QUALITROL® Transformer Monitor System

Hardware and Software Instructions

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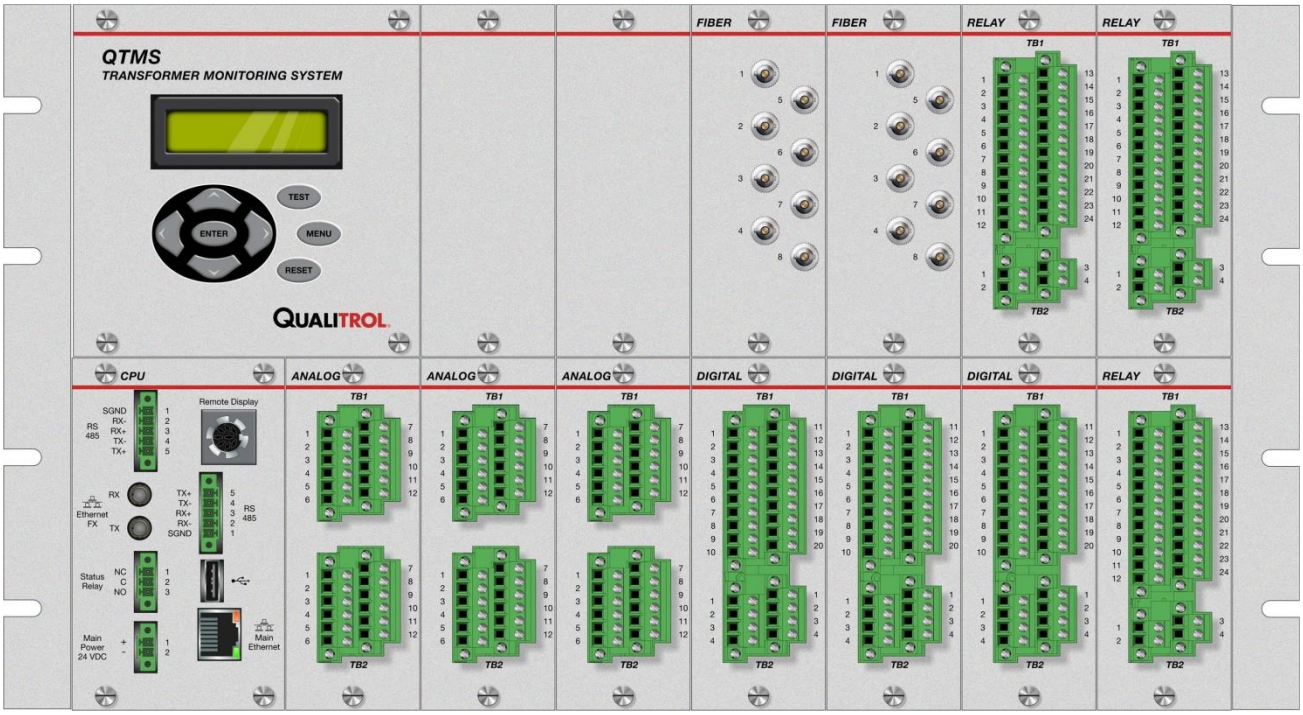

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Hardware Instructions

Overview

QUALITROL® QTMS Series Transformer Monitor System

The NERC compliant QUALITROL® Transformer Monitor System (QTMS) for Substations offers microprocessor technology and advanced digital signal processing to accurately assess the health and performance of oil-filled transformers along with up to the second information concerning all your substation parameters.

The System pulls data from remote sensors and consolidates the data, analyzes it and provides essential information to the user. The unit not only provides remote sensors, but also accepts inputs from other devices already installed on the transformer/substation. The product is flexible allowing the user to scale the device according to the needs of the system. Modules can be easily added to the QTMS to expand system capability.

All sensor inputs, output controls, and communications are housed in one unit device.

The QTMS can be tailored to suit the application. This complete transformer monitoring system can contain up to 14 modules for monitoring values such as:

- Liquid Temperatures (Main Tank Top or Bottom, Load Tap Changer)
- Liquid Levels
- Winding Temperatures
- Ambient Temperatures
- Winding Current
- Cooling Bank Currents
- Gas Density
- Moisture
- Battery Value
- A variety of parameters from transducers, such as Tank Pressure or Dissolved Gas in Oil analysis

Available QTMS inputs include:

- Resistance Temperature Detectors (RTDs)
- Current Transformers (0 – 5 A, 0 – 10 A, 0 – 20 A, 0 – 50 A, 0 – 100 A)
- AC Voltage (0 - 140 VAC or 0 - 320 VAC)
- Potentiometer (5K - 15K)
- Current Loops (0 - 1 or 4 - 20 mA DC)
- DC Voltage (0 - 100 mV or 0 - 10 V)
- Tap Position Resistor Bridge
- Switch Contact Closure (powdered or dry)
- Digital (max voltage:250v)
- Direct Winding Temperature

Other features include:

- An integrated (Web Browser) software package that provides graphical displays and interfaces needed to view information remotely and at point of use
- Software supported in multiple languages
- Local display for viewing data and configuration
- Advanced thermal modeling of winding temperatures
- Superior temperature control for higher loads
- Integrated Load Tap Changer (LTC) temperature monitoring
- Standalone or networked substation monitoring
- Diagnostic tools for condition based maintenance
- Adjustable Form C relays to operate cooling equipment, signal alarms, and provide trip functions, depending on transformer conditions
- RS-485 digital communication ports
- Status relay to indicate loss of power
- Data logger
- Hot swappable modules
- System recognition of installed modules
- Each module tracts its individual revision level
- Module configuration parameters kept in the QTMS CPU

The device is easy to install and use. It is designed to be mounted outdoors, with a heater available inside the enclosure, in a transformer control cabinet, and it is powered by a universal power supply of 90 - 264 VAC 50 - 60 Hz single-phase power or 127 - 300 VDC.

About Qualitrol

Qualitrol has been a leader in supplying pressure, liquid level, and temperature controls since 1945. As an ISO 9001 System-certified company, we are committed to providing quality and reliability, both in our products and in our service.

About These Hardware Instructions

These Hardware Instructions provide all the information you will need to configure, install, and operate your QTMS. They are organized into the following sections:

Controls and Indicators - Diagrams and brief descriptions to help you locate and understand basic functions of each of the controls, indicators, and modules that make up the QTMS.

Module Overviews and Specifications

Installation - Illustrated instructions to guide you through mounting, supplying power to, and wiring your transformer monitor.

Operation - A description of automatic operation, as well as easy instructions on viewing parameters and set points, resetting memories, programming the QTMS using the Keypad, and testing the system.

Functional Specifications - A detailed, functional specification of the monitor.

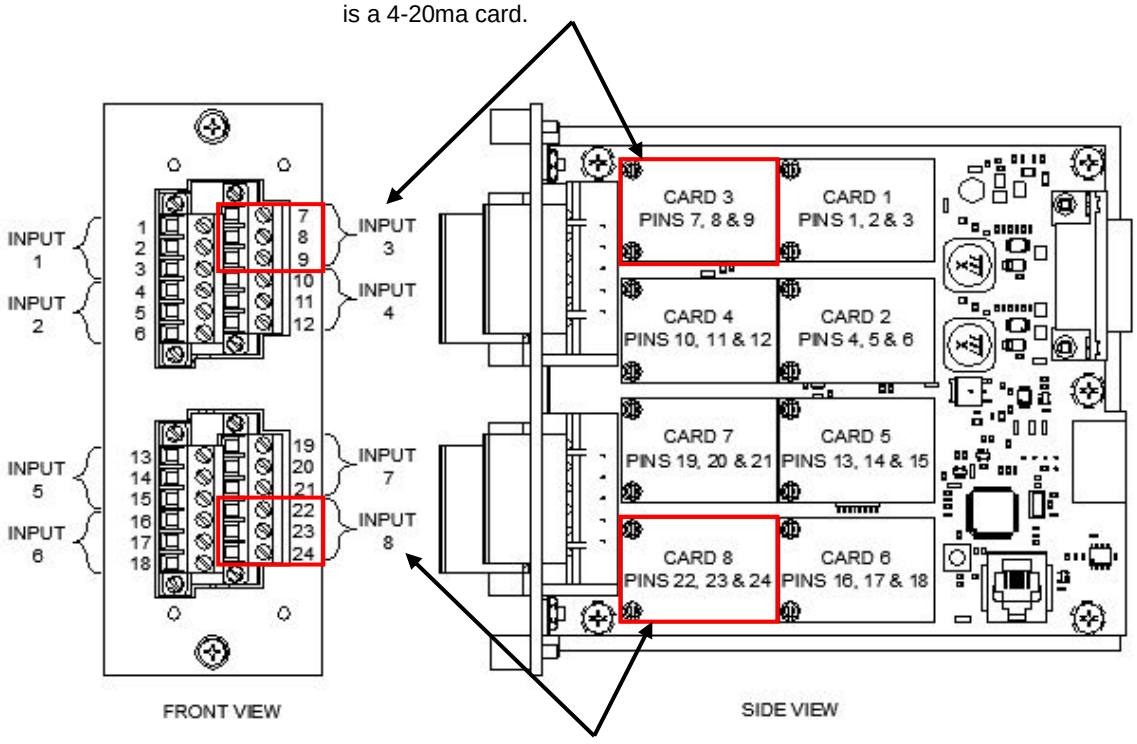
Appendix - Contains mechanical drawings of the QTMS.

QTMS Chassis Overview

The QTMS chassis can contain a total of 14 I/O modules with each module preconfigured at the factory with specific point types as specified by the customer when ordering the unit. Each module is comprised of "cards" containing the associated circuitry for each ordered signal type.

An example is shown in the following.

When ordered, the Analog Input module, signal Input 3, was specified to be a 4-20ma. Card 3 within the module is a 4-20ma card.



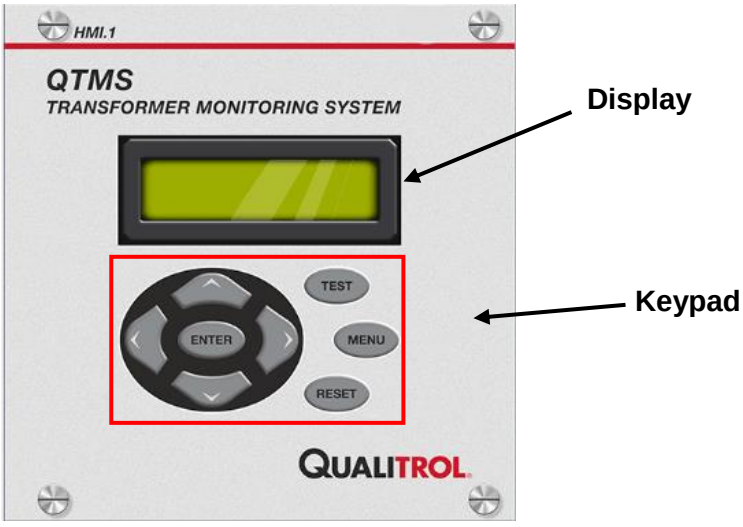
When ordered, the Analog Input module, Input 8, was specified to be a RTD. Card 8 within the module is a RTD card.

Controls and Indicators

HMI Panel

The functions of the display and the keypad on the front panel are described below. For operating instructions, refer to the *Operation* section.

- **DISPLAY -** On a periodic basis, user settable between 1 to 5 seconds, the display automatically scrolls through the channels and displays the channel name and the value of the parameter. It also displays the selected indications of the keypad control.
- **KEYPAD -** The keypad area contains several control keys as follows.
- **ENTER** key is used to change menu modes or accept changes to values.
- **TEST** key is used to confirm the output relay wiring. When pressed, each relay, that is not set to 'Test Lock Out', is actuated, in order, for one second.
- **MENU** key is used to access the programming menu.
- **RESET** key is used to reset the maximum and minimum values, while in the program menu, or unlatch any latched relays while in the normal scrolling mode.
- **ARROW Keys** are used to move through the various menus.



QTMS Front Panel Display

Module Overviews and Specifications

The modules comprising the QTMS include:

- CPU Module:
- Analog Input Module
- Digital Input Module
- Direct Fiber Optic Module
- Relay Output Module

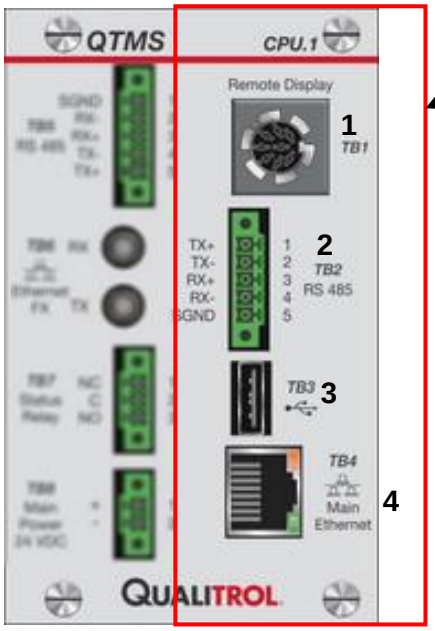
CPU Module New

The QTMS CPU Module is comprised of two separate boards, a CPU board and a communications board that works in conjunction with the CPU board. The communications board is provided in two different versions dependent upon customer system communications requirements.

The CPU board and communications board options are discussed in the following paragraphs.

The CPU Module CPU Board

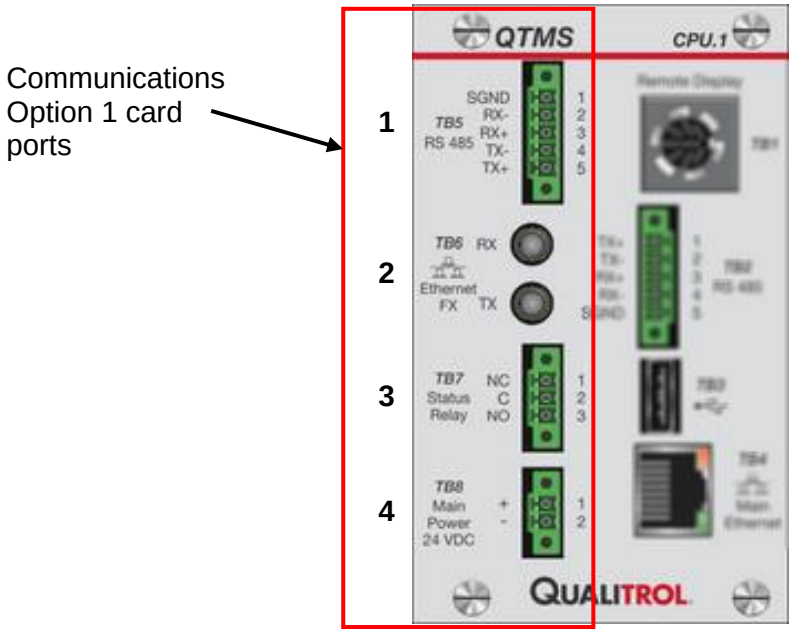
The CPU Module CPU board comes standard with the following.



Index	Port	Definition
1	**TB1** **Remote Display**	Display port for an optional remote display. This port allows the user to reposition the local HMI display.
2	**TB2** **RS-485**	This port can be used in one of two ways. 1. Modbus Master port to communicate digitally with Serveron DGA units or Wika SF_6 gas monitors. 2. Modbus Slave port to communicate using DNP or Modbus.
3	**TB3** **USB**	Used for downloading data, diagnostic, and security logs, QTMS configuration, and factory default configuration.
4	**TB4** **Main Ethernet**	10/100 Ethernet TX, RJ45 port for remote or local QTMS configuration.

CPU Module Communications Board - OPTION 1

Communications Board Option 1 provides the following.



Index	Port	Definition
1	**TB5** **RS-485**	Second RS-485 having the same capability as the TB2 RS-485 port. ***Note:*** Only one of these RS-485 ports can be configured as a Modbus Master - but both ports can be configured as Modbus Slaves.
2	**TB6** **Ethernet FX**	Ethernet FX, ST port for connection to a local network using fiber optic cable.
3	**TB7** **Status Relay**	System Status relay with normally-closed contacts that close (failsafe mode) if a QTMS power failure, a module error or a sensor error occurs.
4	**TB8** **Main Power**	24VDC input power connection.

Communications Board - OPTION 2 (In development)

Communications Board Option 2 provides the following.

Index	Port	Definition
1	**TB5** **Serial Port**	This Fiber Optic Serial port can be used in one of two ways. 1. Modbus Master port to communicate digitally with Serveron DGA units or Wika SF6 gas monitors. 2. Modbus Slave port to communicate using DNP or Modbus.
2	**TB6** **Ethernet FX**	Second 10/100 Ethernet TX, RJ45 port for remote or local QTMS configuration.
3	**TB7** **Status Relay**	System Status relay with normally-closed contacts that close (failsafe mode) if a QTMS power failure, a module error or a sensor error occurs.
4	**TB8** **Main Power**	24VDC input power connection.
	IRIG	IRIG input for data time stamping.

CPU Module Functions

- Scans input modules and log values within one second.
- Actuates a relay, or set an analog current loop value, from any given input within two seconds of any input signal change. This allows the system to read an input signal from one module (module to main CPU), process the information, and then tell the relay module (main CPU to module) to actuate the relay and have the relay actuate within two seconds.
- Provides data stamp timing is by either an internal real time clock or NTP source providing one-second accuracy.
- Contains a form C Status Relay that changes state upon loss of power to the QTMS.
- Contains all system configuration parameters preventing the loss of individual module configuration if a module is replaced or swapped.
- Contains data logs that can be downloaded to a local/remote computer or stored to a USB for later analysis.

  Data Logger: samples individual signal data at a selectable rate of between 1 sec. to 24 hours and stores the samples at a rate of 1 sec. to 24 hours. The samples are stored as either an Average, Minimum, or Maximum value over the store rate period.

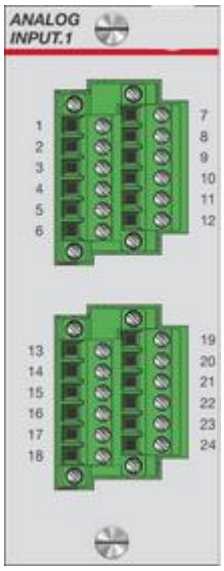
  Data is stored in a circular buffer of at least 90 days.

  Diagnostic Log: tracks system and configuration issues.

  Security Log: tracks user logins.
- Recognizes module type and slot position upon QTMS power-up.
- TMS INSIGHT configuration and monitor software with the ability to view measured values through a web browser and simulate inputs allowing the customer to exercise the system.
- Provides the user with step-by-step calibration routines for analog input and current output signals.
- Contains a video connection providing a repositioned local display.
- Provides two RS-485 ports for communicating to digital sensor devices TM1, TM8, and/or Wika S_{F6} devices using Modbus protocol. These ports can be either two standard RS-485 ports; or a combination of a standard RS-485 and a RS-485 fiber port depending upon the communications option card ordered.
- Can be configured to support multiple languages

Analog Input Module

The Analog Input Module contains up to eight (8) inputs that can be configured for current transducers, RTD, potentiometer and other input devices.



The different types of input signal are as follows.

RTD

Used for monitoring liquid, ambient, or if used in a heated well, winding temperatures. The input to the module is either a 10 ohm copper or a 100 ohm platinum RTD (factory configured).

When used to measure liquid or ambient temperatures, the module is scaled over the range of -40 - 120° C. If it is used in a heated well to simulate winding temperature, the scale is -40 - 200° C. When ordering the QTMS from the factory, the temperature requirements need to be specified.

CT Clamp

Used to measure winding currents, motor currents such as pumps and fans, and, when used in conjunction with an RTD to measure transformer oil temperature, creating a simulated transformer temperature. The input to the module is a current transformer clamp provided by Qualitrol, which has an input range of 0 - 5 A, 0 - 10 A, or 0 - 20 A.

Current Transducer

This module is also used for monitoring transducer output with an output signal in either the 0 - 1 mA DC or 4 - 20 mA DC range. These can be devices such as pressure transducers for measuring main tank pressure, bushing pressure, or dissolved gas in oil transducers.

The module can be configured to operate with either two-wire loop transducers, which are powered by the module, or three-wire transducers that are powered by the module or from the transducer.

The range for this module is scalable to match the output of the transducer. E.g. a dissolved gas monitor with a 4 – 20mA DC output corresponding to 0-5000 ppm can be scaled 0 – 5000 ppm in the QTMS.

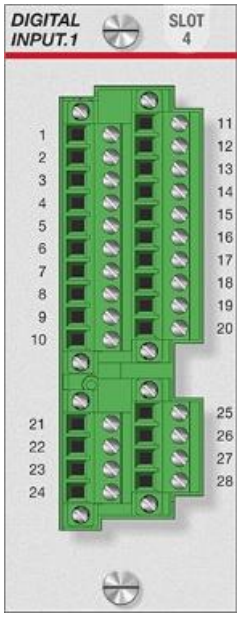
Potentiometer

Input from a potentiometer can be configured for monitoring liquid level, flow gauges, or gas accumulation. The input to the module is a potentiometer that is typically supplied by Qualitrol. The range of the potentiometer input is up to 15,000 ohm. Typically, the 25° mark on a liquid level dial is set to the center of the potentiometer range, and the high and low readings are simply ratios of the angular deflections from the normal setting. Qualitrol gauges use a 340 angular degree potentiometer on a 2:1 gear ratio from the dial travel to the potentiometer travel. The Potentiometer Input Module must be calibrated on site. For more information, see the *Using the Factory Calibrator Tool (Advanced users, only)* section in the *Software Instructions*.

The scaling of the QTMS for this module defaults to 0 - 100%.

The range is scalable to a maximum of 99999.9 VAC.

Digital Input Module



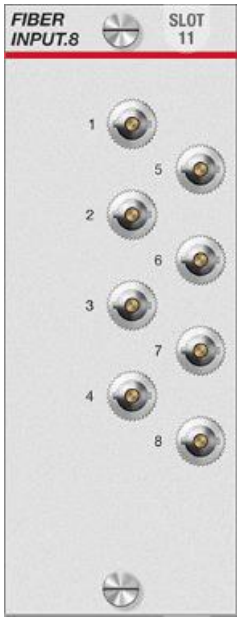
The Digital Input Module accepts up to 14 optically isolated inputs and is used for monitoring contacts as to whether open or closed. An open contact means there is no connection between the contacts; a closed contact signifies a shorted connection across the contacts. This can be used, for example, to monitor relay contacts, alarm status, etc.

This module can monitor 125/250 VDC contacts with the change threshold ~60 VDC.

Note: The system internally treats closed and open contacts as an analog input value of either a value of 0=Off/Closed and 1=On/Open. Therefore if the module is used to control a relay, the relay setpoint should be set midrange (e.g., 0.5).

Note: Either positive or negative voltage is used to sense the state of the contacts

Direct Fiber Optic Temperature Module



The Direct Winding Temperature Module supports up to eight (8) direct fiber optic probes that are installed within the transformer windings. Attached to the module's ST connectors are the ‘extension’ cables. These run from the module connections to the Feed-thru connectors installed on a Feed-thru plate on the transformer. Installed on the other side of the feed-thru connector are the actual fiber optic temperature probes that measure the winding temperature.

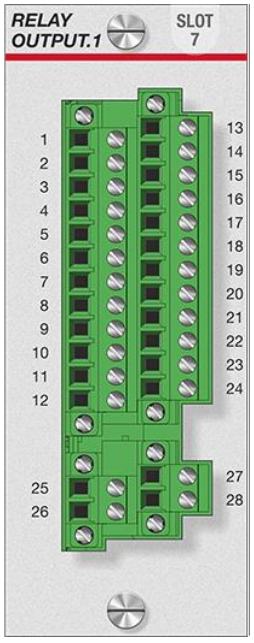
For more information, please refer to section Fiber Optic Module Configuration in this manual.

Note: This module is used when a transformer is supplied with Qualitrol fiber optic temperature winding probes.

Note: This module can be ordered with 4, 6, or 8 input probes.

Relay Output Module

The Relay Output Module is designed to control any equipment that requires a contact for operation such as pumps, fans, etc.



Each contact is configured to be failsafe or non-failsafe, latching or non-latching, and is controlled using a configuration matrix based on system input values. Up to four (4) input values are evaluated based on their current values. An equation is configured using these values based on mathematical expressions, OR, AND, and MINUS. When the result of the equation is true, the system changes the state of the particular output relay.

This module supports:

- Eight (8) form C relays; 10A @120/240 VAC
- Two (2) independent 0-1/0-5/0-10/0-20/4-20 mADC software selectable current loop outputs with an accuracy of 1.0% full scale

Installation

Overview

The QTMS is available in two mounting packages in either a 6U (containing up 14 I/O modules).

The mounting options are:

- 19" Rack Mountable
- Steel NEMA 3R Enclosure
- Panel mount - front mount
- Panel mount - rear mount

Mounting Styles (Please have mechanical person review/write the description for each mounting style)

19" Rack Mount Style

The QTMS is designed to be flush-mounted inside a transformer control cabinet on any smooth surface. The QTMS requires an approximate area of 19 inches in width, 10 inches in height, and 7 inches in depth. An additional area below the unit should be allowed for the wiring harness.

Please refer to Appendix, 19" Rack Mount Chassis for actual dimensions.

Front Mount

The QTMS is designed to be flush-mounted inside a control cabinet on cabinet rails. The QTMS requires an approximate area of 19 inches in width, 12.5 inches in height, and 7 inches in depth. An additional area should be allowed for the wiring harness.

Please refer to Appendix, Front Mount Chassis for actual dimensions.

Rear Mount

The QTMS is designed to be flush-mounted inside a NEMA enclosure. The QTMS requires an approximate area of 19 inches in width, 12.5 inches in height, and 7 inches in depth. An additional area should be allowed for the wiring harness.

Please refer to Appendix, Rear Mount Chassis for actual dimensions.

Location and Mounting

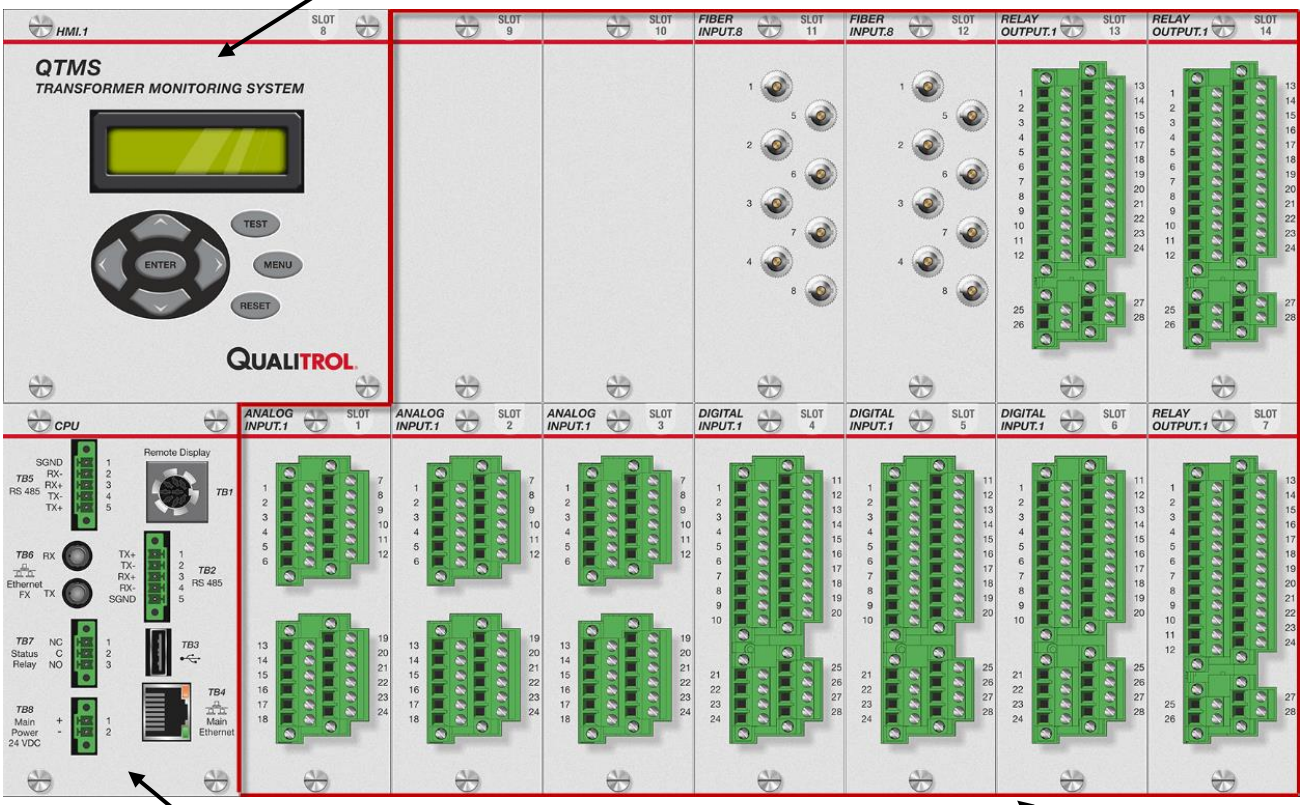
Installing the Hardware

1. Unpack the QTMS.
2. Check that all of the materials on the packing slip are included.
3. Make the necessary holes on the transformer panel for installation of the monitor.

Important:

- Note the mounting differences between the rack, front, and rear chassis mounting styles.
- Units packaged in Qualitrol provided NEMA 3 enclosures should use #10 screws for mounting the device.
- Allow space below the monitor for the wiring harness.

4. Install the monitor.



QTMS Front Panel

Signal and Power Connections

CAUTION: **To prevent personnel and equipment damage, connect signal and power to the QTMS in the following order:**

- Signal Modules
- CPU Modules
- Power

Signal Modules

CAUTION: **Ensure NO POWER is applied to the QTMS when making the following connections to the signal modules.**

1. Wire input sensors to the correct inputs, Slots 1 - 14. Connections vary according to the module type.

Important: Please refer to the wiring schematics or engineering drawings for your specific transformer to ensure proper sensor connections to appropriate QTMS modules.

See the following paragraphs for individual module overview and wiring:

Analog Input Module:

Digital Input Module:

Relay Output Module:

Fiber Input Module:

CPU Module

CAUTION: **Ensure NO POWER is applied to the QTMS when making the following connections to the CPU module.**

2. If interfacing to external intelligent devices, connect the RS-485 communications cable to TB2 or TB5.

Note: Qualitrol supplies a 5-pin Phoenix connector that is capable of handling 24 - 12 AWG shielded cable.

3. Connect the QTMS to the network using either the fiber TB6 connection or to the RJ45 Ethernet connector, TB4.
4. Connect the Status Relay signal to connector TB7.

Power Connection

5. Ensure 24 VDC is connected to the Main Power connector TB8.

CAUTION: **If using a non-supplied Qualitrol power supply, installing power outside of the recommended input range will damage the unit.**

6. Energize the QTMS.

   The monitor briefly displays “Qualitrol” and the version of the system firmware.

Important: The following operation can cause the alarm output state to change.

Preliminary System Test

After installing the QTMS unit, connecting the signal wiring to each signal module, and connecting and applying power, a preliminary test of the overall system can be performed.

Testing the System Using the HMI Panel

1. On the HMI panel, press **TEST**.

   If any relay modules are installed the relays will actuate starting the lowest slot installed Relay 1 to the highest slot installed Relay 8.

Note: Relays that have been configured with the test lockout feature enabled will not operate.

When the test is complete; the monitor defaults to the scrolling mode, cycling consecutively through the display of each input. The QTMS TMS Insight Web browser software is used to configure and test the unit. This software is resident in the QTMS device and no CD is required.

Resetting the Max/Min Values

Note: If using a local display, proceed to step "**If Using the HMI Panel**." If using TMS INSIGHT, proceed to "**If Using TMS INSIGHT**."

1. Next reset the maximum and minimum values.

   If Using the HMI Panel:

   (a) Press **MENU**.

   (b) Scroll to the View Maximum Value column (see menu flowchart).

   (c) Press **RESET**.

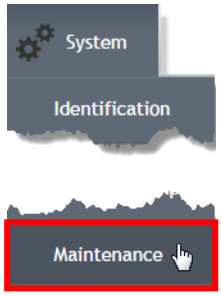
   (d) Scroll to the View Minimum Value column.

   (e) Press **RESET**.

   (f) Press **MENU**.

   If Using TMS INSIGHT:

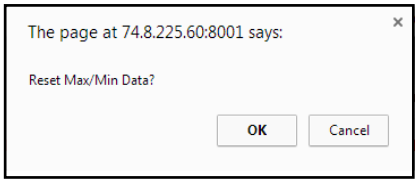
   (a) Select Maintenance under the System menu.



The *System Maintenance* window appears.

(b) From the *System Maintenance* window, click Reset Max/Min Data.

(c) Click OK on the confirmation dialog box.



Analog Input Module

The Analog Input Module accommodates eight (8) individual inputs in the following input signal groups the first pin, which is in **red-bold**, is **Pin 1** of each group.

Input Signal	Terminals
1	**1**,2,3
2	**4**,5,6
3	**7**,8,9
4	**10**,11,12
5	**13**,14,15
6	**16**,17,18
7	**19**,20,21
8	**22**,23,24

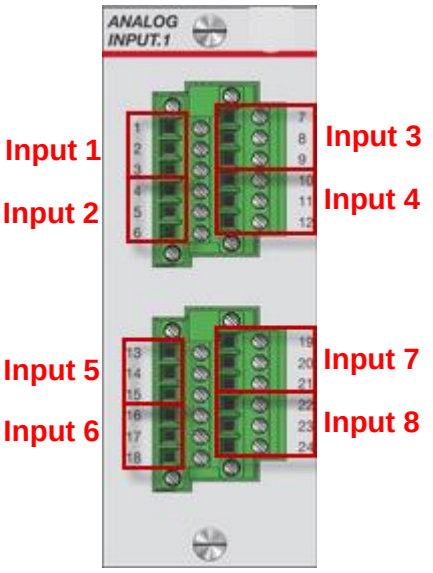
The Analog Input Module can accept several different signal types as follows:

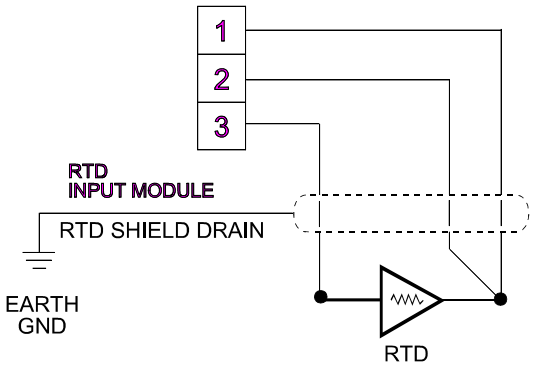
RTD Input Signal

The Analog Input Module accepts either a 10 ohm copper RTD or a 100 ohm Platinum RTD with a three-conductor, shielded cable. It is used to measure liquid and ambient temperature, or if in a heated well, winding temperature. The three conductors are connected to the module, as shown in the RTD Input Wiring Connections figure.

CAUTION: **RTD wiring should be continuous and the shield drain lead must be grounded only at the instrument.**

The module uses a compensation scheme for the RTD cable connection. The three-wire connection compensates for the resistance of the connecting wires.





Point 1, RTD Input Wiring Connection

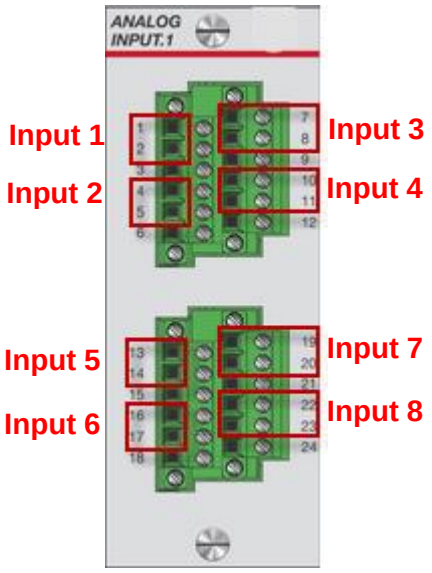
CAUTION: **If the installed RTD is a four-wire, DO NOT connect the fourth wire in parallel with the third wire, this will adversely affect the compensation scheme. If there is a fourth wire on the RTD connection, cut the fourth wire flush with the jacket. Qualitrol recommends a maximum length of 75 feet for RTD cabling.**

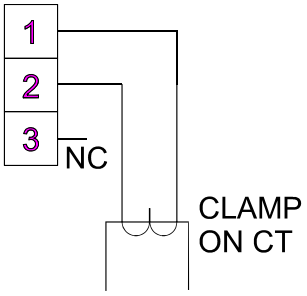
Note: Due to dimensional and mounting variations, the RTD, well, and connector must be ordered separately and are available from Qualitrol.

CT Input Signal

For each CT input signal, one standard clamp on the CT, TRA-017-X, is required to measure currents and calculate winding temperatures.

Pull the supplied Qualitrol clamp on CT Sensor apart and place the wire which carries the current to be sensed, into the CT opening. Push the CT sensor back together and check that it is fully engaged. As shown in the CT Input Connections figure, connect the output wires of the clamp on CT to the proper terminals of the module.





Point 1, CT Input Connection

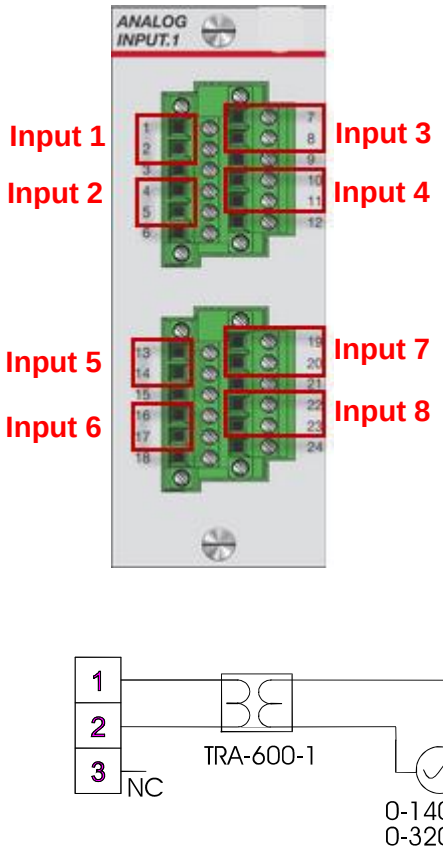
Note: The Qualitrol clamp-on CT sensor comes with 20 feet of cable. While it is not recommended to run the wire longer than 20 feet, if the application requires a longer distance, splice the longer cable as close to the clamp on sensor as possible. This replacement cabling should consist of shielded twisted pair wire.

Note: Because the CT sensor is isolated from the transformer, the burden is so small it can only be measured in a laboratory. For all practical purposes, the burden sensed by the transformer is zero.

CAUTION: **The QTMS measures current using the clamp on CT sensors. Wiring current directly to the QTMS will damage the module.**

AC Voltage Input

For each AC voltage Input signal, one AC Voltage Sensor, TRA-600-1, is required to measure the AC voltage. The module can measure either 0 - 140 VAC or 0 - 320 VAC, 50/60 Hz, as specified at the factory. Connect the voltage to be measured to the sensor input Terminal Block TB1 of the voltage sensor. Then connect the sensor output to the terminal block of the AC Voltage Input Module, as shown in the AC Voltage Input Connections figure.



Point 1, AC Voltage Input Connection

CAUTION: **The QTMS measures voltage using the Voltage sensor. Wiring directly to the Voltage Input Module will damage the unit.**

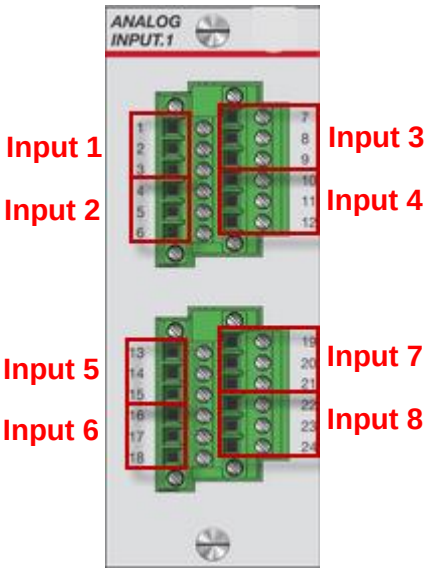
Potentiometer Input

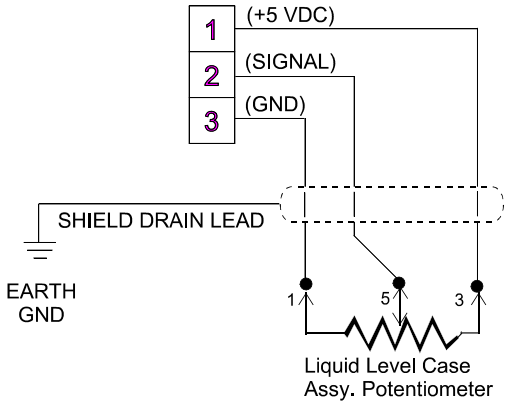
For each potentiometer input signal, one standard potentiometer in the range of 1500 - 15000 ohm, as supplied by various Qualitrol case assemblies, is required to measure liquid level, flow, or gas accumulation. The module must be calibrated on site. See the Level Gauge Calibration section in the Software Instructions.

The three conductors and the shield drain lead are connected to the monitor, as shown in the Potentiometer Input Connections figure.

CAUTION: **Wiring should be continuous, and the shield drain lead must be grounded only at the instrument.**

~~***CAUTION:*** **The loops must be connected to an isolated analog input to avoid potential damage to the QTMS.**~~





Point 1, Potentiometer Input Connection

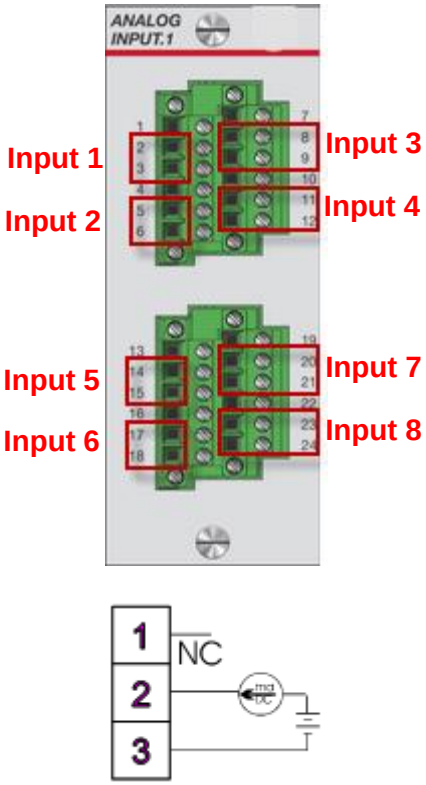
Current Input

The Analog Input Module is configurable to accept either a 0 - 1 mA DC or a 4 - 20 mA DC (SCADA type) signal. Either of these options can be a transducer that is:

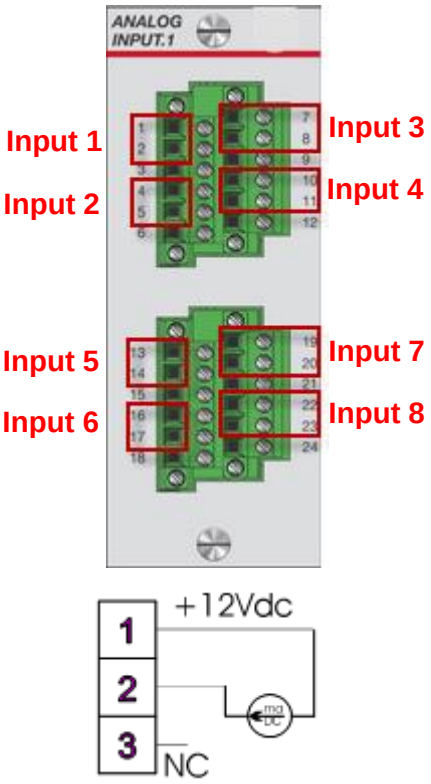
- 2-wire, self-powered from the transducer
- 2-wire, powered from the input module
- 3-wire, powered from the input module

For each Current Input Module, one current transducer (0 - 1 mA DC or 4 - 20 mA DC) is required.

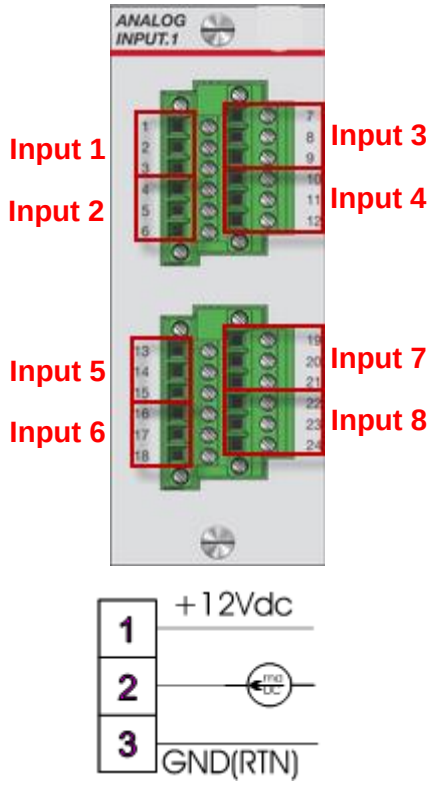
Connect the output wires of the transducer to the terminal block as shown in the following current input wiring figures:



Point 1, 2-wire, Self-Powered from the Transducer



Point 1, 2-wire, Powered from the Input Module



Point 1, 3-wire, Powered from the Input Module Connection

Digital Input Module

The Digital Input Module accommodates 14 optically isolated input signals and measures whether a DC voltage is present across each configured pair of inputs.

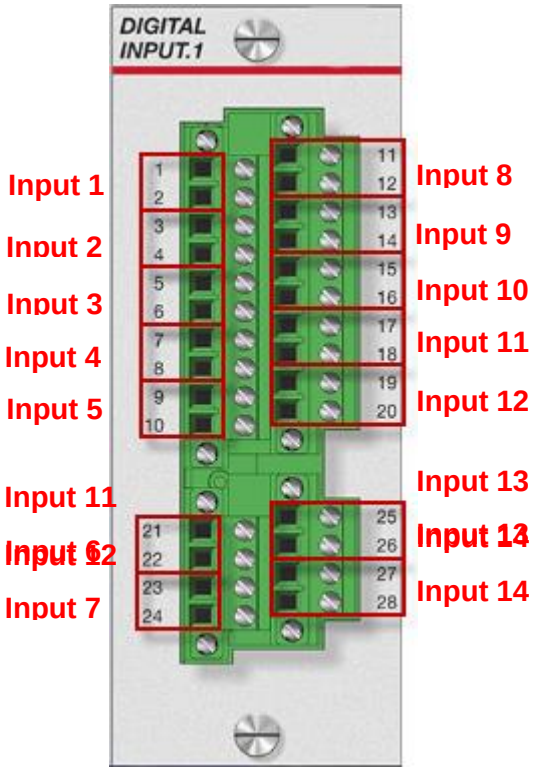
The voltage across an input can range from 0 - 250 VDC with a threshold voltage of approximately 60 VDC.

Closed contact, or zero (0) value = an input voltage of < 60 VDC. The QTMS displays this as a zero (0).

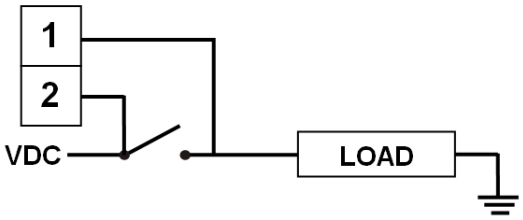
Open contact, or one (1) value = an input voltage of > 60 VDC. The QTMS displays this as a one (1).

Note: If the DI point is used to control a relay output point, the relay output setpoint should be set at midrange, e.g., 0.5 with a hysteresis of less than 0.25.

See the following Contact Wiring figure for correct circuit wiring.

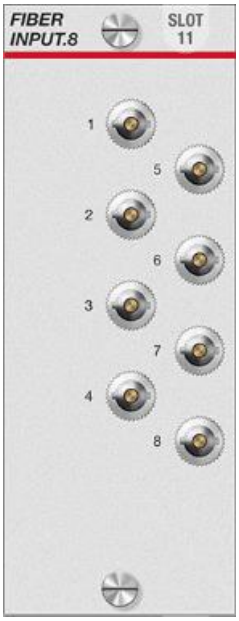


Input numbering is messed up; needs to be fixed. Again.



Point 1, Contact Wiring Connection

Direct Fiber Optic Module



The Direct Winding Temperature Module supports up to eight (8) direct fiber optic probes that are installed within the transformer windings. Attached to the module's ST connectors are the ‘extension’ cables. These run from the module connections to the Feed-thru connectors installed on a Feed-thru plate on the transformer. Installed on the other side of the feed-thru connector are the actual fiber optic temperature probes that measure the winding temperature.

For more information, please refer to section Fiber Optic Module Configuration in this manual.

Note: This module is used when a transformer is supplied with Qualitrol fiber optic temperature winding probes.

Note: This module can be ordered with 4, 6, or 8 input probes.

Relay Output Module

The Relay Output Module provides eight (8) form C contact closures and two (2) current output loops.

Each contact output is controlled by an equation that evaluates the input values of up to four (4) different points using expressions And, Or, or Subtract.

Each current output point is controlled by the evaluation of up to three (3) input points using expressions None, Maximum, and Subtract.

The configuration of the both output types is thoroughly explained in the Configuration Software section of this manual.

Output Contacts

Eight (8) isolated sets of normally open/normally closed output contacts, for Output Relays 1 - 8, are provided for controlling cooling equipment, sounding an alarm, or operating remote breaker coils. Each set is capable of switching 120/240 VAC, 30 VDC @ 10 A.

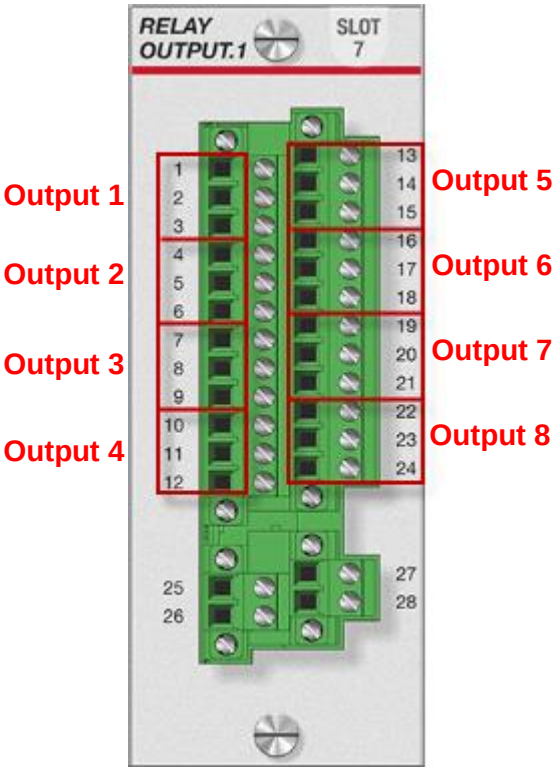
Caution: **Applying high DC voltage to the output relays will damage the relays.**

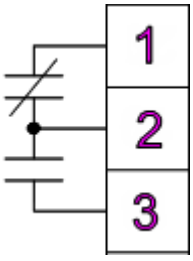
The pin layout for this module is shown on the following page:

RELAY	SIGNAL	PIN
RELAY 1	NORMALLY CLOSED (NC)	1
	COMMON (C)	2
	NORMALLY OPEN (NO)	3
RELAY 2	NORMALLY CLOSED (NC)	4
	COMMON (C)	5
	NORMALLY OPEN (NO)	6
RELAY 3	NORMALLY CLOSED (NC)	7
	COMMON (C)	8
	NORMALLY OPEN (NO)	9
RELAY 4	NORMALLY CLOSED (NC)	10
	COMMON (C)	11
	NORMALLY OPEN (NO)	12
RELAY 5	NORMALLY CLOSED (NC)	13
	COMMON (C)	14
	NORMALLY OPEN (NO)	15
RELAY 6	NORMALLY CLOSED (NC)	16
	COMMON (C)	17
	NORMALLY OPEN (NO)	18
RELAY 7	NORMALLY CLOSED (NC)	19
	COMMON (C)	20

	NORMALLY OPEN (NO)	21
RELAY 8	NORMALLY CLOSED (NC)	22
	COMMON (C)	23
	NORMALLY OPEN (NO)	24

Output Contact Pin Layout



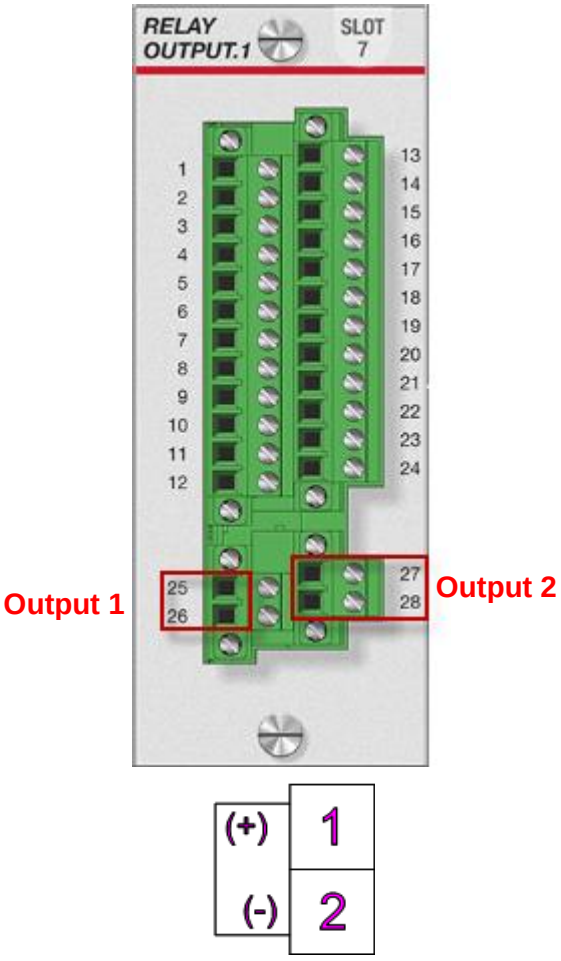


Point 1, Contact Output Wiring Connection

Current Output Loops

The QTMS is configured to supply two (2) milliamp (mA) current outputs for remote indication or use with SCADA devices. This output is proportional to the full scale of the parameter selected in the configuration. Refer to *Functional Specifications* section, for maximum load.

CAUTION: **All remote output signals are independent, variable current loops, driven by the system power and designed to drive a resistive load, such as a current meter. They cannot be grounded or tied together.**



Point 1, Current Loop Output Wiring Connection

Communications

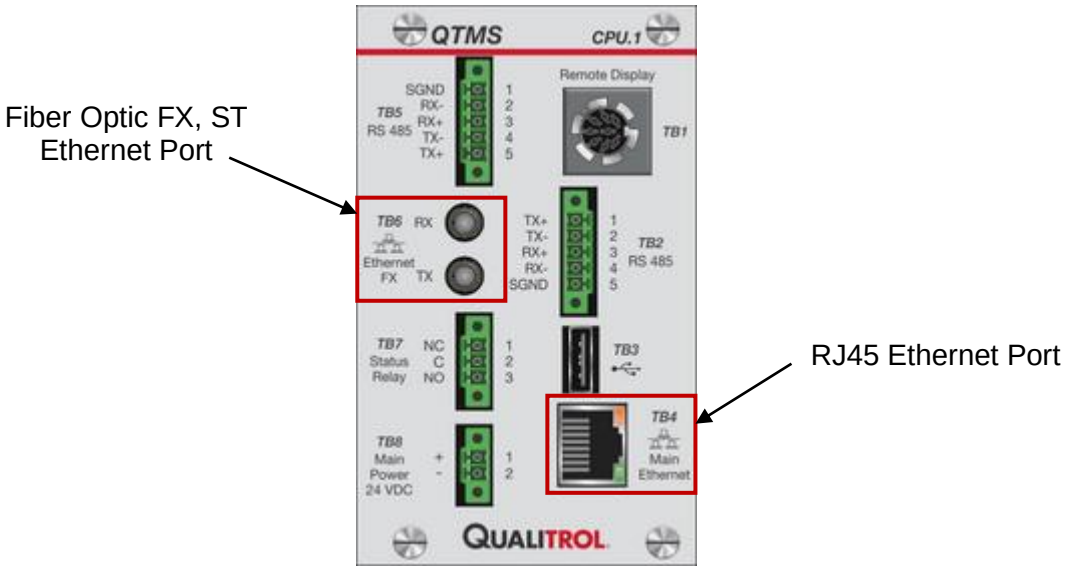
The monitor comes equipped with several types of digital communication capabilities for communicating to a local display, SCADA systems via Ethernet, and digital sensing devices. These communications ports are all located on the CPU Module and will vary dependent upon the communications board selected by the customer and installed at the factory.

Ethernet

The Ethernet ports on the QTMS CPU Module are available for communications to a networked computer running Windows 7 to access the QTMS configuration and maintenance application. This allows the user to observe and make changes remotely to the QTMS configuration parameters.

Several options are available as noted in the following.

Communications Option 1



Ethernet Ports - Communications Board Option 1

RS-485

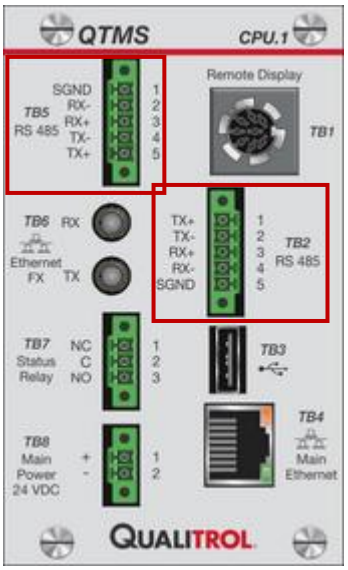
RS-485 serial communications ports are located on the QTMS CPU Module and are used to communicate system variables over various protocols (e.g. DNP 3.0, Modbus) or to communicate to external digital sensor devices. The communication application to predefined digital sensors, including mapping, is factory installed and cannot be accessed or changed by the user. The user selects the device to talk to using the configuration and maintenance application contained in the CPU module.

Communications to the digital sensor device(s) can be via 4-wire or a combination of 4-wire and fiber dependent upon the communications module selected by the customer.

The QTMS RS-485 has been tested using both the B & B Electronics #USOPTL4-LS and the Electro Industries UNICOM 2500-F.

Note: When using a 4-wire connection, **SGND** is a signal ground only and should never be connected to Earth ground.

Communications Option 1



Four-Wire RS-485 Ports - Communications Board Option 1

Operation

Automatic Operation

Viewing Channels or Viewing Mode Scrolling

Power Up

When power is applied to the QTMS, it automatically begins to monitor the inputs and controls the outputs, based on the factory configuration that was specified by the customer. At power up, if there is a display it will briefly show 'Qualitrol' and the system firmware version before going into an Auto Scroll. The Auto Scroll will scroll through every parameter that is configured to be displayed or if no parameters are selected than all parameters with a name/label at a pre-selected interval of one every two to five seconds.

MENU Mode

Viewing Channels

(See the Appendix for an example of the menu structure.)

Auto Scroll, MENU, View Mode Scrolling

Press **MENU** to move the display out of Auto Scroll and into Viewing Mode. The Up and Down Arrows (or **ENTER**) will move you individually through each parameter being monitored. If no key activity takes place for 60 seconds, the monitor automatically reverts to Auto Scroll, or press **MENU** again to revert back to Viewing Mode Scrolling.

Viewing Reset Relays

(See the Appendix for an example of the menu structure.)

MENU, View Mode Scrolling, Right Arrow

Press **MENU** to move the display out of Auto Scroll and into Viewing Mode. The Up and Down Arrows (or **ENTER**) will move you individually through each relay that has actuated starting with the lowest slot number with a relay module/relay 1 and ending with the highest slot/relay 8. If the relay has been latched and the parameters that actuated the relay are no longer active then pressing the **RESET** switch will clear the relay actuation. If the relay has actuated due to a rate of change then pressing **RESET** will clear all the measured rate of change values and reset the relay. If no key activity takes place for 60 seconds, the monitor automatically reverts to Auto Scroll, or press **MENU** again to revert back to Viewing Mode Scrolling.

Viewing Max Readings

MENU, View Mode Scrolling, Right Arrow, Right Arrow

From Viewing Mode, press the Right Arrow twice. The Up and Down Arrows (or **ENTER**) will move you through the maximum values, as well as the time and date of each parameter being monitored. Press **RESET** to reset all of the maximum readings. If no activity takes

place for 60 seconds, the monitor automatically reverts to Auto Scroll, or press **MENU** again to revert the system back to Viewing Mode Scrolling.

Note: To avoid any erroneous readings caused by the installation, Qualitrol recommends resetting the maximum values immediately after setting up the monitor.

Viewing Min Readings

MENU, View Mode Scrolling, Right Arrow, Right Arrow, Right Arrow

From Viewing Mode, press the Right Arrow thrice. The Up and Down Arrows (or **ENTER**) will move you through the minimum values, as well as the time and date of each parameter being monitored. Press **RESET** to reset all of the minimum readings. If no activity takes place for 60 seconds, the monitor automatically reverts to Auto Scroll, or press **MENU** again to revert the system back to Viewing Mode Scrolling.

Note: To avoid any erroneous readings caused by the installation, Qualitrol recommends resetting the minimum values immediately after setting up the monitor.

Viewing Data Logging Options

MENU, View Mode Scrolling, Right Arrows

If the Data Logging Option is installed, from Viewing Mode, press the Right Arrow four times. The Down Arrow (or **ENTER**) will move you to the Data Logger Option to download the Data Logging data to a memory stick. If no key activity takes place for 60 seconds, the monitor automatically reverts to Auto Scroll, or press **MENU** again to revert the system back to Viewing Mode Scrolling.

Program Mode

MENU, View Mode Scrolling, Right Arrows

From Viewing Mode, keep pressing the Right Arrow until you reach the Change Settings column. Press **ENTER** to go to Change Settings Mode. This is the location where you can change the communications IP and Mask settings of the monitor. This mode is protected. Before you are allowed to change any parameters, you must first enter the user ID #. This is the same "password" that is used to for an Administrator in the TMS INSIGHT software. If you are not authorized to change these settings, press **MENU** to go back to Viewing Mode Scrolling.

The Up and Down Arrows allow you to change the value of the character highlighted by the display, while the Right and Left Arrows move the highlighted character. Press **ENTER** to move to the next setting. At the end of the Program Mode menu, press **ENTER** to accept the changes. If no activity takes place for 60 seconds, the monitor automatically reverts to Auto Scroll and discards any changes that were made, or press **MENU** again to revert back to Auto Scroll.

QTMS Front Panel Control

Testing the System

To perform a system confidence test, press and hold **TEST**. Press **TEST** to actuate all non-Test Lockout relays in one-second intervals.

Functional Specifications

Power Supply		Universal; 90 - 264 VAC, 50/60 Hz and 127 - 300 VDC; < 50 watts Fuse: 5.0A / 250V
Processor Module		TX6-DL Dual Core Processor
		10/100 Ethernet TX, RJ45 Port
		USB-A port
		RS485, 4-wire communications port
		Display port for optional remote display
Communications Module	Option 1	Supply power input connection
		Ethernet FX, ST connector
		RS485, 4-wire communications port
		System Status Relay
Communications Module (Future Development)	Option 2	Supply power input connection
		10/100 Ethernet TX, RJ45 port
		Serial Fiber Optic Port, ST connector
		System Status Relay
		IRIG Input Connection
Module Parameters		Supports up to 14 I/O Modules
Analog Input Module	Inputs:	Measures up to 8 parameters
	Accuracy:	+/- 0.5% full scale input range
	Temperature:	100 ohm platinum (Pt100), 10 ohm copper (Cu10) RTD; simulated winding
		Liquid/ambient temperature range: -40 - 120°C
		Winding temperature range: -40 - 200°C
	Current:	Clamp-on CT, 0 - 5A, - 10A, - 20A, - 100A and others available
	DC Current Loops:	0 - 1 and 4 - 20 mA DC
	DC Voltage:	0 - 100 mV DC and 0 - 10 VDC
	AC Voltage:	0 - 140 VAC and 0 - 320 VAC; 50/60 Hz
	Potentiometer:	1500 - 15,000 ohms
	Switch Contact (dry):	Open/Closed
	Switch Contact (powered):	>80 V or >130 V open, jumper selectable; optically isolated
	Tap Position:	0 - 1, 0 - 5, 0 - 10, -5 - +5, -10 - +10, 0 - 125 VDC or non-powered; Resistor Bridges of 40 - 2500 ohm(1% acc, 100 ppm); or 0 - 1 mADC or 4 - 20 mADC
Digital Input Module	Inputs:	Measures up to 14 optically isolated inputs
	Maximum Voltage:	250 VDC
	Threshold Voltage:	>60 VDC
Direct Winding Temperature Fiber Optic	Inputs:	Up to 8 fiber optic input probes
	Accuracy:	+/- 1°C

Output Relay Module	Output Relays:	8 Form C relays; 10 A @ 120/240 VAC; 10 A @ 30 VDC
	Output Current Loops:	2 Loops; 0 - 1 mA (max resistive load 10,000 ohms)/ 4 - 20mA (max resistance 500 ohms); other options available
Data Communications	Protocols Serial:	DNP 3.0 (level 3), Modbus, IEC 60870
	Protocols Ethernet:	IEC 61850, DNP 3.0 (level 3), Modbus, IEC 60870
Memory	Data Logging:	100 variables; store rates 1 minute to 24 hours
	Event Recorder	TBD
Front Panel and Interface (local)	Display:	One easy-to-read 2-line, 16-character alphanumeric Liquid Cryustal Display (LCD). Character size: 0.21" (5.55 mm) high x 0.11" (2.95 mm) wide.
	Controls:	Eight large keys for programmable settings and user interaction.
	Front Panel Membrane:	UV stabilized polyester
Immunity	IEEE C37.90.1 (SWC)	
	Dielectric Potential	1500 VAC across all terminal blocks; 60 seconds to ground
	Radiated Emissions	EN 55011:2009 + A1:2010 / CISPR 11:2009 + A1:2010
	Electrostatic Discharge Immunity	IEC 61000-4-2:2008
	Radiated Electromagnetic Field Immunity	IEC 61000-4-3:2010
	Electrical Fast Transient Burst Immunity	IEC 61000-4-4:2012
	Surge Immunity	IEC 61000-4-5:2005
	Radio Frequency Common Mode Immunity	IEC 61000-4-6:2008
	Power Frequency Magnetic Field Immunity	IEC 61000-4-8:2009
	Voltage Interrupts	IEC 61000-4-11:2004
Environmental	Operating Temperature	-40°C TO +85°C
	Storage Temperature	-60°C TO +85°C
	Operating Humidity	5-95% NON-CONDENSING
	Shock	10g, half-sine in three orthogonal planes
	Vibration	sweep 50 to 240 Hz @ 0.004 inch displacement in three orthogonal planes
	Optional Heater	120/240 VAC heater option
	Size	19 inch rack; 6U high
	Weight	TBD
Wiring	Terminal Connectors:	Accepts wire sizes from 24 - 12 AWG; Cu wire only; minimum 300 volt insulation rating; screw torque 5.0 in/lb

Configuration and Maintenance - Using TMS INSIGHT

Overview

The configuration and maintenance software (TMS INSIGHT) for the QUALITROL® QTMS Full Function Monitor is embedded and runs in the CPU Module. It is user name and password protected and has two levels of privileges; Administrator and Operator. These privilege levels are explained in the Managing User Accounts section of this manual.

This TMS INSIGHT application provides the user with the following:

- Network configuration
- Setup of user accounts
- Setup of front panel display on the HMI module
- Access to current point values and configuration parameters.
- Simulation of input signals
- Configuration of cooling control, alarms, system communications
- Input signal calibration
- Data logging configuration data for individual signal points
- Configuration, management and data collection of cooling banks
- Simulated winding temperature analytical data configuration

To gain access to this application, the user must have a personal computer (PC) that is connected to the QTMS through the local network and a QTMS login account.

Note: The user computer must be running either Windows 7 or Linux with any of the following browsers; Firefox, Chrome, or Internet Explorer versions 8 or 9.

Note: There is no software that must be installed on the user computer. The QTMS configuration and maintenance software is self-contained and running in the CPU.

Note: Throughout these instructions, the software for the QUALITROL® QTMS is also referred to as “remote access,” because it allows the user to communicate remotely with the unit.

Connecting to the QTMS

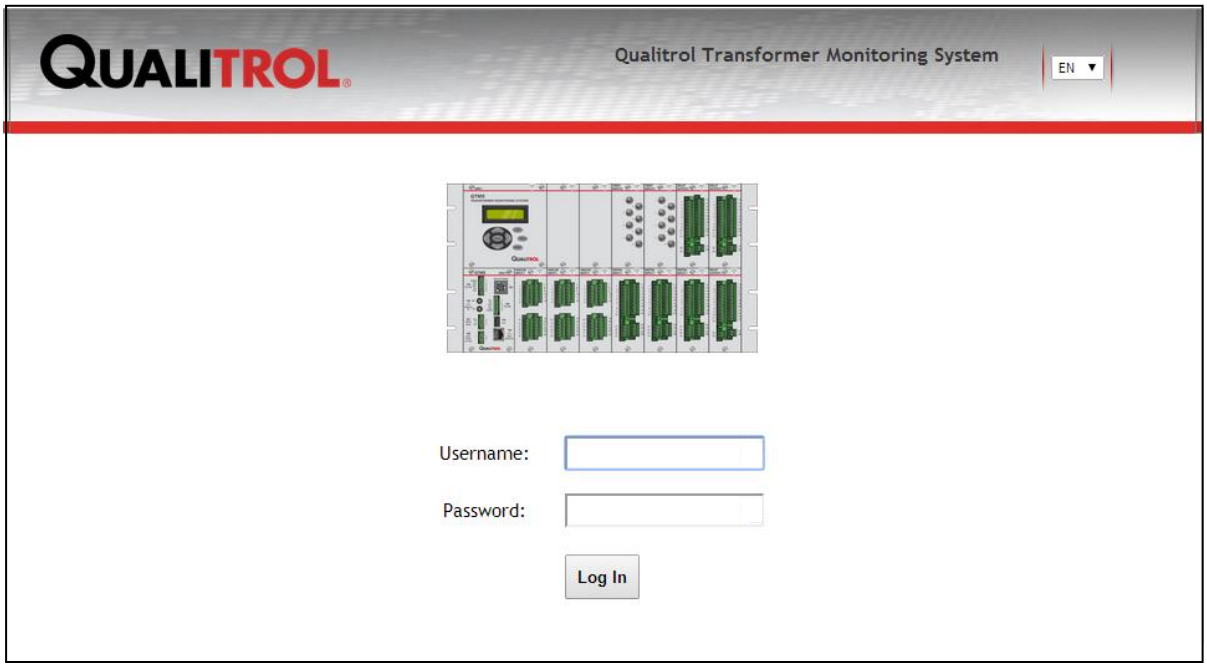
1. Check that the QTMS is connected to the main power and is energized.
2. Ensure the QTMS is connected to the local network.
3. Obtain login information including Username and Password.

Note: The factory default username and password is ‘admin’ as the username and ‘qualitrol’ as the password.

Important: Ensure the factory default username and password is changed to a customer unique username and password. See section Managing User Accounts.

4. Obtain the network address of the QTMS.
5. Connect the user computer to the network, or if local, plug the user computer directly to the QTMS Ethernet port.
7. On the computer initialize the web browser and enter the QTMS IP address. The factory default is 10. 0. 0. 4.

The following window appears when connected to the QTMS.



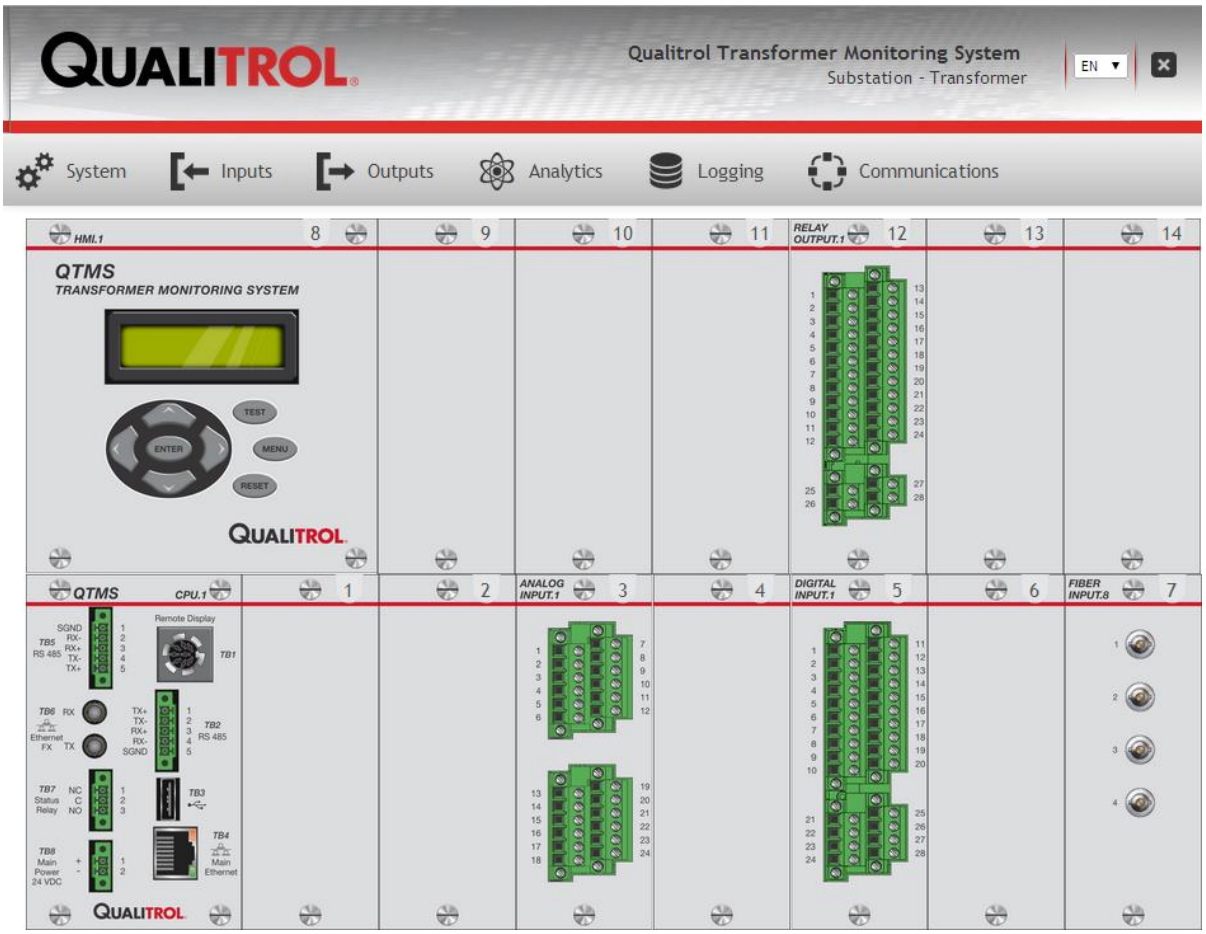
TMS INSIGHT Login Window

Note: The web browser provides an error message if it is unable to connect to the QTMS unit.

8. Enter Username and Password and click **Log In**.

The following window appears showing the current module complement and slot position in the chassis.

Note: If your username and/or password is not recognized the Log In window displays Login Failed



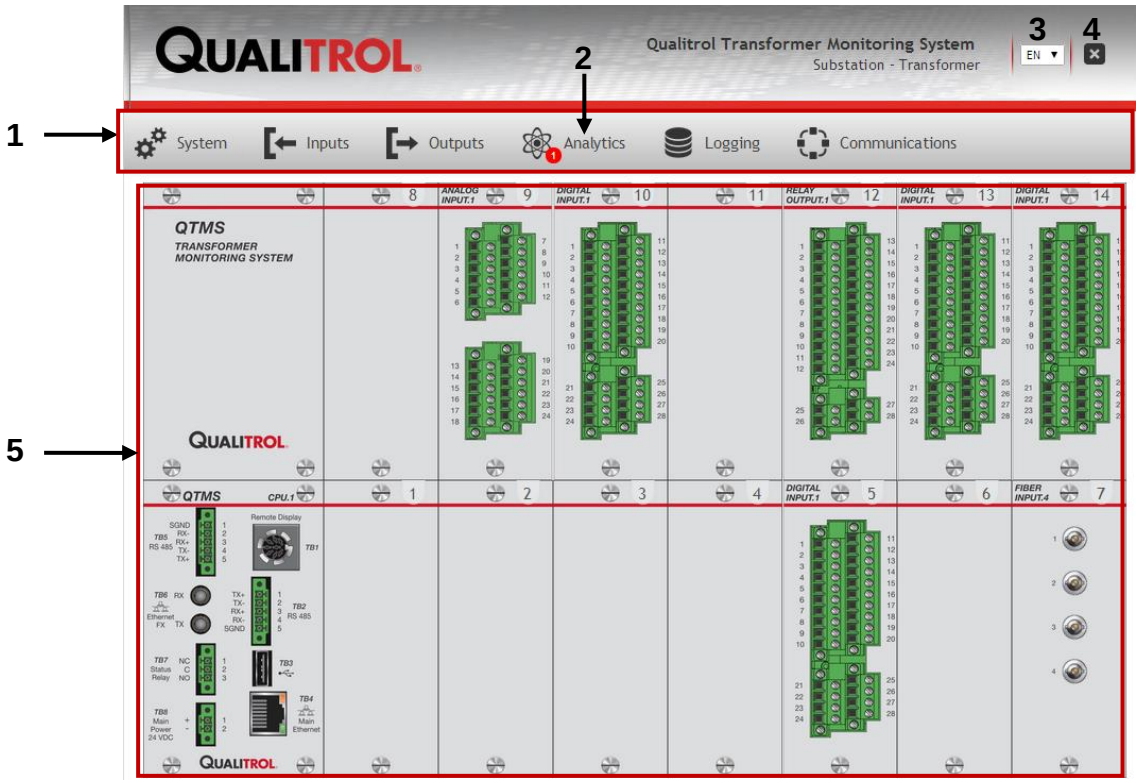
TMS INSIGHT Front Panel Window Indicates a Successful Login.

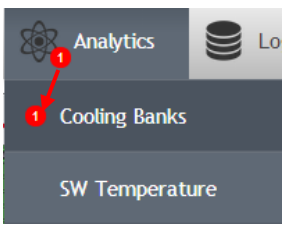
TMS INSIGHT Overview

The following is a general description of the TMS INSIGHT Front Panel and Module windows.

The Front Panel Window

The following is an overview of the TMS INSIGHT Front Panel Window.



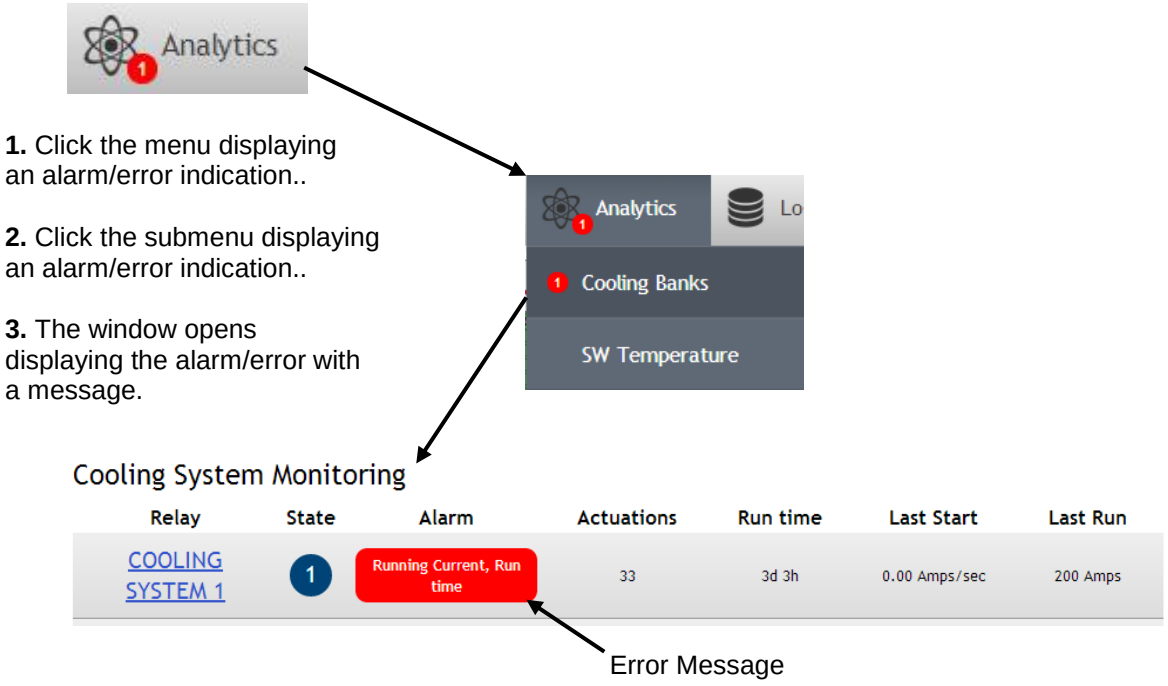
Index	Object	Description
1	**Menu Bar**	Consists of six drop-down menus for system management, module configuration, logging configuration, and communications setup.
2	**Error** 	If an alarm or an error has occurred in any of the submenu areas, in this case a cooling back issue under Analytics, the menu bar will display the number of errors encompassed by a red circle. To see the issue(s), simply click on the submenu(s) displaying the error indication to observe the issue.
3	**Language Selection Menu**	Drop-down menu that allows the user to select the language displayed text on the configuration and maintenance windows.

4	**Log Out Button**	Pressing this logs out the current user.
5	**Module Complement**	Upon power-up, the CPU module reads the current card types and their position in the QTMS backplane, and displays their type and slot position on this window. ***Note:*** Clicking on any of the modules opens the particular module window.

Front Panel Window Error Indicator

If an alarm or error or issue has occurred on any of the Main Menu Bar's submenus, it will be indicated by a number designating the number of errors in the submenu windows which is surrounded by a red.

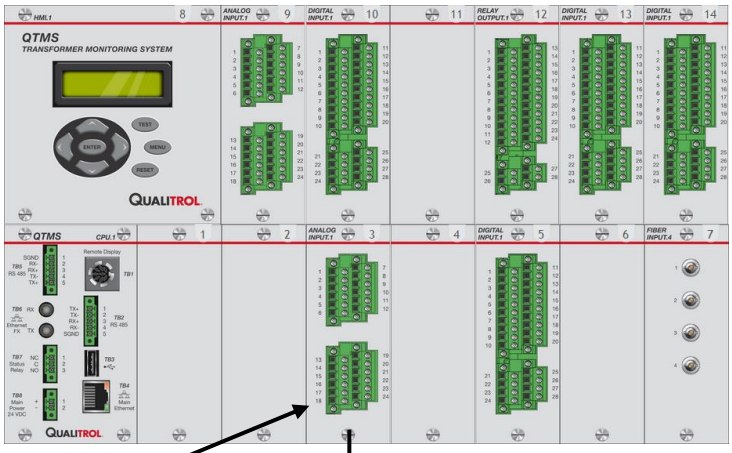
To observe the error, simply click on the Main Menu Bar menu displaying the indication as shown below.



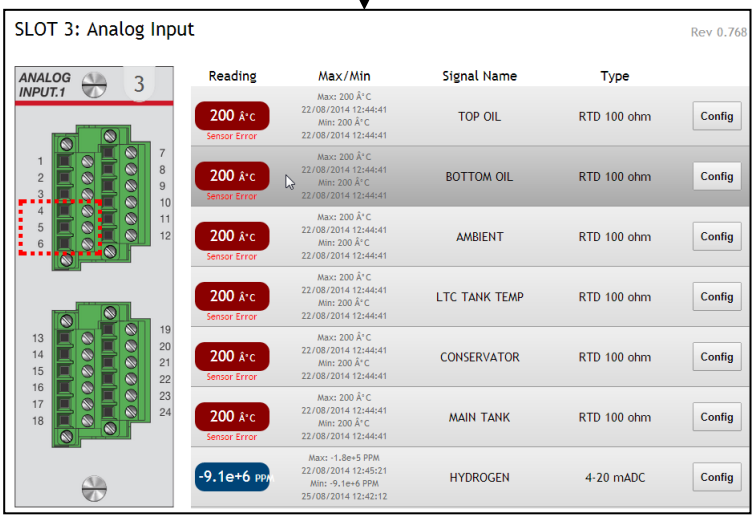
Opening a Module Window

After connecting to the QTMS unit and logging-in, the TMS INSIGHT application displays a view of the QTMS front panel containing the modules and their slot positions. These module slot positions are dynamic in that the user can click on any of the modules to see the associated point values.

An example of this is shown in the following.



Click on a module and the module window for the selected module appears.

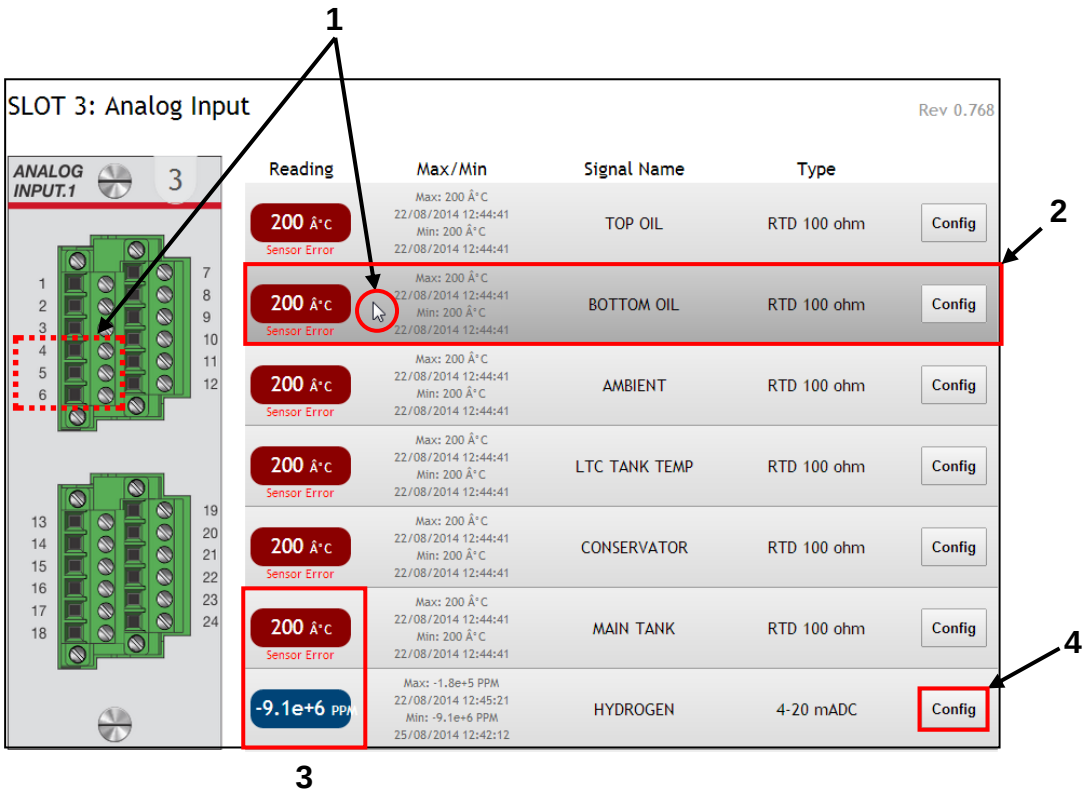


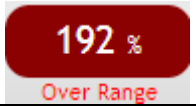
The TMS INSIGHT Module Window

The TMS INSIGHT Module Window displays a list of the signals associated with the module. Each signal shows name, current value, and other related information. As the user moves the pointer across a particular signal, it becomes highlighted and its position on the terminal block is highlighted by a dashed line. If the user has Administrator privileges, a **Config** button appears next to each signal providing a way to modify the point.

Note: The data displayed is particular to each module type.

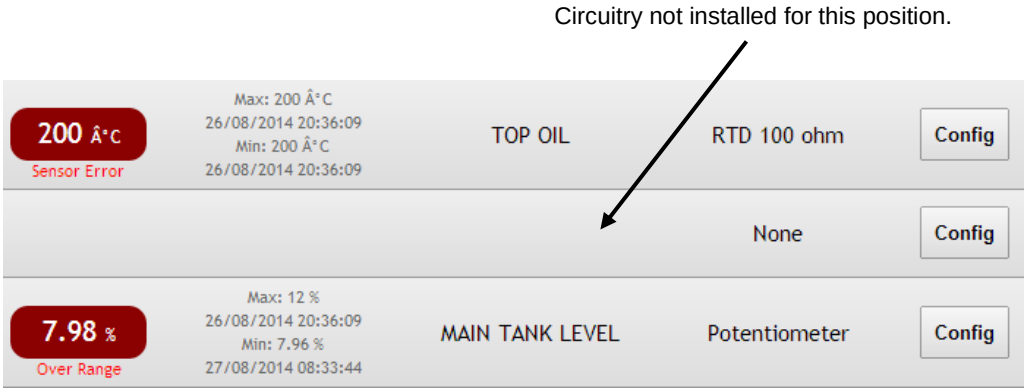
See the following Analog Input Module figure as an example.



Index	Object	Definition
1	**Signal Input Connection**	As the pointer is moved across a point, the point position on the terminal block is shown by a red dashed box and the signal data is highlighted in darker gray.
2	**Signal Data Area**	Signal data area current value, signal name, signal type, and other associated information.
3	**Signal Current Value Area**	In each Signal Data Area the current value of the point is displayed, highlighted in either **Blue**, indicating the value is "normal", or **Red**, indicating the point value is in error or in alarm. If the value is highlighted in Red, an error tag will be displayed below the value entry:  Value is in "Over Range" so it is highlighted in **Red**.
4	**Config Button**	Displayed when the user has Administrator privileges. Clicking this calls the individual point configuration window.

Note: A blank signal position on the Module Window indicates circuitry is not installed for that particular location.

See below.



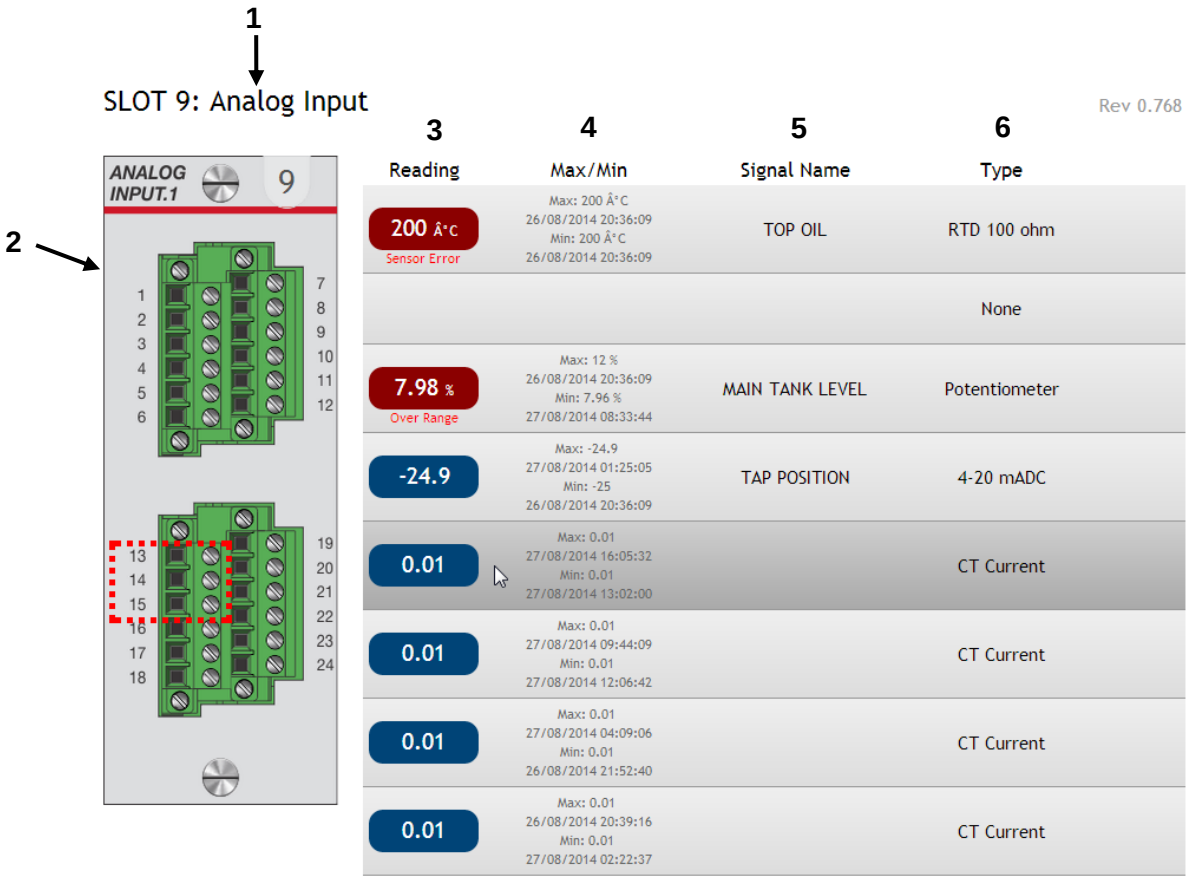
Analog Input Module with No Circuitry Installed for a Particular Signal Position

TMS INSIGHT I/O Module Windows

The following paragraphs describe the different areas of each I/O module window.

Analog Input (AI) Module Window

The AI Module Window displays the slot position, a graphic of the terminal block, the Reading (current value and an error indication of the signal has exceeded the configured limits), Max/Min point value, Signal Name, and Type of point.

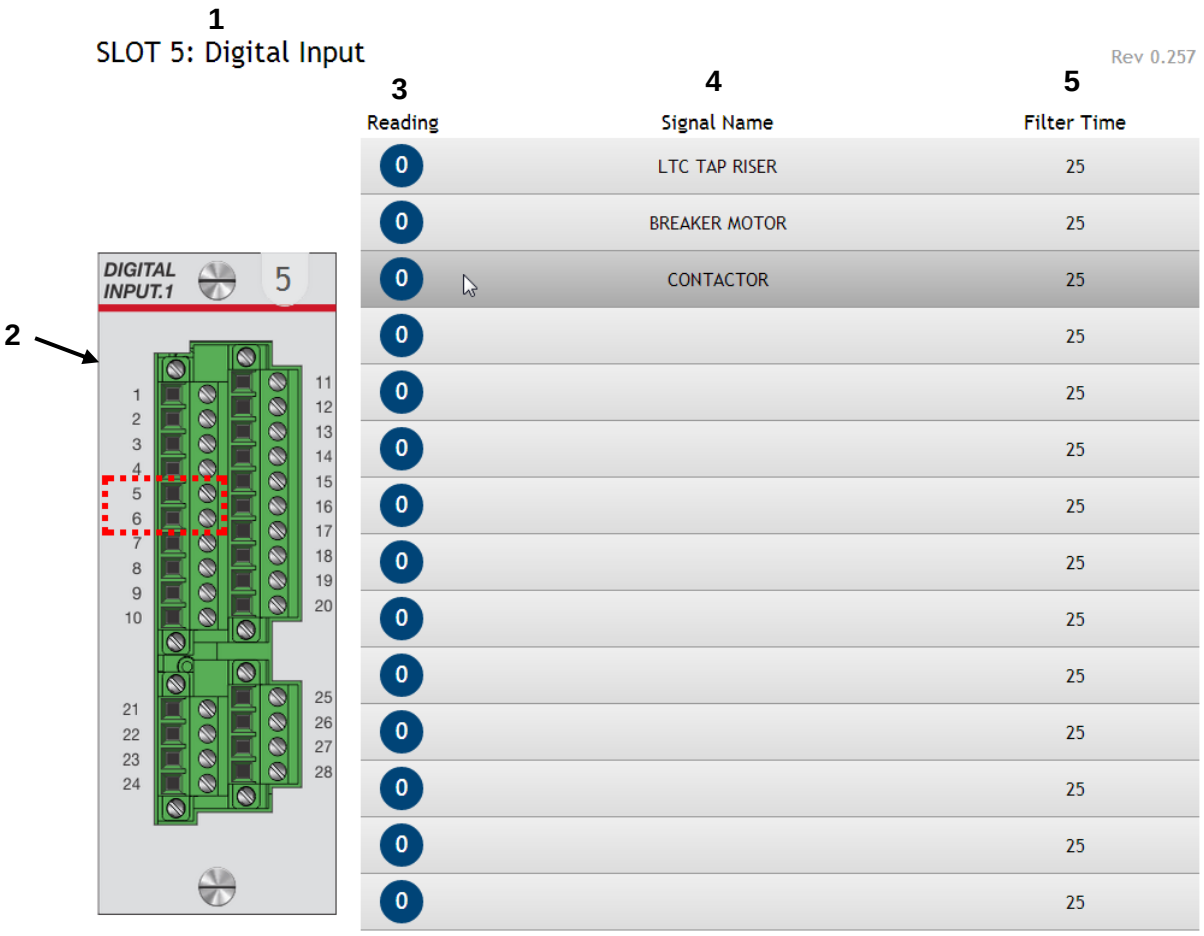


Index	Object	Definition
1	**Slot and Module Type**	Indicates the slot position and the module type.
2	**Module Graphic**	Shows a front view of the module and position of each point. e.g., The pointer hovers over AI point 2. Point 2 is highlighted in dark gray. The module graphic indicates the connection for the point by surrounding the terminals with a red dashed box.
3	**Reading**	This column indicates the current value of each point starting at the top with point 1.

		It also indicates of a point is in error. ***Note:*** See Appendix for a listing of errors and their definitions.
4	**Max/Min**	This column indicates the Maximum and Minimum value of each point along with a time stamp specifying when each of these values occurred.
5	**Signal Name**	Identifies the input point name of each point.
6	**Type**	Identifies the point type of each point.

Digital Input (DI) Module Window

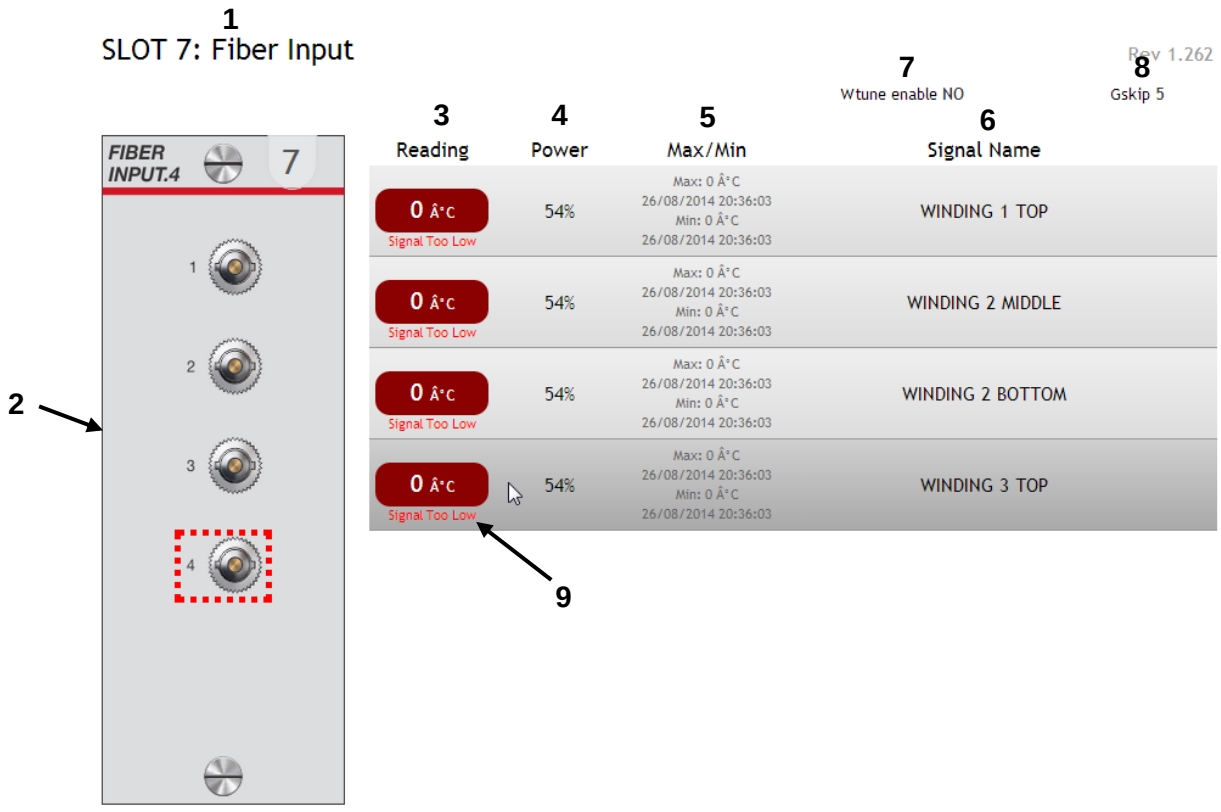
The DI Module Window displays the slot position, a graphic of the terminal block, the Reading (current value, Signal Name, and Filter Time.



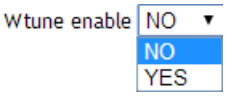
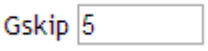
Index	Object	Definition
1	**Slot and Module Type**	Indicates the slot position and the module type.
2	**Module Graphic**	Shows a front view of the module and position of each point. e.g., The pointer hovers over AI point 3. Point 3 is highlighted in dark gray. The module graphic indicates the connection for the point by surrounding the terminals with a red dashed box.
3	**Reading**	This column indicates the current value of each point starting at the top with point 1.
4	**Signal Name**	Identifies the input point name of each point.
5	**Filter Time**	The debounce time that ensures a stable input signal in mSec.

Fiber Input (FI) Module Window

The FI Module Window displays the slot position, a graphic of the terminal block, the Reading (current value), Power, Max/Min point value, Signal Name, whether the module Wtune enable is set, and Gskip 5.



Index	Object	Definition
1	**Slot and Module Type**	Indicates the slot position and the module type.
2	**Module Graphic**	Shows a front view of the module and position of each point. e.g., The pointer hovers over point 4. Point 4 is highlighted in dark gray. The module graphic indicates the connection for the point by surrounding the terminals with a red dashed box.
3	**Reading**	This column indicates the current value of each point starting at the top with point 1. It also indicates if a point is in Error.

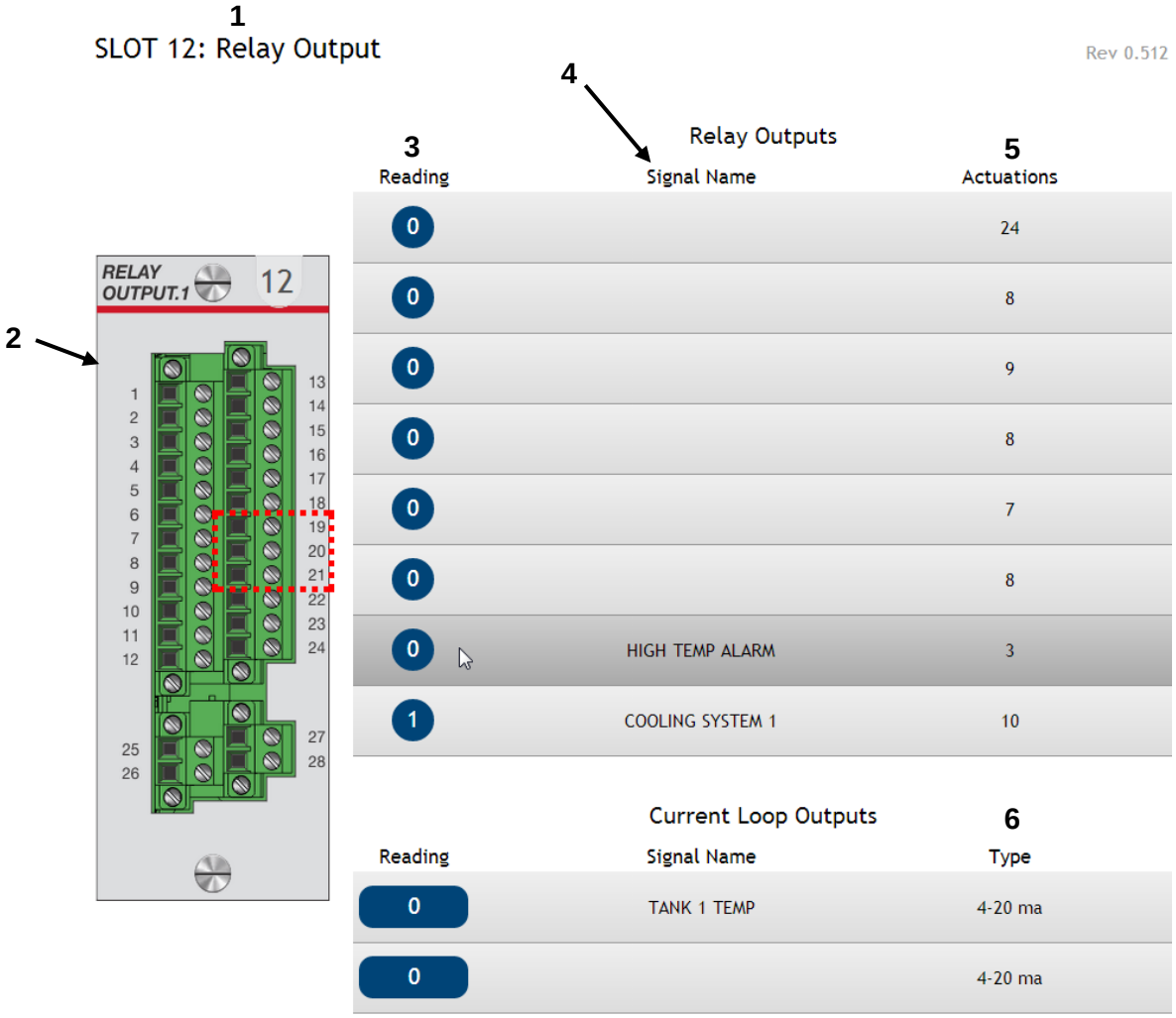
4	**Power**	Indicates the signal strength returning from the fiber tip. The module pulses out a light beam to the tip and the wavelength shifts according to temperature. But the amplitude of the light coming back is the power. It should be 100% but if a probe isn't connected or if the connections are dirty or if there are too many bends in the fiber it can be less than 100.
5	**Max/Min**	This column indicates the Maximum and Minimum value of each point along with a time stamp specifying when each of these values occurred.
6	**Signal Name**	Identifies the input point name of each point.
7	**Wtune** 	This drop-down menu allows the user to select whether to enable (Yes) or disable(No) the Wtune function. Wtune increases the optical integration time of each channel to force the Qualitrol *Fiber Optic Winding Temperature* system to read temperatures when the optical signal is weak. This comes at the expense of a slower response (slower temperature update frequency or rate). ***Important:*** Enabling Wtune is highly recommended for power transformer applications.
8	**Gskip** 	This entry allows the user to indicate the number of scans the system will perform before actually indicating that it cannot read a probe on a specific channel. The entry range is from 0 to 9; a value of 0 indicates that the system makes no attempt at removing dropouts. A value of 3 to 5 is recommended for transformer applications. ***Note:*** This command is useful to eliminate annoying dropouts that can happen when using "weak" probes.
9	**Error Indicator**	See the following table "Fiber Module Error Indications" for a listing of possible errors.

Fiber Module Error Indications

Error	Definition
Saturated Sensor	Sensor Failure - contact factory.
Signal Too High	Input exceeding fiber sensor range.
Signal Too Low	No probe connected, probe fault, too many bends or optical path broken.
Signal Noise	Sensor Failure - contact factory.
Signal Glitch	Sensor Failure - contact factory.
No Signal	No probe connected, probe fault, too many bends or optical path broken.
Calculation Error	Sensor Failure - contact factory.
Disabled	Channel disabled.

Relay Output (RO) Module Window

The RO Module Window displays the slot position, a graphic of the terminal block, the Reading (current value), and Signal Name for both the relay output points and the output current loops. It also shows the number of Actuations for each of the relay outputs and the type of current loop for each loop output.



Index	Object	Definition
1	**Slot and Module Type**	Indicates the slot position and the module type.
2	**Module Graphic**	Shows a front view of the module and position of each point. e.g., The pointer hovers over point 7. Point 7 is highlighted in dark gray. The module graphic indicates the connection for the point by surrounding the terminals with a red dashed box.
3	**Reading**	This column indicates the current value of each point starting at the top with point 1.

4	**Signal Name**	Identifies the point name of each point.
5	**Actuations**	Indicates the number of actuations since it was preset/reset by an Admin user with the configuration.
6	**Type**	Identifies the output current loop type; 0-1, 0-5, 0-10,0-20, or 4-20ma.

TMS INSIGHT Module Configuration Windows

An explanation of the I/O Configuration Windows is presented in the I/O Module Configuration section of this manual.

Setting the Language

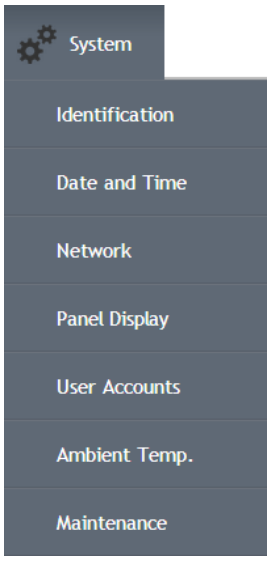
TMS INSIGHT can be set to display text in several languages. This can be done simply by selecting the **Language** drop-down menu located in the upper right-hand corner of the window and selecting the desired language.

Logging Out

To close and log out of the current TMS INSIGHT session, simply click the logout button located in the upper right-hand corner of the window as shown in the following.

System Management - The System Menu

Overview

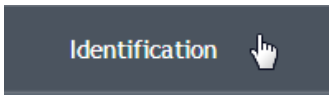


The **System** drop-down menu, located as first selection on the left-hand side of the Menu Bar, allows a user having Administrator rights to access and make changes to the fields found in the different management windows. The selections on this menu provides the Administrator with such things as the ability to create new user accounts, configure the QTMS network parameters, and select a data time stamping source.

Note: As stated above, the user must have Administrator rights to make changes to the fields contained on the System windows.

The following paragraphs describe the different System Management windows.

Identification Setup

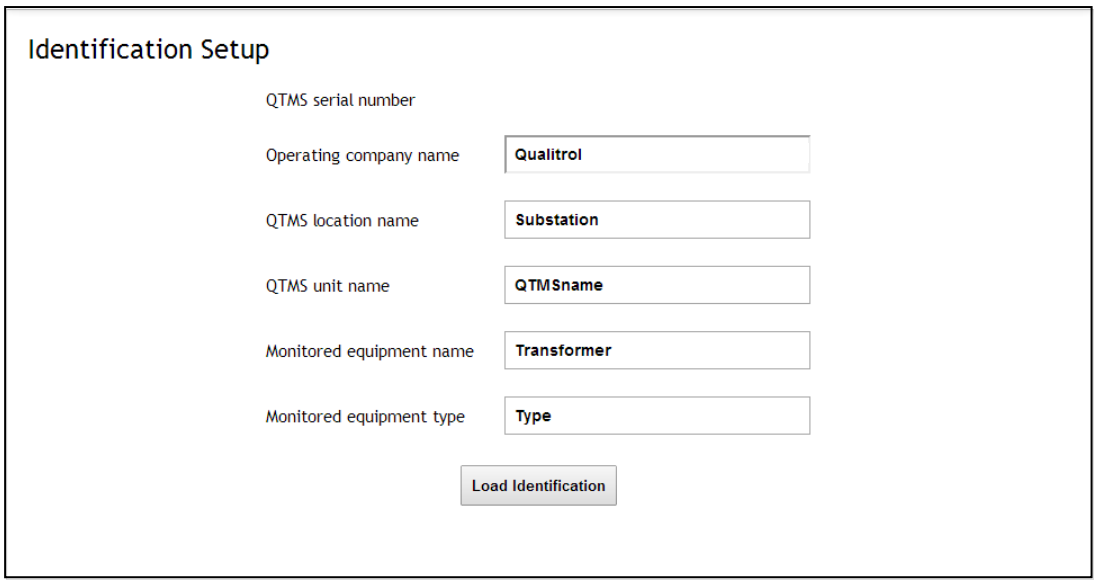


The Identification Setup window provides the Administrator access to the unit serial number along with five editable text fields that distinctly identifies each QTMS owned by the customer.

Note: Each editable field can contain up to 32 alphanumeric characters.

Note: These are informational fields only and have no affect on the operation of the QTMS. The system will run normally with any or all fields left blank.

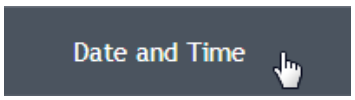
The Identification Setup window fields are described below.



The Identification Setup Window

QTMS serial number	Assigned by the factory and cannot be changed by customer.
Operating company name	Name of company owning the QTMS.
QTMS location name	Specific location of QTMS to distinguish it from other QTMS' owned by the customer.
QTMS unit name	Provides a specific name to each QTMS unit.
Monitored equipment name	Identifies the specific piece of equipment the QTMS is monitoring.
Monitored equipment type	Identifies the type of equipment the QTMS is monitoring.
Load Identification	Clicking this button saves the information entered in the fields above to CPU memory.

Date and Time Configuration



The Date and Time Configuration window is used to configure the timing source for data time-stamping.

The user can select either the internal clock within the CPU Module or configure external Network Time Protocol (NTP).

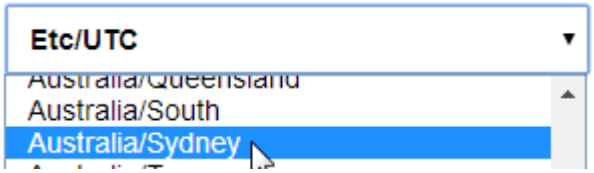
Internal Clock Configuration

The internal clock is used for timing if an external source is not available.

To configure the internal clock, perform the following:

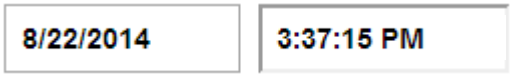
1. Select *NONE* as the **Time source**.

2. Select the proper time zone from the **QTMS timezone** drop-down menu.



Important: If the time zone is changed the system must be rebooted in order for the exerciser to execute on time. If not, the system may actuate at the previous time zone.

3. Enter the correct date and time in the QTMS time entry fields for the selected QTMS time zone in the format shown to the figure to the right.



Important: When using the internal clock as the time source, any changes in time must be done manually.

4. Click the **Load Date and Time** button.

The entered date and time is saved to system memory.

NTP Timing Configuration

Network Time Protocol (NTP) provides a very stable, accurate, time-stamp source. The QTMS provides for the identification of up to four (recommended minimum) NTP time servers.

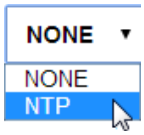
Note: Four (4) NTP servers is the recommended minimum. Four servers protects against one incorrect timesource, or "falseticker".

Note: Consult your network administrator for approved NTP server addresses.

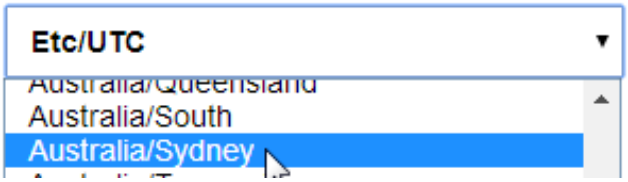
Note: The GMT (Greenwich Mean Time) +/- offsets are switched when using NTP. (e.g. New York is GMT +5). Qualitrol recommends instead of selecting an offset choose the geographical region from the pull down menu.

To configure NTP, perform the following:

1. Select *NTP* as the **Time Source**.



2. Select the proper time zone from the **QTMS timezone** drop-down menu.

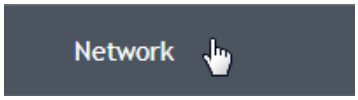


3. Enter the approved NTP server addresses in the **NTP server 1-4** fields as provided by the user's IT Network Manager.

4. Click **the Load Date and Time** button.

The entered date and time is saved to system memory.

Network Settings



The Network Settings window is used to configure the CPU Module Ethernet ports with all QTMS network communication parameters.

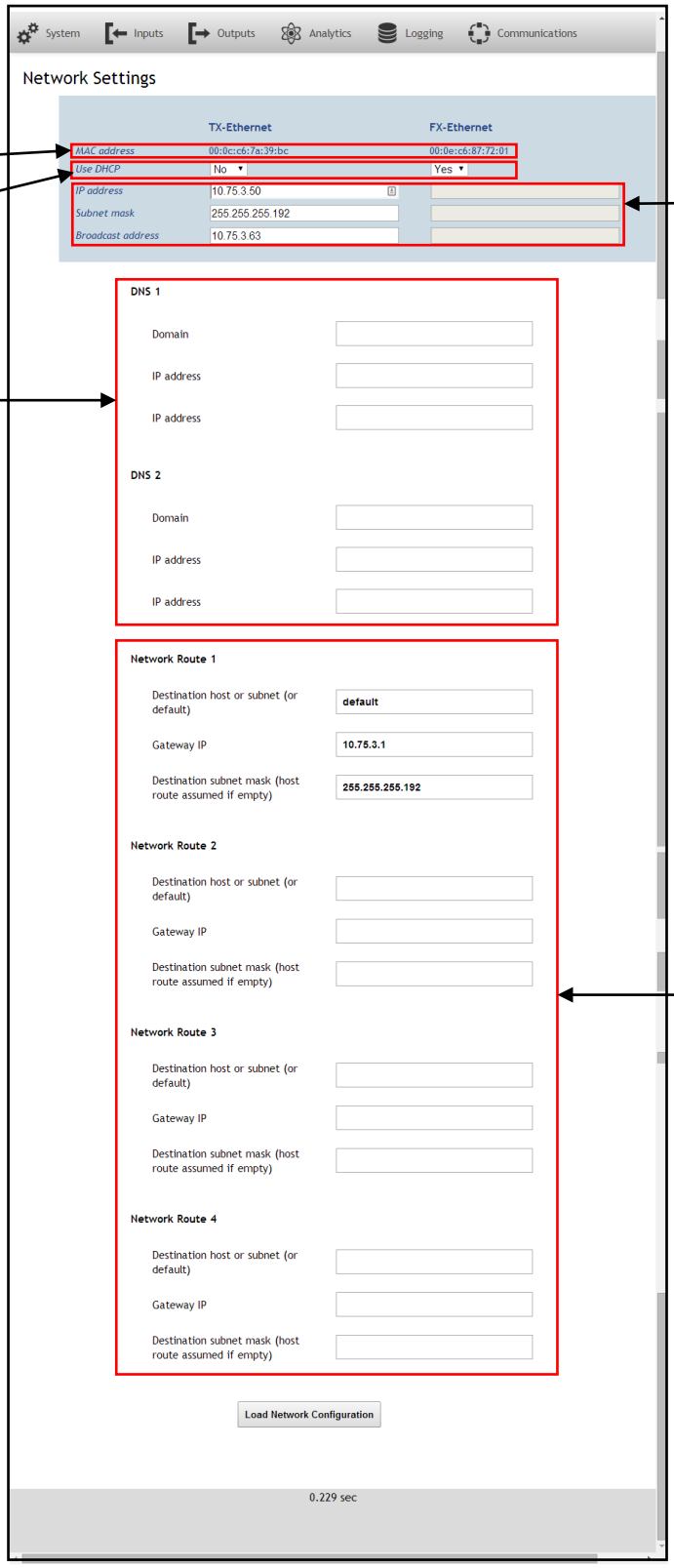
The QTMS can be configured with a fixed network IP address or as a DHCP client.

Fixed IP Address: When the QTMS is configured with a fixed IP address, the fields contained in the blue background area must be completed.

DHCP Configuration: If the QTMS is configured as a DHCP Client, the fields in contained in the blue background area cannot be accessed and are grayed-out. All other fields must contain parameters.

This window also displays the MAC addresses of both CPU Module Ethernet ports as shown below.

	TX-Ethernet	FX-Ethernet
MAC address	00:0c:c6:7a:39:bc	00:0e:c6:87:72:01



MAC address of the Ethernet ports

DHCP enable drop-down menu

These parameters must be provided if the QTMS has a fixed IP address

The QTMS can be designated with two DNS servers on two different networks for redundancy

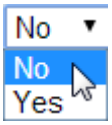
The QTNS can be connected to different networks through four different routers

The Network Settings Window

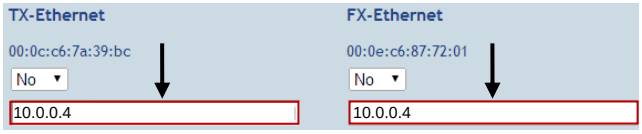
Fixed IP Address Configuration

To configure the QTMS with a fixed address, perform the following:

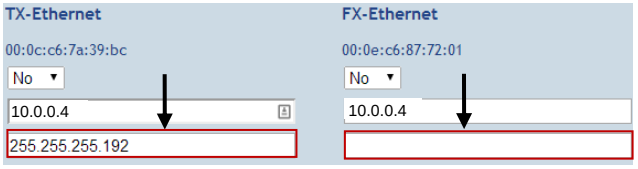
1. Select *No* on the **Use DHCP** drop-down menu.



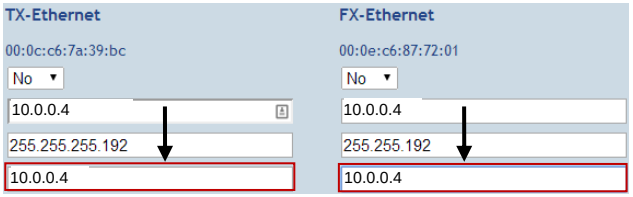
2. Enter the *IP* address in the **IP address** field or fields if both ports are networked.



3. Enter the *subnet mask address* in the **Subnet mask** field or fields if both ports are networked.



4. Enter the *broadcast address* in the **Broadcast address** field or fields if both ports are networked.

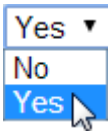


5. Complete the **DNS** and **Network Routing** configuration fields.

DHCP Client Configuration

The QTMS can be configured as a DHCP client to receive its IP address from a DHCP server. To configure The QTMS as a DHCP client:

1. Select *Yes* from the **Use DHCP** drop-down menu.



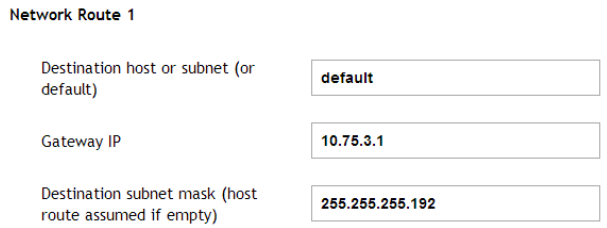
2. Complete the **DNS** and **Network Routing** configuration fields.

DNS and Network Routing Configuration

The DNS and Network Routing fields are completed as follows:

1. Configure up to two DNS servers, **DNS 1**(Primary) and **DNS 2** (Backup), using entry fields, *Domain*, and the two *IP address* fields.

2. If the QTMS is connected to a network router, enter the network routing parameters for up to four routers in areas **Network Router 1 - 4**.



Important: If a route is removed, the QTMS must be rebooted to delete the route from system memory.

3. Click **the Load Network Configuration** button.

Note: DNS Server – Domain Name Server: resolves (converts) domain name to IP address (for example “qualitrolcorp.com” -> 208.75.222.61).

DHCP – Dynamic Host Configuration Protocol: if enabled, than network interface configuration is loaded automatically from network, if disabled – user must manually specify network interface configuration. Some networks do not support DHCP (requires special configuration).

QTMS supports up to four manual DNS Server entries (IP address fiends under DNS 1 and DNS 2), as well as two DNS Servers supplied by DHCP (if DHCP is enabled). So total of 6 DNS Servers can be loaded into QTMS. Due to architecture specifics only three first DNS Servers are used to resolve domain names.

Manually specified DNS servers take precedence over DNS servers supplied by DHCP. Here is an order:

DNS 1, IP Address 1

DNS 1, IP Address 2

DNS 2, IP Address 1

DNS 2, IP Address 2

DHCP: DNS Server 1

DHCP: DNS Server 2

If DNS Server is empty/not set - it is ignored.

Example 1:

DNS 1, IP Address 1 = ns-a.comapny.com

DNS 1, IP Address 2 =

DNS 2, IP Address 1 = ns-c.comapny.com

DNS 2, IP Address 2 =

DHCP: DNS Server 1 = ns-y.comapny.com

DHCP: DNS Server 2 = ns-z.comapny.com

In this scenario only ns-a, ns-c, and ns-y will be used, ns-z will be ignored.

Example 2:

DNS 1, IP Address 1 = ns-a.comapny.com

DNS 1, IP Address 2 = ns-b.comapny.com

DNS 2, IP Address 1 = ns-c.comapny.com

DNS 2, IP Address 2 = ns-d.comapny.com

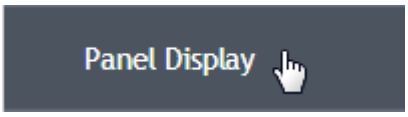
DHCP: DNS Server 1 = ns-y.comapny.com

DHCP: DNS Server 2 = ns-z.comapny.com

In this scenario only ns-a, ns-b, and ns-c will be used, nd-d, ns-y, and ns-z will be ignored.

Panel Display Configuration

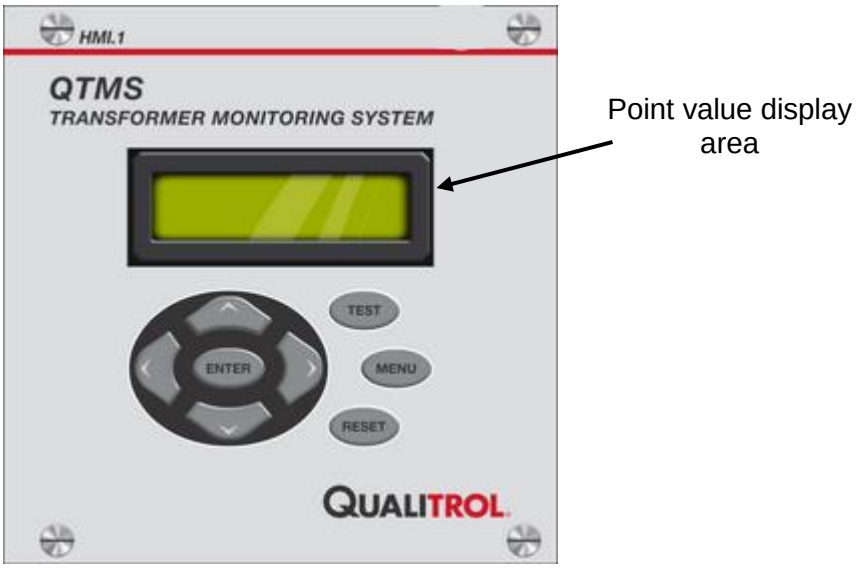
The Panel Display Configuration window is used to select points whose values will be periodically displayed on the QTMS front panel HMI.



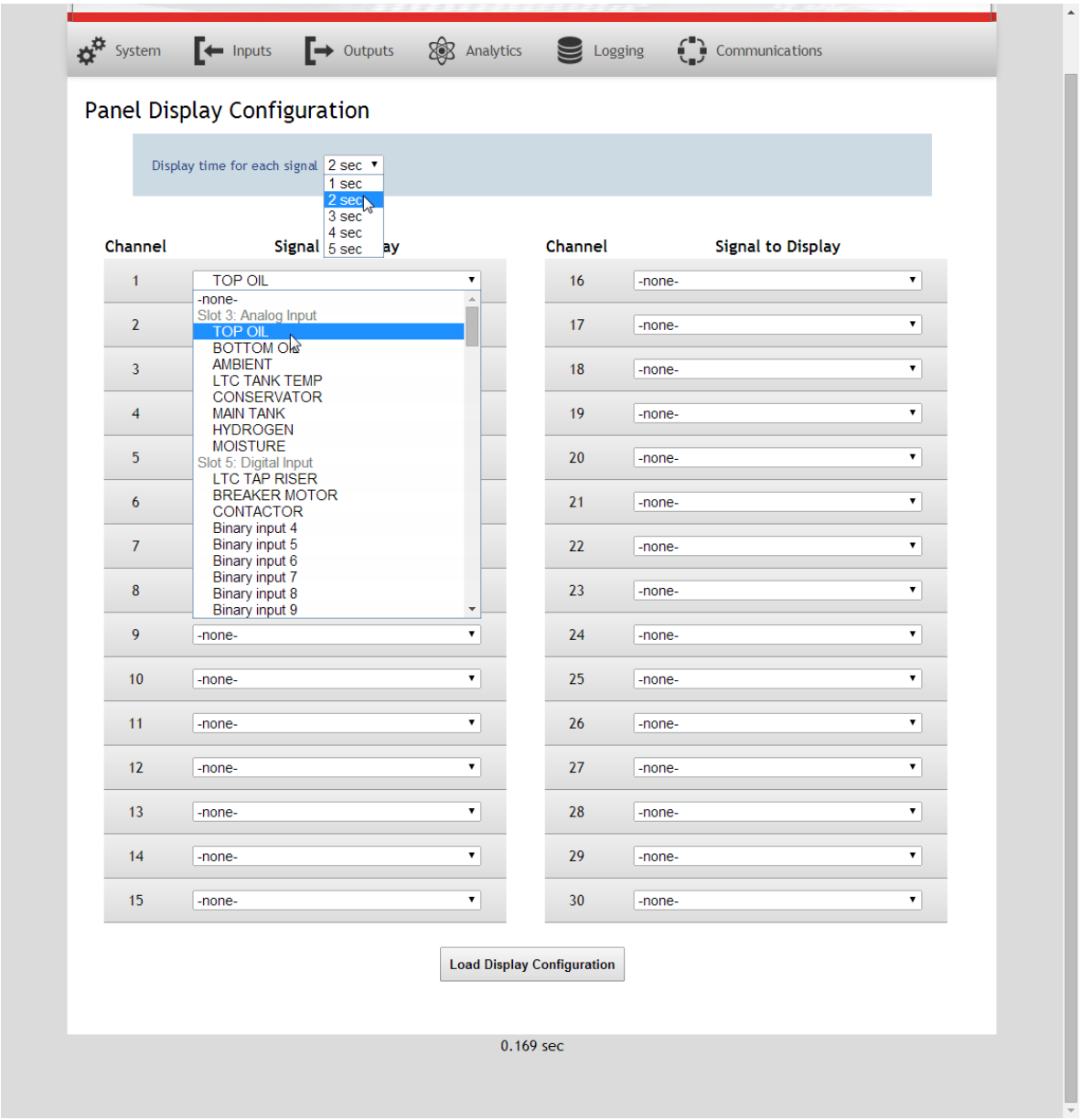
The user is able to select the display time period and up to 30 points using drop-down menus. The point names and associated values are displayed in the sequence Channel 1 - Channel 30.

Note: If no variables are selected for the Panel Display, the system will automatically take the first 30 variables configured with names, starting from Slot 1, to scroll on the local display.

The configuration for the front panel display is shown below.

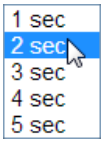


HMI Panel



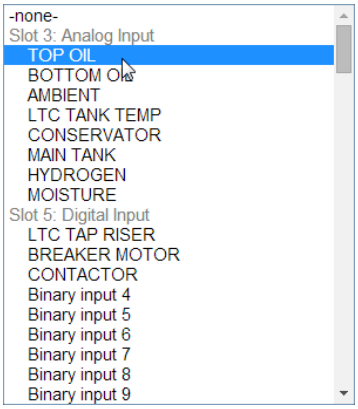
The Panel Display Configuration Window

1. Select the display time from **Display time for each signal** drop-down menu.



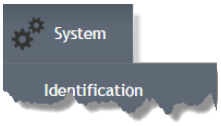
Note: This selection determines how long each individual parameter will be displayed on the local display before scrolling to the next one.

2. Next to each channel, up to 30 channels, select the particular value to display.



3. Click the Load **Display** Configuration button to load the choices into CPU memory.

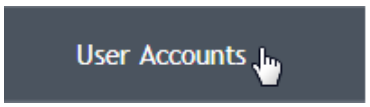
4. To display the changes on the HMI Panel, from the System menu, select Maintenance.



The opens the *System Maintenance* window.

5. Click the **Reboot QTMS** button on the *System Maintenance* window to display the selected point values.

Managing User Accounts



The User Accounts window allows a system administrator to create user accounts for personnel system access. There are two groups that a user can be assigned to: Administrator and Operator.

The two privilege groups have the following rights.

Administrator:

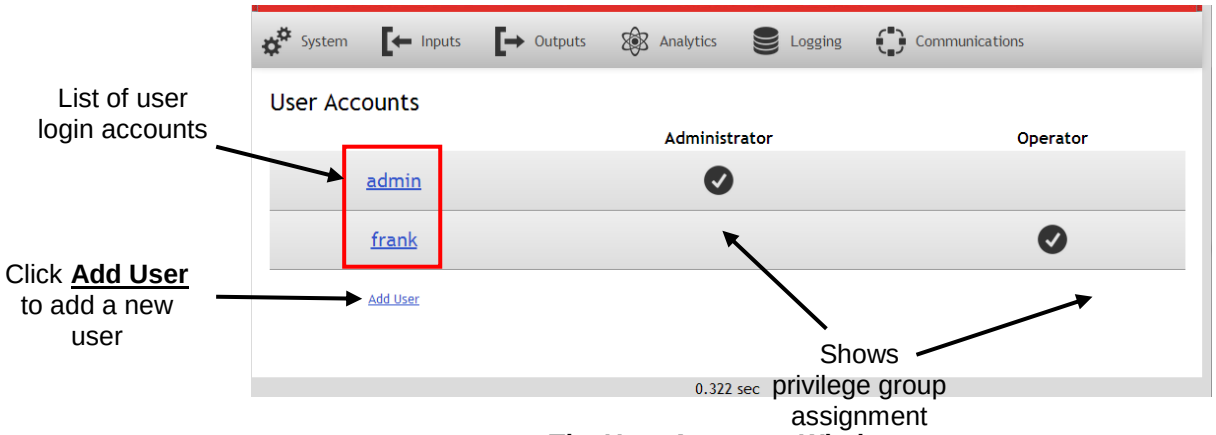
- Change setpoints
- Configure the system
- Calibrate modules
- Reset the data logger

Note: The Administrator group does not have privilege to make physical I/O module configuration changes.

Operator:

- View point values and configuration - all fields are Read Only.
- Download logs
- Reset alarms

Note: The Operator group is not able to make any type of configuration changes.



The User Accounts Window

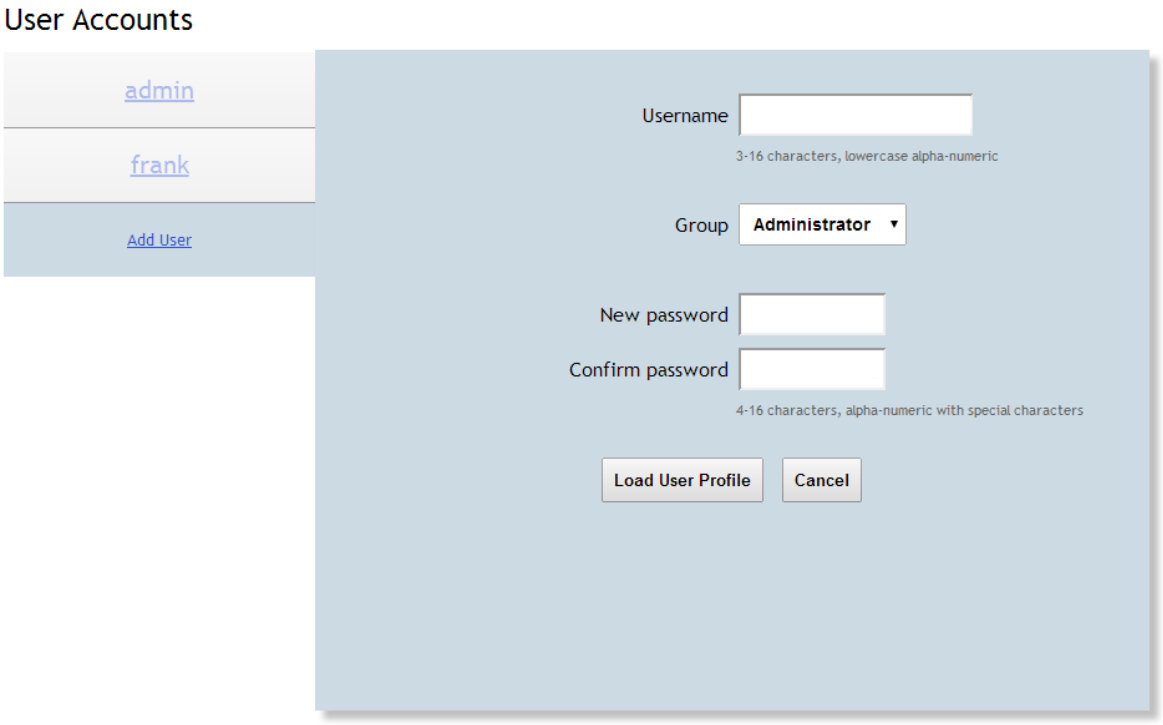
Creating a New User Account

Note: Only users assigned to the Administrator group can create user accounts.

To create a new login account, perform the following:

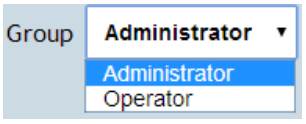
1. Select *Add User* on the **User Accounts** window.

   The following window appears:

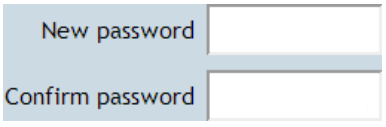


2. Enter a username for the account containing 8-16 alphanumeric characters.

3. Select the appropriate privilege group.



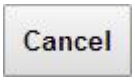
4. Enter and confirm a password containing 4-16 alphanumeric and special characters.



Note: The password must contain at least: one capital letter, one lower case letter, one number, and one special character.

5. Click **Load User Profile** to save the login account.

6. Click **Cancel** to not save the account information.



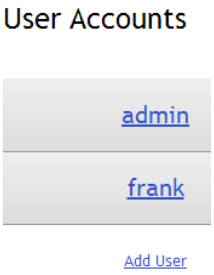
Modifying a User Account

The Administrator can change the group the account is assigned to, or change the password.

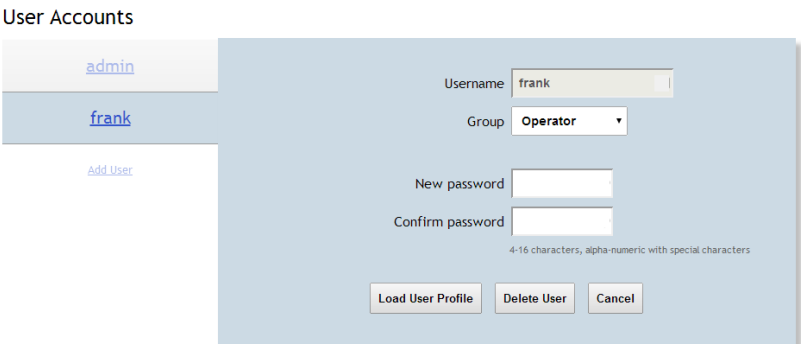
Note: Only users assigned to the Administrator group can modify user accounts.

To create a new login account, perform the following:

1. On the **User Accounts** window, select the account to modify.

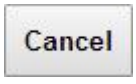


The window shown to the right appears. The selected account is highlighted in blue.



2. Either change the group the account is assigned to or to change the password.
3. Click **Load User Profile** to save the modifications.

4. Click **Cancel** to close the window without making any changes to the account.

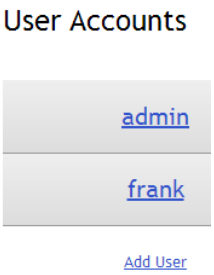


Deleting a User Account

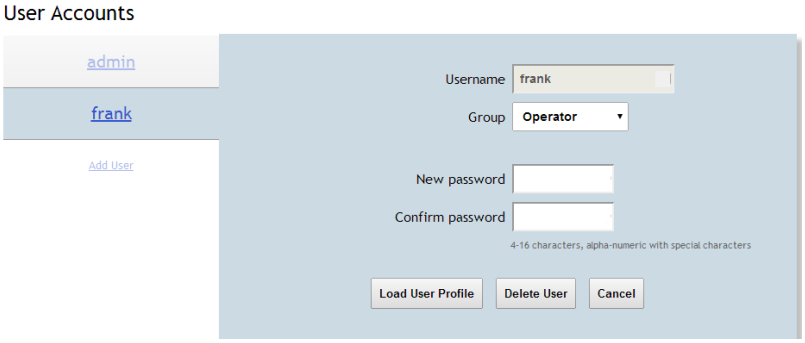
Note: Only users assigned to the Administrator group can delete user accounts.

To delete an account, perform the following:

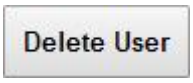
1. On the **User Accounts** window, select the account for deletion.



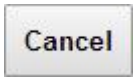
The window shown to the right appears. The selected account is highlighted in blue.



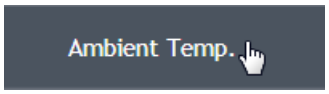
2. Click **Delete User**.



3. Click **Cancel** to close the window without deleting the account.



Ambient Temperature Configuration



This selection provides the setting values of the Ambient Temperature Forecast feature.

Note: An ambient temperature signal must be configured as an Analog Input.

Overview

This function measures the ambient temperature for a specified amount of time and allows the user to adjust the setpoint for relay output operation during forecasted periods of high temperatures causing the cooling system to lose efficiency.

When the Ambient Temperature configuration becomes true, the Relay Output **Setpoint** being controlled by the Ambient Temperature, assumes the **Forecast override setpoint**.

This feature is similar to the **Seasonal Setpoint** feature except that the **Seasonal Setpoint** is used for a specific period of time, such as summer, while the ambient temperature forecast is used for a specific condition, for example, a heat wave.

Note: **Ambient Temperature Forecast Setpoint** has priority over the **Seasonal Setpoint** and the setpoint designated in the Relay Output Matrix Control signal 1 entry.

As an example:

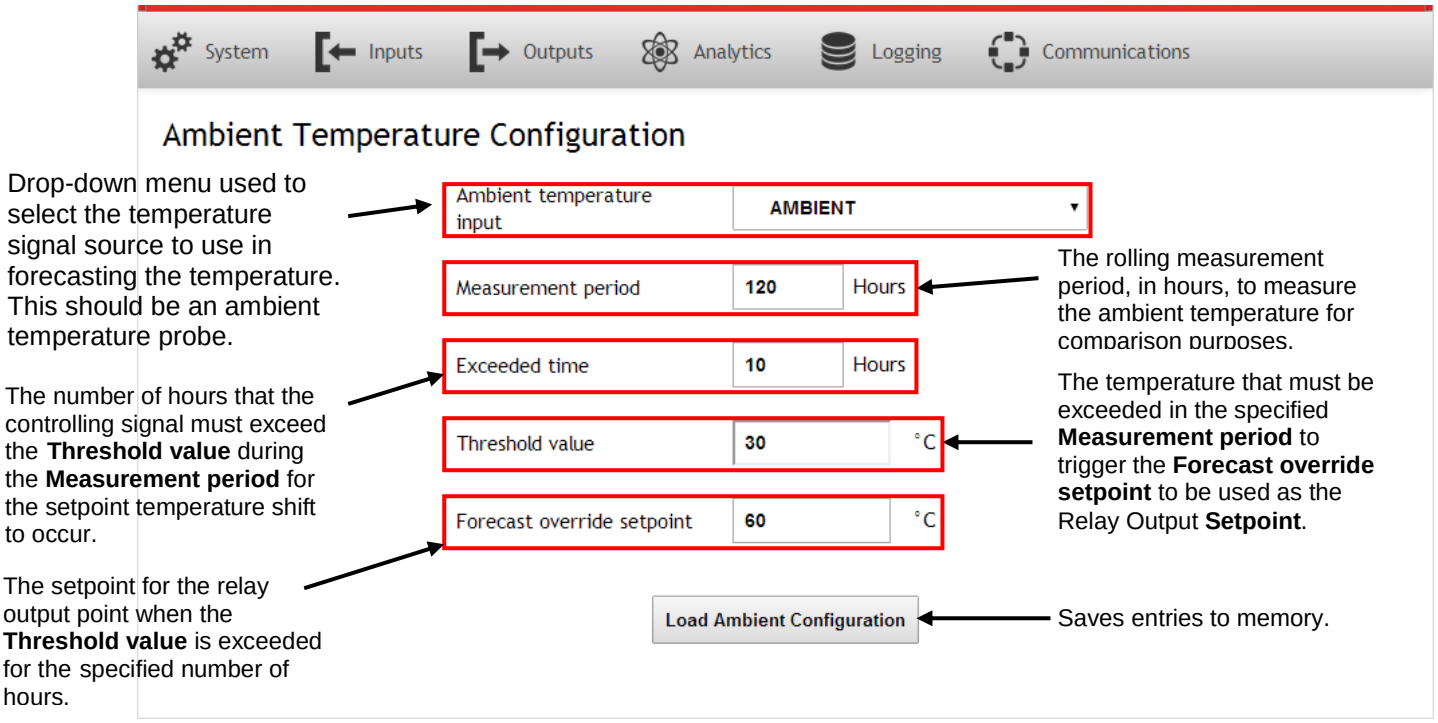
In the *Ambient Temperature Configuration* window, the following parameters are entered:

- **Ambient temperature input**: An ambient probe device
- **Measurement period**: 120 hours (5 days)
- **Exceeded time**: 12 hours
- **Threshold value**: 30° C
- **Forecast override setpoint**: 50° C

If at any time during a rolling 120 hour time period the ambient temperature exceeds 30° C for a total of 12 hours, change the setpoint controlling the Relay Output assigned as the output signal, to 50° C.

Note: Please refer to the Relay Output Configuration section for further explanation of assigning the Ambient Forecast setpoint to a Relay Output point.

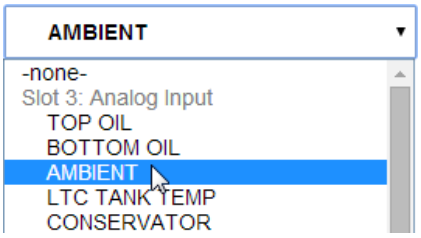
The Ambient Temperature Configuration Window



The Ambient Temperature Configuration Window

Ambient Temperature Configuration

1. Select the analog input point that will measure the ambient temperature.



2. Enter the number of hours to measure the ambient temperature.

3. Enter the number of hours that the controlling signal must exceed the **Threshold value** during the **Measurement period** for the setpoint temperature shift to occur.

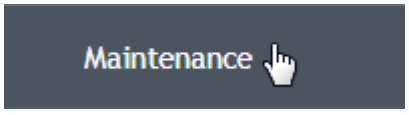
4. Enter the temperature that must be exceeded for the specified **Measurement period** to trigger the **Forecast override setpoint** to

be used as the Relay Output **Setpoint**.

5. The adjusted setpoint for the relay output point when the **Threshold value** is exceeded for the specified number of hours.

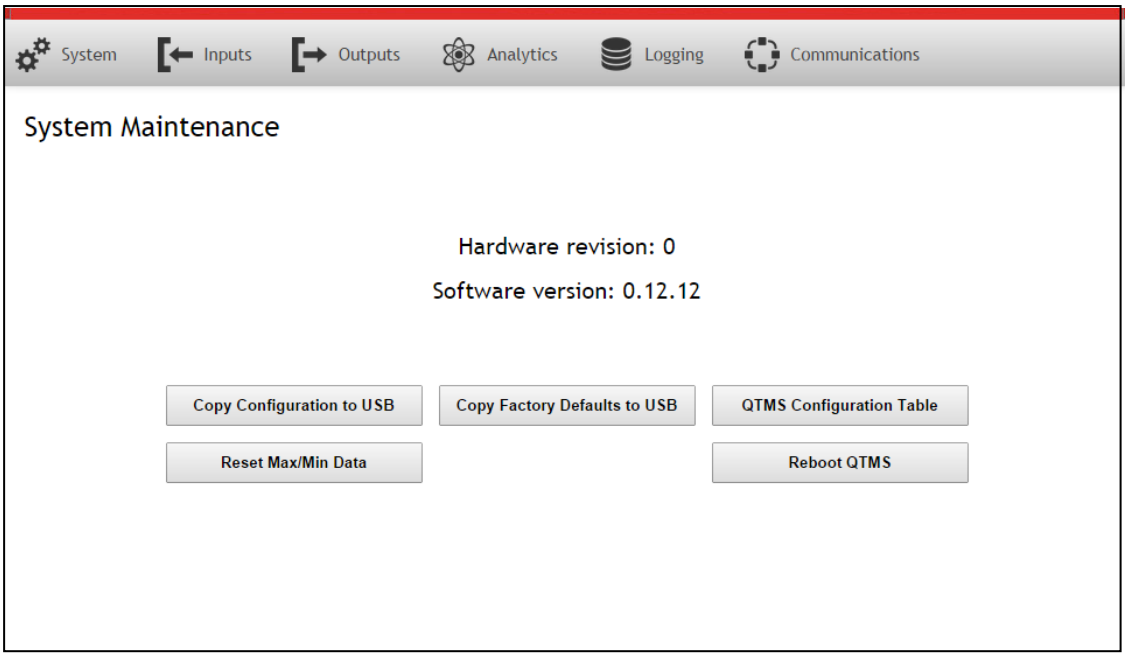
6. Click Load Ambient Configuration to save the entries to memory.

System Maintenance



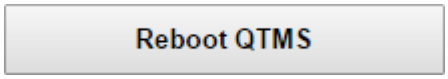
This window displays the current QTMS hardware and software version. It also allows the user to view and/or download the current system configuration, reset the system the Max/Min data values to current time and value, copy the factory default settings to a USB, and reboot the QTMs.

The Maintenance window is shown below:



The System Maintenance Window

Reboot QTMS



This feature allows the user to reboot the QTMS unit.

Copy Configuration to USB

This feature allows the user to download the current system configuration to a USB inserted into the CPU Module USB port.

Note: This file is formatted as a **.txt** file.

Copy Factory Defaults to USB

This feature allows the user to download the factory default settings to a USB inserted in the CPU Module USB port. The factory default settings are the values and parameters as they were configured in the factory when it shipped.

Reset Min/Max Data

All local sensor values have max and min values kept in memory. Clicking this button resets these values to the "current" values and "current" time.

QTMS Configuration Table

This feature allows the user to view on his/her PC the current system configuration. It is an easy way to identify the serial number of the unit, revision level, and configuration parameters of protocols, I/O, and network.

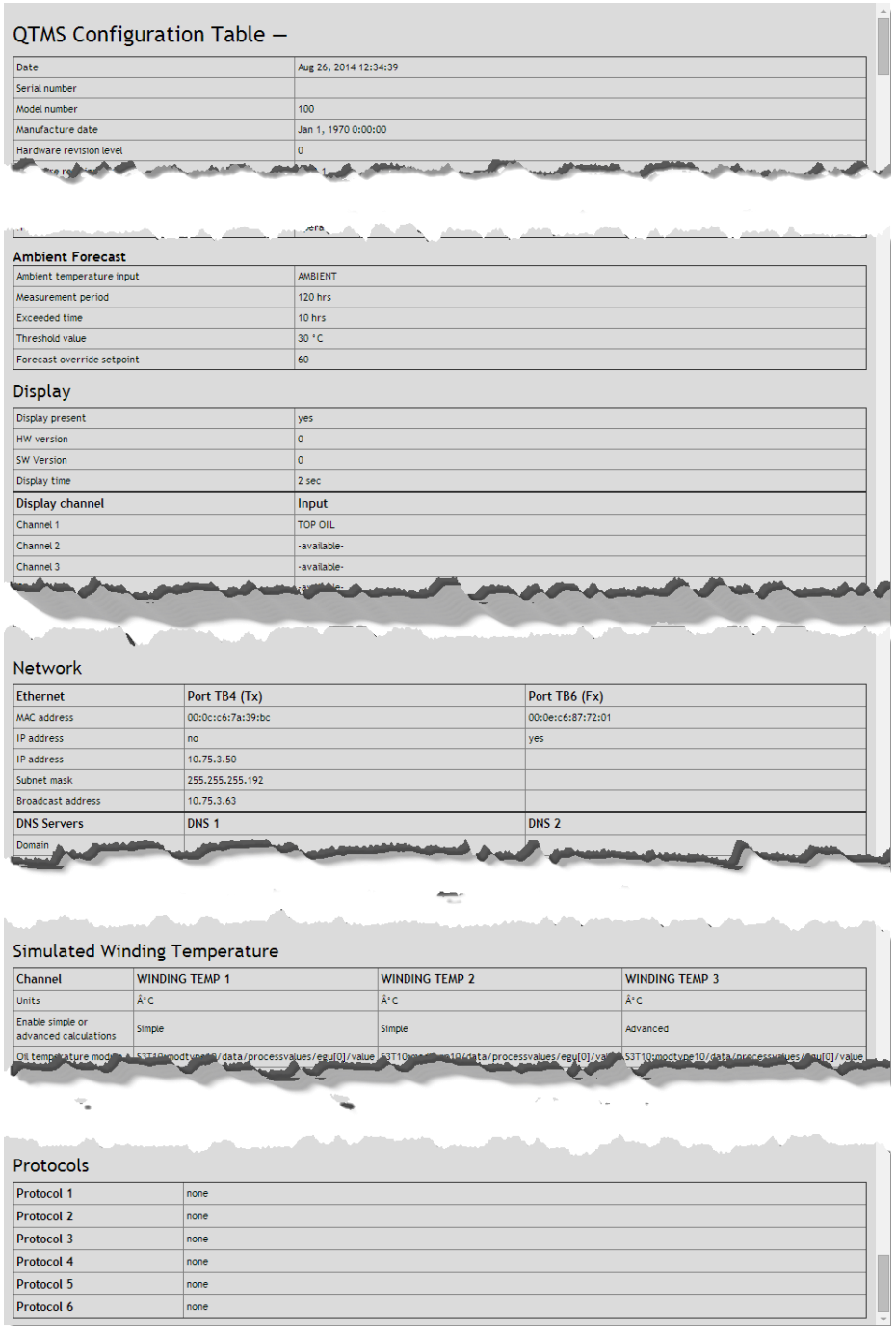
Note: This feature does not copy the configuration to the PC, it is read only.

The Configuration Table includes the following sections:

- QTMS identification information such as serial number, revision level, etc.
- Data and Time
- User Accounts
- Ambient Forecast configuration
- Display parameters
- Network parameters
- Installed module types and slot positions
- Individual module configuration
- Cooling System Monitoring configuration
- Simulated Winding Temperature configuation

- Data Logging values
- External Modbus configuration
- Protocols

The following is an example of the Configuration Table viewed on a PC.



QTMS Configuration Table –

Date	Aug 26, 2014 12:34:39
Serial number	
Model number	100
Manufacture date	Jan 1, 1970 0:00:00
Hardware revision level	0

Ambient Forecast

Ambient temperature input	AMBIENT
Measurement period	120 hrs
Exceeded time	10 hrs
Threshold value	30 °C
Forecast override setpoint	60

Display

Display present	yes
HW version	0
SW Version	0
Display time	2 sec
Display channel	**Input**
Channel 1	TOP OIL
Channel 2	-available-
Channel 3	-available-

Network

Ethernet	Port TB4 (Tx)	Port TB6 (Fx)
MAC address	00:0c:c6:7a:39:bc	00:0e:c6:87:72:01
IP address	no	yes
IP address	10.75.3.50	
Subnet mask	255.255.255.192	
Broadcast address	10.75.3.63	
DNS Servers	**DNS 1**	**DNS 2**
Domain		

Simulated Winding Temperature

Channel	WINDING TEMP 1	WINDING TEMP 2	WINDING TEMP 3
Units	Â°C	Â°C	Â°C
Enable simple or advanced calculations	Simple	Simple	Advanced

Protocols

Protocol 1	none
Protocol 2	none
Protocol 3	none
Protocol 4	none
Protocol 5	none
Protocol 6	none

Sample of QTMS Configuration Table

I/O Module Configuration

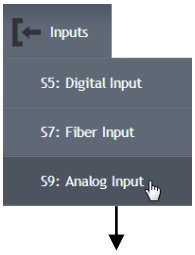
All point configuration is performed using the point configuration window for each signal type. There are two ways to call-up a point configuration window:

- Using the Menu Bar Window Drop-down Menu
- Selecting a module on the Front Panel Window

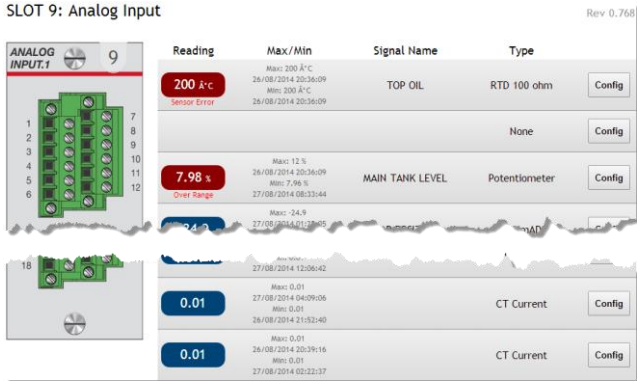
Using the Drop-Down Menu

To call-up a particular point configuration window using the Menu Bar drop-down menu, perform the following:

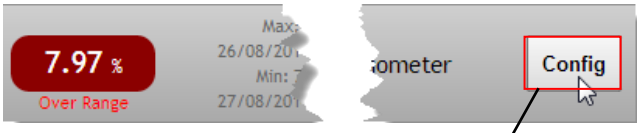
1. On the **Menu Bar Input or Output Menu**, click the module to be configured or modified.



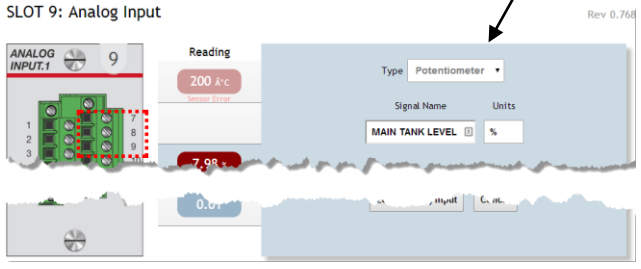
2. The **Module Window** appears.



3. Click **Config** to call-up the particular point configuration window.



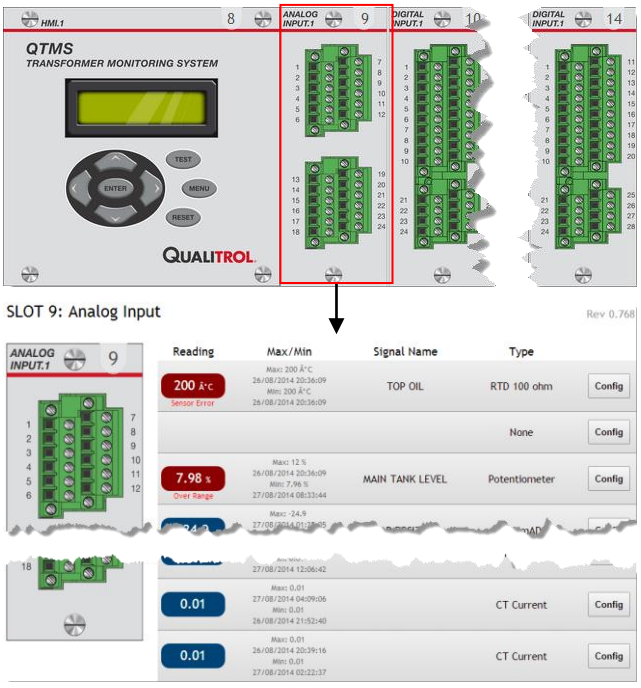
4. **Point Configuration Window** is initialized.



Using the Front Panel Display

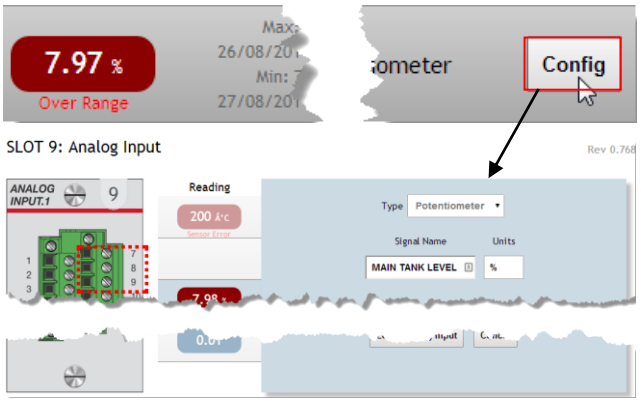
To call-up a particular point configuration window using the Front Panel Window, perform the following:

1. Click on the module to configure or modify.



2. The Module Window appears.

3. Click **Config** to call-up the particular point configuration window.



4. **Point Configuration Window** is initialized.

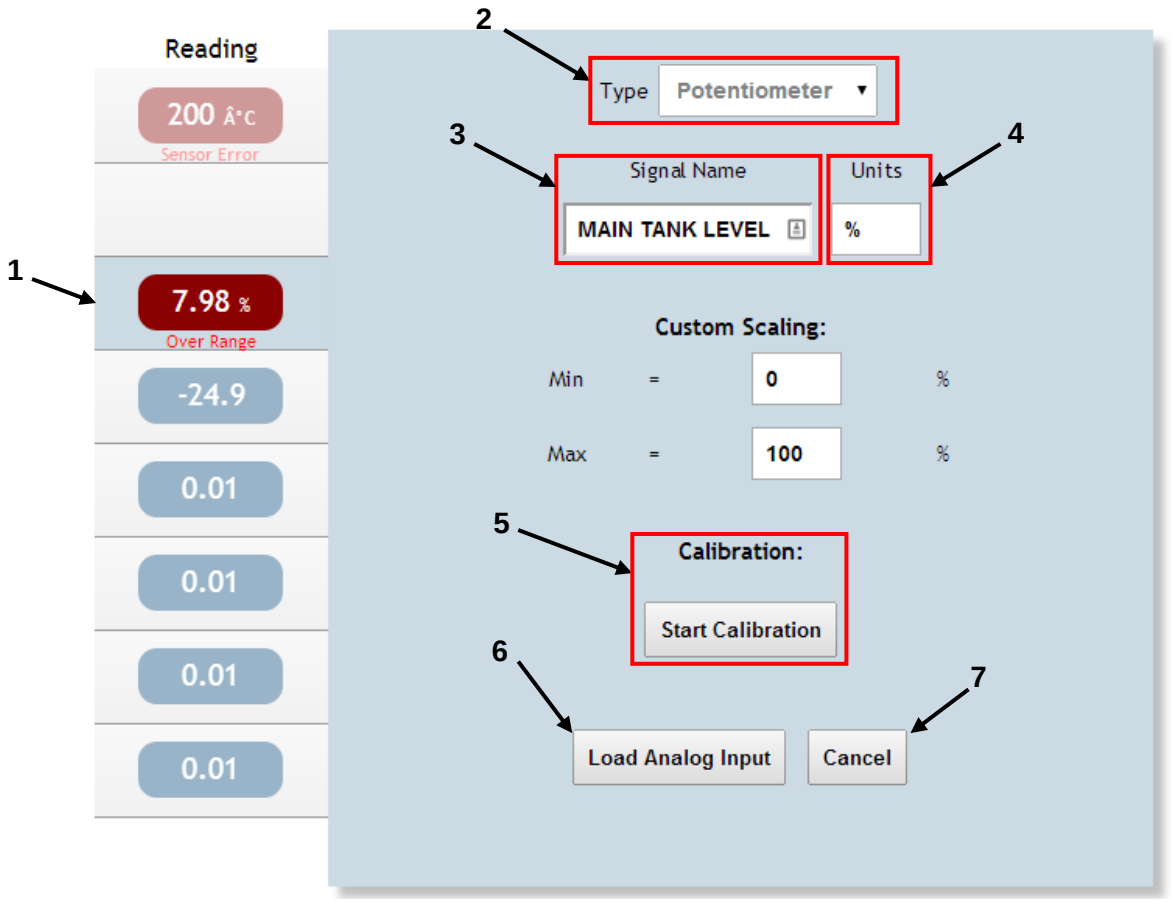
Analog Input Module Configuration

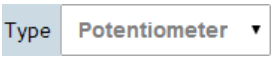
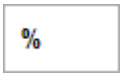
Overview

The Analog Input Module can be configured with up to eight (8) inputs point types. The eight point types and their position on the module are determined when the module is ordered.

AI Configuration Common Fields

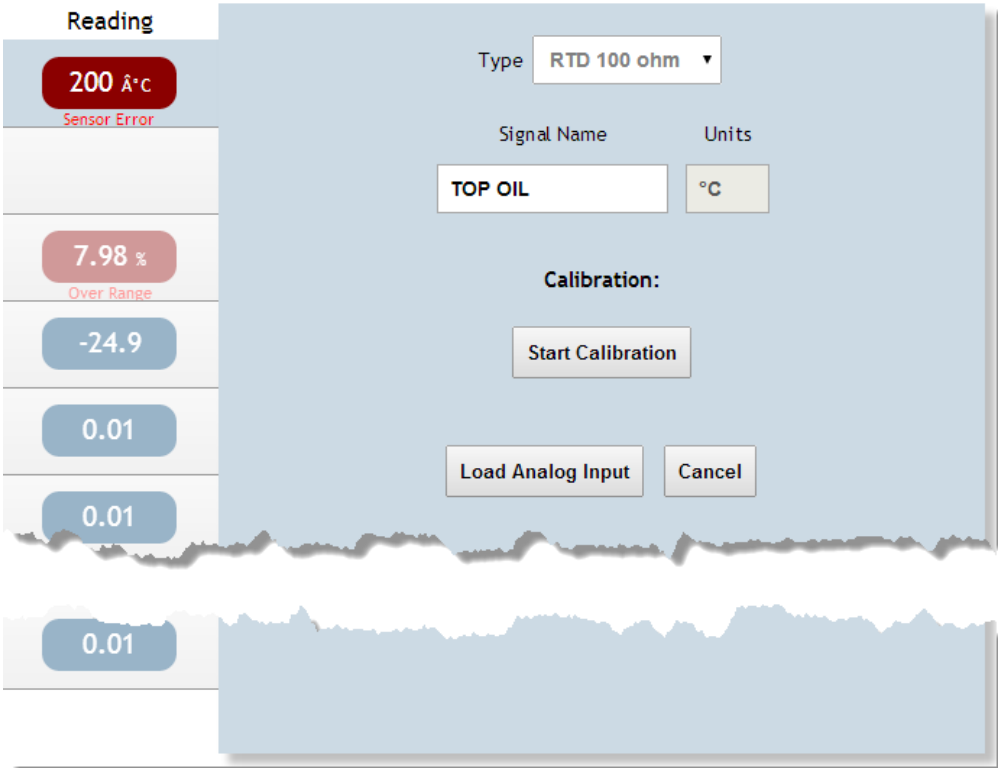
The Analog Input Module can contain several types of input points; RTD, Current, CT current, and Potentiometer. The configuration windows for each of these point types have entry fields that are common. The follow describes these common fields.



Index	Object	Definition
1	**Reading** 	This is an informational field and indicates the current value of point and which point on the input points is being configured. e.g., This is the third point from the top and is highlighted in blue making it point number 3. This field also displays any signal errors.
2	**Type** 	Indicates what point type was installed in this corresponding module location. This is designated at the factory according to the input type that was ordered and installed.
3	**Signal Name** 	Identifies point name. The name can be changed and can consist of up to 16 alphanumeric characters.
4	**Units** 	This field designates the units of measurement for the point. This is a four (4) alphanumeric field for each AI point type except RTD which is fixed as C.
5		Click this button to begin the calibration procedure.
6		Click this button to save the point parameters into memory
7		Click this button to close the window without saving any changes.

RTD

The configuration fields for the RTD point are the same as those described in the AI Configuration Common Fields section.



Current Input: 4 -20mA, 0-1m, 0 -5mA, 0-10mA, and 0-20mA

The following describes the entry fields that are particular to the AI current input point types.

Index	Object	Definition
1	4 mA = 0	This field contains the value of the point when the input is at minimum.
2	20 mA = 100	This field contains the point value when the input is at maximum.

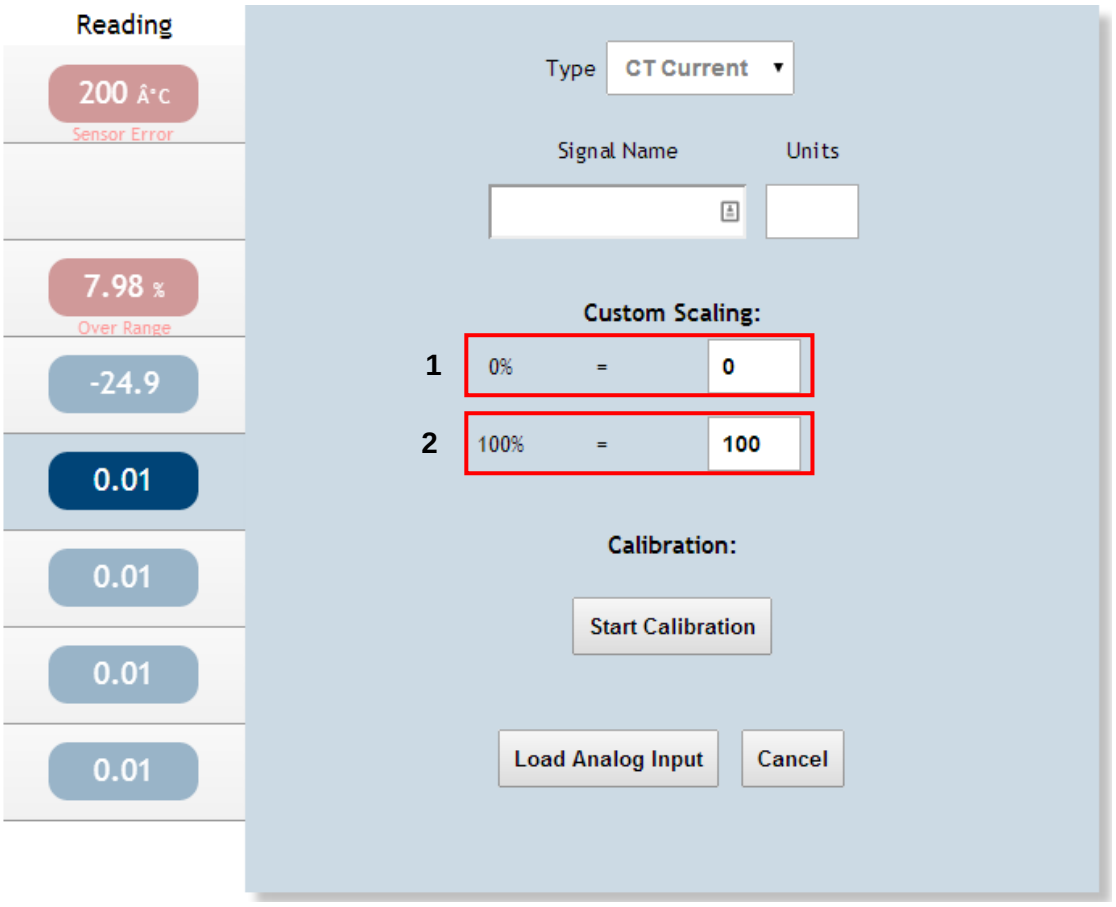
Example: A Dissolved Gas Monitor provides a 0 - 1 mA input representing a 0 - 2000 PPM range.

Using a 0 - 1 mA input point, set:

- **0mA** field to = 0”
- **1mA** field to = 2000”

CT Current

The following describes the entry fields that are particular to the AI CT Current input point.



Index	Object	Definition
1	0% = 0	This field contains the value of the point when the input is at minimum.
2	100% = 100	This field contains the value of the point when the input is at maximum. The default from the factory will be the clamp-on sensor rating.

Example: Using the reading to match the transformer CT output, clamp on sensor rating is 10A; set:

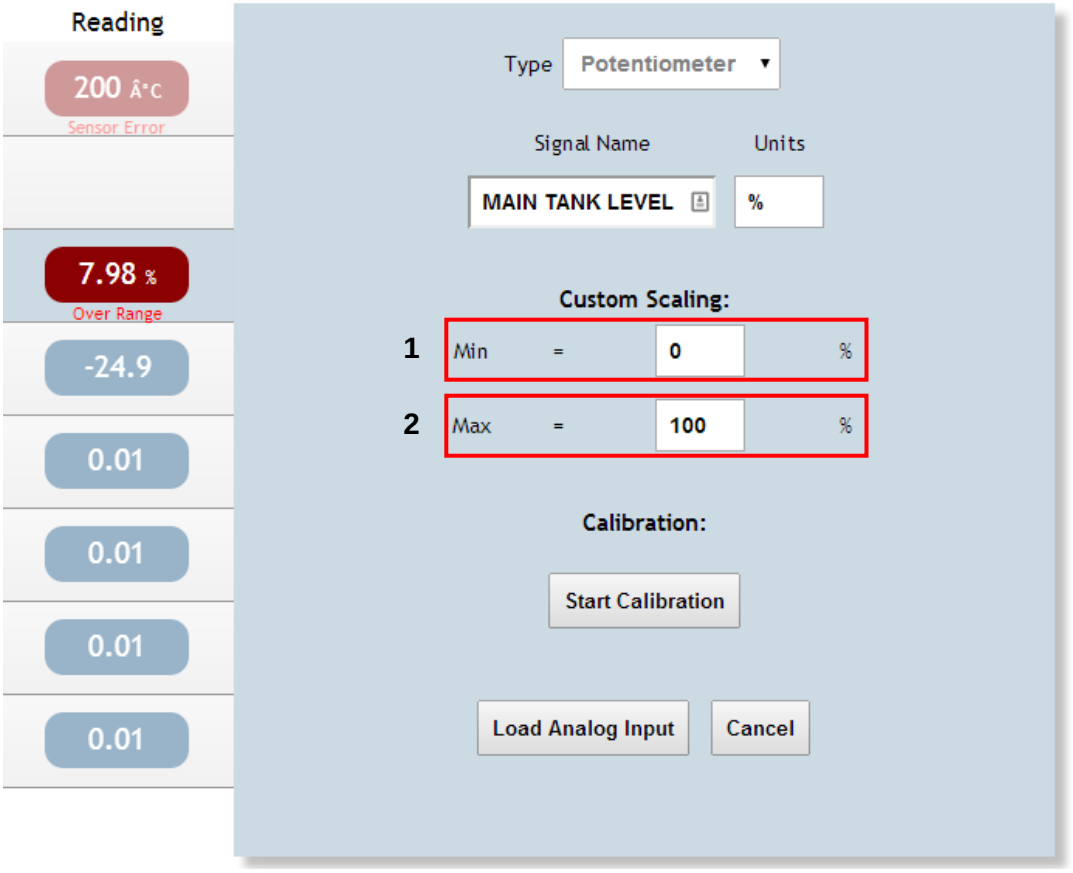
- **0%** field to = 0”
- **100%** field to = 10”

Example: Using the reading to match the transformer load; clamp on sensor rating is 10A, CT ratio is 1200 : 5; set:

- **0%** field to = 0”
- **100%** field to = 2400” (10 * 1200 \ 5)

Potentiometer

The following describes the entry fields that are particular to the AI Potentiometer input point.



Index	Object	Definition
1	Min = 0 %	This field contains the value of the point when the input is at minimum.
2	Max = 100 %	This field contains the value of the point when the input is at maximum.

Example: A Linear Level Gauge goes from 0 – 6 inches; set:

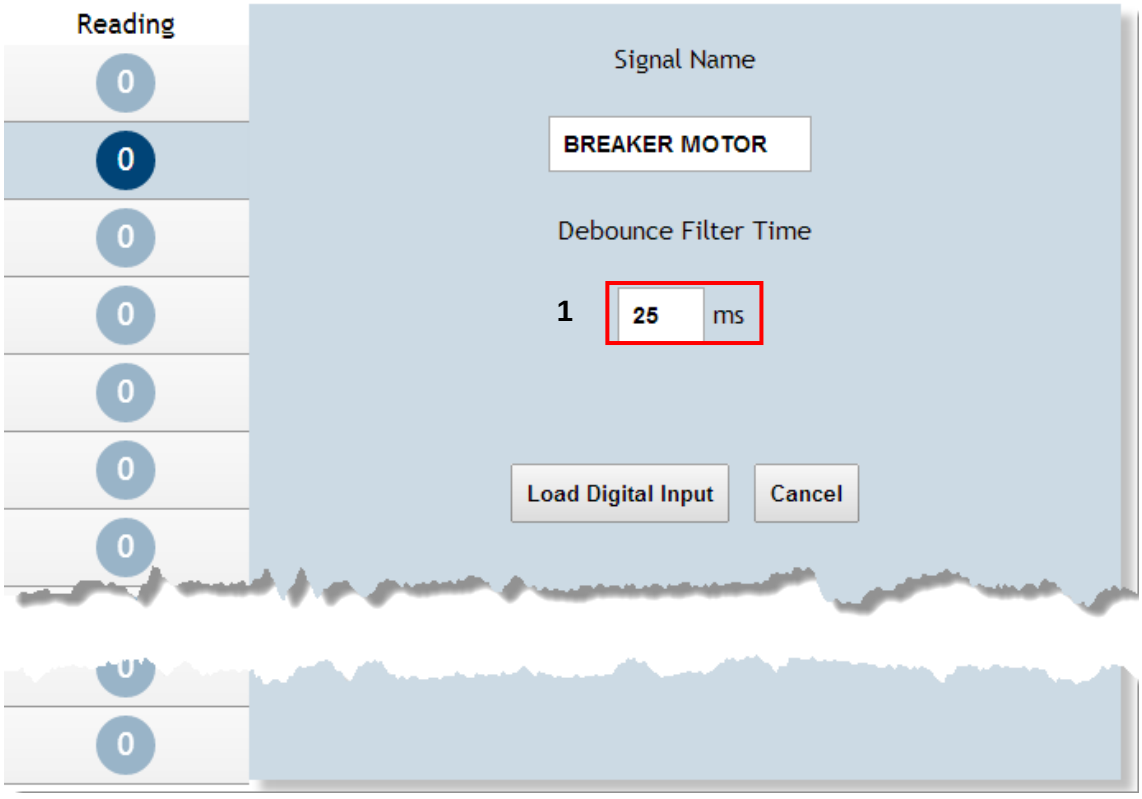
- **Min** field to = 0”
- **Max** field to = 6”

Note: If using a Level Case with a Potentiometer input it is recommended to keep the

units in percentages and during calibration of the case assembly to the Input card, record the alarm states values for setting relay setpoints.

Digital (DI) Input Module

The following describes the entry fields that are particular to the DI input point.

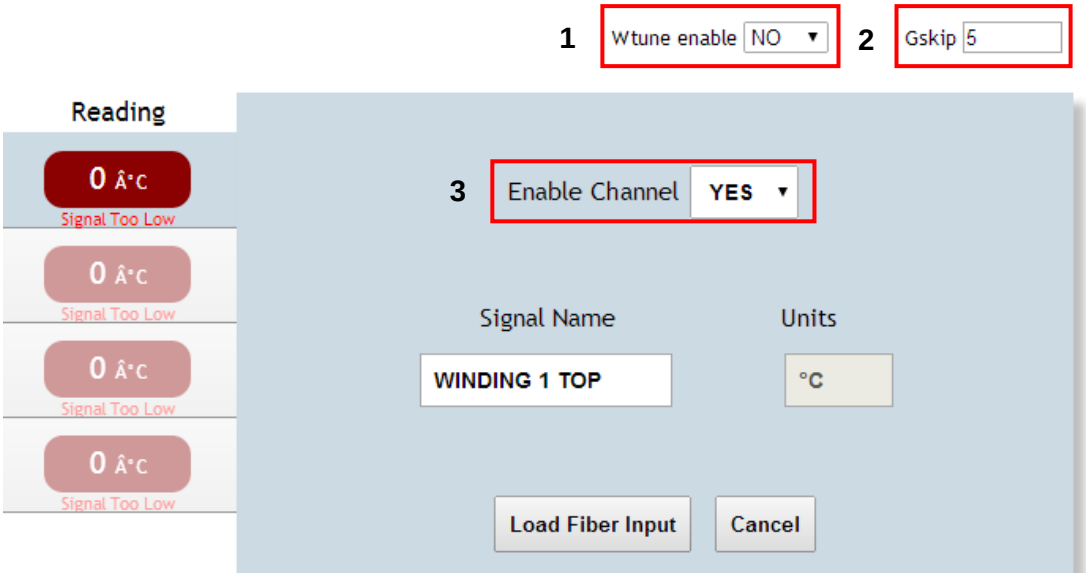


Index	Object	Definition
1	25 ms	This field contains the time a contact change of state occurs before it is registered as such.

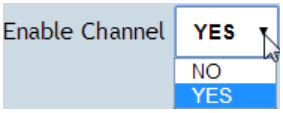
Fiber Input (FI) Module

The following describes the entry fields that are particular to the FI input point.

Important: When this module is installed and configured, there is no need to configure the Simulated Winding Temperature function.

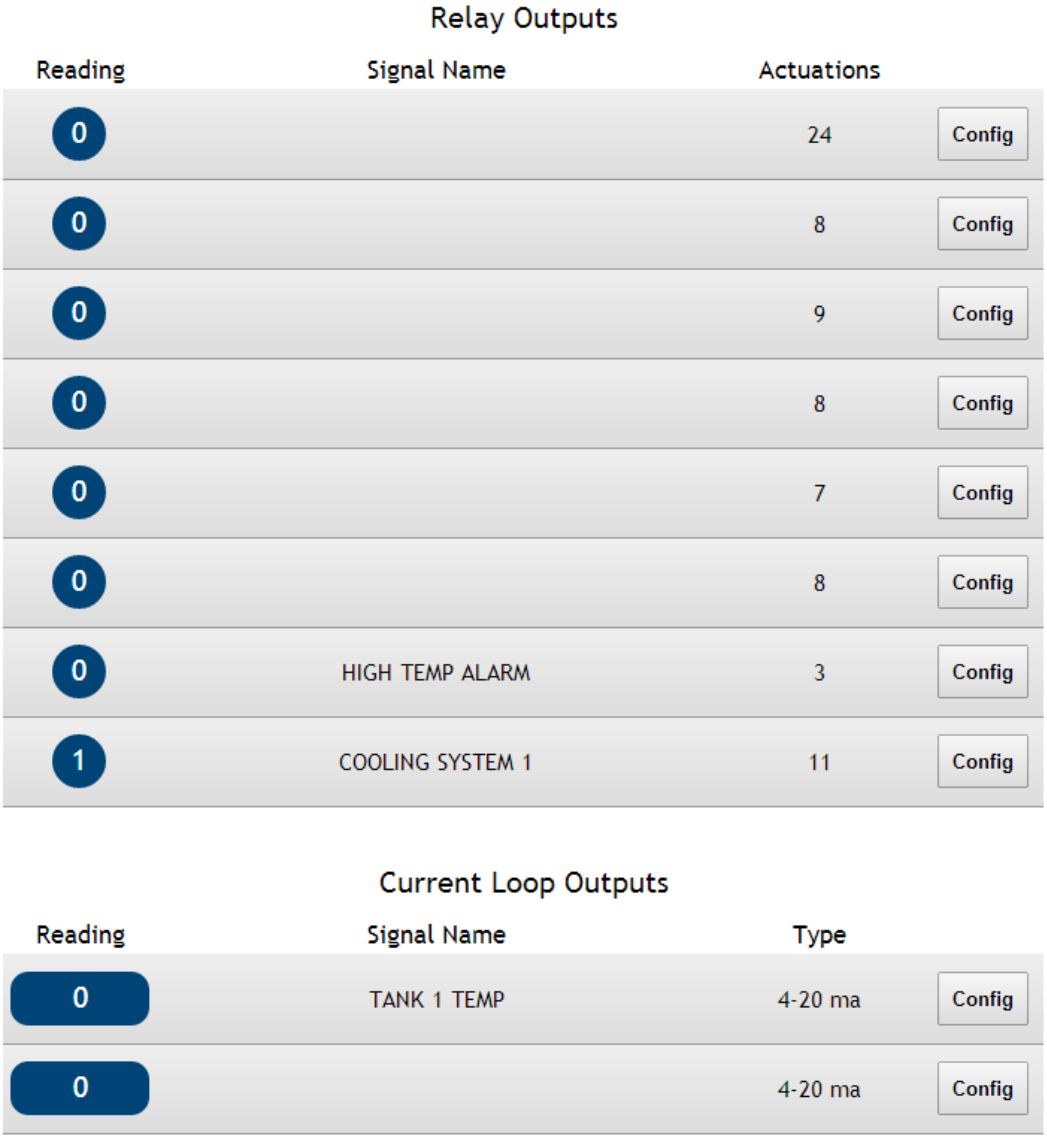


Index	Object	Definition
1	Wtune enable NO (NO / YES)	This drop-down menu allows the user to select whether to enable (Yes) or disable (No) the Wtune function. Wtune increases the optical integration time of each channel to force the Qualitrol system to read temperatures when the optical signal is weak. This comes at the expense of a slower response (slower temperature update frequency or rate). Enabling Wtune is highly recommended for power transformer applications.
2	Gskip 0	This entry allows the user to indicate the number of scans the system will perform before actually indicating that it cannot read a probe on a specific channel. The entry range is from 0 to 9; a value of 0 indicates that the system makes no attempt at removing dropouts. A value of 3 to 5 is recommended for transformer applications. This command is useful to eliminate annoying dropouts that can happen when using “weak” probes. The parameter “i” indicates

3		Enables or disables the particular channel.

Relay Output (RO) Module

The RO Module provides eight (8) contact outputs and two (2) current output loops. The RO Module Window is divided into two (2) parts; Relay Outputs, and Current Loop Outputs. To select the point to configure, click on the **Config** button next to the particular point.



Relay Output (Contact) Configuration

The Relay Output (Contact) Window is divided into several different areas:

- General configuration parameter area that must be configured for each RO point.
- Control area which enables the following control areas:

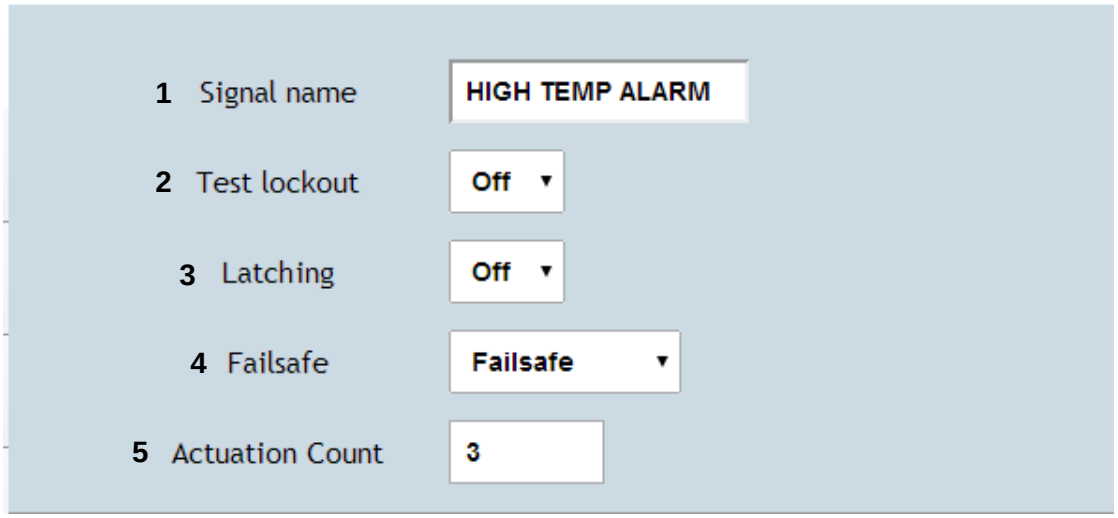
  Cooling Exerciser

  Seasonal Setpoint

  Matrix Control of the point

General Configuration Parameters

The following parameters are relevant to each RO contact point. Once these parameters are configured, the user then determines how the point is controlled and what functionality it assumes in the system.



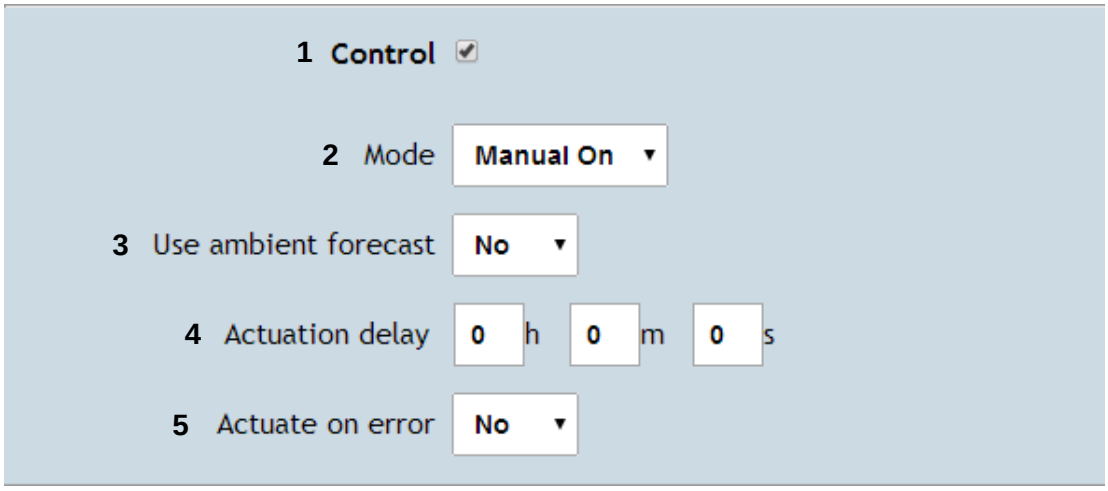
Index	Object	Definition
1	**Signal Name**	16 alphanumeric field identifying the point name of each signal.
2	**Test lockout** Test lockout	When the **TEST** button is pressed on the HMI front panel, the QTMS executes a test cycle of all the relays in the system. The test actuates each relay for one second, starting with relay one in the lowest slot position and finishing with relay eight in the highest slot position. The test continues until all the relays in all the relay modules are cycled. There might be situations when the user does not want the relays to actuate. In these situations, use the **Test Lockout** function. By setting **Test Lockout** to ON when the **TEST** button is pressed, the relay does not change states. Any relay wired to a trip function should have the Test **Lockout function** set to ON.

3	**Latching** Latching	**On:** The relay remains in the actuated state even after the controlling signal no longer exceeds the setpoint value. The relay can only be released by pressing the **RESET** button on the front HMI panel or while the controlling signals do not meet the setpoint conditions. **Off:** The relay actuates and de-actuates according to the output of the Control Signal Matrix table and other function settings.
4	**Failsafe** Failsafe	Allows the user to select the actuation function of the relay. **Failsafe** operation: • The normally closed and common contacts are shorted together when the monitor is de-energized. • If the monitor is energized and the setpoints are not exceeded, the relay changes states. This causes the normally open and common contacts to be shorted. • If the setpoints are exceeded or if the monitor loses power, the normally closed and common contacts are shorted together. ***Important:*** Failsafe operation is recommended for alarm circuits. **Non-failsafe** operation: • The normally closed and common contacts are shorted together if the monitor is de-energized and the setpoints are not exceeded. • The relay changes states when the setpoints are exceeded. ***Important:*** Qualitrol recommends setting any trip contacts for a transformer to **Non-failsafe**. See the following table for further clarification of Failsafe/Non-failsafe operation.
5	**Actuation Count** Actuation Count 3	Indicates the number of relay actuations that have occurred. May be zeroed or preset. Excellent use as an indicator for maintenance purposes.

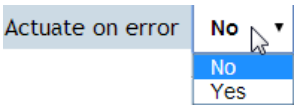
Relay Condition	No Power to QTMS	QTMS Energized < Set Point	QTMS Energized >= Set Point	Loss of Power to QTMS
Non-failsafe	NC - C	NC - C	NO - C	NC - C
Failsafe	NC - C	NO - C	NC - C	NC - C

Control

The Control area allows the user to set the functionality and the input signal(s) that controls the output contact point.

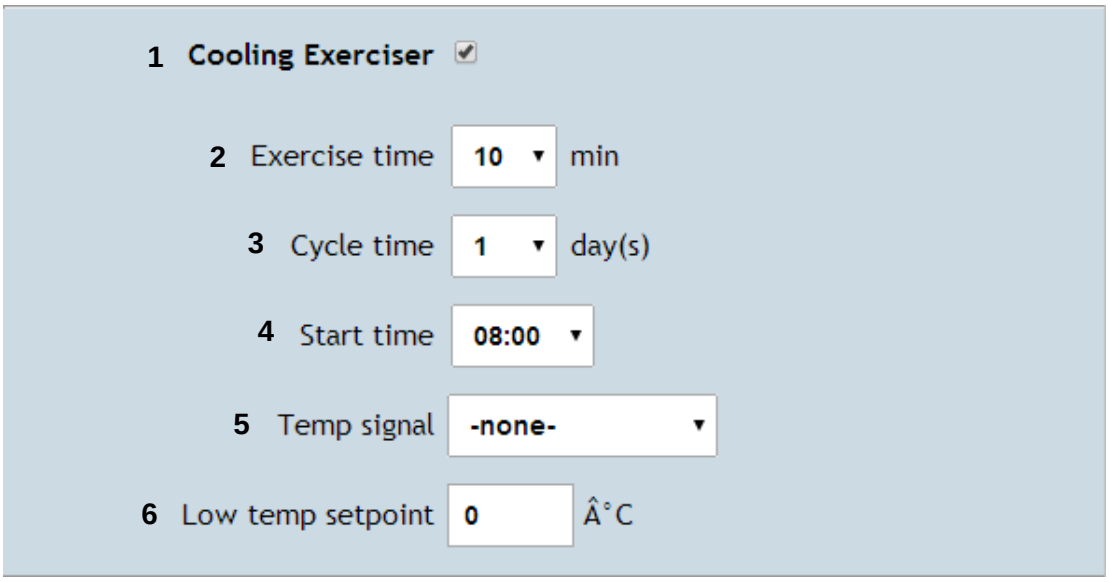


Index	Object	Definition
1	**Control** Control	When checked, enables the user to set the functionality and the input signal(s) that controls the output contact point. When unchecked it disables the relay and the normally closed and common are shorted together.
2	**Mode** Mode Manual On Automatic Manual On	**Manual On:** The relay actuates regardless of the setpoint values. **Automatic:** The relay actuates according to the Control Signal Matrix table and other function settings. This feature can be toggled through the communication channels, which allows you to actuate a relay remotely.
3	**Use ambient forecast** Use ambient forecast No No Yes	Used to enable (Yes) or disable (No) the Ambient Forecast function. See section Ambient Temperature Configuration. ***Note:*** The Ambient Forecast setpoint takes precedence over the Seasonal Setpoint and the point's Matrix Control signal entry.
4	**Actuation delay** Actuation delay 0 h 0 m 0 s	Allows the user to enter the amount of time the actuation of the relay will be delayed after the control signals have continually exceeded the setpoint values.

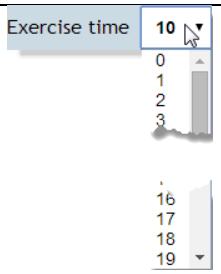
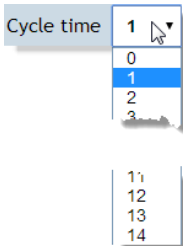
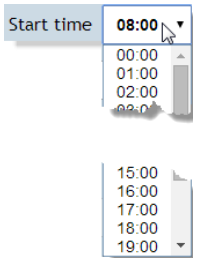
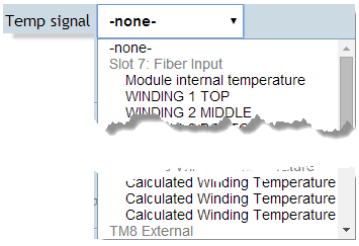
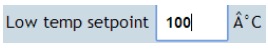
5	**Actuate on error** 	**On**: If any of the control signals in the Control Signal Matrix table have sensor errors, the relay actuates. **Off**: If any of the control signals in the Control Signal Matrix table have sensor errors, the relay does not actuate. When the **Control** check box is left unchecked, it disables the relay and the normally closed and common are shorted together.

Cooling Exerciser

The Cooling Equipment Exerciser actuates the relay for a set period of time at a specified interval of days. This feature allows you to exercise a seldom-used fan to prevent rust, lubricate bearings, and to keep wildlife from nesting in fan cages.



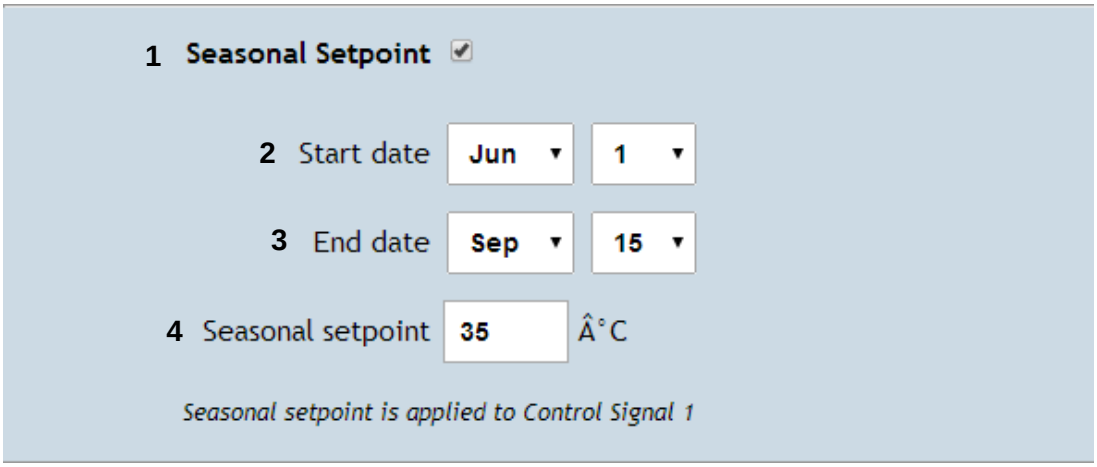
Index	Object	Definition
1	**Cooling Exerciser** Cooling Exerciser	Checking this box enables the Cooling Exerciser function.
2	**Exercise Time**	Allows the user to set the number of minutes that the relay remains actuated when the cycle time is reached. The range is 0 - 59 minutes.

		
3	**Cycle Time** 	Allows the user to set the amount of time between each exerciser actuation. The range is 0 - 30 days.
4	**Start Time** 	Allows the user to set the time of day that the exerciser starts to run once the cycle time is completed. The range is 00:00 - 23:00.
5	**Temp signal** 	If the equipment exerciser is used to exercise cooling pumps (not fans) an ambient input module point can be selected from this drop-down menu to prevent transformer damage caused by the movement of oil at cold temperatures (electro stratification).
6	**Low temp setpoint** 	If a Temp signal is selected then the cooling equipment exerciser will not actuate when the temperature falls below the entered value.

Seasonal Setpoint

The user can adjust the setpoint to compensate for changing seasonal weather conditions. For example, for the warmer summer months when the cooling system is not as efficient, you might want to enter a Seasonal Setpoint value of 70° C for a cooling bank that is normally set to actuate at 80° C at other times of the year.

Important: This feature only affects the setpoint for the **Control Signal 1** entry in the Matrix Control section. If the Seasonal Setpoint is active and the conditions are met, the Seasonal Setpoint has priority over the setpoint in the **Control Signal 1** entry.



Index	Object	Definition
1	**Seasonal Setpoint** Seasonal Setpoint	Checking this box, enables the Seasonal Setpoint function.
2	**Start date** Start date Jan 1 Jan Feb Mar Apr May Dec 1 2 3 4 5 18 19 20	Select the **Month** and **Day** when the Seasonal Setpoint becomes active.
3	**End date** End date Jan 1 Jan Feb Mar Apr May Oct Nov Dec 1 2 3 4 5 18 19	Select the **Month** and **Day** when the Seasonal Setpoint is discontinued. Normal setpoint operation resumes the day after this date.

4	**Seasonal setpoint** Seasonal setpoint 35 Â°C	Enter the temperature setpoint controls the relay when the Seasonal Setpoint is active.

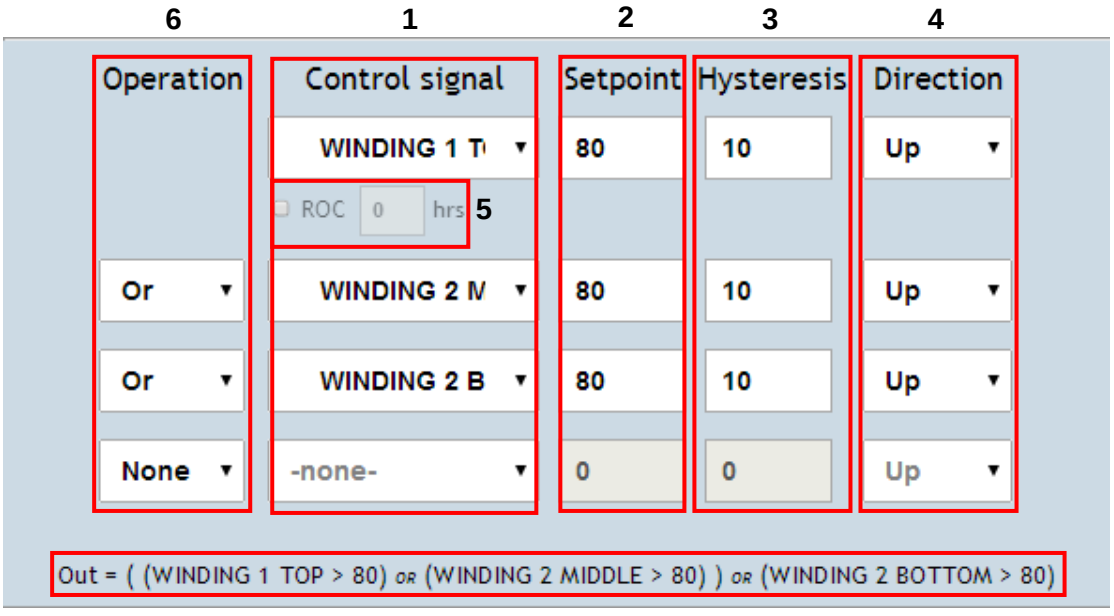
Matrix Control

This section provides a variety of input signal configurations and logic to control the relay actuation. For example, using the math function “or”, the user can actuate the relay with a maximum of four different input signals. Conversely, by using the “or” function and setting the actuation Direction to “down”, you can actuate on the minimum signal of the four control signals inputs.

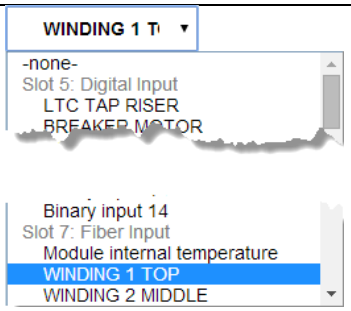
The Matrix area is divided into several different groupings of configuration entries necessary for proper control of a relay output.

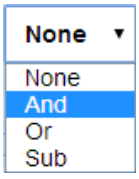
- *Operation*: Provides functions Or, And, Subtract if more than one input controls the output.
- *Control Signal*: Designates the input signals controlling the output.
- *Setpoint*: Designates the trigger value of each controlling input.
- *Hysteresis*: Serves as a debounce or deadband function to prevent relay chattering.
- *Direction*: Determines whether the output activates when the input value(s) are greater than or less than the Setpoint value.

Important: At minimum, a **Control signal** must be selected for the first entry for the point to change state.



Index	Object	Definition
1	**Control signal**	The first Control signal must have a selected point to provide the relay output

		with basic functionality. These selections allow the user to select up to four input points of any type. The measured values of the input points, when compared to the setpoints, actuate or de-actuate the relay according to the logic of the matrix.
2	**Setpoint** 80	Allows the user to select a value corresponding to the control signal, which, when it equals or exceeds the setpoint value, meets the conditions to actuate the relay in that column.
3	**Hysteresis** 10	Allows the user to select a switching differential required to de-actuate the relay. Without hysteresis, a relay could toggle on and off rapidly when the control signal reaches the setpoint value, causing stress on relay circuits. The hysteresis prevents this by providing a “dead” band between on and off. **Example:** If there is only one signal controlling the relay and the actuation **Direction** field (see below) is set to “up”, when the control signal reaches the setpoint value, the relay actuates. The relay de-actuates only when the control signal falls below the setpoint value minus the hysteresis.
4	**Direction** Up Up Down	Select **Up** to actuate the relay when the input signal becomes greater than the setpoint value. Select **Down** to actuate the relay when the input signal becomes less than the setpoint value.
5	**ROC** ROC 5 hrs	***Note:*** The ROC (Rate of Change) feature only affects the first row of the matrix. The ROC time period is the rolling time period used to measure the absolute change in the first control signal. This feature allows the user to set a dynamic setpoint that will actuate due to a rate of change.

		For example: If the control signal is set to a Hydrogen gas input, the setpoint is set to 100 PPM, (the hysteresis is not used with the Rate Of Change feature), the direction is set to 'Up' and the rate of change time period is set to 12 hours. Then if the absolute change of the gas increases 100 PPM over a 12 hour time period, then the relay will actuate (this assumes no other parameters are set in the matrix, otherwise the conditions for row one will be true). The relay will de-actuate if the 12 hour window no longer has an absolute increase of 100 PPM. This same feature can be used for a falling control signal if the actuation direction is set to 'Down'. ***Note:*** If NONE is selected then the ROC feature is inactive and the row is evaluated as a static setpoint. Otherwise values of 2 to 168 hours may be entered for the rate of change time period to evaluate changes in the first control signal.
6	**Operation** 	Allows the user to select a math function in each of the three available fields. The first and third fields allow the math functions **Or**, **And**, and **Sub**-tract. The second field allows only **Or** and **And**. The **Sub** function(s) are first evaluated in the matrix math expression. Otherwise, the overall equation is evaluated from left to right.
7	**Math expression**	This shows the equation resulting from the operations.

Example: If the Matrix table is set up as:

Control Signal 1	**Or**	Control Signal 2	**Or**	Control Signal 3	**Sub**	Control Signal 4

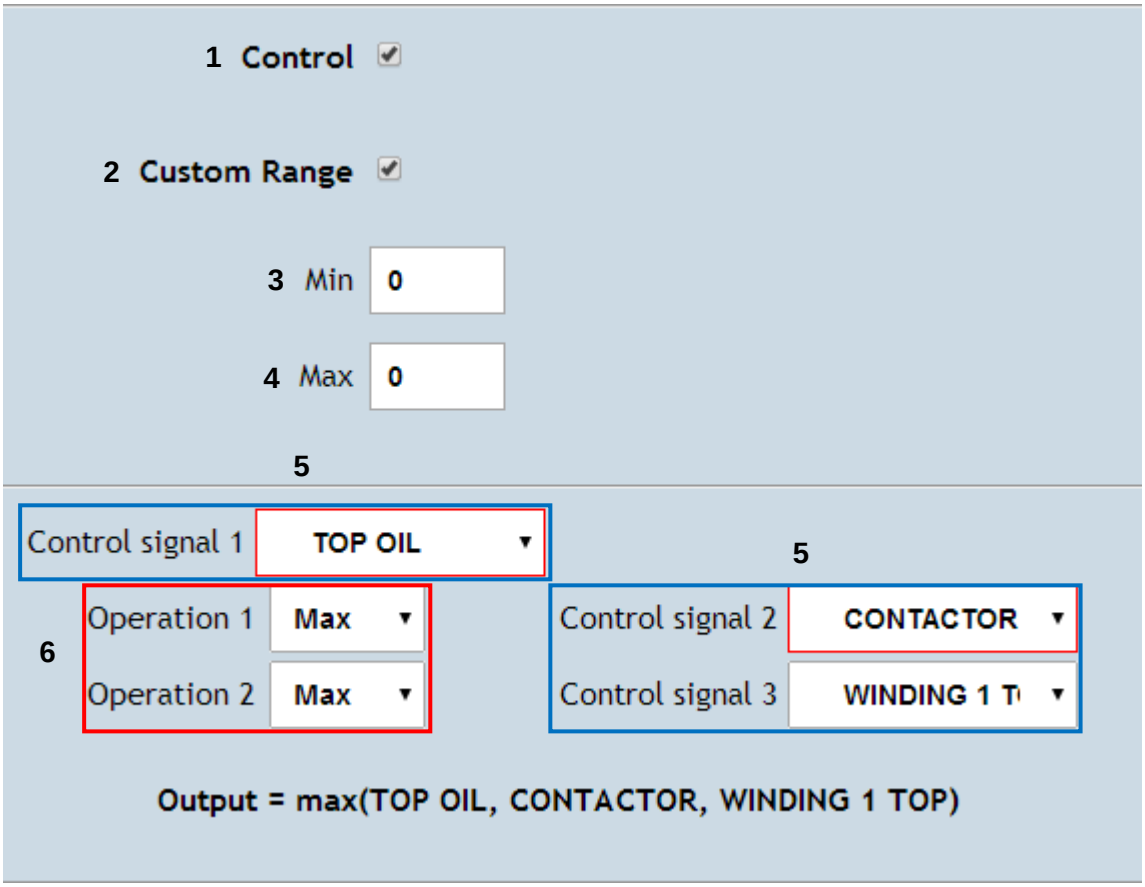
The system evaluates this as:

(("Control Signal 1" **Or** "Control Signal 2") **Or** ("Control Signal 3" **Sub** "Control Signal 4")).

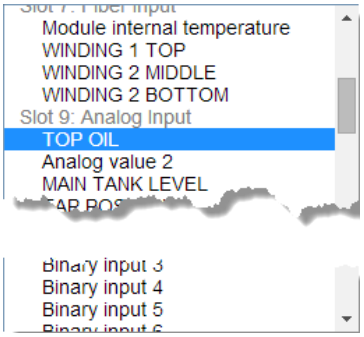
Current Loop Output Configuration

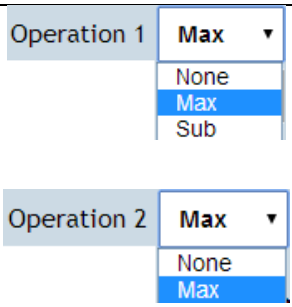
Each QTMS RO Module is equipped with two (2) software selectable 0-1mA, 0-5mA, 0-10mA, and 0-20mA outputs to provide information to Supervisory Control & Data Acquisition (SCADA) systems or remote indications. You can configure each output to send data from any of the inputs or send a derived calculation, such as:

- The maximum value of up to three inputs, or
- A difference calculation between two input modules

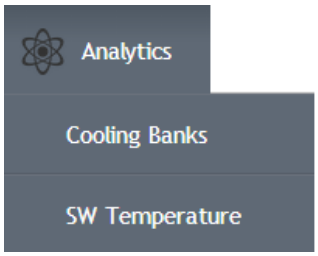


Index	Object	Definition
1	**Control** Control ☑	Allows the user to enable or disable the output loop operation.
2	**Custom Range** Custom Range ☑	Allows the user to select the value range for the current loop output. **Example:** An RTD (designated as **Control signal 1**) measures temperatures from -40 to 120° C. The user selects an output **Type** of 4 - 20 mA and a **Custom Range** of *0* (**Min**) and *100* (**Max**). For temperature measurements of:

		• –40 to 0° C, the current loop output will read 4 mA • 0 - 100° C, the output will correspond directly to 4 - 20 mA ***Note:*** Any temperature measurement over 100° C will continue to read 20 mA. ***Note:*** If no customer scaling is selected then the input range will be scaled to the output: • RTDs, Ambient temperatures are -40 to +120 • Simulated Winding temperatures and Direct Fiber optic probes are -40 to +200. • Potentiometers are 0 to 100%
3	**Min** Min 0	Allows the user to enter an input signal value that corresponds to the minimum output of the current loop. **Example**: When the result of the Matrix control expression ≤ 0° C the output = the low-end value of the output **Type**, i.e., 4mA output for a 4-20mA output loop, or 0mA if the output loop is set to 0-1mA, 0-5mA, etc.
4	**Max** Max 100	Allows the user to enter an input signal value that corresponds to the maximum output of the current loop. **Example**: When the result of the Matrix control expression > 0°, the output = the low-end value of the output **Type**, i.e., 20mA output for a 4-20mA output loop, or 1mA if the output loop is set to 0-1mA, etc.
5	**Control signal 1, 2, 3** 	Allows the user to select the input points(s) that will control the current loop output.
6	**Operation 1, 2**	Allows the user to select the math expression(s) used for selecting maximum values or difference measurements corresponding to the output current loop value.

		
7	**Math expression**	This shows the equation resulting from the operations.

Analytics



This Analytics menu provides the user with access to cooling banks analytical data and configuration, and simulated winding temperature current data and configuration.

Cooling System Monitor

The Cooling System Monitor tracks all of the parameters of a transformer cooling system.

Simulated Winding Temperature

This function allows the user to configure a fixed transformer temperature curve or a curve based on the removal of heat by a cooling system. This curve provides the data to actuate pumps and fans of the cooling system.

The Cooling System Monitor

The Cooling System Monitor tracks all of the parameters of a transformer cooling system. Once installed and initialized, the monitor performs the following functions to help alert the user to immediate or potential system problems:

- Measures the peak inrush and steady-state current of the fan bank and pump motors, and checks for operation within specified limits. This can detect a jammed or broken fan or pump motor.
- Coupled with RTD sensors, measures the differential temperature on both sides of the radiators. This can detect a lack of cooling from the system or a loss of efficiency.
- Provides an input for a sensor to check the oil flow through the cooling system. This can detect a broken pump or a blocked line.
- Provides the option to alarm on excessive actuations or total run time, indicating that it is time for preventive maintenance.

All of these functions allow the user to maximize the use of the cooling function and help extend transformer life.

The Importance of Winding Temperature and Cooling

Paper insulation used in transformers contains organic materials that deteriorate over time at elevated temperatures. Cooling that is activated too slowly allows elevated temperatures to degrade this insulation. Cooling systems that are activated too early or too often will lead to reduced fan and/or oil pump life.

The QTMS implements advances in thermal modeling technology to increase both insulation and cooling system life. The user can set different parameters for each of the possible cooling modes, or stages: ONAN, ONAF, OFAF, and ODAF are the designations for natural convection, forced air, directed air, and oil cooling, respectively.

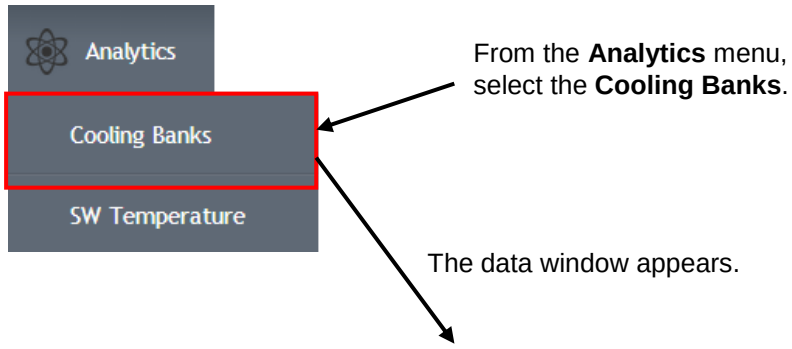
During operation, the QTMS can dynamically alter the parameters to match the present cooling stage being used. The user can individually program each winding for accurate representation of the winding "rise" (gradient). The user can also program the winding time constant and the load current "exponent" for each cooling stage.

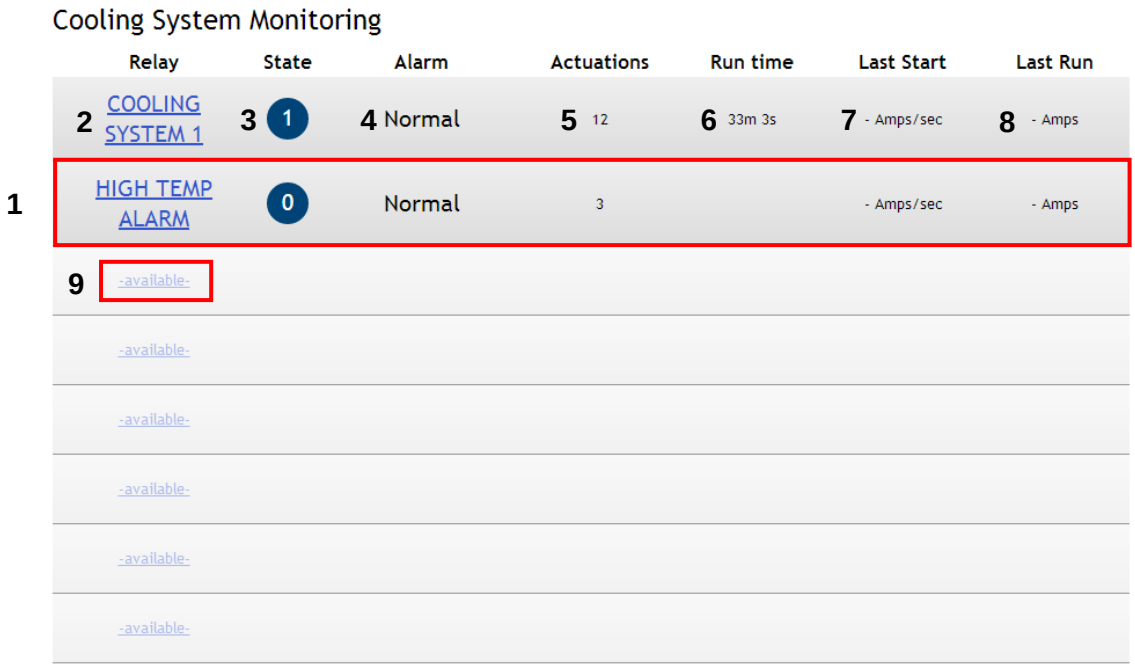
The Cooling System Monitor Data Window

There are two windows that address the Cooling System Monitor: 1) the data window and, 2) the configuration window. The configuration window is accessed from the Data Window.

The Cooling Banks Data Window displays up to eight (8) cooling banks - depending upon the number configured. Each bank controls a transformer pump or fan circuit.

To access the analytics window perform the following.





Index	Object	Definition
1		Each row shows data for a configured Cooling Bank.
2	**Relay**	This column contains the name of the output relay that controls the cooling bank. Clicking on the Relay name opens the cooling bank configuration window for the selected cooling bank.
3	**State**	The State column a displays either 1 or 0. 1 = Cooling bank is running. 0 = Cooling bank not running.
4	**Alarm**	Displays "Normal" if the cooling bank in not in an alarm state. An alarm message is displayed in red if values are outside the following alarm parameters: running current, starting current, coolant flow, the number of actuations is exceeded, runtime has been exceeded, or if the temperature difference between coolant entering the transformer and exiting the transformer exceeds the setpoint. Running Current, Actuations, Run time **Example**: In this example, the states that the Running Current, Actuations, and Run Time are outside the alarm configuration parameters.

		Please refer to the Cooling System Alarms table below.
5	**Actuations**	The total counts of how many times the relay controlling the cooling system has actuated.
6	**Run time**	The total active running time of the cooling system.
7	**Last Start**	Displays the last inrush current, over time, for the controlling cooling fans.
8	**Last Run**	Displays the present or last steady state current for the controlling cooling fans.
9	**-available-**	Denotes an empty cooling bank configuration position. Clicking **-available-** initializes the cooling bank configuration window.

Cooling System Alarms

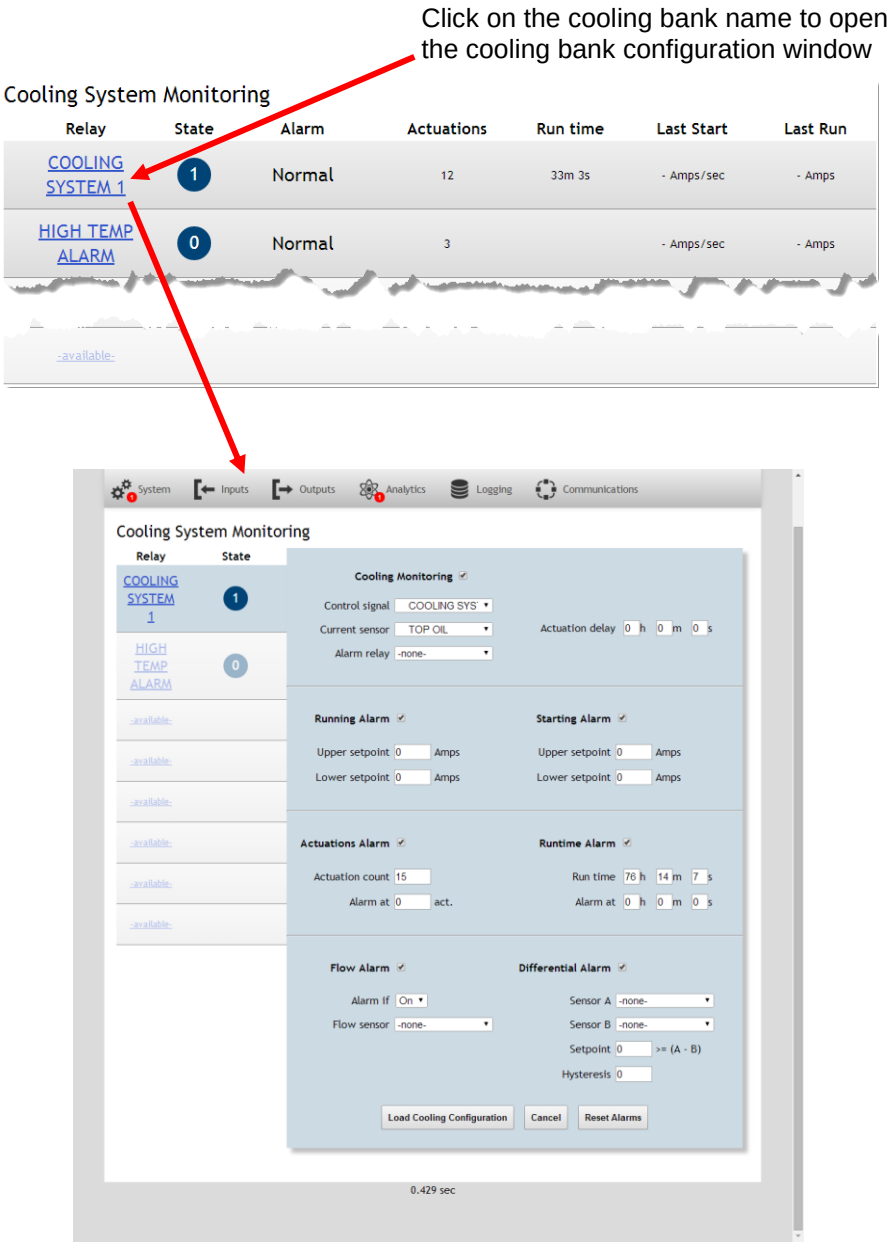
Alarm	Definition
Starting Current	The "Control signal" relay starting current associated with the cooling bank is out of user defined limits.
Running Current	The "Control signal" relay running current associated with the cooling bank is out of user defined limits.
Actuations	The "Control signal" relay associated with the cooling bank has exceeded the of user defined actuation count limit.
Run Time	The "Control signal" relay associated with the cooling bank has exceeded the of user defined runtime limit.
Flow	The "Flow sensor" associated with the cooling bank did not actuate when the cooling system started.
Differential	Normally a measurement between the top of the tank and bottom to prove the radiators are flowing and cooling. This means the differential temperature between the temperature sensors has exceeded the setpoint value.
Normal	No alarm conditions are present.

The Cooling System Monitor Configuration Window

The Cooling Bank Configuration window has all the parameters that need to be viewed or set to run the Cooling Monitor System for the user's particular application.

Opening the System Monitor Configuration Window

To open the cooling bank configuration window, click on the either **-available-** or the cooling bank name in the *Relay* column as shown below.

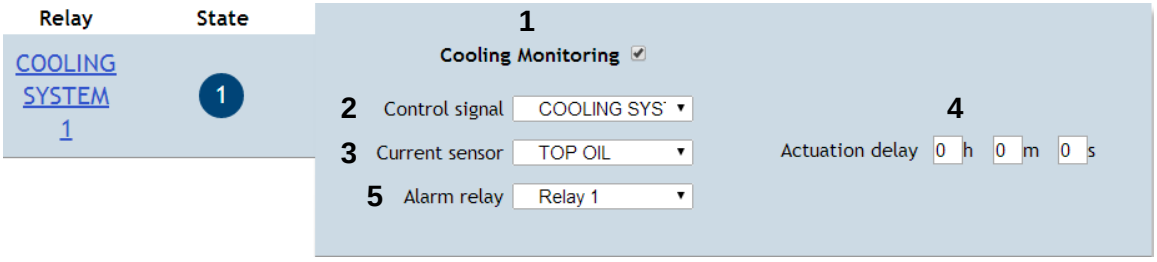


Configuring a Cooling Bank

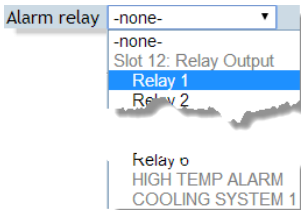
All cooling bank setup parameters are located on the selected configuration window.

Each area of the window is explained separately.

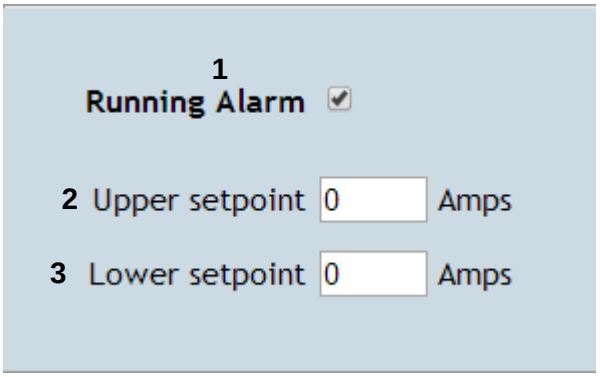
Cooling Monitor



Index	Object	Definition
1	**Cooling Monitoring** Cooling Monitoring ☑	Ticking this box enables the Cooling Monitor function.
2	**Control signal** Control signal COOLING SYS -none- Slot 12: Relay Output Relay 1 state Relay 2 state HIGH TEMP ALARM COOLING SYSTEM 1	Select the relay that starts the cooling system.
3	**Current sensor** Current sensor TOP OIL -none- Slot 9: Analog Input TOP OIL Analog value 2 TM8 0 ExSidDown TM8 0 ValFault	Select the analog input point that measures the fan (or pumps) motor current that start when the **Control signal** relay is actuated.
4	**Alarm delay** Actuation delay 0 h 20 m 0 s	Enter the alarm time delay for the differential measurement or the flow gauge sensor. This does not work for the running bank current, the peak current, total run time or actuation counts.

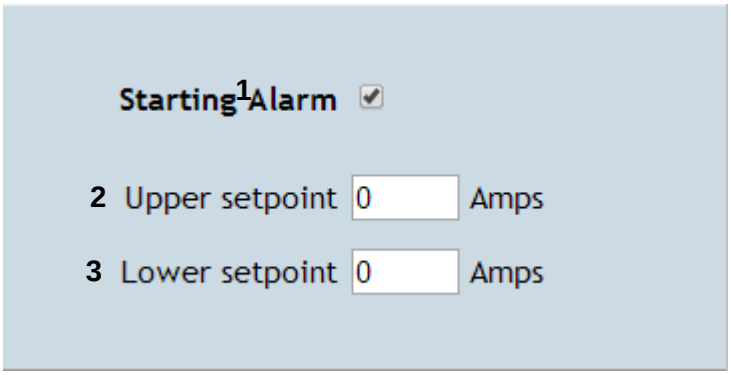
5	**Alarm relay** 	Enter the relay number that will actuate should any of the selected parameters exceed their threshold values. ***Note:*** This relay is configured here and not in the Output Relay section of TMS INSIGHT.

Running Alarm



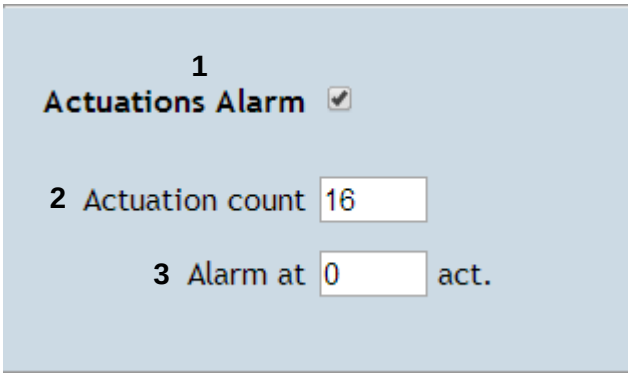
Index	Object	Definition
1	**Running Alarm** Running Alarm ☑	Ticking this box enables the Running Alarm function.
2	**Upper setpoint** Upper setpoint 40 Amps	Enter the upper setpoint value that actuates the selected **Alarm relay** when the steady state current equals or exceeds it.
3	**Lower setpoint** Lower setpoint 10 Amps	Enter the lower setpoint value that actuates the selected **Alarm relay** when the steady state current equals or exceeds it.

Starting Alarm



Index	Object	Definition
1	**Starting Alarm** Starting Alarm ☑	Ticking this box enables the Starting Alarm function.
2	**Upper setpoint** Upper setpoint 45 Amps	Enter the upper setpoint value that actuates the selected **Alarm relay** when the peak current over time equals or exceeds it.
3	**Lower Setpoint** Lower setpoint 20 Amps	Enter the upper setpoint value that actuates the selected **Alarm relay** when the peak current over time equals or falls below it.

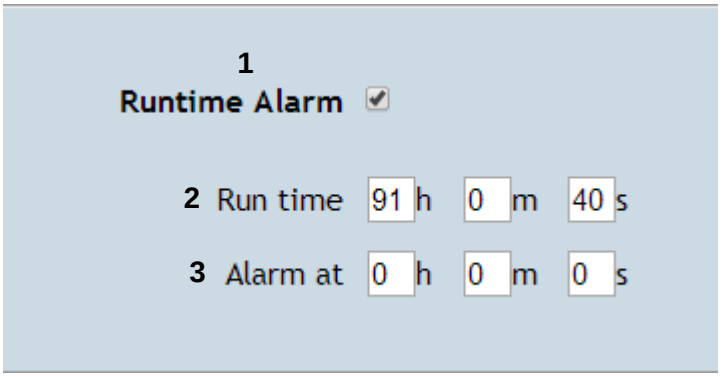
Actuations Alarm



Index	Object	Definition
1	**Actuations Alarm** Actuations Alarm ☑	Ticking this box enables the Actuations Alarm function.
2	**Actuation count** Actuation count 16	This is an edible entry that displays the total number of times the Controlling relay has actuated. ***Note:*** The count can be reset, or preset, or the operator can simply view how many counts the

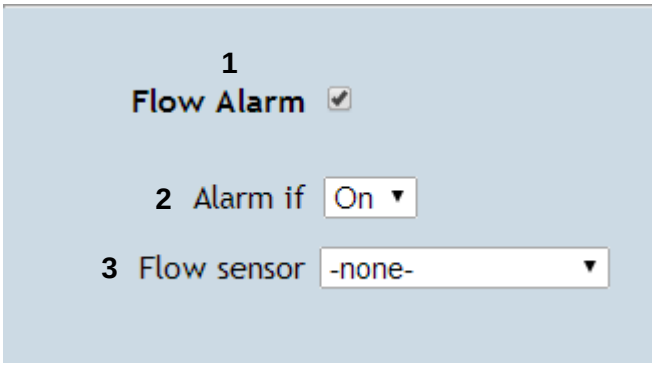
		system has totaled so far. The **Actuation count** appears on the Cooling System Monitor **Data** window.
3	**Alarm at** Alarm at 100 act.	Enter the setpoint value that actuates the selected **Alarm relay** when the actuation count equals or exceeds it.

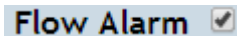
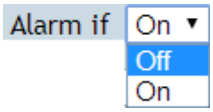
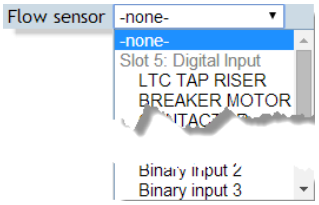
Runtime Alarm



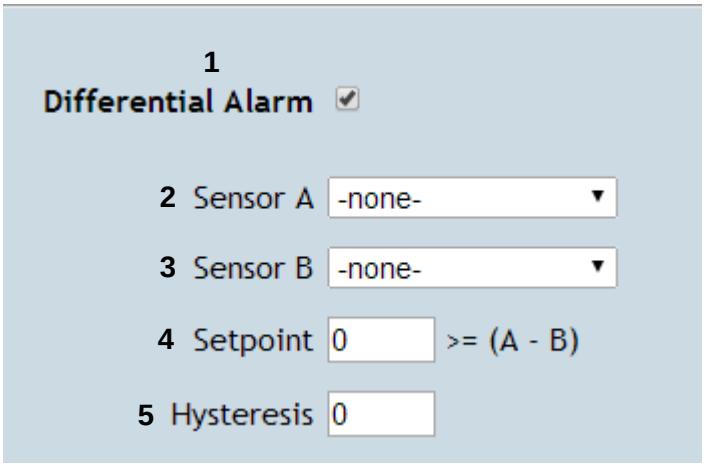
Index	Object	Definition
1	**Runtime Alarm** **Starting Alarm**	Ticking this box enables the Runtime Alarm function.
2	**Run time** Run time 0 h 5 m 19 s	This window contains the total active running time of the selected cooling bank.
3	**Alarm at** Alarm at 3 h 0 m 0 s	Enter the setpoint value that actuates the **Alarm relay** when the total run time equals or exceeds it.

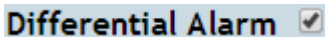
Flow Alarm

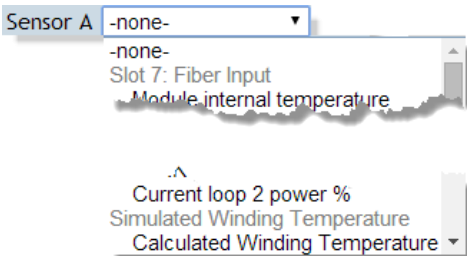
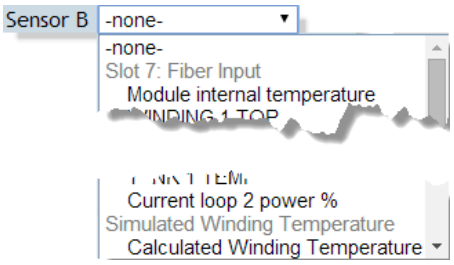
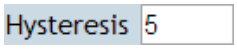


Index	Object	Definition
1	**Flow Alarm** 	Ticking this box enables the Flow Alarm function.
2	**Alarm if** 	Select whether the **Alarm relay** should actuate if the flow gauge is on or off.
3	**Flow sensor** 	If there is an analog input signal that is sensing the flow of the oil of the cooling system, then enter that pointname here.

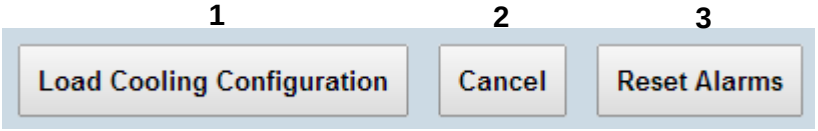
Differential Alarm



Index	Object	Definition
1	**Differential Alarm** 	Ticking this box enables the Differential Alarm function. ***Note:*** This feature works best if there is a top oil sensor and a bottom oil sensor in the tank. If the cooling system is operating correctly, the two temperatures should remain within a certain temperature range of each other.

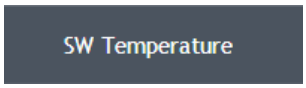
2	**Sensor A** 	Select the first RTD input point that measures the coolant input temperature.
3	**Sensor B** 	Select the second RTD input point that measures the coolant return temperature.
4	**Setpoint** 	Enter the temperature setpoint value in Deg. C that actuates the selected **Alarm relay** when the temperature differential measurement equals or exceeds it.
5	**Hysteresis** 	Enter the switching differential Deg. C of the temperature required to deactivate the alarm relay. ***Note:*** For the alarm relay to deactivate, the temperature must fall below the setpoint minus the hysteresis.

Loading, Reset Alarms, and Canceling Changes



Index	Object	Definition
1	**Load Cooling Configuration**	Clicking this button loads the configuration parameters into system memory.
2	**Cancel**	Clicking this button discards any configuration changes and takes the user back to the *Cooling System Monitor Data* window.
3	**Reset Alarms**	Clicking this button clears all cooling back alarms.

Simulated Winding Temperature



The **Simulated Winding Temperature Window** allows the user to establish a transformer winding temperature curve to translate the winding temperature. This temperature translation value is used to control the cooling bank relays.

The QTMS provides two methods of creating this curve: 1) Simple and, 2) Advanced.

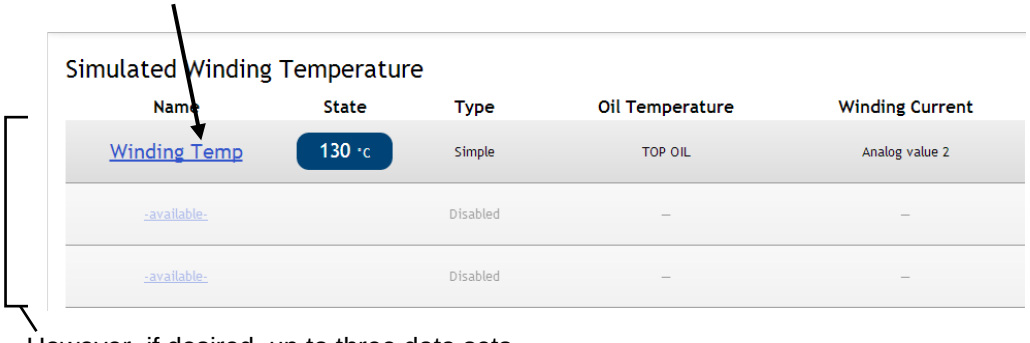
Note: If the QTMS system is provided with a *Fiber Input Module*, a "simulated transformer temperature curve" is not necessary since the actual winding temperature is measured.

Important: To establish a transformer winding temperature curve, the following analog input points must be defined before configuring the **Simulated Winding Temperature**.

- A RTD point that measures transformer oil temperature. This is typically the top oil temperature.
- A current input point that measures the transformer load current. This is provided by a clamp-on current sensor.

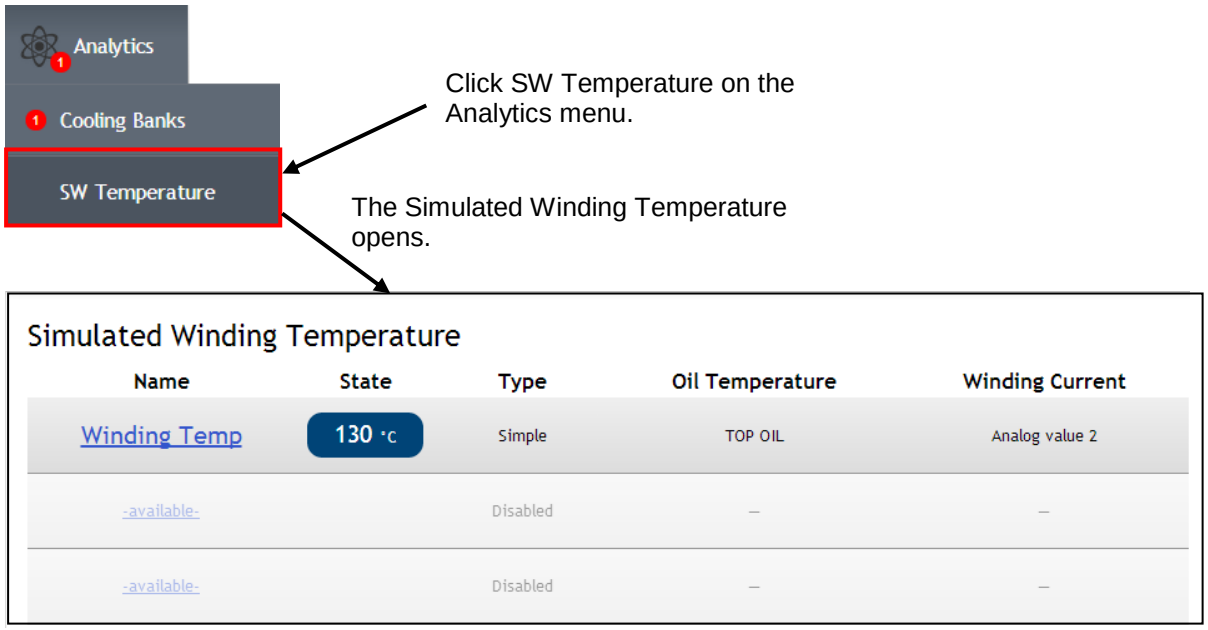
Note: The temperature curve calculation requires, as minimum, one (1) set of parameters. However, QTMS provides for three sets of parameters for defining three (3) analog temperature inputs - one each per phase. In this case all three (3) winding currents can be used to determine overall winding temperatures. Using three (3) CT Temperature inputs allows the transformer to be run harder without any detrimental heating affects.

Only one set of parameters is necessary.

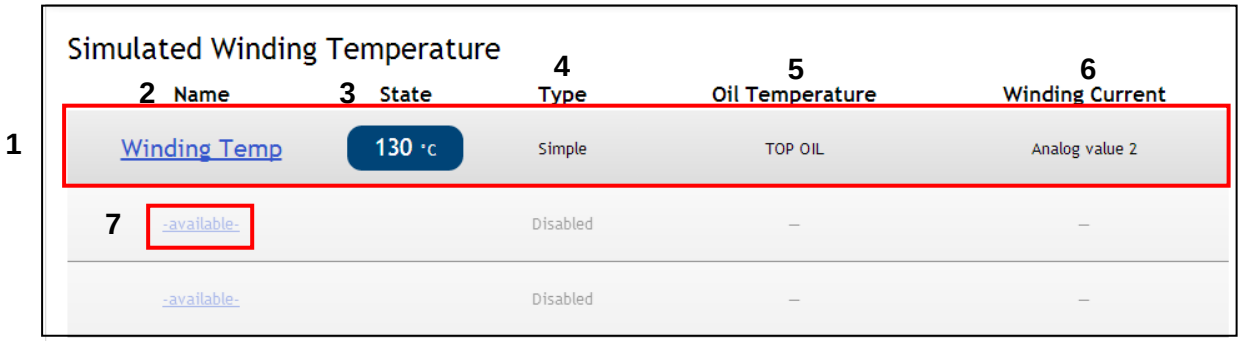


However, if desired, up to three data sets can be defined - one for each transformer phase.

Opening the Simulated Winding Temperature Data Window



The Simulated Winding Temperature Data Window



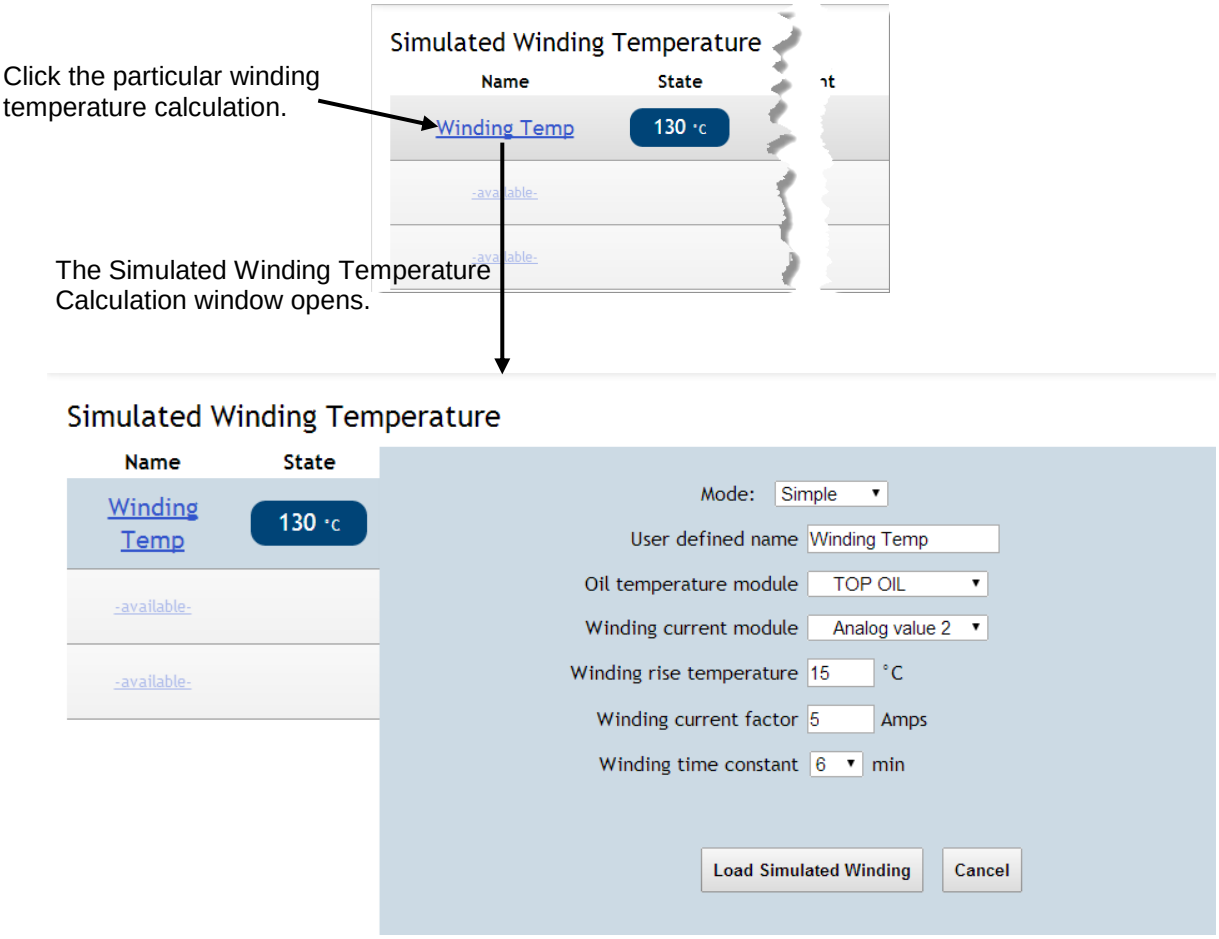
Index	Object	Definition
1		Each row shows current data for simulated winding temperature.
2	**Name**	This column contains the name of the user provided when configuring the temperature curve. Clicking on the **Name** opens the *Simulated Winding Temperature* configuration window for the selected simulation.
3	**State**	Displays the current calculated winding temperature.
4	**Type**	Shows the type of calculation used to determine the transformer temperature curve.
5	**Oil Temperature**	Displays the point that provides the oil temperature value for the winding curve calculation.

6	**Winding Current**	Displays the clamp-on sensor current point that provides the transformer load value.
7	**-available-**	Denotes an empty simulated winding configuration position. Clicking **-available-** initializes the *Simulated Winding Temperature Configuration* window.

Opening the Simulated Winding Temperature Configuration Window

Click the particular winding temperature calculation.

The Simulated Winding Temperature Calculation window opens.

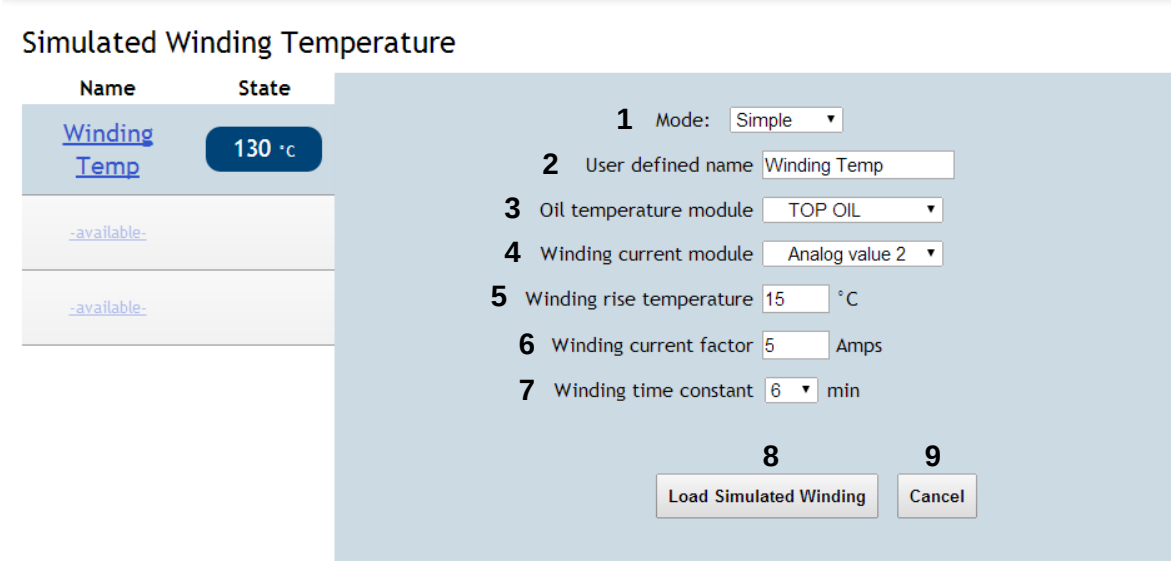


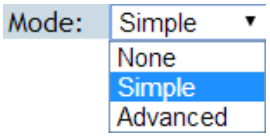
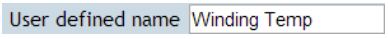
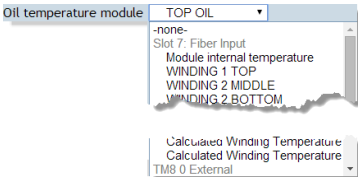
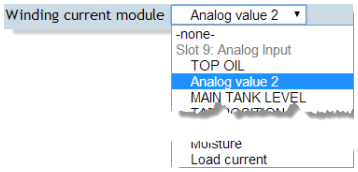
Simple Calculation Configuration

Using the simple calculation, the user provides the temperature rise and time constant factors, along with the RTD and current inputs, to create a transformer winding temperature curve that simulates the temperature of the winding. The result of this curve calculation is used to provide the values for setpoints of the output relays that are assigned to control transformer cooling banks.

The simple winding calculation method corresponds to the process used by the IEEE Guide for Loading Mineral-Oil-Immersed Transformers (IEEE Std C57.91).

The following describes the required entries to create the temperature curve used to determine winding temperature using the Simple method.



Index	Object	Definition
1	**Mode** 	A drop-down menu to select whether the calculation is **Simple** or **Advanced**.
2	**User defined name** 	A user-assigned name for the particular calculation. This field can contain up to 16 alphanumeric characters.
3	**Oil temperature module** 	The user selects the RTD point that provides the transformer oil temperature. This value is added to the winding curve simulation to determine winding temperature. ***Note:*** This point must be configured before configuring the simulated winding temperature curve.
4	**Winding current module** 	The user selects the clamp-on analog CT sensor point that provides the transformer load current. ***Note:*** This point must be configured before configuring the simulated winding temperature curve.

5	**Winding rise temperature** Winding rise temperature 15 °C	Enter the number of degrees that the winding temperature will be *over the oil temperature* (delta T) at the transformer "nominal load" measured by the CT sensor input point designated in the **Winding current module** entry. ***Note:*** The user can calculate this parameter from *the transformer heat run test report* by subtracting the oil temperature at nominal loading from the winding temperature at nominal loading. ***Note:*** To obtain the transformer heat run report, please contact the transformer manufacturer for these values.
6	**Winding current factor** Winding current factor 50 Amps	Enter the transformer "nominal load" value measured at the clamp-on CT sensor that measures the transformer load current.
7	**Winding time constant** Winding time constant 6 0 1 19	Enter the time constant for the temperature rise of the winding. The time constant is defined as: The time it takes the winding temperature to reach 63.2% of its final value for a given current input. It takes approximately five time constants for the temperature to reach full value for a given load. If the time constant is unknown, the IEEE Std C57.91-1995 Annex G recommends a value between 3 and 7 minutes. *Qualitrol recommends a default value of **6** minutes.* ***Note:*** These values can be obtained from heat run data provided by the transformer manufacturer.
8	Load Simulated Winding	Click this button to save the entered parameters to system memory.
9	Cancel	Clicking this button discards any configuration changes and takes the user back to the *Simulated Winding Temperature Data* window.

Advanced Calculation Configuration

This method changes the temperature curve based on the current cooling stage. As each relay closes to initiate a cooling bank, a new curve is employed to determine winding temperature.

The advanced calculation method is capable of adapting the winding temperature model for all the different stages of cooling, thereby giving a more accurate response than the Simple Calculation Method. But to use this method, the winding rise parameters are required for each cooling stage.

Important: To use the Advanced method, the winding rise parameters are required for each cooling stage. These are derived from the manufacture's heat run data.

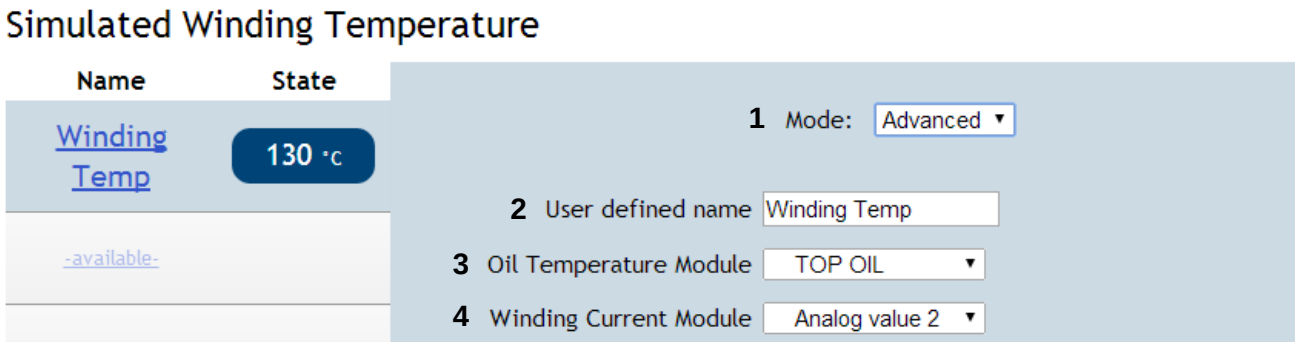
Important: Up to four cooling Stages can be configured. If there are less than four cooling Stages, the unused rows should **match** the last configured row.

Note: The formulas for calculating winding temperatures for this window were derived from the IEEE Std C57.91-1995.

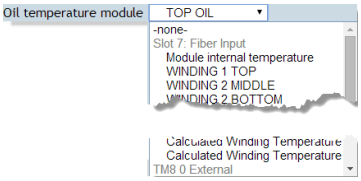
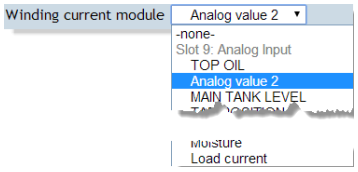
The following describes the required entries to create the temperature curve used to determine winding temperature using the Advanced method.

General Parameters

The first half of the Advanced configuration parameters are common with the Simple entries as show below.

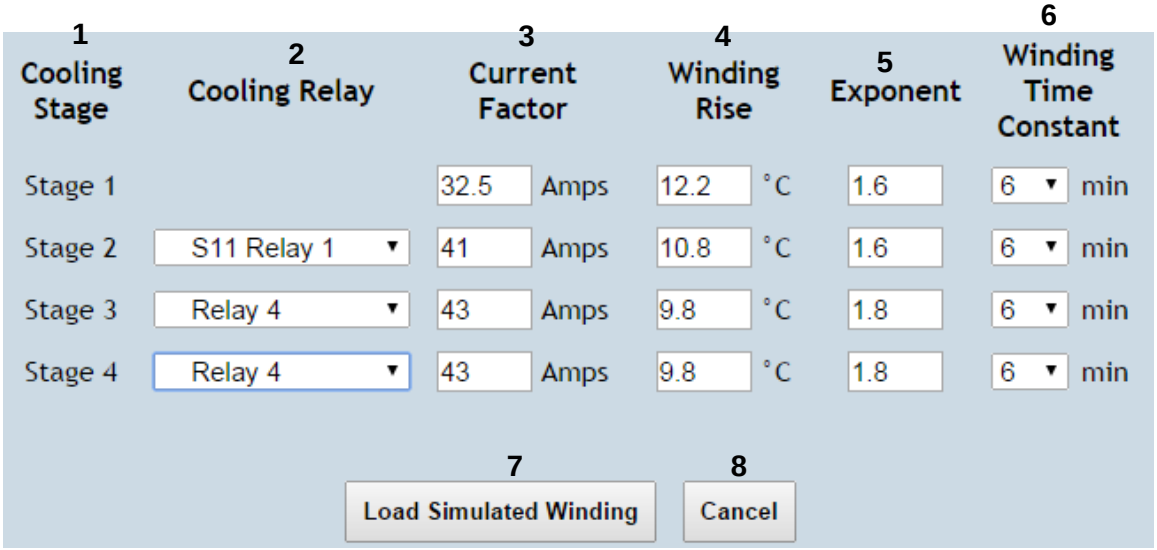


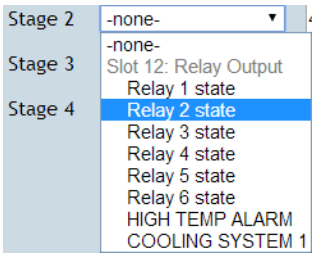
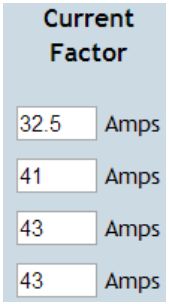
Index	Object	Definition
1	**Mode** Mode: Simple None Simple Advanced	A drop-down menu to select whether the calculation is **Simple** or **Advanced**.
2	**User defined name** User defined name Winding Temp	A user-assigned name for the particular calculation. This field can contain up to 16 alphanumeric characters.

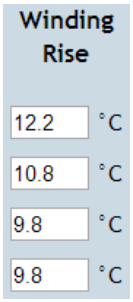
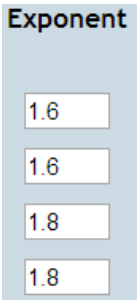
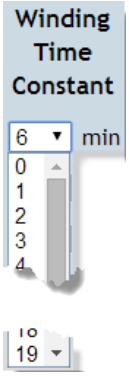
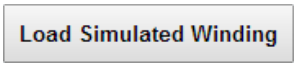
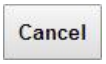
3	**Oil Temperature Module** 	The user selects the RTD point that provides the transformer oil temperature. This value is added to the winding curve simulation to determine winding temperature. ***Note:*** This point must be configured before configuring the simulated winding temperature curve.
4	**Winding Current Module** 	The user selects the clamp-on analog CT sensor point that provides the transformer load current. ***Note:*** This point must be configured before configuring the simulated winding temperature curve.

Advanced Winding Rise Parameters

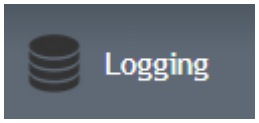
Using the transformer heat run data, the user configures up to four (4) separate temperature curves - one for each Cooling Stage.



Index	Object	Definition
1	**Cooling Stage**	
2	**Cooling Relay** 	Drop-down menus that allow the user to select the output relay associated with each cooling bank cooling stage. Each set of cooling Stage parameters define a simulated temperature curve that determines winding temperature. As each Stage is energized, new parameters are used to determine the temperature. Up to four (4) cooling stage temperature curves, can be defined depending on the physical configuration of the transformer cooling system. As the setpoint of each Stage relay is reached, the associated cooling bank turns on. As each relay fires, a new temperature curve is used to determine the winding temperature. (i.e., when the Stage relay 1 energizes, the Stage 2 parameters are then used to determine the winding temperature.) The temperature that controls the cooling bank 1 relay is controlled by the Stage 1 simulated temperature curve. After cooling bank 1 is running then the cooling bank 2 relay is controlled by the Stage 2 simulated temperature curve and so on through Stages 3 and 4.
3	**Current Factor** 	Allows the user to enter the measured current that the clamp-on analog CT point senses on the secondary side of the instrumentation or metering CT for each current stage at nominal loading. When calculating the analog current sensor input to use for Winding Temperature Simulation the following example may be of value. If the user plans to use current directly from the load value, then omit the CT ratio (in this example 2000/5). **Example:** A 30/40/50 MVA Single-Phase Transformer at 132 - 32 kV with a CT 2000/5 A at its secondary side, which is the winding to be configured. • In ONAN mode: 30 MVA / 32 kV * 5/2000 = X • In first cooling mode: 40 MVA / 32 kV * 5/2000 = X • In second cooling mode: 50 MVA / 32 kV * 5/2000 = X ***Note:*** For a three- phase transformer application, divide the current by the square root of three.

4	**Winding Rise** 	Allows the user to set the temperature gradients (delta T) for each winding at each cooling stage. This value is the winding temperature rise over the specified liquid temperature for that given current factor. The liquid temperature will typically be the top oil temperature measurement. The QTMS accepts a maximum of 70° C for the temperature gradient. ***Note:*** The winding rise value can be calculated from data in the transformer heat run report. The winding rise gradient is the winding rise temperature over ambient minus the oil rise temperature over ambient.
5	**Exponent** 	Allows the user to enter the exponent parameter used in the temperature calculation for each of the four Cooling Modes. The exponent describes the “rise” curve of the winding temperature above the oil temperature. When installing a 509ITM on older transformers, this information might be difficult to obtain. In those cases, Qualitrol recommends: • For ONAN (natural convection): 1.6 • For ONAF (natural convection; forced air – fans only): 1.6 • For OFAF (forced oil; forced air – fans and pumps): 1.8 • For ODAF (directed forced oil and forced air): 2.0
6	**Winding Time Constant** 	Allows the user to select a time constant for each of the four cooling modes. The time constant is defined as the time required to reach 63.2% of the final winding temperature rise for a specific load increase. The winding temperature reaches its final value for a given load in approximately five time constants. ***Note:*** If the time constant is unknown, the IEEE Std C57.91-1995 Annex G recommends a value between 3 and 7 minutes. *Qualitrol recommends a default value of **6** minutes.*
7		Click this button to save the entered parameters to system memory.
8		Clicking this button discards any configuration changes and takes the user back to the *Simulated Winding Temperature Data* window.

Data Logs



The Logging window opens when you click *Logging* from the TMS INSIGHT menu bar.

The Logging window is divided into two major sections: 1) the *Logging* section and, 2) the *Data Logging Configuration* section.

The *Logging* section allows the user access to system logs as follows:

Data Log

- Download the Data Log
- Copy the Data Log to a USB
- Erase the Data Log

Diagnostic Log

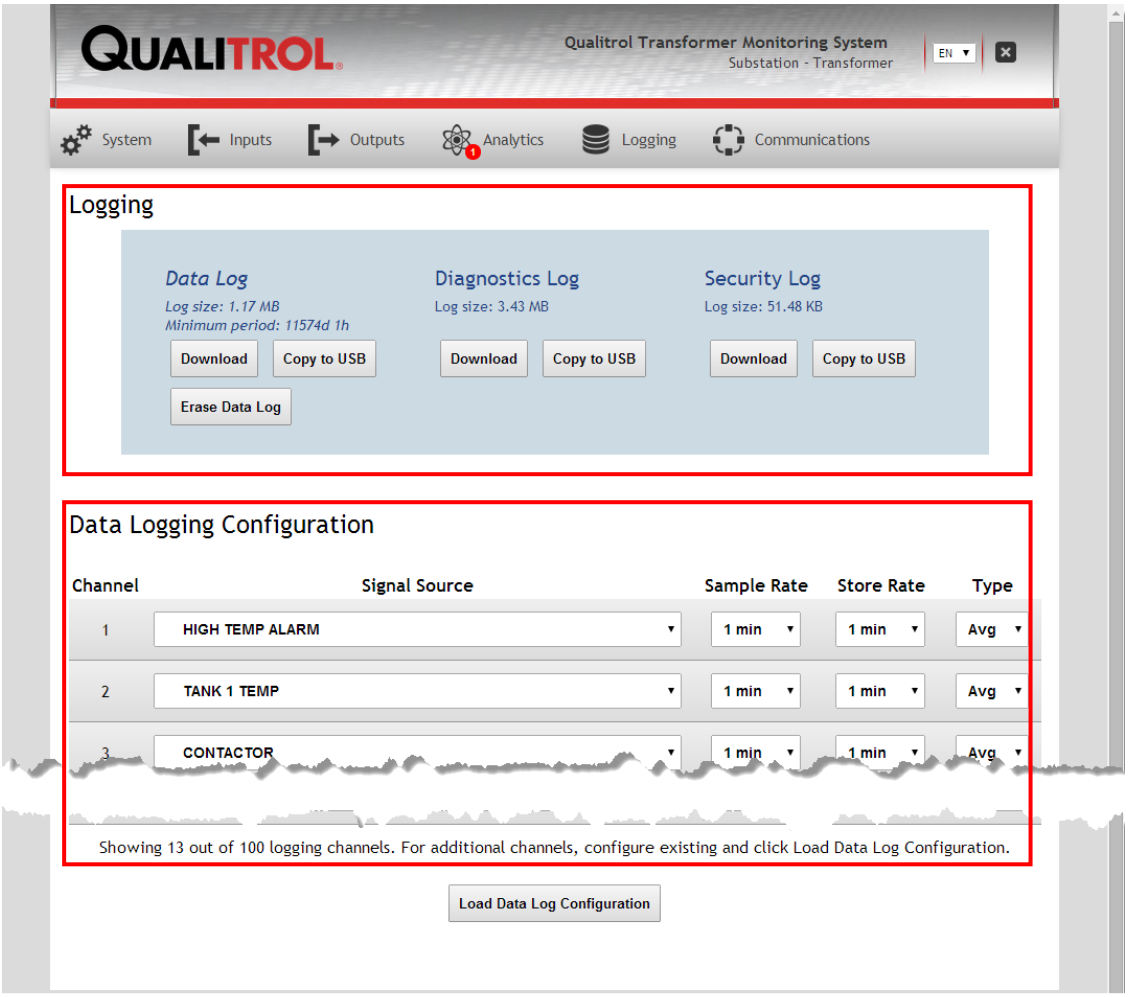
- Download the Diagnostics Log
- Copy the Diagnostics Log to a USB

Security Log

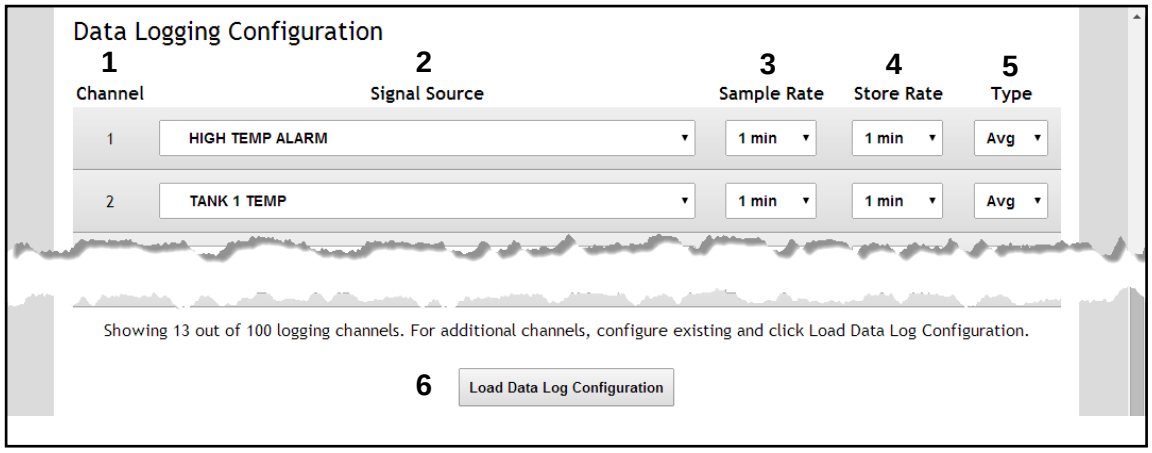
- Download the Security Log
- Copy the Security Log to a USB

The *Data Logging Configuration* section allows the user to assign points for archiving. Up to 100 points of any type can be configured for archiving.

The following shows the two areas of the *Logging* window.


QUALITROL
Qualitrol Transformer Monitoring System
Substation - Transformer
EN
System
Inputs
Outputs
Analytics
Logging
Communications
Logging
Data Log
Log size: 1.17 MB
Minimum period: 11574d 1h
Download
Copy to USB
Erase Data Log
Diagnostics Log
Log size: 3.43 MB
Download
Copy to USB
Security Log
Log size: 51.48 KB
Download
Copy to USB
Data Logging Configuration
Channel
Signal Source
Sample Rate
Store Rate
Type
1
HIGH TEMP ALARM
1 min
1 min
Avg
2
TANK 1 TEMP
1 min
1 min
Avg
3
CONTACTOR
1 min
1 min
Avg
Showing 13 out of 100 logging channels. For additional channels, configure existing and click Load Data Log Configuration.
Load Data Log Configuration

Data Logging Configuration



Index	Object	Definition
1	**Channel**	This is informational only and shows the channel number to be stored.
2	**Signal Source** HIGH TEMP ALARM COOLING SYSTEM 1 TANK 1 TEMP Current loop 2 power % Slot 13: Digital Input binary input 1 binary input 2 binary input 3 binary input 4 binary input 5 binary input 6 binary input 7 binary input 8 binary input 9 binary input 10 binary input 11 binary input 12 binary input 13 binary input 14 Slot 14: Digital Input	Allows the user to select the signal to be monitored for data logging. For input modules and fiber optic probes, this is the present measurement value. For relays, this is the actuation status.
3	**Sample Rate** 1 sec 5 sec 15 sec 30 sec 1 min 5 min 30 min 1 hrs 4 hrs 12 hrs 24 hrs	Allows the user to select the rate at which the data is sampled, from one-second to 24-hours. By sampling at a higher rate than the store rate, you can maximize the number of measurements while minimizing the amount of data logging memory space. The sample rate is used in conjunction with the sample type to: 1. Take the maximum, minimum or average of the measurement. 2. Log the measurement value at the store rate. ***Important:*** Never set the sampling rate slower than the store rate.

4	**Store Rate** 1 sec 5 sec 15 sec 30 sec 1 min 5 min 30 min 1 hrs 4 hrs 12 hrs 24 hrs	Allows the user to select the rate at which the data is logged into memory, from one-second to 24-hours.
5	**Type** Avg Min Max	Allows the user to select how the sample value is stored. The pull-down window provides the options of average (“avg”), minimum (“min”), or maximum (“max”). If the user sets the value to “max”, the maximum value that is sampled during a store rate is kept for logging. The same is true if you select a “min” or “avg” sample type.
6	Load Data Log Configuration	Clicking this button stores the configuration parameters to system memory.

Logging

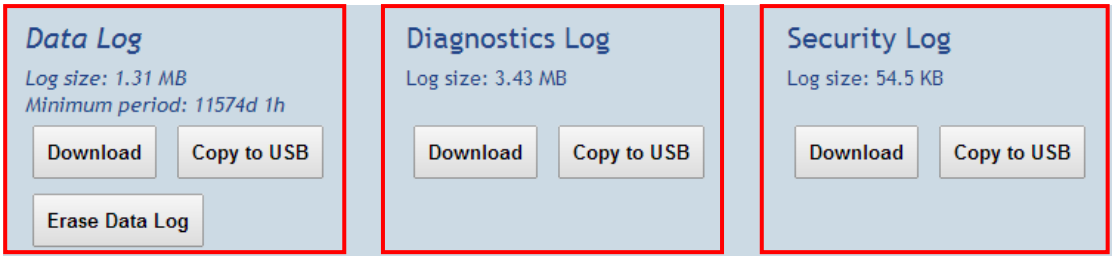
The TMS INSIGHT logging function provides the user with Administrator rights with the means to download log files to their personal computer's file system or copy them to a USB memory stick. All logging files including Data, Diagnostics, and Security can be downloaded.

The Logging window also provides the means to erase the Data Log file.

Note: To use this function, the user must be attached to the network and be logged into the TMS INSIGHT application.

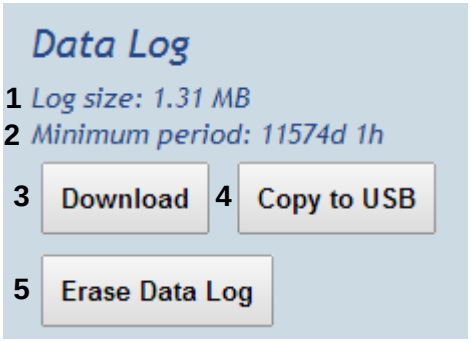
The Logging Window

The Logging window is divided into three areas; 1) Data Log, 2) Diagnostic Log and, 3) Security Log as shown below.



Data Log Area

The Data Log contains the point data that is configured in the *Data Logging Configuration* area.



Index	Object	Definition
1	**Log size**	Displays the size of the file.
2	**Minimum period**	Displays the minimum amount of data in the file based on time.
3	Download	Click the "Download" button to download the log file. The file is downloaded and stored on the user's PC in Microsoft Excel format.
4	Copy to USB	Click the "Copy to USB" button to copy the log file to a USB stick installed in the USB port on front of the CPU Module.
5	Erase Data Log	Click the "Erase the Data Log" to clear all data log of all entries.

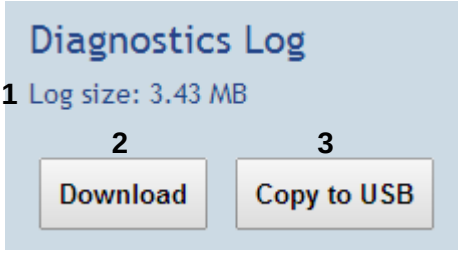
Data Log File Format

	A	B	C	D
1	1	08/29/14, 15:47:13	HIGH TEMP ALARM	0
2	2	08/29/14, 15:47:13	TANK 1 TEMP	0
3	3	08/29/14, 15:47:13	CONTACTOR	0

Column	Title	Definition
A	**Channel**	This is the channel number of the point taken from the *Data Logging Configuration* window.
B	**Time and Date**	This is the data time stamp.
C	**Point Name**	This is the archived point name.
D	**Stored Data Value**	Displays the stored value for the given time stamp.

Diagnostic Log Area

The Diagnostic Log keeps a log of any configuration changes or anomalies such as sensor errors that occur in the system.

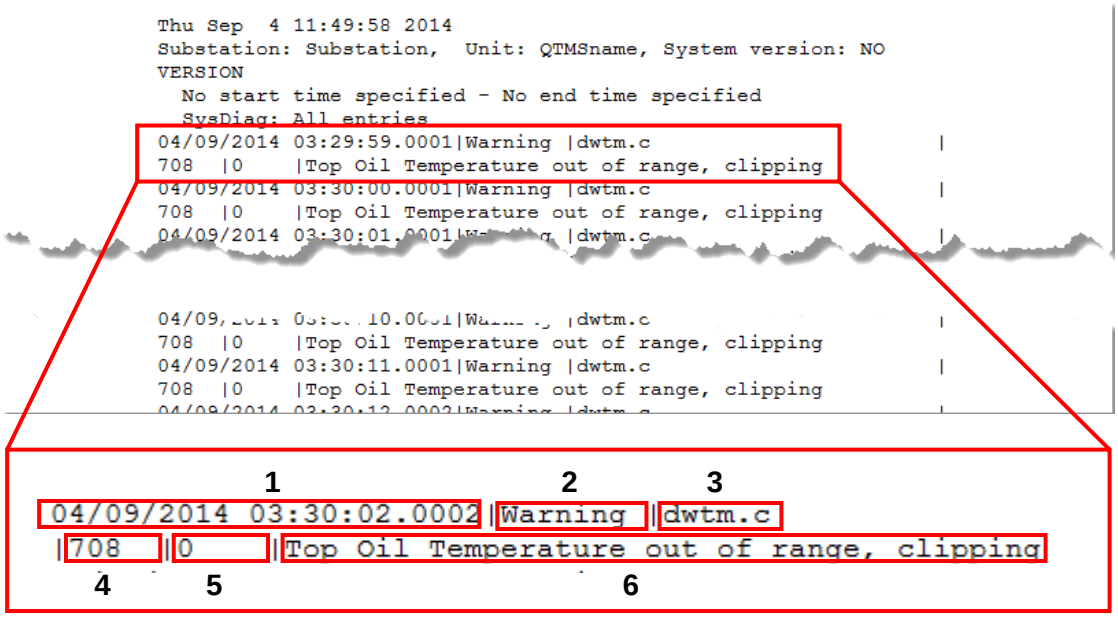


Note: This log cannot be erased.

Index	Object	Definition
1	**Log size**	Displays the size of the file.
2	Download	Click the "Download" button to download the log file. The file is downloaded and stored on the user's PC in Microsoft Excel format.
3	Copy to USB	Click the "Copy to USB" button to copy the log file to a USB stick installed in the USB port on front of the CPU Module.

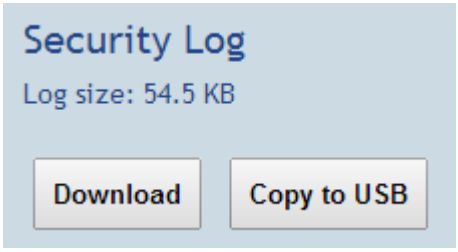
Diagnostic Log File Format

This file is store on the user's PC as a .txt file and can be opened in Wordpad.



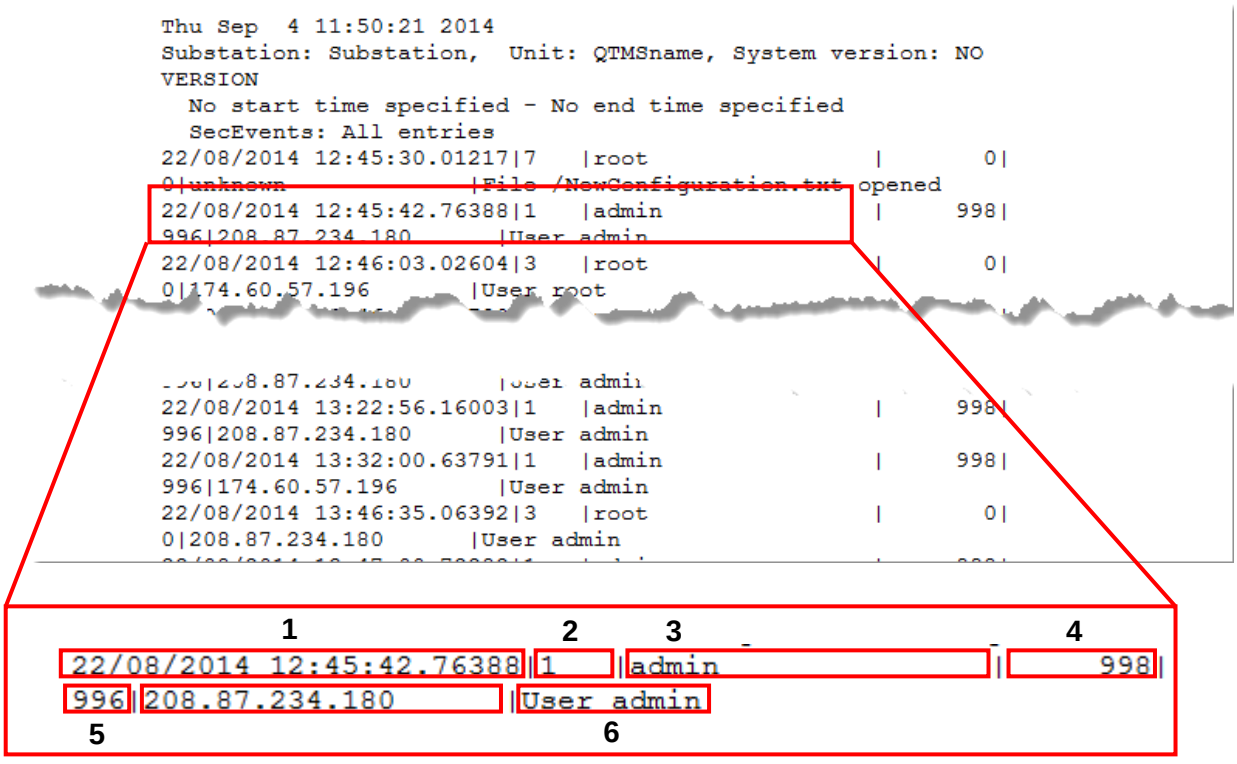
Index	Object	Definition
1	**Time and Date**	Data entry time stamp.
2	**Data Type**	Warning, errors, information
3	**File**	The file that is in use when the event occurred.
4	**Line number**	Line number in the report
5	**Error number**	System error number
6	**Message**	Description of what has occurred.

Security Log Area



Index	Object	Definition
1	**Log size**	Displays the size of the file.
2	Download	Click the "Download" button to download the log file. The file is downloaded and stored on the user's PC in Microsoft Excel format.
3	Copy to USB	Click the "Copy to USB" button to copy the log file to a USB stick installed in the USB port on front of the CPU Module.

Security Log File Format

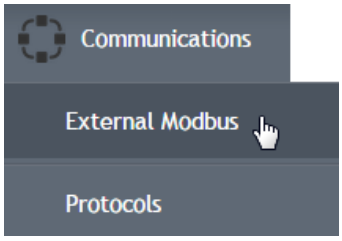


Index	Object	Definition
1	**Time stamp**	Time stamp of the event
2	**Event type**	Event type; user login, etc. See Event Type definitions below.
3	**User name**	The user name in the system
4	**UID**	User ID
5	**GID**	Group ID; user access number
6	**Text description**	Description of the event

Security Log Event Type codes

Event	Definition
1	user login
2	user logout
3	login failure
4	protocol connect event
5	protocol disconnect event
6	control/config change event
7	file operation
8	firmware change event
9	password change event

External Intelligent Device Communication



The QTMS is capable of reading external devices and sensors through the serial communication ports.

Note: Only one serial communications port can be configured as the External Modbus at a time. Therefore if multiple devices are attached to the same port the communication parameters (e.g. baud rates, data bits, etc.) must be the same for the QTMS and all digital devices.

Once an external device or sensor has been connected to the QTMS, the user can select which parameters offered from the device that they wish to be read by the QTMS. These values can then be used to control relays, data logged or communicated through any of the QTMS protocols.

The QTMS presently supports the Serveron TM1, TM8 and the WIKA SF6 sensor.

Sensor Parameters

Serveron TM1 On-Line Transformer Monitor

The Serveron TM1 is a DGA (dissolved gas analysis) on-line monitoring system for oil filled transformers. The TM1 measures and tracks hydrogen and moisture-in-oil.

Note: For the wiring and communications setup to the TM1 please refer to the Serveron manual.

In the table below, note the TM1_X prefix to the names. Since the QTMS supports multiple TM1 connections at the same time, the 'X' references the different units attached. If only one TM1 unit is used then the 'X' will be a '1'. If a second TM1 unit is connected to the QTMS communications chain, then it will be addressed as TM1_2 and so forth. Also in the chart below is what the different parameters will look like if they are selected to be viewed on the local display.

Note: Please refer to the Serveron manual for a complete explanation of the different parameters.

Below are the values exported over Modbus from the TM1 to the QTMS through the digital communications port.

TM1 Parameter List

SERVERON TM1 PARAMETER LIST	LOCAL DISPLAY
TM1_X H2 gas in Oil	TM1_X H2inOil
TM1_X H2 Rate of Change	TM1_X H2_ROC
TM1_X Moisture	TM1_X Moisture
TM1_X AUX1 - H2O saturation	TM1_X Aux1H2O
TM1_X AUX2 - Oil temperature	TM1_X Aux2OilT
TM1_X Record status	TM1_X RecStatus
TM1_X Service Condition bitmap	TM1_X Scbitmap
TM1_X Scale	TM1_X Scale

Serveron TM8 On-Line Transformer Monitor

The Serveron TM8 is an eight gas, DGA (dissolved gas analysis) on-line monitoring system for oil filled transformers. The TM8 measures and tracks hydrogen, oxygen, methane, carbon monoxide, carbon dioxide, ethylene, ethane, acetylene and nitrogen along with moisture-in-oil.

Note: For the wiring and communications setup to the TM8 please refer to the Serveron manual.

The table below lists the values exported over Modbus from the TM8 to the QTMS through the digital communications port. Note the TM8_X prefix to the names. Since the QTMS supports multiple TM8 connections at the same time, the 'X' references the different units attached. If only one TM8 unit is used, then the 'X' will be a '1'. If a second TM8 unit is connected to the QTMS communications chain, then it will be addressed as TM8_2 and so forth. Also in the chart below is what the different parameters will look like if they are selected to be viewed on the local display. Please refer to the Serveron manual for a complete explanation of the different parameters.

TM8 Parameter List

SERVERON TM8 PARAMETER LIST	LOCAL DISPLAY
TM8_X Service required	TM8_X Service
TM8_X Communication Failure	TM8_X CommFault
TM8_X Analysis Run Failure	TM8_X RunFault
TM8_X Helium Tank Empty	TM8_X HeliumOut
TM8_X Calibration Tank Empty	TM8_X CalibOut
TM8_X Extractor Oil-sid Shutdown	TM8_X ExSidDown
TM8_X Rotary Valve Fault	TM8_X ValFault
TM8_X Heater Shutdown	TM8_X HeatDown
TM8_X Heater Low Pressure Switch Active	TM8_X SwitchOn
TM8_X Calibration Gas Certification Date Expired	TM8_X CertDate
TM8_X Enclosure Fan Stalled	TM8_X FanDown
TM8_X System Board ADC Voltage Reference Out of Range	TM8_X sADC_OoR
TM8_X Analog Board ADC Voltage Reference Out of Range	TM8_X aADC_OoR
TM8_X 24 Volt Supply Out of Range	TM8_X 24VoltOoR
TM8_X 5 Volt Supply Out of Range	TM8_X 5VoltOoR
TM8_X System Board 5 Volt Supply Out of Range	TM8_X sys5VOoR
TM8_X 6.8 Volt Supply Out of Range	TM8_X 6.8VOoR
TM8_X 15 Volt Supply Out of Range	TM8_X 15VOoR
TM8_X Analog Board 5 Volt Supply Out of Range	TM8_X ana5VOoR
TM8_X 12 Volt Supply Out of Range	TM8_X 12VOoR
TM8_X System Board DAC Output Voltage Out of Range	TM8_X sDAC_OoR
TM8_X Analog Board DAC Output Voltage Out or Range	TM8_X aDAC_OoR
TM8_X Sample Schedule Disabled	TM8_X SchedOff
TM8_X Persistent Oil Over/Under Temperature	TM8_X OilTemp
TM8_X Persistent Oil Over Pressure	TM8_X OilPress
TM8_X Persistent Oil Sampling Failure	TM8_X OilSample
TM8_X Gases not Calibrated	TM8_X CalError
TM8_X Extractor gas-sode shutdown	TM8_X ExSodDown

TM8_X Persistent Oil Path Restriction	TM8_X OilPath
TM8_X Extractor Oil Purge Over Pressure	TM8_X ExOilPres
TM8_X Extractor Gas Blowout Stopped, EPC Pressure Low	TM8_X ExGasStop
TM8_X CO2 Gas In Oil	TM8_X CO2inOil
TM8_X C2H4 Gas in Oil	TM8_X C2H4inOil
TM8_X C2H2 Gas in Oil	TM8_X C2H2inOil
TM8_X C2H6 Gas in Oil	TM8_X C2H6inOil
TM8_X H2 Gas In Oil	TM8_X H2inOil
TM8_X O2 Gas In Oil	TM8_X O2inOil
TM8_X CH4 Gas In Oil	TM8_X CH4inOil
TM8_X CO Gas in Oil	TM8_X COinOil
TM8_X Total Dissolved Combustible Gas In Oil	TM8_X GasTotal
TM8_X N2 Gas In Oil	TM8_X N2inOil
TM8_X Verification Run CO2	TM8_X VerifCO2
TM8_X Verification Run C2H4	TM8_X VerifC2H4
TM8_X Verification Run C2H2	TM8_X VerifC2H2
TM8_X Verification Run C2H6	TM8_X VerifC2H6
TM8_X Verification Run H2	TM8_X VerifH2
TM8_X Verification Run O2	TM8_X VerifO2
TM8_X Verification Run CH4	TM8_X VerifCH4
TM8_X Verification Run CO	TM8_X VerifCO
TM8_X Ambient Temperature	TM8_X AmbTemp
TM8_X LoadGuide	TM8_X LoadGuide
TM8_X Auxiliary Channel 1 Reading	TM8_X AuxChan1
TM8_X Auxiliary Channel 2 Reading	TM8_X AuxChan2
TM8_X Auxiliary Channel 3 Reading	TM8_X AuxChan3
TM8_X Moisture	TM8_X Moisture
TM8_X Load Current	TM8_X LoadCur
TM8_X CO2 Rate of Change	TM8_X CO2_ROC
TM8_X C2H4 Rate of Change	TM8_X C2H4_ROC
TM8_X C2H2 Rate of Change	TM8_X C2H2_ROC
TM8_X C2H6 Rate of Change	TM8_X C2H6_ROC
TM8_X H2 Rate of Change	TM8_X H2_ROC
TM8_X O2 Rate of Change	TM8_X O2_ROC
TM8_X CH4 Rate of Change	TM8_X CH4_ROC
TM8_X CO Rate of Change	TM8_X CO_ROC
TM8_X Total Dissolved Combustible Gas Rate of Change	TM8_X Total_ROC
TM8_X CO2 Rate of Change Goodness of Fit	TM8_X CO2_ROCg
TM8_X C2H4 Rate of Change Goodness of Fit	TM8_X C2H4_ROCg
TM8_X C2H2 Rate of Change Goodness of Fit	TM8_X C2H2_ROCg
TM8_X C2H6 Rate of Change Goodness of Fit	TM8_X C2H6_ROCg
TM8_X H2 Rate of Change Goodness of Fit	TM8_X H2_ROCg
TM8_X O2 Rate of Change Goodness of Fit	TM8_X O2_ROCg
TM8_X CH4 Rate of Change Goodness of Fit	TM8_X CH4_ROCg
TM8_X CO Rate of Change Goodness of Fit	TM8_X CO_ROCg
TM8_X Total Dissolved Combustible Gas Rate of Change Goodness of Fit	TM8_X TotalROCg

TM8_X CO2 alarm	TM8_X CO2alarm
TM8_X C2H4 alarm	TM8_X C2H4alarm
TM8_X C2H2 alarm	TM8_X C2H2alarm
TM8_X C2H6 alarm	TM8_X C2H6alarm
TM8_X H2 alarm	TM8_X H2alarm
TM8_X O2 alarm	TM8_X O2alarm
TM8_X CH4 alarm	TM8_X CH4alarm
TM8_X CO alarm	TM8_X COalarm
TM8_X Total dissolved combustible gas alarm	TM8_X TotAlarm
TM8_X CO2 Rate of change alarm	TM8_X CO2_ROCa
TM8_X C2H4 Rate of change alarm	TM8_X C2H4_ROCa
TM8_X C2H2 Rate of change alarm	TM8_X C2H2_ROCa
TM8_X C2H6 Rate of change alarm	TM8_X C2H6_ROCa
TM8_X H2 Rate of change alarm	TM8_X H2_ROCa
TM8_X O2 Rate of change alarm	TM8_X O2_ROCa
TM8_X CH4 Rate of change alarm	TM8_X CH4_ROCa
TM8_X CO Rate of change alarm	TM8_X CO_ROCa
TM8_X Total dissolved combustible gas Rate of change alarm	TM8_X Tot_ROCa
TM8_X CO2 caution	TM8_X CO2caut
TM8_X C2H4 caution	TM8_X C2H4caut
TM8_X C2H2 caution	TM8_X C2H2caut
TM8_X C2H6 caution	TM8_X C2H6caut
TM8_X H2 caution	TM8_X H2caut
TM8_X O2 caution	TM8_X O2caut
TM8_X CH4 caution	TM8_X CH4caut
TM8_X CO caution	TM8_X COcaut
TM8_X Total dissolved combustible gas caution	TM8_X TotWarn
TM8_X CO2 Rate of change caution	TM8_X CO2_ROCc
TM8_X C2H4 Rate of change caution	TM8_X C2H4_ROCc
TM8_X C2H2 Rate of change caution	TM8_X C2H2_ROCc
TM8_X C2H6 Rate of change caution	TM8_X C2H6_ROCc
TM8_X H2 Rate of change caution	TM8_X H2_ROCc
TM8_X O2 Rate of change caution	TM8_X O2_ROCc
TM8_X CH4 Rate of change caution	TM8_X CH4_ROCc
TM8_X CO Rate of change caution	TM8_X CO_ROCc
TM8_X Total dissolved combustible gas Rate of change caution	TM8_X Tot_ROCc
TM8_X Modbus scale	TM8_X Modbus
TM8_X Sample run ID	TM8_X sRunID
TM8_X Sample run timestamp	TM8_X sRunTime
TM8_X Sample run abort code	TM8_X sRunAbort
TM8_X Sample run record status	TM8_X sRunRec
TM8_X Sample ppm value status	TM8_X sPPMvalue
TM8_X Sample ROC value status	TM8_X sROCvalue
TM8_X Sample ppm alarm status	TM8_X sPPMvalue
TM8_X Sample ROC alarm status	TM8_X sROCalarm
TM8_X Verification run ID	TM8_X vRunID

TM8_X Verification run timestamp	TM8_X vRunTime
TM8_X Verification run abort code	TM8_X vRunAbort
TM8_X Verification run record status	TM8_X vRunRec
TM8_X Verification run ppm value status	TM8_X vPPMvalue
TM8_X Verification run sensor value status	TM8_X vSensVal
TM8_X Verification run ambient temperature	TM8_X vAmbTemp
TM8_X Sample run LoadGuide percent	TM8_X sLoadGde
Tm8_X Sample run aux 4-20 mA channel 1	TM8_X s4-20ch1
TM8_X Sample run aux 4-20 mA channel 2	TM8_X s4-20ch2
TM8_X Sample run aux 4-20 mA channel 3	TM8_X s4-20ch3
TM8_X Sample run moisture	TM8_X sMoisture
TM8_X Sample run load current	TM8_X sLoadCur
TM8_X Sample run winding temp 1	TM8_X sRunWT1
TM8_X Sample run winding temp 2	TM8_X sRunWT2
TM8_X Sample run winding temp 3	TM8_X sRunWT3
TM8_X Sample run winding temp 4	TM8_X sRunWT4
TM8_X Sample run winding temp 5	TM8_X sRunWT5
TM8_X Sample run winding temp 6	TM8_X sRunWT6
TM8_X Sample run winding temp 7	TM8_X sRunWT7
TM8_X Sample run winding temp 8	TM8_X sRunWT8
TM8_X Winding temp 1	TM8_X WTemp1
TM8_X Winding temp 2	TM8_X WTemp2
TM8_X Winding temp 3	TM8_X WTemp3
TM8_X Winding temp 4	TM8_X WTemp4
TM8_X Winding temp 5	TM8_X WTemp5
TM8_X Winding temp 6	TM8_X WTemp6
TM8_X Winding temp 7	TM8_X WTemp7
TM8_X Winding temp 8	TM8_X WTemp8

WIKA SF_6 Gas Density Transmitter

The WIKA SF_6 Gas Density Transmitter is a multi-sensor system with a digital output for the measurement of pressure and temperature.

Note: For the wiring and communications setup to the SF_6 Gas Density Transmitter please refer to the WIKA manual.

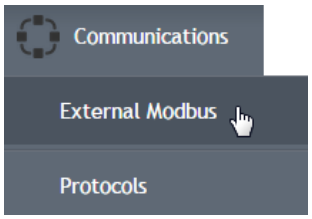
The following table lists the values exported over Modbus from the Transmitter to the QTMS through the digital communications port. Note the sf6_X prefix to the names. Since the QTMS supports multiple SF_6 Transmitter connections at the same time, the 'X' references the different units attached. If only one SF6 unit is used, then the 'X' will be a '1'. If a second SF6 unit is connected to the QTMS communications chain, then it will be addressed as sf6_2 and so forth. Also in the chart below is what the different parameters will look like if they are selected to be viewed on the local display.

Note: Please refer to the WIKI manual for a complete explanation of the different parameters.

WIKA SF6 Parameter List

WIKA SF6 SENSOR PARAMETER LIST	LOCAL DISPLAY
wika_sf6_X Pressure Bar	sf6_X PresBar
wika_sf6_X Pressure MPa	sf6_X PresMPa
wika_sf6_X Pressure Pa	sf6_X PresPa
wika_sf6_X Pressure kPa	sf6_X PreskPa
wika_sf6_X Pressure psi	sf6_X PresPsi
wika_sf6_X Pressure N/cm^2	sf6_X PresN/cm2
wika_sf6_X Temperature C	sf6_X tempC
wika_sf6_X Temperature K	sf6_X tempK
wika_sf6_X Temperature F	sf6_X tempF
wika_sf6_X Density g/l	sf6_X dens_g/L
wika_sf6_X Density kg/m^3	sf6_X presKg/m3
wika_sf6_X Pressure 20C bar	sf6_X pres20bar
wika_sf6_X Atmosphere humidity frost SF6	sf6_X atmF_sf6
wika_sf6_X Atmosphere humidity dew SF6	sf6_X atmD_sf6
wika_sf6_X Tank humidity frost SF6	sf6_X tankF_sf6
wika_sf6_X Tank humidity dew SF6	sf6_X tankD_sf6
wika_sf6_X Atmosphere humidity frost N2 C	sf6_X atmF_N2
wika_sf6_X Atmosphere humidity dew N2 C	sf6_X atmD_N2
wika_sf6_X Tank humidity frost N2 C	sf6_X tankF_N2
wika_sf6_X Tank humidity dew N2 C	sf6_X tankD_N2
wika_sf6_X Humidity from volume SF6 ppm	sf6_X Vhum_sf6
wika_sf6_X Humidity from weight SF6 ppm weight	sf6_X Whum_sf6
wika_sf6_X Humidity from volume N2 ppm	sf6_X Vhum_N2

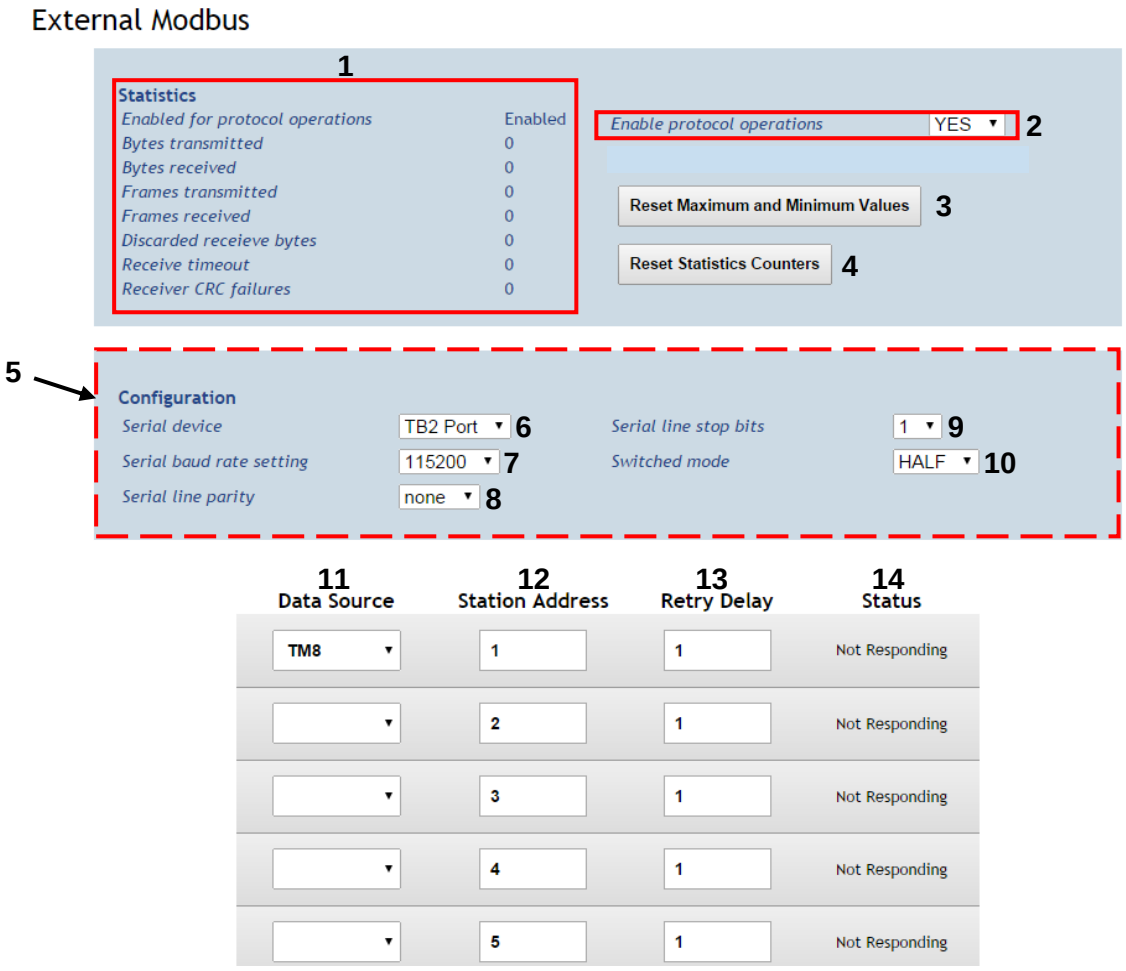
External Intelligent Device Configuration - Modbus



To configure the QTMS for Modbus communications to external intelligent devices, select **Communications** and in the drop-down menu click on **External Modbus**.

The *External Modbus* configuration window opens.

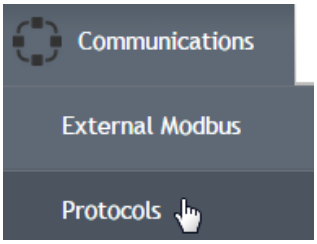
Modbus Configuration Window



Index	Object	Definition
1	**Statistics**	Activity log of communications between the external digital devices and the QTMS unit. This is used to show line quality and troubleshoot communication issues.
2	**Enable protocol operations**	This enables the port to communicate to the external digital sensors.

3	**Reset Maximum and Minimum Values**	Clicking this resets the max and min values read from the external devices.
4	**Reset Statistics Counters**	Resets the communication statistics shown at the left.
	Configuration	***Note:*** The communication parameters for these five boxes must match each external digital device that is connected to the selected port.
6	**Serial device**	Selects which RS485 port (TB2, TB5 or none) on the CPU/Communications card is active for communicating to the external digital devices.
7	**Serial baud rate setting**	Baud rate selection for communicating with the external devices. Range: 1200 to 115,200.
8	**Serial line parity**	Parity selection for the communication; none, even or odd.
9	**Serial line stop bits**	Number of stop bits in the communication package; 1 or 2
10	**Switched mode**	Selects whether the communication is full or half duplex. ***Note:*** Remember all devices connected to this external port must have the same communication settings.
11	**Data Source**	This column selects the external digital devices connecting to the port.
12	**Station Address**	The slave address of the device. ***Note:*** This must match the address configured inside the external device.
13	**Retry Delay**	Delay in seconds to try again if there is a contention on the communication lines.
14	**Status**	Status of the communications between the QTMS and the external digital device.

Communications Protocols



One of the main features of the QTMS device is its ability to communicate remotely over various types of communication ports (serial RS485, TX Ethernet, FX Ethernet) using various protocols (DNP 3.0, Modbus, IEC 61850).

Once the port(s) have been configured, as shown below, refer to the QTMS Protocol Manual IST-119-2 for specific information concerning the protocols.

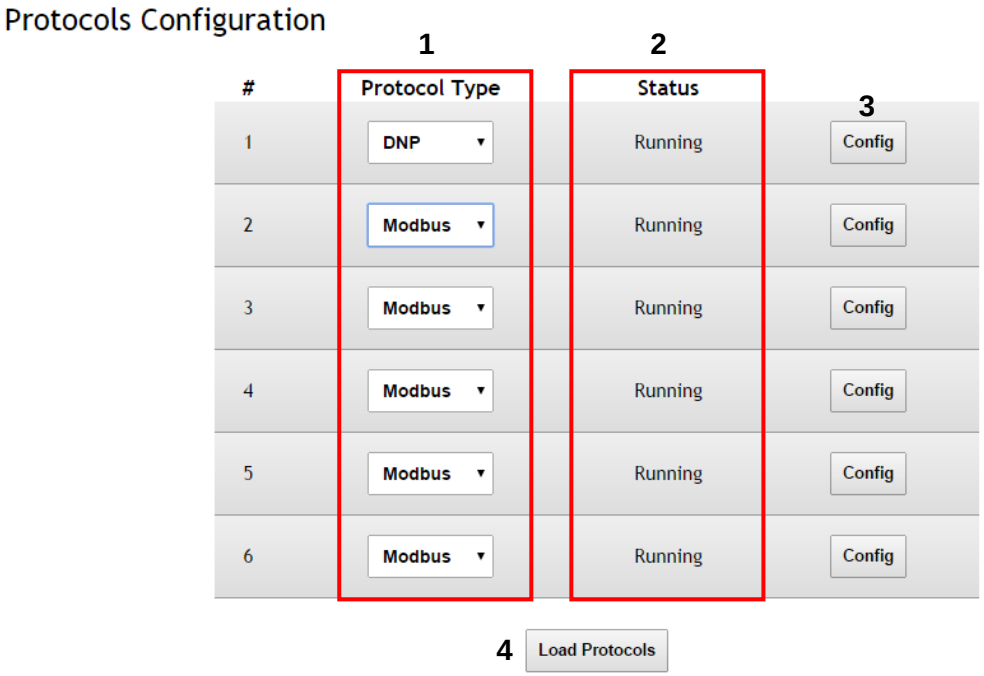
To open the Protocol Setup window, click on **Communications** and on the drop-down menu click **Protocols**.

Port Protocol Setup

There are up to six communications channels available to the QTMS as shown on the *Protocols Configuration* window below. Each row (1-6) represents a channel. These can be of varying combinations of serial communication ports and Ethernet sessions.

If serial communications are configured, one or two of these ports may be configured as Modbus or DNP and are then assigned to TB2 and\or TB5. The remaining communication channels can then be used for Ethernet communication sessions if required.

If no serial communications are required, all six channels can be used as Ethernet, TCP and/or UDP.

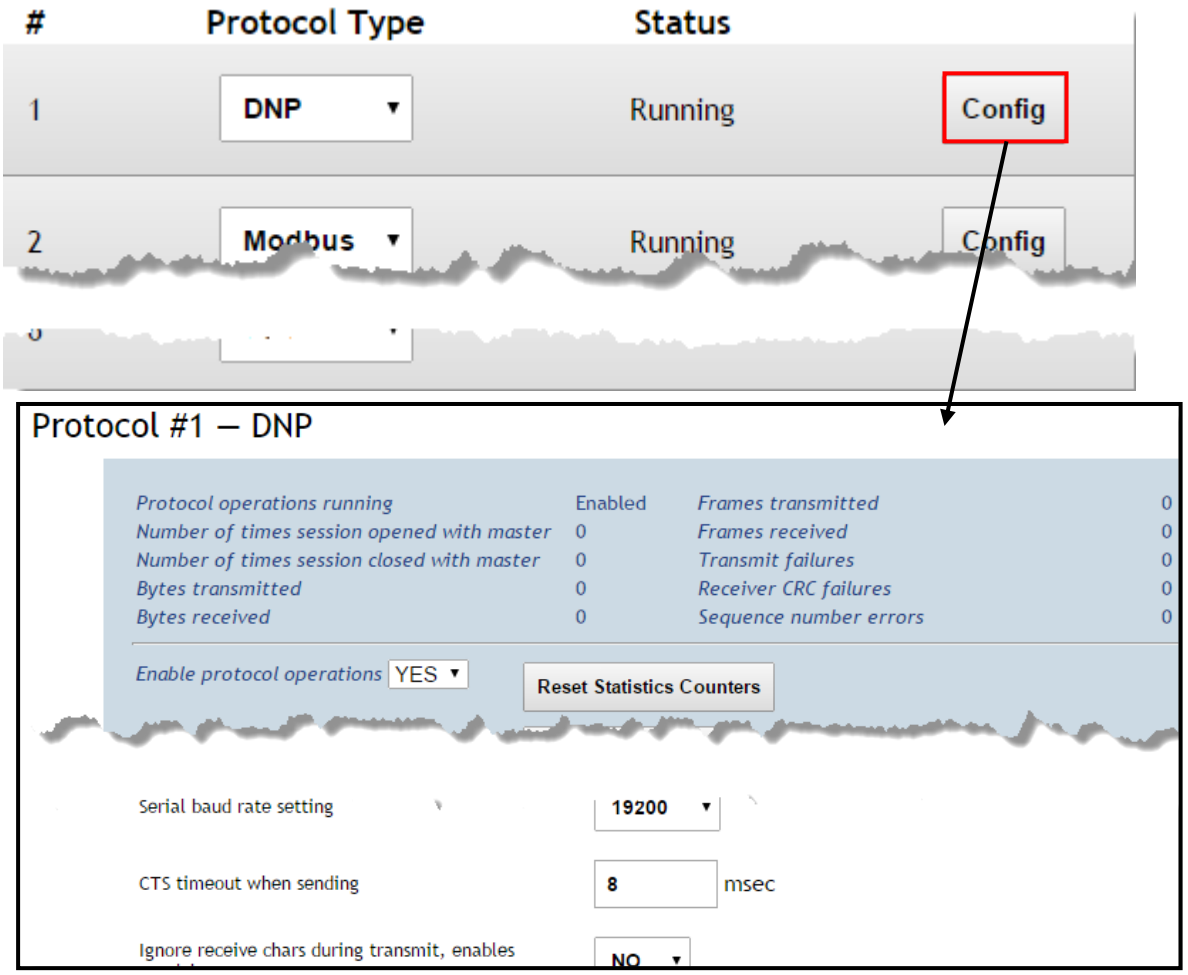


Index	Object	Definition
1	**Protocol Type**	Selects which protocol will be active on the configured port. Each row allows the user to configure everything about whatever port they choose for communication purposes.
2	**Status**	Shows if the port is active or not.
3	Config	Clicking this takes the user to the Configuration screen for the particular port. ***Note:*** Refer to section Protocol Configuration.
4	Load Protocols	Clicking this saves changes.

Protocol Configuration

After selecting the required protocol(s) as described in section, "Port Protocol Setup," the protocol(s) must be configured.

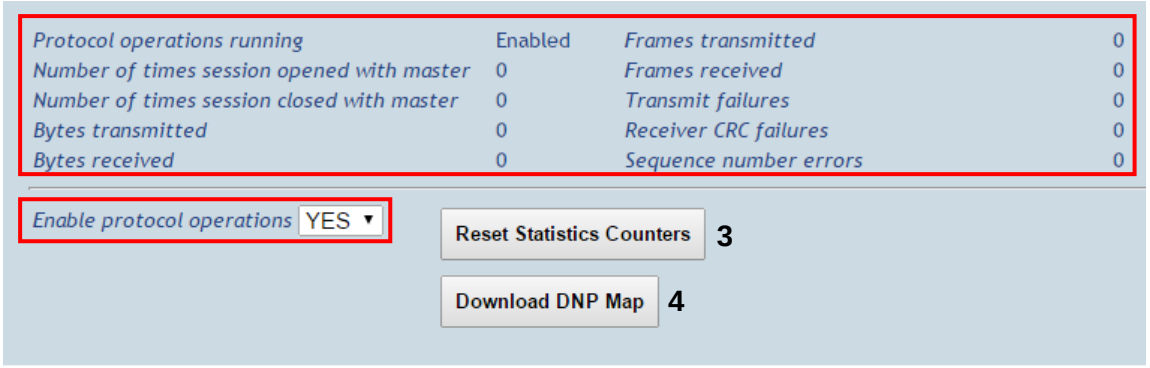
To open the particular *Protocol* configuration window, click **Config** on the *Protocols Configuration* window as shown below.



Note: It might be beneficial to try various settings to see which options meet the user's particular applications best.

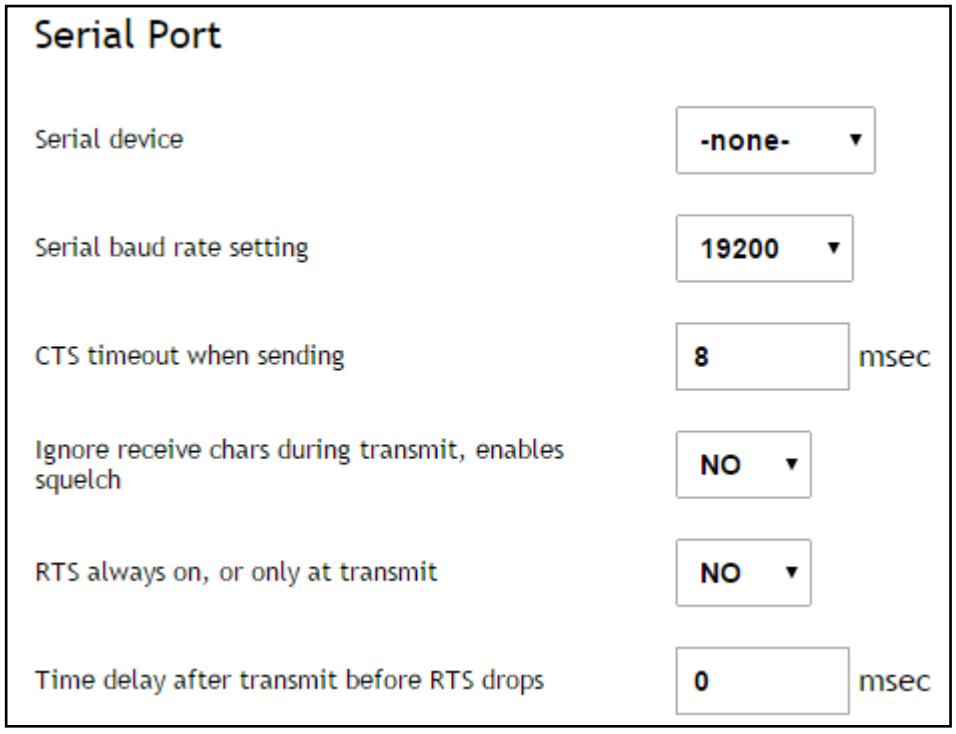
DNP Serial Configuration

DNP Serial - Statistics and Control Area



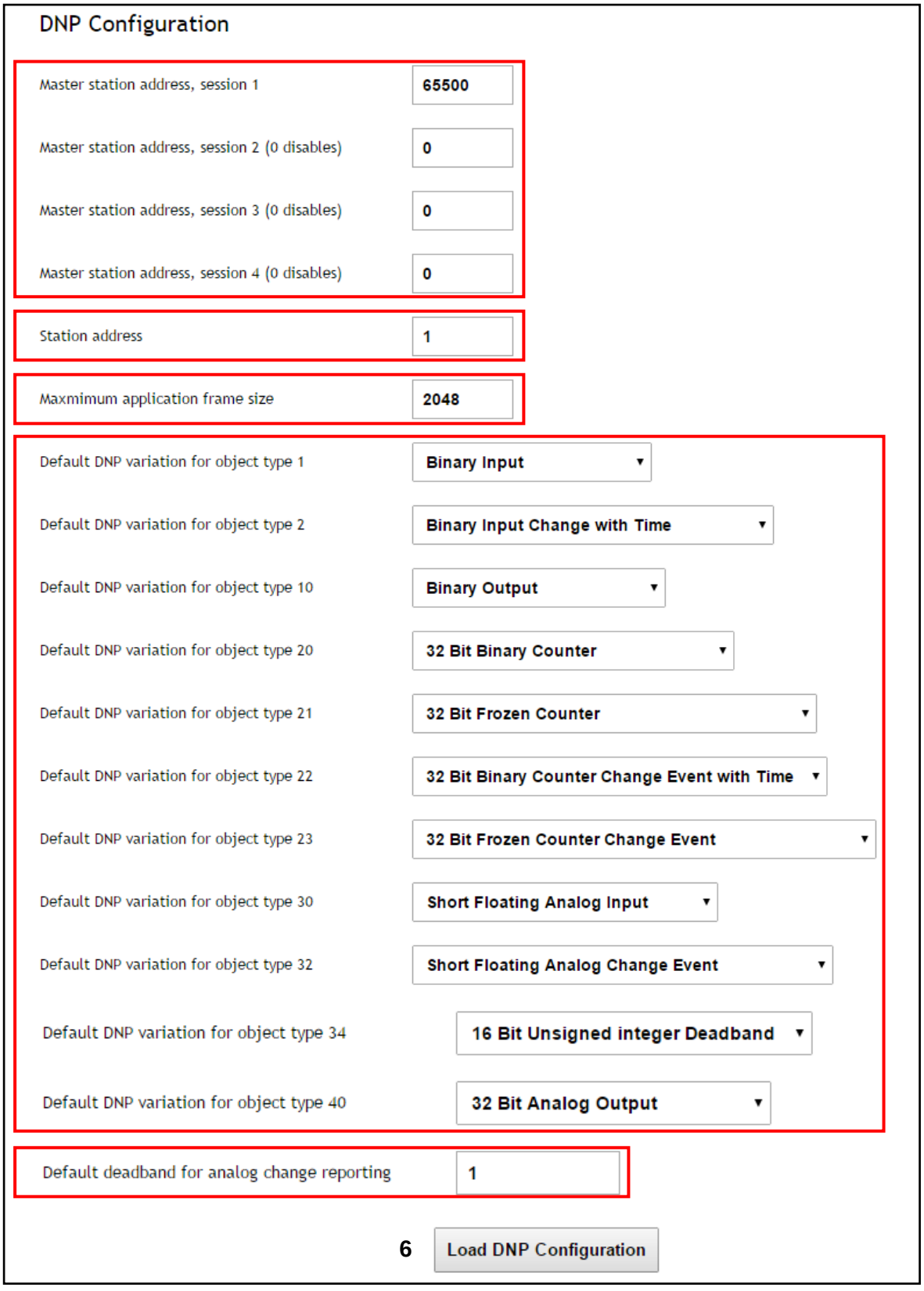
Index	Object	Definition
1	**Statistics**	Activity log of communications to and from the QTMS device over this port.
2	**Enable protocol operations**	This will enable the port for communicating
3	**Reset Statistics Counters**	Clicking on this will reset the communications statistics log.
4	**Download DNP Map**	Clicking the download button will download the DNP map for this QTMS device exactly how it is configured.
5	**Allow DNP time set command to set system time**	Allows or not the DNP time set command to set the system time for the QTMS.
6	**Maximum number of event entries that can be placed in event queue**	Maximum number of event entries that can be placed in event queue; maximum number 100.
7	**Type of data link for the protocol instance**	Selects between Serial, TCP or UDP. Selecting Serial populates the screen with serial parameters.

DNP Serial - Serial Port Area



Index	Object	Definition
1	**Serial device**	Selects which port(s) are available to be configured. TB2 or TB5.
2	**Serial baud rate setting**	Select baud rates from 1200 to 115,200
3	**CTS timeout when sending**	CTS timeout when sending in milliseconds. Not used for RS485 communications
4	**Ignore receive chars during transmit ….**	Ignore receive characters during transmit, enable squelch
5	**RTS always on, or only at transmit**	Sets the RTS function. Not used for RS485 communications.
6	**Time delay after transmit before ….**	Select time delay after transmit before RTS drops out in milliseconds. Not used for RS485 communications.

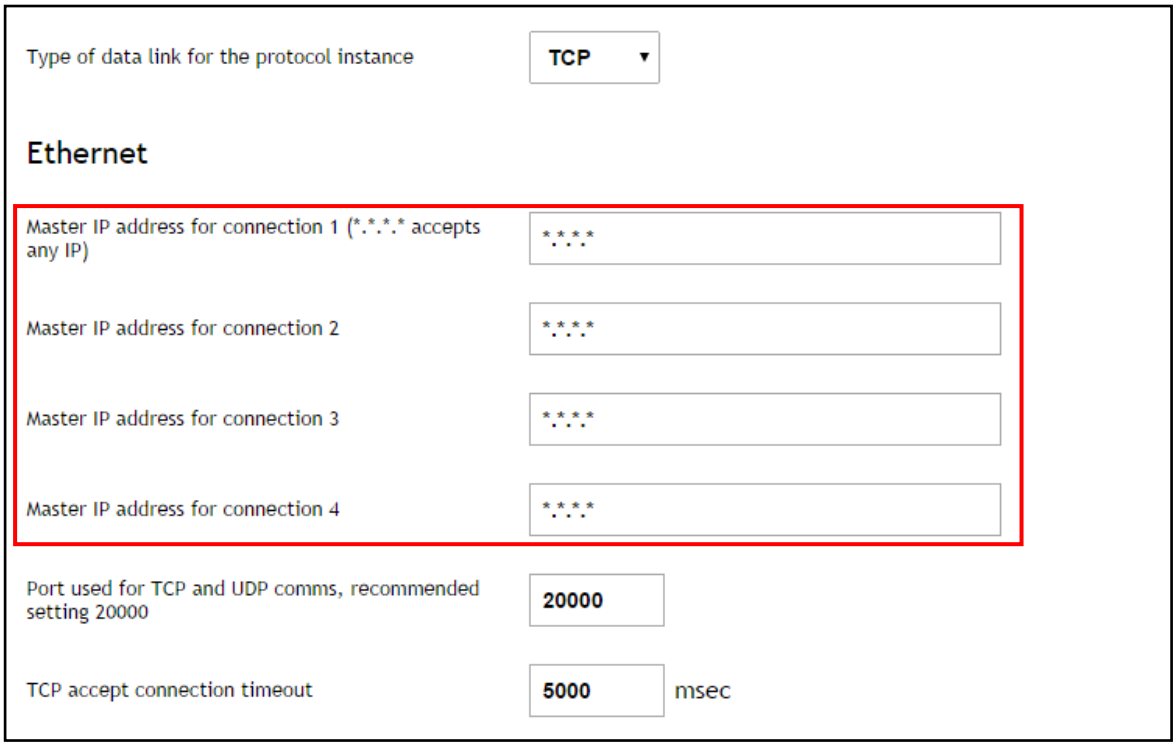
DNP Serial - DNP Configuration Area



Index	Object	Definition
1	**Master station address, session X …**	The QTMS will support multiple master stations. If only one station is used then enter 0 for the remaining stations.
2	**Station address**	Address of this QTMS device to be recognized by the master station.
3	**Maximum application frame size**	Maximum number of frames in a communication package.
4	**Default variation for object type ….**	These boxes allow the user to select the default response for the various object types.
5	**Default deadband for analog change reporting**	This value is the minimum change required for a parameter to be included in analog change reporting.
6	**Load DNP Configuration**	Saves configuration to memory.

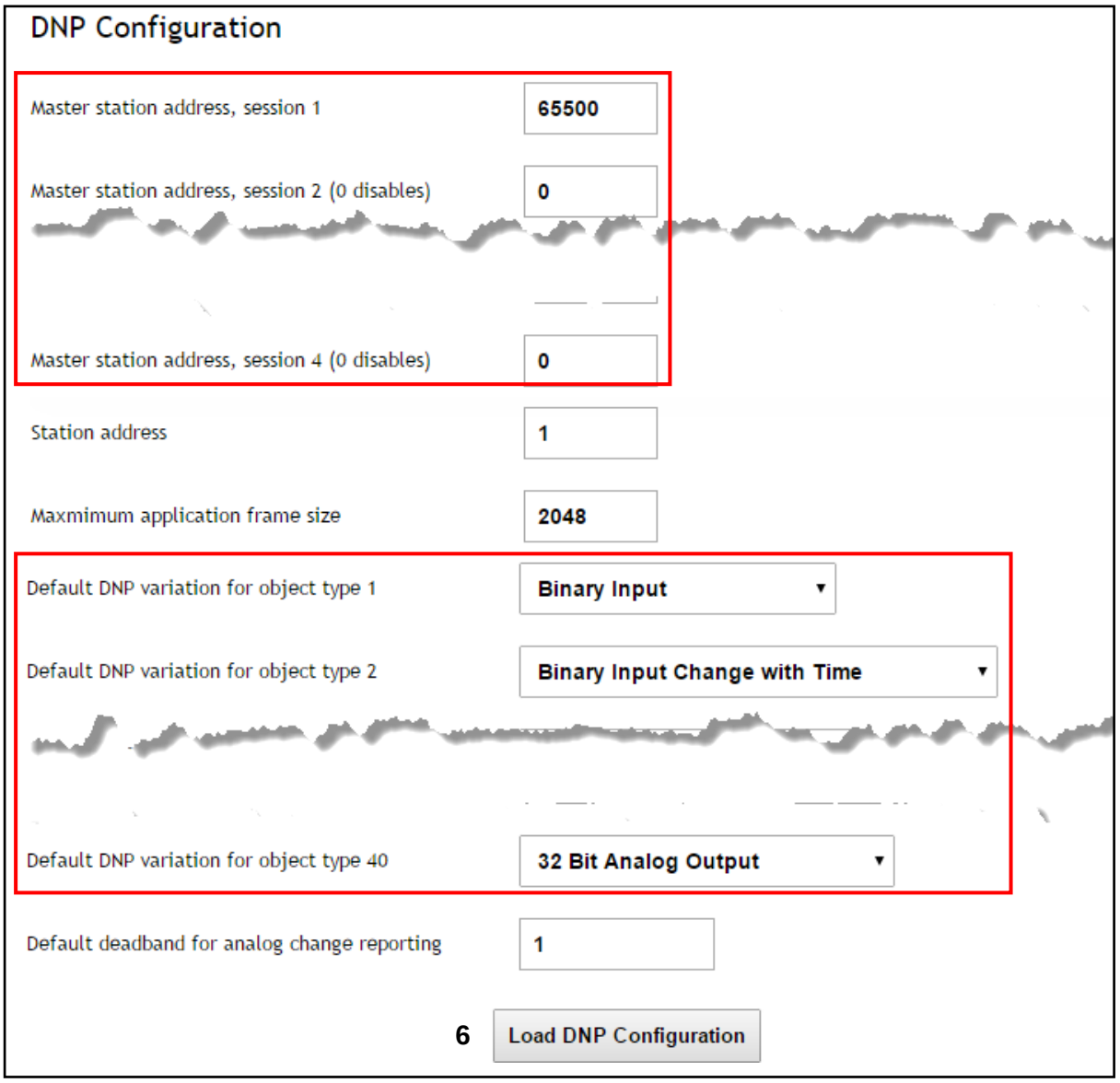
DNP TCP (Ethernet) Configuration

DNP TCP - Ethernet Area



Index	Object	Definition
1	**Type of data link for protocol instance**	Selects between Serial, TCP or UDP. Selecting TCP or UDP populates the screen with Ethernet parameters.
2	**Master IP address for connection 1 - 4**	Master IP address(es) that the QTMS will communicate with. By putting in a specific IP address only that device will be able to communicate with the QTMS over that port
3	**Port used for TCP and UDP comms, recommended setting 2000**	Port setting for communicating to the QTMS device.
4	**TCP accept connection timeout**	Time of port access before the QTMS shut down after requested communications.

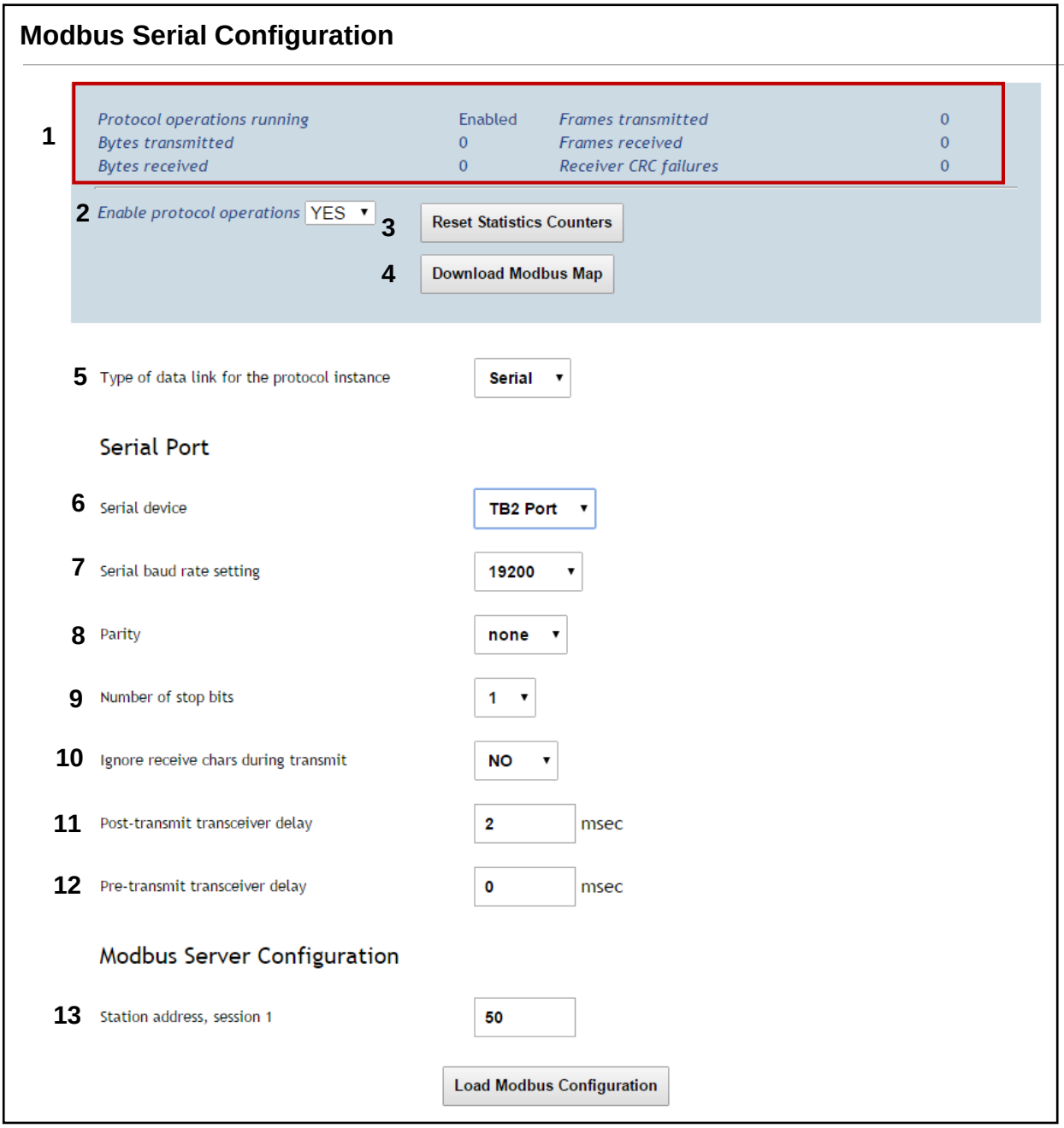
DNP TCP - DNP Configuration Area



Index	Object	Definition
1	**Master station address, session 1 - 4**	The QTMS will support multiple master stations. If only one station is used then enter 0 for the remaining stations.
2	**Station address**	Address of this QTMS device to be recognized by the master station.
3	**Maximum application frame size**	Maximum number of frames in a communication package.
4	**Default variation for object type ….**	These boxes allow the user to select the default response for the various object types.

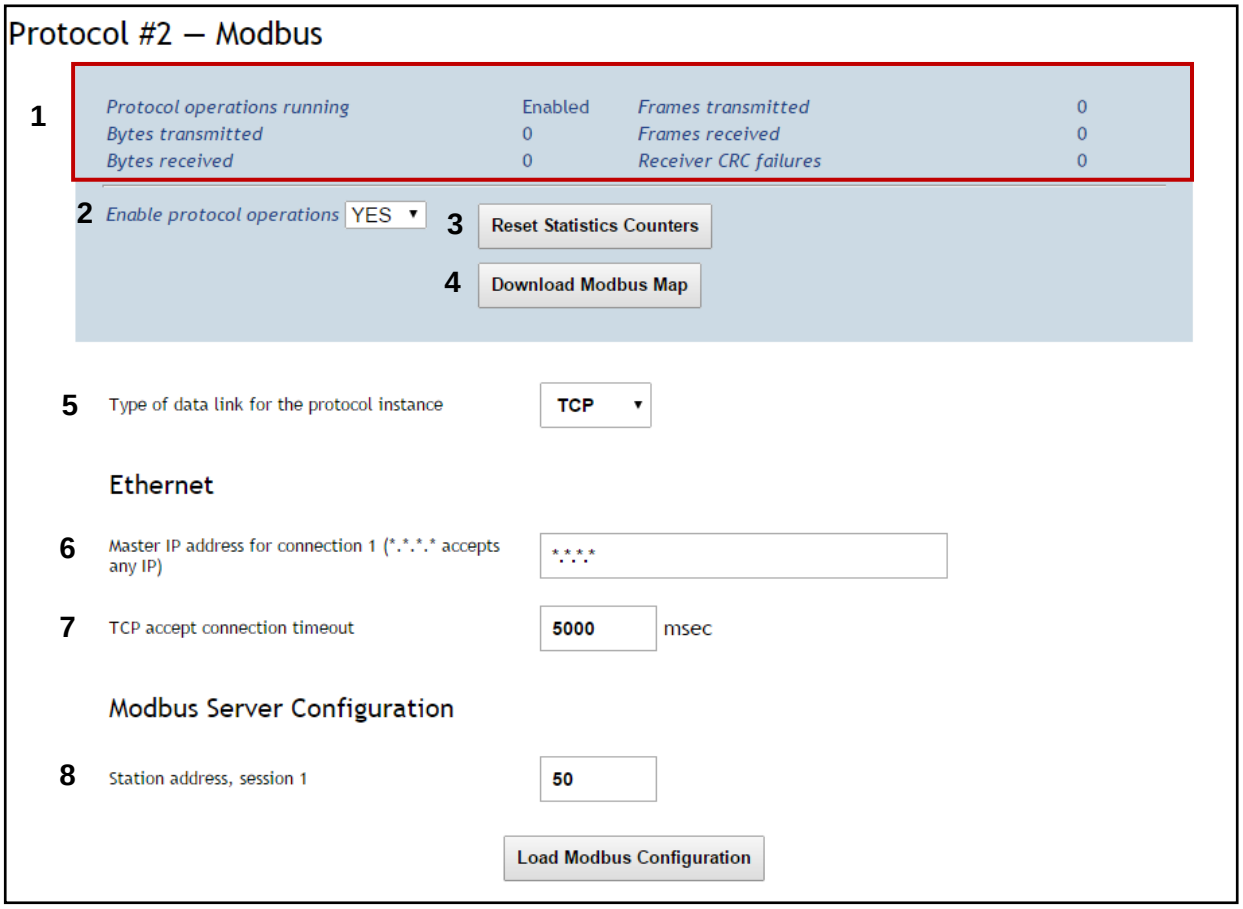
5	**Default deadband for analog change reporting**	This value is the minimum change required for a parameter to be included in analog change reporting.
6	**Load DNP Configuration**	Saves configuration to memory.

Modbus Serial Configuration



Index	Object	Definition
1	**Statistics**	Activity log of communications to and from the QTMS device over this port.
2	**Enable protocol operations**	Enables/disables the port for communicating.
3	**Reset Statistics Counters**	Clicking on this resets the communications statistics log.
4	**Download Modbus Map**	Clicking this downloads the Modbus map for this QTMS device exactly how it is configured.
5	**Type of data link for the protocol instance**	Selects between Serial, TCP or UDP. Selecting Serial populates the screen with serial parameters.
6	**Serial device**	Selects which port(s) are available to be configured. TB2 or TB5.
7	**Serial baud rate setting**	Selects baud rates from 1200 to 115,200.
8	**Parity**	Type of parity for the communication packages; odd, even or none.
9	**Number of stop bits**	Number of stop bits in a communication package; 1 or 2.
10	**Ignore receive characters during transmit**	In half duplex mode prevents characters being transmitted from the QTMS being read back into the device.
11	**Post-transmit transceiver delay**	Delay in milliseconds after transmitting to make sure outgoing characters aren't clipped off by dropping the transmit drive enabled.
12	**Pre-transmit transceiver delay**	Delay in milliseconds before transmitting to ensure outgoing characters aren't clipped by dropping the transmit drive enabled.
13	**Station address, session 1**	Sets QTMS address device for recognition by the master station.

Modbus TCP Configuration



Index	Object	Definition
1	**Statistics**	Activity log of communications to and from the QTMS device over this port.
2	**Enable protocol operations**	Enables/disables the port for communicating.
3	**Reset Statistics Counters**	Clicking on this will reset the communications statistics log.
4	**Download Modbus Map**	Clicking the download button will download the Modbus map for this QTMS device exactly how it is configured.
5	**Type of data link for protocol instance**	Selects between Serial, TCP or UDP. Selecting TCP or UDP populates the screen with Ethernet parameters.
6	**Master IP address for connection 1 ….**	Master IP address that the QTMS will communicate with. By putting in a specific IP address only that device will be able to communicate with the QTMS over that port .
7	**TCP accept connection timeout**	Time of port access before the QTMS shut down after requested communications.

8	**Station address, session 1**	Address of this QTMS device to be recognized by the master station.

Calibrating the QTMS

Overview

This section contains instructions for calibrating the following:

- Current loops
- A level gauge - Potentiometer input
- Tap position resistor bridge

Note: RTD analog inputs are calibrated at the factory so there is no need to calibrate them in the field.

Current Loop Calibration

Overview

To calibrate the QTMS current loops, the following equipment is required:

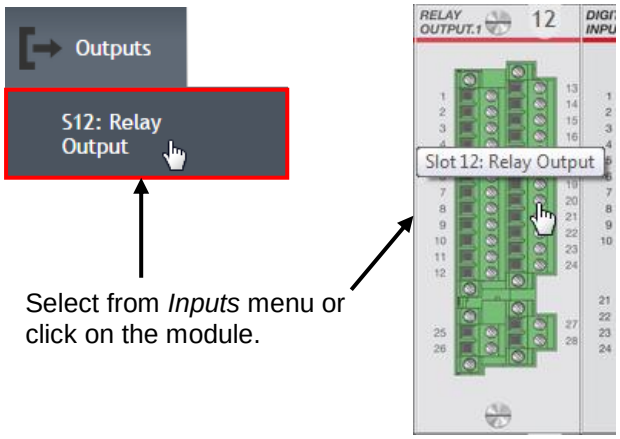
- A QTMS unit
- Current meter
- PC connected to QTMS network
- QTMS Administrator login privilege

Note: This procedure pertains to all available current outputs including 4-20ma, 0-1ma, 0-5ma, 0-10ma, and 0-20ma.

Calibration Procedure

1. Connect and log into the QTMS TMS INSIGHT application using the procedure described in section, *Connecting to the QTMS*.
2. Attach a milliamp-meter to the output terminals for the signal to be calibrated.

   Please refer to section, *Relay Output Module* for terminal connections.
3. From the TMS INSIGHT Front Panel window, either select the particular Relay Output (RO) Module containing the current loop to be calibrated from the "Outputs" drop-down menu, or simply select the module from the Front Panel.



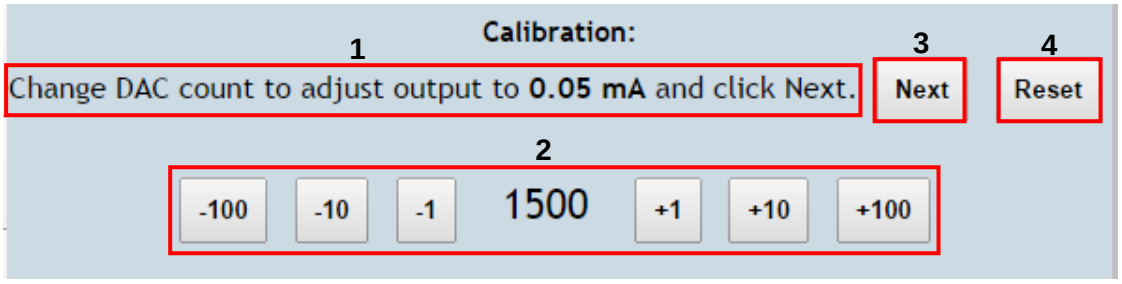
The selected RO Module window opens.

4. From the RO Module window, click the "Config" button for the point to be calibrated.

The selected point configuration window appears.

5. From this window, click ”Start Calibration."

The first instruction appears in the calibration area.



Index	Object	Definition
1	**Calibration Instruction**	After clicking the "Start Calibration" button, step-by-step calibration instructions appear.
2	**Output Adjustment Controls**	DAC adjustment controls used to adjust the output current value. The +/- 100 is for gross adjustment, the +/- 1 is for fine adjustment. Click on these until the value stated in the instruction is read on the milliamp-meter. Only after the proper value is read by the milliamp-meter should the user click the "Next" button to move to the next instruction.

3	**Next**	Click this control to move to the next calibration instruction.
4	**Reset**	Click this control to discard the calibration values and end the calibration procedure. The point will keep the original calibration parameters.
5	Load Current Output	Click this control to load the calibration parameters into system memory.

6. As each step is accomplished, click "Next" to move to the next instruction.
7. Procede through each instruction until the following message appears.

8. Either click "Load Current Output" to save the calibration data, or click "Reset" to discard the data and revert back to the original calibration data.
9. This ends the current loop calibration procedure.

Level Gauge Calibration

Overview

All of the QTMS input signal points are calibrated at Qualitrol, except for Potentiometer (Level Gauge). These sensor inputs are specific to the transformer with which they are associated and must be calibrated on the transformer. This procedure provides the steps for calibrating a Level Gauge to a the QTMS.

To calibrate the QTMS potentiometer input, the following equipment is required:

- A QTMS unit
- A case assembly with a potentiometer output
- PC connected to QTMS network
- QTMS Administrator login privilege

CAUTION: **All QTMS inputs are calibrated at the factory using highly precise measurement equipment except for Potentiometer (Level Gauge) and Tap Position Input signals. If you inadvertently try to calibrate the wrong input point, you might cause the QTMS to malfunction.**

Pre-Calibration Checklist

1. Connect the potentiometer output wires of the lever gauge to the AI Module potentiometer input terminals. Please refer to section, *Potentiometer Input* for terminal connections.
2. To ensure the potentiometer connection is correct, the user can perform the following.
    a. Assign the AI potentiometer point to a *Panel Display Configuration* channel.

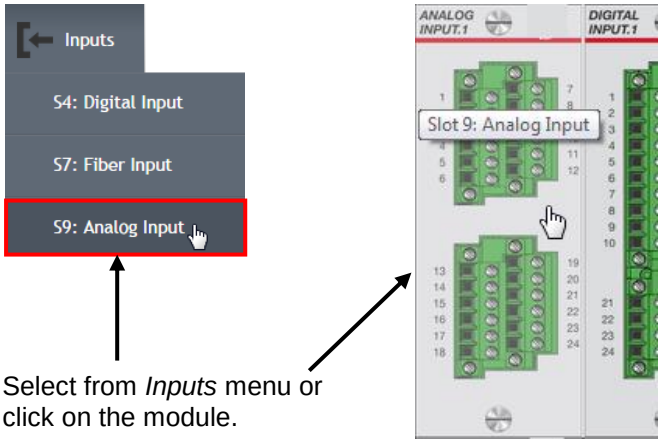
b. Observe that the point is displayed on the HMI Display.

c. Check that the potentiometer is wired correctly by adjusting the case face to raise and lower dial pointer. Observing the HMI Display, as the pointer is raised, the HMI Display value increases and when lowered, the value decreases.

Note: If the potentiometer does not operate correctly, please check the wiring before proceeding with the calibration procedure.

Calibration Procedure

1. Connect and log into the QTMS TMS INSIGHT application using the procedure described in section, *Connecting to the QTMS*.
2. From the TMS INSIGHT Front Panel window, either select the particular Relay Output (RO) Module containing the current loop to be calibrated from the "Outputs" drop-down menu, or simply select the module from the Front Panel.



The selected RO Module window opens.

3. From the AI Module window, click the "Config" button for the point to be calibrated.

The selected point configuration window appears.

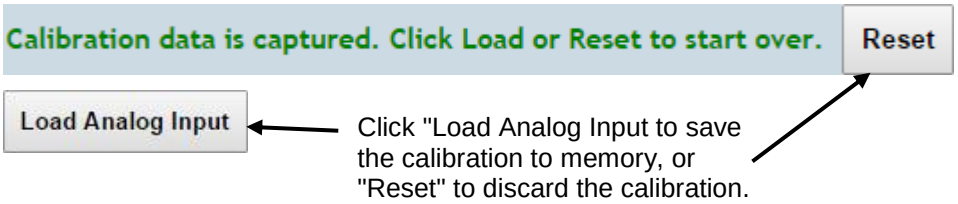
4. From this window, click ”Start Calibration."

Instructions appear that guide the user through the calibration procedure.

5. Set the input to **Min** by adjusting the potentiometer case face pointer to the minimum position as shown.

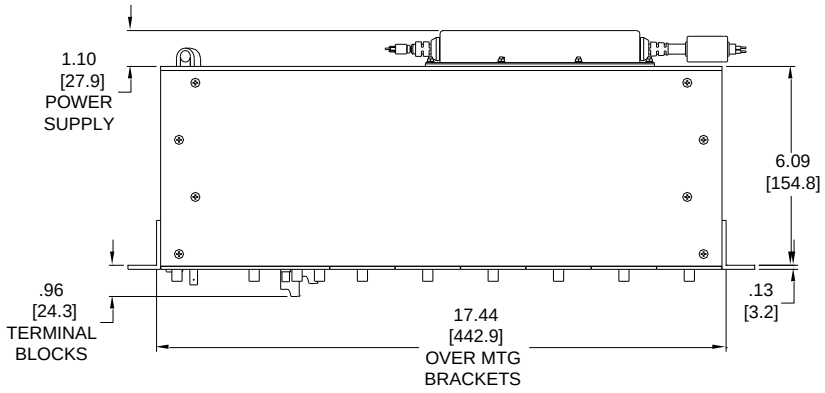
6. Click **Next**.
7. Set the input to Max by adjusting the potentiometer case face to the maximum position as shown.

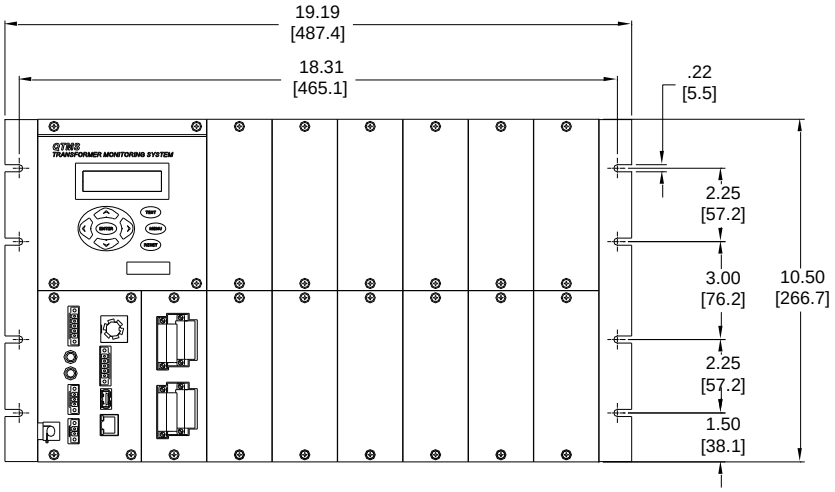
8. Clicking "Next" increments to the next calibration step.
9. The calibration is completed and the following message appears.

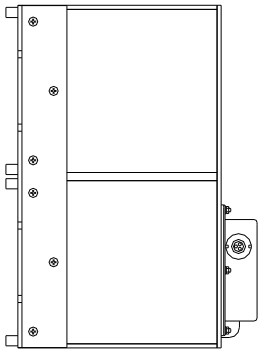


Appendix

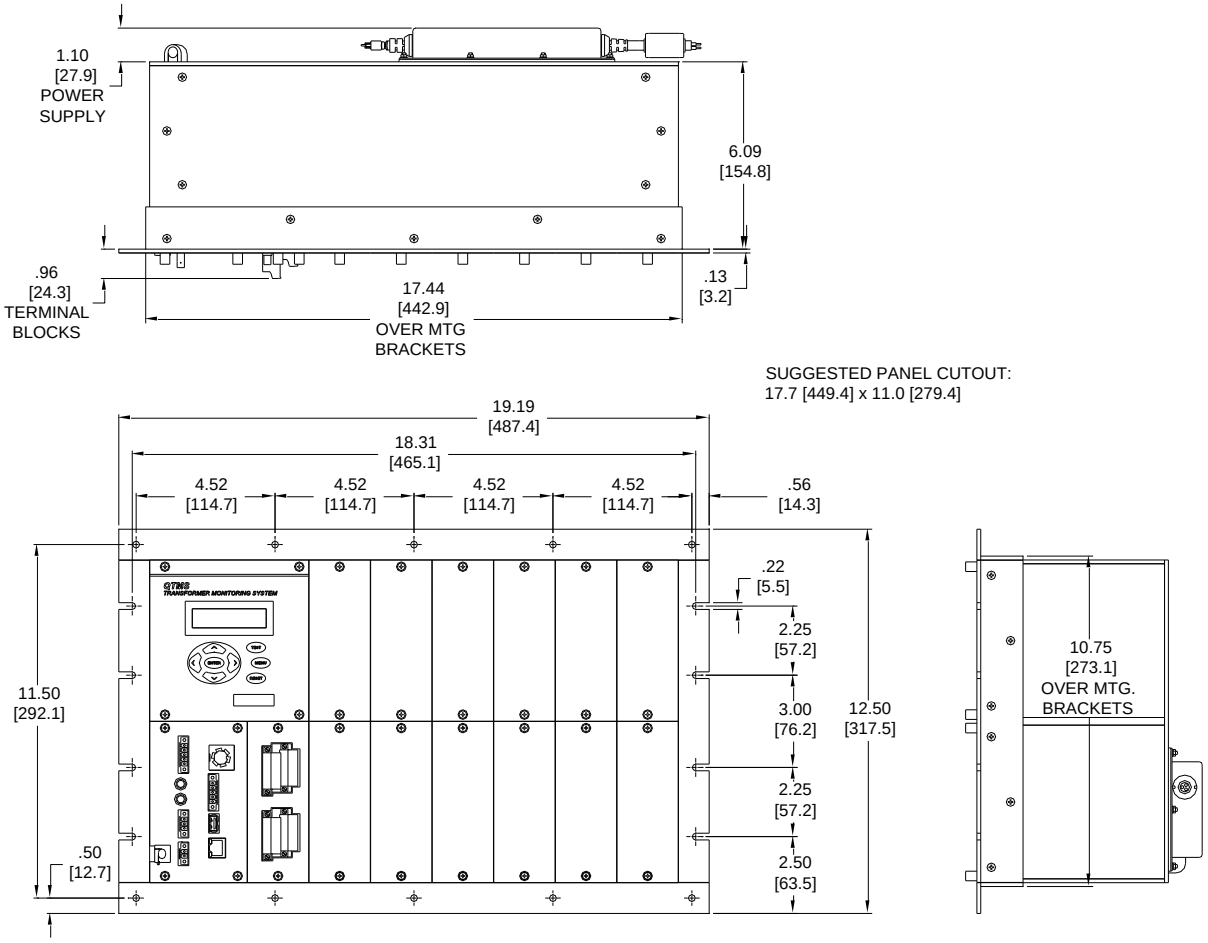
19" Rack Mount Chassis







Front Mount Chassis



Rear Mount Chassis