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TC620/TC621

5V, Dual Trip Point Temperature Sensors

Features

- User Programmable Hysteresis and Temperature Set Point
- Easily Programs with Two 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)
- Onboard Temperature Sensing Applications (TC620X)
- External NTC Thermistor for Remote Sensing Applications (TC621X)
- Available in 8-Pin PDIP and SOIC Packages

Applications

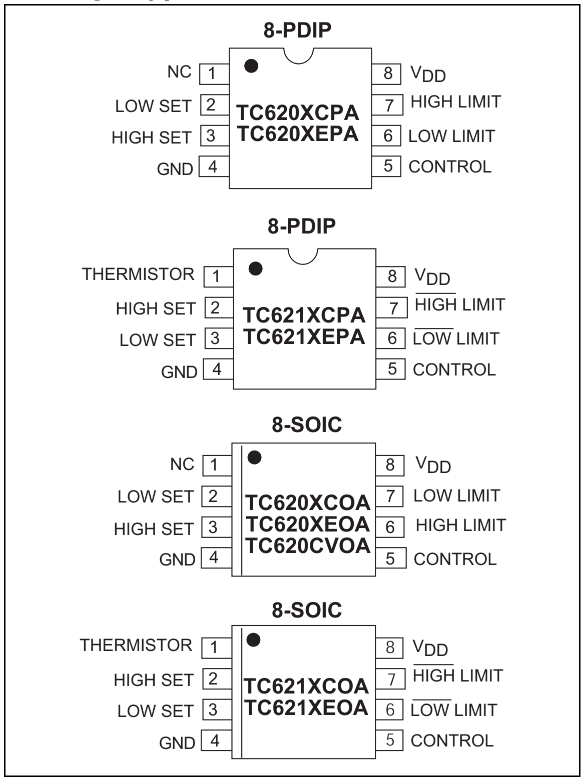
- Power Supply Over Temperature Detection
- Consumer Equipment
- Temperature Regulators
- CPU Thermal Protection

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
TC621C*VOA	8-Pin SOIC	-40°C to +125°C

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

Package Type



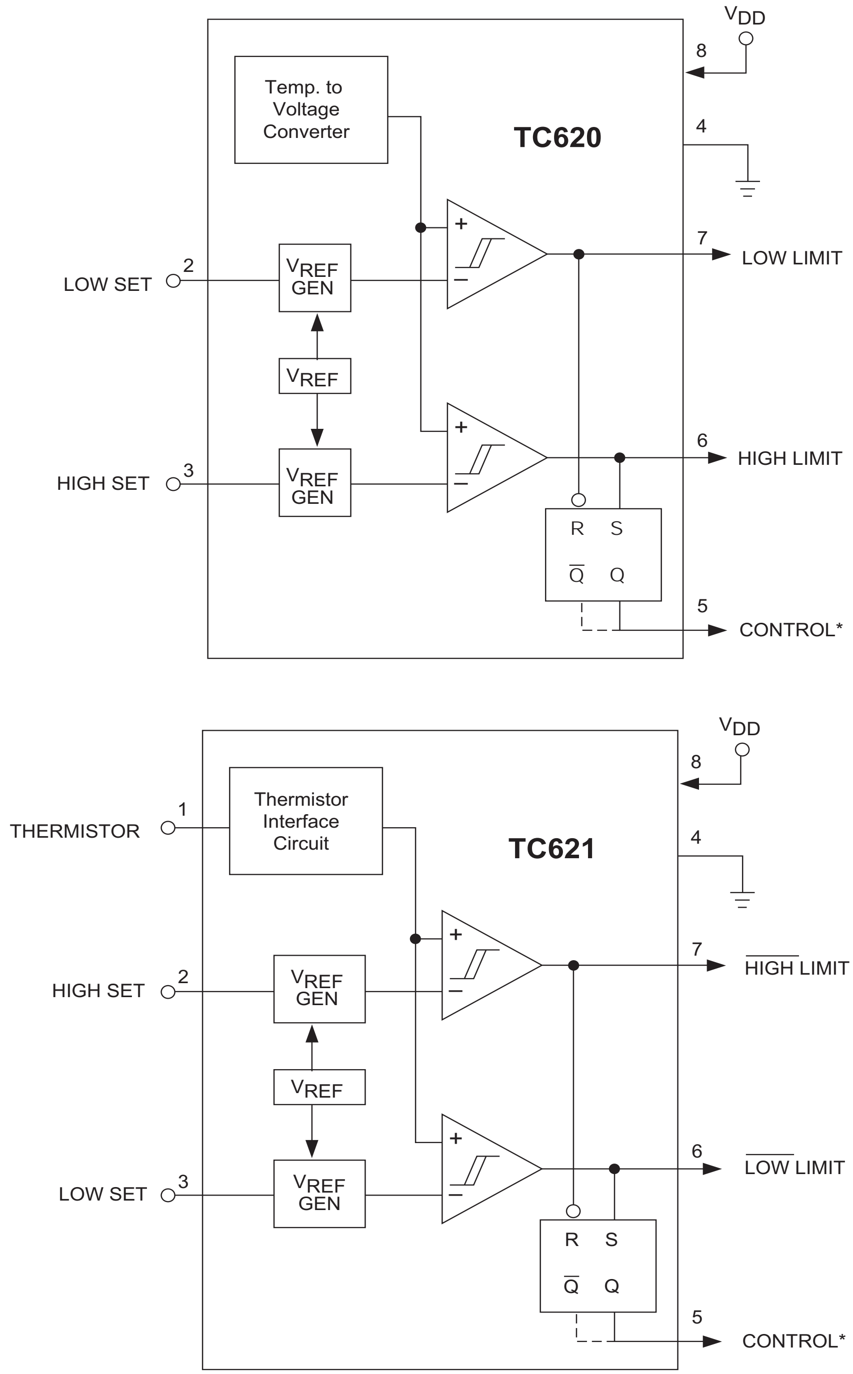
General Description

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.

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 ($T_A \leq 70°C$)
PDIP .... 730 mW
SOIC .... 470 mW
Derating Factors:
Plastic .... 8 mW/°C
Operating Temperature:
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	$5V \leq V_{DD} \leq 18V$
R_{OUT}	Output Resistance	—	400	1000	W	Output High or Low, $5V \leq V_{DD} \leq 18V$
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

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, all parameters apply with $4.5V \leq V_{DD} \leq 18V$.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Specified Temperature Range (C)	T_A	0	—	+70	°C	
Specified Temperature Range (E)	T_A	-40	—	+85	°C	
Specified Temperature Range (V)	T_A	-40	—	+125	°C	
Maximum Junction Temperature	T_J	—	—	+150	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Package Thermal Resistances						
Thermal Resistance, 8L-PDIP	θ_{JA}	—	125	—	°C/W	
Thermal Resistance, 8L-SOIC	θ_{JA}	—	155	—	°C/W	

2.0 PIN DESCRIPTIONS

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

TABLE 2-1: TC620 PIN FUNCTION TABLE

Pin No. (8-Pin PDIP) (8-Pin SOIC)	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.

TABLE 2-2: TC621 PIN FUNCTION TABLE

Pin No. (8-Pin PDIP) (8-Pin SOIC)	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 (±3°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.

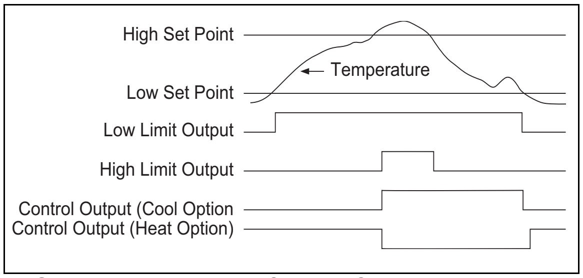


FIGURE 3-1: *TC620/TC621 Input vs. Output Logic.*

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:

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

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.

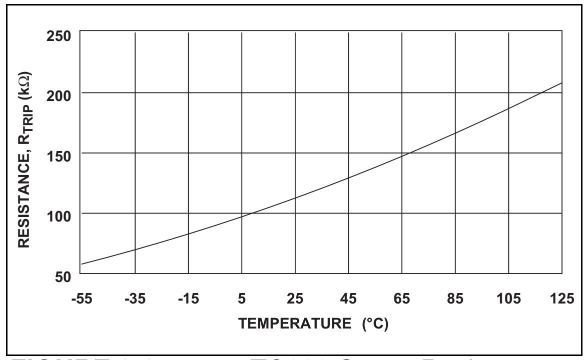


FIGURE 3-2: *TC620 Sense Resistors vs. Trip Temperature.*

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).

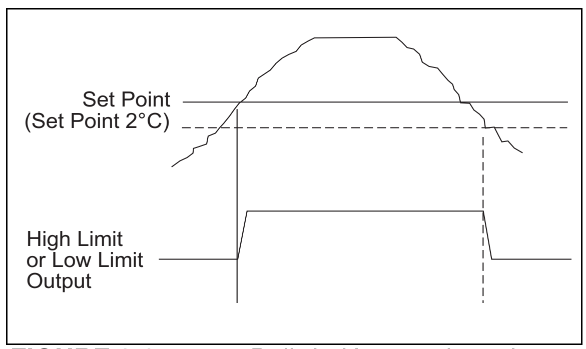


FIGURE 3-3: *Built-In Hysteresis on Low Limit and High Limit Outputs.*

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

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 100 kΩ at 25°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 30 kΩ resistor between HIGH TEMP (Pin 2) and V_{DD} (Pin 8) sets the high temperature trip point at +51°C and a 49 kΩ resistor on LOW TEMP (Pin 3) sets the low temperature trip point to +41°C.

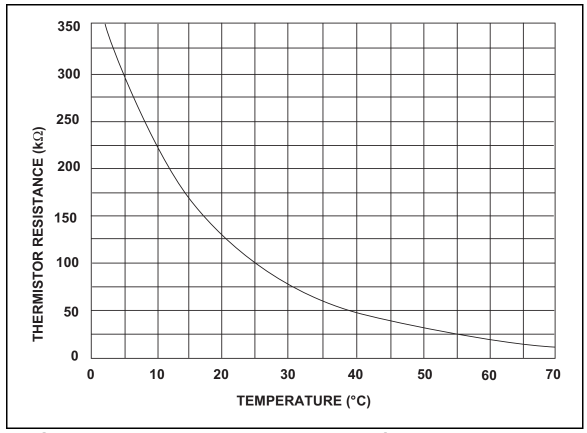


FIGURE 3-4: *Typical NTC Thermistor.*

3.5 TC620/TC621 Outputs

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

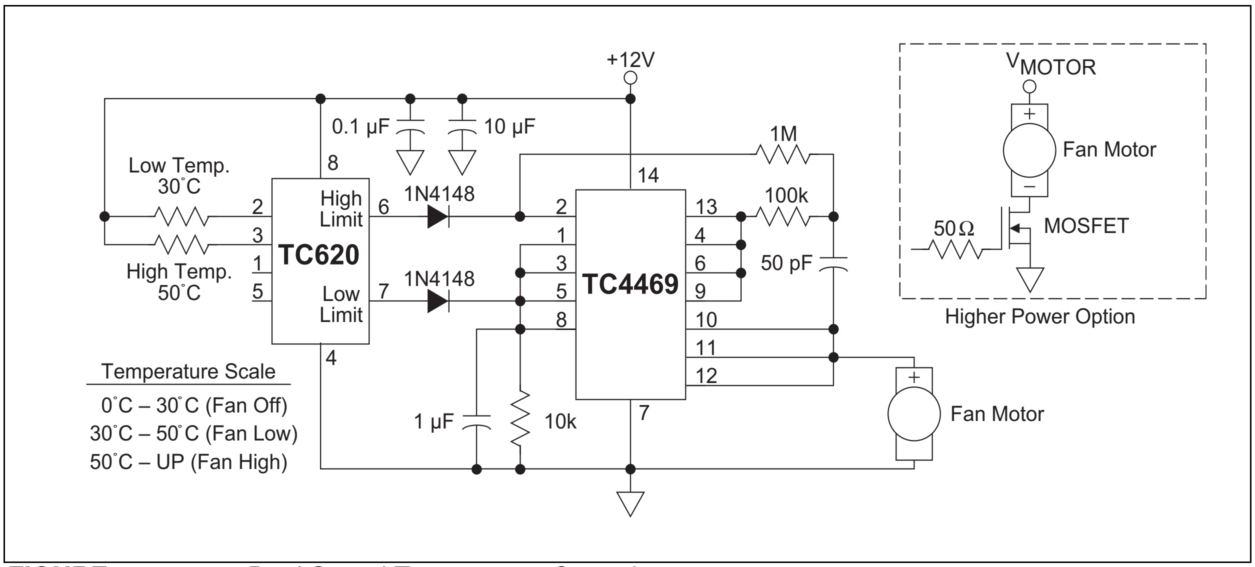


FIGURE 4-1: *Dual Speed Temperature Control.*

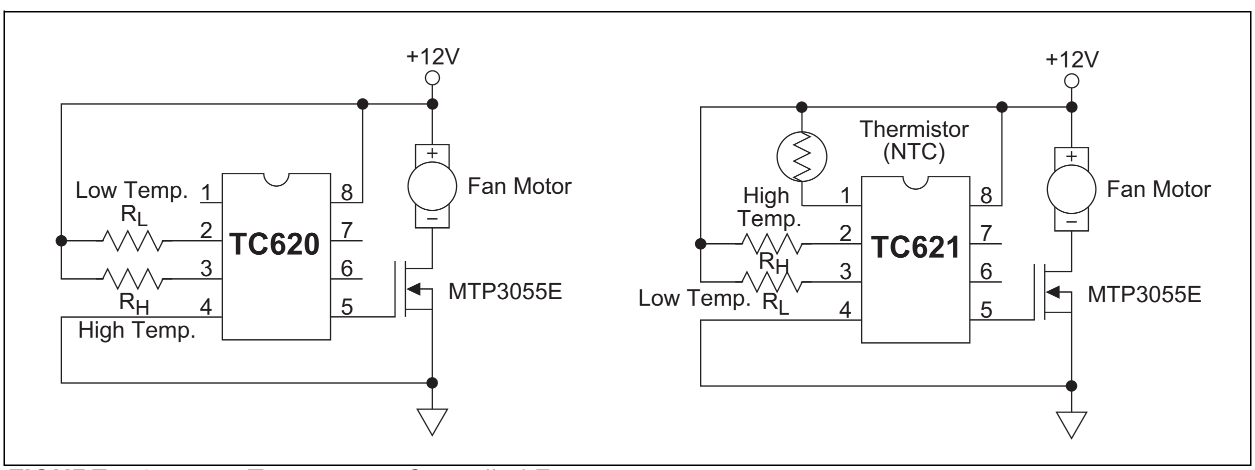


FIGURE 4-2: *Temperature Controlled Fan.*

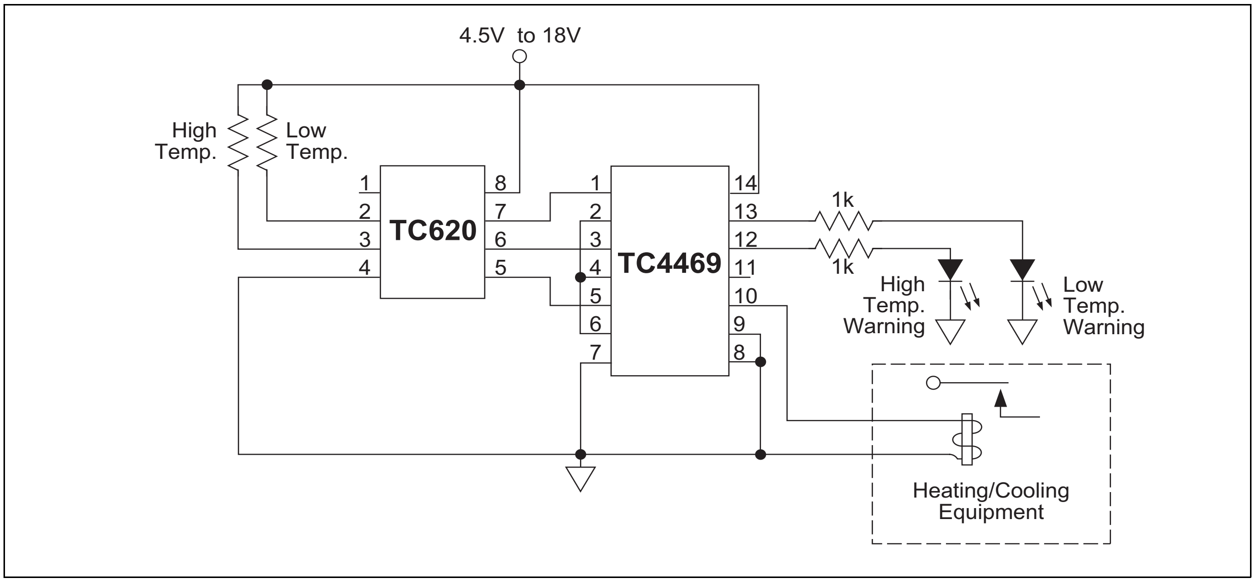
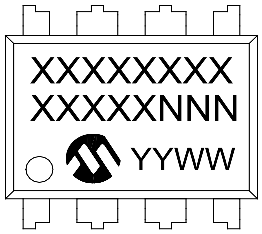


FIGURE 4-3: *Heating and Cooling Application.*

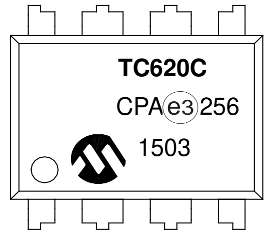
5.0 PACKAGING INFORMATION

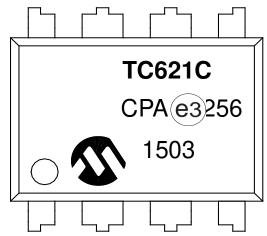
5.1 Package Marking Information

8-Lead PDIP (300 mil)

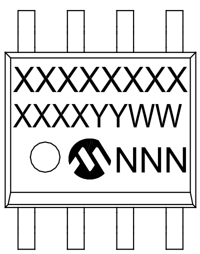


Example

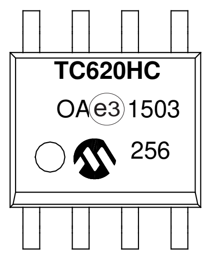


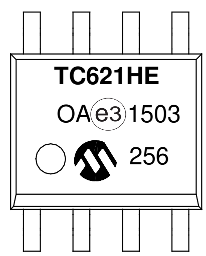


8-Lead SOIC (150 mil)



Example



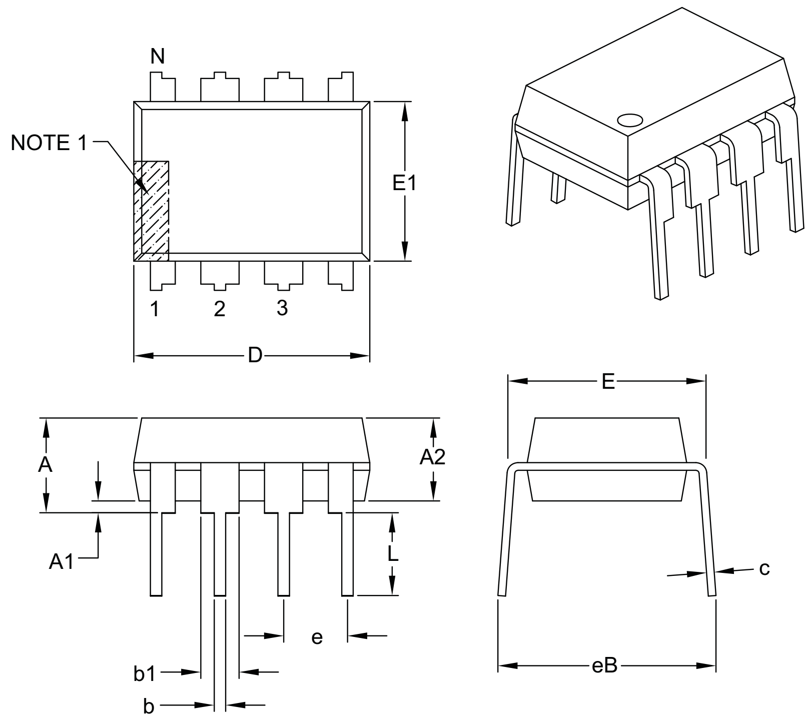


Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

8-Lead Plastic Dual In-Line (PA) – 300 mil Body [PDIP]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



	Units	INCHES		
	Dimension Limits	MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

Notes:

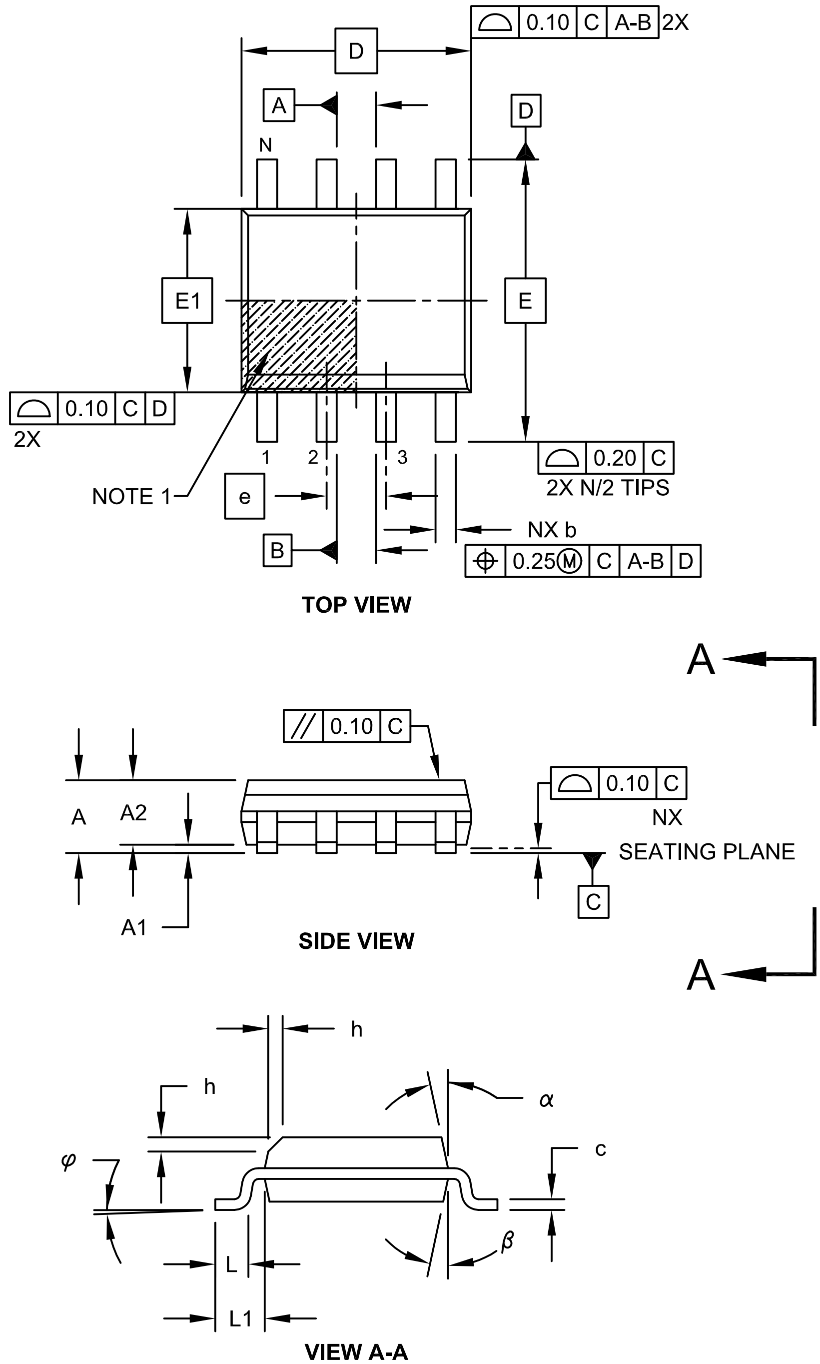
1. Pin 1 visual index feature may vary, but must be located with the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-018B

8-Lead Plastic Small Outline (OA) - Narrow, 3.90 mm Body [SOIC]

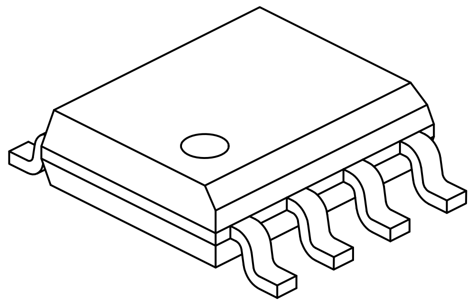
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-057C Sheet 1 of 2

8-Lead Plastic Small Outline (OA) - Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1	1.04 REF		
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.17	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M

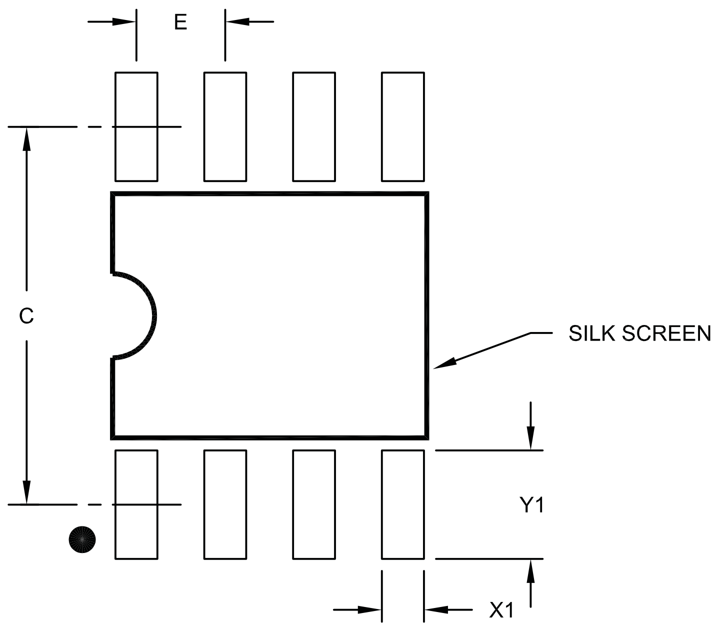
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing No. C04-057C Sheet 2 of 2

8-Lead Plastic Small Outline (OA) – Narrow, 3.90 mm Body [SOIC]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

		Units	MILLIMETERS		
		Dimension Limits	MIN	NOM	MAX
Contact Pitch	E		1.27 BSC		
Contact Pad Spacing	C			5.40	
Contact Pad Width (X8)	X1				0.60
Contact Pad Length (X8)	Y1				1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2057A

NOTES:

APPENDIX A: REVISION HISTORY

Revision E (February 2015)

1. Removed the -55°C to 125°C temperature range reference on page 1.
2. Removed the M version temperature range from page 3 (-55°C to 125°C).
3. Added the Temperature Characteristics table.
4. Added **Section 5.0 "Packaging Information"**.
5. Added the Product Identification System section.

Revision D (December 2012)

1. Added a note to each package outline drawing.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	X	X	XX	XXX	X
Device	Cooling/ Heating	Temperature Range	Package	Tape & Reel	PB Free

Device:	TC620:	5V, Dual Trip Point Temperature Sensors
	TC621:	5V, Dual Trip Point Temperature Sensors
Cooling/Heating Option:	C =	Cooling Option
	H =	Heating Option
Temperature Range:	C =	0°C to +70°C (PDIP and SOIC only)
	E =	-40°C to +85°C
	V =	-40°C to +125°C
Package:	OA =	Plastic SOIC, (150 mil Body), 8-lead
	OA713 =	Plastic SOIC, (150 mil Body), 8-lead (Tape and Reel)
	PA =	Plastic DIP (300 mil Body), 8-lead

Examples:

a) TC620CCOA: 5V Dual Trip Point Temp sensor, Cooling option, 0°C to +70°C SOIC package

b) TC620CEPA: 5V Dual Trip Point Temp sensor, Cooling option, -40°C to +85°C PDIP package.

c) TC620CVPA: 5V Dual Trip Point Temp sensor, Cooling option, -40°C to +125°C PDIP package.

d) TC620HCOA: 5V Dual Trip Point Temp sensor, Heating option, 0°C to +70°C SOIC package

e) TC621HEPA: 5V Dual Trip Point Temp sensor, Heating option, -40°C to +85°C PDIP package.

f) TC620CCOA713: 5V Dual Trip Point Temp sensor, Cooling option, 0°C to +70°C SOIC package.

g) TC621HCOA713: 5V Dual Trip Point Temp sensor, Heating option, 0°C to +70°C SOIC package.

NOTES:

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ISO/TS 16949

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