Low Cost Single Trip Point Temperature Sensor

FEATURES

- **Temperature Set Point Easily Programs with a Single External Resistor**
- **Operates with 2.7V Power Supply (TC624)**
- **TO-220 Package for Direct Mounting to Heatsink (TC622xAT) or Standard 8-Pin PDIP and SOIC**
- **Cost Effective**

APPLICATIONS

- **Power Supply Over-Temperature Detection**
- **Consumer Electronics**
- **Fire/ Heat Detection**
- **UPSs, Amplifiers, Motors**
- **CPU Thermal Management in PCs**

GENERAL DESCRIPTION

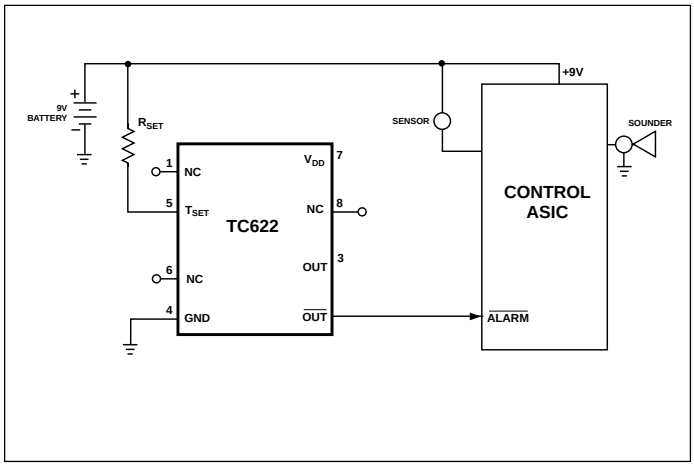
The TC622 and TC624 are programmable solid state temperature sensors designed to replace mechanical switches in sensing and control applications. Both devices integrate the temperature sensor with a voltage reference and all required detector circuitry. The desired temperature set point is set by the user with a single external resistor.

Ambient temperature is sensed and compared to the programmed setpoint. The OUT and $\overline{OUT}$ outputs are driven to their active state when the measured temperature exceeds the programmed setpoint.

The TC622 has a power supply voltage range of 4.5V to 18.0V while the TC624 operates over a power supply range of 2.7V to 4.5V. Both devices are usable over a temperature range of – 40°C to +125°C (TC622Vxx, TC624Vxx). Both devices feature low supply current making them suitable for many portable applications.

Eight-pin through-hole and surface mount packages are available. The TC622 is also offered in a 5-pin TO-220 package.

TYPICAL APPLICATION



Heat Monitor for Smoke Detector

ORDERING INFORMATION

Part No.	Voltage Operation	Package	Ambient Temperature
TC622COA	4.5V to 18V	8-Pin SOIC	0°C to +70°C
TC622CPA	4.5V to 18V	8-Pin Plastic DIP	0°C to +70°C
TC622EAT	4.5V to 18V	5-Pin TO-220	– 40°C to +85°C
TC622EOA	4.5V to 18V	8-Pin SOIC	– 40°C to +85°C
TC622EPA	4.5V to 18V	8-Pin Plastic DIP	– 40°C to +85°C
TC622VAT	4.5V to 18V	5-Pin TO-220	– 40°C to +125°C
TC622VOA	4.5V to 18V	8-Pin SOIC	– 40°C to +125°C
TC622VPA	4.5V to 18V	8-Pin Plastic DIP	– 40°C to +125°C
TC624COA	2.7V to 4.5V	8-Pin SOIC	0°C to +70°C
TC624CPA	2.7V to 4.5V	8-Pin Plastic DIP	0°C to +70°C
TC624EOA	2.7V to 4.5V	8-Pin SOIC	– 40°C to +85°C
TC624EPA	2.7V to 4.5V	8-Pin Plastic DIP	– 40°C to +85°C
TC624VOA	2.7V to 4.5V	8-Pin SOIC	– 40°C to +125°C
TC624VPA	2.7V to 4.5V	8-Pin Plastic DIP	– 40°C to +125°C

ABSOLUTE MAXIMUM RATINGS*

Supply Voltage (TC622) 20V
(TC624) 5.5V
Input Voltage Any Input ..... (GND – 0.3V) to (V_{DD} +0.3V)
Operating Temperature ..... – 40°C to +125°C
C Version ..... 0°C to +70°C
E Version ..... – 40°C to +85°C
V Version ..... – 40°C to +125°C
Maximum Junction Temperature ..... +150°C
Storage Temperature ..... – 65°C to +150°C
Lead Temperature (Soldering, 10 sec) ..... +300°C

*Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS (Over Operating Temperature Range, unless otherwise specified.)

Parameter		Conditions	Min	Typ	Max	Unit
Supply Voltage Range	TC622		4.5	—	18	V
	TC624		2.7		4.5	
Supply Current	TC622	$5.0V \le V_{DD} \le 18V$	—	200	600	µA
	TC624	$2.7V \le V_{DD} \le 4.5V$	—	170	300	
V_{OH}	TC622	$5.0V \le V_{DD} \le 18V$,				
		$-40°C \le T_A \le +125°C$, I_{OH} = 250µA	0.90 x V_{DD}	—	—	V
		I_{OH} = 500µA	0.80 x V_{DD}	—	—	
V_{OL}	TC622	$-40°C \le T_A \le +85°C$, I_{OL} = 500µA	—	—	0.15 x V_{DD}	V
		I_{OL} = 1mA	—	—	0.30 x V_{DD}	
		$-40°C \le T_A \le +125°C$, I_{OL} = 1mA	—	—	0.35 x V_{DD}	
V_{OH}	TC624	$2.7V \le V_{DD} \le 4.5V$,				
		$-40°C \le T_A \le +125°C$, I_{OH} = 250µA	0.9 x V_{DD}	—	—	V
		I_{OH} = 500µA	0.8 x V_{DD}	—	—	
V_{OL}	TC624	$-40°C \le T_A \le +85°C$, I_{OL} = 500µA	—	—	0.1 x V_{DD}	V
		I_{OL} = 1mA	—	—	0.2 x V_{DD}	
		$-40°C \le T_A \le +125°C$, I_{OL} = 1mA	—	—	0.25 x V_{DD}	
Absolute Accuracy	TC622	T_{SET} = Programmed Temperature	T – 5	T ± 1	T + 5	°C
	TC624	T_{SET} = Programmed Temperature	T – 5	T ± 1	T + 5	
Trip Point Hysteresis	TC622		—	2	—	°C
	TC624		—	2	—	

DETAILED DESCRIPTION

Trip Point Programming

The TC622 and TC624 are single point temperature detectors ideal for use in a wide variety of applications. When the temperature of the device exceeds the programmed temperature trip point, T_{SET}, the OUT and $\overline{OUT}$ outputs are driven into their active states. The desired trip-point temperature is programmed with a single external resistor connected between the T_{SET} input and V_{CC}. The relationship between the resistor value and the trip point temperature is given by the equation below.

$$R_{TRIP} = 0.5997 \times T^{2.1312}$$

Where Rtrip = Programming resistor value in Ohms
T = Desired trip temperature in degrees Kelvin.

For example, to program the device to trip at 50°C, the programming resistor is:

$$R_{TRIP} = 0.5997 \times ((50 + 273.15)^{2.1312}) = 133{,}652\ \Omega$$

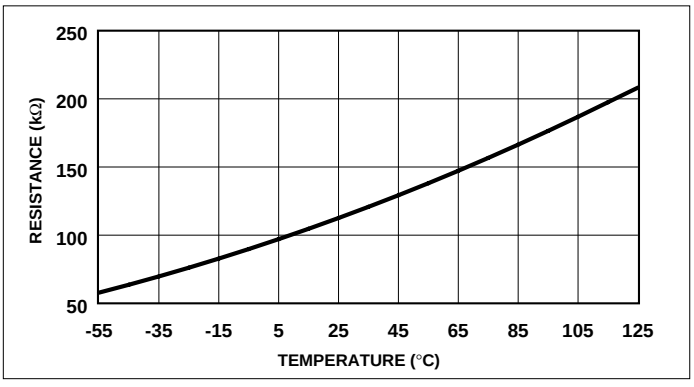


Figure 1. Programming Resistor Values vs. Temperature

Hysteresis

To prevent output "chattering" at the trip point temperature, the temperature detector in the TC622/624 has 2°C of hysteresis (See Figure 2).

The outputs are driven active when the temperature crosses the setpoint determined by the external resistor. As temperature declines below the setpoint, the hysteresis action will hold the outputs true until the temperature drops 2°C below the threshold.

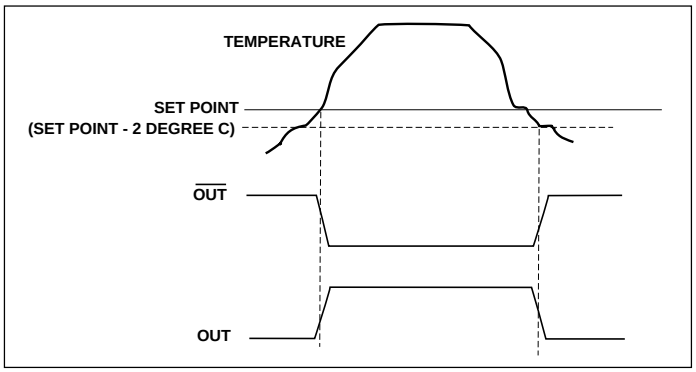


Figure 2. TC622/624 Hysteresis

APPLICATIONS

Over-Temperature Shutdown

The TC622 can be used to create a simple over-temperature shutdown circuit. In this circuit, temperature is sensed within the system enclosure (internal system ambient), or at the heatsink itself. When measured temperature exceeds a preset limit, a fault is indicated and the system shuts down.

Figure 3 illustrates a simple over-temperature shutdown circuit using the TC622 sensor in a single TO-220 package, allowing direct attachment to the heatsink surface. As shown, the TC622 outputs are driven active when the heatsink temperature equals the trip point temperature set by R_{SET}. When this happens, the crowbar circuit is activated, causing the supply output to fold back to zero. The TC622 outputs remain active until the heatsink temperature falls a minimum of 2°C (built-in hysteresis) below the trip point temperature, at which time the device again allows normal supply operation.

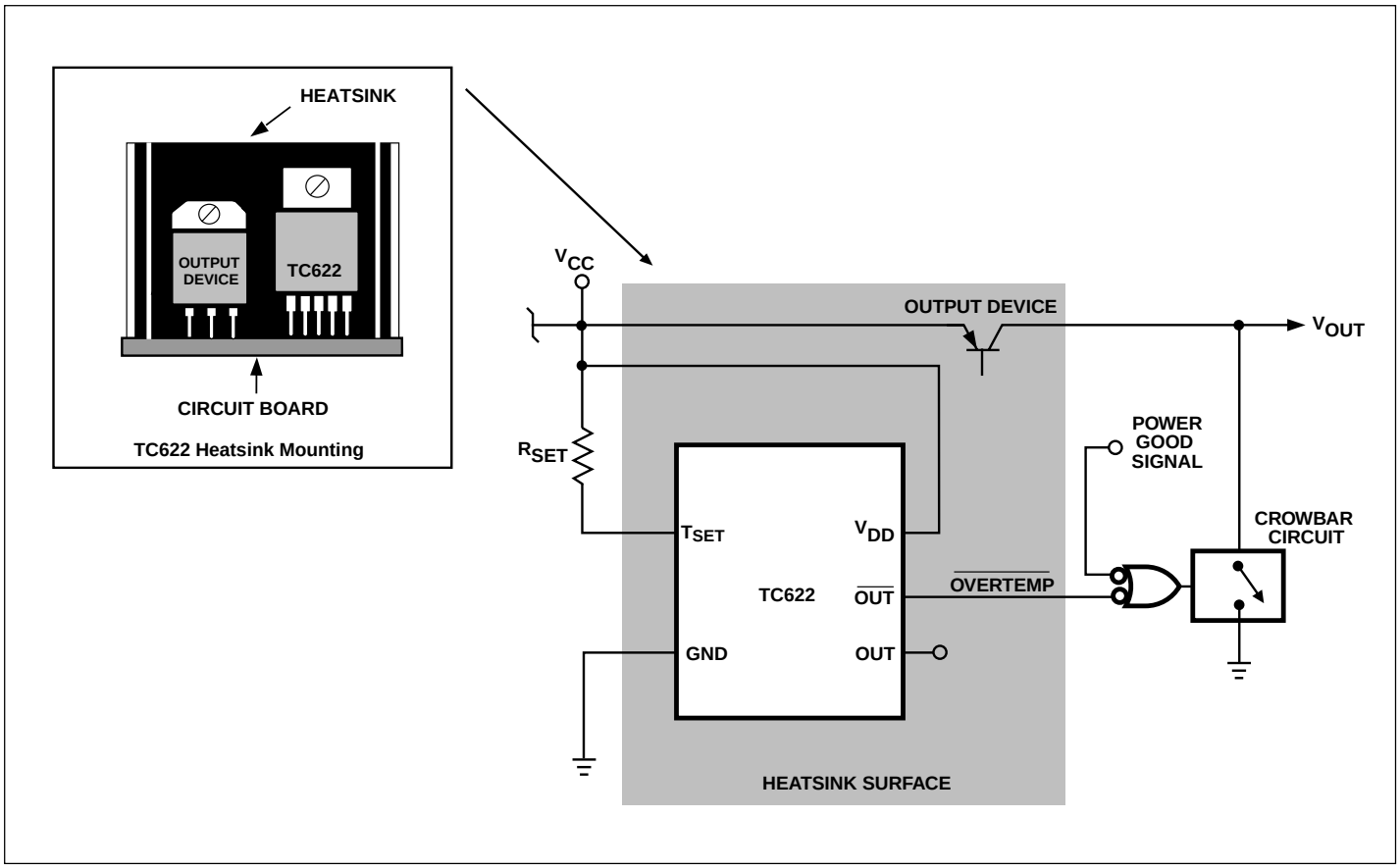


Figure 3. TC622 Power Supply Over-Temperature Shutdown

Cooling and Heating Applications

The TC622/624 can be used to control a DC fan as shown in Figure 4. The fan turns on when the sensed temperature rises above T_{SET} and remains on until the temperature falls below T_{SET} – 2°C.

Figure 5 shows the TC622 acting as a heater thermostat. Circuit operation is identical to that of the cooling fan application.

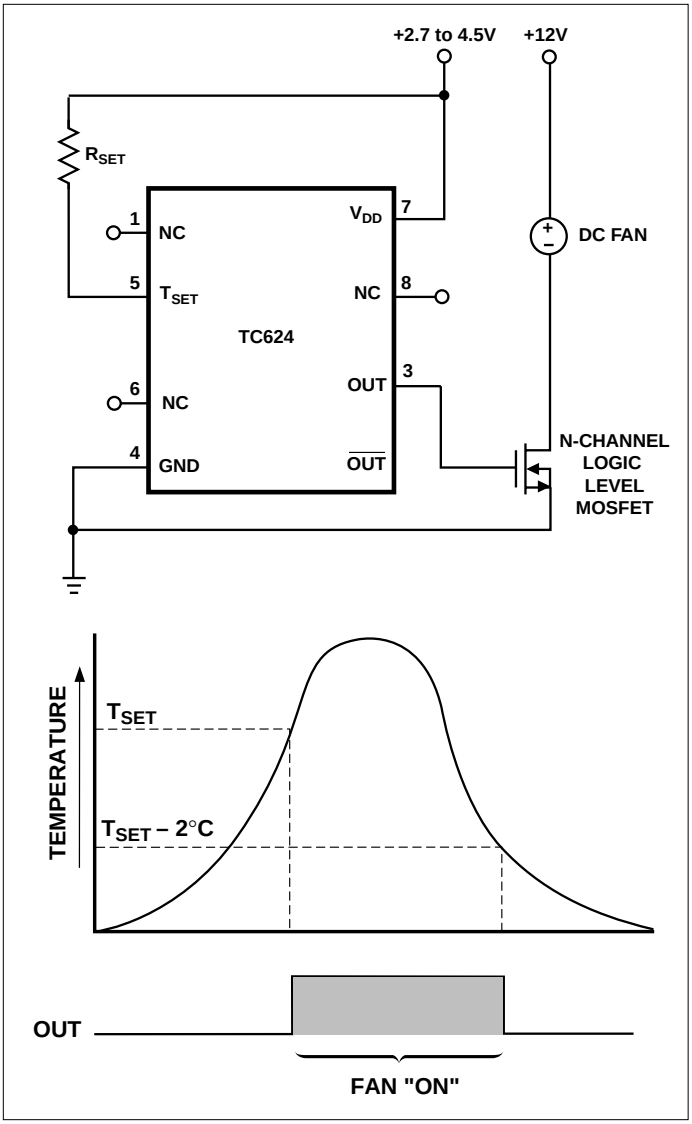


Figure 4. TC624 as a Fan Controller for Notebook PCs

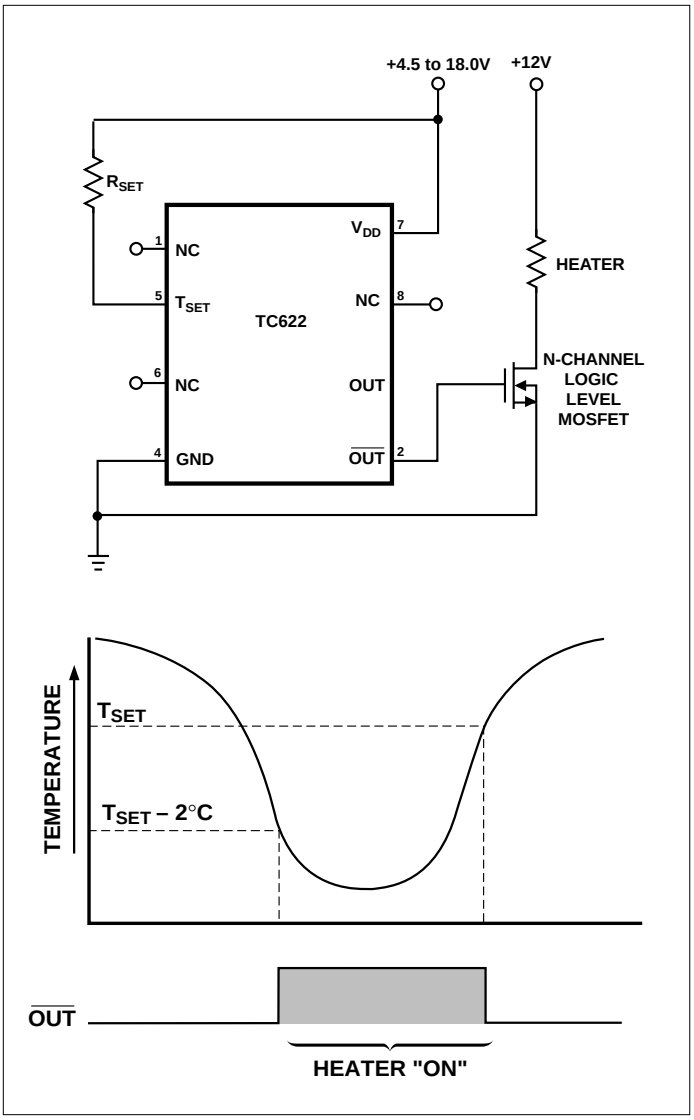
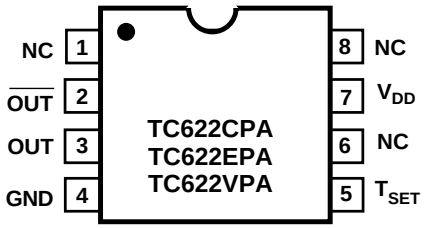


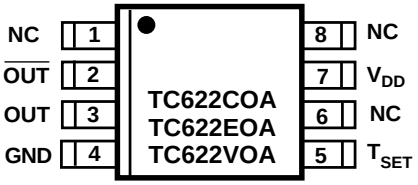
Figure 5. TC622 as a Heater Thermostat

PIN CONFIGURATIONS

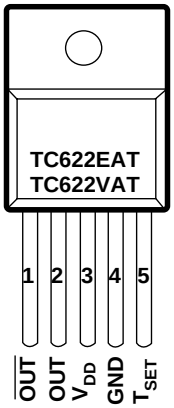
8-Pin DIP



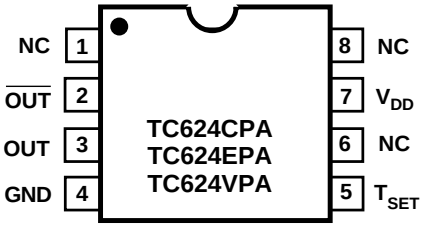
8-Pin SOIC



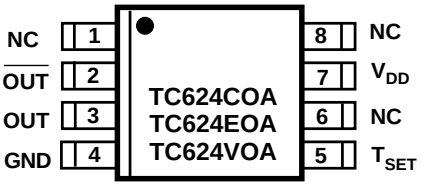
5-Pin TO-220



8-Pin DIP



8-Pin SOIC

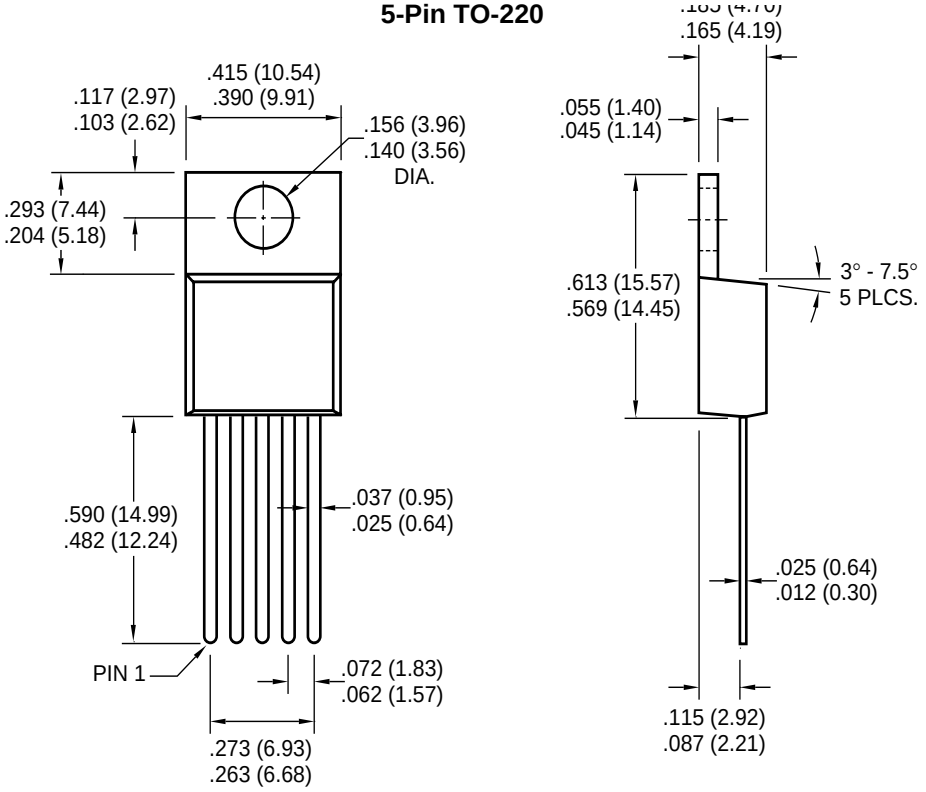


NOTE: For TO-220 Package, Pin 3 is connected to case heatsink.

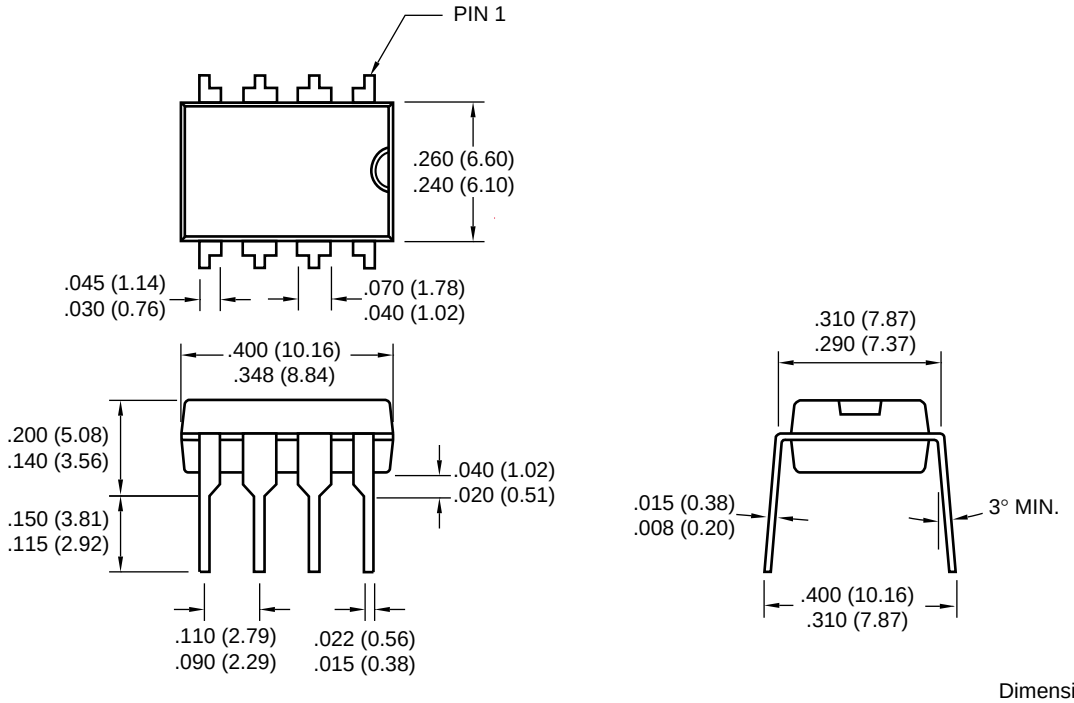
TC622
TC624

PACKAGE DIMENSIONS

5-Pin TO-220



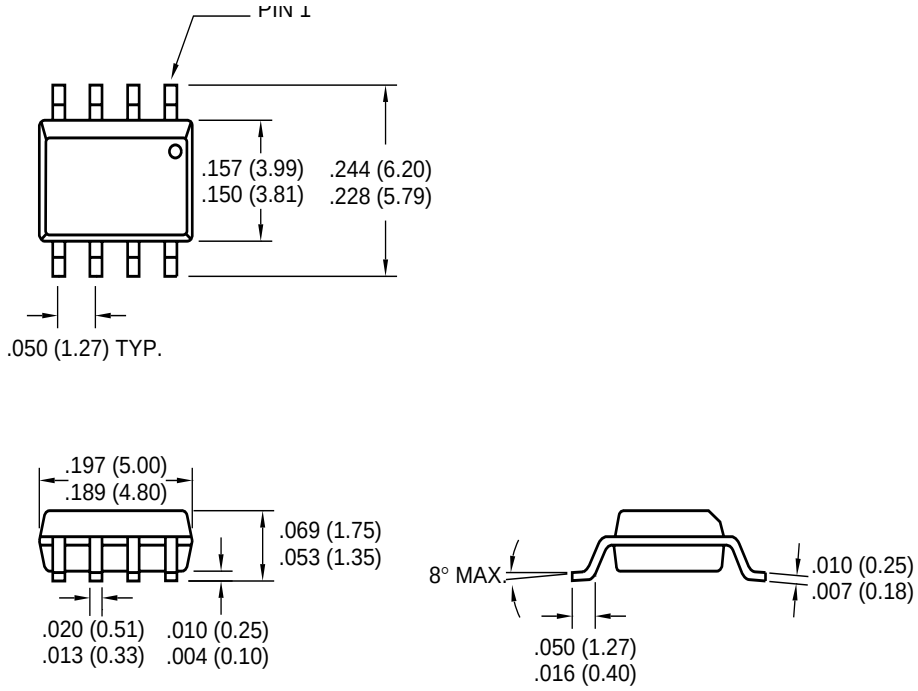
8-Pin Plastic DIP



Dimensions: inches (mm)

PACKAGE DIMENSIONS (CONT.)

8-Pin SOIC



Dimensions: inches (mm)

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