

## 3V Logic Output Temperature Sensor with Programmable Hysteresis

### Features

- User Programmable Hysteresis and Temperature Set Point
- Easily Programs with Two External Resistors
- Wide Temperature Detection Range
  - TC07CXA: -0°C to +70°C
  - TC07EXA: -40°C to +85°C
  - TC07VXA: -40°C to +125°C
- 8-Pin MSOP and 8-Pin SOIC Packages
- Cost Effective

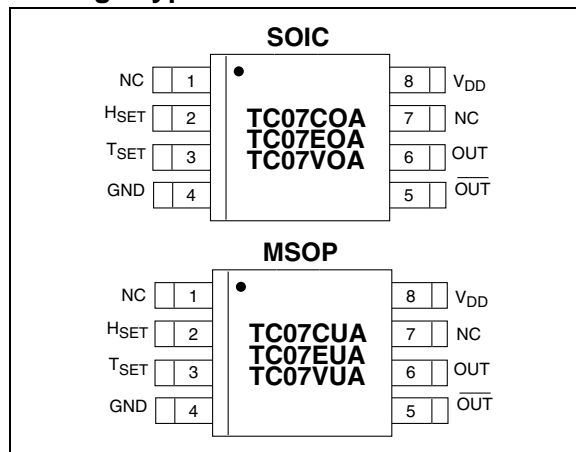
### Applications

- Power Supply Over-Temperature Detection
- Consumer Equipment
- Temperature Regulators

### Device Selection Table

| Part Number | Package    | Temperature Range |
|-------------|------------|-------------------|
| TC07COA     | 8-Pin SOIC | 0°C to +70°C      |
| TC07CUA     | 8-Pin MSOP | 0°C to +70°C      |
| TC07EOA     | 8-Pin SOIC | -40°C to +85°C    |
| TC07EUA     | 8-Pin MSOP | -40°C to +85°C    |
| TC07VOA     | 8-Pin SOIC | -40°C to +125°C   |
| TC07VUA     | 8-Pin MSOP | -40°C to +125°C   |

### Package Type



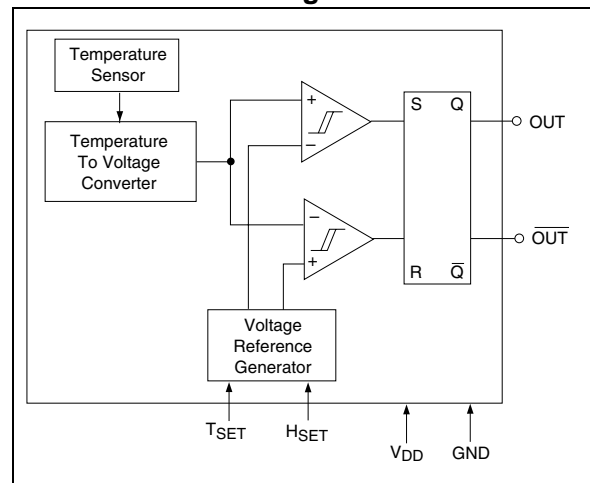
### General Description

The TC07 is a programmable, logic output temperature detector that operates from power supply levels as low as 2.7V. Programming is accomplished with external resistors connected from the temperature set point input ( $T_{SET}$ ) and the hysteresis control input ( $H_{SET}$ ) to  $V_{DD}$ .

Complementary outputs ( $OUT$  and  $\overline{OUT}$ ) are driven active when temperature exceeds the temperature threshold programmed by the resistor on  $T_{SET}$ . The states of these outputs are maintained (latched) until temperature falls below threshold programmed by the resistor on  $H_{SET}$ .

The TC07 has an operating temperature range of -40°C to +125°C (TC07VXA). It features low (<130 $\mu$ A) supply current and with 8-pin MSOP and 8-pin SOIC packages, making it suitable for a wide variety of applications.

### Functional Block Diagram



# TC07

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings\*

Supply Voltage ..... 7V  
Input Voltage Any Input . (GND – 0.3V) to (V<sub>DD</sub> + 0.3V)  
Operating Temperature ..... -40°C to +125°C  
Storage Temperature, T<sub>J</sub> ..... -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.

### TC07 ELECTRICAL SPECIFICATIONS

| Electrical Characteristics: T <sub>A</sub> = Over operational temperature range, unless otherwise specified. |                       |                       |       |                        |      |                                     |
|--|-----------------------|-----------------------|-------|------------------------|------|-------------------------------------|
| Symbol   | Parameter             | Min                   | Typ   | Max                    | Unit | Test Conditions                     |
| V <sub>DD</sub>  | Supply Voltage Range  | 2.7                   | –     | 5.5                    | V    |                                     |
| I <sub>DD</sub>  | Supply Current        | –                     | 130   | 300                    | μA   | 2.7V < V <sub>CC</sub> < 5.5V       |
| V <sub>OH</sub>  | Output Voltage (High) | 0.8 x V <sub>DD</sub> | –     | –                      | V    | I <sub>OUT</sub> = 500μA            |
| V <sub>OL</sub>  | Output Voltage (Low)  | –                     | –     | 0.25 x V <sub>DD</sub> | V    | I <sub>OUT</sub> = 1mA              |
| H  | Minimum Hysteresis    | -5                    | –     | –                      | °C   | H <sub>SET</sub> < T <sub>SET</sub> |
| T <sub>SET</sub>   | Absolute Accuracy     | T - 3                 | T ± 1 | T + 3                  | °C   | T = Programmed Temperature          |
| H <sub>SET</sub>   | Absolute Accuracy     | T - 5                 | T ± 1 | T + 5                  | °C   | T = Programmed Temperature          |

## 2.0 PIN DESCRIPTIONS

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

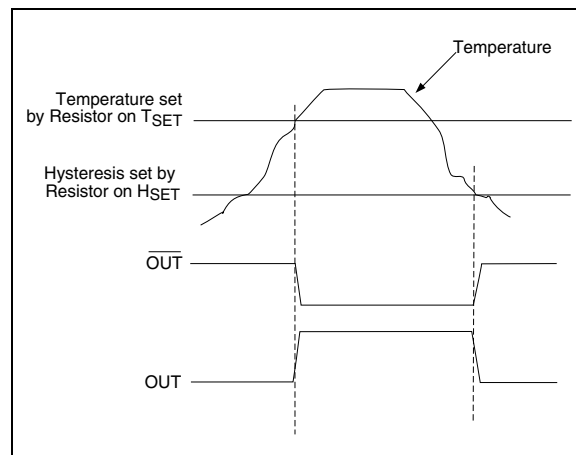
**TABLE 2-1: PIN FUNCTION TABLE**

| Pin No.<br>(8-Pin SOIC)<br>(8-Pin MSOP) | Symbol                  | Description            |
|---|-------------------------|------------------------|
| 1                                       | NC                      | No Internal Connection |
| 2                                       | H <sub>SET</sub>        | Absolute Accuracy      |
| 3                                       | T <sub>SET</sub>        | Absolute Accuracy      |
| 4                                       | GND                     | Ground                 |
| 5                                       | $\overline{\text{OUT}}$ | Minimum Hysteresis     |
| 6                                       | OUT                     | Absolute Accuracy      |
| 7                                       | NC                      | No Internal Connection |
| 8                                       | V <sub>DD</sub>         | Supply Voltage Range   |

## 3.0 DETAILED DESCRIPTION

The TC07 programs with resistors connected from the T<sub>SET</sub> and H<sub>SET</sub> inputs to V<sub>DD</sub>. Output pins  $\overline{\text{OUT}}$  and OUT are driven active when the temperature exceeds the setting determined by the programming resistor on T<sub>SET</sub>. The outputs are maintained (latched) in their active states until temperature drops below the setting determined by the programming resistor on H<sub>SET</sub> (Figure 3-1).

**FIGURE 3-1: TC07 OUTPUT WAVEFORMS**



## 4.0 TYPICAL APPLICATIONS

### 4.1 Trip Point Programming

The resistor values required to achieve the desired trip point temperatures on  $T_{SET}$  and  $H_{SET}$  are calculated using the formula below:

$$R_{TRIP} = 0.6 \times T^{2.13}$$

Where:

$R_{TRIP}$  = Programming resistor value in Ohms  
 $T$  = Desired trip point temperature in degrees Kelvin.

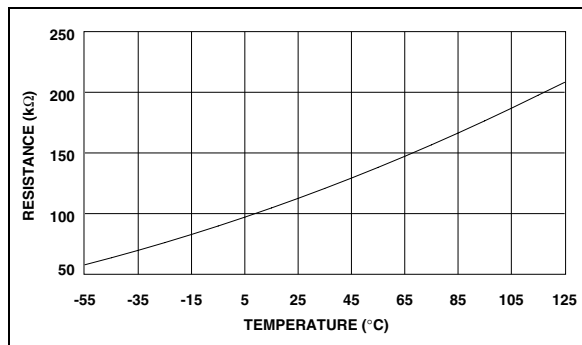
For example, to program the TC07 outputs to go active at 50°C and inactive at 30°C, the  $R_T$  and  $R_H$  programming resistors are calculated as follows:

$$R_T = 0.6 \times ((50 + 273.15)^{2.13}) = 132.8k\Omega$$

$$R_H = 0.6 \times ((30 + 273.15)^{2.13}) = 115.9k\Omega$$

Resistance values for  $T_{SET}$  and  $H_{SET}$  can be approximated using Figure 4-1. Care must be taken to ensure the  $H_{SET}$  programming resistor is a smaller value than the  $T_{SET}$  programming resistor. The temperature programmed on  $H_{SET}$  must be at least 5°C lower than the temperature value programmed by  $T_{SET}$ .

**FIGURE 4-1: PROGRAMMING RESISTOR VALUES VS. TEMPERATURE**

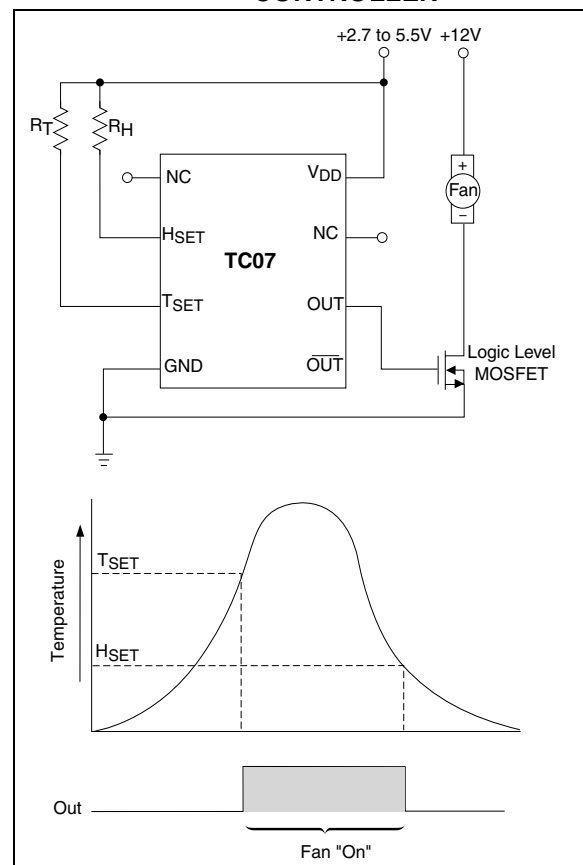


### 4.2 Cooling and Heating Applications

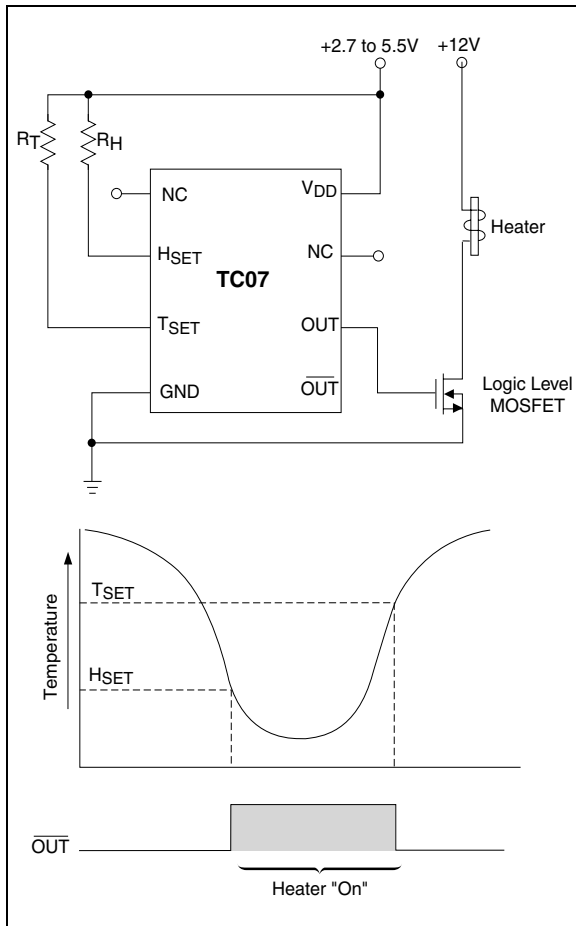
The TC07 can be used to control a DC fan as shown in Figure 4-2. The fan turns on when the sensed temperature rises above the temperature set at  $T_{SET}$  and remains on until the temperature falls below the temperature set at  $H_{SET}$ . The amount of "cooling" performed by the fan is dependent on the programmed hysteresis.

Figure 4-3 shows the TC07 acting as a heater thermostat. Circuit operation is identical to that of the cooling fan application in Figure 4-2.

**FIGURE 4-2: TC07 AS A FAN CONTROLLER**



**FIGURE 4-3: TC07 AS A HEATER THERMOSTAT**



## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

Package marking data not available at this time.

### 5.2 Taping Form

**Component Taping Orientation for 8-Pin MSOP Devices**

Standard Reel Component Orientation  
for TR Suffix Device

**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package    | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|------------|-------------------|-----------|--------------------|-----------|
| 8-Pin MSOP | 12 mm             | 8 mm      | 2500               | 13 in     |

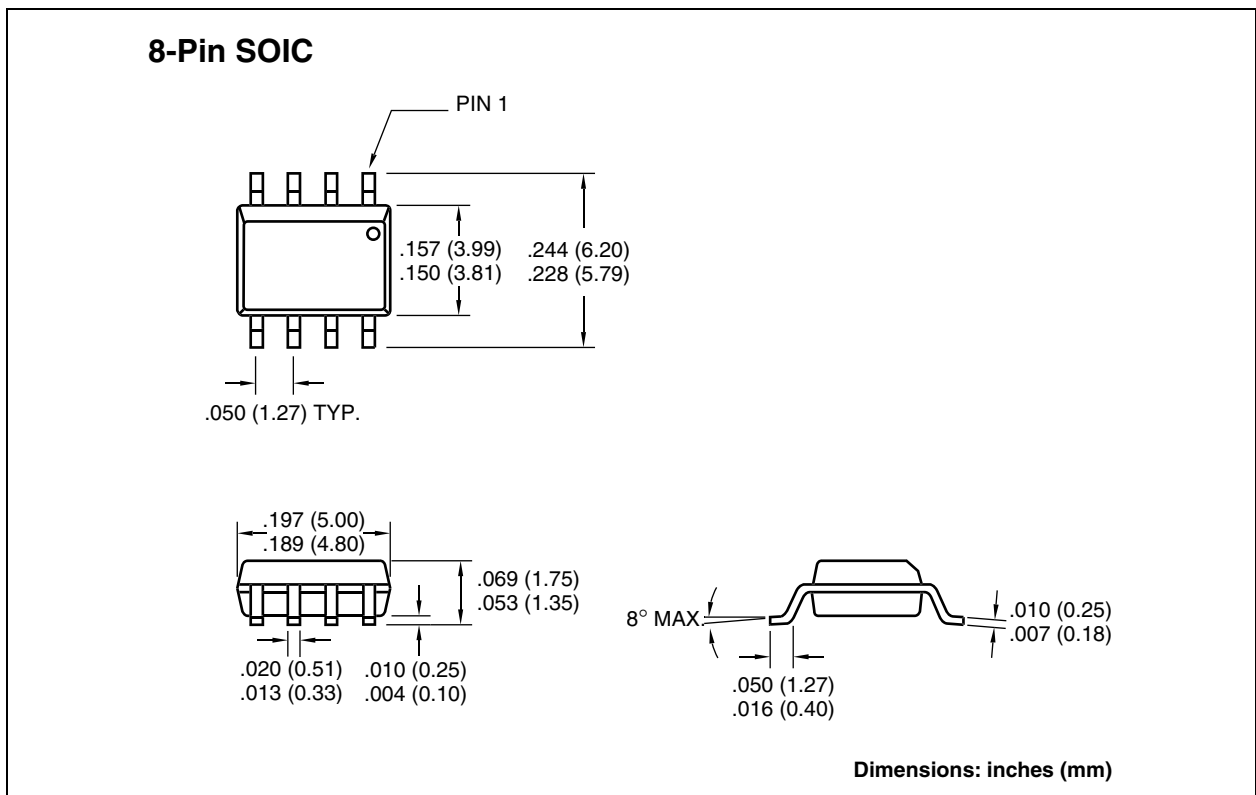
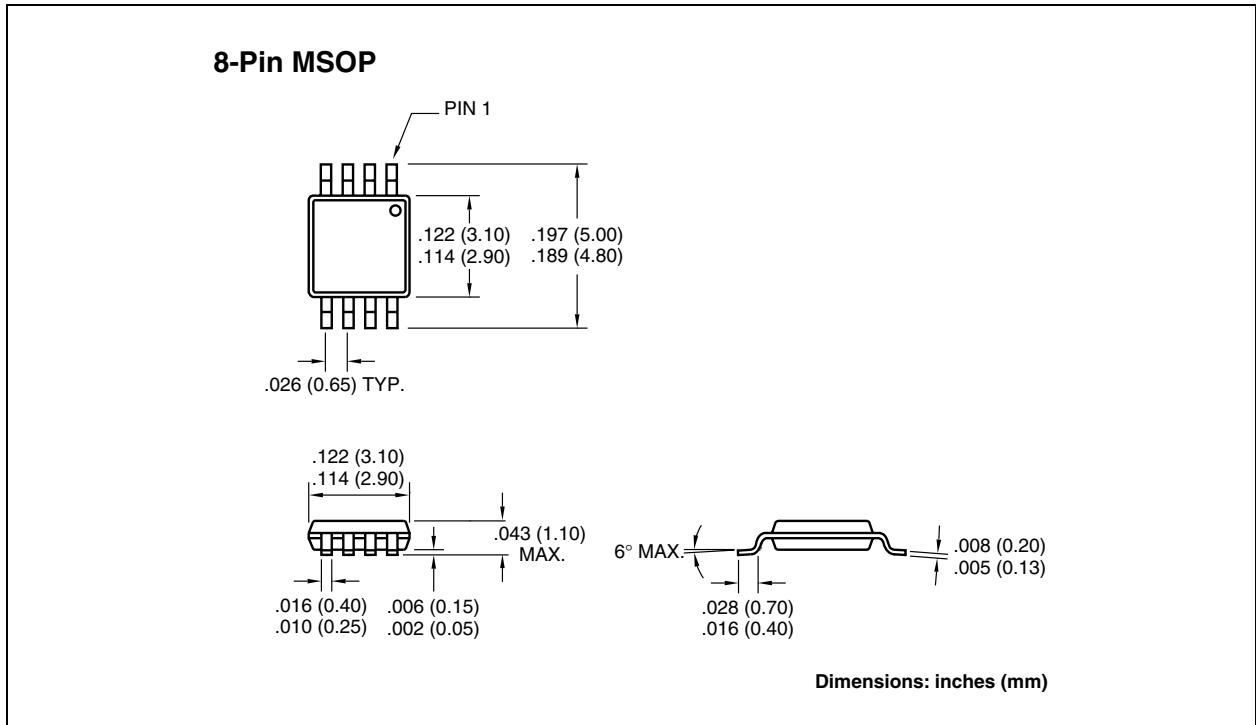
**Component Taping Orientation for 8-Pin SOIC (Narrow) Devices**

Standard Reel Component Orientation  
for TR Suffix Device

**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package        | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|----------------|-------------------|-----------|--------------------|-----------|
| 8-Pin SOIC (N) | 12 mm             | 8 mm      | 2500               | 13 in     |

## 5.3 Package Dimensions



# TC07

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NOTES:



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# TC07

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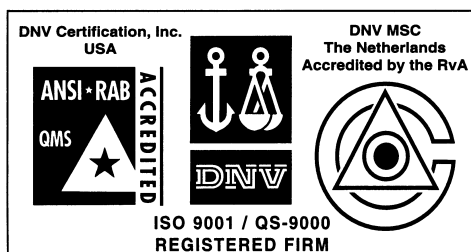
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