TCM2-FX

Control Panel for Fire Sprinkler Freeze Protection Systems

Installation, Operation & Maintenance Guide

THERMON

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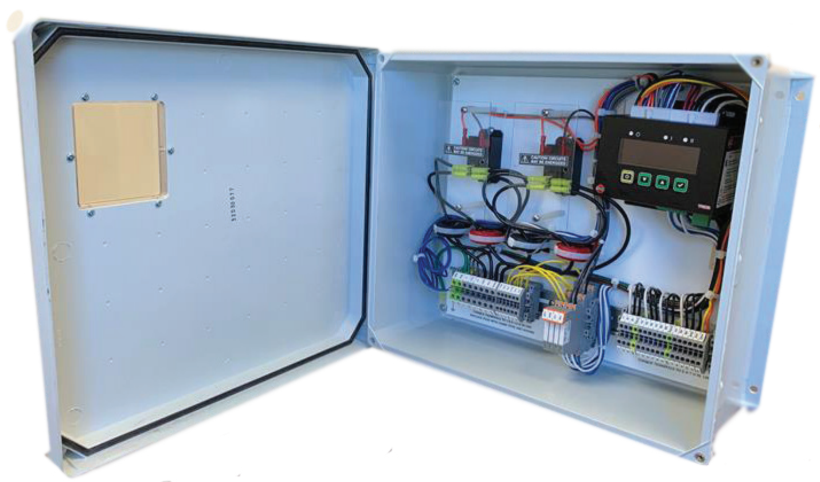

PRODUCT WARRANTY INFORMATION

TCM2-FX Control Panel for Fire Sprinkler Freeze Protection Systems

Installation, Operation & Maintenance Guide

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Section 1: INTRODUCTION

The following serves as a guide and overview of the installation, startup and operation of a TraceNet TCM2-FX 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.

TCM2-FX Control Panel is suitable for use with FLX Heat Trace Cables and Certified Accessories. In the unlikely event that a conflict or uncertainty arises, contact the Thermon engineering support personnel assigned to this project to clarify. Please refer to the Fire Sprinkler Freeze Protection System Installation guide (TEP0615) for additional installation requirements.

The TCM2-FX Control Panel product line included the models listed below.

- TCM2-1-M252/2R-240-I-1P3-0-1-2
- TCM2-1-M252/2R-240-I-1PC3-0-1-2

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

- The TCM2-FX control panels are designed to operate in ambients ranging from -40°F (-40°C) to 113°F (45°C).
- TCM2-FX heat trace control and monitoring systems have been approved/certified for installation and operation in, Installation (ie. Sprinkler systems freeze protection),
- Installation, at altitudes up to 2000 m, and in locations where the Mains supply voltage can fluctuate up to 10%.
- For fire sprinkler application of supply piping and branch lines including sprinkler heads. 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. Ground fault equipment protection is required for each branch circuit, unless applicable codes permit otherwise.

1.2 Initial Inspection and Handling

- The wiring and connections survey recommended is as follows:
- If the servicing of removable electrical connectors is to be conducted, then make certain the area is free of explosive atmospheres.
- If equipment is available, an infrared scan of the interior of the panel cabinet and associated wiring (during operation) is recommended.
- Any unusually high temperatures at connections are usually evidence of poor connections. Tighten connections, repair with new terminations, and/or replace any components which have been exposed to long term overheating. All terminal block connections should be tightened using a torque indicating screwdriver to the levels indicated in Table 1 and project installation drawings.
- Check for corrosion at electrical connections and terminations. Where corrosion of electrical terminals is observed, this may be additional evidence of loose connections and excessive heat. A part replacement may be necessary.
- Inspect wiring for abrasion wear, mechanical damage, and thermal overexposure. Repair or replace any damaged or defective wiring. In all cases where equipment damage is observed, a root cause analysis should be initiated to determine any future corrective action needed to prevent a recurrence.

1.3 The TCM2

The 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.

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

Figure 1.1: TCM2 Control Module

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 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, Standard and System. Trip and Standard are configurable to be normally on or normally off. An audible alarm will sound for any unacknowledged alarms.

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

Section 2: SPECIFICATIONS

TCM2-FX 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-FX Panel Specifications

Parameter	Description
Heat Trace Mains Supply	100 to 277 V~, 50/60 Hz (See **Table 2.2** for Control Module supply information)
Control Points	1 Heat Tracing Circuit
Heat Trace Current	30A
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	ModBus ASCII or RTU, up to 57600 Baud
Control Methods	On/Off MEC, On/Off SSR, Proportional, Ambient or APCM See Section 7.1
Display	4 Line, 20 Character, OLED
Relative Humidity	0 to 90% Non-Condensing
Exterior Panel Operating Temperature	-40 °F to 113°F (-40 °C to 45 °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	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 See Section 7.1
Display	4 Line, 20 Character, OLED
Operating Temperature	-40 °F to 120 °F (-40 °C to 49 °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.

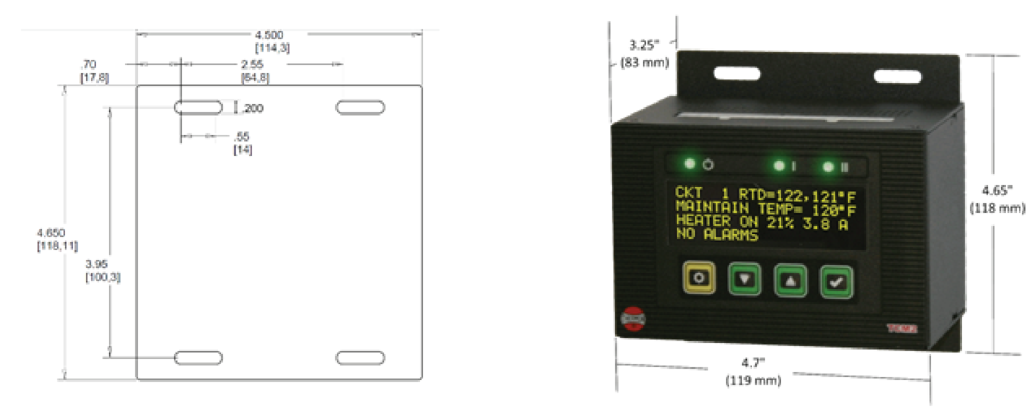


Figure 2.1: TCM2 Module Mounting & Dimensions

Table 2.4: TCM2-FX System Enclosure Options

Enclosure Option	Material	Type	Dimensions (inches)	Dimensions (mm)
P3	Fiberglass	4X (IP54)	16 x 14 x6	406 x 356 x 152
SS3	Stainless Steel	4X (IP54)	17 x 14 x6	407 x 356 x 152
PC3	Polycarbonate	4X (IP66)	18 x 14 x6	408 x 356 x 203

Section 3: MODULE CONNECTIONS AND WIRING

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

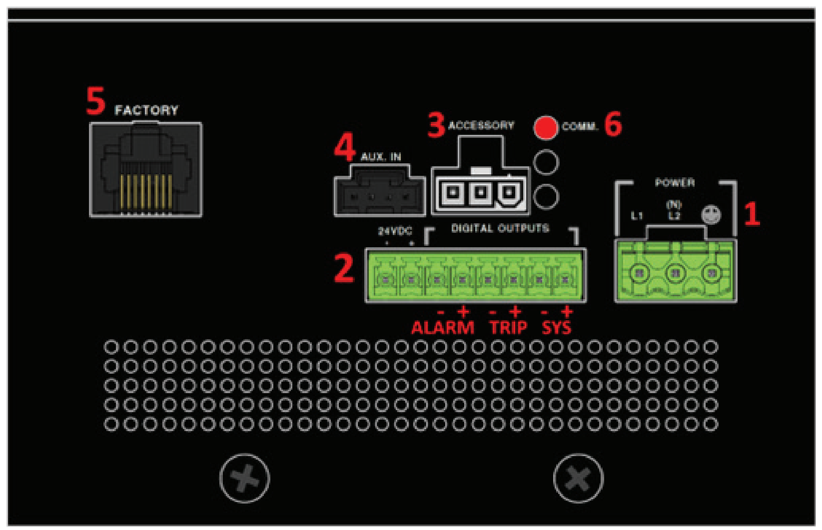


Figure 3.1: Bottom-Side Connections

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. 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.

3.2 Top Side Connections

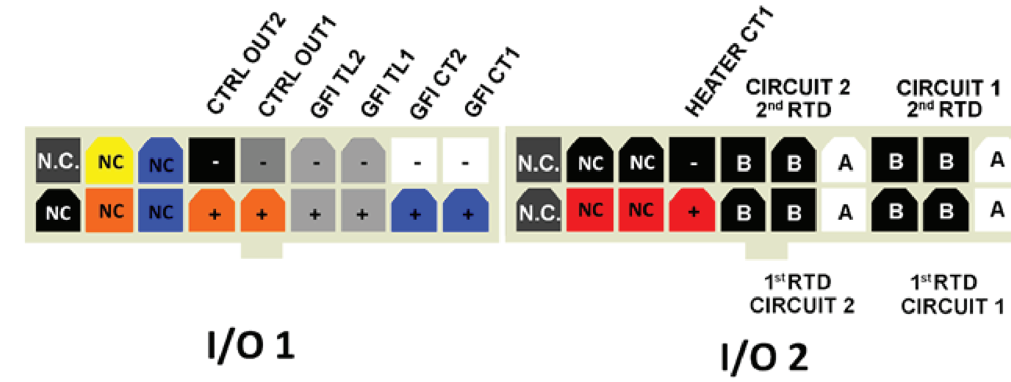


Figure 3.2: Top-Side Connections

- 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.
- GFI CT1 & 2: These are connection points for the ground fault/earth leakage CTs.
- GFITL1 & 2: These are connections for the ground fault/earth leakage interrupt test loop. These wires should be routed through each corresponding ground fault/earth leakage 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.

Section 4: FIELD AND PANEL WIRING

For a successful installation of a TCM2-FX 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.

WARNING - Disconnect all power sources before installation or servicing.
AVERTISSEMENT - Débranchez toutes les sources d'alimentation avant l'installation ou l'entretien.

4.1 Heat Trace and Insulation Installation

The design and monitoring of trace heating systems for fire sprinkler systems shall be in accordance with IEEE std. 515.1. 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.

Keep ends of heating devices and kit components dry before and during installation.

Heat trace shielding is a conductive layer and must be connected to a suitable ground / earthing terminal. The sprinkler system shall also be properly grounded.

For fire sprinkler systems, all installations shall comply with the obstruction requirements of NFPA 13 so that the thermal insulation over the trace heating does not unacceptably obstruct the sprinkler or cover the wrench boss. For upright sprinklers, heat trace and insulation must comply with the below listed requirements.

- Sprigs are typically 1 in iron pipe size (IPS) with 0.5 in thick thermal insulation. The insulation may be oversized to accommodate the heating cable installation, resulting in no greater than 3 in installed outer diameter (OD). (For example, 1 in IPS sprig, insulated with 1.25 in IPS diameter, 0.5 in thick insulation, OD = 2.7 in).
- System installation details of upright sprinkler systems shall specify sprig height and/or arm-over distance to overcome spray pattern obstruction.
- For upright sprinklers only, the sprinkler heads shall be insulated up to the top of the reducing bushing with a taper of 45° to avoid spray-pattern obstruction, as detailed in Figure 14 of IEEE 515.1.
- For trace heating systems for fire sprinkler systems shall be permanently connected to the power supply. If backup power is being provided for the building electrical systems, it shall also provide backup power supply for the trace heating system.

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.**

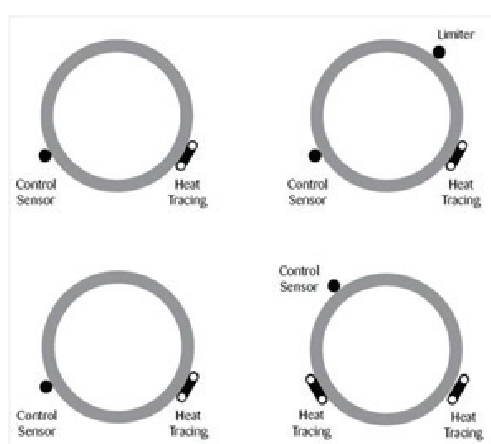


Figure 4.1 RTD Sensor Location

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	0.5 ... 0.6N-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.

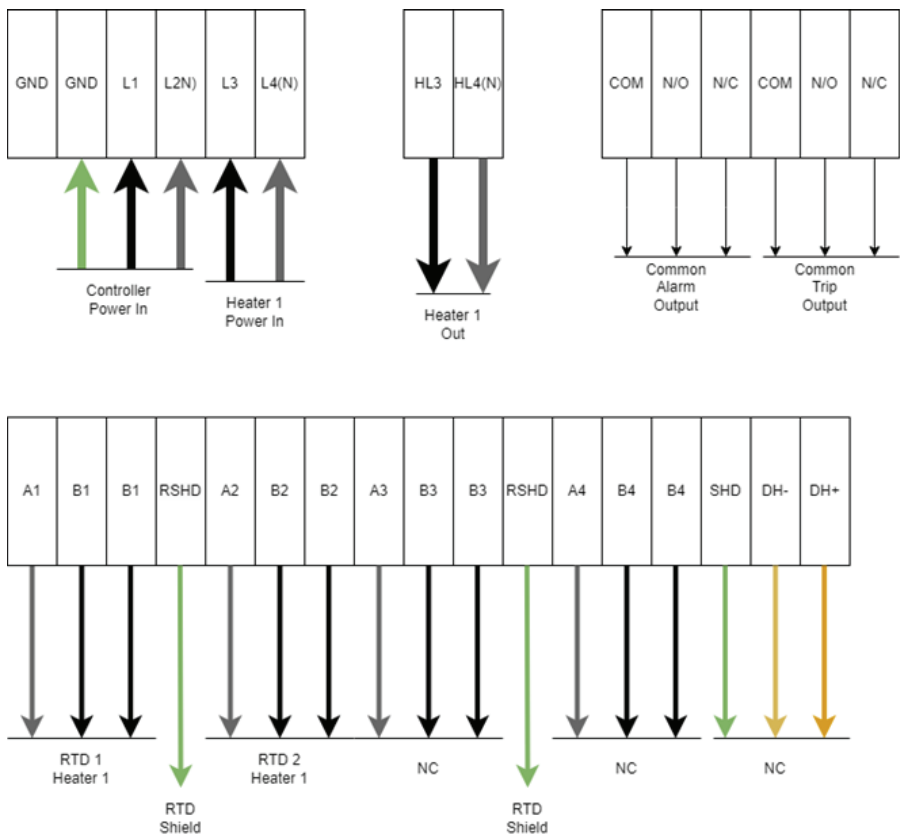
4.4 TraceNet Panel Wiring

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**.

Field Wiring Diagram



4.5 Communication Wiring

For fire sprinkler systems, alarm output shall be connected to any fire detection system monitoring.

4.6 Required Settings

For fire sprinkler systems, Self-Test settings must be turned on and must remain on

Section 5: MONITORING HEAT TRACING CIRCUIT STATUS

5.1 The Interface

Local interaction with the TCM2-FX 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.

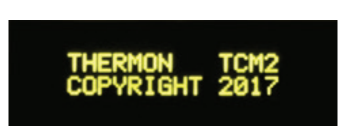


Figure 5.1: TCM2 User Interface at Start-Up

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.

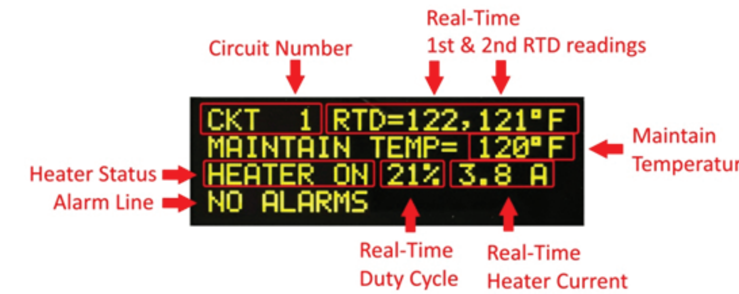


Figure 5.2: Typical Circuit Screen

Table 5.1: TCM2 Keypad and Indicators

Key/Indicator	Description		Function
⏻	Power LED	Green: Red:	Power On System Fault
I, II	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	Main Menu	Enters Main Menu Returns to Circuit Screen from Main Menu Returns to Main Menu from Submenu
▲, ▼	Up and Down Keys	Up and Down Keys	Navigation Value Changes
✔	Acknowledge/Accept Key	Acknowledge/Accept Key	Acknoweldge Alarms Reset Trips Enter Submenu

5.2 Basic Navigation

At the Circuit Screen, alternate between circuits 1 and 2 using and .

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 and to navigate the Main Menu and to enter a submenu.

For submenus with circuit specific settings, for example, MAINTAIN TEMP or RTD SETTINGS, use and 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.

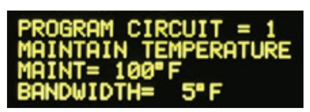


Figure 5.4: Programming Maintain Temperature

Use and 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 five ways, the Alarm Line of the display, tri-color LEDs, digital outputs, and an audible alarm.

When an alarm condition first occurs, the corresponding tri-color LED will flash yellow, the common alarm digital output will annunciate as will the audible alarm, if enabled 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, audible alarm, 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 as will the audible alarm, if enabled 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 and audible alarm 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, causing the common TRIP digital output to deactivate, the circuit LED to stop flashing red, the audible alarm to deactivate and the TCM2 will attempt to resume normal control.

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

Acknowledgements and resets can also be performed remotely 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

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 HIGHTEMPERATURE TRIP (HIGH) set-point.
HIGH GROUND CURRENT	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 CURRENT 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.
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.
alarm type ERROR	Where *alarm type* is one of the above alarm messages indicating which alarm set-points are out of range. For example, HIGH TEMP ERROR, would indicate a problem with the HIGH TEMP ALARM set-point. This could happen if HIGH TEMP ALARM had been mistakenly set below MAINTAIN TEMP set-point or above HIGH TEMP TRIP set-point via the DataHighway. Also, the title of the corresponding submenu would alternately flash with the word ERROR. For this example, HIGH TEMP ALARMS would alternate with ERROR in the main menu.

Section 6: ACESSING 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 and to change each number and to select the number and confirm.

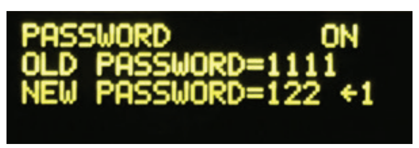


Figure 6.2: Enable/Disable Password or Change Password

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 and , 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 and .

Pressing , selects the circuit and advances the cursor to the first set-point or setting available for editing.

Use and 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 *first menu item in Program Mode	Individual Circuit	MAINTAIN TEMPERATURE	-129°C to E2600°C; -200°F to 1112°F (LOW TEMP ALARM to HIGH TEMP ALARM-1) *see Section 7.4 for Ambient setting	1°
		BANDWIDTH (Control Band)	1°C to 300°C; or 1°F to 300°F (MAINTAIN TEMP + BANDWIDTH not to exceed HIGH TEMP ALARM)	1°
RTD SETTINGS	Individual Circuit	NUMBER OF RTDS	1 or 2	
		RTD FAULT POWER	0%, 18 - 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	Indvidual 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 30.0 A	1 mA
		HEATER POWER CLAMP (FOR ON/OFF SSR only)	0%, 18 – 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 30.0 A	0.1 A
		ALARM	1.0 A to HIGH CURRENT TRIP (HIGH)	0.1 A
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 (See Section 7.1 for Control Method)	ON/OFF MEC, ON/OFF SSR, PROPORTIONAL, AMBIENT, AMBIENT APCM	

Table 6.1: Main Menu Options (Continued)

Menu Option	Applies To	Set-Point/Settings Available	Range/Options	
CONFIGURATION	Both Circuits	GROUND CURRENT TRIP	ON or OFF	
		HEATER CURRENT 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	
		START UP DELAY	0-30 min	
		SOFT START (& Current Alarm Delay)	1-15 *See ON/OFF SSR in Section 7.1	
		FIRST CIRCUIT NUMBER	1 – 98	
		SCREEN SAVER	ON or OFF	
		LANGUAGE	English, Spanish, Russian	
DATA HIGHWAY	Controller	NETWORK ID	1-255	1
		MODBUS Protocol	ASCII 7, 2, NP or RTU 8, 1, NP	
		BAUD RATE	9600, 19200, 38400 or 57600	
ENTER PASSWORD *first menu item in View Mode	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	

Section 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 trace heater 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 power to the trace heater.

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 trace heater 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% (Max duty cycle can be limited using the POWER CLAMP feature in the HEATER CURRENT submenu).

The duration of this gradual increase, or Soft Start, is controlled by the Soft Start option in the Configuration submenu. A Soft Start setting of 1 will increase the duty cycle by 1% ever 1 second, a setting of 2 will increase the duty cycle by 1% every 2 seconds and so on.

The Soft Start setting has the additional function of setting the time, in minutes, that the evaluation of current alarms will be delayed each time the circuit is turned on. This helps avoid nuisance alarms with high in-rush trace heater. This current alarm delay applies to both circuits and all control methods.

Proportional

In Proportional control, the trace heater 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, due to the fast switching, 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 and 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 and 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 trace heater 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 trace heater 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.

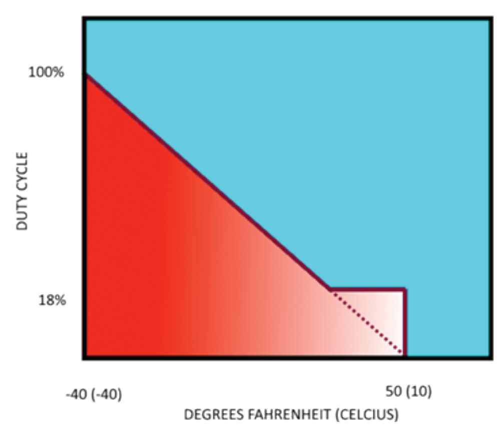


Figure 7.2 APC Power vx Temperature

As shown in Figure 7.2, at the lowest expected ambient temperature the trace heater will operate at 100% power and then ramp down to an 18% power level at HEATER OFF.

If the ambient rises above this value, the trace heater will then turn off. Therefore, 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 control method new to TraceNet controllers is a modified Ambient Proportional Control, APCM. When using APCM, the algorithm uses a longer period over which the duty cycle is adjusted.

Instead of using cycle-omission over a period of about one half second, the duty cycle period is set to a user selectable 20, 25 or 33 minutes.

The algorithm still flows the line in Figure 7.2 but instead of limiting the duty cycle to 18%, there is a minimum on and off time of 1 minute, which corresponds to 5%, 4% or 3%, depending on cycle time. This control method is recommended in applications where, under AMBIENT control, self-regulating cables operate in startup mode and which may cause high current readings and alarms.

In certain applications, it may be desirable to have ambient control while also having one RTD sensor on the pipe for high temperature alarming.

This is possible without further configuration by simply connecting a second RTD and set the HIGH TEMP ALARM to 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 (see Figure 13.4 in Appendix B).

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

Section 8: SYSTEM START-UP

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

8.1 Initial Start-Up Procedure

Trace heater circuits are on independent circuit breakers from the TCM2 controller.

Any time that the TCM2-FX panel must be opened to gain access to the programming of the controller, the installer shall verify that all trace heater 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.

8.2 Troubleshooting Tips

When starting up a newly installed trace heater 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.

Section 9: 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.

9.1 Safety Precautions

The heat tracing can be powered by the project specified nominal voltages ranging from 100 to 277 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.

Section 10: NOTES

11 APPENDIX A: MEMORY MAP

Table 12.1: Circuit Measurement and Status (Read Only)

Function Codes	Address	Description	Values
04	100	Alarm Status Circuit 1	See Table 12.2
04	101	Alarm Status Circuit 2	
04	102	Temp RTD1 Circuit 1	Temp = value ÷ 10
04	103	Temp RTD1 Circuit 2	Temp = value ÷ 10
04	104	Temp RTD2 Circuit 1	Temp = value ÷ 10
04	105	Temp RTD2 Circuit 2	Temp = value ÷ 10
04	106	Control Temp Circuit 1	Temp = value ÷ 10
04	107	Control Temp Circuit 2	Temp = value ÷ 10
04	108	Control RTD Circuit 1	1 = 1st RTD; 2 = 2nd RTD
04	109	Control RTD Circuit 2	1 = 1st RTD; 2 = 2nd RTD
04	110	Ground/Earth Current Circuit 1	Value in mA
04	111	Ground/Earth Current Circuit 2	Value in mA
04	112	Percent ON Circuit 1	%
04	113	Percent ON Circuit 2	%
04	114	Heater Current CT 1	Current = value ÷ 10
04	115	Heater Current CT 2	Current = value ÷ 10
04	116	Heater Current CT 3	Current = value ÷ 10
04	117	No data here	
04	118	Set-Point Error Circuit 1	See Table 12.2
04	119	Set-Point Error Circuit 2	See Table 12.2
04	120	Alarm Status Circuit 1	See Table 12.2
04	121	Temp RTD1 Circuit 1	Temp = Value ÷ 10
04	122	Temp RTD2 Circuit 1	Temp = Value ÷ 10
04	123	Control Temp Circuit 1	Temp = Value ÷ 10
04	124	Control RTD Circuit 1	1 = 1st RTD; 2 = 2nd RTD
04	125	Control RTD Circuit 1	Value in mA
04	126	Percent ON Circuit 1	%
04	127	Heater Current CT 1	Current = value ÷ 10
04	128	Heater Current CT 2[1]	Current = value ÷ 10
04	129	Heater Current CT 3[1]	Current = value ÷ 10

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

Function Codes	Address	Description	Values
04	130	Alarm status Circuit 2	See Table 12.2
04	131	Temp RTD1 Circuit 2	Temp = Value ÷ 10
04	132	Temp RTD2 Circuit 2	Temp = Value ÷ 10
04	133	Control Temp Circuit 2	Temp = Value ÷ 10
04	134	Control RTD Circuit 2	2 = 1st RTD; 2 = 2nd RTD
04	135	Ground/Earth Current Circuit 2	Value in mA
04	136	Percent ON Circuit 2	%
04	137	Heater Current CT 2	Current = Value ÷ 10

Table 12.2: Alarm Status/Acknowledge/Set-Point Error

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
High Current Trip	Set-Point Error	Circuit Fault	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 (Self-Test)	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 Measurement and Status

Function Code(s)	Address	Description	Values
03.06	0	Alarm Acknowledge Circuit 1	See Table 12.2
03.06	1	Alarm Acknowledge Circuit 2	
03.06	2	Maintain Temp Circuit 1	Temp = Value ÷ 10
03.06	3	Maintain Temp Circuit 2	Temp = Value ÷ 10
03.06	4	Control Band Circuit 1	Temp = Value ÷ 10
03.06	5	Control Band Circuit 2	Temp = Value ÷ 10
03.06	6	High Temp Trip RTD 1 Circuit 1	Temp = Value ÷ 10
03.06	7	High Temp Trip RTD 1 Circuit 2	Temp = Value ÷ 10
03.06	8	High Temp Trip RTD 2 Circuit 1	Temp = Value ÷ 10
03.06	9	High Temp Trip RTD 2 Circuit 2	Temp = Value ÷ 10
03.06	10	High Temp Alarm RTD 1 Circuit 1	Temp = Value ÷ 10
03.06	11	High Temp Alarm RTD 1 Circuit 2	Temp = Value ÷ 10
03.06	12	High Temp Alarm RTD 2 Circuit 1	Temp = Value ÷ 10
03.06	13	High Temp Alarm RTD 2 Circuit 2	Temp = Value ÷ 10
03.06	14	Low Temp Alarm RTD 1 Circuit 1	Temp = Value ÷ 10
03.06	15	Low Temp Alarm RTD 1 Circuit 2	Temp = Value ÷ 10
03.06	16	Low Temp Alarm RTD 2 Circuit 1	Temp = Value ÷ 10
03.06	17	Low Temp Alarm RTD 2 Circuit 2	Temp = Value ÷ 10
03.06	18	High Ground/Earth Current Trip Circuit 1	Value in mA
03.06	19	High Ground/Earth Current Trip Circuit 2	Value in mA
03.06	20	High Ground/Earth Current Alarm Circuit 1	Value in mA
03.06	21	High Ground/Earth Current Alarm Circuit 2	Value in mA
03.06	22	High Current Trip Circuit 1	Current = value ÷ 10
03.06	23	High Current Trip Circuit 2	Current = value ÷ 10
03.06	24	High Current Alarm Circuit 1	Current = value ÷ 10
03.06	25	High Current Alarm Circuit 2	Current = value ÷ 10
03.06	26	Low Current Alarm Circuit 1	Current = value ÷ 10
03.06	27	Low Current Alarm Circuit 2	Current = value ÷ 10
03.06	28	Circuit 1 Status	See Table 12.5
03.06	29	Circuit 2 Status	
03.06	30	Control Method Circuit 1	0 = ON/OFF MEC 1 = ON/OFF SSR 2 = Proportional 3 = Ambient 4 = Ambient APCM
03.06	31	Control Method Circuit 2	
03.06	32	Number of RTDs Circuit 1	1 or 2
03.06	33	Number of RTDs Circuit 2	1 or 2
03.06	34	Power Clamp Circuit 1	%
03.06	35	Power Clamp Circuit 2	%

Table 12.4: Circuit Measurement and Status (Continued)

Function Code(s)	Address	Description	Values
03.06	36	RTD Fault Clamp Circuit 1	%
03.06	37	RTD Fault Clamp Circuit 2	%
03.06	38	Trips Enable/Disable Circuit 1	Changes applied to both, See Table 12.3
03.06	39	Trips Enable/Disable Circuit 2	
03.06	40	High Temp Seen RTD 1 Circuit 1	Temp = Value ÷ 10
03.06	41	High Temp Seen RTD 1 Circuit 2	Temp = Value ÷ 10
03.06	42	High Temp Seen RTD 2 Circuit 1	Temp = Value ÷ 10
03.06	43	High Temp Seen RTD 2 Circuit 2	Temp = Value ÷ 10
03.06	44	Low Temp Seen RTD 1 Circuit 1	Temp = Value ÷ 10
03.06	45	Low Temp Seen RTD 1 Circuit 2	Temp = Value ÷ 10
03.06	46	Low Temp Seen RTD 2 Circuit 1	Temp = Value ÷ 10
03.06	47	Low Temp Seen RTD 2 Circuit 2	Temp = Value ÷ 10

Table 12.5: Circuit Status Bits

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	1 = Forced Off	1 = Forced On	1 = Tripped	1 = Enable; 0 = Disable

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-FX 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	0-65535
03	2013	Serial number med	0-65535
03	2014	Serial number high	not shown in interface
	2015	No Data Here	
03	2016	First Circuit Number	1-98
	2017	No Data Here	
03	2018	Screen Saver	0 = Disabled; 1 = Enabled
03	2019	Max Off Current	5-250 (Current = value ÷ 10)
	2020-2021	No Data Here	
03	2022	Relay Output Voltage	0 = 12 V; 1 = 24 V
	2023	No Data Here	
03	2024	Hours in Use	Value in hours
03	2025	Start Up Delay	0-30 minutes
03	2026	Soft Start	0-15, See **Section 7.1**
03	2027	Ground/Earth Fault Sensitivity	0 = Most Sensitive; 3 = Least Sensitive
03	2028-2030	No Data Here	
03	2031	Single Temp Alarms	Should always = 0
03	2032	Max Temp Alarm Delay	0-30 minutes
	2033-2035	No Data Here	
03	2036	Alarm Relay Type	0 = Normally OFF; 1 = Normally ON
03	2037	Alarm Relay Masking	Should always = 65525
	2038	No Data Here	
03	2039	Firmware Version	Upper byte: major version Lower byte: minor version
	2040-2043	No Data Here	
03	2044	Self-Test Hours	0 = OFF or 2-99 Hours
03	2045	Start self-Test	Any read/write starts a self-test
03	2046	Temperature Units	0 = °F; 1 = °C

12 APPENDIX B: ADDITIONAL INFORMATION

12.1: Figure 13.4: Single RTD on Two Circuits

13 APPENDIX C: TROUBLESHOOTING TIPS

A table of Troubleshooting Tips is provided in **Appendix C** to assist during start-up. 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.
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 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.

RTD Alarm

The following summarizes some of the possible causes and solutions for 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.

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 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 some of the possible causes and solutions for heat tracing 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	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.

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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