



# Tempco Instruction Manual

## 1/16 DIN Solid State Temperature Controller— Relay Output—Solid State Output—For Heating

Model Numbers: **TEC-901, TEC-902, TEC-905**



Temperature controls in this series are designed to fit panel cutouts that are 1-25/32" (45mm) square. 4-1/8" minimum depth is required to provide clearance for rear terminal connections. All models have the following specifications in common:

### Input

Thermocouple (T/C)	Type K, J. See Control label.
RTD	Three-wire PT 100 ohm DIN or JIS.
Cold junction compensation	Automatic
Input break protection	Built-in, upscale on open sensor and output off.
Input impedance	10M ohm
Common mode rejection (CMR)	CMRR 120dB, min.
Normal mode rejection (NMR)	NMRR 60dB, min. (60Hz)

### Control Output

Relay—heating	SPDT relay, 3 amps max resistive load at 120V/240VAC, 24VDC.
Optional: 3–32VDC	For control of solid state relay.

### Control Modes

On-Off	Hysteresis: 5.0% of scale symmetrically above and below the set point.
Proportional	Proportional Band fixed at 5% of scale. 20 seconds standard relay cycle time. 1 second for SSR controls. TEC-905 has manual reset of 4% of scale, adjustable externally.

### Indication

Output	Red LED, heater on/green LED, heater off.
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### Set Point

Resolution	<b>TEC-901, 902:</b> 0.2% of SPAN. <b>TEC-905:</b> least significant digit.
Accuracy	<b>TEC-901, 902:</b> 0.2% of SPAN. <b>TEC-905:</b> least significant digit.

### Power

Rating	TEC-901, 902: 110/220VAC ±15% NOT field selectable, 50/60Hz. TEC-905: 90–264VAC. 24V AC/DC models can be special ordered.
Consumption	Less than 3VA.

### Environmental and Physical

Operating Temperature	10 to 125°F (-12 to 52°C)
Humidity	0–90% RH (non-condensing)
Insulation	20M ohm min. (5000VDC)
Breakdown	2000VAC, 50/60Hz, 1 minute
Vibration	10–55Hz, amplitude 1.0mm
Shock	660ft/s <sup>2</sup> (20g)
Weight	9oz (250g)

### Dimensions

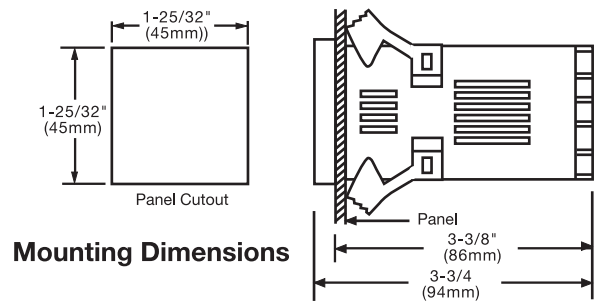
1-7/8" (48mm) x 1-7/8" (48mm) x 3-3/4" (94mm) H x W x D

Depth behind panel: 3-3/8" (86mm).

Panel cutout	1-25/32" square (45 mm square)
DIN case	Plastic full plug-in construction with screw terminals on rear and adjustable brackets for panel mounting.

## Mounting

When mounting one of these instruments, make sure the control and the ambient temperature remain within the 10–125°F range. The control may be mounted in any position. Once the control has been inserted into the panel, use the two mounting brackets provided with the unit to secure it.



Mounting Dimensions

## Manual Reset Adjustment

(TEC-905 only)

Approximately half an hour after adjusting the set point, when the process stabilizes, it may become necessary to adjust "reset" as well. Start with the reset adjustment pointing to zero. If the temperature indication stabilizes above the set point, adjust the reset to the "minus" side; if the temperature stabilizes below the set point, adjust to the "plus" side. Continue making adjustments until the temperature indication stabilizes at the set point. Make sure to allow 15 minutes between adjustments for stabilization.

## Wiring

All wiring should conform to local and national codes.

### Regarding the diagrams that apply to the TEC-901 and TEC-902 models:

*Do not operate 120V controls on a 240V power source*

Diagram 1: 120VAC operation and relay output. If the heater load exceeds 360 watts, an external magnetic contactor must be used.

Diagram 2: 120VAC operation and 3–32VDC output. Use with solid-state relay for heater control. The solid-state relays can be single or three-phase.

### Regarding the diagrams that apply to the TEC-905 model:

Diagram 3: 90–260VAC operation and relay output. If the heater load exceeds 3 amps, an external magnetic contactor must be used.

Diagram 4: 90–260VAC operation and 3–32VDC output. Use with solid-state relay for heater control. The solid-state relays can be single or three-phase.

The TEC-905 possesses universal line voltage capability from 90–264VAC. The TEC-901 and TEC-902, however, are not interchangeable between different line voltages; only the specified line voltage must be used.

When wiring the thermocouple, make sure that the thermocouple and extension wire conform to the thermocouple type specified by the instrument. The thermocouple and the extension wires must have the same polarity and be the same alloy. For accurate measurements, the total lead resistance should not exceed 100 ohms.

To assure effective lead resistance compensation when wiring three wire RTDs (Resistance Temperature Detectors), make sure that all of the leads that connect to the controller are the same gauge and composition. Connect the two common wires of the three wire RTD to terminals 4 and 5. When using a two wire RTD, install a jumper between terminals 4 and 5.

## WARNINGS:

- Dangerous voltages may be present in these instruments. Before installation or troubleshooting, switch off and isolate power to all equipment. If a unit is suspected of being faulty, it should be disconnected and removed to a properly equipped workshop for testing and repair. Component replacement and internal adjustments should be performed by qualified maintenance personnel only.
- To minimize the risk of fire or shock hazards, avoid exposing these instruments to rain or excessive moisture.
- Do not use these instruments in areas that are prone to hazardous conditions such as excessive shock, vibration, dirt, moisture, corrosive gases, or oil. The ambient temperature of the areas should not exceed the maximum rating specified.

## Wiring Precautions:

- Before wiring, verify the correct model number and options on the label. Switch off the power while checking.
- Care must be taken to ensure that the maximum voltage rating specified on the label is not exceeded.
- It is recommended that the power for these units be protected by fuses or circuit breakers rated at the minimum value possible.
- All units should be installed in a suitable enclosure to prevent live parts from being accessible to human hands and metal tools. Metal enclosures and/or subpanels should be grounded in accordance with national and local codes.
- All wiring must conform to appropriate standards of good practice and local codes and regulations. Wiring must be suitable for the voltage, current, and temperature rating of the system.
- Beware not to over-tighten the terminal screws. The torque should not exceed 1 N-m (8.9 lb-in or 10 KgF-cm).
- Unused control terminals should not be used as jumper points as they may be internally connected, causing damage to the unit.
- Verify that the ratings of the output devices and the inputs as specified are not exceeded.
- Except for thermocouple wiring, all wiring should use stranded copper conductor with a maximum gage of 14 AWG.
- Electrical power in industrial environments contains a certain amount of noise in the form of transient voltage and spikes. This electrical noise can adversely affect the operation of microprocessor-based controls. For this reason the use of shielded thermocouple extension wire which connects the sensor to the controller is strongly recommended. This wire is a twisted-pair construction with foil wrap and drain wire. The drain wire is to be attached to ground in the control panel only.

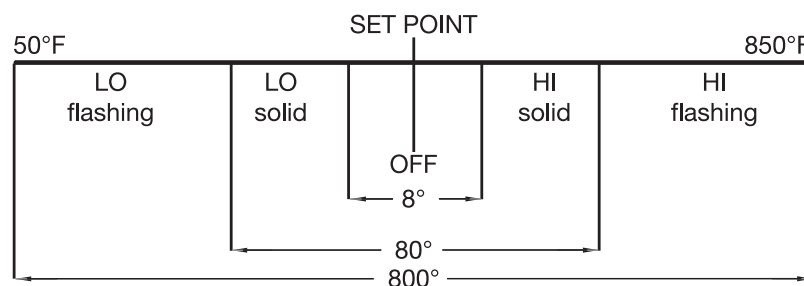
## General Operation

### OUT lamp indication:

Adjust the set point to the temperature desired. The “OUT” lamp will glow red, indicating that the control is calling for heat, and the relay (or SSR) is closed. When the process is within the control’s proportional band ( $20^{\circ}$ ), the lamp will turn green, indicating that the relay (or SSR) is open. The digital display on the TEC-905 will show the process temperature as measured at the RTD sensor or thermocouple. **Note:** If the control is configured as “on-off,” it will not cycle.

### HI and LO indication lamps on TEC-902:

These lamps compare the actual temperature of the process to the control set point. The lamps will flash on and off when the process temperature is more than 10% of the scale from the set point. With the standard temperature range of  $50\text{--}850^{\circ}\text{F}$ , 10% equals  $40^{\circ}$  above or below the set point (HI lamp or LO lamp, respectively). The lamps remain solid when the process temperature is within 10% of the scale from the set point (set point  $\pm 40^{\circ}$ ), and both lamps will remain off if the temperature is within 1% of the set point (set point  $\pm 4^{\circ}$ ).



## Calibration Instructions

Calibration is performed using the four potentiometers located on the bottom of the right-hand circuit board. Open the control by unlatching the clamps on the top and bottom of the control. Allow the control to warm up for at least half an hour before checking the calibration. The functions of the potentiometers is as follows:

- VR1 Low scale calibration
- VR2 Low scale switching point
- VR3 High scale switching point
- VR4 High scale calibration (TEC-905 only)

You must set the “reset” adjustment to zero before calibration. VR1 and VR4 affect each other, so you should calibrate low scale and high scale at least three times each.

## WARNING:

Failure of the thermocouple-RTD sensor, heater output relay, temperature control, or other devices can result in severe damage to a product while in process, melting of the heater, or a damaging fire. An over-temperature protection device must be included in your process that will remove all power from the heater circuit if any of the above failures occur. It is recommended that this device be classified as a safety control. Failure to install such a device where a potential hazard exists could result in damage to equipment and property, and injury to personnel.

**Ordering Code**

TEC-901-\_\_\_\_\_000

TEC-902-\_\_\_\_\_000

TEC-905-\_\_\_\_\_000

## (1) Power Input

- 1 100–130VAC, 50/60Hz (TEC-901, 902)
- 2 200–240VAC, 50/60Hz (TEC-901, 902)
- 4 90–240VAC, 50/60Hz (TEC-905)
- 5 12–36VAC, 50/60Hz, 16–48VDC (TEC-905)
- 9 Other (TEC-905)

## (2) Signal Input

- 1 Thermocouple Type J
- 2 Thermocouple Type K
- 3 RTD—100 ohm PT, DIN
- 4 RTD—100 ohm PT, JIS
- 9 Other

## (3) Standard Range Code (TEC-901, 902)

- 4 0–300°C
- 6 0–600°C
- C 50–550°F
- E 50–850°F

Other options available for large volume orders, consult Tempco for more information.

## (3) Range Code (TEC-905)

- |   |              |   |              |
|---|--------------|---|--------------|
| 2 | -199–199°C   | H | 0–999°C      |
| 3 | -99.9–99.9°C | J | 0–1200°C     |
| 4 | -99–99°C     | K | -399–399°C   |
| 5 | -49.9–49.9°C | L | -199–199°F   |
| 6 | 0–49.9°C     | M | -99.9–99.9°F |
| 7 | 0–99°C       | N | -99–99°F     |
| 8 | 0–99.9°C     | P | 0–99°F       |
| A | 0–199°C      | Q | 0–99.9°F     |
| B | 0–199.9°C    | R | 0–199°F      |
| C | 0–299°C      | S | 0–399°F      |
| D | 0–399°C      | T | 0–599°F      |
| E | 0–499°C      | U | 0–799°F      |
| F | 0–599°C      | V | 0–999°F      |
| G | 0–799°C      | W | 0–1999°F     |

## (4) Control Mode

- 1 On-Off
- 2 Proportional

## (5) Output 1

- 0 None
- 1 Relay—3A/240VAC
- 2 Pulse DC for SSR drive—24VDC (20mA max)
- 3 4–20mA, linear (max load 500 ohms)
- 4 0–20mA, linear (max load 500 ohms)
- 5 0–10VDC, linear (min impedance 500K ohms)
- 6 Triac-SSR output 1A/240VAC
- 9 Other

**Function of Solder Gaps J1–J11**

Location	Short	Open	Function
J1	x		T/C type J or K
"		x	PT100 ohms DIN or JIS
J2		x	Reverse control
"	x		Direct control
J3	x		100°C span
J4	x		200°C span
J5	x		300°C span
J6	x		400°C span
J7	x		460°C span
J8	x		600°C span
J9	x		800°C span
J10	x		1200°C span
J11	x		ON-OFF control
"		x	Time proportional control

**Function of Solder Gaps J12–J13**

J12	J13	Cycle time	Function
Short	Short	20 sec.	Relay output
Open	Short	1 sec.	SSR drive
Open	Open	0.02 sec.	Linear current or voltage output

**Function of Solder Gaps J14–J15 (TEC-905 only)**

J14	J15	Function
Short	Open	Positive setting
Open	Open	Positive and negative setting
Open	Short	Negative setting

## Troubleshooting

Common causes of failures:

- Line wires improperly connected
- Incorrect voltage between line terminals
- No voltage between line terminals
- Connections to terminals are loose, open, or missing
- Short across terminals
- Shorted thermocouple leads
- Thermocouple is open at tip
- Thermocouple lead is broken
- Open or shorted heater circuit
- Open coil in external contactor

- Burned out contactor
- Burned out line fuses
- Defective line switches
- Defective circuit breakers.

If the control still does not function after these points have been checked, the instrument should be returned to Tempco for inspection. Make sure to use adequate packing materials to prevent damage during shipment. Note that no products returned can be accepted without a completed Return Material Authorization (RMA) form.

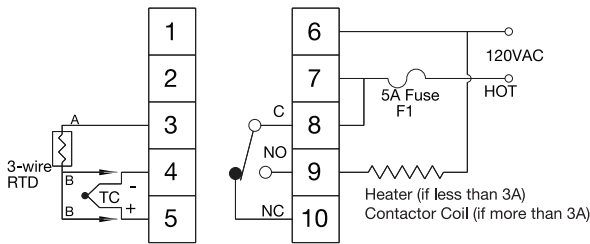


DIAGRAM 1  
TEC-901/902  
120V operation for heating with relay output  
(240V can be used if the control was specified for it and labeled so)

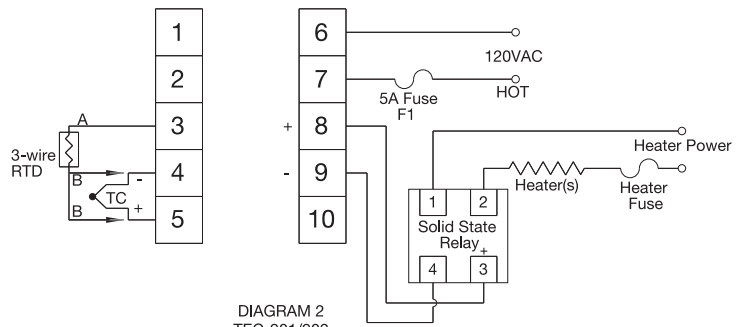


DIAGRAM 2  
TEC-901/902  
120V operation for solid-state relay output  
(240V can be used if the control was specified for it and labeled so)

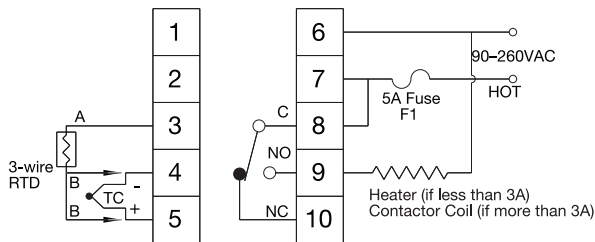


DIAGRAM 3  
TEC-905  
90-260V operation for heating with relay output

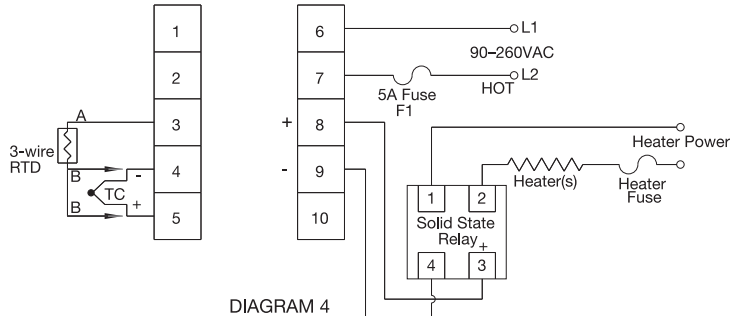


DIAGRAM 4  
TEC-905  
90-260V operation for solid-state relay output

## WARRANTY

Tempco Electric Heater Corporation is pleased to offer suggestions on the use of its products. However, Tempco makes no warranties or representations of any sort regarding the fitness for use, or the application of its products by the Purchaser. The selection, application, or use of Tempco products is the Purchaser's responsibility. No claims will be allowed for any damages or losses, whether direct, indirect, incidental, special, or consequential. Specifications are subject to change without notice. In addition, Tempco reserves the right to make changes—without notification to the Purchaser—to materials or processing that do not affect compliance with any applicable specification. TEC Temperature Controllers are warranted to be free from defects in material and workmanship for two (2) years after delivery to the first purchaser for use. Tempco's sole responsibility under this warranty, at Tempco's option, is limited to replacement or repair, free of charge, or refund of purchase price within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

## RETURNS

No product returns can be accepted without a completed Return Material Authorization (RMA) form.

## TECHNICAL SUPPORT

Technical questions and troubleshooting help is available from Tempco. When calling or writing please give as much background information on the application or process as possible.

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