

## General Description

The MAX811/MAX812 are low-power microprocessor ( $\mu$ P) supervisory circuits used to monitor 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-powered or 3V-powered circuits. The MAX811/MAX812 also provide a debounced manual reset input.

These devices perform a single function: They assert a reset signal whenever the  $V_{CC}$  supply voltage falls below a preset threshold, keeping it asserted for at least 140ms after  $V_{CC}$  has risen above the reset threshold. The only difference between the two devices is that the MAX811 has an active-low RESET output (which is guaranteed to be in the correct state for  $V_{CC}$  down to 1V), while the MAX812 has an active-high RESET output. The reset comparator is designed to ignore fast transients on  $V_{CC}$ . Reset thresholds are available for operation with a variety of supply voltages.

Low supply current makes the MAX811/MAX812 ideal for use in portable equipment. The devices come in a 4-pin SOT143 package.

## Applications

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

## Benefits and Features

- Integrated Voltage Monitor Increases System Robustness with Added Manual Reset
  - Precision Monitoring of 3V, 3.3V, and 5V Power-Supply Voltages
  - 140ms Min Power-On-Reset Pulse Width
  - $\overline{\text{RESET}}$  Output (MAX811), RESET Output (MAX812)
  - Guaranteed Over Temperature
  - Guaranteed  $\overline{\text{RESET}}$  Valid to  $V_{CC} = 1\text{V}$  (MAX811)
  - Power-Supply Transient Immunity
- Saves Board Space
  - No External Components
  - 4-Pin SOT143 Package
- Low Power Consumption Simplifies Power-Supply Requirements
  - 6 $\mu$ A Supply Current

## Ordering Information

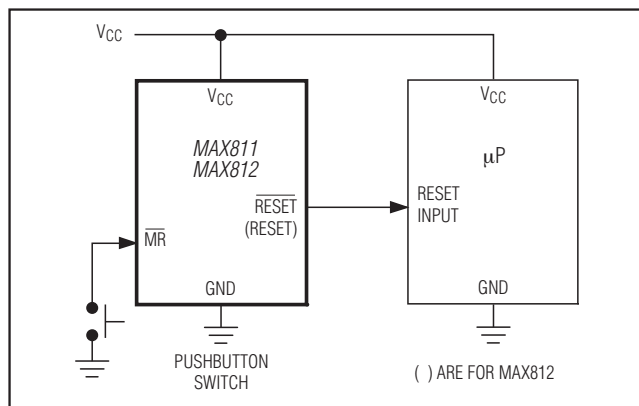
| PART*        | TEMP RANGE     | PIN-PACKAGE |
|--------------|----------------|-------------|
| MAX811_EUS-T | -40°C to +85°C | 4 SOT143    |
| MAX812_EUS-T | -40°C to +85°C | 4 SOT143    |

\*This part offers a choice of five different reset threshold voltages. Select the letter corresponding to the desired nominal reset threshold voltage, and insert it into the blank to complete the part number.

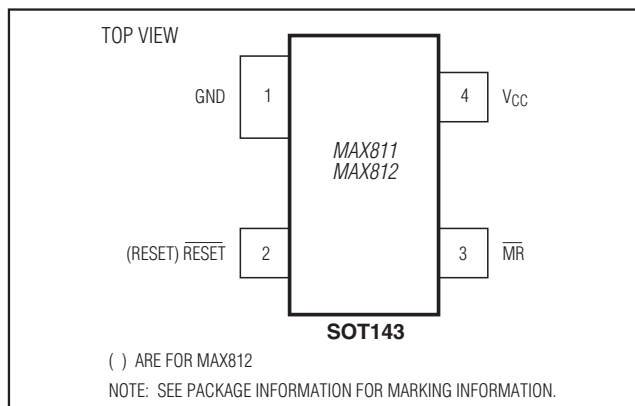
Devices are available in both leaded and lead(Pb)-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

| RESET THRESHOLD |             |
|-----------------|-------------|
| SUFFIX          | VOLTAGE (V) |
| L               | 4.63        |
| M               | 4.38        |
| T               | 3.08        |
| S               | 2.93        |
| R               | 2.63        |

## Typical Operating Circuit



## Pin Configuration



## Absolute Maximum Ratings

Terminal Voltage (with respect to GND)

$V_{CC}$  ..... -0.3V to 6.0V

All Other Inputs ..... -0.3V to ( $V_{CC} + 0.3$ V)

Input Current,  $V_{CC}$ ,  $\overline{MR}$  ..... 20mA

Output Current, RESET or  $\overline{RESET}$  ..... 20mA

Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ )

SOT143 (derate 4mW/ $^\circ\text{C}$  above  $+70^\circ\text{C}$ ) ..... 320mW

Operating Temperature Range .....  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$

Storage Temperature Range .....  $-65^\circ\text{C}$  to  $+160^\circ\text{C}$

Lead Temperature (soldering, 10sec) .....  $+300^\circ\text{C}$

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.

## Electrical Characteristics

( $V_{CC} = 5$ V for L/M versions,  $V_{CC} = 3.3$ V for T/S versions,  $V_{CC} = 3$ V for R version,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ .) (Note 1)

| PARAMETER                                           | SYMBOL   | CONDITIONS                                                                  | MIN                                              | TYP                  | MAX  | UNITS                 |
|-----------------------------------------------------|----------|-----------------------------------------------------------------------------|--------------------------------------------------|----------------------|------|-----------------------|
| Operating Voltage Range                             | $V_{CC}$ | $T_A = 0^\circ\text{C}$ to $+70^\circ\text{C}$                              | 1.0                                              |                      | 5.5  | V                     |
|                                                     |          | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$                            | 1.2                                              |                      |      |                       |
| Supply Current                                      | $I_{CC}$ | MAX81_L/M, $V_{CC} = 5.5$ V, $I_{OUT} = 0$                                  |                                                  | 6                    | 15   | $\mu\text{A}$         |
|                                                     |          | MAX81_R/S/T, $V_{CC} = 3.6$ V, $I_{OUT} = 0$                                |                                                  | 2.7                  | 10   |                       |
| Reset Threshold                                     | $V_{TH}$ | MAX81_L                                                                     | $T_A = +25^\circ\text{C}$                        | 4.54                 | 4.63 | V                     |
|                                                     |          |                                                                             | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | 4.50                 |      |                       |
|                                                     |          | MAX81_M                                                                     | $T_A = +25^\circ\text{C}$                        | 4.30                 | 4.38 |                       |
|                                                     |          |                                                                             | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | 4.25                 |      |                       |
|                                                     |          | MAX81_T                                                                     | $T_A = +25^\circ\text{C}$                        | 3.03                 | 3.08 |                       |
|                                                     |          |                                                                             | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | 3.00                 |      |                       |
|                                                     |          | MAX81_S                                                                     | $T_A = +25^\circ\text{C}$                        | 2.88                 | 2.93 |                       |
|                                                     |          |                                                                             | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | 2.85                 |      |                       |
|                                                     |          | MAX81_R                                                                     | $T_A = +25^\circ\text{C}$                        | 2.58                 | 2.63 |                       |
|                                                     |          |                                                                             | $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ | 2.55                 |      |                       |
| Reset Threshold Tempco                              |          |                                                                             |                                                  | 30                   |      | ppm/ $^\circ\text{C}$ |
| $V_{CC}$ to Reset Delay (Note 2)                    |          | $V_{OD} = 125$ mV, MAX81_L/M                                                |                                                  | 40                   |      | $\mu\text{s}$         |
|                                                     |          | $V_{OD} = 125$ mV, MAX81_R/S/T                                              |                                                  | 20                   |      |                       |
| Reset Active Timeout Period                         | $t_{RP}$ | $V_{CC} = V_{TH}(\text{MAX})$                                               | 140                                              |                      | 560  | ms                    |
| $\overline{MR}$ Minimum Pulse Width                 | $t_{MR}$ |                                                                             | 10                                               |                      |      | $\mu\text{s}$         |
| $\overline{MR}$ Glitch Immunity (Note 3)            |          |                                                                             |                                                  | 100                  |      | ns                    |
| $\overline{MR}$ to Reset Propagation Delay (Note 2) | $t_{MD}$ |                                                                             |                                                  | 0.5                  |      | $\mu\text{s}$         |
| $\overline{MR}$ Input Threshold                     | $V_{IH}$ | $V_{CC} > V_{TH}(\text{MAX})$ , MAX81_L/M                                   | 2.3                                              |                      |      | V                     |
|                                                     | $V_{IL}$ |                                                                             |                                                  | 0.8                  |      |                       |
|                                                     | $V_{IH}$ | $V_{CC} > V_{TH}(\text{MAX})$ , MAX81_R/S/T                                 | $0.7 \times V_{CC}$                              |                      |      |                       |
|                                                     | $V_{IL}$ |                                                                             |                                                  | $0.25 \times V_{CC}$ |      |                       |
| $\overline{MR}$ Pull-Up Resistance                  |          |                                                                             | 10                                               | 20                   | 30   | k $\Omega$            |
| RESET Output Voltage (MAX812)                       | $V_{OH}$ | $I_{SOURCE} = 150\mu\text{A}$ , $1.8\text{V} < V_{CC} < V_{TH}(\text{MIN})$ | $0.8 \times V_{CC}$                              |                      |      | V                     |
|                                                     | $V_{OL}$ | MAX812R/S/T only, $I_{SINK} = 1.2$ mA, $V_{CC} = V_{TH}(\text{MAX})$        | 0.3                                              |                      |      |                       |
|                                                     |          | MAX812L/M only, $I_{SINK} = 3.2$ mA, $V_{CC} = V_{TH}(\text{MAX})$          | 0.4                                              |                      |      |                       |

**Electrical Characteristics (continued)**

( $V_{CC} = 5V$  for L/M versions,  $V_{CC} = 3.3V$  for T/S versions,  $V_{CC} = 3V$  for R version,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted.)

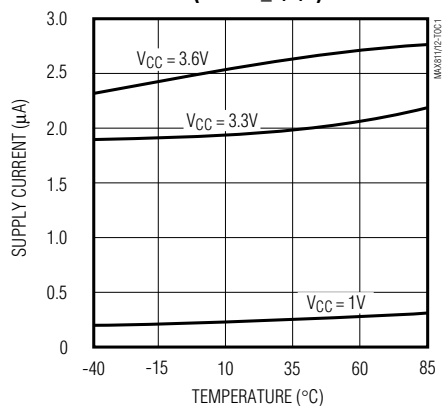
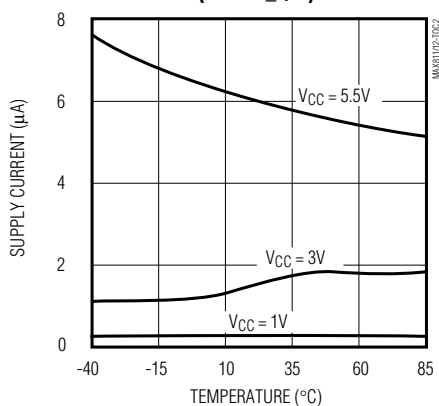
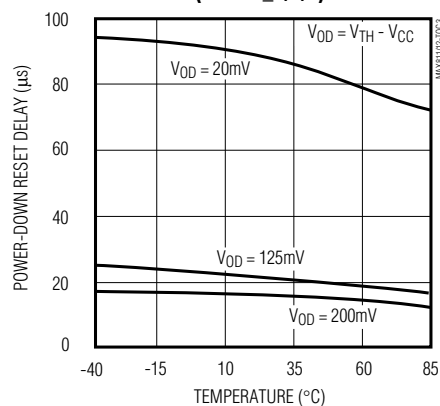
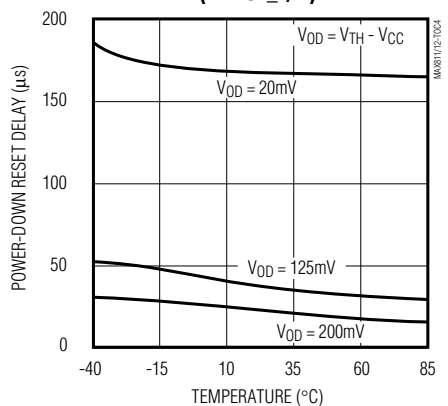
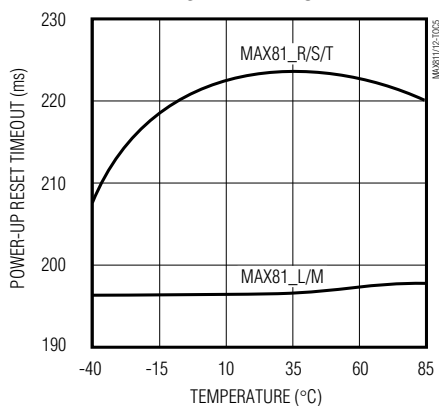
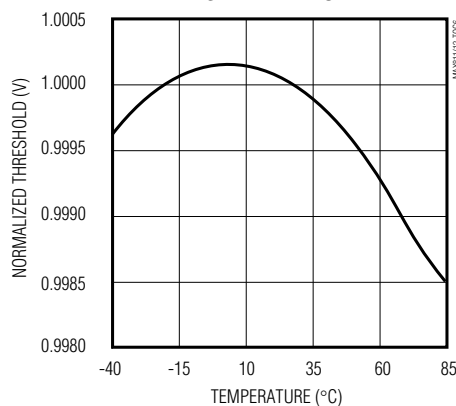
| PARAMETER                                     | SYMBOL   | CONDITIONS                                                            | MIN                 | TYP | MAX | UNITS |
|-----------------------------------------------|----------|-----------------------------------------------------------------------|---------------------|-----|-----|-------|
| $\overline{RESET}$ Output Voltage<br>(MAX811) | $V_{OL}$ | MAX811R/S/T only, $I_{SINK} = 1.2mA$ ,<br>$V_{CC} = V_{TH(MIN)}$      |                     |     | 0.3 | V     |
|                                               |          | MAX811L/M only, $I_{SINK} = 3.2mA$ ,<br>$V_{CC} = V_{TH(MIN)}$        |                     |     | 0.4 |       |
|                                               |          | $I_{SINK} = 50\mu A$ , $V_{CC} > 1.0V$                                |                     |     | 0.3 |       |
|                                               | $V_{OH}$ | MAX811R/S/T only, $I_{SOURCE} = 500\mu A$ ,<br>$V_{CC} > V_{TH(MAX)}$ | $0.8 \times V_{CC}$ |     |     |       |
|                                               |          | MAX811L/M only, $I_{SOURCE} = 800\mu A$ ,<br>$V_{CC} > V_{TH(MAX)}$   | $V_{CC} - 1.5$      |     |     |       |

**Note 1:** Production testing done at  $T_A = +25^{\circ}C$ , over temperature limits guaranteed by design using six sigma design limits.

**Note 2:**  $\overline{RESET}$  output for MAX811, RESET output for MAX812.

**Note 3:** "Glitches" of 100ns or less typically will not generate a reset pulse.

## Typical Operating Characteristics

(T<sub>A</sub> = +25°C, unless otherwise noted.)**SUPPLY CURRENT vs. TEMPERATURE  
(MAX81\_R/S/T)****SUPPLY CURRENT vs. TEMPERATURE  
(MAX81\_L/M)****POWER-DOWN RESET DELAY vs. TEMPERATURE  
(MAX81\_R/S/T)****POWER-DOWN RESET DELAY vs. TEMPERATURE  
(MAX81\_L/M)****POWER-UP RESET TIMEOUT vs. TEMPERATURE****RESET THRESHOLD DEVIATION vs. TEMPERATURE**

## Pin Description

| PIN    |        | NAME                      | FUNCTION                                                                                                                                                                                                                                                                                                                                                                         |
|--------|--------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MAX811 | MAX812 |                           |                                                                                                                                                                                                                                                                                                                                                                                  |
| 1      | 1      | GND                       | Ground                                                                                                                                                                                                                                                                                                                                                                           |
| 2      | —      | $\overline{\text{RESET}}$ | Active-Low Reset Output. $\overline{\text{RESET}}$ remains low while $V_{CC}$ is below the reset threshold or while $\overline{\text{MR}}$ is held low. $\overline{\text{RESET}}$ remains low for the Reset Active Timeout Period ( $t_{RP}$ ) after the reset conditions are terminated.                                                                                        |
| —      | 2      | RESET                     | Active-High Reset Output. RESET remains high while $V_{CC}$ is below the reset threshold or while $\overline{\text{MR}}$ is held low. RESET remains high for Reset Active Timeout Period ( $t_{RP}$ ) after the reset conditions are terminated.                                                                                                                                 |
| 3      | 3      | $\overline{\text{MR}}$    | Manual Reset Input. A logic low on $\overline{\text{MR}}$ asserts reset. Reset remains asserted as long as $\overline{\text{MR}}$ is low and for 180ms after $\overline{\text{MR}}$ returns high. This active-low input has an internal 20k $\Omega$ pull-up resistor. It can be driven from a TTL or CMOS-logic line, or shorted to ground with a switch. Leave open if unused. |
| 4      | 4      | $V_{CC}$                  | +5V, +3.3V, or +3V Supply Voltage                                                                                                                                                                                                                                                                                                                                                |

## Detailed Description

### Reset Output

A microprocessor's ( $\mu$ P's) reset input starts the  $\mu$ P in a known state. These  $\mu$ P supervisory circuits assert reset to prevent code execution errors during power-up, power-down, or brownout conditions.

$\overline{\text{RESET}}$  is guaranteed to be a logic low for  $V_{CC} > 1V$ . Once  $V_{CC}$  exceeds the reset threshold, an internal timer keeps  $\overline{\text{RESET}}$  low for the reset timeout period; after this interval,  $\overline{\text{RESET}}$  goes high.

If a brownout condition occurs ( $V_{CC}$  dips below the reset threshold),  $\overline{\text{RESET}}$  goes low. Any time  $V_{CC}$  goes below the reset threshold, the internal timer resets to zero, and  $\overline{\text{RESET}}$  goes low. The internal timer starts after  $V_{CC}$  returns above the reset threshold, and  $\overline{\text{RESET}}$  remains low for the reset timeout period.

The manual reset input ( $\overline{\text{MR}}$ ) can also initiate a reset. See the *Manual Reset Input* section.

The MAX812 has an active-high RESET output that is the inverse of the MAX811's  $\overline{\text{RESET}}$  output.

### Manual Reset Input

Many  $\mu$ P-based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. A logic low on  $\overline{\text{MR}}$  asserts reset. Reset remains asserted while  $\overline{\text{MR}}$  is low, and for the Reset Active Timeout Period ( $t_{RP}$ ) after  $\overline{\text{MR}}$  returns high. This input has an internal 20k $\Omega$  pull-up resistor, so it can be left open if it is not used.  $\overline{\text{MR}}$  can be driven with TTL or CMOS-logic levels, or with open-drain/collector outputs. Connect a normally open momentary switch from  $\overline{\text{MR}}$  to GND to create a manual-reset function; external debounce circuitry is not required. If  $\overline{\text{MR}}$  is driven from long cables or if the device is used in a noisy environment, connecting a 0.1 $\mu$ F capacitor from  $\overline{\text{MR}}$  to ground provides additional noise immunity.

### Reset Threshold Accuracy

The MAX811/MAX812 are ideal for systems using a 5V  $\pm 5\%$  or 3V  $\pm 5\%$  power supply with ICs specified for 5V  $\pm 10\%$  or 3V  $\pm 10\%$ , respectively. They are designed to meet worst-case specifications over temperature. The reset is guaranteed to assert after the power supply falls out of regulation, but before power drops below the minimum specified operating voltage range for the system ICs. The thresholds are pre-trimmed and exhibit tight distribution, reducing the range over which an undesirable reset may occur.

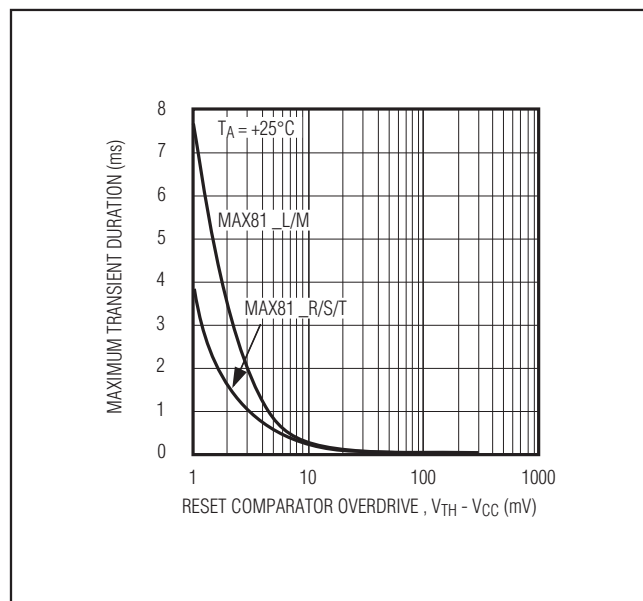


Figure 1. Maximum Transient Duration without Causing a Reset Pulse vs. Comparator Overdrive

## Applications Information

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

In addition to issuing a reset to the  $\mu$ P during power-up, power-down, and brownout conditions, the MAX811/MAX812 are relatively immune to short duration negative-going  $V_{CC}$  transients (glitches).

Figure 1 shows typical transient durations vs. reset comparator overdrive, for which the MAX811/MAX812 do not generate a reset pulse. This graph was generated using 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. Typically, a  $V_{CC}$  transient that goes 125mV below the reset threshold and lasts 40 $\mu$ s or less (MAX811\_L/M) or 20 $\mu$ s or less (MAX811\_T/S/R) will not cause a reset pulse to be issued. A 0.1 $\mu$ F capacitor mounted as close as possible to  $V_{CC}$  provides additional transient immunity.

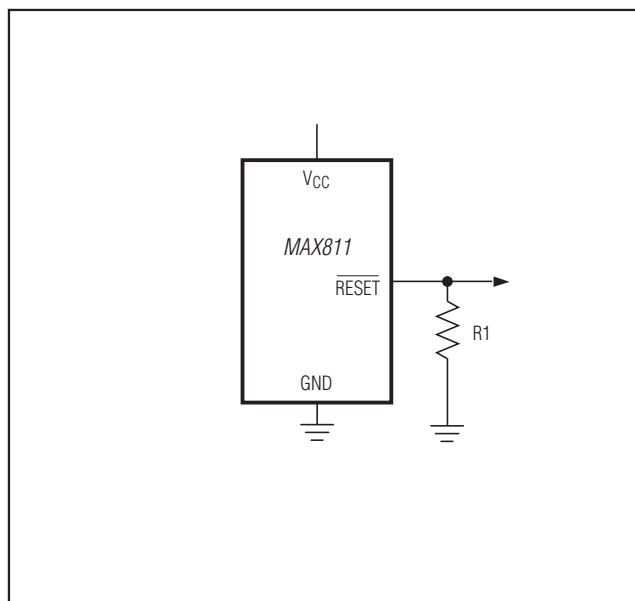


Figure 2.  $\overline{\text{RESET}}$  Valid to  $V_{CC} = \text{Ground}$  Circuit

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

When  $V_{CC}$  falls below 1V, the MAX811  $\overline{\text{RESET}}$  output no longer sinks current—it becomes an open circuit. Therefore, high-impedance CMOS-logic inputs connected to the  $\overline{\text{RESET}}$  output can drift to undetermined voltages. This presents no problem in most applications, since most  $\mu$ P and other circuitry is inoperative with  $V_{CC}$  below 1V. However, in applications where the  $\overline{\text{RESET}}$  output must be valid down to 0V, adding a pull-down resistor to the  $\overline{\text{RESET}}$  pin will cause any stray leakage currents to flow to ground, holding  $\overline{\text{RESET}}$  low (Figure 2). R1's value is not critical; 100k $\Omega$  is large enough not to load RESET and small enough to pull RESET to ground.

A 100k $\Omega$  pull-up resistor to  $V_{CC}$  is also recommended for the MAX812 if RESET is required to remain valid for  $V_{CC} < 1\text{V}$ .

**Interfacing to  $\mu$ Ps with  
Bidirectional Reset Pins**

$\mu$ Ps with bidirectional reset pins (such as the Motorola 68HC11 series) can contend with the MAX811/MAX812 reset outputs. If, for example, the MAX811  $\overline{\text{RESET}}$  output is asserted high and the  $\mu$ P wants to pull it low, indeterminate logic levels may result. To correct such cases, connect a  $4.7\text{k}\Omega$  resistor between the MAX811  $\overline{\text{RESET}}$  (or MAX812  $\overline{\text{RESET}}$ ) output and the  $\mu$ P reset I/O (Figure 3). Buffer the reset output to other system components.

**Chip Information**

TRANSISTOR COUNT: 341

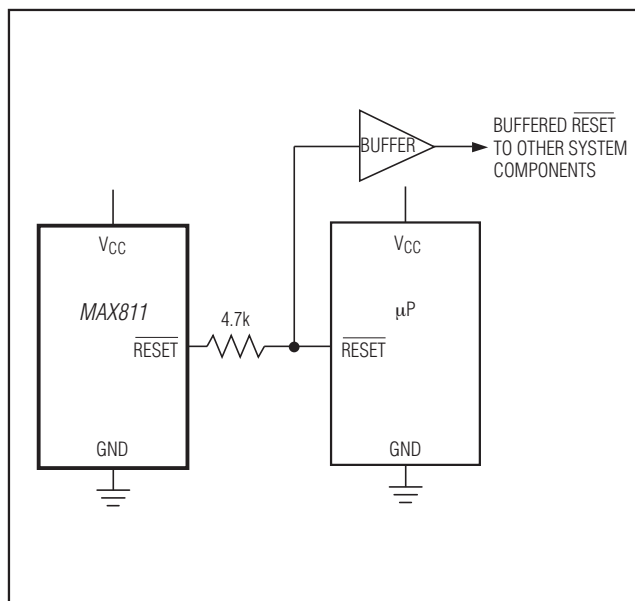
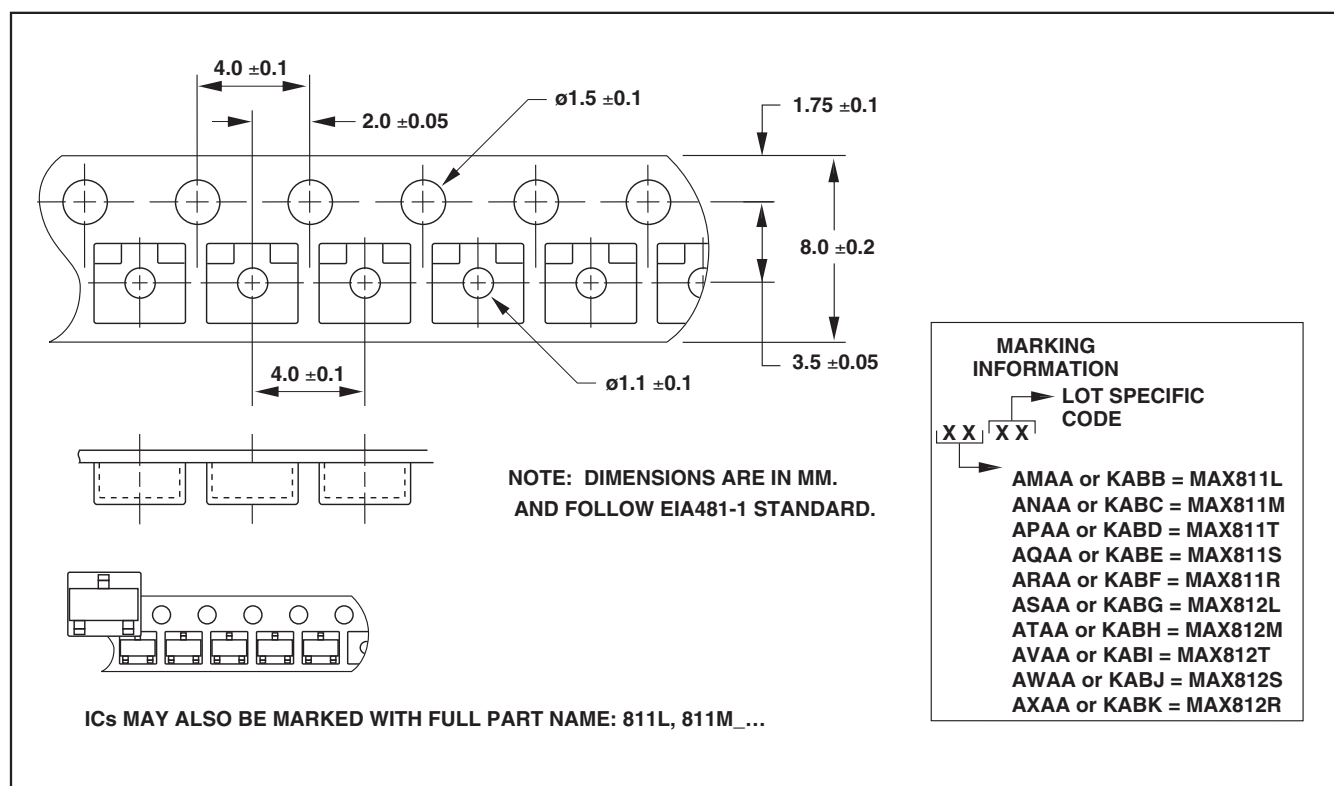


Figure 3. Interfacing to  $\mu$ Ps with Bidirectional Reset I/O

## Package Information

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.

| PACKAGE TYPE | PACKAGE CODE | OUTLINE NO.             | LAND PATTERN NO.        |
|--------------|--------------|-------------------------|-------------------------|
| 4 SOT143     | U4+1         | <a href="#">21-0052</a> | <a href="#">90-0183</a> |



## Revision History

| REVISION<br>NUMBER | REVISION<br>DATE | DESCRIPTION                                                                  | PAGES<br>CHANGED |
|--------------------|------------------|------------------------------------------------------------------------------|------------------|
| 3                  | 6/15             | Updated <i>Benefits and Features</i> and <i>Package Information</i> sections | 1, 8             |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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