



# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## General Description

The MAX6467/MAX6468 microprocessor ( $\mu$ P) supervisory circuits monitor single power-supply voltages from +1.8V to +5.0V and assert a reset if the supply voltage drops below its preset threshold. An edge-triggered, one-shot manual reset function ensures that the  $\mu$ P enters the reset mode for a fixed timeout period only, even in the event of a continuously asserted manual reset. The MAX6467/MAX6468 significantly improve system reliability compared to traditional manual reset supervisory circuits.

A variety of factory-trimmed threshold options accommodate different supply voltages and tolerances, eliminating external components. The factory-set thresholds range from +1.575V to +4.625V to monitor +5.0V, +3.3V, +3.0V, +2.5V, and +1.8V supplies with various tolerances. Reset timeout periods of 150ms (min) and 1200ms (min) are available to accommodate different  $\mu$ P platforms.

A single, active-low  $\overline{\text{RESET}}$  output asserts when  $V_{CC}$  drops below its threshold or if the edge-triggered MR asserts low.  $\overline{\text{RESET}}$  remains low for the reset timeout period after  $V_{CC}$  rises above its threshold and for a fixed, one-shot timeout period after a manual reset input falling edge.  $\overline{\text{RESET}}$  remains valid as long as  $V_{CC}$  remains above +1V. Open-drain (MAX6467) and push-pull (MAX6468) output options provide additional flexibility in the system design.

The MAX6467/MAX6468 are offered in the space-saving 4-pin SOT143 package and the ultra-small 4-pin SC70 package and are specified over the automotive (-40°C to +125°C) temperature range.

## Applications

Cell Phones/PDAs  
Embedded Control Systems  
Industrial Equipment  
Automotive Products  
Portable/Battery-Powered Equipment  
Medical Devices  
DSL Modems  
MP3 Players  
GPS Systems  
Digital Cameras

Typical Operating Circuit appears at end of data sheet.

## Features

- ◆ Precision Factory-Set Reset Threshold Voltages for +5.0V, +3.3V, +3.0V, +2.5V, and +1.8V Supplies
- ◆ Edge-Triggered Manual Reset Input with One-Shot Pulsed Reset Output
- ◆ Two Reset Timeout Period Options (150ms or 1200ms min)
- ◆ Immune to Short Voltage Transients
- ◆ Low Supply Current (3 $\mu$ A at  $V_{CC}$  = +1.8V)
- ◆  $\overline{\text{RESET}}$  Valid to  $V_{CC}$  = +1V
- ◆ Active-Low Open-Drain and Push-Pull  $\overline{\text{RESET}}$  Output Options
- ◆ -40°C to +125°C Operating Temperature Range
- ◆ Small 4-Pin SC70 and SOT143 Packages
- ◆ No External Components Required
- ◆ Pin Compatible with MAX811, MAX6315, MAX6384, and MAX6386

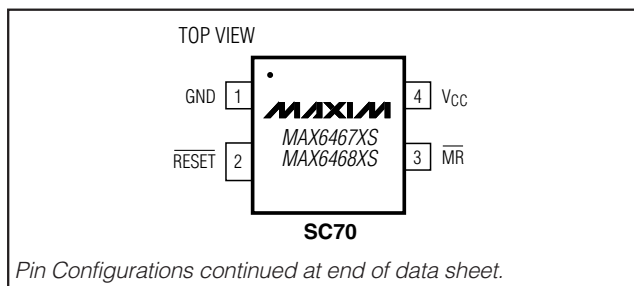
## Ordering Information

| PART            | TEMP RANGE      | PIN-PACKAGE |
|-----------------|-----------------|-------------|
| MAX6467XS__D_-T | -40°C to +125°C | 4 SC70-4    |
| MAX6467US__D_-T | -40°C to +125°C | 4 SOT143-4  |
| MAX6468XS__D_-T | -40°C to +125°C | 4 SC70-4    |
| MAX6468US__D_-T | -40°C to +125°C | 4 SOT143-4  |

**Note:** Insert reset threshold suffix (see Reset Threshold table) after XS or US. 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.

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

## Pin Configurations



# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## ABSOLUTE MAXIMUM RATINGS

|                                       |                                   |
|---------------------------------------|-----------------------------------|
| V <sub>CC</sub> to GND .....          | -0.3V to +6.0V                    |
| RESET to GND .....                    |                                   |
| Open-Drain .....                      | -0.3V to +6.0V                    |
| Push-Pull .....                       | -0.3V to (V <sub>CC</sub> + 0.3V) |
| MR to GND .....                       | -0.3V to (V <sub>CC</sub> + 0.3V) |
| Input/Output Current (all pins) ..... | 20mA                              |

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                 |
| 4-Pin SC70 (derate 3.1mW/°C above +70°C) .....        | 245mW           |
| 4-Pin SOT143 (derate 4mW/°C above +70°C) .....        | 320mW           |
| Operating Temperature Range .....                     | -40°C to +125°C |
| Storage Temperature Range .....                       | -65°C to +150°C |
| Junction Temperature .....                            | +150°C          |
| Lead Temperature (soldering, 10s) .....               | +300°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<sub>CC</sub> = +1.2V to +5.5V, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. 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>  | T <sub>A</sub> = 0°C to +125°C                                                               | 1.0                   |                 | 5.5   | V     |
|                                                                    |                  | T <sub>A</sub> = -40°C to 0°C                                                                | 1.2                   |                 | 5.5   |       |
| Supply Current                                                     | I <sub>CC</sub>  | V <sub>CC</sub> = +5.5V, no load                                                             |                       | 7               | 13    | μA    |
|                                                                    |                  | V <sub>CC</sub> = +3.6V, no load                                                             |                       | 6               | 11    |       |
|                                                                    |                  | V <sub>CC</sub> = +2.5V, no load                                                             |                       | 4               | 8     |       |
|                                                                    |                  | V <sub>CC</sub> = +1.8V, no load                                                             |                       | 3               | 7.5   |       |
| V <sub>CC</sub> Reset Threshold<br>(See the Reset Threshold Table) | V <sub>TH</sub>  | T <sub>A</sub> = +25°C                                                                       | -1.5%                 | V <sub>TH</sub> | +1.5% | V     |
|                                                                    |                  | T <sub>A</sub> = -40°C to +85°C                                                              | -2.5%                 |                 | +2.5% |       |
|                                                                    |                  | T <sub>A</sub> = +85°C to +125°C                                                             | -3%                   |                 | +3%   |       |
| V <sub>CC</sub> Reset Delay                                        | t <sub>RD</sub>  | V <sub>CC</sub> falling at 10mV/μs from V <sub>TH</sub> + 100mV to V <sub>TH</sub> - 100mV   |                       | 35              |       | μs    |
| V <sub>CC</sub> Reset Timeout Period                               | t <sub>RP</sub>  | D3 option                                                                                    | 150                   | 225             | 300   | ms    |
|                                                                    |                  | D7 option                                                                                    | 1200                  | 1800            | 2400  |       |
| $\overline{\text{MR}}$ Timeout Period                              | t <sub>MRP</sub> | D3 and D7 options                                                                            | 150                   | 225             | 300   | ms    |
| $\overline{\text{MR}}$ Rising Debounce Period<br>(Note 2)          | t <sub>DEB</sub> | D3 and D7 options                                                                            | 150                   | 225             | 300   | ms    |
| $\overline{\text{MR}}$ 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                   |                 |       |       |
| $\overline{\text{MR}}$ Minimum Input Pulse                         |                  |                                                                                              | 1                     |                 |       | μs    |
| $\overline{\text{MR}}$ Glitch Rejection                            |                  |                                                                                              |                       | 100             |       | ns    |
| $\overline{\text{MR}}$ to $\overline{\text{RESET}}$ Delay          |                  |                                                                                              |                       | 200             |       | ns    |
| $\overline{\text{MR}}$ Pullup Resistance                           |                  | $\overline{\text{MR}}$ to V <sub>CC</sub>                                                    | 750                   | 1500            | 2250  | Ω     |
| $\overline{\text{RESET}}$ Output High<br>(MAX6468 Only)            | V <sub>OH</sub>  | V <sub>CC</sub> ≥ +2.5V, I <sub>SOURCE</sub> = 500μA, $\overline{\text{RESET}}$ not asserted | 0.8 x V <sub>CC</sub> |                 |       | V     |
|                                                                    |                  | V <sub>CC</sub> ≥ +4.5V, I <sub>SOURCE</sub> = 800μA, $\overline{\text{RESET}}$ not asserted | 0.8 x V <sub>CC</sub> |                 |       |       |

# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC} = +1.2V$  to  $+5.5V$ ,  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 1)

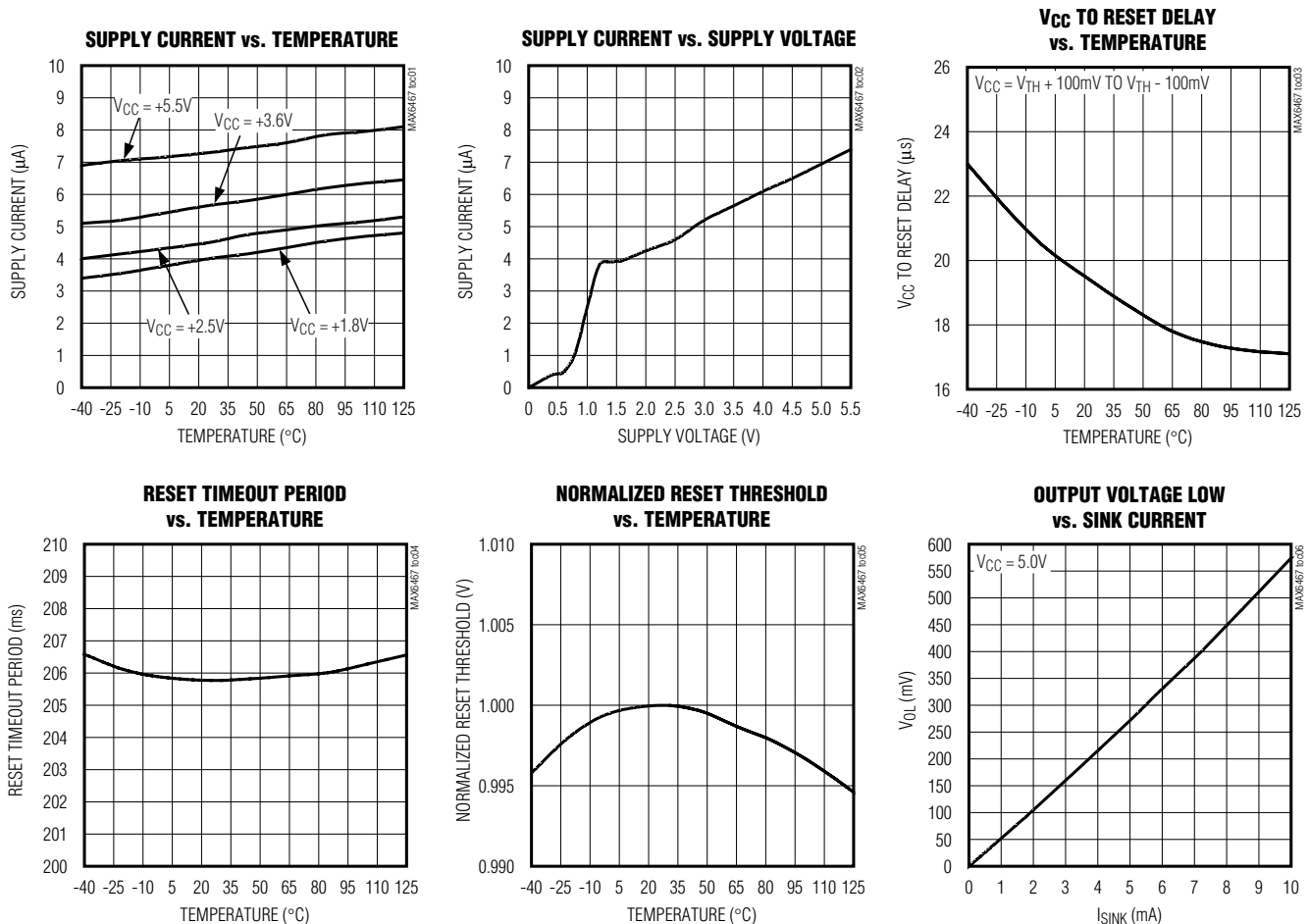
| PARAMETER                                                | SYMBOL    | CONDITIONS                                                             | MIN | TYP | MAX | UNITS   |
|----------------------------------------------------------|-----------|------------------------------------------------------------------------|-----|-----|-----|---------|
| $\overline{RESET}$ Output Low                            | $V_{OL}$  | $V_{CC} \geq +1V$ , $I_{SINK} = 80\mu A$ , $\overline{RESET}$ asserted |     |     | 0.3 | V       |
|                                                          |           | $V_{CC} \geq +2.5V$ , $I_{SINK} = 1.2mA$ , $\overline{RESET}$ asserted |     |     | 0.3 |         |
|                                                          |           | $V_{CC} \geq +4.5V$ , $I_{SINK} = 3.2mA$ , $\overline{RESET}$ asserted |     |     | 0.3 |         |
| $\overline{RESET}$ Output Leakage Current (MAX6467 Only) | $I_{LKG}$ | $\overline{RESET}$ not asserted                                        |     |     | 1   | $\mu A$ |

**Note 1:** Specifications over temperature are guaranteed by design. Production testing at  $T_A = +25^{\circ}C$  only.

**Note 2:** The  $\overline{MR}$  input ignores falling edges that occur within the  $\overline{MR}$  rising debounce period ( $t_{DEB}$ ) after  $\overline{MR}$  first rises from low to high (after a valid  $\overline{MR}$  reset assertion). This prevents invalid reset assertion due to switch bounce.

## Typical Operating Characteristics

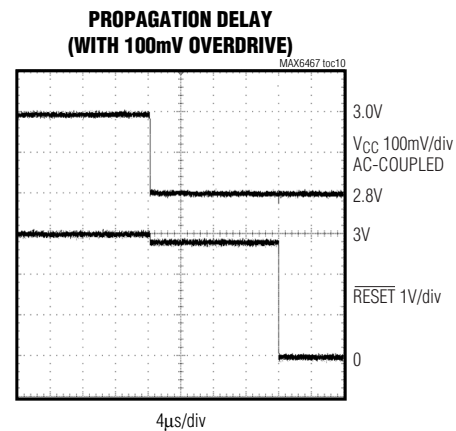
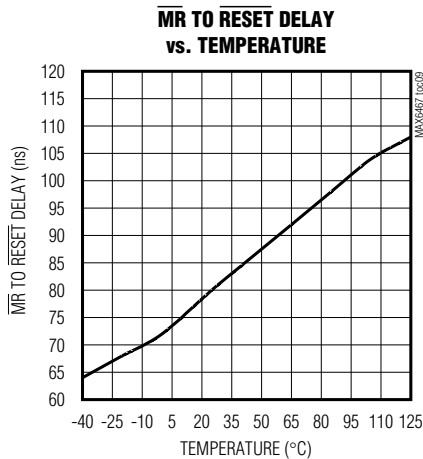
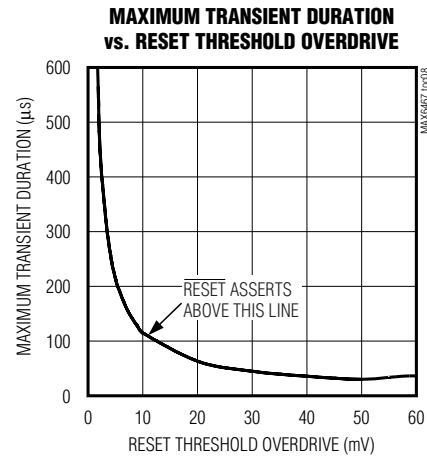
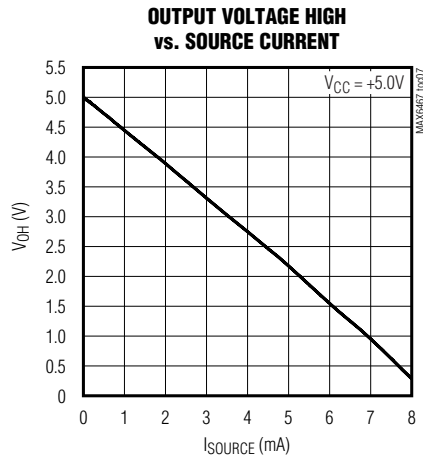
( $V_{CC} = +5V$ , MAX6468US29D3 device,  $T_A = +25^{\circ}C$ , unless otherwise noted.)



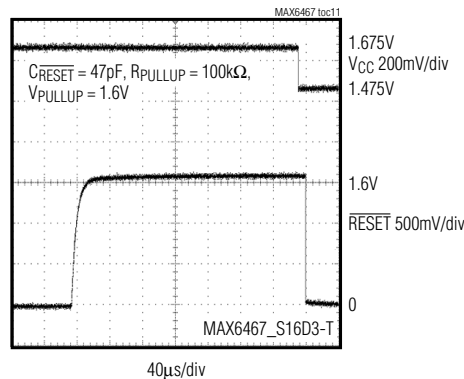
# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## Typical Operating Characteristics (continued)

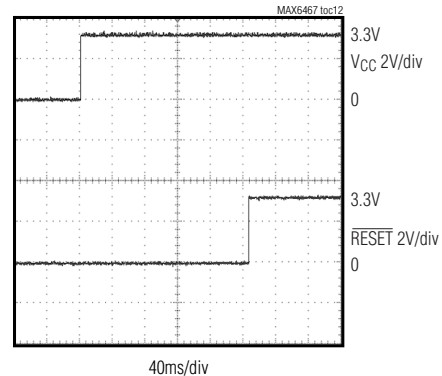
( $V_{CC} = +5V$ , MAX6468US29D3 device,  $T_A = +25^\circ C$ , unless otherwise noted.)



### RESET PULLUP AND PULLDOWN RESPONSE



### RESET TIMEOUT PERIOD



# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## Pin Description

| PIN | NAME                      | FUNCTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | GND                       | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 2   | $\overline{\text{RESET}}$ | Reset Output. $\overline{\text{RESET}}$ is an active-low open-drain (MAX6467) or push-pull (MAX6468) output. $\overline{\text{RESET}}$ asserts low when $V_{CC}$ drops below the selected threshold and remains low for the $V_{CC}$ reset timeout period after $V_{CC}$ rises above the threshold. The $\overline{\text{RESET}}$ one-shot asserts low for a fixed $\overline{\text{MR}}$ reset timeout period on the falling edge of the manual reset input. The open-drain output requires an external pullup resistor. |
| 3   | $\overline{\text{MR}}$    | Manual Reset Input. Drive $\overline{\text{MR}}$ low to initiate a reset output. $\overline{\text{MR}}$ controls an edge-triggered one-shot that asserts $\overline{\text{RESET}}$ low for a fixed $\overline{\text{MR}}$ timeout period when $\overline{\text{MR}}$ is driven low. Internal timing circuitry ignores switch close and open bounce to ensure proper one-shot reset timing.                                                                                                                                |
| 4   | $V_{CC}$                  | Power-Supply Input. $V_{CC}$ provides power to the device and is also a monitored voltage. When $V_{CC}$ drops below the selected threshold, $\overline{\text{RESET}}$ asserts low and remains low for the reset timeout period after $V_{CC}$ rises above the threshold. For better noise immunity, bypass $V_{CC}$ to GND with a 0.1 $\mu\text{F}$ capacitor.                                                                                                                                                           |

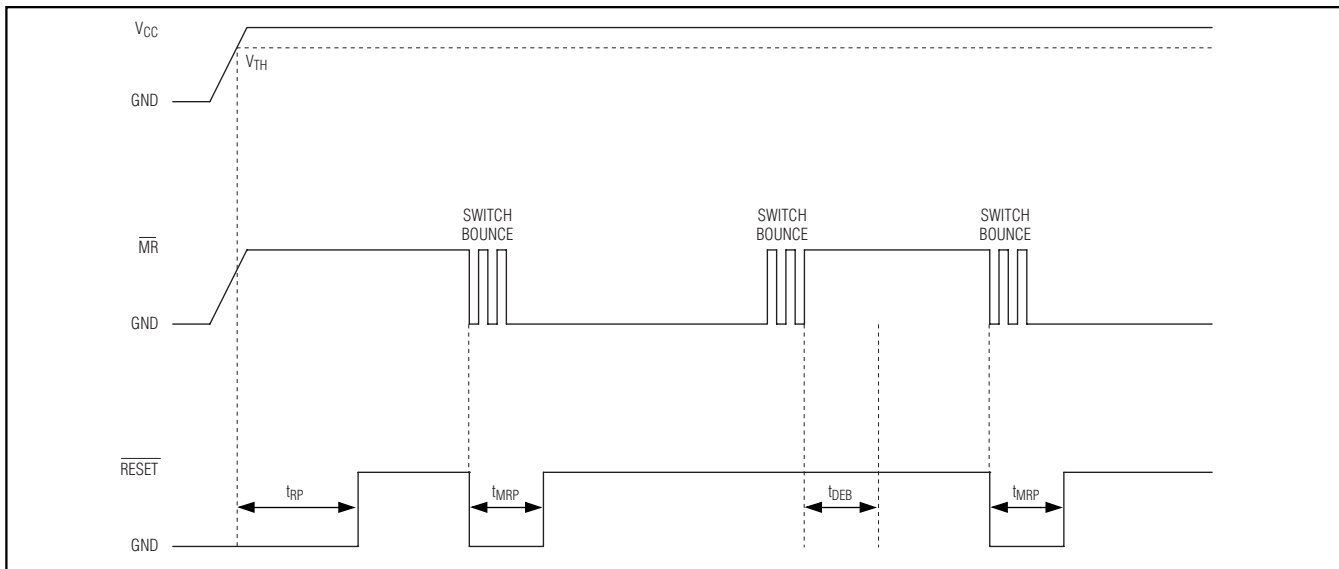


Figure 1. Timing Diagram

## Detailed Description

### Reset Output

The MAX6467 provides an active-low open-drain  $\overline{\text{RESET}}$  output. The MAX6468 provides an active-low push-pull  $\overline{\text{RESET}}$  output.  $\overline{\text{RESET}}$  asserts low if  $V_{CC}$  drops below the selected threshold or if a falling edge occurs on  $\overline{\text{MR}}$ .  $\overline{\text{RESET}}$  remains low for the  $V_{CC}$  reset timeout period after  $V_{CC}$  increases above the threshold voltage or is one-shot pulsed low for the  $\overline{\text{MR}}$  timeout period after a falling edge on  $\overline{\text{MR}}$ .

### Manual Reset Input

Many  $\mu\text{P}$ -based products require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. A falling edge on  $\overline{\text{MR}}$  asserts

$\overline{\text{RESET}}$  low.  $\overline{\text{RESET}}$  is one-shot pulsed low for the  $\overline{\text{MR}}$  timeout period after a falling edge on  $\overline{\text{MR}}$ . An internal 1.5k $\Omega$  pullup resistor to  $V_{CC}$  allows  $\overline{\text{MR}}$  to be left unconnected if 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 pushbutton switch from  $\overline{\text{MR}}$  to GND to realize a manual reset function. External debounce circuitry is not required, as the MAX6467/MAX6468 respond to the first falling edge on  $\overline{\text{MR}}$  and ignore subsequent falling edges within the reset timeout period and during the  $\overline{\text{MR}}$  debounce period (see Figure 1). After  $\overline{\text{MR}}$  goes high for 150ms ( $t_{DEB}$ ), the manual reset one-shot is ready to trigger a reset on the next  $\overline{\text{MR}}$  falling edge. Connect a 0.1 $\mu\text{F}$  capacitor from  $\overline{\text{MR}}$  to GND when using long cables to provide additional noise immunity (Figure 2).

# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## Reset Timeout Delay\*

| RESET TIMEOUT SUFFIX | V <sub>CC</sub> RESET TIMEOUT PERIOD (min/max) (ms) | $\overline{\text{MR}}$ TIMEOUT PERIOD (min/max) (ms) | $\overline{\text{MR}}$ RISING DEBOUNCE PERIOD (min/max) (ms) |
|----------------------|-----------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------|
| D3                   | 150/300                                             | 150/300                                              | 150/300                                                      |
| D7                   | 1200/2400                                           | 150/300                                              | 150/300                                                      |

\*Additional reset timeout options may be available. Contact factory for availability.

## Applications Information

### Falling V<sub>CC</sub> Transients

In addition to issuing a reset to the  $\mu\text{P}$  during power-up, power-down, and brownout conditions, the MAX6467/MAX6468 are relatively immune to short-duration falling V<sub>CC</sub> transients (glitches). The *Typical Operating Characteristics* section shows the Maximum Transient Duration vs. V<sub>CC</sub> Overdrive for which the MAX6467/MAX6468 do not generate a reset pulse. This graph was generated using a falling pulse applied to V<sub>CC</sub> starting above the actual reset threshold and ending below the threshold by the magnitude indicated (V<sub>CC</sub> Overdrive). The graph indicates the typical maximum pulse width a falling V<sub>CC</sub> transient can have without initiating a reset pulse. As the magnitude of the transient increases (goes

farther below the reset threshold), the maximum allowable pulse width decreases. A 0.1 $\mu\text{F}$  bypass capacitor from V<sub>CC</sub> to GND provides additional transient immunity.

### Ensuring a Valid RESET Output Down to V<sub>CC</sub> = 0V

The MAX6467/MAX6468 guarantee proper operation down to V<sub>CC</sub> = +1V. In applications that require valid reset levels down to V<sub>CC</sub> = 0V, a pulldown resistor to active-low outputs (MAX6468 only, Figure 3) ensures that  $\overline{\text{RESET}}$  remains valid while the  $\overline{\text{RESET}}$  output can no longer sink current. This scheme does not work with the open-drain outputs of the MAX6467. Ensure that the resistor value used does not overload the  $\overline{\text{RESET}}$  output when V<sub>CC</sub> is above the reset threshold. For most applications, use 100k $\Omega$  to 1M $\Omega$ .

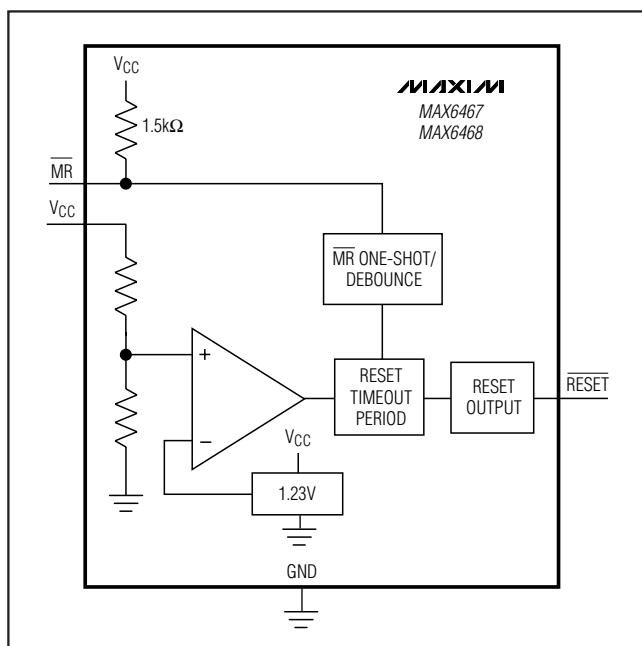


Figure 2. Functional Diagram

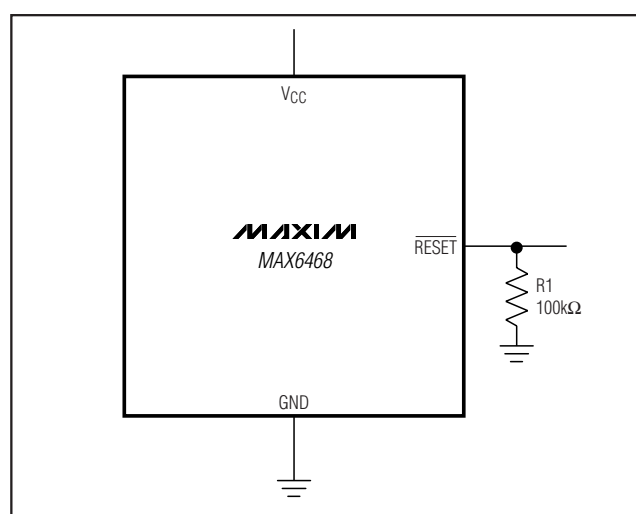


Figure 3.  $\overline{\text{RESET}}$  Valid to V<sub>CC</sub> = 0V

## Chip Information

TRANSISTOR COUNT: 748

PROCESS: BiCMOS

# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

MAX6467/MAX6468

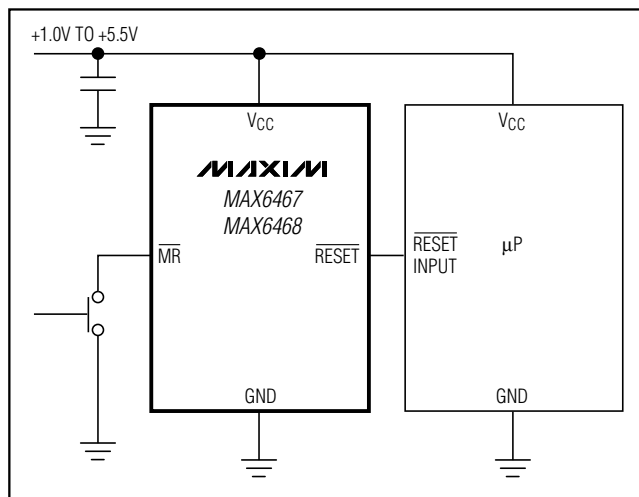
## Standard Versions

| PART          | TOP MARK |
|---------------|----------|
| MAX6467XS16D3 | AGL      |
| MAX6467XS22D3 | AGM      |
| MAX6467XS26D3 | AGN      |
| MAX6467XS29D3 | AGO      |
| MAX6467XS46D3 | AGP      |
| MAX6467US16D3 | KAFN     |
| MAX6467US22D3 | KAFO     |
| MAX6467US26D3 | KAFP     |
| MAX6467US29D3 | KAFQ     |
| MAX6467US46D3 | KAFR     |
| MAX6468XS16D3 | AGQ      |
| MAX6468XS22D3 | AGR      |
| MAX6468XS26D3 | AGS      |
| MAX6468XS29D3 | AGC      |
| MAX6468XS46D3 | AGB      |
| MAX6468US16D3 | KAFS     |
| MAX6468US22D3 | KAFT     |
| MAX6468US26D3 | KAFU     |
| MAX6468US29D3 | KAEW     |
| MAX6468US46D3 | KAFV     |

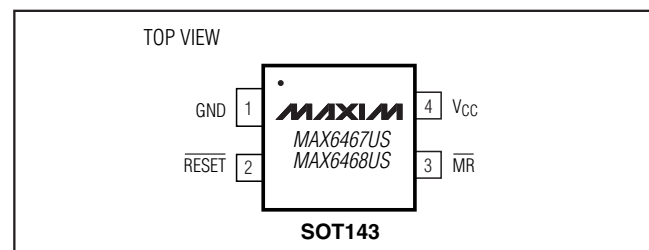
## Reset Threshold (-40°C to +85°C)

| SUFFIX | V <sub>TH</sub> (min) | V <sub>TH</sub> (typ) | V <sub>TH</sub> (max) |
|--------|-----------------------|-----------------------|-----------------------|
| 46     | 4.509                 | 4.625                 | 4.741                 |
| 45     | 4.388                 | 4.500                 | 4.613                 |
| 44     | 4.266                 | 4.375                 | 4.484                 |
| 43     | 4.193                 | 4.300                 | 4.408                 |
| 42     | 4.095                 | 4.200                 | 4.305                 |
| 41     | 3.998                 | 4.100                 | 4.203                 |
| 40     | 3.900                 | 4.000                 | 4.100                 |
| 39     | 3.803                 | 3.900                 | 3.998                 |
| 38     | 3.705                 | 3.800                 | 3.895                 |
| 37     | 3.608                 | 3.700                 | 3.793                 |
| 36     | 3.510                 | 3.600                 | 3.690                 |
| 35     | 3.413                 | 3.500                 | 3.588                 |
| 34     | 3.315                 | 3.400                 | 3.485                 |
| 33     | 3.218                 | 3.300                 | 3.383                 |
| 32     | 3.120                 | 3.200                 | 3.280                 |
| 31     | 2.998                 | 3.075                 | 3.152                 |
| 30     | 2.925                 | 3.000                 | 3.075                 |
| 29     | 2.852                 | 2.925                 | 2.998                 |
| 28     | 2.730                 | 2.800                 | 2.870                 |
| 27     | 2.633                 | 2.700                 | 2.768                 |
| 26     | 2.559                 | 2.625                 | 2.691                 |
| 25     | 2.438                 | 2.500                 | 2.563                 |
| 24     | 2.340                 | 2.400                 | 2.460                 |
| 23     | 2.255                 | 2.313                 | 2.370                 |
| 22     | 2.133                 | 2.188                 | 2.242                 |
| 21     | 2.048                 | 2.100                 | 2.153                 |
| 20     | 1.950                 | 2.000                 | 2.050                 |
| 19     | 1.853                 | 1.900                 | 1.948                 |
| 18     | 1.755                 | 1.800                 | 1.845                 |
| 17     | 1.623                 | 1.665                 | 1.707                 |
| 16     | 1.536                 | 1.575                 | 1.614                 |

## Typical Operating Circuit



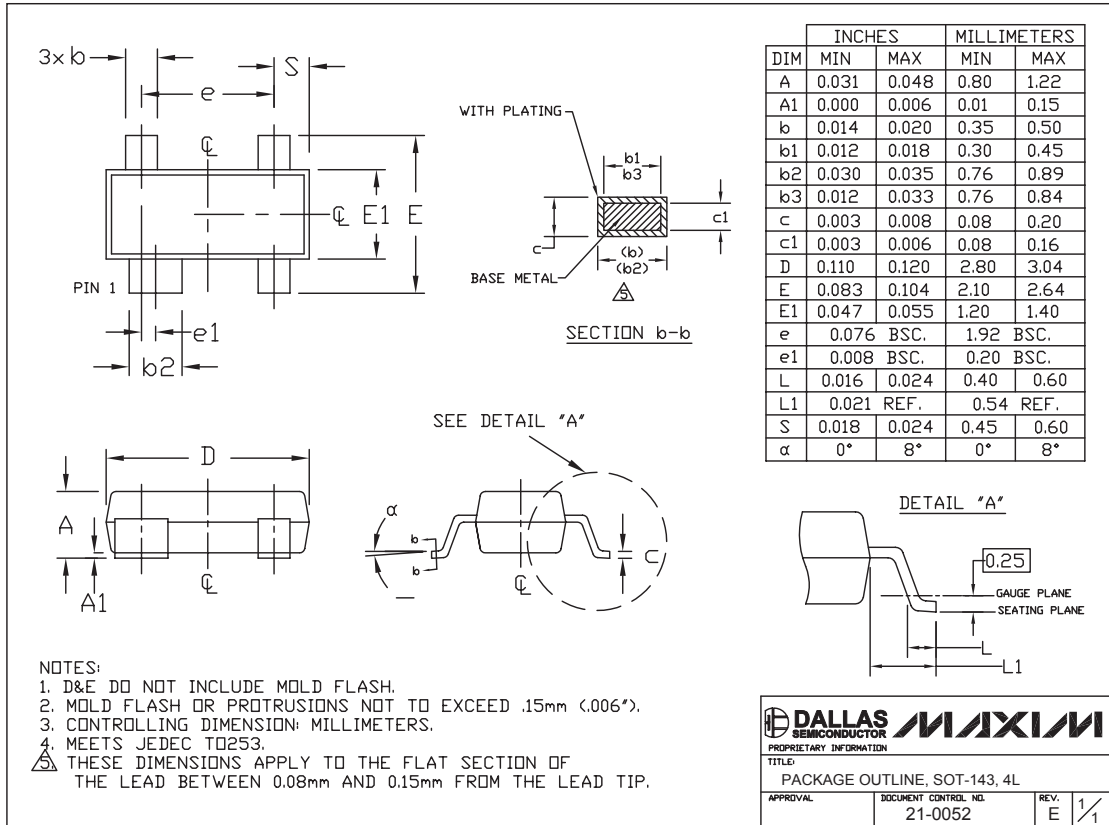
## Pin Configurations (continued)



# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

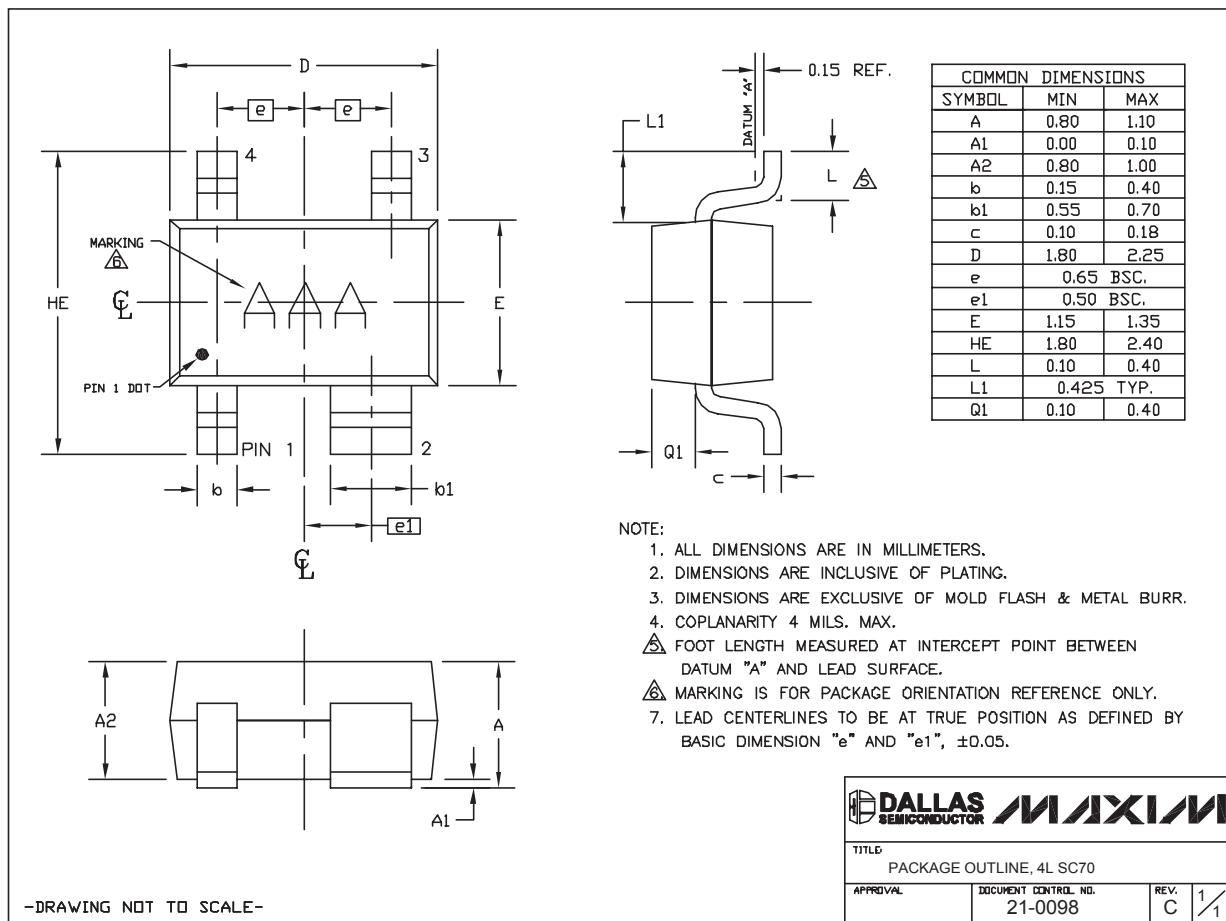


SOT-143 4L-EPS

# Microprocessor Supervisory Reset Circuits with Edge-Triggered, One-Shot Manual Reset

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



SC70, 4LEPS

MAX6467/MAX6468

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