

# MAX6381–MAX6390

# SC70/ $\mu$ DFN, Single/Dual Low-Voltage, Low-Power $\mu$ P Reset Circuits

## General Description

The MAX6381–MAX6390 microprocessor ( $\mu$ P) supervisory circuits monitor power-supply voltages from +1.8V to +5.0V while consuming only 3 $\mu$ A of supply current at +1.8V. Whenever  $V_{CC}$  falls below the factory-set reset thresholds, the reset output asserts and remains asserted for a minimum reset timeout period after  $V_{CC}$  rises above the reset threshold. Reset thresholds are available from +1.58V to +4.63V, in approximately 100mV increments. Seven minimum reset timeout delays ranging from 1ms to 1200ms are available.

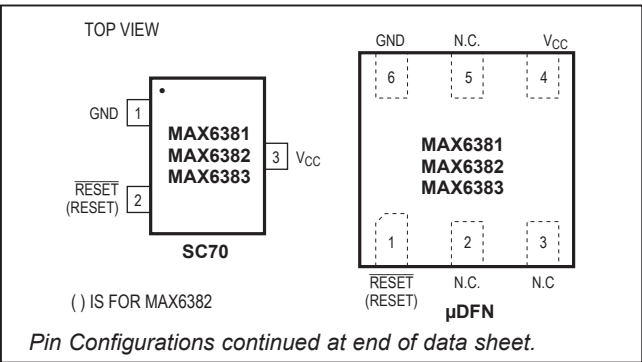
The MAX6381/MAX6384/MAX6387 have a push-pull active-low reset output. The MAX6382/MAX6385/MAX6388 have a push-pull active-high reset output, and the MAX6383/MAX6386/MAX6389/MAX6390 have an open-drain active-low reset output. The MAX6384/MAX6385/MAX6386 also feature a debounced manual reset input (with internal pullup resistor). The MAX6387/MAX6388/MAX6389 have an auxiliary input for monitoring a second voltage. The MAX6390 offers a manual reset input with a longer  $V_{CC}$  reset timeout period (1120ms or 1200ms) and a shorter manual reset timeout (140ms or 150ms).

The MAX6381/MAX6382/MAX6383 are available in 3-pin SC70 and 6-pin  $\mu$ DFN packages and the MAX6384–MAX6390 are available in 4-pin SC70 and 6-pin  $\mu$ DFN packages.

## Applications

- Computers
- Controllers
- Intelligent Instruments
- Critical  $\mu$ P and  $\mu$ C Power Monitoring
- Portable/Battery-Powered Equipment
- Dual Voltage Systems

## Pin Configurations



## Features

- Factory-Set Reset Threshold Voltages Ranging from +1.58V to +4.63V in Approximately 100mV Increments
- $\pm 2.5\%$  Reset Threshold Accuracy Over Temperature ( $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )
- Seven Reset Timeout Periods Available: 1ms, 20ms, 140ms, 280ms, 560ms, 1120ms, 1200ms (min)
- 3 Reset Output Options
  - Active-Low Push-Pull
  - Active-High Push-Pull
  - Active-Low Open-Drain
- Reset Output State Guaranteed Valid Down to  $V_{CC} = 1\text{V}$
- Manual Reset Input (MAX6384/MAX6385/MAX6386)
- Auxiliary RESET IN (MAX6387/MAX6388/MAX6389)
- $V_{CC}$  Reset Timeout (1120ms or 1200ms)/Manual Reset Timeout (140ms or 150ms) (MAX6390)
- Negative-Going  $V_{CC}$  Transient Immunity
- Low Power Consumption of 6 $\mu$ A at +3.6V and 3 $\mu$ A at +1.8V
- Pin Compatible with MAX809/MAX810/MAX803/MAX6326/MAX6327/MAX6328/MAX6346/MAX6347/MAX6348, and MAX6711/MAX6712/MAX6713
- Tiny 3-Pin/4-Pin SC70 and 6-Pin  $\mu$ DFN Packages
- AEC-Q100 Qualified, Refer to Ordering Information for the Specific /V Trim Version

## Ordering Information

| PART              | TEMP RANGE                                      | PIN-PACKAGE |
|-------------------|-------------------------------------------------|-------------|
| MAX6381LT__D_+T   | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 6 $\mu$ DFN |
| MAX6381XR__D_+T   | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 3 SC70      |
| MAX6381XR__D_/V+T | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 3 SC70      |
| MAX6381XR26D3/V+T | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 3 SC70      |
| MAX6381XR46D2/V+T | $-40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 3 SC70      |

**Note:** Insert reset threshold suffix (see Reset Threshold table) after "XR", "XS", or "LT." Insert reset timeout delay (see Reset Timeout Delay table) after "D" to complete the part number. Sample stock is generally held on standard versions only (see Standard Versions table). Standard versions have an order increment requirement of 2500 pieces. Nonstandard versions have an order increment requirement of 10,000 pieces. Contact factory for availability of nonstandard versions.

+Denotes a lead(Pb)-free/RoHS-compliant package.  
/V denotes an automotive qualified part.

Ordering Information continued at end of data sheet.  
Typical Operating Circuit appears at end of data sheet.  
Selector Guide appears at end of data sheet.

## Absolute Maximum Ratings

|                                       |                              |
|---------------------------------------|------------------------------|
| $V_{CC}$ to GND .....                 | -0.3V to +6.0V               |
| RESET Open-Drain Output .....         | -0.3V to +6.0V               |
| RESET, RESET (push-pull output) ..... | -0.3V to ( $V_{CC} + 0.3V$ ) |
| MR, RESET IN .....                    | -0.3V to ( $V_{CC} + 0.3V$ ) |
| Input Current ( $V_{CC}$ ) .....      | 20mA                         |
| Output Current (all pins) .....       | 20mA                         |

|                                                                                   |                                             |
|-----------------------------------------------------------------------------------|---------------------------------------------|
| Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ )                        |                                             |
| 3-Pin SC70 (derate 2.9mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$ ) .....      | 235mW                                       |
| 4-Pin SC70 (derate 3.1mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$ ) .....      | 245mW                                       |
| 6-Pin $\mu$ DFN (derate 2.1mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$ ) ..... | 167.7mW                                     |
| Operating Temperature Range .....                                                 | $-40^\circ\text{C}$ to $+125^\circ\text{C}$ |
| Storage Temperature Range .....                                                   | $-65^\circ\text{C}$ to $+150^\circ\text{C}$ |
| Lead Temperature (soldering, 10s) .....                                           | $+300^\circ\text{C}$                        |
| Soldering Temperature (reflow) .....                                              | $+260^\circ\text{C}$                        |

Stresses beyond 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 beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Package Information

### 3 SC70

|                                             |                                 |
|---------------------------------------------|---------------------------------|
| Package Code                                | X3+2                            |
| Outline Number                              | <a href="#">21-0075</a>         |
| Land Pattern Number                         | <a href="#">90-0208</a>         |
| <b>THERMAL RESISTANCE, MULTILAYER BOARD</b> |                                 |
| Junction to Ambient ( $\theta_{JA}$ )       | 340.4 $^\circ\text{C}/\text{W}$ |
| Junction to Case ( $\theta_{JC}$ )          | 120 $^\circ\text{C}/\text{W}$   |

### 4 SC70

|                                             |                                 |
|---------------------------------------------|---------------------------------|
| Package Code                                | X4+1                            |
| Outline Number                              | <a href="#">21-0098</a>         |
| Land Pattern Number                         | <a href="#">90-0187</a>         |
| <b>THERMAL RESISTANCE, MULTILAYER BOARD</b> |                                 |
| Junction to Ambient ( $\theta_{JA}$ )       | 322.6 $^\circ\text{C}/\text{W}$ |
| Junction to Case ( $\theta_{JC}$ )          | 115 $^\circ\text{C}/\text{W}$   |

### 6 FDFN

|                                             |                               |
|---------------------------------------------|-------------------------------|
| Package Code                                | L611+1                        |
| Outline Number                              | <a href="#">21-0147</a>       |
| Land Pattern Number                         | <a href="#">90-0080</a>       |
| <b>THERMAL RESISTANCE, MULTILAYER BOARD</b> |                               |
| Junction to Ambient ( $\theta_{JA}$ )       | 477 $^\circ\text{C}/\text{W}$ |
| Junction to Case ( $\theta_{JC}$ )          | 122 $^\circ\text{C}/\text{W}$ |

Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

## Electrical Characteristics

(V<sub>CC</sub> = full range, T<sub>A</sub> = -40°C to +125°C, unless otherwise specified. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

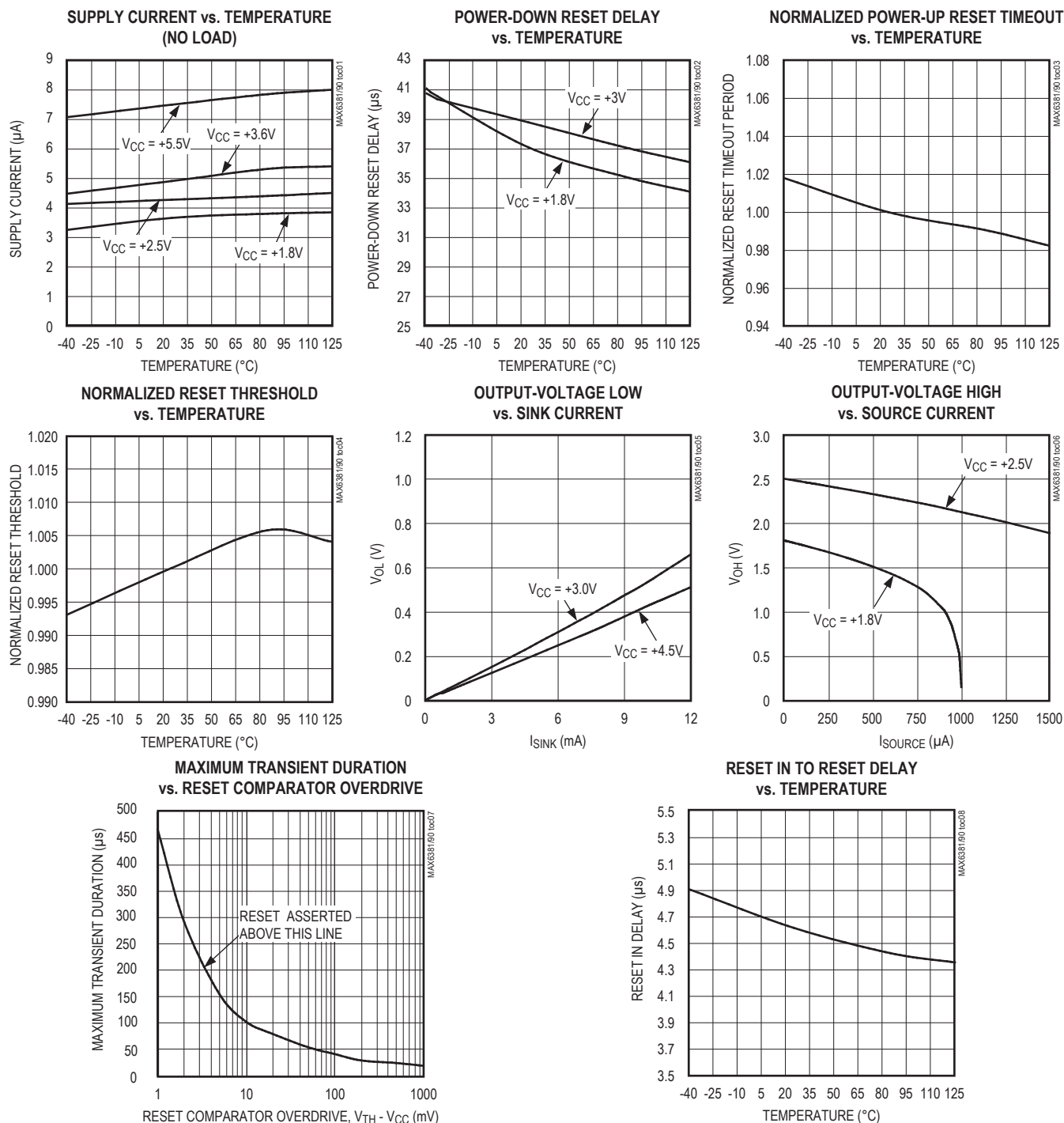
| PARAMETER                                                            | SYMBOL                           | CONDITIONS                                                                                       | MIN                    | TYP             | MAX                    | UNITS                   |
|----------------------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------|------------------------|-----------------|------------------------|-------------------------|
| Operating Voltage Range                                              | V <sub>CC</sub>                  |                                                                                                  | 1.0                    |                 | 5.5                    | V                       |
| V <sub>CC</sub> Supply Current                                       | I <sub>CC</sub>                  | V <sub>CC</sub> = 5.5V, no load                                                                  |                        | 7               | 13                     | $\mu$ A                 |
|                                                                      |                                  | V <sub>CC</sub> = 3.6V, no load                                                                  |                        | 6               | 11                     |                         |
|                                                                      |                                  | V <sub>CC</sub> = 2.5V, no load                                                                  |                        | 4               | 7                      |                         |
|                                                                      |                                  | V <sub>CC</sub> = 1.8V, no load                                                                  |                        | 3               | 6                      |                         |
| V <sub>CC</sub> Reset Threshold<br>(See Reset Thresholds table)      | V <sub>TH</sub>                  | T <sub>A</sub> = +25°C                                                                           | V <sub>TH</sub> - 1.5% | V <sub>TH</sub> | V <sub>TH</sub> + 1.5% | V                       |
|                                                                      |                                  | T <sub>A</sub> = -40°C to +125°C                                                                 | V <sub>TH</sub> - 2.5% | V <sub>TH</sub> | V <sub>TH</sub> + 2.5% |                         |
| Reset Threshold Tempco                                               | $\Delta V_{TH}/^{\circ}\text{C}$ |                                                                                                  |                        | 60              |                        | ppm/ $^{\circ}\text{C}$ |
| V <sub>CC</sub> to Reset Delay                                       |                                  | V <sub>CC</sub> falling at 10mV/ $\mu$ s from V <sub>TH</sub> + 100mV to V <sub>TH</sub> - 100mV |                        | 35              |                        | $\mu$ s                 |
| Reset Timeout Period<br>MAX6381–MAX6389<br>(See Reset Timeout table) | t <sub>RP</sub>                  | D1                                                                                               | 1                      |                 | 2                      | ms                      |
|                                                                      |                                  | D2                                                                                               | 20                     |                 | 40                     |                         |
|                                                                      |                                  | D3                                                                                               | 140                    |                 | 280                    |                         |
|                                                                      |                                  | D5                                                                                               | 280                    |                 | 560                    |                         |
|                                                                      |                                  | D6                                                                                               | 560                    |                 | 1120                   |                         |
|                                                                      |                                  | D4                                                                                               | 1120                   |                 | 2240                   |                         |
|                                                                      |                                  | D7                                                                                               | 1200                   |                 | 2400                   |                         |
| Reset Timeout Period<br>MAX6390                                      | t <sub>RP</sub>                  | $\overline{\text{MR}}$ timeout period                                                            | D4                     | 140             | 280                    | ms                      |
|                                                                      |                                  |                                                                                                  | D7                     | 150             | 300                    |                         |
|                                                                      |                                  | V <sub>CC</sub> timeout period                                                                   | D4                     | 1120            | 2240                   |                         |
|                                                                      |                                  |                                                                                                  | D7                     | 1200            | 2400                   |                         |
| $\overline{\text{MR}}$ Input Voltage                                 | V <sub>IL</sub>                  | V <sub>TH</sub> < 4V                                                                             |                        |                 | 0.3 x V <sub>CC</sub>  | V                       |
|                                                                      | V <sub>IH</sub>                  |                                                                                                  |                        |                 | 0.7 x V <sub>CC</sub>  |                         |
|                                                                      | V <sub>IL</sub>                  | V <sub>TH</sub> > 4V                                                                             |                        |                 | 0.8                    |                         |
|                                                                      | V <sub>IH</sub>                  |                                                                                                  |                        |                 | 2.4                    |                         |

**Electrical Characteristics (continued)**(V<sub>CC</sub> = full range, T<sub>A</sub> = -40°C to +125°C, unless otherwise specified. Typical values are at T<sub>A</sub> = +25°C.) (Note 1)

| PARAMETER                                                   | SYMBOL                | CONDITIONS                                                                                               | MIN   | TYP     | MAX             | UNITS      |
|-------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------|-------|---------|-----------------|------------|
| MR Minimum Input Pulse Width                                |                       |                                                                                                          | 1     |         |                 | $\mu$ s    |
| MR Glitch Rejection                                         |                       |                                                                                                          |       | 100     |                 | ns         |
| MR to Reset Delay                                           |                       |                                                                                                          |       | 200     |                 | ns         |
| MR Internal Pullup Resistance                               |                       | MAX6381–MAX6389                                                                                          | 32    | 63      | 100             | k $\Omega$ |
|                                                             |                       | MAX6390                                                                                                  | 500   | 1560    | 3000            | $\Omega$   |
| RESET IN Input Threshold                                    | V <sub>THRST</sub>    | T <sub>A</sub> = +25°C                                                                                   | 1.245 | 1.27    | 1.295           | V          |
|                                                             |                       | T <sub>A</sub> = 0°C to +85°C                                                                            | 1.232 |         | 1.308           |            |
|                                                             |                       | T <sub>A</sub> = -40°C to +125°C                                                                         | 1.219 |         | 1.321           |            |
| RESET IN to RESET Delay                                     |                       | V <sub>RESETIN</sub> falling at 4mV/ $\mu$ s from V <sub>THRST</sub> + 40mV to V <sub>THRST</sub> - 40mV |       | 4.5     |                 | $\mu$ s    |
| RESET IN Input Leakage Current                              | I <sub>RESET IN</sub> |                                                                                                          | -50   | $\pm 1$ | +50             | nA         |
| Open-Drain $\overline{\text{RESET}}$ Output Voltage         | V <sub>OL</sub>       | V <sub>CC</sub> $\geq$ 4.5V, I <sub>SINK</sub> = 3.2mA, reset asserted                                   |       |         | 0.4             | V          |
|                                                             |                       | V <sub>CC</sub> $\geq$ 2.5V, I <sub>SINK</sub> = 1.2mA, reset asserted                                   |       |         | 0.3             |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 1.0V, I <sub>SINK</sub> = 80 $\mu$ A, reset asserted                              |       |         | 0.3             |            |
| Open-Drain $\overline{\text{RESET}}$ Output Leakage Current | I <sub>LKG</sub>      | V <sub>CC</sub> > V <sub>TH</sub> , $\overline{\text{RESET}}$ not asserted                               |       |         | 1.0             | $\mu$ A    |
| Push-Pull $\overline{\text{RESET}}$ Output Voltage          | V <sub>OL</sub>       | V <sub>CC</sub> $\geq$ 4.5V, I <sub>SINK</sub> = 3.2mA, reset asserted                                   |       |         | 0.4             | V          |
|                                                             |                       | V <sub>CC</sub> $\geq$ 2.5V, I <sub>SINK</sub> = 1.2mA, reset asserted                                   |       |         | 0.3             |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 1.0V, I <sub>SINK</sub> = 80 $\mu$ A, reset asserted                              |       |         | 0.3             |            |
|                                                             | V <sub>OH</sub>       | V <sub>CC</sub> $\geq$ 4.5V, I <sub>SOURCE</sub> = 800 $\mu$ A, reset not asserted                       | 0.8 x |         | V <sub>CC</sub> |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 2.5V, I <sub>SOURCE</sub> = 500 $\mu$ A, reset not asserted                       | 0.8 x |         | V <sub>CC</sub> |            |
| Push-Pull RESET Output Voltage                              | V <sub>OH</sub>       | V <sub>CC</sub> $\geq$ 4.5V, I <sub>SOURCE</sub> = 800 $\mu$ A, reset asserted                           | 0.8 x |         | V <sub>CC</sub> | V          |
|                                                             |                       | V <sub>CC</sub> $\geq$ 2.5V, I <sub>SOURCE</sub> = 500 $\mu$ A, reset asserted                           | 0.8 x |         | V <sub>CC</sub> |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 1.8V, I <sub>SOURCE</sub> = 150 $\mu$ A, reset asserted                           | 0.8 x |         | V <sub>CC</sub> |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 1.0V, I <sub>SOURCE</sub> = 1 $\mu$ A, reset asserted                             | 0.8 x |         | V <sub>CC</sub> |            |
|                                                             | V <sub>OL</sub>       | V <sub>CC</sub> $\geq$ 4.5V, I <sub>SINK</sub> = 3.2mA, reset not asserted                               |       |         | 0.4             |            |
|                                                             |                       | V <sub>CC</sub> $\geq$ 2.5V, I <sub>SINK</sub> = 1.2mA, reset not asserted                               |       |         | 0.3             |            |

**Note 1:** Specifications over temperature are guaranteed by design, not production tested.

## Typical Operating Characteristics



## Pin Description

| PIN                                                                        |                     |         |                                 |         |                    |         | NAME               | FUNCTION                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------|---------------------|---------|---------------------------------|---------|--------------------|---------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| μDFN                                                                       | 3-PIN SC70          |         | 4-PIN SC70                      |         |                    |         |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                                                                            | MAX6381/<br>MAX6383 | MAX6382 | MAX6384/<br>MAX6386/<br>MAX6390 | MAX6385 | MAX6387/<br>MAX689 | MAX6388 |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1<br>(MAX6382/<br>MAX6385/<br>MAX6388)                                     |                     | 2       | —                               | 2       | —                  | 2       | RESET              | Active-High Push-Pull Reset Output. RESET changes from low to high when any monitored voltage (V <sub>CC</sub> or V <sub>RESETIN</sub> ) drops below the reset threshold or $\overline{MR}$ is pulled low. RESET remains high for the reset timeout period after monitored voltages exceed the reset thresholds or $\overline{MR}$ is released.                                                                                         |
| 1<br>(MAX6381/<br>MAX6383/<br>MAX6384/<br>MAX6386/<br>MAX6387/<br>MAX6390) | 2                   | —       | 2                               | —       | 2                  | —       | $\overline{RESET}$ | Active-Low Open-Drain/Push-Pull Reset Output. $\overline{RESET}$ changes from high to low when any monitored voltage (V <sub>CC</sub> or V <sub>RESETIN</sub> ) drops below the reset threshold or $\overline{MR}$ is pulled low. $\overline{RESET}$ remains low for the reset timeout period after the monitored voltages exceed the reset thresholds or $\overline{MR}$ is released. Open-drain requires an external pullup resistor. |
| 2, 3, 5<br>(MAX6381/<br>MAX6382/<br>MAX6383)                               | —                   | —       | —                               | —       | —                  | —       | N.C.               | No Connection. Not Internally connected.                                                                                                                                                                                                                                                                                                                                                                                                |
| 2, 5<br>(MAX6384–<br>MAX6390)                                              |                     |         |                                 |         |                    |         |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 3<br>(MAX6384/<br>MAX6385/<br>MAX6386/<br>MAX6390)                         | —                   | —       | 3                               | 3       | —                  | —       | $\overline{MR}$    | Active-Low Manual Reset Input. Drive low to force a reset. Reset remains active as long as $\overline{MR}$ is low and for the reset timeout period after $\overline{MR}$ is released. Leave unconnected or connect to V <sub>CC</sub> if unused. $\overline{MR}$ has an internal 63kΩ (1.56kΩ for MAX6390) pullup resistor to V <sub>CC</sub> .                                                                                         |
| 3<br>(MAX6387/<br>MAX6388/<br>MAX6389)                                     | —                   | —       | —                               | —       | 3                  | 3       | RESET<br>IN        | Auxiliary Reset Input. High-impedance input to the auxiliary reset comparator. Connect RESET IN to the center point of an external resistor voltage-divider network to set the reset threshold voltage. Reset asserts when either V <sub>CC</sub> or RESET IN falls below its threshold voltage.                                                                                                                                        |
| 4<br>(MAX6381–<br>MAX6390)                                                 | 3                   | 3       | 4                               | 4       | 4                  | 4       | V <sub>CC</sub>    | Supply Voltage for the device and input for fixed V <sub>CC</sub> reset threshold monitor.                                                                                                                                                                                                                                                                                                                                              |
| 6<br>(MAX6381–<br>MAX6390)                                                 | 1                   | 1       | 1                               | 1       | 1                  | 1       | GND                | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                  |

## Detailed Description

### RESET Output

A μP reset input starts the μP in a known state. These μP supervisory circuits assert reset to prevent code execution errors during power-up, power-down, or brownout conditions.

Reset asserts when  $V_{CC}$  is below the reset threshold; once  $V_{CC}$  exceeds the reset threshold, an internal timer keeps the reset output asserted for the reset timeout period. After this interval, reset output deasserts. Reset output is guaranteed to be in the correct logic state for  $V_{CC} \geq 1V$ .

### Manual Reset Input (MAX6384/ MAX6385/MAX6386/MAX6390)

Many μP-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. A logic low on  $\overline{MR}$  asserts reset. Reset remains asserted while  $\overline{MR}$  is low, and for the reset active timeout period ( $t_{RP}$ ) after  $\overline{MR}$  returns high. This input has an internal 63kΩ pullup resistor (1.56kΩ for MAX6390), so it can be left unconnected if it is not used.  $\overline{MR}$  can be driven with TTL or CMOS logic levels, or with open-drain/collector outputs. Connect a normally open momentary switch from  $\overline{MR}$  to GND to create a manual-reset function; external debounce circuitry is not required. If  $\overline{MR}$  is driven from long cables or if the device is used in a noisy environment, connecting a 0.1μF capacitor from  $\overline{MR}$  to GND provides additional noise immunity.

### RESET IN Comparator (MAX6387/MAX6388/MAX6389)

RESET IN is compared to an internal +1.27V reference. If the voltage at RESET IN is less than 1.27V, reset asserts. Use the RESET IN comparator as a user-adjustable reset detector or as a secondary power-supply monitor by implementing a resistor-divider at RESET IN (shown in Figure 1). Reset asserts when either  $V_{CC}$  or RESET IN falls below its respective threshold voltage. Use the following equation to set the threshold:

$$V_{INTH} = V_{THRST} (R1/R2 + 1)$$

where  $V_{THRST} = +1.27V$ . To simplify the resistor selection, choose a value of  $R2$  and calculate  $R1$ :

$$R1 = R2 [(V_{INTH}/V_{THRST}) - 1]$$

Since the input current at RESET IN is 50nA (max), large values can be used for  $R2$  with no significant loss in accuracy.

## Reset Thresholds (-40°C to +125°C)

| SUFFIX | $V_{TH}$ (min) | $V_{TH}$ (nom) | $V_{TH}$ (max) |
|--------|----------------|----------------|----------------|
| 46     | 4.51           | 4.63           | 4.74           |
| 45     | 4.39           | 4.50           | 4.61           |
| 44     | 4.27           | 4.38           | 4.48           |
| 43     | 4.19           | 4.30           | 4.41           |
| 42     | 4.10           | 4.20           | 4.31           |
| 41     | 4.00           | 4.10           | 4.20           |
| 40     | 3.90           | 4.00           | 4.10           |
| 39     | 3.80           | 3.90           | 4.00           |
| 38     | 3.71           | 3.80           | 3.90           |
| 37     | 3.61           | 3.70           | 3.79           |
| 36     | 3.51           | 3.60           | 3.69           |
| 35     | 3.41           | 3.50           | 3.59           |
| 34     | 3.32           | 3.40           | 3.49           |
| 33     | 3.22           | 3.30           | 3.38           |
| 32     | 3.12           | 3.20           | 3.28           |
| 31     | 3.00           | 3.08           | 3.15           |
| 30     | 2.93           | 3.00           | 3.08           |
| 29     | 2.85           | 2.93           | 3.00           |
| 28     | 2.73           | 2.80           | 2.87           |
| 27     | 2.63           | 2.70           | 2.77           |
| 26     | 2.56           | 2.63           | 2.69           |
| 25     | 2.44           | 2.50           | 2.56           |
| 24     | 2.34           | 2.40           | 2.46           |
| 23     | 2.26           | 2.31           | 2.37           |
| 22     | 2.13           | 2.19           | 2.24           |
| 21     | 2.05           | 2.10           | 2.15           |
| 20     | 1.95           | 2.00           | 2.05           |
| 19     | 1.85           | 1.90           | 1.95           |
| 18     | 1.76           | 1.80           | 1.85           |
| 17     | 1.62           | 1.67           | 1.71           |
| 16     | 1.54           | 1.58           | 1.61           |

## Applications Information

### Negative-Going $V_{CC}$ Transients

In addition to issuing a reset to the μP during power-up, power-down, and brownout conditions, the MAX6381–MAX6390 are relatively immune to short duration negative-going  $V_{CC}$  transients (glitches).

The *Typical Operating Characteristics* section shows the Maximum Transient Durations vs. Reset Comparator Overdrive, for which the MAX6381–MAX6390 do not generate a reset pulse. This graph was generated using



# MAX6381–MAX6390

# SC70/ $\mu$ DFN, Single/Dual Low-Voltage, Low-Power $\mu$ P Reset Circuits

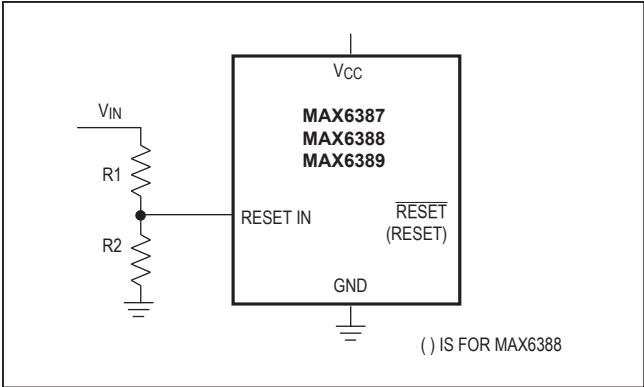


Figure 1. RESET IN Configuration

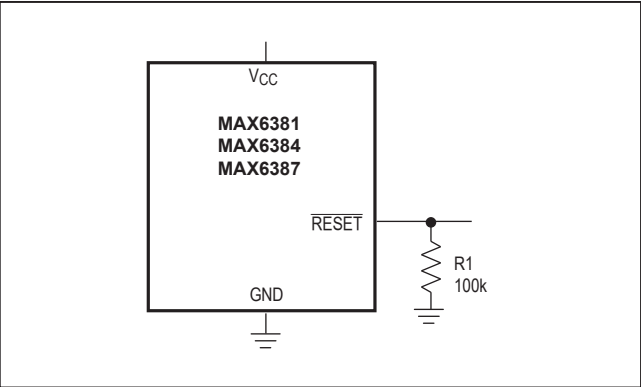


Figure 2. RESET Valid to  $V_{CC}$  = Ground Circuit

## Reset Timeout Delay

| SUFFIX      | MIN         |
|-------------|-------------|
| D1          | 1ms         |
| D2          | 20ms        |
| D3          | 140ms       |
| D5          | 280ms       |
| D6          | 560ms       |
| D4          | 1120ms      |
| D7          | 1200ms      |
| MAX6390__D4 | 1120/140ms* |
| MAX6390__D7 | 1200/150ms* |

\*The MAX6390 has a 1120ms or 1200ms  $\overline{RESET}$  timeout and a 140ms or 150ms manual reset timeout.

a negative-going pulse applied to  $V_{CC}$ , starting above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the typical maximum pulse width a negative-going  $V_{CC}$  transient may have without causing a reset pulse to be issued. As the magnitude of the transient increases (goes farther below the reset threshold), the maximum allowable pulse width decreases. A 0.1 $\mu$ F capacitor mounted as close as possible to  $V_{CC}$  provides additional transient immunity.

## Ensuring a Valid RESET Output Down to $V_{CC}$ = 0V

The MAX6381–MAX6390 are guaranteed to operate properly down to  $V_{CC}$  = 1V. In applications that require valid reset levels down to  $V_{CC}$  = 0V, a pulldown resistor to active-low outputs (push/pull only, Figure 2) and a pullup resistor to active-high outputs (push/pull only) will

ensure that the reset line is valid while the reset output can no longer sink or source current. This scheme does not work with the open-drain outputs of the MAX6383/MAX6386/MAX6389/MAX6390. The resistor value used is not critical, but it must be small enough not to load the reset output when  $V_{CC}$  is above the reset threshold. For most applications, 100k $\Omega$  is adequate.

## Standard Versions

| PART    | RESET THRESHOLD | RESET TIMEOUT |
|---------|-----------------|---------------|
| MAX638_ | 46              | D3            |
|         | 44              |               |
|         | 31              |               |
|         | 29              |               |
|         | 26              |               |
|         | 23              |               |
|         | 22              |               |
|         | 17              |               |
|         | 16              |               |
| MAX6390 | 46              | D4            |
|         | 44              |               |
|         | 31              |               |
|         | 29              |               |
|         | 26              |               |
|         | 23              |               |
|         | 22              |               |
|         | 17              |               |
|         | 16              |               |

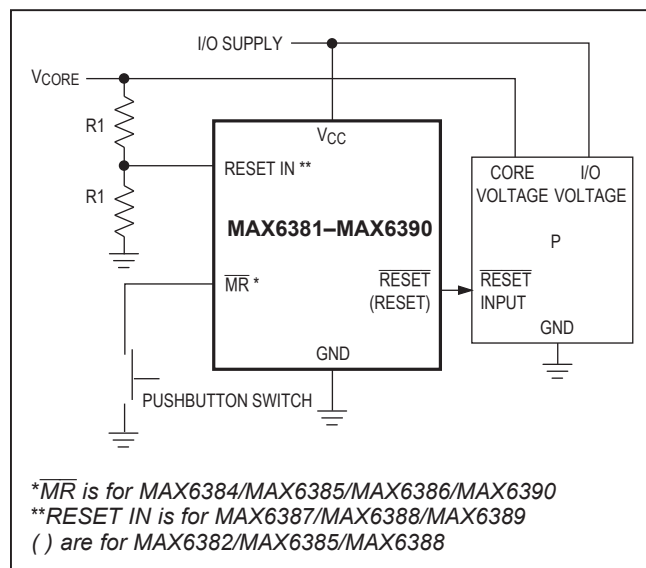


## Selector Guide

| PART NUMBER | PUSH-PULL<br>ACTIVE-LOW | PUSH-PULL<br>ACTIVE-HIGH | OPEN-DRAIN<br>ACTIVE-LOW | MANUAL RESET<br>INPUT $\overline{MR}$ | RESET IN |
|-------------|-------------------------|--------------------------|--------------------------|---------------------------------------|----------|
| MAX6381     | X                       |                          |                          |                                       |          |
| MAX6382     |                         | X                        |                          |                                       |          |
| MAX6383     |                         |                          | X                        |                                       |          |
| MAX6384     | X                       |                          |                          | X                                     |          |
| MAX6385     |                         | X                        |                          | X                                     |          |
| MAX6386     |                         |                          | X                        | X                                     |          |
| MAX6390*    |                         |                          | X                        | X                                     |          |
| MAX6387     | X                       |                          |                          |                                       | X        |
| MAX6388     |                         | X                        |                          |                                       | X        |
| MAX6389     |                         |                          | X                        |                                       | X        |

\*The MAX6390 offers a  $V_{CC}$  reset timeout of 1120ms or 1200ms (min) and a manual reset timeout of 140ms or 150ms (min).

## Typical Operating Circuit



## Ordering Information (continued)

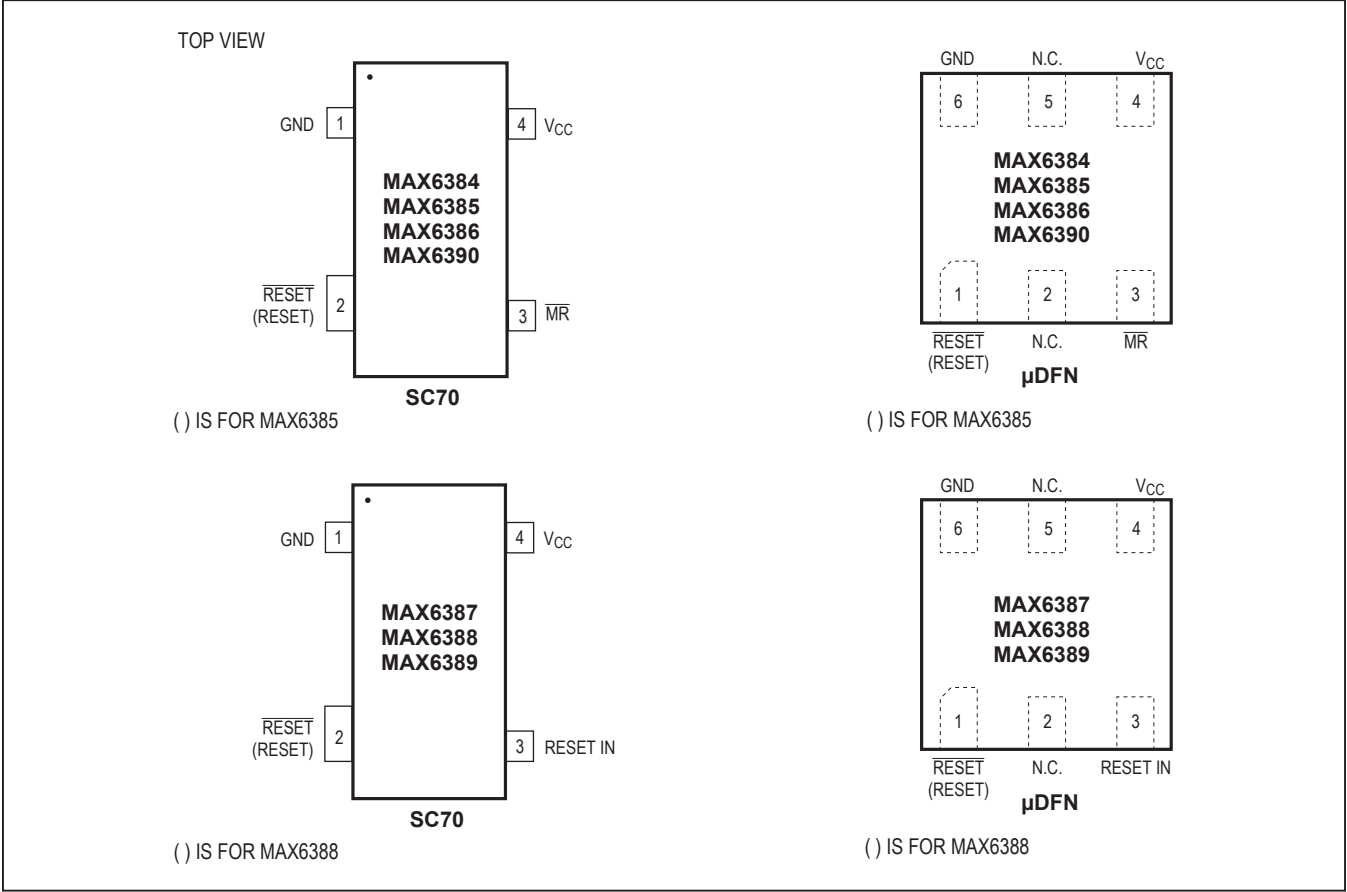
| PART              | TEMP RANGE      | PIN-PACKAGE |
|-------------------|-----------------|-------------|
| MAX6382LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6382XR__D_+T   | -40°C to +125°C | 3 SC70      |
| MAX6383LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6383XR__D_+T   | -40°C to +125°C | 3 SC70      |
| MAX6384LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6384XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6385LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6385XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6386LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6386XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6387LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6387XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6388LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6388XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6389LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6389XS__D_+T   | -40°C to +125°C | 4 SC70      |
| MAX6389XS30D2/V+T | -40°C to +125°C | 4 SC70      |
| MAX6389XS31D1/V+T | -40°C to +125°C | 4 SC70      |
| MAX6389XS32D1/V+T | -40°C to +125°C | 4 SC70      |
| MAX6390LT__D_+T   | -40°C to +125°C | 6 $\mu$ DFN |
| MAX6390XS__D_+T*  | -40°C to +125°C | 4 SC70      |

**Note:** Insert reset threshold suffix (see Reset Threshold table) after "XR", "XS", or "LT." Insert reset timeout delay (see Reset Timeout Delay table) after "D" to complete the part number. Sample stock is generally held on standard versions only (see Standard Versions table). Standard versions have an order increment requirement of 2500 pieces. Nonstandard versions have an order increment requirement of 10,000 pieces. Contact factory for availability of nonstandard versions.

\*MAX6390 is available with D4 or D7 timing only.

+Denotes a lead(Pb)-free/RoHS-compliant package.

Pin Configurations (continued)



Chip Information

PROCESS: BiCMOS

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION                                                                                                      | PAGES CHANGED |
|-----------------|---------------|------------------------------------------------------------------------------------------------------------------|---------------|
| 0               | 10/00         | Initial release                                                                                                  | —             |
| 3               | 12/05         | Added lead-free notation to <i>Ordering Information</i> .                                                        | 1, 8          |
| 4               | 4/07          | Added $\mu$ DFN package to data sheet.                                                                           | 1, 2, 5, 7–13 |
| 5               | 7/12          | Added automotive package to <i>Ordering Information</i> .                                                        | 1             |
| 6               | 3/18          | Updated <i>Ordering Information</i> table                                                                        | 1, 8          |
| 7               | 8/20          | Added <i>Package Information</i> table with thermal characteristics and removed <i>Package Information</i> table | 2, 10         |

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| <a href="#"><u>MAX6387XS26D4+T</u></a> | <a href="#"><u>MAX6383XR16D1+T</u></a> | <a href="#"><u>MAX6381LT16D1+T</u></a> | <a href="#"><u>MAX6381LT16D2+T</u></a> | <a href="#"><u>MAX6381LT16D3+T</u></a> |
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