

**MAXIM****6-Pin  $\mu$ P Reset Circuit with Power-Fail Comparator****MAX6342-MAX6345****General Description**

The MAX6342-MAX6345 family of microprocessor ( $\mu$ P) supervisory circuits monitors power supplies in digital systems. These devices significantly improve system reliability and accuracy compared to separate ICs or discrete components.

The MAX6342-MAX6345 provide factory-trimmed V<sub>CC</sub> reset threshold voltages from 2.33V to 4.63V and operate with supply voltages between +1V and +5.5V. A +1.25V threshold detector allows for a power-fail warning, for low-battery detection, or for monitoring another power supply. The MAX6342 contains an  $\overline{MR}$  input and an active-low push-pull reset. The MAX6343 and MAX6344 are identical to the MAX6342 except they provide an active-low, open-drain reset and an active-high, push-pull reset, respectively. The MAX6345 provides a second reset output in place of the  $\overline{MR}$  input to give it an active-high push-pull reset and an active-low push-pull reset.

All of the devices are packaged in a miniature 6-pin SOT23.

**Applications**

Portable Computers  
Telecom Equipment  
Networking Equipment  
Portable/Battery-Powered Equipment  
Multivoltage Systems  
Embedded Control Systems

*Typical Operating Circuit appears at end of data sheet.*

**Selector Guide 1**

| SUFFIX | RESET THRESHOLD (V) |
|--------|---------------------|
| L      | 4.63                |
| M      | 4.38                |
| T      | 3.08                |
| S      | 2.93                |
| R      | 2.63                |
| Z      | 2.33                |

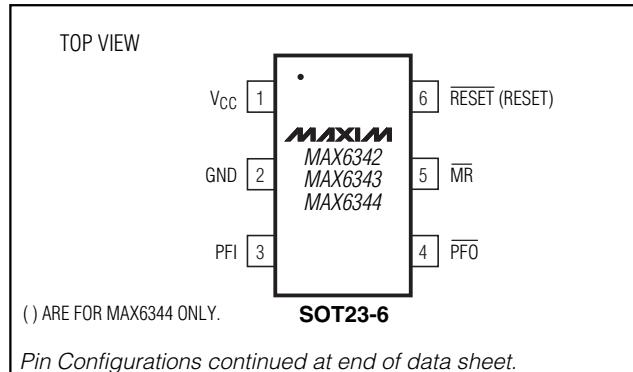
**Features**

- ◆ Small 6-Pin SOT23 Package
- ◆ Precision Factory-Set V<sub>CC</sub> Reset Thresholds Between 2.33V and 4.63V
- ◆ Guaranteed RESET Valid to V<sub>CC</sub> = +1V
- ◆ 100ms min Reset Pulse Width
- ◆ Debounced CMOS-Compatible Manual-Reset Input
- ◆ Voltage Monitor for Power-Fail or Low-Battery Warning

**Ordering Information**

| PART         | TEMP. RANGE     | PIN-PACKAGE |
|--------------|-----------------|-------------|
| MAX6342_UT-T | -40°C to +125°C | 6 SOT23-6   |
| MAX6343_UT-T | -40°C to +125°C | 6 SOT23-6   |
| MAX6344_UT-T | -40°C to +125°C | 6 SOT23-6   |
| MAX6345_UT-T | -40°C to +125°C | 6 SOT23-6   |

**Note:** The MAX6342-MAX6345 are available with factory-set reset thresholds from 2.33V to 4.63V (see Selector Guides 1, 2). Insert the letter corresponding to the desired nominal reset threshold into the blank following the part number. There is a 2500 piece order increment required for the SOT package. SOT Top Marks table appears at end of data sheet.

**Pin Configurations****Selector Guide 2**

| PART    | PUSH-PULL<br>RESET OUTPUT | OPEN-DRAIN<br>RESET OUTPUT | PUSH-PULL RESET<br>OUTPUT | MANUAL-RESET<br>INPUT |
|---------|---------------------------|----------------------------|---------------------------|-----------------------|
| MAX6342 | ✓                         | —                          | —                         | ✓                     |
| MAX6343 | —                         | ✓                          | —                         | ✓                     |
| MAX6344 | —                         | —                          | ✓                         | ✓                     |
| MAX6345 | ✓                         | —                          | ✓                         | —                     |

**MAXIM**

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# 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

## ABSOLUTE MAXIMUM RATINGS

|  |   |
|--|---|
| V <sub>CC</sub> to GND                           | -0.3V to +6V  |
| RESET, $\overline{\text{RESET}}$                 | (MAX6342/MAX6344/MAX6345) -0.3V to (V <sub>CC</sub> + 0.3V) |
| $\overline{\text{RESET}}$ (MAX6343)              | -0.3V to +6V  |
| MR, PFI, $\overline{\text{PFO}}$                 | -0.3V to (V <sub>CC</sub> + 0.3V)                           |
| Input Current, V <sub>CC</sub>                   | 50mA  |
| Output Current, RESET, $\overline{\text{RESET}}$ | 50mA  |

|   |                 |
|---|-----------------|
| Continuous Power Dissipation (T <sub>A</sub> = +70°C) |                 |
| 6-Pin SOT23 (derate 4mW/°C above +70°C)               | 320mW           |
| Operating Temperature Range                           | -40°C to +125°C |
| Junction Temperature                                  | +150°C          |
| Storage Temperature Range                             | -65°C to +150°C |
| Lead Temperature Range (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> = +1.0V 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 and V<sub>CC</sub> = +3V.) (Note 1)

| PARAMETER   | SYMBOL          | CONDITIONS   |   | MIN                   | TYP  | MAX  | UNITS |
|---|-----------------|--|---|-----------------------|------|------|-------|
| Supply Voltage Range  | V <sub>CC</sub> | T <sub>A</sub> = 0°C to +70°C  |   | 1.0                   | 5.5  |      | V     |
|   |                 | T <sub>A</sub> = -40°C to +125°C   |   | 1.2                   | 5.5  |      |       |
| Supply Current  | I <sub>CC</sub> | No load  | V <sub>CC</sub> = 3V, T <sub>A</sub> = -40° to +85°C    | 25                    | 40   |      | μA    |
|   |                 |  | V <sub>CC</sub> = 5.5V, T <sub>A</sub> = -40° to +85°C  | 30                    | 50   |      |       |
|   |                 |  | V <sub>CC</sub> = 3V, T <sub>A</sub> = -40° to +125°C   | 25                    | 50   |      |       |
|   |                 |  | V <sub>CC</sub> = 5.5V, T <sub>A</sub> = -40° to +125°C | 30                    | 60   |      |       |
| Reset Threshold   | V <sub>TH</sub> | MAX634_L   | T <sub>A</sub> = +25°C                                  | 4.56                  | 4.63 | 4.70 | V     |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 4.50                  | 4.75 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 4.40                  | 4.86 |      |       |
|   |                 | MAX634_M   | T <sub>A</sub> = +25°C                                  | 4.31                  | 4.38 | 4.45 |       |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 4.25                  | 4.50 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 4.16                  | 4.56 |      |       |
|   |                 | MAX634_T   | T <sub>A</sub> = +25°C                                  | 3.03                  | 3.08 | 3.13 |       |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 3.00                  | 3.15 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 2.92                  | 3.23 |      |       |
|   |                 | MAX634_S   | T <sub>A</sub> = +25°C                                  | 2.89                  | 2.93 | 2.97 |       |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 2.85                  | 3.00 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 2.78                  | 3.08 |      |       |
|   |                 | MAX634_R   | T <sub>A</sub> = +25°C                                  | 2.59                  | 2.63 | 2.67 |       |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 2.55                  | 2.70 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 2.50                  | 2.76 |      |       |
|   |                 | MAX634_Z   | T <sub>A</sub> = +25°C                                  | 2.30                  | 2.33 | 2.36 |       |
|   |                 |  | T <sub>A</sub> = -40°C to +85°C                         | 2.25                  | 2.38 |      |       |
|   |                 |  | T <sub>A</sub> = -40°C to +125°C                        | 2.21                  | 2.45 |      |       |
| V <sub>CC</sub> to Reset Delay  |                 | V <sub>CC</sub> = V <sub>TH</sub> to (V <sub>TH</sub> - 100mV)             |   | 20                    |      |      | μs    |
| RESET and $\overline{\text{RESET}}$ Outputs Drive Capability (Note 2) | V <sub>OL</sub> | V <sub>CC</sub> > 1.2V, I <sub>SINK</sub> = 100μA                          |   | 0.4                   |      |      | V     |
|   |                 | V <sub>CC</sub> > 2.7V, I <sub>SINK</sub> = 1.2mA                          |   | 0.3                   |      |      |       |
|   |                 | V <sub>CC</sub> > 4.5V, I <sub>SINK</sub> = 3.2mA                          |   | 0.4                   |      |      |       |
|   | V <sub>OH</sub> | V <sub>CC</sub> > 1.2V, I <sub>SOURCE</sub> = 50μA                         |   | 0.8 × V <sub>CC</sub> |      |      | V     |
|   |                 | V <sub>CC</sub> > 2.7V, I <sub>SOURCE</sub> = 500μA (MAX6342/MAX6345 only) |   | 0.8 × V <sub>CC</sub> |      |      |       |
|   |                 | V <sub>CC</sub> > 4.5V, I <sub>SOURCE</sub> = 800μA (MAX6342/MAX6345 only) |   | 0.8 × V <sub>CC</sub> |      |      |       |

# 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

## ELECTRICAL CHARACTERISTICS (continued)

( $V_{CC}$  = +1.0V to +5.5V,  $T_A$  = -40°C to +125°C, unless otherwise noted. Typical values are at  $T_A$  = +25°C and  $V_{CC}$  = +3V.) (Note 1)

| PARAMETER  | SYMBOL    | CONDITIONS                                | MIN                 | TYP        | MAX                 | UNITS     |
|--|-----------|---|---------------------|------------|---------------------|-----------|
| Reset Timeout Period                             | $t_{RP}$  | $T_A$ = -40°C to +85°C                    | 100                 | 180        | 280                 | ms        |
|  |           | $T_A$ = -40°C to +125°C                   | 80                  |            | 360                 |           |
| Open-Drain RESET Output Leakage Current (Note 3) | $I_{LKG}$ | MAX6343 only, $V_{CC} > V_{TH(MAX)}$      |                     | 1          |                     | $\mu$ A   |
| MR Input Low                                     | $V_{IL}$  |   |                     |            | $0.3 \times V_{CC}$ | V         |
| MR Input High                                    | $V_{IH}$  |   |                     |            | $0.7 \times V_{CC}$ | V         |
| MR Pull-Up Resistance                            |           |   | 60                  |            |                     | $k\Omega$ |
| MR Minimum Pulse Width                           |           |   | 1                   |            |                     | $\mu$ s   |
| MR Glitch Rejection                              |           |   |                     | 0.1        |                     | $\mu$ s   |
| MR to Reset Delay                                |           |   |                     | 0.2        |                     | $\mu$ s   |
| PFI Input Threshold                              |           | $T_A$ = -40°C to +85°C                    | 1.2                 | 1.25       | 1.3                 | V         |
|  |           | $T_A$ = -40°C to +125°C                   | 1.15                |            | 1.35                |           |
| PFI Leakage Current (Note 3)                     |           | $T_A$ = -40°C to +85°C                    |                     | $\pm 0.01$ | $\pm 25$            | nA        |
|  |           | $T_A$ = -85°C to +125°C                   |                     |            | $\pm 100$           |           |
| PFO Output Voltage                               | $V_{OL}$  | $V_{CC} = 4.5V$ , $I_{SINK} = 3.2mA$      |                     | 0.4        |                     | V         |
| PFO Output Voltage                               | $V_{OH}$  | $V_{CC} = 4.5V$ , $I_{SOURCE} = 800\mu A$ | 0.8 $\times V_{CC}$ |            |                     | V         |
| PFO Output Short-Circuit Current                 |           | Output sink current                       |                     | 20         |                     | mA        |
|  |           | Output source current                     |                     | 5          |                     |           |
| PFI to PFO Delay                                 |           | $V_{OVERDRIVE} = 15mV$                    |                     | 3          |                     | $\mu$ s   |

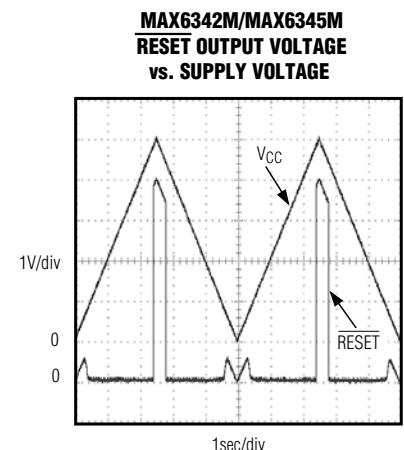
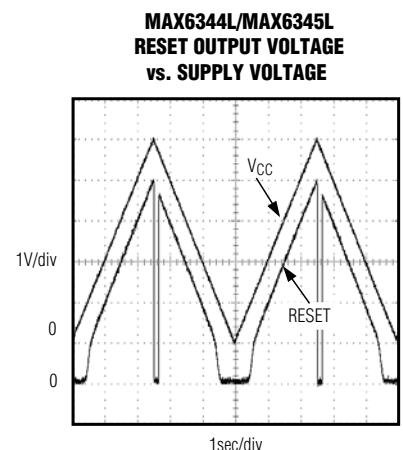
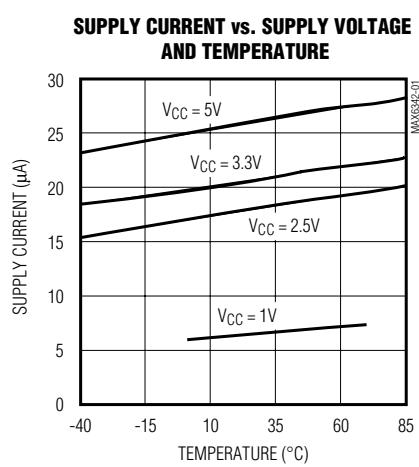
**Note 1:** Overtemperature limits are guaranteed by design and not production tested.

**Note 2:** Apply to each part in accordance with threshold voltage, output configuration, and manual reset status selected.

**Note 3:** Leakage parameters are guaranteed by design and not production tested.

## Typical Operating Characteristics

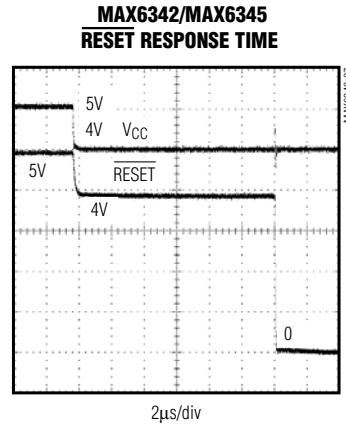
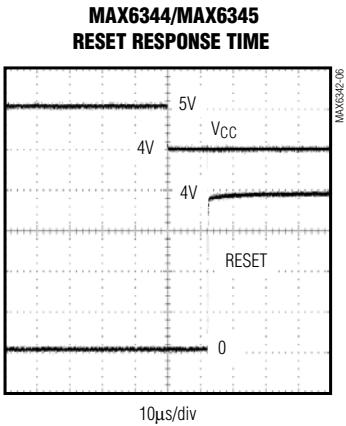
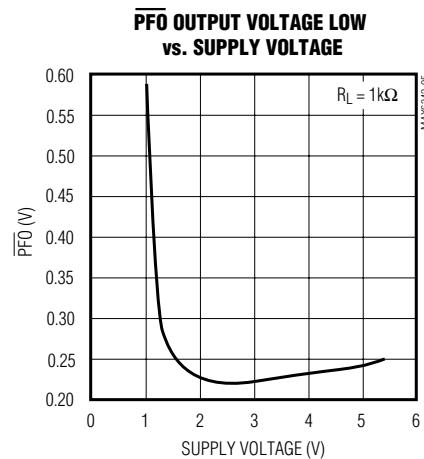
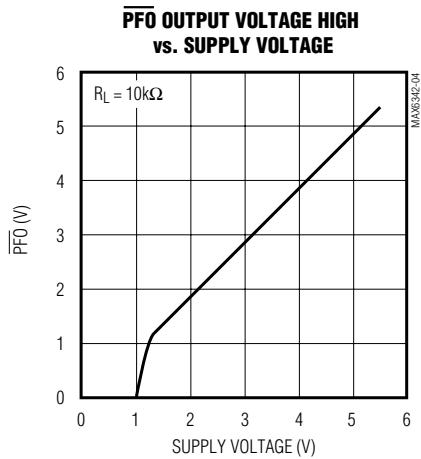
( $V_{PFI} = V_{CC} = +5V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)



## 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

### Typical Operating Characteristics (continued)

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



### Pin Description

| PIN     |         |         |         | NAME            | FUNCTION   |
|---------|---------|---------|---------|-----------------|--|
| MAX6342 | MAX6343 | MAX6344 | MAX6345 |                 |  |
| 1       | 1       | 1       | 1       | V <sub>CC</sub> | Supply Voltage   |
| 2       | 2       | 2       | 2       | GND             | Ground   |
| 3       | 3       | 3       | 3       | PFI             | Power-Fail Voltage Monitor Input. When PFI is $<1.25\text{V}$ , PFO goes low. Connect PFI to GND or V <sub>CC</sub> when not used. |
| 4       | 4       | 4       | 4       | PFO             | Power-Fail Voltage Monitor Output  |

## 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

### Pin Description (continued)

| PIN     |         |         |         | NAME  | FUNCTION  |
|---------|---------|---------|---------|-------|---|
| MAX6342 | MAX6343 | MAX6344 | MAX6345 |       |   |
| 5       | 5       | 5       | —       | MR    | Manual-Reset Input. Pull low to force a reset. <u>RESET</u> or <u>RESET</u> remains active as long as <u>MR</u> is low and for the reset timeout period after <u>MR</u> goes high. Leave unconnected or connect to <u>V<sub>CC</sub></u> if unused. |
| 6       | 6       | —       | 5       | RESET | Active-Low Reset Output. Push-pull for MAX6342/MAX6345. Open-drain for MAX6343. It remains low for 180ms after <u>V<sub>CC</sub></u> rises above the reset threshold or <u>MR</u> goes from low to high.  |
| —       | —       | 6       | 6       | RESET | Active-High Push-Pull Reset Output. It remains high for 180ms after <u>V<sub>CC</sub></u> rises above the reset threshold or <u>MR</u> goes from low to high.   |

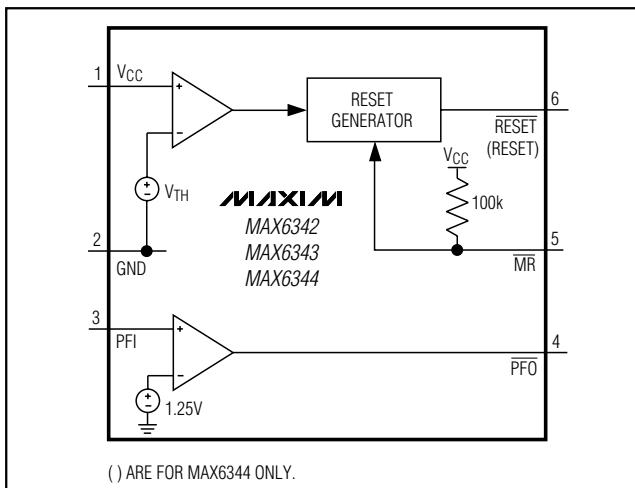


Figure 1. MAX6342/MAX6343/MAX6344 Functional Diagram

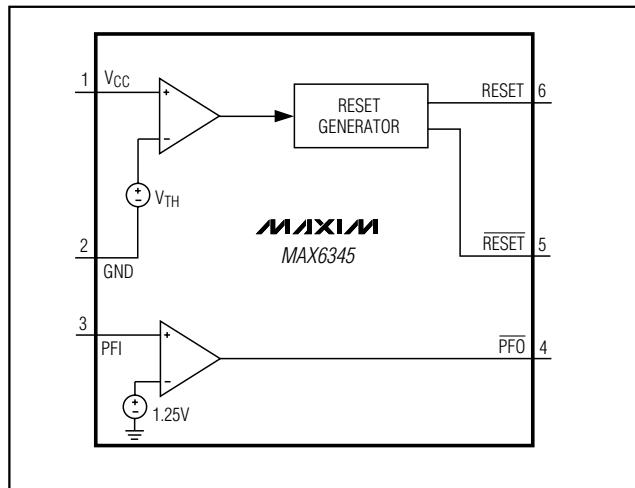


Figure 2. MAX6345 Functional Diagram

### Detailed Description

#### Reset Output

A  $\mu$ 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.

RESET and RESET are guaranteed to be asserted at a valid logic level for  $V_{CC} > +1V$  (see *Electrical Characteristics*). Once RESET asserts, it remains asserted for at least 100ms ( $t_{RP}$ ) after  $V_{CC}$  rises above its threshold value or after MR returns high (Figures 1 and 2).

#### Open-Drain RESET Output

The MAX6343 has an active-low, open-drain reset output. This output sinks current when RESET is asserted.

Connect a pull-up resistor from RESET to any positive supply voltage up to +5.5V (Figure 3). Select a resistor value large enough to register a logic low (see *Electrical Characteristics*), and small enough to register a logic high while supplying all input current and leakage paths connected to the RESET line. A 10k $\Omega$  pull-up is sufficient in most applications.

#### Manual Reset

The MAX6342/MAX6343/MAX6344's manual-reset input (MR) allows reset to be triggered by a pushbutton switch. The switch is effectively debounced by the 1 $\mu$ s min reset pulse width. MR is CMOS-logic compatible.

#### Power-Fail Comparator

The power-fail comparator is useful for various purposes because the power-fail output (PF0) is independent

## 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

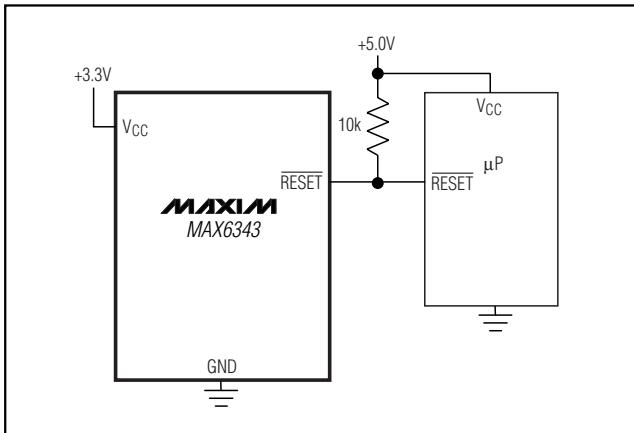


Figure 3. Open-Drain RESET Output Allows Use with Multiple Supplies

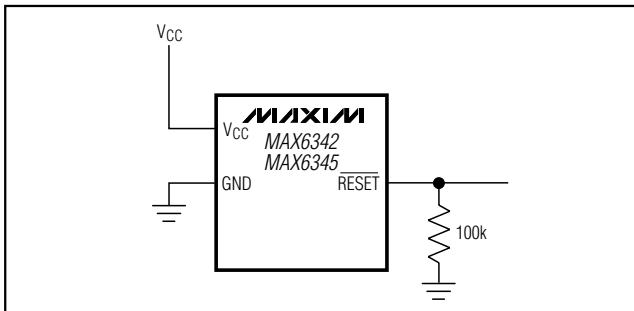


Figure 5. Ensuring RESET Valid to  $V_{CC} = 0$  on Active-Low Push-Pull Outputs

of the reset output. The inverting input is internally connected to a +1.25V reference.

To build an early-warning circuit for power failure, connect the PFI pin to a voltage divider (see *Typical Operating Circuit*). Choose the voltage-divider ratio so that the voltage at PFI falls below +1.25V just before the +5V regulator drops out. Use PFO to interrupt the  $\mu$ P to prepare for an orderly shutdown.

### Applications Information

#### Negative-Going VCC Transients

The MAX6342–MAX6345 supervisors are immune to short-duration, negative-going VCC transients (glitches) that usually do not require the entire system to shut down.

Figure 4 shows typical transient duration vs. reset comparator overdrive, for which the MAX6342–MAX6345 do not generate a reset pulse. The graph was generated using a negative-going pulse applied to VCC, starting 0.5V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width a

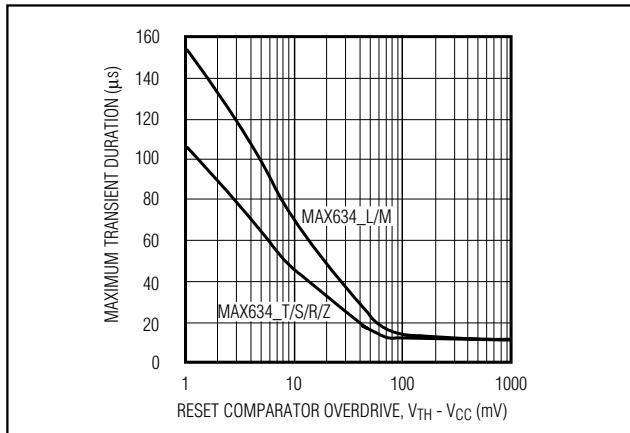


Figure 4. Maximum Transient Duration Magnitude Rejection

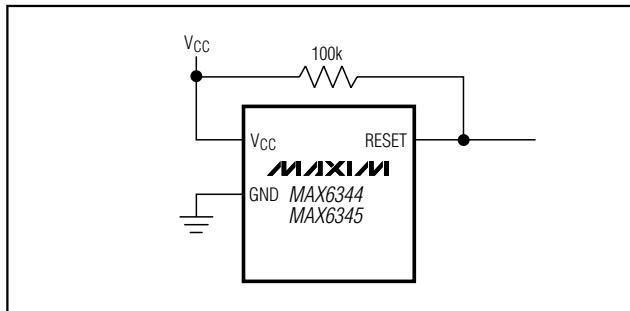


Figure 6. Ensuring RESET Valid to  $V_{CC} = 0$  on Active-High Push-Pull Outputs

negative-going VCC transient can have without causing a reset pulse. As the magnitude of the transient increases (goes further below the reset threshold), the maximum allowable pulse width decreases.

Typically, a VCC transient that goes 100mV below the reset threshold and lasts 12 $\mu$ s or less will not cause a reset pulse. A 1 $\mu$ F bypass capacitor mounted as close as possible to the VCC pin provides additional transient immunity.

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

The MAX6342–MAX6345 are guaranteed to operate properly down to  $V_{CC} = +1V$ . In applications that require valid reset levels down to  $V_{CC} = 0$ , a pull-down resistor to active-low outputs (MAX6342/MAX6345) and a pull-up resistor to active-high outputs (MAX6344/MAX6345) ensure that the reset line is valid when the reset output is no longer sinking or sourcing current (Figures 5 and 6). Note that this method does not work with the open-drain output of the MAX6343. The resistor value used is not critical, but it must be large enough not to load the reset

## 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

**MAX6342-MAX6345**

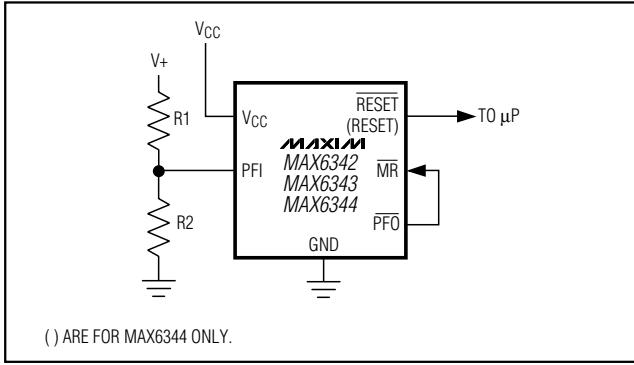


Figure 7. Monitoring Two Supplies

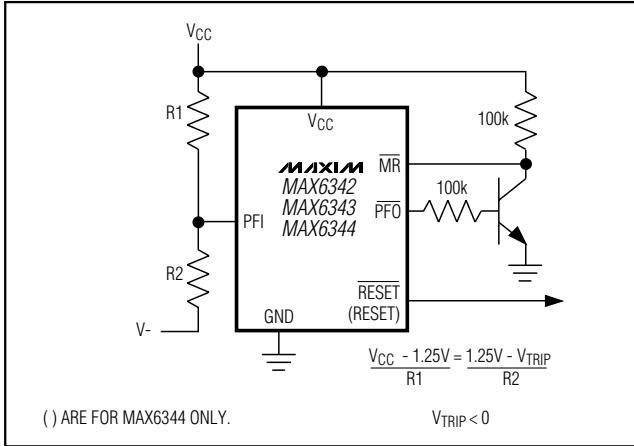


Figure 8. Monitoring a Negative Voltage

output when  $V_{CC}$  is above the reset threshold. For most applications,  $100k\Omega$  is adequate.

### Monitoring Two Supplies

Monitor another voltage by connecting a resistor-divider to PFI as shown in Figure 7. The threshold voltage will then be given by:

$$V_{TH(PFI)} = 1.25[(R1 + R2) / R2]$$

where  $V_{TH(PFI)}$  is the threshold at which the monitored voltage will trip PFO.

A good rule of thumb for selecting the resistors is to choose  $R2$  between  $250k\Omega$  and  $500k\Omega$  and solve for  $R1$ . Connect PFO to MR in applications that require reset to assert when the second voltage falls below its threshold.

### Monitoring a Negative Voltage

Connect the circuit as shown in Figure 8 to use the power-fail comparator to monitor a negative supply rail. PFO stays low when  $V-$  is good. When  $V-$  rises to cause PFI to be above  $+1.25V$ , PFO goes high. By adding the

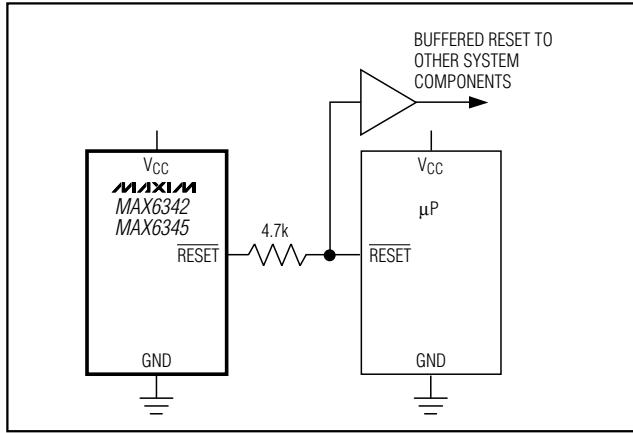


Figure 9. Interfacing to  $\mu$ Ps with Bidirectional Reset I/O

resistors and transistor as shown, a high PFO triggers reset. As long as PFO remains high, the MAX6342/MAX6343/MAX6344 will keep reset asserted. Note that the accuracy of this circuit depends on the PFI threshold tolerance, the  $V_{CC}$  line voltage, and the resistors. Also, ensure that the voltage at PFI remains above GND.

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

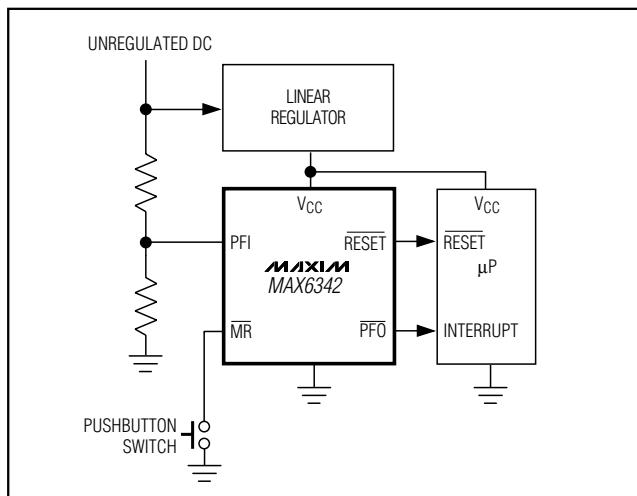
Use the circuit shown in Figure 9 to interface the MAX6342 or MAX6345 with a  $\mu$ P with bidirectional reset pins. The  $4.7k\Omega$  resistor between the reset output and the  $\mu$ P I/O line will ensure that the resets do not cause an indeterminate logic level.

### SOT Top Marks

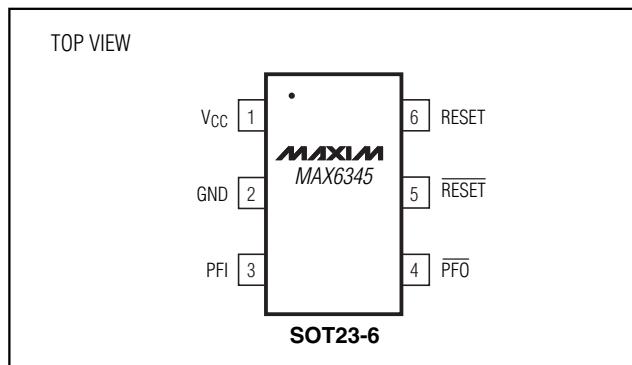
| PART         | SOT TOP MARK | PART         | SOT TOP MARK |
|--------------|--------------|--------------|--------------|
| MAX6342LUT-T | AACP         | MAX6344LUT-T | AADQ         |
| MAX6342MUT-T | AACQ         | MAX6344MUT-T | AADR         |
| MAX6342TUT-T | AACR         | MAX6344TUT-T | AADS         |
| MAX6342SUT-T | AACS         | MAX6344SUT-T | AADT         |
| MAX6342RUT-T | AACT         | MAX6344RUT-T | AADU         |
| MAX6342ZUT-T | AACU         | MAX6344ZUT-T | AADV         |
| MAX6343LUT-T | AACV         | MAX6345LUT-T | AADW         |
| MAX6343MUT-T | AACW         | MAX6345MUT-T | AADX         |
| MAX6343TUT-T | AACX         | MAX6345TUT-T | AADY         |
| MAX6343SUT-T | AACY         | MAX6345SUT-T | AADZ         |
| MAX6343RUT-T | AACZ         | MAX6345RUT-T | AAEA         |
| MAX6343ZUT-T | AADA         | MAX6345ZUT-T | AAEB         |

## 6-Pin $\mu$ P Reset Circuit with Power-Fail Comparator

### Typical Operating Circuit



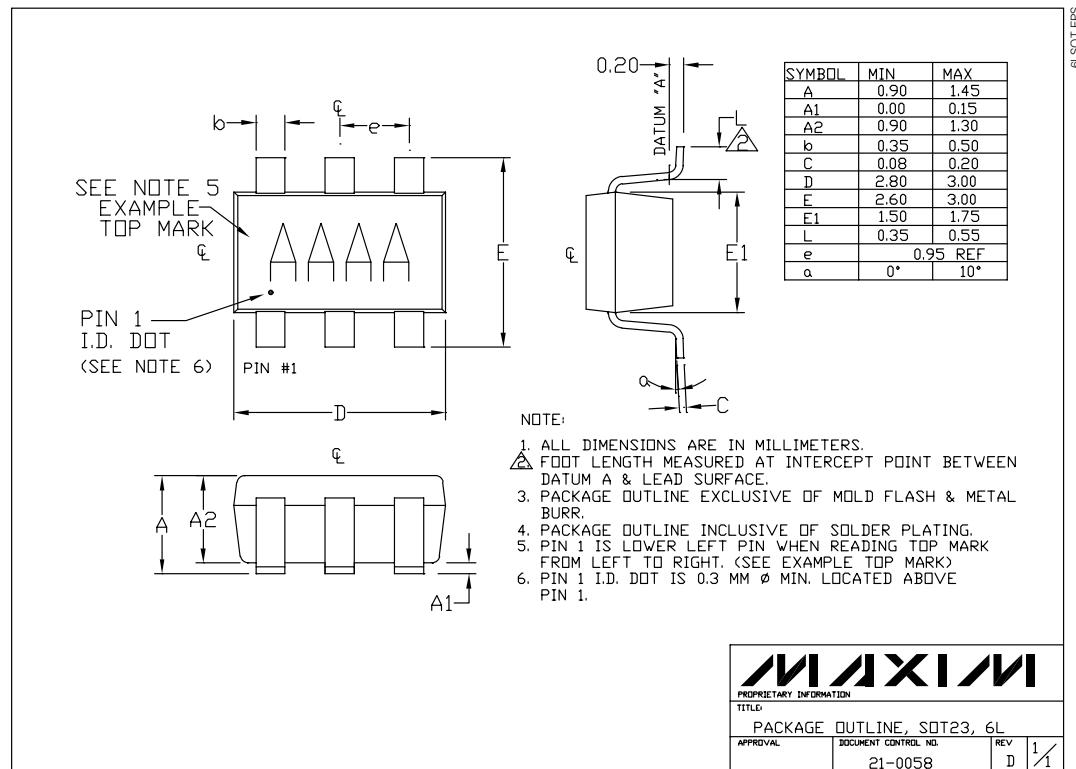
### Pin Configurations (continued)



### Chip Information

TRANSISTOR COUNT: 403

### Package Information



Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.