

**SOT-23**

**Pin Definition:**

| TS3809          | TS3810     |
|-----------------|------------|
| 1. GND          | 1. GND     |
| 2. <u>RESET</u> | 2. (RESET) |
| 3. VCC          | 3. VCC     |

### General Description

The TS3809/3810 series are used for microprocessor ( $\mu$ P) supervisory circuits to monitor the power supplies in  $\mu$ P and digital systems. They provide excellent circuit reliability and low cost by eliminating external components and adjustments when used with +5V, +3.3V, +3.0V, +2.5V powered circuits.

These circuits perform a single function: they assert a reset signal whenever the  $V_{CC}$  supply voltage declines below a preset threshold, keeping it asserted for at least 200ms after  $V_{CC}$  has risen above the reset threshold. Reset thresholds suitable for operation with a variety of supply voltages are available. TS3809/3810 series have push pull outputs. TS3809 series have an active low RESET output, while the TS3810 has an active high (RESET) output. The reset comparator is designed to ignore fast transients on  $V_{CC}$ , and the outputs are guaranteed to be in the correct logic state for  $V_{CC}$  down to 1.0V. Low supply current makes TS3809/3810 series ideal for use in portable equipment.

### Features

- High Accurate:  $\pm 2\%$
- Precision monitoring of +3V, +3.3V and +5V Power supply voltage
- Fully specified over temperature
- Available in three output configurations
- Push-Pull RESET low output (TS3809)
- Push-Pull (RESET) high output (TS3810)
- 200mS typ. Power-on reset pulse width
- 25 $\mu$ S supply current
- Guaranteed reset valid to  $V_{CC}=+1V$
- Power supply transient immunity

### Applications

- Battery-operated systems and Controllers
- Intelligent instruments
- Critical  $\mu$ P and  $\mu$ C power monitoring
- Portable / Battery powered equipment
- Automotive

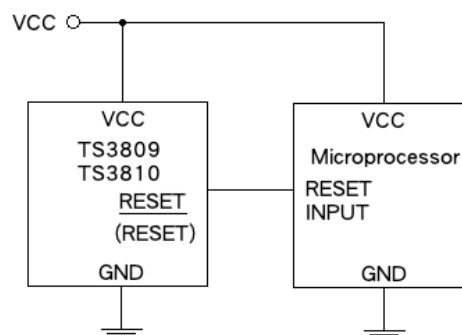
### Ordering Information

| Part No.                 | Package | Packing         |
|--------------------------|---------|-----------------|
| TS3809CX <sub>x</sub> RF | SOT-23  | 3Kpcs / 7" Reel |
| TS3810CX <sub>x</sub> RF | SOT-23  | 3Kpcs / 7" Reel |

Note: <sub>x</sub> is the threshold voltage type, option as:

A : 4.63V    B : 4.38V    C : 4.00V    D : 3.08V  
E : 2.93V    F : 2.63V    G : 2.25V

### Typical Application Circuit



### Absolute Maximum Rating

| Parameter                                     | Symbol      | Maximum                    | Unit         |
|-----------------------------------------------|-------------|----------------------------|--------------|
| Terminal Voltage (with respect to Gnd)        | $V_{CC}$    | GND - 0.3 to GND +6.5      | V            |
| <u>RESET</u> & (RESET) push-pull              | $V_{RESET}$ | GND - 0.3 to $V_{CC}$ +0.3 | V            |
| Input Current, $V_{CC}$                       | $I_{CC}$    | 20                         | mA           |
| Output Current, <u>RESET</u> , (RESET)        | $I_O$       | 5                          | mA           |
| Power Dissipation                             | $P_D$       | $(T_J - T_A)/\theta_{JA}$  | mW           |
| Operating Junction Temperature Range          | $T_{J,OPR}$ | -40 ~ +125                 | $^{\circ}$ C |
| Storage Temperature Range                     | $T_{STG}$   | -65 ~ +150                 | $^{\circ}$ C |
| Lead Soldering Temperature (260 $^{\circ}$ C) | $T_{LEAD}$  | 10                         | S            |

### Thermal Performance

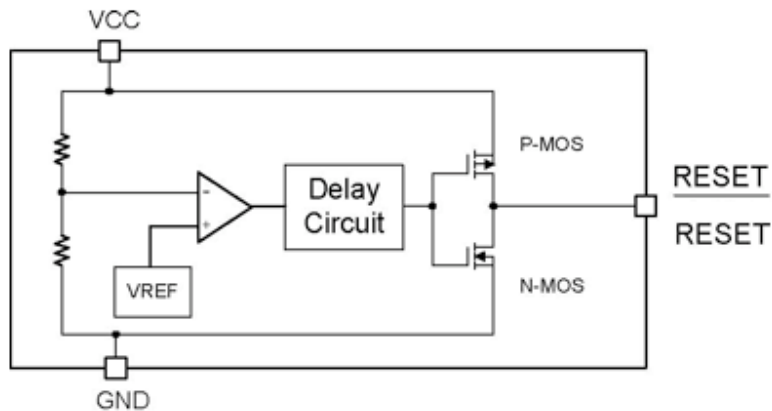
| Parameter                                   | Symbol        | Maximum | Unit                 |
|---------------------------------------------|---------------|---------|----------------------|
| Thermal Resistance from Junction to Case    | $\theta_{JC}$ | 110     | $^{\circ}\text{C/W}$ |
| Thermal Resistance from Junction to ambient | $\theta_{JA}$ | 250     | $^{\circ}\text{C/W}$ |

**Note:**  $\theta_{JA}$  is measured the PCB copper area of approximately  $1\text{in}^2$  (Multi-layer). Needs to connect to  $V_{SS}$  pin.

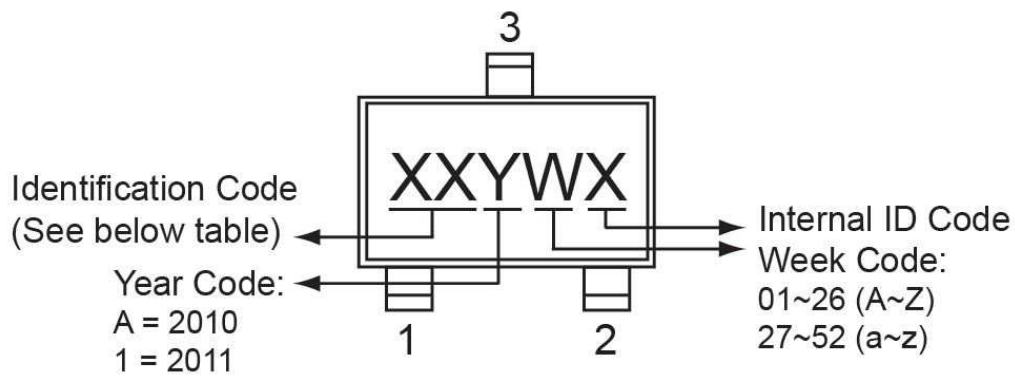
### Electrical Specification ( $T_A = 25^{\circ}\text{C}$ , unless otherwise specified.)

| Parameter                               | Conditions                                                                  | Symbol      | Min        | Typ  | Max  | Unit                          |
|-----------------------------------------|-----------------------------------------------------------------------------|-------------|------------|------|------|-------------------------------|
| Input Supply Voltage                    | $T_A = -40^{\circ}\text{C} \sim +85^{\circ}\text{C}$                        | $V_{CC}$    | 1.0        | --   | 6    | V                             |
| Supply Current                          | $V_{CC} = V_{TH} + 1\text{V}$                                               | $I_{CC}$    | --         | 25   | 35   | $\mu\text{A}$                 |
| Reset Threshold                         | TS3809/3810CXA                                                              | $V_{TH}$    | 4.54       | 4.63 | 4.71 | V                             |
|                                         | TS3809/3810CXB                                                              |             | 4.29       | 4.38 | 4.46 |                               |
|                                         | TS3809/3810CXC                                                              |             | 3.92       | 4.00 | 4.08 |                               |
|                                         | TS3809/3810CXD                                                              |             | 3.02       | 3.08 | 3.15 |                               |
|                                         | TS3809/3810CXE                                                              |             | 2.87       | 2.93 | 3.00 |                               |
|                                         | TS3809/3810CXF                                                              |             | 2.57       | 2.63 | 2.69 |                               |
|                                         | TS3809/3810CXG                                                              |             | 2.20       | 2.25 | 2.30 |                               |
| Reset Threshold Temperature Coefficient | $T_A = 0 \sim +85^{\circ}\text{C}$                                          | $V_{THT}$   | --         | 50   | --   | $\text{ppm}/^{\circ}\text{C}$ |
| Set-up Time                             | $V_{CC} = 0 \sim (V_{TH} - 100\text{mV})$                                   | $T_{SET}$   | 1          | --   | --   | $\mu\text{s}$                 |
| VCC to Reset Delay                      | $V_{CC} = V_{TH} \sim (V_{TH} - 100\text{mV})$                              | $T_{RD}$    | --         | 20   | --   | $\mu\text{s}$                 |
| Reset Active Timeout Period             | $T_A = 0 \sim +85^{\circ}\text{C}$                                          | $T_{DELAY}$ | 140        | 200  | 260  | $\text{mS}$                   |
| RESET Output (TS3809)<br>Voltage Low    | $1.8\text{V} < V_{CC} < V_{TH(\text{MAX})}$ , $I_{SINK} = 1.2\text{mA}$     | $V_{OL}$    | --         | --   | 0.3  | V                             |
|                                         | $1.2\text{V} < V_{CC} < 1.8\text{V}$ , $I_{SINK} = 50\mu\text{A}$           |             |            |      |      |                               |
| RESET Output (TS3809)<br>Voltage High   | $V_{CC} > V_{TH(\text{MAX})}$ , $I_{SOURCE} = 500\mu\text{A}$               | $V_{OH}$    | 0.8<br>VCC | --   | --   | V                             |
| (RESET) Output (TS3810)<br>Voltage Low  | $V_{CC} > V_{TH(\text{MAX})}$ , $I_{SINK} = 1.2\text{mA}$                   | $V_{OL}$    | --         | --   | 0.3  | V                             |
| (RESET) Output (TS3810)<br>Voltage High | $1.8\text{V} < V_{CC} < V_{TH(\text{MAX})}$ , $I_{SOURCE} = 500\mu\text{A}$ | $V_{OH}$    | 0.8<br>VCC | --   | --   | V                             |
|                                         | $1.2\text{V} < V_{CC} < 1.8\text{V}$ , $I_{SOURCE} = 150\mu\text{A}$        |             |            |      |      |                               |
| Hysteresis at Vcc                       | Input Voltage                                                               | $V_{HVS}$   | --         | 40   | --   | mV                            |

### Block Diagram



### Device Top Marking Information



| Part No.  | Identification Code | Part No.  | Identification Code |
|-----------|---------------------|-----------|---------------------|
| TS3809CXA | CA                  | TS3810CXA | CH                  |
| TS3809CXB | CB                  | TS3810CXB | CI                  |
| TS3809CXC | CC                  | TS3810CXC | CJ                  |
| TS3809CXD | CD                  | TS3810CXD | CK                  |
| TS3809CXE | CE                  | TS3810CXE | CL                  |
| TS3809CXF | CF                  | TS3810CXF | CM                  |
| TS3809CXG | CG                  | TS3810CXG | CN                  |

### Application Information

Negative-Going VCC transients in addition to issuing a reset to the  $\mu P$  during power-up, power-down, and brownout conditions, the TS3809/3810 are relatively immune to short-duration negative-going Vcc transients (glitches).

The TS3809/3810 do not generate a reset pulse. The graph was generated using a negative going pulse applied to Vcc, starting 0.5V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width a negative going Vcc transient can have without causing a reset pulse. As the magnitude of the transient increases (goes farther below the reset threshold), the maximum allowable pulse width decreases. Typically, a Vcc transient that goes 100mV below the reset threshold and lasts 20 $\mu$ S or less will not cause a reset pulse. A 0.1 $\mu$ F bypass capacitor mounted as close as possible to the Vcc pin provides additional transient immunity.

### Function Description

A microprocessor's ( $\mu P$ 's) reset input starts the  $\mu P$  in a known state. The TS3809/3810 assert reset to prevent code-execution errors during power-up, power-down, or brownout conditions. They assert a reset signal whenever the Vcc supply voltage declines below a preset threshold, keeping it asserted for at least 140ms after Vcc has risen above the reset threshold. The TS3809/3810 have a push-pull output stage.

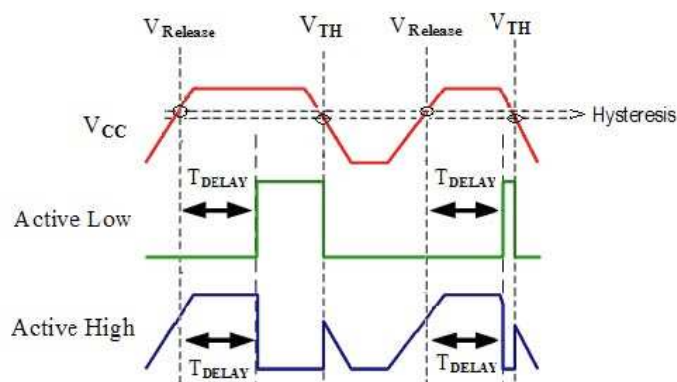
### Ensuring a Valid Reset Output Down to Vcc=0

RESET is guaranteed to be a logic low for VCC > 1.0V. Once VCC exceeds the reset threshold, an internal timer keeps RESET low for the reset timeout period; after this interval, RESET goes high. If a brownout condition occurs (VCC dips below the reset threshold), RESET goes low. Any time VCC goes below the reset threshold, the internal timer resets to zero, and RESET goes low. The internal timer starts after VCC returns above the reset threshold, and RESET remains low for the reset timeout period. When Vcc falls below 1V, the TS3809/3810 reset output no longer sinks current - it becomes an open circuit. Therefore, high impedance CMOS logic input connected to reset can drift to undetermined voltages. This presents no problem in most applications since most  $\mu P$  and other circuitry is inoperative with Vcc below 1V. However, in applications where reset must be valid down to 0V, adding a pull down resistor to reset causes any stray leakage currents to flow to ground, holding reset low (Figure 2.) R1's value is not critical; 100K is large enough not to load reset and small enough to pull RESET to ground. For the TS3809/3810 if reset is required to remain valid for Vcc<1V.

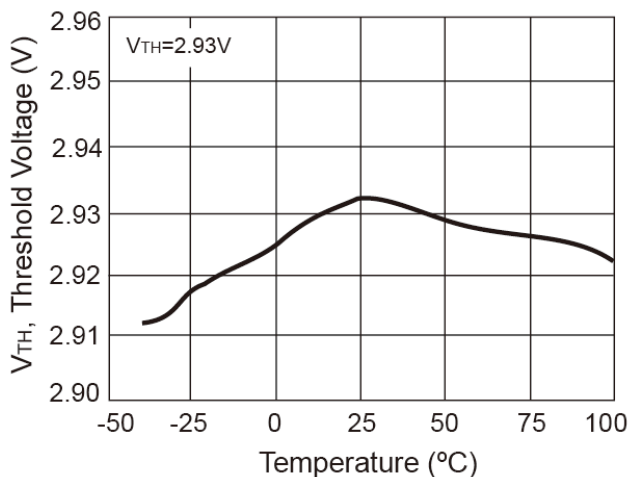
### Benefits of Highly Accurate Reset Threshold

Most  $\mu P$  supervisor ICs have reset threshold voltages between 5% and 10% below the value of nominal supply voltages. This ensures a reset will not occur within 5% of the nominal supply, but will occur when the supply is 10% below nominal. When using ICs rated at only the nominal supply  $\pm 5\%$ , this leaves a zone of uncertainty where the supply is between 5% and 10% low, and where the reset may or may not be asserted.

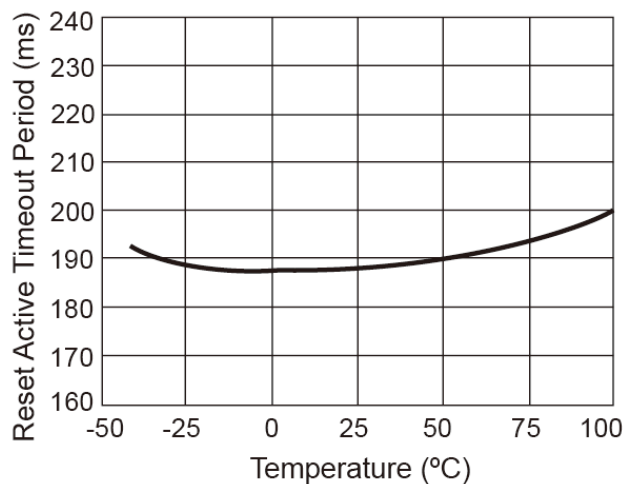
### Timing Diagram



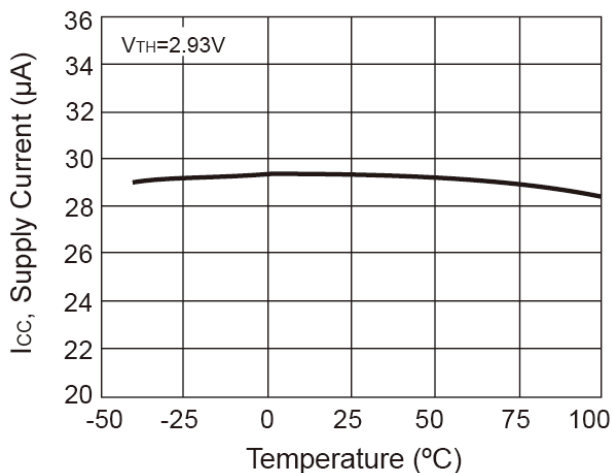
### Electrical Characteristics Curve



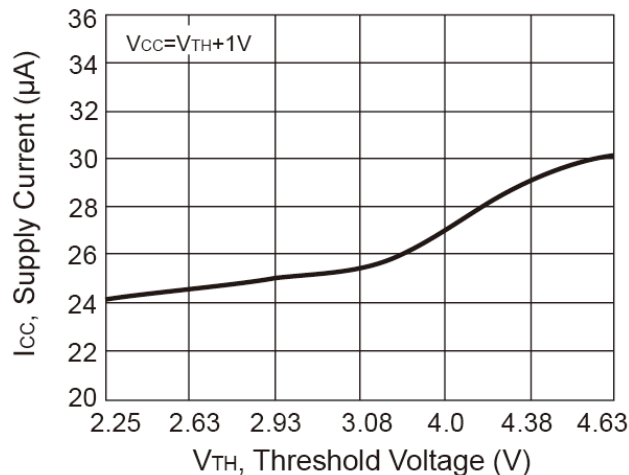
**Figure 1. Threshold Voltage vs. Temperature**



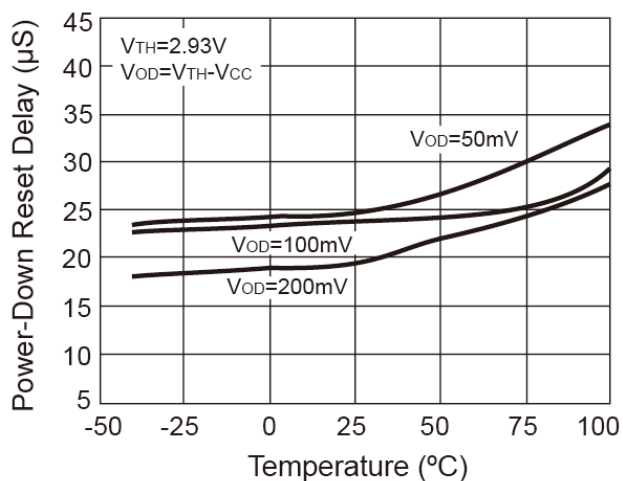
**Figure 2. T<sub>DELAY</sub> vs. Temperature**



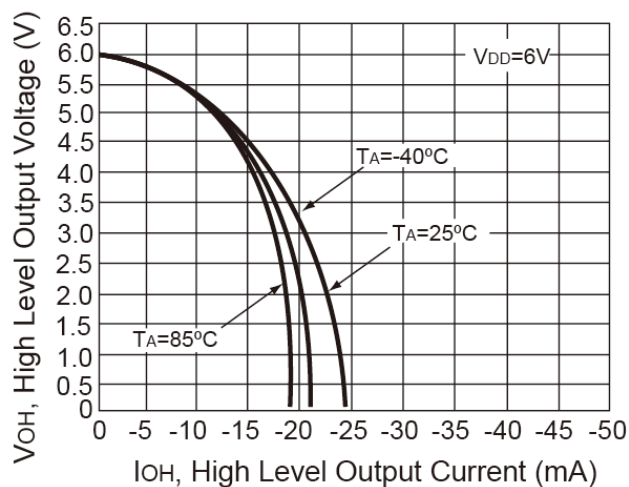
**Figure 3. Supply Current vs. Temperature**



**Figure 4. Supply Current vs. Threshold Voltage**

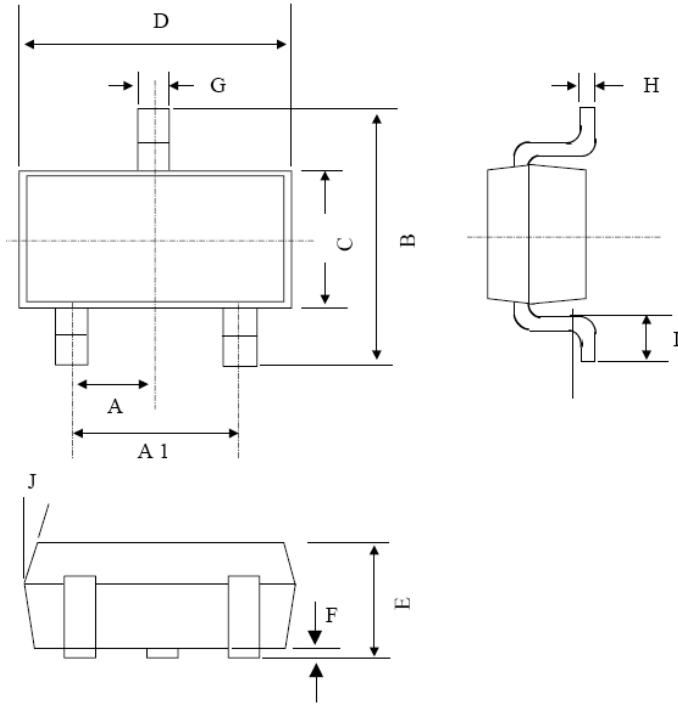


**Figure 5. Power-Down T<sub>DELAY</sub> vs. Temperature**



**Figure 6. Output Voltage vs. Output Current**

## SOT-23 Mechanical Drawing



| SOT-23 DIMENSION |             |      |           |       |
|------------------|-------------|------|-----------|-------|
| DIM              | MILLIMETERS |      | INCHES    |       |
|                  | MIN         | MAX  | MIN       | MAX.  |
| A                | 0.95 BSC    |      | 0.037 BSC |       |
| A1               | 1.9 BSC     |      | 0.074 BSC |       |
| B                | 2.60        | 3.00 | 0.102     | 0.118 |
| C                | 1.40        | 1.70 | 0.055     | 0.067 |
| D                | 2.80        | 3.10 | 0.110     | 0.122 |
| E                | 1.00        | 1.30 | 0.039     | 0.051 |
| F                | 0.00        | 0.10 | 0.000     | 0.004 |
| G                | 0.35        | 0.50 | 0.014     | 0.020 |
| H                | 0.10        | 0.20 | 0.004     | 0.008 |
| I                | 0.30        | 0.60 | 0.012     | 0.024 |
| J                | 5°          | 10°  | 5°        | 10°   |

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