

MODEL T48 - 1/16 DIN TEMPERATURE CONTROLLER

- PID CONTROL WITH REDUCED OVERSHOOT
- ON DEMAND AUTO-TUNING OF PID CONTROL SETTINGS
- NEMA 4X/IP65 BEZEL
- DUAL LED DISPLAYS FOR SIMULTANEOUS INDICATION OF TEMPERATURE AND SETPOINT
- STATUS INDICATORS FOR OUTPUTS AND CONTROL MODES
- ACCEPTS 10 TYPES OF SENSOR INPUTS (Thermocouple or RTD)
- OPTIONAL HEATER CURRENT MONITOR AND HEATER BREAK ALARM
- OPTIONAL DUAL ALARM OUTPUTS
- OPTIONAL TWO LINEAR DC OUTPUTS (0 to 10 V, 0/4 to 20 mA)
- MANUAL/AUTOMATIC CONTROL MODES
- SETPOINT RAMPING FOR PROCESS STARTUP
- PROGRAMMABLE USER INPUT (Digital) FOR ADDED FLEXIBILITY
- SENSOR ERROR COMPENSATION (Offset) AND BREAK DETECTION
- HEATING AND OPTIONAL COOLING OUTPUTS
- PARAMETER SECURITY VIA PROGRAMMABLE LOCKOUTS
- FIELD REPLACEABLE OUTPUT BOARD (Relay or Logic/SSR Drive)



- OPTIONAL TRIAC OUTPUT
- SECOND SETPOINT SETTING
- OPTIONAL REMOTE SETPOINT INPUT (0/4 to 20 mA)
- OPTIONAL RS485 SERIAL COMMUNICATIONS
- PC SOFTWARE AVAILABLE FOR CONTROLLER CONFIGURATION



UL Recognized Component,
File # E156876

DESCRIPTION

The T48 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD elements), precisely displays the process temperature, and provides an accurate output control signal (time proportional or linear DC) to maintain the process at the desired temperature. The controller's comprehensive yet simple programming allows it to meet a wide variety of application requirements.

The controller operates in the PID control mode for both heating and cooling, with on-demand auto-tune, which will establish the tuning constants. The PID tuning constants may be fine-tuned by the operator at any time and then locked out from further modification. The controller employs a unique overshoot suppression feature, which allows the quickest response without excessive overshoot. The unit can be transferred to operate in the manual mode, providing the operator with direct control of the output. The controller may also be programmed to operate in the ON/OFF control mode with adjustable hysteresis. A second setpoint is available on select models to allow quick selection of a different setpoint setting.

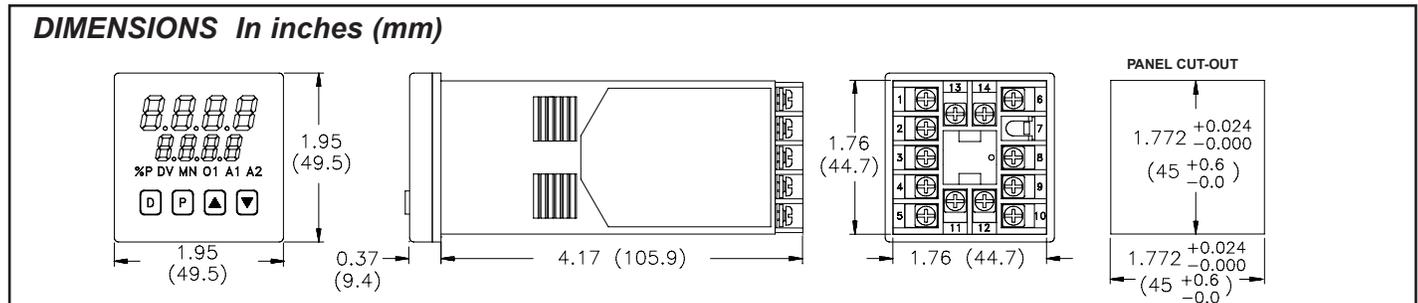
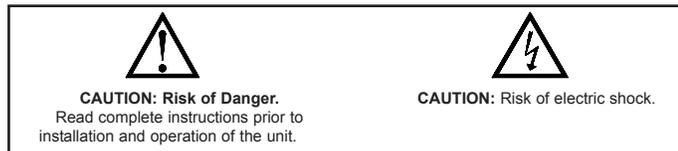
Dual 4-digit displays allow viewing of the process temperature and setpoint simultaneously. Front panel indicators inform the operator of the controller and output status. On many models the main control output and the alarm outputs are field replaceable.

Optional alarm(s) can be configured to activate according to a variety of actions (Absolute HI or LO, Deviation HI or LO, Band IN or OUT, and Heater Current Break) with adjustable hysteresis. A standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region. The second alarm can be configured as a secondary PID output (heat/cool applications).

Optional Main Linear DC output (10 V or 20 mA) can be used for control or temperature re-transmission purposes. Programmable output update time reduces valve or actuator activity. The output range can be scaled independent of the input range.

Optional Second Linear DC output (10 V or 20 mA) provides an independent temperature re-transmission, while the main Linear DC output is being used for control. The output range can be scaled independent of the input range.

Optional Heater Current Monitor provides a direct readout of process heater current. An alarm can be programmed to signal when the heater has failed. This provides early warning of system failure before product quality is affected.



Optional Remote Setpoint input (0/4 to 20 mA) allows for cascade control loops, where tighter control is required; and allows for remotely driven setpoint signal from computers or other similar equipment. Straightforward end point scaling with independent filtering and local/remote transfer option expand the controller's flexibility.

The optional RS485 serial communication interface provides two-way communication between a T48 and other compatible equipment such as a printer, PLC, HMI, or a host computer. In multipoint applications (up to thirty-two), the address number of each T48 on the line can be programmed from 0 to 99. Data from the T48 can be interrogated or changed, and alarm output(s) may be reset by sending the proper command code via serial communications. PC software, SFCRM, allows for easy configuration of controller parameters. These settings can be saved to disk for later use or used for multi-controller down loading. On-line help is provided within the software.

The unit is constructed of a lightweight, high impact plastic case with a tinted front panel. The front panel meets NEMA 4X/IP65 specifications when properly installed. Multiple units can be stacked horizontally or vertically. Modern surface-mount technology, extensive testing, plus high immunity to noise interference makes the controller extremely reliable in industrial environments.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the T48 to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller. An independent and redundant temperature limit indicator with alarm outputs is strongly recommended.

SPECIFICATIONS

1. DISPLAY: Dual 4-digit

Upper Temperature Display: 0.4" (10.2 mm) high red LED

Lower Auxiliary Display: 0.3" (7.6 mm) high green LED

Display Messages:

- "OLOL" - Appears when measurement exceeds + sensor range.
- "ULUL" - Appears when measurement exceeds - sensor range.
- "OPEN" - Appears when open sensor is detected.
- "SHrt" - Appears when shorted sensor is detected (*RTD only*)
- "..." - Appears when display values exceed + display range.
- "..." - Appears when display values exceed - display range.

LED Status Annunciators:

- %P - Lower auxiliary display shows power output in (%).
- MN - Flashing: Controller is in manual mode.
 - On: Local Setpoint (Remote Setpoint option)
 - Off: Remote Setpoint
- DV - Lower auxiliary display shows deviation (*error*) from temperature setpoint or shows heater current.
- O1 - Main control output is active.
- A1 - Alarm #1 is active (*for A1 option*).
- A2 - Alarm #2 is active OR
 - Cooling output (O2) is active

2. POWER:

AC Versions: 85 VAC min. to 250 VAC max., 50 to 60 Hz, 8 VA max.

DC Versions:

DC Power: 18 to 36 VDC; 7 W

AC Power: 24 VAC \pm 10%; 50 to 60 Hz, 9 VA

3. CONTROLS:

Four front panel push buttons for modification and setup of controller functions and one external input user for parameter lockout or other functions.

4. MEMORY:

Nonvolatile E²PROM retains all programmable parameters and values.

5. MAIN SENSOR INPUT:

Sample Period: 100 msec

Response Time: Less than 300 msec typ., 400 msec max. (*to within 99% of final value w/step input; typically, response is limited to response time of probe*)

Failed Sensor Response:

Main Control Output(s): Programmable preset output

Display: "OPEN"

Alarms: Upscale drive

Normal Mode Rejection: 40 dB @ 50/60 Hz (improves with increased digital filtering.)

Common Mode Rejection: Greater than 120 dB, DC to 60 Hz

Protection: Input overload 120 VAC max. for 15 seconds max.

6. THERMOCOUPLE INPUT:

Types: T, E, J, K, R, S, B, N, Linear mV, software selectable

Input Impedance: 20 M Ω all types

Lead resistance effect: 0.25 μ V/ Ω

Cold junction compensation: Less than $\pm 1^\circ\text{C}$ ($\pm 1.5^\circ\text{C}$ max), error over 0 to 50 $^\circ\text{C}$ max. ambient temperature range. Defeated for Linear mV indication mode.

Resolution: 1 $^\circ$ for all types, or 0.1 $^\circ$ for T, E, J, K, and N only.

TC TYPE	RANGE	WIRE COLOR	
		ANSI	BS 1843
T	-200 to +400 $^\circ\text{C}$ -328 to +752 $^\circ\text{F}$	blue (+) red (-)	white (+) blue (-)
E	-200 to +750 $^\circ\text{C}$ -328 to +1382 $^\circ\text{F}$	violet (+) red (-)	brown (+) blue (-)
J	-200 to +760 $^\circ\text{C}$ -328 to 1400 $^\circ\text{F}$	white (+) red (-)	yellow (+) blue (-)
K	-200 to +1250 $^\circ\text{C}$ -328 to +2282 $^\circ\text{F}$	yellow (+) red (-)	brown (+) blue (-)
R	0 to 1768 $^\circ\text{C}$ +32 to +3214 $^\circ\text{F}$	black (+) red (-)	white (+) blue (-)
S	0 to 1768 $^\circ\text{C}$ +32 to 3214 $^\circ\text{F}$	black (+) red (-)	white (+) blue (-)
B	+149 to +1820 $^\circ\text{C}$ +300 to +3308 $^\circ\text{F}$	grey (+) red (-)	no standard
N	-200 to +1300 $^\circ\text{C}$ -328 to +2372 $^\circ\text{F}$	orange (+) red (-)	orange (+) blue (-)
mV	-5.00 to +56.00	no standard	no standard

7. RTD INPUT: 2 or 3 wire, 100 Ω platinum, alpha = 0.00385 (DIN 43760), alpha = 0.0039162

Excitation: 150 μ A typical

Resolution: 1 or 0.1 degree

Lead Resistance: 15 Ω max. per input lead

RTD TYPE	RANGE
385	-200 to +600 $^\circ\text{C}$ -328 to +1100 $^\circ\text{F}$
392	-200 to +600 $^\circ\text{C}$ -328 to +1100 $^\circ\text{F}$
OHMS	1.0 to 320.0

8. INDICATION ACCURACY: \pm (0.3% of Span +1 $^\circ\text{C}$.) includes NIST conformity, cold junction effect and A/D conversion errors at 23 $^\circ\text{C}$ after 20 min. warm-up.

9. USER INPUT: Internally pulled up to +5 VDC (1 M Ω).

$V_{IN\ MAX} = 5.25\ \text{VDC}$, $V_{IL} = 0.85\ \text{V max.}$, $V_{IH} = 3.65\ \text{V min.}$,

$I_{OFF} = 1\ \mu\text{A max.}$

Response Time: 120 msec max.

Functions:

Program Lock	Integral Action Lock
Auto/Manual Mode Select	Setpoint Ramp Enable
Reset Alarms	Setpoint 1/Setpoint 2 Select
Local/Remote Setpoint Select	Serial block print

10. CONTROL AND ALARM OUTPUTS: (Heating, Cooling or Alarm)

Relay outputs with Form A contacts:

Contact Rating: 3 A @ 250 VAC or 30 VDC (resistive load)

1/10 HP @ 120 VAC (inductive load)

Life Expectancy: 100,000 cycles at max. load rating.

(Decreasing load and/or increasing cycle time, increases life expectancy.)

Logic/SSR Drive Outputs:

Rating: 45 mA @ 4 V min., 7 V nominal

Triac Outputs:

Type: Isolated, Zero Crossing Detection

Rating:

Voltage: 120/240 VAC

Max. Load Current: 1 Amp @ 35 $^\circ\text{C}$
0.75 Amp @ 50 $^\circ\text{C}$

Min Load Current: 10 mA

Offstate Leakage Current: 7 mA max. @ 60 Hz

Operating Frequency: 20 to 400 Hz

Protection: Internal transient snubber

11. MAIN CONTROL:

Control: PID or ON/OFF

Output: Time proportioning or Linear DC

Cycle time: Programmable

Auto-tune: When selected, sets proportional band, integral time, and derivative time values.

Probe Break Action: Programmable

12. ALARMS: 1 or 2 alarms (optional)

Modes: Absolute high acting

Absolute low acting

Deviation high acting

Deviation low acting

Inside band acting

Outside band acting
Heater break alarm

Reset Action: Programmable; automatic or latched

Standby Mode: Programmable; enable or disable

Hysteresis: Programmable

Probe Break Action: Upscale

Annunciator: LED backlight for "A1", "A2"

13. **COOLING:** Software selectable (overrides alarm 2)

Control: PID or ON/OFF

Output: Time Proportioning

Cycle time: Programmable

Proportional Gain Adjust: Programmable

Heat/Cool Deadband Overlap: Programmable

14. **MAIN AND SECOND LINEAR DC OUTPUT:** (optional)

Main: Control or Re-transmission, programmable update rate from 0.1 sec to 250 sec

Second: Re-transmission only, fixed update rate of 0.1 sec

* Accuracies are expressed as \pm percentages after 20 minutes warm-up. Output

OUTPUT ** RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	RESOLUTION
0 to 10 V	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	10k ohm min.	1/3500
0 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/3500
4 to 20 mA	0.10% of FS + 1/2 LSD	0.30% of FS + 1/2 LSD	500 ohm max.	1/2800

accuracy is specified in two ways: Accuracy over an 18 to 28°C range at 10 to 75% RH environment; and accuracy over a 0 to 50°C range at 0 to 85% RH (non-condensing) environment. Accuracy over the wide temperature range reflects the temperature coefficient of the internal circuitry.

** Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 10% overrange and a small underrange (negative) signal.

15. **REMOTE SETPOINT INPUT:** (optional)

Input type:

0/4 to 20 mA

Input Resistance: 10 Ω

Overrange: -5% to 105%

Overload: 100 mA (continuous)

Scale Range: -999 to 9999 degrees or -99.9 to 999.9 degrees.

Resolution: 1 part in 10,000.

Accuracy:

At 25°C: $\pm(0.1\%$ of full scale $+1/2$ LSD)

Over 0 to 50°C range: $\pm(0.2\%$ of full scale $+1/2$ LSD)

Reading Rate: 10/sec.

Setpoint Filtering: Programmable Digital

Setpoint Ramping: Programmable, 0.1 to 999.9 degrees/minute.

16. **HEATER CURRENT MONITOR INPUT:** (optional)

Type: Single phase, full wave monitoring of load currents controlled by main output (01).

Input: 100 mA AC output from current transformer (RLC #CT004001) or any CT with 100 mA AC output.

Display Scale Range: 1.0 to 999.9 Amps or 0.0 to 100.0%

Input Resistance: 5 Ω

Accuracy:

At 25°C: $\pm(0.5\%$ of full scale $+1/2$ LSD), (5 to 100% of Range)

Over 0 to 50°C range: $\pm(1.0\%$ of full scale $+1/2$ LSD), (5 to 100% of Range)

Frequency: 50 to 400 Hz.

Alarm Mode: Dual acting; heater element fail detect and control device fail detect.

Overrange: 105% Capacity

Overload: 200 mA (continuous).

17. **SERIAL COMMUNICATIONS:** (optional)

Type: RS485 multipoint, balanced interface

Baud Rate: 300 to 9600

Data Format: 7O1, 7E1, 7N2, 8N1

Node Address: 0-99, max of 32 units per line

Transmit Delay: 2-100 msec or 100-200 msec

Data Encoding: ASCII

Isolation w.r.t Main Input Common: 500 Vrms for 1 min. (50 V working)

Not isolated w.r.t. Remote Setpoint or Heater Current inputs, or Analog Output common

Note: RS485 and the Analog Output commons are not internally isolated within the controller. The terminating equipment of these outputs must not share the same common (ie. earth ground).

18. **ENVIRONMENTAL CONDITIONS:**

Operating Range: 0 to 50°C

Storage Range: -40 to 80°C

Span Drift (max.): 130 ppm/°C, main input

Zero Drift (max.): 1 μ V/°C, main input

Operating and Storage Humidity:

85% max. relative humidity (non-condensing) from 0°C to 50°C.

Altitude: Up to 2000 meters

19. **ISOLATION BREAKDOWN RATINGS:**

AC line with respect to all Inputs and outputs: 250 V working (2300 V for 1 minute).

Main input with respect to Analog Outputs, Remote Setpoint Input, Heater Current Input: 50 V working (2300 V for 1 minute).

All other inputs and outputs with respect to relay contacts: 2000 VAC

Not isolated between Analog Outputs, Remote Setpoint and Heater Current commons.

20. **CERTIFICATIONS AND COMPLIANCES:**

SAFETY

UL Recognized Component, File #E156876, UL873, CSA 22.2 No. 24

Recognized to U.S. and Canadian requirements under the Component Recognition Program of Underwriters Laboratories, Inc.

Type 4X Enclosure rating (Face only), UL50

IECEE CB Scheme Test Certificate # UL1369-156876/USA,

CB Scheme Test Report # 96ME50224-040396

Issued by Underwriters Laboratories, Inc.

IEC 1010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP65 Enclosure rating (Face only), IEC 529

ELECTROMAGNETIC COMPATIBILITY

Notes:

Immunity to EN 50082-2

Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m ¹ 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms ² 150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Simulation of cordless telephones	ENV 50204	Level 3; 10 V/m 900 MHz \pm 5 MHz 200 Hz, 50% duty cycle

Emissions to EN 50081-2

RF interference	EN 55011	Enclosure class A Power mains class A
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1. *No loss of performance during EMI disturbance at 10 V/m.*

Unit is panel mounted in a metal enclosure (Buckeye SM7013-0 or equivalent) that provides at least 20 dB shielding effectiveness. Metal panel is connected to earth ground.

Power Line and I/O cables routed in metal conduit connected to earth ground.

2. *Self-recoverable loss of performance during EMI disturbance at 10 Vrms:*

Analog output may deviate during EMI disturbance.

For operation without loss of performance:

Install power line filter, RLC#LFIL0000 or equivalent.

OR

Install 2 ferrite cores, RLC#FCOR0000 or equivalent, to AC lines at unit for frequencies above 5 MHz.

I/O cables routed in metal conduit connected to earth ground.

Refer to the EMC Installation Guidelines section of the manual for additional information.

21. **CONNECTION:** Wire clamping screw terminals

22. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch. Panel latch can be installed for vertical or horizontal instrument stacking. One piece tinted plastic bezel. Bezel assembly with circuit boards can be removed from the case to change the output board without removing the case from the panel or disconnecting wiring. Unit meets NEMA 4X/IP65 requirements for indoor use, when properly installed. Installation Category II, Pollution Degree 2.

23. **WEIGHT:** 0.38 lbs (0.17 kgs)

ORDERING INFORMATION

Options and Output Boards are factory configured per the part number specified. Part numbers without replacement output boards listed must be returned to the factory for output board replacement.

MODELS WITHOUT RS485 AND LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL O1 OUTPUT	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR O2 (COOL)*	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	REPLACEMENT OUTPUT BOARD	PART NUMBERS	
						18-36 VDC/24 VAC	85 TO 250 VAC
Relay					RBD48100	T4810010	T4810000
Relay	Relay				RBD48111	NA	T4811000
Relay	Relay	Relay			RBD48111	T4811110	T4811100
Relay	Relay	Relay	YES		RBD48111	T4811113	T4811103
Relay	Relay	Relay		YES	RBD48111	T4811114	T4811104
Logic/SSR					RBD48200	T4820010	T4820000
Logic/SSR	Relay				RBD48211	NA	T4821000
Logic/SSR	Relay	Relay			RBD48211	T4821110	T4821100
Logic/SSR	Relay	Relay	YES		RBD48211	T4821113	T4821103
Logic/SSR	Relay	Relay		YES	RBD48211	T4821114	T4821104
Triac	Logic/SSR	Logic/SSR			NA	T4832210	T4832200

* - These part numbers have a single output, programmable as either Control (PID) or as an Alarm.

@ - These part numbers are equipped with a second setpoint.

Option Boards are installed at the factory for the appropriate models. These boards are only needed for field replacement.

MODELS WITH RS485 OR LINEAR DC ANALOG OUTPUT

DEDICATED MAIN CONTROL O1 OUTPUT	MAIN CONTROL O1 OR A1 (ALARM 1) *	DEDICATED ALARM 1 A1 OUTPUT	(ALARM 2) A2 OR O2 (COOL) *	REMOTE SETPOINT INPUT @	HEATER CURRENT INPUT @	RS485 @	MAIN ANALOG OUTPUT** @	SECOND ANALOG OUTPUT** @	PART NUMBERS	
									18-36 VDC/24 VAC	85 TO 250 VAC
Relay						YES ¹			NA	T4810002
	Relay		Relay				YES	YES	T481011A	T481010A
	Relay		Relay				YES		T4810111	T4810101
	Relay		Relay	YES			YES		T4810115	T4810105
	Relay		Relay		YES		YES		T4810116	T4810106
	Relay		Relay			YES	YES		T4810117	T4810107
Relay			Relay	YES		YES			T4810118	T4810108
Relay			Relay		YES	YES			T4810119	T4810109
Relay		Relay	Relay			YES ²			T4811112	T4811102
	Logic/SSR		Logic/SSR				YES		T4820211	T4820201
	Logic/SSR		Logic/SSR	YES			YES		T4820215	T4820205
	Logic/SSR		Logic/SSR		YES		YES		T4820216	T4820206
Logic/SSR			Logic/SSR	YES		YES			T4820218	T4820208
Logic/SSR			Logic/SSR		YES	YES			T4820219	T4820209
Logic/SSR		Relay	Relay			YES			T4821112	T4821102

* - These part numbers have a single output, programmable as either Control (PID) or as an Alarm.

** - These part numbers are jumper and program selectable for either a current or voltage Linear DC output.

@ - These part numbers are equipped with a second setpoint.

1 - Replacement Output Board RBD48100 may be used.

2 - Replacement Output Board RBD48111 may be used.

ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
RLY	External SSR Power Unit (for Logic/SSR output models)	RLY50000
	Single Phase 25 A DIN Rail Mount SSR	RLY60000
	Single Phase 40 A DIN Rail Mount SSR	RLY6A000
	Three Phase DIN Rail Mount SSR	RLY70000
CT	40 Ampere Current Transformer (for Heater Current Input models)	CT004001
	50 Ampere Current Transformer (for Heater Current Input models)	CT005001
SFCRM	Crimson 2 PC Configuration Software for Windows 98, ME, 2000 and XP (for RS485 models)	SFCRM
ICM4	RS232/RS485 Serial Converter Module	ICM40030
ICM5	Three way isolated RS232/RS485 Serial Converter	ICM50000