

Warren G-V – Thermal Control Devices

Solid State Airflow Sensors • Electro-Mechanical Airflow Sensors • Surface Sensing Thermostats • Ambient Sensing Thermostats • Thermal Time-Delay Relays



Experts in thermal management control

For more than 50 years Warren G-V has been a manufacturer of the highest quality electronic components for military and industrial applications in the global marketplace. Today, Warren G-V is an industry leader in the production of thermal control devices. We offer high grade electromechanical and solid state air velocity sensors, electrical thermostats for ambient and surface mount applications as well as thermal delay relays.

Primary markets for these devices include the manufacturers of mid and mainframe computer systems, medical diagnostic devices, air moving equipment as well as energy management equipment in the commercial sector. Our durable control devices for the defense industry are used by the manufacturers of radar and communications systems, aircraft instrument controls and navigational devices. Warren G-V devices feature rugged shock and vibration proof designs that can be installed directly on circuitry boards socket mounted and wired independently.

Warren G-V thermal control devices are used by engineers worldwide. Our factory sales and engineering personnel as well as our representative network are geared to assist our customers with application engineering. Plus, Warren G-V is able to supply timely delivery of our products on both small or large quantity purchases.

Contact Warren G-V, a leader in thermal control devices for the experience and quality that you can depend on!

CONTACT INFORMATION

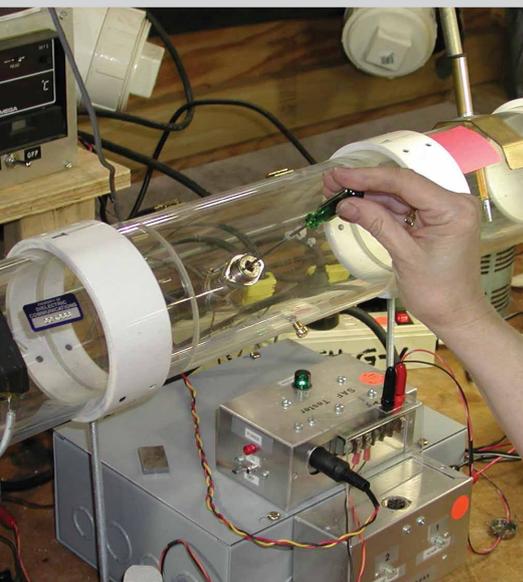
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Warren G-V airflow sensors and thermostats

SOLID STATE AIR VELOCITY SENSORS

SAF Series:

Designed to monitor for positive presence of cooling airflow, this velocity sensor operates on 5V DC. The sensor can be mounted on a board, in a socket, or hard wired to a bracket. The SAF is an AMBIENT COMPENSATED device affording close setting tolerances up to +60° C.

The standard SAF sensor turns “on” an alarm when insufficient air velocity occurs. It is also available in a fail safe output device where the alarm is always “on” during safe airflow and “off” at insufficient levels. A device, which is hermetically sealed, for use in hazardous or contaminated environments is also available.



ELECTRO-MECHANICAL AIR VELOCITY SENSORS

LS Series:

These rugged thermal mechanical air velocity sensors withstand normal shock and vibration requirements associated with military applications and can operate at -55°C if continuously energized. This series of sensors are available in many input voltages ranging from 5V DC to 115V AC.



SURFACE AND AMBIENT SENSING THERMOSTATS

VE and C-8 Series:

These thermostats are rugged in design, hermetically sealed and provide close-on-rise factory settings between -10°C and +150°C for applications both on surface temperature sensing or ambient/liquid temperature setting. Their “slow make-and-break” contact action provides very narrow differentials suitable for precision applications.



THERMAL TIME-DELAY RELAYS

LT Series:

These relays are used primarily in military applications to provide delay functions for sequencing, equipment protection, system warm-up, and other thermal protection applications unique to the demanding needs of operating complex systems in harsh environments.



Analyzing your airflow sensing applications

When planning, there are several key considerations to be evaluated by the applications engineer regarding known conditions and desired settings or alarm points. The following are the most common areas for review:

WHAT IS THE NORMAL, SAFE AIRFLOW LEVEL IN THE SYSTEM?

The best approach to this primary consideration is to measure the normal safe flow at the point where the SAF air sensor is to be installed. To obtain accurate results it may be necessary to provide an access hole and insert an anemometer probe into the closed system cabinet. Measurements of airflow levels without the enclosure will reflect false readings. If actual measurement is not possible, an estimate is needed. In this case, try samples of different settings until the optimum choice is made.

SELECTING A SETTING FOR YOUR APPLICATION:

The setting selection is largely a judgement of the applications engineer. If the object of the sensor is to simply report complete loss of airflow, then an arbitrary setting between “normal” flow and no-flow may be made. In such a case, it's desirable to select on the lower side of the available settings (which range from 50 to 1500 FPM).

A low setting limits the possibility of false alarms created by a mis-assessment of “normal” or other application conditions such as turbulence. If the objective is to detect a level of filter clogging or some other arbitrary setting, such as 50% of normal flow, care must be taken to determine the normal safe flow. Anemometer tests might be made of a typical clogged filter. Be sure to take measurements of air velocity at extreme operating conditions, including input voltage and temperatures that could affect fan or blower performance.

OTHER CONDITIONS AND ENVIRONMENTS:

The SAF sensor is temperature compensated and is designed for use in an environment of +10° to +60°C, under which conditions

the characteristics and tolerances of the SAF specifications would apply. If a mildly corrosive application is encountered, consider our Hermetically Sealed SAF Series.

TURBULENCE:

It's difficult to prevent turbulence, but you can avoid this common condition by careful location of the airflow sensor. The use of an anemometer is helpful for detecting the desired areas of low turbulence. Airflow sensors placed in highly turbulent locations are exposed to many simultaneous air velocities and will attempt to average them – resulting in incorrect values. This could lead to false operations and intermittent switching.

POSITIONING, PLACEMENT AND MOUNTING:

The optimum positioning of the SAF sensor is on a plane parallel to the unit base or header, with the airflow perpendicular to the thermistor sensor assembly. This is how all Warren G-V units are factory calibrated. The SAF sensor may be mounted on a TO-3 socket (Warren G-V provides such a socket with leads, p/n 4-1-260) or on a bracket or directly soldered to a circuit board. For printed circuitry, Warren G-V suggests the round base (see optional series section).

For multiple fan applications, use one sensor for each fan or blower. Using one sensor to monitor more than one fan can result in false readings; either from a single fan failure due to air turbulence changes, or from airflow volume changes, with velocity still remaining above the setting of the sensor.

OTHER CONSIDERATIONS:

Response Time: Defined as the time elapsed between the point at which airflow ceases and the point the output collector indicates an alarm. Usually under 10 seconds. A more accurate assessment of response time depends on the given application and the rate of change in air velocity.

SAF Series air velocity switch

The solid state SAF Series airflow switch assures dependable thermal control and protection for air cooled systems.

The SAF Series advantages include:

- Can drive logic circuits, audible/optical alarms and magnetic relays.
- Available in sealed and dust-proof versions.
- Can be socket mounted, PCB or hard wired.
- Available in 50 to 1500 linear feet per minute ranges.
- Not affected by ambient temperatures.
- 5 VDC design with low power dissipation.
- Signal conditioning not required.

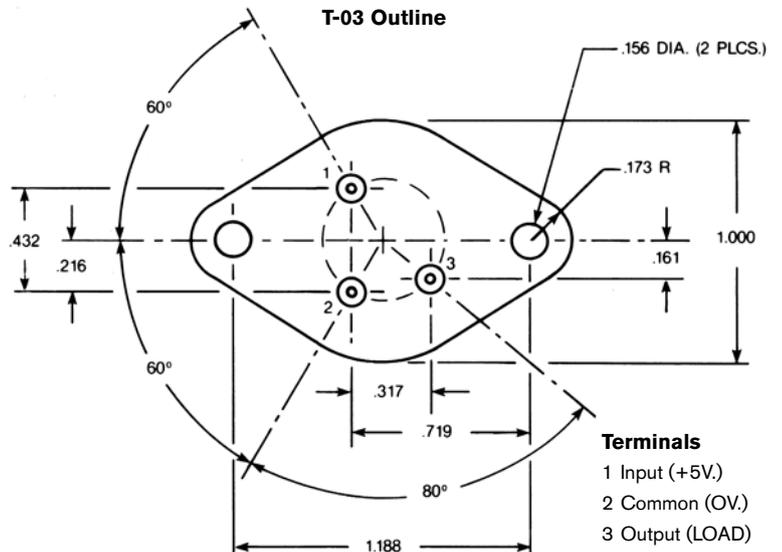
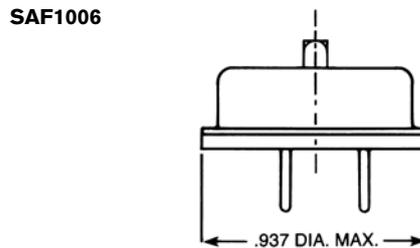
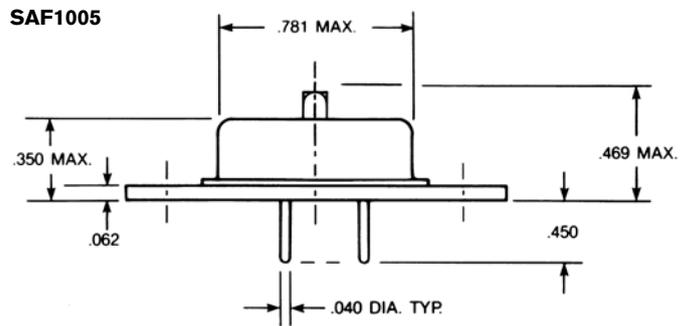


The advanced SAF Series Airflow Switch provides early detection and protection from overheating in high-end computer systems and peripherals, large power supplies, HVAC equipment, medical diagnostic systems and other electronic systems requiring forced air cooling.

The design is based on a heated thermistor which monitors the airstream and detects a loss or reduction of airflow due to fan failures, clogged filters or obstructions in the air inlet/outlet. The thermistor temperature and, therefore, its resistance, is affected by changes in air velocity. The SAF thermistor is part of a sensing bridge which compares its own resistance against a reference circuit and determines the air velocity at which the device will trigger an output.

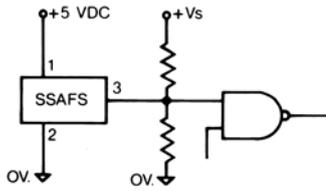
The innovative, low profile airflow sensor is easily mountable directly on the most densely populated circuit boards with as little as .625 inch spacing between boards, in sockets or bracket mount in plenums. All SAF models are complete, self-contained sensor/alarm devices requiring no additional circuitry.

All SAF Series Sensors are designed to be used in conjunction with typical logic circuitry. They operate on a +5 VDC supply and their output provides an open collector NPN transistor with its emitter connected to ground (0v). This type of versatile output allows driving logic circuits, indicating incandescent or LED lights or even magnetic relays, from DC sources from 5V to 30V.

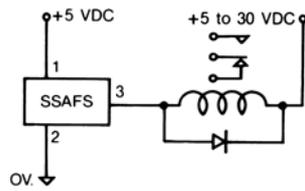


TYPICAL APPLICATIONS

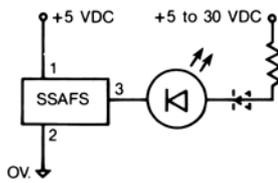
1 Controlling logic circuitry



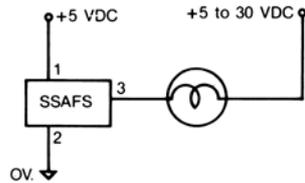
2 Controlling a relay



3 Controlling an L.E.D

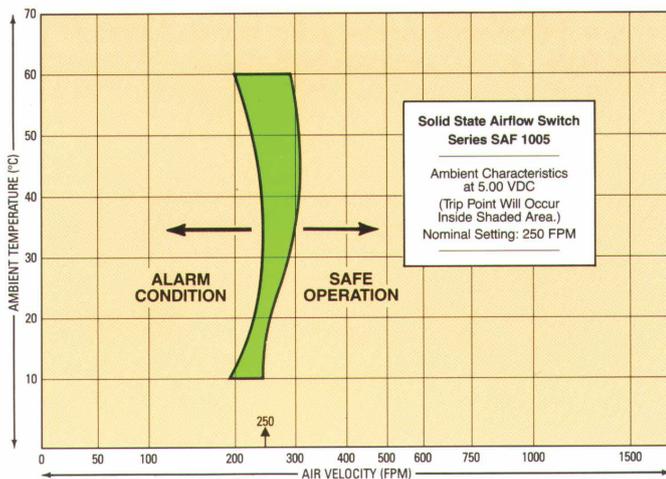


4 Controlling incandescents



IMPROVED AMBIENT TEMPERATURE COMPENSATION

Warren G-V design criteria for the SAF Solid-State Airflow Sensor incorporates ambient temperature compensation techniques which provide close operating point tolerances over the ambient range of +10° to +60°C. The typical operating point versus ambient temperature curve for 250 FPM is illustrated.



THE SAF SERIES

The Standard Series/SAF1005 – indicates an “alarm condition” on low or no airflow by turning output transistor “on”; output is similar to a closed mechanical contact between output and ground when in alarm condition. A round version, SAF1006 without a flange is available for less board space utilization.

The Fail Safe Series/SAF1025 – an alternative to above-described series, a device failure indicates an “alarm condition” by turning the output “off”; similar to open contacts in alarm condition. It will operate with a wider hysteresis.

The Hermetically Sealed Series – withstands all board washing methods; more suitable for applications with hostile environments. Sealed versions of all the above units are available.

SPECIFICATIONS

Input Voltage:	+5 VDC (±5%)
Power Dissipation:	½w max
Output:	open collector, solid state, able to sink up to 100 MA to ground, from DC sources up to 30V
Sensing range:	50 to 1500 F.P.M.
Sensing Tolerance:	+10°C to +60°C see ambient temperature compensation curve
Sensitivity:	±25 F.P.M. from actual setting
Hysteresis:	Series SAF1005 (Standard Model) is typically 10% of the setting

SAF MODEL OPTIONS

Dust Proof		Hermetically Sealed	
Flanged	Round Base	Flanged	Round Base
SAF1005	SAF1006	SAF1007	SAF1008
SAF1025	SAF1026	SAF1027	SAF1028

LT Series – Hermetically Sealed Miniature Timing Relays

LT miniature thermal time delay relays are a unique design incorporating small size with the ability to meet the most stringent shock and vibration requirements. The LT Series are widely used for environmentally demanding industrial and commercial applications where operational requirements and size are a major criteria for selection.



Benefits include:

- Small size
- Hermetically sealed, factory set
- Low profile
- Shock and vibration resistant
- Will meet MIL-R-19648 requirements

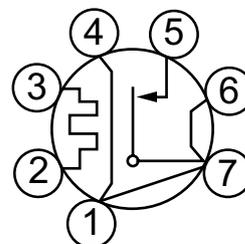
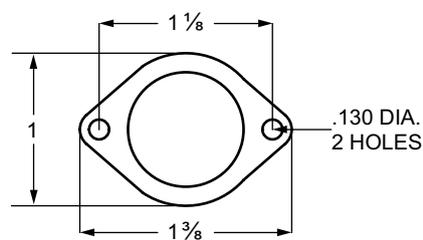
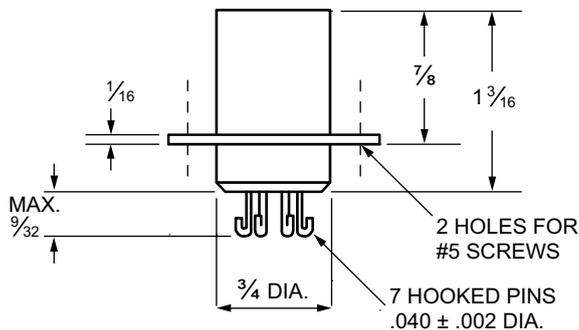
SPECIFICATIONS	
Delay Range:	2 – 75 Seconds
Operating Tolerance:	±15% at rated voltage
Vibration:	10g/500 cps
Shock:	50g -11ms
Operating Temperature:	-65°C to +85°C (-85°F to +185°F)
Standard Heater Voltages:	28 and 115 VAC/VDC
Contacts:	SPST - N.O. and N.C.
Contact Ratings:	Non-Inductive: 2 amps to 250 VAC 1 amp to 32 VDC Inductive: 25VA to 250 VAC** 1/8 amp to 32 VDC
Power Requirement:	4 watts
Connections:	Hook-pin, 7 point
Finish:	Electroless Nickel plating

**1 amp maximum below 32 V

Delay Time (Seconds)	STANDARD MODELS (NORMALLY OPEN CONTACTS)			
	RATED HEATER VOLTAGE			
	28 VAC/VDC		115 VAC/VDC	
	NO	NC	NO	NC
2	LT-2101	LT-2102	LT-3101	LT-3102
5	LT-2201	LT-2202	LT-3201	LT-3202
7	LT-2421	LT-2422	LT-3409	LT-3410
10	LT-2401	LT-2402	LT-3401	LT-3402
15	LT-2501	LT-2502	LT-3501	LT-3502
30	LT-2601	LT-2602	LT-3601	LT-3602
50	LY-2711	LT-2712	LT-3711	LT-3712
60	LT-2801	LT-2802	LT-3801	LT-3802
75	LT-2811	LT-2812	LT-3811	LT-3812

Note: Custom voltages and timings available upon request.

Outline Dimensions



Wiring Connections

All dimensions in inches

LS Series – Electro-Mechanical Air Velocity Sensors

Description: LS airflow sensors are cooling effect monitors that provide a positive indication of the presence of airflow. Independent of the air temperature, these units are used to operate an alarm or shutdown device when airflow drops below a preset level.

Operations: LS airflow sensors utilize a differential expansion principle in which the air entering the inlet circulates and cools an electrically heated internal element. Varied voltage source designs available. When the airflow drops below the nominal setting, the temperature of the heated element rises quickly causing the operation of a contact (either N.O. or N.C.). This inherent thermal delay avoids contact operation on brief interruptions of airflow. On restoration of air flow the sensor will automatically reset after a brief cooling period.

Advantages:

- Small size meets MIL shock/vibration/ambient requirements.
- Operate down to -55°C if continually energized.
- High reliability/enhanced MTBF rate.
- Self contained sensor/switch, no additional circuitry required.
- Built in time delay ignores transient air flow losses.

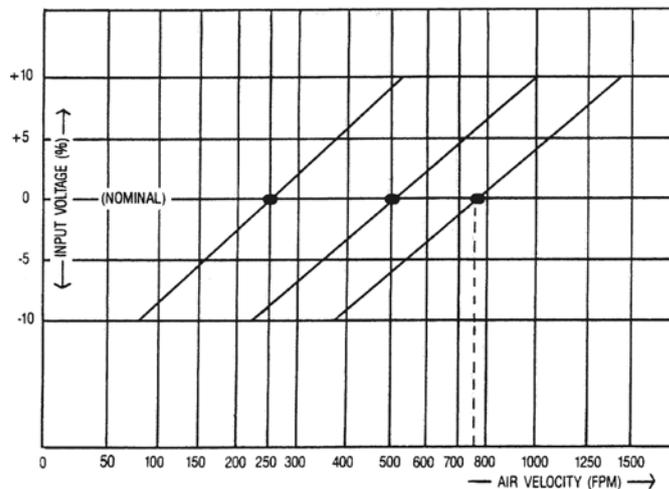
Applications:

- Computer/peripheral systems.
- Shipboard ventilation/exhaust systems.
- Fire control systems.
- MIL communications systems.
- MIL radar systems.
- Weapons systems.



SPECIFICATIONS	
Heater Voltage:	5V., 12V., 28V., or 115V. AC/DC Other voltages available
Input Power:	4 Watts, nominal
Contact Rating:	2A. resistive up to 115V. AC 1A. resistive up to 32V. DC
Usable Voltage Range:	±10% of nominal, see voltage variation chart below
Setting:	Per table, page 10
Response Time:	1 to 20 seconds (depending on setting and air velocity prior to stoppage)
Temperature Range:	-55°C to +85°C, energized
Vibration:	10g to 500 Hz.
Shock:	50g for 11 msec.

LS Series Airflow Sensors Input Voltage vs. Setting



LS SERIES

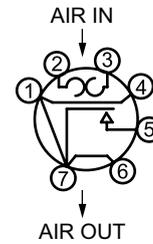
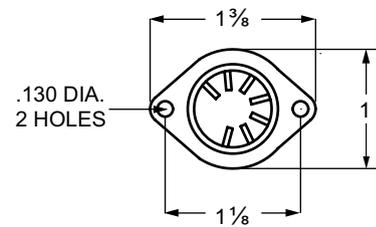
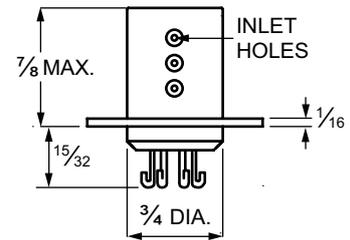
REFER TO TABLE AND SPECIFY MODEL

Heater Voltage AC/DC	Contact Configuration S.P.S.T (#)	Air Flow (*) (Linear Feet Per Minute)		
		250 F.P.M.	500 F.P.M.	750 F.P.M.
5V.	N.O.	LS-6025	LS-6027	LS-6029
	N.C.	LS-6052	LS-6054	LS-6056
12V.	N.O.	LS-6031	LS-6033	LS-6035
	N.C.	LS-6058	LS-6060	LS-6062
28V.	N.O.	LS-5053	LS-5011	LS-5057
	N.C.	LS-5054	LS-5022	LS-5058
115V.	N.O.	LS-5055	LS-5001	LS-5059
	N.C.	LS-5056	LS-5016	LS-5060

(*) Nominal Factory Setting. Tolerance ± 100 Ft./Min. at Rated Voltage.

(#) N.O.: Contacts close on loss of air flow. N.C.: Contacts open on loss of air flow.

Outline Dimensions



All dimensions in inches

Surface and Ambient Sensing Thermostats – VE and C8 Series

VE SERIES

Description: VE Surface Temperature Sensors are temperature operated switches ideally suited for applications requiring small, precise but rugged devices. They are designed to sense surface temperature within very narrow differentials with a high degree of reliability.

Operations: VE Surface Temperature Sensors have a unique dual bimetal design which produces larger forces and contact motion than ordinarily found in devices of this size. Intimate coupling between the mounting base and actuating elements produces an exceptionally fast response time. Contact chatter is eliminated and the unit has no resonant points below 2000 Hz.

Advantages:

- Miniature size.
- Direct Metallic Heat Conduction.
- Rapid Response.
- High Shock and Vibration Characteristics.
- Field Adjustable.
- Hermetically Sealed (optional).
- UL recognized component.

Applications:

- Semiconductor Heat Sinks.
- Crystal and Capacitor Ovens.
- Cooling System Control.
- Computer Systems.
- Motors and Generators.
- Alarm Systems.



Military Environments

Designed for military environments for exposure to -55°C to +150°C, the VE Series meets the rugged shock and vibration requirements associated with military and high-grade industrial applications. Typical control applications include:

- Heat Sunked Components.
- Electronic Systems.
- Temperature Sensitive Systems.
- Frequency Stability.
- Power Supplies.
- Heat Dissipation Systems.
- Motors, Generators, Compressors.
- Truck, Railcar Environmental Applications.

SPECIFICATIONS

Setting:	See table (page 13). Unit can be set to any temperature within the specified ranges.
Setting Tolerance:	±5°F (±3°C)
Contact:	Open on rise or close on rise. Rating: 3A @ 115 VAC Resistive 1A @ 32 VDC Resistive
Vibration:	10g to 2000Hz.*
Shock:	10g 11 msec.*

*When temperature is at least 3°C from the actual temperature setting.

C8 SERIES

Description: C8 Ambient Temperature Sensors are cartridge-size thermal switches ideally suited to control or monitor temperature in either air or liquid mediums. Available in different mounting arrangements, they provide a high degree of sensitivity and operate under severe environmental conditions.

Operations: C8 Sensors are based on a differential expansion principle, comparing the expansion or contraction of the outer shell in relation to an internal member that is not affected by temperature. The differential in expansion of these two members is then multiplied by the internal mechanism and transferred as a motion to the contacts. The contacts are built in a separate fused glass header with a minimum current path to reduce self-heating effects.

Advantages:

- Fast response Time.
- Narrow Temperature Differential.
- Hermetically Sealed.
- Stable Under Severe Shock and Vibration.
- UL recognized component.

Applications:

- Heating and Cooling Equipment.
- Ventilation Systems.
- Fire Detection.
- Hydraulic Systems.
- Critical Temperature Equipment.



Military Environments

Designed for military environments for exposure to -55°C to +150°C, the C8 Series meets the rugged shock and vibration requirements associated with military and high-grade industrial applications. Typical control and alarm applications include:

- Heating and Cooling Equipment.
- Ventilation Systems.
- Fire Detection.
- Hydraulic Systems.
- Critical Temperature Equipment.

SPECIFICATIONS

Setting Tolerance:	±5°F (±3°C)
Contact:	S.P.S.T. close on rise 5A @ 115 VAC Resistive 1A @ 32 VDC Resistive.
Vibration:	25g to 1000Hz.*
Shock:	50g 11 msec.*
Material:	C8-C, C8-B, C8-F Brass zinc plated with chromate finish. C8-P is nickel plated.

*When temperature is at least 3°C from the actual temperature setting.

VE SERIES

1. Factory Set and Hermetically Sealed – Contact factory.

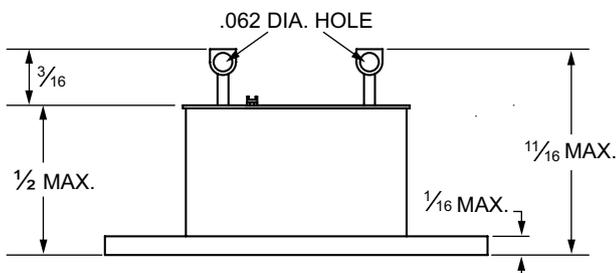
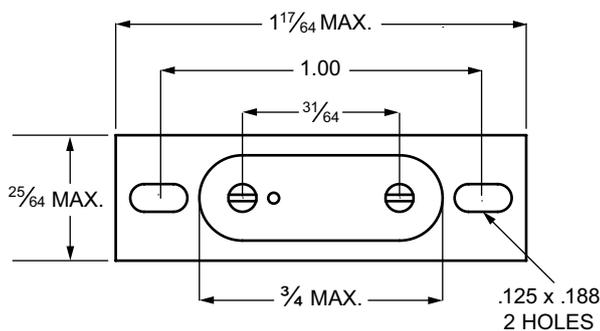
Specify desired temperature setting °F or °C and indicate open on rise or close on rise contact configuration.

2. Field Adjustable – Unsealed. Order from table below.

TEMPERATURE RANGE	MODEL NO.	
	Contact Open on Rise	Contact Close on Rise
0°C to +55°C +32°F to +131°F	VE-2101	VE-2102
+50°C to +105°C +122°F to +221°F	VE-3101	VE-3102
+100°C to +150°C +212°F to +300°F	VE-4101	VE-4102
-50°C to +5°C -67°F to +41°F	VE-1101	VE-1102

Outline Dimensions

Detailed outline drawings with tolerances are available on request.



Direct replacement for Fenwal Series 32410/32411. The Fenwal Company discontinued this popular surface sensing series in 1987. The Warren G-V Series VE Thermostat mounts on the same 1.00" centerline as direct replacement, meeting all electrical and thermal requirements of the former unit.

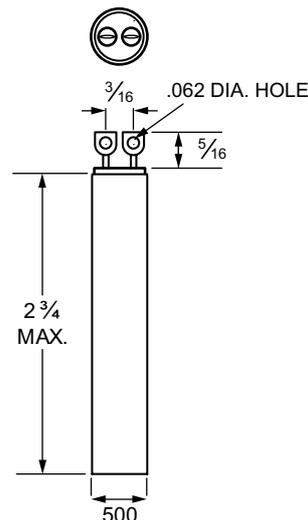
C8 SERIES

MOUNTING:	
Model:	Type of Mounting:
C8-C C8-B C8-F C8-P	No mounting bracket Side mounting bracket 3-hole flange mount Pipe fitting
CONTACT:	
C.R.	Close on Rise
FACTORY TEMPERATURE SETTING:	
	-25°C to +150°C -30°F to +300°F

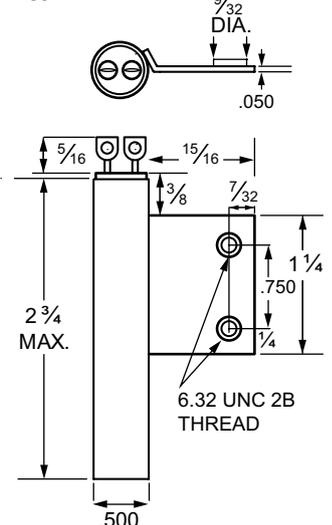
EXAMPLE: To order a 3-hole flange mounted C8 unit set for 80°F with normally open contacts – Specify: C8-F, C.R., 80°F.

Outline Dimensions

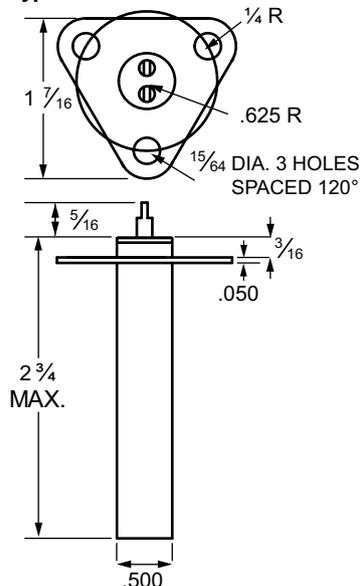
Type C8-C



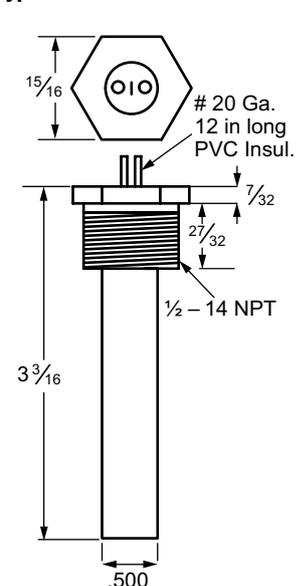
Type C8-B



Type C8-F



Type C8-P



All dimensions in inches

Warranty

The Manufacturer warrants that all goods supplied hereunder, whether or not of its own manufacture, will be of the kind described herein or in any specification and drawing approved by the Manufacturer and of merchantable quality and free from defects in material or workmanship under normal use and prescribed maintenance for a period of one (1) year. Neither this warranty nor any other, expressed or implied, shall apply to goods delivered hereunder which have been damaged or subjected to alteration or negligence after delivery. The Manufacturer's only obligation for breach of this warranty shall be the repair, without charge, or the furnishing Ex Works Raymond, of a similar part to replace any part which within one (1) year, with the exception as noted above, from date of shipment is proven to have been defective, provided that (i) the Purchaser shall have notified the Manufacturer within ten (10) days of the discovery of such defect and not later than ten (10) days after the last day of this warranty, and (ii) the Manufacturer shall have the option of requiring the return of the defective material (transportation prepaid) to establish the claim. The Manufacturer shall not in any event be liable for the Purchaser's manufacturing costs, loss of profits, good will or any other special, consequential, incidental, or other damages resulting from such defects. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, WHICH EXTEND BEYOND THE WARRANTY SET FORTH HEREIN.

Visit www.warrengv.com

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