

## MODELS T16 & P16 - TEMPERATURE/PROCESS CONTROLLERS



- PID CONTROL WITH REDUCED OVERSHOOT
- T16 ACCEPTS TC AND RTD
- P16 ACCEPTS 0-10 V AND 0/4-20 mA SIGNALS
- ON DEMAND AUTO-TUNING OF PID SETTINGS
- DC ANALOG OUTPUT (OPTIONAL)
- USER PROGRAMMABLE FUNCTION BUTTON
- PC OR FRONT PANEL PROGRAMMING
- PC CONFIGURABLE WITH TP16KIT



UL Recognized Component,  
File #E156876

### GENERAL DESCRIPTION

The Model T16 Controller accepts signals from a variety of temperature sensors (thermocouple or RTD), while the Model P16 Controller accepts either a 0 to 10 VDC or 0/4 to 20 mA DC input signal. Both controllers can provide an accurate output control signal (time proportional or DC Analog Output) to maintain a process at a setpoint value. 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. The comprehensive programming allows these controllers to meet a wide variety of application requirements.

### MAIN CONTROL

The controller operates in the PID Control Mode for both heating and cooling, with on-demand auto-tune, that establishes the tuning constants. The PID tuning constants may be fine-tuned through the front panel and then locked out from further modification. The controller employs a unique overshoot suppression feature, that allows the quickest response without excessive overshoot. Switching to Manual Mode provides the operator direct control of the output. The controller may also be programmed to operate in On/Off mode with adjustable hysteresis.

### ALARMS

Optional alarm(s) can be configured independently for absolute high or low acting with balanced or unbalanced hysteresis. They can also be configured for deviation and band alarm. In these modes, the alarm trigger values track the setpoint value. Adjustable alarm hysteresis can be used for delaying output response. The alarms can be programmed for Automatic or Latching operation. A selectable standby feature suppresses the alarm during power-up until the temperature stabilizes outside the alarm region.

### ANALOG OUTPUT OPTION

The optional DC Analog Output (10 V or 20 mA) can be configured and scaled for control or re-transmission purposes. The programmable output update time reduces valve or actuator activity.

### PC PROGRAMMING KIT

The optional TP16KIT contains a programming module with a 9 pin RS232 connector, cable and Crimson, a Windows® based configuration software. The software allows downloading, uploading and storage of T16 and P16 program files. All controllers have a communications port that allows configuration by PC even without controller power connected. Controller calibration is also possible using the software when the proper calibration equipment and controller power is connected.

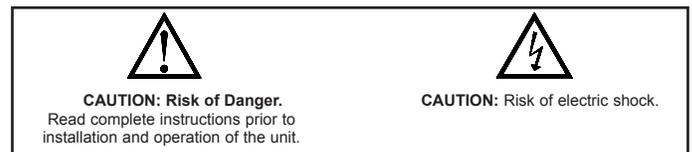
### CONSTRUCTION

The controller is constructed of a lightweight, high impact, black plastic textured case and bezel with a clear display window. The front panel meets NEMA 4X/IP65 specifications when properly installed. In applications that do not require protection to NEMA 4X, multiple controllers 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.

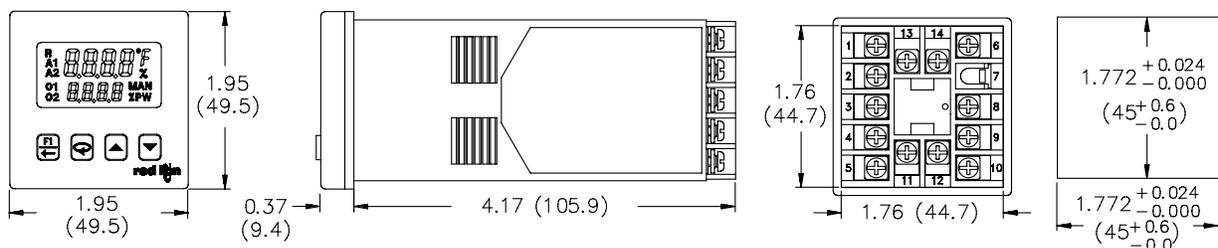
### SAFETY SUMMARY

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 controller 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.



### DIMENSIONS In inches (mm)



## GENERAL SPECIFICATIONS

1. **DISPLAY:** 2 Line by 4-digit, LCD negative image transmissive with backlighting.

**Top (Process) Display:** 0.3" (7.6 mm) high digits with red backlighting.

**Bottom (Parameter) Display:** 0.2" (5.1 mm) high digits with green backlighting.

2. **ANNUNCIATORS:**

**Status Annunciators:**

O1 - Main control output is active.

O2 - Cooling output is active (when Alarm 2 is used for cooling).

A1 - Alarm 1 output is active.

A2 - Alarm 2 output is active.

°F, °C - Temperature units.

%PW - Output power percentage is shown in Bottom display.

MAN - Controller is in Manual Mode.

R - Ramping Setpoint indicator.

% - Percent indicator (P16 models only).

**Display Messages:**

**UUUL** - Measurement exceeds + sensor range

**UUUL** - Measurement exceeds - sensor range

**OPEN** - Open sensor is detected (T16 only)

**SHrt** - Shorted sensor is detected (RTD only)

**SE#5** - Measurement exceeds controller limits (P16 only)

**dddd** - Display value exceeds + display range

**-ddd** - Display value exceeds - display range

3. **POWER:**

**Line Voltage Models:**

85 to 250 VAC, 50/60 Hz, 8 VA

**Low Voltage Models:**

DC Power: 18 to 36 VDC, 4 W

AC Power: 24 VAC, ±10%, 50/60 Hz, 7 VA

4. **CONTROLS:** Three rubber push buttons for modification and setup of controller parameters. One additional button (F1) for user programmable function. One external user input (models with alarms) for parameter lockout or other user programmable functions.

5. **MEMORY:** Nonvolatile E<sup>2</sup>PROM retains all programmable parameters.

6. **ISOLATION LEVEL:**

**AC power with respect to all other I/O:** 250 V working (2300 V for 1 min.)

**Sensor input to analog output:** 50 V working (500 V for 1 minute)

**Relay contacts to all other I/O:** 300 V working (2300 V for 1 minute)

**DC power with respect to sensor input and analog output:** 50 V working (500 V for 1 minute)

7. **CERTIFICATIONS AND COMPLIANCES:**

**SAFETY**

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

Recognized to US and Canadian requirements under the Component

Recognition Program of Underwriters Laboratories, Inc.

Type 4X Enclosure rating (Face only), UL50

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

IP65 Enclosure rating (Face only), IEC 529

**ELECTROMAGNETIC COMPATIBILITY**

**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<sup>1</sup>  
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<sup>2</sup>  
150 KHz - 80 MHz

**Emissions to EN 50081-2**

RF interference EN 55011 Enclosure class A  
Power mains class A

*Notes:*

1. *Self-recoverable loss of performance during EMI disturbance at 10 V/m: Measurement input signal may deviate during EMI disturbance.*

*For operation without loss of performance:*

*Install one ferrite core one turn, RLC #FCOR0000 or equivalent, to I/O cables at unit.*

2. *Self-recoverable loss of performance during EMI disturbance at 10 Vrms: Process and analog output signal may deviate during EMI disturbance.*

*For operation without loss of performance:*

*Install one ferrite core one turn, RLC #FCOR0000 or equivalent, to I/O cables and power cable at unit.*

*Refer to the EMC Installation Guidelines section of this bulletin for additional information.*

8. **ENVIRONMENTAL CONDITIONS:**

**Operating Temperature Range:** 0 to 50°C

**Storage Temperature Range:** -40 to 80°C

**Operating and Storage Humidity:** 85% max relative humidity (non-condensing) from 0°C to 50°C

**Vibration According to IEC 68-2-6:** Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g's.

**Shock According to IEC 68-2-27:** Operational 20 g's (10 g relay), 11 msec in 3 directions.

**Altitude:** Up to 2000 meters

9. **CONNECTION:** Wire-clamping screw terminals

10. **CONSTRUCTION:** Black plastic alloy case and collar style panel latch.

Panel latch can be installed for vertical or horizontal instrument stacking.

Black plastic textured bezel with transparent display window. Controller

meets NEMA 4X/IP65 requirements for indoor use when properly installed.

Installation Category II, Pollution Degree 2.

11. **WEIGHT:** 6.3 oz (179 g)

## INPUT SPECIFICATIONS

1. **SENSOR INPUT:**

**Sample Period:** 100 msec (10 Hz rate)

**Step Response Time:** 300 msec typical, 400 msec max to within 99% of final value with step input.

**Failed Sensor Response:**

Main Control Output(s): Programmable preset output

Display: "OPEN"

Alarms: Upscale drive

Analog Output: Upscale drive when assigned to retransmitted input.

**Normal Mode Rejection:** >40 dB @ 50/60 Hz

**Common Mode Rejection:** >120 dB, DC to 60 Hz

**Overvoltage Protection:** 120 VAC @ 15 sec max

2. **RTD INPUTS:** (T16 only)

**Type:** 2 or 3 wire

**Excitation:** 150 µA typical

**Lead Resistance:** 15 Ω max per input lead

**Resolution:** 1° or 0.1° for all types

TYPE	INPUT TYPE	RANGE	STANDARD
385	100 Ω platinum, Alpha = .00385	-200 to +600°C -328 to +1112°F	IEC 751
392	100 Ω platinum, Alpha = .003919	-200 to +600°C -328 to +1112°F	No official standard
672	120 Ω nickel, Alpha = .00672	-80 to +215°C -112 to +419°F	No official standard
Ohms	Linear Resistance	0.0 to 320.0 Ω	N/A

3. **THERMOCOUPLE INPUTS:** (T16 only)

**Types:** T, E, J, K, R, S, B, N, C, and Linear mV

**Input Impedance:** 20 MΩ for all types

**Lead Resistance Effect:** 0.25 µV/Ω

**Cold Junction Compensation:** Less than ±1°C typical (1.5°C max) error over ambient temperature range.

**Resolution:** 1° for types R, S, B and 1° or 0.1° for all other types

TYPE	DISPLAY RANGE	WIRE COLOR		STANDARD
		ANSI	BS 1843	
T	-200 to +400°C -328 to +752°F	(+) Blue (-) Red	(+) White (-) Blue	ITS-90
E	-200 to +750°C -328 to +1382°F	(+) Violet (-) Red	(+) Brown (-) Blue	ITS-90
J	-200 to +760°C -328 to +1400°F	(+) White (-) Red	(+) Yellow (-) Blue	ITS-90
K	-200 to +1250°C -328 to +2282°F	(+) Yellow (-) Red	(+) Brown (-) Blue	ITS-90
R	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
S	0 to +1768°C +32 to +3214°F	No standard	(+) White (-) Blue	ITS-90
B	+149 to +1820°C +300 to +3308°F	No standard	No standard	ITS-90
N	-200 to +1300°C -328 to +2372°F	(+) Orange (-) Red	(+) Orange (-) Blue	ITS-90
C W5/W6	0 to +2315°C +32 to +4199°F	No standard	No standard	ASTM E988-96
mV	-5.00 mV to 56.00 mV	N/A	N/A	N/A

## INPUT SPECIFICATIONS (Cont'd)

### 4. SIGNAL INPUT: (P16 only)

INPUT RANGE	ACCURACY *	IMPEDANCE	MAX CONTINUOUS OVERLOAD	RESOLUTION
10 VDC (-1 to 11)	0.30 % of reading +0.03V	1 MΩ	50 V	10 mV
20 mA DC (-2 to 22)	0.30 % of reading +0.04mA	10 Ω	100 mA	10 μA

\* Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

### 5. TEMPERATURE INDICATION ACCURACY: (T16 only)

± (0.3% of span, +1°C) at 23 °C ambient after 20 minute warm up. Includes NIST conformity, cold junction effect, A/D conversion errors and linearization conformity.

**Span Drift (maximum):** 130 PPM/°C

### 6. USER INPUT: (Only controllers with alarms have a user input terminal.)

Internally pulled up to +7 VDC (100 KΩ),  $V_{IN\ MAX} = 35\ V$ ,  $V_{IL} = 0.6\ V$  max,

$V_{IH} = 1.5\ V$  min,  $I_{OFF} = 40\ \mu A$  max

**Response Time:** 120 msec max

**Functions:** Programmable

## OUTPUT SPECIFICATIONS

### 1. CONTROL AND ALARM OUTPUTS:

#### Relay Output:

**Type:** Form A

**Contact Rating:** 3 A @ 250 VAC or 30 VDC; 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 Output (main control output only):**

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

### 2. MAIN CONTROL:

**Control:** PID or On/Off

**Output:** Time proportioning or DC Analog

**Cycle Time:** Programmable

**Auto-Tune:** When selected, sets proportional band, integral time, derivative time, and output dampening time. Also sets input filter and (if applicable) cooling gain.

**Probe Break Action:** Programmable

### 3. ALARMS: (optional) 2 relay alarm outputs.

#### Modes:

None

Absolute High Acting (Balanced or Unbalanced Hysteresis)

Absolute Low Acting (Balanced or Unbalanced Hysteresis)

Deviation High Acting

Deviation Low Acting

Inside Band Acting

Outside Band Acting

Heat (Alarm 1 on Analog Output models only)

Cool (Alarm 2)

**Reset Action:** Programmable; automatic or latched

**Standby Mode:** Programmable; enable or disable

**Hysteresis:** Programmable

**Sensor Fail Response:** Upscale

**Annunciator:** "A1" and "A2" programmable for normal or reverse acting

### 4. 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

### 5. ANALOG DC OUTPUT: (optional)

**Action:** Control or retransmission

**Update Rate:** 0.1 to 250 sec

OUTPUT RANGE **	ACCURACY *	COMPLIANCE	RESOLUTION
0 to 10 V	0.3% of FS + ½ LSD	10 kΩ min	1/8000
0 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/8000
4 to 20 mA	0.3% of FS + ½ LSD	500 Ω max	1/6400

\* Accuracies are expressed as ± percentages over 0 to 50 °C ambient range after 20 minute warm-up.

\*\* Outputs are independently jumper selectable for either 10 V or 20 mA. The output range may be field calibrated to yield approximately 5% overrange and a small underrange (negative) signal.

## ORDERING INFORMATION

MODEL NO.	MAIN CONTROL	2 ALARMS & USER INPUT	PART NUMBERS	
			18-36 VDC/24 VAC	85 to 250 VAC
T16	Relay	—	T1610010	T1610000
	Relay	Yes	T1611110	T1611100
	Logic/SSR	—	T1620010	T1620000
	Logic/SSR	Yes	T1621110	T1621100
	Analog Out *	Yes	T1641110	T1641100
P16	Relay	—	P1610010	P1610000
	Relay	Yes	P1611110	P1611100
	Logic/SSR	—	P1620010	P1620000
	Logic/SSR	Yes	P1621110	P1621100
	Analog Out *	Yes	P1641110	P1641100

\* Analog out may be used for retransmitted signals. When using analog output for retransmitted signals, AL1 becomes main control O1, if selected for heating in the analog out models.

## ACCESSORIES

MODEL NO.	DESCRIPTION	PART NUMBERS
TP16	Programming Kit 1 : Includes Software, Comms Module w/ 9-pin connector and cable, and 115 VAC Power Adapter	TP16KIT1
	Programming Kit 2 : Includes Software, Comms Module w/ 9-pin connector and cable	TP16KIT2
RLY	External SSR Power Unit (for Logic/SSR models)	RLY50000
	25 A Single Phase Din Rail Mount Solid State Relay	RLY60000
	40 A Single Phase Din Rail Mount Solid State Relay	RLY6A000
	Three Phase Din Rail Mount Solid State Relay	RLY70000