

## 3-Pin Microcontroller Reset Monitors

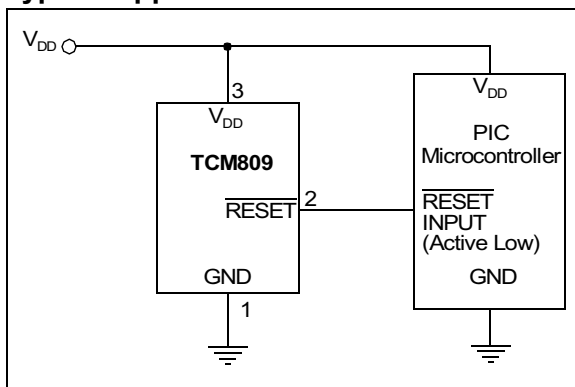
### Features

- Precision  $V_{DD}$  Monitor for 2.5V, 3.0V, 3.3V, 5.0V Nominal System Voltage Supplies
- 140 msec Minimum RESET Timeout Period
- RESET Output to  $V_{DD} = 1.0V$  (TCM809)
- Low Supply Current, 9  $\mu A$  (typ.)
- $V_{DD}$  Transient Immunity
- Small 3-Pin SC-70 and SOT-23B Packages
- No External Components
- Push-pull RESET output
- Temperature Range:
  - Commercial (E): -40°C to +85°C
  - Industrial (V): -40°C to +125°C

### Applications

- Computers
- Embedded Systems
- Battery Powered Equipment
- Critical Microcontroller Power Supply Monitoring
- Automotive

### Typical Application Circuit



### General Description

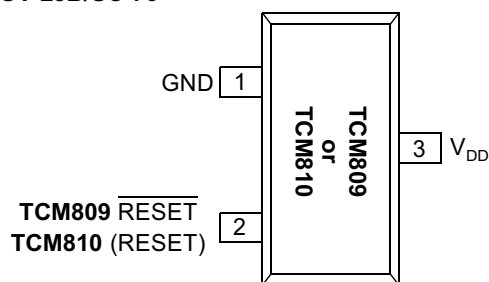
The TCM809 and TCM810 are cost effective system supervisor circuits designed to monitor  $V_{DD}$  in digital systems and provide a reset signal to the host processor when necessary. No external components are required.

The RESET output is typically driven active within 20  $\mu sec$  (SOT-23) or 65  $\mu sec$  (SC-70) of  $V_{DD}$  falling through the reset voltage threshold. RESET is maintained active for a minimum of 140 msec after  $V_{DD}$  rises above the reset threshold. The TCM810 has an active-high RESET output while the TCM809 has an active-low RESET output. The output of the TCM809/TCM810 is valid down to  $V_{DD} = 1V$ . Both devices are available in 3-Pin SOT-23B and SC-70 packages.

The TCM809/TCM810 are optimized to reject fast transient glitches on the  $V_{DD}$  line. Low supply current of 9  $\mu A$  (typ.,  $V_{DD} = 3.3V$ ) makes these devices suitable for battery powered applications.

### Pin Configurations

#### SOT-23B/SC-70



**Note:** 3-Pin SOT-23B is equivalent to JEDEC TO-236

# TCM809/TCM810

## 1.0 ELECTRICAL CHARACTERISTICS

### ABSOLUTE MAXIMUM RATINGS\*

Supply Voltage ( $V_{DD}$  to GND) .....6.0V  
 $\overline{\text{RESET}}$ , RESET ..... - 0.3V to ( $V_{DD} + 0.3V$ )  
Input Current,  $V_{DD}$ .....20 mA  
Output Current,  $\overline{\text{RESET}}$ , RESET .....20 mA  
 $dV/dt$  ( $V_{DD}$ )..... 100V/ $\mu\text{sec}$   
Operating Temperature Range..... - 40°C to +125°C  
Power Dissipation ( $T_A = 70^\circ\text{C}$ ):  
3-Pin SOT-23B (derate 4 mW/ $^\circ\text{C}$  above +70°C).....320 mW  
3-Pin SC-70 (derate 2.17 mW/ $^\circ\text{C}$  above +70°C).....174 mW  
Storage Temperature Range..... - 65°C to +150°C  
Maximum Junction Temperature,  $T_J$ ..... 150°C

\***Notice:** Stresses above those listed under "Maximum ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

## PIN FUNCTION TABLE

| NAME           | FUNCTION                                                                                                                                                             |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GND            | Ground                                                                                                                                                               |
| RESET (TCM809) | RESET push-pull output remains low while $V_{DD}$ is below the reset voltage threshold and for 240 msec (140 msec min.) after $V_{DD}$ rises above reset threshold.  |
| RESET (TCM810) | RESET push-pull output remains high while $V_{DD}$ is below the reset voltage threshold and for 240 msec (140 msec min.) after $V_{DD}$ rises above reset threshold. |
| $V_{DD}$       | Supply voltage (+2.5V, +3.0V, +3.3V, +5.0V)                                                                                                                          |

## ELECTRICAL CHARACTERISTICS

$V_{DD}$  = Full Range,  $T_A$  = Operating Temperature Range, unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 5V$  for L/M/J, 3.3V for T/S, 3.0V for R, and 2.5V for Z (**Note 1**).

| Parameter                            | Sym      | Min                            | Typ         | Max               | Units                 | Test Conditions                                                                                                                                                         |
|--------------------------------------|----------|--------------------------------|-------------|-------------------|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $V_{DD}$ Range                       |          | 1.0<br>1.2                     | —<br>—      | 5.5<br>5.5        | V                     | $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                     |
| Supply Current (SOT-23)              | $I_{CC}$ | —<br>—                         | 24<br>17    | 60<br>50          | $\mu\text{A}$         | TCM8xxL/M/J: $V_{DD} < 5.5V$<br>TCM8xxR/S/T/Z: $V_{DD} < 3.6V$                                                                                                          |
| Supply Current (SC-70)               | $I_{CC}$ | —<br>—                         | 12<br>9     | 30<br>25          | $\mu\text{A}$         | TCM8xxL/M/J: $V_{DD} < 5.5V$<br>TCM8xxR/S/T/Z: $V_{DD} < 3.6V$                                                                                                          |
| Reset Threshold ( <b>Note 2</b> )    | $V_{TH}$ | 4.56<br>4.50                   | 4.63<br>—   | 4.70<br>4.75      | V                     | TCM8xxL: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 4.31<br>4.25                   | 4.38<br>—   | 4.45<br>4.50      |                       | TCM8xxM: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 3.93<br>3.89                   | 4.00<br>—   | 4.06<br>4.10      |                       | TCM809J: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 3.04<br>3.00                   | 3.08<br>—   | 3.11<br>3.15      |                       | TCM8xxT: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 2.89<br>2.85                   | 2.93<br>—   | 2.96<br>3.00      |                       | TCM8xxS: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 2.59<br>2.55                   | 2.63<br>—   | 2.66<br>2.70      |                       | TCM8xxR: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
|                                      |          | 2.28<br>2.25                   | 2.32<br>—   | 2.35<br>2.38      |                       | TCM8xxZ: $T_A = +25^\circ\text{C}$<br>$T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$                                                                                 |
| Reset Threshold Tempco               |          | —                              | 30          | —                 | ppm/ $^\circ\text{C}$ |                                                                                                                                                                         |
| $V_{DD}$ to Reset Delay, SOT-23      |          | —                              | 20          | —                 | $\mu\text{sec}$       | $V_{DD} = V_{TH}$ to ( $V_{TH} - 100$ mV) ( <b>Note 2</b> )                                                                                                             |
| $V_{DD}$ to Reset Delay, SC-70       |          | —                              | 65          | —                 | $\mu\text{sec}$       | $V_{DD} = V_{TH}$ to ( $V_{TH} - 100$ mV) ( <b>Note 2</b> )                                                                                                             |
| Reset Active Time-out Period, SOT-23 |          | 140                            | 240         | 560               | msec                  |                                                                                                                                                                         |
| Reset Active Time-out Period, SC-70  |          | 140                            | 320         | 560               | msec                  |                                                                                                                                                                         |
| RESET Output Voltage Low (TCM809)    | $V_{OL}$ | —<br>—<br>—                    | —<br>—<br>— | 0.3<br>0.4<br>0.3 | V                     | TCM809R/S/T/Z: $V_{DD} = V_{TH}$ min, $I_{SINK} = 1.2$ mA<br>TCM809L/M/J: $V_{DD} = V_{TH}$ min, $I_{SINK} = 3.2$ mA<br>$V_{DD} > 1.0V$ , $I_{SINK} = 50$ $\mu\text{A}$ |
| RESET Output Voltage High (TCM809)   | $V_{OH}$ | 0.8 $V_{DD}$<br>$V_{DD} - 1.5$ | —<br>—      | —<br>—            | V                     | TCM809R/S/T/Z: $V_{DD} > V_{TH}$ max, $I_{SOURCE} = 500$ $\mu\text{A}$<br>TCM809L/M/J: $V_{DD} > V_{TH}$ max, $I_{SOURCE} = 800$ $\mu\text{A}$                          |

**Note 1:** Production testing done at  $T_A = +25^\circ\text{C}$ , over temperature limits ensured by QC screen.  
**Note 2:** RESET Output for TCM809, RESET Output for TCM810.

# TCM809/TCM810

$V_{DD}$  = Full Range,  $T_A$  = Operating Temperature Range, unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ ,  $V_{DD} = 5\text{V}$  for L/M/J, 3.3V for T/S, 3.0V for R, and 2.5V for Z (**Note 1**).

| Parameter                          | Sym      | Min          | Typ    | Max        | Units | Test Conditions                                                                                                                                        |
|------------------------------------|----------|--------------|--------|------------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| RESET Output Voltage Low (TCM810)  | $V_{OL}$ | —<br>—       | —<br>— | 0.3<br>0.4 | V     | TCM810R/S/T/Z: $V_{DD} = V_{TH} \text{ max}$ , $I_{SINK} = 1.2 \text{ mA}$<br>TCM810L/M/J: $V_{DD} = V_{TH} \text{ max}$ , $I_{SINK} = 3.2 \text{ mA}$ |
| RESET Output Voltage High (TCM810) | $V_{OH}$ | $0.8 V_{DD}$ | —      | —          | V     | $1.8 < V_{DD} < V_{TH} \text{ min}$ , $I_{SOURCE} = 150 \mu\text{A}$                                                                                   |

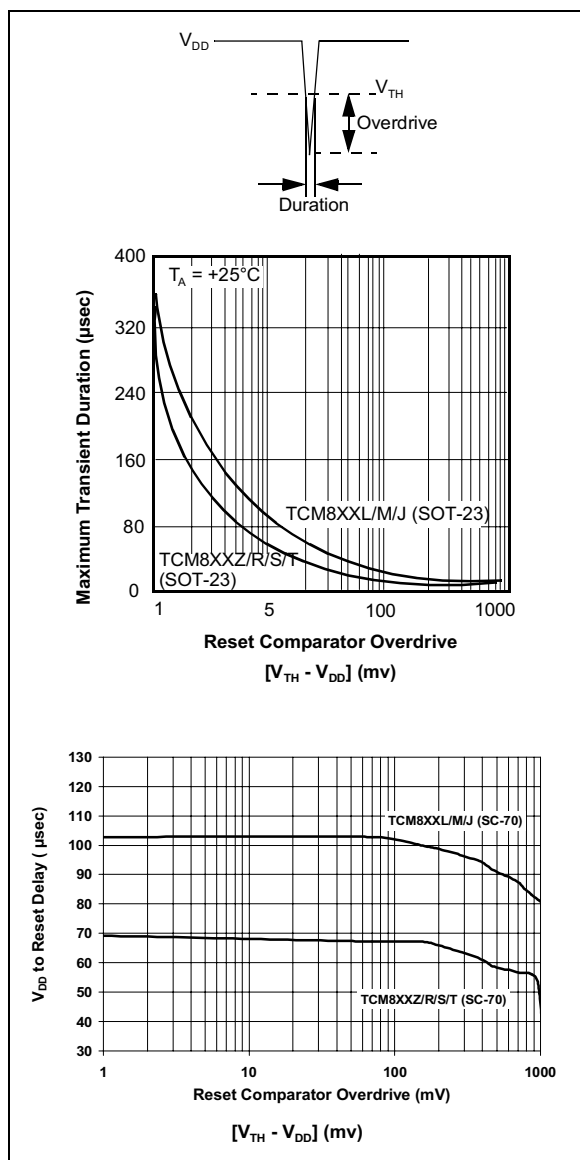
**Note** 1: Production testing done at  $T_A = +25^\circ\text{C}$ , over temperature limits ensured by QC screen.  
2: RESET Output for TCM809, RESET Output for TCM810.

# TCM809/TCM810

## 2.0 APPLICATIONS INFORMATION

### 2.1 V<sub>DD</sub> Transient Rejection

The TCM809/TCM810 provides accurate  $V_{DD}$  monitoring and reset timing during power-up, power-down, and brownout/sag conditions. These devices also reject negative-going transients (glitches) on the power supply line. Figure 2-1 shows the maximum transient duration vs. maximum negative excursion (overdrive) for glitch rejection. Any combination of duration and overdrive which lies under the curve will not generate a reset signal.

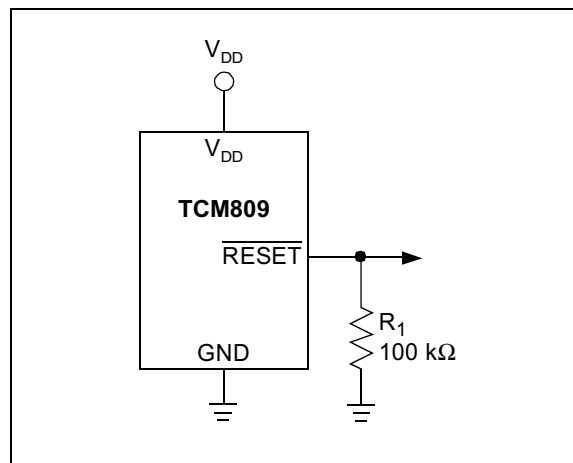


**FIGURE 2-1:** Maximum Transient Duration vs. Overdrive for Glitch Rejection at 25°C.

Combinations above the curve are detected as a brownout or power-down condition. Transient immunity can be improved by adding a capacitor in close proximity to the  $V_{DD}$  pin of the TCM809/TCM810.

### 2.2 RESET Signal Integrity During Power-Down

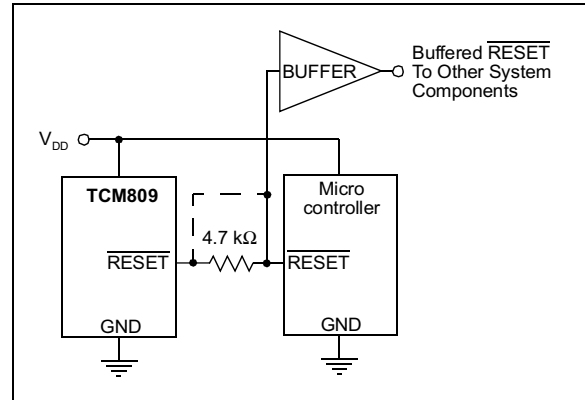
The TCM809  $\overline{\text{RESET}}$  output is valid to  $V_{DD} = 1.0\text{V}$ . Below this voltage the output becomes an "open circuit" and does not sink current. This means CMOS logic inputs to the microcontroller will be floating at an undetermined voltage. Most digital systems are completely shutdown well above this voltage. However, in situations where  $\overline{\text{RESET}}$  must be maintained valid to  $V_{DD} = 0\text{V}$ , a pull-down resistor must be connected from  $\overline{\text{RESET}}$  to ground to discharge stray capacitances and hold the output low (Figure 2-2). This resistor value, though not critical, should be chosen such that it does not appreciably load  $\overline{\text{RESET}}$  under normal operation (100 kΩ will be suitable for most applications). Similarly, a pull-up resistor to  $V_{DD}$  is required for the TCM810 to ensure a valid high  $\overline{\text{RESET}}$  for  $V_{DD}$  below 1.0V.



**FIGURE 2-2:** The addition of  $R_1$  at the  $\overline{\text{RESET}}$  output of the TCM809 ensures that the  $\overline{\text{RESET}}$  output is valid to  $V_{DD} = 0\text{V}$ .

## 2.3 Controllers and Processors With Bidirectional I/O Pins

Some microcontrollers have bi-directional reset pins. Depending on the current drive capability of the controller pin, an indeterminate logic level may result if there is a logic conflict. This can be avoided by adding a 4.7 k $\Omega$  resistor in series with the output of the TCM809/TCM810 (Figure 2-3). If there are other components in the system which require a reset signal, they should be buffered so as not to load the reset line. If the other components are required to follow the reset I/O of the microcontroller, the buffer should be connected as shown with the solid line.

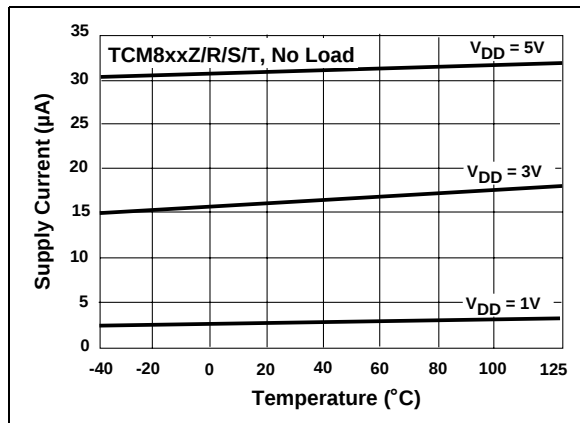


**FIGURE 2-3:** Interfacing the TCM809 to a Bidirectional RESET I/O.

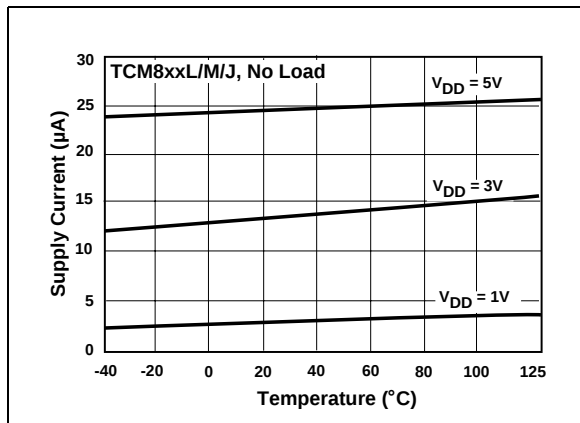
# TCM809/TCM810

## 3.0 TYPICAL PERFORMANCE CHARACTERISTICS

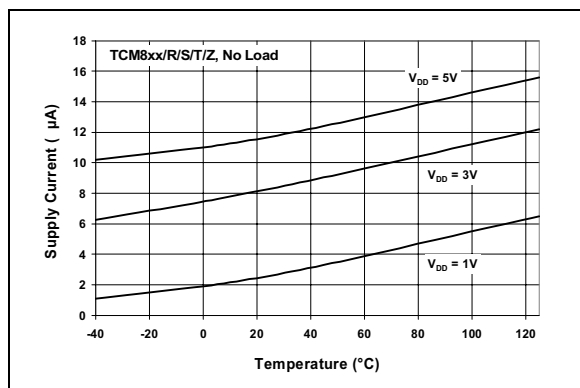
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.



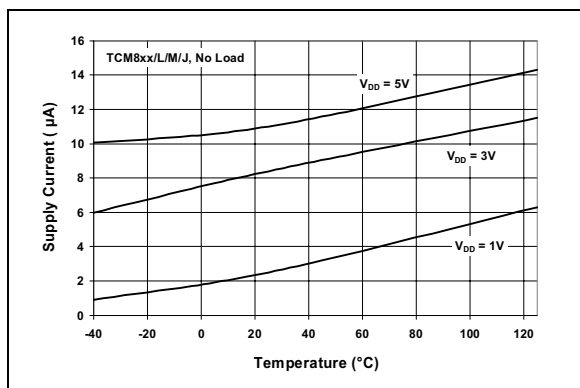
**FIGURE 3-1:** Supply Current vs. Temperature, SOT-23.



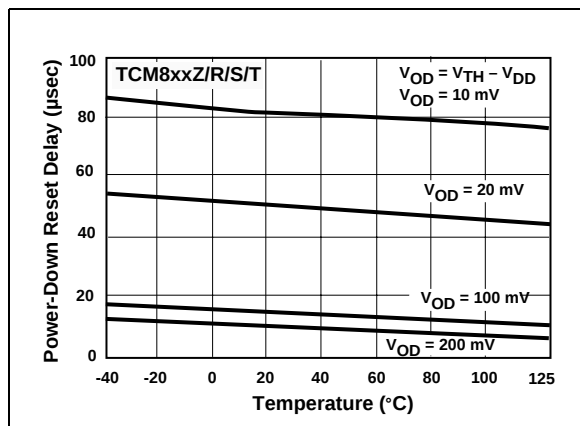
**FIGURE 3-4:** Supply Current vs. Temperature, SOT-23.



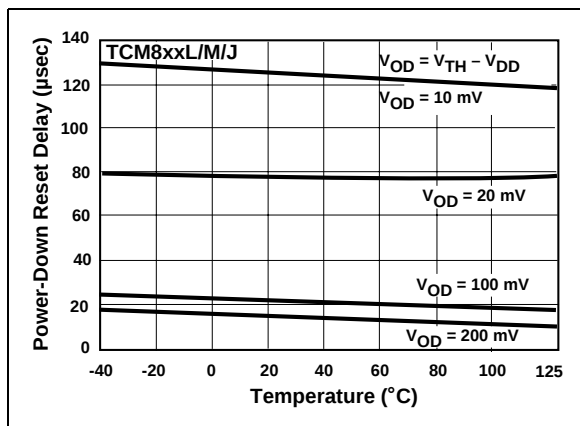
**FIGURE 3-2:** Supply Current vs. Temperature, SC-70.



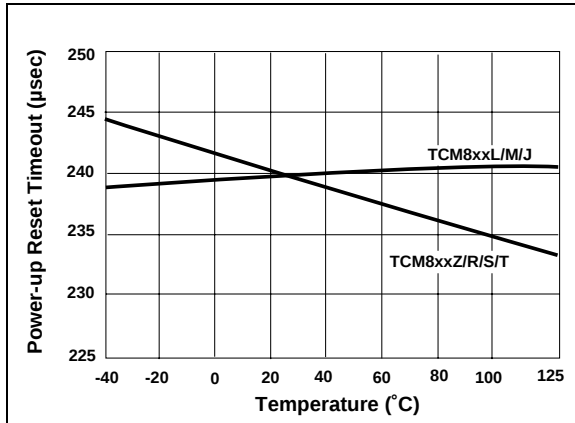
**FIGURE 3-5:** Supply Current vs. Temperature, SC-70.



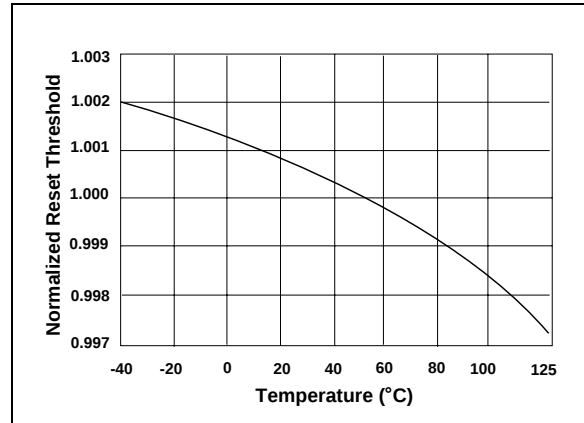
**FIGURE 3-3:** Power-Down Reset Delay vs. Temperature, SOT-23.



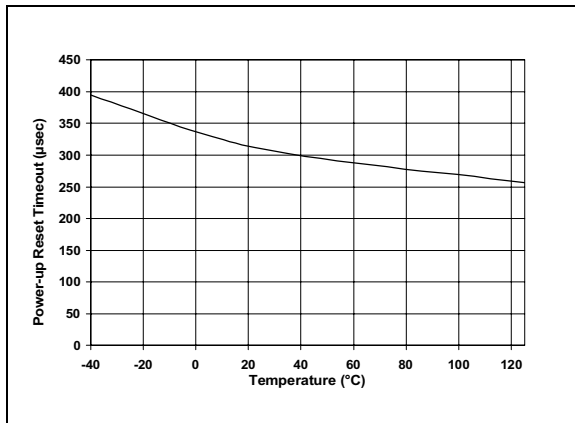
**FIGURE 3-6:** Power-Down Reset Delay vs. Temperature, SOT-23.



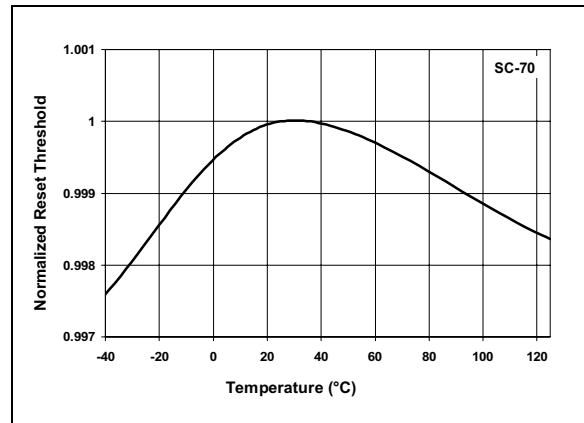
**FIGURE 3-7:** Power-Up Reset Time-out vs. Temperature, SOT-23.



**FIGURE 3-9:** Normalized Reset Threshold vs. Temperature, SOT-23.



**FIGURE 3-8:** Power-up Reset Time-out vs. Temperature, SC-70.



**FIGURE 3-10:** Normalized Reset Threshold vs. Temperature, SC-70.

# TCM809/TCM810

## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

3-Pin SOT-23B

①

②

③

④

3-Pin SC-70

①

②

③

④

⑤

⑥

Top Side

Bottom Side

| Part Number           | SOT-23/SC-70 |
|-----------------------|--------------|
| TCM809LENB            | J1           |
| TCM809MENB            | J2           |
| TCM809TENB            | J3           |
| TCM809SENB            | J4           |
| TCM809RENB            | J5           |
| TCM809JENB            | J6           |
| TCM809ZENB            | J7           |
| TCM809LVNB/TCM809LVLB | JZ           |
| TCM809MVNB/TCM809MVLB | JY           |
| TCM809TVNB/TCM809TVLB | JX           |
| TCM809SVNB/TCM809SVLB | JV           |
| TCM809RVNB/TCM809RVLB | JU           |
| TCM809JVNB/TCM809JVLB | JT           |
| TCM809ZVNB/TCM809ZVLB | JS           |

| Part Number           | SOT-23/SC-70 |
|-----------------------|--------------|
| TCM810LENB            | K1           |
| TCM810MENB            | K2           |
| TCM810TENB            | K3           |
| TCM810SENB            | K4           |
| TCM810RENB            | K5           |
| TCM810ZENB            | K6           |
| TCM810LVNB/TCM810LVLB | KZ           |
| TCM810MVNB/TCM810MVLB | KY           |
| TCM810TVNB/TCM810TVLB | KX           |
| TCM810SVNB/TCM810SVLB | KV           |
| TCM810RVNB/TCM810RVLB | KU           |
| TCM810ZVNB/TCM810ZVLB | KT           |

Legend:

1

Part Number + temperature range and voltage (two-digit code)

2

Part Number + temperature range and voltage (two-digit code)

3

Lot ID number

4

Year and work week

5

Year and work week

6

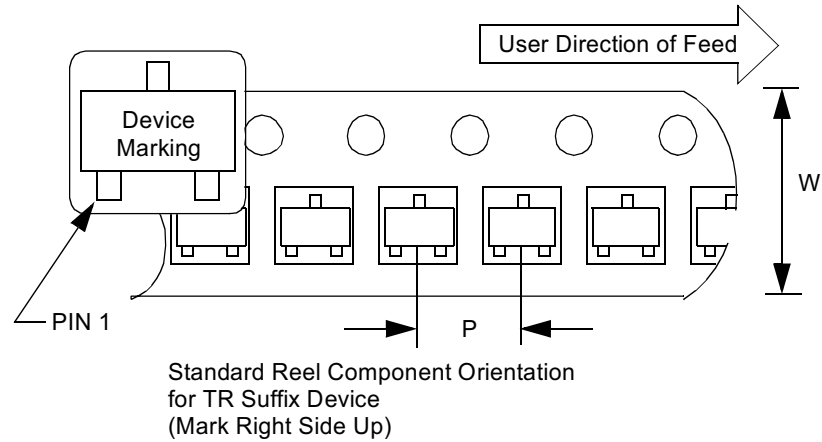
Year and work week

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.

## 4.2 Taping Form

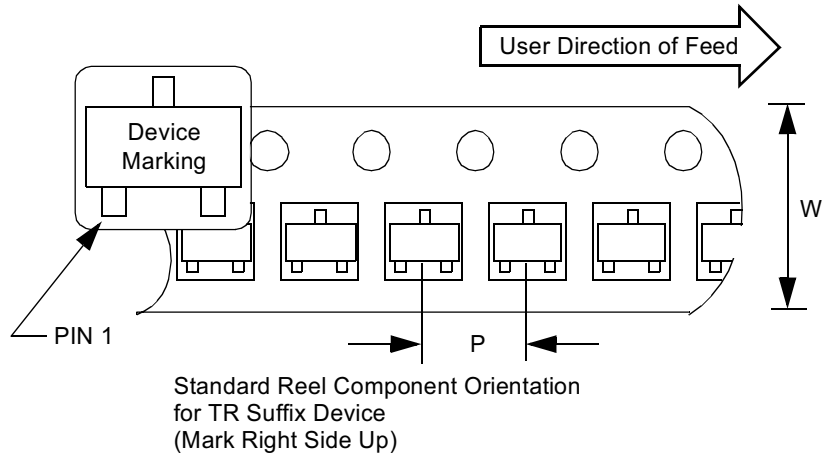
Component Taping Orientation for 3-Pin SOT-23 (JEDEC TO-236) Devices



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

| Package       | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---------------|-------------------|-----------|--------------------|-----------|
| 3-Pin SOT-23B | 8 mm              | 4 mm      | 3000               | 7 in.     |

Component Taping Orientation for 3-Pin SC-70 (EIAJ) Devices



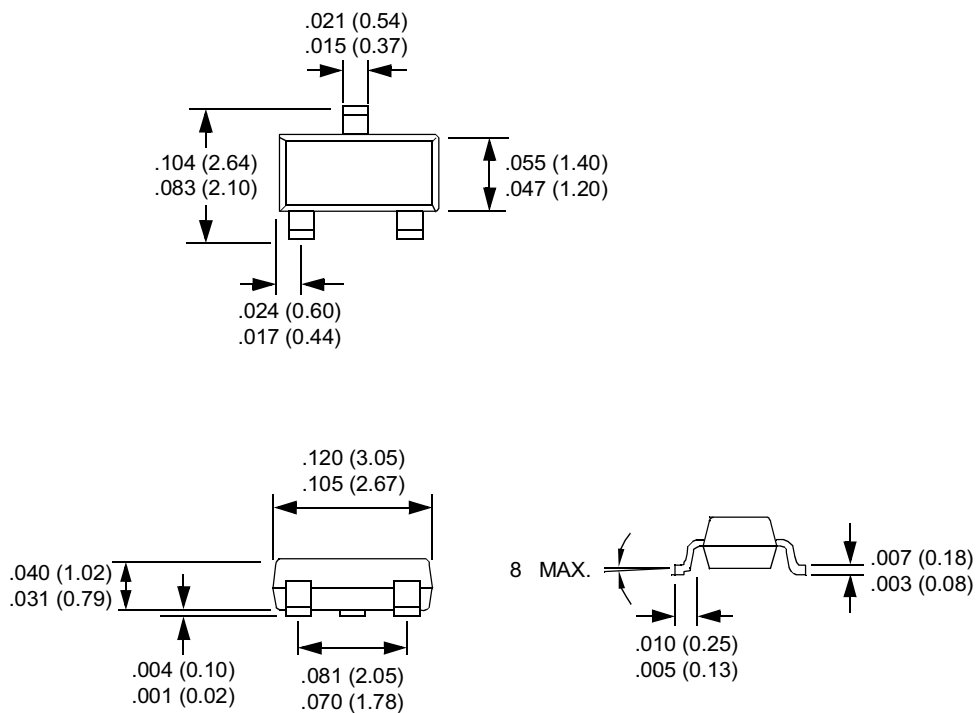
Carrier Tape, Number of Components Per Reel and Reel Size:

| Package     | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|-------------|-------------------|-----------|--------------------|-----------|
| 3-Pin SC-70 | 8 mm              | 4 mm      | 3000               | 7 in.     |

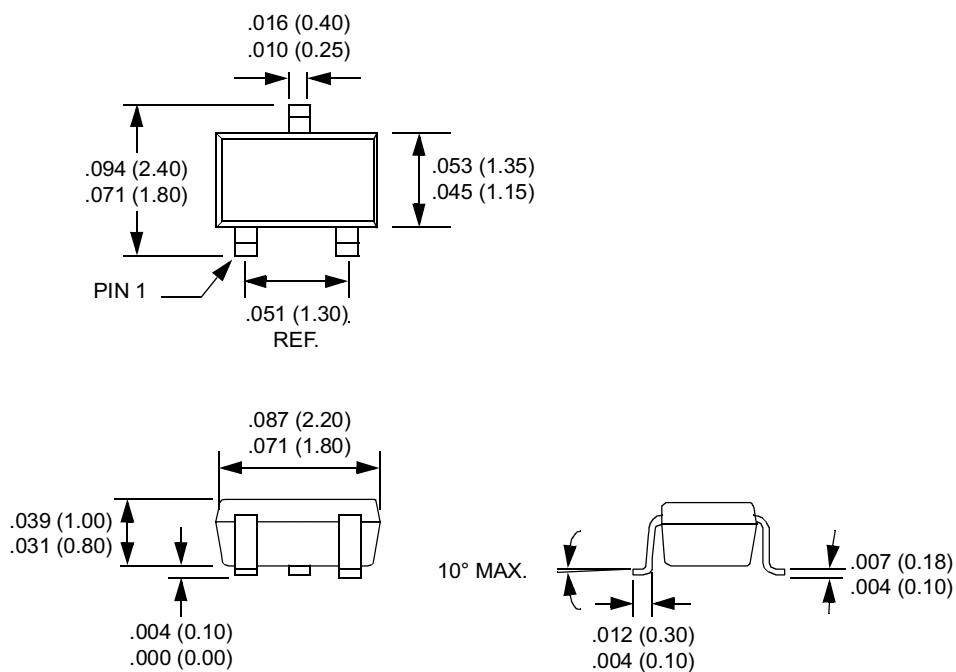
# TCM809/TCM810

## 4.3 Packaging Information

3-Pin SOT-23B



3-Pin SC-70



## ON-LINE SUPPORT

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**[www.microchip.com](http://www.microchip.com)**

The file transfer site is available by using an FTP service to connect to:

**<ftp://ftp.microchip.com>**

The web site and file transfer site provide a variety of services. Users may download files for the latest Development Tools, Data Sheets, Application Notes, User's Guides, Articles and Sample Programs. A variety of Microchip specific business information is also available, including listings of Microchip sales offices, distributors and factory representatives. Other data available for consideration is:

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- Conferences for products, Development Systems, technical information and more
- Listing of seminars and events

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013001

# TCM809/TCM810

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It is our intention to provide you with the best documentation possible to ensure successful use of your Microchip product. If you wish to provide your comments on organization, clarity, subject matter, and ways in which our documentation can better serve you, please FAX your comments to the Technical Publications Manager at (480) 792-4150.

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Application (optional):

Would you like a reply? \_\_\_\_Y \_\_\_\_N

Device: **TCM809/TCM810** Literature Number: **DS21661A**

Questions:

1. What are the best features of this document?

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2. How does this document meet your hardware and software development needs?

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3. Do you find the organization of this data sheet easy to follow? If not, why?

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4. What additions to the data sheet do you think would enhance the structure and subject?

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5. What deletions from the data sheet could be made without affecting the overall usefulness?

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6. Is there any incorrect or misleading information (what and where)?

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7. How would you improve this document?

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8. How would you improve our software, systems, and silicon products?

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## PRODUCT IDENTIFICATION SYSTEM

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

| <u>PART NO.</u>                  | <u>X</u>                                                                                                                                                                                                                                                                  | <u>X</u>          |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Device                           | V <sub>DD</sub> Reset Threshold                                                                                                                                                                                                                                           | Temperature Range |
| Device:                          | TCM809: Microcontroller with active-low <u>RESET</u> output<br>TCM809TR: Microcontroller with active-low RESET output (Tape and Reel)<br>TCM810: Microcontroller with active-high RESET output<br>TCM810TR: Microcontroller with active-high RESET output (Tape and Reel) |                   |
| V <sub>DD</sub> Reset Threshold: | L = 4.63V<br>M = 4.38V<br>J = 4.00V<br>T = 3.08V<br>S = 2.93V<br>R = 2.63V<br>Z = 2.32V                                                                                                                                                                                   |                   |
| Temperature Range:               | E = -40°C to +85°C<br>V = -40°C to +125°C                                                                                                                                                                                                                                 |                   |
| Package:                         | NB = SOT-23B, 3-pin<br>LB = SC-70, 3-pin                                                                                                                                                                                                                                  |                   |

### Examples:

- TCM809LENB: SOT-23B, 3-Pin Microcontroller Reset Monitor, 4.63V Reset Threshold, Temperature of -40°C to +85°C.
- TCM810ZVLB: SC-70, 3-Pin Microcontroller Reset Monitor, 2.32V Reset Threshold, Temperature of -40°C to +125°C.

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# TCM809/TCM810

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NOTES:

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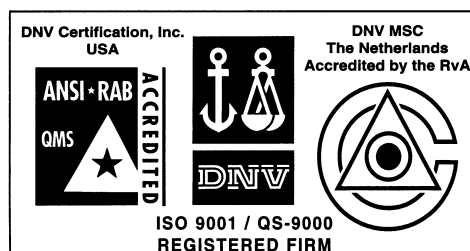
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