THERMOTRON®

A Venturedyne, Ltd., Company

CM2 Control Module Technical Manual

Revision 4: May 3, 2011

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Revision 4: May 3, 2011

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Specifications

Operating temperature	0°C to +50°C
Power requirements	95-135 Vac or 216-253 Vac, 47-63 Hertz, 100 volt-amps maximum
Input power	The CM2 will draw a maximum of 0.5 amps at 120 Vac, or 0.25 amps at 240 Vac.
Measuring accuracy	0.25% of span typical
Sampling rate	Process variable sampled every 0.1 seconds
Inputs	• 2 thermocouple/RTD: factory configurable for type T, K, E, or J or RTD -200°C to +400°C • 6 thermocouple: factory configurable for type T, K, E, or J -200°C to +400°C • 2 analog: 0-20 mA or 0-10 Vdc. • 2 analog: 0-10 Vdc only • 6 TTL: factory configurable
Outputs	• 8 TTL: factory configurable • 16 SSR: factory configurable • 16 SSR: auxiliary only • 2 analog: 0-10 Vdc or 0-20 mA • 1 TTL alarm output
Dimensions	9.75 inches x 8.5 inches x 3.5 inches (L x W x H)

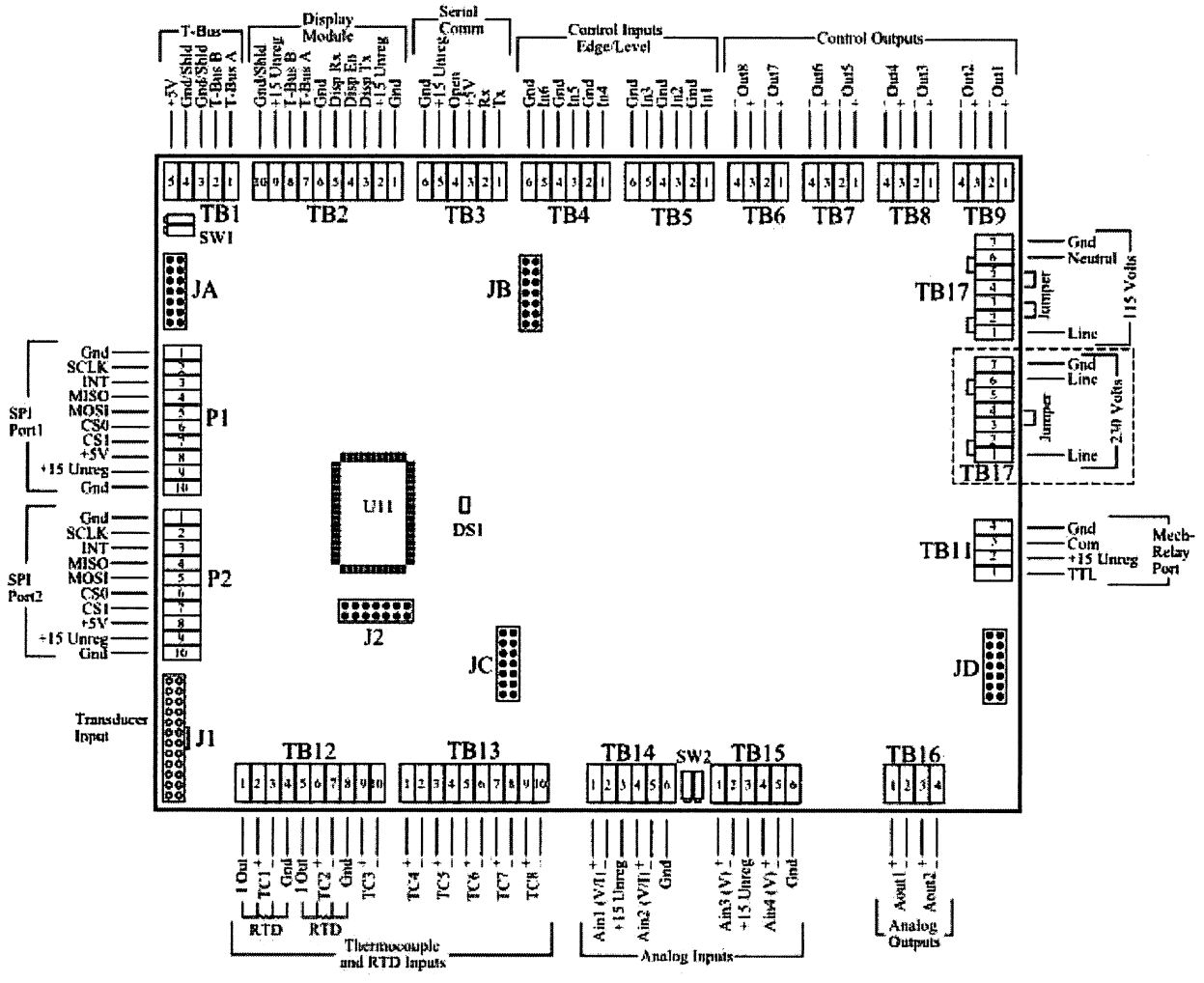
Section 1: Component Descriptions

This manual provides technical information, basic troubleshooting steps, and component replacement procedures for the CM2 control module. This section describes the major components.

CAUTION: This manual is **NOT** a substitute for adequate technical training.

CM2 control module

The figure below shows a CM2 control module, including its major components and terminal assignments. The following section describes each component and the interface characteristics at each I/O terminal.



Component description

DS1 **Watchdog indicator LED**: Under normal operation this LED will flash at a regular interval. A flashing rate of 2 Hz indicates communication is established between the control module and a connected display module. A flashing rate of 1 Hz indicates the control module is working correctly but there is no communication with a display module.

J1 **Transducer input port**: The transducer input board ribbon cable is connected to this port.

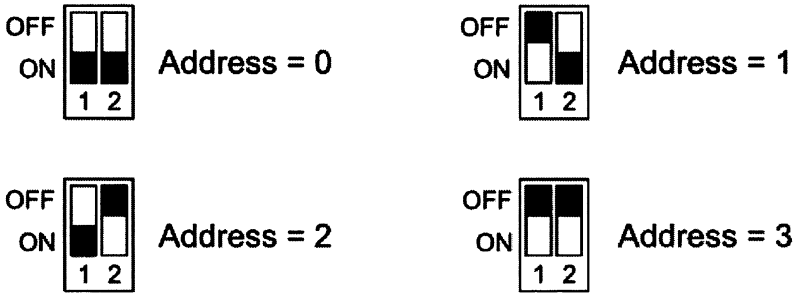
J2 **JTAG port**: Thermotron use only.

JA-JD **Solid-state relay (SSR) board connectors**: These four connectors mate with a regular or enhanced SSR board.

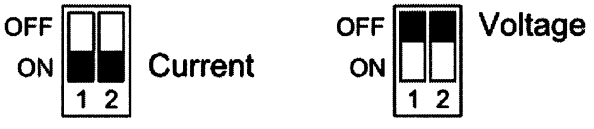
JA provides the connections for digital outputs 9 through 12
JB provides the connections for digital outputs 13 through 16
JC provides the connections for digital outputs 17 through 20
JD provides the connections for digital outputs 21 through 24

P1, P2 **SPI ports 1 and 2**: Provide power and data lines for Thermotron expansion boards. The pinout for these connectors is shown in the CM2 diagram above.

SW1 There are two switches located in SW1. These two switches determine the address for the CM2. The different address settings are shown below.



SW2 There are two switches located at SW2. These switches control the operating mode of analog inputs 1 and 2. Analog inputs 3 and 4 are not affected by SW2. For more details see the information on TB14, TB15.



TB1 **T-Bus port**: This terminal block provides a connection to the T-Bus serial bus. This T-Bus connector provides power (5 volts) and ground pins to support devices that are powered off of the T-Bus. The pinout for the T-Bus is shown in the CM2 diagram.

TB2 **Display connector port**: This terminal block provides power and data lines for a Thermotron display module. The pinout for this connector is shown in the CM2 diagram.

TB3 **Serial communications port**: Connect the serial I/O converter, Ethernet converter, or GPIB converter to this connector. This will allow the CM2 to communicate on the network provided by the connected converter board. For 3200 applications this is where the 3200 display would be connected.

TB4, TB5 **Digital inputs**: These terminal blocks provide TTL-compatible control inputs for the CM2. Each input is software selectable as either level-sensitive or edge-sensitive. The pinout for these terminal blocks is shown in the CM2 diagram.

TB6-TB9 **Digital outputs**: These four terminal blocks provide eight TTL-compatible outputs. Their pinout is shown in the CM2 diagram.

TB11 **Mechanical relay port**: This terminal block provides a 5-volt TTL signal to drive a mechanical relay. The alarm signal is always active (5V) unless a control channel exceeds its process alarm limits or a monitor channel exceeds its alarm limits. In addition, Thermotron can configure the 8800 to operate the alarm output during a System Monitor refrigeration trip. Whenever an alarm condition is detected the alarm output is deactivated (0V).

A 20-volt unregulated output is also available on this port to provide power to the window heater for certain chamber models. This output is designed to drive a 20.6-ohm load.

The terminals are:

Terminal	Description
1	Switched TTL output, high when no alarms, low when in alarm condition
2	20-volt unregulated output used to power window heater
3	Common
4	Ground

TB12, TB13 **Thermocouple inputs**: These two terminal blocks provide eight thermocouple input ports. Each thermocouple channel can be configured as type T, J, K, or E. Pins 1-8 on TB12 provide two channels of RTD support. The pinout for TB12 and TB13 is shown in the CM2 diagram.

TB14, TB15 **Analog input**: These terminal blocks provide analog input ports for the CM2, as well as power and ground for powering sensors and transducers. The power provided in this port is located on pin 3, as shown in the diagram. This is an unregulated voltage that is approximately 21 volts in normal conditions (120 Vac, 60 Hz). This voltage will vary with varying line conditions. By default the analog input port is set up for a voltage input (0 to 10 volts), but analog inputs 1 and 2 can be configured to handle a current input (0 to 30 milliamps) by switching SW2. **CAUTION: Exceeding 30 milliamps into this port in current mode could damage the board.** The pinout for TB14 and TB15 is shown in the CM2 diagram.

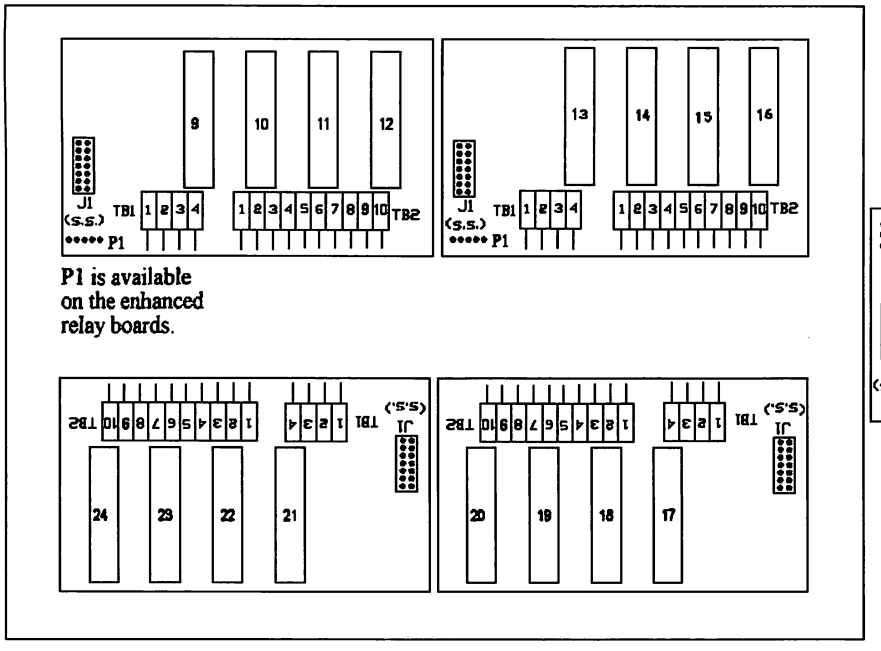
TB16 **Analog outputs**: This terminal block provides two analog outputs. Each output is software configurable as either a current (0-50 milliamps) output or voltage (0-10 volts) output. **CAUTION: Exceeding 50 milliamps could damage the board.** The pinout for this terminal block is shown in the CM2 diagram.

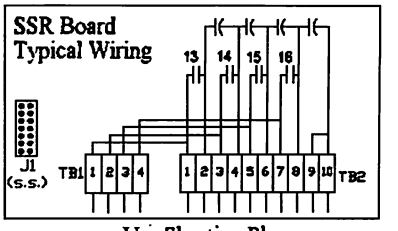
TB17 **Power supply line connector**: This is where the CM2 is connected to the AC voltage supply lines of the chamber. The different wiring required for 120 Vac and 230 Vac applications is shown in the CM2 diagram.

U11 **Microprocessor chip**.

Solid-state relay boards

The solid-state relay (SSR) boards mount on stand-off connectors JA through JD of the CM2. These relays use the CM2's TTL-compatible outputs 9 through 24 to operate 115-volt, 3-amp solid-state relays. The figure below shows the typical SSR board layout for a CM2 control module when all four boards are used. The following section provides a description of each component of the relay boards.





Use Shorting Plugs
on TB1 to Connect Relays.

Component description

J1 Board connector J1 is located beneath the board and connects to one of the CM2's stand-off connectors. It receives the TTL signals from the CM2.

P1 External auxiliary relay board connector. This connector is available only on enhanced relay boards. The P1 connector increases the outputs of one CM2. The first four pins provide TTL outputs for four solid-state relays on an external solid-state relay board, and the fifth pin provides the logic ground connection.

The output assignments of these boards are set in the display module firmware:

- The upper left relay board position provides assignments for outputs AUX 1-1 through AUX 1-4.
- The upper right board provides assignments for AUX 1-5 through AUX 1-8.
- The lower right board provides assignments for AUX 2-1 through AUX 2-4.
- The lower left board provides assignments for AUX 2-5 through AUX 2-8.

SSR 9-24 The TTL outputs operate these 115-Vdc, 3-amp relays to provide control outputs to the chamber systems or other circuits. Each relay has a corresponding LED. The LED indicates if the corresponding digital output driving the relay has been activated. **NOTE**: It is possible for the SSR to malfunction with the LED lit.

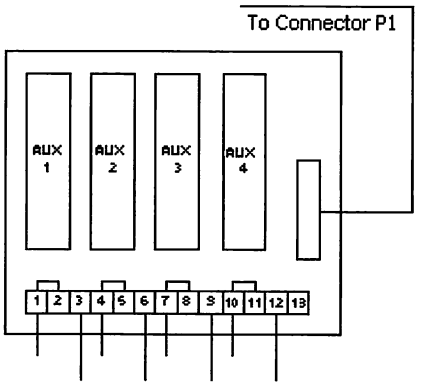
TB1 This is a shorting terminal block that allows you to short the line side of the relays together when they share a common line. Pins 1, 2, 3, and 4 correspond to the line side of each relay as shown in the illustration earlier in this section.

TB2 This is the relay terminal block that provides the chamber control system connections. Terminals 1, 3, 5, and 7 are the line-side terminals; terminals 2, 4, 6, and 8 are the load-side terminals; and terminals 9 and 10 are the neutral line terminals.

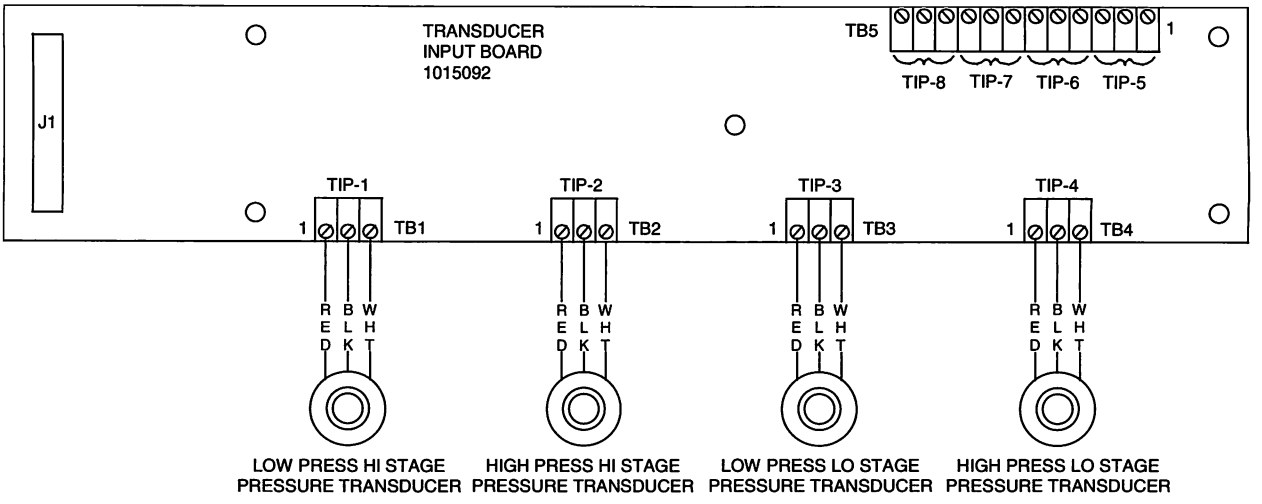
External solid-state relay boards

The CM2 uses external solid-state relay boards for hard-wired AUX relays. These boards use the CM2's direct current TTL outputs from connector P1 of the internal SSR board to operate up to four 120/1/60 3A relays. Each relay has three dedicated terminal outputs:

- The first terminal (1, 4, 7, or 10) is the line terminal.
- The last terminal (3, 6, 9, or 12) is the load terminal.
- Terminal 13 is the neutral line terminal.



Pressure transducer board



The pressure transducer board allows the CM2 to read refrigeration system pressures and transducer inputs from other systems. The illustration above shows a pressure transducer board with the refrigeration system connections. These are the standard assignments for terminal blocks TB1 through TB4. Terminal block TB5 provides four additional sensor inputs.

The refrigeration systems use two different transducers:

- The low-pressure suction inputs use 0-200 psi transducers with a 1-5 Vdc sensor signal range.
- The high-pressure discharge inputs use 0-600 psi transducers with a 1-5 Vdc sensor signal range.

Each TIP terminal set has three inputs:

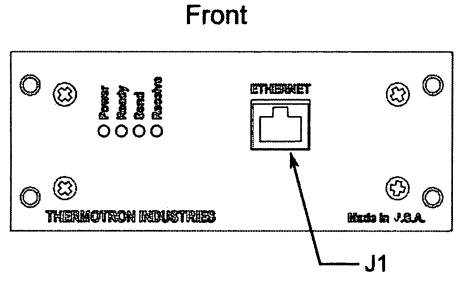
Terminal	**Description**
1 (red)	+20 Vdc unregulated power supply to the transducer
2 (black)	Ground
3 (white)	1-5 Vdc sensor signal from the pressure transducer, and 0-5 Vdc sensor signal from the level transducer

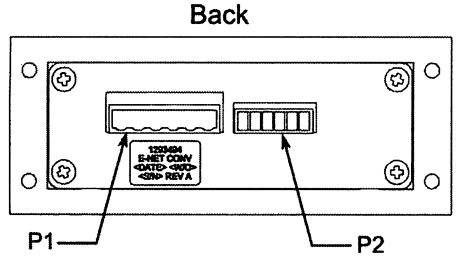
The signals output to a control module through a 24-conductor ribbon cable at connector J1.

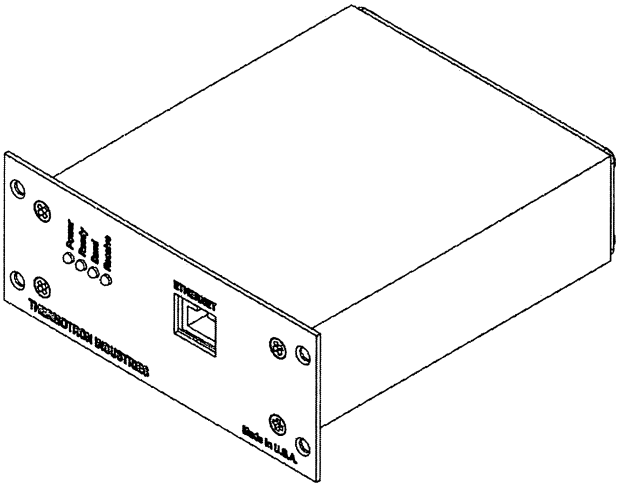
Optional GPIB converter

The GPIB converter assembly provides an IEEE-488 interface between the CM2 and a standard GPIB interface. The CM2 interfaces with the converter through terminal block TB3. The CM2 connected to the converter **MUST BE** directly connected to a display module.

Optional Ethernet converter







Component description

The Ethernet converter provides Ethernet support to the 3200 display. The GPIB converter or serial I/O converter can be connected to a 3200 CM2 directly or daisy-chained through the Ethernet converter, but only one protocol may be used at a time.

J1 **Ethernet jack**: Provides the Ethernet connection to the Ethernet network. This connector has a green and yellow LED on it. When the green LED is on, the Ethernet converter is connected to a 100-Mbps or faster network. If the yellow LED is on, then the Ethernet converter is connected to a 10-Mbps network. When either of these LEDs is flashing, the Ethernet converter is communicating over the network.

P1 **CM2 connector**: Provides the interface between the converter and the 3200 CM2.

P2 **GPIB connector**: The GPIB converter may be connected to the CM2 through this connector.

LEDs **Power**: Indicates that the Ethernet converter is powered properly.

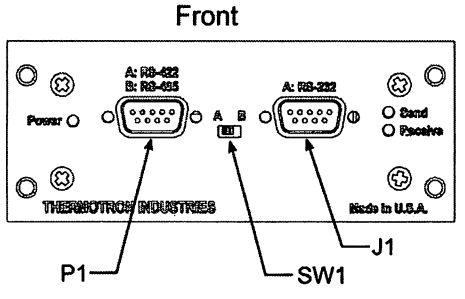
Ready: Indicates that the Ethernet converter is ready for communication. If this LED is off, there will be communication errors.

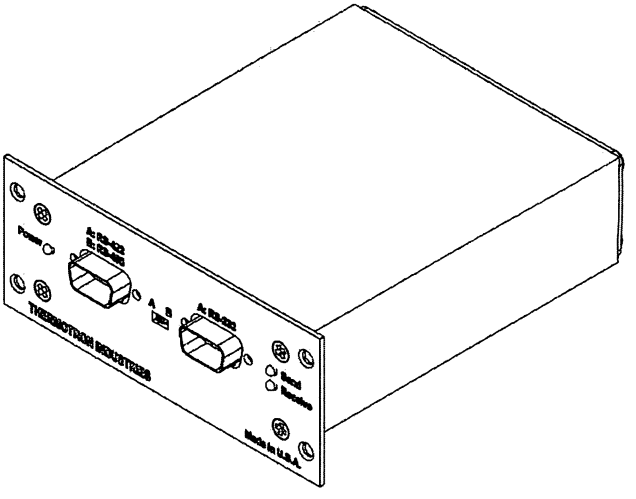
Send/Receive: When these LEDs are flashing, the Ethernet converter is sending and receiving data to the CM2.

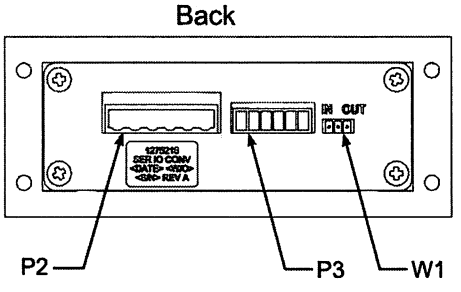
Specifications

Input power The Ethernet converter will draw a maximum of 400 mA at 5 Vdc from the CM2.

Optional serial I/O converter







Component description

The serial I/O converter provides serial communication support to the CM2. This board can be switched between RS-232, RS-485, and RS-422. Power, send, and receive LEDs on the front of the converter indicate that the converter is on and sending and receiving data. The GPIB converter or Ethernet converter can be daisy-chained through the serial I/O converter, but only one protocol may be used at a time.

P1 **RS-232 connector**: See SW1.

J1 **RS-485 or RS-422 connector**: See SW1.

P2 **CM2 connector**: Provides the interface between the serial I/O converter and the CM2.

P3 **GPIB connector**: The GPIB converter may be connected to the CM2 through this connector.

SW1 Selects which serial interface can be used:

		Protocol		
		232	485	422
Position	A	X		X
	B		X	

W1 Jumper to connect the terminating resistor, if needed, for RS-485.

Pinout

P1	
Pin	**Description**
1	RX (+)
2	TX (+)
3	*open*
4	*open*
5	*open*
6	RX (-)
7	TX (-)
8	*open*
9	*open*

J1	
Pin	**Description**
1	*open*
2	TX
3	RX
4	*open*
5	GND
6	*open*
7	*open*
8	*open*
9	*open*

Specifications

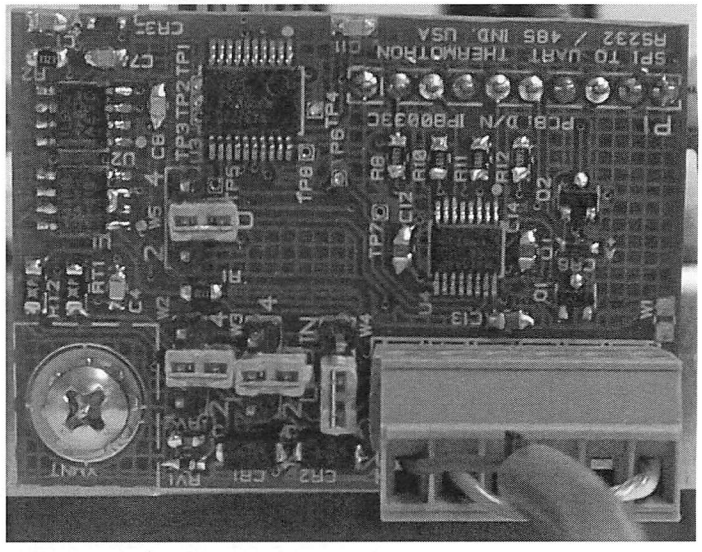
Baud rate The maximum baud rate at which the serial I/O converter can operate is 115200 bps.

Input power The serial I/O converter will draw a maximum of 35 mA at 5 Vdc from the CM2.

SPI to UART converter

The SPI to UART converter provides three computer interface protocols. RS-232, RS-485 and UART interfaces are selectable by jumper configurations on the SPI to UART converter. In addition to the SPI to UART converter, a cable and a bulkhead connector are all that is needed for RS-232 or RS-485 communication.

The table below shows the part numbers that need to be used together for each interface. There are four cable lengths available for each interface.



Interface	SPI to UART Converter	Bulkhead	Cable	
RS-232	1327104	1327073	1326938	3.5 feet
			1326946	10 feet
			1326954	20 feet
			1326962	50 feet
RS-485	1327104	1327055	1326970	3.5 feet
			1326988	10 feet
			1326996	20 feet
			1327007	50 feet

The SPI to UART converter can be put in the UART mode and connected to the Ethernet converter (P/N: 1293494) or the GPIB converter (P/N: 1062160) to provide Ethernet or GPIB interface. The SPI to UART converter is required only for 3200 applications. Other CM2 applications do not require this converter.

Pinout

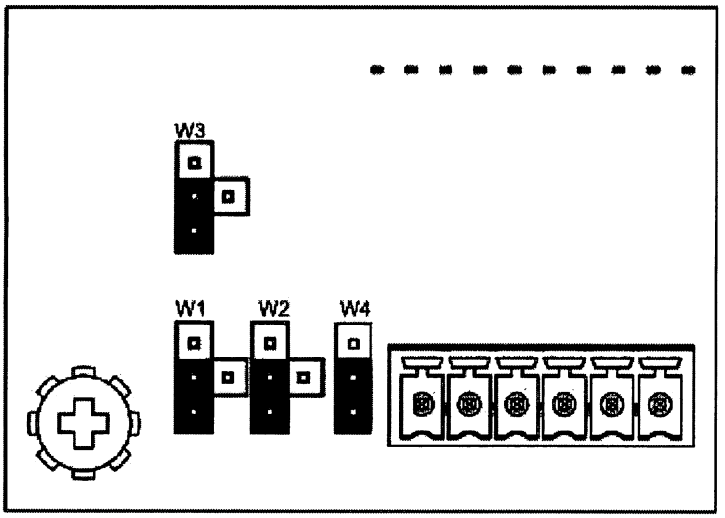
P1 This connector provides the connection to P1 on the control module. Power, ground, and the SPI interface are included on this connector.

TB1 This connector provides the UART/RS-232/RS-485 interfaces for the computer interface options. Power and ground for the interface options are also provided on this connector.

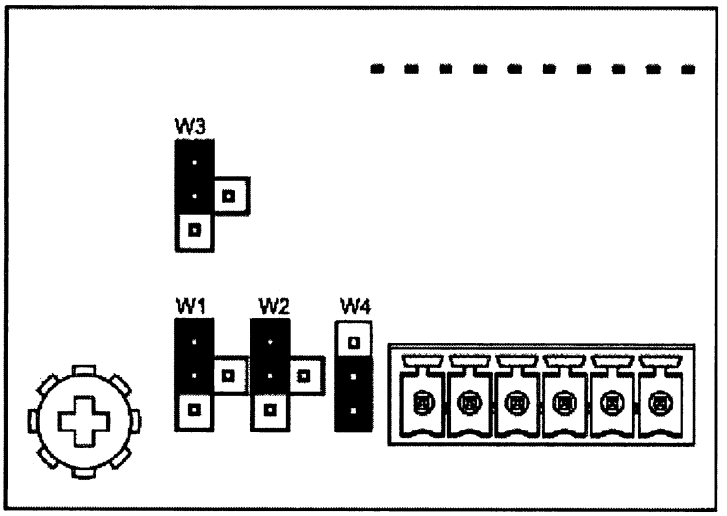
RS-232/UART	
Pin	**Function**
1	TX
2	RX
3	+5V
4	OPEN
5	+24V
6	GND

RS-485	
Pin	**Function**
1	(-)
2	(+)
3	+5V
4	OPEN
5	+24V
6	GND

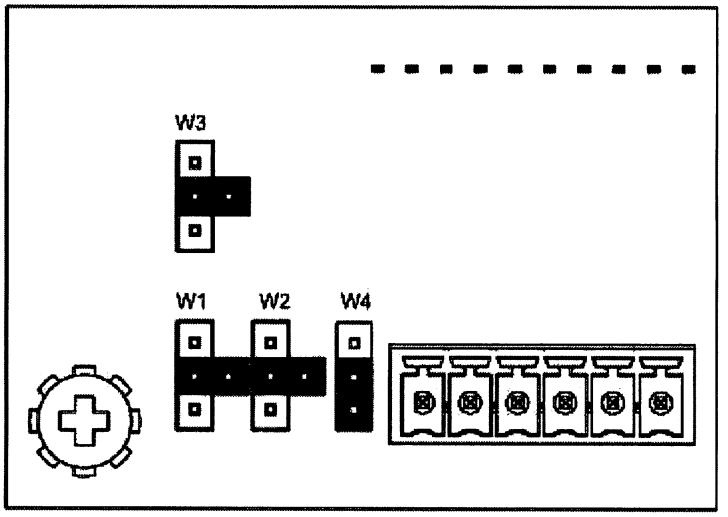
W1-W3 These jumpers are used to select the interface for TB1. All three jumpers need to be in the same configuration for an interface to work.



RS-232 selected



RS-485 selected



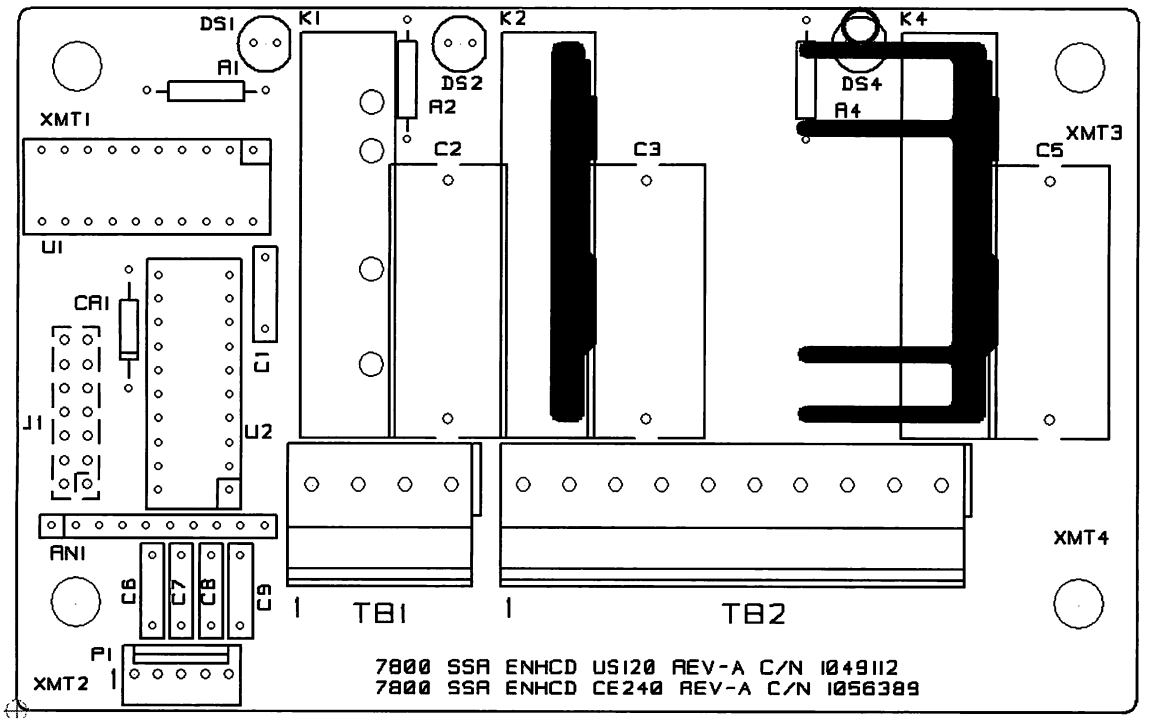
UART selected

W4 This jumper is labeled "IN" on one end. If the jumper is in the "IN" position, a 121-ohm terminator resistor is across the RS-485 lines. If the jumper is in the other position the terminator resistor is disconnected from the circuit. This jumper can only be in the "IN" position for certain RS-485 applications. All other interfaces and applications require this jumper to not be in the "IN" position.

Specifications

Input power The SPI to UART converter revision C will draw a maximum of 9 mA at 5 Vdc from the CM2.

Optional high-current relay board



Component description

The high-current relay board provides three relay outputs. There are three different relays on this assembly. Each relay has a different power rating. This relay board can be used to replace three externally mounted relays inside the electrical panel. The relay designated K4 is rated for 8 amps at +50°C. The relay designated K2 is rated for 4 amps at +50°C. The relay designated K1 is rated for 3 amps at +50°C.

J1 This connector provides the connection to the control module. Digital signals are used to control the relays. Power and ground is also provided through this connector.

TB1 This connector provides a second terminal block for the relay outputs.

TB1 pin 1 shorted to TB2 pin 1: Rated for 3 amps
TB1 pin 2 shorted to TB2 pin 3: Rated for 4 amps
TB1 pin 3 shorted to TB2 pin 5: Not used
TB1 pin 4 shorted to TB2 pin 7: Rated for 8 amps

TB2 This terminal block provides the output connections for the three relays.

TB2 pins 1, 2: Rated for 240 volts and 3 amps
TB2 pins 3, 4: Rated for 240 volts and 4 amps
TB2 pins 5, 6: Not used
TB2 pins 7, 8: Rated for 240 volts and 8 amps
TB2 pins 9, 10: Neutral connection

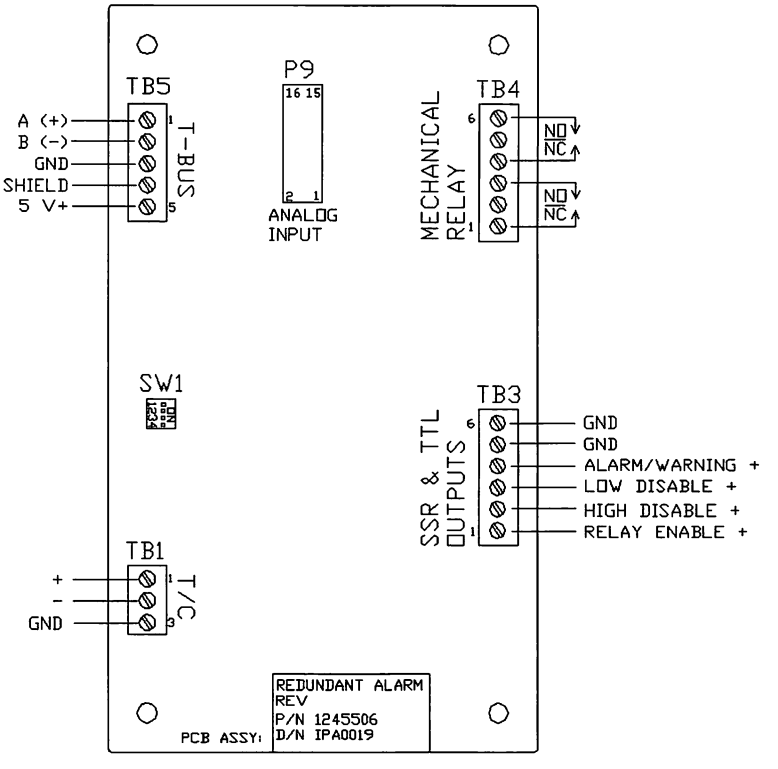
DS1, 2, 4 LED's are located next to each relay. The LED will be on when the relay is on.

Specifications

Input power The high-current relay board will draw a maximum of 65 mA at 5 Vdc from the CM2.

Therm-Alarm

CAUTION: It is *your* responsibility to set Therm-Alarm limits appropriate for your product, and to properly place any Therm-Alarm thermocouples or analog sensors. When used properly, the Therm-Alarm is an effective product protection device; however, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive products, you should have an additional back-up product protection device. If you are testing products with live electrical loads, you should install additional power cutoffs. Please call Thermotron Industries if you have any questions on additional product protection.



The Therm-Alarm is a product protection instrument that is a CM2 peripheral device. Each Therm-Alarm senses the product temperature using its own thermocouple. The Therm-Alarm thermocouple should be inside the chamber at the product under test. In addition to the temperature thermocouple, each Therm-Alarm has an expansion port that can be used to sense an analog signal as well. The type and properties of the analog signal are determined by the function board attached to the expansion port. When you program the Therm-Alarm limits and other settings from the display module, the Therm-Alarm stores these settings and operates as an independent instrument. If it senses an out-of-limit condition, the Therm-Alarm trips the chamber's control system, operates its alarm relays, and sends the out-of-limit information to the display module for alarm processing. This figure shows the layout of the Therm-Alarm and the following section describes the terminal assignments. See "Connecting a Backup Safety Circuit to TB4" later in this section for separate alarm connections.

Component description

TB1 Type T thermocouple input. TB1 provides the connections for the input thermocouple wire. The terminals are:

Terminal	Description
1	Positive copper (+) thermocouple input. Connect the copper thermocouple wire (coated with blue insulation).
2	Negative constantan (-) thermocouple input. Connect the constantan thermocouple wire (coated with red insulation).
3	Earth ground connection. If a shielded thermocouple wire is used, connect the shield to this terminal.

TB3 This terminal block provides the connections for the SSR and TTL outputs. These outputs are used to indicate the status of the Therm-Alarm. Terminals 1, 2, 3, and 4 can provide 24 milliamps at the minimum guaranteed high voltage of 3.8 Vdc. The terminals are:

Terminal	Description
1	Positive (+) connection for the relay enable output. The relay enable signal is low when the mechanical relay is de-energized during the alarm, failure, and open thermocouple modes. It is high during normal operation.
2	Positive (+) connection for the high disable output. The high disable signal is low during a high-temperature alarm and high during normal operation.
3	Positive (+) connection for the low disable output. The low disable signal is low during a low-temperature alarm and high during normal operation.
4	Positive (+) connection for the alarm/warning output. The alarm/warning signal is low when the Therm-Alarm is in the alarm or warning mode, and it is high during normal operation.
5 & 6	Earth ground connections. Connect the shield of any shielded wire used on TB3.

TB4 **WARNING: TB4 can have power applied to it even when power is removed from TB5.**

Mechanical relay contacts. This terminal block provides connections for the double-pole, double-throw relay, which is controlled by the operating modes of the Therm-Alarm:

- The relay is energized during the scanning and temperature warning modes.
- The relay is de-energized during the temperature alarm, failure, and open thermocouple modes.

The three left terminals are for switch A, and the three right terminals are for switch B. Each switch's rated load is 0.5 amps at 125 Vac, 2 amps at 30 Vdc. Max carry and operating current is 2 amps. Maximum switching capacity is 62.5 volt-amps, 60 watts. Typically one switch is connected to the chamber power and the other is for customer use. The six terminals are:

Terminal	Description
1	Normally closed contact pin of switch A. When the relay is energized, the contact opens between terminals 1 and 2. When the relay is de-energized, the contact closes between terminals 1 and 2.
2	Common contact pin of switch A.
3	Normally open contact pin of switch A. When the relay is energized, the contact closes between terminals 2 and 3. When the relay is de-energized, the contact opens between terminals 2 and 3.
4	Normally closed contact pin of switch B. When the relay is energized, the contact opens between terminals 4 and 5. When the relay is de-energized, the contact closes between terminals 4 and 5.
5	Common contact pin of switch B.
6	Normally open contact pin of switch B. When the relay is energized, the contact closes between terminals 5 and 6. When the relay is de-energized, the contact opens between terminals 5 and 6.

Refer to "Connecting a Backup Safety Circuit to TB4" later in this section.

NOTE: If connecting an inductive load to the mechanical relay contact, a snubber must be placed across the load to protect the contacts.

TB5 T-Bus communications terminals and power supply inputs. This terminal block provides the connections for the EIA-485 twisted pair cable. This cable connects to the CM2 using the T-Bus interface. The T-Bus cable will include the necessary power connections on pins 4 and 5. The power supply must be 5 Vdc ±5% at 250 milliamps per Therm-Alarm connected.

Terminal	Description
1	Positive (A+) EIA-485 cable connection
2	Negative (B-) EIA-485 cable connection
3	Earth ground connection
4	Shield
5	Power

SW1 Therm-Alarm address switch. This switch is used to address up to four Therm-Alarms connected to the CM2. The addressing is listed below:

SW1 Switches				Address
S1	S2	S3	S4	
ON	ON	ON	ON	1
OFF	ON	ON	ON	2
ON	OFF	ON	ON	3
OFF	OFF	ON	ON	4

P9 Function board header. This 16-pin header provides the connections for the optional analog input function boards. These function boards provide additional protection for your product based on a linear analog signal such as humidity, vibration, etc. For a list of available function boards and options please contact Thermotron. **NOTE**: This header is for Thermotron use only.

Connecting a backup safety circuit to TB4

WARNING: **TB4 can have power applied to it even when power is removed from TB5.**

CAUTION: **It is *your* responsibility to set Therm-Alarm limits appropriate for your product, and to properly place any Therm-Alarm thermocouples or analog sensors. When used properly, the Therm-Alarm is an effective product protection device; however, it is not a fail-safe device and will not guarantee the safety of your product. If you are testing expensive products, you should have an additional backup product protection device. If you are testing products with live electrical loads, you should install additional power cutoffs. Please call Thermotron Industries if you have any questions on additional product protection.**

Normally switch A or switch B is used in the chamber's safety circuit. This switch opens the safety circuit during the alarm, failure, or open thermocouple modes. You can use the unused contact set to provide backup protection for your product. Two examples of product protection are described below. In both examples, switch A is used for the chamber and switch B is used for the customer's backup circuit.

Backup alarm system example

1. Connect a separate power supply to the normally closed contact pin at terminal 4. **NOTE**: The power supply must be completely separate from the chamber power supply.
2. Connect the alarm circuit to terminal 5 (switch B common contact pin).
3. The contact between terminals 4 and 5 closes if power is removed by a temperature trip or if power is lost. When the contact closes, the separate power supply energizes the customer-installed alarm.

Product power cutoff example for a product with a live electrical load

1. Connect a separate power supply to the normally open contact pin at terminal 6. **NOTE**: The power supply must be completely separate from the chamber power supply.
2. Connect the product power contactor control circuit to the common contact pin at terminal 5.
3. The contact between terminals 5 and 6 opens if power is removed by a temperature trip or if power is lost. The open contact disables the product contactor circuit and removes power from the product.

Replacing a Therm-Alarm

1. Remove power from the chamber.
2. Make sure the wires are marked properly. Also note the address switch locations at SW1.
3. Remove the cables, wires, and jumpers from the terminal blocks.
4. Unscrew and remove the Therm-Alarm, and place it in a static-shielding container.
5. Remove the new Therm-Alarm from its static-sensitive container, and mount it using the hardware removed in step 4.
6. Install the cables, wires, and jumpers that were removed in step 3.

Section 2: Troubleshooting and Component Replacement

CAUTION: This section provides basic troubleshooting and component replacement procedures. This section is not a substitute for adequate technical training. Improper handling of equipment and/or improperly performing the included procedures could damage your chamber, programmer/ controller, and/or products under test.

Static-sensitive device caution statement

CAUTION: The CM2 contains components that are sensitive to electrostatic charges. When working with the display module or CM2 components, make sure to provide a static-safe work environment.

The grounding procedures described below can effectively remove static from conductive objects such as your body or tools. However, you must also keep non-conductive objects, such as synthetic clothing, coffee cups, and vinyl or plastic products, as far away from the static-sensitive components as possible.

- Use a portable static-dissipative field service kit that includes a work mat and wrist strap with ground cords. Follow all instructions for proper use of the static protection equipment.
- Transport any replacement components in static-shielding bags or containers.
- After removing a faulty component, store it immediately in a static-shielding bag or container.

Basic troubleshooting

The following section provides basic troubleshooting procedures based on the symptoms encountered. The troubleshooting procedures are written in progressive steps. As each step is completed, check the operation of the CM2 and display module. If the step repaired the problem, discontinue troubleshooting the symptom.

Symptom 1: The DS1 lamp of a CM2 is not flashing

1. Check all of the power connections, including the power source, to TB17 of the CM2.
2. Replace the power cable.
3. Check the solid-state relay boards' connections with relay board connectors JA through JD. If the pins in JA, JB, JC, or JD are shorted together, they can stop DS1.
4. Replace the CM2.

Symptom 2: The DS1 lamp of a CM2 is flashing, but slowly (1 Hz)

NOTE: The following steps refer only to the 8200 and 8800 programmer/controllers, which normally flash at 2 Hz. The 3200 programmer/controller always flashes at 1 Hz.

1. If your chamber has one CM2, follow these steps:
   a. Check the continuity and connections of the 10-conductor cable between ST1 of the MSBC unit and TB2 of the CM2.
   b. If your chamber has a Therm-Alarm, see if the display module recognizes the Therm-Alarm.
      i) If it recognizes the Therm-Alarm, replace the CM2.
      ii) If it does not recognize the Therm-Alarm, check the T-Bus connections between the CM2 and the Therm-Alarm.
   c. Disconnect the Therm-Alarm. If DS1 returns to a 2 Hz flash rate, replace the Therm-Alarm.
2. If your chamber has more than one CM2, follow these steps:
   a. If all of the CM2s are flashing slowly:
      i) Check the continuity and connections of the 10-conductor cable between ST1 of the MSBC unit and TB2 of the CM2.
      ii) Replace the display module.
   b. Check all the T-Bus connections between the problem CM2(s) and Therm-Alarm(s) and the T-Bus connections between the problem CM2(s) and the other CM2(s).
   c. If one CM2 is flashing slowly while the others are operating normally, replace the CM2.

Symptom 3: The date and/or time is incorrect after a power failure

1. Set the time and date.
2. Manually cycle power to verify data loss is due to a power failure.
3. Replace the display module.

Symptom 4: The terminal block inputs of the CM2 are intermittent

1. If DS1 of the CM2 is flashing at a 1 Hz rate, go to Symptom 2.
2. Check the connections at all of the terminal blocks.
3. Check the input signal sources. See the electrical schematics. Refer to any applicable OEM literature for the signal sources.
4. Replace the CM2.

Symptom 5: Terminal block outputs are not operating properly

1. If DS1 of the CM2 is flashing at a 1 Hz rate, go to Symptom 2.
2. Check the connections at the terminal blocks.
3. Check each problem output signal.
   a. Disconnect the external load from the terminal block.
   b. Use a DMM to check for proper signal levels.
   c. Reconnect the load.
   d. Check the external load and related circuit for any failures. On analog outputs configured for current, make sure the external load does not exceed 560 ohms.
4. Replace the CM2.

Symptom 6: The relay board outputs are not operating

1. Check the relay board's J1 connection to the CM2.
2. Check the TB1 shorting block against the instrument schematics. Replace any missing jumpers.
3. Check the terminal blocks for proper connections.
4. Operate the relays, watching their LEDs as you measure the voltage at their outputs.
   a. Check the circuit loads attached to the relays. The loads must draw no more than 3 amperes.
   b. Check the circuits that the loads affect.
   c. Swap relay boards, making sure you swap the wires and jumpers as well.
   d. If the problem moves, replace the failing relay board.
   e. If the problem stays in the same place:
      - Check the circuit loads attached to the relays. The loads must draw no more than 3 amperes.
      - Check the circuits that the loads affect.
5. Replace the CM2.

Symptom 7: The "Open Thermocouple" message is displayed

1. Check the continuity across the thermocouples. Replace the thermocouple if it is open.
2. Short the thermocouple input terminals together. The terminal should read the temperature of the ambient air. If it shows a definite difference, recalibrate according to the procedure in your display module manual
3. Replace the CM2.

Symptom 8: The thermocouple inputs drift

1. Make sure there is no cross ventilation at the thermocouple input terminals on the CM2. Cross ventilation can affect the CM2's ambient junction compensation accuracy.
2. Recalibrate the inputs that drift according to the procedure in your display module instruction manual.
3. Replace the CM2.

Symptom 9: The analog outputs cannot obtain a full 0-10 Vdc or 0-20 mA range

1. Check the connections at the terminal blocks.
2. Recalibrate the failing analog outputs according to the procedure in your display module instruction manual.
3. Check each problem output signal.
   a. Disconnect the external load from the terminal block.
   b. Use a DMM to check for proper signal levels.
   c. Check any current-driven loads to make sure they do not exceed 560 ohms.
   d. Reconnect the load.
4. Replace the CM2.

Symptom 10: A Therm-Alarm is not operating

1. If DS1 of the CM2 connected to the Therm-Alarm is flashing at a 1 Hz rate, go to Symptom 2.
2. Check the T-Bus cable connection between the Therm-Alarm and the CM2.
3. Check power to the Therm-Alarm.
4. Replace the Therm-Alarm.

Symptom 11: A Therm-Alarm sends the "Open Thermocouple" message

1. Check the continuity across the thermocouple. Replace the thermocouple if it is open.
2. Short the thermocouple input terminals together. The terminal should read the temperature of the ambient air. If it shows a definite difference, recalibrate according to the procedure in your display module instruction manual.
3. Replace the Therm-Alarm.

Symptom 12: A Therm-Alarm output does not operate properly

1. Check the terminal blocks for proper connections.
2. Check the circuit loads attached to the outputs.
3. Check the circuits that the loads affect.
4. Replace the Therm-Alarm.

Symptom 13: A Therm-Alarm's thermocouple input drifts

1. Make sure there is no cross ventilation at the thermocouple input terminals on the CM2. Cross ventilation can affect the CM2's ambient junction compensation accuracy.
2. Recalibrate the input according to the procedure in your display module instruction manual.
3. Replace the Therm-Alarm.

Component replacement

The following section describes how to check and replace the CM2, peripheral devices, and boards.

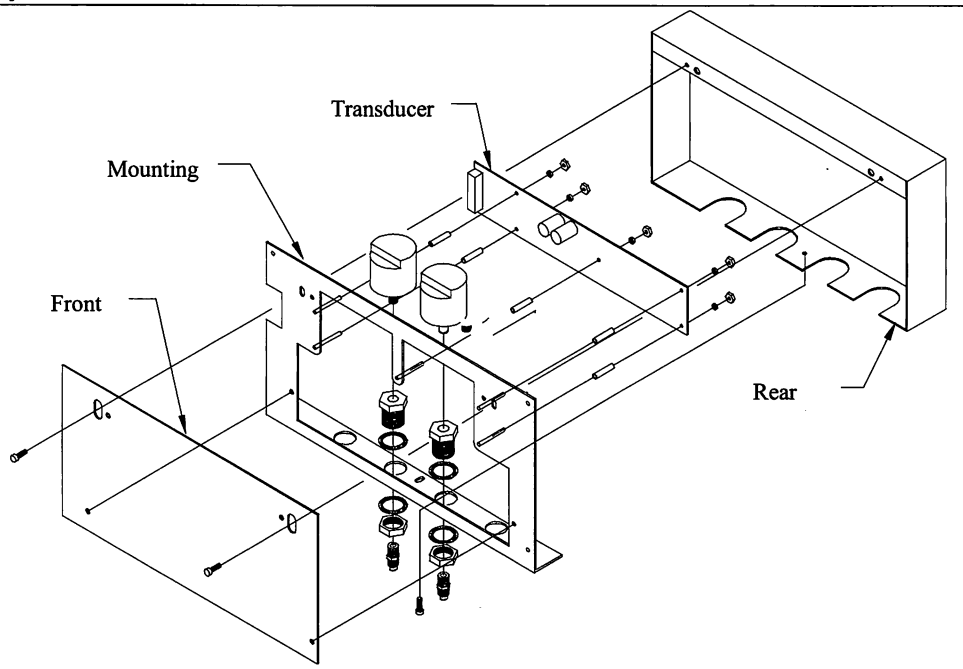
Replacing a CM2 control module

1. Remove power from the chamber.
2. To remove the CM2 from the chamber:
   a. Disconnect all of the terminal blocks from the CM2.
      i) The black plastic terminal blocks slide up and off the CM2's terminal pins.
      ii) On larger blocks, use a small screwdriver to pry the terminal blocks up and off the board.
   b. Unscrew the relay boards from the front of the CM2.
   c. Disconnect the relay boards from the CM2.
   d. Lift the CM2 out and place it in a static-shielding container.
3. To install the new CM2:
   a. Remove the new board from its static-shielding container.
   b. Plug connector J1 of each relay board into its proper CM2 connector, and mount it to the cover using the screws and washers.
   c. Install the terminal blocks removed in step 2.a.

Replacing a relay board

1. Remove power from the chamber.
2. Disconnect all of the terminal blocks from the relay board.
   a. The black plastic terminal blocks slide up and off the CM2's terminal pins.
   b. On larger blocks, use a small screwdriver to pry the terminal blocks up and off the board.
3. Unscrew the relay board from the front of the CM2.
4. Disconnect the relay board from the CM2 and place it in a static-shielding container.
5. Remove the new board from its static-shielding container.
6. Plug connector J1 of the relay board into its proper CM2 connector, and mount it to the cover using the screws and washers.
7. Install the terminal blocks removed in step 2.

Replacing a pressure transducer board



NOTE: The assembly is located on the machinery compartment frame by the condensing unit.

1. Remove power from the chamber.
2. To remove the pressure transducer board from the chamber:
   a. Open or remove the service panel or door to access the transducer assembly.
   b. Unscrew and remove the front cover. Refer to the figure above as needed.
   c. Unscrew and remove the rear housing from the transducer assembly to access the three screws on the front and bottom of the mounting plate.
   d. Note the orientation of the ribbon cable connector by the ribbon wire colors, and then disconnect the ribbon cable from the pressure transducer board.
   e. Disconnect all the terminal blocks from the pressure transducer board. The black plastic terminal blocks slide up and off the terminal pins.
   f. Remove the screws and washers that secure the pressure transducer board to the back of the mounting plate, and place the board into a static-shielding container.
3. To install the new pressure transducer board into the chamber:
   a. Remove the new board from its static-shielding container.
   b. Install the board to the mounting plate using the screws removed in step 2.f.
   c. Install the ribbon cable and terminal blocks removed in steps 2.d and 2.e. Make sure the ribbon cable connector is not reversed when you install it.
   d. Apply power to the chamber and verify proper operations.
   e. Remove power from the chamber.
   f. Install the front and rear covers.
4. Close the compartment door or mount the service panel.

Replacing an IEEE-488 converter

1. Remove power from the chamber.
2. Remove the GPIB cable and serial interface cable from the converter.
3. Unscrew and remove the converter, and place it in a static-shielding container.
4. Remove the new converter from its static-sensitive container. Mount it using the hardware removed in step 3.
5. Install the cables that were removed in step 2.
6. Set up the IEEE-488 interface as described in your display module instruction manual.

Replacing a Therm-Alarm

1. Remove power from the chamber.
2. Remove the cables, wires, and jumpers from the terminal blocks.
3. Unscrew and remove the Therm-Alarm, and place it in a static-shielding container.
4. Remove the new Therm-Alarm from its static-sensitive container, and mount it using the hardware removed in step 3.
5. Install the cables, wires, and jumpers that were removed in step 2.

Calling Thermotron for technical support

1. Make sure you have the following information before you call:
   - All the failure indications provided by the programmer/controller.
   - All the configuration information supplied by Thermotron.
   - If you were troubleshooting the programmer/controller, what steps have you performed, and what were the results?
   - What functions work on the programmer/controller?
2. Contact your local Thermotron Field Service Office, or contact the Technical Liaison Assistants at Thermotron Industries in Holland, Michigan. The telephone number is (616) 392-6550, and the fax number is (616) 393-4889.

Ordering a replacement part

Write or telephone the Thermotron Parts and Logistics Department. The telephone number is (616) 392-6550 and the fax number is (616) 393-4549. The address is:

Thermotron Industries
291 Kollen Park Drive
Holland, MI 49423
ATTN.: Parts and Logistics Department

Include the following information in any correspondence:

- The complete seven-digit Thermotron part number. Refer to the parts list for the correct part number.
- The serial number of the chamber for which the replacement is being ordered.
- The specific problem with the failed part. Include a copy of all the configuration information supplied by Thermotron.
- A purchase order number.

What to do if the CM2 fails

1. Contact your local Thermotron Field Service office. A service representative will help you determine the nature of the problem and the proper steps to resolve the problem.
2. To return a Thermotron part or instrument, follow these steps:
   a. Contact the Parts and Logistics department at Thermotron Industries in Holland, Michigan, USA. The telephone number is (616) 392-6550, and the fax number is (616) 393-4549.
   b. When you telephone, our staff needs the following information:
      - Your name
      - The name of your company
      - The model and serial number of your chamber
      - A brief description of the failure
   c. Parts and Logistics will authorize the return of the material and issue a Returned Material Tag (RMT) number.
   d. Write the name and telephone number of a contact person at your location and the RMT number on the packing list.
   e. Write the RMT number on the outside of the shipping container in a visible location.
   f. Ship all parts FOB to:

      Thermotron Industries
      836 Brooks Avenue
      Holland, MI 49423
      ATTN: (Issued RMT Number)
3. You may be asked for a Purchase Order Number before a replacement part can be shipped. Full credit will be issued under the terms and limits of the warranty if the defective part is received at Thermotron within 30 days of issuance of the RMT number.

Glossary

auxiliary relay: A solid-state relay operated by an auxiliary output that uses the TTL output to switch a line voltage. Auxiliary relays operate additional systems or circuits. You can turn these outputs on or off during programmed intervals, or you can operate them in manual mode.

calibration: The process of checking or adjusting an instrument by comparing it with a standard.

chamber: A general name for a Thermotron environmental simulation testing system. The chamber includes the testing section, the machinery section, and the console. On air-cooled chambers, air-cooled condensers are also part of the chamber.

control channels (process variable channels): Channels that receive analog inputs from thermocouples and other sensing devices used to monitor the environmental conditions inside the chamber's test space. The control module operates the chamber control systems based on the process variable readings and the demands of the test.

DMM: Digital multimeter.

GPIB: General Purpose Interface Bus; a parallel interface bus built under the IEEE-488 standard.

process variable: The actual sensed condition within the test space, such as temperature or humidity, that is controlled by the programmer/controller.

process variable channels: See control channels.

product: The device or equipment the chamber tests.

resistance temperature device (RTD): An electronic device used to sense temperature as a function of resistance.

RS-232: A standard serial data interface between two electronic devices.

RS-485: A standard serial half-duplex (shared transmit/receive line) data interface between two or more electronic devices with addressing capabilities.

RTD: See resistance temperature device.

solid-state relay board: A circuit board that uses digital outputs from the control module to operate 115 Vdc 3A relays.

SSR: Solid-state relay.

Therm-Alarm: A product protection instrument that monitors the temperature at the product. If the product temperature exceeds either the high or low temperature you select, the Therm-Alarm disables the chamber control systems and alerts you with audible and visible alarms.

thermocouple (t/c): A device used to sense temperature as a function of current.