5V, Dual Trip Point Temperature Sensors

FEATURES

- **User-Programmable Hysteresis and Temperature Set Point**
- **Easily Programs with 2 External Resistors**
- **Wide Temperature Detection Range .... – 40°C to +125°C (TC620/621CVx)**
- **External Thermistor for Remote Sensing Applications (TC621x)**

APPLICATIONS

- **Power Supply Overtemperature Detection**
- **Consumer Equipment**
- **Temperature Regulators**
- **CPU Thermal Protection**

ORDERING INFORMATION

Part No.	Package	Ambient Temperature
TC620x*COA	8-Pin SOIC	0°C to +70°C
TC620x*CPA	8-Pin Plastic DIP	0°C to +70°C
TC620x*EOA	8-Pin SOIC	– 40°C to +85°C
TC620x*EPA	8-Pin Plastic DIP	– 40°C to +85°C
TC620C*VOA	8-Pin SOIC	– 40°C to +125°C
TC621x*COA	8-Pin SOIC	0°C to +70°C
TC621x*CPA	8-Pin Plastic DIP	0°C to +70°C

GENERAL DESCRIPTION

The TC620 and TC621 are programmable logic output temperature detectors designed for use in thermal management applications. The TC620 features an on-board temperature sensor, while the TC621 connects to an external NTC thermistor for remote sensing applications.
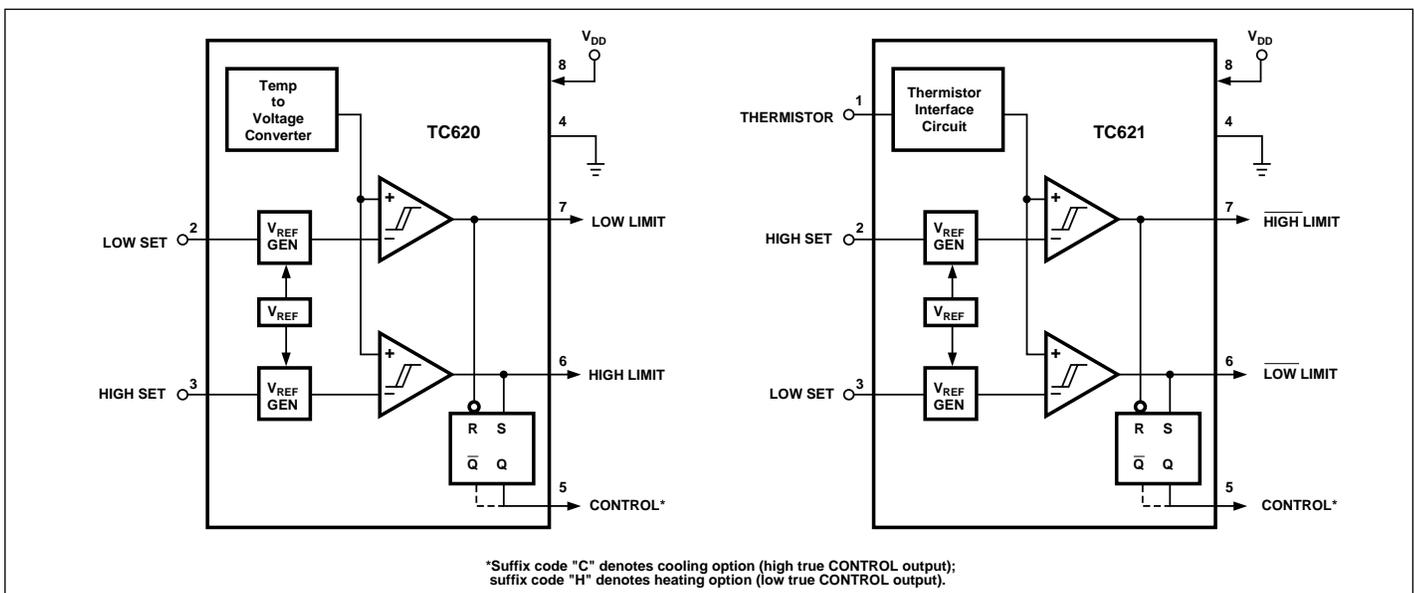
Both devices feature dual thermal interrupt outputs (HIGH LIMIT and LOW LIMIT), each of which program with a single external resistor. On the TC620, these outputs are driven active (high) when measured temperature equals the user-programmed limits. The CONTROL (hysteresis) output is driven high when temperature equals the high limit setting, and returns low when temperature falls below the low limit setting. This output can be used to provide simple ON/OFF control to a cooling fan or heater. The TC621 provides the same output functions except that the logical states are inverted.

The TC620/621 are usable over a maximum temperature range of – 40°C to +125°C.

Part No.	Package	Ambient Temperature
TC621x*EOA	8-Pin SOIC	– 40°C to +85°C
TC621x*EPA	8-Pin Plastic DIP	– 40°C to +85°C

*The part code will be C or H (see Functional Block Diagram, below, and page 2).

FUNCTIONAL BLOCK DIAGRAM

*Suffix code "C" denotes cooling option (high true CONTROL output);
suffix code "H" denotes heating option (low true CONTROL output).

TC620
TC621

ABSOLUTE MAXIMUM RATINGS*

Package Power Dissipation ($T_A \leq 70°C$)
    PDIP 730mW
    SOIC 470mW
Derating Factors
    Plastic .... 8mW/°C
Supply Voltage 20V
Input Voltage Any Input .... (GND – 0.3V) to (V_{DD} +0.3V)
Operating Temperature
    M Version .... – 55°C to +125°C
    V Version .... – 40°C to +125°C
    E Version .... – 40°C to +85°C
    C Version .... 0°C to +70°C
Maximum Chip Temperature................................ +150°C
Storage Temperature .... – 65°C to +150°C
Lead Temperature (Soldering, 10 sec) .... +300°C

*Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. 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: $T_A = 25°C$, unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Unit
Supply Voltage Range		4.5	—	18	V
Supply Current	$5V \leq V_{DD} \leq 18V$	—	270	400	µA
Output Resistance	Output High or Low, $5V \leq V_{DD} \leq 18V$	—	400	1000	Ω
Output Current	Temp Sensed Source/Sink	—	—	1	mA
Output Current	Cool/Heat Source/Sink	—	—	1	mA
Absolute Accuracy	T = Programmed Temperature	T – 3	T	T + 3	°C

PIN CONFIGURATIONS (DIP and SOIC)

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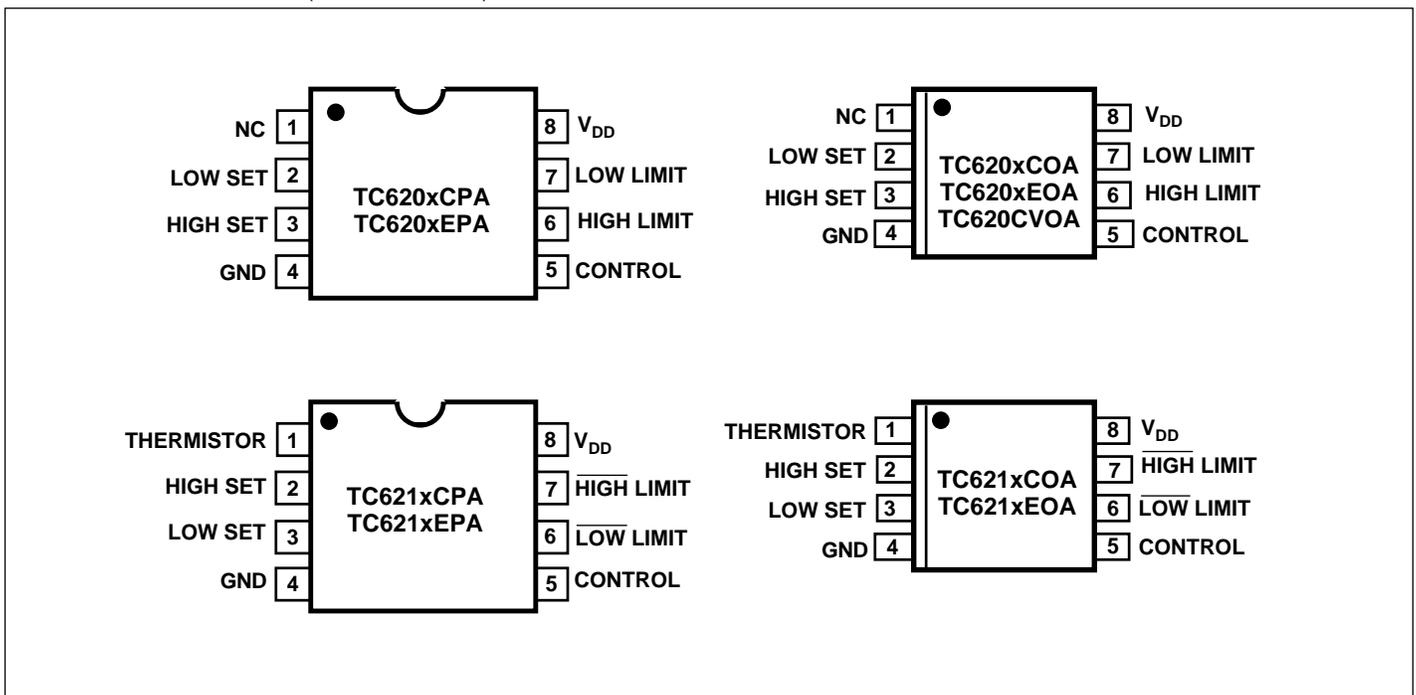
DETAILED DESCRIPTION

The TC620/621 consists of a positive temperature coefficient (PTC) temperature sensor, and a dual threshold detector. Temperature setpoint programming is easily accomplished with external programming resistors from the HIGH SET and LOW SET inputs to V_{DD}. The HIGH LIMIT and LOW LIMIT outputs remain low as long as measured temperature is below setpoint values. As measured temperature increases, the LOW LIMIT output is driven high when temperature equals the LOW SET setpoint ($\pm 3°C$ max). If temperature continues to climb, the HIGH LIMIT output is driven high when temperature equals the HIGH SET setpoint (Figure 1). The CONTROL (hysteresis) output is latched in its active state at the temperature specified by the HIGH SET resistor. CONTROL is maintained active until temperature falls to the value specified by the LOW SET resistor.
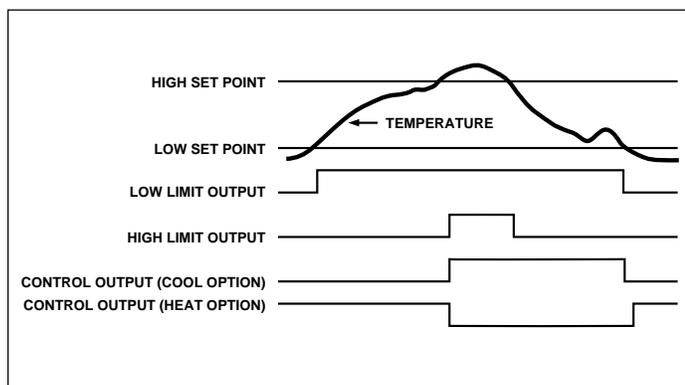

Figure 1: TC620/621 Input vs. Output Logic

Programming The TC620

The resistor values to achieve the desired trip-point temperatures on HIGH SET and LOW SET are calculated using EQUATION 1 below:

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

Where: Rtrip = Programming resistor in Ohms
    T = The desired trip point temperature in degrees Kelvin

Equation 1.

For example, a 50°C setting on either the HIGH SET or LOW SET input is calculated using Equation 1 as follows:

$$R_{set} = 0.5997 \times ((50 + 273.15)^{2.1312}) = 133.6k\ \Omega$$

Care must be taken to ensure the LOW SET programming resistor is a smaller value than the HIGH SET programming resistor. Failure to do this will result in erroneous operation of the CONTROL output.

Care must also be taken to ensure the LOW SET temperature setting is at least 5°C lower than the HIGH SET temperature setting. That is:

$$LOW\ SET \leq HIGH\ SET - 5°C$$

The nomograph of Figure 2 can help the user obtain an estimate of the external resistor values required for the desired LOW SET and HIGH SET trip points.
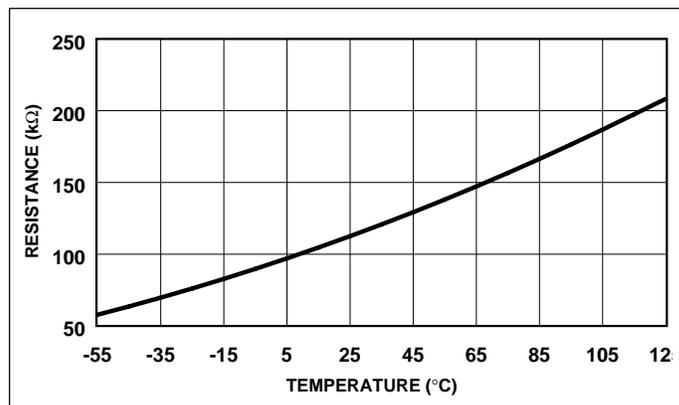

Figure 2. TC620 Sense Resistors vs. Trip Temperature

Built-in Hysteresis

To prevent output "chattering" when measured temperature is at (or near) the programmed trip point values, the LOW SET and HIGH SET inputs each have built-in hysteresis of $-2°C$ below the programmed settings (Figure 3).
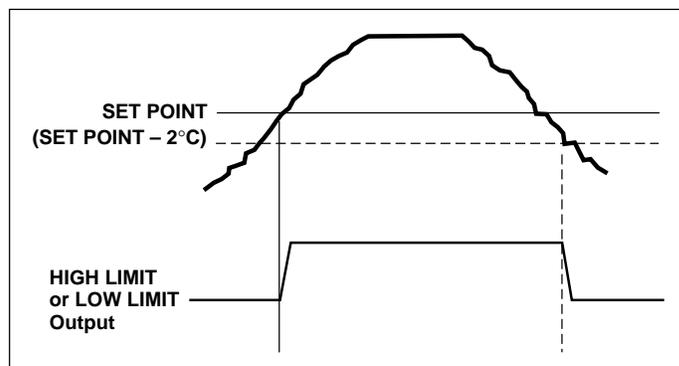

Figure 3: Built-in Hysteresis on Low Limit and High Limit Outputs

As shown, the outputs remain in their active state (hysteresis) until temperature falls an additional 2°C below the user's setting.

TC620
TC621

Using The TC621

The TC621 operation is identical to that of the TC620, but requires an external NTC thermistor. Use the resistance versus temperature curve of the thermistor to determine the values of the programming resistors. Note that the pin numbers for the HIGH SET and LOW SET programming resistors for the TC621 are reversed versus that of the TC620 (i.e. the resistor value on HIGH SET [pin 2] should always be lower than the one connected to LOW SET [pin 3]). Also note that the outputs of the TC621 are LOW TRUE when used with an NTC thermistor.

TC621 Thermistor Selection

The TC621 uses an external thermistor to monitor the controlling temperature. A thermistor with a resistance value of approximately 100kΩ at 25°C is recommended.

A temperature setpoint is selected by picking a resistor whose value is equal to the resistance of the thermistor at the desired temperature. For example, a 30kΩ resistor between HIGH TEMP (pin 2) and V_{DD} (pin 8) sets the high temperature trip point at +51°C and a 49kΩ resistor on LOW TEMP (pin 3) sets the low temperature trip point to +41°C.

TC620/621 Outputs

Both devices have complimentary output stages. They are rated at a source or sink current of 1mA maximum.
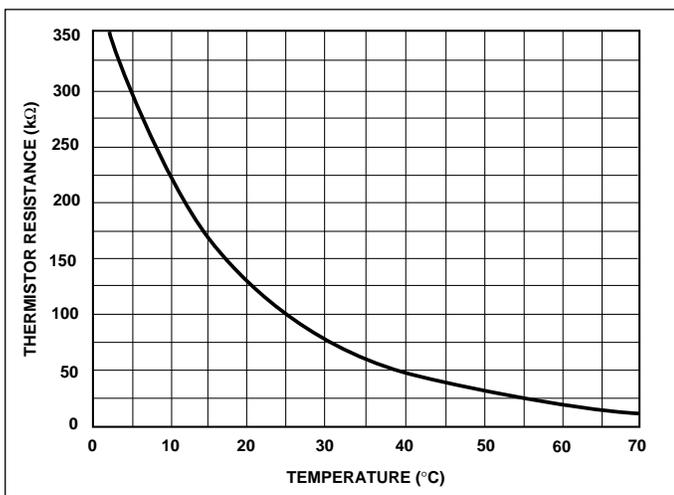
TYPICAL NTC THERMISTOR

Figure 4. Typical Thermistor Resistance vs. Temperature

APPLICATIONS

Dual Speed Temperature Control

The Dual Speed Temperature Control uses a TC620 and a TC4469 quad driver. Two of the drivers are configured in a simple oscillator. When the temperature is below the LOW TEMP set point, the output of the driver is OFF. When the temperature exceeds the LOW TEMP set point, the TC4469 gates the oscillator signal to the outputs of the driver. This square wave signal modulates the remaining outputs and drives the motor at a low speed. If this speed cannot keep the temperature below the HIGH TEMP set point, then the driver turns on continuously which increases the fan speed to high. The TC620 will monitor the temperature and only allow the fan to operate when needed, and at the required speed to maintain the desired temperature. A higher power option can be designed by adding a resistor and a power MOSFET.

Temperature Controlled Fan

In this application, a high and a low temperature is selected by two 'set' resistors. The TC620 monitors the ambient temperature and turns the FET switch on when the temperature exceeds the HIGH TEMP set point. The fan remains on until the temperature decreases to the LOW TEMP set point. This provides the hysteresis. In this application, the fan turns on only when required.

The TC621 uses an external thermistor to monitor the ambient temperature. This adds one part, but allows more flexibility in location of the sensor.
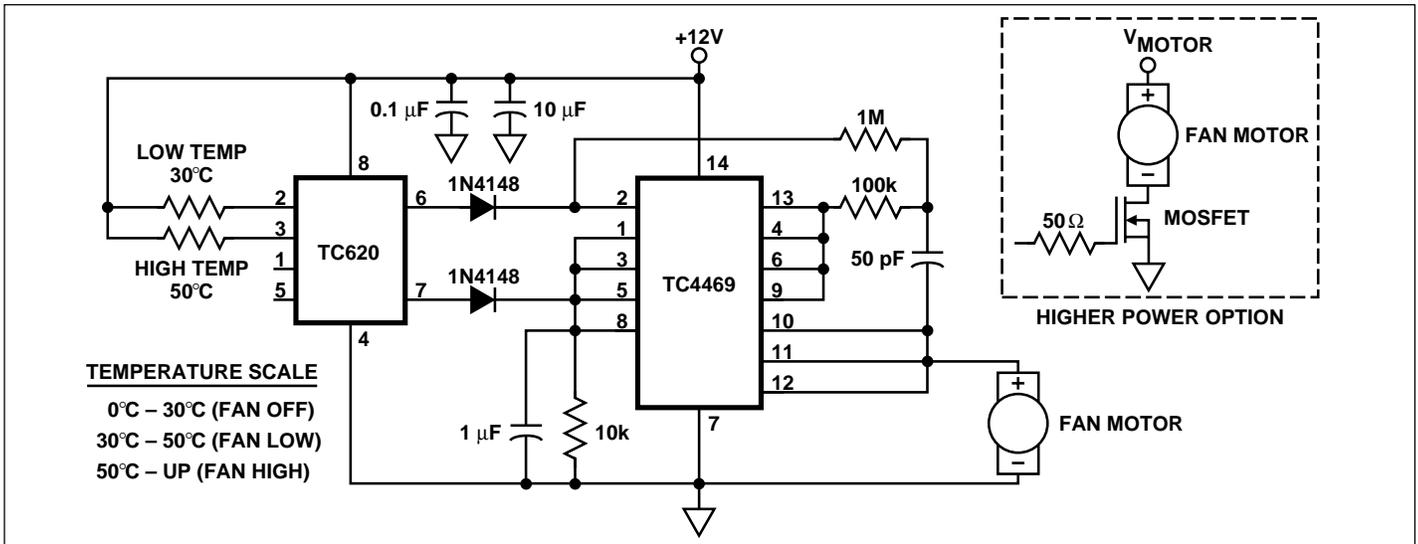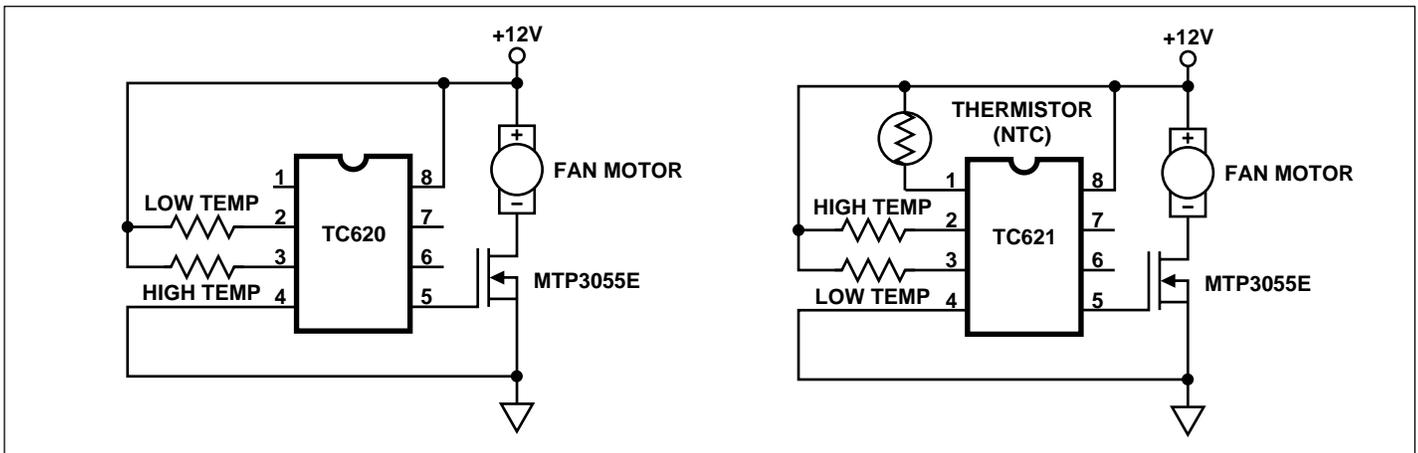
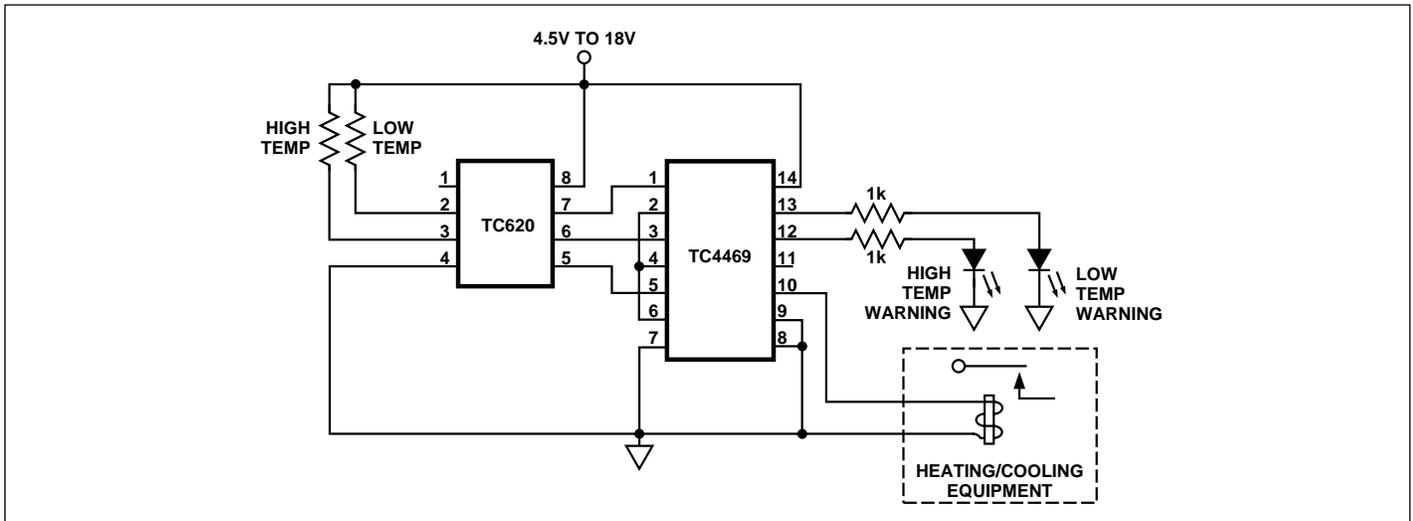# 5V, Dual Trip Point Temperature Sensors

Figure 5.

Figure 6.

Figure 7. TC620 Heating/Cooling Application
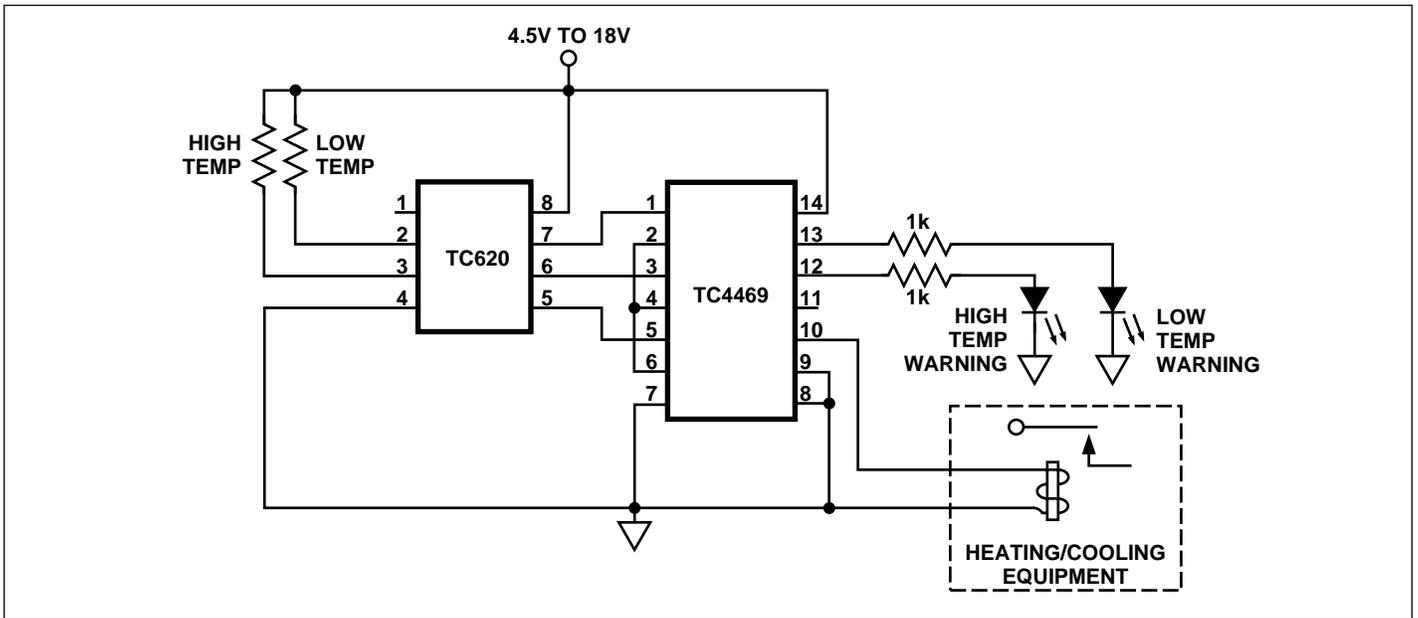
TC620
TC621

Figure 8. TC620 Heating/Cooling Application

PACKAGE DIMENSIONS

8-Pin PDIP (Narrow)

PIN 1

.260 (6.60)
.240 (6.10)

.045 (1.14)
.030 (0.76)

.070 (1.78)
.040 (1.02)

.400 (10.16)
.348 (8.84)

.200 (5.08)
.140 (3.56)

.040 (1.02)
.020 (0.51)

.150 (3.81)
.115 (2.92)

.110 (2.79)
.090 (2.29)

.022 (0.56)
.015 (0.38)

.310 (7.87)
.290 (7.37)

.015 (0.38)
.008 (0.20)

3° MIN.

.400 (10.16)
.310 (7.87)
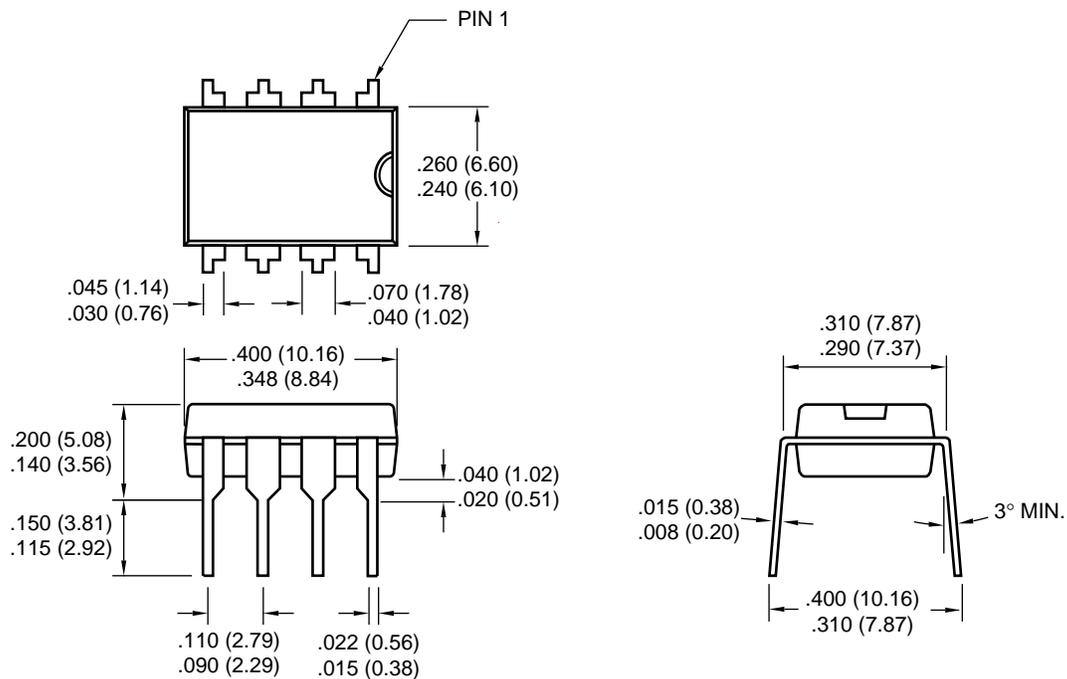
Dimensions: inches (mm)

5V, Dual Trip Point Temperature Sensors

PACKAGE DIMENSIONS (Cont.)

8-Pin SOIC

.157 (3.99)
.150 (3.81)

.244 (6.20)
.228 (5.79)

.050 (1.27) TYP.

.197 (5.00)
.189 (4.80)

.069 (1.75)
.053 (1.35)

.020 (0.51)
.013 (0.33)

.010 (0.25)
.004 (0.10)

8° MAX.

.010 (0.25)
.007 (0.18)

.050 (1.27)
.016 (0.40)

Dimensions: inches (mm)
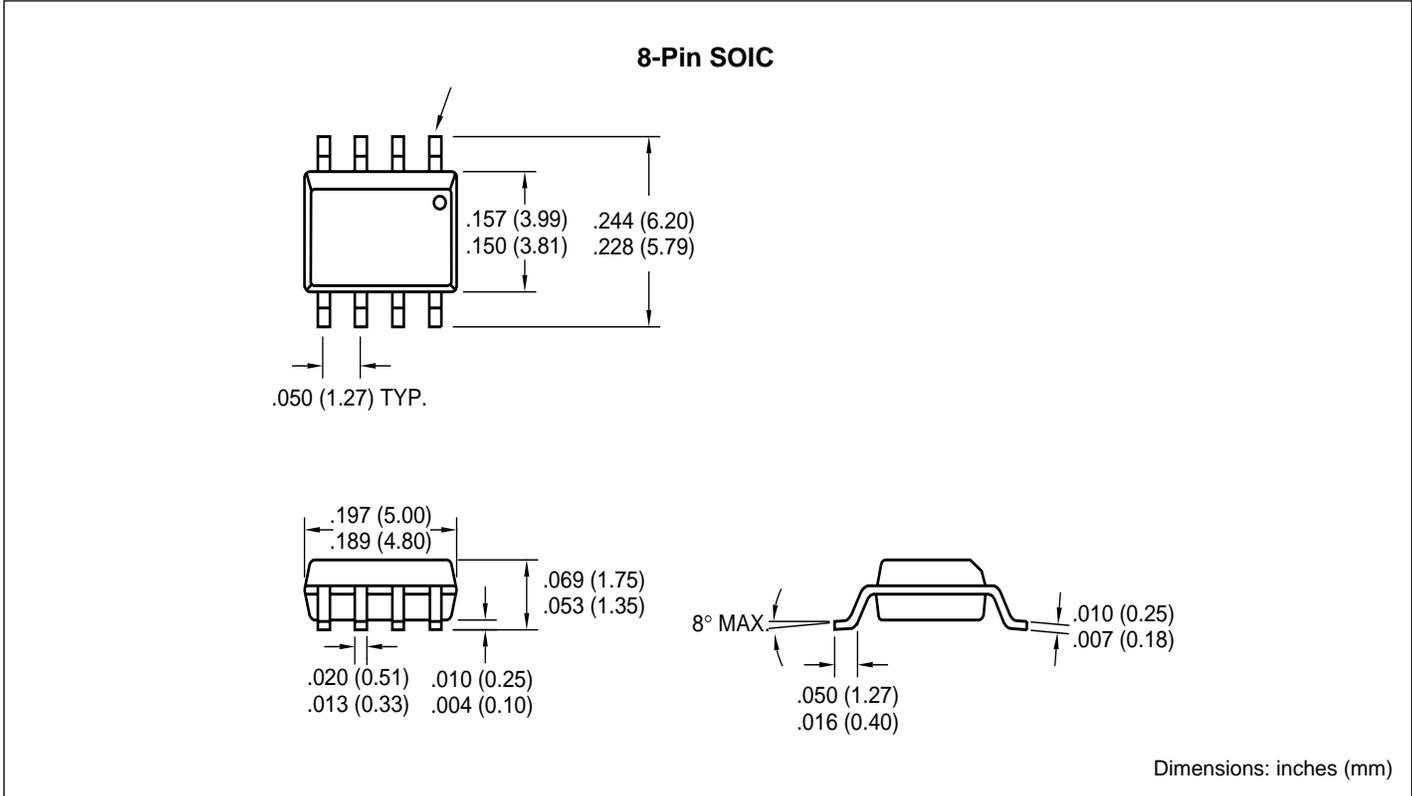
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