Integer (i.e. 123.5 millimeters is truncated to 123 millimeters.)

Temperature

This includes Product and Gas Temperature

- None
- 0.25 Degrees
  - 0.000 ~0.124 --- 0.00 °C
  - 0.125 ~0.374 --- 0.25 °C
  - 0.375 ~0.624 --- 0.50 °C
  - 0.625 ~0.874 --- 0.75 °C
  - 0.875 ~1.124 --- 1.00 °C
- 0.5 Degrees
  - 0.00 ~0.29 -- 0.0 °C
  - 0.30 ~0.79 -- 0.5 °C
  - 0.80 ~1.29 --1.0 °C

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
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
ΔTemp	=	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)

Calculations
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)
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·(Lx'+L0')³+Qn·(Lx'+L0')²+Rn·(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

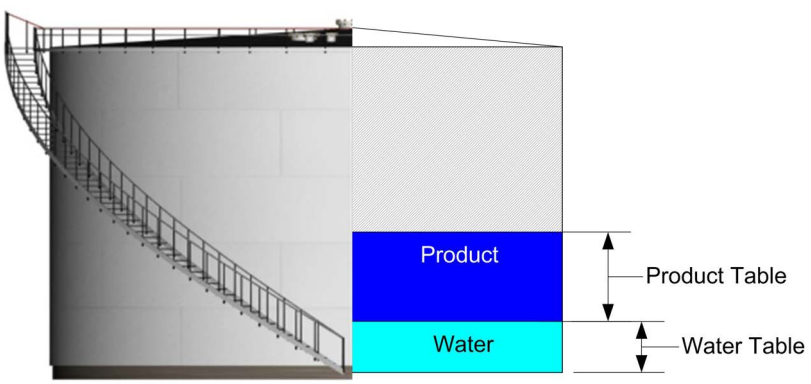
It is typical for customers to have two separate strapping tables, one for product and one for water bottom. These tables can be either related to one another or totally independent. This section details the calculation methods used by the 8810 RTU when configured to use separate water and product tables.

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)

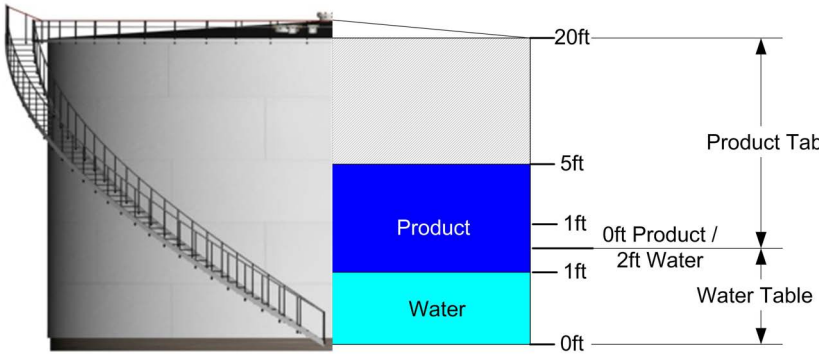
The key concept in the integrated product and water table mode of operation is that the top point of the water table is assumed to coincide with the bottom point of the product table.

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

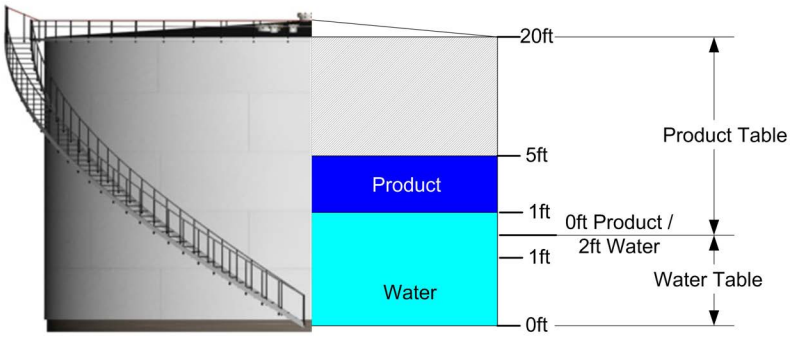
The 8810 RTU recognizes that the measured product level is below that of the bottom point in the product table, so it uses the top of the water table to extend the range:

- 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:

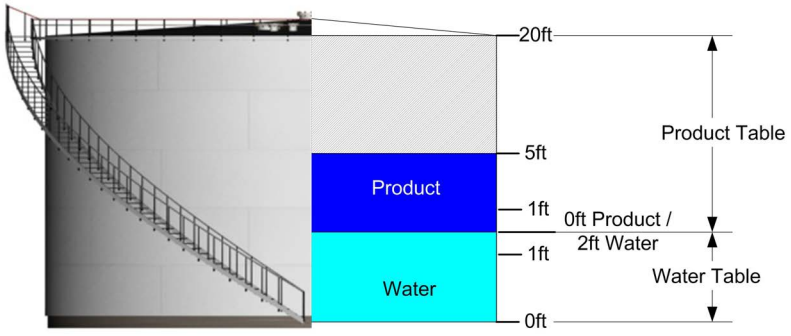
- From the water table +2ft of water = 2000 gal
- From the product table +1ft of water = 1000 gal
- Total water volume for + 3ft of water = 3000 gal

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.

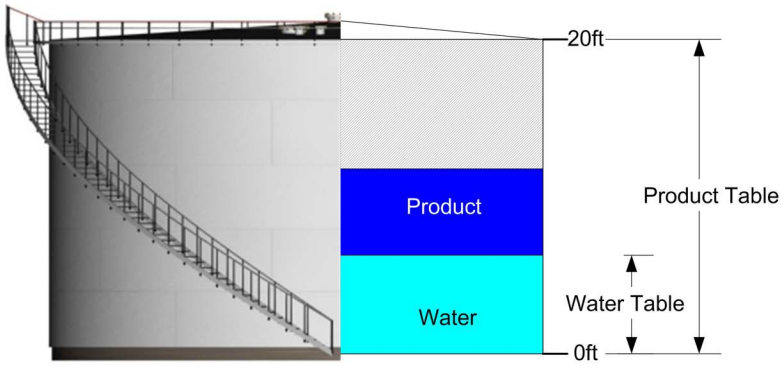
Product Table		Water Table	
Product Level	**Product Vol**	**Water Level**	**Water Vol**
0	0	0	0
1 ft	1000 gal	1 ft	1000 gal
2 ft	2000 gal	2 ft	2000 gal
5 ft	5000 gal		
20 ft	20,000 gal		

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:

∆Ts = 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
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

$$NSV = (TOV - FW) \times CTSh \times VCF \times (1.0 - {}^{BS\ \&\ W}/_{100}) - \left(\frac{1}{\rho 15} - \frac{1}{BSG}\right) \times FRA$$

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

NSV	=	Net Standard Volume
%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
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)

Volume Correction Method	API °F: Table 6B/5B
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 17-1: 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

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

Where:

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

The 8810 RTU and Volume Calculations

The 8810 RTU is capable of performing the complex calculations necessary for the up-to-date and modern American Petroleum Institute (API) standards of volume correction according to the API 2004 standards.

While the 8810 will perform the calculations, the following tables will explain how to configure the 8810 to allow it to deliver the necessary computations depending upon the company's need.

CPU Config & CPU Dynamic					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
CPU Config	AmbientTempSrc			MAN	Ambient temperature source. Enumerated type: • 1 = AmbientTemp • 2 = ManAmbientTemp
	ManAmbientTemp			MAN	Manual Ambient Temperature. This is a user-configurable ambient temperature to be used if AmbientTemp is not periodically updated via Modbus (see AmbientTemp).
	AmbTempConvert			MAN	Ambient Temperature Conversion. 4 character ASCII string (e.g. 'CtoF' for Celsius-to-Fahrenheit). Units conversion for AmbientTemp. Needed if AmbientTemp has a different units than Temp.
	AmbTempDB			MAN	Ambient Temperature Deadband. Used to prevent small AmbientTemp variations from causing extraneous tank calculations. The default is 1.0 degree F or C.
CPU Dynamic	AmbientTemp	Temperature Ambient		SRC	Sourced Ambient Temperature. Only used if ShellCorrect is 'Correction'. To get a value, first configure a Modbus Integer or Floating Point Register to periodically read a temperature from a remote device. Then configure a Modbus Register Map to map the Register value to AmbientTemp.

Table 17-2: Volume Correction Settings for the CPU (CPU Config and CPU Dynamic) Settings

Tank Configuration Parameters

Tank Config					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
Tank Calculations	StandardsOrg	Standards Organization**		MAN	Standards organization Enumerated type: 1 = American Petroleum Institute (API)
	StandardsRev	Standard – Revision**		MAN	Standards revision Enumerated type: 1 = Commodity 2004 (API)
	CommodityType	Commodity – Table**		MAN	Commodity type Enumerated type: • 1 = Alpha 60 • 2 = Crude Oil • 3 = Refined Product • 4 = Lubricating Oil
	Alpha60	Alpha**		MAN	Product Alpha 60 This coefficient is used only if CommodityType is "Alpha 60" Range is 0.00023 to 0.00096 for Fahrenheit, 0.000414 to 0.001674 for Celsius
	StdTemp	Standard Temperature**		MAN	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 60F is used regardless of the StdTemp value.
	StrapFile			MAN	Tank strap file (a.k.a., tank strapping chart) ASCII name of the Strap File (up to 32 characters).

Tank Config					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	LevelConvert			MAN	4 character ASCII string (For example, "FtoM" for feet to meters) • C = Centimeters • F = Feet • M = Meters • m = Millimeters • P = Feet-Inches-Sixteenth • S = Sixteenths • T = Thirtyseconds • 0 = Feet-Inches-Sixteenths (Mark/Space only) • 1 = Feet (Mark/Space only) • 2 = 0-20 Meters (Mark/Space only) • 3 = 0-30 Meters (Mark/Space only)
	TempConvert			MAN	4 character ASCII string for temperature conversions (For example, "FtoC" for Fahrenheit to Celsius) • C = Celsius • F = Fahrenheit • 1 = Add 100 to Fahrenheit (Mark/Space only)
	DensityConvert			MAN	4 character ASCII string for density conversions (For example, "AtoK" for API to KG/M3) • A = API • G = GMML • K = KG/M3 • L = LB/F3
	WeightConvert			MAN	4 character ASCII string for weight/mass conversions (For example, "LtoK" for Pounds to Kilograms) • K = Kilograms • L = Pounds • M = Metric Tons • T = Tons

Tank Config					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
Tank Calculations	VolumeConvert			MAN	4 character ASCII string for volume conversions (For example, "GtoL" for Gallons to Liters) • B = Barrels • G = Gallons • L = Liters • M = Cubic Meters
	PressConvert			MAN	4 character ASCII string for pressure conversions (For example, "PtoM" for PSI to Megapascals) • C = KG/CM2 • I = inH2O • K = Kilopascals • M = Megapascals • m = Millibars • P = PSI • S = Pascals
	SWPct		S&W%	MAN	Sediment & water percent Also referred to as Sediment & Water
	LevelOffset			MAN	Numeric offset applied to Level
	TempOffset			MAN	Numeric offset applied to Temp
Tank Properties	RoofType	Roof Type		CONFIG	Roof type Enumerated type: • 1 = In Table (Floating Roof) • 2 = Not In Table (Floating Roof) • 3 = Fixed Roof • 4 = No Roof Similar to FuelsManager, this combines the concepts of "Roof Type" and "Weight In Strapping Table" into one parameter.
	TankGeometry	Tank Geometry		CONFIG	Tank geometry Enumerated type: • 1 = Vertical Cylinder • 2 = Horizontal Rounded • 3 = Horizontal Flat

Tank Config					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	ShellCorrect	Tank Shell Correction		CONFIG	Tank shell correction Enumerated type: • 1 = No Correction • 2 = Uninsulated Tank • 3 = Insulated Tank
	TankMaterial	Tank Material		CONFIG	Tank shell material Only used if ShellCorrect is "Uninsulated" or "Insulated" Enumerated type: • 1 = Mild Steel • 2 = Stainless Steel • 3 = Aluminum • 4 = Other Material
	ExpCoef	Tank Expansion Coefficient	ExpCoef	CONFIG	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 filled out.
Calculation Source	LevelSrc			CONFIG	Product level source Enumerated type: • 1 = Level • 2 = ManLevel
	ManLevel			CONFIG	Manual Level value
	TempSrc			CONFIG	Product temperature source Enumerated type: • 1 = Temp • 2 = ManTemp
	ManTemp			CONFIG	Manual temperature value
	SolidsLevelSrc			CONFIG	Solids level source Enumerated type: • 1 = SolidsLevel • 2 = ManSolidsLevel
	ManSolidsLevel			CONFIG	Manual solids level value Set to -1 for 0 SolidsVol
	WaterLevelSrc			CONFIG	Water level source Enumerated type: • 1 = WaterLevel • 2 = ManWaterLevel

Tank Config					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	ManWaterLevel			CONFIG	Manual water level value Set to -1 for 0 WaterVol
	DensityMethod			CONFIG	Density method Enumerated type: • 1 = No Method • 2 = Gauged • 3 = Manual Standard
	StdDensity	Density Product Standard		CONFIG or CALC	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

Table 17-3: Volume Correction Settings for Tank Config Settings

Tank Dynamic/Command Parameters

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
Calculation Source	Level	Level Product		SOURCE	Sourced product level
	GaugeStatus	Gauge Status		SOURCE	Gauge status: • 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			SOURCE	Displacer position (For EN811, EN854, NMS5x, and NMX8x gauges only)
	Level			SOURCE	Tank level
	Temp	Temperature Product		SOURCE	Sourced product temperature
	SolidsLevel	Level Solids		SOURCE	Sourced solids (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 EN811, EN854, NMS5x, and NMS8x devices support solids level
	WaterLevel	Level Water		SOURCE	Sourced water level Note that only EN811, EN854, NMS5x, and NMS8x devices support water level
	Gauged Density	Density Product Observed***		SOURCE	Source product density Note that only EN811, EN854, NMS5x, and NMS8x devices support product density

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	DensityTemp	Temperature Density		SOURCE	Sourced product temperature at the time that GaugedDensity was calculated Note that only EN811, EN854, NMS5x, and NMS8x devices support gauged density
	Pressure	Pressure Vapor		SOURCE	The pressure applied to the fluid in the storage container or tank Pressure will change the density of the product thus impacting the VCF calculation Currently always reported as 0
	RTD1				RTD1 (Only for ATT 4000 and FTT 29xx)
	ScanStatus				Status of the scan: • 1 = Scanning • 2 = Invalid Module • 3 = Invalid Channel • 4 = Disabled Channel • 5 = Invalid DeviceType • 6 = Invalid ScanCmd • 7 = Invalid CIUAddr • 8 = Invalid Controller • 9 = Invalid Interface Module • 10 = Invalid Protocol • 11 = RegMap Source
	Elapse				Time of the last update by a REGMAP
	PntStatus			CALC	Bit 0x0008 is added for "Tank Calculation Error" CalcCode and CalcText contain the details of why the "Tank Calculation Error" bit was set • 16 = 0x0010: Invalid Level • 32 = 0x0020: Invalid Temp • 64 = 0x0040: Invalid Density • 80 = 0x0050": Invalid Level & Invalid Density • 112 = 0x0070: Invalid Level & Invalid Temp & Invalid Density
	PntCheckSum				Point check sum

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
Advanced Gauging	DeviceStatus			CALC	Bit 0x0x0010 is added for 'Tank Calculation Error' and bit 0x0020 is added for 'Floating Roof Landed'. A landed floating roof is not treated like an error condition but a floating roof in the critical zone is. Therefore, a critical zone error is reported by setting the 'Tank Calculation Error' bit and reporting this specific error condition in CalcCode and CalcText.
	CmdStatus				Status of the last command: • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout
	CallLevelCmd				Calibrate product level command ((Only for ATT 4000, FTT 29xx, and MTS)
	CallIntfCmd				Calibrate interface level command (Only for MTS)
	AlarmStatus				Tank alarm status
	DeviceStatus				Device status of the bitmap: • 0x8000 0000 = Not Balanced • 0x4000 0000 = Invalid Density • 0x0000 0080 = Tank Calculations Disabled • 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

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	LevelStatus				Tank level status as reported by the gauge VeRTUe and ViewRTU display the value in hexadecimal Other tools display the value in decimal Refer to Enraf documentation for the values reported by the gauge (Only for EN811, EN854, EN873, EN990, ATT 4000, FTT 29xx, GSI 2000, Varec 1800, Varec 1900, and Varec 6500)
	TempStatus				Tank temperature status as reported by the gauge VeRTUe and ViewRTU display the value in hexadecimal Other tools display the value in decimal Refer to Enraf documentation for the values reported by the gauge (Only for EN811, EN854, EN873, EN990, ATT 4000, FTT 29xx, GSI 2000, Varec 1800, Varec 1900, and Varec 6500)
	WaterStatus				Water level status (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	ItemCmd				Item command (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	TestCmd				Operational test command (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	CmdReply				Command reply (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	PerCmdReply				Periodic command reply (Only for EN811, EN854, EN873, EN990, and FTT 29xx)

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	PerFPValue1				Periodic floating point value (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	PerFPValue2				Periodic floating point value (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	PerlValue1				Periodic integer value (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	PerlValue2				Periodic integer value (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	ItemCmdFile				Item command file name (Only for EN811, EN854, EN873, EN990, and FTT 29xx)
	FastScanCmd				Fast scan command • 1 = Disable • 2 = Enable
	FastScanTimer				Fast scan timer in minutes
	ScanList				Scan list • 1 = Normal Scan • 2 = Fast Scan
	Volume				Volume (Only for Optilevel)
	Ullage				Ullage Uses the same units as configured in LevelConvert (Only for Optilevel)
	Offset				Offset (Only for Optilevel)
	Version				Version (Only for MTS and Optilevel)

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
Tank Calculation	CalcCmd			COMMAND	Tank Calculation Command. Enumerated type: • 1 = Copy StrapFile from USB to RTU (a.k.a. "download") • 2 = Copy StrapFile from RTU to USB (a.k.a. "upload") • 3 = Run Calculation Typically, calculations are run only when an input changes This option allows the user to manually force a one-time recalculation
	CalcCmdStatus			CALC	Tank Calculation Command Status. Enumerated type: • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout
	CalcCode			CALC	Tank Calculations status code with a value of "0" meaning there is no error with the most recent tank calculations
	CalcText			CALC	ASCII text explanation of CalcCode
	StrapTemp	Strap Temperature	TSh_{REF}	STRAPFILE	Product temperature read from the strap file
	StrapDensity	Strap Density		STRAPFILE	Product density read from the strap file
	RoofFloatingHt	Roof Floating Height*		STRAPFILE	Roof floating height read from the strap file 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	Roof Landed Height*		STRAPFILE	Roof landed height read from the strap file
	RoofWt	Roof Weight**		STRAPFILE	Roof weight read from the strap file
Density Calculations	ObsDensity	Density Observed		CALC	Observed density ObsDensity is calculated from StdDensity and product temperature
	DensInAir	Density Product in Air		CALC	Product density In air Converted from ObsDensity based on API 12.3, Table 5

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	StdDensInAir	Density Product Standard in Air		CALC	Product standard density in air Converted from StdDensity based on API 12.3, Table 5
Volume Calculations	VolCorFactor	Volume Correction for Temperature and Pressure	CTPL	CALC	Volume correction factor Calculated from StdDensity and product temperature and pressure (For this release, pressure is always 0)
	TempCorFactor	Volume Correction For Temperature	CTL	CALC	Correction due to temperature Since pressure is always 0 for this release, this is the same value as VolCorFactor
	PressCorFactor	Volume Correction For Pressure	CPL	CALC	Correction due to pressure Since pressure is always 0 for this release, this is reported as 1.0
	TankShellTemp	Tank Installation Temperature	TSh	CALC	Tank shell temperature If ShellCorrect is "Insulated", then TankShellTemp is the same as Temp Else, TankShellTemp is ((7 x Temp) + AmbientTemp) / 8
	TankShellCor	Tank Shell Correction	CTSh	CALC	Tank shell correction factor Only used if ShellCorrect is "Correction" 1 + (2 * ExpCoef * (TankShellTemp – StrapTemp)) + (ExpCoef2 * (TankShellTemp * StrapTemp)2)
	FloatRoofCor	Volume Roof Correction	FRC	CALC	Floating roof correction Only used if RoofType equals "Not In Table." RoofWt / (DensInAir * VolCorFactor)
	FloatRoofAdj		FRA	CALC	Floating roof adjustment Only used if RoofType equals 'In Table' (RoofWt / StrapDensity) – (RoofWt / ObsDensity)
	StrapVol	Volume Total Observed	TOV	CALC	Total observed volume Strap lookup from product level
	SolidsVol	Volume Solids		CALC	Strap lookup for SolidsLevel
	WaterVol	Volume Water		CALC	Strap lookup for WaterLevel with SolidsVol subtracted
	FreeWaterVol	Volume Bottoms	FW	CALC	Free water volume SolidsVol + WaterVol

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	RoofVol			CALC	Roof volume If RoofType equals "Not In Table", then RoofVol = FloatRoofCor If RoofType equals "In Table," then RoofVol = FloatRoofAdj
	GrossObsVol	Volume Gross Observed	GOV	CALC	Gross observed volume ((StrapVol – FreeWaterVol) x TankShellCor) +/– FloatRoofCor or FloatRoofAdj
	GrossStdVol	Volume Gross Standard	GSV	CALC	Gross standard volume GrossObsVol x VolCorFactor
	TotalCalcVol	Volume Total Calculated	TCV	CALC	Total calculated volume GrossStdVol + FreeWaterVol
	NetStdVol	Volume Net Standard	NSV	CALC	Net standard volume Note that the "(100 – SW%) / 100" portion of the equation is called Correction for Solids & Water (CSW) ((100 – SWPct) / 100) * GrossStdVol
	SWVol	Volume SW	$S\&W_{VOL}$	CALC	Solids & water volume (Solids is also known as Sediment) GrossStdVol – NetStdVol
Weight Calculations	GrossStdWt	Weight Gross Standard	GWS	CALC	Gross standard weight GrossStdVol * DensInAir
	NetStdWt	Weight Net Standard	NSW	CALC	Net standard weight NetStdVol * DensInAir

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
NMS/NRF/NMR	NMSDeviceCmd				NMS device commands for both the NMS5x and NMS8x lines: • 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 (NMS8x only) • 13 = Run Tank Profile • 14 = Run Interface Profile • 15 = Run Manual Profile • 16 = Level Standby (NMS8x only)
	NMSCmdStatus				Status of the last NMS command for both the NMS5x and NMS8x lines: • 1 = Start • 2 = Complete • 3 = Error • 4 = Executing • 5 = Invalid • 6 = Timeout
	NMSStatusCode				Gauge status code for both the NMS5x and NMS8x lines
	NMSStatusText				Gauge status texts for both the NMS5x and NMS8x lines
	ActualDiag				Actual diagnostics for the NMS5x line, NMS8x line, NRF81, and NMR8x line Point status for the NRF590
	UpperIntLevel				Upper interface level for the NMS5x line, NMS8x line, NRF81, and NMR8x line
	LowerIntLevel				Lower interface level for the NMS5x line, NMS8x line, NRF81, and NMR8x line
	BottomLevel				Tank bottom for both the NMS5x and NMS8x lines

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	UpperDensity				Upper density for the NMS5x line, NMS8x line, NRF81, and NMR8x line
	MiddleDensity				Middle density for the NMS5x line, NMS8x line, NRF81, and NMR8x line
	LowerDensity				Lower density for the NMS5x line, NMS8x line, NRF81, and NMR8x line
	NxxObsDensity				Nxx observed density for the NMS8x line, NRF590, NRF81, and NMR8x line
	P1				P1 (bottom) for the NMS8x line, NRF590, NRF81, and NMR8x line
	P2				P2 (middle) for the NMS8x line, NRF590, NRF81, and NMR8x line
	P3				P3 (top) for the NMS8x line, NRF590, NRF81, and NMR8x line
	VaporTemp				Vapor temperature for the NMS8x line, NRF590, NRF81, and NMR8x line
	AirTemp				Air temperature for the NMS8x line, NRF81, and NMR8x line
	LevelPct				Tank level percentage for the NMS8x line, NRF590, NRF81, and NMR8x line
	MeasLevel				Measured level without corrections for the NMS8x line, NRF590, NRF81, and NMR8x line
	TankUllage				Tank ullage for the NMS8x line, NRF81, and NMR8x line
	Alarm1				Alarm 1 for the NMS8x line, NRF81, and NMR8x line
	Alarm2				Alarm 2 for the NMS8x line, NRF81, and NMR8x line
	Alarm3				Alarm 3 for the NMS8x line, NRF81, and NMR8x line
	Alarm4				Alarm 4 for the NMS8x line, NRF81, and NMR8x line
	FilteredDist				Filtered distance for the NMR8x line
	SignalQuality				Signal quality for the NMR8x line: • 0 = No Signal • 1 = Weak Signal • 2 = Medium Signal • 3 = Strong Signal

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
TLS (Only for TLS-3xx and TLS-4xx)	TLSVolume				Volume
	TLSTCVolume				Temperature corrected volume
	TLSWaterVolume				Water volume
	TLSUllage				Ullage
	TLSStatusBits				Bitmap of the tank status bits: • 0x0004 = Invalid Fuel Height Alarm • 0x0002 = Leak Detection In Progress • 0x0001 = Delivery In Progress

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	TLSTankAlarms				Bitmap of the tank alarms: • 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

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	TLSSensorStat				Liquid sensor status: • 0 = Normal • 1 = Setup Data Warning • 2 = Fuel Alarm • 3 = Out Alarm • 4 = Short Alarm • 5 = Water Alarm • 6 = Water Out Alarm • 7 = High Liquid Alarm • 8 = Low Liquid Alarm • 9 = Liquid Warning
	TLSStartTime				Leak detect starting date and time
	TLSDuration				Leak detect test duration in hours
	TLSStartTemp				Leak detect starting temperature
	TLSEndTemp				Leak detect ending temperature
	TLSStartVolume				Leak detect starting volume
	TLSEndRate				Leak detect ending rate
	TLSTestType1				Previous in-tank leak test result: • 0 = 0.20 gal/hr Test • 1 = 0.10 gal/hr Test • 2 = Gross (3 gal/hr) Test
	TLSStartTime1				Previous in-tank leak test start time
	TLSManiStatus1				Previous in-tank leak manifold: • 1 = Tank Not Manifolded During Leak Test • 2 = Tank Manifolded During Leak Test
	TLSTestResult1				Previous in-tank leak test result: • 1 = Test Invalid • 2 = Test Passed • 3 = Test Failed
	TLSTestType2				Previous in-tank leak test result: • 0 = 0.20 gal/hr Test • 1 = 0.10 gal/hr Test • 2 = Gross (3 gal/hr) Test
	TLSStartTime2				Previous in-tank leak test start time

Tank Dynamic/Command					
OPC UA Folder	**Display Name**	**FM Settings**	**API Abbr.**	**Input From**	**Notes**
	TLSManiStatus2				Previous in-tank leak manifold: • 1 = Tank Not Manifolded During Leak Test • 2 = Tank Manifolded During Leak Test
	TLSTestResult2				Previous in-tank leak test result: • 1 = Test Invalid • 2 = Test Passed • 3 = Test Failed
	TLSTestType3				Previous in-tank leak test result: • 0 = 0.20 gal/hr Test • 1 = 0.10 gal/hr Test • 2 = Gross (3 gal/hr) Test
	TLSStartTime3				Previous in-tank leak test start time
	TLSManiStatus3				Previous in-tank leak manifold: • 1 = Tank Not Manifolded During Leak Test • 2 = Tank Manifolded During Leak Test
	TLSTestResult3				Previous in-tank leak test result: • 1 = Test Invalid • 2 = Test Passed • 3 = Test Failed

Table 17-4: Volume Correction Settings for Tank Dynamic Settings

Notes

*	Setting in FM available to operations like a Tag
**	Label in config settings, not a Tag
***	*Does not yet exist but needs to*

18 Point Status Tables

Purpose

The purpose of the Point Status Tables section is to give users the understanding of what options the 8810 RTU provides for point status configuration depending upon the tank, alarm, or device.

Channel Point Status Table

Channel - PntStatus	Text
0x0000 0001	Communication Timeout
0x0000 0002	Channel Initialization Failure
0x0000 0004	Hardware Communication Error (set when OS reports a hardware error)
0x0000 0008	USB Device Controller Error (Serial or Tankway Module)
0x0000 0010	Transmit Data Error
0x0000 0020	Channel Disabled
0x0000 0040	Protocol Mismatch (configured protocol is incompatiable with installed module)
0x0000 0080	DIO Input Value Override
0x0000 0100	DIO Output Signal Does Not Match Loopback Signal
0x0000 0200	Mark/Space Line Shorted
0x0000 0400	Power Failure
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	Module Not Installed
0x0200 0000	Module Mismatch (configured module does not match installed module)

Channel - PntStatus	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	CIU Communication Timeout
0x0000 0004	Not Scanning
0x0000 0008	Tank Calculation Error
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	

Alarm Point Status Table

Alarm - PntStatus	Text
0x0000 0001	Alarm Output Mod/Channel Suppressed
0x0000 0002	Alarm Output Mod/Channel Suppressed
0x0000 0004	Alarm Output Mod/Channel Suppressed
0x0000 0008	Alarm Output Mod/Channel Suppressed
0x0000 0010	Alarm Output Mod/Channel Suppressed
0x0000 0020	Alarm Output Mod/Channel Suppressed
0x0000 0040	Alarm Output Mod/Channel Suppressed
0x0000 0080	Alarm Output Mod/Channel Suppressed
0x0000 0100	Alarm Output Mod/Channel Suppressed
0x0000 0200	Alarm Output Mod/Channel Suppressed
0x0000 0400	Alarm Output Mod/Channel Suppressed
0x0000 0800	Alarm Output Mod/Channel Suppressed
0x0000 1000	Alarm Output Mod/Channel Suppressed
0x0000 2000	Alarm Output Mod/Channel Suppressed
0x0000 4000	Alarm Output Mod/Channel Suppressed
0x0000 8000	Alarm Output Mod/Channel Suppressed
0x0001 0000	
0x0002 0000	
0x0004 0000	
0x0008 0000	
0x0010 0000	
0x0020 0000	
0x0040 0000	
0x0080 0000	
0x0100 0000	Module Not Installed
0x0200 0000	Module Mismatch (configured module does not match installed module)
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	

19 Tank Device Status Tables

Purpose

The purpose of the Tank Device Status tables are to help the user understand what the 8810 RTU can understand from the supported devices and what the devices' respective status errors are. The tables are broken into four tables: the first table consisting of the EN811, EN854, EN873, and EN990 Enraf devices; the second table consisting of the ATT 4000, FTT 29xx, GSI 2000, V1800, V1900, and V6500 devices; the third table consisting of the NMS5x, NMS8x, NRF590, NRF81, and NMR8x devices; the fourth table consisting of the LJ1000, LJ1500, LJ2000, and MTS devices; and the fifth and final table consisting of the TLS3xx, TLS4xx, X76CTM, and the OptiLevel devices.

The EN811, EN854, EN873, and EN990 Device Status Table

DeviceStatus Bit	Error	EN811	EN854	EN873	EN990
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	Tank Calculation Error	Y	Y	Y	Y
0x00000020	Floating Roof Landed	Y	Y	Y	Y
0x00000040	Register Map Source	Y	Y	Y	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				
0x00020000	No Calculation				
0x00040000	Configuration Error				
0x00080000	Calculation Error				
0x00100000	Bad CPU Board				
0x00200000	Bad Comms Board				
0x00400000	Stale Level				
0x00800000	40 Bit Response				

DeviceStatus Bit	Error	EN811	EN854	EN873	EN990
0x01000000	Temp Overrange				
0x01000000	Dual Band Error				
0x01000000	Low Speed Response				
0x02000000	Vin Power				
0x04000000	Vf Power				
0x08000000	Discreet 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		
0x80000000	Alarm Status				
0x80000000	Temp Value Is Positive				
0x80000000	Not Balanced				
0x80000000	Low Encoder Battery				
0x80000000	CIU Timeout	Y	Y	Y	Y

The ATT 4000, FTT 29xx, GSI 2000, V1800, V1900, and V6500 Device StatusTable

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	Tank Calculation Error	Y	Y	Y	Y	Y	Y
0x00000020	Floating Roof Landed	Y	Y	Y	Y	Y	Y
0x00000040	Register Map Source	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	Discreet 2						
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						

DeviceStatus Bit	Error	ATT 4000	FTT 29xx	GSI 2000	V1800	V1900	V6500
0x80000000	Alarm Status						
0x80000000	Temp Value Is Positive						
0x80000000	Not Balanced						
0x80000000	Low Encoder Battery	Y					
0x80000000	CIU Timeout		Y				

The 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	Tank Calculation Error	Y	Y	Y	Y	Y
0x00000020	Floating Roof Landed	Y	Y	Y	Y	Y
0x00000040	Register Map Source	Y	Y	Y	Y	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					
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	Discreet 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

DeviceStatus Bit	Error	NMS5x	NMS8x	NRF590	NRF81	NMR8x
0x80000000	Alarm Status					
0x80000000	Temp Value Is Positive					
0x80000000	Not Balanced	Y	Y			
0x80000000	Low Encoder Battery					
0x80000000	CIU Timeout					

The LJ1000, LJ1500, LJ2000, and MTS Device Status Table

DeviceStatus Bit	Error	LJ1000	LJ1500	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	Tank Calculation Error	Y	Y	Y	Y
0x00000020	Floating Roof Landed	Y	Y	Y	Y
0x00000040	Register Map Source	Y	Y	Y	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				
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	Discreet 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	Y	Y	Y	
0x40000000	Bad Density				

DeviceStatus Bit	Error	LJ1000	LJ1500	LJ2000	MTS
0x80000000	Alarm Status				Y
0x80000000	Temp Value Is Positive	Y	Y	Y	
0x80000000	Not Balanced				
0x80000000	Low Encoder Battery				
0x80000000	CIU Timeout				

The TLS3xx, TLS4xx, X76CTM, and OptiLevel Device Status Table

DeviceStatus Bit	Error	TLS3xx	TLS4xx	X76CTM	OptiLevel
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	Tank Calculation Error	Y	Y	Y	Y
0x00000020	Floating Roof Landed	Y	Y	Y	Y
0x00000040	Register Map Source	Y	Y	Y	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				
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	Discreet 2				
0x08000000	Missing Comm Board				
0x08000000	Space Short				
0x08000000	Adjustment in Progress				Y
0x10000000	Discrete 1				
0x10000000	Transmitter Error				

DeviceStatus Bit	Error	TLS3xx	TLS4xx	X76CTM	OptiLevel
0x10000000	Mark Short				
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 Battery				
0x80000000	CIU Timeout				
0x80000000	Wrong DIP Settings				Y

20 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 8810 RTU 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 Reconcilliation Warning	Minor	368
02	26	Tank Alarm	Tank HRM Reconcilliation 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

21 Troubleshooting

This chapter describes the procedures used to isolate hardware faults. If the 8810 RTU is not functioning normally, the user is able to troubleshoot the device through Vertue or by reading the displayed error code on the LCD screen and the table at the end of this chapter.

Troubleshooting the 8810 RTU

LCD Display

The 8811 CPU's LCD display shows the status of 8810 and the inserted cards. The list of error codes and their meanings are listed in the table towards the end of this chapter. The LCD display also displays the IP address and status of the 8810 RTU.

Powercycling the 8810

Power cycling or reinitializing the 8810 RTU is either done by:

- Through accessing Vertue's Admin System Commands and resetting the CPU or using an OPC client.
- Physically removing the 8811 CPU module and then re-inserting it.

CPU Module Software Installed Resets

The following actions will cause the 8810 to power cycle and cause the 8811 CPU module to power cycle:

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

Mark/Space LED Troubleshooting

The 8815 Mark/Space module's LED lights can communicate the status of the module based upon the status of the lights.

The Mark/Space LEDs

There are four basic LEDs for each of the two channels and how they work and flash during normal usage. The X can stand for either channel 1 or channel 2:

Mark/Space LEDs	Explanation	Normal Light Status
CH X TX	Channel X Transmit LED	Flashes on during a transmit message
CH X RX	Channel X Receive LED	Flashes on as a message is being received from a level transmitter

Mark/Space LEDs	Explanation	Normal Light Status
CH X Field Pwr	Channel X Field Power	Indicates that the M/S Bus is powered by the voltage aplied to the CPU Field Input
CH X Input Pwr	Channel X Input Power	Indicates that the M/S Bus is powered by the voltage applied to the Power In X terminal on the M/S module

Mark/Space Troubleshooting

By observing the lights and referencing the table below, the user can determine what hardware issues are occurring with the Mark/Space module:

Light Status	Possible Issues
No TX LED	• Check for proper configuration of the Tank point in the RTU (DeviceType, Module, & Channel) • Check for the proper configuration of the Port (Protocol & ChanState) • Check for the proper configuration of the Module (ModConfigured)
No RX LED	• Check for the proper configuration of the Tank point in the RTU (DeviceType & DeviceID) • Check for proper connections and wiring • Check power & bus status (see below)
No Field Pwr LED	• Check that 48 VCD is properly connected to Field A and/or Field B terminal(s) of the CPU module • Check the Channel X Pwr Select Switch (SW2 or SW3 on the M/S IFM) is set to V Field • Check CH X Fuse (front of the M/S IFM)
No Input Pwr LED	• Check that 48 VCD is proper connected to Power In X (on the front of the M/S IFM) • Check the Channel X Pwr Select Switch (SW2 or SW3 on the MS
Field Pwr LED flashes once a second	Indication that the Mark signal line is shorted (either at the M/S IFM, a level transmitter in the field, or in the associated field wiring)
Input Pwr LED flashes once a second	Indication that the Space signal line is shorted (either at the M/S IFM, a level transmitter in the field, or in the associated field wiring)

8810 RTU Error Codes

The following list are designed to assist the user to determine what is happening with the 8810 and associated cards to help them fix issues that are occurring. Any error code that is not displayed below will require assistance from Varec's Technical Support.

Error Code	Description	Resolution	Source Code File
0x090A	Error configuring IP address.	Reconfigure using a correctly formatted IP address.	SPInetworkConfig.c

Error Code	Description	Resolution	Source Code File
0x090B	Error configuring subnet mask.	Reconfigure using a correctly formatted subnet mask.	SPInetworkConfig.c
0x090C	Error configuring gateway address.	Reconfigure using a correctly formatted gateway address.	SPInetworkConfig.c
0x0D09	The Modbus client used an unsupported Modbus WriteCmd.	Reconfigure WriteCmd in MFPREG or MIREG. Supported Modbus write Functions are: 5, 6, 16, 66.	MODBUSclientTask.c
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	MODBUSclientTask.c
0x0F20	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCcpum.c
0x011A7	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCgwblk.c
0x1209	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCintfm.c
0x1309	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCmfpreg.c
0x1409	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCmireg.c
0x150B	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCport.c
0x1750	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCtanka.c

Error Code	Description	Resolution	Source Code File
0x1850	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible. Also verify that the OPA UA Status Code of the parameter is "Good".	OPCtankb.c
0x1A11	Invalid CPU Module ModCmd option has been selected.	Select a valid ModCmd option.	PNTcpum.c
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.	LOGdebugLog.c
0x1C05	Problem encountered reading the internal USB flash drive while executing a system reset or downloading the database.	A default GWBLK configuration has been created. Examine the GWBLK points to confirm that they have the desired configuration settings.	PNTgwblk.c
0x1E04	Invalid Interface Module ModCmd option has been selected.	Select a valid ModCmd option.	PNTintfm.c
0x1E09	Problem encountered reading the internal USB Flash Drive while executing a system reset or downloading the database.	A default interface module configuration has been created. Examine the interface module points to confirm that they have the desired configuration settings.	PNTintfm.c
0x1F01	Error reading data from the interface module.	Remove the interface module and plug it back in.	PNTintfm.c
0x1F02	Error reading data from the interface module.	Remove the interface module and plug it back in.	PNTintfm.c
0x1F03	Error reading data from the interface module.	Remove the interface module and plug it back in.	PNTintfm.c
0x1F08	Unable to obtain USB Device Controller for a Serial Module.	Remove the Serial module and plug it back in.	PNTintfm.c
0x2002	The user tried to configure an invalid MFPREG IPAddress.	Reconfigure using a valid IP address. If this error happens again, contact Varec.	PNTmfpreg.c
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.	PNTmfpreg.c
0x2007	Problem encountered reading the internal non-volatile memory while executing a system reset or downloading the database.	A default MFPREG configuration has been created. Examine the MFPREG points to confirm that they have the desired configuration settings.	PNTmfpreg.c
0x2102	The user tried to configure an invalid MIREG IPAddress.	Reconfigure using a valid IP address.	PNTmireg.c
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.	PNTmireg.c
0x2107	Problem encountered reading the internal non-volatile memory while executing a system reset or downloading the database.	A default MIREG configuration has been created. Examine the MIREG points to confirm that they have the desired configuration settings.	PNTmireg.c

Error Code	Description	Resolution	Source Code File
0x2206	Problem encountered reading the internal non-volatile memory while executing a system reset or downloading the database.	A default PORT (a.k.a., channel) configuration has been created. Examine the PORT (a.k.a., channel) points to confirm that they have the desired configuration settings.	PNTport.c
0x2506	Problem encountered reading the internal non-volatile memory while executing a system reset or downloading the database.	A default Tank configuration has been created. Examine the Tank points to confirm that they have the desired configuration setting.	PNTtanka.c
0x2510	Error encountered while using a Tank's DeviceCmd "Copy ItemCmdFile", "Copy Cfg to USB", or "Copy Log to USB" options.	Select a valid DeviceCmd and try the operation again.	PNTtanka.c
0x2512	Error encountered while using a Tank's DeviceCmd "Copy ItemCmdFile", "Copy Cfg to USB", or "Copy Log to USB" options.	Install an external USB Flash Drive and try the operation again.	PNTtanka.c
0x2606	Problem encountered reading the internal non-volatile memory while executing a system reset or downloading the database.	A default Tank configuration has been created. Examine the Tank points to confirm that they have the desired configuration settings.	PNTtankb.c
0x270f	An external USB flash drive was detected during RTU power-up.	An external USB flash drive should not be plugged in when booting up the RTU. Remove the external USB flash drive and then power cycle the RTU.	PNTtask.c
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.	PORTenrafMaster.c
0x2B04	Problem encountered while executing a Tank DeviceCmd.	A tank's ItemCmdFile could not be opened. Verify that the configured ItemCmdFile exists.	PORTenrafMaster.c
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.	PORTenrafMaster.c
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.	PORTenrafMaster.c
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.	PORTenrafMaster.c
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.	PORTenrafMaster.c
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.	PORTenrafMaster.c

Error Code	Description	Resolution	Source Code File
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 RTU.	PORTmodbusSlave.c
0x3005	Unable to find an address match for the incoming Modbus Function 1, 2, 3, or 4.	Check the Gateway Block Addresses to make sure that they match what's being sent by the Modbus Master device.	PORTmodbusSlave.c
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 RTU.	PORTmodbusSlave.c
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.	PORTmodbusSlave.c
0x300E	Invalid Force Data field received for Modbus Function 5.	Check the device that is sending message to the RTU. FF00 indicates "ON", 0000 indicates "OFF".	PORTmodbusSlave.c
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 RTU.	PORTmodbusSlave.c
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 RTU.	PORTmodbusSlave.c
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.	PORTmodbusSlave.c
0x3017	The RTU received a Modbus command for a function that the RTU does not support.	Check device sending message to the RTU.	PORTmodbusSlave.c
0x3109	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCalarm.c
0x3201	Invalid AlarmCmd option has been selected.	Select a valid AlarmCmd option.	PNTalarmTask.c
0x3206	An Alarm configuration file was not found.	This error might be reported after a firmware upgrade. A default Alarm configuration file was automatically created. Check the configuration of the Alarm.	PNTalarmTask.c
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.	PORTmodbusMaster.c
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.	PORTmodbusMaster.c
0x3609	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCregmap.c

Error Code	Description	Resolution	Source Code File
0x3706	A Register Map configuration file was not found	This error might be reported after a firmware upgrade. A default Register Map configuration file was automatically created. Check the configuration of the Register Map.	PNTregmapTask.c
0x3920	External USB flash drive not detected while copying the firmware from the external USB flash drive to the RTU.	Insert an external USB flash drive. If one is installed, then try removing the External USB and plugging it back in.	PNTcpuModCmd.c
0x3929	Error encountered while copying the firmware from the external USB flash drive to the RTU.	Either the boot.uimage or ngrtu file must be on the external USB flash drive. Verify if either file is present.	PNTcpuModCmd.c
0x3941	External USB flash drive not detected while copying the configuration database from the external USB flash drive to the RTU.	Insert an external USB flash drive. If one is installed, then try removing the External USB and plugging it back in.	PNTcpuModCmd.c
0x3942	The value of DBDirectory used to copy the configuration database from the external USB flash drive to the RTU is invalid.	The first character of DBDirectory must be alpha-numeric. Configure a valid DBDirectory and try copying the database again.	PNTcpuModCmd.c
0x3943	Error encountered while copying the configuration database from the External USB to the Internal USB.	The DBDirectory does on exist on the external USB flash drive. Add the missing directory and all of its database files.	PNTcpuModCmd.c
0x3944	Error encountered while copying the configuration database from the External USB to the Internal USB.	One or more database file is missing from the DBDirectory on the external USB flash drive. Verify that the contents of the DBDirectory are complete.	PNTcpuModCmd.c
0x3945	A database file on the external USB flash drive is incompatible with the RTU.	A database file is an unexpected size. Use database files that are compatible with the RTU.	PNTcpuModCmd.c
0x3949	An alarm database file on the external USB flash drive is incompatible with the RTU.	A database file is an unexpected size. Use database files that are compatible with the RTU.	PNTcpuModCmd.c
0x3950	External USB flash drive not detected while copying the configuration database from the RTU 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	PNTcpuModCmd.c
0x3951	The value of DBDirectory used to copy the configuration database from the RTU to the external USB flash drive is invalid.	The first character of DBDirectory must be alpha-numeric. Configure a valid DBDirectory and try copying the database again.	PNTcpuModCmd.c
0x3953	Too many directory copies exist while copying the configuration database from the RTU to the external USB.	A maximum of 5 copies are permitted. Delete one or more of the copy directories and try copying the configuration database again.	PNTcpuModCmd.c
0x3960	External USB flash drive installed while trying to set the configuration to factory default.	Remove the external USB flash drive and execute the command again.	PNTcpuModCmd.c
0x3A10	Unexpected status message received.	This error code should not be reported in a properly operating system. If it is reported, then record the steps taken immediately before this occurred and contact Varec.	PORTtankway.c
0x3B01	Invalid CertCmd option has been selected.	Select a valid CertCmd option.	PNTx509Task.c

Error Code	Description	Resolution	Source Code File
0x3B06	An X509 configuration file was not found.	This error might be reported after a firmware upgrade. A default X509 configuration file was automatically created. Check the configuration of the X509.	PNTx509Task.c
0x3B12	Invalid X509 CertFile filename encountered.	Verify that CertFile is a valid filename. If the server certificate, also verify that PrivateKeyFile is a valid filename.	PNTx509Task.c
0x3B16	The external USB flash drive was not installed when trying to copy A X.509 certificate 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.	PNTx509Task.c
0x3B19	An invalid file was encountered when trying to copy an X.509 certificate between the 8810 RTU and the External USB flash drive.	Verify that the source file exists.	PNTx509Task.c
0x3B20	An invalid file was encountered when trying to copy an X.509 private key from the external USB flash drive to the RTU	This error is reported when a 0-byte size file is encountered. Verify the size and contents of the source file.	PNTx509Task.c
0x3B50	An error was encountered while deleting an X.509 certificate.	The certificate files does not exist. Verify that PntStatus is non-0.	PNTx509Task.c
0x3C09	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCx509.c
0x3D07	A TLS configuration file was not found.	This error might be reported after a firmware upgrade. A default Remote File Transfer configuration file was automatically created. Check the configuration of the Remote File Transfer.	PNTtls.c
0x3E09	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCtls.c
0x3F09	An OPC UA client sent an unsupported Node ID to the RTU.	Investigate OPC UA client to determine why it is sending an invalid Node ID. For example, verify that Vertue and the RTU versions are compatible.	OPCrft.c
0x4015	A Remote File Transfer configuration file was not found.	This error might be reported after a firmware upgrade. A default Remote File Transfer configuration file was automatically created. Check the configuration of the Remote File Transfer.	PNTrft.c

22 Order Codes

8810 Remote Terminal Unit

Part Number	Description
N8810	Base 8810 Housing, 8811 CPU Module, blank covers, and panel mounting brackets
N8811	Spare 8811 CPU Module
N8812	8812 Bi-Phase Mark Module
N8813	8813 Digital I/O Module
N8814	8814 Serial Module
N8815	8815 Mark/Space Module
N8816	8816 L&J Tankway Module
400061639	24 VCD Output, 5A, 100W Power Supply (Sola SDN 5-24-100P)
P108-04-024	RS232 DB9 F/F Null Modem Cable, 10 ft
P111-41-008*	DC Output Module, 3-60 VDC, 1.5 mA Max. Off-State Leakage @ Max. Line
P111-41-009*	DC Input Module, 3-32 VDC
P111-41-011	DC Output Module, 4-200 VDC, 0.1 mA Max. Off-State Leakage @ Max. Line
P111-41-012*	DC Output Module, 3-60 VDC, 0.1 mA Max. Off-State Leakage @ Max. Line
P111-41-013*	DC Input Module, 35-60 VDC
P111-41-014*	DC Input Module, 10-32 VDC

* These mini I/O modules all have an isolation voltage of 4000 V rms, a storage temperature range of -40 to 125° C, and an operating temperature range of -40 to 100° C

Note All 8813 output module terminal connections are rated for 60 VDC max., 1 A max.

Note 8813 input module P111-41-013 is rated 60 VDC max, 6 mA max. All other 8813 input modules are rated 32 VDC max., 18 mA max.

Notes

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