

## Single Bulb Thermostats Proportional General Instructions

### APPLICATION

For proportional temperature control of media in ducts, plenum chambers, liquid lines, tanks, etc.

### SPECIFICATIONS

**Setpoint Dial:** Graduated adjusting knob with recessed locking screw. See Table 1 for specific ranges.

**Sensing Elements:** Liquid filled copper.

**Throttling Range:** See Table 1.

**Ambient Temperature Limits:**

**Case,** Shipping and Operating, -40 to 140°F (-40 to 60°C)

**Bulb,** See Table 1.

**Electrical Switch:** SPDT with proportional feedback from actuator through a solenoid.

**Ratings,** For 24 Vac, 60 Hz control circuit, contact rating 1.0 Amp at 24Vac.

**Connections:** Coded screw terminals.

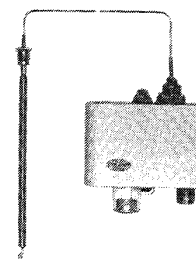
**Cover:** All metal with 1/2" conduit opening.

**Mounting:** Case can be mounted on any flat vertical surface free of vibration. See Accessories for bulb mounting kits, order separately.

**Dimensions:**

**Case,** 3-3/4" high x 5-1/4" wide x 1-7/8" deep (95 mm x 133 mm x 48 mm). See Figure 11 for details.

**Element and Capillary,** See Table 1.



TP-201

### OPTIONS

Available in °C. Available with 20' (6 m) or 45' (13.7 m) capillary. For hazardous locations, specify TP6-2XX, TP6-3XX, TP6-4XX, thermostats factory assembled in AT-401 are UL listed and CSA certified.

### ACCESSORIES

AT-201	Copper well
AT-203	Stainless steel well
AT-208	Duct mounting kit for bulbs
AT-211	Bulb shield
AT-401	Housing for hazardous locations

Table-1 Specifications.

Part Number	Setpoint Dial Range °F	Throttling Range (T.R.)**		Max. Safe Bulb Temp °F (°C)	Dimensions		Typical Application
		Factory Set	Adj.		Capillary Feet (m)	Bulb Inches (mm)	
TP-201	-40 to 40	9	4-12	190(88)	6(1.8) Copper	3/8 x 9-1/2 (9.5 m x 241) Straight Insertion	Low Temp.
TP-202	10 to 90	4	4-12	230(110)	6(1.8) Copper		Return Air or Chilled Water
TP-202-020					20(6) Copper		
TP-204	100 to 180	9	4-12	320(160)	6(1.8) Copper		Hot Water or Warm Air
TP-205	150 to 230				6(1.8) Copper		Condenser water
TP-209	50 to 130	4	4-12	230(110)	6(1.8) Copper		
TP-221	0 to 160	15	5-25	230(110)	10(3) Armored		
TP-222	90 to 250	15	5-25	320(160)	10(3) Armored	3/4 x 7-1/2 (19 x 191) Coil	Process Control
TP-223	190 to 350	15	5-25	420(215)	10(3) Armored		
TP-307*	50 to 130	15	5-25	230(110)	6(1.8) Copper		Low Limit Fan Discharge
TP-307-020*	50 to 130	15	5-25	230(110)	20(6) Copper		
TP-402	10 to 90	9	4-12	230(110)	6(1.8) Copper	3/16 x 52 (4.8 x 1.3 m) Averaging	Mixed Air
TP-402-020	10 to 90	9	4-12	230(110)	20(6) Copper		

\* Unit has split tongue which enables it to call for heat regardless of the temperature of the pilot thermostat. To use TP-307 as a standard thermostat add a jumper between terminals "C" and "2".

\*\*Temperature change required at the sensing element to run the controlled actuator output shaft from one end of its stroke to the other.

## PRE-INSTALLATION

### Inspection

Visually inspect the carton for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the carton and visually inspect the device for obvious defects. Return damaged or defective products.

### Required Installation Items

- Wiring diagram
- Tools (not provided):
  - Volt-ohm meter
  - Appropriate screwdriver for mounting screws
  - Appropriate drill and drill bit for mounting screws
- Appropriate accessories
- Mounting screws (not provided)

## INSTALLATION

### Caution:

1. Installer must be a qualified, experienced technician.
2. Disconnect power supply before installation to prevent electrical shock and equipment damage.
3. Make all connections in accordance with the wiring diagram, and in accordance with national and local electrical codes.
4. Do not exceed ratings of the device.

### Controller Mounting

Mount the controller in an upright position on a wall or vertical flat surface that does not vibrate. Solenoid armature must hang vertical in coil (see Figure 8).

**Caution:** Avoid location near stem coils, pipes, or where radiant heat will affect the bulb or capillary.

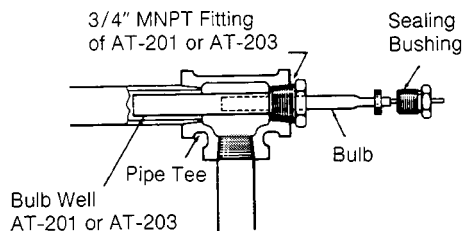


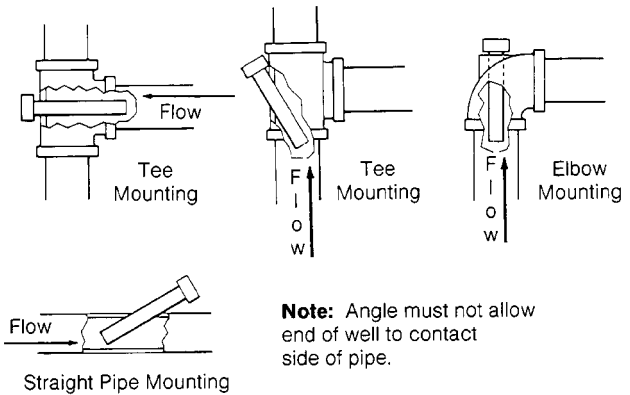
Figure-1 Liquid Line and Tank Mounting with AT-201 or AT-203.

### Bulb Mounting

#### Liquid Line and Tank Mounting

Use copper (AT-201) or stainless steel (AT-203) wells.

1. Install bulb well into 3/4" FNPT opening.
2. Insert bulb into well.
3. Tighten packing nut into bulb well until firmly seated.



Part Number	Application Limitations at 250°F Fluid Temp. (Max. 350°F)	
	Maximum Recommended Velocity (FPS)	Maximum Recommended Static Pressure (psig)
AT-201	11	250
AT-203	20	500

Figure-2 Bulb Well Installation Limitations.

### Duct Mounting

1. Cut 1/2" (13 mm) or 7/8" (22 mm) hole in duct.
2. Slip gasket over capillary between bracket and bulb.
3. Fasten bracket to duct work with sheet metal screws provided.

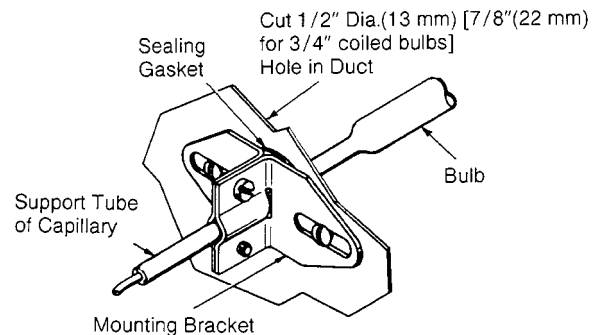


Figure-3 Duct Mounting with AT-208.

### Outdoor Wall Mounting

Use AT-211 shield kit.

1. Mount bulb to outside wall or surface with bulb clip.
2. Place shield over bulb and fasten to mounting surface.

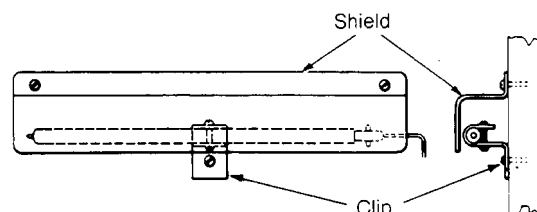


Figure-4 Outdoor Mounting with AT-211.

## Wiring

Large, coded screw type terminals are provided for all electrical connections.

Make all connections in accordance with the job wiring diagram and in compliance with National and Local Electrical Codes.

### Terminal Coding and Switch Action TP-2XX, TP-402

"C" is common of SPDT switch. "R" closed on a decrease in temperature, "B" closed on an increase in temperature. "2" is connected to ground either directly or by a jumper to "C". "1" is connected to the potentiometer wiper arm of the actuator. See Figures 5 and 8.

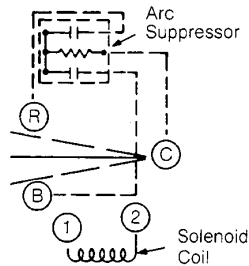


Figure-5 TP-2XX, TP-402 Terminal Coding and Switch Action.

### TP-307

"C" is common of one SPST switch action which closes to "B" on an increase in temperature. "2" is common of the other SPST switch action which closes to "R" on a decrease in temperature. Also "2" is connected to the other side. See Figures 6 and 10.

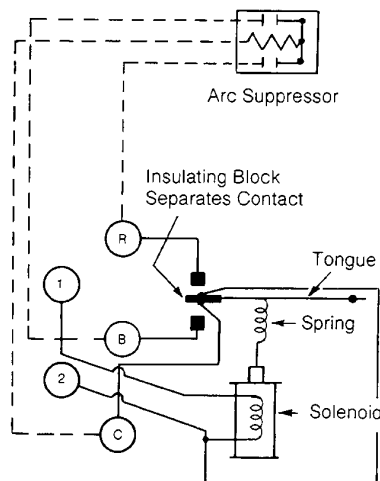


Figure-6 TP-307 Terminal Coding and Switch Action.

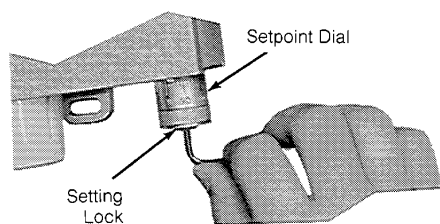


Figure-7 Setpoint Dial Adjustments.

## ADJUSTMENTS

**Setpoint Dial (See Figure 7):** Turn knob, at the bottom of the case, to the required setting. The setting can be locked by tightening the recessed allen screw in the bottom of the dial.

**Throttling Range (T.R.) (See Figure 8):** Adjust the throttling range by moving the slider on the tongue to the left (increases T.R.) or to the right (decreases T.R.).

**To obtain the effective T.R.** Multiply the slider range setting by the minimum T.R. of the controller. For example, a slider range setting of "2" for a controller with a T.R. of 4 to 12°F (2 to 7°C) will give an approximate T.R. of [2 x 4°F(2°C)] 8°F(4°C).

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**Note:** The control must be recalibrated whenever the T.R. slider setting has been changed. See Calibration.

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The T.R. adjustment should be set to the lowest value possible without causing instability (hunting) of the actuator. Stable operation of the actuator does not necessarily mean the actuator should not often run. The throttling range setting is too low and should be increased until stable operation results if:

1. The actuator shaft rotates continuously over a large portion of its stroke.
- or
2. The actuator shaft frequently reverses direction at control point.

## CALIBRATION (See Figure 8)

1. Apply power to the thermostat controller and actuator.
2. Place the sensing bulb in an ambient temperature equal to the approximate midpoint of the dial scale. For example, if the controller has a dial scale of 50 to 130°F, the midpoint of the dial is 90°F.
3. Remove the case cover.
4. Allow sensing bulb to stabilize for approximately 10 minutes.
5. Pry off the wire barrier.
6. Turn the setpoint dial until the tongue "floats" with the actuator shaft at the midpoint of its travel.
7. Disconnect the wire jumper from the printed circuit board by pulling straight out.

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**Note:** Do not disconnect the end attached to the tongue assembly.

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8. Turn the setpoint dial to the ambient temperature of sensing bulb.
9. Turn the calibration screw until the tongue again "floats" between the two contacts. Turning the calibration screw to the right (CW) raises the control point temperature, while turning the screw to the left (CCW) lowers the control point temperature.
10. Re-install wire jumper on the printed circuit board.
11. Replace wire barrier and case cover.
12. Adjust setpoint dial to desired setting.
13. Return the bulb to its proper location.

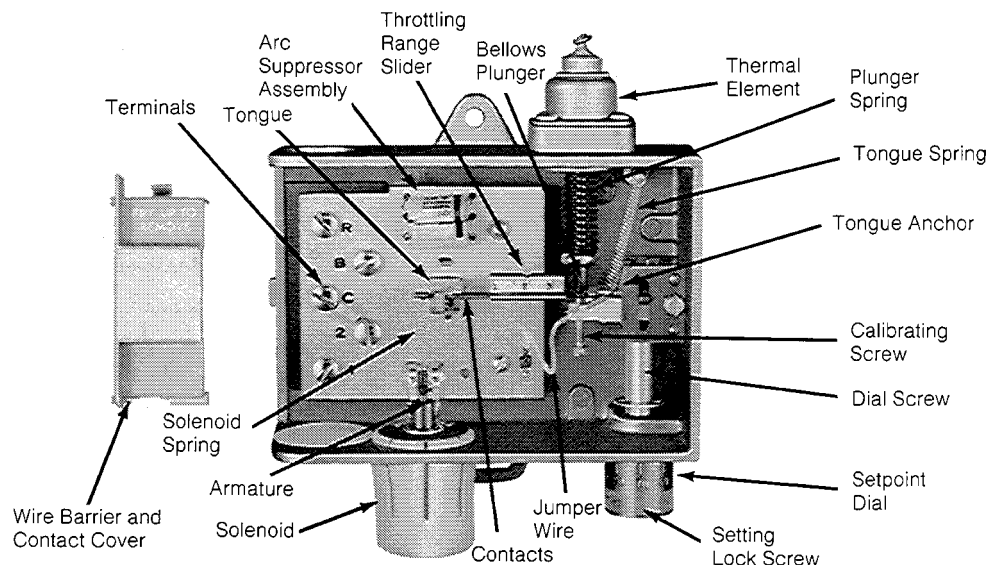


Figure-8 Part Identification.

## FIELD SERVICE

See Figure 8.

**Table-2 Armature Troubleshooting.**

Condition	Action
Does not move Smoothly	Move armature up and down with a toothpick or match while blowing out any dirt in the sleeve.
Greasy	Put a few drops of carbon tetrachloride in the sleeve to free the armature.
Chattering	Level the controller so the armature hangs vertically in the coil.

To check the operation of the solenoid armature:

1. Disconnect all field wiring.
2. Remove wire barrier.
3. Adjust setpoint dial until tongue "floats" between the two contacts.
4. Apply 24 Vac to terminal "1" and "2" and check that the shoulder on the armature is not more than 3/64" (1.2 mm) above extreme top of solenoid assembly.

5. To raise or lower the armature, insert a thin blade screwdriver into opening in the bottom of the solenoid assembly. This will engage the slot in the bottom of the armature and permit it to be turned either to the right or left.

**Note:** At least two threads must be engaged between the spring and the armature.

6. Replace wire barrier, field wiring and case cover.

## Differential

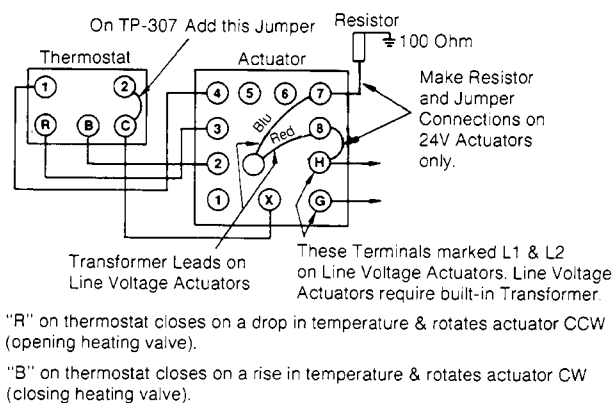
Factory set at approximately 1-1/2°F (.8°C) and should not be changed.

The contact gap is factory set at .003". This dimension may be checked with a feeler gauge. The white nylon screw in the lower contact bar may be rotated to adjust the gap only if necessary.

## MAINTENANCE

Regular maintenance of the system is recommended to assure sustained maximum performance.

### Proportional Heating



### Proportional Cooling

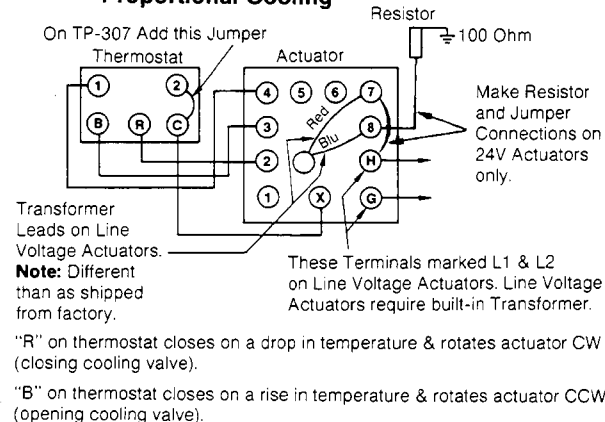
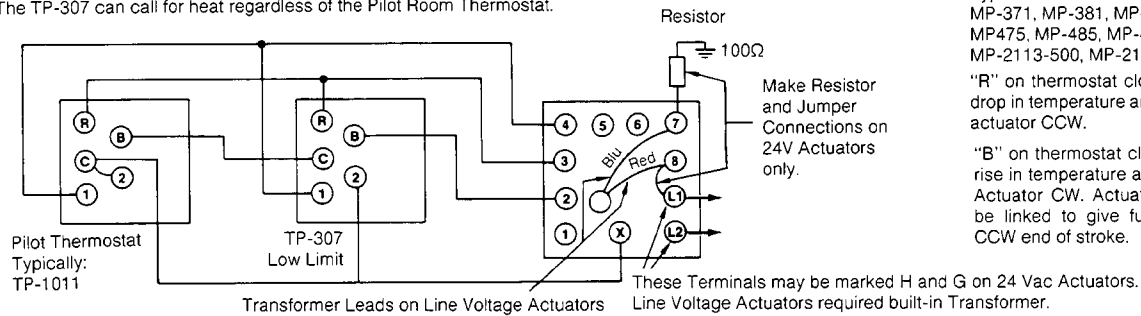


Figure-9 TP-2XX, TP-402 Control Action and Terminal Identification.

## Typical TP-307, Low Limit

The TP-307 can call for heat regardless of the Pilot Room Thermostat.

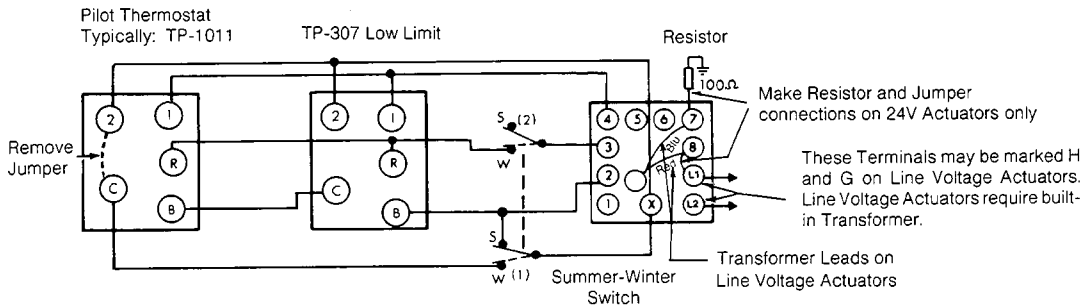


Typical Actuators MP-361, MP-371, MP-381, MP-382, MP-475, MP-485, MP-486, MP-2113-500, MP-2150-500

"R" on thermostat closes on a drop in temperature and rotates actuator CCW.

"B" on thermostat closes on a rise in temperature and rotates Actuator CW. Actuator should be linked to give full heat at CCW end of stroke.

## Summer-Winter Switching of TP-307

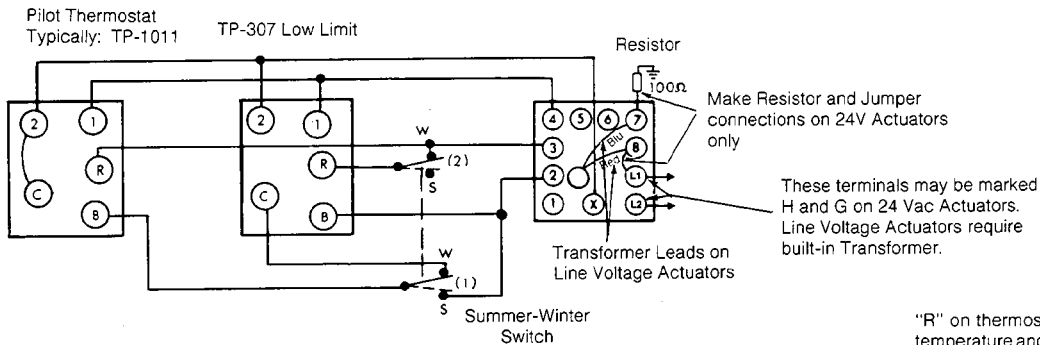


The Summer-Winter switch takes both the room Microtherm and low limit out of control and the operator is run to the clockwise full cool position. Note that pole (2) of the switch is required to open the circuit between R and terminal 3 to prevent the possibility of making a grounded circuit to terminals 3 and 2 at the same time.

"R" on thermostat closes on a drop in temperature and rotates Actuator CCW.

"B" on thermostat closes on a rise in temperature and rotates Actuator CW.

## Summer-Winter Switching of TP-307



The low limit only is switched out of the circuit for summer operation. Pole (2) of the relay is required to isolate the red contact of the low limit.

"R" on thermostat closes on a drop in temperature and rotates Actuator CCW.

"B" on thermostat closes on a rise in temperature and rotates Actuator CW.

Figure-10 TP-307, Low Limit Control Action and Terminal Identification.

Technical drawing of a 1/2 inch NPT female plug. The drawing shows a side view of the plug with a threaded top section and a wider body. Dimensions are indicated with arrows and text:

- Top section height:  $1-1/8$
- Body height:  $1-3/16$
- Body diameter:  $11/16$
- Threaded section diameter:  $61/64$

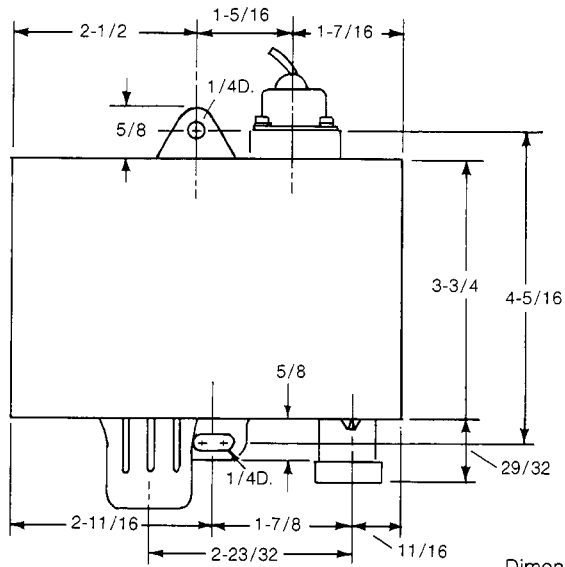


Figure-11 Case Dimensions.



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