

Therm-O-Disc

Product Information



INNOVATIVE SOLUTIONS



THERM-O-DISC™

Sensing Solutions

Putting systems in touch with their surroundings to enable new levels of understanding, awareness, and response.



Hermetic Solutions

Ensuring a robust electrical or signal connection across adverse environmental conditions.



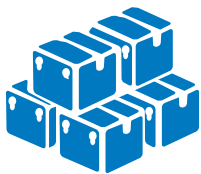
Enabling safe, reliable, and efficient system control.

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Trustworthy, stable company with over 75 years of proven reliability



Broadest range of product options



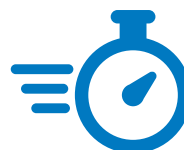
Over 1/2 billion units produced annually



Local, direct support, worldwide



Leading product application experts



Rapid custom prototypes

Bimetal Disc Thermostat

Product Information and
Application Notes

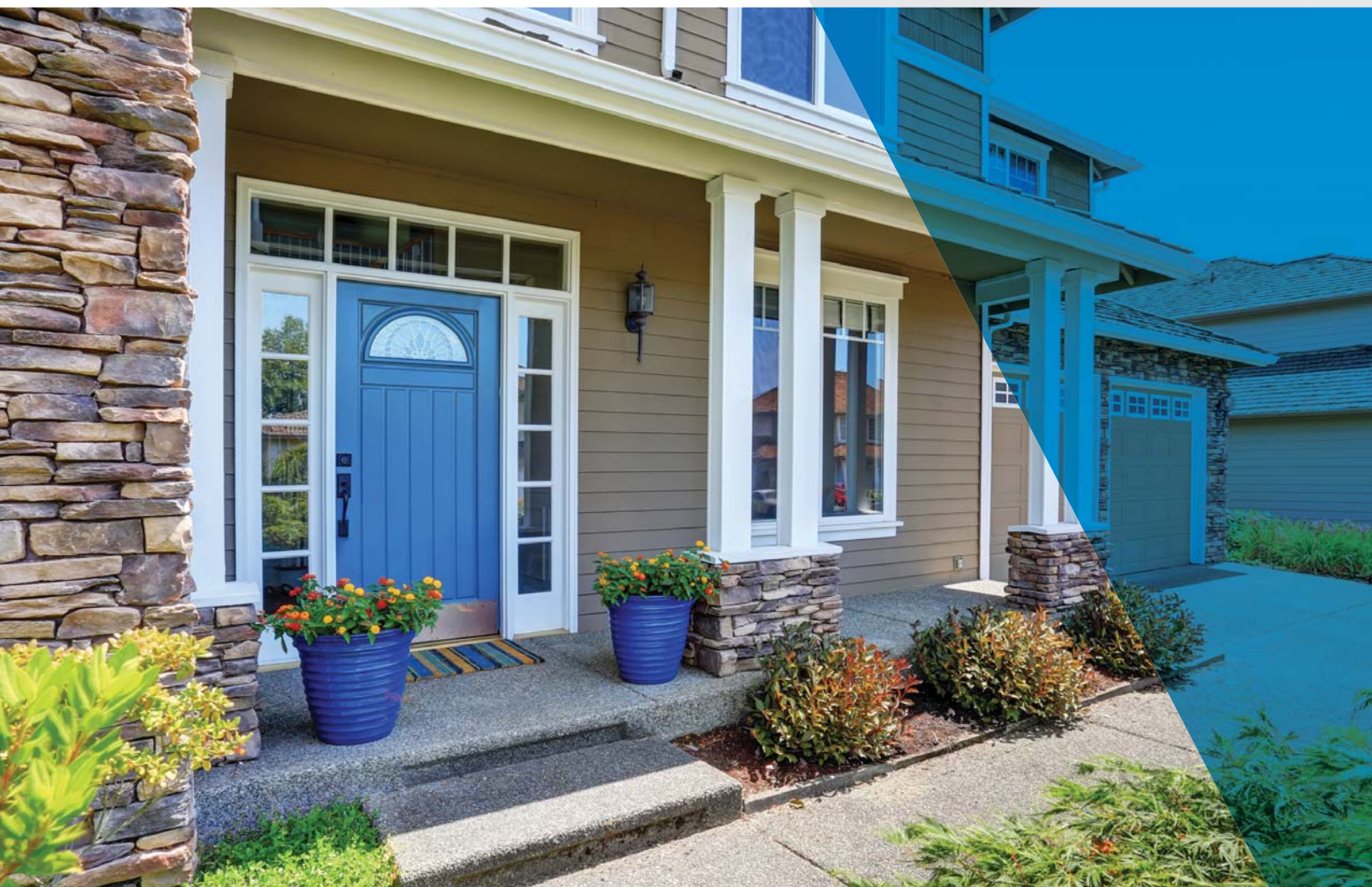


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Bimetal Disc Thermostat Application Notes



Operating Principles

Bimetal disc thermostats are thermally actuated switches. When the bimetal disc is exposed to its predetermined calibration temperature, it snaps and either opens or closes a set of contacts. This breaks or completes the electrical circuit that has been applied to the thermostat.



There are three basic types of thermostat switch actions:

- **Automatic Reset:** This type of control can be built to either open or close its electrical contacts as the temperature increases. Once the temperature of the bimetal disc has returned to the specified reset temperature, the contacts will automatically return to their original state.
- **Manual Reset:** This type of control is available only with electrical contacts that open as the temperature increases. The contacts may be reset by manually pushing on the reset button after the control has cooled below the open temperature calibration.
- **Single Operation:** This type of control is available only with electrical contacts that open as the temperature increases. Once the electrical contacts have opened, they will not automatically reclose unless the ambient that the disc senses drops to a temperature well below room temperature (typically below -31°F).

Temperature Sensing & Response

Many factors can affect how a thermostat senses and responds to temperature changes in an application. Typical factors include, but are not limited to, the following:

- Mass of the thermostat
- Switch head ambient temperature. The “switch head” is the plastic or ceramic body and terminal area of the thermostat. It does not include the sensing area
- Air flow across the sensing surface or sensing area. The “sensing surface” (or area) consists of the bimetal disc and metal disc housing
- Air flow across the switch head of the thermostat
- Internal heating from carrying the application electrical load
- Disc cup or housing type (i.e. enclosed, as on left in picture below, or exposed, as on right)
- Rate of temperature rise and fall in the application
- Intimacy of contact between the thermostat sensing surface and the surface it is mounted on
- Heat transfer by conduction, convection or radiation



It is important to understand that the temperature of the thermostat will typically change more slowly than or lag the temperature it is trying to sense. The impact of the factors mentioned previously will determine the magnitude of the thermal lag. Thermal lag will directly affect determination of thermostat calibration to regulate or limit temperature for a particular application. Reference the “Determining Calibration” section for how to use a thermocouple sample thermostat to establish thermostat calibration.

Control Location

The location of the thermostat should be carefully selected. Adequate time should be used to determine the temperatures in the various locations within the product to assure the location of the sensor can best measure and control the performance of the product. Various methods may be employed to measure these temperatures such as infrared thermography, multiple thermocouples, etc.

Determining Calibration

A thermocouple sample thermostat is typically used as a key indication of what the calibration temperature of a thermostat should be for a particular application (see Figure 3). The thermocouple is ideally attached internally to the control on the bimetal disc for optimum results since the bimetal disc is the component that senses the temperature in a bimetal thermostat. The sample control has the same thermal response as a functional thermostat but the contacts will not open.

Once a preliminary calibration temperature has been determined with the thermocouple sample control, a functional control calibrated at the desired temperature must be tested in the application to verify that the calibration is appropriate. Therm-O-Disc provides thermocouple samples upon request. Type J, Type K, and Type T thermocouples are available.

A thermocouple may be placed externally on a thermostat (see Figures 4 and 5). The preferable location would be on the metal disc “cup” / mounting bracket at a point closest to the sensing surface. The sensing surface is the flat area of the “cup” or bimetal housing for thermostats with enclosed bimetal discs. Those with exposed bimetal discs should have the thermocouple positioned as close to the disc as is practical. Care should be taken to assure that the thermocouple wires do not contact one another except at the sensing junction.

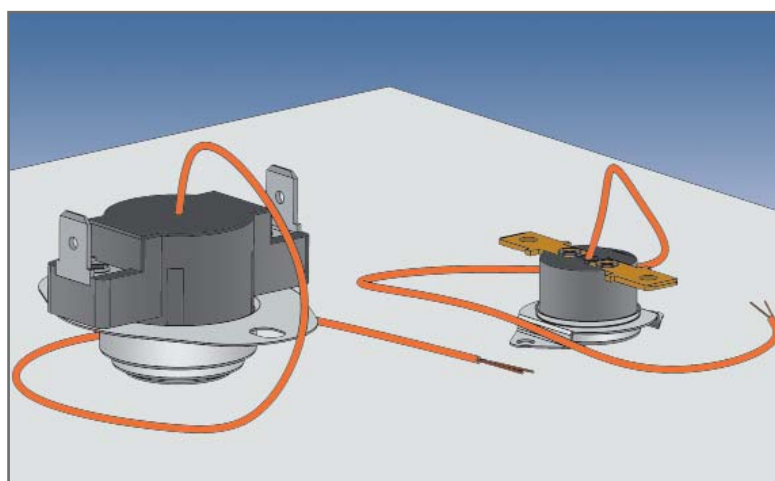


Figure 3
Thermocouple Sample Controls

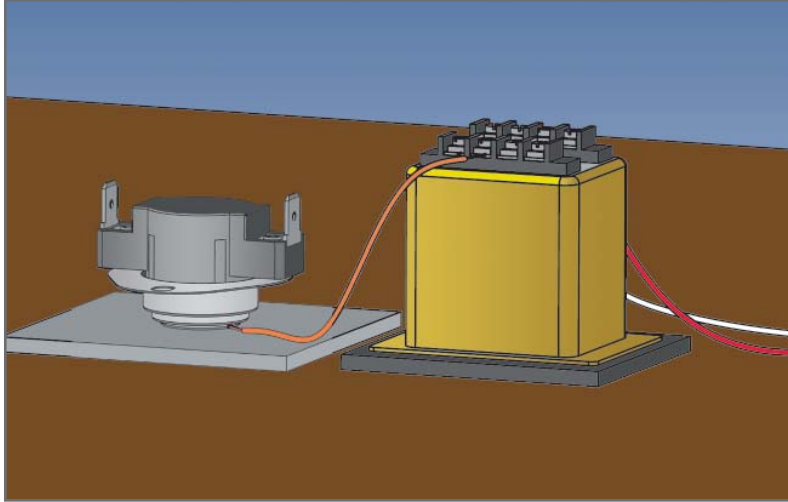


Figure 4
Thermocouple placed externally to thermostat

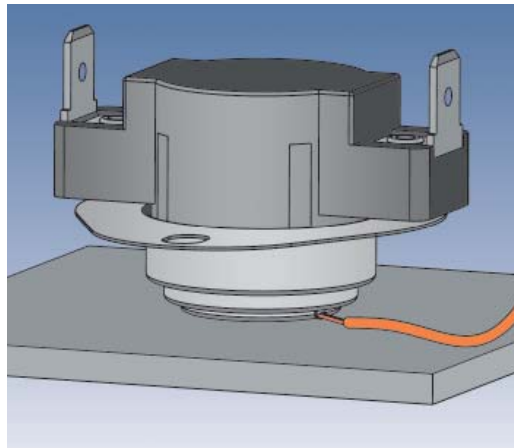


Figure 5
Thermocouple placed externally to thermostat

Thermostats are used to both regulate and to limit temperatures. A thermostat that regulates temperature is exposed to temperatures of normal operating conditions of a particular application, plus an overshoot temperature. A thermostat that limits temperature is exposed to temperatures of abnormal operating conditions, plus an overshoot temperature. It is important to determine both the normal and abnormal operating temperatures as well as the respective temperature overshoots in each application in order to specify the appropriate thermostat calibration. Since most applications include both regulating and limiting thermostats, it is essential to prevent nuisance tripping of the limit by fully understanding the temperature overshoots. It is important to know what the maximum exposure temperature is to assure that components and complete units do not exceed their respective rated temperatures. The maximum exposure temperature is the combined result of the maximum ambient temperature added to the temperature increase due to the application plus the overshoot.



Test Guidelines

Install the thermocouple sample thermostat in the appropriate location (see earlier section named “Control Location”) using both the same mounting and electrical connections as will be used in the application. The thermocouple lead should be connected to a device that will monitor and record the output from the thermocouple. Only personnel properly trained in the safe use of electrical equipment should perform testing. Caution must be exercised to assure that line voltage, if present, must not injure personnel or damage equipment. Use of an isolation transformer is recommended if there is any chance that the thermocouple wires may see line voltage.

- CAUTION** To avoid a false reading of the unit under test, thermocouple wires must not make contact with each other except at the temperature sensing junction.
- CAUTION** Ensure that the thermocouple wire insulation will provide isolation against short circuiting and shock hazards.
- CAUTION** The terminal of the temperature measuring instrument, to which the thermocouple is attached, will be the same potential as the connecting circuit wire. This instrument must be electrically isolated and considerable caution must be exercised in its use, since one of the thermocouple terminals is frequently grounded to the instrument chassis.

It will likely be necessary to conduct several trials with varying ambient temperature, air flow rate and/or volume, rate of temperature rise or fall, etc. to identify normal and abnormal operation. Normal manufacturing and assembly variation between units and any applicable approval agency requirements or industry standards must also be considered.

Monitor the temperatures under normal operating conditions using the thermocouple sample thermostat. Repeat using conditions for abnormal operating conditions. Conduct as many trials as are necessary to understand all the potential fault conditions and to assure that the rated temperature of components (including the thermostat) and the test units are not exceeded. The test may be set up to be able to manually open the electrical circuit when the thermocouple sample thermostat reaches a particular target temperature (as determined from testing described above). Continuing to monitor the temperature of the thermocouple sample after the circuit is manually opened, and determining the maximum temperature excursion beyond the “open” temperature can determine the temperature overshoot. This can be conducted for both regulating and limiting thermostats. Once the preliminary calibration value for the thermostat has been determined, by taking into account normal and abnormal operating conditions, product and test variation and overshoots, it is necessary to repeat testing with functional thermostats. It may be necessary to try thermostats calibrated both higher and lower than the targeted temperature to better optimize the calibration temperature. This will also provide useful information for specifying the calibration tolerance.



Important Notice

Users must determine the suitability of the control for their application, including the level of reliability required, and are solely responsible for the function of the end-use product. These controls contain exposed electrical components and are not intended to withstand exposure to water or other environmental contaminants which can compromise insulating components. Such exposure may result in insulation breakdown and accompanying localized electrical heating.

A control may remain permanently closed or open as a result of exposure to excessive mechanical, electrical, thermal or environmental conditions or at normal end-of-life. If failure of the control to operate could result in personal injury or property damage, the user should incorporate supplemental system control features to achieve the desired level of reliability and safety. For example, backup controls have been incorporated in a number of applications for this reason.

Glossary

Ambient – The typical environmental temperature at which a product is exposed.

Approval Agencies – Agencies created to verify the safety and/or functionality of electrical and gas household products. Therm-O-Disc products are typically recognized at the major global agencies, including UL, CSA, VDE, CQC, and MITI.

Automatic Reset – A type of thermostat that will reset itself at a specific temperature (set point minus differential = reset temperature).

Bimetal – Metallic strip material made by bonding two different materials together with different thermal expansion rates.

Bumper – An actuating pin that transmits motion from the sensing mechanism to an actuating arm.

Contacts – Term for components used in all electrical-type products that physically make and break electrical circuits.

Comparative Tracking Index (CTI) – A measure of material surface electrical tracking (resistance).

Cycle Rating – The agency-recognized number of operations that a control will function, given a specific temperature range and electrical load.

Dielectric Strength – A product’s ability to withstand an application of a pre-determined over-voltage for a specified period of time.

Differential – The temperature difference between the opening and closing points of a control.

Disc Cup – A cup that holds a disc in place on a disc-type control.

Disc – A thin, circular bimetallic component.

DPDT (Double Pole, Double Throw) – An electrical term where “pole” is a leg of an electrical circuit and “throw” describes the switch action. Therefore, a DPDT will switch two legs and each leg will open a set of contacts, and close another set (4 contacts).

DPST (Double Pole, Single Throw) – An electrical term where “pole” means a leg of an electrical circuit and “throw” describes the switch action. Therefore, DPST will switch two legs and each leg is switched open or closed by one mechanism.

Fan-Type Control – A thermal control designed such that the contacts close on temperature rise. Also referred to as “close on rise,” or “normally open.”

Fuse-Type Control – A control built to cycle only once.

Limit-Type Control – A thermal control designed such that the contacts open on temperature rise. Also referred to as “open on rise,” or “normally closed.”

M1 – Refers to manual reset devices. If the reset button is held down, the control can cycle thermally.

M2 – Refers to manual reset devices. If the reset button is held down, the control must stay open and not reset automatically.

Manual Reset (M.R.) – A control that opens automatically, but must be reclosed manually by pressing a button or lever.

NTC (Negative Temperature Coefficient) – A resistor that reduces resistance (ohms) with a temperature increase.

Pole – The number of completely separate circuits contained in a control.

Prime Differential – The thermal differential between the nominal open temperature and the minimum close temperature.

PTC (Positive Temperature Coefficient) – A resistor that increases resistance (ohms) with temperature increase.

Reference Dimension – A dimension without tolerance used only for information purposes that does not govern production or inspection operations.

Reset Temperature – The temperature at which the contacts return to their normal position.

Set Point – Temperature at which normally closed contacts will open, or normally open contacts will close. Also referred to as operating temperature.

SPDT (Single Pole, Double Throw) – An electrical switch term where “pole” means a leg of an electrical circuit and “throw” describes the switch action. Therefore, a SPDT will switch one leg that will open a set of contacts, and close another set.

SPST (Single Pole, Single Throw) – An electrical term describing switch actions. A SPST will switch one leg and open one set of contacts.

Stenciling – The marking on a product identifying the product type, calibration temperature, part number and plant of manufacture.

Switchcase – The component that represents the thermostat “body,” made from insulating material that supports switch mechanisms.

Thermal Cutoff (TCO) – A product that functions as a thermal fuse (one time operation). Various operating temperatures are achieved by formulating a pellet that melts at very specific temperatures.

Thermistor – A device that exhibits a large change in electrical resistance with a change in temperature.

Tolerance – The allowable range above or below the set point or reset temperature.

Trip-Free – A term associated with manual reset type controls. When the reset button is depressed it cannot restrict the normal opening of the control.

Important Information

Many variables can affect the operational characteristics of a thermostat. It is for this reason that we recommend that you conduct thorough testing of our products in your specific application. Therm-O-Disc has both functional and thermocoupled samples readily available for determining the desired performance and the correct response in your application. To obtain samples please contact your local Therm-O-Disc sales representative directly. To ensure a quick turnaround, please have the following information ready:

- Application description
- Electrical load
- Operating temperature requirements
- Agency recognition(s) required
- Mounting and terminal configurations
- Estimated annual volume

Don't know what product you need? Do you have a general question about our products? Visit thermodisc.com or contact your local Therm-O-Disc sales office. Our Applications Engineers are always available to assist you in answering your questions or in obtaining any samples you may need.

10H Linear Limit Series Special Purpose Controls



Snap-Action Capillary Controls

The 10H series temperature control from Therm-O-Disc was originally developed to sense hot spots along the length of electric baseboard heaters. It is also used in other applications where it is necessary to sense temperatures along a continuous length.

The 10H capillary tube is vacuum-charged with selected fluids to give specific calibrations. When the calibration temperature is reached, a change in fluid vapor pressure allows the diaphragm to snap through and operate the contacts. The snap-action design provides high-speed contact separation and excellent reliability.

Typical applications for the 10H include electric baseboard heaters and other HVAC applications.



Features and Benefits

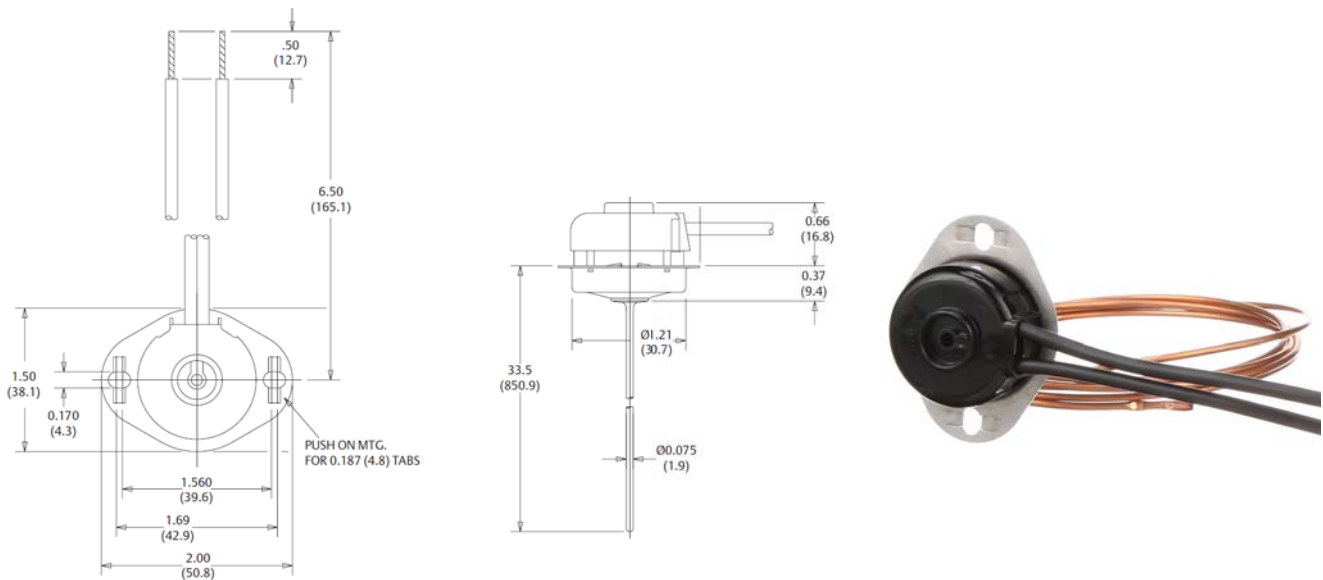
The 10H features include:

- The ability to sense temperature along a continuous length.
- Excellent sensitivity. Since the capillary tube is charged, the 10H responds to the hottest spot along the capillary tube.
- High-speed contact separation for long contact life.
- Design flexibility provided by a variety of switch actions, capillary tube lengths, mounting brackets and terminations.

Switch Actions

The 10H is available in two switch actions:

Automatic Reset (Type 10H11) – SPST contacts open on temperature rise and automatically reset on temperature fall (see figure 1).

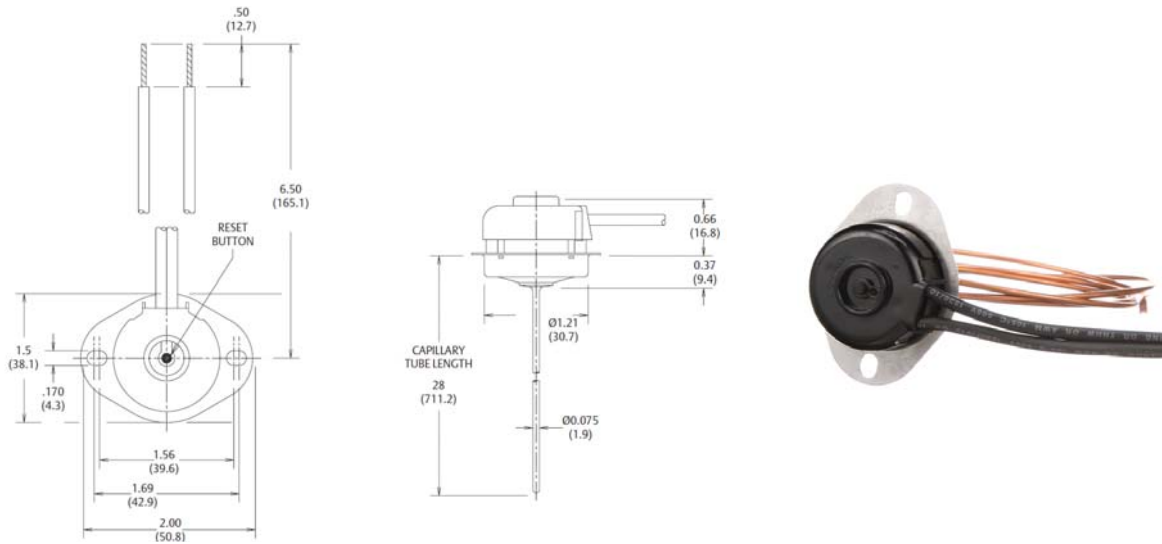


Shown with terminal cover and “push on” mounting bracket.

Figure 1

Dimensions are shown in inches and (millimeters).

Manual Reset (Type 10H14) – SPST contacts open on temperature rise and can be reset when the control has cooled to a lower temperature and the reset button has been depressed. The 10H manual reset is agency recognized as an “M1 trip free” construction, which means that if the reset button is held down, the control can cycle thermally (see figure 2).



Shown with required terminal cover and standard mounting bracket

Figure 2

Dimensions are shown in inches and (millimeters).

Terminal Characteristics

The 10H can be calibrated to open on temperature rise between 150°F (65.6°C) and 350°F (177°C), with a standard tolerance of $\pm 15^\circ\text{F}$ ($\pm 8.5^\circ\text{C}$). The 10H automatic reset will reclose the contacts at approximately 40°F (22°C) below its open temperature. Manual reset controls may automatically reset when exposed to temperatures below -31°F (-35°C).

Capillary Tube

The 10H is available with the copper capillary tube in preferred lengths from 24" to 144" as measured from the bottom of the mounting flange.

Mounting Brackets

The standard mounting bracket (see figure 2) has two slots, each .170" (4.318mm) wide. An alternate "push on" mounting bracket (see figure 1) is also available.

Terminations

Standard leads are two 6 1/2" (165.1mm), #14 AWG, 105°C, 1/32" (10.8mm) thick, black PVC insulation, stripped 1/2" (12.7mm). Also available (automatic reset only) are 1/4" (6.30mm), 90° angle, .032" (0.8mm) blade terminals. A snap-on terminal cover is available for controls supplied with lead wires.

General Electrical Ratings

The 10H series of controls has been rated UL and CSA. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Maximum Open Temperature	Maximum Switchcase Temperature	Volts AC	Resistive Amperes	Inductive Amps		Pilot Duty VA	Cycles	Agency Recognition
					FLA	LRA			
10H11 (Auto Reset)	350 °F (177 °C)	221 °F (100 °C)	277 600	25 -	4.8 -	28.8 -	480 125	100,000 100,000	UL Guide MBPR2, File MH-5304
10H14 (Manual Reset)	350 °F (177 °C)	221 °F (100 °C)	277 600	25 -	4.8 -	28.8 -	480 125	6,000 6,000	
10H11 (Auto Reset)	350 °F (177 °C)	221 °F (100 °C)	277 600	25 10	- -	- -	125 -	100,000 100,000	CSA File LR19988
10H14 (Manual Reset)	350 °F (177 °C)	221 °F (100 °C)	277 350 600	25 15 10			460 350 400	6,000 6,000 6,000	

Note: For complete and current ratings, please consult a Therm-O-Disc sales engineer. At thermostat end-of-life, the contacts may remain permanently open or closed.

10RS Radiant Energy Series Special Purpose Control



Snap-Action Radiant Controls

The 10RS line of controls from Therm-O-Disc offers reliable sensing of radiant energy in hot surface ignition applications, such as gas clothes dryers.

The unique snap-action bimetal design not only provides high-speed contact separation and time-proven reliability, but also enables the 10RS to maintain radiant sensitivity while compensating for ambient temperature changes.

A glass 'window' is used to maximize the effect of radiant energy on the bimetal element without exposing the entire control to high ignitor temperatures.

These features have made the Therm-O-Disc 10RS an integral component of gas ignition systems.



Features and Benefits

The 10RS features include:

- Glass “window” design maximizes effect of radiant energy without sensor overheating.
- Unique “U”-shaped actuator compensates for ambient temperature conditions.
- High-speed contact switching for exceptional life characteristics.

Switch Actions and Typical Applications

The 10RS is an automatic reset, single pole, single throw (SPST) switch that opens its electrical contacts when exposed to heat generated by radiant energy. This is accomplished with a “U”-shaped bimetal actuator which has one leg exposed to radiant energy while the other leg is shielded.

As radiant energy passing through the glass “window” heats the exposed bimetal leg, a temperature differential is created which causes the bimetal element to snap and open the contacts. As radiant energy dissipates, both actuator legs return to approximately the same temperature, allowing the contacts to automatically reclose.

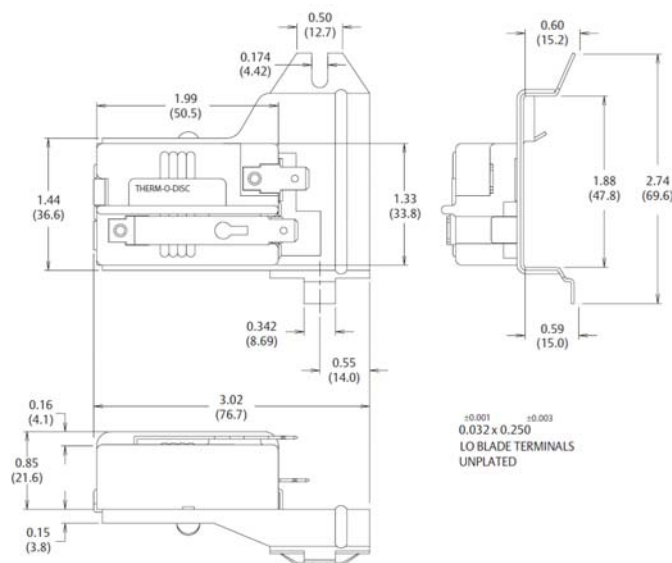
Typical Applications

The type 10RS control is utilized in gas-fired appliances in conjunction with a hot surface ignitor. As red hot ignitor temperatures are achieved, the 10RS opens the circuit which signals the gas valve to open. Upon ignition, radiant energy from the gas flame keeps the 10RS open until the operating cycle is completed. Once the gas valve closes and the flame dissipates, the contacts reclose and the ignition cycle is complete.

Calibration

The standard 10RS calibration calls for the contacts to open within 12 to 20 seconds after exposure to a radiant energy source. Contact reclose occurs within 26 to 40 seconds after the radiant source dissipates.

Note: Calibration timing of the 10RS in the actual application is dependent upon the type of ignition system and position of the sensor relative to the radiant energy source.



Dimensions are shown in inches and (millimeters).

Mounting Bracket

The 10RS is available in two standard tab mounts. The brackets are fabricated from .032" (.81mm) aluminum and can easily be mounted with a sheet metal screw.

Terminal Configurations

The 10RS is furnished with .032" x .250" (.81mm x 6.35mm) brass quick connects in the horizontal position.

General Electrical Ratings

The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.



Maximum Bimetal Temperature (°F)	Maximum Ambient Temperature (°F)	Cycles	Resistive Amperes	Volts AC	Agency Recognition
375	325	100,000	5.75	120	CSA File 112672-0-000

Note: At thermostat end-of-life the contacts may remain permanently closed or open. For complete and current ratings, please contact our Sales Engineering Department



12S, 14S, 15S Series Time Delay Relays and Sequencers



Time Delay Relays and Sequencers

The Therm-O-Disc type 12S, 14S and 15S series time delay relays and sequencers are field-proven devices for controlling the operation of heating elements and/or fans in electric furnaces and heat pumps. These controls combine a solid-state positive temperature coefficient (PTC) heater with bimetal actuated contacts to provide time-delayed electrical switching. A wide variety of bimetal disc and PTC combinations are available to provide a broad range of timings. The 12S is a single timing device while the 14S uses two bimetal discs to achieve two independent timings. The 15S consists of one, two or three 12S and/or 14S controls mounted on a common plate.



Features and Benefits

The 12S, 14S and 15S features include:

- Available with auto-reset SPST, DPST and SPDT switch configurations.
- PTC heater for stable operation over a wide range of temperatures and voltages.
- Snap-action bimetal disc for high-speed contact separation.
- Standard operating ambients between -40°F (-40°C) and 150°F (65.6°C).
- Available with a wide variety of terminals and mounting plates.
- Welded construction for integrity of current-carrying components.
- Quiet operation

Switch Actions and Typical Applications

Automatic Reset SPST – Can be built to either open or close a set of contacts within a specified time range.

Automatic Reset DPST – Utilizes one bimetal disc to simultaneously open or close two independent sets of contacts within a specified time range.

Automatic Reset SPDT – This 12S configuration is the same as the SPST except with the addition of an auxiliary contact that makes and breaks circuit in opposition to the main contacts.

CAUTION . . . When designing a SPDT circuit, an electrical load must be applied to terminal 2 and/or 3 to avoid a transient short circuit condition during switching.

12S Series

The 12S series utilizes one bimetal disc to achieve single-timing operation. The 12S is available in SPST (see figure 1), SPDT (see figure 2), and DPST (see figure 3) switch actions. A variety of standard timings are available for general time delay applications.

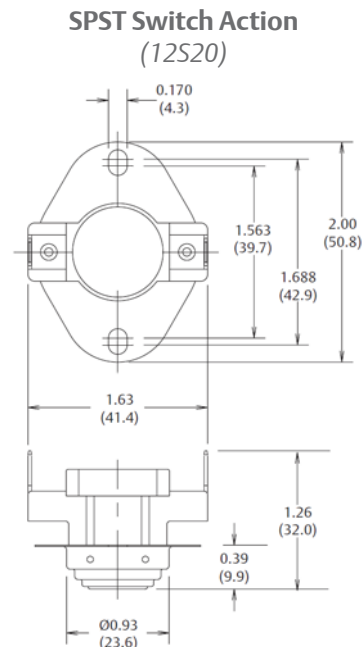


Figure 1

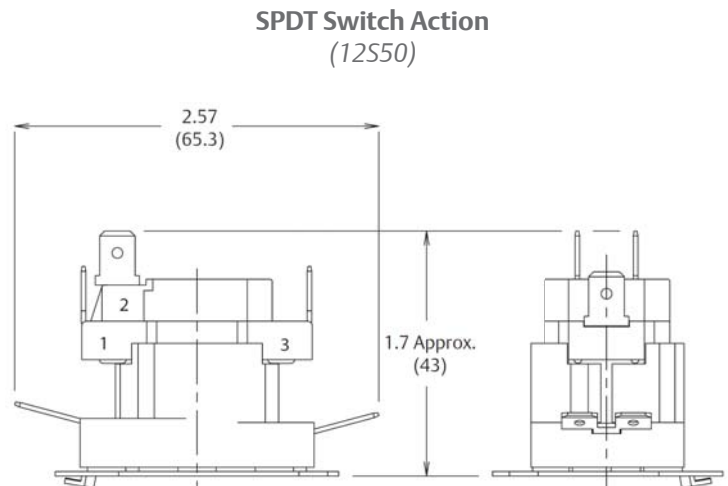
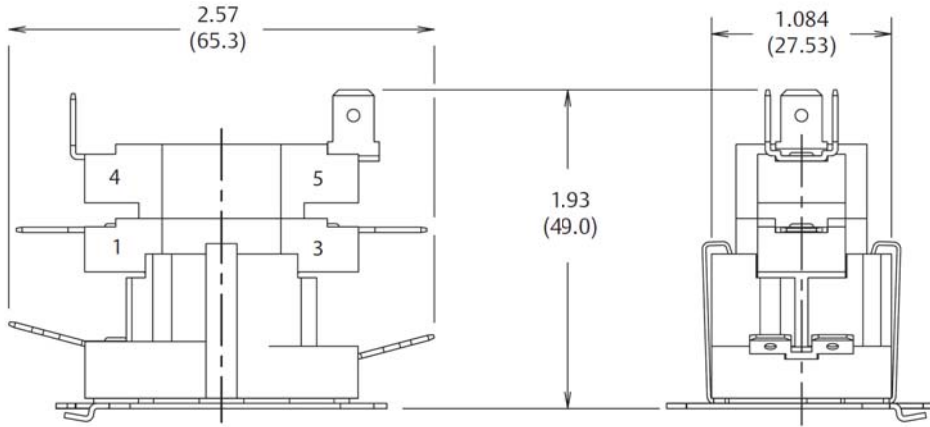


Figure 2



DPST Switch Action
(12S22)
Figure 3
Dimensions are shown in inches
and (millimeters).



12S Timings*

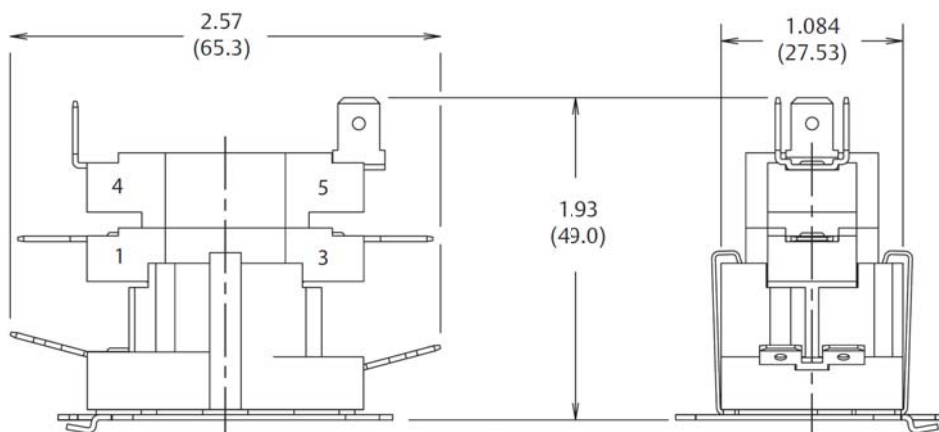
PTC	ON	OFF
24VAC	1-30 Sec.	40-80 Sec.
	10-40 Sec.	20-60 Sec.
	20-55 Sec.	15-55 Sec.
	25-110 Sec.	5-45 Sec.

*Please contact us to discuss specific timings needed.

14S Series

The 14S series is available in two possible configurations:

- 2 stages, where each stage is SPST and operated by a disc for each stage. The two stages can have different on/off times. See figure 4.
- 3 stages, where the two lower stages are DPST operated simultaneously by one disc. The top stage is SPST and operated by the other disc.



SPST Switch Action (Each Stage)
(14S22)
Figure 4
Dimensions are shown in inches and (millimeters).

14S Timings*

PTC	ON	OFF
24VAC	1-110 Sec.	1-110 Sec.

*Please contact us to discuss specific timings needed.

15S Series

The 15S series consists of either two or three 12S and /or 14S controls mounted on a common baseplate. The timing of the package assures that a set of designated contacts will turn on first and turn off last.

The chart shows the timing range for the 15S package.

15S Timings*

PTC	ON	OFF
24V	1-110 Sec.	1-110 Sec.

*Please contact us to discuss specific timings needed.

PTC Heater

Solid state PTC (Positive Temperature Coefficient) heaters are used to bias the operation of the contacts. These heaters are self-current limiting for stable switch operation over a range of temperatures and over-voltages. The standard line of controls uses a 24VAC PTC rated for Class II circuits. The peak inrush current of the 24VAC PTC heater varies from .35 to 1.0 amps. The inrush current drops below 1/2 of the peak value within approximately 10 seconds and reaches a steady state current between 0.10 and 0.18 amps.



Operating Ambients

The standard sequencer line is designed to operate in ambients ranging from -40°F to 150°F (-40°C to 65.6°F). The actual sequencer ON and OFF times are 100% checked to the required timings at a 75°F (23.9°C) ambient. The OFF timings are determined after the PTC heater has been energized for a total of five minutes. Timings in an ambient above or below 75°F (23.9°C) will vary and should be evaluated in the end use application to determine suitability. A specific high ambient construction is available at extra cost to allow operation up to 165°F (74°C). This construction requires an “H” in our type number (example 12SH22).

Standard Terminals and Markings

The standard heater terminals are .032” x .250” (6.3 x .8mm) double 15° brass male quick connects. The stage terminals are .032 x .250” (6.3 x .8 mm) tin plated brass. See figures 1, 2, 3, 4 for common stage terminals and terminal numbering

Mounting Plates

The standard mounting plate incorporates a tab and hole arrangement for mounting one (see figure 5) or two (see figure 6) controls. The standard mounting plate for three controls incorporates a slot and hole arrangement (see figure 7). Optional or custom mounting plates are available to meet specific application requirements.



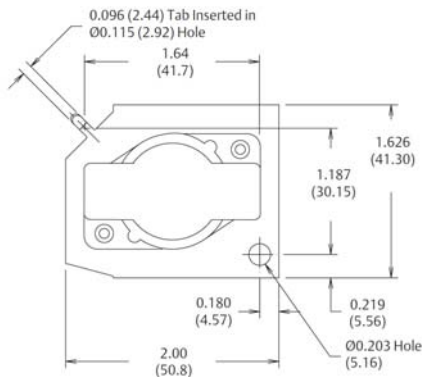


Figure 5

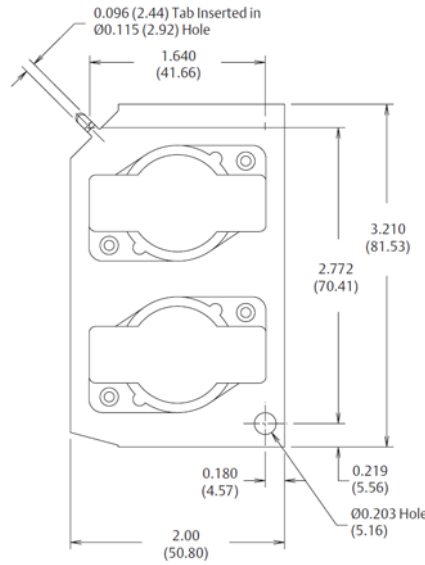


Figure 6

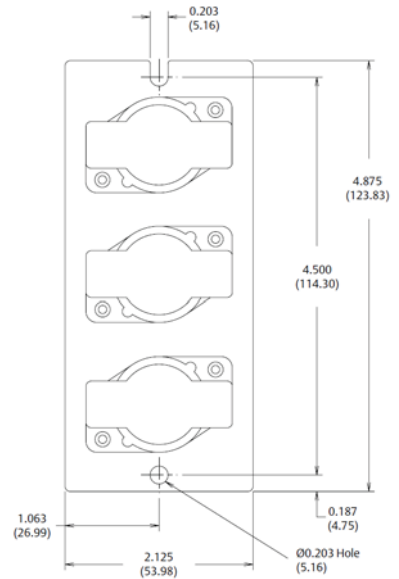


Figure 7

Electrical Spacings

The 12S, 14S, 15S series have electrical spacings of 1/4" (6.35mm) through air and 3/8" (9.52mm) over surface to ground. With the suffix "X," increased spacings of 3/8" (9.53mm) through air and 1/2" (12.7mm) over surface to ground are available.

General Electrical Ratings

The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

UL Agency Rating

Type	Switching Action	Volts AC	Resistive Amps	Inductive amps		Pilot Duty VA	Cycles	Agency Recognition
				FLA	LRA			
12S/15S	SPST	240	25	8	48	-	100,000	
		240	30*	-	-	-	100,000	
		277	25	-	-	-	30,000	
		480	12.5	5	30	480	100,000	
12S	SPDT (Main Contacts 1-3)	240	25	8	48	-	100,000	
		277	25	-	-	-	30,000	
		480	12.5	5	30	480	100,000	
12S	SPDT (Auxiliary Contacts 1-2)	240	-	4.1	8	125	30,000	ULE19279
		277	25	-	-	-	30,000	
		480	-	-	-	125	30,000	
		480	-	3	16	-	100,000	
12S/15S	DPST	120	-	13.8	82.8	125	30,000	
		240	25	8	48	125	100,000	
		240	30*	-	-	-	30,000	
		277	25	-	-	-	30,000	
		480	12.5	5	30	480	100,000	
14S	2 Pole and 3 Pole	240	25	8	-	-	100,000	
		240	30*	-	-	-	100,000	
		480	12.5	5	-	-	100,000	

* Note: For complete ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open. Maximum combination inductive/resistive, where maximum inductive load is 7FLA, 42LRA. Upper Stage Only.

CSA Agency Ratings

Type	Switching Action	Volts AC	Resistive amps	Inductive amps		Pilot Duty VA	Cycles	Agency Recognition
				FLA	LRA			
12S/15S	SPST	120	-	1.0	6.0	-	100,000	
		240	-	5.0	30	-	100,000	
		240	30*	-	-	-	100,000	
		480	-	-	-	125	100,000	
12S	SPDT (Main Contacts 1-3)	120	-	10	60	-	100,000	
		240	-	5	30	-	100,000	
		480	-	-	-	125	100,000	
12S	SPDT (Auxiliary Contacts 1-2)	120	10	-	-	125	100,000	CSA 062037
		240	5	5	30	-	100,000	
		480	-	-	-	125	30,000	
12S/15S	DPST	120	-	10	60	-	100,000	
		240	25	5	30	-	100,000	
		240	30*	-	-	-	100,000	
		480	-	-	-	125	100,000	
14S	2 Pole+ 3 Pole	240	25	5	30	-	100,000	
		240	30*	-	-	-	100,000	
		480	-	-	-	12.5	100,000	

* Note: For complete ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open. Maximum combination inductive/resistive, where maximum inductive load is 7FLA, 42LRA. Upper Stage Only.

Part Numbering System

Common Sequencer Type Numbers for 12S and 14S

Type	Number of Stages	Description
12S20	1	Normally Open, SPST
12S22	2	Normally Open, DPST
12S50	1	Normally Open, SPDT
14S22	2	Normally Open, Each Stage SPST
14S222	3	Normally Open – Lower Two Stages DPST Upper Stage SPST

15S Type Numbers

1st Suffix 1st sequencer on baseplate	2nd Suffix 2nd sequencer on baseplate (if provided)	3rd Suffix 3rd sequencer on baseplate (if provided)	Base sequencer type at each location
1	1	1	12S20
2	2	2	12S22
4	4	4	14S22

You can combine any above configurations on a common base plate.
Example: 15S221 would contain 12S22-12S22-12S20

14T Series Moisture Resistant Temperature Controls



Heavy-Duty Snap-Action Temperature Controls

The 14T line of heavy-duty sealed bimetal disc controls from Therm-O-Disc meets the higher electrical requirements of commercial applications. The design provides moisture resistance for moisture prone environments. The snap-action of the 1" temperature sensing bimetal disc provides high-speed contact separation resulting in exceptional life characteristics at electrical loads up to 25 amps at 120/240VAC. A variety of mounting configurations, lead wires and terminations give maximum design flexibility. The heavy-duty construction and long life characteristics have made the 14T a popular choice for heating, ventilation and air conditioning systems.



Features and Benefits

The 14T features include:

- Sealed construction provides moisture resistance for moisture prone environments.
- High-speed contact separation ensures long contact life.
- A wide variety of mounting configurations, lead wires and terminations provide maximum design flexibility.
- Large 25 amp capacity allows direct control of compressors and fans, reducing the need for additional components.

Switch Actions and Typical Applications

The 14T is available in two switch actions:

Automatic Reset SPST – In this configuration, the switch can be built to either open or close its electrical contacts on temperature rise. Once the temperature in the application has returned to the specified reset temperature, the contacts will automatically return to their original state. Typical uses of this construction include limiting and regulating temperatures in air conditioners, heat pumps and fan coil units.

Automatic Reset SPDT – This design is the same as the SPST described above with the addition of an auxiliary contact which makes circuit upon opening of the main contacts and breaks circuit when the main contacts reset. Refer to the “General Electrical Ratings” chart for rating limitations on the auxiliary contacts. Typical uses of this construction include fan speed changeover at a specified temperature and lighting of an indicator lamp when an abnormal temperature condition has been reached.

Mounting Configurations

The 14T is available in a variety of mounting configurations:

Surface Mounting – The surface mounting configuration positions the bimetal disc sensing element firmly against the mounting surface, thereby sensing the actual mounting surface temperature (see figures 1 and 2).

SPST Surface Mounting

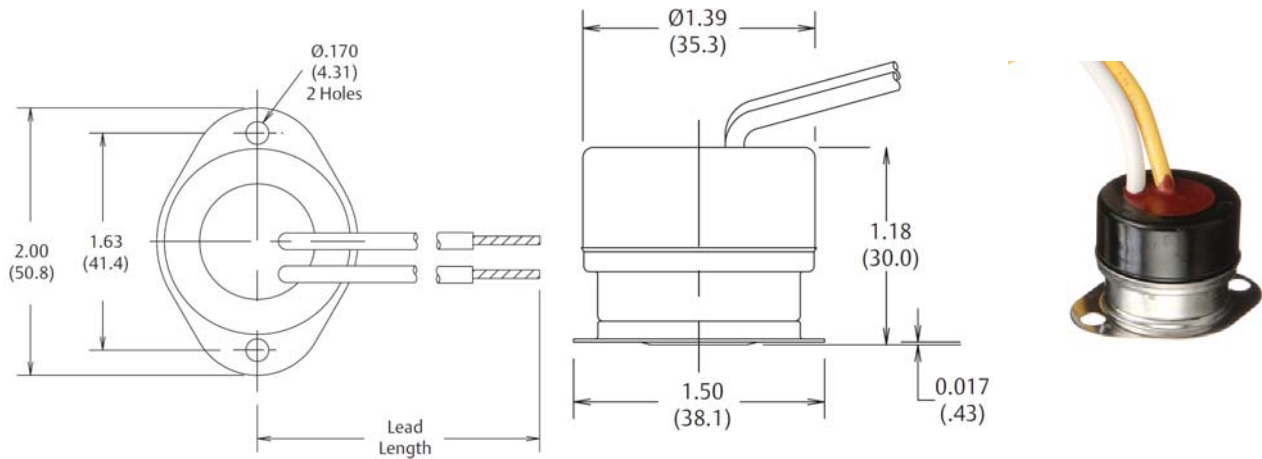


Figure 1
Dimensions are shown in inches and (millimeters).

SPDT Surface Mounting

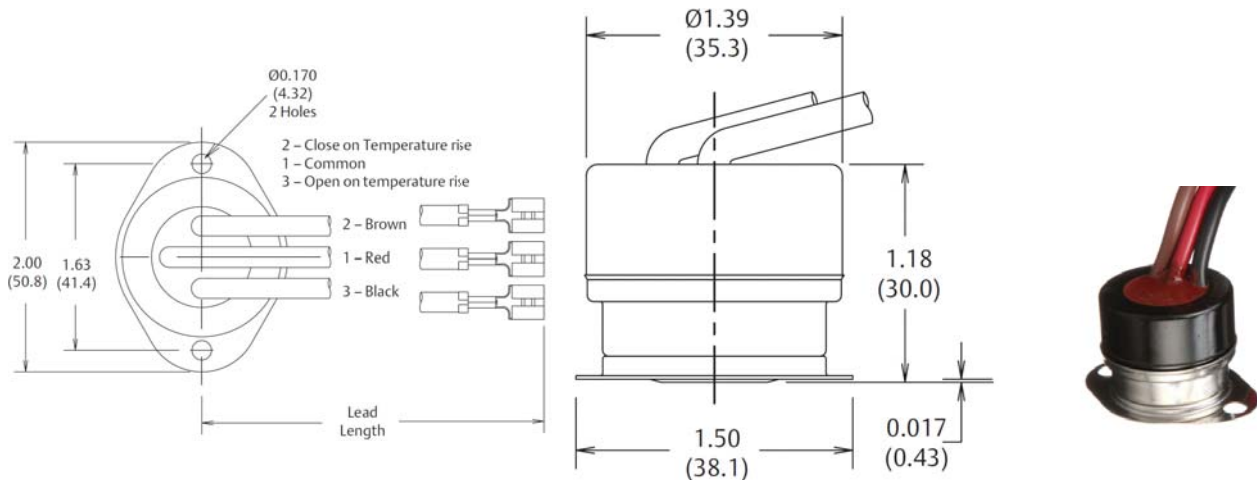


Figure 2
Dimensions are shown in inches and (millimeters).

No Mounting Flange – The 14T is available without a mounting flange for customers who wish to design their own mounting method. Dimensions as shown in figures 1 and 2, except there is no mounting bracket shown.

Tube Mounting – In this mounting configuration, the 14T is supplied with a saddle-shaped disc cup and a removable spring clip which holds the control firmly on a tube. This configuration is available for 3/8", 1/2", 5/8" O.D. tubes (see figure 3).

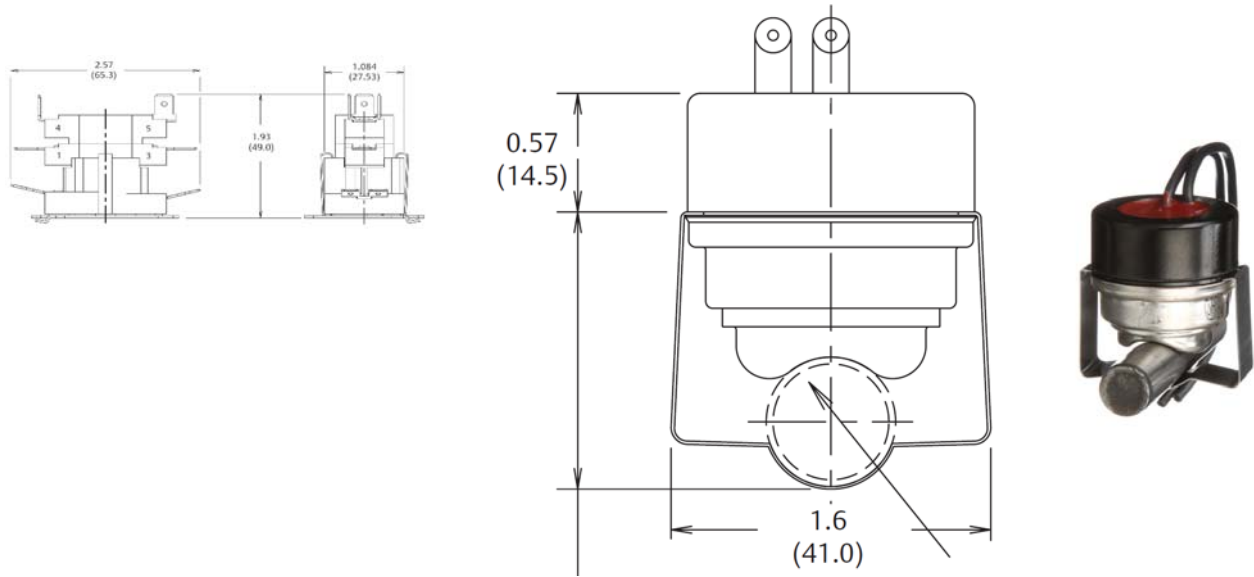


Figure 3
Dimensions are shown in inches and (millimeters).

Lead Wire and Terminal Configurations

The standard lead wires are #18 AWG stranded copper wire with 1/32" thick 105°C PVC insulation. A variety of other lead wire size and insulation thickness combinations are available at additional cost. The standard lead wire direction exits from the top of the control. The lead wire can also be specified to exit perpendicular to the mounting hole center-line for surface mount and parallel to the tube for tube mounting. This can be varied in 45 angular degree increments, if required by the application.

Conduit Connector – The 14T is also available with a conduit connector designed to enclose the lead wires in a rigid thin wall or flexible metal conduit. In this configuration, the leads extend from the top of the control instead of the side (see figure 4).

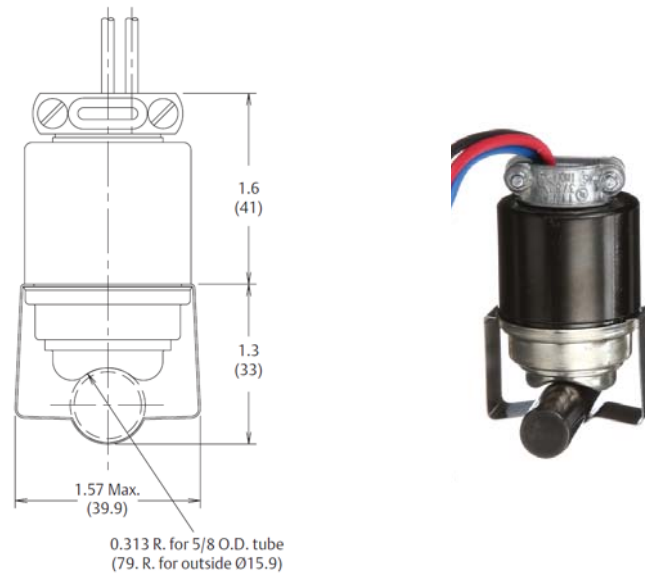


Figure 4
Dimensions are shown in inches and (millimeters).

The standard insulation colors are red, brown and black. Other colors can be provided, as required by a specific application.

The standard maximum combined lead wire length is 24” for SPST and 36” for SPDT controls. Additional lead wire and a variety of popular quick connect terminals are available at additional cost.

For more information on optional lead wires, insulation colors and terminations, please consult one of our sales engineers.

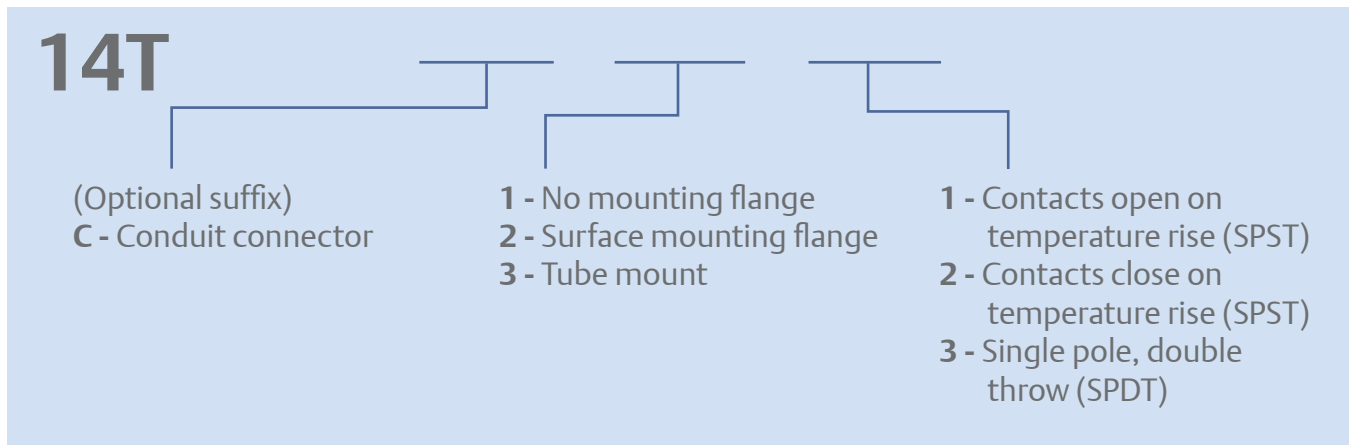
Calibration Temperatures, Differentials and Tolerances

To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Then locate, across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates which differentials are available in each of the calibration set point ranges. Tighter open and close tolerances are available at additional cost. For more information on tightened tolerances or availability of differentials not listed in the chart, please consult one of our sales engineers.

Calibration Temperatures, Differentials and Standard Tolerance of the 14T Series (SPST and SPDT only)

Highest Calibration Set point Range (Open or Close)	Nominal Differentials (nominal open and close set point)									
	10-14°F 5.5-8°C		15-19°F 8.5-10.5°C		20-29°F 11-16°C		30-39°F 16.5-21.5°C		40-50°F 22-33°C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
0°-80°F -18°-26°C	±6	±6	±6	±6	±6	±6	±6	±7	±6	±7
	±3.5	±3.5	±3.5	±3.5	±3.5	±3.5	±3.5	±4	±3.5	±4
81°-222°F 27°-105°C	±5	±5	±5	±5	±5	±5	±5	±5	±5	±7
	±3	±3	±3	±3	±3	±3	±3	±3	±3	±4

Part Numbering System



General Electrical Ratings

The 14T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Max Temp.	Contact Arrangement	Cycles Rating	Inductive Amps		Pilot Duty VA	Resistive Amperes	Volts AC	Agency Recognition
			FLA	LRA				
14T, 14F 221 °F* 105 °C	SPST or SPDT any load combination except resistive rating on one contact set only	6,000	16	72	125	-	120	UL E29653
		6,000	10	45	125	-	240	
		30,000	10	60	125	25	120	
		30,000	5	30	125	25	240	
	SPST or SPDT any combination	30,000	16	72	125	15	240	
		30,000	10	60	125	-	277	
14T, 14F 150 °F* 65.5 °C	SPST or SPDT any load combination except resistive rating on one contact set only	100,000	10	60	125	25	120	
		100,000	5	30	125	25	240	
		30,000	2.5	15			575	
		100,000				0.5	600	
	SPST or SPDT (125VA pilot duty only on contacts 1-2 of SPDT)	100,000	0	0	125	25	277	
265 °F 129.5 °C	SPST	100,000				10	120	
						5	240	
14T 221 °F* 105 °C	SPST	30,000	10	60	125	25	120	CSA LR10281
		30,000	5	30	125	25	240	
		60,000	16	72	125	-	120	
		60,000	10	45	125	-	240	
	SPDT (limited to 125VA on one contact)	30,000	10	60	125	25	120	
		30,000	5	30	125	25	240	
	SPST or SPDT (any load combination)	30,000	7.5	45	125	15	120	
		30,000	3.75	22.5	125	15	240	
		30,000	16	72	125	-	240	
	150 °F 65.5 °C	SPST	30,000	2.5	15			
100,000						0.5	600	
265 °F 129.9 °C		100,000				10	120	
						5	240	

Note: This is a consolidated summary of the 14T series rating. For complete and current ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open.

30M MOTOR PROTECTION Series Special Purpose Controls



Special Purpose Controls

The Therm-O-Disc line of Motor Protectors offers accurate and reliable protection against hazardous overheating in single phase/single voltage A/C motors. Available in a variety of product types, these motor protectors employ a snap-acting, current and temperature responsive bimetal disc for proven performance over life. An internal resistance heater utilizes the effects of current to bias the operation of the bimetal disc for added thermal response. A wide range of bimetal and heater combinations are available to cover specific design requirements. This design flexibility and proven performance has made Therm-O-Disc Motor Protectors a popular choice among the leading manufacturers of fractional horsepower motors.



Features and Benefits

The Motor Protector features include:

- High-speed contact separation ensures long contact life.
- Current and temperature responsiveness for excellent design flexibility.
- Manual and automatic reset switching actions combined with a wide selection of bimetal discs and heaters to meet a variety of possible application needs.
- 100% temperature calibration and trip time tests assure high quality levels.

The Operating Principle of Motor Protectors

The operating mechanism inherent to all Therm-O-Disc Motor Protectors is the snap-action bimetal disc. During abnormal conditions, heat generated by resistance and/or motor ambient causes the bimetal disc to snap at the specified calibration temperature. This allows the circuit to open within the maximum safe limits of the motor windings. Once the motor returns to a normal operating temperature, the bimetal disc resets (automatically or manually). This closes the circuit and re-energizes the motor. This same snap-action principle is utilized in millions of Therm-O-Disc products applied in the appliance, heating and air conditioning industries.

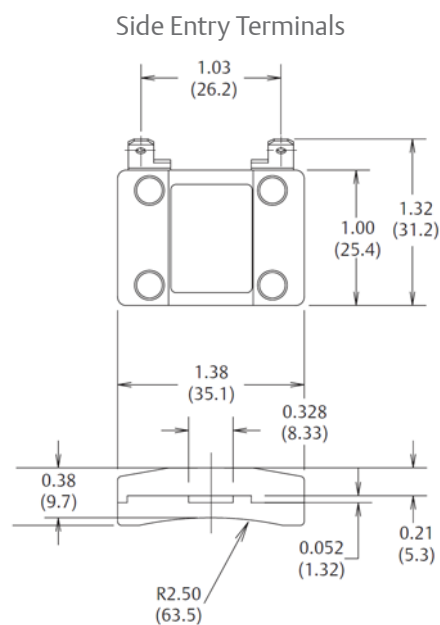


Figure 1
Dimensions are shown in inches and (millimeters).

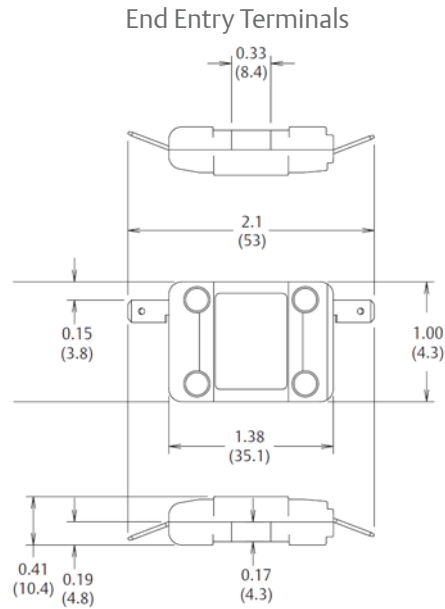


Figure 2
Dimensions are shown in inches and (millimeters).

Type 30M – The Therm-O-Disc Type 30M (see figure 4) SPST manual reset protector is a compact device designed for applications where inadvertent equipment restarts may result in potential hazard. The contacts may be manually reset after the control has cooled 30°-50°C below the open temperature calibration. The 30M features a “trip free” manual reset design. UL designates the 30M reset as “M1,” meaning the motor protector shall automatically reset to the closed position after normal operating conditions have been restored if the reset button is held in the reset position. Typical uses include disposer and oil burner applications where “tripping” the device should result in the end user taking corrective action. Standard terminations are weld-type connections. Male quick connect terminals, lead wire assemblies and bimetal and heater combinations are available to meet specific requirements. This “trip free” construction means that processing the reset button will not reclose the contacts until the control has cooled.

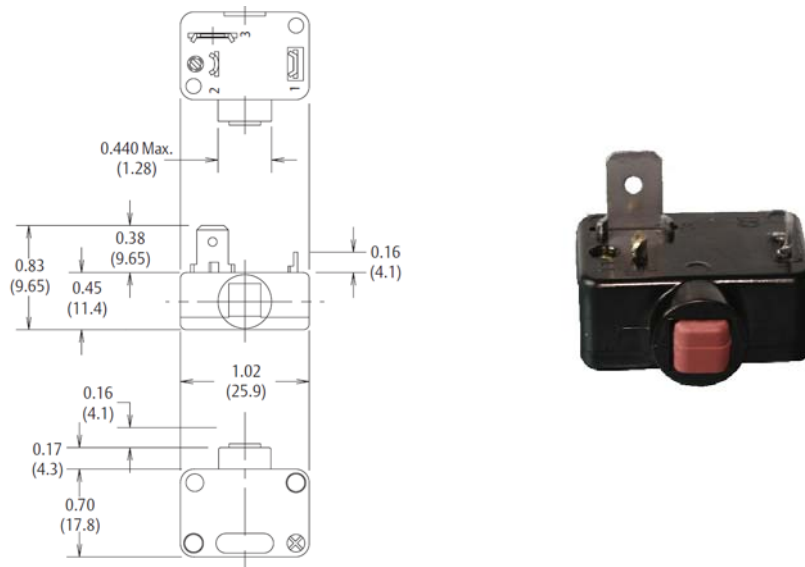


Figure 3
Dimensions are shown in inches and (millimeters).

Lead Wire and Terminal Configurations

All Therm-O-Disc Motor Protectors can be furnished with a variety of terminal and lead wire configurations. Custom packages or special assemblies may be specified to meet unique application needs. By taking advantage of our high volume production methods, Therm-O-Disc may be able to provide significant savings. Our sales engineers can assist in selecting a package that is tailored to specific requirements.

Mounting Configurations

Due to the variation of terminal and switch configurations, Therm-O-Disc Motor Protectors may be mounted in a number of positions. For maximum performance, we recommend locating the protector as close to the motor windings as possible. Customers typically provide their own mounting methods.

Product Quality

Therm-O-Disc Motor Protectors are assembled, calibrated and tested automatically, using the latest manufacturing technologies and quality methods. Each motor protector is 100% temperature calibrated and tested to ensure high quality levels. Our goal of providing motor protectors of the highest uniform quality is reinforced by the training of our operators in modern statistical techniques. Therm-O-Disc is committed to continuously improving our quality and manufacturing capabilities. This objective, in turn, allows our products to meet the escalating standards of our customers.

Protector Selection

To determine which Therm-O-Disc Motor Protector is right for a specific application, simply use the following steps:

- Select the appropriate switch action (manual or automatic) and product type.
- Verify that electrical load does not exceed the recommended rating of the device.
- Determine calibration based on test data.
- Determine the specific bimetal and heater resistance required for the application. (Consult factory for trip curves.)
- Test the protector to verify compliance with specific requirements.
- Choose from a variety of optional components to complete a package.

Calibration Range, Differentials, and Standard Tolerances

Protector Type	30M
Open Range (°C)	80-150
Open Tolerance (°C)	±5
Close Range (°C)	45-110
Close Tolerance (°C)	±10
Minimum Differential (°C)	30
Maximum Differential (°C)	50

NOTE: For additional information on calibrations, tolerances or differentials not listed in this chart, please contact our Sales Engineering Department.

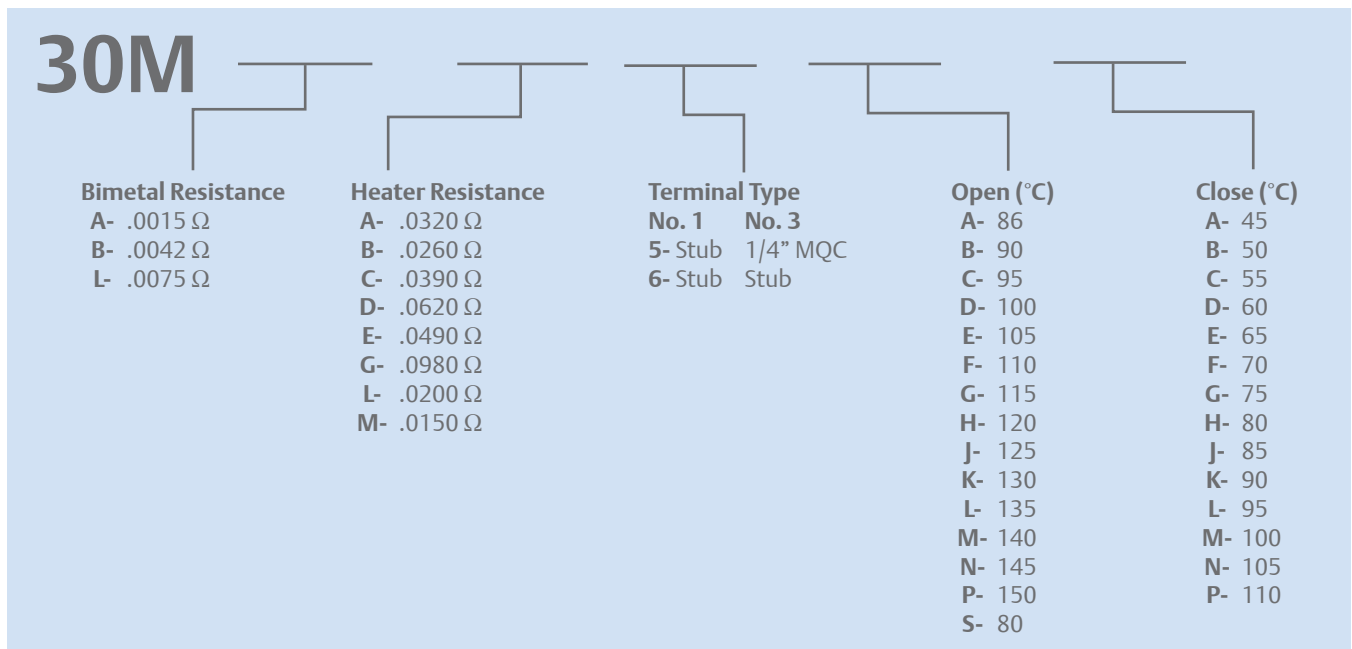
General Electrical Ratings

The Motor Protector series has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Protector Type	Maximum Temperature (°C)	Recommended Contact Ratings*	Limited Short Circuit	Group Fusing Short Circuit	Agency Recognition
30M	150	50 amp L.R. @ 120 V 37 amp L.R. @240V	1000 amp Circuit: 40 amp fuse @240V	2000 amp Circuit: 80 amp fuse @120V	UL File E52937 CSA File LR80616

* Therm-O-Disc Motor Protectors are recognized by Underwriters Laboratory (UL) and certified by the Canadian Standards Association (CSA). For complete details on European Agencies or the latest rating information, please contact our Sales Engineering Department.

Part Numbering System



36T Series Snap-Action Temperature Controls



Snap-Action Temperature Control

The 36T Series of 1/2" bimetal temperature controls from Therm-O-Disc offers proven reliability in a compact, versatile, cost-effective design. The snap action of the bimetal disc provides high-speed contact separation resulting in excellent life cycle characteristics at electrical loads up to 15 amps at 120VAC and 10 amps at 250VAC (100,000 cycles) and 16 amps at 250VAC (30,000 cycles).

A variety of terminal and mounting configurations are available for maximum design flexibility. The quality, reliability, affordability, versatility and world-wide agency approvals of the 36T Series make it the thermostat of choice for a wide variety of temperature control applications.



Switch Actions

The 36T is available in three single pole, single throw (SPST) switch actions:

Automatic Reset – Can be built to either open or close its contacts on temperature rise.

Manual Reset – Available with contacts that open on temperature rise. The contacts can be reset by depressing the button after the control has cooled down.

Single Operation Fuse Disc – Available with contacts that open on temperature rise, and which never reclose unless the ambient temperature drops below +32°F (0°C) or below -31°F (-35°C).

Typical Applications

The 36T is applied to a wide variety of applications as either a regulating control or a safety limit. Examples of applications include:

- Coffeemakers
- Sandwich toasters
- Dishwashers
- Dryers
- Washing machines
- Refrigerators
- Microwave ovens
- Water heaters
- Furnaces
- Boilers
- Electric heaters
- Office equipment
- Automotive seat heaters

Mounting Configurations

The 36T is available in several mounting configurations:

No Mounting Bracket – The 36T may be specified without a mounting bracket. One popular version (designated 36TM or 36TMH) has a switch body designed to accept the customer's clamp bracket (see Figure 1).

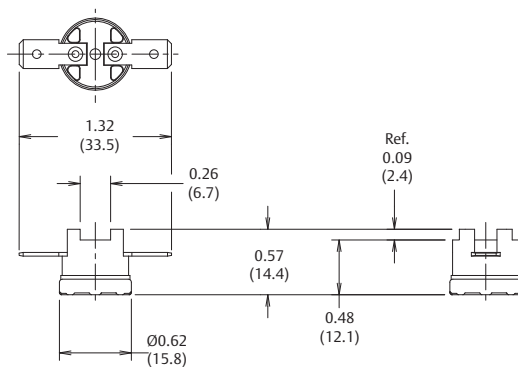


Figure 1
Dimensions are shown in inches and (millimeters).

Surface Mount Bracket – The bimetal disc sensing element is positioned firmly against the mounting surface so it senses the actual mounting surface temperature (see Figure 2). There are many available surface mounting brackets available – typically in either aluminum or stainless steel.

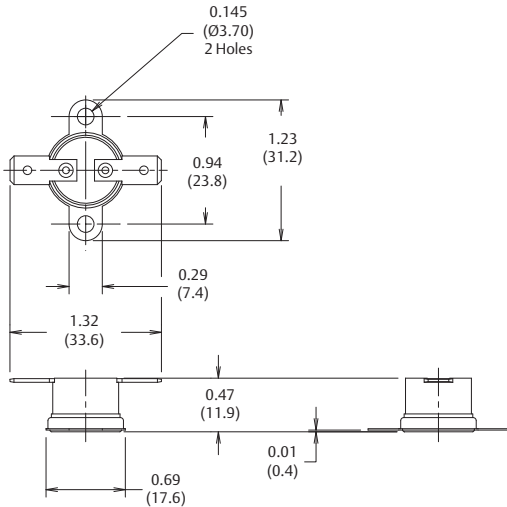


Figure 2
Dimensions are shown in inches and (millimeters).

Surface brackets can be supplied on the 36T either loose or crimped in a fixed position (except for ceramic body 36Ts, 36Ts with stainless steel disc housings, and 36Ts with raised pad disc housings, which must be supplied loose).

Airstream Mount – The bimetal housing extends through a hole in the mounting surface into the airstream (see Figure 3). There are many available aluminum and stainless steel airstream mount configurations.

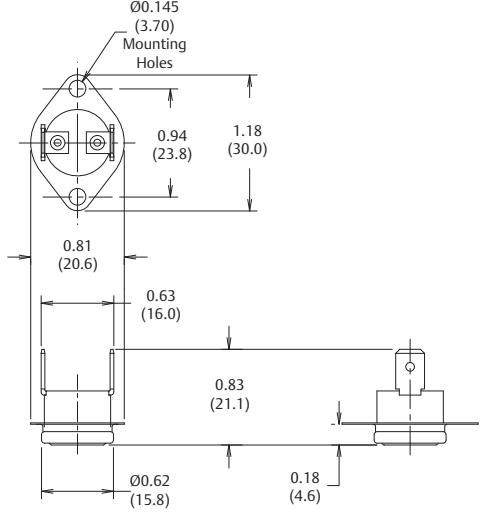


Figure 3
Dimensions are shown in inches and (millimeters).

Terminal to Mounting Hole Crimp Angle

Both surface brackets and air stream housings can be supplied where the customer can specify the angular orientation (in 15 degree increments) of the terminals with respect to the mounting hole centerline (see figure 4).

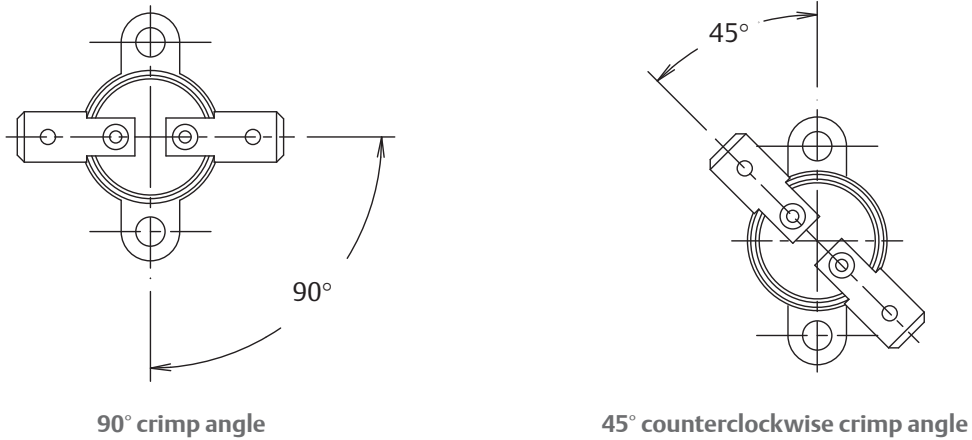


Figure 4

Stud Mount – The 36T can be supplied with an integral threaded stud mount. Figure 5 shows two popular brass stud mounts with hex shape (brass stud available with plastic switchcases only). Figure 6 shows an aluminum stud mount available with plastic or ceramic switchcases.



Figure 5



Figure 6

36T Board Mount – The 36T is mounted on extension straps, for applications where the thermostat must extend further into the airstream to sense adequately (see Figure 7). Available strap lengths include 2” (50.4mm), 3” (75.6mm), 5” (126mm) and 7” (176.4mm). Insulating sleeves can be provided for the extension straps, and various mounting board configurations are available.



Figure 7

Thermal Response

Most 36Ts are provided with an enclosed disc. The enclosed disc construction provides greater protection against airborne contaminants entering the control. It also protects the bimetal disc from possible damage during customer handling. In applications where faster response to radiant heat is required, an exposed bimetal disc can be specified.

36T Mounting Options

The letter “A” means available. Consult a Sales Engineer for other available configurations.

Surface Mount – No Mounting Bracket

Description	Aluminum	Stainless Steel (not available with ceramic body)	Drawing
Enclosed (raised pad)	A	A	Figure 8
Enclosed (flat)	A	A	Figure 9A
Exposed	A	A	Figure 9B

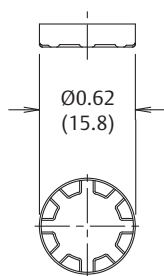


Figure 8

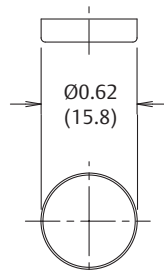


Figure 9A

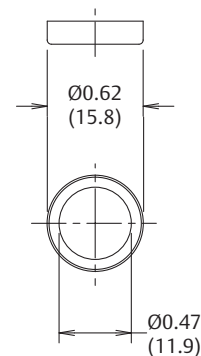


Figure 9B

Dimensions are shown in inches and (millimeters).

Surface Mount – With Mounting Bracket

Mounting Hole	Aluminum Bracket	Stainless Steel Bracket	Drawing
0.125" (3.2mm) diameter	A	A	Figure 10A
0.145" (3.7mm) diameter	A	A	Figure 10B
0.172" (4.4mm) diameter	—	A	Figure 11

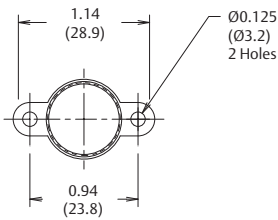


Figure 10A

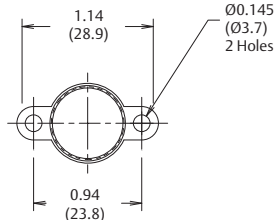


Figure 10B

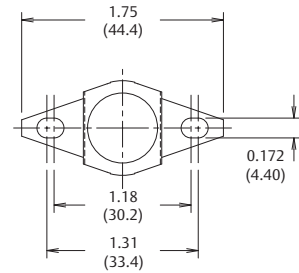


Figure 11

Dimensions are shown in inches and (millimeters).

Airstream Mount

Mounting Hole	Aluminum (enclosed)	Aluminum (exposed)	Stainless Steel (enclosed)	Stainless Steel (exposed)	Drawing
			(not available with ceramic body)		
0.145" (3.7mm) diameter	A	A	A	A	Figure 12
0.188" (4.74mm) wide slot	A	A	A	A	Figure 13
0.170" (4.28mm) wide slot	—	A	A	A	Figure 14

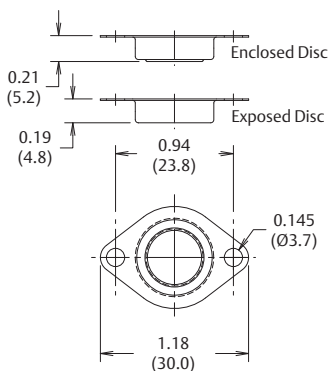


Figure 12

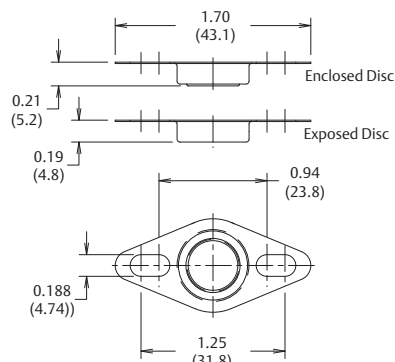


Figure 13

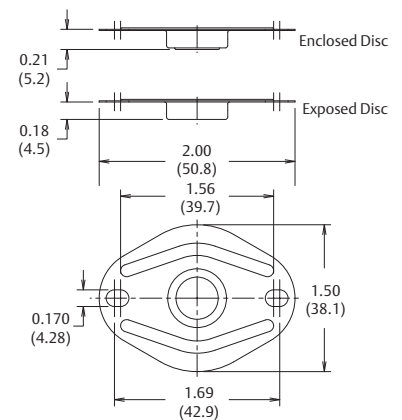


Figure 14

Dimensions are shown in inches and (millimeters).

Stud Mount

Thread	Stud length	Material	Drawing
M4 x 0.7mm	0.24" (6mm)	Brass (not available with ceramic body)	Figure 15
M4 x 0.7mm	0.190" (4.7mm)	Aluminum	Figure 16

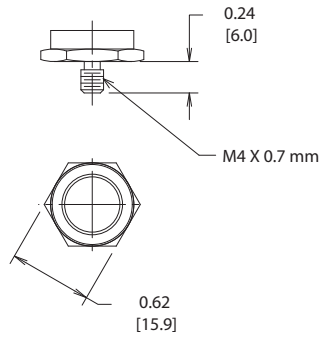


Figure 15

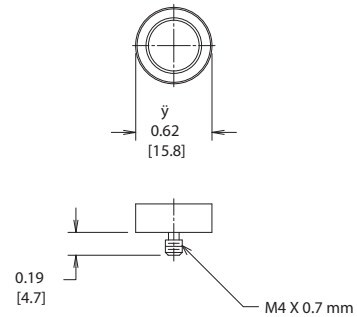


Figure 16

Dimensions are shown in inches and (millimeters).

36T Terminals

Most 36Ts are supplied with 1/4" x .032" (6.3mm x .8mm) quick connect blade terminals that are available in unplated brass, tin plated brass and nickel plated steel. We also have 3/16" (4.8mm) blade terminals available in both .020" (0.5mm) and .032" (0.8mm) thicknesses. Most of these blade terminals are available in 0, 45 and 90 degree angles. The 36T can also be supplied with various weld tab and crimp/solder terminals. Please see the 36T Standard Terminals chart that shows our most frequently used terminals. Note that other configurations/platings may be available if our standard offerings do not satisfy your application. Please contact a Sales Engineer to discuss requirements.



36T Standard Terminals

Dimensions are shown in inches and (millimeters). "A" designates available.

Mounting Hole	Terminal Angle	Unplated Brass	Tin Plated Brass	Tin Plated Brass Steel	Drawing
3/16 x .020 (4.8 x 0.5 blade)	low	A	A	A	Figure 17
	45°	--	A	A	
	90°	A	A	A	
3/16 x .032 (4.8 x 0.8 blade)	low	A	A	A	Figure 18
	45°	A	A	--	
	90°	A	A	A	
1/4 x .032 (6.3 x 0.8 blade without stops)	low	A	A	A	Figure 19
	45°	A	A	A	
	90°	A	A	A	
1/4 x .032 (6.3 x 0.8 blade)	low	--	A	A	Figure 20
	45°	A	A	--	
	90°	A	A	A	
.020 (0.5) weld tab	90°	--	--	A	Figure 21
.020 (0.5) crimp/solder	90°	--	A	--	Figure 22
.020 (0.5) solder	low	--	A	--	Figure 23
.020 (0.5) PCB solder	90°	--	A	--	Figure 24

3/16 (4.8) x 0.020 (.5) Blade

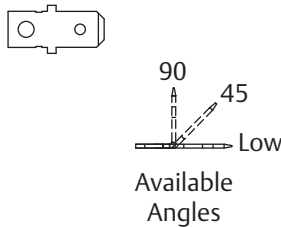


Figure 17

3/16 (4.8) x 0.032 (.8) Blade

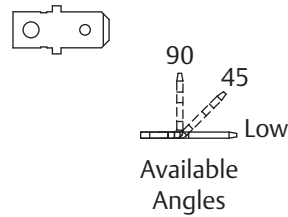


Figure 18

1/4 (6.3) x 0.032 (.8) Blade Without Stops

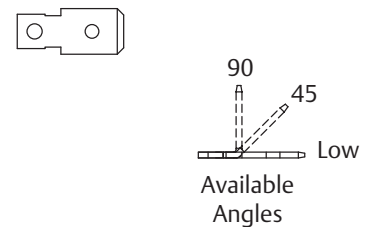


Figure 19

1/4 (6.3) x 0.032 (.8) Blade

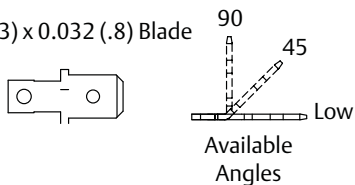


Figure 20

0.020 (.5) Weld Tab



Figure 21

0.020 (.5) Crimp / Solder



Figure 22

0.020 (.5) Solder

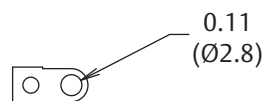


Figure 23

0.020 (.5) PCB Solder

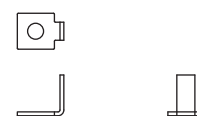


Figure 24

Dimensions are shown in inches and (millimeters).

36T Switchcases

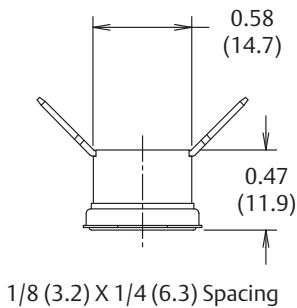
There are many available switchcases (or switchbodies) available for the 36T. When choosing a particular switchcase, there are several key items to consider:

Electrical Spacing – This is the minimum distance required to prevent electrical “arcing” from a live part (terminal) to a dead part (disc housing). The required electrical spacing is determined by the customer’s agency spacing requirements. There are 36T switchcases with two different spacings available:

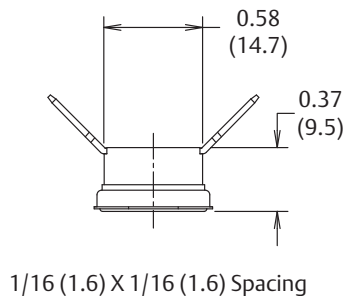
- 1/8” (3.2mm) by 1/4” (6.3mm) air/surface – designated by an ‘X’ in the nomenclature (see Figure 25). (Preferred)
- 1/16” (1.6mm) by 1/16” (1.6mm) air/surface (see Figures 26, 27).

The greater spacings are achieved by an increased switchcase height.

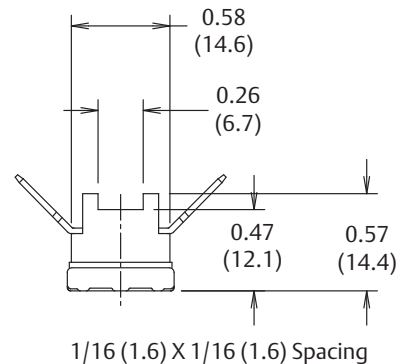
Mounting – All of the available switchcases can be provided in both surface (with or without brackets) or airstream mount configurations. There are several switchcases designed to accept a customer clamp bracket (over the top of the switchcase). These are designated by an ‘M’ in the nomenclature. (See Figure 27)



TX, TXE, TXH
Figure 25



T, TE, TH
Figure 26



TM, TMH, TME
Figure 27

Dimensions are shown in inches and (millimeters).

Switchcase Material – For calibrations up to 350°F (177°C), plastic can be specified; for calibrations above 350°F (177°C), ceramic is available. Ceramic switchcases are designated by ‘H’ in the nomenclature.

Manual Reset – Manual reset switchcases are basically similar to those used on automatic reset and fuse disc configurations except for a hole in the top of the case (for the reset pin) and a pad on the top of the case to prevent overtravel of the reset pin. Please refer to the manual reset portion of the catalog for more information.

Calibration Temperatures, Differentials and Tolerances

36Ts (automatic reset) are supplied to customer specified open and close calibration set points with a tolerance on both set points.

Please refer to the chart below. To use this chart, start by finding the higher of your open/close calibration set points in the far left hand column. Then look across the top (left to right) to locate your desired nominal differential. Differential is the difference between your nominal open and close calibration set points. The available open and close set point tolerances are shown where the two columns converge. Please note that this chart is applicable to either normally closed contacts (contacts open on temperature rise) or normally open contacts (contacts close on temperature rise).

Example 1:

If you require a nominal open temperature of 250°F (121°C) and a nominal close temperature of 210°F (99°C), then the nominal differential = 40°F (22°C), so the tolerance on the open temperature is $\pm 7^\circ\text{F}$ ($\pm 4^\circ\text{C}$), and the tolerance on the close temperature is $\pm 11^\circ\text{F}$ ($\pm 6^\circ\text{C}$). (Refer to the yellow shaded area in the chart.)

Example 2:

If you require a nominal close temperature of 160°F (71°C) and a nominal open temperature of 140°F (60°C), then the nominal differential = 20°F (11°C), so the tolerance on the open temperature is $\pm 5^\circ\text{F}$ ($\pm 3^\circ\text{C}$), and the tolerance on the close temperature is $\pm 7^\circ\text{F}$ ($\pm 4^\circ\text{C}$). (Refer to the gray shaded area in the chart.)

Calibration Temperatures, Differentials and Standard Tolerance for the 36T Series

Highest Calibration Set Point (Open or Close)	NOMINAL DIFFERENTIAL (temperature difference between nominal open and close set point)															
	*F15-19 *C8.5-10.5		20-24 11-13.5		25-29 14-16		30-39 16.5-21.5		40-49 22-27		50-60 27.5-33.5		61-80 34-44.5		81-100 45-55.5	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
35°F-79°F 2°C-26°C	± 5	± 6	± 5	± 6	± 5	± 7	± 5	± 8	± 6	± 8	± 7	± 9	-	-	-	-
80°F-180°F 27°C-82°C	± 5	± 6	± 5	± 7	± 5	± 7	± 5	± 8	± 5	± 8	± 6	± 10	± 7	± 11	± 9	± 13
181°F-230°F 83°C-110°C	± 5	± 7	± 5	± 7	± 5	± 8	± 5	± 8	± 6	± 9	± 7	± 11	± 8	± 12	± 10	± 14
231°F-300°F 111°C-149°C	-	-	-	-	± 6	± 9	± 6	± 10	± 7	± 11	± 8	± 11	± 9	± 14	± 11	± 17
301°F-350°F 150°C-177°C	-	-	-	-	-	-	-	-	-	-	± 8	± 12	± 10	± 15	± 12	± 20
351°F-428°F 178°C-220°C	-	-	-	-	-	-	-	-	-	-	-	-	± 16	± 23	± 18	± 25

- NOTES:**
1. We can supply tolerances that are tighter than those shown at extra cost. Please contact a Sales Engineer.
 2. Wider tolerances required for conical contact construction. Please contact a Sales Engineer.
 3. Requires ceramic construction for temperatures above 350°F (177°C)
 4. Lowest nominal open or close calibration is -6°F (-21°C).

36T Manual Reset

The 36T manual reset is available with normally closed contacts that open on temperature rise and is a non-trip free design. The 36T manual reset is normally supplied so that it does not automatically reset unless the ambient temperature drops below -31°F (-35°C).

Once the 36T manual reset has opened at its calibration temperature, the ambient temperature must drop before it can be reset. To determine the manually resettable temperature for a specific open temperature – refer to the graph in Figure 28. The manually resettable temperature is the temperature at which (or below which) the 36T can be reset. To use this chart, first find the point on the vertical axis that designates the nominal open temperature minus the tolerance. Then, move across to the curve and find the manually resettable temperature on the horizontal axis. There are two lines shown: one without a compressible washer, and one with a compressible washer. The compressible washer (located under the reset button) can be specified (at extra cost) when the customer desires a higher manually resettable temperature.

Example:

For an open temp/tolerance of 210°F (99°C) ±10°F (±5.5°C), the manually resettable temperature is 100°F (38°C) without the compressible washer, which means that the 36T can be reset when the temperature is at or below 100°F (38°C).

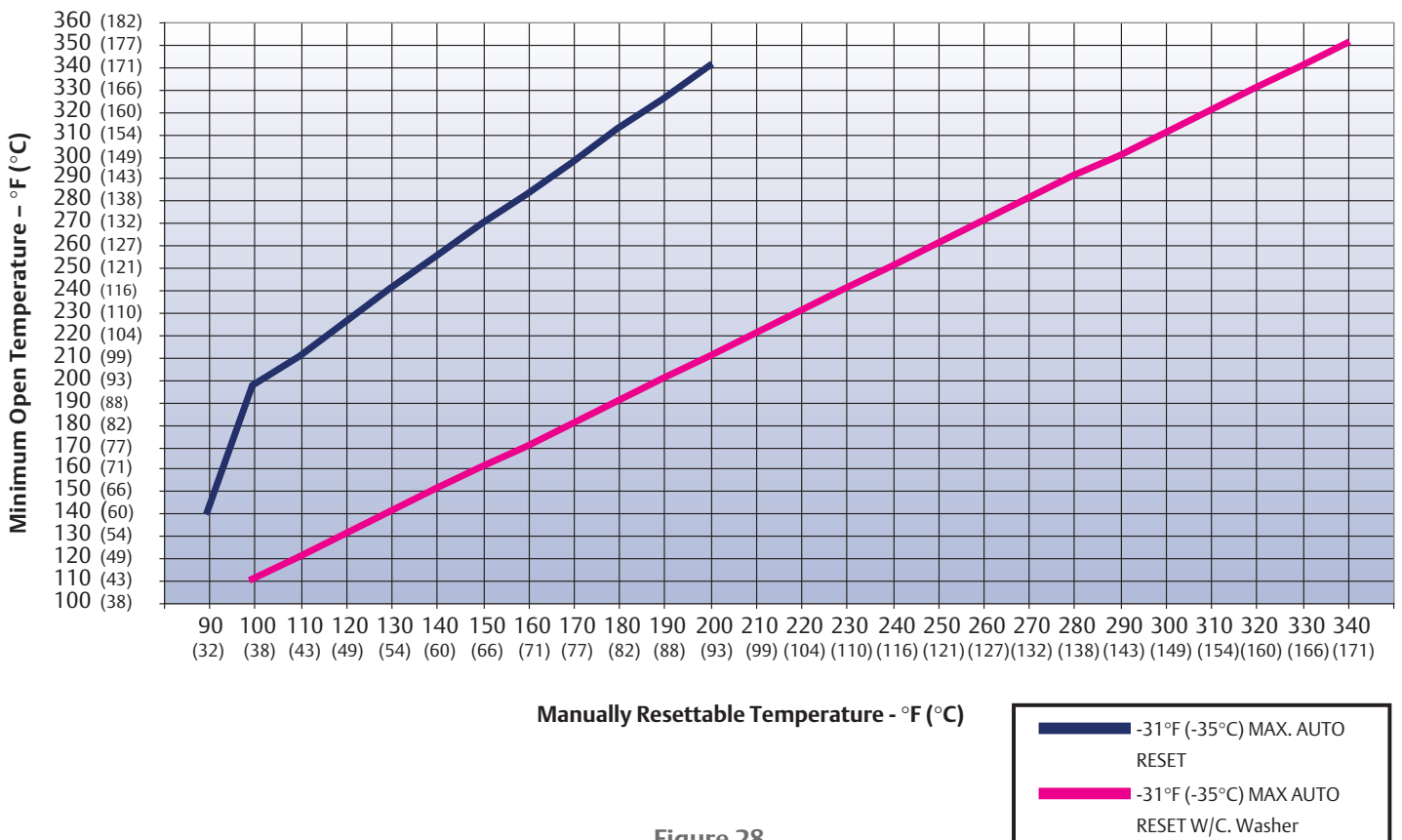


Figure 28

For 36T manual reset calibrations/tolerances, see the table below. Please contact a Sales Engineer if non-standard calibrations or tolerances are required.

Calibration Range		Standard Calibration Tolerance	
°F	°C	°F	°C
150-200	65-93	±8	±4.5
201-240	94-115	±10	±5.5
241-280	116-138	±12	±6.5
281-320	139-160	±14	±8
321-350	161-177	±16	±9

36T Manual Reset Mounting and Terminals – The 36T manual reset is available with all of the mounting and terminal configurations that are available on the automatic reset 36T. Figures 29 and 30 show two very common configurations.



Figure 29



Figure 30

Single Operation 36F

The 36F fuse thermostat is a single operation version of the 36T. Once the electrical contacts have opened, they will not reclose unless the ambient temperature drops below +32°F (0°C), or below -31°F (-35°C).

The 36F is available with any of the terminals, mounting configurations or switchcases that are available on the 36T automatic reset version.

The 36F is available with the same open temperature set points and tolerances as the 36T manual reset. Please refer to the chart in the manual reset section. The customer should specify either a +32°F (0°C) or a -31°F (-35°C) maximum automatic reset temperature for the 36F.

General Electrical Ratings

The 36T series of controls has been rated by major agencies throughout the world. Agencies include UL, CSA, VDE, CQC, MITI, and KETI. 36T series controls are rated up to 15Amps @ 120Volts, and 16Amps @ 240Volts. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application. Please consult a Sales Engineer for rating information that covers your specific application.

Type Numbering System

The following table summarizes the type numbering system for the 36T. These designations represent the type numbers that are agency recognized.

36 _____

T – Automatic Reset or Manual Reset

F – Single Operation (fuse disc)

M – Switchcase designed to accept customer clamp (*see figure 1*)

X – Switchcase with increased electrical spacing
1/8" (3mm) through air and 1/4" (6.3mm) over surface

V – Conical movable contact – silver

VG – Conical gold movable contact (with gold-plated stationary contact)

E – Eyelet construction (required for European agency approval)

H – Ceramic switchcase

0 – No mounting bracket

1 – Airstream mount

2 – Surface mount bracket

3 – Stud mount

4 – Large flange – airstream mount

1 – Contacts open on temperature rise

2 – Contacts close on temperature rise

4 – Fuse disc with automatic reset
temperature below -31°F (-35°C)

6 – Manual reset or fuse disc with automatic reset
temperature below 32°F (0°C)

36T Board Mount Nomenclature

36 _____

- T** – Automatic Reset – plastic switchcase
- TH** – Automatic Reset – ceramic switchcase
- TVH** – Automatic Reset – ceramic switchcase – conical silver movable contact

- 0** – No mounting bracket
 - 1** – Contacts open on temperature rise
 - 2** – Contacts close on temperature rise
 - B** – Board mount
 - 2** – 2” strap length*
 - 3** – 3” strap length*
 - 5** – 5” strap length*
 - 7** – 7” strap length*

* Approximate length

Important Notice

Users must determine the suitability of the control for their application, including the level of reliability required, and are solely responsible for the function of the end-use product. These controls contain exposed electrical components and are not intended to withstand exposure to water or other environmental contaminants which can compromise insulating components. Such exposure may result in insulation breakdown and accompanying localized electrical heating.

A control may remain permanently closed or open as a result of exposure to excessive mechanical, electrical, thermal or environmental conditions or at normal end-of-life. If failure of the control to operate could result in personal injury or property damage, the user should incorporate supplemental system control features to achieve the desired level of reliability and safety. For example, backup controls have been incorporated in a number of applications for this reason.

37T Series Moisture Resistant Temperature Controls



Moisture Resistant Temperature Controls

The 37T series of 3/4" (19mm) bimetals disc temperature controls from Therm-O-Disc offers proven reliability in a moisture resistant sealed design. The snap-action of the bimetals disc provides high-speed contact separation resulting in excellent life cycle characteristics at electrical loads up to 10 amps at 120VAC and 5 amps at 250VAC. The sealed design provides moisture resistance for moisture prone environments. A wide variety of terminal, lead wire and mounting configurations are available to provide maximum design flexibility.

The 37T is the most popular and widely applied temperature control in refrigeration applications such as defrost termination and ice cube maker control. It is also applied in a range of heat pump and air conditioning applications.



Features and Benefits

The 37T features include:

- Sealed construction provides moisture resistance for moisture prone environments.
- High-speed contact separation ensures long contact life.
- A wide variety of mounting configurations, lead wires and terminations provide maximum design flexibility.
- All materials have been selected to pass the refrigeration industry's odor and taste tests.
- Controls are 100% operation checked and dielectric tested.

Switch Actions and Typical Applications

The 37T is available in two switch actions:

Automatic Reset SPST – In this design, the switch can be built to either open or close its electrical contacts on temperature rise. Once the temperature in the application has returned to the specified reset temperature, the contacts automatically return to their original state. Open on rise contact design is typically used for refrigeration defrost termination and ice cube maker control. Type 37TF includes an internal resistor wired in parallel with the contacts which serves as an aid to factory circuit testing where the contacts are open at room temperature.

Automatic Reset SPDT – This design is the same as the SPST with the addition of an auxiliary contact which makes a circuit upon the opening of the main contacts and breaks the circuit when the main contacts reset. In this design, any combination of electrical ratings shown in the rating table may be switched from one circuit to the other.

Mounting Configurations

The 37T is available in several mounting configurations:

No Mounting Bracket – The 37T may be specified without a mounting bracket. The 37T (see figure 1) is available with a polyethylene cap or a phenolic centerpost which may be used for a customer’s bracket. The phenolic centerpost may be customized to meet unique requirements. mount configurations. Airstream mounting is typically used in applications where the temperature being sensed is contained within an enclosure such as an air duct or heater box. An optional surface mount configuration is available for applications where the temperature being sensed is the actual mounting surface. Exposed or enclosed bimetal disc mounting versions may be specified.

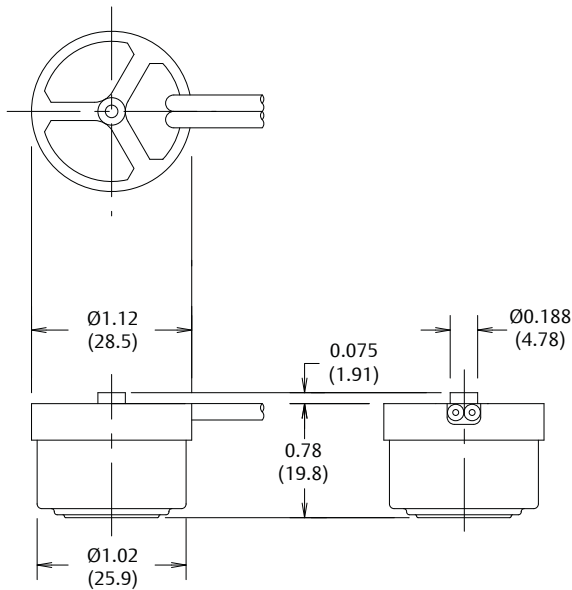


Figure 1
Dimensions are shown in inches and (millimeters).

Surface Mounting – The surface mounting configuration (see figure 2) positions the sensing element firmly against the surface to be monitored.

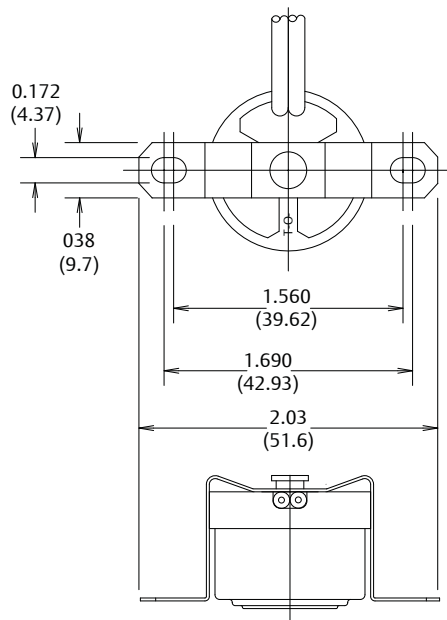


Figure 2
Dimensions are shown in inches and (millimeters).

Tube Mounting – Several different tube mountings are available (see figures 4-7). These brackets firmly attach the 37T to tubes ranging from 1/4” (6.4mm) to 7/8” (22.2mm) in diameter. Radius cups provide best thermal response are available in stainless steel, tin plated copper, and Aluminum.

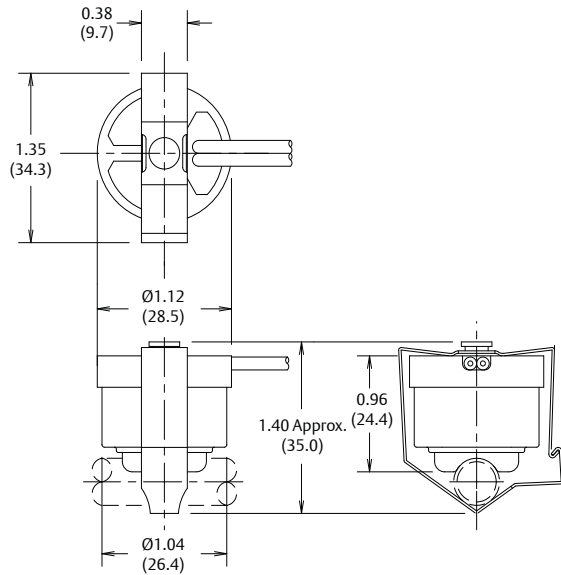


Figure 3
Dimensions are shown in inches and (millimeters).

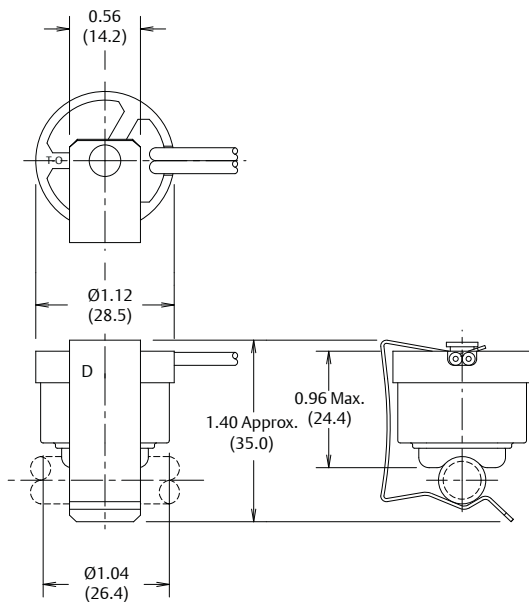


Figure 4
Dimensions are shown in inches and (millimeters).

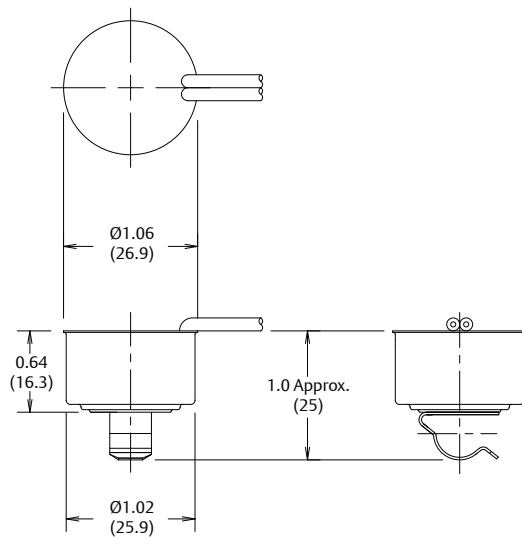


Figure 5
Dimensions are shown in inches and (millimeters).

Lead Wire and Terminal Configurations

Standard Lead Wire- The standard leads for the 37T controls are available in lengths between 3" (76.2mm) and 36" (914.4mm) with #18 AWG, 16/30 standard copper wire and 1/32" (0.8mm) thick 105 °C PVC odorless insulation stripped 1/2" (13mm).

In addition, #16 AWG wire can be supplied with 1/32 (0.8mm) or 1/16" (1.6mm) thick insulation. The maximum wire size available is #14 AWG with 1/32" (0.8mm) insulation.

Terminals- A wide variety of terminals can be attached to the 37T lead wires in addition to strip and retain. Please consult a Therm-O-Disc sales engineer for further variations of terminals, wire lengths, and/or wire types.

Pin terminals- The 37TB construction provides pin terminals in place of lead wire coming from the thermostat (see figure 8).

High Temperature 37TJ Construction

The 37TJ construction incorporates a stainless steel disc cup, as well as high temperature sealant and lead wires. The 37TJ, available in SPST construction only, may be calibrated up to 300°F (149°) with maximum ambient temperatures up to 257°F (125°C).

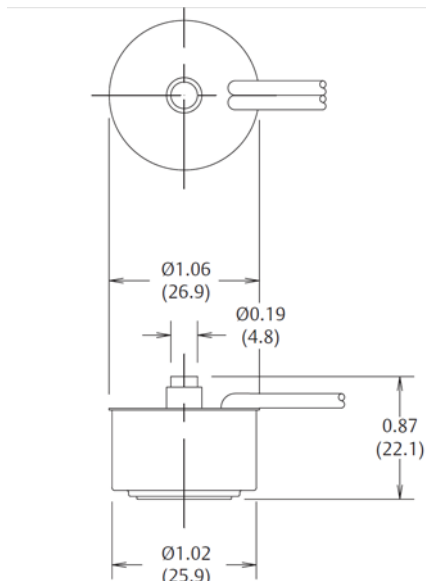


Figure 6
Dimensions are shown in inches and (millimeters).

Clip-in Mounting – Clip-in mounting brackets (see figure 3) hold the sensing element firmly against the surface where the thickness of the surface is from .03” (0.8mm) to .06” (1.5mm).

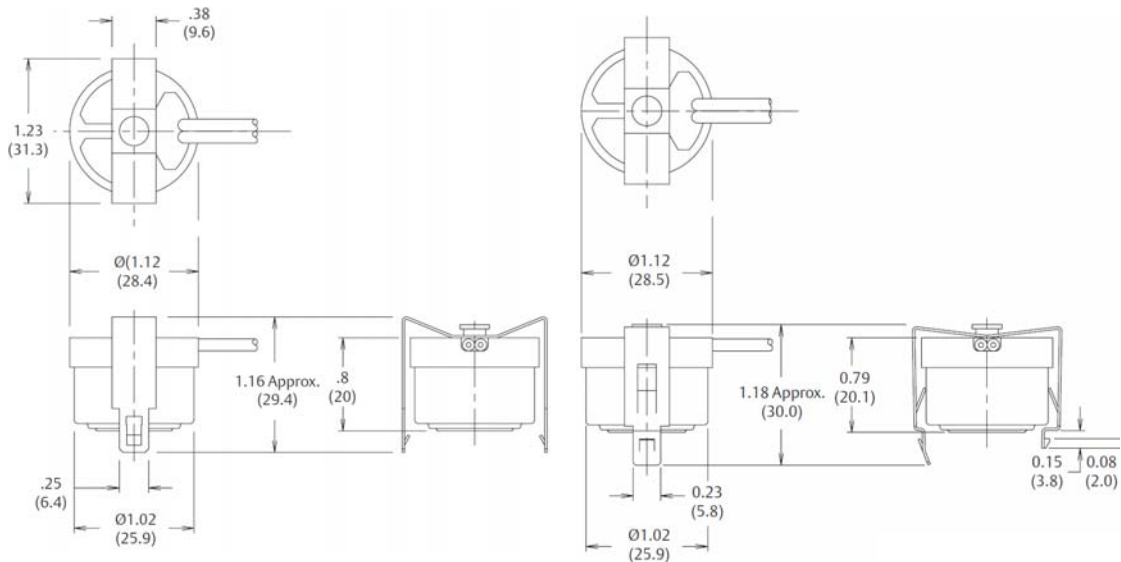


Figure 7
Dimensions are shown in inches and (millimeters).



Thermal Response

The temperature sensitive bimetal disc is located at the bottom of the disc cup adjacent to the surface to be monitored. Aluminum, tin-plated copper and stainless steel cups are available for calibrations not exceeding 172°F (78°C) and temperature overrides not exceeding 200°F (93°C). Stainless steel disc cups may also be used for higher temperature applications.

Calibration Temperatures, Differentials and Tolerances

To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Then locate, across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates what differentials are available in each of the calibration set point ranges. Closer tolerances and special differentials are available at extra cost. Please consult a sales engineer for further information.

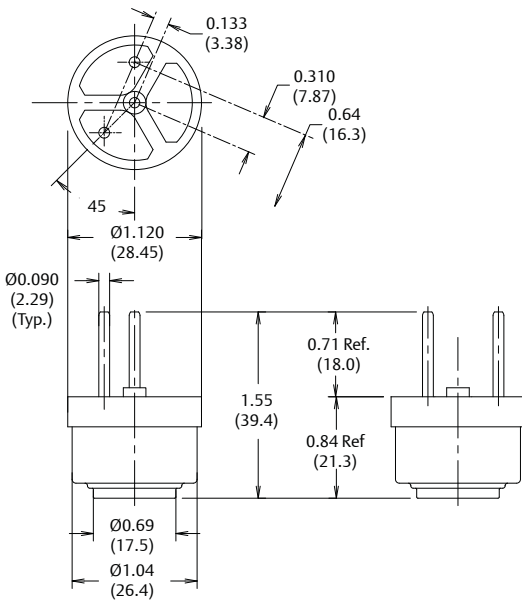


Figure 8
Dimensions are shown in inches and (millimeters).

Calibration Temperatures, Differentials and Tolerances

To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Then locate, across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates what differentials are available in each of the calibration set point ranges. Closer tolerances and special differentials are available at extra cost. Please consult a sales engineer for further information.

Calibration Temperatures, Differentials and Standard Tolerance of the 37T Series

Highest Calibration Set Point Range (Open or Close)	Nominal Differentials (temperature difference between nominal open and close set point)											
	10-14F* 5.5-8°C		15-19°F 8.5-10.5°C		20-29°F 11-16°C		30-39°F 16.5-21.5°C		40-50°F 22.27.5°C		51-80°F 28-44.5°C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
10°-80°F** -12°-27°C	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±5 ±3	±7 ±4	- -	- -
81°-200°F*** 28°-93°C	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±7 ±4	±5 ±3	±7 ±4	- -	- -
201°-221°F*** 94°-105°C	- -	- -	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±6 ±3.5	±8 ±4.5	±7 ±4	±8 ±5	- -	- -
222°-300°F**** 106°-149°C (37TJ only)	- -	- -	- -	- -	±6 ±3.5	±8 ±4.5	±7 ±4	±9 ±5	±8 ±4.5	±11 ±6	±9 ±5	±13 ±7

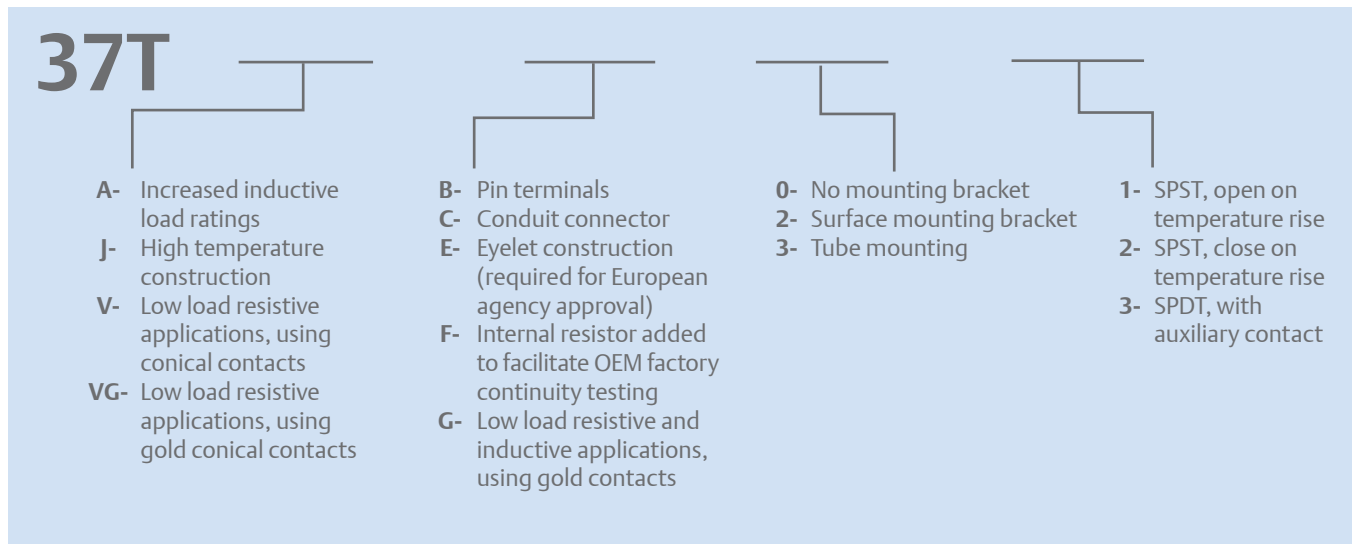
* SPDT – Minimum differential is 15°F (8°C).

** The minimum bottom temperature is -10°F (-23°C).

*** Type 37T maximum ambient temperature for the polyethylene cap is 172°F (78°C).

**** Type 37TJ maximum ambient temperature for the epoxy and lead wires in 257°F (125°C).

Part Numbering System



General Electric Rating

The 37T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Max Temp.	Contact Arrangement	Cycles	Inductive Amps		Pilot Duty VA	Resistive Amperes	Watts	Volts AC	Agency Recognition
				FLA	LRA					
37T, 37TB, 37TJ	221 °F* 105 °C	SPST or SPDT****	100,000	5.8	34.8	125	10.0	1200	120	UL File E29653
			100,000	2.9	17.4	125	5.0	1200	240	
			100,000	-	-	-	1.0	-	277	
			30,000	3.6	21.6	125	-	-	277	
37TV, 37TVF	221 °F * 105 °C	low load application	30,000	-	-	-	10.0	-	120	
			100,000	-	-	-	7.0	-	120	
			100,000	-	-	-	2.5	-	240	
			100,000	-	-	-	1.0	-	24VDC	
37TG, 37TVG	221 °F* 105 °C	low load application	100,000	-	-	125	1.0	-	120	
			100,000	-	-	-	1.0	-	24VDC	
37TA	221 °F* 105 °C	high inductive load	300,000	7.5	40.0	-	-	-	120	
37TF	***	SPST only	100,000	5.8	34.8	125	10.0	1200	120	
37TJ	300 °F** 149 °C	high temperature SPST only	30,000	-	-	125	-	-	120	
			30,000	2.9	17.4	-	5.0	-	240	
37T, 37TJ	221 °F* 105 °C	SPST or SPDT****	30,000	5.8	34.8	125	10.0	1200	120	
			30,000	2.9	17.4	125	5.0	1200	240	
			30,000	3.6	21.6	-	-	-	277	
			100,000	-	-	125	-	-	277	
			100,000	-	-	-	8.3	-	120	
37TJ	300 °F** 149 °C	high temperature SPST only	100,000	-	-	125	2.0	-	120	CSA File LR19988 File LR62082
37TG 37TVG	221 °F* 105 °C	low load application	100,00	-	-	-	1.0	-	120	
			100,00	-	-	-	1.0	-	24VDC	
37TA	221 °F* 105 °C	high inductive load	30,000	7.8	46.8	-	-	-	120	
37TV, 37TVF	221 °F* 105 °C	low load application	30,000	-	-	-	10.0	-	120	
			100,000	-	-	-	5.0	-	120	
			100,000	-	-	-	2.5	-	240	
37TF	***	SPST only	100,000	5.8	34.8	125	10.0	1200	120	
37TE 37TFE	105 °C ***	SPST only	100,000	2.9	-	-	5.0	-	250	BEAB File CO662
	10,000		2.9	-	-	8.5	-	250		
37TVE 37TVFE	105 °C ***	SPST only	30,000	-	-	-	5.0	-	250	
	100,000		-	-	-	2.5	-	250		

For complete and current ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open.

* (a) The 37T maximum ambient temperature for the polyethylene cap is 172°F (78°C).

(b) Aluminum and tin-plated copper disc cups are limited to calibrations not exceeding 172°F (78°C) and temperature over-rides not exceeding 200°F (93°C).

** The maximum ambient temperature for the epoxy and lead wires is 257°F (125°C).

*** 56K or 240K Ohm resistor.

**** For SPDT, any combination of ratings in the table may be used. The 37TJ is SPST only.

39T Series Moisture Resistant Temperature Controls



Moisture Resistant Temperature Controls

The 39T series of 1/2" (13mm) bimetals disc temperature controls from Therm-O-Disc offers proven reliability in a moisture resistant sealed design. The snap-action of the bimetals disc provides high-speed contact separation resulting in excellent life cycle characteristics. The sealed design provides moisture resistance for moisture prone environments. A variety of lead wire configurations are available to provide maximum design flexibility.

The 39T has been specifically designed to permit easy mounting onto copper or aluminum tubing with excellent retention and thermal response. The stainless steel mounting bracket has been designed to accommodate a wide range of tubing sizes without the need to modify the control platform.

The most popular applications include refrigeration defrost termination and ice cube maker control. It is also applied in a range of heat pump and air conditioning applications.



Features and Benefits

The 39T features include:

- Sealed construction provides moisture resistance for moisture prone environments.
- High-speed contact separation ensures long contact life.
- A variety of lead wire options provide excellent design flexibility.
- All materials have been selected to pass the refrigeration industry's odor and taste tests.
- Controls are 100% operation tested.

Switch Actions and Typical Applications

The 39T is an automatic reset (SPST) switch. The switch can be built to either open or close its electrical contacts on temperature rise or fall. Once the temperature in the application has returned to the specified reset temperature, the contacts automatically return to their original state. Open on rise contact design is typically used for refrigeration defrost termination and ice cube maker control. The type 39TR includes an internal resistor wired in parallel with the contacts which serves as an aid to factory circuit testing where the contacts are open at room temperature.

Mounting Brackets

The 39T (see figure 1) has been specifically designed to permit easy mounting onto copper or aluminum tubing with excellent retention and thermal response. The stainless steel mounting bracket has been designed to accommodate a wide range of tubing sizes without the need to modify the control platform or worry about thermal response. To assure compatibility with other materials, the 39T can be provided with either an aluminum or tin-plated copper sensing surface.

The rugged design of the sensing surface permits carefree handling regardless of the sensing material chosen.

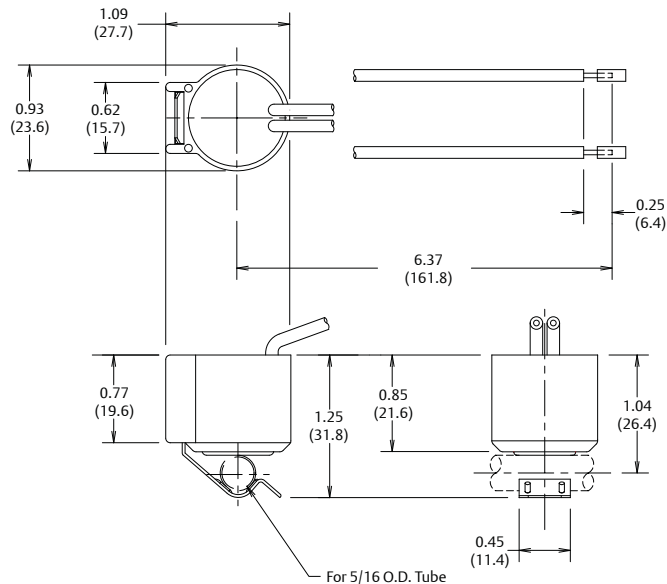


Figure 1
Dimensions are shown in inches and (millimeters).

Thermal Response

The temperature sensitive bimetal disc is located at the bottom of the disc cup adjacent to the surface to be monitored. Aluminum and tin-plated copper cups are available for calibrations not exceeding 221°F (105°C) and temperature overrides not exceeding 250°F (121°C).

Lead Wire and Terminal Configurations

Standard Lead Wire- The standard leads for the 39T controls are available in lengths between 3” (76.2mm) and 36” (914.4mm) with #18 AWG, 16/30 standard copper wire and 1/32” (0.8mm) thick 105 °C PVC odorless insulation stripped 1/2” (13mm).

In addition, #16 AWG wire can be supplied with 1/32 (0.8mm) or 1/16” (1.6mm) thick insulation. The maximum wire size available is #14 AWG with 1/32” (0.8mm) insulation.

Terminals- A wide variety of terminals can be attached to the 39T lead wires in addition to strip and retain. Please consult a Therm-O-Disc sales engineer for further variations of terminals, wire lengths, and/or wire types.

Pin terminals- The 39TB construction provides pin terminals in place of lead wire coming from the thermostat.

Calibration Temperature, Differentials and Tolerances

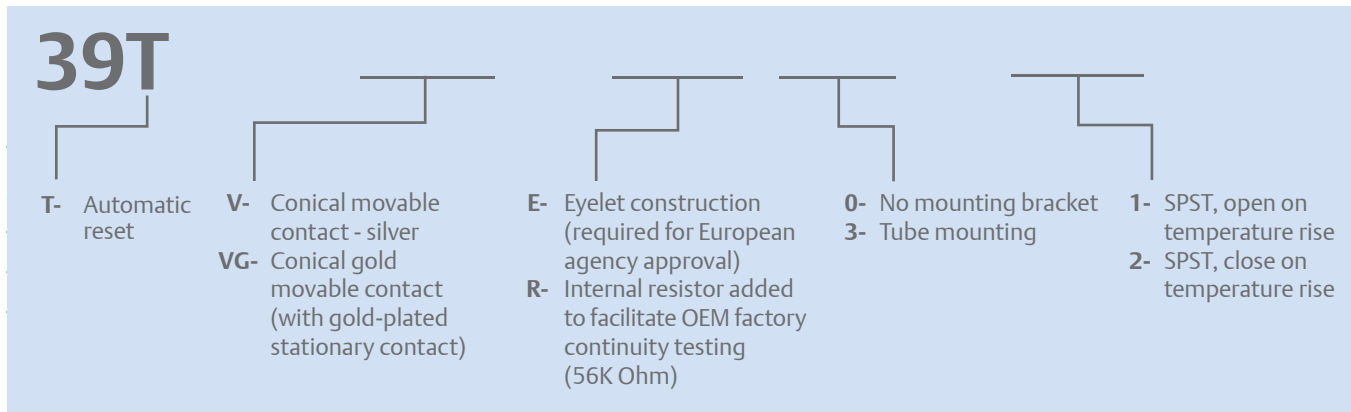
To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Then locate, across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates what differentials are available in each of the calibration set point ranges. Closer tolerances and special differentials are available at extra cost. Please consult a sales engineer for further information.

Calibration Temperatures, Differentials and Standard Tolerance of the 39T Series

Highest calibration Set Point Range (Open or Close)	Nominal Differentials (temperature difference between nominal open and close set point)									
	15-19 °F 8.5-10.5 °C		20-29 °F 11-16 °C		30-39 °F 16.5-21.5 °C		40-50 °F 22-27.5 °C		51-80 °F 28-44.5 °C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
15 °-80 °F** -9 °-27 °C	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±5 ±3	±7 ±4	- -	- -
81 °-200 °F*** 28 °-93 °C	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±7 ±4	±5 ±3	±7 ±4	- -	- -
201 °-221 °F*** 94 °-105 °C	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±6 ±3.5	±8 ±4.5	±7 ±4	±9 ±5	- -	- -

NOTE: Minimum differential is 15°F (8°C).
The minimum bottom temperature is 0°F (-18°C).

Part Numbering System



General Electrical Ratings

The 39T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Max Temp	Contact Arrangement	Cycles	Inductive Amperes		Pilot Duty	Resistive Amperes	DC Amperes	Volts AC	Agency Recognition
				FLA	LRA					
39TV	221°F 105°C	SPST	30,000	—	—	—	10.0	120	CUL File E29653	
			100,000				5.0	120		
			100,000				2.5	240		
39T	221°F 105°C	SPST	30,000	3.6	21.6	125			277	CUL File E29653
			100,000					1	24	
			100,000	2.9	17.4	125			240	
			100,000				1		277	
39TXVE	221°F 105°C	SPST	30,000				5.0	250	CB Cert# US/12884/UL	
			100,000				2.5	250		
39TVE	221°F 105°C	SPST	100,000	0.8			5	125	VDE CERT # 4002298	
			100,000	0.4			2.5	250		
			30,000	0.8			5	250		

For complete and current ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open.

44T,48T Series Auto Reset Bitmetal Controls



Low Voltage Temperature Controls

The 44T/48T series line of bimetals temperature switches provide high speed contact separation resulting in exceptional life characteristics. Gold plated contacts with biased closed operation results in a repeatable low resistance with reliable switching action in more rigorous environments. Typical applications include gas appliances and heating systems as well as automotive air ambient, coolant, transmission fluid, emissions, and drivability systems.

Both 44T and 48T provide a variety of terminals, lead wire and mounting configurations, as well as a wide range of temperature calibrations, are available to provide maximum application flexibility.



Features and Benefits

The 44T and 48T features include:

- Epoxy sealed for resistance to contamination from the application environment.
- Vibration resistant construction provides for high reliability.
- High Speed contact separation and contact force ensure long contact life and reliable operation.
- 3/4" snap-action disc for high-speed contact separation and long life.
- Low internal resistance.
- 100% tested for electrical operation.
- Wide range of available calibration temperatures.
- Large selection of terminals and lead wires.
- Surface, airstream or stud mounting configurations.
- A 48TS with a single terminal and grounding through the stud.

Switch Actions and Typical Applications

The 44T and 48T are automatic reset single pole, single throw (SPST) switch that is designed to open its electrical contacts on temperature rise. Once the temperature in the application has returned to the specified reset calibration, the switch will automatically return to the closed position.

Typical uses of the Therm-O-Disc 44T include limiting or regulating temperatures in gas appliances and heating systems that require the thermostat to make/break the millivolt circuit of a thermocouple or the low voltage circuit of other types of devices.

For low voltage applications requiring a “one-shot” or fuse operation, the 44F is a SPST switch whose contacts open on temperature rise. However, the 44F is a single operation device. Once the switch has operated, the “fuse” disc prevents reset of the contacts to their closed state at temperatures above -31°F (-35°C).

Therm-O-Disc 48T can be used in a variety of automotive temperature sensing applications. Each control incorporates high contact force, epoxy sealant and vibration resistant construction which meets ASTM salt spray and other environmental test requirements.

Typical applications include:

- Control of electrically driven coolant fan motors found in most smaller cars which utilize front wheel drive and transverse mounted engines. The switch can carry the electrical load of the coolant fan directly, thus eliminating the need for a fan relay.
- Control of early fuel evaporation heater relay and turn-off of the early fuel evaporation heater on coolant temperature rise. These switches are designed to provide maximum sensitivity and quick thermal response to changes in temperature.
- Ambient air sensing for air conditioning systems, sensors for engine coolant, transmission fluid, emission, and driveability systems. Customized mounting capabilities can satisfy airstream, surface or stud mount requirements.
- Control of such applications as cold engine lockout and engine coolant fans which demand heavier electrical loads up to 14VDC at 10 amps.

Application Configurations

Typical configurations for surface, airstream and stud mounting are shown in the line drawing. A variety of lead wires and terminals are also available for any of the mounting configurations. The 44T/48T open temperature calibration may be specified between 120°-300°F (49°-149°C).

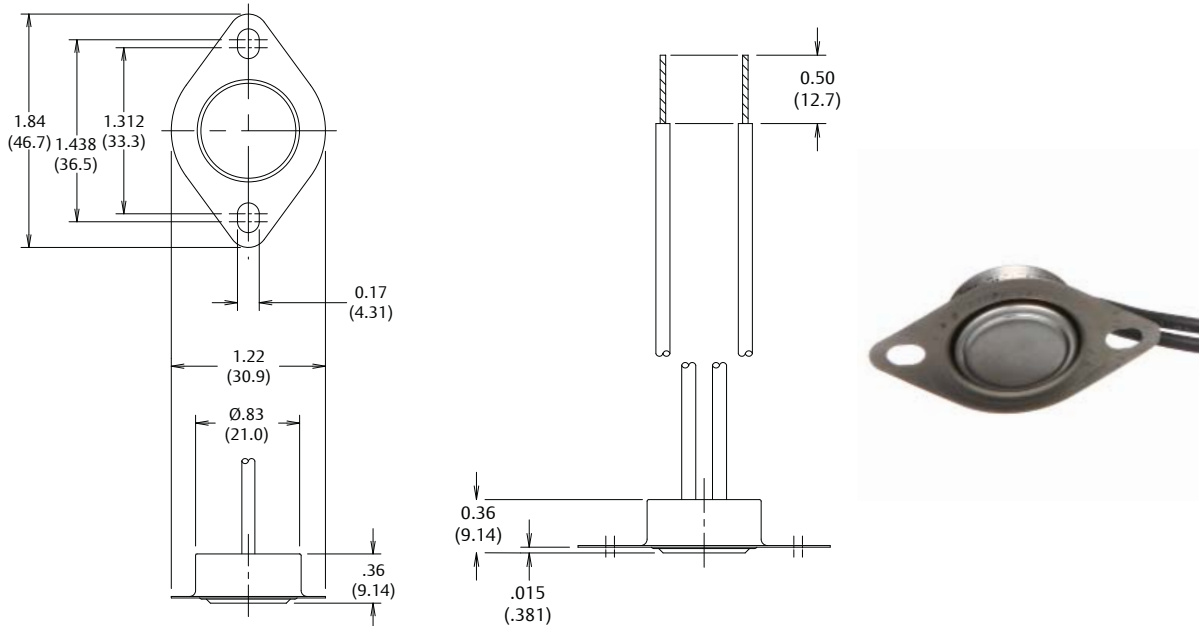


Figure 1
Dimensions are shown in inches and (millimeters).
Surface Mounting

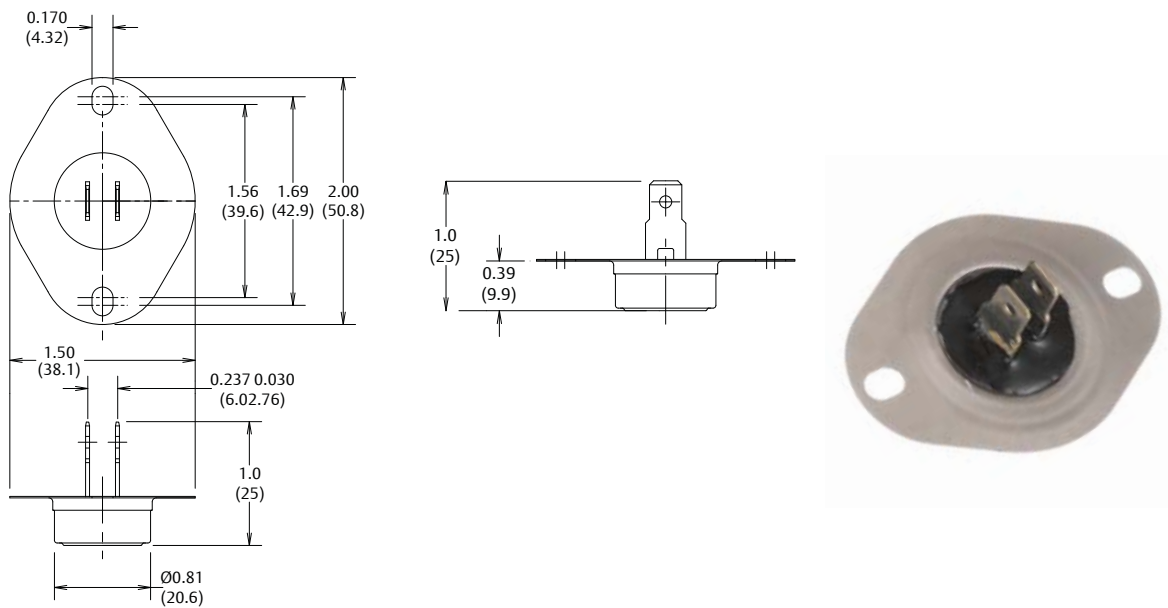


Figure 2
Dimensions are shown in inches and (millimeters).
Airstream Mounting

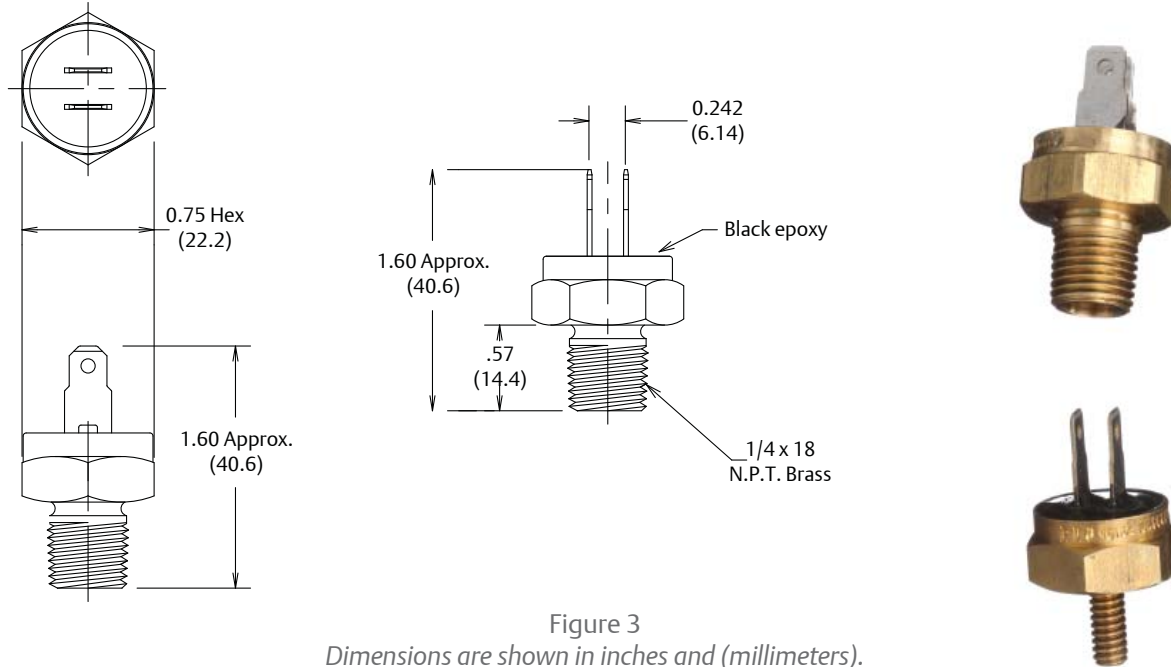


Figure 3
 Dimensions are shown in inches and (millimeters).
Stud Mounting

General Electrical Ratings*

The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Max. Temperature	Comments	Cycle Rating	Pilot amps	Resistive amps	Volts AC	Agency Recognition
44T	300°F	Gold Contacts	100,000	- 40	1.0 -	12VDC 26	UL File MH-5304
44F			Fuse	- 40	1.0 -	12VDC 26	
44TA			100,000	40	-	26	UL
44FA			Fuse	40	-	26	File MH-5304
44T	300°F	Gold Contacts Gas Appliance Thermostat	100,000	- 40	1.0 -	12VDC 26	CSA Z21.23
44TG	200°F	Gold Contacts Automatic Gas Shut-off device, 120°F min. reclose	100	- 40	1.0 -	12VDC 26	CSA Z21.22
48T			100,000		10	14VDC	

*Consolidated ratings. For complete and current ratings, please contact a sales engineer.

Calibration Temperatures and Tolerance 44T/48T

Open Temperature	Open Tolerance	Prime Differential*
120°-200°F (48.9°-93.3°C)	± 8°F (± 4.4°C)	20°-50°F (11.1°-27.8°C)
201°-250°F (93.9°-121.1°C)	± 10°F (± 5.6°C)	30°-50°F (16.7°-27.8°C)
251°-300°F (121.7°-148.9°C)	± 12°F (± 6.7°C)	30°-50°F (16.7°-27.8°C)

* Prime Differential = The difference between the nominal opening temperature and the minimum reset temperature.

Calibration Example

Normally closed, open on temperature rise.

Open = 190°±8°F

40°F Prime Differential

This specification means that the thermostat will open its contacts at 190°±8°F and reclose at a temperature not lower than 190°-40°F = 150°F.

Typical Temperature Switch Configurations

Therm-O-Disc can supply our 44T/48T Temperature Switches in a wide variety of configurations. Some specifications are shown on the “Typical Configurations” chart. According to specific applications, switches with different mountings, diameters, thread types, connections and housings are available. Our sales engineers can assist in selecting a switch package that is tailored to specific requirements.

For testing purposes, calibrated samples and/or equal mass thermocouple samples can be provided. Please contact one of our Sales Engineers for details.

49T/49F Series Snap-Action Temperature Controls



Snap-Action Temperature Controls

The 49T line of controls from Therm-O-Disc offers proven 3/4" (19mm) bimetal disc reliability in a high temperature package. The ceramic design of the 49T control, along with the snap action of the bimetal disc, provides exceptional life characteristics at calibrations up to 550°F (288°C).

The bimetal disc housing may be either enclosed for protection from contaminants or exposed for greater thermal sensitivity. To ensure electrical integrity, terminal connections are made with #8 terminal screws. The ability to handle electrical loads up to 25 amps at high temperatures has made the Therm-O-Disc 49T a popular choice with heating and major appliance manufacturers.



Features and Benefits

The 49T series features include:

- Ceramic construction for high-temperature operation up to 550°F (288°C).
- Snap-action bimetal disc for high-speed contact separation.
- Available with an exposed or enclosed bimetal disc in either increased thermal response or protection from airborne contaminants.
- Welded construction for integrity of current-carrying components.



Switch Actions and Typical Applications

The 49T is an automatic reset single pole, single throw (SPST) switch that can be built to either open or close its electrical contacts on temperature rise. Once the temperature in the application has returned to the specified reset calibration, the switch will automatically return to its original state.

Typical uses of the Therm-O-Disc 49T include limiting or regulating temperatures in appliances and heating systems. This reliable, economical switch also provides temperature control in a variety of commercial and industrial applications. Airstream or surface mounting flanges are available with the 49T and are interchangeable with the Therm-O-Disc 60T series of temperature controls.

Mounting Configurations

Airstream Mounting – In this mounting configuration, the bimetal disc sensing element protrudes through the mounting surface where the temperature being sensed is contained within an enclosure (air duct, heater box, etc.), (see figure 1).

Surface Mounting – The surface mounting configuration positions the bimetal disc sensing element firmly against the mounting surface, thereby sensing the actual mounting surface temperature (see figure 2).

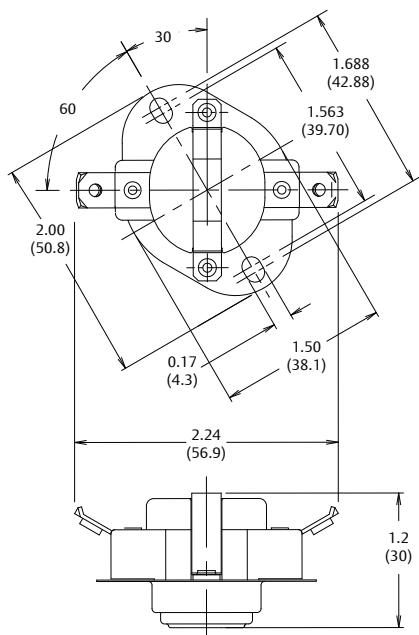


Figure 1

Airstream Mount

Dimensions are shown in inches and (millimeters).

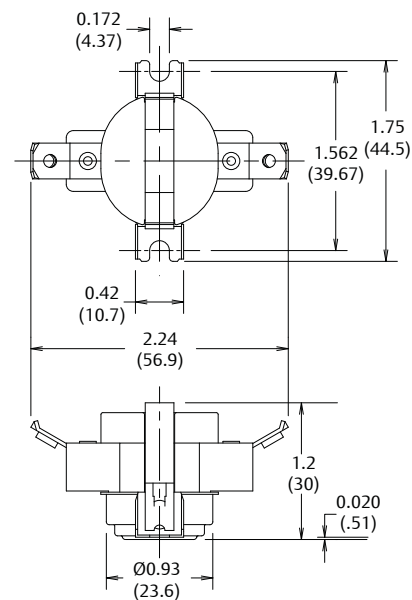


Figure 2

Surface Mounting

Dimensions are shown in inches and (millimeters).



Calibration Temperatures, Differentials and Standard Tolerances of the 49T Series

Highest Calibration Set Point Range (Open or Close)	Nominal Differentials (nominal open and close set point)											
	20-29 °F 11.1-16.1 °C		30-39 °F 16.7-21.7 °C		40-49 °F 22.2-27.2 °C		50-59 °F 27.8-32.8 °C		40-59 °F 22.2-32.8 °C		60-90 °F 33.3-50.0 °C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
80°-200°F 26.7°-93.3°C	±5°F ±2.8°C	±6°F ±3.3°C	±5°F ±2.8°C	±7°F ±3.9°C	±6°F ±3.3°C	±8°F ±4.4°C	-	-	-	-	-	-
201°-250°F 93.9°-121.1°C	±6°F ±3.3°C	±7°F ±3.9°C	±6°F ±3.3°C	±8°F ±4.4°C	±7°F ±3.9°C	±9°F ±5.0°C	-	-	-	-	-	-
251°-300°F 121.7°-148.9°C	-	-	±7°F ±3.9°C	±10°F ±5.6°C	±8°F ±4.4°C	±15°F ±8.3°C	±8°F ±4.4°C	±15°F ±8.3°C	-	-	-	-
301°-350°F 149.4°-176.7°C	-	-	±8°F ±4.4°C	±15°F ±8.3°C	±9°F ±5.0°C	±20°F ±11.1°C	±9°F ±5.0°C	±20°F ±11.1°C	-	-	-	-
351°-400°F 177.2°-204.4°C	-	-	-	-	-	-	-	-	±10°F ±5.6°C	±20°F ±11.1°C	-	-
401°-450°F 205.0°-232.2°C	-	-	-	-	-	-	-	-	±15°F ±8.3°C	±20°F ±11.1°C	-	-
451°-500°F 232.8°-260.0°C	-	-	-	-	-	-	-	-	±20°F ±11.1°C	±25°F ±13.9°C	±20°F ±11.1°C	±25°F ±13.9°C
501°-550°F 260.6°-287.8°C	-	-	-	-	-	-	-	-	±25°F ±13.9°C	±30°F ±16.7°C	±25°F ±13.9°C	±30°F ±16.7°C

Type 49F One shot Fuse Disc

The 49F is identical in construction to the 49T automatic reset, except that it's bimetal disc is calibrated to reclose at -31°F (-35°C) maximum.

It is available with the same disc housings: airstream or surface, enclosed or exposed, as the 49T.

Screw terminals are also supplied

It is an excellent choice as a primary or back up limit in applications with high temperature such as cooking appliances.

49F Calibration Temperatures and Tolerances

Open Temperature	Tolerance
80 °F- 200 °F (28 °-93 °C)	±8°F (±4.5°C)
201 °F-300 °F (94 °C-149 °C)	±10°F(±5.5°C)
301 °F-550 °F (150 °C-288 °C)	±25°F (±13.9°C)



General Electrical Ratings- 49T/49F

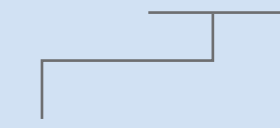
The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Max Temp.	Volts AC	Inductive Amps		Pilot Duty VA	Resistive Amperes	Cycles	Agency Recognition
			FLA	LRA				
49T Auto Reset	550°F (288°C)	250	-	-	-	25	100,000	UL File MH-5304
		277	-	-	-	15	100,000	
		120	10	60	125	-	100,000	
		240	5	30	125	-	100,000	
49T Auto Reset	550°F (288°C)	277	-	-	-	15	100,000	CSA File LR19988
		120	10	60	125	-	100,000	
		240	5	30	125	-	100,000	
		277	-	-	-	25	6,000	
49F One-Shot Fuse Disc	550°F (288°C)	250	-	-	-	25	1	UL/CB IEC60730-1 Reference 99NK43584-053000
49F One-Shot Fuse	550°F (288°C)	250	-	-	-	25	1	CSA File LR10281C
49F One-Shot Fuse Disc	550°F (288°C)	250	-	-	-	10	1	VDE Certificate 400338916

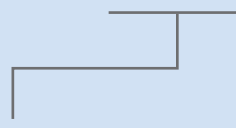
Note: At thermostat end-of-life, the contacts may remain closed or open. Please contact our Sales Engineering Department for specific agency ratings.

Part Numbering System

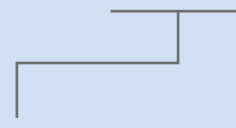
49



- T- Automatic reset
- F- One-shot fuse disc



- 1- Airstream mount
- 2- Surface mount



- 1- Contacts open on temperature rise (normally closed)
- 2- Contacts close on temperature rise (normally open)

58T Series Adjustable Temperature Controls



Adjustable Temperature Controls

The 58T line of adjustable temperature controls from Therm-O-Disc is designed for applications requiring accurate calibration tolerances and narrow temperature differential. The bimetal disc design of the 58T provides instantaneous “snap-action” contact operation, which offers excellent reliability under heavy electrical load conditions – 277VAC, 25 amps resistive and 20 amps inductive.



Features and Benefits

The 58T series features include:

- Tight calibration and differential tolerances provide accurate temperature control.
- Instantaneous contact separation provides excellent reliability for use in applications with heavy inductive or resistive electrical loads.
- A wide variety of mounting brackets, adjusting stems, terminals and lead wires provide excellent design flexibility.

Typical Applications

Typical applications include electric baseboard heaters, room air conditioners, portable and built-in electric heaters and attic ventilator fans.

Switch Actions

The 58T cycling contacts are single pole, single throw (SPST). They can be provided to open on temperature rise and close on temperature fall, as required for electric heat applications; or to close on temperature rise and open on temperature fall, as required for ventilator fans or room air conditioners.

The 58T is available with auxiliary mechanically operated contacts to provide either a double pole break in the “off” position for electric heat applications or a “fan on only” feature.

Thermal Characteristics

Calibration – The 58T can be calibrated at any temperature from 30°F (-1°C) to 165°F (74°C). Our preferred calibration tolerance is $\pm 5^\circ\text{F}$ ($\pm 2.8^\circ\text{C}$), with tighter tolerances available when required.

Differential – The differential is the difference between the nominal open and close temperatures. Our preferred differential is 7°F (4°C) $\pm 5^\circ\text{F}$ ($\pm 2.8^\circ\text{C}$). Tighter differentials are available at extra cost.

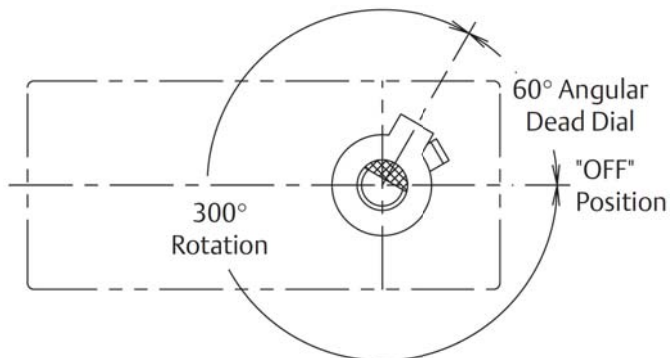
Range – The range is the difference between the thermostat operating temperatures measured at extremes of the set positions of the adjusting stem – full clockwise vs. full counterclockwise. The preferred range for the 58T is 60°F (35°C).

For more information on calibration, differentials and ranges not mentioned above, please consult one of our sales engineers.



Calibration Positions

The desired calibration can be specified at any point on the dial. The preferred calibration position is when the adjusting stem is located clockwise against the positive stop (see figure 1).



***Stop and stem flat are shown in standard extreme clockwise position.
High Position- open on rise switching (electric heat). Low Position- close on rise switching (air conditioning).***
Figure 1

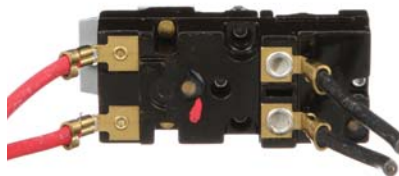
Positive Off Feature

Positive off means that when the adjusting stem is turned to the off position, the contacts will not close regardless of ambient temperature. This is accomplished by a mechanical shuttle mechanism that prevents the bumper from moving and closing contacts.

58T's with positive off will have 270 degrees of usable rotation (vs. 300° without positive off).

All 58T's with 4 terminals have the mechanically operated auxiliary contacts and also have the positive off feature.

58T's with 2 terminals, (without the mechanically operated auxiliary contact) are not provided with the positive off feature unless requested by the customer. For those 58T's there is an S in the Type nomenclature designating positive off. Example: 58T1S.



Mounting Configurations

There are a variety of mounting brackets available for the 58T. A centerline (see figure 3) or transverse (see figure 4) bracket can be used depending upon the orientation to the temperature control specified.

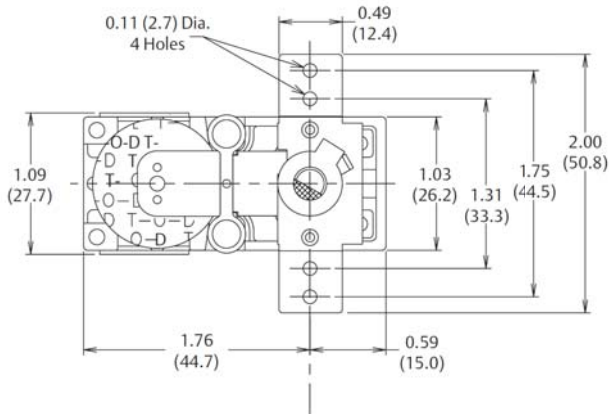


Figure 3

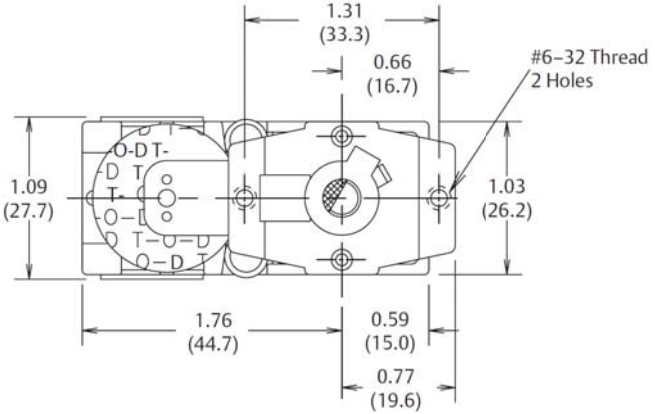


Figure 4

Dimensions are shown in inches and (millimeters).

Adjusting Stem

The adjusting stem of the 58T is available in three different standard heights: 3/8" (9.53mm), 1/2" (12.7mm) and 5/8" (15.9mm) (see figure 5). The adjusting stem can also be provided with or without a flat. The stem flat can be oriented per a specific dial requirements relative to the pointer.

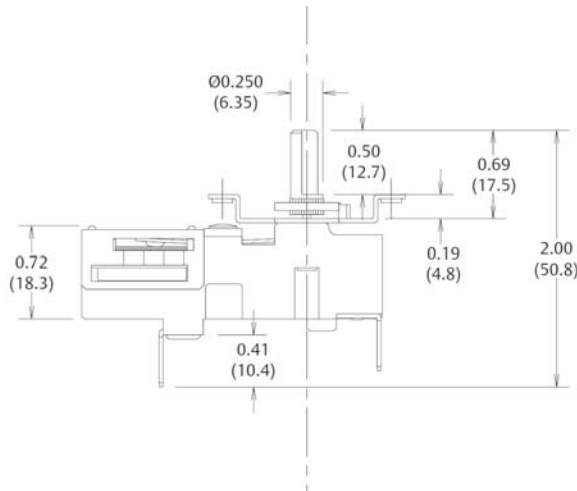


Figure 4

Dimensions are shown in inches and (millimeters).

Terminal Selection

1/4" (6.35mm), 90°, unplated brass terminals are preferred for the 58T. A variety of other blade and screw terminals, and lead wires are available.



General Electrical Ratings

The 58T series from Therm-O-Disc is both UL and CSA recognized.

Thermostat Type	Volts AC	Resistive Amperes	Inductive Amperes		Pilot Duty VA	Max. Temperature	Cycles	Agency Recognition
			FLA	LRA				
58T (Max 25 Amps)	277	25	20	90	720	150°F (65.5°C)	100,000	UL E19279
	240	10	-	-	-	165°F (74°C)	30,000	
	480	10	10	45	720	150°F (65.5°C)	30,000	
58TV (Max 22 Amps)	120	-	9	48	-	150°F (65.5°C)	30,000	
	277	22	-	-	-	150°F (65.5°C)	30,000	
	350	15.5	-	-	-	150°F (65.5°C)	30,000	
	600	10	-	-	-	150°F (65.5°C)	30,000	
	240	22	-	-	-	150°F (65.5°C)	100,000	
277	18	-	-	-	150°F (65.5°C)	100,000		
58T,TV	277	25	20	90	720	150°F (65.5°C)	30,000	
	240	10	-	-	-	165°F (74°C)	30,000	
	600	10	-	-	-	150°F (65.5°C)	30,000	

Part Numbering System

58T

-
- 1- Cycline contacts - open on temperature rise
 - 2- Cycling contacts - close on temperature rise

-
- V- (Max. 22 Amp. construction)

-
- D- Auxiliary contacts, positive off
 - S- Single pole, positive off



59T, 66T Series Electric Water Heater Controls



Snap-Action Bimetal Discs in Both Controls

The 59T and 66T series controls are designed to meet the high electrical capacity requirements of electric water heaters. Both use a temperature sensitive bimetal disc to deliver snap-action to the contacts. The speed and force of contact separation provides long-dependable control life at high electrical loads.

Features and Benefits

The 59T and 66T series features include:

- The 59T mounting tabs snap into the customer's bracket to mount the thermostat on the surface of the tank
- The M2 trip free manual reset 66T limit control is available with non-adjustable calibrations from 160° to 235°F (71° to 113°C)
- The 59T has an adjustable range of approximately 60°F (33°C)
The lowest adjustable limit is 90°F (32°C) and the highest adjustable limit is 200°F (93°C)
- Controls are 100% operation checked



Switch Actions

The 59T is available in two switch actions:

Automatic reset SPST – The switch opens the normally closed contacts on temperature rise. The contacts automatically return to the closed position when temperatures return to the reset point.

Automatic reset SPDT – This operation is the same as the SPST with the addition of an auxiliary set of contacts, which make circuit upon opening of the normally closed contacts and breaks this circuit upon automatic reset.

The 66T is a manual reset DPST – The switch opens two sets of normally closed contacts on temperature rise to provide full power disconnect of both conductors. The contacts will reset to the closed position when the reset button is depressed after the control has cooled to 90°F. Once opened, until the reset button is pressed, the contacts will not automatically reset at control temperatures above 32°F (0°C).

The construction is classified as “M2 Trip Free” by the approval agencies. This design holds the contacts open in the event the reset button is held in the depressed position in an attempt to defeat the manual reset function of the thermostat.

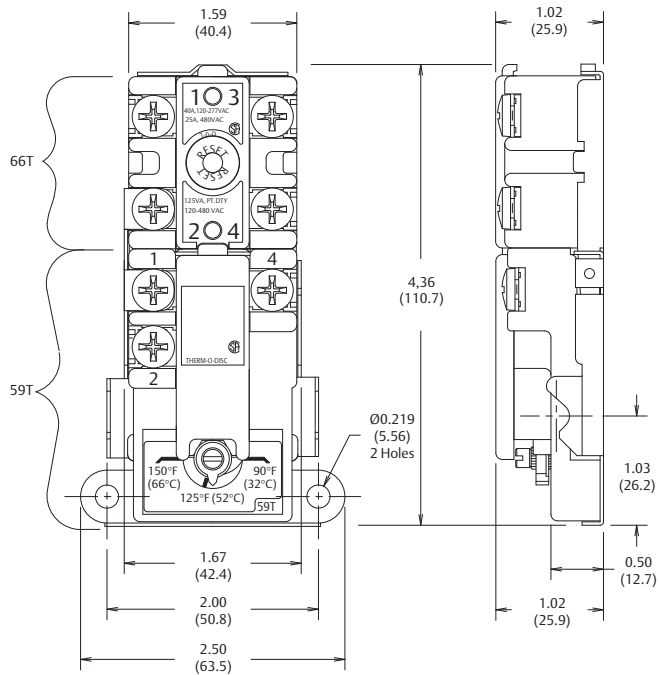
Typical Application

The thermostats and wiring diagram (shown on next page) are typical of a residential electrical storage water heater installation using two heating elements for non-simultaneous operation. The upper electrical control is a combination 59T SPDT regulating thermostat and a 66T DPST manual reset limiting thermostat. The lower electrical control is a 59T SPST thermostat. All the thermostats sense the surface temperature of the water heater tank.

The 66T function is to provide full power disconnect (through both power conductors) in the event of an overheat condition. The 59T SPDT normally closed contacts route power to the upper heating element. When the 59T SPDT control reaches its set temperature, its switch action breaks power to the upper heating element and switches power to the lower heating element through the normally closed contacts of the 59T SPST. When its set point is satisfied, the switch action breaks power to the lower heating element.



59T SPDT, 66T DPST



Dimensions are shown in inches and (millimeters)

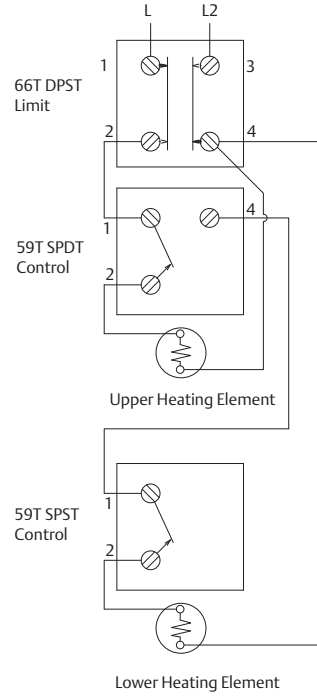
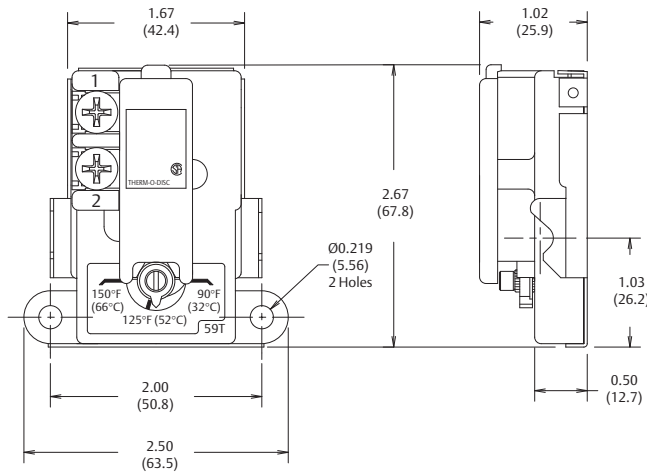


Figure 1

Double element limited demand circuit for full power disconnect through both power conductors.

59T SPST



Dimensions are shown in inches and (millimeters)

The thermostats and wiring for single element water heaters are shown below. The combination 59T SPST and 66T DPST is used in residential 240VAC applications, as well as in commercial electric water heater applications where each element may be independently controlled (see Figure 2 below). The combination 59T SPST and 66T DPST can also be used in 120VAC single element installations by leaving terminals 3 and 4 of 66T not utilized. (see Figure 3 below)

59T SPST, 66T DPST

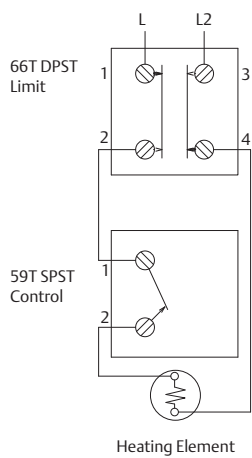
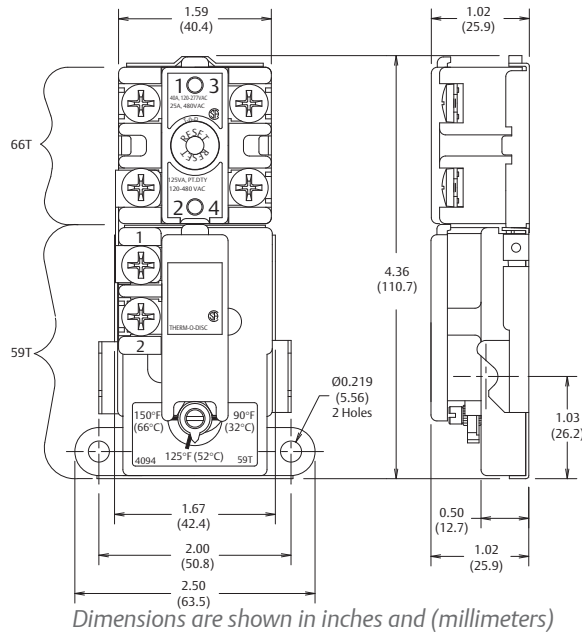


Figure 2

240VAC Single element circuit for full power disconnect through both power conductors.

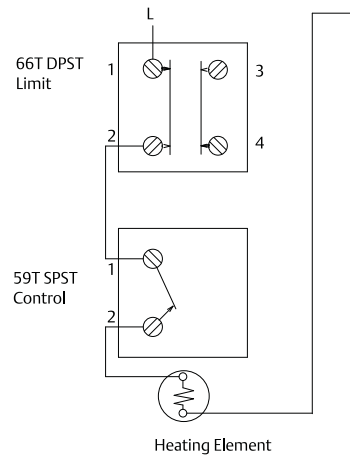


Figure 3

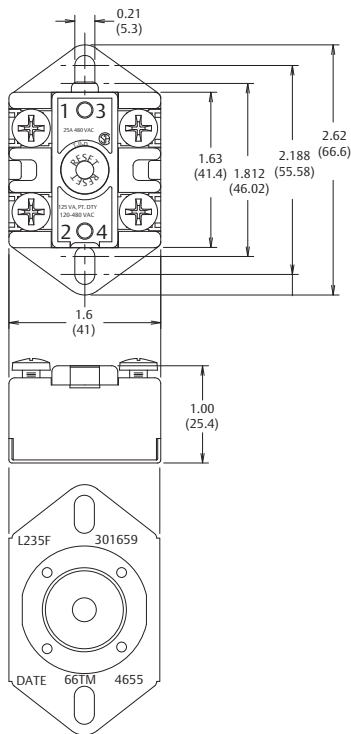
120VAC single element circuit for full power disconnect.

66TM Option

The 66T DPST is available with the 66TM mounting option shown below. The flanges on the backplate allow the 66TM to be screw or stud-mounted.

Temperature Calibration

Type	Thermal Range	Factory Calibration Temps	Lowest Dial Setting	Highest Dial Setting	Temperature Differential
59T SPST	60°F (34°C)	Minimum 100°F +/- 5°F (38°C +/- 3°C) Maximum 170°F +/- 5°F (77°C +/- 3°C)	90°F (32°C)	200°F (93°C)	5-15°F (3-8°C)
59T SPDT	60°F (34°C)	Minimum 100°F +/- 5°F (38°C +/- 3°C) Maximum 170°F +/- 5°F (77°C +/- 3°C)	90°F (32°C)	200°F (93°C)	17-27°F (9-15°C)
66T DPST 66TM DPST	N/A	Minimum 160°F +/- 5°F (71°C +/- 3°C) Maximum 235°F +/- 5°F (113°C +/- 3°C)	N/A	N/A	N/A



Dimensions are shown in inches and (millimeters)

General Electrical Ratings

The 59T, 66T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.



Thermostat Type	Maximum Calibration Temperature	Cycles	Pilot Duty VA	Resistive Amps	Volts AC	Agency & File #
59T SPST	181°F/83°C	30,000		13.5	480	UL File # E19279 CSA File # LR10281
		100,000		30	250	
	200°F/93°C	30,000		25	277	
		30,000		12.5	480	
		30,000	125		120/480	
59T SPDT	181°F/83°C	30,000		13.5	480	UL File # E19279 CSA File # LR10281
		30,000		30	250	
	200°F/93°C	30,000		25	277	
		30,000		12.5	480	
		30,000	125		120/480	
66T or 66TM DPST	235°F/113°C	6,000		40	277	UL File # E19279 CSA File # LR10281
		6,000		25	480	
		6,000	125		120/480	
59T SPST	212°F/100°C	30,000		30	250	VDE File # 121213
		100,000		16	480	
66T or 66TM DPST	248°F/120°C	30		40	250	VDE File # 40014721
		30		30	400	
		100		30	250	
		100		16	480	
59T SPST 59T SPDT	181°F (83°C)	10,000		25	240	Intertek CB Report # 102503546DAL-001
		10,000		28.8	208	
		10,000		21.67	277	
		10,000		15.8	380	
		10,000		14.7	408	
		10,000		12.5	480	
66T DPST	200°F (93°C)	30		25	240	Intertek CB Report # 102503546DAL-001
		30		28.8	208	
		30		21.67	277	
		30		15.8	380	
		30		14.7	408	
		30		12.5	480	

60T Series Snap-Action Temperature Controls



Snap-Action Temperature Control

The 60T line of 3/4" (19mm) bimetal disc temperature controls from Therm-O-Disc offers proven reliability in a versatile, cost-effective design. The snap-action of the temperature sensing bimetal disc provides high-speed contact separation, resulting in exceptional life characteristics at electrical loads up to 25 amps at 240VAC. A wide variety of terminal and mounting configurations are available for maximum design flexibility. This unsurpassed flexibility and time proven reliability, at an affordable price, has made the Therm-O-Disc 60T the most popular and widely applied temperature control in the major appliance and heating/air conditioning industries.

Switch Actions and Typical Applications

The 60T is available in three switch actions:

- Automatic Reset SPST
- Automatic Reset SPDT
- Manual Reset SPST (M2 Trip Free)

Automatic Reset SPST – In this design, the switch can be built to either open or close its electrical contacts on temperature rise. Once the temperature of the bimetal disc has returned to a specified reset temperature, the contacts will automatically return to their original state. Typical uses of this construction include limiting and regulating temperatures in clothes dryers and heating/air conditioning systems (see figures 1 and 2).



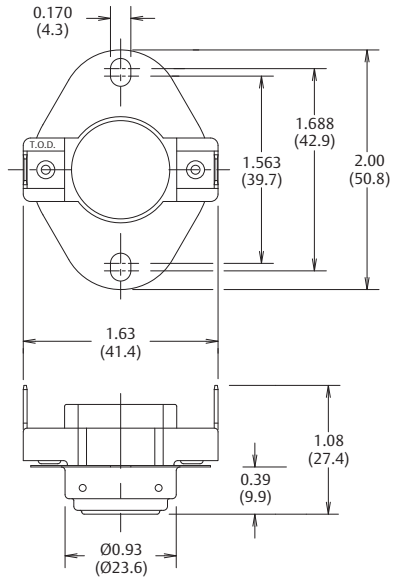


Figure 1
Airstream Mounting (enclosed)

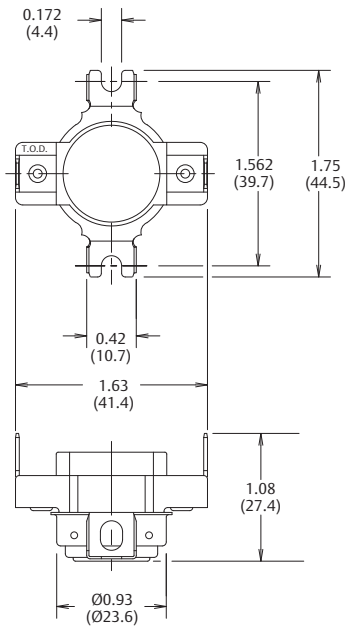


Figure 2
Surface Mounting (enclosed)
Dimensions are shown in inches and (millimeters).

Automatic Reset SPDT – This design is the same as the SPST described above with the addition of an auxiliary contact which makes circuit upon the opening of the main contacts and breaks circuit when the main contacts reset. Refer to the “General Electrical Ratings” chart for rating limitations on the auxiliary contacts. Typical uses of this construction include fan speed changeover at a specified temperature and lighting of an indicator lamp when an abnormal temperature condition has been reached (see figure 3).

CAUTION...When designing a circuit for a single pole, double throw control, an electrical load must be applied to terminal number 2 and/or 3 to avoid a possible short circuit condition.

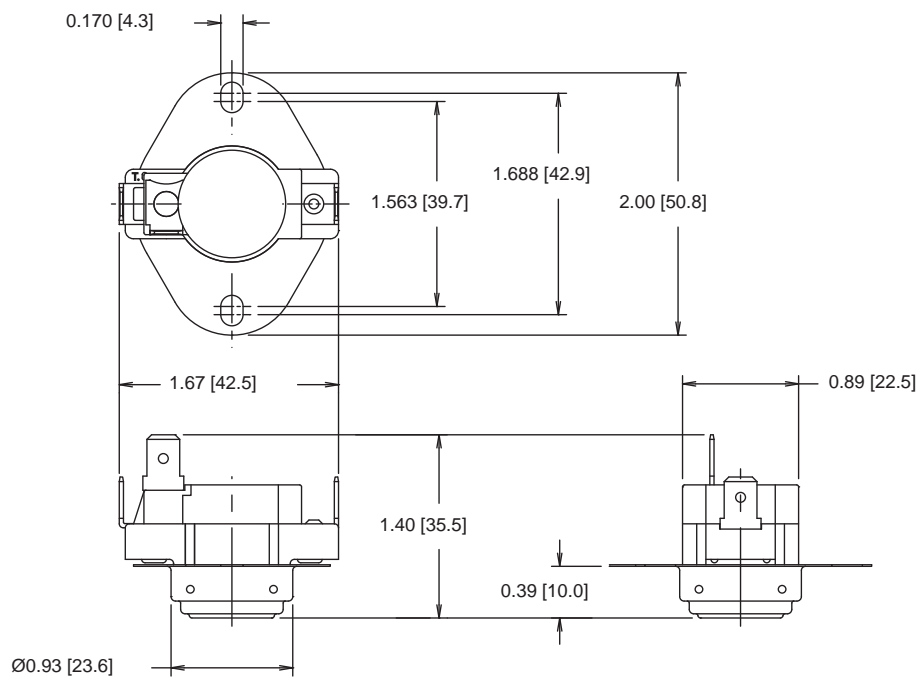


Figure 3
SPDT automatic reset - airstream mounting

Dimensions are shown in inches and (millimeters).

Manual Reset SPST – This design is available only with electrical contacts which open on temperature rise. The contacts may be manually reset after the control has cooled below the open temperature calibration. This construction is classified as ‘M2 Trip Free’ by the approval agencies. A patented design holds the contacts open in the event the reset button is held in the depressed position in an attempt to defeat the manual reset function of the thermostat. Typical uses include any temperature limiting application where operation of the thermostat should result in the user or service personnel having to attend the unit (see figure 4).

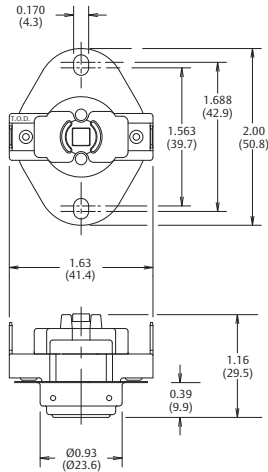


Figure 4
SPST manual reset - airstream mounting

Thermal Response

An enclosed (see Figure 5) or exposed (see Figure 6) disc may be specified with any of the airstream or surface mounting configurations. The enclosed disc construction provides greater protection than the exposed disc construction, keeping airborne contaminants such as dirt and dust from entering the control. It also protects the bimetal disc from possible physical damage during assembly and in the final application. In applications where faster response to radiant heat is required, an exposed bimetal disc or an optional matte finish disc may be specified.



Figure 5
Enclosed Disc



Figure 6
Exposed Disc

Dimensions are shown in inches and (millimeters).

Mounting Configurations

The 60T is available in an airstream or a surface mount configuration:

Airstream Mounting – This mounting configuration positions the bimetal disc through a hole in the mounting surface to sense temperature within an enclosure such as a heater box or air duct. The standard configuration (see figure 1) positions the bimetal disc .39” (9.9mm) into the airstream while an optional version (see figure 5) positions the bimetal disc .78” (19.8mm) into the airstream. Airstream configurations may be specified with a flange (see figure 5) or without a flange (see figure 6) to suit specific application needs.

Surface Mounting – This optional mounting configuration positions the bimetal disc firmly against the mounting surface to sense the actual mounting surface temperature.

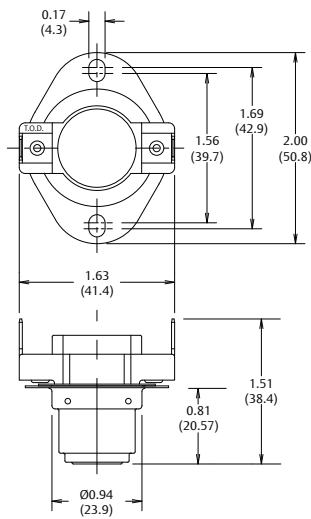


Figure 5

SPST Airstream Mounting - Deep Disc Cup

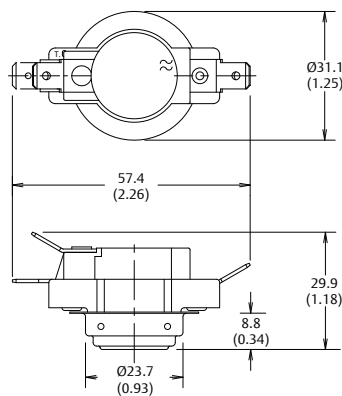


Figure 6

SPDT Airstream - No Flange

Dimensions are shown in inches and (millimeters).

Terminal Configurations

Standard Terminals – Standard terminations for the 60T are .250" x .032" (6.3 x .8mm) tin-plated brass blade terminals formed at 90 angular degrees to the thermostat mounting surface. Terminal angles of 0 and 30 degrees can also be provided (see below).



0° Terminal Angle



90° Terminal Angle



30° Terminal Angle

Blade Terminal Angles

Non-Standard Terminals – The 60T can also be provided with a variety of optional terminals. Some of the more common variations include .188" (4.8mm) blade terminals, 8-32 screw terminals and fork terminals. Unique variations are also available (see below).



Non-Standard Terminals

Terminal Orientation

For added flexibility, the orientation of the terminals with respect to the mounting bracket can be specified in 45 angular degree increments (see below).



Terminals 90° to mounting holes (standard)



Terminals 45° **clockwise** to mounting holes



Terminals 45° **counterclockwise** to mounting holes

Terminal to Mounting Bracket Orientation

Calibration Temperatures, Differentials and Tolerances

To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Locate across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates what differentials are available in each of the calibration set point ranges. Tighter open and close tolerances are available at added cost. Thermocouple samples can be provided to assist in determining the appropriate calibration temperature for specific application.



For more information on tightened tolerances or availability of differentials not listed in the chart, please consult one of our sales engineers.

Calibration Temperatures, Differentials and Standard Tolerance for the 60T Series

Highest Calibration Set Point (Open or Close)	NOMINAL DIFFERENTIAL (temperature difference between nominal open and close set point)													
	10-14°F 5.5-8°C		15-19°F 8.5-10.5°C		20-29°F 11-16°C		30-39°F 16.5-21.5°C		40-49°F 22-33°C		50-80°F 33.5-44.5°C		Manual Reset 34-44.5°C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
0°-79°F -18°-26°C	±6 ±3.5	±6 ±3.5	±6 ±3.5	±6 ±3.5	±6 ±3.5	±6 ±3.5	±6 ±3.5	±7 ±4	±6 ±3.5	±8 ±4.5	±7 ±4	±8 ±4.5	-	-
80°-200°F 28°-93°C	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±6 ±3.5	±8 ±4.5	±8 ±4.5	<- 31 <-35
201°-250°F 94°-121°C	-	-	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±6 ±3.5	±8 ±4.5	±7 ±4	±9 ±5	±7 ±4	<- 31 <-35
251°-300°F 122°-149°C	-	-	-	-	±6 ±3.5	±8 ±4.5	±6 ±3.5	±8 ±4.5	±7 ±4	±10 ±5.5	±8 ±4.5	±11 ±6	±8 ±4.5	<- 31 <-35
301°-350°F 150°-177°C	-	-	-	-	±7 ±4	±9 ±5	±7 ±4	±10 ±5.5	±8 ±4.5	±12 ±6.5	±9 ±5	±13 ±7	±9 ±5	<- 31 <-35

NOTES: Tighter tolerances and/or differentials than those listed in the chart are also available. Please consult a Therm-O-Disc sales engineer for assistance.

General Electrical Ratings

The 60T series of controls has been rated by major agencies throughout the world including UL, CSA, VDE, CQC, and KETI. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal, and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not solely rely on agency ratings, but must perform adequate testing to confirm that the control will operate as intended in the users' application.

The first table below summarizes many of our UL / CSA ratings. The maximum nominal open temperature is 350°F (175°C). The auto reset ratings shown are 100,000 cycles and the manual reset ratings shown are 6,000 cycles.

The second table below summarizes many of our VDE ratings. The maximum nominal open temperature is 350°F (175°C).

Thermostat Type	Contact Arrangement	Inductive Amps		Pilot Duty	Resistive Amps	Volts AC	Agency Recognition
		FLA	LRA	VA			
60T Auto Reset	Contacts 1 & 3 SPST or SPDT	10	60	125	25	120	UL E19279
		5	30	125	25	240	
		-	-	125	21.6	277	
		-	-	125	12.5	480	
		2	12	400	10	600	
60T Auto Reset	Contacts 1 & 2 SPDT	-	-	125	-	277	
		5.8	34.8	-	10	120*	
		2.9	17.4	-	10	240*	
60T Manual Reset	Contacts 1&3	-	-	-	25	277	
		0.65	3.9	125	12.5	480	
		5.5	33	1061	-	480	
60T Auto Reset	Contacts 1 & 3 SPST or SPDT	2	12	400	10	600	
		10	60	125	25	120	
		5	30	125	25	240	
		-	-	125	21.6	277	
		-	-	125	12.5	480	
60T Auto Reset	Contacts 1 & 2 SPDT	2	12	400	10	600	
		-	-	125	-	277	
		5.8	34.8	-	10	120*	
60T Manual Reset	Contacts 1&3	2.9	17.4	-	10	240*	
		-	-	-	25	277	
		0.65	3.9	125	12.5	480	
60T Manual Reset	Contacts 1&3	5.5	33	1061	-	480	
		2	12	400	10	600	
		-	-	-	-	-	

*6000 cycles

Thermostat Type	Contact Arrangement	Inductive amps FLA	Resistive amps	Voltage VAC	Cycles	Agency Recognition
60T Auto Reset SPST	Contacts 1 & 3 SPST	3.3	16	250	100,000	VDE 40021320
		3.3	16	400	1,000	
		3.3	25	250	100,000	
		-	45	250	6,000	
60T Auto Reset SPDT	Contacts 1&3 SPDT	3.3	25	250	10,000	
	Contacts 1&2 SPDT	2.2	5	250	10,000	
60T Manual Reset	Contacts 1 & 3	3.3	16	250	1,000	
		3.3	25	250	300	
		-	37.5	250	300	

Part Numbering System

60T

- G** – Gold contacts for low electrical loads
- None** – 1/8" x 1/4" electrical spacings
- X** – 1/4" x 3/8" electrical spacings
- XX** – 3/8" x 1/2" electrical spacings
- 0** – Flangeless airstream mount (.38" depth)
- 1** – Flanged airstream mount (.38" depth)
- 2** – Surface mount
- 3** – Tube or stud mount
- 8** – Flanged or flangeless airstream mount (.81" depth)
- 1** – Normally closed contacts; contacts open on temperature rise
- 2** – Normally open contacts; contacts close on temperature rise
- 3** – Single pole, double throw (SPDT)
- 5** – Manual reset (trip free M2)

Example: 60TG11=60T control with gold contacts, airstream mounting bracket and normally closed contacts that open on temperature rise.



60F, 61F Series Snap-Action *One-Shot* Temperature Controls



Snap-Action Temperature Controls

The 60F and 61F line of 3/4" (19mm) bimetal disc temperature limit controls offer reliable "one shot" operation at temperatures up to 350°F (177°C). Utilizing the same bimetal temperature sensing principle as the 60T automatic reset control, the 60F and 61F permit a uniform approach to the application of temperature limits. A wide variety of terminal and mounting configurations are available to give maximum design flexibility. Rated for electrical loads up to 25 amps at 600VAC (60F) and 49 amps at 600VAC (61F), these temperature limit controls provide unsurpassed over-temperature protection in a non-resettable design.



Features and Benefits

The 60F/61F series features include:

- Single operation for reliable, non-resettable, temperature limiting.
- Special Kapton insulator for application voltages up to 600VAC.
- Snap-action bimetal disc for high-speed contact separation.
- Welded construction for integrity of current-carrying components.
- A wide variety of terminal and mounting options for design flexibility.
- Available with an exposed or enclosed bimetal disc for either increased thermal response or protection from airborne contaminants.

Switch Actions and Typical Applications

The 60F and 61F are single pole, single throw (SPST) switches designed to open their electrical contacts on temperature rise. Once the switch has operated, the unique bimetal “fuse” disc prevents reset of the contacts to their original state at temperatures above -31°F (-35°C). The 60F reflects the same 25 Amp contact rating found in the 60T automatic reset series while the 61F provides a higher current-carrying construction for 49 Amp capability. The Therm-O-Disc 60F and 61F are typically utilized as primary or secondary temperature limits in electric heating equipment.

Mounting Brackets

The 60F and 61F are available in either flangeless (see figure 1) or flanged (see figure 2) airstream mount configurations. Airstream mounting is typically used in applications where the temperature being sensed is contained within an enclosure such as an air duct or heater box. An optional surface mount configuration is available for applications where the temperature being sensed is the actual mounting surface. Exposed or enclosed bimetal disc mounting versions may be specified with any of the mounting configurations.

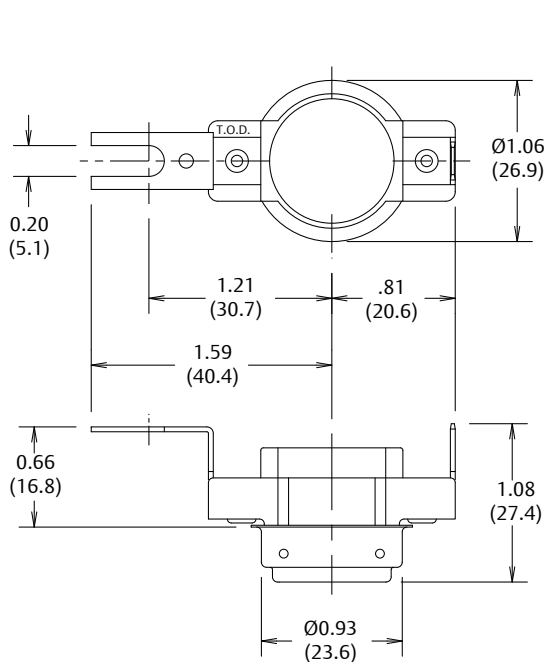


Figure 1

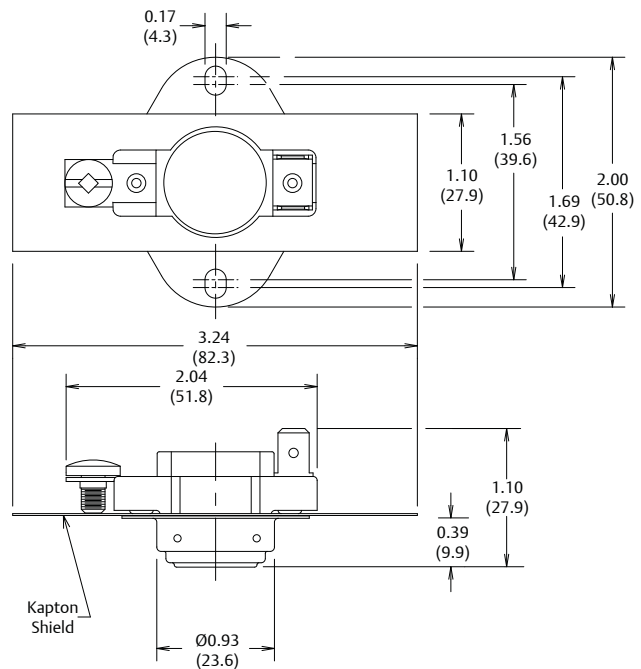


Figure 2

Dimensions are shown in inches and (millimeters).

Terminal Configurations

Standard terminations for the 60F are .250" x .032" (6.35mm x .81mm) tin-plated brass blades. The 61F is provided with a 10-32 screw and double .250" x .032" (6.35mm x .81mm) blade combination. Optional configurations, which include fork, screw and double blade terminations, are available at additional cost.

General Electrical Ratings

The 60F, 61F series of controls has been rated by UL, CSA, VDE, and CQC. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Inductive Amps		Pilot Duty	Resistive Amps	Volts	Agency Recognition
	FLA	LRA				
60F SPST	-	-	500	25	600VAC	UL MH5304 CSA LR10281C
	14	72	-	25	240VAC	UL MH5304
	-	-	-	45*	250VAC	VDE 135009
	-	-	-	5	24VDC	VDE135009
61F SPST	12	72	-	49	240VAC	UL MH5304
	-	-	1000	48	600VAC	UL MH5304 CSA LR10281C

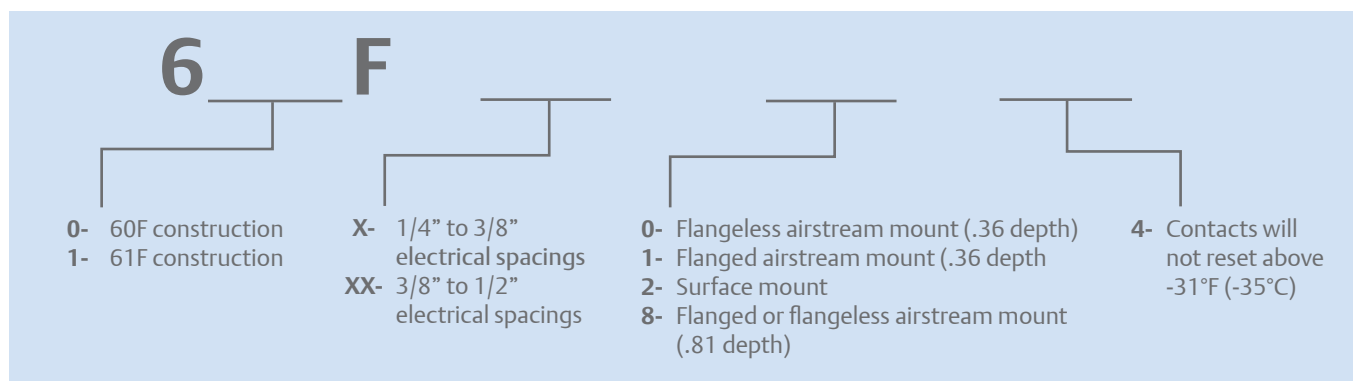
*Requires Screw Terminals Above 25 Amps.

Calibration Temperatures and Tolerances

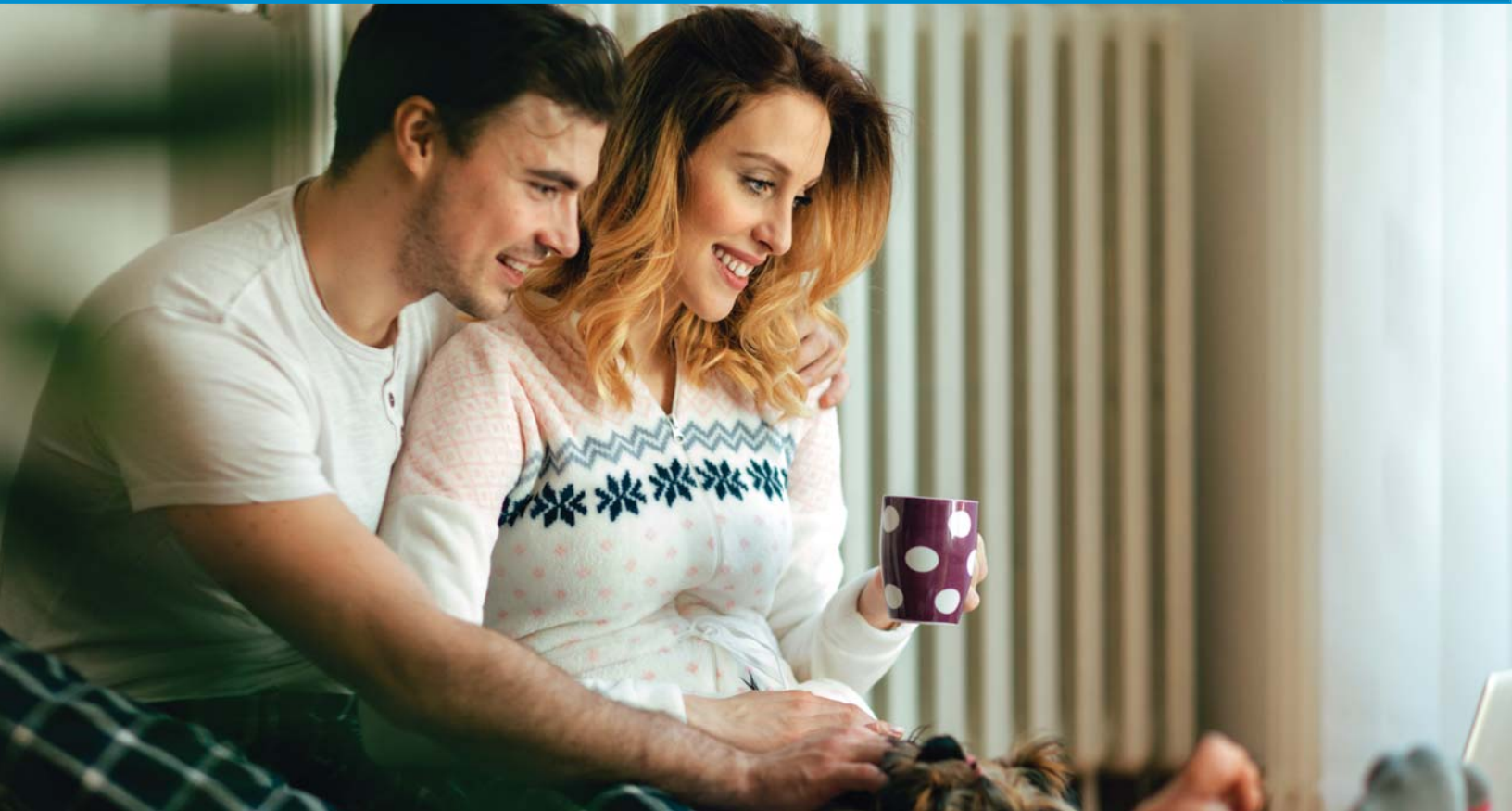
Thermostat Type	Opening Temperature Tolerances		
	80°-200°F (28°-93°C)	201°-300°F (94°-149°C)	301°-350°F (150°-177°C)
60F,61F	±8° (±4.5°C)	±10°F (±5.5°C)	±12°F (±6.5°C)



Part Numbering System



64T/64F Series Snap-Action Temperature Controls



Snap-Action Temperature Controls

The 64T line of temperature controls from Therm-O-Disc combines a double pole, single throw (DPST) switch mechanism with a 3/4" (19mm) bimetal disc to provide simultaneous operation of two separate electrical circuits. Available in calibrations from 80°F to 350°F (28°C to 177°C) and nominal differentials from 30°F to 80°F (16.5°C to 44.5°C), the 64T provides excellent life characteristics at electrical loads up to 25 amps at 240VAC. A wide variety of terminal and mounting configurations are available for design flexibility.



Features and Benefits

The 64T series features include:

- Double pole, single throw switch configuration.
- Auto-reset switch action with nominal differentials from 30°F to 80°F (16.5°C to 44.5°C).
- Snap-action bimetal disc for high-speed contact separation.
- Available with an exposed or enclosed bimetal disc in either surface or airstream mounting configurations.
- Welded construction for integrity of current-carrying-components.

Switch Actions and Typical Applications

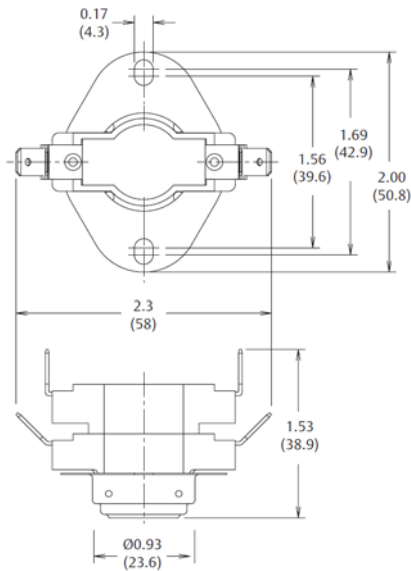
The 64T is an automatic reset double pole, single throw (DPST) switch that can be built to either open or close two independent sets of contacts on temperature rise. Once the temperature falls to the specified reset calibration, the contacts automatically return to their original state. A “two stage” switch configuration allows simultaneous switching of two independent circuits with a single bimetal disc. The 64T is typically utilized to limit temperatures of heating elements in electric furnaces and clothes dryers.

Electrical Spacings

The 64T has electrical spacings of 1/8” (3.18mm) through air and 1/4” (6.3mm) over surface. Increased electrical spacings of 1/4” x 3/8” (6.3mm x 9.53mm) (64TX) and 3/8” x 1/2” (9.53mm x 12.70mm) (64TXX) are available.

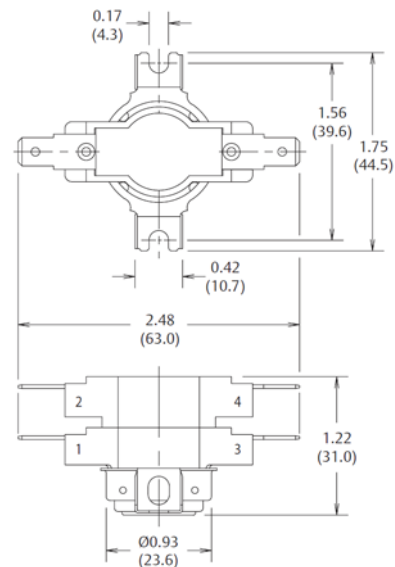
Mounting Configurations

The 64T is available in either airstream (see figure 1) or surface (see figure 2) mount configurations. Exposed or enclosed bimetal disc versions may be specified with any of the mounting configurations.



Airstream Mounting
Figure 1

Dimensions are shown in inches and (millimeters).



SPST Surface Mounting
Figure 2

Dimensions are shown in inches and (millimeters).

Terminal Configurations

Standard terminations for the 64T are .250" x .032" (6.3mm x .8mm) tin-plated brass blades.

Terminal form angles of 0, 45 and 90 degrees are available. (90° available only on top stage)



General Electrical Ratings

The 64T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Inductive Amps		Pilot Duty VA	Resistive Am-peres	Volts AC	Cycles Rating	Agency Recognition
FLA	LRA					
10	60	480	25	120	100,000	UL
5	30	480	25	240	100,000	File MH-5304
2.5	15	480	20	300	100,000	CSA
-	-	480	10	600*	100,000	File LR62036

Note: At thermostat end-of-life, the contacts may remain permanently open or closed
 *600VAC rating at CSA only.

Calibration Temperatures, Differentials and Standard Tolerances of the 64T Series

Highest Calibration Set point (Open or Close)	Standard Tolerances	
	Open	Close
0°-79°F (-18°-26°C)	±6°F (±3.3°C)	±8°F (±4.4°C)
80°-200°F (28°-93°C)	±5°F (±2.8°C)	±9°F (±5.0°C)
201°-250°F (94°-121°C)	±6°F (±3.3°C)	±11°F (±6.1°C)
251°-300°F (122°-149°C)	±7°F (±3.9°C)	±12°F (±6.7°)
301°-350°F (150°-177°C)	±10°F (±5.6°C)	±16°F (±8.9°C)

Note: 30°-80°F (16.7°- 44.4°C) nominal differential available.

Type 64F- One Shot Fuse Disc

The 64F is identical in construction to the 64T auto reset, except the bimetal disc is calibrated to close no higher than -31F (-35C). It is useful for agency required backup limits where space is at premium.

It is available in both airstream and surface mount, and also with enclosed or exposed disc, same as the 64T.

Due to the 600VAC/ 40 amp rating, the 64F must be supplied with double blade tin-plated brass terminals. The upper terminals are 1/4" 90°, and the lower terminals are 1/4" 30° (see picture).



64F with double terminals

64F Agency Electrical Ratings

Resistive Amps	Volts AC	Cycles of Operation	Agency Recognition
40	600	1	UL/CULE19279

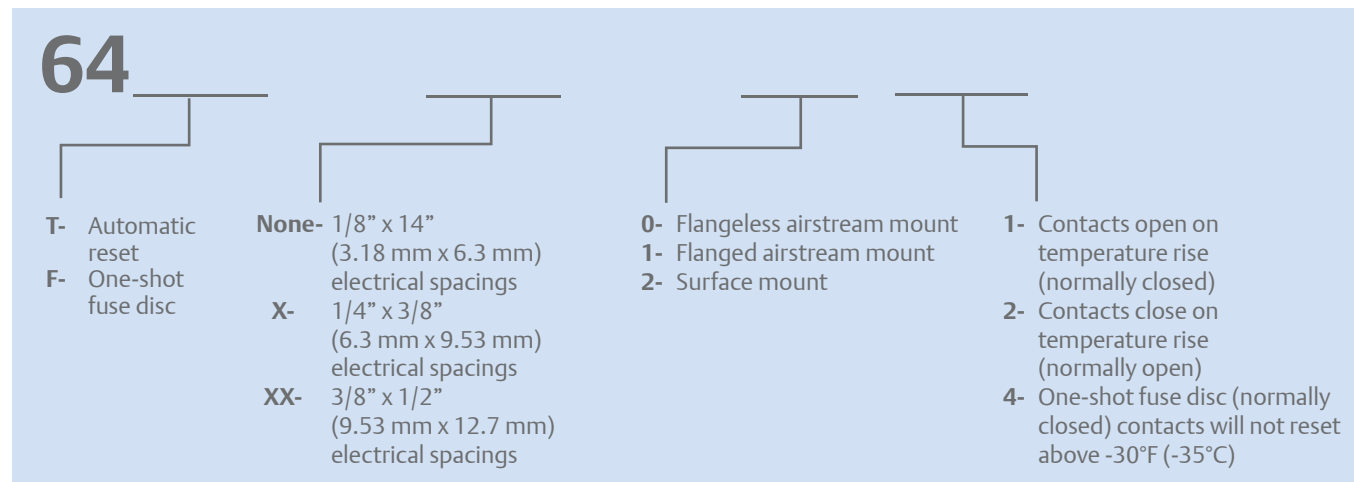
64F Calibration

Open Temperature	Open Temperature Tolerance
201°-300°F (94°-150°C)	±10°F (±5.5°C)

64F Tmax

The above open temperatures and electrical rating require that the ambient temperature the switchcase is exposed to under normal operation conditions does not exceed 176°F (80°C).

Part Numbering System



General Electrical Ratings

The 64T series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

69T Series Internal Heater Biased Temperature Controls



Snap-Action Temperature Controls

The 69T line of 3/4" (19mm) bimetal disc temperature controls from Therm-O-Disc offers multiple temperature operation in a unique, cost-effective design. The snap-action bimetal disc provides high-speed contact separation resulting in exceptional life characteristics at electrical loads up to 25 amps at 240VAC. By utilizing resistors mounted internally, the open or close calibration of the bimetal disc can be biased lower. The more power applied to the internal resistors the more supplemental heat is generated to bias the operating temperature of the control. The 69T is a cost-effective alternative in applications where multiple temperature control is required, such as clothes dryers.



Features and Benefits

The 69T features include:

- Internal resistor construction for consistent temperature depression.
- Available in automatic reset SPST and SPDT switch configurations.
- Snap-action bimetal disc for high-speed contact separation.
- A wide variety of terminal and mounting options for design flexibility.
- Welded construction for integrity of current-carrying components.
- Exposed or enclosed bimetal disc for either increased thermal response or protection from airborne contaminants.

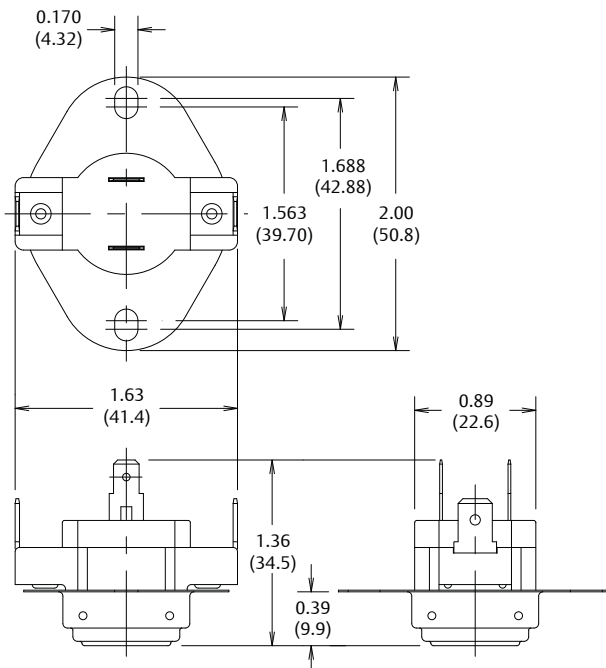
Switch Actions and Typical Applications

The 69T is available in two automatic reset switch actions:

Automatic Reset SPST – In this design, the switch can be built to either open or close its electrical contacts on temperature rise. Once the temperature of the bimetal disc has returned to the specified reset temperature, the contacts automatically return to their original state. The SPST switch action is typically used to regulate clothes dryer drum temperatures (see figures 1 and 2).

Automatic Reset SPDT – This design is the same as the SPST described above with the addition of an auxiliary set of contacts that open and close in opposition to the main contacts. Refer to the “General Electrical Ratings” chart for rating limitations on the auxiliary contacts. Typical uses of this construction include fan speed changeover at a specified temperature and lighting of an indicator lamp when an abnormal temperature condition has been reached (see figure 3).

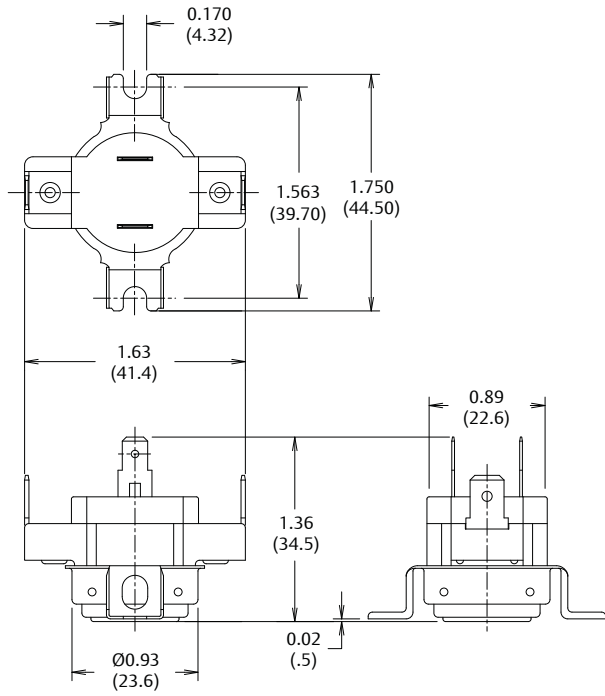
CAUTION . . . When designing a circuit for a single pole, double throw control, an electrical load must be applied to terminal number 2 and/or 3 to avoid a possible short-circuit condition.



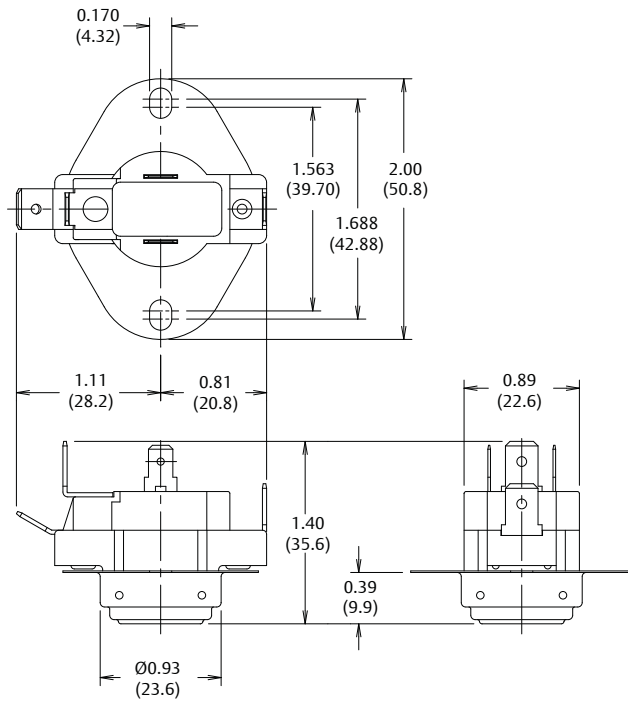
SPST Automatic Reset Airstream Mounting

Figure 1

Dimensions are shown in inches and (millimeters).



SPST Automatic Reset Surface Mounting
 Figure 2
 Dimensions are shown in inches and (millimeters).



SPDT Automatic Reset Airstream Mounting
 Figure 3
 Dimensions are shown in inches and (millimeters).

Mounting Configurations

Airstream Mounting – This mounting configuration positions the bimetal disc .39” (9.9mm) through a hole in the mounting surface to sense temperature within an enclosure such as a heater box or air duct (see figure 1).

Surface Mounting – This optional mounting configuration positions the bimetal disc firmly against the mounting surface to sense the actual mounting surface temperature (see figure 2).

Thermal Response

An exposed or enclosed bimetal disc may be specified with any of the airstream or surface mounting configurations. The enclosed disc construction provides greater protection than the exposed disc construction, keeping airborne contaminants, such as dirt and dust, from entering the control. It also protects the bimetal disc from possible physical damage during assembly and in the final application.

Terminal Configurations

Standard terminations for the 69T are .250” x .032” (6.3 x .8mm) tin-plated brass blade terminals formed at 90 angular degrees to the thermostat mounting surface. Terminal angles of 0 and 30 degrees can also be provided.

Terminal orientation – For added flexibility, the orientation of the terminals with respect to the mounting bracket can be specified in 45 angular degree increments (see figure 4).



Terminals 90° to mounting holes (standard)



Terminals 45° counterclockwise to mounting holes

Figure 4

Temperature Depression

The amount of change in the open or close calibration that results from energizing the internal resistors is referred to as temperature depression. The amount of depression which can be realized in an actual application is dependent upon several characteristics. Resistor wattage and voltage, ambient, airflow, thermal off-set and rate of temperature change are all variables which affect temperature depression. As a point of reference, the depression chart reflects the approximate temperature shift after energizing the internal resistors in a circulating air chamber. Due to the material rating of the thermostat body, limitations to the resistors wattage and thermostat calibration are necessary. Refer to the temperature depression chart for maximum resistance and calibration combinations. The depression data shown was obtained in a controlled test environment; application performance may vary.

Temperature Depression

Internal Heater		Maximum Calibration	Temperature Depression	
Voltage	Resistance		Open	Close
120 VAC	7000 Ohms	180°F(82.2°C)	3°F (7.2°C)	15°F (8.3°C)
120 VAC	9000 Ohms	233°F(111.7°C)	9°F (5.0°C)	11°F (6.1°C)
120 VAC	3600 Ohms	155°F(68.3°C)	27°F (15°C)	32°F (17.8°C)
24 VAC	281 Ohms	171°F(77.2°C)	10°F (5.6°)	11°F (6.1°C)



Calibration Temperature, Differentials and Tolerance

To use the calibration chart, locate the range in the left hand column, in which the highest calibration set point (open or close) falls. Then locate, across the top, the range in which the nominal differential falls. The standard open and close set point tolerances are shown where the two columns converge. The chart also indicates what differentials are available in each of the calibration set point ranges. Tighter open and close tolerances are available at added cost. Thermocouple samples can be provided to assist in determining the appropriate calibration temperature for specific application. For more information on tightened tolerances or availability of differentials not listed in the chart, please consult one of our sales engineers.

Calibration Temperatures, Differentials and Standard Tolerance of the 69T Series

Highest calibration Set Point Range (Open or Close)	Nominal Differentials (temperature difference between nominal open and close set point)									
	10-14°F 5-5.8°C		15-19°F 8.5-10.5°C		20-29°F 11-16°C		30-39°F 16.5-21.5°C		40-59°F 22-33°C	
	Open	Close	Open	Close	Open	Close	Open	Close	Open	Close
0°-79°F -18°-26°C	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±5 ±3	±7 ±4
80°-283°F 28°-111.7°C	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±5 ±3	±7 ±4	±5 ±3	±7 ±4

Part Numbering System

69T

- None-** 1/8" x 14" (3.18 mm x 6.3 mm) electrical spacings
- X-** 1/4" x 3/8" (6.3 mm x 9.53 mm) electrical spacings
- K-** 3600 Ohm resistance
- 0-** Flangeless airstream mount (.38" depth)
- 1-** Flanged airstream mount (.38" depth)
- 2-** Surface mount
- 1-** Contacts open on temperature rise (normally closed)
- 2-** Contacts close on temperature rise (normally open)
- 4-** Single pole, double throw (SPDT)

Example: 69T23=control with surface mount and single pole double throw switching

General Electrical Ratings

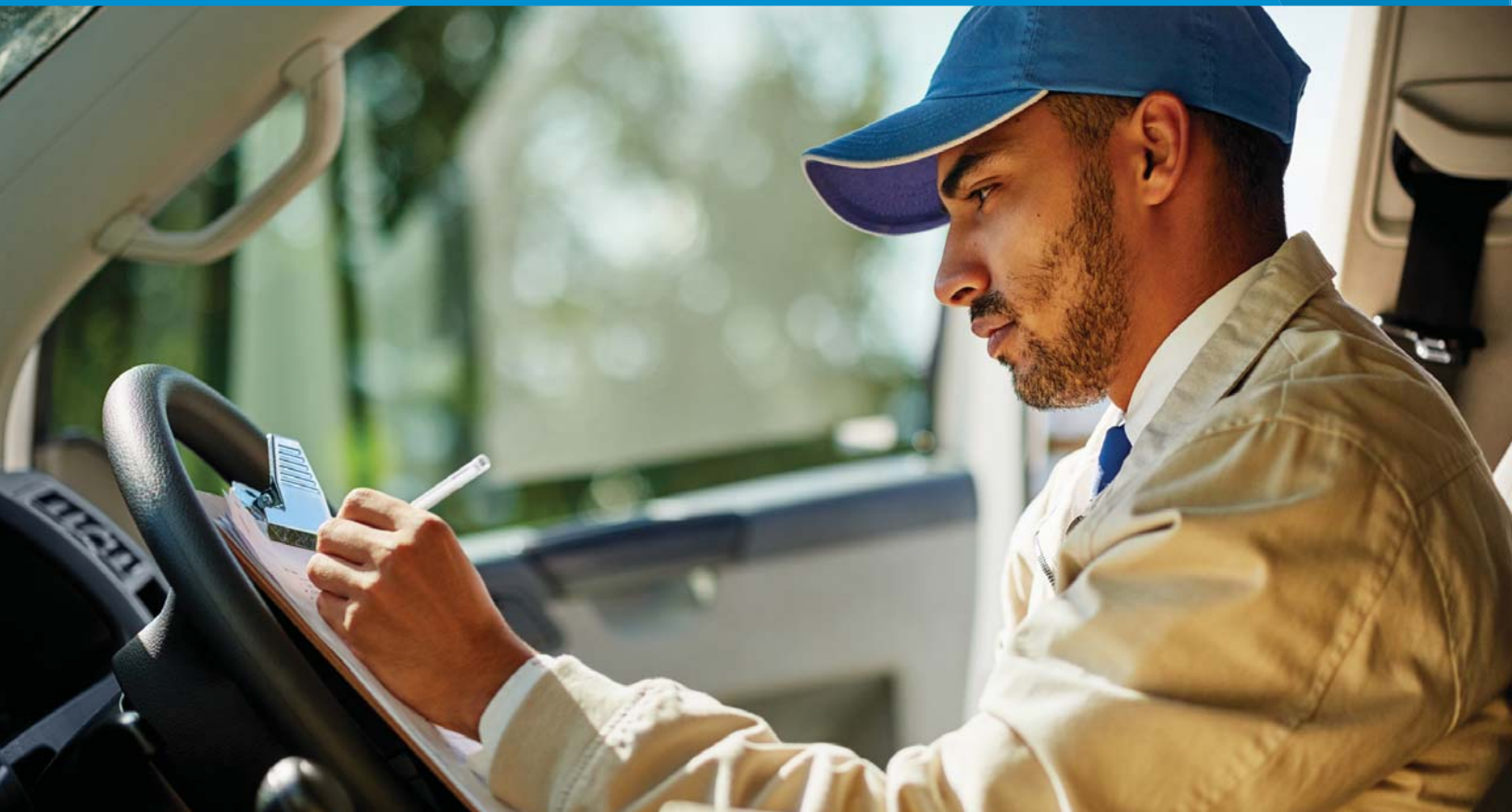
The 69T, 69TK series of controls has been rated by major agencies throughout the world. The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Thermostat Type	Contact Arrangement	Inductive Amperes		Pilot Duty	Resistive Amperes	Volts AC	Agency Recognition
		FLA	LRA				
69T	Contacts 1 & 3 SPST or SPDT	10	60	125	25	120	UL E19279
		5	30	125	25	240	
		-	-	125	12.5	277	
69T	Contacts 1 & 2 SPDT	-	-	125	-	120	CSA LR10281C
		10	60	125	25	120	
		5	30	125	25	240	
69T	Contacts 1 & 3 SPST	-	-	-	16*	250	VDE 40010454
		-	-	-	25**	250	
		-	-	-	-	-	

* 169°F (76°C) Max Nominal Calibration

** 158°F (70°C) Max Nominal Calibration

74T Series Adjustable Temperature Controls



Adjustable Temperature Controls

The 74T line of temperature controls features adjustable fan or limit operation in a versatile 3/4" (19mm) bimetal disc design. Available in calibrations from 110°F to 250°F (43°C to 121°C) and mean differentials from 20°F to 40°F (11°C to 22°C), the 74T allows adjustment of the operating temperature within an approximate 40°F (22°C) thermal range. The snap-action of the temperature sensing bimetal disc provides high-speed contact separation for exceptional life characteristics at electrical loads up to 25 amps at 240VAC. Airstream or surface mounting flanges are available with the 74T.



Features and Benefits

The 74T series features include:

- Adjustable operating temperatures for maximum design or service flexibility.
- Snap-action bimetal disc for high-speed contact separation.
- Welded construction for integrity of current-carrying components.
- Available with an exposed or enclosed bimetal disc for either increased thermal response or protection from airborne contaminants.



Switch Actions and Typical Applications

The 74T is an automatic reset single pole, single throw (SPST) switch that can be built to either open or close its electrical contacts on temperature rise. The desired calibration can be adjusted within the thermal range of the pointer set positions. Once the application temperature cools to the specified reset differential, the contacts automatically return to their original state.

Typical applications include fan controls for heating products and regulating controls for appliances. The ability to adjust calibrations also makes the 74T an excellent choice for service or field replacement applications.

Mounting Configurations

The 74T is available in either airstream (see figure 1) or surface (see figure 2) mount configurations. Exposed or enclosed bimetal disc versions may be specified with any of the mounting configurations.



Picture 1

*Dimensions are shown in inches and (millimeters).
Airstream Mounting*



Picture 2

*Dimensions are shown in inches and (millimeters).
Surface Mounting*

Dial Layout

The standard dial plate layout can be provided with alphabetical (standard) or numerical (extra cost) characters to identify the calibration set points.

Thermal Characteristics

Calibration – The 74T can be calibrated at any temperature from 110°F to 250°F (43°C to 121°C). The standard calibration set point is located at mid-dial. Refer to the tabulation block for calibration tolerances.

Differential – The differential is the difference between the nominal open and close temperature. Preferred differentials are 20°F to 40°F (11°C to 22°C).

Range – The range is the difference between the thermostat operating temperatures measured at the extremes of the pointer set positions: extreme clockwise vs. extreme counterclockwise.

Terminal Configurations

Standard terminations for the 74T are .250" x .032" (6.35mm x .81mm) tin-plated brass blades. Terminal form angles of 0, 30, 90 degrees are available.

General Electrical Ratings

The 74T agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Inductive Amps		Pilot Duty VA	Resistive Amperes	Volts AC	Cycles	Agency Recognition
FLA	LRA					
-	-	125	25	120	100,000	UL
-	-	125	25	240	100,000	File E19279
14	72	-	-	120	30,000	CSA
10	60	-	-	240	30,000	File LR1281C

Note: For complete ratings information, please contact our Sales Engineering Department. At thermostat end-of-life, the contacts may remain permanently closed or open.

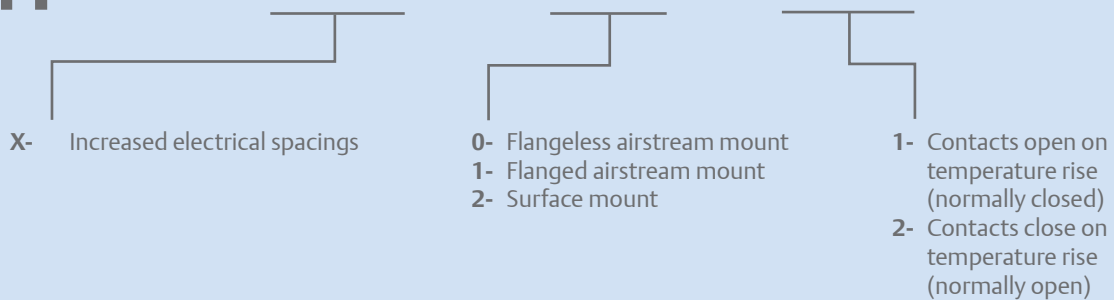


Calibration Temperatures and Tolerance

Calibration at Set Point	Mean Differentials							
	20-29 °F 11.1-16.1 °C				30-39 °F 16.7-21.7 °C			
	Limit		Fan		Limit		Fan	
	Open	Close	Open	Close	Open	Close	Open	Close
110°-200°F (43.4°-93.3°C)	±6°F (3.3°C)	±7°F (3.9°C)	±7°F (3.9°C)	±6°F (3.3°C)	±6°F (3.3°C)	±8°F (4.4°C)	±8°F (4.4°C)	±6°F (3.3°C)
201°-250°F (93.9°-121.1°C)	±7°F (3.9°C)	±8°F (4.4°C)	±8°F (4.4°C)	±7°F (3.9°C)	±8°F (4.4°C)	±9°F (5.0°C)	±9°F (5.0°C)	±8°F (4.4°C)

Part Numbering System

74T



75TF Series Snap-Action Temperature Controls



Snap-Action Temperature Controls

The 75TF line of temperature controls combines automatic reset and single operation in one unique switch design. Two independent switch mechanisms, electrically in series, provide primary and secondary temperature sensing at electrical loads up to 6000 watts. The 5/8" (16mm) cycling disc is available in calibrations from 80°F to 300°F (27°C to 149°C) and differentials from 15°F to 50°F (8°C to 28°C) while the 3/4" (19mm) fuse disc is available in calibrations from 150°F to 350°F (66°C to 177°C).

A variety of terminal and mounting options are available for design flexibility. The 75TF is a viable alternative in applications where space prohibits two separate sensing devices.



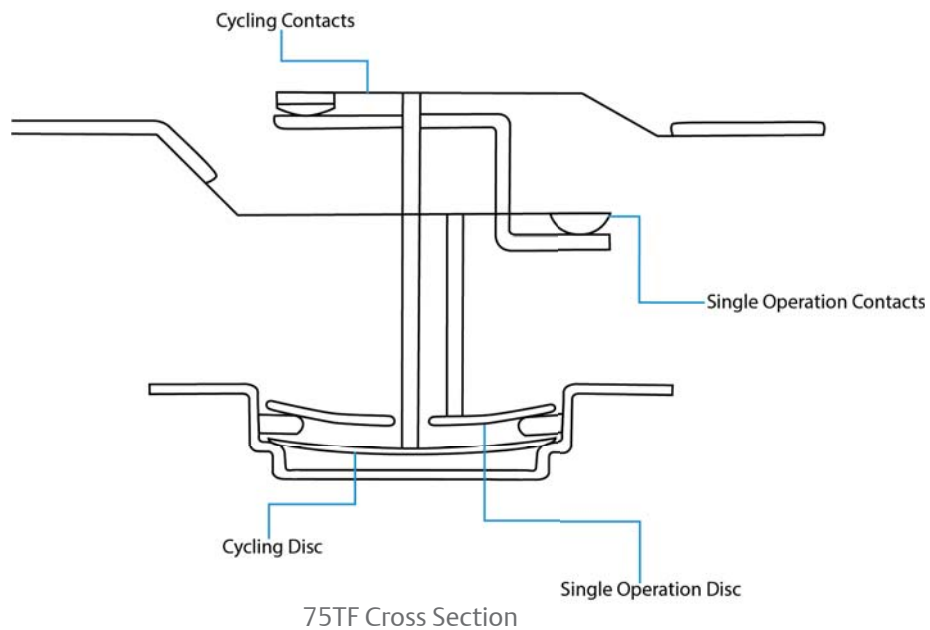
Features and Benefits

The 75TF series features include:

- Primary and secondary temperature sensing in the same location.
- Automatic reset SPST in series with the single operation SPST.
- Snap-action bimetal disc for high-speed contact separation.
- A wide variety of terminal and mounting options for design flexibility.
- Welded construction for integrity of current-carrying components.
- Available with an exposed or enclosed bimetal disc for either increased thermal response or protection from airborne contaminants.

Switch Actions and Typical Applications

The 75TF combines two single pole, single throw (SPST) circuits in series to provide cycling and “one-shot” temperature operation. The cycling disc and contacts are agency rated to 100,000 cycles. Utilizing a unique bridging contact system, the single operation switch opens the circuit at the specified back-up calibration in the event the cycling switch fails to operate, and will not reset in ambient temperatures above -31 °F (-35 °C). Typical applications include electric heat furnaces and electric dryers where approval agencies require the use of limit and back-up limit protection.



Mounting

The 75TF is available in either flanged airstream (see figure 1) or flangeless airstream (see figure 2) mounting configurations. Airstream mounting is typically used in applications where the temperature being sensed is contained within an enclosure such as an air duct or heater box. An optional surface mount configuration is available for applications where the temperature being sensed is the actual mounting surface. Exposed or enclosed bimetal disc versions may be specified with any of the mounting configurations.

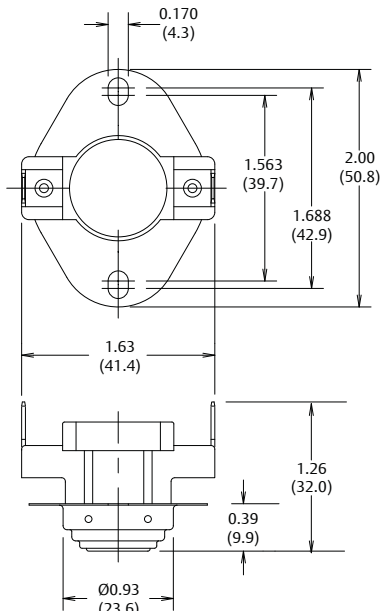


Figure 1

Dimensions are shown in inches and (millimeters).

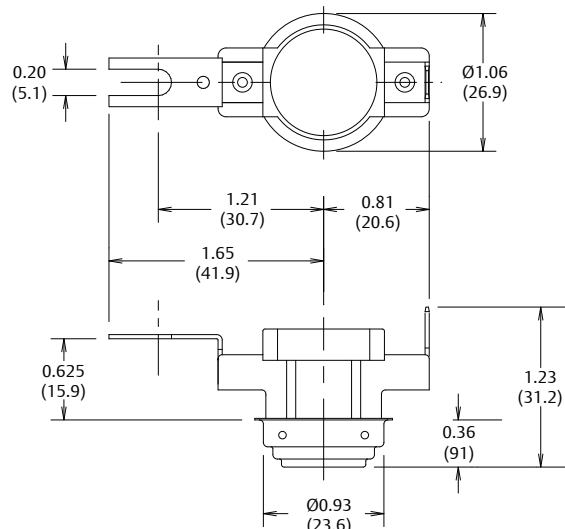


Figure 2

Dimensions are shown in inches and (millimeters).

Terminal Configurations

Standard terminations for the 75TF are .250" x .032" (6.35mm x .81mm) unplated brass blade terminals formed at 90 angular degrees. Terminal angles of 0 and 30 degrees can also be provided. Optional screw or fork terminals are available at additional cost.



General Electric Ratings

The agency ratings can be used as a guide when evaluating specific applications. However, the mechanical, electrical, thermal and environmental conditions to which a control may be exposed in an application may differ significantly from agency test conditions. Therefore, the user must not rely solely on agency ratings, but must perform adequate testing of the product to confirm that the control selected will operate as intended in the user's application.

Contact Switching	Pilot Duty VA	Resistive Amperes	Volts AC	Cycles of Operation	Agency Recognition
Automatic Reset	125	25	120-240	100,000	UL File MH5304
	125	21.7	277	100,000	
	125	12.5	480	100,000	
Single Operation	125	25	120-240	1	CSA File LR10281C
	125	21.7	277	1	
	125	12.5	480	1	

NOTE: At thermostat end-of-life, the contacts may remain permanently closed or open

Calibration Temperatures, Differentials and Standard Tolerance of the 75TF Series

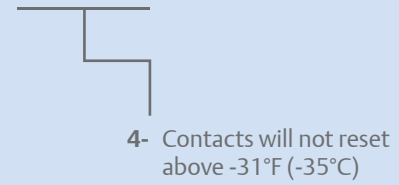
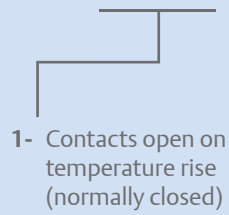
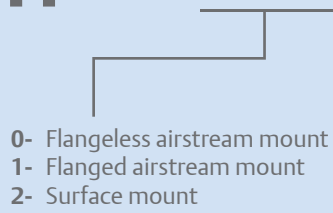
Automatic Reset Calibration	Mean Differentials							
	15-19 °F 8.3-10.6 °C		20-29 °F 11.1-16.1 °C		30-39 °F 16.7-21.7 °C		40-50 °F 22.2-27.8 °C	
	Open	Close	Open	Close	Open	Close	Open	Close
80°-200°F 27°-93°C	±5 ±3	±5 ±3	±5 ±3	±6 ±3.5	±5 ±3	±7 ±4	±5 ±3	±9 ±5
201°-250°F 94°-121°C	±5 ±3	±5 ±3	±5 ±3	±6 ±3.5	±5 ±3	±10 ±5.5	±6 ±3.5	±11 ±6
251°-300°F 122°-149°C	-	-	-	-	±6 ±3.5	±12 ±6.5	±7 ±4	±12 ±6.5

Single Operation Calibration	Top Temperature Range	Tolerance	Reset Point
	150°-249°F	±8°F	-31°F
	66°-120°C	±4.4°C	-35°C
	250°-299°F	±10°F	-31°F
	121°-148°C	±5.5°C	-35°C
	300°-350°F	±15°F	-31°F
149°-177°C	±8.3°C	-35°C	

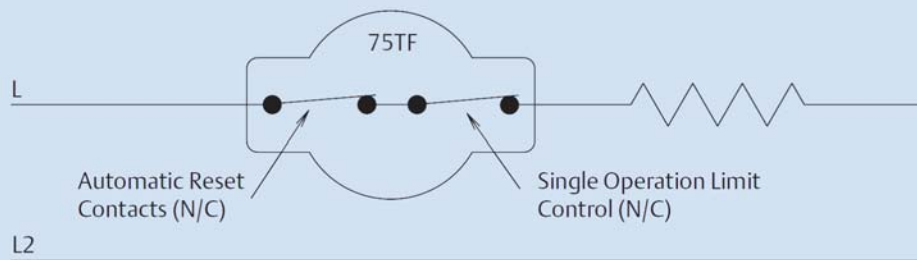
Note: Nominal fuse calibration must be minimum 20°F (-7°C) higher than the cycling disc nominal open temperature.

Part Numbering System

75TF



Circuit Diagram



HLX Manual Reset Limit Control



Manual Reset Limit Control

The HLX double pole, single throw limit control provides excellent temperature limiting protection. Large exposed bimetal disc and substantial contact construction ensures reliable fast acting performance along with agency recognized 240VAC and 50 amps resistive switching capabilities.

The thermostat contact cannot be held closed by blocking the reset lever, and the switch mechanism operates independently of the reset lever, for safe M1 type trip-free performance.



Features and Benefits

The manual reset lever on the HLX is flush with the side of the case when the thermostat is closed. When the thermostat reaches the operation temperature and the contacts open, the reset lever pops out beyond the side of the case indicating the electric power has been shut off.

The thermostat contact cannot be held closed by blocking the reset lever, and the switch mechanism operates independently of the reset lever.

- Contacts open on temperature rise
- Double pole, single throw switching
- Exposed disc only
- M1 Trip free construction
- 10–32 screw terminals provided



Applications

Typical applications of the HLX include:

- Electrical Water Heaters
- Portable Electrical Heaters
- Industrial Electric Heaters
- Hot and Cold Vending Machines
- Miscellaneous Applications

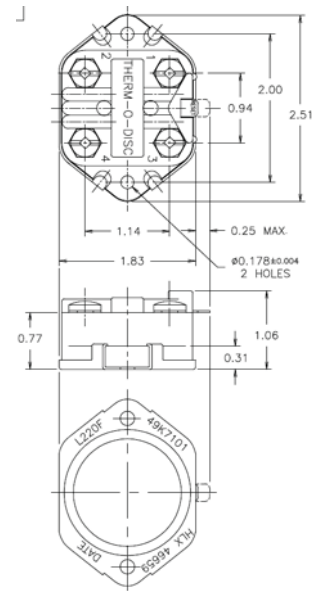


Figure 1

Operating Temperatures

Can be calibrated to operate at any temperature up to 300 F. Normal Differentials between opening and closing range from 40° F to 70° F, depending on the top operating temperature.

General Electrical Rating

Max Temperature	Contact Arrangement	inductive Amperes		Pilot Duty VA	Resistive Amperes	Volts AC	Agency Recognition
		FLA	LRA				
300 °F	Double Pole	-	-	125	50	240	UL E19279
149 °C	Single Throw	-	-	125	25	480	
250 °F		-	-	-	30	600	
121 °C		-	-	-	-	-	
300 °F	-	4.6	27.6	125		120	UL MH5304
149 °C	-	2.3	13.8	125	25	480	
	-	-	-	125	50	480	
250 °F	Double Pole			125	50	240	CSA LR10281 (HL only)
121 °C	Single Throw			125	25	480	
				-	30	600	
				330	-	125	
				415	-	250	
				1000	-	600	

Tolerance Ratings

Open Temperature	Open Tolerance
100°-200 °F	5°F
201°-250 °F	6°F
251°-300 °F	7°F

Important Notice

Users must determine the suitability of the control for their application, including the level of reliability required, and are solely responsible for the function of the end-use product.

These controls contain exposed electrical components and are not intended to withstand exposure to water or other environmental contaminants which can compromise insulating components. Such exposure may result in insulation breakdown and accompanying localized electrical heating.

A control may remain permanently closed or open as a result of exposure to excessive mechanical, electrical, thermal or environmental conditions or at normal end-of-life. If failure of the control to operate could result in personal injury or property damage, the user should incorporate supplemental system control features to achieve the desired level of reliability and safety. For example, backup controls have been incorporated in a number of applications for this reason.

25VS Vapor Sensor



Vapor Sensor

The 25VS flammable vapor sensor is a silicone-based sensor that detects vapors released during a typical gasoline spill. The 25VS requires no power to operate and offers long life and good sensitivity to most gasoline components within a wide temperature operating range.

Therm-O-Disc's 25VS was custom designed for the Water Heater Industry Joint Research and Development Consortium to meet Flammable Vapor Ignition Resistance (FVIR) requirements of ANSI Z21.94/CSA 6.31 standard.

Principle of Operation

The 25VS sensor is comprised of three primary components: a sensor film, an insert-molded base, and a molded cover. The sensor film (a proprietary mixture of silicone and carbon) is deposited on the insert-molded base and shielded from the environment with a thermoplastic cover ultrasonically welded to the base.

The custom designed silicone system provides a robust foundation and support structure for the carbon. The carbon, which acts as a conductor, is dispersed throughout the silicone such



that, in the absence of gasoline vapor, the carbon particles are in solid electrical contact. When the silicone encounters gasoline vapor, it expands, pulling some of the carbon particles apart, increasing the resistance of the sensor. The magnitude of resistance increase is dependent upon the gasoline vapor concentration; higher concentrations cause increased expansion of the silicone film, which result in a higher sensor resistance and vice versa.

Unique Benefits

The Therm-O-Disc 25VS flammable vapor sensor yields several unique benefits when compared with other vapor sensing technologies. Unlike active sensors that typically utilize metal-oxide or infrared technologies, the 25VS does not require an external power source to detect flammable vapors, only the amount of power used by the customer’s control circuit to read the sensor’s resistance. This feature provides design flexibility and contributes to the efficient operation of the water heater control circuit to which it is connected.

“One Shot” Use

Generally, the sensor will reset after a limited exposure to flammable vapor. However, Therm-O-Disc cannot validate the sensor’s response to flammable vapors after an initial flammable vapor exposure in the field. Therefore, the sensor must be replaced after an exposure to flammable vapor.

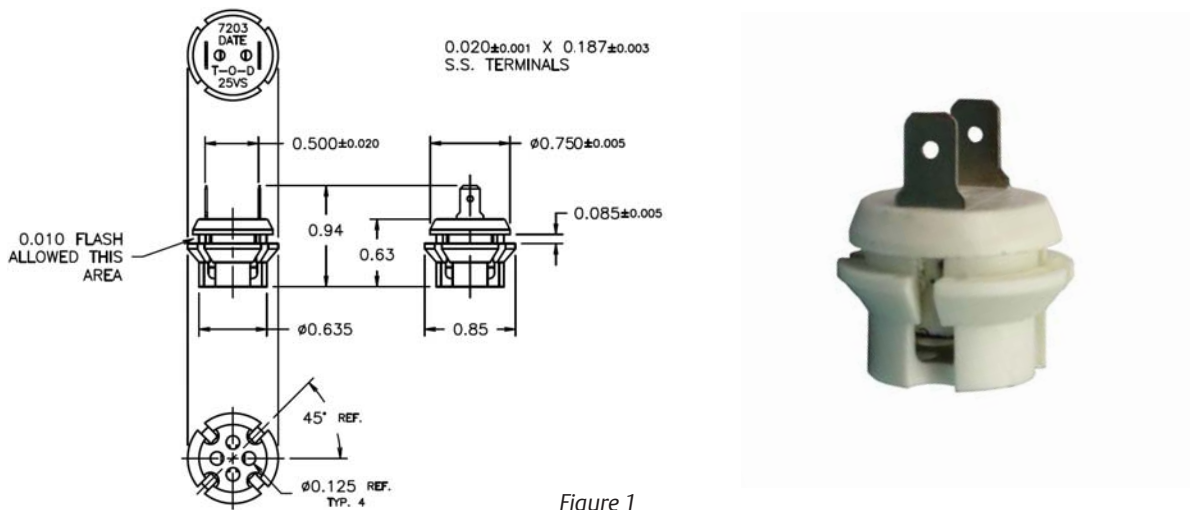


Figure 1
Dimensions are shown in inches and (millimeters).

Agency Ratings

Base Resistance @25 °C	Standard	Detected Gas(s)	Trip Point	Operating Temperature Range	Storage Temperature	Voltage	Humidity
7 to 25 K Ω	ANSI Z21.94/CSA 6,31	Gasoline vapor	50 k Ω	0 °C to 65°F (32°F to 150°F)	-40°C to 80°C (-40°F to 176°F)	5VDC	10% to 90% RH

Important Notice

Users must determine the suitability of any Therm-O-Disc component for their specific application, including the level of reliability required, and are solely responsible for the function of the end-use product. The scope of the technical and application information included in this article is necessarily limited. Operating environments and conditions can materially affect the operating results of Therm-O-Disc™ products. It is important to review the Application Notes which can be found at Emerson.com/thermodisc

These controls contain exposed electrical components and are not intended to withstand exposure to water or other environmental contaminants which can compromise insulating components. Such exposure may result in insulation breakdown and accompanying localized electrical heating.

A control may remain permanently closed or open as a result of exposure to excessive mechanical, electrical, thermal or environmental conditions or at normal end-of-life. If failure of the control to operate could result in personal injury or property damage, the user should incorporate supplemental system control features to achieve the desired level of reliability and safety. For example, backup controls have been incorporated in a number of applications for this reason.

MICROTEMP® Thermal Fuses

Product Information and
Application Notes



Contents

G4 Thermal Fuses	3
G5 Thermal Fuses	5
Z6 Thermal Fuses.....	7
Mountings and Configurations	9
Application Notes.....	16

Upper Limit Temperature Protection

MICROTEMP®, the original thermal fuse from Therm-O-Disc, offers the broadest combination of globally certified temperatures and electrical loads, as well as the broadest range of packages, mountings and design configurations on the market today.

MICROTEMP Features:

- Globally certified temperatures and electrical loads
- One-shot operation cuts off electrical power
- Current interruption capacity up to 25 amps @ 250VAC
- Low resistance
- Compact size
- RoHS compliant

Operating Principle

The active trigger mechanism of the thermal fuse is an exclusively formulated, electrically nonconductive pellet. Under normal operating temperatures, the solid pellet holds spring loaded contacts closed. When a predetermined temperature is reached, the pellet melts, allowing the compression spring to relax. The trip spring then slides the contact away from the lead and the circuit is opened.

After the thermal fuse opens a circuit, the fuse needs to be replaced. This replacement procedure must include correction of the fault condition before the product is operated again.

	G4	G5	Z6	G6	G7	G8	S9
Typical Resistive Rating at 250VAC	10A	20A	16A Higher Tm Than G6	16A More Temperature Ratings Than Z6	5A	25A	15A
Details found on page	3	5	7	See pages 14-15			

Application Notes - Page 16
Mountings & Configurations - Page 9

NOTE: The terms *thermal fuse*, *thermal cutoff*, *thermal link*, and *TCO* are synonymous and may be used interchangeably throughout the catalog.

G4 MICROTEMP Thermal Fuses



G4 MICROTEMP - the Original Thermal Fuse

Providing reliable back-up protection for temperature controlling thermostats and other over-temperature conditions, the G4 series MICROTEMP thermal fuse is the industry standard for over-temperature protection. The G4 is rated for continuous operating currents up to 10 amps @ 250VAC.

Benefits

- The industry standard for over-temperature protection
- Available in a wide range of temperatures to offer design flexibility in your application
- Available in mounted and packaged designs

Features

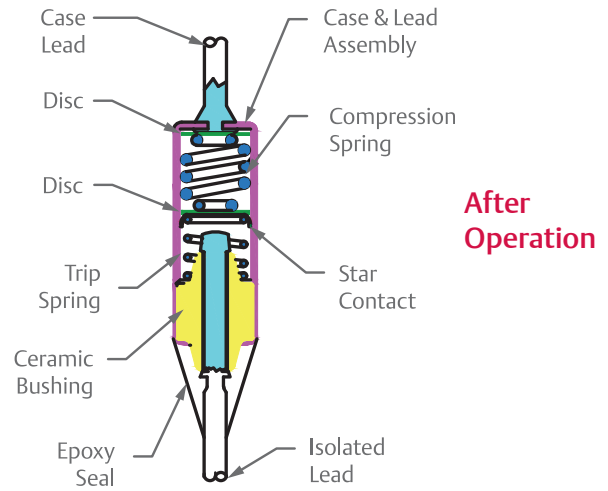
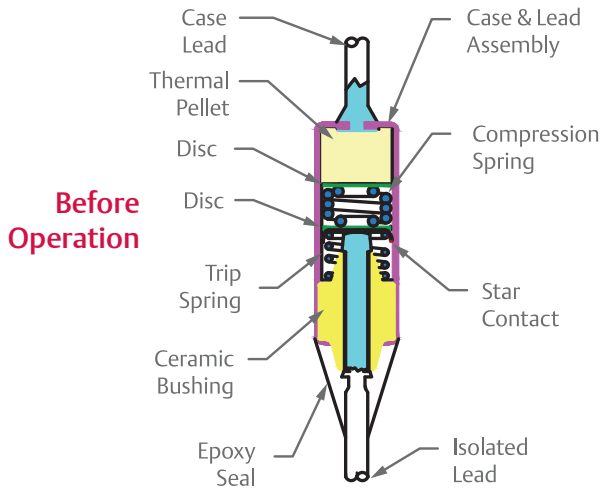
- One shot operation cuts off electrical power
- 10A/250VAC, 15A/120VAC, 5A/24VDC
- Low Resistance
- Compact size

Applications

- Portable Appliance
- Major Appliance
- HVAC
- Power Supplies
- Water Heater
- Other



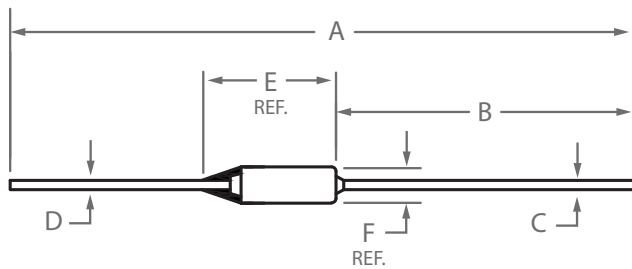
G4 MICROTEMP Product Information



Standard Dimensions

		Standard Leads
A	Overall Length $\pm .12"$ ($\pm 3.0\text{mm}$)*	2.51" (63.8mm)
B	Case Lead Length $\pm .06"$ ($\pm 1.5\text{mm}$)	1.38" (34.9mm)
C	Case Lead Diameter	0.040" (1.0mm)
	Case Lead Material	Tin Plated Copper
D	Isolated Lead Diameter	0.040" (1.0mm)
	Isolated Lead Material	Silver Plated Copper
E/F	Case Dimensions, Including Epoxy	.58" L x .158" D (14.7mm x 4.0mm)

* Overall length available up to 5.83" (148mm)



Electrical Ratings

Agency	Resistive	Inductive
UL/CSA	10A/250VAC 15A/120VAC 5A/24VDC	8A/250VAC 14A/120VAC
VDE	10A/250VAC	8A/250VAC
CCC	10A/250VAC	8A/250VAC
PSE JET	10A/250VAC	
Korea	10A/250VAC	

Operating Temperature Summary

Tf°C	Th°C	Tm°C
072	57	100
073	58	100
077	62	300
084	69	220
091	76	300
093	78	300
098	83	300
104	89	200
110	95	240
117	102	240
121	106	300
128	113	205
134	119	205
141	126	205
144	129	300
152	137	205
158	143	240
167	152	210
172	157	310
184	169	240
190	175	350
192	177	210
205	190	310
216	200	450
229	200	450
240	200	450
257	220	470

Tf = Functioning open temperature $+0/-5^{\circ}\text{C}$

Th = Maximum temperature of the thermal fuse, measured at the case end, at which the thermal fuse can be maintained for a period of at least 168 hours without opening

Tm = Maximum overshoot temperature. Temperature up to which the open thermal fuse will not change state

G5 MICROTEMP Thermal Fuses



G5 MICROTEMP - the Original Thermal Fuse

Designed for higher voltage and current applications, the G5 MICROTEMP Thermal Fuse is rated for operating currents up to 20 amps @ 277 VAC. The internal construction of the G5 is designed for interrupting higher currents and withstanding higher temperatures than other models.

Benefits

- Designed for higher voltage and current applications
- Available in a wide range of temperatures to offer design flexibility in your application
- Available in mounted and packaged designs

Features

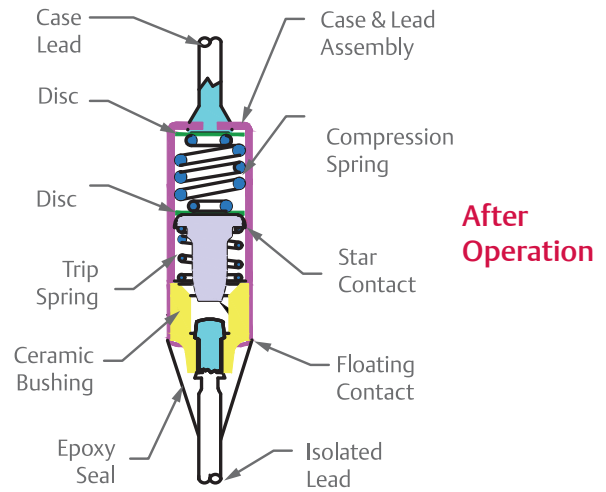
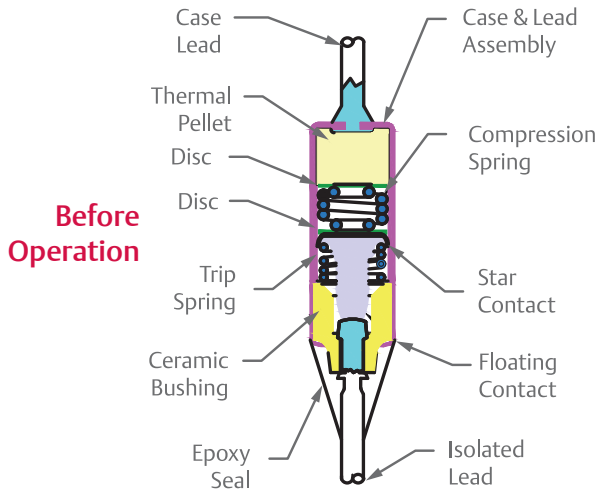
- One shot operation cuts off electrical power
- 20A/250VAC, 20A/277VAC, 25A/120VAC
- High Overshoot Temperature T_m
- Compact Size

Applications

- Portable Appliance
- Major Appliance
- HVAC
- Power Supplies
- Automotive
- Water Heater
- Other



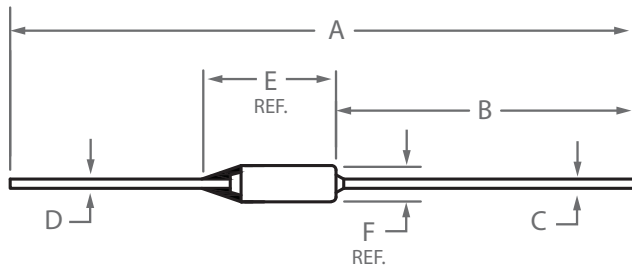
G5 MICROTEMP Product Information



Standard Dimensions

		Standard Leads
A	Overall Length $\pm .12"$ ($\pm 3.0\text{mm}$)*	2.51" (63.8mm)
B	Case Lead Length $\pm .06"$ ($\pm 1.5\text{mm}$)	1.38" (34.9mm)
C	Case Lead Diameter	0.040" (1.0mm)
	Case Lead Material	Tin Plated Copper
D	Isolated Lead Diameter	0.040" (1.0mm)
	Isolated Lead Material	Silver Plated Copper
E/F	Case Dimensions, Including Epoxy	.58" L x .158" D (14.7mm x 4.0mm)

* Overall length available up to 5.83" (148mm)



Electrical Ratings

Agency	Resistive
UL/CSA	20A/250VAC
	25A/120AC
	21A/240VAC
	20A/277VAC
VDE	20A/250VAC
CCC	20A/250VAC
PSE JET	15A/250VAC
Korea	16A/250VAC

Operating Temperature Summary

Tf°C	Th°C	Tm°C
072	57	410
073	58	410
077	62	410
084	69	220
091	76	430
093	78	410
098	83	410
104	89	225
110	95	225
117	102	410
121	106	410
128	113	235
134	119	410
141	126	350
144	129	410
152	137	410
158	143	410
167	152	410
172	157	410
184	169	410
190	175	410
192	177	350
205	190	410
216	200	410
229	200	410
240	200	410

Tf = Functioning open temperature $+0/-5^{\circ}\text{C}$

Th = Maximum temperature of the thermal fuse, measured at the case end, at which the thermal fuse can be maintained for a period of at least 168 hours without opening

Tm = Maximum overshoot temperature. Temperature up to which the open thermal fuse will not change state

Z6 MICROTEMP Thermal Fuses



Z6 MICROTEMP - the Original Thermal Fuse

MICROTEMP thermal fuses offer an accurate, reliable solution to the need for upper limit temperature protection against overheating by interrupting an electrical circuit when operating temperatures exceed the rated temperature. Designed to meet European voltage and current applications, the Z6 is rated for operating currents up to 16 amps @ 250 VAC.

Benefits

- Same excellent quality and reliability you have come to expect in MICROTEMP thermal fuses
- Fast thermal response
- High Overshoot Temperature T_m ratings

Features

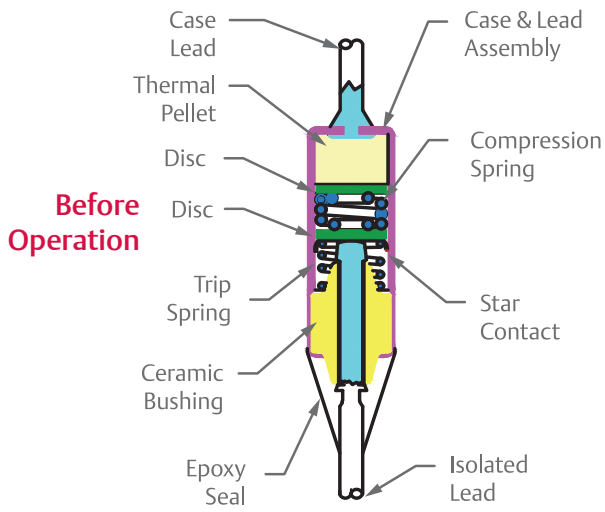
- One shot operation cuts off electrical power
- 16A/250VAC
- Low Resistance
- Compact Size

Applications

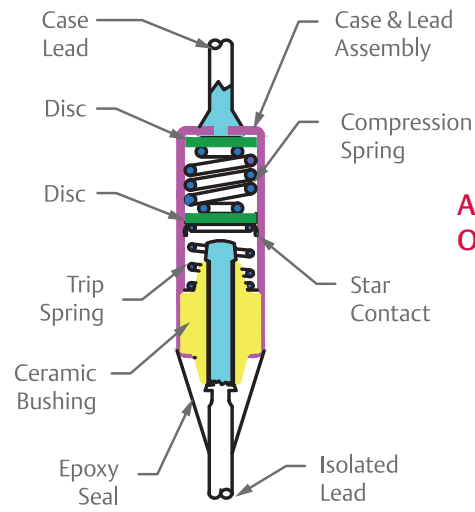
- Major Appliance
- Portable Appliance
- HVAC
- Water Heater
- Hair Care
- Other



Z6 MICROTEMP Product Information



Before Operation

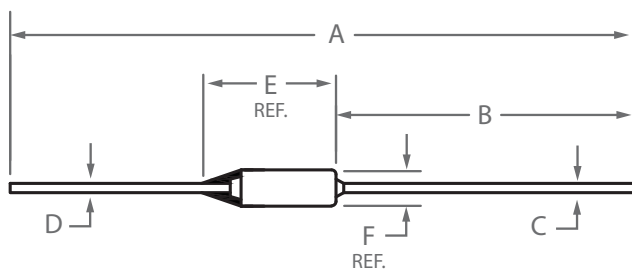


After Operation

Standard Dimensions

		Standard Leads
A	Overall Length $\pm .12"$ ($\pm 3.0\text{mm}$)*	2.51" (63.8mm)
B	Case Lead Length $\pm .06"$ ($\pm 1.5\text{mm}$)	1.38" (34.9mm)
C	Case Lead Diameter	0.040" (1.0mm)
	Case Lead Material	Tin Plated Copper
D	Isolated Lead Diameter	0.040" (1.0mm)
	Isolated Lead Material	Silver Plated Copper
E/F	Case Dimensions, Including Epoxy	.58" L x .158" D (14.7mm x 4.0mm)

* Overall length available up to 5.83" (148mm)



Operating Temperature Summary

Tf °C	Th °C	Tm °C
098	083	280
104	089	260
117	102	275
121	106	380
144	134	380
152	142	380
167	157	380
184	174	380
229	200	380
240	200	380

Tf = Functioning open temperature $+0/-5^{\circ}\text{C}$

Th = Maximum temperature of the thermal fuse, measured at the case end, at which the thermal fuse can be maintained for a period of at least 168 hours without opening

Tm = Maximum overshoot temperature. Temperature up to which the open thermal fuse will not change state

Electric Rating

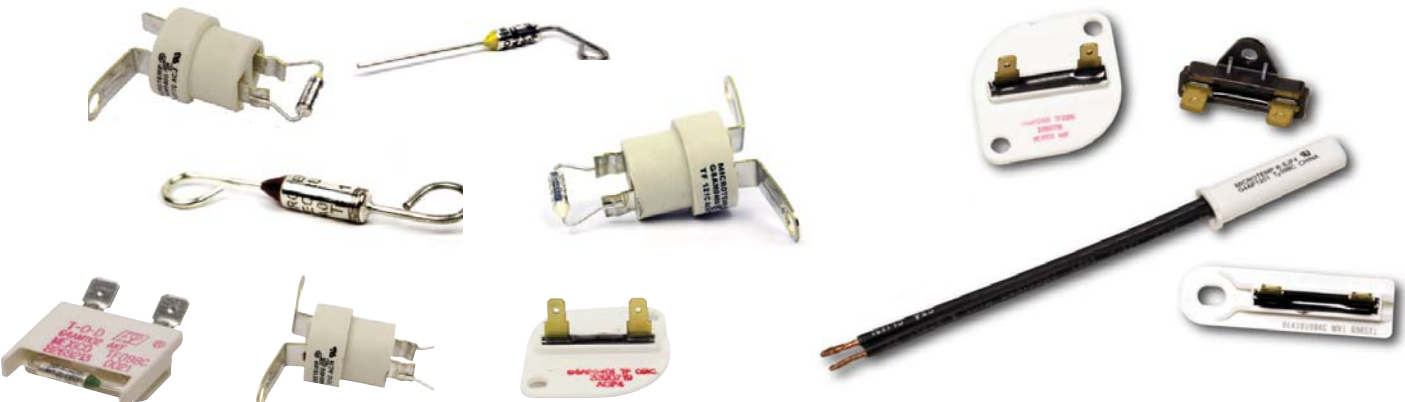
Agency	Resistive
UL	16A/250VAC
CSA	16A/250VAC
VDE	16A/250VAC
CCC	16A/250VAC
PSE JET	16A/250VAC

MICROTEMP Mountings & Configurations



MICROTEMP thermal fuses are available in a wide range of mountings and configurations to meet a variety of application requirements.

The G Series represents the world standard in thermal fuses. MICROTEMP TCO's were the first chemical-pellet spring-type TCO ever developed and continue to be the thermal cutoff of choice for many years.



MICROTEMP Thermal Fuses

Therm-O-Disc

Packaged Thermal Fuses

MICROTEMP thermal fuses also come in a variety of mounted and packaged options. Designed primarily for HVAC heating applications, the GXAM04 and GXAM06 packages mount a standard thermal fuse on a high temperature ceramic base.

The popular GXAP packages consist of a thermal fuse epoxy-potted into a plastic insulating mounting case. The assembly can be supplied with various case materials, shapes and terminations. They can be easily replaced in the field without disturbing the rest of the circuit.

Packaged TCO Material Specifications

Type	Base Material	Material Rating Temperature °C	Maximum Tf°C Temperature °C
GXAP02	PPS Glass Filled	220	192
GXAP04	PBT Glass Filled	120	134
GXAP05	PBT Glass Filled	120	134
GXAP10	PPS Mineral Filled	220	192
GXAP12	PBT Glass Filled	120	134
GXAM04	Ceramic DIN VDE 0335, C221	>250	257
GXAM06	Ceramic DIN VDE 0335, C221	>250	257
GXAM11	PBT	120	134



GXAM06



GXAP04



GXAP02
GXAP10



GXAM04



GXAM11



GXAP05



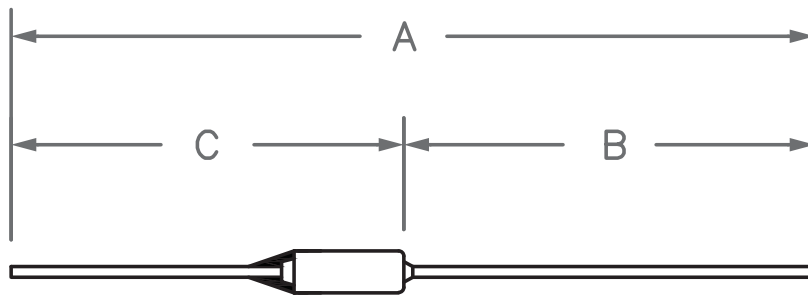
GXAP12

Lead Configurations

Thermal fuses can be furnished with virtually any lead configuration specified for an application. Lead curls are available to match most screw sizes along with varying lead lengths and lead forms. All types of terminations, such as quick connects, ring terminals and blade terminals are available at additional cost. In addition, tape and reel packaging can be specified to meet high volume requirements.



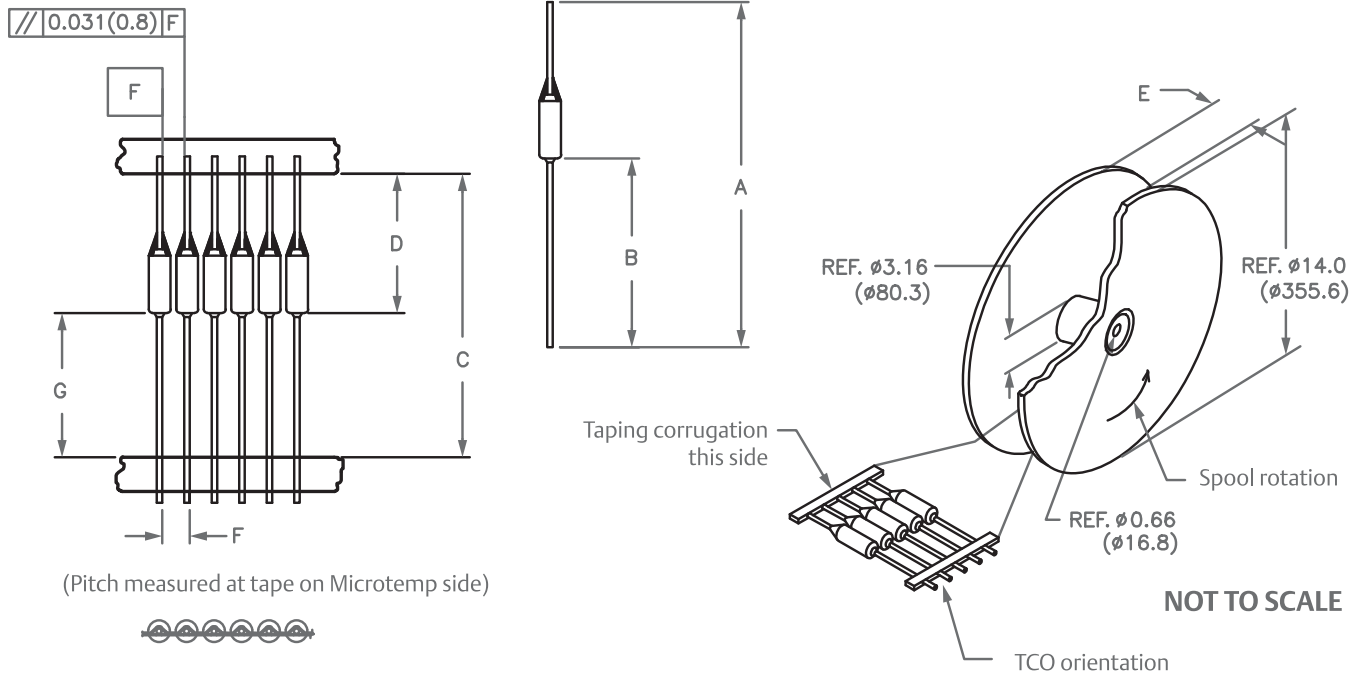
Lead Cutting



Minimum Dimensions - Inches (mm)

A	B	C
0.95 (24.2)	0.22 (5.6)	0.73 (18.6)

Tape & Reel Packaging



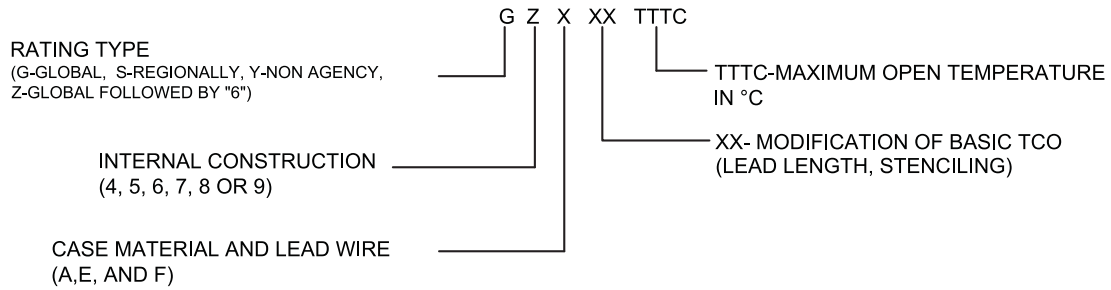
Dimensions - Inches (mm)

Item	A	B	C	D	E	F	G
G4AA0901TTTC	2.52 (63.8)	1.38 (34.9)	2.062 (52.4)	1.031 (26.2)	2.859 (72.6)	0.200 (5.1)	-
G5AA0901TTTC	2.52 (63.8)	1.38 (34.9)	2.062 (52.4)	1.031 (26.2)	2.859 (72.6)	0.200 (5.1)	1.13 (28.7) Min.
G7FA0900TTTC	3.26 (82.9)	1.38 (34.9)	2.760 (70.1)	1.630 (41.4)	3.600 (91.4)	0.197 (5.0)	1.13 (28.7) Min.

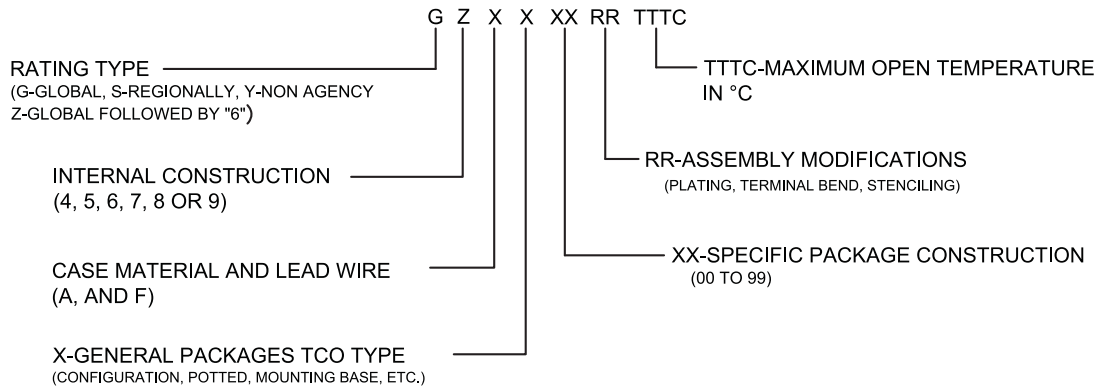
Additional packaging configurations available

Product Nomenclature

MICROTEMP® THERMAL CUTOFF GLOBAL PRIMARY NUMBERING SYSTEM




MICROTEMP® THERMAL CUTOFF GLOBAL SECONDARY NUMBERING SYSTEM



As shown above, Therm-O-Disc MICROTEMP TCOs follow a consistent product nomenclature that identifies the basic product type, lead wire size, special features and packaging options. For example, a standard G4 series TCO calibrated to open at 192°C would have a part number G4A00192C.

MICROTEMP TCO Product Markings

XXXXXXXX	Special customer identification (when required, up to 9 characters)
MICROTEMP®	Registered trademark
PZZZZZ	Manufacturing plant (P); date code
G Z X XX	Primary part number
GZXXXXRR	Secondary part number
T _F TTTC	Maximum open temperature °C
	Underwriters Labs logo

Temperature Ratings

MICROTEMP thermal fuses are available in a wide range of opening temperatures, providing designers a high degree of flexibility. The proper calibration will be affected by application variables such as I²R self heating of the thermal fuse, heat transfer through insulation and heat dissipation due to heat sinking and air flow. Thermocoupled thermal fuse samples, that match the physical and electrical characteristics of a functional thermal fuse, are available to help evaluate application specific variables.

Tf °C	G4A		G5A		G6A		G7F		G8A		Z6A	
	Th °C	Tm °C	Th °C	Tm °C	Th °C	Tm °C	Th °C	Tm °C	Th °C	Tm °C	Th °C	Tm °C
72	57	100	57	410	47	100	-	-	47	410	-	-
73	58	100	58	410	48	100	-	-	48	410	-	-
77	62	300	62	410	62	300	62	125	62	410	-	-
84	69	220	69	220	69	220	69	125	69	220	-	-
91	76	300	76	430	76	300	-	-	-	-	-	-
93	78	300	78	410	-	-	78	140	78	410	-	-
98	83	300	83	410	83	300	83	140	83	410	83	280
104	89	200	89	225	89	200	-	-	89	225	89	260
110	95	240	95	225	-	-	95	140	95	225	-	-
117	102	240	102	410	102	240	102	150	102	410	102	275
121	106	300	106	410	106	300	106	150	106	410	106	380
128	113	205	113	235	113	205	113	150	113	235	-	-
134	119	205	119	410	-	-	119	175	-	-	-	-
141	126	205	126	350	-	-	126	175	-	-	-	-
144	129	300	129	410	129	300	129	175	119	410	134	380
152	137	205	137	410	127	205	137	175	-	-	142	380
158	143	240	143	410	-	-	143	200	-	-	-	-
167	152	210	152	410	-	-	152	200	152	410	157	380
172	157	310	157	410	-	-	157	200	-	-	-	-
184	169	240	169	410	169	210	169	200	169	410	174	380
190	175	350	175	410	-	-	175	270	-	-	-	-
192	177	210	177	350	167	210	177	210	177	350	-	-
205	190	310	190	410	-	-	-	-	-	-	-	-
216	200	450	200	410	-	-	-	-	-	-	-	-
229	200	450	200	410	200	375	-	-	200	410	200	380
240	200	450	200	410	200	450	-	-	200	410	200	380
257	220	470	-	-	-	-	-	-	-	-	-	-

Tf = Functioning open temperature +0/-5°C

Th = Maximum temperature of the thermal fuse, measured at the case end, at which the thermal fuse can be maintained for a period of at least 168 hours without opening

Tm = Maximum overshoot temperature. Temperature up to which the open thermal fuse will not change state

NOTES:

- It is advised that TCOs are not exposed to continuous operating temperatures in excess of T_f -25°C
- Comparative tracking index (all primary TCOs): 250VAC
- G4, G5, G6, G7 and G8 series TCOs with Tf ≥ 175°C comply with UL conductive heat aging (CHAT) requirements.

Electrical Rating Summary

Electrical Current & Voltage Rating

Series	G4		G5	G6	Z6	G7		G8	S9
Agency	Resistive	Inductive	Resistive	Resistive	Resistive	Resistive	Inductive	Resistive	Resistive
UL/CSA	10A/250VAC 15A/120VAC 5A/24VDC	8A/250VAC 14A/120VAC	20A/250VAC 25A/120VAC 21A/240VAC 20A/277VAC	16A/250VAC	16A/250VAC	5A/250VAC 5A/24VDC	4.5A/250VAC ¹ 4.5A/120VAC ¹	20A/277VAC 25A/250VAC	
VDE	10A/250VAC	8A/250VAC	20A/250VAC	16A/250VAC	16A/250VAC	5A/250VAC	4.5A/250VAC	25A/250VAC	
CCC	5A/24VDC 10A/250VAC	8A/250VAC	20A/250VAC	16A/250VAC	16A/250VAC	5A/24VDC 5A/250VAC	4.5A/250VAC	25A/250VAC	
PSE JET	10A/250VAC		15A/250VAC	15A/250VAC	16A/250VAC	5A/250VAC		25A/250VAC	15A/250VAC
Korea	10A/250VAC		16A/250VAC			5A/250VAC			

¹ Except for 184C rating

² MICROTEMP thermal fuse with primary part number GX5XTTTC has PSE JET agency approval

SJET	S4	S7	S9
125C	30A/16VDC		
152C		15A/16VDC	
172C	30A/16VDC		50A/16VDC
240C	30A/16VDC		50A/16VDC

Direct Current (DC) Applications

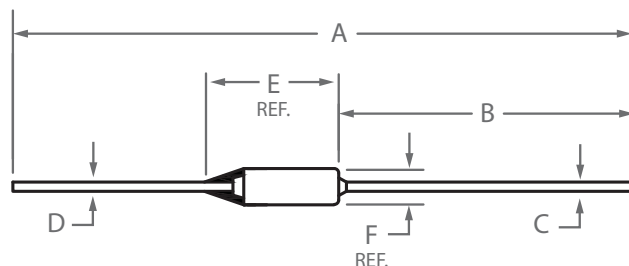
The G4, G7 and S9 series MICROTEMP thermal fuses have published electrical ratings for direct current (DC) applications. Current interruption capacity in DC circuits is highly application sensitive.

Therm-O-Disc recommends thorough testing of DC electrical applications.

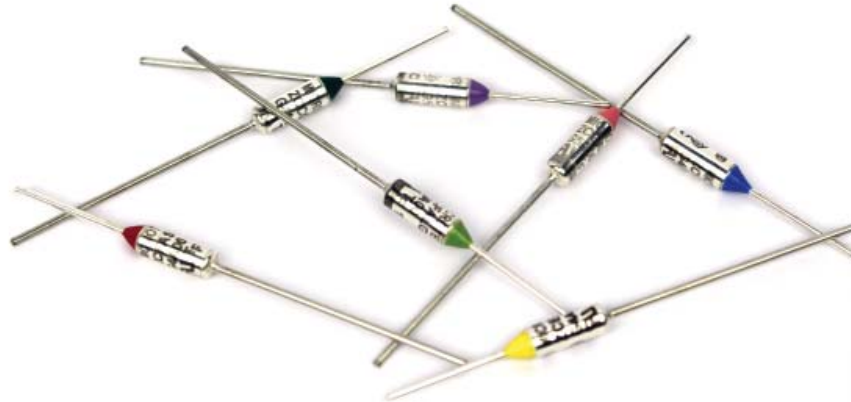
MICROTEMP TCO Standard Dimensions

		Dimensions - Inches (Millimeters)	G4, G5, G6, Z6, G8 Series	G7 Series	S9 Series	
Standard Leads	A	Overall Length $\pm .12$ (± 3.0)	2.51 (63.8)*	N/A	2.51 (64.8)	
	B	Case Lead Length $\pm .06$ (± 1.5)	1.38 (34.9)	N/A	1.38 (34.9)	
Long Leads	A	Overall Length $\pm .12$ (± 3.0)	3.26 (82.9)	3.26 (82.9)	3.26 (82.9)	
	B	Case Lead Length $\pm .06$ (± 1.5)	1.38 (34.9)	1.38 (34.9)	1.38 (34.9)	
Lead Material & Diameter	C	Case Lead	Tin Plated Copper	0.040 (1.0)	0.023 (.57)	0.057 (1.4)
	D	Isolated Lead	Silver Plated Copper	0.040 (1.0)	0.023 (.57)	0.057 (1.4)
Case Dimensions	E	Case Length (Reference)	0.58 (14.7)	0.38 (9.6)	0.58 (14.7)	
	F	Case Diameter (Reference)	0.158 (4.0)	0.118 (3.0)	0.158 (4.0)	

*Overall length available up to 5.83" (148mm)



Application of Thermal Fuses



MICROTEMP® thermal cutoffs, available in a variety of standard and custom configurations, provide reliable one-shot, over-temperature protection in a wide range of applications. Performance can be affected by installation method and location of the thermal cutoff. Both application and installation is important in the overall performance of the product, and thorough testing is necessary for both AC and DC applications. The following guidelines will answer most questions concerning these two subjects.

General Considerations

Location

Sufficient time and effort must be used to determine the proper and most desirable location for a thermal fuse. The employment of infrared thermography, or a sufficient number of thermocouples to identify the highest temperature areas in the application during normal operation and fault conditions, should be considered. The location that provides the largest differential between these two conditions is generally most desirable.

Calibration Temperature

It is necessary to select a thermal fuse rating above the maximum temperature experienced by the thermal fuse during normal operation, including expected short-term temperature overshoots. The temperatures experienced by the thermal fuse during normal operation will determine the life expectancy of the thermal fuse. If the thermal fuse rating is too close to the temperature experienced during normal operation (including overshoot temperature after opening of a thermostat, etc.), the probability of a nuisance trip increases. Nuisance trips are caused by pellet shrinkage due to repeated operation at temperatures near but below calibration temperature, or excessive thermal gradients across the case of the TCO and its leads (see Thermal Gradients). The design engineer must make the decision between response and life of the TCO based on product requirements. It is important to remember that temperatures experienced in actual application will vary from unit to unit.

Thermal Gradients

Ideal thermal fuse placement subjects the entire thermal fuse case, leads, epoxy seal and internal components to a uniform temperature environment.

Care should be exercised in the placement of the thermal fuse to minimize thermal gradients across the thermal fuse body. In certain applications, the thermal fuse can be mounted in a position where heat is conducted to the body of the thermal fuse through one of the leads, resulting in thermal gradients across the thermal fuse. Over time, the thermal fuse life can be reduced by thermal gradients if the isolated (epoxy) lead is at a consistently lower temperature than the

case lead. Long term testing is recommended in determining whether these conditions exist in the application.

To minimize the effects of thermal gradients and the temperature increase of the TCO body from this heat flow, attach the isolated (epoxy) lead, rather than the case lead, to the heat source. Thermocoupled fuses can be supplied with the thermocouples on both ends to facilitate gradient evaluations.

Temperature Limits

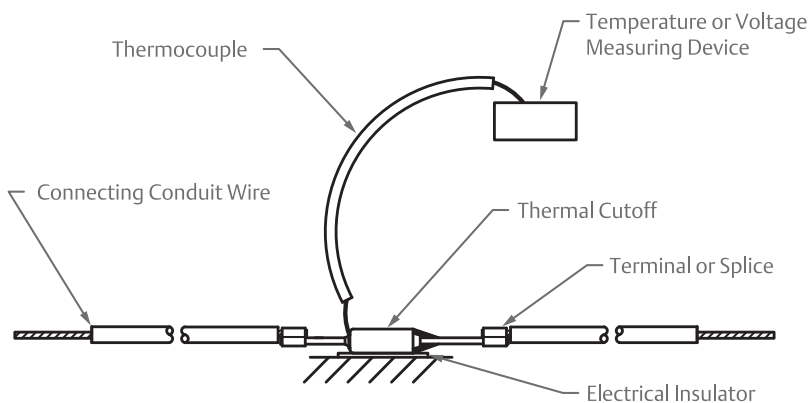
The temperatures experienced during normal operation, including expected temperature overshoots, will determine the life expectancy of the thermal fuse. Nuisance trips can result if the thermal fuse rating is too close to the temperatures experienced during normal operation. Thermal fuses of any temperature rating should not be subjected to continuous normal temperatures in excess of 200°C. Additionally, overshoot temperatures after the opening of the thermal fuse should be minimized to avoid possible dielectric breakdown and re-conduction of the thermal fuse.

Test Procedure

Application of Thermal Fuses

A thermal measurement procedure that utilizes a thermocoupled thermal fuse can assist in determining the appropriate calibration temperature and design location of MICROTEMP™ thermal fuses. The thermocoupled thermal fuse matches the electrical characteristics of the thermal fuse but does not have thermally responsive parts. The thermocoupled thermal fuse is supplied with a thermocouple attached to the case of the thermal fuse (see below). Thermocoupled thermal fuses can be supplied with Type J, Type T, or Type K thermocouples.

Install the thermocoupled thermal fuse in the electrical circuit that is to open in the event of a fault condition. Position it in the area that has been selected to be protected within the product based on prior determinations of the maximum permissible temperatures to be allowed. The thermocouple thermal fuse should be installed using the same mounting and electrical connection that will be used for functional thermal fuses in production. Connect the thermocouple leads to a digital temperature measuring device to record temperatures. The product to be protected can now be operated, and the normal operating temperature monitored. Note that the thermocouple thermal fuse is not a functional thermal fuse and therefore will not open the circuit in the test setup.



The figure above illustrates a typical installation of a thermocouple thermal fuse. Note that the body of the thermocouple thermal fuse is at the same potential as the connecting circuit; therefore, it must be electrically isolated from the surface against which the fuse is mounted. Also note that the thermocouple wire is at the same potential as the connecting circuit.

Installation, Processing and Handling of Thermal Fuses

CAUTION

To avoid a false reading of the unit under test, thermocouple wires must not make contact with each other except at the temperature sensing junction.

CAUTION

Ensure that the thermocouple wire insulation will provide isolation against short circuiting and shock hazards.

CAUTION

The terminal of the temperature measuring instrument, to which the thermocouple is attached, will be at the same potential as the connecting circuit wire. This instrument must be electrically isolated and considerable caution must be exercised in its use, since one of the thermocouple terminals is frequently grounded to the instrument chassis.

Before using measuring equipment powered directly from standard line voltages, check operation manuals. Be sure line voltages impressed on the thermocouple wires by the thermocoupled thermal fuse will not cause damage to the instrument.

Application testing is necessary to select a properly rated thermal fuse. Test factors include, but are not limited to, the heating effect of the current through the fuse, adjoining terminals and leads, heating or cooling effect of the terminals and external leads, rate of temperature rise, air flow, shock, vibration and other environmental and operating conditions unique to the application. The closer the actual operating and ambient conditions can be simulated during test, the more valid the test results will be.

The product and application being tested will determine the number of cycles that must be run to determine the maximum 'normal' operating temperature. 'Overshoot' temperatures should be included in the determination of the maximum 'normal' operating temperature. The overshoot temperature is often considerably higher than the temperature reached at the moment the thermal fuse opens. The conclusion of these tests will provide the maximum 'normal' operating temperature at the thermal fuse (at maximum anticipated voltage, ambient temperature, etc.). The overshoot temperature seen by the thermal fuse after the thermal fuse opens in the application must also be carefully examined and compared to overshoot temperature T_m .

Manufacturing tolerances and variations should be carefully considered, and a sufficient number of units evaluated, to provide statistical basis on which to determine the operating overshoot temperatures.

After obtaining the above information, test the product under fault conditions and monitor to determine that desired fault condition temperatures are not exceeded.

Where there are a variety of fault conditions, (eg, short-circuited thermostats and transform secondaries, locked motor rotors and solenoids, high ambient temperatures, restricted or blocked airflow, etc), consideration should be given to multiple fault conditions which could occur simultaneously during the lifetime of the product, and to faults which may cause localized overheating in areas away from the thermal fuse.

When the fault conditions have been set up, note the temperature of the thermocoupled fuses when the maximum desired temperature limit is reached. At this point the circuit is manually interrupted. This test should be run several times, in several different units. In some applications, it will not be possible to 'save' the tested item from damage, but only prevent the product from creating an external fire or electrical hazard. Damaged products should not be retest-

ed, since the results may not be the same as with undamaged units. The thermal fuse T_f selected should be equal to or less than the temperature recorded at the thermal fuse at the time the maximum desired temperature is reached.

CAUTION

Excessive overshoot temperature after the opening of the thermal fuse may cause dielectric breakdown of the thermal fuse and allow re-conduction to occur. Functional thermal fuses should be tested to verify proper operation of the thermal fuses in the application (see MICROTEMP Thermal Fuse Operating Temperature Summary and Electrical Rating Summary on page 14).

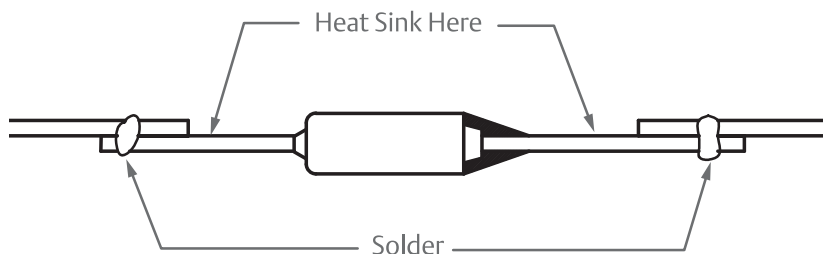


Substitute actual thermal fuses in a sufficient number of finished products and re-run the tests to obtain statistical verification of the results. For multiple thermal fuse applications, test functional thermal fuses under fault conditions so that the product overheats and each thermal fuse is independently called upon to interrupt the flow of current. Each thermal fuse should open the circuit independently of any other over-temperature limit controls, with product damage not exceeding an acceptable level. This test should be run using the maximum voltage and current the thermal fuse will be expected to interrupt and hold open.

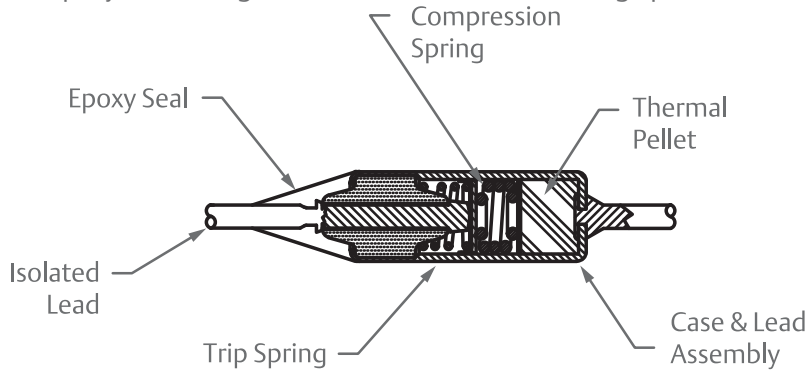
The performance of a MICROTEMP thermal cutoff can be affected by installation methods such as soldering, welding, splicing, lead bending, insulation, clamping and mounting. Certain precautions should be taken during installation to ensure that the MICROTEMP thermal cutoff is not damaged, which may cause it to not operate in its intended manner. Likewise, care should be taken during installation to ensure that the TCO in every unit experiences the expected temperature range environment previously determined during the calibration temperature selection. The following guidelines should be used to minimize undesirable conditions that can result from improper installation practices.

Soldering Leads

Thermal fuse leads should be heat-sunk during the soldering operation (see below). If excessive heat is conducted by the leads into the thermal fuse, it can shorten the life of the thermal fuse. In addition, excessive lead temperatures can damage the epoxy and possibly result in the thermal fuse failing to open. More heat-sinking is necessary for thermal fuses with lower T_f temperatures.

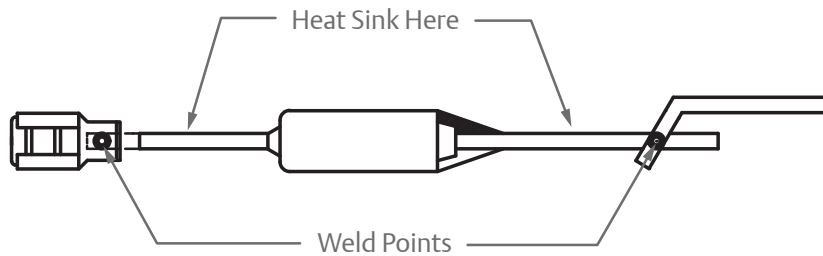


Test samples should be x-rayed before and after the soldering operation. The size of the pellet should be measured to verify that no shrinkage has occurred during the soldering operation. The epoxy seal should retain its size and shape and not discolor. If the pellet or the epoxy have changed size as a result of the soldering operation more heat sinking is required.



Welding Leads

The thermal fuse leads may also need to be heat sunk during a welding operation. The same precautions and tests described in the soldering section should be followed for welding leads.

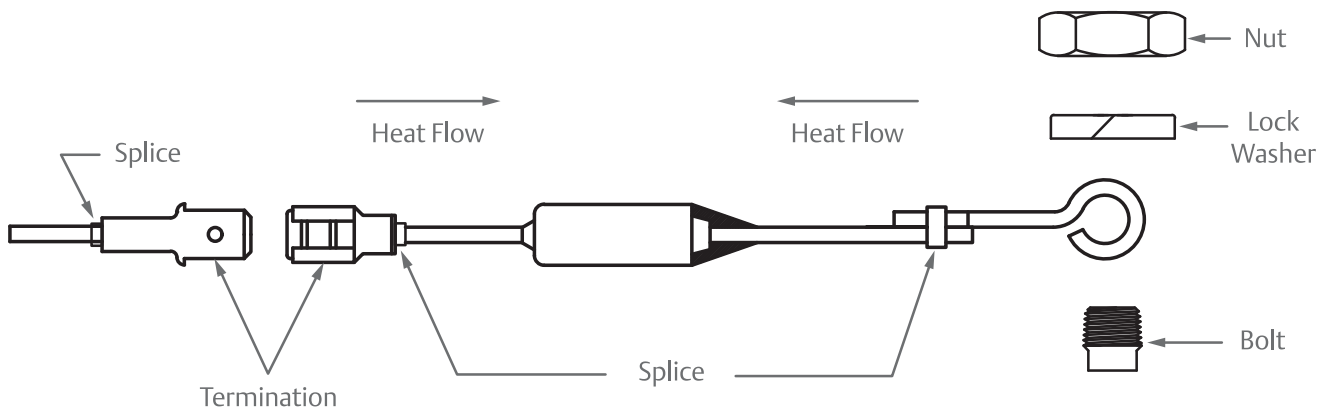


To avoid damaging or welding internal parts, care should be taken that none of the welding current is conducted through the thermal fuse. A welding current of hundreds of amperes can weld the internal parts together, resulting in the thermal fuse failing to open.

Thermal fuse leads must be supported during the weld operation to prevent damaging the thermal fuse epoxy seal.

Splices and Terminations

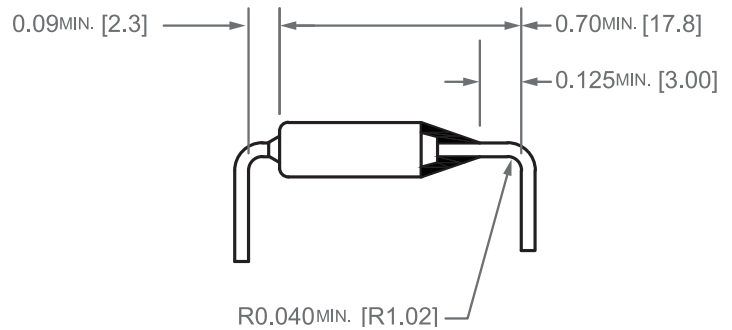
Insecure splices and terminations may produce high resistance junctions which can cause self-heating (I^2R) as power is dissipated across these junctions during product operation. Heat from these areas can flow down the thermal fuse leads and increase the temperature of the thermal fuse. Nuisance openings of the thermal fuse or degradation of the epoxy seal can occur as a result of the heat generated by high resistance junctions. The splice or termination junction may initially measure low resistance, but can change to a much higher resistance after several temperature cycles. It is generally better to splice thermal fuse leads to stranded lead wires rather than solid wires as the stranded wire may be crimped tighter and maintain better electrical contact during temperature cycling.



The temperature capabilities of the splice and/or termination should be considered. For example, solder back-up should be considered for splices of solid wires, and terminations in applications cycled at temperatures exceeding 150°C.

Bending Leads

When configuring leads, special care must be exercised in supporting the leads at each end near the body of the thermal fuse so that the case will not be distorted or the epoxy will not be cracked or broken. At least 0.125" (3mm) should be maintained between the epoxy seal and any lead bends.



CAUTION

The thermal fuse may fail to open the electrical circuit under certain conditions. Distortion of the case, breaking or cracking the seal, exposing the epoxy seal to cleaning solvents, compression of the leads and current surges that exceed the operating specifications of the thermal fuse may cause the thermal fuse not to open. In addition, pellet shrinkage due to thermal aging under some circumstances may also result in failure to open. Finally, a very low rate of temperature rise may produce conditions that may also result in failure to open. Care must be taken to avoid any mishandling or misapplication of the thermal fuse.

CAUTION

Although thermal fuses are highly reliable devices, a thermal fuse may fail to open for one or more of the reasons set forth above. These conditions must be taken into account by the product design engineer in determining the level of reliability needed for the application. If failure of the thermal fuse to open could result in personal injury or property damage, the product design engineer may want to consider using one or more redundant thermal fuses of different ratings to achieve the desired level of reliability. A number of consumer product design engineers have incorporated redundant thermal fuses of different ratings in their designs for this reason.

Samples and Quotations

Thermocoupled thermal fuse samples and thermal fuse samples are readily available for determining the correct response and desired performance in an application. Contact your nearest Therm-O-Disc sales office for more information.



Definition of Terms

Maximum Open Temperature or Rated Functioning Temperature (Tf or TF)

The maximum temperature at which the thermal fuse changes its state of conductivity to open circuit with detection current as the only load. The rated functioning temperature is measured during a temperature rise of approximately 0.5°C per minute.

Holding Temperature (Th or TH)

The maximum temperature of the thermal fuse, measured at the case end of the thermal fuse, at which the thermal fuse can be maintained for a period of 168 hours without opening. NOTE: It is advised that thermal fuses are not exposed to continuous operating temperatures in excess of Tf-25°C.

Maximum Overshoot Temperature or Maximum Temperature Limit (Tm or TM): The maximum temperature at which the thermal fuse, having changed its state of conductivity, can be maintained at twice rated voltage for a specified period of time, during which its mechanical and electrical properties will not be impaired.

Rated Voltage

The maximum voltage that can be applied to the circuit in which the thermal fuse is used.

Rated Current

The maximum current that the thermal fuse is rated to interrupt at the rated voltage.

Thermal Fuse, Thermal Cutoff, Thermal Link, and TCO

All are synonymous and may be used interchangeably throughout the catalog.

Agency Recognition

MICROTEMP™ thermal fuses are recognized by the following major agencies



UL
Underwriters
Laboratories Inc.
(USA)



BEAB
British
Electrotechnical
Approvals Board



METI
Ministry of
Economy, Trade
and Industry of
Japan



CSA
Canadian
Standards
Association



CCC
China
Compulsory
Product
Certification



VDE
Verband
Deutscher
Elektrotechniker e.V.
(F. R. G.)

MICROTEMP™ thermal fuses are recognized by the major approval agencies throughout the world for AC circuit applications. These agency electrical ratings can be used as a guideline when evaluating specific thermal fuse applications. However, the electrical and thermal conditions to which the thermal fuse may be exposed in an application may differ significantly from agency test conditions. Accordingly, customers should not rely solely on agency ratings but rather must perform adequate testing on the particular application to confirm that the thermal fuse selected is appropriate for that application and will operate as intended.

Important Notice

Users must determine the suitability of the thermal fuse for their application, including the level of reliability required, and are solely responsible for the function of the end-use product.

These thermal fuses contain exposed electrical components and are not intended to withstand exposure to water or other environmental contaminants which can compromise insulating components. Such exposure may result in insulation breakdown and accompanying localized electrical heating.

A thermal fuse may remain permanently closed or open as a result of exposure to excessive mechanical, electrical, thermal or environmental conditions or at normal end-of-life. If failure of the control to operate could result in personal injury or property damage, the user should incorporate supplemental system control features to achieve the desired level of reliability and safety. For example, backup temperature limiting devices have been incorporated in a number of applications for this reason.



Scan with your smartphone
for more information or visit
Emerson.com

Important Notice

The scope of the technical and application information included in this article is necessarily limited. Operating environments and conditions can materially affect the operating results of Therm-O-Disc™ products.

Users must determine the suitability of any Therm-O-Disc component for their specific application, including the level of reliability required, and are solely responsible for the function of the end-use product. It is important to review the Application Notes which can be found at [Emerson.com/thermodisc](https://www.emerson.com/thermodisc)

NTC Thermistor Temperature Sensors

Product Information and
Application Notes



THERM-O-DISC™


EMERSON™

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Together with our customers, Therm-O-Disc continuously works on new designs to meet the high demands of today's and future applications. We offer a wide range of NTC sensor packages, known for their long term stability and accurate measurements.

NTC thermistors are a semiconductor ceramic made with various metal oxides. Their electrical resistance decreases with increasing temperature. This resistance is processed by an electronic circuit to provide temperature measurement. While a bimetallic thermostat provides both temperature sensing and electrical circuit control, an NTC thermistor itself does not provide any control over heating elements, relays, etc. A thermistor is strictly a sensor and an electrical control would need to be implemented by the circuit utilizing the sensor.

Therm-O-Disc NTC Sensors offer economical, reliable and accurate solutions to those applications requiring more extensive sensing than the one or two temperature points typically offered by a bimetallic thermostat. NTC sensors provide a change in resistance with temperature that when combined with an electronic circuit provide a means of continuity measuring temperature over a wide range.

10J Series



The 10J series is a lead-wired temperature measurement sensor with a cost effective plastic shell. Custom designs can be developed if needed to meet complex application requirements. Complete or partial plastic designs can be developed with customized mounting features to fit various applications. Alternate materials and UL recognized models available upon request.

Specifications

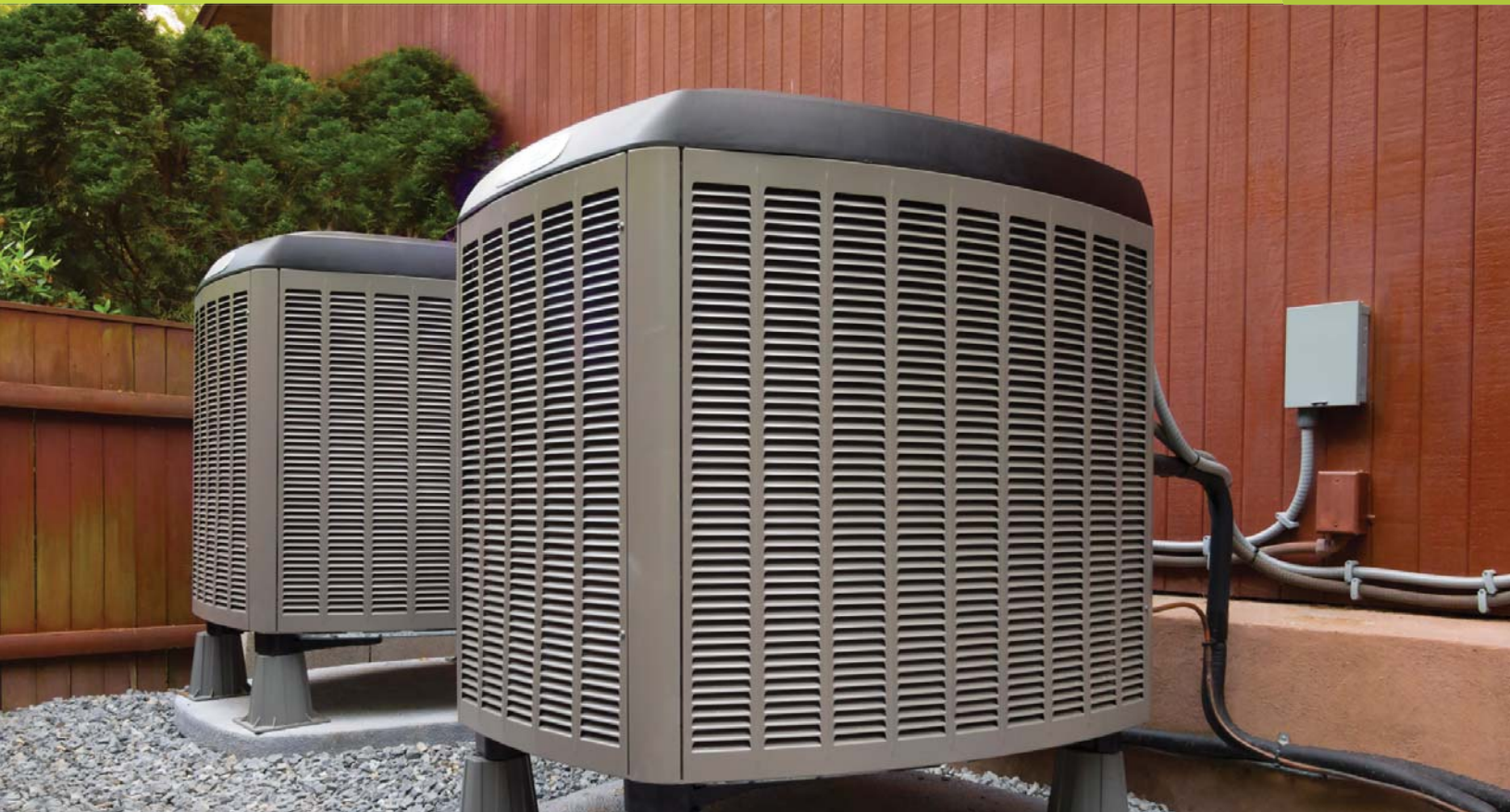
- Typical thermal time constant 10 sec. (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Typical operating temperature range -40°C to 80°C or -20° to 105°C (dependant on wire rating)
- Insulation strength 500VAC/0.5mA/2sec. (inquire for others)
- Stable performance with high degree of accuracy

Applications

- Heat Pumps
- HVAC
- Furnace



11J Series



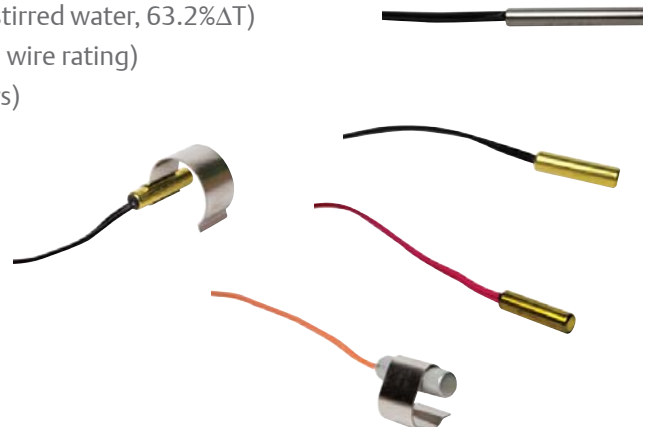
The 11J series is a lead-wired temperature measurement sensor with a brass/metal shell for use in HVAC systems. Custom designs can be developed if needed to meet complex application requirements. Brass or Stainless Steel designs can be developed with customized mounting features or one of several snap-on clips to fit various applications. UL recognized models available upon request.

Specifications

- Thermal time constant 10 sec. (measured: 25°C air to 85°C stirred water, 63.2%ΔT)
- Operating temperature range -40°C to 150°C (dependant on wire rating)
- Insulation strength 1500VAC/0.5mA/2sec. (inquire for others)
- Moisture resistance

Applications

- Floor Heating
- Heat Pumps
- Boilers
- HVAC
- Solar Water Heaters
- Ambient Air Temperature Sensing



12J Series



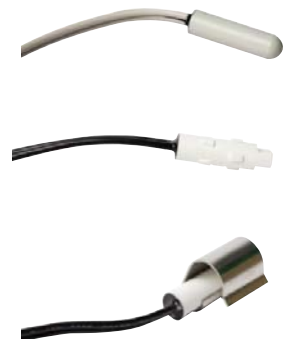
The 12J series is a lead-wired temperature measurement sensor with epoxy-filled plastic shell. Designed for use in refrigeration and other high humidity environments, it can also be used successfully in general purpose applications. UL recognized models available upon request.

Specifications

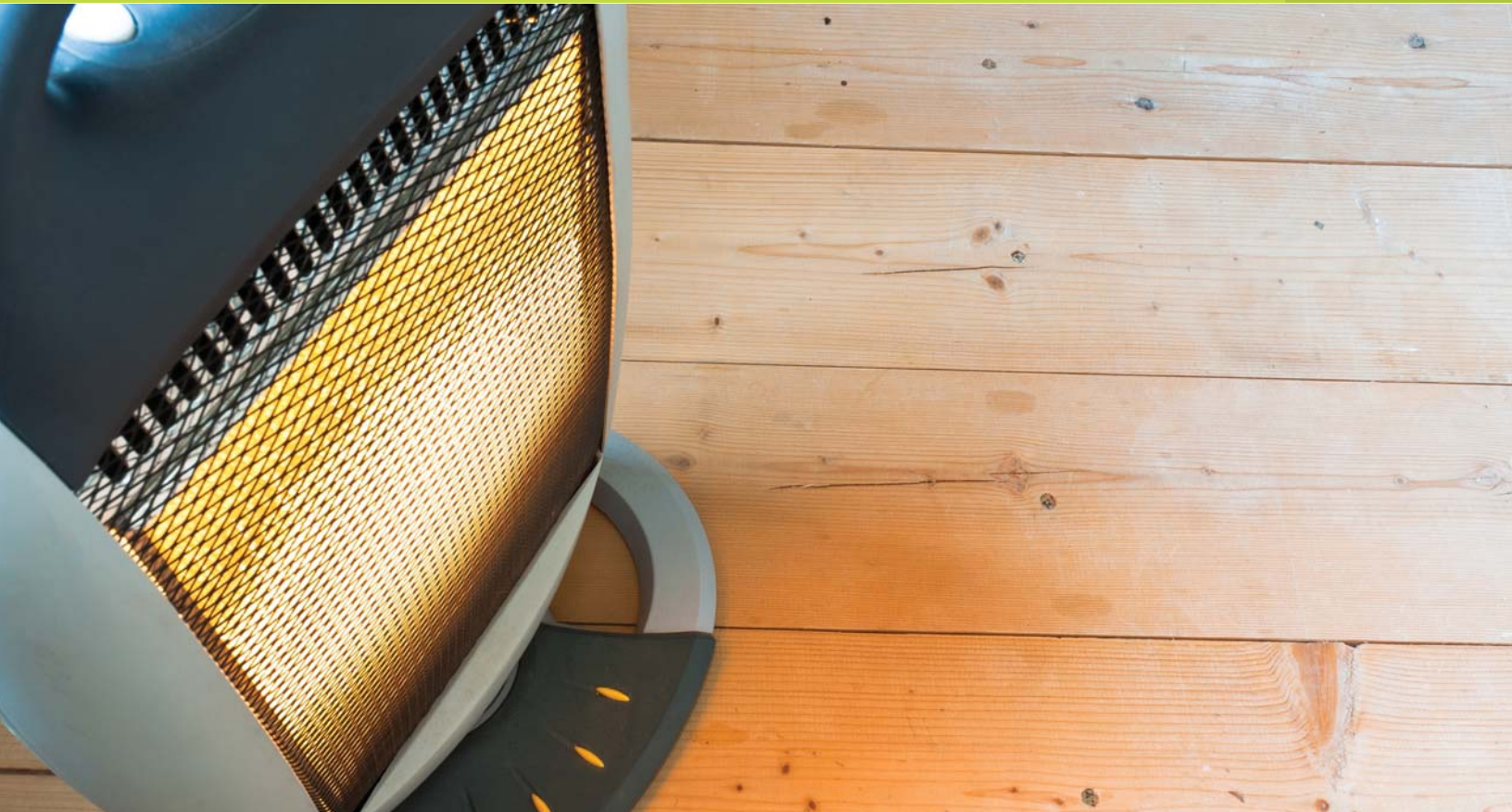
- Typical thermal time constant 11 sec. (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Operating temperature range -40°C to 80°C or -40°C to 105°C (dependant on wire rating)
- Temperature exposure 1000 hours at -20°C & at 80°C, typical < 1% ΔR
- Insulation strength 3750VAC/0.5mA/2sec.
- Stable performance with high degree of accuracy
- Moisture resistance

Applications

- Refrigeration systems
- Freezer compartments
- Floor Heating
- Heat pumps
- Boilers
- Ambient temperature sensing



13J Series



The 13J series is a lead-wired temperature measurement sensor for applications where small size and fast response time is required. Its design is focused on the heater requirements and widely used in dry and high temperature environments. UL recognized models available upon request.

Specifications

- Thermal time constant 0.9 to 5sec (dependant on configuration) (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Operating temperature range -40°C to 175°C (dependant on shrink tube and wire rating)
- Insulation strength 600VAC/0.5mA/2sec (dependant on shrink tube rating)
- Stable performance and high degree of accuracy

Applications

- Heater
- Humidifier
- Gas Boiler
- Ambient temperature sensing in dry environment
- HVAC systems



15J and 16J Series



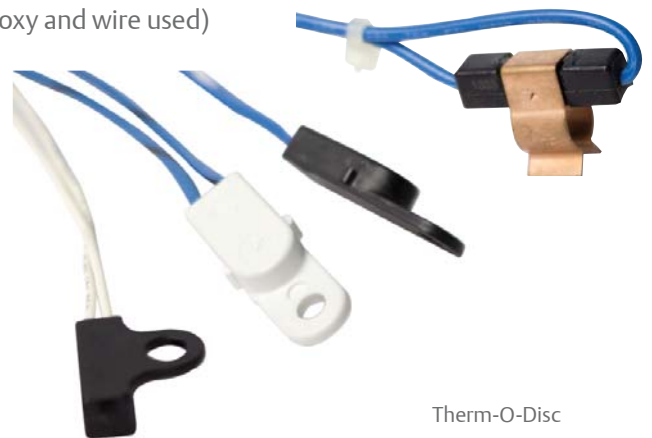
The 15J & 16J series are lead-wired temperature measurement sensors available as a fully-molded plastic body or epoxy-potted shell design with a Therm-O-Disc H-unit inside. These sensor types are typically designed for the refrigerator market but may be used in other humid environment applications. UL recognized models available upon request.

Specifications

- Thermal time constant: fully-molded 12-20 sec; epoxy-potted 13-15 sec. (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Operating temperature range -40°C up to 130°C (dependent on epoxy and wire used)
- Insulation strength 500VAC/0.5mA/2sec (inquire for others)
- Stable performance with high degree of accuracy

Applications

- Refrigerator
- Freezer compartments
- Ambient temperature sensing in humid environment
- HVAC systems
- Dishwashers



36J Series



36JB Series

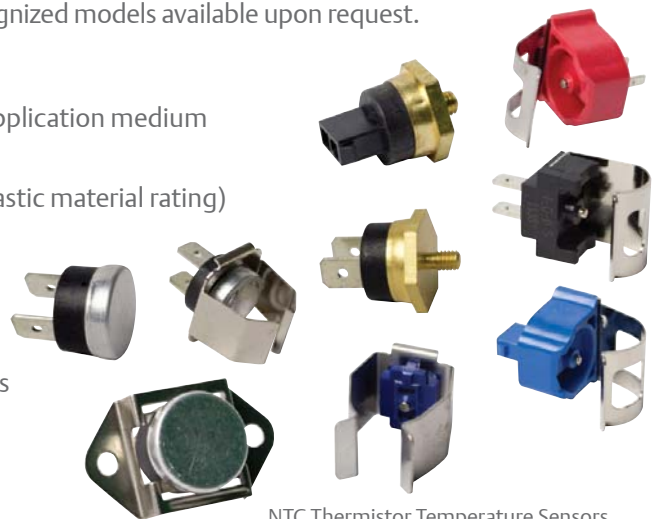
The 36JB series is a temperature measurement sensor based on the ½” thermostat design. It’s available with bead thermistor inside and comes in several well known designs as well as a fast response version. Designs can be developed with various mounting features including clips to fit various applications. UL recognized models available upon request.

Specifications

- Thermal time constant: 2-3 sec. (measured: 25°C air to 85°C, application medium [brass pipe, flatness, screw thread, or stirred water], 63.2% ΔT)
- Operating temperature range -40°C to 200°C (dependent on plastic material rating)
- Insulation strength 500VAC/0.5mA/2sec. (inquire for others)
- Moisture resistance

Applications

- Boiler Heating Systems
- Storage Water Heaters
- General fast response applications
- Small Appliances



36J Series

36JD Series

The 36JD series is a temperature measurement sensor based on the ½” thermostat design. It has two fast response thermistors inside and comes in the same housing design as 36JB/JH. By electronically analyzing the differential of both thermistors, this product replaces an NTC and a thermostat with a single device. Designs can be developed with various mounting features including clips to fit various applications.

Specifications

- Thermal time constant: 3-4 sec. (measured: 25°C air to 85°C application medium brass tube or hot plate, 63.2% ΔT)
- Operating temperature range -20°C to 130°C
- Insulation strength 500VAC/0.5mA/1sec. (inquire for others)
- Moisture resistance

Applications

- Boiler Heating Systems
- Instant Hot Water Heater



36JH Series

The 36JH series is a temperature measurement sensor based on the ½” thermostat design. It’s available with an H-Unit sensor inside and comes in numerous widely used designs. UL recognized models available upon request. Designs can be developed with various mounting features including clips to fit various applications.

Specifications

- Thermal time constant: 11 sec. (measured: 25°C air to 85°C application medium brass tube or hot plate, 63.2% ΔT)
- Operating temperature range -40°C to 200°C
- Insulation strength 1500VAC/0.5mA/2sec. (inquire for others)
- Moisture resistance

Applications

- Boiler Heating Systems
- AC Units
- Laundry
 - Clothes Dryer
 - Washer
- Dishwashers



74J and 75J Series



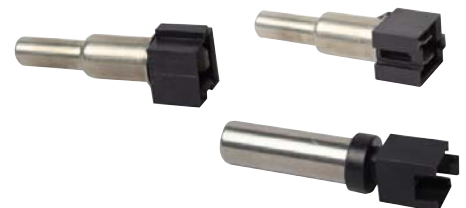
The 74J and 75J series temperature sensors are developed for major appliances like clothes washers and dishwashers. The 74J is available in an all-plastic design as well as stainless steel versions. Metal or plastic designs can be developed with customized features and connector options to fit various applications. The 75J is an all-plastic design. UL recognized models available upon request.

Specifications

- Typical thermal time constant 10-22 sec. dependant on material (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Typical operating temperature range -40°C to 130°C
- Insulation strength 3750VAC/0.5mA/1sec. (inquire for alternative values)
- Stable performance with high degree of accuracy

Applications

- Laundry
 - Washer
- Dishwasher
- Water Heaters



76J and 77J Series



These series are developed for air-stream temperature measurement with a plastic or metal shell, customized as needed to interface with application requirements. UL recognized models available upon request.

Applications

- Laundry
 - Clothes Dryer
 - Washer
- HVAC Air Duct Sensing



76J and 77J Series

76J Series

Complete or partial plastic designs typically developed with flange-style mounting features to fit various applications.

Specifications

- Typical thermal time constant (dependant on wire rating): (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
Metal – 1 sec. **Plastic** – dependent on plastic thickness.
- Typical operating temperature range -40°C to 125°C
- Insulation strength 1500VAC/0.5mA/2sec. (inquire for others)
- Stable performance with high degree of accuracy
- Moisture resistant



77J Series

Plastic and metal designs with flange-style mounting feature. Some plastic designs are Class II insulation compliant.

Specifications

- Thermal time constant (measured: 25°C air to 85°C stirred water, 63.2% ΔT)
Metal – 1 sec. **Plastic** – dependent on plastic thickness.
- Operating temperature range -40°C to 200°C (dependant on wire rating)
- Insulation strength 3750VAC/0.5mA/2sec. (inquire for others)
- Plastic sealed shell is moisture resistant



80J Series



The 80J series is a design solution with plastic cover and box, focused on the measurement of outdoor ambient temperature. Plastic designs can be developed with customized appearance and mounting features. Molded from UV resistant materials.

Specifications

- Typical operating temperature range -30°C to 60°C
- Temperature exposure 1000 hours at -20°C & at 80°C , typical $< 1\% \Delta R$
- Stable performance with high degree of accuracy

Applications

- Outdoor temperature sensing



93J Series



The 93J is a precise temperature measurement sensor with an ultra fast response time to be used in numerous applications. Both the immersion style and the flat-tipped version are available in various rugged designs. UL recognized models are available upon request.

Specifications

- Typical thermal time constant 1-2 sec. (dependent on tip configuration)
(measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Typical operating temperature range -40°C to 200°C (dependent on wire rating, epoxy rating and plastic)
- Insulation strength 500VAC/0.5mA/2sec. (inquire for others)
- Stable performance with high degree of accuracy
- Moisture resistant

Applications

- Boiler Heating Systems
- Bath/Spa (Shower units)
- Laundry
 - Dryer
 - Steamer
- Small Appliances
 - Coffee Makers
 - Single Brewers, Multi-Brewers
 - Kettles
 - Dishwasher



95J Series



The 95J series is a temperature measurement sensor intended to be immersed in direct contact with liquids like water or flue gases. It has a small tip with a fast response and comes in several designs with different molded connector types and thread options. Metal or plastic designs can be developed with customized mounting features to fit various applications. UL recognized models available upon request.

Specifications

- Typical thermal time constant 1-1.8 sec. (dependent on tip configuration)
(measured: 25°C air to 85°C stirred water, 63.2% ΔT)
- Typical operating temperature range -40°C to 140°C (dependant on wire rating)
- Insulation strength 500VAC/0.5mA/2sec. (inquire for others)
- Stable performance with high degree of accuracy
- Moisture resistant

Applications

- Boiler Heating Systems
- Storage water heaters
- Other fast response in liquid applications
- Exhaust gas temperature detection



Automotive and RV



These custom designs can be developed with easy mounting features to fit various applications for sensing air or fluid temperature in engine or interior HVAC applications of automotive and recreational vehicles.

Applications

- Ambient Air Temp
- Intake Air Temp
- HVAC Temp
- Engine Temp
- Battery Temp – Electric & Hybrid Vehicles



Automotive and RV

Specifications

Ambient Air Temp Sensors

All-plastic designs for measuring ambient air temperature

- Fast thermal response
- Stable performance with high degree of accuracy
- Operating temp range -40° to 105°C
- Various mounting and interface configurations
- Moisture resistant

Intake Air Temp Sensors

Measures average temperature of air intake to the engine.

HVAC Air Temp Sensors

Measures temperature of air flow in interior air ducts and evaporator fins.

- Fast thermal response
- Stable performance with high degree of accuracy
- Operating temp range -40° to 85°C
- Various mounting and interface configurations
- Moisture resistant

Engine Coolant and Exhaust Temp Sensors

Measure temperature of fluid in engine coolant or exhaust gas applications.

- Fast thermal response
- Stable performance with high degree of accuracy
- Operating temp range -40° to 150°C; 250°C for exhaust gas sensor
- Various mounting and interface configurations
- Moisture resistant

Battery Temp Sensors

Measure temperature of battery cell or battery coolant applications.

- Fast thermal response
- Stable performance with high degree of accuracy
- Operating temp range -40° to 85°C to 100°C (depending on design)
- Various mounting and interface configurations
- Moisture resistant

For custom designs to meet your application needs, contact a Therm-O-Disc Sales Engineer. Refer to Technical Data for BETA specs.



Technical Data

Typical Resistance/Temperature

T (°C)	Grade 1	Grade 5	Grade 9	Grade 15	Grade 18	Grade 19
	B25/85=3977K	B25/85=4107K	B25/85=3435K	B25/85=3740K	B25/85=4269K	B25/85=3468K
Multiplier						
-40	33.731	37.254	19.582	25.792	43.675	21.650
-35	24.320	26.633	14.828	19.117	30.734	16.235
-30	17.741	19.258	11.343	14.308	21.888	12.302
-25	13.080	14.068	8.7613	10.808	15.766	9.413
-20	9.7391	10.382	6.8274	8.235	11.481	7.269
-15	7.3206	7.7426	5.3675	6.3280	8.4469	5.6631
-10	5.5531	5.8255	4.2524	4.9020	6.2765	4.4483
-5	4.2457	4.4229	3.3904	3.8260	4.7080	3.5214
0	3.2741	3.3847	2.7226	3.0080	3.5634	2.8084
5	2.5446	2.6125	2.2026	2.3830	2.7204	2.2555
10	1.9930	2.0342	1.7929	1.8990	2.0940	1.8236
15	1.5726	1.5947	1.4675	1.5240	1.6246	1.4838
20	1.2497	1.2594	1.2081	1.2310	1.2700	1.2146
25	1	1	1	1	1	1
30	0.8055	0.8008	0.8314	0.8171	0.7929	0.8282
35	0.6529	0.8448	0.6947	0.6713	0.6329	0.6897
40	0.5324	0.5223	0.5833	0.5544	0.5084	0.5774
45	0.4367	0.4256	0.4916	0.4603	0.4109	0.4858
50	0.3602	0.3487	0.416	0.3841	0.3340	0.4106
55	0.2986	0.2872	0.3534	0.3219	0.2731	0.3487
60	0.2488	0.2379	0.3013	0.2711	0.2245	0.2974
65	0.2083	0.198	0.2585	0.2293	0.1855	0.2547
70	0.1752	0.1655	0.2227	0.1948	0.1541	0.2191
75	0.1481	0.1389	0.1324	0.1662	0.1286	0.1891
80	0.1257	0.1174	0.1668	0.1423	0.1078	0.1639
85	0.1070	0.0995	0.14510	0.12230	0.09083	0.14246
90	0.0916	0.0847	0.12697	0.10550	0.07683	0.12434
95	0.0787	0.0724	0.11115	0.09133	0.06526	0.10886
100	0.0680	0.0621	0.09760	0.07935	0.05566	0.09560
105	0.05890	0.0535	0.08596	0.06917	0.04766	0.08420
110	0.05118	0.0462	0.07593	0.06048	0.04096	0.07438
115	0.04466	0.0401	0.06726	0.05305	0.03533	0.06588
120	0.03911	0.0349	0.05926	0.04668	0.03058	0.05850
125	0.03435	0.0304	0.05324	0.04119	0.02656	0.05209
130	0.03028	0.0267	0.04756	0.03645	0.02314	0.04649
135	0.02676	0.0234	0.04260	0.03234	0.02023	0.04158
140	0.02373	0.0206	0.03826	0.02878	0.01773	0.03729
145	0.02109	0.0182	0.03443	0.02567	0.01559	0.03351
150	0.01879	0.0162	0.03106	0.02295	0.01375	0.03018

For higher temp values, contact a Therm-O-Disc Sales Engineer.

Product Nomenclature

Thermistors

Model Designation System

XXJ	1B	XXXXX
I	II	III

- I – Series designator, where X is any numeral between 0-9
- II – BETA value indicator + NTC type (Ex: 1B, 1C, 1E, 1G, 1H, 1M, 1R, 1S, etc.)
- III – Customer specific numbers (4 or 5 digits)

Product Nomenclature

Thermistors – UL Recognized

Model Designation System

XXJ	1B	A	M	XXXXX
I	II	III	IV	V

- I – Series designator, where X is any numeral between 0-9
- II – BETA value indicator + NTC type (Ex: 1B, 1E, 1G, 1H, 1M, 1R, etc.)
- III – Temperature rating – A, B, C etc. – See table below for details

III	Max Op Temp
A	80
B	90
C	105
D	120
E	125
F	130
G	150
H	180
K	200

- IV – Construction
 - E - Plastic shell with epoxy fill
 - M - Metal shell
 - R - Molded in plastic
 - X - Not insulated with or without shell
- V – Customer specific numbers (4 or 5 digits)

Important Notice

The scope of the technical and application information included in this article is necessarily limited. Operating environments and conditions can materially affect the operating results of Therm-O-Disc™ products. Users must determine the suitability of any Therm-O-Disc component for their specific application, including the level of reliability required, and are solely responsible for the function of the end-use product. It is important to review the Application Notes which can be found at www.tod.com.

The warranty of this product stated in the terms and conditions of sale does not extend to any losses or damages due to misuse, accident, abuse, neglect, normal wear and tear, negligence (other than Seller's), unauthorized modification or alteration, use beyond rate capacity, or improper installation, maintenance or application. To the extent that Buyer or its agents has supplied specifications, information, representation of operating conditions or other data to Seller in the selection or design of the product and preparation of Seller's quotation, and in the event that actual operating conditions or other conditions differ from those represented by Buyer, any warranties or other provisions contained herein which are affected by such conditions shall be null and void. Buyer is solely responsible for determining the suitability of this product for its application. Furthermore, Buyer is solely responsible for the function of the end-use product. Seller terms and conditions apply.

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EMERSON. CONSIDER IT SOLVED.™

Hermetic Solutions

- Air Conditioning & Refrigeration
- Industrial

Product Information



FUSITE™



About the Fusite Brand

When an application demands a robust electrical or signal connection to bridge an inert atmosphere or vacuum on one side and a high-pressure, high-temperature or corrosive condition on the other, Fusite hermetic solutions have helped our customers achieve mission success for more than 75 years.

Founded during World War II, the company introduced a one-piece hermetically sealed electrical feedthrough which provided all-weather protection to sensitive military equipment. The technology was soon adopted by the Air Conditioning and Refrigeration (AC/R) compressor industry, where the name Fusite became synonymous with the compressor's electrical feedthrough. Fusite hermetic solutions are now found in numerous applications for AC/R, processing industries, energy storage, defense, aerospace and telecommunications, to name a few.

A global brand, Fusite's manufacturing footprint includes plants in USA, Europe and Asia. In addition to sealing glass to metal, Fusite also is vertically integrated with plating, brazing, soldering and welding, as well as manufacturing of copper core conductor pins and glass.

The company employs a broad range of engineers with technical expertise in materials engineering. Engineering facilities house state-of-the-art equipment to conduct material system analysis, mechanical/electrical design and testing, thermal imaging, shock/cycle testing, burst testing and finite element analysis.

Table of Contents

AC/R

- Compressor feedthroughs
- Semi-Hermetic Electrical Feedthroughs
- Single Pin Feedthroughs
- CO₂ Compressor Feedthroughs
- Sight Glasses
- Connector Blocks

Industrial

- Sensor Feedthroughs
- Pump Feedthroughs
- Hybrid Car Compressor Electrical Feedthroughs
- Battery Feedthroughs



Compressor Feedthroughs

Fusite manufactures premium glass-to-metal (GTM) hermetic seals, connectors, feedthroughs, and related components for air conditioning and refrigeration applications.

When high reliability throughout the lifecycle of a compressor or pump is needed, Fusite is one of the world's most trusted sources, ensuring consistent quality no matter what size the order.

In environments where refrigerants or other compressed materials are contained in a sealed system, our GTM hermetic feedthroughs allow a secure and reliable means to pass electrical power from an outside source to the motor inside.

We produce feedthroughs for everything from fractional 1/4 horsepower electric motors (up to 300 volts), all the way up to large 40 horsepower commercial integral motors (up to 600 volts).

Primary Applications

As a worldwide leader in glass-to-metal hermetic seals for refrigerator, freezer, and air conditioning compressor applications, Fusite manufactures hundreds of millions of compressor feedthroughs each year. Our feedthroughs are also used in vending machines, heat pumps, and other pressurized systems.

Other Application Areas

In addition to feedthroughs that meet a variety of commonly used refrigerants (such as R22, R134a, R410a), Fusite has developed products for higher pressure applications such as CO₂.

Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: Min. 2500 volts @ < 0.5 mA leakage
- Burst pressure: Typical GTM seals meet or exceed 2,250 psi pressure test, but should be verified in customer specific applications.
- Regulatory: UL Recognition

Customization

We also custom design compressor and pump feedthroughs for a variety of applications, with specialized features such as:

- Solid pin and high-conductivity copper core pins (produced in-house by Fusite)
- Molded silicone rubber for outside electrical over-surface
- Heavy duty ceramic insulators for inside electrical over-surface
- Glass pre-forms are produced from Fusite's proprietary custom smelted glass
- Straight pin, flags, and connector block connections
- Single-pin and multi-pin configurations
- Resistance-welded and bolt-on attachment styles



Semi-Hermetic Electric Feedthroughs

Fusite offers Plate models and Power Bolts, which provide a means for compressor manufacturers to make service connections for power.

Fusite's high-amperage and power-bolt feedthroughs utilize state-of-the-art glass-to-metal (GTM) sealing technology and insulating properties to accommodate high-amperage applications.

These feedthroughs are available in single-pin or multi-pin configurations which can be directly sealed or threaded into a mounting plate.

Applications

Our high-amperage feedthroughs are used in commercial air conditioners, pumps, large chillers, screw compressors, and other high-amperage applications.

Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: 5000 volts @ < 0.5 mA leakage utilizing ceramic insulators or rubber over molding
- Current carrying capacity: Up to 400 A with terminal pin materials such as solid stainless, stainless with copper core, and carbon steel
- Operating pressure: Up to 1450 psi or to our customers' specification
- Regulatory: UL Recognition on select models



Single Pin Feedthroughs

For limited space conditions, Fusite offers a full range of standard single-pin feedthroughs with durable hermetic seals, with typical power and sensor applications up to 20 A continuous. Both weld-in and threaded style designs are available in various pin materials.



Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: Min. 2500 volts @ < 0.5 mA leakage
- Burst pressure: Typical GTM seals meet or exceed 2,250 psi pressure test, but should be verified in customer specific applications.
- Regulatory: UL Recognition on select models

CO₂ Compressor Feedthroughs

Because of Fusite's long history of glass-to-metal experience, we understand the complexities of CO₂ compressors, including the type of specialized materials required for this application. As GTM experts, we are able to design electrical feedthroughs for CO₂ compressors that allow for higher operating pressure required by CO₂ refrigerant.



Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: Min. 2500 volts @ < 0.5 mA leakage
- Burst pressure: Typical GTM seals meet or exceed 8,000 psi pressure test, but should be verified in customer specific applications.
- Regulatory: UL Recognition on select models

Sight Glasses

Fusite uses its leading-edge glass-to-metal (GTM) sealing process to create highly compressed seals for hermetic sight glasses that are used as windows for visual level and flow indicators in high-pressure or vacuum applications. We offer a variety of bolt-on, weld-in, and threaded configurations. Standard models include single port glasses for simple level checking and multiple port glasses for more complex systems.

Applications

Fusite sight glasses can be used to check liquid levels in pumps, compressors, or other components requiring visual level or flow checks. Typically sight glasses utilize thread and hexagon bodies for flat gasket seals, with flange-type bodies for bolt mounting for O-ring seals, and also for solder mounting and resistance welding.



Typical Specifications

- Hermeticity: $<1 \times 10^{-7}$ standard cc/sec helium
- Burst pressure: Up to 15,000 psi, or to our customers' specifications
- Regulatory: Recognized by global regulatory agencies (such as UL, TUV, and GL) on select models

Customization

Fusite has broad capabilities to develop customized sight glasses to meet customer-specific requirements. The customization options we offer include:

- Housing material: Low/mild carbon steel, stainless steel
- Solder mounting and resistance welding versions
- Various plating finishes: Nickel, trivalent chromate, tin
- Customized viewing areas: Recessed prism, annular/round prism, waffle prism, and clear sight
- Thread and hexagon bodies for flat gasket seals, with flange-type bodies for bolt mounting for O-ring seals

Connector Blocks

Fusite offers connector blocks, which provide a means for compressor manufacturers to make service connections for power.



Sensor Feedthroughs

Fusite's extensive glass-to-metal (GTM) experience solves the toughest of sensor feedthroughs production and performance challenges, especially in process instrument applications where there is an inert atmosphere or vacuum on one side and wide-ranging high-pressure, high-temperature, or corrosive conditions on the other.

Fusite increases sensor feedthroughs performance with its hermetic sealing capabilities that ensure enduring reliability.

Applications

Fusite hermetic sensor headers, sensor feedthroughs, and multi-pin connectors are used in a variety of process instrument applications including pressure, vacuum, flow, oil and gas, petrochemical, and thermal sensors, as well as other sensor applications.

Customization

Fusite has broad capabilities for developing customized hermetic sensor feedthroughs, headers and connectors, with these options:

- Hermetic sealing to various metals including CRS, stainless steel, high temperature alloys, copper and titanium
- Hermetic sealing of all standard materials brazed assemblies, including components such as tubes and pins
- Specialization in process development with the ability to scale up from manual low-volume assembly to fully automated high-volume production
- Expertise in custom assembly and test fixture designs
- In-house plating: Nickel and gold plating (soft and hard) to customer specifications
- Capability to test hermeticity to 1×10^{-9} std. cc/sec helium

Typical Specifications

- Hermeticity: $< 1 \times 10^{-8}$ std. cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: 600 volts @ < 0.5 mA leakage
- Burst Pressure: Up to 25,000 psi, depending on the application
- For any application requiring hermetic signal feedthroughs, electronic packages, or sensor housings, headers, and packaging



Pump Feedthroughs

Fusite designs and develops custom glass-to-metal (GTM) feedthroughs for use in the industrial and commercial pump industry to meet the specific application requirements of our customers. Our feedthroughs stand up to harsh environments and meet the durability and high reliability requirements of major pump OEMs around the world.

Applications

Fusite GTM feedthroughs are custom designed for various pump applications, including water pumps, slurry pumps, chemical pumps, and mixed-use pumps.

Customization

Fusite has broad capabilities to develop customized pump feedthroughs to meet customer-specific requirements. The customization options we offer include:

- Solid pin and high conductivity copper core pins (produced in-house by Fusite)
- Molded silicone rubber for outside electrical over-surface
- Heavy duty ceramic insulators for inside electrical over-surface
- Glass pre-forms are produced from Fusite's proprietary custom smelted glass
- Straight pin, flags, and connector block connections
- Single-pin and multi-pin configurations
- Resistance-welded and bolt-on attachment styles

Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: Min. 2500 volts @ < 0.5 mA leakage
- Burst pressure: Typical GTM seals meet or exceed 2,250 psi pressure test, but should be verified in customer specific applications
- Regulatory: UL Recognition on select models



Hybrid Car Compressor Electrical Feedthroughs

Relying on 70 years of experience in manufacturing premium glass-to-metal (GTM) hermetic seals for AC/R applications, Fusite designed the first feedthrough in the world for use in hybrid electric vehicle air conditioning (AC) compressors.

We continue to provide innovative GTM products and solutions, such as electrically driven AC compressors, to most of the existing and emerging hybrid and all-electric vehicle OEMs around the globe.

Applications

Fusite GTM feedthroughs are custom designed for hybrid vehicle and all-electric vehicle AC compressors.

Customization

Fusite delivers custom designs for hybrid auto compressor customers with the following design options:

- Molded silicone rubber for outside electrical over-surface
- Heavy duty ceramic insulators for inside electrical over-surface
- Straight pin, flag or tab-style pin connections
- Resistance-welded and bolt-on attachment styles

Typical Specifications

- Hermeticity: $< 1 \times 10^{-7}$ standard cc/sec helium
- Insulation resistance: $> 10,000$ megohm @ 500 VDC
- Dielectric voltage: Min. 2500 volts @ < 0.5 mA leakage
- Burst pressure: Should be verified in customer specific applications.



Battery Feedthroughs

Fusite manufactures battery seals designed for extreme temperature environments and long-endurance applications. Fusite's glass-to-metal seals can also withstand the harshest corrosives.

Fusite employs specialized high-volume manufacturing processes and techniques, such as proprietary corrosion-resistant glasses, vision inspection, and vibratory assembly machinery. This provides the best overall value and highest reliability whether the requirement is for a small quantity of prototypes or millions of units.

Applications

Fusite high reliability battery seals and lids are used worldwide in aerospace power and automotive mixed-use applications, as well as military hand-held radio communications, surveillance systems, and battery back-up systems.

Customization

Fusite engineers are experts at creating custom designs to meet engineering specifications, often turning prototype drawings around in less than 24 hours. With broad and deep experience, each Fusite custom design has the highest degree of performance reliability available today.

Typical Specifications

- Hermeticity: Better than 1×10^{-8} cc/sec helium
- Battery seals and lids are produced with components compatible with, lithium thionyl chloride, lithium sulphur dioxide, and lithium manganese dioxide
- Standard sizes include 1/2AA through D
- Models can be either resistance or laser-welded onto a battery lid
- For any application requiring hermetic battery seals, lids, terminals, or batteries requiring lithium or silver-zinc hermetic seals
- Ability to combine pure metals, such as molybdenum used in feedthrough pins and stainless or cold-rolled steel used in battery bodies, with corrosion-resistant glass (e.g. TA-23) in battery seals and lids for the utmost in reliability, performance, and durability





About Emerson

Emerson (NYSE: EMR), headquartered in St. Louis, Missouri (USA), is a global technology and engineering company providing innovative solutions for customers in industrial, commercial, and residential markets. Our Emerson Automation Solutions business helps process, hybrid, and discrete manufacturers maximize production, protect personnel and the environment while optimizing their energy and operating costs. Our Emerson Commercial and Residential Solutions business helps ensure human comfort and health, protect food quality and safety, advance energy efficiency, and create sustainable infrastructure. For more information visit **Emerson.com**.



Scan with your smartphone
for more information or visit
Emerson.com/fusite

Important Notice

The scope of the technical and application information included in this article is necessarily limited. Operating environments and conditions can materially affect the operating results of Fusite™ products.

Users must determine the suitability of any Thermodisc component for their specific application, including the level of reliability required, and are solely responsible for the function of the end-use product. While every precaution has been taken to ensure accuracy and completeness herein, Fusite assumes no responsibility, and disclaims all liability, for damages resulting from use of this information or for any errors or omissions. Specifications are subject to change without notice. It is important to review the Application Notes which can be found at [Emerson.com/fusite](https://www.emerson.com/fusite). Seller terms and conditions apply.

Hermetic Solutions

- Aerospace
- Defense

Product Overview



THUNDERLINE 


EMERSON™

Trust Your Circuits to the Globally Recognized Hermetic Packaging Professionals

Contents

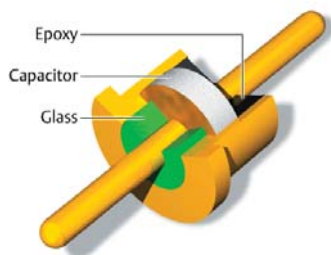
- Thunderline Feedthrus 3
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For over thirty years, Thunderline-Z has provided innovative and reliable solutions for glass-to-metal seal components and packages all over the world. Whether your need is for a feedthru, or a complex package with multiple solder schedules, we will assist you from preliminary design to volume manufacturing. By tapping into our technical experience in solder and furnace applications, and oven profiling, you can shorten your design cycles and eliminate wasteful prototyping. Our engineers are trained to work with your design team, providing support and information that is used to create the best glass-to-metal seal solution.

We are experienced in all aspects of military, commercial, and space applications, and deliver value added glass-to-metal seal solutions.

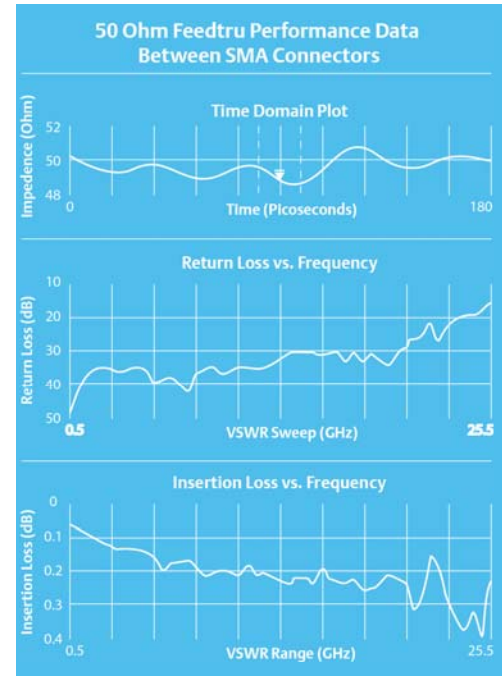
Thunderline Feedthrus

Thunderline-Z (TZ) is recognized the world over for manufacturing premium quality RF and DC feedthrus. We have achieved this reputation as a result of our attention to tight control of tolerances and unyielding commitment to clearly documented manufacturing processes. The result is optimum capability to yield up to zero meniscus levels in our feedthrus. Zero meniscus delivers high frequency response while also maintaining the metal-to-metal contact necessary to achieve optimal power transfer.



In addition to offering hundreds of standard RF and DC feedthrus, we specialize in incorporating filtering directly inside our DC feedthrus for capacitance requirements. Thunderline CapFeeds™ filter unwanted interference via an

integrated capacitor across the DC line. This capacitor can range in value from 10 to 33,000 picofarads. The value of this capacitor is chosen based on the frequency of the spurious signal required to be shunted to the ground. TZ utilizes proprietary SolderTight™ construction to add this filtering capacitor which allows for varied soldering schedules up to 300°C.



Thunderline 50s™
Our premium quality RF/50 Ohm feedthrus come in pin diameters from 0.009" to 0.020" and performance up to 65 GHz.



Thunderline DC Feeds™
These rugged DC feedthrus come in an infinite mix of pin, body diameters, and lengths.



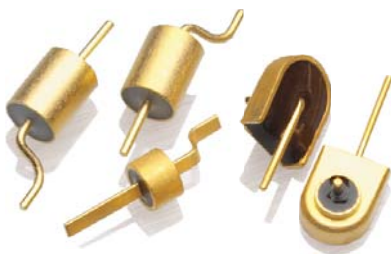
Thunderline CapFeeds™
These capacitive feedthrus are available in body diameters from 0.098". A range of capacitance values at varying tolerances is available.

Our experience has yielded an impressive design library of Kovar and steel RF, DC, and capacitive feedthrus. We also offer varied pin tip options and body and pin length and diameters.

To find a solution that is right for you, simply visit our website and our online tools. When you are finished with these tools and your attention turns to our prototypes, contact our highly skilled sales support team who will search our available feedthru inventory for samples.

Feedthru Fast Facts
Pin Sizes .009" through .040"
RF Performance up to 65 GHz
Hermeticity 1×10^{-8} ccHe/sec @ 1 atm
DC Feedthrus Kovar and Steel
Surface Mount RF & DC
Dual Diameter Pins
Multi-Pin Feedthrus
Capacitive Feedthrus 10 pf to 33,000 pf
Flange and Straight Body
Plate Options Gold or Tin
Pin Tip Options Flattened, Flattened and Pierced, Gull Wing Bend, Nail Head, Radiused, Straight Cut, Probe, Angled, Cone, Notched, Right Angle

Frequency GHz	Pin Dia. P/D	Body Dia. B/D	Body Length
65	.009	.068	.055
42	.012	.076	.040
42	.012	.076	.055
42	.012	.076	.075
42	.012	.076	.120
42	.012	.076	.160
28	.015	.098	.035
28	.015	.098	.040
28	.015	.098	.060
28	.015	.098	.062
28	.015	.098	.075
28	.015	.098	.090
28	.015	.098	.125
18	.018	.110	.040
18	.018	.110	.060
18	.018	.110	.090
8	.020	.158	.060
8	.020	.158	.060



Thunderline SMT Pins™
Thunderline-Z offers a variety of conventional bent pin feedthrus, as well as the new Thunderline BellPin™-- a revolutionary patented design that provides optimal surface mount contact.



Thunderline Multi-Pins™
These multi-pin headers come in a variety of styles from 2 pin up to 10 or more pins. They are built for both DC and RF applications up to 42 GHz and are available with combined RF and DC functionality in the same header.



Thunderline Thread-In Feedthrus™
Designed for floor installations not requiring hermeticity, Thunderline-Z Thread-In Feedthrus offer easy and reliable installation. In both DC and RF styles, these parts not only offer an excellent alternative to messy epoxy installation but also serve as an easy repair pin solution.

Custom Packaging

An advanced, flexible approach to creating premium custom packages

We can assist you with choosing the right approach to creating your custom packages. Whether your solution calls for our SolderTight or DirectBond™ processes, we will guide you through every step in creating a rugged and reliable glass-to-metal seal package.

Our expertise includes working with Kovar™, aluminum, alumina alloys, brass, cold rolled steel (CRS), stainless steel, and inconel. Our experienced engineers will work closely with you with layout and can recommend hole sizes, oven profiling and solder selection. They will help you create a superior package design by optimizing holes for direct sealing Kovar or soldering into aluminum. Besides being experts in the use of gold/tin solder, we are also adept at other solders such as Sn96.

If you need a hybrid solution using both direct fire and solder we can assist you in mapping out the proper sequence of manufacturing.

Hermeticity is achievable to 1×10^{-9} ccHe/sec @1 atm.

Manufacturing Services

Solder
8 Zone Solder Reflow Oven

Direct Fire
Belt glass/ Brazing Furnaces

Brazing

Laser Welding

Temperature Profiling

Machining

Plating

Wire Cutting

Advanced Test & Measurement

SolderTight™

SolderTight technology blends Thunderline-Z's years of experience with proprietary soldering oven profiling techniques to create premium packages.

DirectBond™

DirectBond is our answer to the need for extremely high performance direct sealed packages where glass is matched and sealed directly to a metal housing.

ZBond™

Zbond brazing technology is used in combination with our DirectBond packaging solutions to add value when additional components such as ground pins, heat sinks, pads, and exhaust tubes need to be bonded within a package.

Components Installed

Thunderline 50s

Thunderline CapFeeds

Thunderline DCFeeds

Thunderline BellPins

Thunderline Profit Feeds

Thunderline Multipins

Press-on Connectors

Field Replaceable SMAs

Grounding Pins

Solder Experience

Gold/Tin (80/20)

Tin based (Sn96, Sb5)

Plating Options

Nickel *Gold*

Silver *Copper*

Tin

Base Materials

Kovar

Aluminum

Cold Rolled Steel (CRS)

Inconel

Stainless Steel

Copper

Brass

Perfected Process, Optimal Quality

A perfected process leads to optimal quality

At Thunderline-Z, quality is built into our entire process, leaving final inspection as a cross-check of our procedures.

Quality Assurance and Reliability Testing

We provide products to a variety of customers in both the military and commercial marketplace. As such, we work with many standards and specifications. Our QA group also works diligently with our design and manufacturing teams to install inspection criteria into the beginning, middle, and end of our entire process. By building in quality at every step in the manufacturing process, we continue to secure our position as the true leader in the glass-to-metal seal industry.

Inspection and Reliability Testing

Quality Standard MIL-I-45208A

Calibrations System MIL-STD 883

Audited to ISO 9001:2015

RoHs Compliance

DFARS Clause 252.225-7014

X-Ray Analysis First Article or 100%

Dye Penetrate Evaluation

Dimensions:

Drop Gauges, Micrometer, Vernier Deltronic Optical Comparitor

Coordinate Measurement Machine (CMM)

Stabilization Bake MIL-STD 883/ Method 1008.2

Temperature Cycling MIL-STD 883/Method 1010.7

Helium Fine Leak Test MIL-STD 883/ Method 1014.1

Electrical Hi-Pot and Continuity 202/ Method 301

Capacitance

Steam Age

Solderability

Lead Integrity

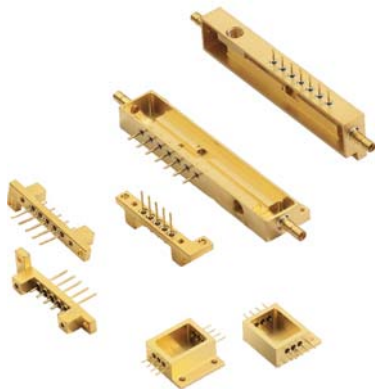
Moisture

Salt Spray



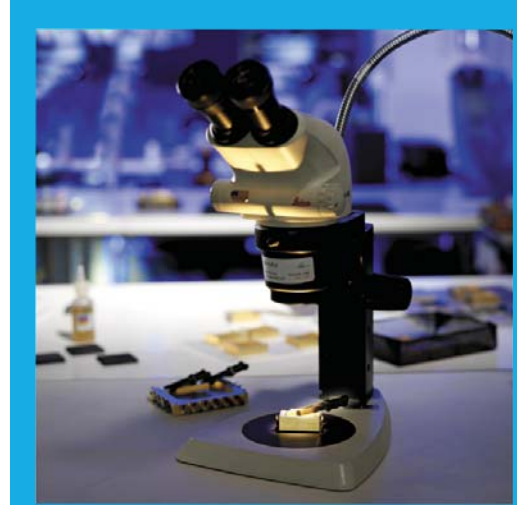
Temperature Profiling

The key to helping ensure a reliable, high quality, hermetic seal lies in establishing proper oven profiles. TZ utilizes state-of-the-art multi-atmosphere and multi-zone temperature solder ovens and glass furnaces to create unique settings for various requirements. As part of the first article evaluation, our skilled operators evaluate each design for thermal mass, temperature coefficient of expansion, fixturing, plating, solder type and other key criteria to establish a precise oven profile for each assembly. Once identified, each oven profile is stored in our operation methods for use in future builds. Whether your need is for a solder module, or a matched glass seal, direct fire assembly, we have the right combination of equipment and experience to provide you a high performance, hermetic package. With over thirty years of solder and direct fire experience, Thunderline-Z has the expertise to deliver your design on schedule and in budget.



Machined Housings

Thunderline-Z has extensive knowledge of housing materials and plating finishes, and a wide array of component installation options. With tolerance as tight as 0.001 inches, our attention to detail is second to none.



Fixturing

We design, build, and control every aspect of the fixturing used in the assembly process. Fixturing is the key to reliability and repeatability of both our feedthrus and packages. Each require extremely tight-tolerance, machine carbon fixtures. Our design team can guide you through first article units, providing stress testing and mechanical evaluation as required prior to the first volume build. In-house control of our fixtures, combined with archived oven profiles (which are verified with every repeat build) are important steps in our quality assurance program.



Laser Sealing Capabilities

Laser Lidding

With a state-of-the-art laser center, we are your total RF/Microwave packaging solution provider. High powered laser systems complete the packaging cycle and offer the best solution to lidding concerns. Our laser technicians are highly skilled in delivering consistent, repeatable seals and are specialists for stability. Using a combination of continuously variable laser power and pulse shaping techniques, our team achieves consistently accurate welds between lids and packaged housings while employing the know-how to work around critical circuit paths.

Component Installation

With a second station in our laser center featuring a low-power laser system, we can perform reliable placement and sealing of the most challenging feedthrus and connectors. Compared to conventional solder sealing or seam sealing approaches, our laser welding forms the most robust metal-to-metal seal around the perimeter of a package. This maintains a higher level of hermeticity for the most demanding environments, including Class S (space-based) applications.

Laser Center Features

- State-of-the-art ND YAG laser
- Glove box welder for hermetic packages
- Stand-alone Class IV system for component installation
- Adjustable environment
- ANSI/ESD S20.20 compliant
- Fine and gross leak testing method 112, condition C and D
- Cross-sectional analysis
- X-ray analysis

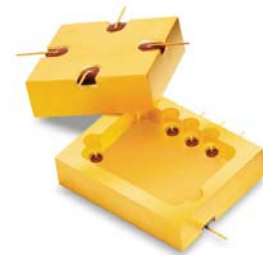
Built for Customization and Innovation

Complex machining? Varied solder schedules? Direct fire/solder combinations? Internal connections? Component mounting? Exotic plating? Filtered connections?

You name it, we have your packaging issues covered.

Go with the Pros

We are dedicated to supplying high quality hermetic packages. We've optimized our electrical design, RF design, application engineering, fixturing, tooling, machining, wire and lead fabrication, sealing and brazing departments into a one-stop resource. When combining DC and RF leads in the same package, there are many technical issues to consider: mechanical tolerances that affect RF or electrical performance; power dissipation; material selection; and solder options. We are fully equipped to handle these issues efficiently.



Our surface mount bell pins are available in .015" and .009" diameter, affording designers performance options well into K-band

Visit Emerson.com for more details.





Custom Packaging Capabilities

Hermetically Engineered RF/Microwave Modules

Thunderline-Z's advanced hermetic package manufacturing line employs multi-atmosphere and multi-zone oven temperature control, along with a broad range of soldering technology in the microwave business. Our expertise includes working with Kovar, aluminum, alumina alloys, brass, cold rolled steel (CRS), stainless steel, and inonel. Our highly experienced engineers can help you calculate hole sizes, oven profiling and solder selection and in creating a superior package design for direct sealing Kovar or soldering into aluminum. Thunderline-Z is an industry leader in the use of Au/Sn solder and uniquely qualified in the use of Sn96 and Sb5. If a hybrid solution using both direct fire and solder is needed, we can assist in mapping out the proper manufacturing sequence.

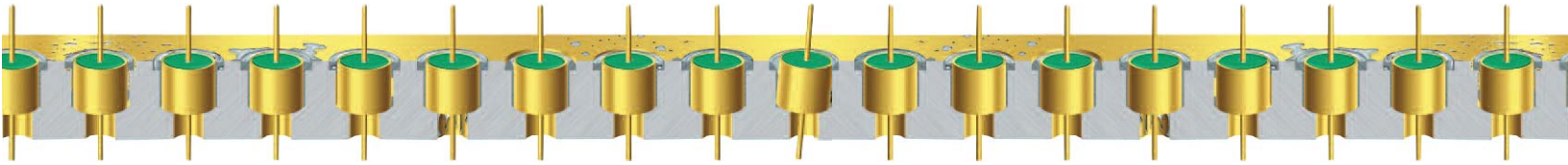
High Frequency Surface Mount Packages

Utilizing our the BellPin feedthru, we can quickly deliver hermetically sealed custom aluminum alloy packages with true surface mount connections that perform through K-band. This unique approach offers several pin position options and delivers premium VSWR characteristics while helping to ensure low parasitic inductance. These packages are ideal for everything from prototype jobs to high volume manufacturing. They are supplied 100% hermetically tested and are available in a variety of plating options including nickel, silver, or gold.

Inspection and Reliability Measure

- Quality Standard: ISO-9001-2008
- Calibrations System: MIL-C-45662
- Audited to AS-9003
- RoHs Compliance
- DFARS Clause 252.225-7014
- X-Ray Analysis: First Article or 100%
- Electrical: Hi-Pot and Continuity 202/ Method 301
- Solderability
- Dye Penetrate Evaluation
- Stabilization Bake: MIL-STD 883/ Method 1008.2
- Temperature Cycling: MIL-STD 883/Method 1010.7/MIL-STD 2020
- Helium Fine Leak Test: MIL-STD 883/Method 1014.1
- Capacitance
- Lead Integrity

Top Ten Soldering Pitfalls and How to Avoid Them



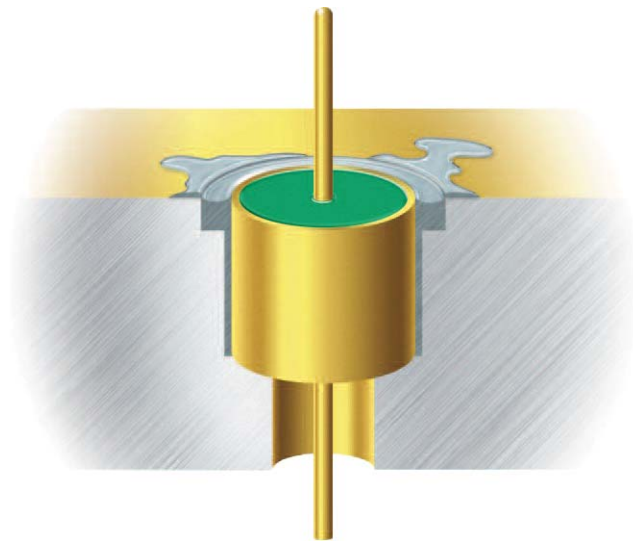
The quality of the package is only as good as the performance of the feedthru.

The performance of the feedthru is only as good as the integrity of the solder joint.

Soldering feedthrus can be tricky business, and a faulty solder joint can make or break the performance of a package. Thunderline-Z's extensive package design and manufacturing experience has helped us to understand many of the soldering problems you may be facing. We have assembled this guide to help you avoid the most common feedthru installation pitfalls and to recognize them, should they occur.

1

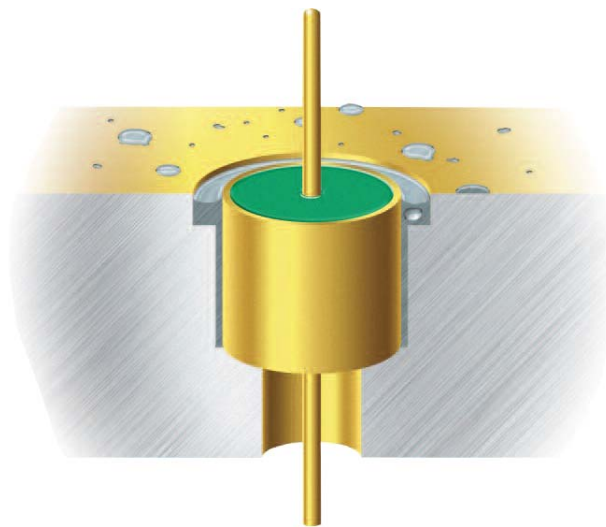
Solder Overflow



Problem: Solder overflow is the appearance of uneven solder flowing out of and around the solder joint area. In addition to being a visual reason for part rejection, overflowing solder is a cause for concern.

Causes: A number of uncontrolled processes can cause solder overflow including temperature, solder volume and package hole geometry. Excessive temperature and uneven heat distribution are the most common causes. Another, less common but more concerning cause, is a mismatch between solder volume and the hole geometry in the soldered package.

Solutions: The solutions to solder overflow are to control temperature and engineer hole geometry for the solder used. The best way to control temperature is with a soldering furnace with tightly monitored temperature profiles and atmosphere management. To select the optimum solder, the design of the housing is the first consideration. The hole geometry must be matched to the type of feedthru or connector being used and to the characteristics and volume of the solder selected. Further control is gained by utilizing tight tolerance solder preforms to supply the proper volume of solder to the joint.



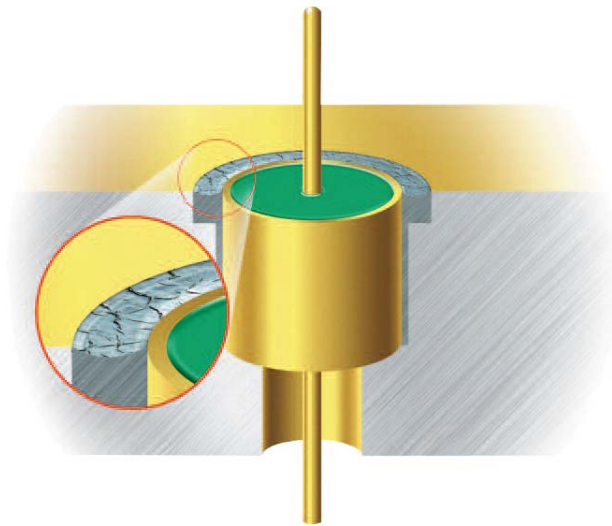
Problem: Solder splash is recognized by small bursts of solder extending away from the solder joint.

Causes: There are several potential causes for solder splash: uneven temperature gradients within the receptor housing during solder flow; improper flux and/or solder selection; incompatible housing or feedthru plating; or an incorrect flow temperature for the solder. Poor preparation of the housing before solder application can also lead to solder splash.

Solutions: To prevent solder splash it is important to allow enough time for heat to be introduced to the package housing. This is accomplished best by thermocouple monitoring and accurately controlling the dwell time within the furnace prior to increasing temperature for solder flow. It is also important to thoroughly clean the housing to remove residual dirt and oils. This helps ensure an uninterrupted flow of solder to the solder joint. Gaining an understanding of solder types and fluxes is also important.

3

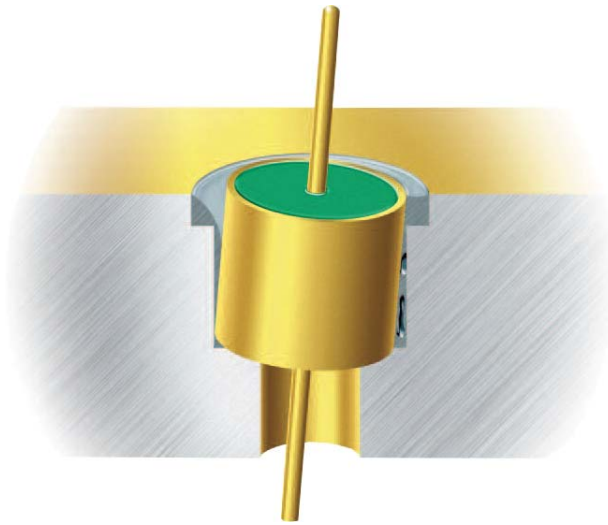
Solder Crystallization



Problem: Solder crystallization is characterized by a cracked and uneven appearance of the solder joint. Although not necessarily an immediate cause for visual rejection, crystallization in the joint may indicate a poor solder joint that will fail over time and should be corrected.

Causes: Solder crystallization commonly occurs as a result of improper flux selection or not thoroughly cleaning the housing with the right cleaning materials. Crystallization can also occur as a result of temperature gradients during the soldering process. In an oven soldering process the wrong mix of forming gases can also result in crystallization.

Solutions: The selection of a flux that matches the soldering process conditions, such as temperature and cleaning, is important to avoiding crystallization. The use of a soldering oven also adds considerable control to the process. Tailoring the temperature profile and ambient gas flows to the selected solder and plating materials is key in creating a quality solder joint. By uniformly increasing temperature and matching the forming gases in the furnace to the selected solder and housing plating material, you will gain control over the key parameters in avoiding crystallization.



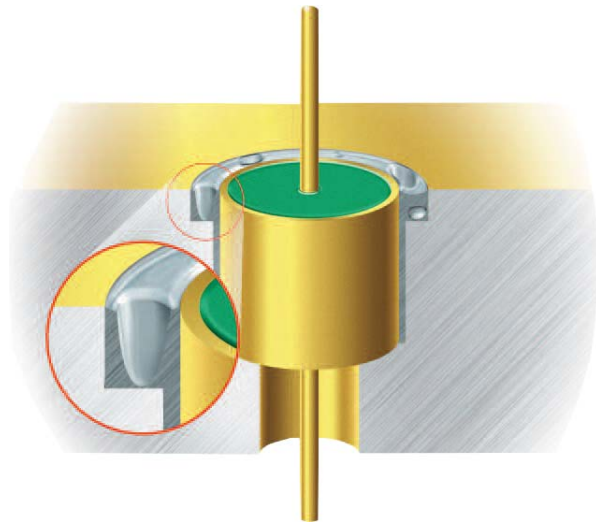
Problem: When the body of a feedthru is not flush with the housing this is a visual clue that the body shell is not parallel with the walls of the hole. A crooked feedthru is also an indication of an uneven soldered joint and therefore a weak point and reason for failure upon inspection.

Causes: There can be a number of reasons for poor mechanical alignment between the feedthru and housing hole, including: a poorly machined hole; a poorly designed or built fixture; a worn fixture; or the wrong hole geometry.

Solutions: A statistical inspection of housings prior to soldering can ensure the base structure is proper. Having a fixture engineered for a specific housing layout and tolerances is key. Designing the hole cavity to work with the fixture and soldering preform is another important design consideration.

5

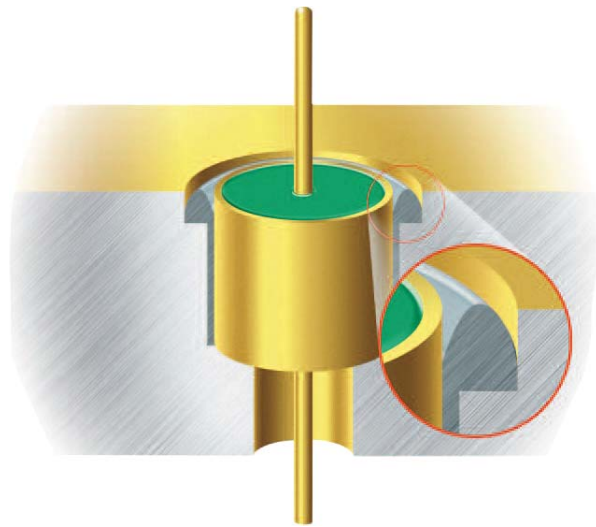
Solder Blow Holes



Problem: Voids in a solder joint will visually appear as pin holes or have a crater like, or “blow hole”, appearance where the bottom of the void is not visible. Both of these appearances are reasons for rejection and concern for the integrity of a solder joint.

Causes: The cause for solder voids can be singular or a combination of many factors. The primary reasons for solder voids include: improper volume of solder; an uneven temperature profile; poorly designed hole geometry; improper alignment of the feedthru leading to uneven solder paths; or selecting the wrong flux.

Solutions: Precision cavity and solder preform are essential to ensuring an optimum fill of the solder area. To eliminate voids caused by uneven solder flow it is important to maintain feedthru alignment using a fixture during assembly and oven transport. Establishing and controlling a soldering temperature profile is also key to managing the flux evaporation rate to eliminate voids during soldering.



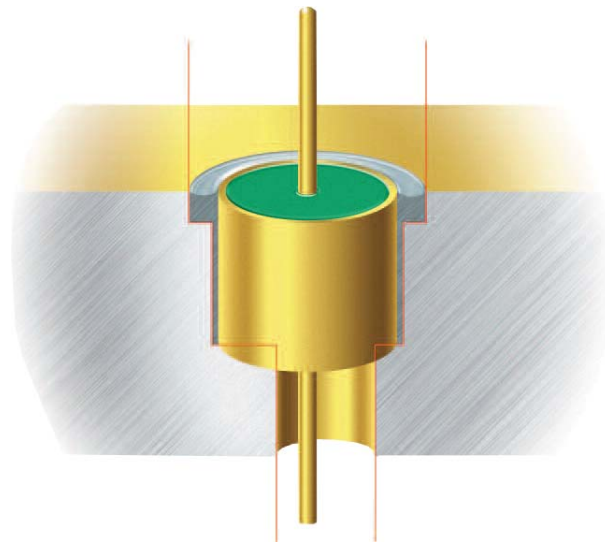
Problem: A poor wetting angle, or lack of wetting, is an indication that there is an improper solder flow and thus poor bonding. A good solder joint will have an angular filler at the base of a joint, a strong wetting angle is an indication that the solder joint has a strong bond.

Causes: A prime cause for a poor fillet or poor wetting angle is the result of insufficient heat energy from either poor temperature control or component duration in a heating zone. Parts that are not properly prepared to remove contamination can reject solder, this rejection will also lead to a poor wetting angle. The breakdown of flux at the soldering temperature can also be a possible cause to investigate poor wetting.

Solutions: Engineering an oven temperature profile for the housing to be soldered will ensure the right distribution of heat energy for good solder flow. Regular oven calibration for temperature will ensure the repeatability of a temperature profile. Cleaning of metal surfaces is essential to ensure the removal of oils and oxide contaminants prior to soldering. Selecting the proper flux for the temperature ranges to be worked is also critical in forming a strong solder bond.

7

Misaligned Holes



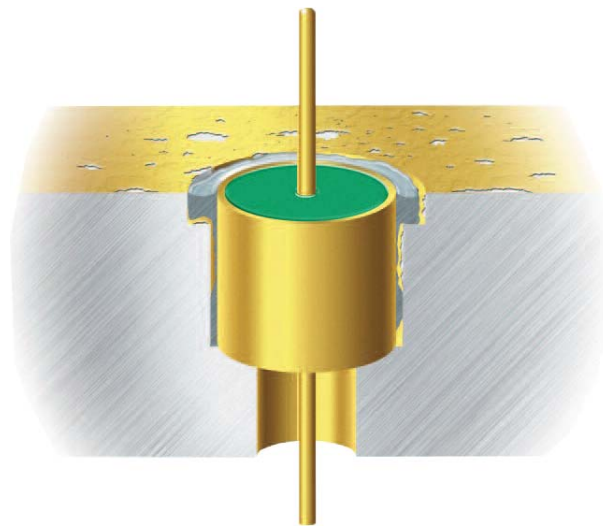
Problem: To the installer or inspector a misaligned hole may not be readily apparent. A properly machined hole however, is crucial in providing a repeatable and sustainable solder joint. Improper width or depth can lead to feedthru damage and alter electrical performance. If the cavity for the solder joint is too small the solder may not flow evenly to reach and completely wet the area of the two metal surfaces to be joined. If the cavity is too big or too wide there is greater chance for the component being sealed to move or for solder to find its way out of the cavity.

Causes: Poor mechanical design and machining.

Solutions: The key is to pay as much attention to the design and tolerances of the holes for each type of component as is spent on the overall package design. This will prevent individual components from becoming the weak link in the final package. This requires an understanding of the relationship of hole and component geometries and knowledge of soldering processes for varied applications.

Poor/Improper Plating

8

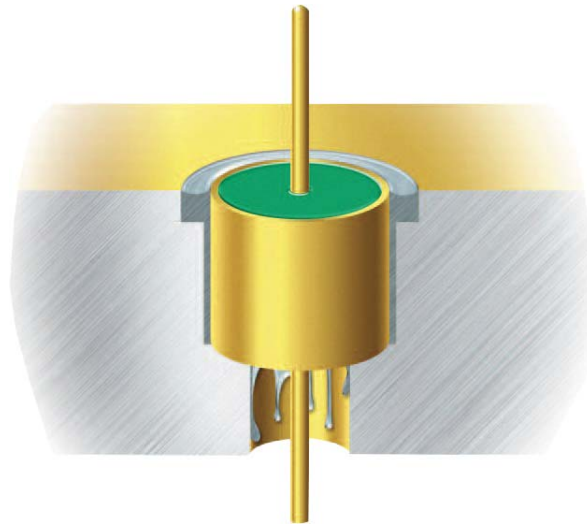


Problem: Blisters, voids or flaking of the plating in the solder joint area can lead to poor solder adhesion and therefore a weak joint that may later result in a hermetic or electrical failure. While the plating finish may be correct for the base metal, the plating selection also needs to match requirements for adherence to the filler metal used in the solder joint.

Causes: Poor plating adhesion is often the result of impurities left on metal surfaces prior to plating or storage, or can be the result of selecting the wrong plating for the desired application. In making plating choices the base housing material and the solder filler metal need to be taken into consideration.

Solutions: To select the right plating for a specific application involved, it is necessary to consider the housing base metal, the soldering process and the environmental conditions that the final package will incur. Proper cleaning of the base metal is also essential to provide a strong plated surface. Matching fluids and cleaners not properly selected and managed will cause a plating adhesion problem.

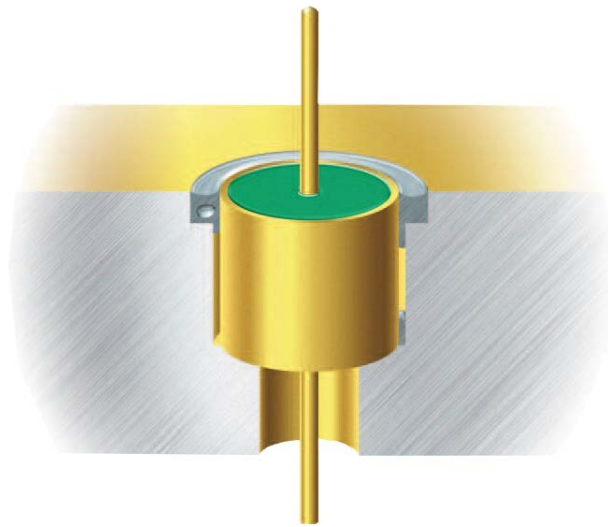
9

Airline
Obstruction

Problem: Airline obstructions caused by uncontrolled solder flow creates an improper ratio of pin diameter to aperture diameter which determine the ohmic impedance value.

Causes: Alteration in the airline geometry is generally the result of solder flowing into an area where it does not belong. This creep of solder can be the result of having an excess solder volume, poor heat control during the flow of solder or poor fixturing for the solder operation.

Solutions: Using the correct volume of solder for the feedthru- and hole design provides a basis to control the flow of solder outside of the joint area. Holding the system securely in place with proper fixturing and maintaining this fixturing builds upon this base. The optimal system for heat control is using an oven to form the solder joint. Realizing the heat profile of the oven is most important. Proper maintenance, multiple oven zones, and repeatability in temperature and oven atmosphere, are essential to completely control the solder joint formation.



Problem: The most difficult, and perhaps most dangerous pitfall of all, is when voids are out of sight. Hidden voids can be a cause for mechanical failure or hermeticity loss over time. Electrical performance may also be in jeopardy.

Causes: Any one or several of the previously discussed causes may have occurred.

Solutions: Because voids below the surface are not visible, your first line of defense is proper electrical testing and an understanding of the potential causes of poor performance. Reviewing all of the previously discussed solutions and systematically addressing each one, is the only way to prevent hidden voids from reoccurring.

Start Your Installation With a High Quality Feedthru From Thunderline-Z



Thunderline 50s

Thunderline 50s are the world's largest variety of RF feedthrus in the industry, with pin diameters from 0.009 to 0.040 and frequency ranges from 3 to 65 GHz. High quality levels are achieved through tight control of tolerances and the manufacturing process to yield a zero meniscus. This allows for higher frequency response while maintaining a metal-to-metal contact with the housing to achieve optimal power transfer.

Thunderline CapFeeds

Thunderline CapFeeds offer a DC feedthru filtered to the customer's specification. The robust construction allows the customer the freedom of the broadest solder schedule available. CapFeeds are available in diameters from 0.098 upward. A complete range of capacitance values at varying tolerances is available as single feedthrus or in multi-header designs.

Thunderline DC Feeds

Thunderline DC Feeds are manufactured using precision components and controlled furnace technologies. Feedthrus are available in all quantities from research and development to high volume commercial applications. These rugged DC feedthrus come in an infinite mix of pin and body diameters and lengths. They are designed to satisfy the desire of quality minded engineers while meeting the competitive pricing demands needed in today's marketplace.

Thunderline BellPins

The Thunderline BellPin is a revolutionary design that has been developed to work with lightweight, aluminum or brass housings. They easily attach to the bottom of packages to create true hermetic surface-mountable parts. They are an ideal solution to costly, bulky Kovar packaging problems. By employing BellPins in your next design you'll be able to decrease costs while maintaining package integrity.

Thunderline Thread-In

Designed for floor installations not requiring hermeticity, Thunderline-Z Thread-In Feedthrus offer easy and reliable installation. Available in 2-56 and 4-40 external thread sizes and, in both DC and RF styles, these parts not only offer an excellent alternative to messy epoxy installation but also serve as an easy repair pin solution.

Put Thunderline-Z's Packaging Expertise to Work for You.

If you're struggling with production constraints, quality issues or a limited time frame in which to complete your packages, turn to Thunderline-Z. In addition to providing the world's most popular feedthrus over the last three decades, we have also delivered over 1,000,000 custom hermetic packages.

It all starts with our oven technology. Our state-of-the art process employs multi-atmosphere and multi-zone temperature control. And our experience encompasses the broadest range of soldering technology in the microwave business. You can trust our industry trained engineering team because they know the unique science of designing for hermeticity. We can provide turnkey packages with any combination of feedthrus, press on connectors and multi-pin headers you can imagine.

SolderTight

SolderTight technology is a proprietary soldering approach that blends Thunderline-Z's years of metallurgy experience with advanced oven profiling techniques. This technology allows us to create premium packages with any combination of Thunderline Feedthrus and a variety of connector options including custom connector designs. From basic tin for general applications, to gold/tin solder for applications demanding higher strength and longevity, we have the extensive experience and controlled manufacturing processes to deliver exceptional quality. Customers prefer our packages because they are truly hermetic, easily affordable and delivered to their schedule.

DirectBond

DirectBond is Thunderline-Z's answer to the need for extremely high performance direct sealed packages where glass is matched and sealed directly to a metal housing. While our experience in soldering has led to premium soldering packages, our additional research and development of tightly monitored temperature control ensure the tightest matched direct seal packages as well. By utilizing these controls we have perfected an approach that guarantees true hermeticity over the widest temperature ranges and helps solve high frequency power loss problem inherent in other manufacturing techniques.

ZBond

ZBond technology is used in combination with our DirectBond packaging solutions to add value when additional components such as ground pins, heat sinks, pads, and exhaust tubes need to be bonded within a package. Our extensive knowledge of stainless steel, Kovar, molybdenum, copper and multitude of alloys have led to this unique brazing approach that provides flexibility for heat dissipation and thermal transfer in package designs.



Scan with your smartphone
for more information or visit
Emerson.com

Important Notice

The scope of the technical and application information included in this article is necessarily limited. Operating environments and conditions can materially affect the operating results of Therm-O-Disc™ products.

Users must determine the suitability of any Therm-O-Disc component for their specific application, including the level of reliability required, and are solely responsible for the function of the end-use product. It is important to review the Application Notes which can be found at [Emerson.com/thermodisc](https://www.emerson.com/thermodisc)

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