TraceNet™ Control and Monitoring System

TCM2

Installation, Start-Up,

Operating and Maintenance Guide

THERMON

TCM2

Installation, Start-Up, Operating and Maintenance Guide

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Contents

1 Introduction

The following serves as a guide and overview of the installation, startup and operation of a TraceNet TCM2 heat tracing control and monitoring system. This guide shall be used in conjunction with the project specific control system drawings and any other standard installation instructions/guides provided. In the unlikely event that a conflict or uncertainty arises, contact the Thermon engineering support personnel assigned to this project to clarify.

> *All installation personnel should be properly trained and qualified to safely install, service and program this TraceNet heat tracing control panel as well as to operate the associated heat tracing system. Service shall only be performed by a certified technician. Equipment is located in enclosures whose doors can only be opened through use of a tool.*

1.1 The Panel Location

A wide variety of TraceNet TCM2 system configurations are possible. The TCM2 control panels are designed to operate in ambients ranging from -40°F (-40°C) to 104°F (40°C) and higher. TraceNet TCM2 heat trace control and monitoring systems have been approved/certified for installation and operation in ORDINARY LOCATIONS and CLASS I, DIV 2, GROUPS B, C, D, T4 HAZARDOUS LOCATIONS ONLY, Installation Category II, at altitudes up to 2000 m, and in locations where the Mains supply voltage can fluctuate up to 10%. The actual markings provided on the panel will detail the specific location requirements for each design. The module may be used in pollution degree 2 or better.

1.2 Initial Inspection and Handling

Upon receiving the TraceNet TCM2 control panel, it is important to confirm that the contents of the shipping containers agree with the shipping documents and with the purchase order. Also, it is important to check the shipped container exterior and packing materials for any possible freight damage. Where damage is observed, take photos and notify the carrier as well as your nearest Thermon engineering support center before proceeding further.

After carefully removing the panel from its shipping container, move the panel to its selected location, either by utilizing the pallet base and the securement strapping provided (using a lift truck/fork lift in the case of large panels), or by lifting and mounting to a wall/rack for smaller panels. Where lifting eyes are provided on the panel, they should be used when handling.

Where the panel has external heat sinks to dissipate the heat generated by solid state relay switching, it is recommended that a minimum of 6” (150 mm) of clearance be allowed between heat sinks and walls or other panels to minimize heat buildup at the heat sinks.

Where heat sinks are present on adjacent panels, allow 12” (300 mm) clearance between heat sinks for sufficient natural air movement.

Warning: Heat Sink Temperatures May Exceed 60°C

Adequate door clearance for service work entry and conduit panel entries should be anticipated when establishing the exact panel location. The panel should be positioned such that the operator can easily access any disconnecting breakers or fuses. When the panel is located outdoors, the panel should be located at a sufficient height to avoid potential standing water.

Once the panel has been properly located, refer to the project specific installation details for the recommended floor mounting as well as wall mounting details.

Once bolted in place, the panel is ready for final configuration, wiring, and site required assembly. Note that the TCM2 control and monitoring module is normally shipped in special packaging to minimize any undue impact stress during shipment. It should be removed from its packaging being attentive to any shipping damage that may have occurred during its transit.

WHEN USED IN A HAZARDOUS LOCATION THE FOLLOWING WILL APPLY.

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS

AVERTISSEMENT – RISQUE D’EXPLOSION – AVANT DE DÉCONNECTER L’EQUIPEMENT, COUPER LE COURANT OU S’ASSURER QUE L’EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX

WARNING – EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2

AVERTISSEMENT – RISQUE D’EXPLOSION – LA SUBSTITUTION DE COMPASANTS PEUT RENDRE CE MATÉRIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2

1.3 The TCM2

The TCM2 is a microprocessor-based temperature control and monitoring module developed specifically for heat tracing. Designed for use exclusively in Thermon manufactured control systems, the TCM2 module provides a complete control solution for up to two heat tracing circuits.

> *Each TCM2 module is supplied with all necessary connection hardware. Substitutions may impair protections provided by the equipment.*

Figure 1.1: TCM2 Control Module

1.4 Features

Features of the TCM2 module include the following

- Bright Four-Line OLED Display
- Resettable Minimum and Maximum Temperature Values

- Alarm Functions
  - High and Low Temperature
  - High and Low Current
  - High Ground/Earth Leakage Current
  - Circuit Fault
  - Damaged Temperature Sensor
- 3-phase Current Monitoring[1]

- Trip Functions
  - High Temperature
  - High Current
  - High Ground/Earth Leakage Current

The TCM2's four-line display, tri-color status LEDs and four-button interface offer the operator intuitive access to the heat tracing system operating parameters including heat trace status, all set-points, temperature data, operational control

[1] Factory configurable option. See **Section 7.5** for more information

parameters and communication settings. Tri-color LEDs on the front of the TCM2 module indicate module status including power, system health, alarm and trip status on a per-circuit basis.

The TCM2 module is provided with three 24 VDC digital outputs: TRIP, ALARM and SYS. TRIP and ALARM are configurable to be normally on or normally off.

The TCM2 is also equipped with an isolated RS-485 port capable of ModBus ASCII or RTU communications. Over a shielded two-wire twisted-pair physical layer, the TCM2 communicates with Thermon's TraceNet Command system as well as distributed control systems (DCS) at data rates up to 57600 baud. Ethernet connectivity is available with the factory addition of a serial to Ethernet converter.

The TCM2 contains an internal 3.15 Amp, 250 V~ fuse that is designed to be serviced only at the factory.

The TCM2 module can be utilized in a variety of TraceNet control and monitoring systems. Specific wiring and equipment arrangement details are provided in drawings included within the TCM2 Series panel at the time of shipment. The TCM2 module is also backward compatible and may be used as an upgrade within legacy HeatChek TC Series Systems formerly utilizing a TC202a, TC201a or TC101a control and monitoring module.

The TCM2 module is intended for installation exclusively in Thermon designed TCM2 panels. The Mains feed to the TCM2 module shall be current limited, either by a breaker or a fuse, with a current rating no higher than 30 A. The panel is designed such that the temperature internal to the enclosure does not exceed the maximum operating temperature of the TCM2 module. All wiring to the unit must conform to local electrical codes.

2 Specifications

TCM2 control panels are available in a variety of configurations. The table below serves as general specification information for these control panels.

Table 2.1: TCM2 Panel Specifications

Parameter	Description
Heat Trace Mains Supply	100 to 600 V~, 50/60 Hz (See **Table 2.2** for Control Module supply information)
Control Points	Up to 2 Heat Tracing Circuits
Heat Trace Current	See **Table 2.3**: Maximum Heater Current Through Each Solid State Relay
Temperature Inputs	Up to Two per Control Point; Platinum RTDs 100 Ω @ 32 °F (0 °C)
Temperature Control Range	-200 °F to 1112 °F (-129 °C to 600 °C)
Alarm Contact Relays	24 VDC, 200 mA
Communication	RS-485 , ModBus ASCII or RTU, up to 57600 Baud
Control Methods	On/Off MEC, On/Off SSR, Proportional, Ambient or APCM
Display	4 Line, 20 Character, OLED
Relative Humidity	0 to 90% Non-Condensing
Exterior Panel Operating Temperature	-40 °F to 104 °F (-40 °C to 40 °C)
Interior Operating Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Storage Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Dimensions (W x H x D)	See **Table 2.4**

The table below serves as general specification information for the TCM2 control module.

Table 2.2: TCM2 Module Specifications

Parameter	Description
Mains Supply	100 to 240 V~, 50/60 Hz, Overvoltage Category II
Max. Input Current	740 mA
Power Consumption	95 VA max
Control Points	Up to 2 Heat Tracing Circuits
Temperature Inputs	Up to Two per Control Point; Platinum RTD's 100 Ω @ 32 °F (0 °C)
Temperature Control Range	-200 °F to 1112 °F (-129 °C to 600 °C)
Communication	RS-485, ModBus ASCII or RTU, up to 57600 Baud
Accessory Power Output	9 W @ 24 VDC
Digital Alarm Outputs	3 x 24 VDC, 100 mA
Control Outputs	2 x 24 VDC, 100 mA or 2 x 12 VDC, 100 mA (user selectable)
Control Methods	On/Off MEC, On/Off SSR, Proportional, Ambient or APCM
Display	4 Line, 20 Character, OLED
Operating Temperature	-40 °F to 140 °F (-40 °C to 60 °C)
Storage Temperature	-40 °F to 176 °F (-40 °C to 80 °C)
Dimensions (W x H x D)	4.7" x 4.65" x 3.25" (119mm x 118mm x 83mm) Module should be mounted as seen in **Figure 2.1** and include a minimum 2" (50 mm) clearance above the module and 1.5" (38 mm) clearance below the module.

Figure 2.1: TCM2 Module Dimensions

Table 2.3: Maximum Heater Current Through Each Solid State Relay

Enclosure Option	Module Type	SSR30A (single pole relay)		SSR15A (double pole relay)		SSR30B (single pole relay)		SSR15B (double pole relay)		SSR50C Up to 3 single pole relays(1,2,3)		SSR30B/2R (single pole relay)	
		40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)	40°F (4°C)	104°F (40°C)
P2, SS2	TCM2-1	30	19	22	9	30	30	24	15	--	--	30	25
P3, SS3	TCM2-1	30	24	24	12	30	30	24	15	--	--	30	30
	TCM2-2	30	12	19	6	30	30	24	14.75	--	--	--	--
SS3	TCM2-1	--	--	--	--	46(1,2)	46(1,2)	--	--	--	--	--	--
	TCM2-2	--	--	--	--	46(1,2)	46(1,2)	--	--	--	--	--	--
SS4	TCM2-1	30	24	24	12	30	30	24	15	50/60	60/50	30	28
	TCM2-2	30	24	24	12	30	30	24	15	60/50	60/50	--	--

Note: For TCM2-x, the x denotes relay count. Double-pole relay or 2 single-pole relays required for 208VAC or 240VAC to break both legs.

[1] Relays in separate enclosure from control module.
[2] Amperage values over 30 only apply to higher amperage relays such as Crydom HD60125.
[3] 60 A allowed only when using 1 or 2 relays.

Table 2.4: TCM2 System Enclosure Options

Enclosure Option	Material	Type	Dimensions (inches)	Dimensions (mm)
P2	Fiberglass	4X (IP54)	12 x 14 x 6	305 x 356 x 152
SS2	Stainless Steel	4X (IP54)	12 x 14 x 6	305 x 356 x 152
P3	Fiberglass	4X (IP54)	16 x 14 x 6	406 x 356 x 152
SS3	Stainless Steel	4X (IP54)	16 x 14 x 6	406 x 356 x 152
SS4	Stainless Steel	4X (IP54)	36 x 30 x 16	914 x 762 x 406

3 Module Connections & Wiring

The TCM2 is intended for use exclusively in TraceNet TCM2 Control and Monitoring System panels. Refer to **Figures 3.1** and **3.2** for TCM2 Module connections.

Design considerations within panel:

- Control wiring is rated to 105°C
- GFI test loop wires should be passed through their corresponding GFI CT's
- Alarm digital outputs are intended to drive internal signal relays or lights and should not be directly connected to field wiring
- Care must be taken to avoid exceeding the temperature rating of the TCM2. Refer to **Table 2.3** for panel current ratings.

3.1 Bottom Side Connections

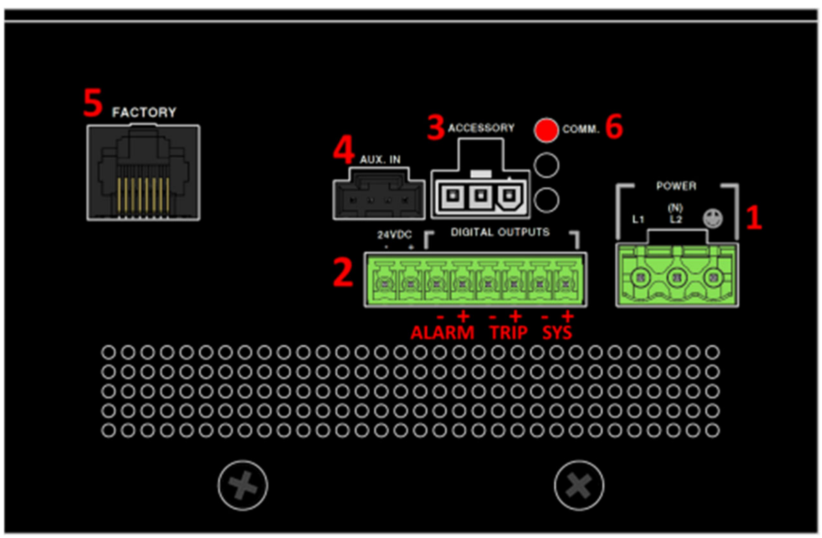


Figure 3.1: Bottom-Side Connections

1. POWER: Mains supply input accepts 100 – 240 V~, at 50/60 Hz. L1 is Line 1, L2 is Line 2 or Neutral, and the symbol ⏚ is the protective conductor/ground connection.
2. 24 VDC & DIGITAL OUTPUTS: A 24 VDC output is provided to power accessories such as a serial to Ethernet converter. The output supplies up to 9 W and is over-current protected. The Digital outputs provide alarm functionality. Each 24 VDC output is current limited to 100 mA.

The positive legs of each output are electrically connected. The outputs may be used to drive indicators or audible alarms, etc., or may be used to drive relays to connect to field wiring. TRIP and ALARM are configurable to be normally on or normally off. The TRIP output activates if either circuit trips for any reason. This requires a manual reset either at the module or by the remote communication. The ALARM output activates if either circuit experiences any type of alarm. The output deactivates when acknowledged or when the alarm condition is no longer present. The SYS alarm is hard wired to be normally on and to activate in the event of a CPU fault. *Note: These are open collector digital outputs not dry contact relays. They should not be connected directly in parallel or series.* **Digital outputs should not be directly connected to field wiring.**

3. ACCESSORY: Reserved for future developments and for entering factory test mode when connected to the isolated RS-485 (Right Pin > D-; Middle Pin > S; Left Pin > D+).
4. AUX IN: Provides connection for optional factory-installed externally mounted interface buttons (See **Appendix B** for wiring diagram).
5. FACTORY: This port is for factory programming only.
6. COMM LED: Indicates traffic on the isolated data highway RS-485.

3.2 Top Side Connections

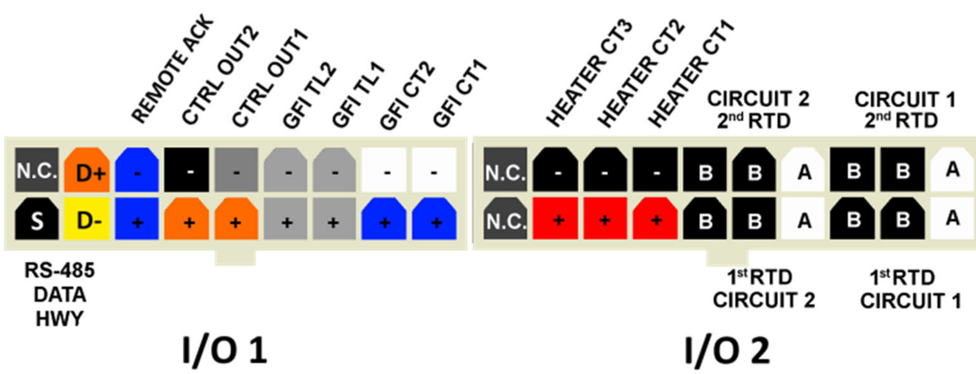


Figure 3.2: Top-Side Connections.

- RTD field wiring should be shielded and the shield grounded at one end. Ground connections are provided in the panel for this purpose.
- HEATER CT1, 2 and 3: In normal 2 circuit configuration, HEATER CT1 is used for Circuit 1, HEATER CT2 is used for Circuit 2 and HEATER CT3 is not used. When operating as a single-circuit 3-phase controller all three CTs are used, one on each leg of the 3-Phase heater outputs (See **Section 7.5**).
- GFI CT1 & 2: These are connection points for the ground/earth fault CTs.
- GFITL1 & 2: These are connections for the ground/earth fault interrupt test loop. These wires should be routed through each corresponding ground/earth fault CT. These wires are used to pass a small amount of

current (about 50 mA~) through the GFI CT to verify functionality on command or at a user configurable interval.

- CTRL OUT 1 & 2: These output signals control the power SSRs or mechanical relays which energize the heat trace. Signal voltage defaults to 12 VDC but can be changed to 24 VDC in the Factory Menu. Each output is current limited to 100 mA.
- REMOTE ACK: This isolated input allows acknowledgement of alarms without opening the panel. It may be connected to a pushbutton switch or to the contacts of a relay driven by a remote signal. The positive side provides an isolated 5 VDC signal. When switched, the negative side drives the diode of an opto-coupler to signal to the TCM2 acknowledgement of the alarm or trip.
- RS-485 DATA HWY: D+ & D- are the differential bus lines for communications. S is the common leg and is often connected to the shield in a 2-wire twisted pair cable. Though this configuration is common, ideally, S is connected to another wire within the cable and the shield is grounded on one side only. See **Section 8** for more information.

4 Field and Panel Wiring

For a successful installation of a TraceNet TCM series heat tracing control and monitoring system, a number of equally critical parts of the system must be installed properly. Areas requiring close attention are the heat trace and insulation, the RTD temperature sensor installation, the distribution of the field RTD and power wiring, and the installation and routing of wiring inside the TraceNet TCM panel.

> *The heat tracing system installation shall be in accordance with the electrical area classification requirements and as well shall conform to the latest requirements as detailed in applicable heat tracing standards, the local Electrical Code and plant standard practices. Where conflicts arise, contact the project engineer for resolution. If the equipment is used in a manner not specified in this Guide, protections provided by the equipment may be impaired.*

4.1 Heat Trace and Insulation Installation

All heat trace circuits and insulation shall be installed in accordance with project installation details provided. In addition, refer to the Electric Heat Tracing Maintenance and Troubleshooting Guide (Thermon Form No. 20745) for general procedures and installation tips.

4.2 RTD Installation and Wiring

RTD control sensors should generally be installed on the process lines or in ambient (where ambient sensing is applied) in a location that is most representative of the entire heat trace circuit. In general, it is recommended that the sensors not be located at heat sinks such as pipe supports, pumps, and valves as the control system response needs to be based on the majority of the process line. The RTD control sensor location on the process piping should follow the installation guidelines detailed in **Figure 4.1**.

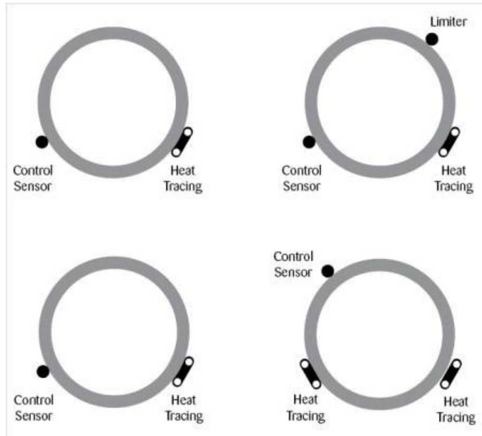


Figure 4.1: RTD Sensor Location

Where RTD sensors are installed on the process piping, follow the guidelines above. In special cases where the limiting temperature sensor is to be installed on the heater itself, it is important to recognize that an offset should be anticipated in the trip set-point to allow for sensor reading error and overshoot.

As a general rule, field RTD wiring and power wiring should not be routed in the same conduit or proximity in a tray as the temperature signals can become distorted and result in improper readings.

4.3 Power Distribution Wiring and Breakers

All field power wiring materials used shall be suitable for the intended service and shall be rated for insulation service temperatures up to and exceeding 221°F (105°C) unless higher values are otherwise noted in project specifications. Power supply wiring from the power transformers to the power distribution panel and distribution wiring to the heat trace circuits shall be rated for the heat trace use voltage or higher and shall be of a sufficiently large wire size to minimize voltage drop. Heat trace circuit breakers should be selected based on the type of heat trace used, the service voltage, and the circuit current draw characteristics. It is especially important when using self-regulating trace heaters to make sure that the circuit breaker response curve type is coordinated with the startup characteristic of the trace heater in a cold start condition. TCM2 controller circuit breakers should have current ratings no higher than 15 A. In addition to the controller circuit breaker, every heat trace circuit shall be provided with a circuit breaker as a means for disconnection. All circuit breakers shall be easily identifiable and accessible. All distribution wiring connections should be tightened using a torque indicating screw driver to the levels indicated in Table 4.1.

Table 4.1: Recommended Torque Values

Location of Terminals	Torque Values (Typical)*	
Distribution Equipment	13.2 to 15.9 in. lbs.	1.49 to 1.80 N-m

* Required torque values may vary depending on individual system designs and size of terminals. Refer to project documentation for additional information.

Protective earth/ground connection is required. Ground/earth with minimum 12 AWG conductors to a known and proven plant ground or by grounding rods.

4.4 TraceNet Panel Wiring

TraceNet TCM Series panels are configured and prewired into an integrated heat trace control and monitoring panel. Clean terminal strips are provided to facilitate the field wiring into the panels. Refer to the project specific panel drawings when installing the field wiring within the panel. Anticipated field wiring is conventionally shown by dashed lines. All field power wiring materials used shall be suitable for the intended service and shall be rated for insulation service temperatures of at least 221°F (105°C) unless higher values are otherwise noted in project specifications. All TraceNet component terminal block connections should be tightened using a torque indicating screw driver to the levels indicated in **Table 4.1**.

4.5 Serial Communication Wiring

TraceNet TCM Series panels may be linked together for communications with an RS-485 communication cable at distances up to 4000 ft (1200 m)[1]. In addition, a 120 Ohm termination module should be used at each end of the RS-485 network. The recommended communication cables for use in the RS-485 network are as given in **Table 4.2**.

[1] Max length depends on site conditions and baud rate

Table 4.2: Recommended RS-485 Cable Type

Cable Type	Recommended
120 ohm, -20°C to +60°C (-4°F to +140°F) 22AWG FHDPE insulation PVC outer jacket	Belden 3107A or equal
120 ohm, -30°C to +80°C (-22°F to +176°F) 24AWG PE insulation PVC outer jacket	Belden 9842 or equal
120 ohm, -70°C to +200°C (-94°F to +392°F) 24AWG Teflon FEP insulation Teflon FEP outer jacket	Belden 89842 or equal

Note: All these products are designated as 120 ohm impedance for balanced line communication uses.

5 Monitoring Heat Tracing Circuit Status

5.1 The Interface

Local interaction with the TCM2 panel takes place through the TCM2 module's simplified four-button membrane switch, four-line display and its three tri-color LEDs. See **Table 5.1** which follows for a complete explanation of the physical interface. Upon power up, the TCM2 will display the start-up screen message similar to that shown in Figure 5.1.

Figure 5.1: TCM2 User Interface at Start-Up

After this start-up message, the TCM2 will immediately begin normal operation and display the Circuit Screen. Once the Circuit Screen is shown, the TCM2 will control each enabled circuit according to its set-points. Figure 5.2 describes the information shown on a typical Circuit Screen in normal operation with two RTD's on Circuit 1 and no alarms. If any alarms are present, a corresponding alarm message will be displayed on the lowest line of the screen, the Alarm Line. If multiple alarm events occur on a circuit, the TCM2 will display one alarm message at a time until all have been cleared.

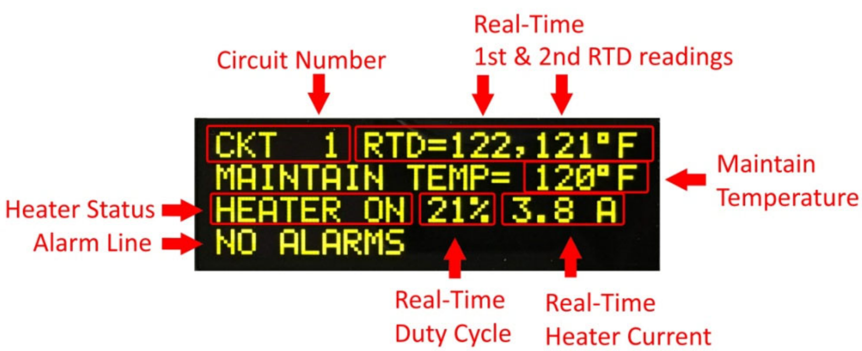
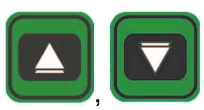


Figure 5.2: Typical Circuit Screen

Table 5.1: TCM2 Keypad and Indicators

Key/Indicator	Description		Function
	Power LED	Green: Red:	Power On System Fault
	Circuit 1 and Circuit 2 LED	Off: Green: Flashing Yellow: Solid Yellow: Flashing Red: Solid Red:	Heater OFF No Alarms & Heater ON One or more Unacknowledged ALARM Present One or more Acknowledged ALARM Present Unacknowledged TRIP or RTD fault Acknowledged TRIP or RTD Fault
	Main Menu		Enters Main Menu Returns to Circuit Screen from Main Menu Returns to Main Menu from Submenu
	Up and Down Arrow Keys		Navigation Value Changes
	Acknowledge/Accept Key		Acknowledge Alarms Reset Trips Enter Submenu Accept Change

5.2 Basic Navigation

At the Circuit Screen, alternate between circuits 1 and 2 using & . Acknowledge Alarms and reset Trips using . Press to access the Main Menu of the TCM2.

Figure 5.3: Main Menu

The Main Menu gives the user access to all set-points and configuration options. Use & to navigate the Main Menu and to enter a submenu. For submenus with circuit specific settings, for example, MAINTAIN TEMP or RTD SETTINGS, use & to switch between circuits. In View Mode, where editing is prohibited, simply returns to the Main Menu. In Program Mode, selects a circuit for set-point editing.

Figure 5.4: Programming Maintain Temperature

Use & to change a value, then to accept the change and move on to the next set-point or setting, or press to cancel the change and return to the Main Menu. To return to the Circuit Screen from the Main Menu, press . See **Table 6.1**, in **Part 6: Accessing Control Settings** for a list of Main Menu Options.

5.3 Alarms

In the event that the measured conditions of the heat trace circuit fall outside the user-defined parameters, the TCM2 will notify the user in four ways, the Alarm Line of the display, tri-color LEDs, digital outputs and through RS-485 communications. When an alarm condition first occurs, the corresponding tri-color LED will flash yellow, the common alarm digital output will annunciate and a message will appear on the Alarm Line of the corresponding Circuit Screen to inform the user of the type of alarm present. Pressing will acknowledge the alarm, deactivate the digital output, change the tri-color LED from flashing yellow to solid yellow and “ACK” will be displayed after the alarm message on the Alarm Line of the display. Alarms will automatically clear when the alarm condition is no longer present.

5.4 Trips

In the event that the measured conditions of the heat trace circuit go beyond the TRIP settings of the circuit, the circuit will trip, i.e. turn off. When a circuit trips, the circuit will be deactivated, the corresponding tri-color LED will flash red, the common TRIP digital output will annunciate and a corresponding message will be displayed on the Alarm Line of the display. A TRIP event is different from an ALARM event in that the heat trace circuit is deactivated and will remain deactivated until the circuit is manually reset by the user.

For Temperature TRIPS pressing ☑ once will acknowledge the TRIP causing the circuit LED to stop flashing and stay solid red and the common TRIP digital output to deactivate. To reset a high temperature TRIP and reactivate the circuit, ☑ must be pressed again.

For heater current and ground/earth fault TRIPs, pressing ☑ will reset the TRIP, cause the common TRIP digital output to deactivate, the circuit LED to stop flashing red and the TCM2 will attempt to resume normal control.

If the conditions which caused the trip are still present, the circuit will TRIP again.

All alarms, trips and acknowledgements are transmitted via RS-485. Acknowledgements and resets can also be performed remotely from a TraceNet Command system or through a plant DCS systems via ModBus commands.

See **Appendix A** for ModBus Memory Map.

See **Table 5.2** for a comprehensive explanation of alarm messages.

Table 5.2: Alarm Messages

Message	Explanation
RTD FAULT ALARM	An RTD reading is out of range when the resistance exceeds 313 Ω or is less than 48 Ω. In either case, the RTD has been damaged or has been disconnected in service. NOTE: The TCM2 will continue to control off of a second undamaged RTD when available.
LOW TEMP ALARM	The measured temperature has fallen below a value equal to the LOW TEMPERATURE ALARM set-point.
HIGH TEMP ALARM	The measured temperature has risen above a value equal to the HIGH TEMPERATURE ALARM set-point but has not yet risen above a value equal to the HIGH TEMPERATURE TRIP/HIGH set-point.
HIGH TEMP TRIP (HIGH HIGH TEMP)	If HIGH TEMPERATURE TRIP is ON (OFF), this message will be displayed if the measured temperature rises above a value equal to the HIGH TEMPERATURE TRIP (HIGH) set-point.
HIGH GROUND CURR	The measured ground/earth leakage current has risen above the GROUND CURRENT ALARM set-point but not above the GROUND CURRENT TRIP/ALARM2 set-point.
GROUND CURR TRIP (HIGH HIGH GROUND)	If GROUND CURRENT TRIP is ON (OFF), this message will be displayed if the measured ground/earth leakage current rises above the GROUND CURRENT TRIP (HIGH) set-point.

Table 5.2: Alarm Messages (Continued)

Message	Explanation
LOW AMPS ALARM	The measured heater current has fallen lower than the LOW CURRENT ALARM set-point.
HIGH AMPS ALARM	The measured heater current rise is higher than the HIGH CURRENT ALARM set-point but not above the HIGH CURRENT TRIP/HIGH.
HIGH AMPS TRIP (HIGH HIGH AMPS)	If HIGH CURRENT TRIP is ON (OFF), this message will be displayed if the measured heater current is higher than the HIGH CURRENT TRIP (HIGH) set-point.
CKT FAULT ALARM	Indicates that a control relay was nonresponsive during a SELF-TEST or that heater current was detected when the circuit was off.

6 Accessing Control Settings

6.1 Password Protection

The TCM2 module features password protection for settings. The user has the option to set a four-digit numerical password which must be entered in order to authorize changes to any set-point or setting. Without the password, all setting and set-points may be viewed, alarms/trips may be acknowledged and circuits may be reset but no settings or set-points may be modified. When the correct password is entered, the TCM2 enters Program Mode where changes are authorized for 30 minutes. After the 30 minutes has passed, the password will again be required. The default password is 0000.

Figure 6.1: Enter Password to enter Program Mode

By default, password protection is disabled. The first line of the Main Menu displays whether the control module is in View Mode or Program Mode (See **Figure 6.1**). To enable the password, enter the Main Menu and select PASSWORD SETTINGS. Change PASSWORD from OFF to ON and enter a password using & to change each number and to select the number and confirm.

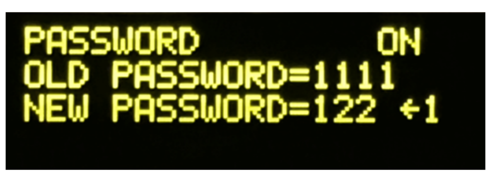


Figure 6.2: Enable/Disable Password or Change Password

6.2 Adjusting Set-points

To adjust the control parameters of the TCM2 module, be sure first, to enter Program Mode by entering the correct password or by disabling password protection as per the previous section. Then, using &, navigate to the desired submenu and press . **Table 6.1** shows a complete listing of all submenus as well as each set-point and setting contained within and their valid ranges. For set-points or settings which apply only to one circuit, for example MAINTAIN TEMP, the desired circuit must be selected upon entering the submenu using & . Pressing , selects the circuit and advances the cursor to the first set-point or setting available for editing. Use & to change the value and to accept the new value and advance the cursor to the next set-point or setting available for editing. When finished editing within a submenu, use to return to the Main Menu. When finished making changes, press to return to the Circuit Screen from the Main Menu.

Table 6.1: Main Menu Options

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
MAINTAIN TEMPERATURE	Individual Circuit	MAINTAIN TEMPERATURE	-129°C to 600°C; -200°F to 1112°F (LOW TEMP ALARM to HIGH TEMP ALARM) *see **Section 7.4** for Ambient setting	1°
		BANDWIDTH (Control Band)	1°C to 300°C; or 1°F to 300°F	1°
RTD SETTINGS	Individual Circuit	NUMBER OF RTDS	1 or 2	
		RTD FAULT POWER	0 – 100%	1 %
HIGH TEMP ALARMS	Individual Circuit	TRIP or HIGH (HIGH is a higher level alarm if HIGH TEMP TRIP is OFF)	HIGH TEMP ALARM to 1112°F or 600°C	1°
		ALARM	MAINTAIN TEMP+BANDWIDTH+1 to HIGH TEMPERATURE TRIP (HIGH)	1°
		HIGH TEMP SEEN	RESET = Y or N	1°
LOW TEMP ALARM	Individual Circuit	LOW TEMP ALARM	-200°F or -200°C to MAINTAIN TEMP	1°
		LOW TEMP SEEN	RESET = Y or N	1°
GROUND CURRENT	Individual Circuit	GROUND CURRENT (real-time ground/earth fault current measurement)	0-225 mA	1 mA
		TRIP or HIGH (HIGH is a higher level alarm if GROUND CUR TRIP is OFF)	GROUND CURRENT ALARM to 225 mA	1 mA
		GROUND CURRENT ALARM	20 to GROUND CURRENT TRIP (HIGH)	1 mA
HEATER CURRENT	Individual Circuit	HEATER CURRENT (real-time heater current measurement)	0.0 A to 240.0 A	0.1 A
		HEATER POWER CLAMP (FOR ON/OFF SSR only)	0 – 100%	1 %
HIGH CURRENT ALARMS	Individual Circuit	TRIP or HIGH (HIGH is higher level alarm if HEATER CUR TRIP is OFF	HIGH CURRENT ALARM to 245.0 A	0.1 A
		ALARM	1.0 A to HIGH CURRENT TRIP (HIGH)	0.1 A

Table 6.1: Main Menu Options (Continued)

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
LOW CURRENT ALARM	Individual Circuit	ALARM	0.0 A to HIGH CURRENT ALARM -1.0A	0.1 A
HEATER ENABLE	Individual Circuit	HEATER	ENABLED, FORCED ON or DISABLED	
		CONTROL (Control Method)	ON/OFF MEC, ON/OFF SSR, PROPORTIONAL, AMBIENT, AMBIENT APCM (See **Section 7.1** for Control Method)	
CONFIGURATION	Both Circuits	GROUND CUR TRIP	ON or OFF	
		HEATER CUR TRIP	ON or OFF	
		HIGH TEMP TRIP	ON or OFF	
		ALARM ON (Digital Outputs Activate On…)	ALL ALARMS or TEMP ONLY	
		ALARM OUTPUT NRM (Alarm Outputs Normally)	ON or OFF	
		RTD UNITS (Temperature Units)	°C or °F	
		APCM CYCLE TIME	20, 25 or 33 min	
		AUTO SELF TEST	OFF or every 2 – 99 hours	1 hour
		START UP DELAY	0-30 min	1 min
		SOFT START	1 – 8 min	1 min
		FIRST CIRCUIT NUMBER	0-99	1
		SCREEN SAVER	ON or OFF	
		LANGUAGE	English, Spanish, Russian	
		SELF TEST	▲ for Self-test, ▼ for Ground Test	

Table 6.1: Main Menu Options (Continued)

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	Precision
DATA HIGHWAY	Controller	NETWORK ID	1-247	1
		MODBUS Protocol	ASCII 7, 2, NP or RTU 8, 1, NP	
		BAUD RATE	9600, 19200, 38400, 57600	
ENTER PASSWORD	Controller in View Mode	PASSWORD	0000 – 9999	
PASSWORD SETTINGS	Controller in Program Mode	PASSWORD	ON or OFF (enable or disable password protection)	
		NEW PASSWORD	0000-9999 (DEFAULT = OLD PASSWORD)	
		OTHER SETTINGS (See below)	Seen after New Password Entered	
OTHER SETTINGS	Controller	FIRMWARE version	Major.Minor version	
		HOURS IN USE	Time on from manufacture	
		CID (Chip Identifier)	Family# + Unique Identifier	

7 Heat Trace Control and Monitoring

7.1 Control Method

To provide the most flexible and application specific heat trace solution, the TCM2 is capable of controlling using several different algorithms or control methods. These include ON/OFF MEC, ON/OFF SSR, Proportional and Ambient Proportional Control (APC and APCM). Each circuit's control method is independently configurable.

ON/OFF MEC

The simplest form of control is ON/OFF MEC. This simply turns the heat trace on when the RTD reading falls below the Maintain Temp and turns it off when the RTD read is above the Maintain Temp plus the control band (bandwidth). This control method is intended for use in applications using mechanical relays to switch the heat trace.

ON/OFF SSR

ON/OFF SSR adds the Soft Start feature to ON/OFF control. This control method takes advantage of the Solid-State Relay's high switching life to decrease temperature overshoot. Under ON/OFF SSR control, the heat trace will turn on and off the same way it does in ON/OFF but will gradually increase the duty cycle by way of cycle-omission from 18% to 100%. The duration of this gradual increase, or Soft Start, can be adjusted in the Configuration submenu.

Proportional

In Proportional control, the heat trace is on at a 100% duty cycle below and up to the Maintain Temp and the duty cycle decreases linearly to 18% at the Maintain Temp plus the control band. This control method is ideal for process sensing applications but is not suitable for applications using mechanical relays.

Ambient & Ambient APCM

See **Section 7.4**, **The TCM2 in Ambient Sensing Applications** for full explanation of this control method.

7.2 Setting the Control Method

Before attempting to change settings and set-points, be sure the TCM2 is in Program Mode. To determine whether the control module is in View Mode or Program Mode, check the first line of the Main Menu. If in View Mode, first enter the password to enter Program Mode (see **Section 6.1 Password Protection** for more information).

Figure 7.1: Main Menu in Program Mode

Then enter the HEATER ENABLE submenu. Use & to move to the circuit in question and to select the circuit. This will move the cursor to the first option, HEATER, which allows enabling, disabling or forcing ON a circuit. Change the setting and press or just press to keep the current setting and move to the next option, CONTROL. This sets the Control Method for this circuit. See **Section 7.1** for a complete explanation of the CONTROL options. Use & to choose the desired Control Method and to accept the change and move the cursor back to the top of this submenu. From here another circuit may be selected or press to return to the Main Menu.

7.3 The TCM2 in Process Sensing Applications

The control method which provides the most tightly controlled temperature and highest energy efficiency is Proportional control with 1 or 2 RTDs per heat trace circuit. When configured with two RTD sensors, the TCM2 will control off of the lowest reading and alarm off of the highest reading. Both RTD readings will be displayed on the Circuit Screen. In the case of process sensing control, one must be aware of the normal flow directions within the process piping and only group process piping having a common flow condition with the control sensors. A failure to do so can result in non-flowing areas cooling and freezing when the flowing portions have appropriately turned the heat trace circuit off.

7.4 The TCM2 in Ambient Sensing Applications

The TCM2 may also be configured for Ambient Proportional Control (APC). One or two RTD's may be used to sense ambient temperatures in the process area. Under the APC method, the HEATER 100% and HEATER OFF are shown in place of MAINTAIN TEMP and BANDWIDTH. HEATER 100% should be set to the lowest expected ambient temperature. HEATER OFF should be set to the temperature at which the heat is no longer required.

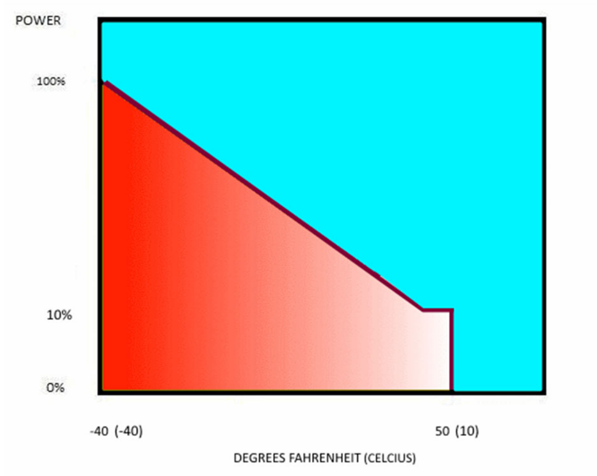


Figure 7.2: APC Power vs Temperature

As shown in Figure 7.2, at the lowest expected ambient temperature the heat trace will operate at 100% power and then ramp down to a 18% power level at HEATER OFF. If the ambient rises above this value, the heat trace will then turn off. So, for example, if the lowest expected ambient temperature around a given process unit is -40°F (-40°C), then one would set the circuit to operate using APC, and set HEATER 100% to -40°F (-40°C). HEATER OFF would be set to 50°F (10°C). A feature unique to the TCM2 among TraceNet controllers is the capability of using mechanical relays for ambient control. When using mechanical relays, the ambient algorithm changes the period over which duty cycle is adjusted. Instead of using cycle-omission over a period of about one second, the duty cycle period is set to a cycle time of 20, 25 or 33 minutes. This control method may also be used in applications where, under AMBIENT control, self-regulating cables operate in startup mode and can cause high current readings and alarms. In certain applications, it may be desirable to have ambient control but also to have one RTD sensor on the pipe for high temperature alarming. This is possible without further configuration. Just set the HIGH TEMP ALARM at the desired temperature. When using AMBIENT or AMBIENT APCM, LOW TEMP ALARM is disabled but the HIGH TEMP ALARM remains active. It is also possible to use a single RTD on both circuits by simply connecting both RTD inputs to the same RTD (i.e. connecting A to A, B to B and B to B).

APC control is not recommended where steam outs and high exposure temperature process conditions are expected and where the heat-trace due to its inherent characteristics cannot be operated during such events.

7.5 Single-Circuit 3-Phase

A new feature unique to the TCM2 among the TraceNet family of control and monitoring systems is the ability to directly monitor all three phases of a 3-phase system. In this single circuit 3-phase option, the TCM2 will monitor and display all three current readings on the Circuit Screen. Once configured for 3-phase operation there are no additional options to configure to begin normal operation. A high or low current condition on any phase or ground/earth fault condition will result in an alarm or trip as per the circuit settings and set-points. This is a factory configuration.

Figure 7.3: Circuit Screen in Single-Circuit 3-Phase Operation

8 The TCM2 Data Highway Communications

The TCM2 is provided with RS-485 communications. This allows for communication via Modbus ASCII or RTU protocols to a TraceNet Command System and/or to the facility's Distributed Control System (DCS). The TCM2 is also provided with an auxiliary 24 VDC power source which can an optional serial to Ethernet converter for applications where Ethernet is preferred. Through these communication links, all of the operating parameters which are programmable at the module can be accessible at the central PC workstation or DCS system console.

For communications linking information between the TCM2 and a PC workstation, refer to the TraceNet Command Operating Guide. Through the TraceNet Command System, the user has remote access to all the set-points and settings in the TCM2, including the ability to remotely view all parameters in real-time[1], acknowledge alarms and reset tripped circuits. The TCM2 Data Highway uses Modbus over RS-485, a world-wide standard in reliable industrial communications. Available with two user selectable protocol configurations and four common Baud rates, the TCM2 is ready to be integrated into the vast majority of current user systems including Thermon legacy HeatChek® control systems. **Appendix A** shows the memory map which should be used by DCS programmers to integrate the TCM2 into the plant's DCS. Current systems utilizing Thermon's TraceView or TraceView Network Explorer will require an upgrade to the new TraceNet Command system.

To access the TCM2 communications settings, enter the DATA HIGHWAY submenu (for help navigating to submenus see **Basic Navigation** in **Section 5** of this manual.)

Figure 8.1: Data Highway

[1]Installations with high circuit counts may take longer to update circuit information

The DATA HIGHWAY submenu allows the user to set the Network ADDRESS of the TCM2 to a number between 1 and 247, the protocol configuration to either RTU 8, 1, NP or ASCII 7, 2, NP and the baud rate to either 9600 (if used on the same network as legacy Thermon HeatChek systems), 19200, 38400 or 57600.

For best results, a 120 Ω shielded twisted-pair cable is recommended. The Data Highway port on the TCM2 is isolated to 5 kVrms with protection against ESD to 15 kV. For shielding to be effective, the shield should be grounded on one side but not on both.

TCM2 panels can also be configured with reliable serial to Ethernet converters for easy IP connectivity.

9 System Start-Up

All heat trace circuits should be properly terminated and meggered prior to energizing the heat trace power distribution and control panels. In addition, all pipes should be insulated and weather sealed to achieve the expected heat up and temperature maintenance performance of the system.

9.1 Initial Start-Up Procedure

Heat trace circuits are on independent circuit breakers from the TCM2 controller. Any time that the TCM2 panel must be opened to gain access to the programming of the controller, the installer shall verify that all heat trace circuits are disconnected at the circuit breakers. This is done to provide protection from higher voltages while maintaining power so that the installer may program the controller.

If the equipment is used in a manner not specified in this Guide, protections provided by the equipment may be impaired.

9.2 Troubleshooting Tips

When starting up a newly installed heat trace and control and monitoring system, it is not uncommon to encounter numerous alarm and trip events. Data entry errors, unanticipated temperature overshoots due to system inertia or too tight control band settings, and incomplete installation details are just a few of the many contributing factors to this result. A table of Troubleshooting Tips is provided in **Appendix C** to assist during start-up.

10 Maintenance

Preventive maintenance consists of inspection, testing, checking connections and general cleaning of equipment at scheduled intervals. The maintenance recommendations that follow are intended to support and in some cases add to those procedures detailed in the facility's Planned Maintenance System (PMS). In case of conflicts, contact the project engineer for resolution. When carrying out the scheduled maintenance program, the following safety precautions should be observed.

10.1 Safety Precautions

The heat tracing can be powered by the project specified nominal voltages ranging from 100 to 600 VAC. It is important that only authorized trained personnel conduct these maintenance and service activities. Before conducting any maintenance or service procedure, exercise required lockout and tag out procedures at the appropriate circuit breakers. Additionally, test within the control panel to ensure that the specific heat tracing and control circuit of interest is fully de-energized and the equipment is grounded. See **Section 9.1** for more information.

If it becomes necessary to service or test live equipment, the following instructions must be followed:

Use one hand when servicing the equipment. Accidental death or severe injury may occur especially if a current path is created through the body from one hand to the other.

First, de-energize the equipment. To de-energize any capacitors connected into the circuits, temporarily ground the terminals where work is to be done.

Connect the multi-meter/instrument to the terminals of interest using a range higher than the expected. Make sure that personnel are not grounded whenever a need arises to adjust equipment or test circuit operation. Verify that all test equipment used is properly maintained and safe for the intended use.

Without touching the multi-meter/instrument, energize the equipment and read the values indicated on the multi-meter/instrument.

Remove the test leads after de-energizing the circuit of interest.

To avoid electrostatic discharge, clean the module only with a cloth dampened with water.

11 Notes

12 Appendix A: Memory Map

Table 12.1: Circuit Measurement and Status (Read Only)

Function Code(s)	Address	Description	Values
04	100	Alarm Acknowledge Circuit 1	See **Table 12.2**
04	101	Alarm Acknowledge Circuit 2	
04	102	Temp RTD1 Circuit 1	Temp = value x 10
04	103	Temp RTD1 Circuit 2	Temp = value x 10
04	104	Temp RTD2 Circuit 1	Temp = value x 10
04	105	Temp RTD2 Circuit 2	Temp = value x 10
04	106	Control Temp Circuit 1	Temp = value x 10
04	107	Control Temp Circuit 2	Temp = value x 10
04	108	Control RTD Circuit 1	
04	109	Control RTD Circuit 2	
04	110	Ground/Earth Current Circuit 1	
04	111	Ground/Earth Current Circuit 2	
04	112	Percent ON Circuit 1	
04	113	Percent ON Circuit 2	
04	114	Heater Current CT 1	
04	115	Heater Current CT 2	
04	116	Heater Current CT 3	
	117-119	No data	
04	120	Alarm Status Circuit 1	
04	121	Temp RTD1 Circuit 1	Temp = Value x 10
04	122	Temp RTD2 Circuit 1	Temp = Value x 10
04	123	Control Temp Circuit 1	Temp = Value x 10
04	124	Control RTD Circuit 1	RTD 1 or RTD 2
04	125	Ground/Earth Current Circuit 1	
04	126	Percent ON Circuit 1	
04	127	Heater Current CT 1	
04	128	Heater Current CT 2	
04	129	Heater Current CT 3	

Table 12.1: Circuit Measurement and Status (Read Only) Continued

Function Code(s)	Address	Description	Values
04	130	Alarm status Circuit 2	
04	131	Temp RTD1 Circuit 2	Temp = Value x 10
04	132	Temp RTD2 Circuit 2	Temp = Value x 10
04	133	Control Temp Circuit 2	Temp = Value x 10
04	134	Control RTD Circuit 2	RTD 1 or RTD 2
04	135	Ground/Earth Current Circuit 2	
04	136	Percent ON Circuit 2	
04	137	Heater Current CT 2	

Table 12.2: Alarm Status/Acknowledge

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High Current Trip	Not Used	Circuit OFF	Ground/Earth Fault Trip	High Temp Trip RTD2	High Temp Trip RTD 1	RTD2 Fault	RTD1 Fault	High Current Alarm	Low Current Alarm	Circuit Fault	Ground/Earth Fault Alarm	High Temp Alarm RTD2	High Temp Alarm RTD 1	Low Temp Alarm RTD 2	Low Temp Alarm RTD 1

Table 12.3: Trips Enable/Disable Bits

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Heater Current Trip	Not Used	Not Used	Ground/Earth Current Trip	High Temp Trip RTD2	High Temp Trip RTD 1	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Table 12.4: Circuit Measurements/Status

Function Code(s)	Address	Description	Values
03	0	Alarm Acknowledge Circuit 1	See **Table 12.2**
03	1	Alarm Acknowledge Circuit 2	
03	2	Maintain Temp Circuit 1	
03	3	Maintain Temp Circuit 2	
03	4	Control Band Circuit 1	
03	5	Control Band Circuit 2	
03	6	High Temp Trip RTD 1 Circuit 1	
03	7	High Temp Trip RTD 1 Circuit 2	
03	8	High Temp Trip RTD 2 Circuit 1	
03	9	High Temp Trip RTD 2 Circuit 2	
03	10	High Temp Alarm RTD 1 Circuit 1	
03	11	High Temp Alarm RTD 1 Circuit 2	
03	12	High Temp Alarm RTD 2 Circuit 1	
03	13	High Temp Alarm RTD 2 Circuit 2	
03	14	Low Temp Alarm RTD 1 Circuit 1	
03	15	Low Temp Alarm RTD 1 Circuit 2	
03	16	Low Temp Alarm RTD 2 Circuit 1	
03	17	Low Temp Alarm RTD 2 Circuit 2	
03	18	High Ground/Earth Current Trip Circuit 1	
03	19	High Ground/Earth Current Trip Circuit 2	
03	20	High Ground/Earth Current Alarm Circuit 1	
03	21	High Ground/Earth Current Alarm Circuit 2	
03	22	High Current Trip Circuit 1	
03	23	High Current Trip Circuit 2	
03	24	High Current Alarm Circuit 1	
03	25	High Current Alarm Circuit 2	
03	26	Low Current Alarm Circuit 1	
03	27	Low Current Alarm Circuit 2	
03	28	Circuit 1 Status	See **Table 12.5**
03	29	Circuit 2 Status	
03	30	Control Method Circuit 1	0 = ON/OFF MEC 1 = ON/OFF SSR 2 = Proportional 3 = Ambient 4 = Ambient APCM
03	31	Control Method Circuit 2	
03	32	Number of RTD Circuit 1	
03	33	Number of RTD Circuit 2	
03	34	Power Clamp Circuit 1	
03	35	Power Clamp Circuit 2	

Figure 12.4: Circuit Measurements/Status (Continued)

Function Code(s)	Address Hex	Decimal	Description	Values
03	0x0024	36	RTD Fault Clamp Circuit 1	
03	0x0025	37	RTD Fault Clamp Circuit 2	
03	0x0026	38	Trips Enable/Disable Circuit 1	See **Table 12.3**
03	0x0027	39	Trips Enable/Disable Circuit 2	
03	0x0028	40	High Temp Seen RTD 1 Circuit 1	
03	0x0029	41	High Temp Seen RTD 1 Circuit 2	
03	0x002A	42	High Temp Seen RTD 2 Circuit 1	
03	0x002B	43	High Temp Seen RTD 2 Circuit 2	
03	0x002C	44	Low Temp Seen RTD 1 Circuit 1	
03	0x002D	45	Low Temp Seen RTD 1 Circuit 2	
03	0x002E	46	Low Temp Seen RTD 2 Circuit 1	
03	0x002F	47	Low Temp Seen RTD 2 Circuit 2	

Table 12.5: Circuit Status Bits

Bit	Description
3	Forced OFF
2	Forced ON
1	Tripped
0	Enabled

Table 12.6: Read Only Controller Data

Function Code(s)	Address	Description	Values
03	2008	Language	0 = English; 1 = Spanish; 2 = Russian;
03	2009	Password	0000 – 9999
03	2010	Password Enable	0 = Disabled; 1 = Enabled
03	2011	TCM2 Type	0 = 2-circuit (Default) 1 = 1-circuit, 1 CT; 2 = 1-Circuit, 2 CTs; 3 = 1-Circuit, 3 CTs
03	2012	Serial number low	
03	2013	Serial number med	
03	2014	Serial number high	
	2015	No Data Here	
03	2016	Circuit Offset	
	2017	No Data Here	
03	2018	Screen Saver	
	2019	Max Off Current	
03	2020-2021	No Data Here	
03	2022	Relay Output Voltage	0 = 12 V; 1 = 24 V
	2023	No Data Here	
	2024	Hours in Use	
03	2025	Start Up Delay	
	2026	Soft Start	
03	2027	Ground/Earth Fault Sensitivity	0 = Most Sensitive; 3 = Least Sensitive
	2028-2030	No Data Here	
03	2031	Single Temp Alarms	Should always = 0
03	2032	High Temp Alarm Delay	
	2033-2035	No Data Here	
03	2036	Alarm Relay Type	0 = Normally OFF; 1 = Normally ON
	2037	Alarm Relay Masking	
	2038	No Data Here	
03	2039	Firmware Version Number	
	2040-2043	No Data Here	
03	2044	Self-Test Hours	
	2045	Start self-Test	Non-zero Starts a self-test
03	2046	Units	0 = F; 1 = C

13 Appendix B: Additional Information

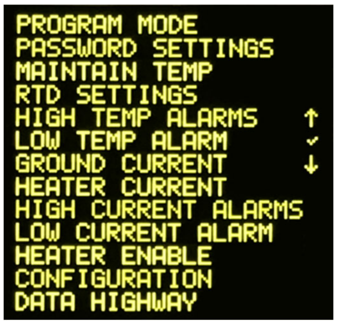


Figure 13.1: Program Mode Menu

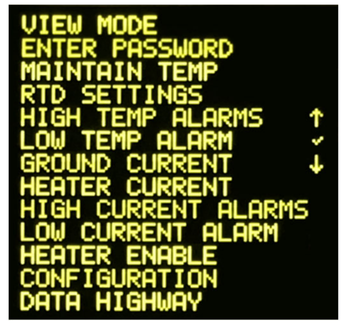


Figure 13.3: View Mode Menu

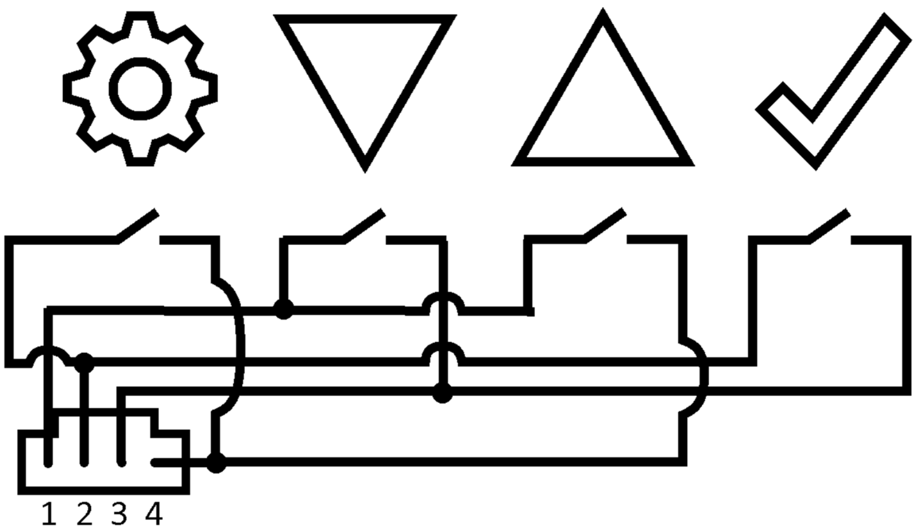


Figure 13.2: External Keypad Wiring Diagram

14 Appendix C: Troubleshooting Tips

Troubleshooting tips are provided here as a beginning point in correcting start-up issues and clearing out alarm and trip events.

High Temperature Reading/Alarm

The following summarizes some of the possible causes and solutions for heat tracing high temperature alarms.

Cause	Possible Solutions
Temperature of product in process line is above alarm set point or the expected reading due to events other than heat tracing such as high processing temperatures, steam-outs, etc.	Let process return to normal condition or adjust alarm set point (if approved by project engineer) to allow for this processing condition.
High alarm setting programmed or expected reading did not consider natural temperature overshoot associated with the control scheme.	Move control set point down to allow for overshoot or raise the high temperature alarm set point (if approved by project engineer). It may also be possible to decrease the control band on the control circuit or adjust the type of control from on-off to proportional.
Improperly located RTD sensor.	Is the RTD sensor installed next to a heated tank or a steam jacketed pump that might cause a higher than expected reading? Is the RTD sensor on the heater itself? Move the RTD sensor to location more representative of the majority of the piping. Is the sensor location representative for properly controlling under all flow scenarios? Review location of the RTD(s) with respect to the known process flow patterns which occur and change as appropriate.

Wrong insulation size, type, or thickness on all of the line being traced.	Measure circumference of insulation, divide by π, and compare to insulation diameter charts for proper over sizing. Check insulation type and thickness against design specification. Replace insulation or review system design for alternate operating possibilities.
Wrong insulation size, type, or thickness on part of the line being traced.	The insulation system should be as specified in the design for the entire circuit being traced. Having a lower heat loss on one part of the circuit and higher heat loss insulation on the other part of the circuit (perhaps where the RTD sensor is) will result in the better insulated line being too hot. Redo the insulation to assure uniformity and consistency.
Damaged RTD temperature sensor.	Disconnect RTD sensor and measure resistance. Compare to resistance tables for corresponding value of temperature. Compare to pipe or equipment temperature known by another probe or sensor. If different, the RTD sensor may need replacement.
Heat tracing over designed in heat output and or/ due to cable availability or natural design selections available. This can result in higher than expected temperatures due to overshoot (especially when used with on-off control mode). This can also occur in an ambient sensing control modes.	Review design as well as installation instructions. Check heat tracing for presence of proper current. Since replacing the circuit may not be a desirable option here, the first approach should be to adjust the control method which the TraceNet control system has been configured in.
Heat tracing circuits are miswired such that the RTD for circuit 1 is controlling circuit 2, etc.	Trace and recheck field and panel wiring. Use circuit "turn-on" and "turn-off" technique or disconnect RTD’s one at a time to see if the proper RTD failure alarm occurs on the right circuit. Let process return to normal condition or adjust alarm set point (if approved by project engineer) to allow for this processing condition.

Low Temperature Reading/Alarm

The following summarizes some of the possible causes and solutions for heat tracing low temperature readings/alarms.

Cause	Possible Solutions
Temperature of product in process line is below the alarm set point or expected reading due to events other than heat tracing- low pumping temperatures, etc.	Let process operations return to normal conditions and then recheck for alarms. Alternately adjust alarm set point (with project engineers approval) to allow for this process condition.
Low temperature alarm programmed setting or expected reading did not consider natural temperature undershoot associated with control scheme.	Move control set point up to allow for natural undershoot or lower the low temperature alarm set point (when approved by project engineer).
Damaged, open, or wet thermal insulation does not allow the heat provided to hold the desired temperature.	Repair damage to insulation.
Wrong insulation size, type, or thickness on all of circuit being traced.	Measure circumference of insulation, divide by π, and compare to insulation diameter charts for proper over sizing. Check insulation type and thickness against design specification. Replace insulation or review system design for alternate operating possibilities which involve more heat output.
Wrong insulation size, type, or thickness on part of circuit being traced.	The insulation system should be as specified in the design for the entire circuit being traced. Having high heat loss on one part of the circuit and lower heat loss insulation on the other part of the circuit (perhaps where the sensor is) will result in the not so well insulated line being too cold. Redo the insulation to assure uniformity and consistency.

Improperly located RTD temperature sensor.	Is RTD sensor next to pipe support, equipment, or other heat sink? Move RTD sensor to location more representative of the majority of the piping.
Improperly installed RTD temperature sensor or RTD temperature probe.	Permanent RTD temperature sensors are most accurate when installed along the pipe or equipment with at least a foot of probe and sensor wire running along the pipe before exiting through the insulation. Permanent RTD sensors which enter the insulation at 90 degrees may be more sensitive to error associated with them depending on insulation installation or how well the sensor is physically attached. Adjust control set point to compensate for any accuracy offset. When using a 90 degree RTD probe for diagnostics, verify this measurement technique on a known pipe in the same general temperature range and insulation configuration.
Damaged RTD sensor.	Disconnect RTD sensor and measure resistance. Compare to resistance tables for corresponding value of temperature. Compare to pipe or equipment temperature known by another probe or sensor. If different, the RTD sensor may need replacement.
Heat tracing undersized, improperly installed or damaged.	Review design/installation. Check heat tracing for presence of proper current and also meg for dielectric resistance. Repair or replace heat tracing.
Heat tracing circuits are wired such that the RTD for circuit A is controlling circuit B, etc.	Trace and recheck field and panel wiring. Use circuit "turn-on" and "turn-off" technique or disconnect RTD’s one at a time to see if the proper RTD failure alarm occurs on the right circuit.

Heat tracing does not heat. Breaker has been switched off due to maintenance activities or has possibly malfunctioned.	As soon as maintenance activities cease and after conferring with operations manager, switch breaker back ON. Note that some period of time will elapse before the temperature alarm goes away (pipes and equipment take time to heat up).

RTD Sensor Alarm

The following summarizes some of the possible causes and solutions for a heat tracing RTD sensor reading alarm.

Cause	Possible Solutions
RTD connections are wired improperly or have become loose.	Confirm wiring and connections are correct.
RTD has failed open or has extremely high resistance or RTD has failed shorted or has very low resistance.	Has lightning damaged the sensor? Maybe the piping has had some welding going on nearby? Maybe the RTD has gotten wet? Replace RTD.

Communications Alarm

The following summarizes some of the possible causes and solutions for heat tracing communications alarms.

Cause	Possible Solutions
Improperly set controller address, duplicate addresses or improper configuration firmware/software.	Change controller address or reconfigure firmware/software.
Loose or open connection in RS485 line.	Recheck for continuity in all communication lines.
Too many modules in network.	Check network limitations versus actual configuration.
Too long of an accumulated communication distance.	Consider the addition of a repeater.
Too many reflections of signal usually caused by improper terminations in net-work.	Add termination resistors as appropriate.

Circuit Fault Alarm

The following summarizes some of the possible causes and solutions for heat tracing circuit fault alarms.

Cause	Possible Solutions
Upon initial installation start-up, improper wiring of the relay or low current in heater.	Confirm correct wiring and presence of the heater. Where normal operating amperage is in range of 0 to 250mA, disabling the Self-Test function or adding multiple loops through the current sensing toroid may be required.
During daily operations; possibly indicates relay contact failure.	If relay has failed, replace.
Breaker off.	Turn on breaker after conferring with operations manager.

High Current Readings/Alarms

The following summarizes some of the possible causes and solutions for heat tracing high current readings or alarms.

Cause	Possible Solutions
Self-regulating heater or power limiting heater current may exceed set value during normal operation or start-up operations.	Increase high current alarm set point (if approved by project engineer). For startup operation current alarm nuisances, it may also be desirable to increase the delay time (before a current reading is done after turn on) set in the controller.
Self-regulating or power limiting heater may be operating at cooler than design pipe temperatures due to processing conditions and thus heaters may be drawing higher current values.	Increase high current alarm set point (if approved by project engineer).

Self-regulating or power limiting heater may be operating in its cold start regime.	When reading current on one of these type heaters, it is necessary to read the current at steady state. One may have to wait as long as 5 minutes for heater steady state values. After five minutes the current value will continue to drop as the pipe or equipment begins to warm.
Heater circuit may be longer than anticipated in the design stage.	Verify installed length (if possible) and if different review design. If length is different but performance-wise the “as built” design is acceptable, initiate “as built” drawing change and change controller high current setting.
Wrong heater wattage or heater resistance may be installed.	Check heater set tags or markings on heater cable against installation drawings. As an additional check, disconnect heater from power and measure DC resistance.
Heat tracing may be powered on wrong voltage.	Recheck heater supply voltage.
Current sensing circuitry may have encountered a problem.	Use a different current clamp type meter which is known to be accurate and do a comparative reading. Investigate current measurement circuitry further. Note that one should only read heater currents when the heater is 100% on.
Field heater wiring is improperly labeled and/or connected such that the heater and the circuit number are not matched.	Trace out the circuit wiring from the field back into the panel and subsequently to the controller. Wherever possible, turn the circuit “off” and “on” and watch for an appropriate response. If this is the problem, redo the wiring.

Short circuit in a series resistance circuit	Disconnect heater from power, meg between each of the conductors and ground for proper dielectric rating. If okay, measure resistance of circuit for agreement with design values.

Low Current Readings/Alarms

The following summarizes the possible causes and solutions for heat tracing low current readings/alarms.

Cause	Possible Solutions
Self-regulating or power limiting heater may be operating at higher than design pipe temperatures due to processing conditions and thus heaters may be drawing lower current values.	Decrease low current alarm set-point (if approved by project engineer).
Loss of a branch of the heat tracing circuit.	Measure total current and each branch current. Compare to design values. Check all connections.
Breaker off.	Turn breaker back on after conferring with operations manager.
Heat tracing cable may have been exposed to temperatures in excess of their maximum temperature ratings (excessive steam-out temperatures or upset process temperature events) and could have damaged the heater.	Replace heater.
Controller may be in error in reading current	Use a different current clamp type meter which is known to be accurate and do a comparative reading. If the current measuring circuitry is in error, investigate controls further. Note that one should only read heater currents when the heater is 100% on.

Heater circuit may be shorter than anticipated in the design stage.	Verify installed length (if possible) and if different review design. If length is different but performance-wise the "as built" design is acceptable, initiate "as built" drawing change and change controller low current setting. Check heater set tags or markings on heater cable against installation drawings. As an additional check, disconnect heater from power and measure DC resistance.
Wrong heater wattage or heater resistance may be installed.	Measure pipe temperature and measure steady-state heater current, voltage, and length. Compare to manufacturer's rated power curve. Replace heat tracing cable if necessary.
Heat tracing may be powered on wrong voltage.	Recheck heater supply voltage.
Current sensing circuitry may have encountered a problem.	Use a different current clamp type meter which is known to be accurate and do a comparative reading. Investigate current measurement circuitry further. Note that one should only read heater currents when the heater is 100% on.
Field heater wiring is improperly labeled and/or connected such that the heater and the circuit number are not matched.	Trace out the circuit wiring from the field back into the panel and subsequently to the controller. Wherever possible, turn the circuit "off" and "on" and watch for an appropriate response. If this is the problem, redo the wiring.
Open circuit in a series resistance circuit.	Disconnect heater from power, meg between each of the conductors and ground for proper dielectric rating. If okay, measure resistance of circuit for agreement with design values.

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High Ground/Earth Current Alarm

The following summarizes some of the possible causes and solutions for heat tracing high ground current alarm.

Cause	Possible Solutions
Heat tracing is damaged.	Disconnect heat tracing circuit and determine if alarm clears. If so, repair heat tracing.
Wiring to heat tracing had high leakage current.	Disconnect heat tracing and sequentially disconnect power wiring until the alarm ceases. Check last section removed for damage.
Improper wiring of current sense wires through torroid.	The current sensing toroid must have the outgoing heater current lead and the return current heater lead run through the toroid for a proper ground leakage measurement. Redo wire routing if only one wire has been run through the current sensing toroid.
Heat tracing power wires in a multiple circuit system improperly paired.	If the return current wire in the toroid is from a different circuit the two heater currents will not cancel and leave only leakage to be measured. Correct wiring.
Heat tracing circuit has higher than expected leakage due to circuit length or higher voltage.	Replace the EPD breaker with a higher ground/earth current trip device if available. Where a controller (with variable leakage trip functions) is doing the ground/earth leakage detection function, increase ground/earth leakage alarm set point (if approved by project engineer).

If issues remain after exercising all these possible causes and solutions for heat tracing alarms and trips, contact your nearest Thermon engineering center for assistance and/or for arranging for field service.

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