

5V, Dual Trip Point Temperature Sensors

Features

- User Programmable Hysteresis and Temperature Set Point
- Easily Programs with 2 External Resistors
- Wide Temperature Detection Range:
 - 0°C to 70°C: (TC620/TC621CCX)
 - 40°C to +125°C: (TC620/TC621CVX)
 - 40°C to +85°C: (TC620/TC621CEX)
 - 55°C to +125°C: (TC620/TC621CMX)
- Onboard Temperature Sensing Applications (TC620X)
- External NTC Thermistor for Remote Sensing Applications (TC621X)
- Available in 8-Pin PDIP and SOIC Packages

Applications

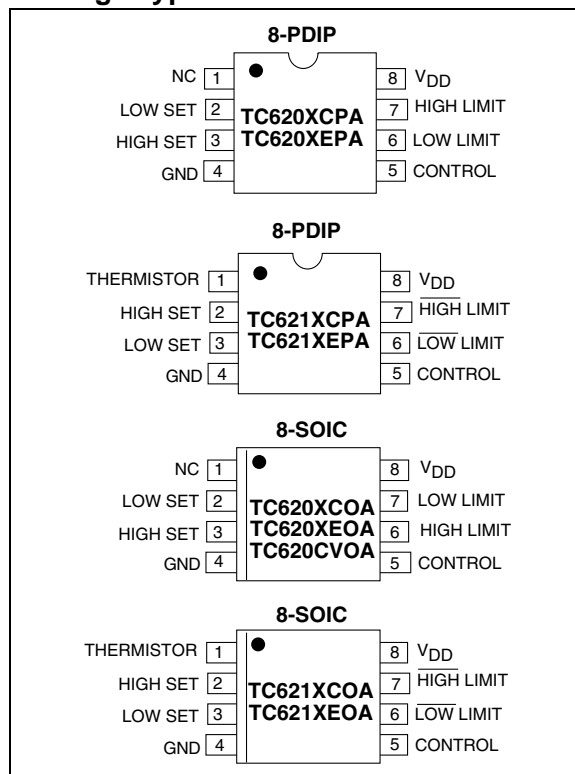
- Power Supply Over Temperature Detection
- Consumer Equipment
- Temperature Regulators
- CPU Thermal Protection

Device Selection Table

| Part Number | Package | Temperature Range |
|-------------|------------|-------------------|
| TC620X*COA | 8-Pin SOIC | 0°C to +70°C |
| TC620X*CPA | 8-Pin PDIP | 0°C to +70°C |
| TC620X*EOA | 8-Pin SOIC | -40°C to +85°C |
| TC620X*EPA | 8-Pin PDIP | -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 PDIP | 0°C to +70°C |
| TC621X*EOA | 8-Pin SOIC | -40°C to +85°C |
| TC621X*EPA | 8-Pin PDIP | -40°C to +85°C |

NOTE: *The part code will be C or H.
(See Functional Block Diagrams).

Package Type



General Description

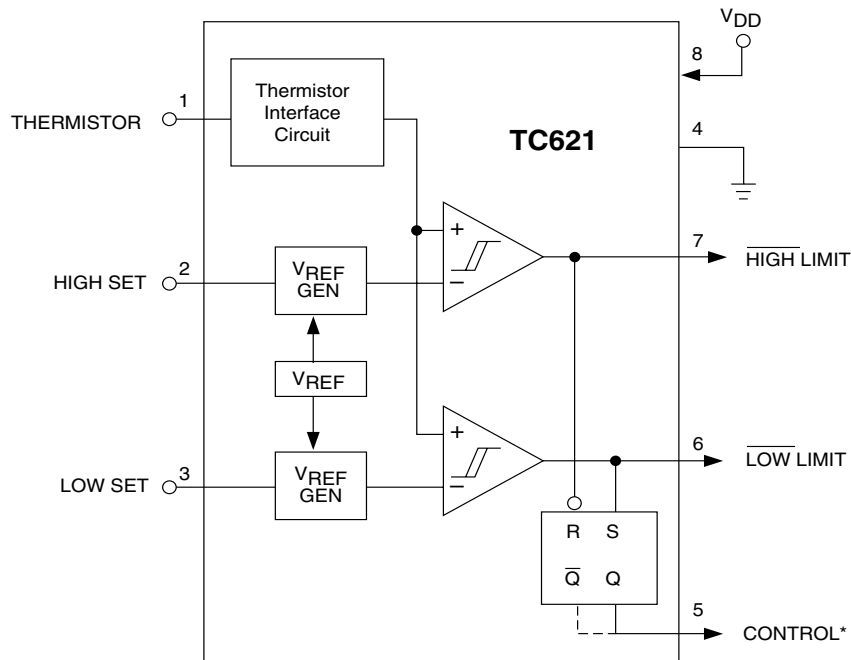
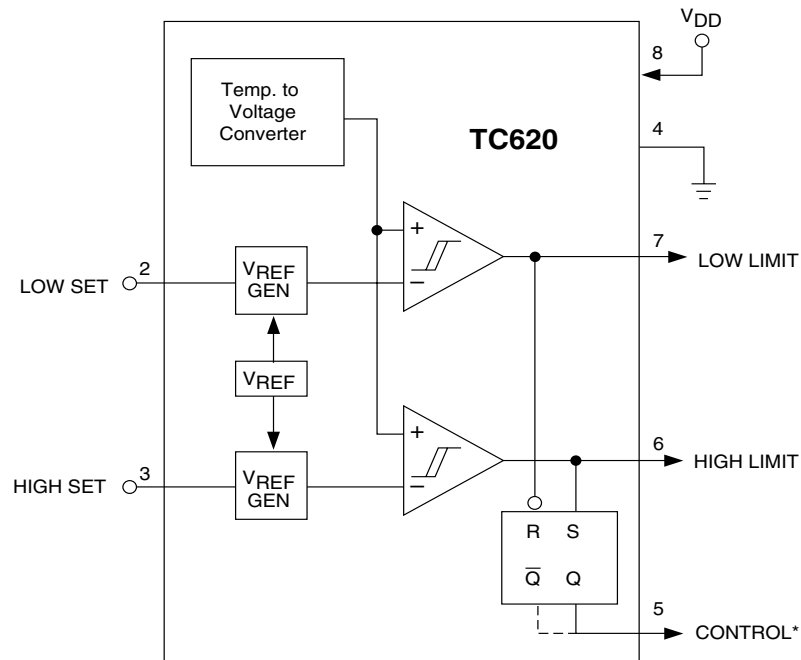
The TC620 and TC621 are programmable logic output temperature detectors designed for use in thermal management applications. The TC620 features an onboard temperature sensor, while the TC621 connects to an external NTC thermistor for remote sensing applications.

Both devices feature dual thermal interrupt outputs (HIGH LIMIT and LOW LIMIT), each of which is programmed 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 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/TC621 are usable over operating temperature ranges of 0°C to 70°C, -40°C to +125°C and -55°C to 125°C.

TC620/TC621

Functional Block Diagrams



*Suffix code "C" denotes cooling option (High true CONTROL output).

Suffix code "H" denotes heating option (Low true CONTROL output).

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings*

| | |
|---|-----------------|
| Supply Voltage | 20V |
| Input Voltage Any Input.. (GND – 0.3V) to (V _{DD} +0.3V) | |
| Package Power Dissipation (T _A ≤ 70°C) | |
| PDIP | 730mW |
| SOIC | 470mW |
| Derating Factors: | |
| Plastic | 8mW/°C |
| 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 |
| Storage Temperature | -65°C to +150°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.

TC620/TC621 ELECTRICAL SPECIFICATIONS

| Electrical Characteristics: T _A = 25°C, unless otherwise specified. | | | | | | |
|--|----------------------|-------|-----|-------|------|--|
| Symbol | Parameter | Min | Typ | Max | Unit | Test Conditions |
| V _{DD} | Supply Voltage Range | 4.5 | — | 18 | V | |
| I _{DD} | Supply Current | — | 270 | 400 | μA | 5V ≤ V _{DD} ≤ 18V |
| R _{OUT} | Output Resistance | — | 400 | 1000 | Ω | Output High or Low, 5V ≤ V _{DD} ≤ 18V |
| I _{OUT} | Output Current | — | — | 1 | mA | Temp Sensed Source/Sink |
| I _{OUT} | Output Current | — | — | 1 | mA | Cool/Heat Source/Sink |
| T _{ERR} | Absolute Accuracy | T - 3 | T | T + 3 | °C | T = Programmed Temperature |

TC620/TC621

2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

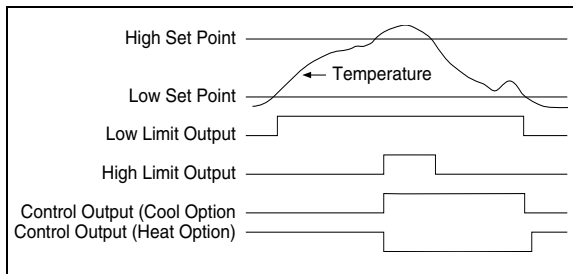
| Pin No. (8-Pin PDIP) (8-Pin SOIC) 0°C to +70°C -40°C to +85°C -40°C to +125°C | Symbol | Description |
|--|------------|--|
| 1 | NC | No Internal Connection. |
| 2 | LOW SET | Low temperature set point. Connect an external 1% resistor from LOW SET to V_{DD} to set trip point. |
| 3 | HIGH SET | High temperature set point. Connect an external 1% resistor from HIGH SET to V_{DD} to set trip point. |
| 4 | GND | Ground Terminal. |
| 5 | CONTROL | Control output. |
| 6 | HIGH LIMIT | High temperature push/pull output. |
| 7 | LOW LIMIT | Low temperature push/pull output. |
| 8 | V_{DD} | Power supply input. |

| Pin No. (8-Pin PDIP) (8-Pin SOIC) 0°C to +70°C -40°C to +85°C | Symbol | Description |
|---|--------------------------------|--|
| 1 | THERMISTOR | Thermistor input. |
| 2 | HIGH SET | High temperature set point. Connect an external 1% resistor from HIGH SET to V_{DD} to set trip point. |
| 3 | LOW SET | Low temperature set point. Connect an external 1% resistor from LOW SET to V_{DD} to set trip point. |
| 4 | GND | Ground Terminal. |
| 5 | CONTROL | Control output. |
| 6 | $\overline{\text{LOW LIMIT}}$ | Low temperature push/pull output. |
| 7 | $\overline{\text{HIGH LIMIT}}$ | High temperature push/pull output. |
| 8 | V_{DD} | Power supply input. |

3.0 DETAILED DESCRIPTION

The TC620 has a positive temperature coefficient temperature sensor and a dual threshold detector. Temperature set point programming is accomplished with external 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 set point values. As measured temperature increases, the LOW LIMIT output is driven high when temperature equals the LOW SET set point ($\pm 3^\circ\text{C}$ max). If temperature continues to climb, the HIGH LIMIT output is driven high when temperature equals the HIGH SET set point (Figure 3-1). 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 3-1: TC620/TC621 INPUT VS. OUTPUT LOGIC



3.1 Programming the TC620

The resistor values to achieve the desired trip point temperatures on HIGH SET and LOW SET are calculated using Equation 3-1:

EQUATION 3-1:

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

Where:

R_{TRIP} = Programming resistor in Ohms
 T = The desired trip point temperature in degrees Kelvin.

For example, a 50°C setting on either the HIGH SET or LOW SET input is calculated using Equation 3-2 as follows:

EQUATION 3-2:

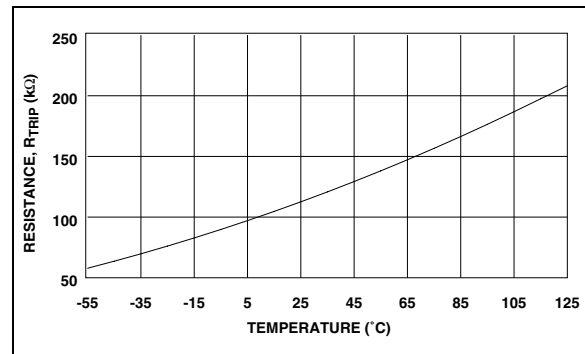
$$R_{SET} = 0.5997 \times ((50 + 273.15)^{2.1312}) = 133.6\text{k}\Omega$$

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.

Figure 3-2 can help the user obtain an estimate of the external resistor values required for the desired LOW SET and HIGH SET trip points.

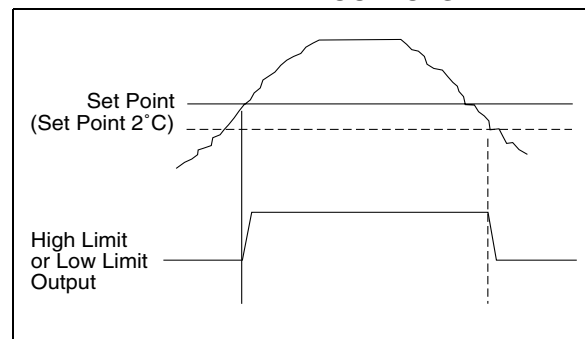
FIGURE 3-2: TC620 SENSE RESISTORS VS. TRIP TEMPERATURE



3.2 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 3-3).

FIGURE 3-3: 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

3.3 Using the TC621

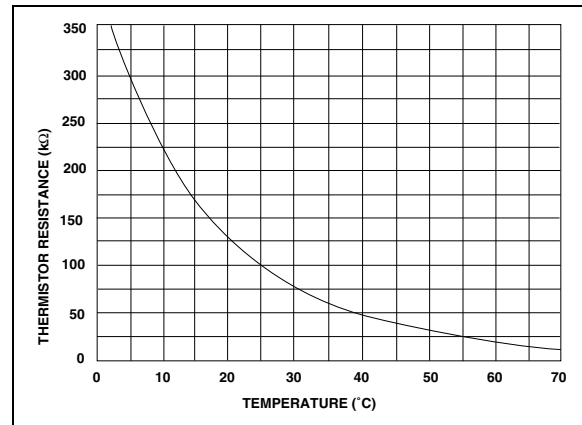
The TC621 operation is similar to that of the TC620, but requires an external NTC thermistor. Use the resistance versus temperature curve of the thermistor to determine the values of the programming resistors. Note that the pin numbers for the HIGH SET and LOW SET programming resistors for the TC621 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.

3.4 TC621 Thermistor Selection

The TC621 uses an external thermistor to monitor the controlling temperature. A thermistor with a resistance value of approximately 100k Ω at 25 $^{\circ}$ C is recommended.

A temperature set point is selected by picking a resistor whose value is equal to the resistance of the thermistor at the desired temperature. For example, using the data shown in Figure 3-4, a 30k Ω resistor between HIGH TEMP (Pin 2) and V_{DD} (Pin 8) sets the high temperature trip point at +51 $^{\circ}$ C and a 49k Ω resistor on LOW TEMP (Pin 3) sets the low temperature trip point to +41 $^{\circ}$ C.

FIGURE 3-4: TYPICAL NTC THERMISTOR



3.5 TC620/TC621 Outputs

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

4.0 TYPICAL APPLICATIONS

4.1 Dual Speed Temperature Control

In Figure 4-1, the Dual Speed Temperature Control uses a TC620 and a TC4469 quad driver. Two of the drivers of the TC4469 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.

4.2 Temperature Controlled Fan

In the application in Figure 4-2, a high and a low temperature is selected by two R_L and R_H . 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 with the location of the temperature sensor.

FIGURE 4-1: DUAL SPEED TEMPERATURE CONTROL

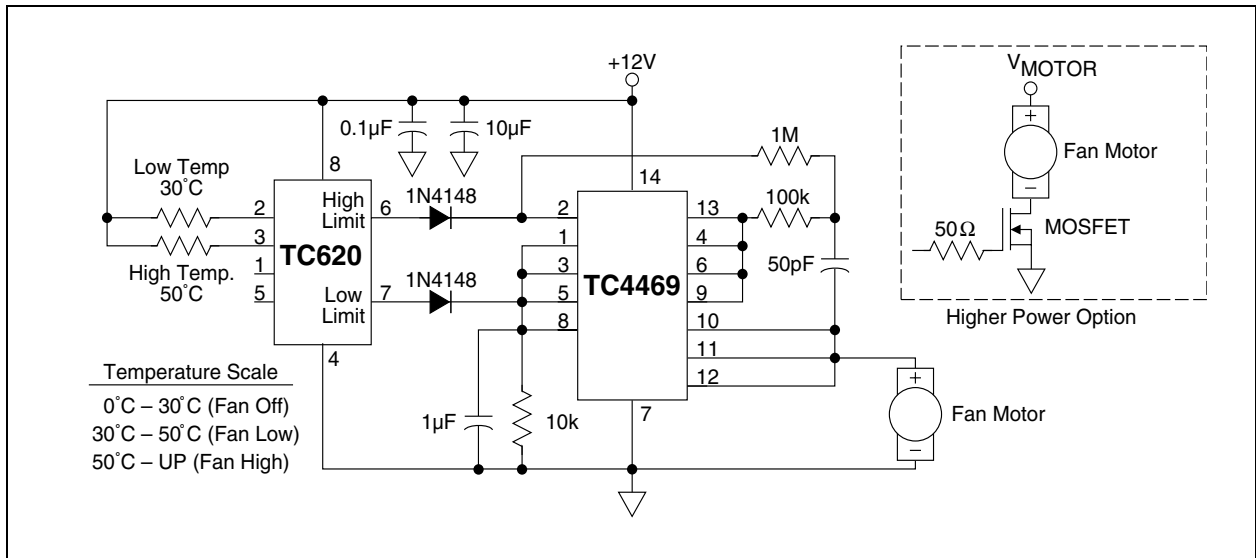
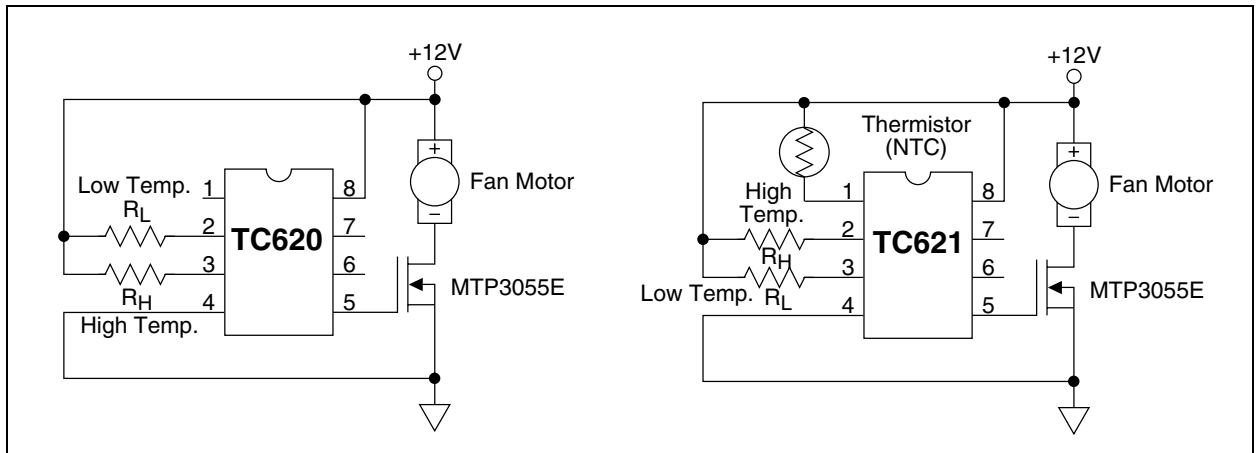
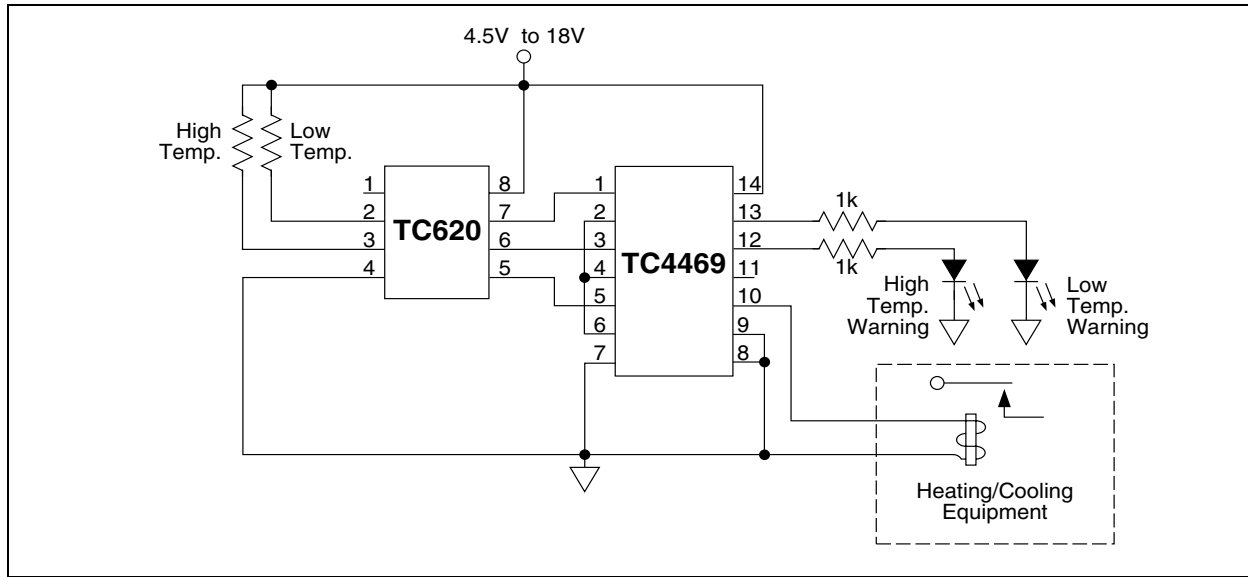


FIGURE 4-2: TEMPERATURE CONTROLLED FAN



TC620/TC621

FIGURE 4-3: HEATING AND COOLING APPLICATION

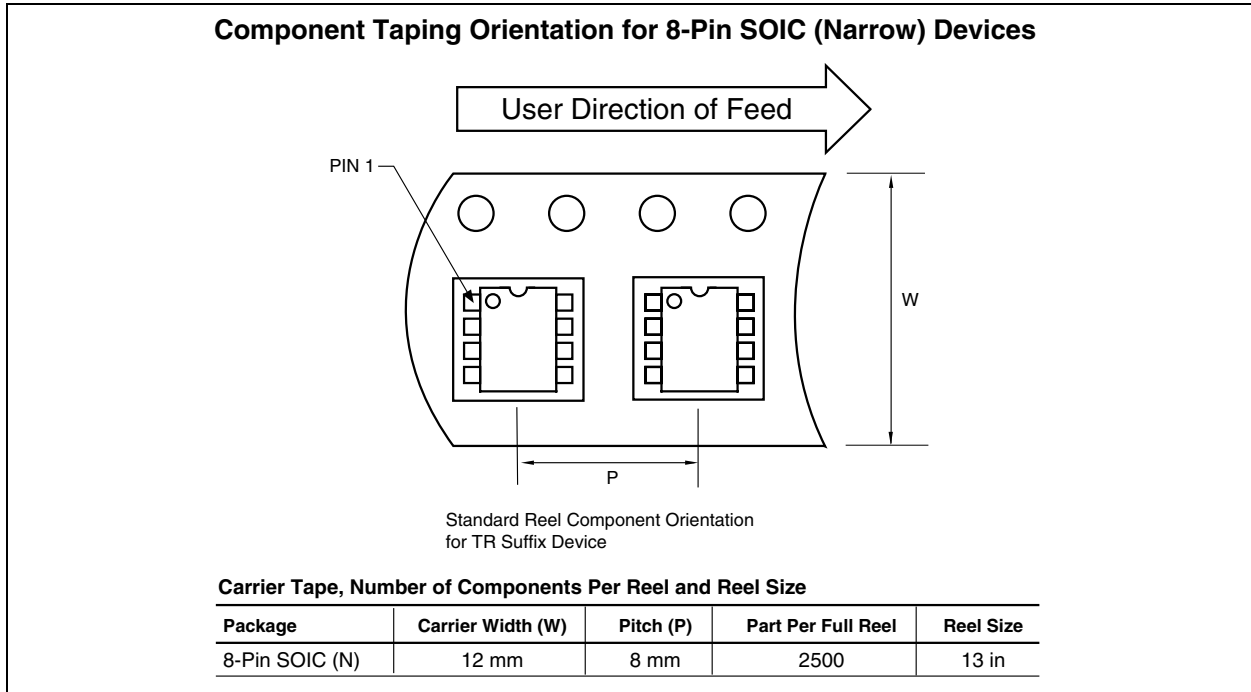


5.0 PACKAGING INFORMATION

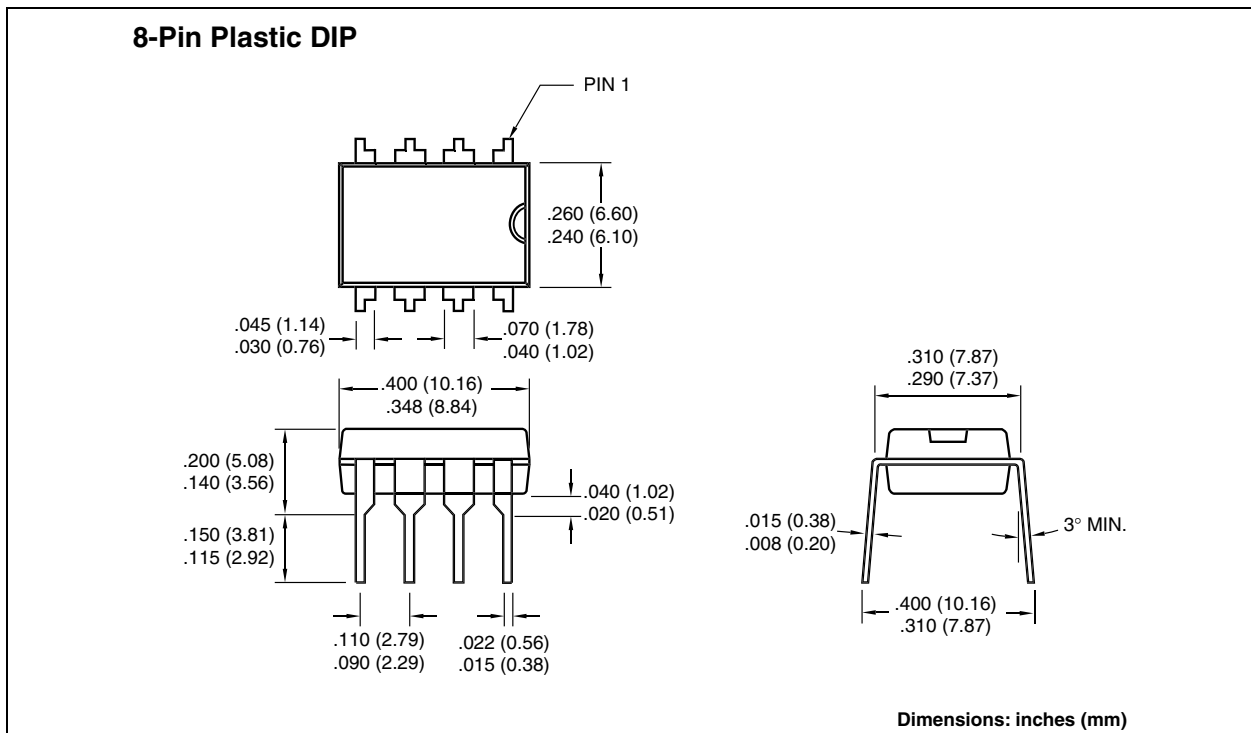
5.1 Package Marking Information

Package marking data not available at this time.

5.2 Taping Form



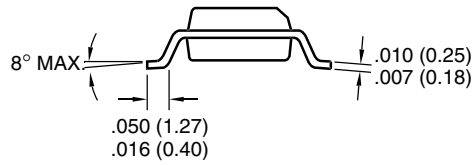
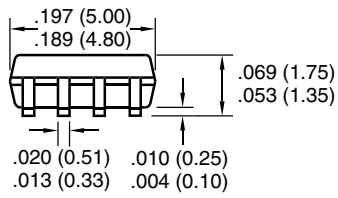
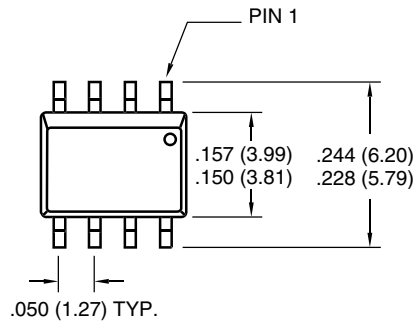
5.3 Package Dimensions



TC620/TC621

Package Dimensions (Continued)

8-Pin SOIC



Dimensions: inches (mm)

SALES AND SUPPORT

Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

New Customer Notification System

Register on our web site (www.microchip.com/cn) to receive the most current information on our products.

TC620/TC621

NOTES:

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, FilterLab, KEELOQ, microID, MPLAB, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

dsPIC, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, MXDEV, PICC, PICDEM, PICDEM.net, rfPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A.

Serialized Quick Turn Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2002, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.



MICROCHIP

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo

2767 S. Albright Road
Kokomo, Indiana 46902
Tel: 765-864-8360 Fax: 765-864-8387

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Consulting (Shanghai)
Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu

Microchip Technology Consulting (Shanghai)
Co., Ltd., Chengdu Liaison Office
Rm. 2401, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou

Microchip Technology Consulting (Shanghai)
Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Shanghai

Microchip Technology Consulting (Shanghai)
Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai)
Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong

Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaugnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Nordic ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy

Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

03/01/02

